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Catfishes and non-native fish species indicator of river health from the Ganga river, India

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Catfishes are highly exploited fishes all over the world being used as human food, angling, sports and ornamental fishery or aquariums (Bhattacharjee *et al.* 2012, Tripathi *et al.* 2017a, Prakash *et al.* 2019, Tripathi *et al.* 2024). Riverine fisheries are very essential for the livelihoods, employments, source of protein and food security of millions of people around the world (Dwivedi & Mishra 2023). It is clearly reported that the fisheries of all types of waters are essential for the livelihoods and food security of millions of people around the world (Welcomme 2008, Dwivedi & Nautiyal 2010, Pathak *et al.* 2015, Mayank *et al.* 2017, Kumar *et al.* 2023, Nautiyal *et al.* 2024). In current time, unsustainable harvesting of natural stock (example in seas, rivers, streams) of fishes, invasion of exotic fish species and habitat degradation of riverine ecosystem is an emerging conservation issue in the tropics, which has resulted in the stock decline of important fish species (Argent *et al.* 2003, Allan *et al.* 2005, Pathak *et al.* 2015, Dwivedi *et al.* 2016a, 2023, Sarkar *et al.* 2017, Tiwari et al 2024, Mishra *et al.* 2021, 2023).

Non-native fishes are continuing altering the diversity and stock status of fishes in riverine ecosystems (Mishra & Dwivedi 2023, Mishra & Dwivedi 2021, Tiwari *et al.* 2024). Statistical records of fish catch composition are helpful in understanding the trends in fisheries, health of river, invasion potential of exotic species and effective management for sustained yield of fishes. The fish landing is a vitally important aspect for livelihood and food security globally (Dwivedi *et al.* 2004, 2014, Rizvi *et al.* 2010, Mayank & Dwivedi 2016, Tripathi et al 2024). Although now a day's riverine fish landing is suffering from over exploitation but this scarcity maintain by catfishes in a fraction (Dwivedi *et al.* 2007, 2017, Kumar *et al.* 2013, Nautiyal & Dwivedi 2019).

The fishing pressure are altering biodiversity, size composition (Dwivedi *et al.* 2009, Mayank & Dwivedi 2006, Pathak *et al.* 2013, Kumar *et al.* 2023), age and growth (Tripathi *et al.* 2010, Pathak *et al.* 2014), sex ratio (Khan *et al.* 2007, Srivastava *et al.* 2009, Mayank *et al.* 2009, 2021, Mishra & Dwivedi 2022) and feeding nature (Tripathi *et al.* 2013). The catfish group is a very important group of enduring fishes and had fantastic strength for resisting with pollution, heavy metal, habitat alternation, siltation, damming and channelization of river (Nautiyal & Dwivedi 2019, Tiwari *et al.* 2013, 2014, 2016, Dwivedi *et al.* 2016b, 2017, Tripathi *et al.* 2017b). These fishes are physiologically very hardy and have high feasibility in feeding behavior.

In general, these fishes fed on macro-organisms such as fish, arthropods, mollusk and amphibians which shortly maintain energy level for body need. These fishes create a number of adaptations to deal with the constraint of ephemeral habitats (e.g. low DO, low water level, high temperature, late monsoon, poor monsoon and seasonal river bed alteration) and food supply. The catfish fishery stocks are most heavily fished and include the most popular freshwater fisheries in the Ganga basin, India. The stock of fishes fluctuated from time to time through multi-stressors (Argent *et al.* 2003, Cooke *et al.* 2005, Timm & Wissmar 2014).

The fish species contributing significantly to fishery have always been assessed through landings, largely to explain the fishery trends well exemplified by the riverine landings monitored regularly for the Ganga, Yamuna rivers and tributaries (Gupta & Tyagi 1992, Dwivedi 2009, Vass *et al.* 2010, Pathak *et al.*

2011, Mayank & Dwivedi 2015). The objective of the present study was to give recent data regarding landing scenario in respect of river health and importance of catfishes from the Ganga river. The data was collected group-wise i.e. Indian major carp (*Catla catla, Labeo rohita, Cirrhinus mrigala*), exotic fishes (*Cyprinus carpio, Oreochromis niloticus*), commercially important catfishes (*Sperata aor, S. seenghala, Clupisoma garua, Eutropiichthys vacha, Wallago attu, Rita rita*) and rest were recorded as miscellaneous.

Observations on the total landings in 2014-15 showed that the total catch and average catch day^{-1} were dominated by miscellaneous fishes followed by *O. niloticus* (Nile Tilapia) and *S. seenghala* while in 2015-16 also dominated by miscellaneous fishes followed by *C. carpio* and *O. niloticus*. Analysis of annual data on fish landing showed that *O. niloticus* and *C. carpio* have powerfully invaded in the middle stretch of the Ganga river at Allahabad in a bigway. The estimated annual catch was dominated by miscellaneous group (22.16 kg day^{-1}) followed by *O. niloticus* (12.76 kg day^{-1}) and *S. seenghala* (12.63 kg day^{-1}) and they accounted for 23.19% 13.36% and 13.21%, respectively.

The estimated annual catch was dominated by miscellaneous group (23.67 kg day^{-1}, 19.09%) followed by *C. carpio* (19.22 kg day^{-1}, 15.50%) and *O. niloticus* (18.05 kg day^{-1}, 14.56%) Catch statistics over many years indicated a declining trend for riverine catches, both in quantitative and qualitative terms (Gupta & Tyagi 1992, Vass *et al.* 2010, Mayank & Dwivedi 2015, Dwivedi *et al.* 2017, Tripathi *et al.* 2024). Annual estimates of landing data indicated that the Ganga river at Prayagraj region was most suitable for the miscellaneous group and non-native fish species.

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