Original Article

Diversity of Finfishes and Commercially Important Species in the River Ganga in and around Patna Region

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Abstract

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The River Ganga harbors variety of finfish species including other fauna and flora. It has become a great nutritive value and indicator of ecological condition of river ecosystem which provides sustenance and meet protein requirement to local fishermen as well as other riparian population. The commercial and subsistence fishing activities are in practice by local fishermen using various types of nets, gears and tackles viz., gill nets of varying mesh sizes, large and small drag net, cast net, lift net, dip net, scoop net, plunge basket trap, hooks and long lines in and around Patna region. Most of the fishermen used sturdy plank built boat for the operation of variety of gill nets, drag nets and cast net, long lines, scoop net, and plunge basket trap. The local fishermen also exploit temporarily formed water bodies of the River Ganga to catch existing fishes during non-flood season. Variety of finfish species were monitored from the bulk of fisher catch during many visits at ten landing sites in and around Patna region. A total of 106 finfish species were identified from the bulk of catches belonging to 67 genera, 28 families and 9 orders. A single cartilaginous fish *(Hypolophussephen)* was recorded during flood season while most of the fish were bony skeleton which include 2 feather backs, 4 shads, 2 anchovies, 4 Indian major caprs, 8 barbs, 17 other carps and minnows, one each mahseer, Indian trout, latia fish, Pungas catfish, air breathing catfish, stinging catfish, angler fish, half beak fish, gar fish, panchax minnow, Gangeticmudeel, mottled nandus, badis fish, goby, climbing perch, 2 garra fish, 3 loaches, 8 bag rid catfish, 4 eurasian catfish, 6 schilbid catfish, 11 sisorid catfish, 3 glass fishes, 2 croakers, 2 mullets, 3 gouramies, 4 murrels, 3 spiny eels, and 2 puffer fish. The fish diversity identified from the river Ganga revealed that water is still suitable for proliferation and survival of different types of fish species.

Keywords: Fish Fauna; Diversity; Commercially Important; River Ganga; Patna

Introduction

There are 14 different river systems in India each of which has catchment area of about 20,000 sq. km or more, 44 medium rivers having an average catchment area between 2,000 and 20,000 sq. km and innumerable small rivers and desert streams that have drainage of less than 2,000 sq. km. Indian rivers carry a surface runoff of 164.5 million hectare meter (mhm), which is 5.6% of the total runoff flowing in all the river of the world (Sinha, 1997). The river basins cover an extensive areas as floodplain wetlands viz; chaurs, beels, jheels, mauns, kol, dhab, etc. They together form an area of more than 200,000 ha sustaining various types of fishes besides other aquatic fauna.

The River Ganga (2525 km), the lifeline of Indian sub-continent, originates at an altitude of 4100 meters above mean sea level from an ice cave, Gaumukh, near Gangotri in the Himalayas and discharges into the Bay of Bengal. The Ganga basin is the largest river basin in India (861404 sq. km). It drains 8 states namely Uttar Pradesh, Haryana, Delhi, Himachal Pradesh, Rajasthan, Madhya Pradesh, Bihar and West Bengal. The Ganga enters the state of Bihar at Chausa near Buxar and leaves at Rajmahal after

covering a distance of about 550 km. It is a broad meandering river of advanced stage and its plains cover an approximate area of 71,680 sq. km and accounts for about 42% of the surface of state (Ahmad and Singh, 1991). The main tributaries of the Ganga are Ramganga, Yamuna, Tons, Gomti, Ghaghara, Sone, Gandak, Burhi Gandak, Kosi etc. These tributaries account for 60% of the total water of the river. It has one of the densest human populations of the world, about more than 550 people per sq. km. The Ganga-Brahmaputra-Meghna river basins takes up just 0.12% of the World's landmass, it is home to 10% of its population (Patel, 1996).

The freshwater fish fauna of India is quite interesting and offers an exceptional opportunity to study the diversity and their distribution. From the known geographical distribution of genera of primary freshwater fishes, it has been clearly indicated that the fish fauna comprises three categories viz., Indian, Indo-Chinese and Malayan with indigenous Gondwana elements and intrusive genera (Jayaram, 1977). The original fauna has been retained on isolated hill tops of the peninsular India where suitable ecological niches are available. The striking vividity in ecological and morphoedaphic features of the Himalayan and Peninsular drainages has a pronounced bearing on the qualitative and quantitative distribution of fish fauna (Kamal, 1991).

The richness of animal resources of India is largely due to its geographical position and the fact that it possesses all possible kinds of ecosystems within its territorial limits. The ecology of major regions of India is however, largely dependent on rainfall. The area of Indian land territory is only about 2.4% of world's total land masses. India harbors as much as 8% of all known species of animals and plants which stands seventh as far as the number of species contributed to agriculture is concerned (Khoshoo, 1995). There are 74,875 species of animals; out of this 2546 are fishes both marine and freshwater comprising 59.27% and 2.02% of total number of biota respectively (Khoshoo, 1995). Globally fish constitutes almost half of the total number of vertebrates. Nelson (1984) estimated 21,723 living species of fish in the world compared with 21450 extant tetrapods. Earlier about 20,000 species of fishes were estimated, out of which approximately 19,400 were teleosts, nearly 59% marine and 41% freshwater (ZSI, 1991). 2650 fish species were also estimated from the faunal limits of India (ZSI, 1991). The present estimate is, however, 2546 species belonging to 969 genera and 254 families.

The fishery resources of the River Ganga are of tremendous economic and nutritional value. People regard the Gangetic fish as the gift of the Holy Ganga, which has good commercial value as compared to other fish. Hamilton (1822) identified 275 species of fishes from Ganga and its branches and opined that 'the list is far from complete'. The River Ganga at present sustains approximately 2500 species of biota including microorganisms to mammals. Various developmental and anthropogenic activities, such as irrigation hydro-electric project, flood control measures, water abstraction, domestic discharge, disposal of waste water and garbage, cloth washing, bathing, cattle wallowing, defecation, navigation, oil spilling, disgorging of animal carcasses and partly burnt human cadaver, cremation, recreation and trade for the community living etc are going on along the bank of the Ganga. Such activities are increasing day by day and adversely affecting the riverine biota as well as the pristine purity of the river water. Despite all activities, a report indicated that 375 species of fish are still surviving in the River Ganga (Talwar, 1991). Out of this 17 species are threatened and 4 have become endangered. Many of these viz; sting ray, featherbacks, hilsa, shads, herrings, anchovies, Indian major carps, minor carps, large and small catfishes, croacker, mullets, murrels, live fishes, spiny eels, shrimps and prawns are of varying commercial importance. The exploitation of these natural resources is being carried out exclusively by the local fishing community, an economically poor section of the society, through traditional techniques. The Ganga fishery supports a sizeable number of riparian fishermen all along its course. The variety and the extent of riverine catch from the River Ganga used to be considerable in the past but in the last few decades due to increasing anthropogenic stresses including developmental activities in the Ganga basin, the ecology of river in general and fishery in particular have adversely been affected. It has changed the stock dynamics, species diversity, and catch weight composition. The incidence of fish killing due to pollution which in turn emerge in the form of diseases like epizootic ulcerative syndrome, dropsy, fin rot, and asphyxiation among ichthyofauna (Das, 1997).

Methodology

The city of Patna (25° 37' N; 85° 21' E) is situated 53 meters above mean sea level (MSL) along the southern bank of the River Ganga. The stretch of the

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River Ganga at Patna is 22 km from upstream Digha to downstream Malsalami. The fish diversity of the River Ganga, its monitoring, survey and evaluation were undertaken by systematic planning which involves strategic sampling and analyses. The frequency of the survey, monitoring and schedules of sampling, keeping in view with fishing operation at landing sites, catch composition, pollution load and the hydrological aspects of the river through proper designing. It was carried out with proper accuracy to avoid any error. During the present investigation, the data of finfish diversity and fisheries at each landing site were collected between 5.30 to 9.30 am taking all the necessary precautions. The landing site I to X were selected for weekly survey. Fresh fish samples were collected from the River Ganga at landing sites and immediately brought in the laboratory for identification of species with the help of standard keys and diagnostic characters such as morphometric, meristic and descriptive features of each species following Day (1878), Hora (1927, 1930), Menon (1974), Srivastava (1980), Talwar and Jhingran (1991) and Jayaram (1977 and 1999).

Results and Discussion

Fish Stock Resources and Species Diversity

Fishes available in the River Ganga and its adjoining floodplains in and around Patna with their common names and names in local parlance was closely monitored and finfish species were identified with the help of standard keys and distinguishing characters. The systematic positions of all identified fishes have been given in Table-1. A total of 106 species of finfish and two species of crustacean (Prawn and shrimp) have been recorded from the River Ganga during the present study. Besides identification of fish species, five different fish habitats and breeding grounds were also identified in the River Ganga in and around Patna. These habitats are the main channel of the river, the adjoining floodplains and three types of temporary lentic water bodies usually formed in the floodplains which are either connected with the main channel or remains separated for few months. Such lentic water bodies are called "Kol", "Dhab" and "Maon" in local parlance. "Kol" remains connected with the river channel whereas the others are not. Out of 106 species recorded, 81 species were from "Kol", 45 from "Dhab" and 27 from "Maon". Many species were found to be present in all such water bodies. The main channel of the River Ganga was found to harbour all 106 species. All these fish species were caught by varieties of indigenous, non-mechanized boats which were used for operating the larger nets in high as well as low water currents in the Ganga river system in and around Patna region. Small riverine and estuarine crafts known as 'Dinghis' or 'Nao' are extensively employed. Nevertheless, with the advancement of technical know-how and ideas, certain gears are used more frequently. By and large, the cotton and jute nets have been replaced by nylon nets. Fishermen use a series of gears when water level starts increasing or when flood starts receding. Generally, static, filtering, plunge basket trapping and long- lining gears are used during the period because fish migrates either towards floodplains or back for the purposes of feeding or breeding. During monsoon period, some of the nets like shooting nets are used for the collection of spawn while other nets for fry, fingerlings and brooders. Application of bamboo reeds and strips for forming barriers across the width of narrow channels are also common. Various gill nets, longlines, plunge basket traps or individual fish traps are dominantly used during high water period. Long fences containing several small cages are used to catch the fish into one central holding chamber. Drag nets/seine nets, large meshed gill nets, shallop with white screen, purse net, scoop net are used during dry season. Large mesh sized gill net is used usually in the middle stretch of the river in order to catch big size fish during dry season. Hilsa and Indian major carps of commercial value are caught by purse net and gill nets having varied mesh sizes. All these traditional gears are helpful in sampling of variety of finfish species from the river Ganga and also source of livelihood for fishermen community.

A single cartilaginous fish, *Hypolophussephen,* was recorded from the Ganga at Patna that too only once during flood season. Most of the species were recorded bony skeleton which includes feather back (2 species), shads (4 species), anchovies (2 species), Indian major carps (4 species), barbs (8 species), other carps and minnows (17 species), mahaseer (1 species), Indian trout (1 species), latia fish (1 species), garra fish (2 species), loaches (3 species), bagrid catfish (8 species), Eurasian catfish (4 species), schilbid catfish (6 species), pungas catfish (1 species), sisorid catfish (11 species), airbreathing catfish (1 species), air sac/stinging catfish (1 species), square head or angler fish (1 species), half beak fish (1 species), gar fish (1 species), panchax minnow (1 species), Gangetic mud eel (1 species), glass fishes (3 species), croakers (2 species), mottled nandus (1 species), badis fish (1 species), mullets (2 species),

gobie (1 species), climbing perch (1 species), gouramies (3 species), snakeheads or murrels (4 species), spiny eels (3 species) and puffer fish (2 species). A total of 106 fish species the catch data of 69 finfish and 2 crustacean species have been recorded during the present study. However, 45 species were found to be commercially more important. Cyprinids were found to be largest contributor at all the landing site.

The declining trend of commercial fishes in the River Ganga in recent past is a matter of great concern and is a big challenge for the fishery scientist. In recent past the fish diversity has attracted the attention of diverse group of biologists including ichthyologists and taxonomists because of the increasing demand of protein requirement, sustained land food production, conservation and management of inland natural resources. Ichthyofaunal resources and species diversity are known to be influenced by various factors affecting ecosystem as well as fishermen. The contribution of some of the ichthyologists such as Hickley and Starkie (1985) who studied on the cost effective sampling of fish populations in large water bodies. Jhingran and Gupta (1987) studied on the reappraisal of the fisheries ecology of the Ganga river system. Natrajan (1989) reviewed the environmental impact of Ganga basin development on gene pool and fisheries of the Ganga River system. Jhingran (1991) described challenging frontiers in freshwater fisheries. Kamal (1991) studied on the riverine fisheries in India-a retrospect. Ahmad and Singh (1991) studied on the river systems of Bihar: Scope, prospects, potentialities and conservation of capture fisheries. Mondal and Gupta (1992) studied on the fish population dynamics and their role in resource assessment.

Fish catch its catch composition and commercial value

Besides enumeration and identification of fish species from different habitats, the catch composition were also recorded during the present study at ten different landing sites species-wise contribution of 71species including 2 species of crustaceans and their month-wise, season-wise occurrence and diversity were recorded. It was found that *Clupiso-magarua* contributed maximum (14.68%) of total catch followed by *Aspido pariamorar*(10.56%) and *Setipinnasps.* (7.04%). The classification based on major habitat preference and food habits have also evaluated. The contribution of 14 species was observed to be more than 2 percent in over all catch from the River Ganga. The size of individual fish species and their respective commercial values in local markets were recorded. It was interesting to note that commercial value of fishes varied according to freshness, size, species and season. The least available fishes were more costly as for example prawns, hilsa, Indian major carp, mahaseer, butter fish, ailia, batchawa, patasi, silond, pungas, goonchh, rita, magur, singhi, spiny eel etc. However, mahseer was rarest of rare catch and whenever, it was caught; its selling price was rupees 150 per kilogram. Larger carps and hilsa were sold at rupees 120 to 200 per kilogram whereas rate of most of the catfishes varied from rupees 100 to 250 per kilogram depending upon size and quality. The commercial values of some of the smaller species *(Ailiacoila*and *Pseudeutropiusatherinoids)* were found to be quite high as they were in good demand. Interestingly, it was observed that riverine fish or Gangetic fish have more commercial value as compared to cultured fish in and around Patna.

Fish species diversity and commercial importance

The Ganga River system harbours a rich diversity of Ichthyofauna. Menon (1974) listed 141 species occurring in the Ganga river system belonging to 72 genera, 30 families and 11 orders. Out of 141 species of finfish, 28 were economically important species. During the present investigation the ichthyofaunal diversity was of 106 species occurring in the river Ganga in and around Patna belonging to 67 genera, 28 families and 9 orders. Out of 106 species 45 were recorded to be commercially important which is liked by the consumer in Patna locality. The warm water lotic species of economic importance are the major carps (*Catlacatla, cirrhinusmrigala, Labeorohita*and *L. calbasu*) and the large catfishes *Mystusaor, M. seenghala, Rita rita, Wallagoattu, Siloniasilondia, Pangasiuspangasius* and *Bagarius-bagarius* as reported by Natrajan, 1989. Besides these *Notopteruschitala, Channamarulius* and species found in marshy habitats include *Clariasbatrachus, Heteropneustes fossilis, Channa* sps; *Amphipnouscuchia, Anabas testudineus, Mastacembelus* sps, *Notopterus notopterus* and *Gudusia chapra* are economically important fish. The anadro-moushilsa fetches approximately rupees 500 to 800 per kilogram. Hilsa species recognized as of great commercial importance in eastern part of India (West Bengal, Assam, Bihar, Arunachal Pradesh) including eastern part of Uttar Pradesh and Bangladesh.

Talwar (1991) listed 375 species of fish from the entire Ganga river. National Bureau of Fish Genetic Resources in its annual report 1996-97 has reported 382 species from Ganga river system out of which 111 are from Uttar Pradesh and Bihar. Under the present investigation in a small stretch of 30 km of Ganga near Patna, interestingly a total of 106

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Table 1: Systematic Position of Fish Fauna in the River Ganga in and around Patna Region

Grade – Pisces
Class – Chondrichthyes
Sub-class- Elasmobranchii
Order- Rajiformes
Suborder – Myliobatidoidei
Family – Dasyatidae
1. *Hypolophussephen (Frosskal)*
Class – Osteichthyes
Sub-class – Actinopterygii
Subdivision – Teleostei
Infradivision – Osteoglossomorpha
Order – Osteoglossiformes
Suborder – Notopteroidei
Family – Notopteridae
2. *Notopterusnotopterus (Pallas)*
3. *Notopteruschitala (Ham.)*
Infra division – Clupeomorpha
Order - Clupeiformes
Family – Clupeidae
Subfamily – Alosinae
4. *Gudusiachapra (Ham.)*
5. *Hilsa (Tenualosa) ilisha (Ham.)*
Subfamily – Dorosomatinae
6. *Gonialosamanmina (Ham.)*
7. *G. modestus (Day)*
Family – Engranulidae
8. *Setipinnabrevifilis (Valen.)*
9. *S. Phasa (Ham.)*
Infradivision – Euteleostei
Order – Cypriniformes
Family – Cyprinidae
Sub-family – Cyprininae
10. *Catlacatla (Ham.)*
11. *Chaguniuschagunio (Ham.)*
12. *Cirrhinusmrigala (Ham.)*
13. *C. reba (Ham.)*
14. *Labeobata (Ham.)*
15. *L. calbasu (Ham.)*
16. *L. gonius (Ham.)*
17. *L. pangusia (Ham.)*
18. *L. rohita (Ham.)*
19. *Osteobramacotiocotio (Ham.)*
20. *Puntiuschola (Ham.)*
21. *P. conchonius (Ham.)*
22. *P. phutunio (Ham.)*
23. *P. saranasarana (Ham.)*
Family – Schilbeidae
Subfamily – Ailiinae
59. *Ailiacoila (Ham.)*
Subfamily – Schilbeinae
60. *Clupisomagarua (Ham.)*
61. *Eutropiichthys murius (Ham.)*
62. *E. vacha (Ham.)*
63. *Pseudeutropius atherinoides (Bloch)*
64. *Siloniasilondia (Ham.)*
Family – Pangasiidae
65. *Pangasiuspangasius (Ham.)*
Family – Sisoridae
66. *Bagariusbagarius (Ham.)*
67. *B. yarrellii (Sykes)*
68. *Eristhistespussilus (Mull. &Tros.)*
69. *Gagatacenia (Ham.)*
70. *G. gagata (Ham.)*
71. *Glyptothoraxtelchitta (Ham.)*
72. *Hara hara (Ham.)*
73. *H. Jerdoni (Day)*

24. *P. sophore (Ham.)*
25. *P. ticto (Ham.)*
26. *Tor tor (Ham.)*
Subfamily – Cultrinae
27. *Chela cachius (Ham.)*
28. *C. laubuca (Ham.)*
29. *Salmostomabacaila (Ham.)*
30. *Securiculagora (Ham.)*
Subfamily – Rasborinae
31. *Amblypharyngodonmicrolepis (Bleeker)*
32. *A. mola (Ham.)*
33. *Aspidopariajaya (Ham.)*
34. *A. morar (Ham.)*
35. *Daniodangila (Ham.)*
36. *Daniodevario (Ham.)*
37. *Esomusdanricus (Ham.)*
38. *Parluciosomadaniconius (Ham.)*
39. *Raimas bola (Ham.)*
Subfamily – Garrinae
40. *Crossocheiluslatiuslatius (Ham.)*
41. *Garragotylagotyla (Gray.)*
42. *Garralamta (Ham.)*
Subfamily – Nmacheilinae
43. *Nemacheilusbotia(Ham.)*
Family – Cobitidae
Subfamily – Cobitinae
44. *Lepidocephalusguntea (Ham.)*
Subfamily – Botiinae
45. *Botiadario (Ham.)*
46. *B. Lohachatachaudhuri*
Order – Siluriformes
Family – Bagridae
47. *Aorichthysaor (Ham.)*
48. *A. seenghala (Sykes)*
49. *Mystusbleekeri (Day)*
50. *M. cavasius (Ham.)*
51. *M. menoda (Ham.)*
52. *M. tengara (Ham.)*
53. *M. vittatus (Bloch)*
54. *Rita rita (Ham.)*
Family – Siluridae
55. *Ompokbimaculatus (Bloch)*
56. *O. pabda (Ham.)*
57. *O. pabo (Ham.)*
58. *Wallagoattu (Schneider)*

85. *Pseudambassisbaculis (Ham.)*
86. *P. ranga (Ham.)*
Family – Sciaenidae
87. *Johniuscoitor (Ham.)*
88. *J. gangeticus (Talwar)*
Family – Nandidae
Subfamily – Nandinae
89. *Nandusnandus (Ham.)*
Sub-family – Badinae
90. *Badisbadis (Ham.)*
Suborder – Mugiloidei
Family – Mugilidae
91. *Rhinomugilcorsula (Ham.)*
92. *Sicamugilcascasia (Ham.)*
Suborder – Gobioidei
Family – Gobiidae
Subfamily – Gobiinae
93. *Glossogobiusgiuris (Ham.)*
Suborder – Anabantoidei

74. *Nangranangra (Ham.)*
75. *N. Viridescens (Ham.)*
76. *Sisorrhabdophorus (Ham.)*
    Family – Clariidae
77. *Clarias batrachus (Linnaeus)*
    Family – Heteropneustidae
78. *Heteropneustes fossilis (Bloch.)*
    Family – Chacidae
79. *Chacachaca (Ham.)*
    Order – Cyprinodontiformes
    Suborder – Exocoetoidei
    Family – Hemiramphidae
80. *Hyporhamphus limbatus (Valen.)*
    Family – Belonidae
81. *Xenentodoncancila (Ham.)*
    Sub-order – Cyprinodontoidei
    Family – Aplocheilidae
82. *Aplocheiluspanchax (Ham.)*
    Order – Synbranchiformes
    Family – Synbranchidae
83. *Monopterus (Amphipnous) cuchia (Ham.)*
    Order – Perciformes
    Suborder – Percoidei
    Family – Ambassidae
84. *Chanda nama (Ham.)*

Family – Anabantidae
94. *Anabas testudineus (Bloch.)*
    Family – Belontiidae
    Subfamily – Trichogasterinae
95. *Colisafasciatus (Scheinder)*
96. *C. lalia (Ham.)*
97. *C. sota (Ham.)*
    Suborder – Channoidei
    Family – Channidae
98. *Channamarulius (Ham.)*
99. *C. orientalis (Bloch & Schneider)*
100. *C. punctatus (Bloch)*
101. *C. striatus (Bloch)*
    Suborder – Mastacembeloidei
    Family – Mastacembelidae
102. *Macrognathus aral (Bloch & Schneider)*
103. *M. pancalus (Ham.)*
104. *Mastacembelus armatus (Lacepede)*
    Order – Tetraodontiformes
    Family – Tetraodontidae
105. *Chelonodon fluviatilis (Ham.)*
106. *Tetraodon cutcutia (Ham.)*

species of ichthyofauna has been recorded and identified. Besides the fishes of economic importance listed by Natrajan (1989), Schilbeids (*Eutropiichthysvacha, Clupisomagarua, Ailiacoila* and *Pseudeutropiusatherinoides*), silurids (*Ompokpabda*) were found to be commercially very important. The other economically important species recorded at Patna were *Gonialosamanmina, Setipinnasps, Labeobata, L. gonius, Salmostomabacaila, Aspidopariamorar, A. jaya, Mystuscavasius, M. tengra, Bagariusyarrellii, Nangraviridescence, Xenentodoncancila, Johniuscoitor, Rhinomugilcorsula, Sicamugilcascasia, Channaorientalis, C. punctatus, C. striatus, Macrognathusaral* and *M. pancalus*. In total around 45 species recorded in catches at Patna are commercially important. *Amphipnouscuchia* and *Anabas testudineus*, though categorized as economically important by Natrajan (1989), are not liked by the consumer at Patna. These fishes are economically least important.

Due to human intervention and competing demands for water as a resource, many aquatic species now face a reduction in abundance or even extinction. For many rivers of the world, the abundance and composition of original fish communities has been significantly altered. The combination of both the direct effects of exploitation and the indirect influences of other sectorial activities have had considerable implications for the survival and livelihood of fish

and fisheries of most river basins of the world. The intensity of fishing pressures on naturally occurring riverine fish species and stock vary seasonally in the River Ganga with changes in abundances with flood requirement and fish life cycles. The effects of human activities in the Ganges river include altered morphology of river, disturbed flow pattern, eliminated or reduced fish habitat areas, altered species diversity and quality as well as quantity of fish stock, and reduced water quality. Such activities are increasing day by day due to human intervention and increasing population. The future of ichthyofaunal diversity and its well being lies on the responsibility of the aquatic resources exploiter, policy maker and adoption of conservation and management measures including good water quality of the River Ganga so that the stock of threatened, vulnerable, endangered and depleted finfish species may be replenished.

Acknowledgement

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