



Study of Fish Exploitation Pattern of River Bharathapuzha, Kerala, India

C. R. Renjithkumar^{1,2*}, K. Roshni² and B. M. Kurup¹

¹ Cochin University of Science and Technology, Fine Arts Avenue, Cochin - 682 016, India

² Kerala University of Fisheries and Ocean Studies, Panangad - 682 506, India

Abstract

A total of 31 finfish species belonging to 7 orders and 28 genera and one shell fish species were recorded in the exploited pattern of Bharathapuzha river. Total annual fish landing from the Bharathapuzha river was quantified as 112.56 t. Highest landing was recorded during the post-monsoon season and lowest during the monsoon season. The main species contributed to the landing are *Dawkinsia filamentosa* (17.34 t), *Systemus sarana* (12.06 t), *Hypsleobarbus kurali* (9.89 t), *Parambassis dayi* (8.39 t) and *Wallago attu* (7.61). *Gibelion catla*, *Labeo rohita*, *Cirrhinus mrigala* (Indian major carps) and *Oreochromis mossambicus* were the non-native species represented in the exploited fishery. Gill nets, cast nets, seine nets and hook and lines were the major fishing gears used in the river. Catch per unit effort (CPUE) recorded in gill net for major species were *Pseudotroplus maculatus* (0.75 kg h⁻¹), *Devario aequipinnatus* (0.5 kg h⁻¹), *L. rohita* (0.38 kg h⁻¹), *D. filamentosa* (0.20 kg h⁻¹) and *S. sarana* (0.18 kg h⁻¹). The highest CPUE recorded in cast net was for *Hypsleobarbus kurali* (0.51 kg h⁻¹), *Hyporhamphus xanthopterus* (0.50 kg h⁻¹), *Mystus vittatus* (0.38 kg h⁻¹) and *W. attu* (0.29 kg h⁻¹). In seine net high CPUE was recorded in *Channa striata* (0.17 kg h⁻¹), *L. rohita* (0.16 kg h⁻¹) and *Etroplus suratensis* (0.13 kg h⁻¹).

Keywords: Fishery, cyprinidae, non-native fishes, catch per unit effort

Introduction

Riverine fisheries are considered an important environmental resource providing a protein source,

food security and livelihood for multitudes of people worldwide (Romulo et al., 2017). The sector is composed of small scale fishers and nearly 61 million people are engaged in it worldwide, of which 50% are women (Bartley et al., 2015). The lack of reliable data on the riverine fisheries makes it difficult to identify trends in the fisheries production. Reason for poor data related to riverine fisheries is due to various factors such as remote and widely dispersed fishing and landing centres, high seasonal nature of catch, low value, extended livelihood activities of fishers and local and domestic trade of catch (Bartley et al., 2015). Over the last few decades the riverine fishery resources of India have caused substantial decline due to habitat destruction, introduction of exotic species, overexploitation, water abstraction, dam construction, pollution of natural waters and climate change (Bhatt et al., 2016).

The Bharathapuzha river, also called as 'Nila' originates from Kovittola Betta at Kundra reserve forest of Tamil Nadu, southern India in the Western Ghats at an elevation of 2,336 m and flows through Tamil Nadu and Kerala state before emptying into Arabian Sea. The river has the highest species richness and endemism in terms of freshwater aquatic fauna and is referred as one of the freshwater 'Key Biodiversity Areas' (KBAs) in Southern Western Ghats (Molur et al., 2011). Deforestation, construction of dams and check dams, pollution, indiscriminate sand mining, introduction of non-native fish species and destructive fishing practices such as electric fishing, use of plant poisons, using small mesh sized nets and dynamiting are menacing the fish diversity of Bharathapuzha river (Bijukumar et al., 2013). The studies on fish fauna in the Bharathapuzha River were carried out by different workers though most of these studies were restricted to the diversity and taxonomy of fishes (Devi & Indra, 1986; Bijukumar & Sushama,

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*E-mail-renjith.kumar347@gmail.com

2001; Sushama et al., 2004; Bijukumar et al., 2013). However, studies on the quantification of exploited fisheries of rivers of Kerala are still lacking except few initiatives in Pampa and Muvattupuzha river (Renjithkumar et al., 2011; 2016). There is no available information on the status of exploited fisheries in Bharathapuzha river till date. Therefore, the present study was carried out in this direction to unravel the catch composition and fishing effort in the fish production of Bharathapuzha river.

Materials and Methods

The 7 most important fish landing centers along the Bharathapuzha river from up to downstream were selected for the study which include Chamravattom, Kuttipuram, Pattambi, Cheerakuzhi, Kondazhi, Lekkeddi and Malampuzha (Fig. 1). Seasonal sampling was conducted during pre-monsoon (February-May), monsoon (June-September) and post-monsoon (October-January) seasons from February 2010- January 2011. These landing centres are the main locations where commercial fishermen bring their catches. Fishermen were interviewed in the morning (6-8 am) and gear wise landing of each fish species in every landing centres were collected. All the fishes landed from the landing centres were included in the study and fish species were identified with the help of standard literature (Talwar & Jhingran, 1991; Jayaram, 2009). The fishing hours for each gear and total hours spent for fishing were also recorded. Biodiversity status of fish species were assessed following IUCN criteria (IUCN, 2019). Catch per unit effort (CPUE) of each type of fishing gear was calculated on the basis of total catch per day divided by the number of fishing units occupied on a daily basis. Daily landings from each type of gears were computed (Kurup et al., 1992) using formula.

$$W = (w/n) \times N$$

Where W = total weight of fish, w = total weight of fish from gear sampled, n = number of gear sampled, N = total number of similar gears operated

Monthly catch was then estimated by multiplying daily catch with total number of fishing days in a month. Seasonal fish landing was quantified by multiplying the catch of each month with number of months in the season. By summarizing the total landing of three seasons, the annual fish production was estimated.

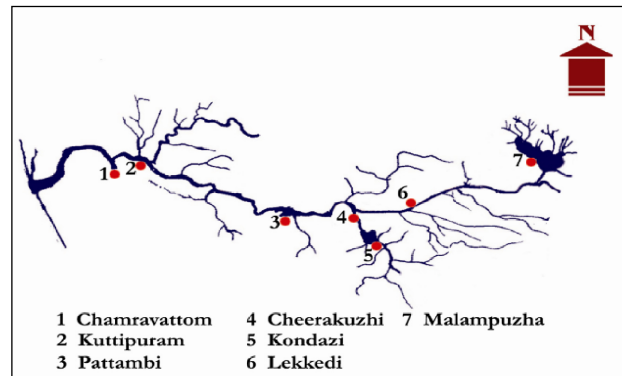


Fig. 1. Map showing the sampling sites in Bharathapuzha River

Results and Discussion

Exploited fish diversity of Bharathapuzha river comprised of 31 finfish species belonging to 7 orders and 16 families (Table 1), which is on higher side when compared to 23 species from Muvattupuzha river and 26 species from Pampa river (Renjithkumar et al., 2011; 2016). Bijukumar et al. (2013) reported 117 fish species from Bharathapuzha river which includes 13 threatened fish species. Family Cyprinidae was the dominant among different groups with a numerical strength of 11 species followed Cichlidae (3 species), Siluridae, Bagridae and Channidae (2 species each). The preponderance of family Cyprinidae is reported in most of the South East Asian rivers (Nguyen & De Silva, 2006). On the evaluation of exploited fish diversity as per IUCN criteria, two each of vulnerable (VU) and near-threatened (NT) categories of fishes were recorded in the landing. Among the seven landing centres, Malampuzha contributed 54.41% to the total fish landing, followed by Lekkeddi (19.25%) and Kuttipuram (17.96%). Only a marginal fishery was recorded in other landing centres such as Cheerakuzhi (3.30%), Pattambi (3.09%), Chamravattom (1.22%) and Kondazi (0.77%).

Obtaining accurate information about riverine fisheries production is difficult when compared to marine and estuarine sectors because most riverine fisheries are highly dispersed, unorganized and small-scale in nature and lacking essential infrastructure facilities (Allan et al., 2005; Bartley et al., 2015). The annual exploited fishery of the Bharathapuzha river estimated in the present study was 112.56 t. Renjithkumar et al. (2011) estimated the exploited fishery in Pampa river, which covers

Table 1. Species composition and landing in the exploited fishery of Bharathapuzha river

Sl No	Order	Family	Scientific Name	IUCN status	Landing (t)	Size range (mm)		
1	Elopiformes	Megalopidae	<i>Megalops cyprinoides</i>	DD	0.74	101-203		
2	Anguilliformes	Anguillidae	<i>Anguilla bengalensis</i>	NT	2.40	268-712		
3	Cypriniformes	Cyprinidae	<i>Gibelion catla</i>	LC	3.98	240-720		
4			<i>Cirrhinus mrigala</i>	LC	3.74	290-560		
5			<i>Labeo rohita</i>	LC	5.14	190-360		
6			<i>Hypselobarbus kurali</i>	LC	9.89	168-310		
7			<i>Dawkinsia filamentosa</i>	LC	17.34	58-140		
8			<i>Systemus sarana</i>	LC	12.06	89-200		
9			<i>Puntius amphibius</i>	DD	0.10	82-110		
10			<i>Amblypharyngodon microlepis</i>	LC	2.55	44-106		
11			<i>Devario aequipinnatus</i>	DD	0.24	58-86		
12			<i>Devario malabaricus</i>	LC	0.10	60-90		
13			<i>Salmophasia boopis</i>	LC	0.12	50-60		
14	Siluriformes	Bagridae	<i>Mystus cavasius</i>	LC	0.43	61-94		
15			<i>Mystus vittatus</i>	LC	1.97	60-100		
16		Siluridae	<i>Ompok bimaculatus</i>	NT	0.63	148-213		
17	Beloniformes	Heteropneustidae	<i>Wallago attu</i>	VU	7.61	262-800		
18			<i>Heteropneustes fossilis</i>	LC	1.23	128-210		
19			<i>Xenentodon cancila</i>	LC	1.47	158-220		
20			<i>Hyporhamphus xanthopterus</i>	VU	2.67	14-198		
21		Ambassidae	<i>Parambassis dayi</i>	LC	8.39	54-112		
22			<i>Pristolepis marginata</i>	LC	0.03	102-118		
23		Cichlidae	<i>Pseudetroplus maculatus</i>	LC	0.91	49-82		
24			<i>Etroplus suratensis</i>	LC	4.23	108-234		
25			<i>Oreochromis mossambicus</i>	EX	2.83	114-224		
26		Gobiidae	<i>Glossogobius giuris</i>	LC	0.73	114-172		
27	Perciformes	Anabantidae	<i>Anabas testudineus</i>	LC	0.03	114-148		
28		Channidae	<i>Channa striata</i>	LC	5.17	133-362		
29			<i>Channa marulius</i>	LC	0.34	156-340		
30		Sillaginidae	<i>Sillago vincenti</i>	NE	0.60	150-210		
31		Synbranchiformes	Mastacembelidae	<i>Mastacembelus armatus</i>	LC	5.31	178-321	
Prawn species								
<i>Macrobrachium rosenbergii</i>					9.55			
Total					112.56			

a small portion of Kuttanad wetland ecosystem, as 394.22 t. The low fish landing in Bharathapuzha river may be due to the difference in biological productivity, prevailing environmental conditions and species composition in the landing. The exploited fishery resources of Muvattupuzha river of central Kerala have been estimated as 45.01 t (Renjithkumar et al., 2016). Highest landings were recorded during post-monsoon season (80.58 t) in

Bharathapuzha river, whereas the highest production in Pampa river was reported in pre-monsoon periods (49%) (Renjithkumar et al., 2011). Dominant fish species in the landing were *Dawkinsia filamentosa*, *Systomus sarana*, *Hypselobarbus kurali*, *Parambassis dayi* and *Wallago attu*.

Dugout canoes and coracles were the major fishing craft employed for fishery. Gill net locally known as

'Odakkuvula' was the predominant fishing gear in Bharathapuzha river and accounted for 87% of catch followed by cast net (11%) (Fig. 2). Renjithkumar et al., 2011; 2016 reported that gill net was the major gear used for fishery exploitation in Pampa and Muvattupuzha river and they accounted 77% and 88% contribution respectively to the total catch in these rivers. Gill net was the major gear used for fishery exploitation by inland fishermen in Kerala because these nets are relatively inexpensive and easy to use even in difficult environment conditions. Gill net size varied from 50-150 metre and mesh size in the range 25-120 mm were used for fishing. The landing from gill nets comprised of *D. filamentosa* (15.4%), *S. sarana* (11%) and *H. kurali* (8.9%). Highest catch per unit effort (CPUE) recorded in gill net for *Pseudotroplus maculatus* (0.75 kg h^{-1}), *Devario aequipinnatus* (0.5 kg h^{-1}), *L. rohita* (0.38 kg h^{-1}), *D. filamentosa* (0.20 kg h^{-1}) and *S. sarana* (0.18 kg h^{-1}) (Fig. 3). Cast nets (10-20 mm) locally known as 'Veesuvala' contributed only a small fishery in Bharathapuzha river. The major species in the cast nets consisted of *D. filamentosa* (16.82%), *W. attu* (14.29%) and *H. kurali* (12.38%). The highest CPUE recorded in cast net was for *H. kurali* (0.51 kg h^{-1}), *Hyporhamphus xanthopterus* (0.50 kg h^{-1}), *Mystus vittatus* (0.38 kg h^{-1}) and *W. attu* (0.29 kg h^{-1}) (Fig. 4). Seine net is a fine meshed net (4-10 m long, mesh sizes 8-16 mm) operated in the lower stream of the river and the main species caught in the nets were *Etroplus suratensis* (32.35 %), *L. rohita* (21.13%) and *Channa striata* (17.49%). In seine net high catch per effort was recorded in *C. striata* (0.17 kg h^{-1}), *L. rohita* (0.16 kg h^{-1}) and *E. suratensis* (0.13 kg h^{-1}) (Fig. 5). Hook & line accounted for only a small fraction of the landing and the main catches consisted of *C. striata*, *C. marulius* and *Mastacembelus armatus*.

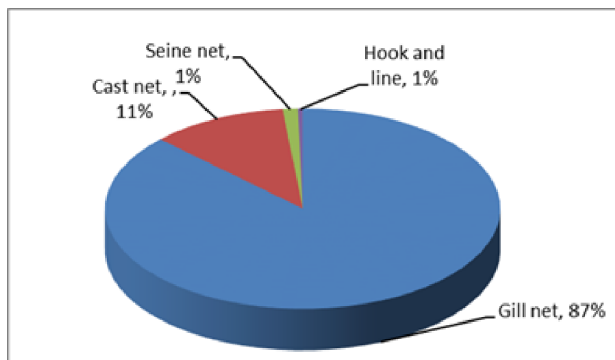


Fig. 2. Percentage contribution of various gears in the exploited fishery of Bharathapuzha river

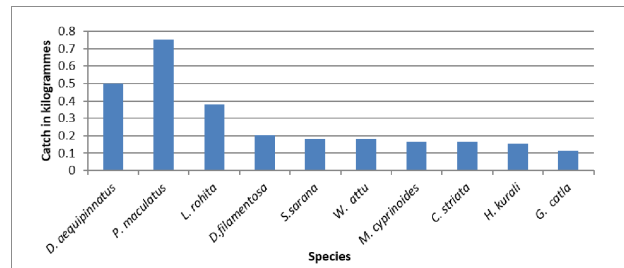


Fig. 3. Catch per unit effort of major fish species exploited by gill nets in Bharathapuzha river

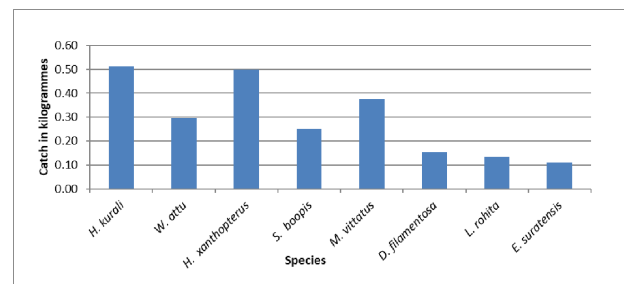


Fig. 4. Catch per unit effort of major fish species exploited by cast nets in Bharathapuzha river

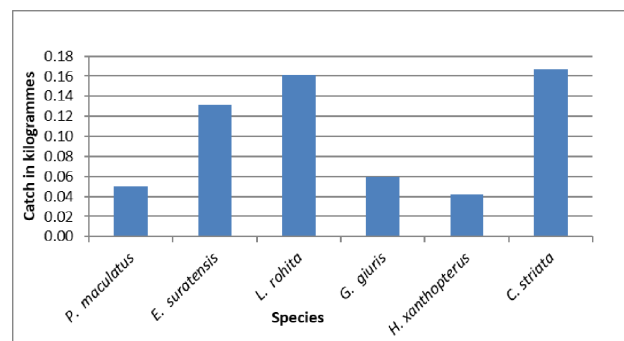


Fig. 5. Catch per unit effort of major fish species exploited by seine nets in Bharathapuzha River

Narayanan (2008) reported that miscellaneous group fishes constitute about 50% of the total catch in Malampuzha reservoir situated at the upstream reaches of Bharathapuzha River. Among them, small barbs represented by two species viz., *D. filamentosa* (17.34 t) and *S. sarana* (12.06 t) recorded the highest landing (29%) in the river. Renjithkumar et al. (2011) also reported that barbs constitute 15% of the fish landing in Pampa river, Kerala. Glassy perchlet, *Parambassis dayi* formed an important fishery in the river contributing 8.39 t in the landing. This type of pattern in the landing has been also observed in other tropical riverine fisheries (Welcomme, 1975; Petrere et al., 2005). Fish groups with opportunistic life history habits (small size, high fecundity,

continuous reproductive and short life span) have low economic value in small and large-scale fisheries and receive little attention from researchers and fishy scientists (Montana et al., 2011). The decline of large sized species in landing of Ganga river could due to high catch of smaller sized fish groups (Payne & Temple, 1996). *Anguilla bengalensis* commonly known as Indian mottled eel contributed a 2.40 t in the fish landing in Bharatahpuzha river. Renjithkumar et al. (2016) reported a low landing (0.12 t) of *A. bengalensis* in Muvattupuzha river of Kerala. It is a catadromous migratory fish and adult eel migrate to deep ocean for spawning and larval eel migrate to upstream area of the river (Arai & Abdul, 2017). There is considerable reduction in the catch of eel and other migratory species in Bharatahpuzha river due to the construction of check dams and reservoir (Bijukumar et al., 2013). The giant freshwater prawn *M. rosenbergii* supported a lucrative fishery (9.55 t) in Bharatapuzha river especially in Malampuzha reservoir. Narayanan (2008) reported an annual landing of 10.78 t of *M. rosenbergii* from Malampuzha reservoir. The species contributed 27.05 t landing in Pampa River (Renjithkumar et al., 2011). The exploited stock of *M. rosenbergii* from Vembanad Lake and 5 km stretch confluent rivers was quantified as 121.14 t annually (Kurup & Harikrishnan, 2000). The depletion of the stock of *M. rosenbergii* was attributed mainly to the impact of manmade changes in the ecosystem such as habitat alteration, reduction of natural grow-outs, recruitment over-fishing etc (Kurup et al., 1992).

The present study reported four non-native fish species in the fishery landing. Bijukumar et al. (2013) reported six non-native fish species such as *G. catla*, *L. rohita* and *C. mrigala* (Indian major carps) are transplanted species from North India while *O. mossambicus* were exotic to the country. Introduction of non-native fishes impacts the native fish stock through competition, predation, disease transmission, hybridization and erosion the gene pool (Julien & Olden, 2011). Indian major carps together contributed 11.43% landing in the river. Indian major carps have been stocked in the peninsular reservoirs and have established their breeding populations in many reservoirs in states of Southern India (Sugunan, 2000). The IMCs were stocked in the upper reservoirs of Bharathapuzha river for production enhancement from where they reached in the lower stretches forming stable populations (Bijukumar & Sushama, 2001). The size range of Catla, Rohu and Mrigal in the present study is in

between 24 and 72 cm, 29 and 56 cm, 19 and 36 cm respectively though Narayanan (2008) recorded a larger size of 128 cm, 117 cm and 120 cm for Catla, Rohu and Mrigal in Malampuzha reservoir of Bharatahpuzha river. Sreenivasan (1996) reported that introduction of Indian major carps is leading to the decline of endemic Peninsular carps such as *Cirrhinus cirrhosa*, *Labeo kontius*, *Puntius carnaticus*, *P. dubius* and *P. pulchellus* in reservoirs of South India. The occurrence of ripe *L. rohita* females from the rivers of central Kerala point to towards their slow establishment in the riverine ecosystem of Kerala (Goplakrishnan & Basheer, 2000). The higher landings of Indian major carps in Bharathapuzha River could probably leads to the propagation of these fishes in the river. State fisheries department of Kerala claims that the ranching of IMCs cause no harm to native fishes because they fail to breed under ecological conditions of Kerala rivers however local fishers fear that these non-native varieties could threaten the native fish species (Per Com.). Tilapia was first introduced in the river in 1956 and established their population (Narayanan, 2008) and accounted for 2.5% of the fishery of this river. Several reports are available on native fish species decline in India including reservoirs and rivers due to the proliferation and establishment of tilapia (Sreenivasan & Sundarajan, 1967; Murthy et al., 1986; Natarajan & Menon, 1989; Lakra et al., 2008; Singh & Lakra, 2011). The well-established population of tilapia caused negative effects on native fish fauna especially to orange chromide, *P. maculatus* in the Chalakudy River, India because tilapia shares more or less ecological niche as those of orange chromide (Raghavan et al., 2008). *O. mossambicus* posed severe threat to the existence of *Tor khudree* in Periyar Lake as 78% of their food were common (Kurup et al., 2006). Mahanta et al. (2003) observed that tilapia contributed 70% of the catch in Malampuzha reservoir in Bharatahpuzha River. Secondary freshwater fish species such as *Hyporhamphus xanthopterus* (2.77 t), *Megalops cyprinoides* (0.74 t) and *Sillago vincenti* (0.60 t) contributed to 3.56% in the fishery. Bijukumar & Sushama (2001) reported that estuarine fishes migrate from saline areas to upstream area of the water. Migration of fish between fresh water, marine and estuarine habitats is common among many fish species around the world (Mallen-Cooper, 2000).

The exploited fish diversity of Bharathapuzha river consists of 31 finfish species including two threatened and four non-native fish species. Regulation

should be brought regarding the catch of threatened fishes like *Wallago attu* and *Hyporhamphus xanthopterus* for food. Prevention of the further spread of existing non-native fishes in to new areas of the river and check on the establishment of new exotic species in the wild should be ensured. There is also need to educate the fishermen and local people through awareness programmes and workshops on the impacts of alien species invasion.

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