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Studies on invasion and impact of feral population of Nile tilapia (*Oreochromis niloticus*) in Krishna River of Mahabubnagar district in Telangana, India

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Abstract
The present account is an attempt to document the occurrence and abundance of the feral fish, *Oreochromis niloticus* in Krishna River in Mahabubnagar district of Telangana state, India. In this study, we aimed to determine the abundance of *O. niloticus* which has formed a feral population in the Krishna River, the largest one in the district. Abundance of *O. niloticus* in the fishery of the river was observed from January 2012 to December 2014. This feral *O.niloticus* was calculated which ranged from 35.99 to 48.82% during successive years. And also observed the significant declining of the Indian Major Carp species in the river.

Keywords: Nile tilapia, Carp, Catfishes, Krishna River, Mahabubnagar District, Telangana.

1. Introduction
Tilapia, a native to Africa and Middle East has emerged as one of the most internationally traded food fishes in the world [1]. There are about 70 species of tilapias; most of them are native to Western rivers of Africa. Of these mainly Nile tilapia (*Oreochromis niloticus*), has become feral population in the Krishna River. Nile tilapia is a relatively large cichlid fish, which is introduced to several countries where its populations exist outside its natural range e.g. Brazil, Australia, Bangladesh, Srilanka, India [1, 2]. Commercially, tilapias are the second most important group of wild-captured fish, after carps [3].
Escapement of tilapia from aquaculture facilities due to recurring floods or inadvertent releases frequently happened. However, recent occurrence of tilapia in the fishery of the Krishna River system has been a concern. It was interesting to see a considerable size of *O.niloticus* in the fishery of the Krishna River system. This scenario prompted us to study its abundance, size range and impact on local species. The study was undertaken under two perspectives; the former was to ascertaining the colonization of the escapee *O.niloticus* through natural population in the Krishna River system and the latter was to assess its possible impacts on the local fishery and the fish diversity.

2. Methods and materials
2.1 Location: The Krishna River starts from Makthal taluk in the district where the Bhima tributary joins the Krishna (Sangam). The study area was divided into three stretches for convenience i.e., the upper stretch starts from Makthal to Gadwal, the middle stretch from Gadwal to Alampur and down stretch from Alampur to Kollapur. The study area included 15 collection sites. The fish were collected in the Krishna River from Krishna village to Somasila village which is approximately 250 Km length in the district **(Table 1 & Fig. 1, 2)**.

2.2 Fish sampling: Fish samples were collected from the landing centers on quarterly basis during 2012 to 2014. Fishermen generally used multi-meshed gill nets of mesh size ranged from 10–150 mm as well as cast nets, drag nets and hook-lines for fishing in the river. From commercial catches, fishes were collected at the landing centers and were identified and weighed using portable digital balance. Fish species were identified with the help of standard keys mentioned in the taxonomic literature [4-6]. Secondary data were also collected through observation and interview with fishermen through questionnaires at the studied area.

Table1: Sampling stations on *O.niloticus* from Krishna River in Mahabubnagar district.

Sample village code	Name of the village	Mandal
Upper Stretch		
1	Krishna	Maganoor
2	Mudumal	Maganoor
3	Panchadevpadu	Makthal
4	Mustipally	Makthal
5	Peddakadumur	Narwa
Middle Stretch		
6	Revulapally	Dharoor
7	Rekulapally	Gadwal
8	Chenugonipally	Gadwal
9	Nadiagraram	Gadwal
10	Bearol	Gadwal
Lower Stretch		
11	Yaparla	Alampur
12	Kyathur	Alampur
13	Gondimalla	Alampur
14	Chellepad	Weepangandla
15	Somasila	Kollapur

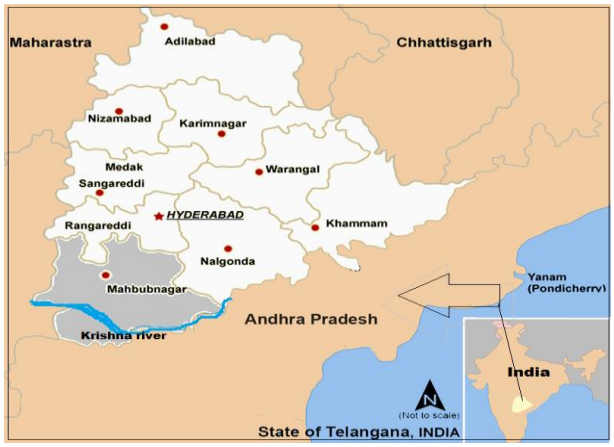

Fig 1: Location of Mahabubnagar district in Telangana state, India.

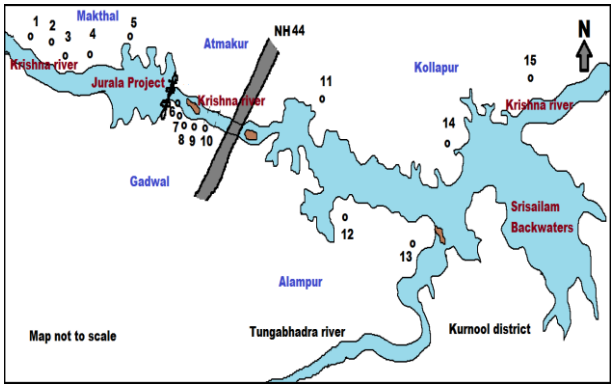

Fig 2: Sampling stations in the Krishna River in Mahabubnagar district.
(1. Krishna, 2. Mudumal, 3. Panchadevpadu, 4. Mustipally, 5. Peddakadumur, 6. Revulapally, 7.Chenugonipally, 8. Nadiagraram, 9. Bearol, 10. Yaparla, 11. Kyathur, 12. Gondimalla, 14. Chellepad, 15 Somasila)

3. Results

The abundance of the *O. niloticus* ranged from 35.99-48.82% during 2012 to 2014 at different sampling locations. The weight of the fish ranged from 15 - 1750 g during the study period **(Fig. 3-7)**. The *O. niloticus* included high proportion of large fish weighing from 350-450 g. The large fish weighing 850-1750 g were recorded in low proportion. The recorded data on the occurrence of *O.niloticus* for the years 2012 to 2014 revealed that catch of *O.niloticus* increased successively during this period **(Table 2)**.

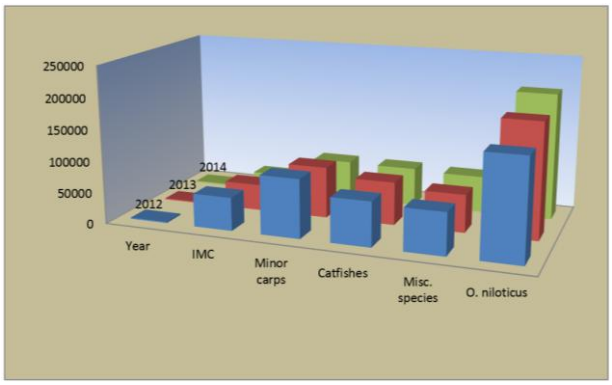

Fig 3: Abundance of species group along with *O. niloticus* in the Krishna River.

Fig. 4: The weight of the *O. niloticus* ranged from 15 g (bottom) to 110 g (top) in the Krishna River.

Fig 5: The weight of the *O. niloticus* ranged from 160 g (bottom) to 1750 g (top) in the Krishna River.

Fig. 6: The common harvesting weight of the *O. niloticus* ranged from 350 - 450 g in the Krishna River.

Fig 7: A fisherman collecting the fish, *O. niloticus* from the net in Krishna River.

The important fish biodiversity of the Krishna River collected from different sampling station were identified and commercially important fish diversity were grouped as Indian Major Carps (IMCs), minor carps, catfishes, miscellaneous and exotic fishes (*O.niloticus*). The Indian major carps comprised of *Catla catla, Cirrhinus mrigala* and *Labeo rohita* constituting 6.96% to 11.91% of the total catch. The IMCs included high proportion of large fish weighing 2–4 kg and the small fishes were in low proportion. The catch of *Catla catla* was remarkably low. It was also observed that there was a 2.28% to 4.95 % decline in catch of IMCs over the years during the study period. The minor carps in the total catch were mainly represented by *Labeo bata, L.calbasu, Cirrhinus reba, Puntius spp.* etc., constituted 15.17%–21.06%. Catfishes in general were represented by *Sperata aor, S. seenghala, Rita spp., Wallago attu, Mystus spp.* etc., constituted 14.87%–15.96% of the total catch. Other miscellaneous fishes were *Etroplus suratensis, Amblypharyngodon mola, Chanda nama, Salmostoma bacaila, Rhinomugil corsula, Glossogobius giuris, Mastacembelus armatus, Anguilla bengalensis, Notopterus notopterus* etc., representing 14.18%–15.08% of total catch. *O.niloticus* was present in all the catches from the Krishna River.

4. Discussion

Oreochromis niloticus was introduced into India during 1987 for aquaculture purpose and now it contributes more than 7.17% in total inland fish production [7]. Results of this study delineated increased abundance of *O. niloticus* in the fishery the fish has now established feral population in the Krishna River. Many researchers opined that Nile tilapia is notorious with their resistance against bad water quality conditions, develops its own ecology for its survival and repopulating by competing with other fishes.

Significant negative effects of *O.niloticus* on the piscine diversity have been reported [8, 9]. *O.niloticus* in India has already been reported to cause sharp decline in the catches of endemic fishes [7, 8]. The declining trend of Indian major carps in the Ganga River and increasing appearance of *O.niloticus* in the fishery is a warranting situation of biological invasion threatening ecological integrity. The invasion of exotic *O. niloticus* in the fishery of the Ganga River has been recent aggravating the threats to the indigenous fish diversity including environmental problem [10, 11]. *O. niloticus* adapt, in to newer areas exploiting local resources and suppressing native species [12].

Exotic fish introductions have been reported to impact the fish biodiversity and have provided significant warnings of the various effects on environment posing threats to the community trophic structure disrupting biological integrity [8, 13-14]. It has also been realized that the nature and extent of such changes being complex remains unpredictable. Exotic species may become invasive and are capable of decreasing biodiversity through competition, predation and habitat degradation of wild populations in short or long course of time [7, 8, 13, 14]. The problem of repopulating *O. niloticus* in degrading water of the river has come up to population faster. This would not only influence the human but might induce either more adaptability of the biota living in it or might cause damage to various species which would not be able to adapt to such fast ongoing change. The adverse impacts on the wild population due to *O. niloticus* have been assessed in the Krishna River and it is a big concern to the conservation biologists. Its rapid spread and colonization in the Krishna is understood to cause dramatic ecological disruptions at the community and ecosystem levels.

The results of this study highlights that the *O. niloticus* has established in the Krishna River as a pest through naturally breeding populations which is now becoming the source for secondary invasions at other places. The result of this study indicated that ecological conditions in the Krishna River were homogenizing by the increasing population of *O. niloticus* which could be of great threat to the ecological integrity for this important river sustaining rich fish biodiversity. Understanding the fundamental niche of invasive species and therefore provides the basis for better-informed conservation and management policies.

5. Acknowledgements

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Table 2: Catch contribution of different species groups along with *Oreochromis niloticus* captured from the Krishna River from 2012-2014 in Mahabubnagar District.

Year	Total number	Group-wise abundance (number)									
		IMC	%	Minor carps	%	Catfishes	%	Misc. species	%	*O. niloticus*	%
2012	443786	52839	11.91	93466	21.06	70831	15.96	66941	15.08	159709	35.99
2013	435439	41930	9.63	81756	18.78	68458	15.72	60373	13.86	182922	42.01
2014	412318	28684	6.96	62552	15.17	61327	14.87	58472	14.18	201283	48.82

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