Advances in Aquaculture and Fisheries Management Vol. 2 (5), pp. 137-142, May, 2014. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Biodiversity of Fish of Betravati River in Madhya Pradesh, India with particular orientation to a sacred ghat

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Accepted 04 April, 2014

Many sacred natural sites are areas of great importance for the conservation of biodiversity. Sacred natural sites can be considered a subset of "sacred sites", which may be defined as areas of special spiritual significance to people and communities. The wider category of sacred sites may include primarily natural areas (such as forests), but also human-built or monumental areas (such as temples). Many built or monumental sacred sites are themselves located in areas with high natural values that are often recognised by the faith concerned. IUCN focuses on areas that are primarily natural, as they link to its mission, but generally supports the cause of conserving both monumental and natural sacred sites as valuable elements of human cultures. In this regards authors have tried to identify a natural sacred site at Betwa River in Madhya Pradesh and compared the fish diversity and distribution to two non sacred sites. The sampling was carryout between 2006 - April 2007. Sixty fish species belonging to 15 families and 34 genera out of 60 species, 48 species have been recorded at a sacred ghat. A total of 5,461 individuals of fish were counted during the one study period. The most abundant family was Cyprinidae, having 3,594 individuals (65.81%) and subdominant family was Ambassidae, which accounted for 441 individuals (8.08%); rest of the families contributed in order of abundance throughout the study. The diversity indices (Shannon, Simpson and Margalef) showed higher values at S3 (a sacred ghat) sampling site as compared to other two (S1, and S2) non sacred sampling sites.

Key words: Betwa river, biotic indices, ecological status, fish diversity and sacred ghat.

INTRODUCTION

India has a long tradition of wise conservation strategies that are useful to people and society. Biodiversity is the most valuable but least appreciated resource, and it can be a key to the maintenance of the world (Wilson, 1992). In India, biodiversity outside protected areas is rich because of close relationships between religious, socio-cultural beliefs and conservation. Rapid decline in biological diversity – species, ecosystems, and genetic diversity – is one of the critical challenges of the 21st century. There are many practical reasons for conserving biodiversity, not to mention benefits related to food, medicine, and other materials as well as, the environmental services supplied by natural ecosystems.

However, the driving force behind biodiversity conservation remains and will primarily remain ethical. According to surveys, most people believe that we have an obligation to avoid the extinction of species and races and the destruction of ecosystems caused by our own actions (WWF, 2005).

This can pose a threat to sacred spaces, if spiritual, cultural, and religious values are not included in the planning stage of conservation management. Although protecting a sacred site officially or through legislation prevents its traditional use, and likely to cause a cultural split and indignation by degrading the well preserved sacred nature (WWF, 2005). Sacred groves have been well documented for their conservation values in terrestrial ecosystems in India (Gadgil and Vartak, 1976a, 1976b, 1981; Chandran and Gadgil, 1993; Gadgi,1995; Ramkrishnan et al., 1998, Pande, 1998; Malhotra et al., 2001; Tripathi, 2005) like sacred groves, there are many aquatic sanctuaries in existence near temples situated on the banks of rivers and ponds, (Chandrasekharaiah,

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1996; Malhotra et al., 2001; Gadgil, 2003; Dhanze and Dhanze, 2004; Das, 2005). The objectives of the present study suggest that, these sacred groves and pools could become very useful tools for aquatic biodiversity conservation.

MATERIALS AND METHODS

Study area

The Betwa or Vetrawati is a river of great antiquity and immense mythological and religious values for the people of the Malwa region of Madhya Pradesh for hundreds of years. This third largest river of the Malwa region is not only important from the geo ecological point of view but also has a significantly potent socio- economic impact on the area through which it flows. Viewing from an angle, Betwa is an, Betwa is an important tributary of the Yamuna which in turn is a tributary of the river Ganga. This makes the Betwa as an important river of sacred gangetic river system. The River Betwa rises from the main Vindhyan range in the extreme south west of the Raisen district at Jhirri village. It flows for an estimated total length of 573 km of which 216 km in Madhya Pradesh and 98 km in Uttar Pradesh and finally joins the river Yamuna at Hamirpur in Uttar Pradesh. The river has a huge catchments area of around 46580 sq.km. During the course of its flow, Betwa receives 14 tributaries of which as many as 11 are located in the Madhya Pradesh. The study was carried out at three sites in River Betwa that is, Bhojpur (S1), near Pagneshwar village (S2) and Ramghat Vidisaha (S3). Ramghat of river Betwa is a sacred ghat situated in the Vidisha district of Madhya Pradesh. It is a religious ghat and many temples are situated on both the banks of the river. About 1 km length of this stretch is restricted for fishing and fishermen avoid to fish in this stretch. However some fishermen perform netting operations in the adjoining area and they sometimes enter this stretch for fishing. Incidentally, this stretch harbors a deep pool with a depth of 14 m. The pool is about 0.75 km long and 60 m wide in dimension.

Data collection and analysis

Fish sampling was performed in 100m reach of all the three sampling sites. In each the sapling sites in different habitats such as pools and runs using monofilaments mesh size gill nets a different mesh sizes (10 to 100 mm) and cast nets. Gill netting was installed over night and cast netting during day time (fish collection methods of Arun, 1998; Mheen, 1995; Arunachalam, 2000). After the collection of fishes were examined, counted and released. A few specimens (5 to 10) of unidentified species were preserved on buffered formalin (4%) and transported to the laboratory for analysis. Species identification and confirmation were carryout by using the standard keys of Qureshi and Qureshi (1983), Talwar and Jhingran (1991), Shrivastava (1998), Jayaram (1999). The diversity indices viz. Shannon index, Simpson index, Margalef index and evenness index were used to calculate with the help of softwares PAST (Hammer et al., 2001) and Biodiversity Pro (McAleece et al., 1999).

RESULTS

Fish assemblage structure, species and spatial variation

During the entire study period, a total of 60 fish species belonging to 18 families and 36 Genera were recorded. From all the three stations, Cyprinidae formed the largest dominant family contributing 29 species (48.33%); Bagridae formed the subdominant family contributing 6 species (10%) and the rest of the families followed order of abundance. A total of 1,973 individuals of fish were caught during the one year study period. The most abundant family was Cyprinidae, having 1,303 individuals (66.04%) and subdominant family was Cobitidae, which accounted for 178 individuals (9.02 %); rest of the families contributed in order of abundance throughout the study as summarized in Table 1 and Figure 1.

In the one year study period a total of 60 fish species were documented. Out of this, maximum 48 (1108 individuals) species were recorded at sampling site S3 Ramghat (a sacred ghat), 25 fish species (215 individuals) at sampling site (S2) at Pagneshwar village, 21 species (650 individuals) were recorded at sampling site (S1) at Bhojpur which is summarized in Table 1. Species richness varied greatly at spatial scale. Station 3 (Ramghat) showed higher species richness (48 sp.) as compared to other two stations (that is, 25 and 21 sp. respectively).

Biotic indices

The values of Shannon diversity index ranged from 2.54 to 3.18. The lowest value was for site S2 and the highest value was for site S3 (sacred ghat). The values of Simpson diversity index were between 0.08 to 0.11. The lowest value was also for site S3 (Ramghat) and the highest value was for site S2. The values of Margalef diversity index were between 3.71 to 6.70. The lowest value was for site S1 and the highest value was for site S3 (sacred site).

This index shows variation depending on the number of species, so that the number of individuals is less important for calculation. The values of Evenness diversity index were between 0.50 to 0.64. The lowest value was for site S3 (Ramghat) and the highest value was for site S1 as given in Table 2.

Ecological Conservation Status of Fishes (ECSF)

Ecological conservation status of fresh water fishes of India have been assessed as per the criteria of IUCN under six categories as EN (Endangered), VU (Vulnerable), LRlc (Lower risk lest concern), LRnt (Lower risk near threatened), DD (Data deficient) and NE, Not evaluated (CAFF 2006). According to CAFF in Betwa river, 26 (42%) species belongs to LRnt, 12 (20%) species belongs to VU, 7 (12%) species under LRlc, 7 (12%) species were found in EN, 4 (7%) species represented DD and 4 (7%) species belongs to NE category as shown in Figure 2.

Table 1. Abundance of fishes in Betwa river of Madhya Pradesh.

S/no.	Family	Species	S1	S2	S3
1	Notopteridae	*Notopterus notopterus*	1	0	12
2	Clupeidae	*Gonialosa manmina*	0	4	6
3	Cyprinidae	*Amblypharogodon mola*	15	0	30
4		*Barilius barila*	0	15	0
5		*Barilius bandelisis*	11	0	0
6		*Labeo bata*	10	4	13
7		*Labeo gonius*	0	0	5
8		*Labeo angra*	3	2	0
9		*Labeo fimbraitus*	0	8	10
10		*Labeo boga*	0	0	2
11		*Labeo rohita*	0	0	15
12		*Labeo calbasu*	13	13	44
13		*Cirrhinus mrigala*	0	0	3
14		*Catla catla*	0	0	8
15		*Chela laubuca*	3	8	14
16		*Cypprinus carpio*	0	0	3
17		*Puntius conchonius*	33	0	46
18		*Puntius saphore*	45	0	24
19		*Puntius sarana*	0	0	22
20		*Puntius ticto*	91	0	0
21		*Puntius dorsalis*	0	10	12
22		*Puntius titius*	0	12	10
23		*Garra gotyla*	44	38	91
24		*Danio davario*	46	0	0
25		*Oxygaster bacaila*	105	46	188
26		*Oxygaster gora*	11	0	4
27		*Oxygaster clupoides*	0	0	3
28		*Osteobrama cotio*	0	22	51
29		*Rasbora daniconius*	0	0	88
30		*Rasbora elanga*	3	0	0
31		*Tor tor*	0	0	6
32	Bagridae	*Mystus cavasius*	12	0	13
33		*Mystus tengra*	0	1	0
34		*Mystus bleekeri*	10	0	0
35		*Mystus seenghala*	0	6	6
36		*Mystus aor*	0	2	8
37		*Rita rita*	0	0	2
38	Siluridae	*Ompok bimaculatus*	14	12	46
39		*Wallago attu*	0	0	20
40	Schilbeidae	*Clupisoma garua*	0	0	44
41		*Silonia silondia*	0	3	0
42		*Eutropiichthys vacha*	0	5	3
43	Clariidae	*Clarias batrachus*	0	0	3
44	Saccobranchidae	*Heteropneustes fossilis*	0	0	3
45	Sisoridae	*Bagarius bagarius*	0	0	2
46	Cobitidae	*Lepidocephalichthys guntea*	55	0	77
47		*Namachilus botia*	46	0	0
48	Ambassidae	*Chanda ranga*	33	0	88
49		*Chanda nama*	23	0	0
50	Nandidae	*Nandus nandus*	0	0	3
51	Cichlidae	*Talapia mossombica*	0	0	15

Table 1. Contd.

52	Gobiidae	*Glossogobius giuris*	11	0	0
53	Mastacembelidae	*Mastacembelus armatus*	0	2	10
54		*Mastacembelus pancalus*	9	0	12
55	Ophiocephalidae	*Channa marulius*	0	0	6
56		*Channa gachua*	0	1	3
57		*Channa straitus*	3	0	5
58		*Channa punctatus*	0	1	9
59	Belonidae	*Xenentodon cancila*	0	0	14
60	Mugilidae	*Rhinomugil corsula*	0	0	6
			650	215	1108

Figure 1: Family wise species diversity and abundance of fishes in Betwa river

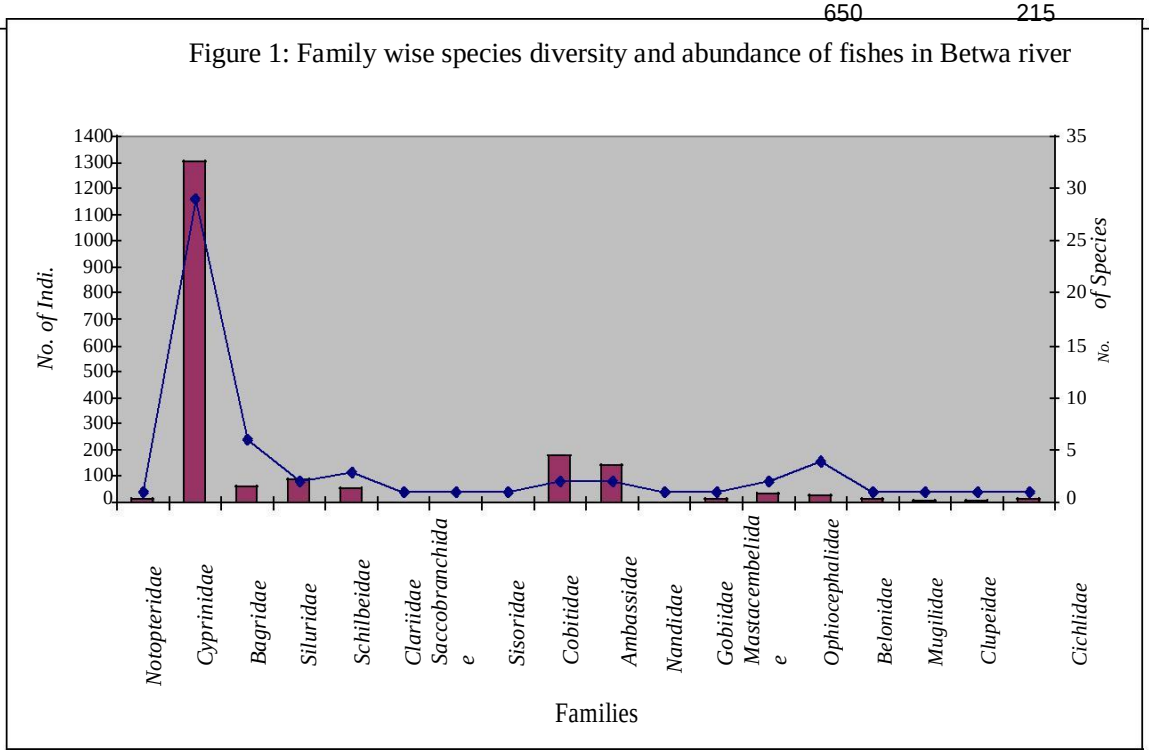

Figure 1. Family wise species diversity and abundance o f fishes in Betwa river.

Table 2. Numeric data of the fishes in Betwa river of Madhya Pradesh.

Variable	S1	S2	S3
Taxa_S	25	21	48
Individuals	650	215	1108
Shannon_H	2.77	2.54	3.18
Simpson_1-D	0.09	0.11	0.08
Evenness_e^H/S	0.64	0.60	0.50
Margalef	3.71	3.72	6.70

DISCUSSION

There has been a close linkage between human beings and nature conservation since the beginning of hunting and gathering societies. The relationship between humankind and earth is based on a belief that the planet's biosphere life support system is sacred (Cairns, 2002). In India, as elsewhere in many parts of the world, a number of communities practice different forms of nature worship. Early humans worshipped nature with

Table 2: Ecological conservation status of fishes in Betwa River

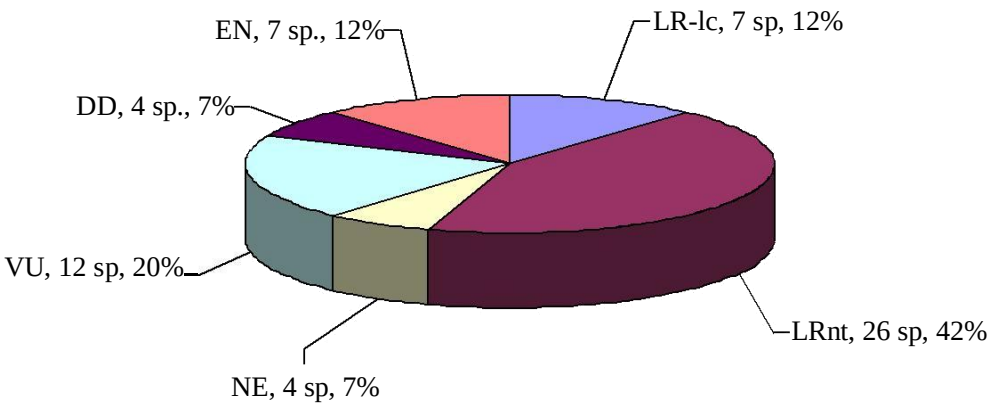

Figure 2. Ecological conservation of fishes in Betwa river.

reverence and exploited its resources sustainable to meet their minimum needs only. Every culture has beliefs which answer in different ways the fundamental question about how and where people originated, and how they should behave with their environment (Elder and Wong, 1994).

Much has been stated about declining fish biodiversity and its conservation issues in Indian River Systems (Menon, 1989; Dubey, 1994; Anon, 1995; Kapoor et al., 1998; Kapoor and Sarkar, 2005). In situ conservation is one of the several prominent and suggestive measures for conservation of fish biodiversity. In particular, the establishment of fish sanctuaries has been recommended in many scientific meetings to give protection to aquatic fauna on the lines of terrestrial wildlife sanctuaries. In the present legislative framework many stretches of river have been declared as fish sanctuaries/no fishing zones in many states. In Madhya Pradesh 37 no fishing zones have been notified in many rivers under MP Fisheries Act 1956 but most of these lacked proper vigilance and monitoring systems. In the opinion of many workers legislations alone cannot help in conservation of fish diversity unless community is involved in it (Dubey and Ahmad, 1995).

Pertinent literature indicates that 56 species were recorded from Betwa River by Adholia (1979) in his studies on hydrobiology of the Betwa River and its fishery resources. No other records are available on this river after this study. The largest study showed the presence of sixty fish species belonging to 7 orders 18 families and 36 Genera in Betwa River. Among these, 14 are newly recorded fish species in this river which were not recorded in earlier study in this river (Adholia, 1979). Ten species were not recorded in the study which was earlier recorded by Adholia (1979). The present paper reveals that forty eight species were recorded at Ramghat, Vidisha which is a sacred site in the present study. This indicates that the limited stretch of about 1.5 km harbors 48 species which is about 75% of the total stretch of River Betwa. According to local residents and fishermen Ramghat is a religious place hosting some old temples on the both banks of River Betwa. Fishing activity is prohibited on this ghat with social restrictions. During the present survey we observed that the social restriction is very effective and fishermen do not perform netting in this area. Moreover, this stretch harbors a deep pool with a depth of 14 m.

Quantifying biodiversity is one of the most complicated aspects of biodiversity (Gaston and Spicer, 1998). Many indices of biodiversity have been created in an attempt to capture the diversity of an ecosystem. These indices attempt to define biodiversity in many different ways though most indices use a combination of number of species and the degree of difference between those species (Gaston and Spicer, 1998). Huston (1994) argued that it is absurd to expect one index to characterize the diversity of an entire ecosystem and said that the best way to characterize biodiversity is through the use of numerous biodiversity indices. It is unlikely to ever discover the “true” biodiversity of an ecosystem (Gaston and Spicer, 1998). The goal of using multiple indices is to try to describe the diversity of an ecosystem as accurately as possible.

In the present study we have applied four diversity indices which were Shannon index, Simpson index, Margalef index and Evenness index. Shannon index as 3.18 was highest at S3 (Ramghat) sampling site and indicates good diversity while two other S1 and S2 sampling indicates moderately polluted water. According to Wilhm and Dorris (1966) Shannon index (H) value ranged from >3 indicates clean water, 1.00 to 3.00 indicates moderate water and <1.00 indicates heavily polluted water.

Simpson's diversity is one of a number of diversity indices, used to measure diversity. It takes into account the number of species present as well as the relative abundance of each species. The Simpson index represents the probability that two randomly selected individuals in the habitat will belong to the same species.

In this form, Simpson index ranges from 0 to 1, with 0

representing infinite diversity and 1 representing no diversity. A low Simpson index value equates high diversity, whereas a high value correlates to a low diversity. During the study the highest Simpson index value as 0.11 was recorded at S2 while lowest value as 0.08 was recorded at S3 (sacred ghat) sampling site. The same pattern was found in the present study because of highest number of species and number of individuals were found at S3 (Sacred ghat) and less species richness and abundance were recorded at two other sites (S1) and (S2).

Margelef index has no limit value and it shows a variation depending upon the number of species. Thus, it is used for comparison the sites (Kocataş, 1992). In present study margelef index was same as Shannon index, highest values was present at the S3 (sacred ghat) and lowest values at two other sites (S1 and S2) respectively. It is indicates that highest diversity was found at sacred ghat (Ramghat) as compared to two other sites (S1 and S2).

Species evenness refers to how close in numbers each species in an environment. Mathematically it is defined as a diversity index, a measure of biodiversity which quantifies how equal the community is numerically. For example, if there are 40 foxes, and 1000 dogs, the community is not very even. But if there are 40 foxes and 42 dogs, the community is quite even. In the present study evenness range varied between 0.50 to 0.64. It is clearly indicated that there is no evenly distribution of the species and only 50 to 64% evenness were found at all the three sampling sites. A

total of 60 species, out of 48 species was recorded at this sacred ghat. Maximum numbers of endangered and vulnerable species have been associated with S3 (Sacred ghat) as compared to other two sites (S1 and S2). Damde et al. (2010) also recorded highest diversity at sacred sites as compared to others sampling sites in Tapti River of Madhya Pradesh. This study also suggested that sacred places can become a very useful tool for aquatic biodiversity conservation. The need of the hour is to document and advertise such hotspots of biodiversity which can be a source of motivation in other areas for conservation of the same.

The earlier mentioned description indicates that the religious sanctuaries can play a major role in conservation of aquatic biodiversity. Dhanze and Dhanze (2004) have documented such religious fish sanctuaries known as “Machhyal” in Himachal Pradesh. According to Dash (2005) there are 11 religious aquatic sanctuaries in Sikkim state. Malhotra et al. (2001) while studying sacred groves found some sacred pools in Orissa where fish is worshipped and conserved. Gadgil (2003) has recorded some of the fish sanctuaries with religious beliefs. These examples corroborate our findings and indicate that conservation of biodiversity has been practiced by the community since long and has become a part of our cultural heritage.

Conclusion

Sacred groves and pools serve as tools that permit the management of biotic resources through people’s participation. Knowledge and awareness about sacred sites is very important for developing new strategies for rehabilitation and restoration of degraded landscapes. This should involve local people and provide training for the promotion of traditional and social norms. There is an urgent need for conservation, restoration, and proper management of existing sites. Traditional approaches for nature conservation include a number of prescriptions and proscriptions for the sustainable use of resources. These landscapes need proper conservation, management, and protection. To protect them from further degradation, conservation strategies must be employed.

ACKNOWLEDGEMENTS

The authors are thankful to MP State Biodiversity Board for providing financial assistance for this study and Prof. Pradeep Shrivastava, Dean of Faculty of Life Sciences Department of Environmental Science and Limnology, Barkatullah University Bhopal for encouragement and providing facilities in the lab and field.

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