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ARTICLE

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INVASION, SPATIAL OCCURRENCE AND STATUS OF EXOTIC FISHES IN RIVER GANGA

BASANTA KUMAR DAS[a*], ARCHISMAN RAY[a], HIMANSHU SEKHAR SWAIN[a] AND UTTAM KUMAR SARKAR[b]

Globally, rapid alteration of aquatic diversity has created a much of habitat degradation, water pollution, induction of exotic or foreign species, climate change over exploitation and other anthropogenic activities. The River Ganga is the largest river in India and reported as the fifth longest in world. Several studies on fish ecology, fisheries and other aspects have been reported largely to improve fisheries and their distribution pattern. The Ganga River harbours a rich fish biodiversity and an updated list of 190 fish species have been reported as per a recent study[1]. However, proper and systematic evaluation of the exotic fish species is prerequisite for undertaking any conservation and management plan and sustainable fisheries. As per the reports, over 300 different exotic fish species was introduced in India during the past few decades particularly for various humanoid activities like sport fishing, mosquito regulation and experimental aquaculture. The impact of such exotics over the indigenous fish species assemblage is yet to be evaluated vividly. Although it has helped in augmenting the fish diversity spectrum of the country, it is realized that the induction has certainly affected the native diversity in terms of food, space and proliferation.

In view of that, ICAR- Central Inland Fisheries Research Institute under Namami Gange project assessed the occurrence and distribution of such non-native fish species in a systematic way and recorded altogether eight different exotic fish species. These are Grass carp (*Ctenopharyngodon Idella*), Silver carp (*Hypophthalmicthys molitrix*), Big head carp (*Hypophthalmicthys nobilis*), Scale carp (*Cyprinus carpio* var. *communis*), Mirror carp (*Cyprinus carpio* var. *specularis*), Tilapia (*Oreochromis niloticus*), Magur (*Clarias gariepinus*) and Crocodile (*Pterygopliicthys disjunctivus*) fishes. All the exotics are classified into seven genera, five families and three orders as identified from the freshwater stretch of River Ganga. These non-native fishes is believed to be introduced in the main channel of the river mainly due to escapements from nearby aquaculture farms, over flowing catchments during peak flooding seasons. Several biologists and environmentalist have worked and published articles upon the adverse impact of exotics on native fish diversity pattern in middle stretch of river Ganges.

The present study conducted by ICAR-CIFRI has found a new exotic species namely *Pterygoplicthys disjunctivus* from the freshwater section of Ganga river. This report has also added to the findings of the species from other tributaries of the river[2]. Illegal and innocuous introduction from local ornamental fish markets might be the cause of rise of such fast proliferating algivorous species[3]. Moreover, ornamental exotics like *Barbonymus altus* commonly known as Red tailed tinfoil and *Pterygoplicthys anisitsi* reported by Sarkar et al.[2] and Roshith et al.[4]. The dominance and proliferation of exotic common carp in middle stretch of River Ganga as reported by several workers[5,6] has been one of the important alarming situations in recent years. Exotics like common

a National Mission for Clean Ganga Laboratory, ICAR- Central Inland Fisheries Research Institute, Barrackpore, Kolkata - 700120.

b Reservoir and Wetland Fisheries Division, ICAR- Central Inland Fisheries Research Institute, Barrackpore, Kolkata - 700120.

* Corresponding author: basantakumard@gmail.com

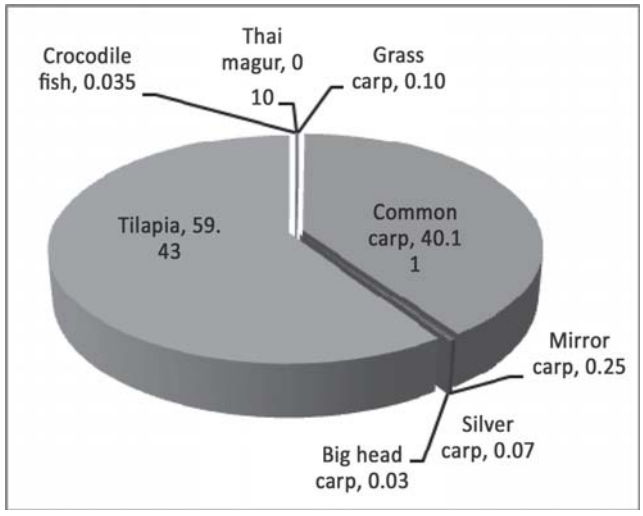

Fig. 1. Relative abundance of exotic fishes during 2017

carp and tilapia in the middle stretch particularly from Prayagraj to Buxar are now exploited commercially[7,8].

As evaluated, the relative abundance of few exotics like common carp (44.31%) and tilapia (30.15%) were found in agreement to the findings reported by Sarkar et al.[2] from river Ganga. Scale carp (19.59%) and mirror carp (13.61%) are reported to be the two most dominating varieties of exotics from upper colder regions of the river. The rise in adaptation of these exotics certainly confirms their quick adaptability and natural recruitment in lotic habitat. Increasing abundance of the scale carp (1.46%), tilapia (2.01%) and African magur (0.37%) are also noted in high numbers from middle stretch (Haridwar to Varanasi) of river Ganges. Other exotic Chinese carps like grass carp, big head carp and silver carp were observed below 0.10 %. However, as discussed major abundance of

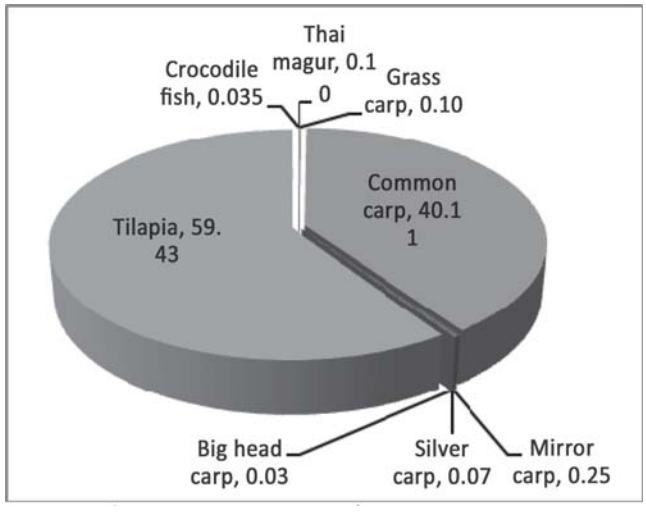

Fig. 2. Relative abundance of exotic fishes during 2018

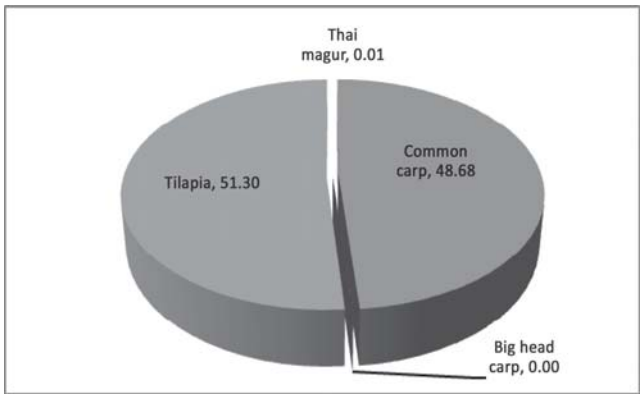

Fig. 3. Relative abundance of exotic fishes during 2019

common carp and tilapia was noted from Kanpur (7.31% & 6.64%), Prayagraj (16.49% & 7.36%) and Varanasi (4.95% & 4.59%) respectively. These might be due to the rich organic loading from the domestic and industrial outfall that may have created an added advantage for these species to sustain.

Increasing abundance of the common carp and its impact on local fish landings was also noted and reported from Buxar stretch of river Ganga[9]. Infrequent availability of these non-native fish species were noticed from lower stretch (Bhagalpur to Tribeni) of Ganges. Out of all reported exotics, sizeable amount of distribution (52.63%) was recorded for common carp (*C. carpio*) from almost ten different sampling points along river Ganga. Species like tilapia and grass carp was also recorded to be from local level distribution with index of 42.10% and 36.84% respectively. Favourable hydrological parameters like reduced water flow, increased sediment organic load and frequent river water abstraction has certainly triggered the

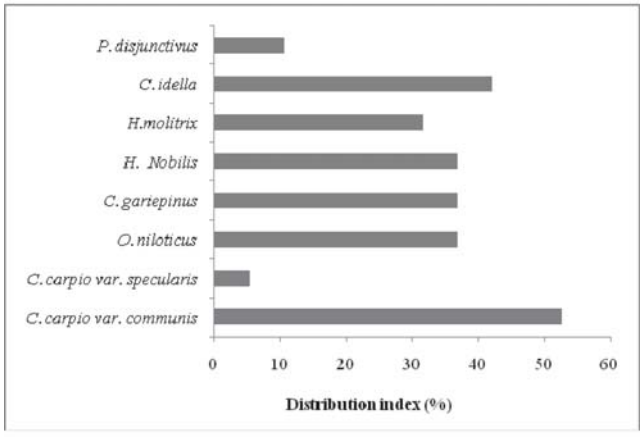

Fig. 4. Distribution Index (%) of Exotic Fish Species in River Ganga

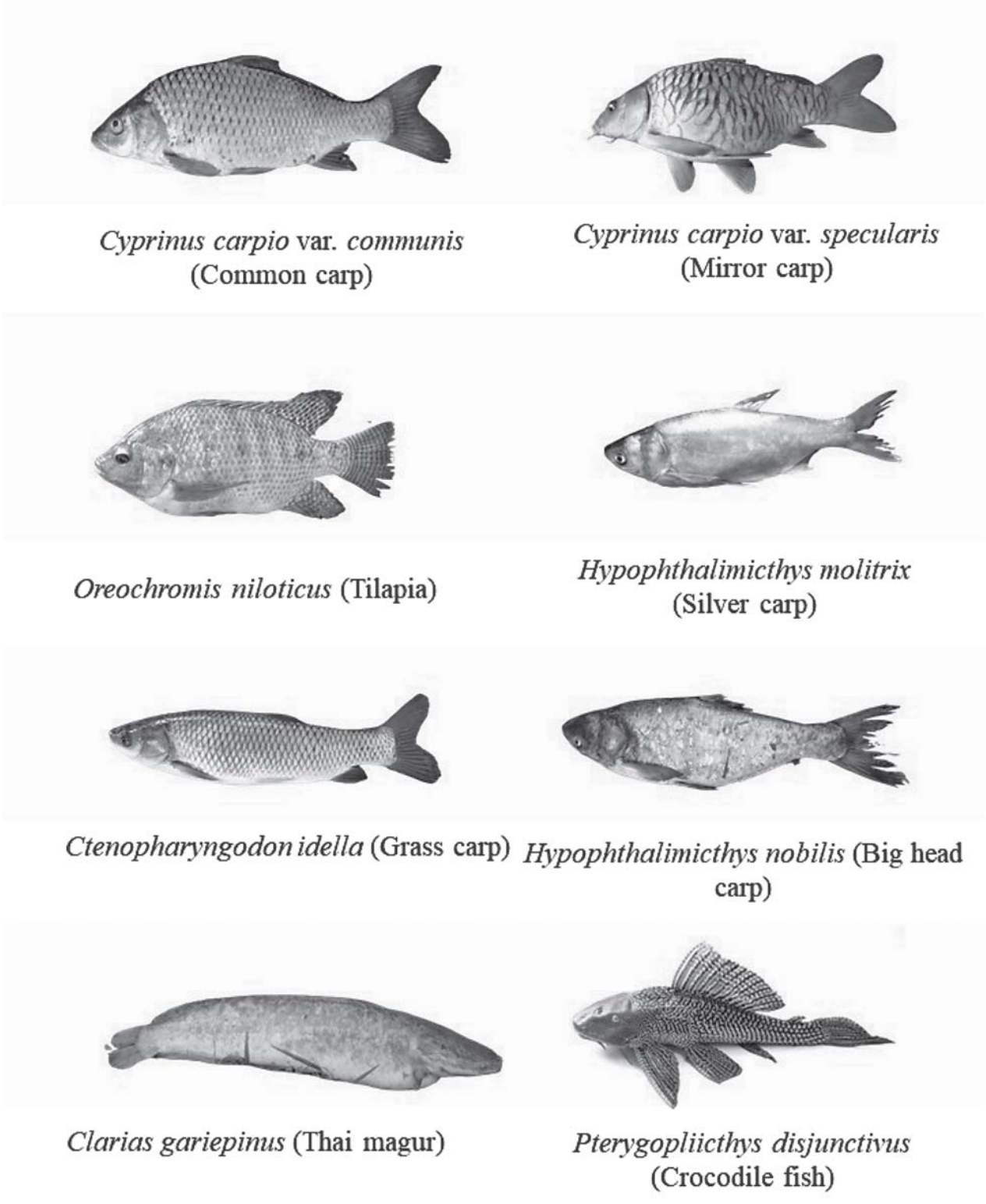

Fig. 5 Exotic fish species of River Ganga

proliferation and augmentation of these exotics.

Invasion Index of Exotic Fish Species in River Ganga

Quantification and estimation of the invasion index of exotic fish species have been a useful method for determining the impact of fishes in the respective water body. The methodology behind the determination of

Table 1. Invasion Index Analysis of Exotics in Different Sites of River Ganga

Sl no.	Sites	Index value (I_x) Common carp	Remarks	Index value (I_x) Tilapia	Remarks
1.	Haridwar	0.06	Less impacted	-	-
2.	Bijnour	0.09	Less impacted	0.002	Less impacted
3.	Narora	0.07	Less impacted	0.06	Less impacted
4.	Farukhabad	0.16	Less impacted	0.28	Less impacted
5.	Kanpur	0.40	Moderately impacted	0.60	Moderately impacted
6.	Prayagraj	0.85	Moderately impacted	0.28	Less impacted
7.	Varanasi	1.73	Highly impacted	0.45	Moderately impacted
8.	Buxar	1.25	Highly impacted	0.21	Less impacted

Invasion Index (Ix) was calculated to assess the rate of impact. The invasion index assesses the rate up to which a particular alien species has invaded in a particular system [7]. The Index (I_x) is calculated on the basis of exotic abundance (En) with respect to other native riverine fish species (N). Value less than '0' depicts a lesser loss of native fish diversity, while a value above 1 results in a higher rate of loss. In this study the index has been assessed for a period of 2017-2020 for two common invaded species Common carp and Tilapia in the river.

The results clearly indicate that the supremacy of common carp (*C. carpio*) particularly in the stretch of Varanasi to Buxar in middle stretch has created higher impact on native fishes. On the other hand, the value suggests moderate and considerably less impact of exotic tilapia in entire river stretch. The risks and the environmental impacts due to the incursion of exotic fish species in the Ganga River has created serious concerns related to the conservation of native fish biodiversity. The introduction of such alien fish have resulted in alteration of strong community in riverine fisheries at regional and global scale. Thus, adequate management measures must be ensured to withstand the threats exerted by the alien fishes upon the native fish biodiversity. Proper implementation of guidelines developed by Govt. of India and development of action plan related to the introduction of exotic fish species into the natural water systems need to standardized by the respective agencies on priority basis. ❐

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