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First Record of Freshwater Invasive Catfish, *Clarias gariepinus* (Burchell, 1822) in Dharamtar Estuary, West Coast of India

VIKAS PATHAK[1], DHANYA M. LAL[1], RINCHEN NOPU BHUTIA[2], SATHISH CHENNURI[1], SHASHI BHUSHAN[1], GEETANJALI DESHMUKHE[1] and A. K. JAISWAR[1]*

[1]ICAR - Central Institute of Fisheries Education, Versova, Andheri (W), Mumbai - 400 061, Maharashtra, India
[2]ICAR-Central Soil Salinity Research Institute, Regional Research Station, Canning Town - 743 329, West Bengal, India

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African catfish, *Clarias gariepinus* (Burchell, 1822) is recorded, for the first time in Dol net, from Dharamtar estuary, West coast of India, in an attempt for sampling during October 2018 to February 2020 for documentation of ichthyofaunal diversity of the estuary. The species has been found to have enormous power of adaptation to survive in euryhaline conditions, especially estuarine conditions, which is a probable reason for its occurrence in the Dharamtar estuarine ecosystem. The present communication also deals with the comparative account on morphometry of fish and otolith of *C. gariepinus and C. batrachus* as a tool for confirmation of species. Otolith of *C. gariepinus* was observed to be three layered with 1.575431 elongation, 0.489 roundness, 25.672 circularity, 0.715 rectangularity, 0.490 form factor and 0.223431 ellipticity. The present investigation has generated baseline data on otolith for biological study.

(***Key words:*** *Adaptation, African catfish, Discrimination, Ichthyofaunal diversity, Invasive species)*

Aquaculture practices are responsible for the introduction of a majority of exotic fishes worldwide. More than 50 finfish species, alien to other nations, are being cultured in the Asian continent (De Silva *et al*., 2006). One of the extensively cultured and fast invading species in Indian freshwater ecosystems, the *Clarius gariepinus* (Burchell, 1822), is native species of Africa (Teugels *et al*., 1998). On account of its potential of adaptation to adverse environmental condition and instability of habitat (Marchand, 2009), it has invaded and survived in most of the Asian countries (Radhakrishnan *et al*., 2011). The reasons for such adaptation may be its fast growth rate and predatory, cannibalistic and voracious feeding habit, on a wide range of food items from zooplankton to fish of half of its length where the amphibians, reptiles and birds form occasional food (De Moor and Bruton, 1988) and all types of biowastes (De Graff and Jansen, 1996), along with the ability to tolerate a wide range of temperature (Adeyemo, 2003) and its resistance power to diseases (Sambhu, 2004). Thus, the invasion of this species in natural water bodies can be a serious threat to the existence of indigenous species (Radhakrishnan *et al*., 2011).

C. gariepinus (Burchell, 1822) was introduced in India from Bangladesh (Thakur, 1998) for culture in Assam, West Bengal and Andhra Pradesh, in mixed culture system along with the Indian major carps (Baruah *et al*., 1999). This practice led to serious losses to farmers that forced them to switch over to monoculture of the species (Baruah *et al*., 1999). The species has been emphasized to affect native aquatic biodiversity by Krishnakumar *et al*. (2011). Depletion of 56 native fish species was observed in Bangladesh, due to the introduction of *C. gariepinus* (Krishnakumar *et al*., 2011). Foreseeing negative impact on indigenous species such as *C. batrachus*, *Catla catla*, etc. the culture of *C. gariepinus* was banned in India by the Department of Animal Husbandry, Dairying and Fisheries (DAHD&F), Ministry of Agriculture, Government of India, vide office letter number 31016/1/96-FY dated 19-12-97 (Krishnakumar *et al*., 2011; Singh *et al*., 2015). In this scenario, the present communication deals with the first record of *C. gariepinus* from an estuarine ecosystem, the Dharamtar estuary along with a taxonomic note. The *C. batrachus* was taken for comparative study because *C. batrachus* contribute similar morphological characteristics.

**Corresponding author:* E-mail: akjaiswar@cife.edu.in

MATERIALS AND METHODS

The Dharamtar estuary situated in the eastern part of the Arabian sea and on the west coast of Maharashtra, India. It is a complex estuarine ecosystem of the Amba and Patal Ganga rivers. The sampling for estuarine fishes was carried out on 1st September 2019 (during regular sampling from Oct. 2018 to Feb. 2020) in the Dharamtar estuary, Maharashtra, using dol net (Fig. 1). Two specimens of *Clarias gariepinus* were collected during sampling at dawn (0800-1000 hrs).

Fish samples were transported to the laboratory in an ice-filled box and identified by using the appropriate keys (Compaoré *et al*., 2015). The specimens of *C. gariepinus* and *C. batrachus* (collected from Ujjaini reservoir, Pune) were photographed by a Cannon 1200D DSLR camera. Weight was recorded to nearest 0.1gm using digital weighing balance, morphometric variables were measured to nearest 0.01 mm using digital vernier callipers and the meristic characters were counted under a magnifying glass. Otoliths of the specimens were extracted by breaking the otic capsule of the neurocranium. Extracted otoliths were cleaned in dilute nitric acid and photographed by Olympus Leica stereo-zoom microscope SZX16, which was utilized for further estimates. The morphometric variables (perimeter, length, width, area, roundness, circularity, ellipticity, rectangularity, form factor and elongation) were measured by using the software Sigma Scan Pro Version 5.0.0.

In order to correlate the abundance of other fish species, the water quality parameters such as temperature, pH, transparency, alkalinity, dissolved oxygen (DO), carbon dioxide (CO_2), biological oxygen demand (BOD), total dissolved solids (TDS), total suspended solids (TSS), total solids (TS) and salinity were determined. Field measurements were recorded for variables, *viz*., pH (pH Tutor, CyberScan), water temperature (mercury thermometer), salinity (refractometer), transparency (Secchi disk). Water samples were collected in amber-colored, labeled glass bottles for analysis in the laboratory. Samples were preserved at 4°C without freezing and taken to the laboratory within 3 hours of collection for analysis by following standard methods (APHA, 1989) and presented in this communication.

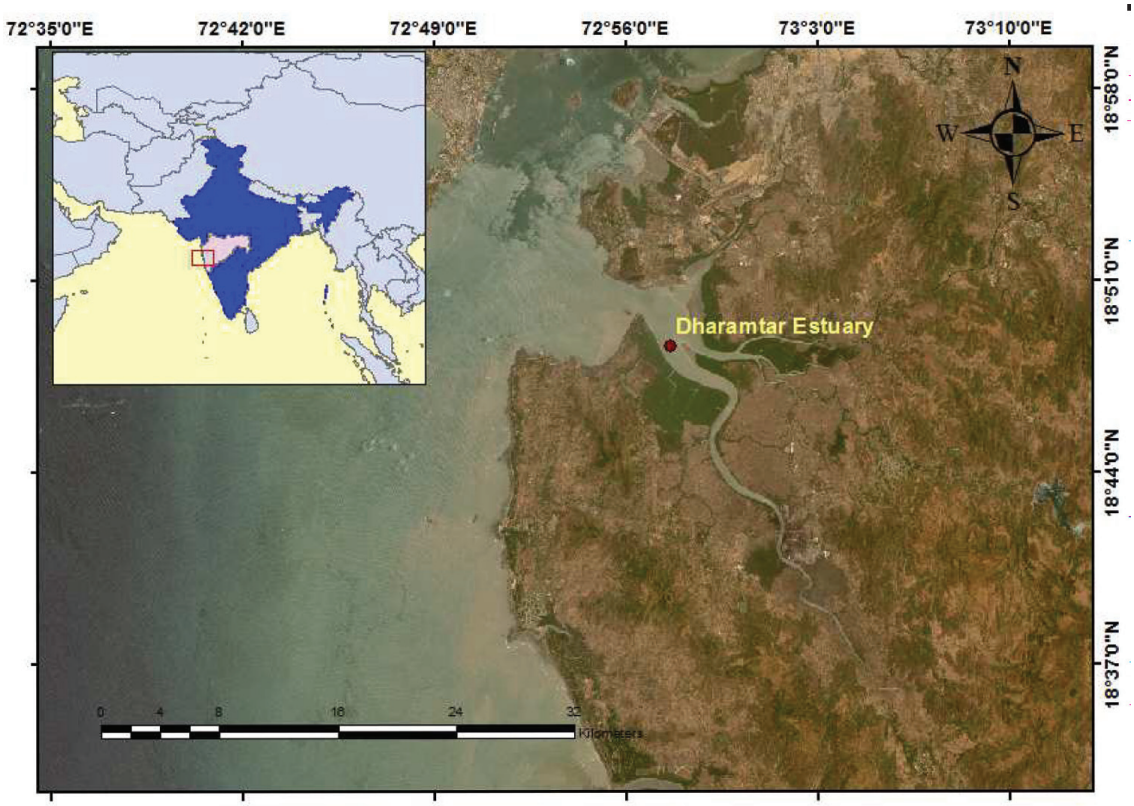

Fig. 1. *Sampling location*

RESULTS AND DISCUSSION

In the present investigation, the *C. gariepinus* was discriminated from morphologically similar species (*C. batrachus*) based on their morphological and otolith features and reported availability of *C. gariepinus* in estuarine water.

Classification and identification

Order: Siluriformes

Family: Clariidae

Genus: *Clarias*

Species: *gariepinus* (Burchell, 1822)

Diagnostic characters

Body elongate, head moderately depressed with small eye, dorsal fin rays 70; anal fin ray 46; 4 pair large barbales; maxillary barbels longer than head; the number of gillrakers on the first-gill arch 72; dorsal and anal fin reaches almost up to caudal fin; pectoral fin bears one strong spine; pectoral fin spine serrated only on outer periphery, occipital process "W" in shaped, head length 25.26% of standard length (Table 1.), otolith three layer with 1.575431 elongation and 0.223431 ellipticity (Tables 2 and 3). The color of the body was dark dorsally and pale white ventrally. The finding of the present study supports the finding of Froese and Pauly (2013) and Iswanto *et al*. (2015).

The head length of *C. gariepinus* was found to be larger than *C. batrachus* on the scale of standard length (Table 1). The circularity, ellipticity and rectangularity of otolith was also estimated to be higher than *C. batrachus*, while roundness, form factor and elongation were more in *C. batrachus* (Table 3).

The water quality parameters of sampling location, recorded during gear hauling, was found to be in the normal limits (water temperature 27°C, pH 6.7, transparency 0.5m, dissolved oxygen 6.4 ppm, biological oxygen demand 2ppm, alkalinity 42 ppm, T.D.S 5 ppt, T.S.S 0.25 ppt and T.S. (5.25 ppt), except salinity (6.09 ppt) as per the WHO standard for the fish health Chapman (1996).

Huxel (1999) opined that displacement of native species by non-native species can occur in less than five years. The culture of *C. gariepinus* (Fig. 2) is banned in India by vide office letter number 31016/1/96-FY dated 19-12-1997, due to its highly carnivorous feeding habit and fast invasion in freshwater bodies (Singh *et al*., 2015). Lowe *et al*. (2000) reported 100 of the world's worst invasive species, including 8 species of fishes such as *Salmo trutta, Cyprinus carpio, Micropterus salmoides, Oreochromis mossambicus, Lates niloticus, Oncorhynchus mykiss, Clarias gariepinus, Gambusia affinis*. It is reported for all types of freshwater ecosystems including estuaries since it can survive very well on insects, fish, snails, earthworm, frog, young bird, plants, plankton, fruits and also rotten flesh (Fish Base, 2019).

Table 1. *Morphometric measurements of the fish*

% of standard length		
Parameters	*C. gariepinus*	*C. batrachus*
Pre dorsal fin length	32.361	34.405
Post dorsal fin length	96.329	99.405
Total length	115.112	119.132
Post pelvic fin length	96.651	95.686
Pre pelvic fin length	58.066	50.804
Pre pectoral fin length	21.740	22.508
Head length	25.676	25.707
Pre orbital length	5.415	6.326
Dorsal fin base length	64.871	66.447
Caudal fin depth	7.516	8.240
Pelvic fin base length	38.701	50.667
Eye diameter	3.512	3.207

Table 2. *Morphometric measurements (mm) of otolith*

Parameters	*C. gariepinus*	*C. batrachus*
Area	2.899	5.140
Perimeter	8.626	10.565
Length	2.527	3.386
Width	1.604	2.338

Table 3. *Shape indices of otolith*

Parameters	*C. gariepinus*	*C. batrachus*
Roundness	0.489	0.578
Circularity	25.672	21.832
Ellipticity	0.223	0.182
Rectangularity	0.715	0.645
Form factor	0.490	0.578
Elongation	1.575	1.446

Britz and Hecht (1989) reported that juveniles of *C. gariepinus* can survive to the upto salinity of 5 ppt (100% survival), hence record of species in 6.09 ppt salinity, in present study, may be due to potential of its adaptability to wide changes in salinity. *C. gariepinus* looks like indigenous cat fish *C. batrachus* (Fig.3) in external appearance; however, there are shape differences in occipital process which is "W" shaped in *C. gariepinus* (Fig. 4a) and "N" shaped (Fig.4b) in *C. batrachus*. Further, the structure of otoliths also varied significantly. The otolith was observed to be three layered in *C. gariepinus* (Fig. 5a), while two layered in *C. batrachus* (Fig. 5b).

There is a huge paucity of study on impacts, some are inferred from laboratory observations, but have not been exhibit at community level. It has initiated concerns about the about the documentation genetic impacts of *C. gariepinus* and the hybrids on wild populations of African catfish. Recently, introgressive hybridization has been detected in African natural waters (Baimai, 2001). Genetic introgression of native wild clariid catfish by hybrid catfish (*C. gariepinus* x *C. macrocephalus*) have been reported in Thailand (Sakamoto *et al*., 2000).

Weir (1972) reported that *C. gariepinus* have ability to alter invertebrate community composition and density in South Africa. Kadye & Booth (2012) demonstrated responses of invertebrate communities to *C. gariepinus* predation and predation release. Cambray (2003), given two anecdotal accounts which generalize impacts on 2 endangered fishes in South Africa: (1) the depletion of *Sandelia bainsii* from habitats occupied by *C. gariepinus* and (2) the sharp reduction in the availibility of *Pseudobarbus asper* in the Gamtoos River. Due to these problems with clariid catfish Bangladesh

Fig. 2. *C. gariepinus (Burchell, 1822)*

Fig. 3. *C. batrachus (Linnaeus, 1758)*

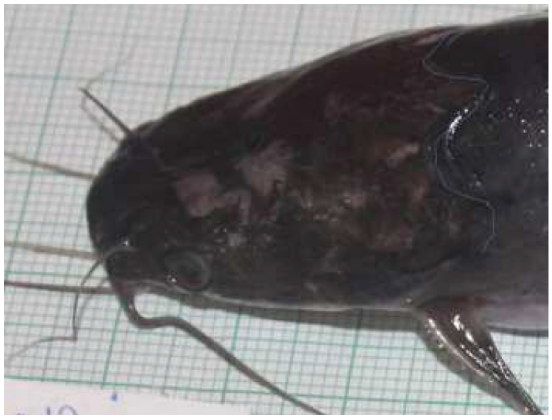

Fig. 4a. *Occipital process of C. gariepinus (Burchell, 1822)*

Fig. 4b. *C. batrachus (Linnaeus, 1758)*

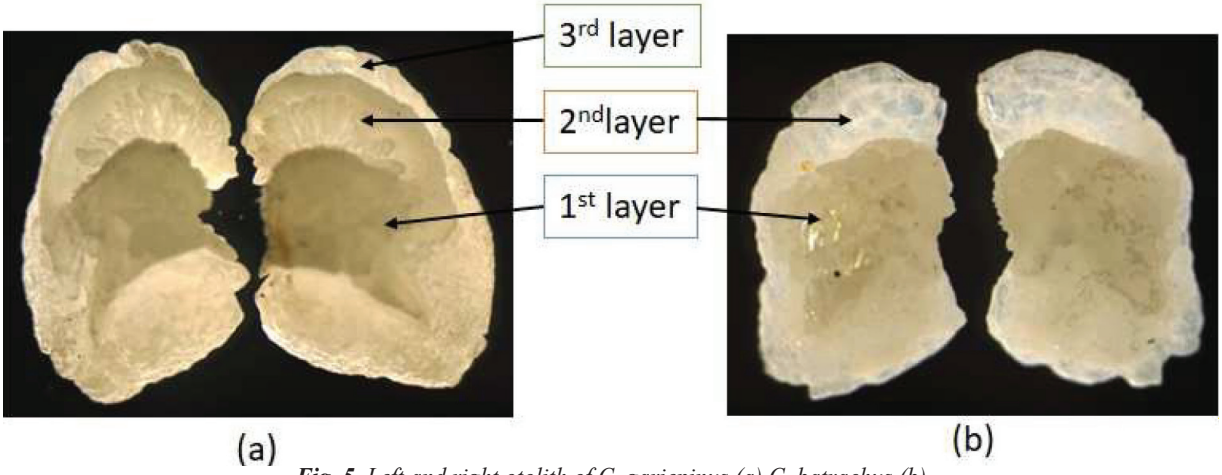

Fig. 5. *Left and right otolith of C. gariepinus (a) C. batrachus (b)*

Government and Government of India have imposed a ban on introduction and culture of *C. gariepinus*.

Such impact investigations are urgently needed to better understand the outcome of these invasions and to develop pertinent strategies to palliate spread and impacts.Information of such study could contribute to the management plans to minimizing impacts of *C. gariepinus*. A part of this, mass awareness of the impact concerning *C. gariepinus* should be generated among farmers, fishermen, scientists, legislators and the general public to provide for the stringent application of such regulatory measures.

Several factors such wide range of feed acceptance, higher tolerance to changes in surrounding environment, disease resistance, higher growth rate, ability to hide in vegetation, air breathing habit and ability to walk on land are responsible for the fast invasion of *C. gariepinus* in all type of fresh water ecosystem in India and in turn, probable reason for depletion of native species, where ever the species has invaded. Hence, the Department of Animal Husbandry, Dairying and Fisheries (DAHD&F), Ministry of Agriculture, Government of India has banned the culture of this fish.

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CONFLICTS OF INTEREST

There is no conflict of interest.

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