

Food, Feeding Habit and Reproductive Biology of Tire-track Spiny Eel (*Mastacembelus armatus*): A Review

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Abstract

Mastacembelus armatus which is popularly known as tire-track spiny eel or zig-zag eel is a common fish species of Indian sub-continent. It is a popular table fish due to delicious taste and high nutritional value. In Bangladesh, its demand is even higher than that of the carps. It also has good popularity as an aquarium fish and recently has been reported to be exported as indigenous ornamental fish from India to other countries. Information so far available on its food, feeding habit and reproductive biology is in a scattered manner and till date no such consolidated report on these aspects is available. The present review report aims to summarize all the available information on these aspects along with pointing out the lacunae of information further study of which will benefit its fishery and trade.

Keywords: *Mastacembelus armatus*; Tier-track eel; Feeding habit; Reproductive biology

Species Introduction

Mastacembelus armatus is a common fish species of Indian sub-continent. It belongs to the family Mastacembelidae under the order Synbranchiformes. It is one of the most popular table fishes with delicious flesh quality having a special flavor, characteristic texture and high protein, oil and vitamin C content [1-3]; and thus has a good market demand [3,4]. Even in Bangladesh, its market value is double than that of carp species [2,3]. In northern and eastern India, the fish is very popular when sold alive [4]. It is also popular as an aquarium fish due to its attractive color pattern and has high demand among the aquarium fish hobbyists [5-7]. Already it has been reported to be exported as indigenous ornamental fish from India to other countries [8].

Common names

Mastacembelus armatus is commonly known as tire-track spiny eel/ zig-zag eel.

Vernacular names

Mastacembelus armatus is vernacularly known as baim/bami/baam in India; baim in Bangladesh and chusi bam in Nepal [9-11].

Synonyms

- Macrogathus armatus* (Lacepede, 1800)
- Mastacembelus ponticerianus* (Cuvier and Valenciennes, 1832)
- Mastacembelus marmoratus* (Cuvier and Valenciennes, 1832)
- Macrogathus caudatus* (McClelland, 1842)
- Mastacembelus manipurensis* (Hora, 1921)

Distribution

Mastacembelus armatus is widely distributed in India, Bangladesh, Pakistan, Nepal, Sumatra, Sri Lanka, Thailand, Vietnam, Indonesia, Myanmar, Malaysia, Southern China and other parts of South East Asia [9-15].

Habitat

Mastacembelus armatus occurs in a variety of freshwater habitats in the plains as well as in hills of India [10]. It mainly inhabits rivers, canals, beels, ponds and inundated fields [9,16]. It also occurs in still waters, both in coastal marshes and dry zone tanks; occasionally this fish species stays in partly buried condition under fine substrate [17].

Morphological characters

Talwar and Jhingran [10], Day [12] and Nagar and Khan [18] have earlier well documented some morphological characters of *Mastacembelus armatus* which has been summarized here. The body is slender, elongated and slightly compressed. The maxilla reaches below the front edge of the eye. Pre-opercle is with 2 or 3 spines which are usually conspicuous, but often one or more may be embedded in skin. Pre-orbital spine is strong and is usually piercing the skin. The mouth is a transverse crescentic slit; bounded by an upper and a lower labial fold. The upper jaw extends anteriorly in front of the lower and participates in the formation of the tri-lobed snout, consisting of a median stiff, solid and pointed process and two lateral soft, hollow and blunt projections.

On the floor of bucco-pharynx, a triangular tongue consisting of the glossohyal enclosed in a thick mucous membrane is present. Teeth are present on the jaws and pharynx; no vomerine and palatine teeth are present. Teeth are sub equal, short, pointed, inclined inwards and arranged in patches. Fin: Long dorsal and anal fin is present which are confluent with the caudal fin. Spinous dorsal fin is inserted above middle or posterior third of the pectoral fins. Last dorsal spine is small and hidden beneath the skin. Color: Dark brown in color becomes lighter on the abdomen and usually with zig-zag lines; sometimes

connecting to form a network but almost never extending onto abdomen. A blackish band is present which goes through the eye and is continued in an undulating course along the upper half of the side to the caudal fin. Above this band, there is a row of black spots along the

base of the soft dorsal fin and a short black band over the back under dorsal spines. Pectoral fins are usually spotted; dorsal and anal fins are usually banded or spotted (Figure 1).



Figure 1: Fresh specimen of *Mastacembelus armatus*

Food and feeding habit

Most of the earlier researchers [4,13,19-27] have reported *Mastacembelus armatus* as a carnivorous fish except Mookerjee et al. [28] who have documented its herbivorous feeding habit.

Khan [19] has reported its preference for eggs and fry of other fishes while Das and Moitra [20] have pointed out that this fish mainly feeds on crustaceans. Bhuiyan [13] has documented that young fish of this species mainly feeds on crustacean and insect larvae while the adults devour small fish and tadpoles. Jhingran [21] has reported its piscivorous nature while Dutta [22] has reported it as a selective insectivorous fish.

Serajuddin and Mustafa [23] have documented fish, shrimps and insects as the mostly preferred food items for this fish species. Young fishes have maximum preference for aquatic insects and annelids while adults have high preference for crustacean followed by fish, aquatic insects and annelids.

Observing the well-developed dentition, absence of gill rakers, strongly built stomach and short intestine, together with the dominance of animal matter in the gut contents, Serajuddin et al. [4] have reported the carnivorous and active predatory habit of *Mastacembelus armatus*. Freshwater shrimps (*Macrobrachium* spp.), dipteran larvae, brine shrimps (*Brachipus* sp.), earthworms (aquatic oligochaetes) and minor carps (cyprinids) have been reported as preferred food items in order of their frequency of occurrence in the gut. Crustacea and forage fish have been documented as basic food for the adults while annelids and aquatic insects have been reported as the basic food for the juveniles. No substantial change in diet between young and adult fish has been reported by them.

Abujam and Biswas [24] have reported that spiny eel is a zooplankton feeder when young and is having insectivorous feeding habit in later stages. The adult feeds on earthworms, insects, micro

crustaceans, and larvae of other aquatic invertebrates. Alam et al. [26] have reported fish, aquatic insects, crustaceans, molluscs and annelids as the main food of *Mastacembelus armatus* in order of preference. Panikkar et al. [27] have documented fishes and prawns as their mostly preferred food items.

Reproductive Biology

Sexual dimorphism

Male and female of *Mastacembelus armatus* can only be distinguished during the breeding season observing some particular characters; males are active and brighter in color while females are pot-bellied and dull in color. On putting slight pressure on abdomen, milt comes out in males while eggs ooze out in case of females [29].

Sex ratio

Panikkar et al. [27] have reported female dominance in their studied population of *Mastacembelus armatus* while Serajuddin and Pathak [15] have documented equal proportion of male and female in their study.

Gonad maturity stages

Based on the morphological and histological features of the gonads, Verma and Alim [30] have documented five maturity stages (Resting phase, Preparatory phase, Pre-spawning phase, Spawning phase and Post-spawning phase) both for female and male of *Mastacembelus armatus* which has been summarized in Table 1. Apart from this, no such information in detail is available on this aspect.

Gonad Maturity Stage	Ovaries	Testes
Phase I or Resting Phase	Small, shrunken with reduced vascular supply, finger like projections from the wall called ovigerous folds containing small oocytes and oogonia are present.	Small, almost thread like with reduced vascular supply.
Phase II or Preparatory Phase	Pale yellowish in colour, small yolky oocyte are visible with nucleoli arranged along the inner surface of the nuclear membrane. Yolk nucleus of Balbiani appears in ooplasm.	Whitish, translucent uneven in size with one end broader. Slight increase in volume and vascular supply.
Phase III or Pre-spawning Phase	Yellow in colour occupying greater space in the abdominal cavity, oocytes clearly visible with distinct nucleus, whole of the ooplasm is filled with protein yolk bodies.	Appear turgid and pink in colour due to increased blood supply.
Phase IV or Spawning Phase	Occupies most of the portion of abdominal cavity, ripe ova are filled with large yolk globules, under abdominal pressure ova oozes out.	Testes appears slightly reddish due to maximum increase in blood supply, considerable increase in volume of testis was noted. Due to increased abdominal pressure milt oozes out.
Phase V or Post-Spawning Phase	Ovaries shrunken in size, collapsed, blood supply reduced, corpora atretica can be seen.	Becomes small in size and translucent, blood supply decreases.

Table 1: Morphological and histological characteristics of gonads during different phases of reproductive cycle of *Mastacembelus armatus* as has been documented by Verma and Alim (2014).

Fecundity

A number of researches already have been performed to study the fecundity of *Mastacembelus armatus*. Narejo et al. [29] have reported fecundity range of 580-10,980 for this fish species. Later fecundity range of 3,155-24,684 [2]; 2,854-7,234 [31]; 927-7,409 [15]; 2,235-19,493 [3]; 2,235-19,493 [32]; 942-18,726 [33]; 1,872-5,402 [34] and 1,416-11,000 [35] have been documented by other researchers.

Breeding periodicity

Late June to early September has been reported as the breeding season for *Mastacembelus armatus* by Serajuddin and Pathak [15] at Aligarh, India while Uthayakumar et al. [33] and Anand [35] have reported June to October and March to June as the breeding season for this fish species at Tamil Nadu and Marathwada, India respectively. At Mymensingh, Bangladesh May to July [29] and March to July [2] has been reported as its breeding season while April to June has been documented for the same at Kishoreganj, Bangladesh both by Patwary [32] and Ali et al. [3]. All these researchers have reported this fish species as a single spawner except Gupta [36] who has documented its multiple spawning natures in his study at Uttar Pradesh, India. He has reported April to November as its breeding season with two spawning months, one in May and another in October for *Mastacembelus armatus*.

Role of photo period, temperature and monsoon rainfall as spawning inducers has been reported by Serajuddin and Pathak [15] for this fish species.

Conclusion

Considering the information documented on feeding and reproductive biology of *Mastacembelus armatus* in this review report, it is quite clear that considerable research has been carried out so far on food and feeding habit of this fish species, though further scope of

research is there on different aspects of its reproductive biology to fill up the information gap.

All the earlier researchers have considered this fish as a carnivorous species except Mookerjee et al. [28] who have reported its herbivorous food habit. This kind of controversy regarding food habit has also been reported for other fish species [37-44]. This sort of difference in feeding habit may be due to reasons like difference in food availability, selectivity etc. Morpho-histological study of the alimentary canal can be a good approach to overcome this controversy. Most of the earlier researchers have reported on feeding habit of *Mastacembelus armatus* by analyzing the gut content which is a noble and very basic method for this kind of study. Anand et al. [25] have studied the morphology of the structures associated with feeding in *Mastacembelus armatus* while Nagar and Khan [18] though have studied the anatomy and histology of the alimentary canal of this fish species have not concluded anything finally on its feeding habit. Thus morpho-histological and enzymatic study of the alimentary canal can be done to eliminate the confusion regarding its feeding habit. On the other hand, no substantial change in diet between young and adult fish has been reported by Serajuddin et al. [4] for this fish species. This particular observation can further be strengthened by age wise and stage wise morpho-histological and enzymatic study of the alimentary canal.

The information so far available on sex -ratio and gonad maturity stages of this fish species is very much scanty; thus further study is needed on these two aspects. On the other hand, though considerable information is present on fecundity and breeding periodicity of this species, but it's full of contradiction. The fecundity ranges which have been reported by Serajuddin and Pathak [15], Narejo et al. [29], Sultan [31] and Anand [35] are different from those have been documented by Rahman et al. [2], Ali et al. [3], Patwary [32] and Uthayakumar et al. [33]. Though no such variation has been documented on breeding periodicity of *Mastacembelus armatus* at different regions of Bangladesh; variation has been observed in India. Late June to early September has been reported as the breeding season for *Mastacembelus armatus* by Serajuddin and Pathak [15] at Aligarh while Uthayakumar et al. [33] have reported June to October as the

breeding season for this fish species at Tamil Nadu. Breeding period of March to June has been reported by Anand [35] at Marathwada. Gupta [36] has reported a long breeding season (April to November) with two spawning months for this fish species at Uttar Pradesh. This kind of variation in breeding periodicity may be due to variation in hydrology, climate, food availability, health status of the fish etc.

Thus there is scope for further research on food, feeding habit and reproductive biology of *Mastacembelus armatus* to fill up the information gap which has been pointed out in this review report.

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