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Biology Of *Macrognathus* Sp. With Special Reference To *Macrognathus Pancalus* (Hamilton) And *Macrognathus Aral* (Bloch And Schneider)

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Abstract:

Macrognathus is a genus of eel-like fish of the family Mastacembelidae of the order Synbranchiformes. The majority of South and Southeast Asia is home to these fish. The major food category of this genus is crustaceans (such as prawns) and aquatic insects (*Chaoborus* spp.), while juveniles mostly consume annelids (such as earthworms). According to various studies, it was found that the male: female ratio of *Macrognathus* sp is roughly 1:1. *Macrognathus* exhibit a wide range of fecundity, and the number of ova or eggs laid by a single female depends on several variables, including size, age, species, and the ecological habitats of the fish, including the availability of food. The fecundity of these fishes is found to be high when the fish were breeding, which occurred from May through August. The average ovarian diameter of *M. pancalus* has been found to increase every month. In some studies, lentic habitats showed higher ova diameter than lotic habitats for *Macrognathus* sp. For *Macrognathus* sp. the males matured at lengths of 10 to 11 cm and females at lengths of 11 to 12 cm on the other hand *M. aral* was found to be matured at an average of 12.05 cm for males and 16.05 cm for females.

Keywords: Feeding habit, reproductive biology, fecundity, weight length relationship, fish maturity.

INTRODUCTION

The Indo-Burma or Indochina bioregion includes the northeastern part of India, which is one of the country's major biodiversity hot spots (Kottelat and Whitten, 1996). It is located between 21º57 and 29º23 N and 87º58 and 97º09 E. Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura are its eight constituent states. In addition to the Himalayan foothills, the Gangetic delta and plain, the Chin-Arakan Coast, and the Sittaung-Irrawaddy regions were included in these regions (Abell et al., 2008).
Two genera of the family Mastacembelid spiny eels, *Macrognathus Lacepde*, 1800 and *Mastacembelus Scopoli*, 1777, are found in the majority of Tropical and Subtropical Africa, the Middle East, Southeast Asia, North to China, and Iran (Berra, 2001). They are known as spiky eels because they have well-separated dorsal spines. It features an elongated body with 7–40 strong, detachable dorsal spines, one–three spines on the anal fin, few body scales, no pelvic fins or girdles, gill holes on the sides, a short tail fin, and a laterally compressed

caudal region. According to Hora (1921), they frequently live at high altitudes and in lowlands, in hill streams, rivers, lakes, and reservoirs (Hora,1921).

According to FishBase, there are currently 25 recognised species in this genus. Some of the most common species found in the Northeastern region of India are *Macrognathus albus*, *Macrognathus aral* (Bloch and Schneider, 1801) (Onestripe spiny eel), *Macrognathus circumcinctus* (Hora, 1924), *Macrognathus morehensis* (Arunkumar and Singh, 2000), *Macrognathus pancalus* (Hamilton, 1822) (Barred spiny eel), *Macrognathus pavo* (Britz, 2010), *Macrognathus siangensis* (Arunkumar, 2016) (Froese et al., 2014).

In India and its neighbouring nations, the barred spiny eel, *Macrognathus pancalus* Hamilton 1822 (also known as the striped spiny eel), has considerable culinary and decorative significance. It lives in estuaries, slow-moving rivers in plains, and various other freshwater habitats (Talwar and Jhingran, 1991). *M. pancalus* is crucial in supplying the necessary nutrients. Additionally, the species has recently been exported to the United States, Europe, and other Asian nations due to its attractive appeal as an aquarium fish native to India (Sugunan et al., 2002; Tripathi, 2004). The demand for spiny eels, which are commercially significant and delicious as table fish, nearly always outpaces supply, especially in northern and eastern India where people prefer less bony fish (Serajuddin, 2005).

The *Macrognathus aral* (Bloch and Schneider) can be found in slow-moving, shallow water in plains and estuaries, as well as in canals, streams, beels, ponds, and fields that have been flooded (Talwar and Jhingran, 1991). The species is in extremely high demand in the north-east, especially in upper Assam. The species that is commonly referred to as the "peacock eel" on the global market also has high ornamental appeal.

FEEDING HABIT

According to studies, the weight of the gut contents ranged from 0.016 to 0.66 g, with insect larvae making up 91.27%, annelids 4.85%, and other unidentified digested components accounting for the remaining 3.88%. These species, according to Serajuddin and Ali (2005), exhibit stenophagism style of nutrition, suggesting that despite the availability of a variety of food sources, they favor certain foods such as aquatic insects, crustaceans, annelids, tiny forage fish, etc (Serajuddin and Ali, 2005). Eating intensity and the gastronomic index peaked in August and were at their highest levels from June through September, indicating a busy eating time. Although there were size-specific variations, Serajuddin and Ali (2005) reported that October to December was the period of less vigorous feeding. The amount of food resources present in the fish's habitat may have an impact on this (Serajuddin and Ali, 2005).

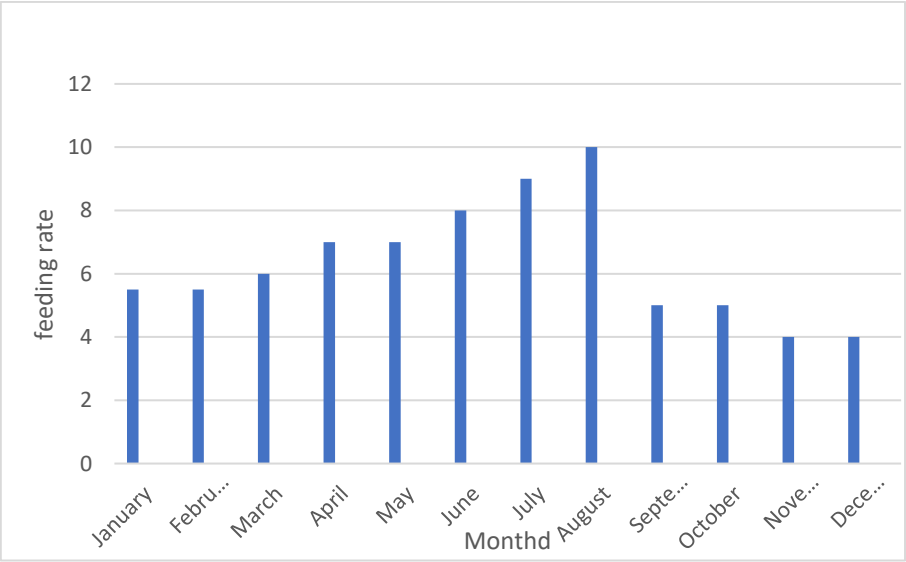

Fig: Showing monthly feeding activity of *Macrognathus pancalus*.

Similar findings were observed in a number of closely related species, including *M. armatus* (Dutta, 1989/1990; Serajuddin et al., 1998). According to a study by Suresh et al., dipterens (*Chironomus* sp., *Tanypus* sp., *Pentaneura* sp., and *Chaoborus* sp.), trichopterans, and ephemeropterans are the major insect larvae in the gastrointestinal content of *Macrognathus* sp. The most prevalent annelid species were oligochaetes, particularly

Tubifex species, *Branchiura* species, and *Lumbriculus* species. Additionally, it was discovered that the major eating material varied based on habitats and time (Suresh et al., 2006).
The values of feeding intensity of males and females of *M. pancalus* at different stages of sexual maturity are given in Table 1. Maximum feeding intensity was observed in both sexes in the maturing stage (III) (Serajuddin and Ali, 2005).

Male				Female			
Maturity stages	Empty guts (%)	Medium fullness guts (%)	Full guts (%)	Maturity stages	Empty guts (%)	Medium fullness guts (%)	Full guts (%)
I	51	29	20	I	50	35	15
II	48	30	22	II	50	30	20
III	45	13	42	III	45	15	40
IV	65	20	15	IV	60	30	10
V	40	35	25	V	45	25	30

Table 1: Feeding intensity of *M. pancalus* at different stages of maturity

Seven main categories (shown in Table 2) are used to group the foods examined in *M. pancalus.* In adults, this fish mostly consumed crustaceans (such as prawns) and aquatic insects (*Chaoborus* spp.), while juveniles mostly consumed annelids (such as earthworms). Depending on how frequently they appeared, this fish also consumed Caridina and smaller carps. According to Serajuddin and Ali (2005), gastropods and aquatic vegetation were regarded as unintentional foods. Nikolsky (1963) classified the dietary items of *M. pancalus* into four groups: annelids as the primary food for young people and aquatic insects and crustaceans as the primary food for adults (Table 2). However, it is possible to think of annelids as the secondary diet for adults and aquatic insect larvae and crustaceans as the primary food for juveniles. For both adults and kids, mollusks and aquatic vegetation might be considered incidental foods. It is possible that this fish exhibits selective feeding behavior (Nikolsky, 1963).

	Food items	Numerical Count (%)	Frequency of Occurrence (%)	Gravimetric index (%)
I	Annelids			
	Earthworm	Numerous	24.5	12.00
II	Crustaceans			
	Prawn	58	43.2	75.02
	Caridina	20	15.0	02.76
	Daphnia	16	10.0	00.00
	Branchinella	05	06.8	22.39
III	Aquatic insects			
	Chaoborus	65	55.3	95.33
	Tipula	12	22.3	05.56
	Unidentified	Numerous	21.5	02.43
IV	Teleostomi			
	Esomus	09	08.7	10.67
	Unidentified	30	58.6	67.21
	Scale	35	30.6	00.89
V	Molluscs Gastropods	04	03.6	00.32
VI	Digested matter	-	28.5	25.67
VII	Aquatic vegetation	Numerous	07.8	03.25

Table 2: Showing various food items taken by *Macrognathus pancalus* (Serajuddin and Ali, 2005)

REPRODUCTIVE BIOLOGY

Swarup et al.,'s study from 1972 found that the male:female sex ratio for *M. pancalus* was roughly 1: 1. In this investigation, the absence of males from September to December could not be explained (Swarup et al., 1972).

Out of 197 fish specimens analyzed in an Abujam and Biswas 2011 study on *M. aral*, 155 were males and 42 were females. The overall M:F ratio was 1:0.27, which shows that the distribution of sexes is very skewed. Due to their bigger size and the niche, they occupy than males (20.8 cm and 27.53 g), females frequently avoid being caught in fishing gear (28.5 cm and 88.23 g compared to 20.8 cm and 27.53 g for males) (Abujam and Biswas, 2011). The ratio of males to females ranged from 1:0.08 in November to 1:2.17 in June. The identification of 312 males and 155 females from the 467 fish samples tested yielded a M:F ratio of 1:0.5 overall. According to the monthly sex ratio, there was a sizable departure from the customary 1:1 ratio, and the ratio tended to favour males in the majority of the months (Abujam and Biswas, 2020).

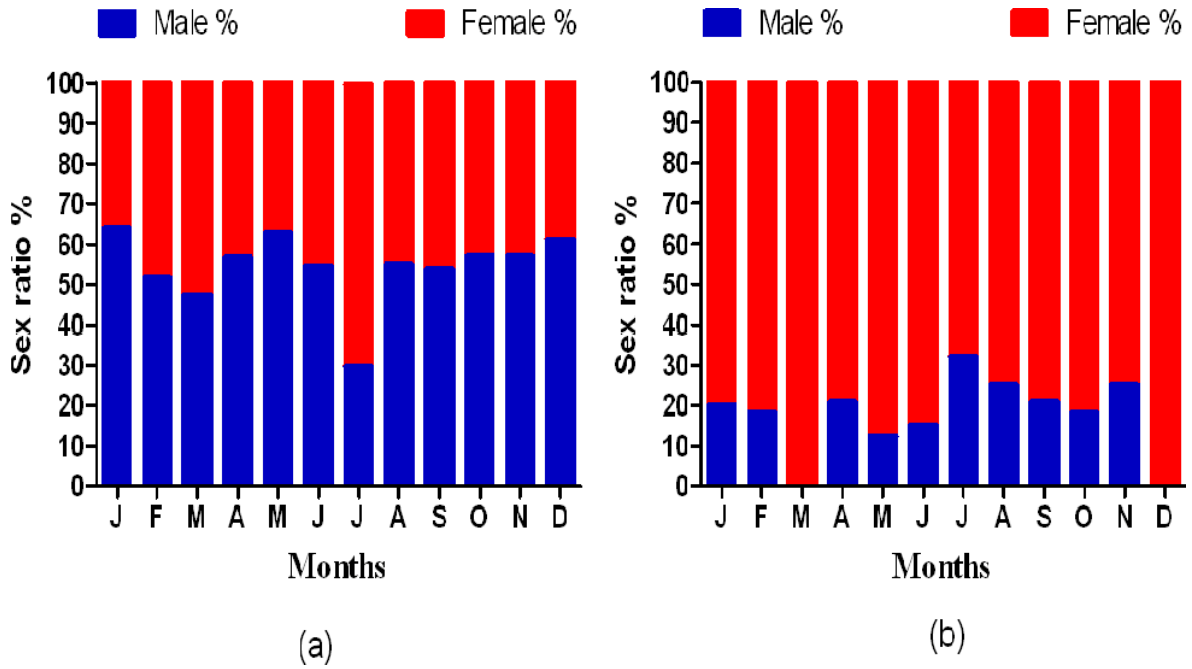

Fig: Showing sex ratio of *Macrognathus pancalus* in lectic and lotic ecosystem (Ali and Serajuddin, 2012)

From a study done by Chakraborty and Goswami (2016), it is recorded that the total length of *Macrognathus aral* (male and female) ranges from 11.3 to 22.1 cm in male whereas 10.8 to 30.3 cm in female (Chakraborty and Goswami, 2016). The total body weight ranges from 2.05 to 20.27 g in male and 4.95 to 93.6 g in female. Males were found to be smaller than females, with a mean height of 9.91 cm and a mean weight of 3.79 g for females. The fish's fecundity, or capacity to bear live offspring, ranged from 227 (fish 10.7 cm; 5.03 g) to 8310 (fish 17 cm; 30.31 g), while the relative fecundity range (fecundity per gram body weight equal to absolute fecundity) was 45 to 274. Monthly Fecundity was high when the fish were breeding, which occurred from May through August. According to Swarup et al., (1972), fecundity rose as fish length and weight increased (Swarup et al., 1972). Female *M. aral* was found to have a relative fecundity range of 39.63-18.61 and an average absolute fecundity of 833.43-248.26 to 3027.57-1689.66 each month. May through September shows a spike in fecundity (Abujam and Biswas, 2011). Abujam and Biswas discovered in 2020 that the prolonged breeding season or parental care could be responsible for the decreased fertility seen. In case of *Macrognathus aral* also similar findings were reported (Abujam and Biswas, 2020).

Fishes exhibit a wide range of fecundity, and the number of ova or eggs laid by a single female depends on a number of variables, including size, age, species, and the ecological habitats of the fish, including the availability of food (Fagade et al., 1984; Moyle and Cech, 2000; Annappaswamy et al., 2008).

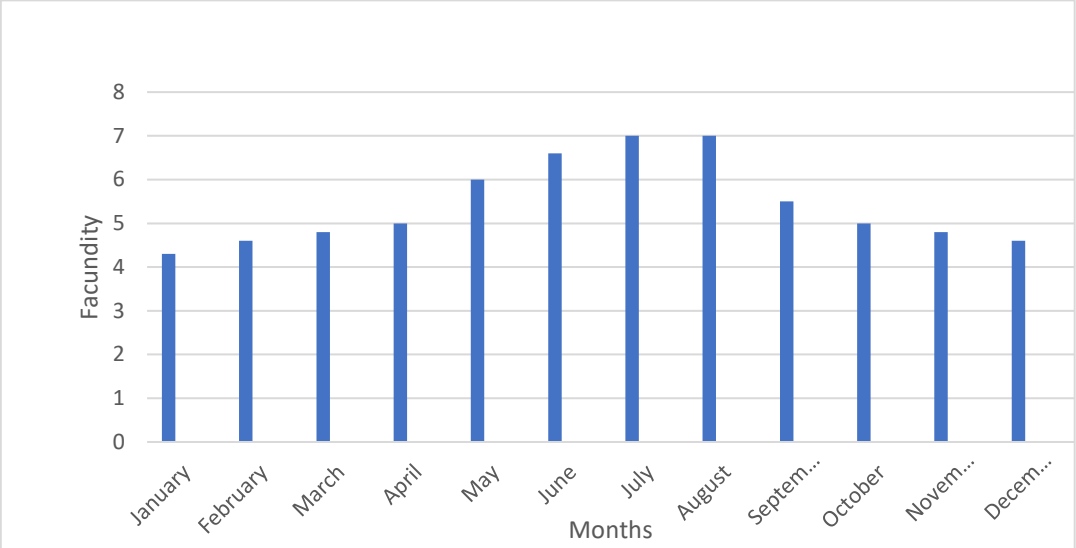

Fig: Showing monthly variation of fecundity in *Macrognathus pancalus*

The ova diameter in *Macrognathus aral* gradually rose from 0.3 (March) to 1.4 mm (May). In the ovaries, immature ova (0.3-0.6 mm) were discovered between March and April. Ripe ova ranged in size from 0.91 to 1.4 mm and peaked in May (1.4 mm), whereas maturing and mature ova (0.61-0.9 mm) were found from March to September. The diameter of the eggs was constant and spherical. Both Nabi and Hussain (1996) in *Macrognathus aculeatus* and Suresh et al., (2006) in *Macrognathus pancalus* observed similar findings. From October forward, the frequency of maturing and mature ova steadily decreases, and between November and February, they are completely missing, signalling the end of spawning (Nabi and Hussain, 1996; Suresh et al., 2006). They then started to occur more frequently starting in March. This suggested that the fish's spawning season likely lasts from March to September. The gradual change in intraovarian diameter over a period of at least a year can provide insight on the fish studies' spawning periodicity (Biswas, 1993). In a study done by Pathak et al., 2012 it was observed that the lentic habitats showed higher ova diameter than lotic habitat. In lentic habitat the ova diameter ranged between 796 to 1618µ and in the case of a lotic environment it was found to be ranged between 70 to 138µ (Pathak et al., 2012).

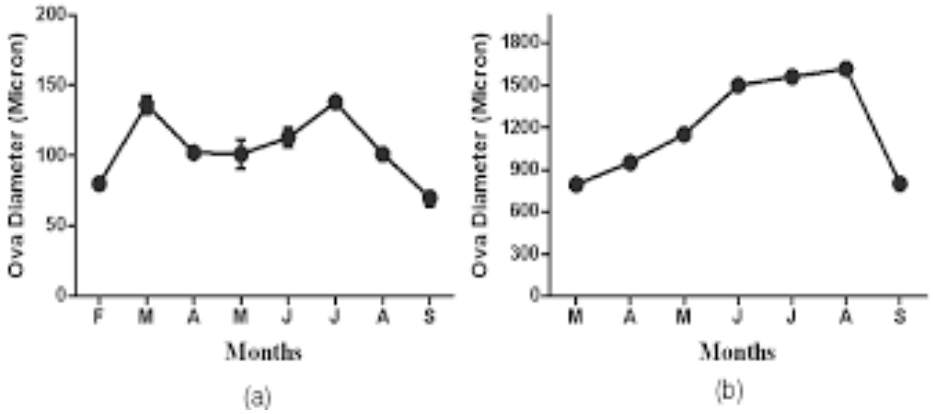

Fig: Ova diameter (µ) of barred spiny eel, *M. pancalus* (a) Lotic ecosystem, (b) Lentic ecosystem (Pathak et al., 2012)

The average ovarian diameter of *M. pancalus* has increased on a monthly basis. The eggs of mature fish were huge and yellowish/light greenish in color, whereas the ovaries of growing females were pale orange in color. The diameter of the ova rose progressively over time, from 0.3 mm in February to 1.3 mm in June–August. A majority of the time, from February to May, immature ova with diameters between 0.3 and 0.6 mm were discovered. Ripe ova (8-1.3 mm) were mostly found between May and August, while maturing ova (0.5-0.9 mm) and mature ova (0.7-1.1 mm) were mostly found between March and October. Spiny eels' mature, ripe ova are uniform in diameter and round or spherical in shape, which suggests that the eggs were shed in a single batch during the peak spawning season from May to July. Only a few immature eggs remained in the totally spent ovary, and this stage was often met from October onward until February. Between February/March and

August/September, the ova's diameter gradually grew. Peak breeding occurred between May and August, according to the occurrence of larger-sized eggs (Abujam and Biswas, 2020).

LENGTH-WEIGHT RELATION AND MATURITY:

The length-to-weight ratio of a fish determines its potential yield (Le Cren, 1951; Chonder, 1972). In a study done on the fish species *M. pancalus*, Suresh et al., (2006) reported that the maturity curve was plotted for the fish by direct observation of the ovaries and testis, and that it also indicated that 50% of the males matured at lengths of 10 to 11 cm and females at lengths of 11 to 12 cm (Suresh et al., 2006). According to a study done in 2011 by Abujam and Biswas the first maturity in the case of *M. aral* was found to be an average of 12.05 cm for males and 16.05 cm for females (Abujam and Biswas, 2011). Weather-wise, *M. pancalus* showed positive allometric growth in the winter in both sexes, but females showed negative allometric growth in the pre-monsoon and post-monsoon seasons (Abujam and Biswas, 2015). Males mature at a lesser size than females, according to Abujam and Biswas' experiment from 2020, which showed that 50% of the fish in the length groups of 9–12 cm for males and 12–15 cm for females reached maturity (Lm50). For males and females, the calculated mean size at initial maturity was 10.5 cm and 13.5 cm, respectively (Abujam and Biswas, 2020). While immature females were noted from February to May, *M. pancalus* was accessible from January to May and then again from October onward. From January to June, maturing males were also noted, and from February to June, maturing females. Beginning in July, the number of developing fish in both sexes decreased. Ripe male and females were most prevalent from June to August/September, while mature males and females were most prevalent from March to August. Furthermore, mature fish occurrence started to diminish in September, whereas ripe fish were not seen from October to May. *M. pancalus* seems to reproduce/spawn from June to September. The increased frequency of wasted male and females from September to January further supports this. The conclusion that the spawning was finished by September may therefore be drawn (Abujam and Biswas, 2020). All stages of maturation were seen to occur in the majority of the yearly months. In March and April, females were primarily immature (stage I) and maturing (stage II). Males were in developing stages between April and May, mature and ripe stages were available between May and August, and a similar trend was reported by Abujam and Biswas (2010) in upper Assam's spiny eel. Mature (stage III) and ripe (stage IV) specimens were recorded from May onwards until August, and spent stages (stage V) appeared from September onwards (till December). Males were seen in their spent and recovered stages between September and February (Abujam and Biswas 2011).

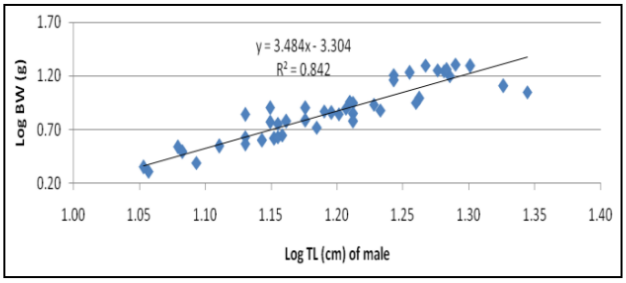

Fig: Relation between Log Total Length (cm) and Log Body Weight (g) of *Macrognathus aral* (male) (Chakraborty and Goswami, 2016)

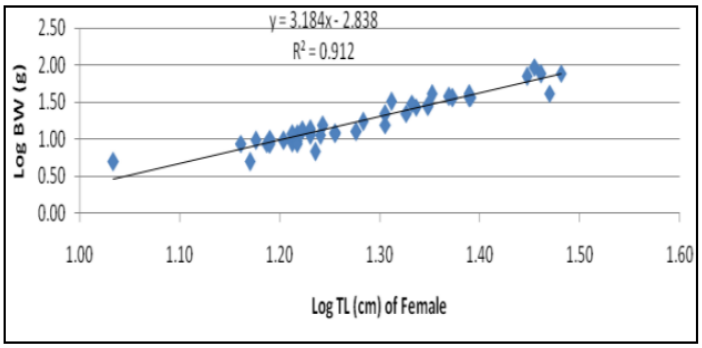

Fig: Relation between Log Total Length (cm) and Log Body Weight (g) of *Macrognathus aral* (female) (Chakraborty and Goswami, 2016)

CONCLUSION

Macrognathus sp. is an edible fish and these spiny eels can be collected easily during summer season. This paper is a compilation of biology of *Macrognathus* species to make the data available in one place. Though most of the species of *Macrognathus* sp are widely available in Northeastern part of India only few of them are in focus and studies has not been done for most of the species. Therefore, it is expected that to unveiled more biological features such as feeding habit, reproductive biology etc of this fish more studies will be conducted in future.

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