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Position of alien fish species, *Oreochromis niloticus and Cyprinus carpio* from the Yamuna River at Prayagraj

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Abstract
The fish *Oreochromis niloticus* (Nile Tilapia) and *Cyprinus carpio* (common carp) are the important exotic fish species on the Indian continent. Protein, vitamins and minerals are present in sufficient amount in fish. In Yamuna river at Prayagraj approximate annual catch was dominated by *O. niloticus* (149.51 kg day-1) followed by *C. carpio* (141.20 kg day-1) and other major contributions are of a diverse group of fishes (99.61 kg day-1) and there calculated annual percentage is 23.50%, 22.08% and 16.01%, respectively. The Indian major carps viz. *L. rohita, C. catla* and *C. mrigala* shared smaller proportions i.e. 3.34%, 2.10% and 6.03, respectively indicating a decline in their fishery. Significant detrimental effects of exotic fish species *O. niloticus* and *C. carpio* on the endemic fish diversity have been reported to cause a rapid decline in the catches of native fish species.

Keywords: exotic fish, Yamuna River, Indian major carps and species

Introduction
The '*exotic or alien*' species of fishes are the species that are the non-native species that force the native species to move them within or outside their natural ranges (Harris, 1994) [12]. The fish *Oreochromis niloticus* (Nile Tilapia) and *Cyprinus carpio* (common carp) belong to this category i.e., exotic species in the Indian continent. Nile tilapia (*Oreochromis niloticus)* (Linnaeus) is a exotic fish species native to India, Nile tilapia is widely distributed in 85 different countries of tropical and sub-tropical regions all over the world. Common carp looks like an ornamental variant of the East Asian common carp that was carried to Japan from China and commonly cultivated for their colour and scale variation (Axelrod, 1973) [7]. *Cyprinus carpio* (Common carp) is very important fish for commercial purpose and have great importance among freshwater cultivable fish around the world (Biro, 1995; Zhou et. al. 2003; Pathak et. al., 2011) [8, 25, 19]. Invasion of these fishes have been resulted in a drastic loss of biodiversity and change the local population patterns in freshwater system significantly.

Protein, vitamins and minerals are present in considerable amounts in fish (Tiwari *et al*. 2014) [21]. Freshwater fish are a very important vertebrate group that has a high predictable extinction rate in comparison to terrestrial fauna and marine mammals (Argent *et al.* 2003; Cooke *et al*. 2005) [5, 9]. Overfishing and overcapacity of fishing boats are the two prominent causes of degradation in the natural fishery system (Yakubu *et al*., 2011) [24]. Fish are an important sustainable natural resource and are exploited for livelihood and commercial purposes from lakes, streams, rivers, reservoirs, canals, ponds and wetlands (Dwivedi and Nautiyal, 2010) [10]. Increasing migration and frequent changes in many traditional customs (Jia and Chen 2011) have recently led to an increase in the demand for fish as well as other aquatic products. (Jia and Chen 2011). The fish species contributing significantly to fishery have always been assessed through landings, largely to explain the fishery trends well demonstrated by the riverine landings monitored often for the Yamuna River as well as Ganga River at Prayagraj. (Anon 2010, 2013).

Other workers like Gupta and Tyagi (1992) [11], Singh *et al*. (1998) [20], Vass *et al*. (2010) [23], Pathak *et al*. (2011) [19] and Masud (2013) [15] contributed significantly to these rivers at Prayagraj.

Statistical records of fish catch composition help to understand the trends in fisheries and effective management for sustained production of fish. Data on fish landing can be used to assess the current position of fish stock and for the assessment of trends. Changes in the yield can help in finding out whether a population is decreasing significantly or maintaining itself at a stable level. Fishing closely resembles natural mortality, often leading to changes in population structure, such as age structure, age of maturity, and sex ratio. Fishing not only shrinks the population but also alters its inter-specific and inter-specific relationships. The loss due to fishing can be compensated to the same extent. Theoretically, selective fishing could greatly alter the composition and lead to 'biological over-fishing, a stage where populations cannot reproduce themselves and maintain their stocks (Nikolskii, 1980) [18].

The present study aimed to provide recent data regarding the landing scenario and invasion potential of aliens from the Yamuna River.

Materials and Methods

The present study was conducted between the Period December 2018 to November 2019. The fish sample was procured from Sadiapur fish market in Prayagraj. Sadiapur fish market is situated on the left side of river Yamuna and a major part of fishing from the lower part of the river is most commonly used in this market. The fish market in Sadiapur was visited early in the morning for fish data collection. Past literature has shown that a large part of the night is brought to this wholesale fish market for disposal from the lower reaches of the Yamuna river. For commercially viable fish the data was collected on species wise viz., *C. catla, L. rohita, C. mrigala, C. carpio, O. niloticus, Sperataaor, S. seenghala, Clupisoma garua, Eutropiichthys vacha, Wallago attu, Rita rita, L. Calbasu* and *Mastacembelus armatus*) and rest were considered as miscellaneous. The stratified sampling design method was adopted for the collection of data (Tyagi and Mandal 2008) [22]. A gradation system is adapted for the division of month, which was divided into four grades of seven to eight consecutive days, depending on the month and data from each grade was collected at random for two days. The unit of data collection is the unit of the day.

Results and Discussion

The data of fish landing was recorded on sampling day from the wholesale fish market of Sadiapur and estimates were obtained. Annual data analysis on fish landing showed that two exotic fish species *O. niloticus* and *C. carpio* have established a wild population in the lower stretch of the Yamuna River at Prayagraj.

In Yamuna river at Prayagraj approximate annual catch was overnumbered by *O. niloticus* (149.51 kg day-1) followed by *C. carpio* (141.20 kg day-1) and other significant contributions are of the miscellaneous group (99.61 kg day-1) and there calculated yearly percentage is 23.50%, 22.08% and 16.01%, respectively (Table 1). Estimation of annual landing data indicates that the Yamuna River at the Prayagraj region was suitable for *O. niloticus*. Among Indian major carps, *C. mrigala* shared a maximum contribution of 39.10 kg day-1 (6.03%). *C. catla* and *L. rohita* shared 13.80 kg day-1and 21.68 kg day-1, respectively (Table 1). *S. Seenghala* is a very important commercially important catfish that contributes a maximum (44.60 kg day-1). The average catch was 43.68 kg day-1 for *C. garua* (6.87%), 23.80 kg day-1 for *W. attu* (3.79%); 19.10 kg day-1 for *E. Vacha* (3.04%); 18.90 kg day-1 for *S. Aor* (3.05%) and 10.02 kg day-1 for *R. rita* (1.64%). The contribution of *L.calbasu* (8.12 kg day-1) and *M. armatus* ((2.99 kg day-1) is comparatively very low.

The estimated annual catch was higher for *O. niloticus* (5562 kg) than *C. carpio* (52260 Kg) and miscellaneous (37894 kg). *S. Seenghala* also contributed a significant proportion with a share of 16226 kg (Fig. 1). The annual catch of *C. catla* was 4967 kg; *L. Rohita* 7906 kg; *C. mrigala* 14267 kg; *S. Aor* 7210 kg; *E. vacha* 7201 kg; *W. attu* 8967 kg and *R. rita* 3890 kg (Table 1).

Table 1: Annual landing of fishes from the Yamuna River at Prayagraj

Fish Species	Average catch/day (kg)	Total catch of the year (kg)	Percentage (%)
Catlacatla	13.80	4967	2.10
Labeorohita	21.68	7906	3.34
Cirrhinusmrigala	39.10	14267	6.03
Cyprinus carpio	141.20	52260	22.08
Oreochromis niloticus	149.50	55621	23.50
Sperataseenghala	44.60	16226	6.86
Sperataaor	18.90	7210	3.05
Clupisomagarua	43.68	16260	6.87
Eutropiichthysvacha	19.10	7201	3.04
Wallago attu	23.80	8967	3.79
Rita rita	10.02	3890	1.64
Labeocalbasu	8.12	2999	1.27
Mastacembelusarmatus	2.99	969	0.41
Miscellaneous	99.61	37894	16.01

With the increase in fishing methods and techniques, production can be increased to a particular level, but over-exploitation of fish resources can reduce fish yield. If efforts are still increased without a reduction in total catches and catch rates, the stock under exploitation may collapse and the fishing society may face the problem of resettlement.

For aquaculture purposes, *Oreochromis niloticus* was introduced in the year 1987 in India and nowadays shares more than 7.17% in whole inland fish production (Singh and Lakra, 2006) [1]. The density of common carp, *C. Carpio* is high in freshwater ecosystems (Arlinghaus and Mehner 2003) [6]. Apart from common carp and Nile tilapia the miscellaneous group of fishes and catfishes are rising as the major fishery in the Yamuna River and in their tributaries (Anon 2002). Previously Gupta and Tyagi (1992) [11] analyzed that the miscellaneous group of fishes comprised the highest share (50.50%) while *A. aor* and *A. seenghala* combinedly accounted for 16.81% at Prayagraj. Few years ago, Singh *et al*. (1998) [20] found that *A. aor* and *A. seenghala* were dominant species (45.2%) in comparison with the miscellaneous group of fishes (28.2%) and *L. Calbasu* (14.6%) in the Ganga and the Yamuna at Allahabad. Considerable harmful effects of exotic fish species *O.niloticus* and *C carpio* on the

native fish diversity have been observed and it has already been reported to cause a sharp decline in the catches of endemic fishes (Singh and Lakra 2006) [6]. The Indian major carps viz *L. rohita*, *C. catla* and *C. mrigala* shared small proportions 3.34%, 2.10% and 6.03%, respectively showing a decline in their fishery. Mishra and Moza (2001) [17] reported that the general fish population in the Yamuna River (From Delhi to Etawah), is dominated by large-sized catfishes (49.26%) followed by major carp (28.54%).

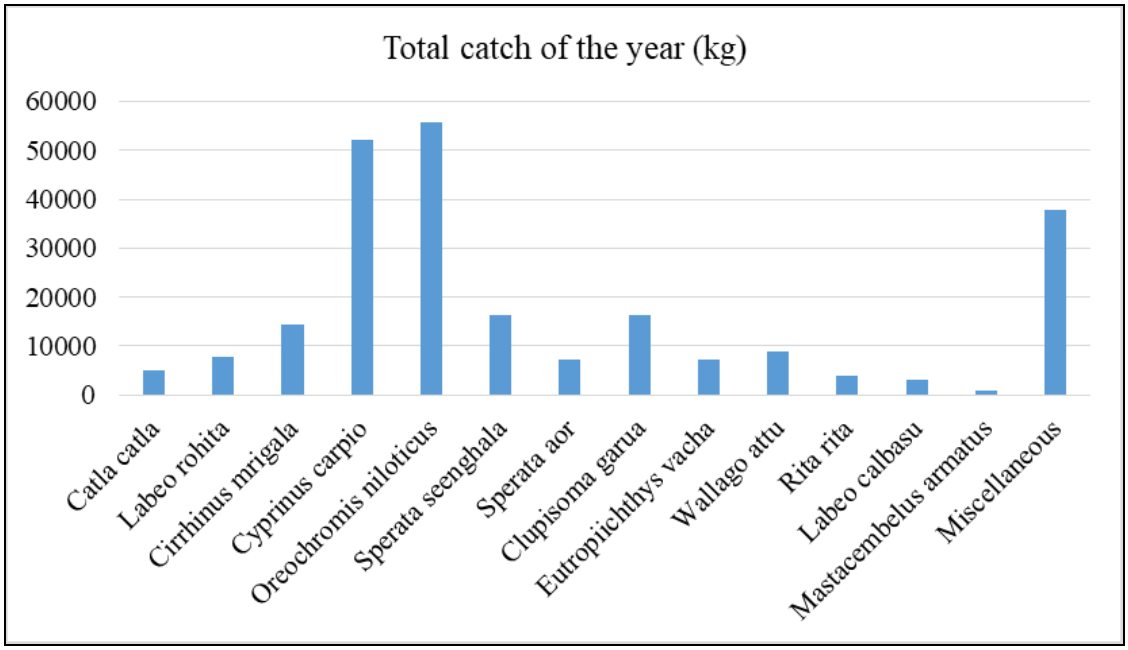

Fig 1: Landing profile of different fish species from the Yamuna River at Prayagraj

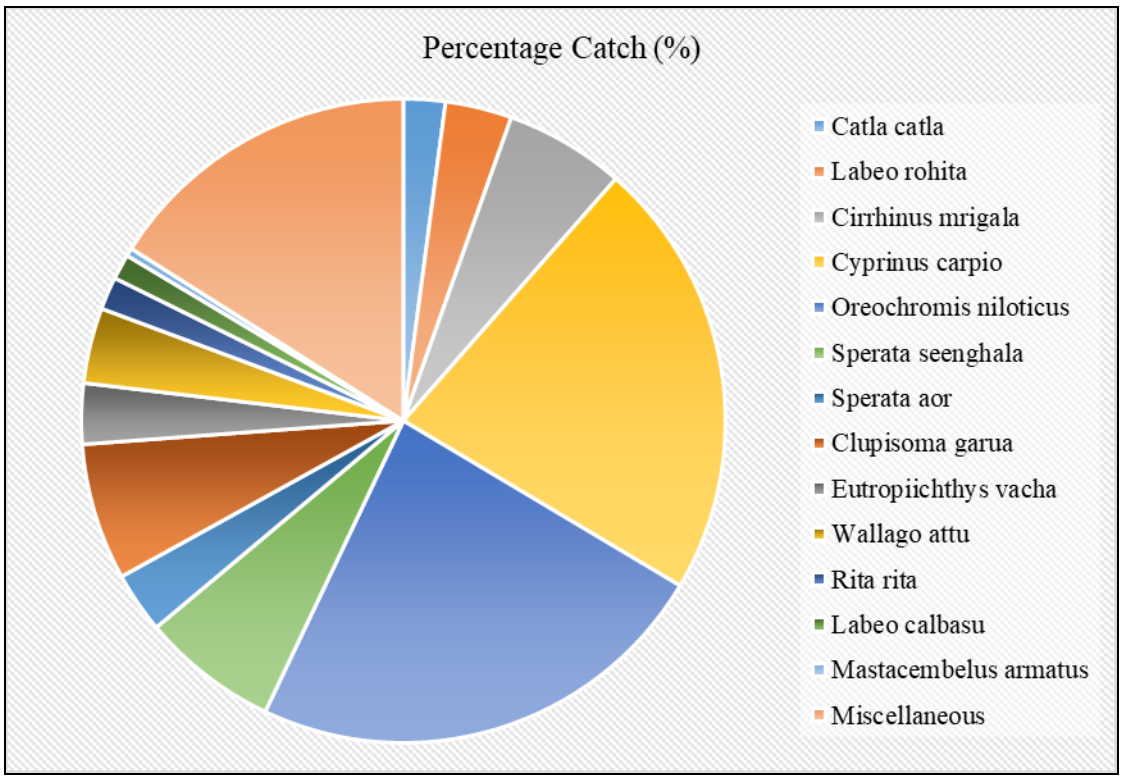

Fig 2: Annual percentage catch of different fish species from the Yamuna River at Prayagraj

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