

Distribution and Taxonomic Study of a Newly Recorded Croaking Gourami, *Trichopsis vittata* (Cuvier, 1831) in Bangladesh

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Abstract

Trichopsis vittata (Cuvier 1831), a freshwater croaking gourami (*Osphronemidae*), typically regarded as a negative biological indicator, has been recorded from four different freshwater habitats in Bangladesh during the study period from December 2017 to August 2018. Taxonomic identification was confirmed from the external appearance, morphometric measurements and meristic counts of the species. The body was laterally elongated with clearly visible stripes and black blotch above the pectoral fin base. Average total length, standard length, pre-dorsal length, pelvic fin base length, dorsal fin base length, anal-fin base length, and pectoral-fin base length were 5.3 cm, 3.64 cm, 2.36 cm, 2.17 cm, 1.95 cm, 1.5 cm, and 1.0 cm. The number of rays in the dorsal fin, anal fin, pectoral fin, pelvic fin, and caudal fin were 7-10, 31-34, 9-11, 5-8 and 14-17. The occurrence of *T. vittata* in these rivers indicates their rapid spreading across the country within a very short period of time. Intensive research programs along with counter surveys are suggested to cross-check their spreading pattern, ecological sensitivity, and impacts on native fish biodiversity.

Keywords: Alien Species; Croaking Noise; Obligate Air-Breathing; Standard Length; Conservation Status

Introduction

Bangladesh is a South Asian country having precious water resources comprised of inland freshwater, brackish water, and marine waters enriched with aquatic biodiversity of about 800 fish species [1,2]. It is in the third position among the most suitable regions for fisheries and aquaculture in the world due to geographic position. Freshwater habitats of Bangladesh contain biodiversity of 260 indigenous fish and 24 freshwater prawn species. Such rich species diversity is attributed to the large area of flooded wetlands including beels, haors, baors, lakes, and the major river systems of the Padma, Meghna, and Jamuna [3]. There are about 40-50 small indigenous species (SIS) are available in Bangladesh which can grow up to a maximum length of 25 cm [4]. Besides these, about 150 exotic fish species have been introduced into the country over the last decades for aquaculture purposes, of which about 24 fish species are found in the floodplains and tributaries of the Ganges Delta [5-7].

Recently, a notable number of individuals of invasive croaking gourami, *Trichopsis vittata* (Cuvier 1831, Family: *Osphronemidae*) have been recorded from different freshwater habitats of Dhaka and Chittagong division. The croaking gourami *T. vittata* is a South-east Asian freshwater fish species from the perch group, distributed worldwide from Thailand to Indonesia, Cambodia, Laos, and Vietnam [8-10], Myanmar [11]; the USA [12-14] and India [15-17].

This species is not commercially important, often sold as a part of mixed catches in markets. It is an insectivorous fish, naturally capable of producing a croaking noise using pectoral fins [18-20]. Vocalization often starts on the day after hatching and changes with the age of hatchlings and the structure of sound-producing organs [21,22]. They are obligate air-breather, have no lateral line system and fins possess marked filamentation [8]. *T. vittata* is typically regarded as a negative biological indicator. This species was identified for the first time in Bangladesh from the Meghna River and its adjacent areas [3]. Few other studies reported their occurrence from the old Brahmaputra river and its distributaries (Dhaleshwari and Turag), the Meghna river and adjacent areas, and the Baikka Beel wetland sanctuary in Moulovibazar district of Bangladesh, but their source of introduction and impacts on native fish biodiversity in Bangladesh water are still unknown [6,11,23].

Mostly, the exotic or non-native or invasive alien species (IAS) are introduced intentionally or accidentally to an area outside of its natural distribution. These species are not harmful in their native habitats, but they compete with native fish species for food and habitats when they enter into a new environment. These species can spread very easily and quickly without being affected by the local enemies. Invasive species is one of the major causes of native biodiversity loss as it can alter and degrade the habitat status; reduce food supplies, and poses threats to the environment. Ac-

According to Moyle and Leidy [24], approximately 20% of the world's freshwater fish species are already extinct or in a serious declining phase due to the introduction of IAS. Another school of scientists opined that definitely, this species will compete for niche space and food with native species [17]. However, very limited works have been conducted on *T. vittata* in Bangladesh for which most part of their life is unrevealed to us. In this context, this study aimed to enhance our understanding of the taxonomic status, source of introduction, impacts on native fish biodiversity and spreading pattern of this croaking gourami for proper management and conservation in Bangladesh.

Materials and Method

The inland open water bodies of Bangladesh are rich sources of different types of fishes from ancient times. There are about 700 actively flowing rivers in Bangladesh across the country having 260 freshwater fish and other commercially important aquatic organisms. *T. vittata* was first collected from the freshwater swamps interconnected with the River Buriganga on 14th December 2017 at 11:40 am. Different types of fishing traps and gears were used in sampling the fish. A total of twenty-one individuals were collected from the Buriganga, Feni, Muhuri and Kalidas Paharia River (Figure 1) from December 2017 to August 2018. Among the study sites, the Buriganga River a highly polluted freshwater habitat located in the central division (Dhaka) of Bangladesh. The Feni River is a trans-boundary river originated from the hill ranges of south Tripura in India (23°20'N and 91°47'E) and entered Bangladesh through Sabroom town of India. This river is used to form the demarcation line between Chittagong, Noakhali and Tripura State of India. The Muhuri River also known as Little Feni originated from Noakhali District joins the Feni River near its mouth at Char Kalidas point.

Among the sampling sites, two were main river streams and two others are freshwater swamp interconnected with the main river. The collection localities are grouped in a relatively small area. Three specimens were collected from the River Buriganga and adjacent areas, six from the Kalidas Paharia River, seven from the Feni River and five from the Muhuri River (Table 1).

Sampling Stations	Geographical Locations		Individuals Collected
	Longitude	Latitude	
The Buriganga River	90°21'45.6"E	22°42'36.81"N	3
Kalidas Paharia River	91°28'29.6"E	22°54'22.11"N	6
Feni River	91°27'52.5"E	22°54'40.21"N	7
Muhuri River	91°30'25.5"E	22°55'17.11"N	5

Table 1: Total individuals of *T. vittata* collected from four different freshwater habitats in Bangladesh with specific geographical locations.

Collected fish samples were immediately preserved in 10% formaldehyde for taxonomic study. After that, the fish samples were transferred into 30%, 50% and 70% subsequent solutions of ethanol for long-time preservation following the preservation method stated by Talwar and Jingran [15] and Sterba [25]. Morphometric and meristic characteristics including Total Length (TL), Standard Length (SL), Forked Length (FL), Head Length (HL), Peduncle Length (PL), Peduncle Depth (PD), Pectoral Fin Length (P₁FL), Pelvic Fin Length (P₂FL), Pelvic Fin Base Length (P2FB), Scale Above Lateral Line (SALL), rays in dorsal fin, anal fin, pectoral fin, pelvic fin, and caudal fin and others were studied using standard methodology used by Murdy and Shibukawa [26].

Results and Discussion

The body shape of the collected *T. vittata* samples was laterally elongated and the dorsal fin originates far behind the base of the pectoral fin. Body-color was a pale brown with black spots on the fins and two black stripes on both sides of the body. The iris of the eye was bright blue. Multi-branched fin rays are present in the anal fin with six to eight spines. Pelvic fin contains 1 spine, followed by a filament and 4 branched rays. The dorsal fin contains 2-4 spines. The anal fin has few elongated filament-like rays extending to the tip of caudal fin; and black blotches above the pectoral-fin base. About 13 transverse scale rows are present in their body and lateral line absent (Figure 2).

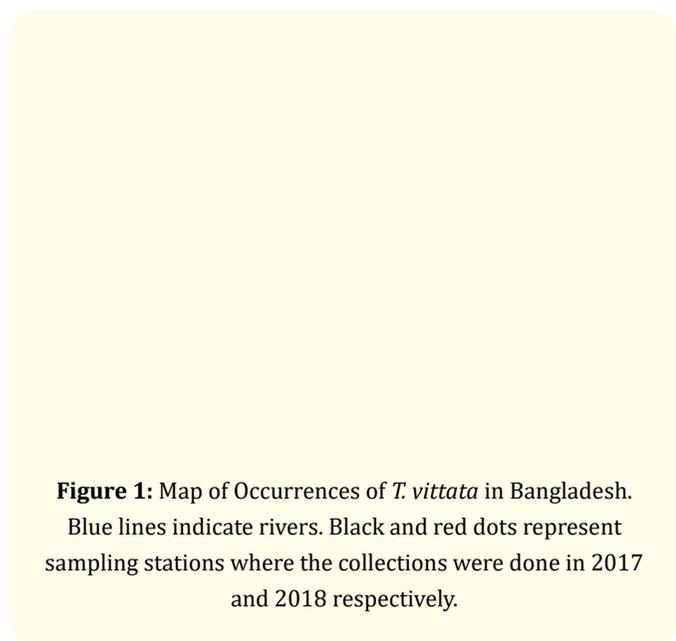


Figure 1: Map of Occurrences of *T. vittata* in Bangladesh. Blue lines indicate rivers. Black and red dots represent sampling stations where the collections were done in 2017 and 2018 respectively.

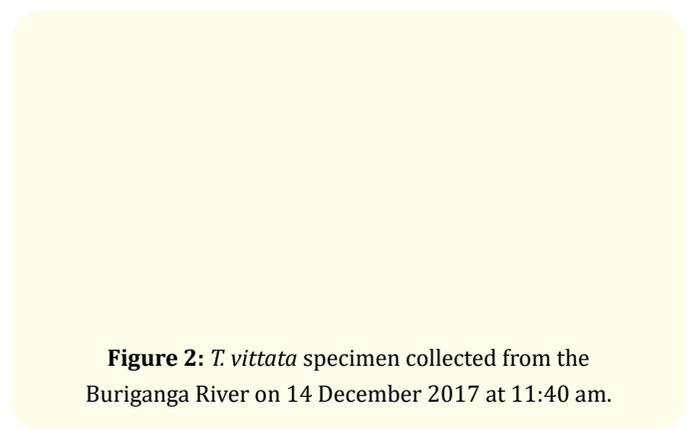


Figure 2: *T. vittata* specimen collected from the Buriganga River on 14 December 2017 at 11:40 am.

Morphometric measurements of *T. vittata* are shown in Table 2. Average total length, standard length, pre-dorsal length, pre-orbital length, post-orbital length, and inter-orbital lengths were 5.3 cm, 3.64 cm, 2.36 cm, 0.36 cm, 0.67 cm and 0.42 cm respectively. The

pelvic fin base length, dorsal fin base length, anal-fin base length, and pectoral-fin base length were 2.17 cm, 1.95 cm, 1.5 cm, and 1.0 cm respectively.

Morphometric Characteristics	Average Value (cm)	Wilk's Lambda
Total length	5.30	0.687
Standard length	3.64	0.501
Body Depth	1.30	0.357
Eye diameter	0.37	0.581
Pre-dorsal length	2.36	0.648
Pre-orbital length	0.36	0.698
Post-orbital length	0.67	0.461
Inter-Orbital length	0.42	0.115
Dorsal Fin base length	1.95	0.549
Pectoral Fin base length	1.00	0.275
Pelvic Fin base length	2.17	0.596
Anal fin base length	1.50	0.119

Table 2: Morphometric measurements of *T. vittata* specimens collected during the study period.

Meristic characters are the characteristics that are discrete, serially repeated, and countable. Meristic counts for dorsal fin rays of *T. vittata* ranged between 7-10, anal fin rays ranged between 31-34, pectoral fin rays ranged as 9-11, pelvic fin rays ranged as 5-8 and caudal fin rays ranged as 14-17. The average numbers of the measured rays were the same among the specimens collected from four different water bodies (Table 3).

Meristic Characteristics	Populations			
	Buriganga River	Feni River	Muhuri River	Kalidas Paharia River
Dorsal fin rays	7-10	7-10	7-10	7-10
Anal fin rays	31-34	31-34	31-34	31-34
Pectoral fin rays	9-11	9-11	9-11	9-11
Pelvic fin rays	5-8	5-8	5-8	5-8
Caudal fin rays	14-17	14-17	14-17	14-17

Table 3: Meristic counts of the *T. vittata* specimens collected during the study period.

The dorsal fin rays, pectoral fin rays, pelvic fin rays, and the caudal fin rays were similar among the specimens collected from different freshwater habitats located in different region. A similar number fin rays were also recorded by Norén., *et al.* [11], Akash and Hossain [6] and Islam., *et al.* [23]. Several studies reported that the number of fin rays of the same species does not differ much from each other [3,27,28].

There are about 24 exotic fish species found in the floodplains and tributaries of the Ganges Delta. Exotic fish species have been introduced in Bangladesh either due to aquarium release or deliberate aquaculture attempts and bio-control efforts. *T. vittata* is a newer addition to the list and the source of introduction is still

unknown [6,11]. In the sampling areas around the River Buriganga, this species was found in an incredibly low density in both the sampling times, though in two different times of a year. On the other hand, around the river Feni, Muhuri and Kalidas Paharia, the species count was subsequently higher at different times of the year than in Buriganga River. Plainly, the overall count of this species was sufficient to prove their existence in these waters, proving their biological information exceedingly valuable for further studies on them.

The presence of *T. vittata* was always associated with nearly stagnant, freshwater habitats marked with zero salinity and rich in submerged and floating vegetation. Previously this species was recorded from the Meghna River and the Old Brahmaputra River. In the river Buriganga, only about 25 species variants have survived due to the terrible atrocities of mankind over nature and high aquatic pollution which were 50 in number just ten years before. In such an unfavorable condition with a higher level of pollution, the existence of *T. vittata* is a surprising issue. Maybe this species has managed to attain their existence and survival. This finding is similar to the finding of Ng., *et al.* [29] and Li., *et al.* [30] where they recorded *T. vittata* from heavily disturbed freshwater ecology with lower pH and dissolved oxygen level. Li., *et al.* recorded *T. vittata* from the stream containing 3.52 mg/L dissolved oxygen level [30].

Even it is unknown exactly either the *T. vittata* is found as a true survivor or newly introduced. It can only be presumed that there is a possibility that the species was released illegally but there is no such evidence of that. There is strong controversy among the scientists regarding their way and source of introduction. Norén., *et al.* [11], who identified *Trichopsis vittata* from Bangladesh and Myanmar with scientific documentation for the first time, mentioned it most likely an aquarium escape but another school [6] disagreed to this opinion and opined their (*T. vittata*) establishment in Bangladesh is owing to deliberate aquaculture attempts, acting as an invasion vector. The sampling locations in the southeastern Feni-Muhuri rivers system is far away from the main town and have no direct connection with the river system. So there is no possibility of introducing *T. vittata* in this region from aquarium escape. In addition, the local aquarium fish traders and fish farmers are not familiar with this invasive fish species. Findings from this study strongly discarded the previous opinions regarding the source of introduction of *T. vittata* in Bangladesh. Akash and Hossain [6] showed a north-eastwardly colonization pattern of this fish over the last years. Findings from the present study clearly indicate the quick spreading of *T. vittata* across the whole country, rather than a single spreading pattern. Although the exotic fish species are not harmful in their native habitats, they must compete with native fish species for food and habitats when they enter into a new environment as they can spread very easily and quickly without being affected by local enemies. Invasive fish species can cause great harm to native biodiversity through herbivory, predation, competition, hybridization, disease transmission and ecosystem alteration. Moreover, they may alter ecosystem functioning, ecosystem services, community structure, habitats, and food webs and nutrient fluxes.

Conclusion

T. vittata is a non-native fish species that has been recorded from several water bodies in Bangladesh including the Meghna River, Buriganga River, Feni River, Muhuri River, and Kalidas Paharia River. But it is unknown either it was introduced accidentally from aquarium escape or intentionally for aquaculture purposes. This fish is spreading very quickly across the country over the years which will definitely affect the native fish biodiversity. However, the impact of this species on other indigenous fish species is currently unknown. The absence of data does not equate to a lack of effects. *T. vittata* will compete for niche space and food with native species which is a major threat to sustaining indigenous fishes. Further research needs to enhance our understanding of geographic ranges, behavioral interactions, and impacts of *T. vittata* on the native fish biodiversity.

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Conflict of Interest

The authors declare that there is economic interest or any other conflicts of interest regarding the publication of this article. The funding bodies had no role in the study design, data collection, data analysis, data interpretation or decision to publish the findings.

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