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Non-native fish species from the Tributary of the Ganga river, Uttar Pradesh: A Note

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Fish is an important part of the human food with malnourishment (Dwivedi *et al.* 2009, 2011, 2014, Dwivedi & Jha 2013, Tiwari *et al.* 2013, 2020, Prakash *et al.* 2019). Fishes have great significance in the life of mankind (Mayank *et al.* 2018, Pathak *et al.* 2011a, Tiwari *et al.* 2016, 2024, Nautiyal *et al*. 2024, Dwivedi 2025). Exotic fish species or non-native fishes linked with introductions, status of biodiversity, ecosystem services and climate associated range shifts present major ecological and economical concerns globally (Cheung *et al.* 2009; Pathak *et al.* 2011b, Simberloff *et al.* 2013, Dwivedi *et al.* 2016a, Tripathi *et al.* 2017, 2024). Introductions of exotic species are known to modify the similarity in species composition and inland fish assemblages (Olden & Rooney 2006, Fulton *et al.* 2011, Mayank & Dwivedi 2015a, Dwivedi *et al*. 2023, Mishra *et al*. 2021, 2023, Dwivedi & Mishra 2021, 2023).

Two non-native fishes, Common carp, *Cyprinus carpio* and Nile tilapia, *Oreochromis niloticus* has been powerfully invaded from the Yamuna river at Prayagraj, India (Table 1). Both fishes are generating a healthy pressure to other commercially important indigenous fishes as well as trace fishes from the Yamuna river. Both species are creating a pressure for indigenous fish species for space, feeding and breeding. The fish culture structure in the Ganga basin is setup dense by exotic fish species especially *C. carpio*. During the past three decades it has been viewed that the impacts of increasing human and industrial activities in the Yamuna river, contributing to the pollution of the river. Both species are also abundantly available in world-wide (Vilizzi *et al*. 2015). Exotic fishes can cause considerable adverse impacts on the function of aquatic ecosystems and beating of native species (Hector & Bagchi 2007, Miehls *et al*. 2009, Dwivedi *et al*. 2016b, Mayank et *al*. 2021). Invasion of exotic species in any freshwater ecosystem (e.g. rivers, reservoirs, wetlands) are first of all threatened commercial fisheries (Example large size fish) (Vitule e*t al*.2012, Dwivedi & Nautiyal 2010, Kumar *et al.* 2013, Nautiyal & Dwivedi 2019, Tripathi *et al*. 2024).

The Yamuna river originates from the Yamunotri glacier, Uttrakhand. River Yamuna is the largest right bank tributary of the Ganga river. It is the second most important river system in the Ganga basin. Its drainage system covers two geographical regions namely hilly (Vindhyan area) and plain. Each of the geographic regions of the Yamuna river possesses a particular fish fauna (Mayank & Dwivedi 2015a), which as mentioned includes two established exotic species of fish of which both have formed local, self- reproducing populations in the Ganga basin. It has huge stock of exotic fish species specially *C. carpio* and *O. niloticus* and many commercially important indigenous fishes from the lower stretch at Prayagraj, Uttar Pradesh. It is (e.g. the Yamuna river) main source for exotic species for the Ganga river (Tripathi *et al.* 2017, 2024, Dwivedi *et al.* 2016c) and its tributaries. Riverine fin fish (small size) in particular provide an affordable source of animal protein to rural and poor peoples in developing countries (Dwivedi & Mayank 2013). Art and science of fish harvesting have been evolved by fishermen communities and passed on from generation to generation (Dwivedi 2009, Nautiyal & Dwivedi2019). Human demand for fish and fish product for food, sport and livelihood for fishermen community has historically (Ramos *et al.* 2018, Tiwari *et al*. 2024).

Due to water quality, invasion of exotic species and high fishing activities are the main causes of declining in stocks of large and medium size fishes as like *Catla catla, Labeo rohita, L. calbasu, Cirrhinus mrigala, Sperata aor, S. seenghala, Wallago attu,*

Bagarius bagarius and *Eutropiichthys vacha, Clupisoma garuva, L. bata* from the lower strecthc of the Yamuna river. Current time, the exotic fish species are being the main source of landing and livelihood for fishermen community and other peoples which are involved in fisheries sector from the Yamuna river. Exotic species, in particular have generally been estimated to succeeding degraded and damaged aquatic ecosystems in many area of the world-wide. Altered hydrological circumstance sand impact of anthropogenic activities has badly hampered the breeding biology and recruitment pattern in the rivers, streams and large water bodies, resulting in decline in the production. The exotic species are computed the second most source of biodiversity loss, after alteration and destruction of ecosystems (Vitousek *et al*. 1997, Mayank & Dwivedi 2015b).

Table 1 Composition of *Cyprinus carpio* and *Oreochromis niloticus* from the different rivers

Authors	Species		Rivers
	C. carpio (%)	*O. niloticus* (%)	
Nautiyal & Dwivedi 2019	17.8		Ken
Nautiyal & Dwivedi 2019	6.43		Paisuni
Nautiyal & Dwivedi 2019	4.06		Tons
Tripathi *et al.* 2017a	8.18	13.36	Ganga
Tripathi *et al.* 2017b	15.50	14.56	Ganga
Mayank & Dwivedi 2015a	21.76	24.36	Yamuna
Pathak *et al.* 2011a	32.99	19.07	Yamuna
Moza & Mishra 2001	4.5%		Yamuna

The Yamuna river fishery is indiscriminately and historically changed due to invasion of two alien fish species, *C. carpio* and *O. niloticus* since last decade of 20th century and first decade of 21stcentury, respectively. *C. carpio* and *O. niloticus* arrived accidentally in the Yamuna river at middle stretch. The vectors and pathways of these exotic fishes were introduced to the Yamuna river unknown. An alien species is defined as one that has been translocated, accidentally or deliberately, beyond its natural distribution regions. The stocks of Indian major carps (i.e. *C. catla, L. rohita, C. mrigala*) have been declined rapidly. Indian major carps are found in small quantities during the summer season from the Yamuna river. The landing scenario of catfishes has also been increased in the river.

The large sized fishes also declined from the lower stretch of the Yamuna river at Prayagraj region such as *C. catla, L. rohita, L. calbasu, C. mrigala, W. attu, S. aor, S. seenghala* and *B. bagarius*. Although, the total landing of fishes at landing centre of Prayagraj is declined even though the decline of the landing has prevail over by the invasion of *C. carpio* and *O. niloticus* in recent years. Somehow, the smaller size species maintained their production level and become the important component of fishers livelihood. The main prominent changes have also been recorded to alter in maturation periods towards earlier maturation at smaller sizes of these indigenous species from the Yamuna river. The non-native fish species are play bog role in the landing and trading from the Yamuna river. The stock of these fishes well established from the Yamuna river (Mayank & Dwivedi 2016a). These fishes are breeds two or three times in a year and create a pressure for native species due to breeding grounds (Dwivedi *et al*. 2016b, Dwivedi & Mayank 2017).

The non-native fishes are also changing the stock, age structure, growth, feeding behaviour and fecundity of indigenous fish species (Tahseen *et al.* 2015, Imran *et al.* 2015). The altered hydrologic regime, geomorphic adjustment and chemical degradation of rivers are resulting in total landing loss (Nautiyal *et al.* 2004, Jha *et al.* 2015, Mayank & Dwivedi 2015b, Dwivedi *et al.* 2016c). Landing provides a means to understand the productivity of the aquatic ecosystems and structure of food web (Dwivedi *et al.* 2018, Mayank & Dwivedi 2016b).The total length of commercially important fishes especially indigenous fish species are dramatically declined from the Yamuna river after invasion of exotic species. The largest sizes of fishes are maintaining the healthy recruitment process and breed successfully in non-suitable climate (Mayank *et al.* 2009, 2016, Dwivedi *et al*. 2011).

Fishing pressure impacts has been estimated from the natural system in several ways (Dwivedi & Nautiyal 2012, Mayank & Dwivedi 2016a, 2017). A fishery's utility represents the total benefit stakeholders derive from engaging in fishing (Rizvi *et al.* 2010, Laugen *et al.* 2014). The large network of

inland water bodies masses will carry onto afford great potential for economic capture fishery which consequently will compete well with fast growing fish culture practices (Dwivedi *et al.* 2004, Pathak *et al.* 2011a, Mayank *et al.* 2017). The natural fisheries rely entirely on natural feeding and breeding with interlinking fundamental to other living organisms in ecosystems (Dwivedi *et al.* 2011a, 2017a, 2017b, Tripathi *et al.* 2024). Fecundity of both species is higher in the country compare to other part of the world. Both species are also multiple breeder once year. The fecundity, defined as the number of offspring born over a given period of time, can be a key determinant of whether or not an introduced population establishes and subsequently persists (Pöckl 2007, Khan *et al.* 2007).

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