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SS Mishra
DADF, Ministry of Agriculture, Krishi Bhawan, New Delhi, India

S Mohanty
Division of Livestock and Fisheries Management, ICAR Research Complex for Eastern Region, Patna, Bihar, India

MS Chari
Indira Gandhi Krishi Viswavidyalaya, Raipur, Chhattisgarh, India

HK Vardia
Dean, College of Fisheries, Kawardha, Chhattisgarh, India

Correspondence
SS Mishra
DADF, Ministry of Agriculture, Krishi Bhawan, New Delhi, India

Biodiversity assessment of Kodar reservoir of Chhattisgarh

SS Mishra, S Mohanty, MS Chari and HK Vardia

Abstract
In the context of massive loss of biodiversity, conservation of freshwater fauna has received increasing attention in recent times. Hence, assessment of the aquatic biodiversity and potential for the exploitation of natural resource of Chhattisgarh was attempted. Freshwater fish biodiversity in Kodar reservoir has been represented about 44 sps. Belonging to 14 families. Some of the important fish species found in the reservoir were viz Catla, Rohu, Mrigal, Grass carp, Silver carp, Common Carp, Olive barb, Pangasius and Mystus species etc. Along the stretch of the reservoir, 29 dominant phytoplankton species representing 9 families under 4 major divisions were enlisted along-with their distinct quantitative variations. Likewise, Zooplankton comprised of 11 species representing 8 families under three major phyla, along-with a great quantitative variation in different seasons at different study stations.

Keywords: Reservoir, diversity indices, fish fauna, planktonic biomass, abundance

1. Introduction
Biodiversity in inland waters is important to sustain health of the ecosystem as well as the prosperity of our society. It is also significant for its economic value as a habitat for commercially important species and plays an important role in food and nutritional security of people, especially in the rural areas. India is well known for its mega biodiversity of biological wealth, harbouring over 12 percent of the shell fish and fin fishes (Kapoor and Sarkar, 2003) [18]. The diversity of fish fauna has its own importance like other aquatic and terrestrial animals. They constitute very important trophic link in water bodies. Some of them are commercially important species with good economic value.
Biodiversity, the variety and variability of life, is found on every continent and in every ocean worldwide. The central India has enormous potential in terms of diverse water resources in the form of stream, rivers, reservoirs, subterranean aquatic systems, traditional lakes and domestic ponds with a wide variety of fresh water fishes. Chhattisgarh in particular is blessed with a number of natural resources and lies in the catchment of the rivers, the Mahanadi, Godavari, Ganga and Narmada. Their main tributaries are Kharun, Tandula, Arpa, Hasdeo, Shivnath, Sabari, Indrawati, Sone and Tanda. Some Reservoirs are also there, which helps to improve the fish production of the state; they are Gangrel, Hasdeo bang, Sondur, Dud, Kodar and Kumhari etc.
Fish and fisheries are dispensable part in the life cycle and livelihood of this country and is the part of our cultural heritage. Reservoirs provide significant contributions to the global fisheries. In many parts of the world, a reservoir fishery is essential and often represent an irreplaceable resource of low cost animal protein providing balanced human diet. No fish biodiversity study has been conducted in Kodar reservoir of Mahasamund district so far. With the aim of conducting biodiversity study of the district a small effort has been made to understand the ichthyobiodiversity.

2. Materials and Methods
Chhattisgarh state was formed after bifurcation of old Madhya Pradesh in 1st November 2000. Geographically Chhattisgarh is situated between 17º 46'– 24º 80' N latitude and 80º 15' – 84º 24' E longitude. It has hilly areas, plateau and river basins. Chhattisgarh plains form basin of many rivers and its water potential is trapped in the form of some reservoirs. The state receives a good amount of precipitation (1200-1600 mm) as well.

2.1. Selection of reservoir

Kodar reservoir is located near Tumgaon, 4 km towards Saraipalli on N.H.-6, in the district Mahasamund. The perennial reservoir, Kodar is situated between 21^0 47' – 21^0 31' N latitude and 82^0 14' – 82^0 19' E longitude. Beautiful green forests are present near the periphery of this reservoir. The Full Reservoir Level (FRL) is 3588 ha and the Dead Storage Level (DSL) is 512 ha (Table 1), so the average water spread area is 2080 ha. The average depth is 19 m. The fish production recorded from this reservoir in the year (2008-09) was 60.90 tons as per records of Directorate of fisheries, Raipur. Fisheries Mahasangh (Federation) leased this reservoir to Rukuseth for five years for fisheries activity.

2.2. Selection of sampling site

There is only one landing site in the reservoir. Kohri in Kodar reservoir is the major fish landing center. Fish samples were collected during the whole fishery season from March to August at an interval of 4-5 days. The collected specimen was preserved in 10% formaldehyde solution and 4 g borax powder was added to avoid formation of formaldehyde gas.

2.3. Identification of fishes

Fishes were identified with the help of the keys given by (Day, 1986; Datta Munshi and Shrivastava, 1988; Jhingran, 1991 and Jayaram, 1994) [8, 6, 17, 16]. Identification of fish specimen was based on diagnostic characters such as body form, colour, size, shape and position of fins, meristic features such as number of rays in a fin or the number of scales in a specific series, presence of distinctive organs such as barbels, or the lateral line and various body proportions such as ratio of length of the head to the total length of the body, etc. After identification, fish species were compared amongst various sampling sites in different river basins and the frequency of occurrence differed significantly.

2.4. Catch composition of fishes

Fish catch composition in the reservoir was studied. It comprised of roughly 70% Indian major carps, 20% minor carps, medium sized carps and 10% cat fish and other fishes. Out of minor carps, medium sized carps like *Labeo bata* and *Labeo calbasu* contribute a major share.

3. Results

Present study records a total of 44 fish species (+ marked in table 2) were observed in Kodar reservoir, out of 44 species 2 belong to the order Osteoglossiformes (2 species of Notopteridae), 18 species belong to the order Cypriniformes (18 species of Cyprinidae), 14 species belong to the order Siluriformes (3 species of Siluridae, 6 species of Bagridae, 1 species of Schilbeidae, 1 species of Pangasiidae, 1 species of Saccobranchidae and 2 species of Claridae), 9 species belong to the order Perciformes (2 species of Centropomidae, 1 species of Nandidae, 2 species of Cichlidae, 3 species of Anabantidae and 1 species of Gobiidae) and 1 species belong to the order Mastacembeliformes (1 species of Mastacembelidae). With the exception of a few small species of carp minnows, all others are fairly well known and do not call any special comments from a systematic point of view.

Among the Cyprinidae family: *Catla catla, Cirrhinus mrigala and Labeo rohita* are the dominant fishes in the reservoir comprising of approximately 70% of the fish landings in the total catch. These three well-known major carps of high cultivable value were recorded good numbers. Besides native fishes, some exotic fishes and minor carps were also observed in the reservoir. They were silver carp, *Hypophthalmichthys molitrix* and common carp, *Cyprinus carpio* which were thriving very well. Among minor and medium sized carps *Labeo bata, Labeo calbasu, Cirrhinus reba, Labeo boga, Puntius ticto, Puntius sophore,* and *Puntius chola* were also observed.

Table 1: Particulars of the Reservoir Kodar (Source- Directorate of fisheries, Raipur, 2012-13)

Particulars	Kodar
Altitude (above MSL)	295
Year of dam impoundment	1981
Catchment area (sq. km)	725.27
Gross storage capacity (ha m)	2050
Dead storage capacity (ha m)	512
Water spread area at FRL (ha)	3588
Maximum depth of reservoir (m)	27.78
Total catch (ton) (2008-09)	60.90
Number of fishermen	217
Height of the main dam (m)	28.53

Table 2: Comparison of Ichthyofauna reported by different workers in the Mahanadi Basin

S. No.	Fish species	Hora (1940)	Jayaram & Majumdar (1976)	Singh (2004)	Omprakash (2004)	Desai & Shrivastava (2004)	Dev (2008)	Dahire (2008)	Present study
									Kodar
1	*Anabas testudineus* (Bloch)	-	-	+	+	-	+	+	+
2	*Anabas oligolepis* (Bleeker)	-	-	+	+	-	+	+	+
3	*Amblypharyngodon mola* (Ham.)	+	+	+	+	+	+	+	+
4	*Amblyceps mangois* (Ham.)	+	-	-	-	-	-	+	-
5	*Aspidoparia morar* (Ham.)	-	+	-	-	+	-	-	-
6	*Ailia coila* (Ham.-Buch)	-	+	-	-	-	-	-	-
7	*Badis badis*(Ham.)	+	+		-	-	-	-	-
8	*Bagarius bagarius*	+	+	-	+	-	-	-	-
9	*Barilius bendelesis (Ham.)*	+	+	+	+	+	+	-	-
10	*Barilius barna*(Ham.)	+	+	-	-	-	-	-	-
11	*Barilius barila*(Ham.- Bush.)	-	-	-	-	+	-	-	-
12	*Barilius vagra*(Ham.)	-	+	-	-	-	-	-	-
13	*Catla catla* (Ham.)	-	+	+	+	+	-	+	+
14	*Cirrhinus mrigala* (Ham.)	-	-	+	+	+	-	+	+
15	*Cirrhinus reba*(Ham.)	-	-	+	+	+	+	+	+
16	*Chela (Laubuca) laubuca* (Ham.)	+	-	-	-	+	-	-	-
17	*Ctenopharyngodon idella* (Val.)	-	-	+	+	-	+	+	+
18	*Channa gachua* (Ham.)	+	-	+	+	-	+	+	-

19	*Channa marulius* (Ham.)	-	-	+	+	-	+	+	-
20	*Channa orientalis* (Bloch and Schn.)	-	-	-	-	+	-	+	-
21	*Channa punctatus* (Bloch)	+	+	+	+	-	+	+	-
22	*Channa striatus* (Bloch)	-	+	+	+	+	+	+	-
23	*Chanda nama* (Ham.)	-	+	+	+	+	+	+	+
24	*Chanda ranga* (Ham.)	+	+	+	+	+	+	+	+
25	*Clarias batrachus* (Linn)	+	-	+	+	-	+	+	+
26	*Clarias gariepinus* (Bloch)	-	-	+	-	-	+	+	+
27	*Clupisoma bastari* (Datta and Karmakar)	-	-	-	-	+	-	-	-
28	*Clupisoma garua*(Ham.-Buch)	-	+	-	-	-	-	-	-
29	*Colisa faciatus*(Bl. &Schn.)	-	-	+	+	-	+	+	+
30	*Cyprinus carpio* (Linn.)	-	-	+	+	-	+	+	+
31	*Denio devario* (Ham.)	-	-	+	+	+	+	+	+
32	*Danio aequipinnatus* (Ham.)	+	-	-	-	-	-	-	-
33	*Denio (Brachydenio) rerio* (Ham.)	+	+	-	-	-	-	-	-
34	*Garra annandalei*	-	-	+	+	-	-	-	-
35	*Esomos danricus* (Ham.)	+	+	-	-	+	-	-	-
36	*Eriethistes hara* (Ham.)	+	-	-	-	-	-	-	-
37	*Eutropiichthysvacha* (Ham.-Buch)	-	+	+	+	-	+	+	+
38	*Gagata cenia* (Ham.)	-	+	-	-	-	-	-	-
39	*Garra gotyla gotyla* (Gray)	-	-	-	-	+	-	-	-
40	*Garra mullya* (Sykes)	+	-	-	-	-	-	-	-
41	*Glossogobius giuris* (Ham.)	+	+	+	+	+	+	+	+
42	*Gonialossa manmina* (Ham.)	-	+	-	-	-	-	-	-
43	*Gudusia chapra*(Ham.)	-	-	+	+	+	+	+	-
44	*Gonoproktopterus kolus*	-	-	+	+	-	+	-	-
45	*Heteropneustes fossilis* (Bloch)	+	-	+	+	-	+	+	+
46	*Hypophthalmichthys molitrix*(Val.)	-	-	+	+	-	+	+	+
47	*Arichtisthys nobilis* (Rich.)	-	-	+	+	-	+	+	+
48	*Labeo angra* (Ham.)	-	-	+	+	-	+	-	-
49	*Labeo bata* (Ham.)	-	+	+	+	+	+	+	+
50	*Labeo boga* (Bloch)	-	-	+	+	-	+	+	+
51	*Labeo boggut* (Sykes)	+	-	+	+	-	+	-	-
52	*Labeo calbasu* (Ham.)	-	-	+	+	+	-	+	+
53	*Labeo fimbriatus* (Bloch)	-	-	-	-	+	-	**+N**	-
54	*Labeo gonius* (Ham.)	-	-	+	+	+	+	+	-
55	*Labeo rohita* (Ham.)	-	+	+	+	+	+	+	+
56	*Lepidocephalichthys guntea* (Ham.)	+	+	+	+	+	+	-	-
57	*Macrognathus aculeatus* (Bloch)	+	+	+	+	-	-	+	-
58	*Mastacembelus pancalus* (Ham.)	+	+	+	+	+	-	+	-
59	*Mastacembelusarmatus* (Lacepede)	+	+	+	+	+	-	+	+
60	*Mystus aor* (Ham.)	+	-	+	+	+	-	+	+
61	*Mystus seenghala* (Sykes)	-	+	+	+	+	-	+	+
62	*Mystus bleekeri* (Day)	-	-	+	+	+	+	+	+
63	*Mystus tengara* (Ham.)	+	+	+	+	-	-	+	+
64	*Mystus vittatus* (Bloch)	+	+	+	+	+	-	+	+
65	*Mystus cavassius* (Ham.)	+	+	+	+	+	-	+	+
66	*Nandus nandus* (Ham.)	+	-	+	+	+	+	+	+
67	*Noemacheilus botia* (Ham.)	+	-	+	+	-	-	-	-
68	*Noemacheilus denisonnii* (Day)	+	-	-	-	+	+	-	-
69	*Notopterus chitala* (Ham.)	-	-	+	+	-	+	+	+
70	*Notopterus notopterus* (Pallas)	-	+	+	+	+	+	+	+
71	*Ompok bimaculatus* (Bloch)	-	+	+	+	+	+	+	+
72	*Oreochromis mossambica* (Peters)	-	-	+	+	-	+	+	+
73	*Oreochromis niloticus* (Linn.)	-	-	+	+	-	+	+	+
74	*Orichthys cosuatus* (Ham.)	+	-	-	-	-	-	-	-
75	*Osteobrama cotio* (Ham.)	-	+	+	+	+	+	+	-
76	*Osteobrama vigorsii* (Sykes)	-	-	-	-	+	-	-	-
77	*Pangasius pangasius* (Ham.)	-	-	+	+	-	+	+	+
78	*Pseudeotropius atherinoides* (Bloch)	+	-	+	+	-	-	+	-
79	*Parluciosoma daniconius*(Ham.- Buch.)	+	+	+	+	+	+	-	+
80	*Puntius chola*(Ham.)	-	-	+	+	-	+	+	+
81	*Puntius dorsalis* (Jerdon)	+	-	+	+	+	+	-	-
82	*Puntius gelius*(Ham.)	+	+	-	-	-	-	-	-
83	*Puntius guganio*(Ham.)	+	-	-	-	+	-	-	-
84	*Puntius phutunio*(Ham.-Buch.)	-	-	-	-	+	-	+	-
85	*Puntius sarana* (Ham.)	+	+	+	+	+	+	+	+
86	*Puntius sophore* (Ham.)	+	+	+	+	+	+	+	+

87	*Puntius tetrarupagus* (McClelland)	+	-	-	-	-	-	-	-
88	*Puntius ticto* (Ham.)	+	+	+	+	+	+	+	+
89	*Rita rita* (Ham.)	-	-	+	+	-	+	-	-
90	*Rita chrysea* (Day)	-	+	-	-	-	-	-	-
91	*Rhinomugil corsula* (Ham.)	-	+	+	+	+	-	-	-
92	*Salmostoma bacaila* (Ham.)	+	+	+	+	+	+	-	+
93	*Salmostoma phulo* (Ham.- Bush)	-	-	-	-	+	-	-	-
94	*Tor tor*(Ham.- Bush)	-	-	-	-	-	***+N***	***+N***	-
95	*Wallago attu* (Bl. And Schn.)	-	+	+	+	+	+	+	+
96	*Xenentoden cancila* (Ham.)	+	+	+	+	+	+	+	-

Recorded = (+); Not recorded = (-); New record = (N)

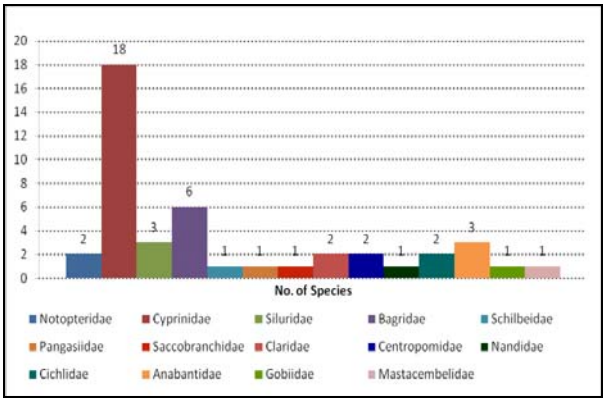

Fig 1: Occurrence of different fish species in Kodar reservoir of Chhattisgarh

4. Discussion

The present study indicates that, the Kodar reservoir resources are rich in fish fauna. A total of 44 different species belonging to 5 orders, 14 families and 28 genera were recorded from this region. In the erstwhile reservoirs of Madhya Pradesh (including Chhattisgarh) a total of 191 species of fishes were recorded on the basis of study done by various scientists from 1940 to 2001 (Dubey, 2007) [11]. However in Chhattisgarh a total of 95 species were recorded by different scientists (Hora, 1940; David, 1959; Jayaram and Majumdar, 1976; Vardia, 1991; Singh, 2004; Omprakash, 2004; Desai and Shrivastava, 2004; Dev, 2008, Dahire, 2008) [14, 7, 16, 30, 26, 9, 10, 5].

In the present study, comparison is made between the present study and studies done by earlier workers in Mahanadi river system (Table 2). It is observed that, 9 species are commonly reported by all studies in Mahanadi till date which includes *Amblypharyngodon mola* (Ham.), *Chanda ranga* (Ham.), *Glossogobius giuris* (Ham.), *Mystus vittatus* (Bloch), *Mystus cavassius* (Ham.), *Parluciosoma daniconius* (Ham.), *Puntius sarana* (Ham.), *Puntius sophore* (Ham.), *Puntius ticto* (Ham.). Present study when compared with the work of Hora (1940) [14], few species which were not reported by him but reported in the present study are: *Anabas testudineus* (Bloch), *Anabas oligolepis* (Bleeker), *Cirrhinus reba* (Ham.), *Ctenopharyngodon idella* (Val.), *Chanda nama* (Ham.), *Clarias gariepinus* (Bloch), *Colisa faciatus* (Bl. &Schn.), *Cyprinus carpio* (Linn.), *Eutropiichthys vacha* (Ham.-Buch), *Gudusia chapra* (Ham.), *Gonoproktopterus kolus* (Sykes), *Hypophthalmichthys molitrix* (Val.), *Arichtisthys nobilis* (Rich.), *Labeo bata* (Ham.), *Labeo boga* (Bloch), *Labeo gonius* (Ham.), *Labeo rohita* (Ham.), *Mystus seenghala* (Sykes), *Mystus bleekeri* (Day), *Notopterus chitala* (Ham.), *Notopterus notopterus* (Pallas), *Ompok bimaculatus* (Bloch), *Oreochromis mossambica* (Peters), *Oreochromis niloticus* (Linn.), *Pangasiu spangasius* (Ham.), *Puntius chola* (Ham.), and *Wallago attu* (Bl. and Schn.).

Similarly the species which were absent in the list of Jayaram and Majumdar (1976) [16] but recorded in the present study are: *Anabas testudineus* (Bloch), *Anabas oligolepis* (Bleeker), *Cirrhinus reba* (Ham.), *Ctenopharyngodon idella* (Val.), *Clarias batrachus* (Linn), *Clarias gariepinus* (Bloch), *Colisa faciatus* (Bl. &Schn.), *Cyprinus carpio* (Linn.), *Gudusia chapra* (Ham.), *Heteropneustes fossilis* (Bloch), *Hypophthalmichthys molitrix* (Val.), *Arichtisthys nobilis* (Rich.), *Labeo boga* (Bloch), *Mystus aor* (Ham.), *Mystus bleekeri* (Day), *Nandus nandus* (Ham.), *Notopterus chitala* (Ham.), *Oreochromis mossambica* (Peters), *Oreochromis niloticus* (Linn.), *Pangasius pangasius* (Ham.) and *Puntius chola* (Ham.). The species which are absent in present study and reported by Jayram and Majumdar (1976) [16] are as follows: *Aspidoparia morar* (Ham.), *Ailia coila* (Ham.-Buch), *Ailia coila* (Ham.-Buch), *Badis badis* (Ham.), *Bagarius bagarius, Barilius barna* (Ham.), *Barilius vagra* (Ham.), *Clupisoma garua* (Ham.-Buch), *Denio (Brachydenio) rerio* (Ham.), *Esomos danricus* (Ham.), *Gagata cenia* (Ham.), *Gonialossa manmina* (Ham.), *Mastacembelus pancalus* (Ham.), *Puntius gelius* (Ham.), *Rita chrysea* (Day) and *Rhinomugil corsula* (Ham.).

In Comparison between the enlisted fish fauna of present study (2009) and Singh (2004) [26] only 8 species were not reported earlier. Those species include, *Catla catla* (Ham.), *Cirrhinus mrigala* (Ham.), *Garraannandalei, Labeo boggut* (Sykes), *Labeo calbasu* (Ham.), *Mastacembelus pancalus* (Ham.), *Pseudeotropius atherinoides* (Bloch) and *Rhinomugil corsula* (Ham.).

Comparative study with Omprakash (2004) [21] reveals that, one species namely *Clarias gariepinus* (Bloch) was reported in the present study. Similarly 18 fish species reported by Omprakash (2004) [21] are not found in the present study (*Bagarius bagarius*, *Barilius bendelesis*, *Channa gachua*, *Channa marulius, Channa punctatus, Channa striatus, Gonoproktopterus kolus, Labeo angra, Labeo boggut, Lepidocephalichthys guntea, Noemacheilus botia, Osteobrama cotio, Osteobrama vigorsii, Pseudeotropius atherinoides, Puntius dorsalis, Rita rita and Rhinomugil corsula, Xenentoden cancila*) with rest of species are common to both the studies.

Biodiversity threats in the form of diverse types of human interventions are the main reasons for the alarming variations of fish populations in most of the reservoirs. The great altitudinal differences coupled with varied physiography have contributed to great variations in the region, having definite pockets representing tropical, sub–tropical areas. Unsustainable exploitation by using un prohibited fishing methods are very rampant together with habitat destruction of natural spawning and breeding ground of the fishes through sand mining are the major causes of population decline and endangerment as reported by Kurup *et al.* (2001) [19].

5. Conclusion

With the rapid aqua-expansion, population explosion and ever-increasing demand for fish as protein-rich food, aquatic ecosystems of India are under constant pressure due to anthropogenic stresses like habitat destruction, over exploitation, indiscriminate killing of juveniles and adults, excessive water abstraction leaving inadequate water for fish, aquatic pollution, disease and uncontrolled introduction of exotics. Among the fish culturing countries in the globe, India took a major share of large diversity of fish fauna and more number of threatened fish. It is needed to undertake research to increase fundamental understanding of the factors and processes that regulate biodiversity in fresh water systems to predict the likely effects of human induced changes, to the effects of human activity and to plan effective restoration and rehabilitation initiatives. Some strategies and scientific interventions should be made for fish biodiversity conservation to protect the native fish fauna as well as the ecosystem.

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