Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(4): 292-300
© 2017 JEZS
Received: 06-05-2017
Accepted: 07-06-2017

Kokate Amit A
College of Fisheries Shirgaon, Dr B. S. Konkan Agricultural University, Ratnagiri, Maharashtra, India

Bhosale Bhaskar P
College of Fisheries Shirgaon, Dr B. S. Konkan Agricultural University, Ratnagiri, Maharashtra, India

Chogale Narendra D
Marine Biological Research Station, Dr B. S. Konkan Agricultural University, Ratnagiri, Maharashtra, India

Metar Santosh Y
Marine Biological Research Station, Dr B. S. Konkan Agricultural University, Ratnagiri, Maharashtra, India

Pawar Ravindra A
Marine Biological Research Station, Dr B. S. Konkan Agricultural University, Ratnagiri, Maharashtra, India

Nirmale Vivek H
Marine Biological Research Station, Dr B. S. Konkan Agricultural University, Ratnagiri, Maharashtra, India

Pagarkar Asif U
Marine Biological Research Station, Dr B. S. Konkan Agricultural University, Ratnagiri, Maharashtra, India

Correspondence
Chogale Narendra D
Marine Biological Research Station, Dr B. S. Konkan Agricultural University, Ratnagiri, Maharashtra, India

Comparison of ichthyofaunal diversity of Sangli region of Krishna River, Maharashtra, India

Kokate Amit A, Bhoxsale Bhaskar P, Chogale Narendra D, Metar Santosh Y, Pawar Ravindra A, Nirmale Vivek H and Pagarkar Asif U

Abstract
The present was studies carried out on capture fisheries of Krishna river of Sangli district Maharashtra with referred to fishery status and fish yield and species composition for suggesting management recommendation for conservation and restoration of Krishna river of Sangli district of Maharashtra during a period of March 2015 to Feb 2016. Catch composition data was obtained through monthly visit to the five landing stations viz Tambave, Takari, Bhilwadi, Kasba Digraj, Haripur to know the diversity status of ichthyofauna. During the study, a total of 25 finfishes species were recorded in the interior 105 km study area. The species belonging to 11 families and 21 Genera were grouped into five groups Namely IMC, Minor carps, Weed fishes, Catfishes and exotic fishes.
Overall the minor carps contributed the most (36%), followed by catfishes (31%), IMC (19%), weed fishes (10%) and exotic fishes (4%) excepting Takari. The exotic species always contributed lowest to the catches from all locations. ANOVA revealed significant difference for all stations ($P<0.05$) except with the only exception of Haripur where no such effect evident ($P>0.05$). Similarly statistical significant of the season was recorded for all species groups ($P<0.05$) without any exceptions.

Keywords: Ichthyofaunal Diversity, landing centre, Sangli region, River Krishna

1. Introduction
The aquatic ecosystem is important and it has large number of economically important animals especially fish which is an important source of food. Das *et al.* [3] mentioned that there are 14 major rivers in India viz. Ganga. Brahmaputm, Brahmnni, Cauvery, Godavari, Indus, Krishna, Mahanadi, Mahi, Narmada, Periyar, Sabarmati, Suharnarekha, Tapti, covering 83% of the drainage basin and account for 85% of the surface flow.
Shinde and Pathan [17] studied the fish biodiversity, the variety and abundance of fresh water fishes in Pravara River at Pravara Sangam Dist. Ahmednagar (M.S) India. Bhat [1] studied on the Diversity and composition of freshwater fishes in river systems of Central Western Ghats, India. Singh and Johal [18] studied on the present status of fish species diversity of river Ganga in the vicinity of Allahabad, Utter Pradesh, India. Kumar *et al.* [10] studied on the fish diversity in the River Mahanadi and identified the probable potential ornamental fishes among them with reference to threats and conservation measures. Murugan *et al.* [13] studied the fresh water fish community of Periyakulam riverine wetland in Kanyakumari district, Tamil Nadu.
Laxmappa *et al.* [12] mentioned that the Krishna is one of the longest rivers of India and flows about 1400 km in length. It originates at Mahabaleshwar in Maharashtra, flows through the states of Maharashtra, Karnataka, Telangana and Andhra Pradesh and meets the sea in the Bay of Bengal. Krishna River is most important river as far as Sanagli district of Maharashtra state. So data on fish yield, stock status species composition of Krishna river of Sangli district Maharashtra are meagre and also the studies on status of fish and fisheries of river Krishna in Sangli district has not been undertaken. Therefore the present studies on capture fisheries of Krishna river of Sangli district Maharashtra will reveal important observation referred to species composition may helpful for suggesting management recommendation for conservation and restoration of Krishna river of Sangli district of Maharashtra.

2. Material and Methods
The present study was carried out along the entire 105 Km stretch of River Krishna from the Sangli district ($16^0$86'70"N and $74^0$56'70"E) of Maharashtra. Sangli District is present in the western part of Maharashtra.

It is geographically located at $16^0$86'70"N latitude and $74^0$56'70"E longitude, surrounded by Satara and Solapur districts to the north, Bijapur District, Karnataka to the east, Kolhapur and Belgaum, Karnataka districts to the south, and Ratnagiri District to the west. Sangli district is situated around river basins of the Warna and Krishna. Sangli City is the district headquarters and total area is 8,578 km². The district is 24.51% urban.

Five sampling stations of district were selected randomly for the purpose of collecting data for the study. Namely Tambave (A), Takari (B), Bhilawadi(C), Kasba Digraj (D), Haripur (E) situated along the river bank in the district (Fig. 1). Actual visit of different selected sampling station was done on monthly basis and the data collection and collection of samples and Species wise catch details of station.

Random sampling was used to select the respondent at every sampling station.For purpose of convenience, analysis and interpretation all species that were encountered during the study period were grouped in to five: IMC (Indian major carps), Minor Carp, Weed Fishes, Catfishes, and Exotics. All subsequent analyses were done with reference to these five groups. Species identification was done as per given by Talwar and Jhingran [19] and Jayaram [5].

2.1 Statistical analysis

Descriptive statistics was computed for the species (group) composition data. Species groups were analysed for the effect of station and seasons on their availability using ANOVA [21]. All analyses were performed on SAS 9.3.

3. Results

During the study, a total of 25 fin fishes species were recorded in the interior 105 km study area. The species belonging to 11 families and 21 Genera were grouped into five groups namely Indian major carp (IMC), Minor carps, Weed fishes, Catfishes and Exotic fishes Table 1. Species wise availability at the five sampling station is given in Table 2.

Catch composition in terms of weight was computed based on the respondents knowledge of the weekly landings from their respective zones of operations. Data for each sampling stations was raised to account for the total operations. Fishing units in each zone, varied within and between the zones. Therefore, the species wise weight composition data that is provided in the following sections is an approximation only. None the less, the estimates prove to be valuable in comparing the trends based on sampling station and season.

The species wise catch trends at the five stations are given in Fig. 2 to 5. IMC and minor carps formed the majority of the catch at Tambave and Takari. However, the percent share of IMC to total catch decline for station Bhilwadi, Kasba Digraj and Haripur. Infact for Kasba Digraj, the share of IMC was zero percent. Overall the minor carps contributed the most (36%), catfishes (31%), IMC (19%), weed fishes (10%) and exotic fishes (4%) except in Takari. The exotic species always contributed lowest to the catches from all locations (Fig. 7). The season wise catch trends at the given in Fig. 8-10. Minor carp (35%), catfishes (29%) were the dominant group during winter; minor carp (36%), catfishes (32%) during summer and minor carps (34%) and catfishes (33%) during monsoon.

Two way ANOVA was perform to a statistical analysis if the sampling location and/ or the sessions had any effect on catch composition. According the ANOVA revealed significant difference for all stations ($P<0.05$) except with the only of Haripur where no such effect evident ($P>0.05$). Similarly statistical significant of the season was recorded for all species groups ($P<0.05$) without any exceptions.

Fig. 11 and 12 reveals the station wise difference in the availability of IMC according to stations and seasons respectively. Stations Tambave, Takari, Bhilwadi and Kasba Digraj revealed significant differences in the distribution of Indian Major Carps ($P<0.05$). For seasons the landing during winter were significant different than that of Monsoon ($P<0.05$). However the summer landings did not differs significantly from that of winter and Monsoon ($P>0.05$).

Distribution of minor carps at Takari and Kasba Digraj was significantly different from Tambave, Haripur and Bhilwadi (Fig. 13 and 14). Season wise catch compositions during Monsoon was significantly different from that of winter and summer ($P<0.05$). Distribution of weed fishes at Takari and Bhilwadi was significantly different from that of Tambave, Kasba Digraj and Haripur ($P<0.05$) (Fig. 15). Season wise catch composition during monsoon was significantly different from that of winter and summer ($P<0.05$) (Fig. 16). Catfishes distribution differed significantly for Tambave and Takari as compared to Bhilwadi, Kasba Digraj and Haripur ($P<0.05$) (Fig 17). Season wise catch compositions during monsoon was significantly different from that of winter and summer ($P<0.05$) (Fig 18). Availability of exotic species did not differ significantly for any of the stations ($P>0.05$) (Fig 19). Species distribution during monsoon differ significantly that of winter and summer ($P<0.05$) (Fig 20).

Table 1: List of fish species diversity recorded from the Krishna River in Sangli District.

Family	Species
GROUP 1: Indian major carps (IMC)	
Cyprinidae	*Catla catla* (Hamilton, 1822)
	Labeo rohita (Hamilton, 1822)
	Cirrhinus mrigala (Hamilton, 1822)
Group 2: Minnor Carps	
Cyprinidae	*Labeo calbasu* (Hamilton, 1822)
	Gonoproktopterus curmuca (Hamilton, 1807)
	Labeo potail (Sykes, 1839)
	Neolissochilus hexagonolepis (McCleeand, 1839)
	Osteochilus nashii (Day, 1869)
	Schismatorhynchos nukta (Sykes, 1839)
GROUP 3: Weed Fishes	
Cyprinidae	*Puntius sarana sarana* (Hamilton, 1822)
	Salmostoma bacaila (Hamilton, 1822)
Ambassidae	*Chanda* sp. (Hamilton, 1822)
Mastecembalidae	*Mastacembelus armatus* (Lacepede, 1800)
Cobitidae	*Botia striata* (Narayan Rao, 1920)
GROUP 4: Catfishes	
Bagridae	*Aorichthys Seenghala* (Sykes, 1839)
	Mystus Cavasius (Hamilton, 1822)
	Mystus Malabaricus (Jerdon, 1849)
	Rita Rita (Hamilton, 1822)
Chanidae	*Channa Marulius* (Hamilton, 1822)
	Channa Striatus (Bloch, 1793)
Heteropneustidae	*Heteropneustes Fossilis* (Bloch, 1794)
Siluridae	*Ompok Pabda* (Hamilton, 1822)
Sisoridae	*Glyptothorax Launch* (Sykes, 1839)
Pangasiidae	*Pangasius Pangasius* (Hamilton, 1822)
Group 5: Exotic	
Cichlidae	*Oreochromis Mossambicus* (Peters, 1852)

Table 2: Species wise abundance and distribution of fishes at the five sampling station.

Species	A	B	C	D	E
CYPRINIDE					
Catla catla	✓	✓	-	-	✓
Labeo rohita	✓	✓	-	-	✓
Cirrhinus mrigala	✓	✓	✓	-	-
Labeo calbasu	✓	✓	✓	✓	✓
Gonoproktopterus curmuca	✓	✓	✓	✓	✓
Labeo potail	-	-	-	✓	✓
Neolissochilus hexagonolepis	✓	✓	✓	✓	✓
Osteochilus nashii	✓	✓	✓	✓	✓
Schismatorhynchos nukta	✓	✓	✓	✓	✓
Puntius sarana sarana	✓	✓	✓	✓	✓
Salmostoma bacaila	-	-	✓	✓	-
AMBASSIDAE					
Chanda sp.	-	-	✓	-	-
MASTECEMBALIDAE					
Mastacembalus armatus	✓	✓	✓	✓	✓
COBITIDAE					
Botia striata	-	-	✓	-	-
BAGRIDAE					
Aorichthys seenghala	✓	✓	✓	✓	✓
Mystus cavasius			✓	✓	✓
Mystus malabaricus	✓	✓	✓	✓	✓
Rita rita	-	-	-	-	✓
CHANIDAE					
Channa marulius	-	-	✓	✓	✓
Channa striatus	-	-	✓	✓	✓
HETEROPNEUSTIDAE					
Heteropneustes fossilis	✓	✓	✓	✓	✓
SILURIDAE					
Ompok pabda	-	-	✓	✓	✓
SISORIDAE					
Glyptothorax launch	✓	✓	✓	✓	✓
PANGASIIDAE					
Pangasius pangasius	✓	✓	✓	✓	✓
CICHLIDAE					
Oreochrimis mossambicus	✓	✓	✓	✓	✓

(**Note: A**= Tambave, **B**= Takari, **C**= Bhilwadi, **D**= Kasba digraj, **E**= Haripur)

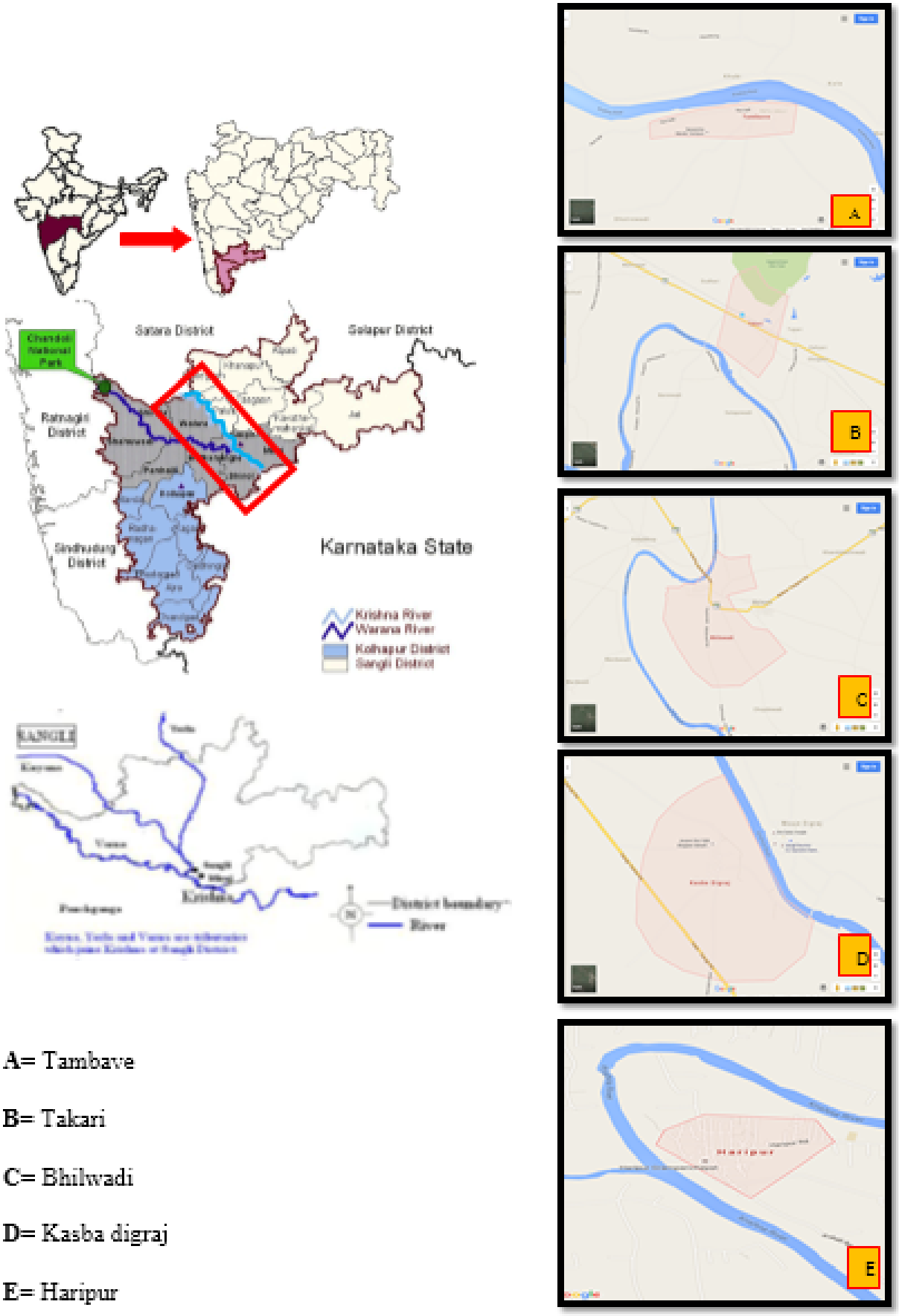

Fig 1: Sampling Stations consider in present study.

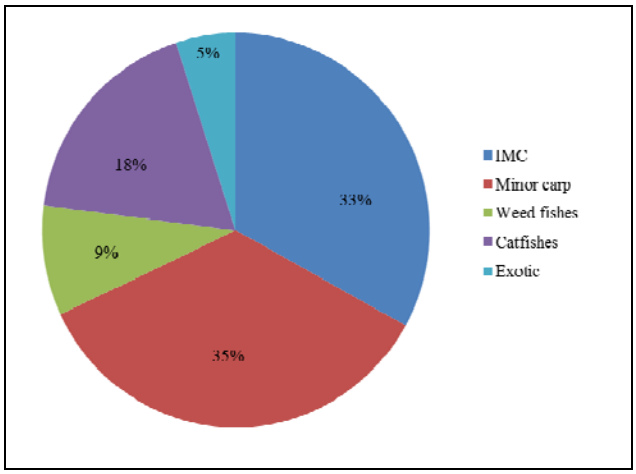

Fig 2: Fish species trends according to sampling stations at Tambave.

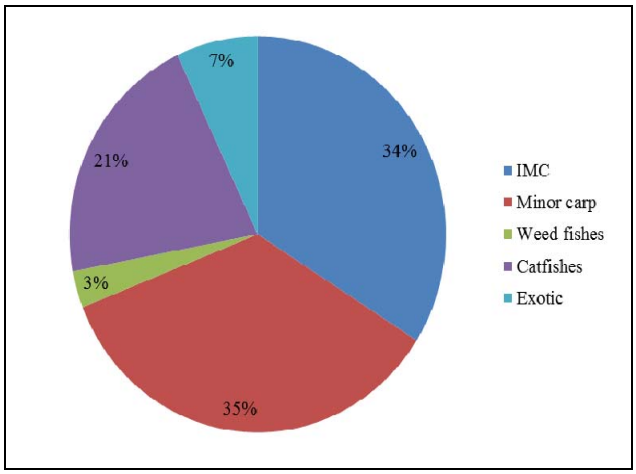

Fig 3: Fish species trends according to sampling stations at Takari.

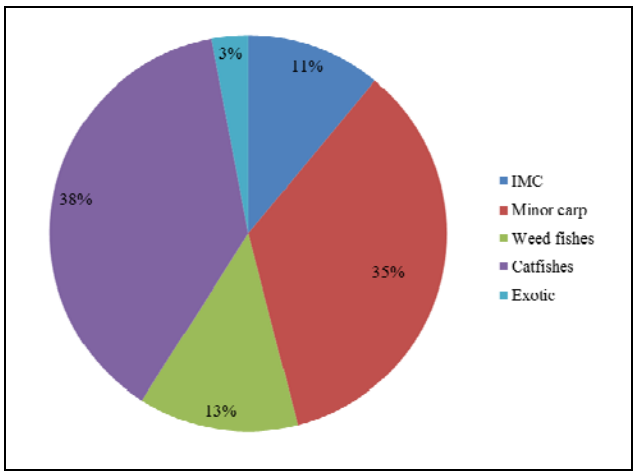

Fig 4: Fish species trends according to sampling stations at Bhilwadi

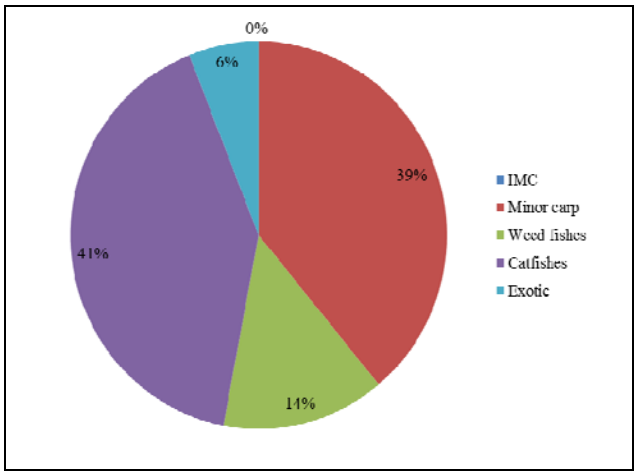

Fig 5: Fish species trends according to sampling stations at Kasba Digraj.

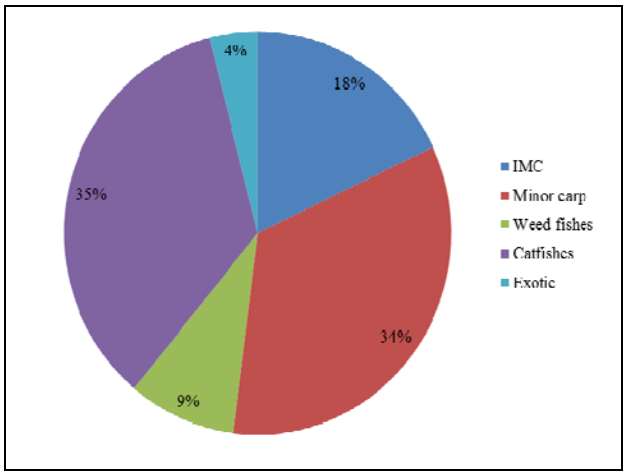

Fig 6: Fish species trends according to sampling stations at Haripur

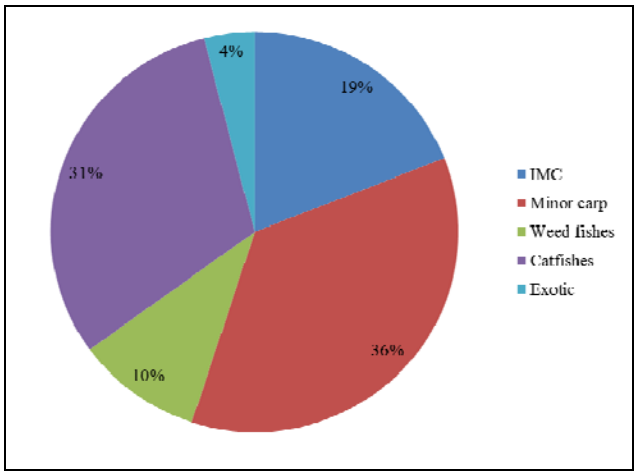

Fig 7: Overall fish species trends

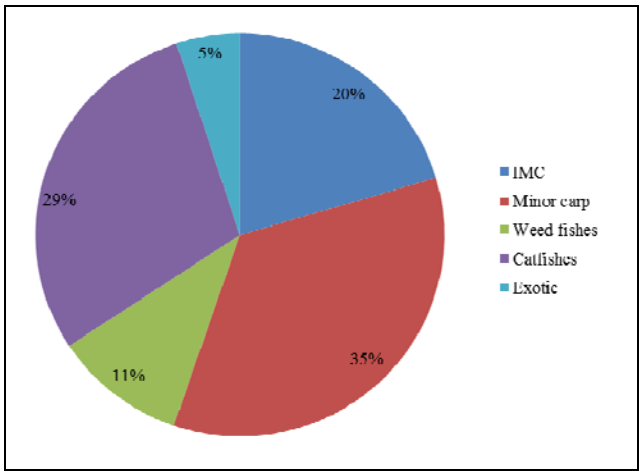

Fig 8: Fish species trends according to seasons (Winter).

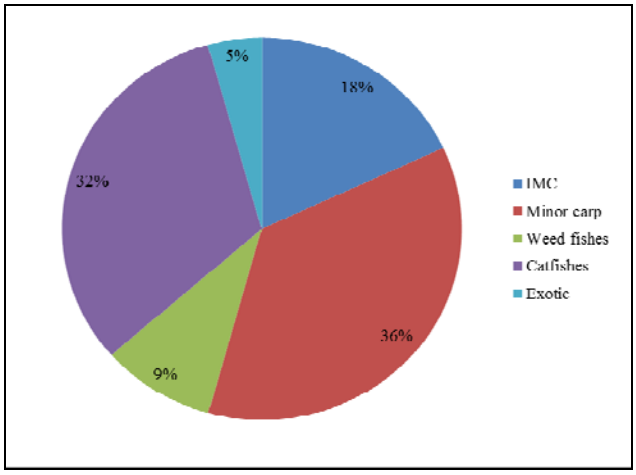

Fig 9: Fish species trends according to seasons (Summer).

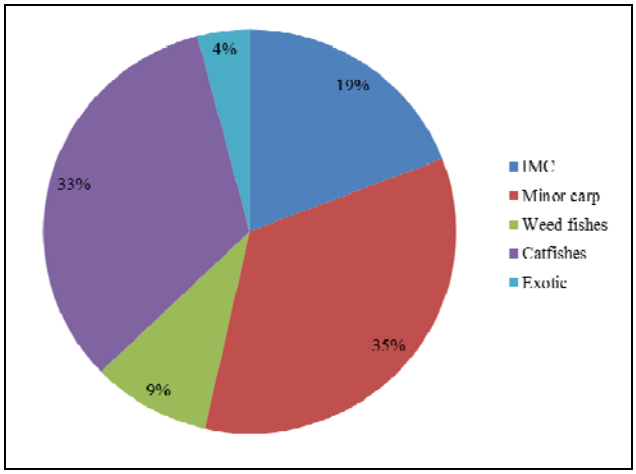

Fig 10: Fish species trends according to seasons (Monsoon).

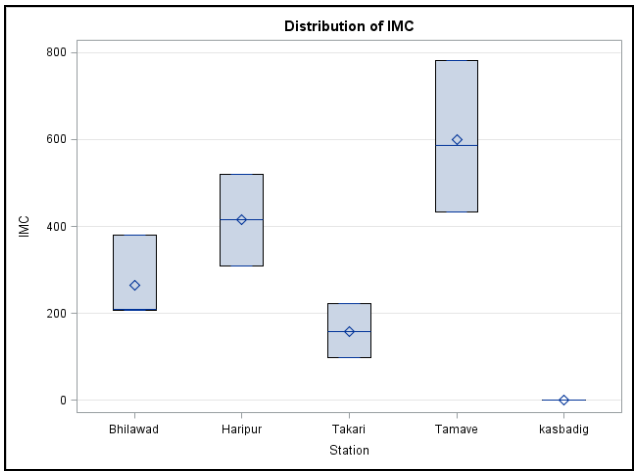

Fig 11: Effect of locations on fish species composition (IMC).

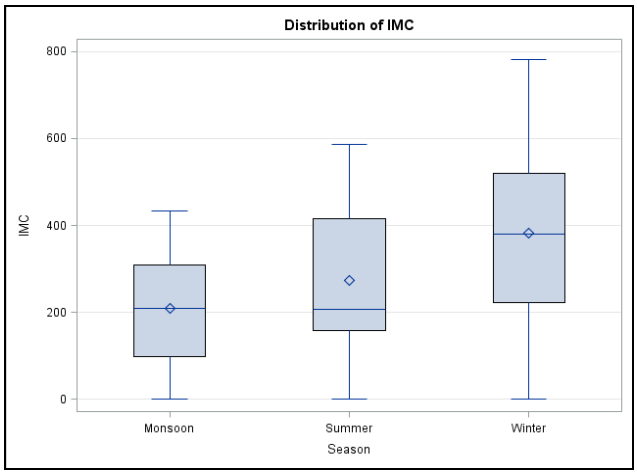

Fig 12: Effect of season on fish species composition (IMC).

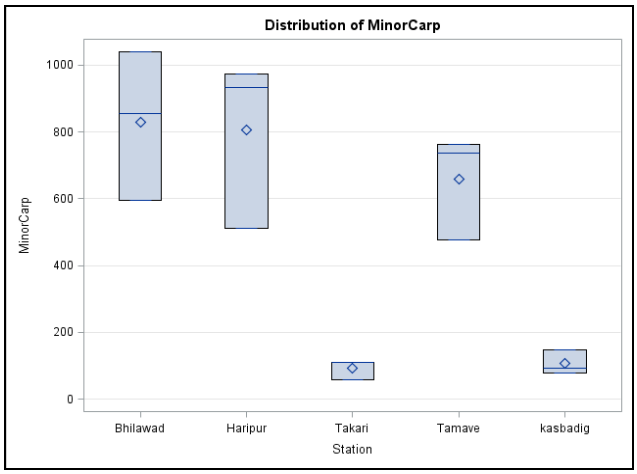

Fig 13: Effect of locations on fish species composition (Minor carp).

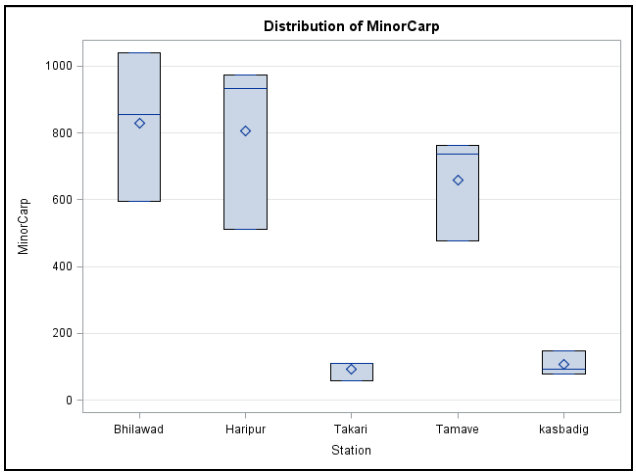

Fig 14: Effect of season on fish species composition (Minor carp).

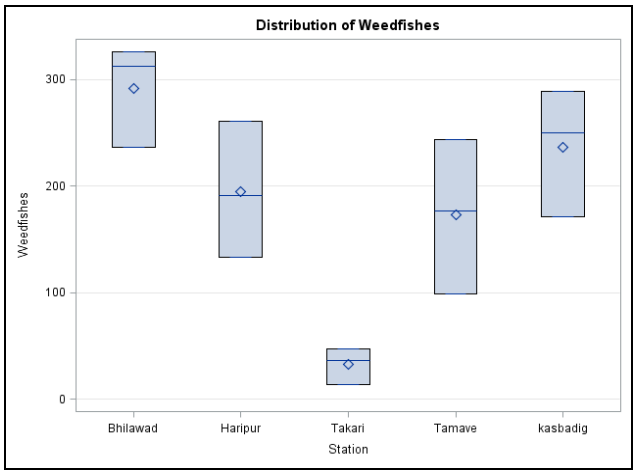

Fig 15: Effect of locations on fish species composition (Weed fishes).

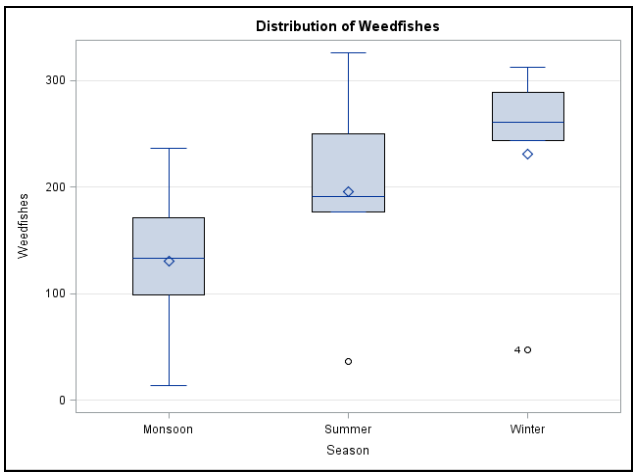

Fig 16: Effect of season on fish species composition (Weed fishes).

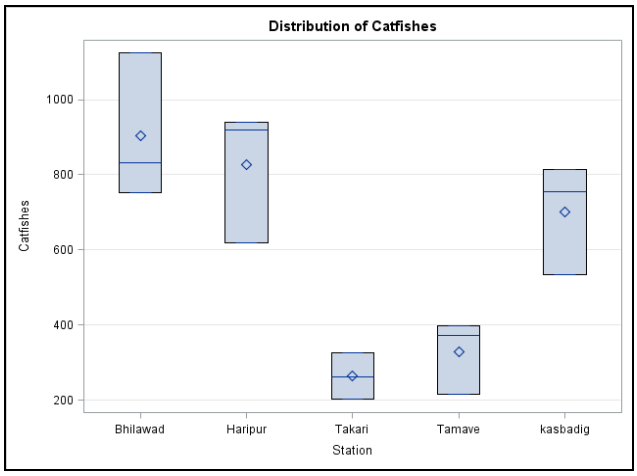

Fig 17: Effect of locations on fish species composition (Catfishes).

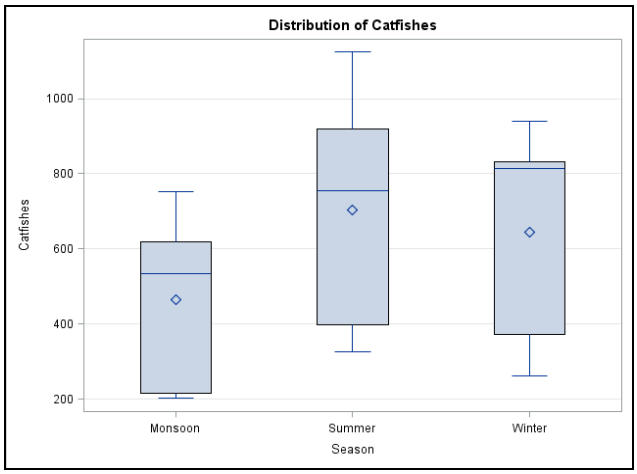

Fig 18: Effect of season on fish species composition (Catfishes).

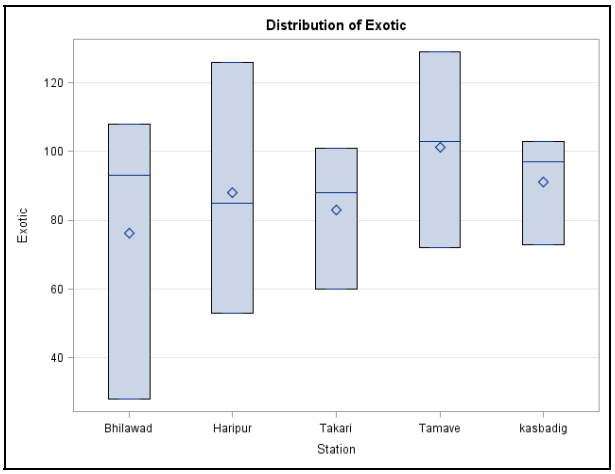

Fig 19: Effect of locations on fish species composition (Exotic).

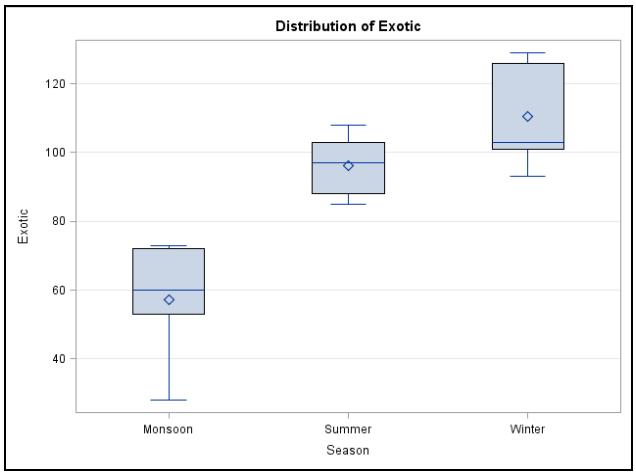

Fig 20: Effect of season on fish species composition (Exotic).

4. Discussion

During the study period, a total of 25 species of fishes were recorded in the catches of different gears by the fishermen on the Krishna River. A total of 25 species belonging to 11 families and 21 genera were recorded in present study. Most of the species belong to family such as Cyprinide, Bagridae, Chanidae, Ambassidae, Hetropeneustidae, Mastecmbalidae, Cichlidae, Siluridae, Sisoridae, Combitidae, and Pangoasiidae. Generally most of the species was found in all the stations, except *Rita rita* was observed at Haripur, *Botia striata* at Bhilwadi and *Chanda* sp. at Bhilwadi only**.**

Similarly, Jadhav *et al.* [4] studied the freshwater fish fauna for a period of two year from May 2007 to April 2009 and recorded 58 fish species belonging to 16 families and 38 genera. Cyprinidae was the most dominant family, contributing 30 species in 15 genera. A total of 22 fish species in the Koyna river are endemic to western Ghat, of which 11 are restricted to the Krishna River system of the total 58 species, 8 were abundant, 21 Common, 19 moderate and 10 rare in study area. Murugan *et al.* [13] recorded total of 30 fish species belonging to 13 families from study sites of Periyakulam riverine wetland. They are *Anguilla bicolor, Aplocheilus lineatus, A. panchax, A. parvus, Mesoemacheilus triangularis, Mystus bleekeri, M. malabaricus, Xenentodon cancila, Pseudosphromenus cupanus, Etroplus maculates, E. suratensis, Parambassis thomassi, Channa marulius, C. punctatus, Devario malabaricus, Rasbora daniconius, Hypselobarbus kurali, Puntius amphibious, Dawkinsia arulius, Puntius chola, Puntius dorsalis, Dawkinsia filamentosus, Puntius sophore, Pethia ticto, Puntius vittatus, Dawkinsia rohani, Garra mullya, Glossogobius giuris, Macrognathus malabaricus* and *Ompok malabaricus.* Kharat *et al.* [7] recorded total of 51 fish species belonging to 14 families and 35 genera were recorded of these, 15 fish species are endemic to the Western Ghats of India while five are endemic to the Krishna River system. Out of a total 51 species, 49 fish species were recorded from Krishna River at Wai while 42 fish species were recorded from Dhom reservoir. Abundance-wise distribution suggests that Krishna River at Wai hosts 11 abundant, six common, 20 moderate and 12 rare fish species. Similarly, in Dhom reservoir, there are five abundant, 14 common, 16 moderate and seven rare fish species. Ubharhande and Sonawane [12] observed that the ichthyofauna belong to 07 order 10 families, 19 genus and 21 species, where Cyprinidae family is dominant with 10 (47.63%) species followed by Channidae and Mastacembelidae with 02 (9.52%) species, Balitoridae, Bagridae, Clariidae, Belonidae, Notopteridae, Cichlidae, and Poecilidae contribute 01 (4.76%) species each in Pantakli dam from Buldhana district, (M.S) India.

Jayaram [6] recorded total 58 number fish species along the upper stretch of Krishna River from Wai to Bagalkot during 1987-88. In the present study 25 species recorded from the five sampling stations of Sangli district of Maharashtra. The dwindling number of fish species is observed mainly due to the limited area of sampling and several anthropogenic activities including over fishing, deforestation, introduced fish species organic and inorganic pollution, recreational activities and sand mining.

In present study, the IMC and minor carps formed the majority of the catch at Tambave and Takari. However the percent share of IMC to total catch decline for station Bhilwadi, Kasba Digraj and Haripur. Infact for Kasba Digraj, the share of IMC was zero percent. Overall the minor carps contributed the most (36%), catfishes (31%), IMC (19%), weed fishes (10%) and exotic fishes (4%) except in Takari. The exotic species always contributed lowest to the catches from all locations.

There was no report on the species trends according to sampling stations therefore; the result of the present study cannot be compared with the earlier report.

The Minor carps (35%), catfishes (29%) were the dominant group during winter; minor carp (36%), catfishes (32%) during summer and minor carps (34%) and catfishes (33%) during monsoon. Similarly, Jayaram [6] observed that season wise certain species alone occur both during pre-monsoon and post monsoon periods, this being regulated by the availability of water in the river and water flow. The same observation was recorded in the present study.

The stations Tambave, Takari, Bhilwadi and Kasba Digraj revealed significant differences in the distribution of Indian Major Carps ($P<0.05$) for seasons the landing during winter were significant different than that of Monsoon ($P<0.05$). However the summer landings did not differs significantly from that of winter and monsoon ($P>0.05$). Lakra *et al.* [11] has been observed the relative abundance of Indian major carps varies in all sites except Orcha. The relative abundance of *Labeo rohita* was relatively higher (2.75%) as compared to *Catla catla* and *Cirrhinus mrigala* which ranged between 1.33% and 1.21%.

Distribution of Minor carps at Takari and Kasba Digraj was significantly different from Tambave, Haripur and Bhilwadi. Season wise catch compositions during monsoon was significantly different from that of winter and summer ($P<0.05$). Lakra *et al.* [11] has found the relative abundance of medium carp *Labeo calbasu* was low (1%) among all sites in Betwa river.

Distribution of species at Takari and Bhilwadi was significantly different from that of Tambave, Kasba Digraj and Haripur ($P<0.05$). Season wise catch composition during monsoon was significantly different from that of winter and summer ($P<0.05$).

Catfishes distribution differed significantly for Tambave and Takari as compared to Bhilwadi, Kasba Digraj and Haripur ($P<0.05$). Season wise catch compositions during monsoon was significantly different from that of winter and summer ($P<0.05$). Lakra *et al.* [11] has been observed found among the eight endangered species, two (*E. vacha* and *Ompok bimaculatus*) relatively higher relative abundance in sites Bhojpur to Rajhat. The relative abundance of *Ompok pabda* was moderate (0.64–1.33) in upper stretch and selected site (Rajhat) in middle stretch, while the remaining five species

showed low relative abundance and their accessibility was only confined in the upper and middle stretch.

Availability of exotic species did not differ significantly for any of the stations ($P>0.05$). Species distribution during monsoon differ significantly that of winter and summer ($P<0.05$). Jadhav *et al.* [4] did not record any alien fishes in the Koyna River. Nevertheless, a number of studies suggest that the fish fauna of Western Ghat is severely threatened by alien species Kharat *et al.* [7]; Daniels [2]; Raghavan *et al.* [14]; Knight [9]. Sarkar *et al.* [16] found that higher relative abundance and distribution of exotic species indicate threat to the other local species due to their establishment in river. This may cause difficulty to manage other species of conservation importance in the river and may become importance in the river and may become challenging due to interaction of climatic change in future (Rahel *et al.*) [15].

5. Conclusion

The present study was undertaken to fishery status and fish yield and species composition for suggesting management recommendation for conservation and restoration of Krishna river of Sangli district of Maharashtra, India. A total of 25 fin fishes species belonging to 11 families and 21 Genera were recorded and were grouped into five groups Namely IMC, Minor carps, Weed fishes, Catfishes and exotic fishes. However, not all species of fish were available in all the seasons. But the non-availability and less availability of some species indicate the alarming decline of the diversity of fishes in the surveyed area. It is also noted that most of the endemic and native species are replaced with some exotic species. So, for conservation of these fish species various strategies is the need of the hour which may be halting of siltation, promoting controlled harvest, exploring checks of the growth of exotic species and control of water pollution.

Therefore, it is imperative that efforts should be undertaken to develop ecosystem-based management strategies with inputs from government, non-government organizations and other stakeholders, with the objectives of sustainable utilization of resources.

6. Acknowledgement

Authors are thankful to Dr. Tapas Bhattacharya, Hon'ble Vice Chancellor for encouragement during the course of work. Also thanks to Dr. R. Pai, Associate Dean, College of Fisheries, Ratnagiri for providing necessary facilities and guidance during the course of this work.

7. References

1. Bhat A. Diversity and composition of freshwater fishes in river systems of Central Western Ghats, India. Environmental Biology of Fishes 2003; 68:25-38.
2. Daniels RJR. Introduced fishes: a potential threat to the native freshwater fishes of peninsular India. Journal of the Bombay Natural History Society 2006; 103(2-3):346-348.
3. Das MK, Samanta S, Saha PK. Riverine Health and Impact on Fisheries in India. Policy Paper No. 01, Central Inland Fisheries Research Institute, Barrackpore, Kolkata 2007; 120:1.
4. Jadhav BV, Kharat SS, Raut RN, Paingankar M, Dahanukar N. Freshwater fish fauna of Koyna River, northern Western Ghats, India. Journal of Threatened Taxa. 2011; 3(1):1449-1455.
5. Jayaram KC. The freshwater fishes of Indian region. The director, Zoological Survey of India, Calcutta, 1981.
6. Jayaram KC. The Krishna River System: A Bioresources Study. Occasional Paper No. 160. Records of Zoological Society of India 1995, 167.
7. Kharat SS, Paingankar M, Dahanukar N. Freshwater fish fauna of Krishna River at Wai, northern Western Ghats, India. Journal of Threatened Taxa 2012; 4(6):2644-2652.
8. Kharat SS, Dahanukar N, Raut RN, Mahabaleshwarkar M. Long term changes in freshwater fish species composition in north Western Ghats, Pune District. Current Science. 2003; 84(6):816-820.
9. Knight JDM. Invasive ornamental fish: a potential threat to aquatic biodiversity in peninsular India. Journal of Threatened Taxa. 2010; 2(2):700-704.
10. Kumar ST, Charan GB, Kumar SS. Identifying the Probable Potential Ornamental Fishes among them with reference to Threats and Conservation Measures Review of the Research on the Fish Diversity in the River Mahanadi and. Research Journal of Animal, Veterinary and Fishery Sciences. 2013; 1(3):16-24.
11. Lakra WS, Sarkar UK, Kumar RS, Pandey A, Dubey VK, Gusain OP. Fish diversity, habitat ecology and their conservation and management issues of a tropical River in Ganga basin, India. Environmentalist. 2010; 10:10669-010-9277-6.
12. Laxmappa B, Bakshi RR, Laxmappa DVSN. Studies on ichthyofaunal diversity of Krishna River in Mahabubnagar district, Telangana, India. International Journal of Fisheries and Aquatic Studies. 2015; 2(5):99-104
13. Murugan M, Murugan T, Wins AJ. Study of freshwater fish fauna in Periyakulam Riverine Wetland, Kanyakumari district, Tamilnadu. International Journal of Fisheries and Aquatic Studies. 2015; 2(5):150-152.
14. Raghavan RG, Prasad PH, Anvar-Ali, Pereira B. Exotic fish species in a global biodiversity hotspot: observations from river Chalakudy, part of Western Ghats, Kerala, India. Biological Invasions. 2008; 10(1):37-40.
15. Rahel FJ, Bierwagen B, Taniguchi Y. Managing aquatic species of conservation concern in the face of climate change and invasive species. Conserv Biol 2008; 22(3):551-561.
16. Sarkar UK, Gupta BK, Lakra WS. Biodiversity, ecohydrology, threat status and conservation priority of freshwater fishes of River Gomti, a tributary of River Ganga (India). Environmentalist. 2010; 30:3-17.
17. Shinde SE, Pathan TS, Raut KS, Bhandare RY, Sonawane DL. Fish Biodiversity of Pravara River at Pravara Sangam District Ahmednagar, (M.S.) India. World Journal of Zoology. 2009; 4(3):176-179.
18. Singh HR, Johal MS. Present status of fish fauna diversity of river Ganga in vasinity of Allahabad, utter Pradesh, India. Environmentalist, 2009; 2:69-78.
19. Talwar PK, Jhingran AG. Inland fishes of India and Adjacent Countries. Oxford and IBH Publishing co. Pvt. Ltd., New Delhi, 1991.
20. Ubharhande SB, Sonawane SR. Study of freshwater fish fauna and water quality at Paintakli dam from Buldhana district, (M.S) India. Journal of Experimental Sciences. 2012; 3(7):04-08.
21. Zar JH. Biostatistical Analysis, fourth edition, Tan prints (I) Pvt. Ltd., Delhi, India, 2005.