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COMPOSITION OF NON-NATIVE FISHES IN THE EXPLOITED FISHERY OF BHARATHAPUZHA RIVER, KERALA, INDIA

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Abstract: Non-native fish species invasion has been recognized as one of the major threats to the fish biodiversity in Kerala waters. The introduction of a non-native species in an ecosystem may pose an ecological risk if the species is able to integrate itself successfully. The Bharathapuzha River originates from Palghat gap of Western Ghats and empties into Arabian Sea flowing through Palakkad, Thrissur and Malappuram districts of Kerala. Nearly 31 fish species were identified in the exploited fishery of the river. No studies have been made till to calculate the catch of non-native fishes of this river. In the present study an attempt was made to quantify the non-native fishes of Bharathapuzha River on the basis of regular surveys and sampling conducted at the landing centres during different seasons. The annual catch of each species was estimated by summarizing the monthly fish landings. The contribution of non-native species to the total fishery of Bharathapuzha River was estimated to be 13.93%. Indian major carps (*Gibelion catla, Labeo rohita, Cirrhinus mrigala*) and *Oreochromis mossambicus* were the non-native species represented in the exploited fishery. *G. catla* (3.98 t), *L. rohita* (5.14 t) and *C. mrigala* (3.74 t) were the transplanted species, which together formed 11.43% in the total landing of the river. The size range of Catla, Rohu and Mrigal in the catch were 240-720 mm, 290-560 mm and 190-360 mm respectively. The exotic fish, *O. mossambicus* accounted for 2.5% of the fishery. An urgent monitoring of the population stocks of non-native fishes and the formulation of a proper regulation strategy is of immediate need to conserve the diverse native fish fauna of the river.

Key words: Quantification, Indian major carps, *Oreochromis mossambicus,* threats, regulation

INTRODUCTION

Man-made impacts in freshwater ecosystems around the world have resulted in losing of a greater proportion of their species diversity than terrestrial and marine habitats (Dudgeon *et al*., 2006; Johnson *et al*., 2008). Fishes are one of the most threatened faunas around the world primarily due to habitat degradation and the introduction of non-native species (Agostinho *et al.,* 2005; Gozlan, 2008; Johnson *et al*., 2008; Ferrareze *et al*., 2014; Winemiller *et al.,* 2016) and such activities lead to severe risk and threats to the community structure, ecosystem functioning and human activities (Lin *et al*., 2013). Many of such introductions have caused irreparable damage to the invaded ecosystems (Soundararajan *et al.,* 2015). Non-native fish species are introduced in to India for aquaculture, enhancing the local fisheries, sport fishing, aquarium trade and biological control (Bijukumar, 2000; Lakra *et al*., 2008). Invasive fish species has been recognized as one of the foremost menace to the aquatic biodiversity in Kerala and 31 species were identified as being alien to the Kerala part of Western Ghats (Radhakrishnan *et al*., 2012).

Despite the recent increase in research on fish invasions around the world, information on the quantity of exotic fish exploitation is still scare. In Kerala only a few studies were carried out regarding fish introductions and such works documented only the non-native species diversity (Raghavan *et al.,* 2008; Krishnakumar *et al.,* 2009; Radhakrishnan *et al.,* 2012). The investigations on fish diversity in the Bharathapuzha river were carried out by Easa and Basha (1995), Easa and Shaji (1997), Bijukumar and Sushama (2001), Kurup *et al.* (2004), Sushama *et al*. (2004), Devi

et al. (2005) and Bijukumar *et al*. (2013). However, most of these studies were restricted to the diversity and taxonomy of fishes. No studies have been made till to compute the catch of non-native fishes in Bharathapuzha River. In the present study an attempt was made to quantify the non-native fishes of Bharathapuzha River on the basis of regular surveys and sampling conducted at the major fish landing centres during different seasons.

MATERIALS AND METHODS

The Bharathapuzha River, also known as '*Nila*', is the second longest river in Kerala (209 km) originating from Kovittola Betta at Kundra reserve forest of Palghat gap in the Western Ghats at 2,336 m above msl (Sushama, 2014). The river flows through Coimbatore district of Tamil Nadu and Palakkad, Thrissur and Malappuram districts of Kerala and finally empties into Arabian Sea at Ponnani. It has a total basin area of 6,186 km^2, of which 4,400 km^2 lies in Kerala and the remaining portion in Tamil Nadu. The main tributaries of the river are Kalpathipuzha, Gayathripuzha, Thoothapuzha and Chitturpuzha.

The surveys and sampling were carried out during pre-monsoon, monsoon and post-monsoon seasons in the fish landing centres of Bharathapuzha River from 2007 to 2010. Chamravattom, Cheerakuzhi, Malampuzha, Kuttipuram, Kondazhi, Pattambi and Lekkidi were the landing centres (Fig 1). Quantity of exploited native and non-native fishes in the river were estimated based on the data collected from the landing centres. Details of landings of fishes were collected from more than 30% of the gears giving emphasis to native and non-native species composition, weight and actual fishing hours spent for fishing. Catch per unit effort (CPUE) was computed following Scaria *et al*. (1997). Samples were collected and fixed in 8% formaldehyde and identified using standard literature (Talwar and Jhingran, 1991; Jayaram, 2009). From the catch, the non-native fish species was separately counted separately. Daily landings of non-native species were computed following Kurup *et al*. (1992).

$W = (w/n) X N$

Where, W = total weight of non-native fish species, w = total weight of fish from gear sampled, n = number of gear sampled, N = total number of similar gears operated.

Monthly catch was estimated by multiplying daily catch with total number of fishing days in a month. Season wise landing was estimated by multiplying monthly catch to number of months in the season. The annual exploited quantity was calculated by summarizing the landings of three seasons.

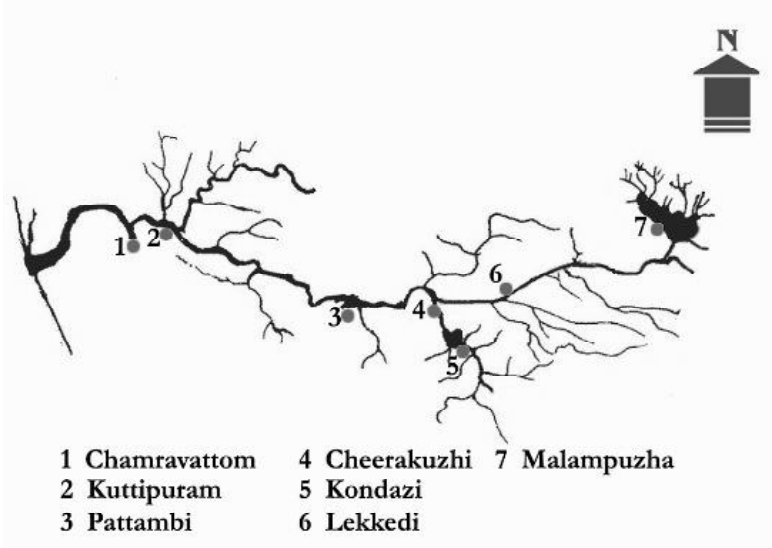

Fig. 1: Map of Bharathapuzha river basin showing landing centres surveyed

RESULTS AND DISCUSSION

31 fish species belonging 7 orders and 16 families were recorded in the exploited fishery of Bharathapuzha River. These fish community composition are essential to the understanding and conservation of the ecosystem, and are especially important to determine the potential threats posed by the exotic fishes. Four non-native fish species viz. *Gibelion catla, Labeo rohita*, *Cirrhinus mrigala* and *Oreochromis mossambicus* were recorded in the fishery from various landing centres of the river (Fig. 2). Bijukumar *et al.* (2013) reported six non-native fish species (*Cyprinus carpio, G. catla, L. rohita*, *C. mrigala*, *O. mossambicus* and *O. niloticus*) from Bharathapuzha River. The Indian major carps were escaped into the lower stream of the river from Malampuzha reservoir and successfully established its population in wild (Bijukumar and Sushama, 2001). Bijukumar *et al.* (2013) reported that *O. mossambicus* has established viable populations throughout the river including estuarine area. Among the exotic fishes, *L. rohita* (33%) contributed the highest in landings and maximum catch per unit effort (CPUE) in the river. The CPUE of non-native fish species in Bharathapuzha River is depicted in Fig. 3.

G. catla (3.98 t), *L. rohitha* (5.14 t) and *C. mrigala* (3.74 t) commonly noted as Indian major carps were the transplanted species, which together constituted 11.43% in the total landing of the river. The size range of Catla, Rohu, Mrigal were in between 240-720 mm, 290- 560 mm, 190-360 mm respectively in the catch. They were introduced in the rivers and reservoirs of the Kerala state for boosting the inland fish production (Sugunan, 2000; Santha, 2007; Nandakumar, 2010). *G. catla* occurs in rivers of northern India and were first introduced in to Kerala in Periyar Lake from Godavari River (Chacko, 1948) and this effort was a failure. This species has reduced the catch of many indigenous fish fauna including *Labeo fimbriatus*, which was predominant in Santhanur reservoir (Tamil Nadu) in the mid 1960s contributing 36% of the catch and in 2000s catla contributes 80-90% of the total catch (Sugunan, 2000). Rohu and Mrigal were first introduced to Kerala in 1951 to increase the fish production and State government and private farmers were not aware of the aftermath of ranching of these non-native and hatchery reared species (Gopalakrishnan and Basheer, 2000). Sreenivasan (1995) reported that introduction of non-native Chinese and Indian major Carps as the major elements leading to the decline of endemic Peninsular carps such as *Cirrhinus cirrhosa, Labeo kontius, Puntius carnaticus, P. dubius* and *P. pulchellus* in many reservoirs of Southern India. Gopalakrishnan and Basheer (2000) reported four ripe Rohu females from Pamba River which indicates their chances of breeding population establishment. The present report on the high landings of Indian Major Carps in Bharathapuzha River shows a possibility of their natural expansion. The cultured stock of IMC is genetically diverge from its wild relatives, may be escape from the ponds into natural waters, creating the possibility for interbreeding between non-native/cultured stock and native/wild stock (Silas, 2010).

O. mossambicus is native to Africa and Middle East has been listed as one of the top 100 worst invasive species across the world (Lowe *et al.*, 2000) and has successfully spread to over 90 countries (De Silva *et al.,* 2004; Canonico *et al.,* 2005; Russel *et al.,* 2012). The species displays a high dietary plasticity by feeding opportunistically on invertebrates, zooplankton, larval fish and eggs (Maitipe and De Silva, 1985; Arthington *et al.,* 1994). The potential for dietary competition between this species and native fish is highly likely, as well as the potential for the direct predation of small or juvenile fish. By invading a new system, *O. mossambicus* may disrupt the trophic processes causing changes that can propagate throughout the food web. It was accounted 18% of the non-native fishery of Bharathapuzha River. The invasion of *O. mossambicus*, generates a negative impact on both freshwater and brackish water fisheries (Bijukumar, 2000). Its prolific breeding habit and parental care causing space overlap with local species and tilapia form their establishment in the Godavari, Krishna, Cauvery, Yamuna, Sharavathi, Ganga, Bharathapuzha and Chalakudy rivers of India (Bijukumar, 2000; Bhat, 2003; Lakra *et al.,* 2008; Raghavan *et al.,* 2008; Sarkar *et al.,* 2010). The ecological consequences of establish

ment tilapias in such water bodies could be serious (Canonico *et al.,* 2005; Lakra *et al.,* 2008) and several reports are available on fish species decline in India from various water bodies due to the successful establishment of tilapia (Jhingran, 1984). Tilapia has negatively affected the indigenous *Cirrhinus reba* and caused the decline of the catch from 70% to 20% in Kabini reservoir (Murthy *et al*., 1986). The introduction of *O. mossambicus* in the Vaigai reservoir of South India replaced all fish species including major carps and has accounted 99% of the total catch (Sreenivasan and Sundarajan, 1967). Introduction of tilapia has pull down the population of *Labeo kontius* in Vaigai reservoir and *Puntius dubius* in Amaravathy reservoir (Natarajan and Menon, 1989). Growth rates of *G. catla, Labeo fimbriatus* and *C. mrigala* were adversely affected by tilapia population in Ayakulam pond (Sreenivasan, 1996). Tilapia out-competed many local species and resulted in the reduction in the average weight of Indian major carps in Jaisalmund Lake (Rajasthan) (Lakra *et al.,* 2008). The growth of *Chanos chanos* was reduced to less than 100g/year compared with the usual 500g/year in water bodies in Tamil Nadu where tilapia was introduced (Singh and Lakra, 2011). Mahanta *et al.* (2003) observed that Tilapia was stocked Malampuzha Reservoir in Kerala in early sixties and presently this species contributed 70% of the catch. *O. mossambicus* created dreadful threat to the existence of *Tor khudree* in Periyar Lake as 78% of their food were common (Kurup *et al.,* 2006). The established population of tilapia may cause negative impact on native fish fauna especially to Orange Chromide, *Pseudetroplus maculatus* in Chalakudy River because tilapia shares the same ecological resources as that of orange chromidae (Raghavan *et al.,* 2008).

High landing of non-native fishes in Bharathapuzha River is definitely a pointer towards their potential threats to indigenous species in future. An urgent monitoring of the population stocks of non-native fishes and the formulation of a proper regulation strategy is of immediate need to conserve the diverse native fish fauna of the river. State Fisheries Department is of the view that these species probably don't breed under the ecological conditions of the local rivers in Kerala, however local fishers fear that in long run, these exotic varieties could endanger the indigenous fish species by establishing natural breeding population.

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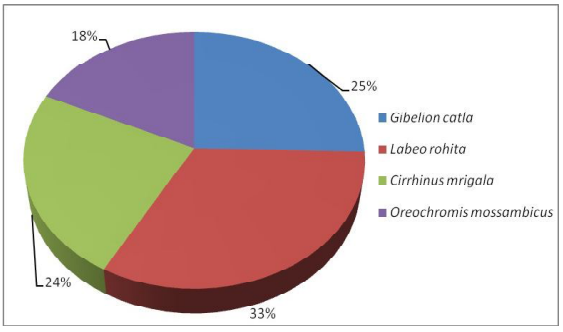

Fig. 2. Percentage composition of non-native fishes in the exploited fishery of Bharathapuzha river

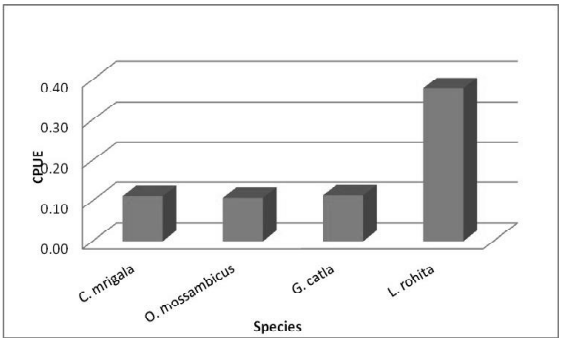

Fig. 3. CPUE of non-natives fishes in Bharathapuzha river

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