

## Size distribution and abundance of juvenile hilsa, *Tenualosa ilisha* in the major rivers of Bangladesh

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**Abstract.** The study was conducted in the six major rivers (Padma, Meghna, Jamuna, Brahmaputra Surma and Andermanik) of Bangladesh to evaluate the abundance and distribution of juvenile hilsa, *Tenualosa ilisha* from February to April 2017. Fish samples are collected by using monofilament gill net. The total length and depth of the gill net was 100 m and 4.5 m respectively. The mesh size of first 25 m net was 2.5 cm; second 25 m was 3.5 cm; third 25 m was 4.5 cm and the last 25 m was 5.5 cm. Daytime sampling was done at all the sites on a monthly basis and the Catch per Unit Effort (CPUE), total length (cm) and weight (g) were recorded and analyzed. The result showed that the highest CPUE of juvenile *T. ilisha* was observed at Ramgati station which was 72 individuals/100 m gill net/30 minutes. The second and third highest CPUE was found in Nalchira (58 individuals/100 m net/30 min) and Charking (46 individuals/100m net/30 min), those stations are located in lower Meghna region. There was a significance variation ( $P < 0.05$ ) of CPUE among the 18 stations. It is clear that the high abundance of juvenile *T. ilisha* in the lower Meghna River while the low abundance in upper part of the rivers. The abundance of juvenile *T. ilisha* was the highest in March (19 individuals/100 m net/30 min) and the lowest was in April (14 individuals/100 m net/30 min), while there was no significant difference among the months. The study indicated that *T. ilisha* juvenile are distributed all over the months from lower to upper of the rivers. The average length of juvenile in February, March and April was  $9.18 \pm 0.10$  cm,  $15.94 \pm 0.17$  cm and  $22.11 \pm 0.18$  cm respectively. It was also observed that the average weight of juveniles in February was  $9.88 \pm 0.25$  g while it was  $41.16 \pm 1.48$  g in March and  $100.94 \pm 1.29$  g in April respectively. During the study period there no *T. ilisha* juveniles was found in the upper areas of Padma, Jamuna and Surma rivers. It may be concluded that major nursery grounds are between Chandpur and Hatya of Meghna River.

**Key Words:** hilsa shad, jatka, nursery ground, CPUE, riverine ecosystem.

**Introduction.** Hilsa (*Tenualosa ilisha*) is the national fish, involves the most important open water single species fishery in Bangladesh especially during the monsoon in almost all the major river system, estuaries and the sea of Bangladesh (Amin et al 2004). It contributes approximately 0.5 million tons of fish, which presently signifies about 12% of the country's entire fish production and 1.15 of the total GDP of Bangladesh (Rahman et al 2018a). The young stage (up to 25.0 cm) of *T. ilisha* is usually called "Jatka" in Bangladesh. Juvenile *T. ilisha* (Jatka) use the different rivers and coastal areas as their nursery grounds and usually at the onset of monsoon. During this time, a huge amount of juvenile *T. ilisha* is being caught in Bangladesh, which extremely hinders the natural recruitment of *T. ilisha*. Earlier, the distribution of juvenile *T. ilisha* was almost in all the major rivers throughout the country. In a study conducted under Fourth Fisheries Project (FFP), the distribution of juvenile *T. ilisha* was found in 152 administrative sub districts (upazila) of 39 districts and the highest catch of Juvenile *T. ilisha* is concentrated in the different districts of Barisal and Chittagong divisions (Haldar 2002). Due to various factors such as low water discharge, siltation, construction of several barrages outside and inside Bangladesh, construction of flood control drainage and irrigation canal (FCDI) and flood control and drainage (FCD), about 1,500 km streams and rivers of *T. ilisha* habitat in the upper region of the country has been lost (Haldar et al 2001). At present,

some of the main rivers (the Padma, Tista and old Brahmaputra) are also degraded and *T. ilisha* fishery of these rivers is in the stage of almost lost and endangered. Therefore, the present study is conducted from lower part to upper part of the Bangladesh waters to distinguish their distribution as well as their migration rout of juvenile *T. ilisha*.

## Material and Method

**Study area and duration.** The study was conducted in the four major rivers (Padma, Meghna, Jamuna and Surma) of Bangladesh between February 2017 and April 2017 when juvenile *T. ilisha* are available in the rivers.

**Sample collection.** Fish samples are collected by using monofilament gill net. The total length and depth of the experimental gill net was 100 and 4.5 m respectively. The mesh size of first 25 m net was 2.5 cm; of second 25 m was 3.5 cm; of the third 25 m was 4.5 cm and of the last 25 m was 5.5 cm. Daytime sampling was done at all the sites and juvenile *T. ilisha* were collected monthly from eighteen sampling sites: Padma (Gazaria, Goalandah, Sujanagar, Godagari), Jamuna (Kazipur and Sariakandi), Surma (Sunamganj and Osmaninagar), Brahmaputra (Vairab and Sarail), Meghna (Chandpur, Luxipur, Charking, Nalchira, Monpura, Tajumuddin and Daulatkhan) and Andermanik (Kalapara) river. The geographical position of sampling locations has been measured in the field by GPS (GNSS viewer apps for android) and located in between 21° 57.264' and 25° 04.407' north latitudes and between 88° 18.777' and 91° 40.847' east longitudes. Total length (cm) and weight (g) of the fish was measured by a meter scale and digital balance respectively during the study period.

**Data integration and statistical analysis.** The distribution and abundance data was processed using statistical package, IBM SPSS statistics version 23.0 for Windows (SPSS Inc., USA). All data are expressed as average (mean±SE). Statistical analysis was performed using two way ANOVA following Turkey post hoc tests were using to evaluate the abundance and distribution of juvenile fish in different month and location. Differences were considered significant at  $p < 0.05$ .

## Results and Discussion

**Abundance of juvenile *T. ilisha* (catch per unit effort).** The inclusive mean Catch per Unit Effort (CPUE) of juvenile *T. ilisha* from the study area was assessed to be 17 individuals/100 m net/30 min (Figure 1). The result showed that the highest abundance of juvenile *T. ilisha* were detected at Ramgati station which was 72 individuals/100 m gill net/30 minutes. The second and third highest CPUE was found in Nalchira (58 individual/100 m net/30 min) and Charking (46 individuals/100 m net/30 min), those are located in lower Meghna. There was a significant variation of CPUE among the 18 stations ( $P < 0.05$ ). It is clear that the highest abundance of juvenile *T. ilisha* was found in the lower Meghna river and lowest abundance in upper Meghna river. Rahman & Haldar (1998) reported that the swimming larvae migrate to suitable nursery grounds and become juvenile *T. ilisha* and those are in the lower part of rivers and, eventually, in coastal waters. According to Haldar (2002) the *T. ilisha* fishery is mainly concentrated in the lower parts of the rivers, estuaries and in the sea. Hossain et al (2016) found the most suitable area for *T. ilisha* fisheries are the Meghna, Shahbajpur, Tetulia and Ander Manik rivers, and the channels of Sandwip, Kutubdia and Moheshkhali islands, which provides the most suitable habitat for the species and as accounted of 6, 11, 29, 38 and 56% of the area for spawning, eggs, fry, adults and juveniles respectively. Hossain et al (2014) studied 29.484 km<sup>2</sup> of rivers, estuaries and marine environments and found that 56% (16.388 km<sup>2</sup>) water bodies is the most beneficial and followed 21% (6.054 km<sup>2</sup>) while 24% (7.042 km<sup>2</sup>) is not suitable for juvenile *T. ilisha*. Therefore, our findings agreed with their findings.

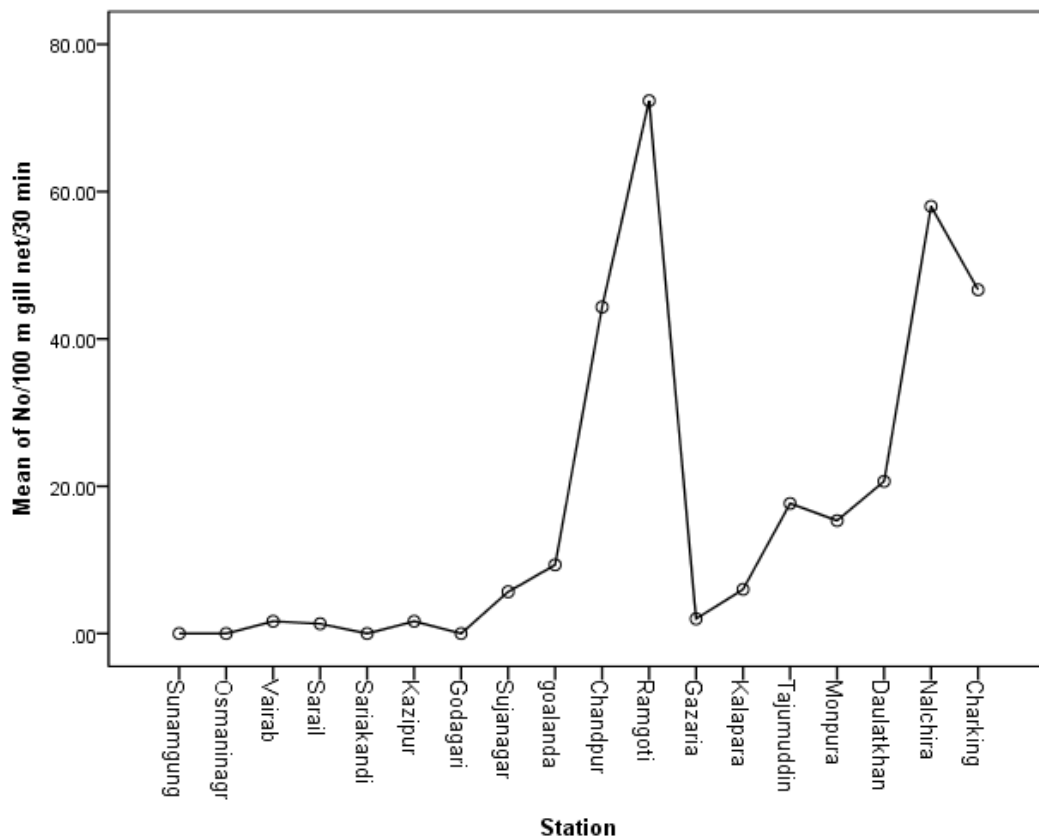


Figure 1. Spatial abundance of juvenile *Tenuailosha ilisha*.

The monthly average values of CPUE was the highest in March (19 individuals/100 m net/30 min) and the lowest was in April (14 individuals/100 m net/30 min), while there was no significant variation among the months. The result focused that *T. ilisha* juvenile are distributed all over the months from lower to upper of the river. The mean CPUE of juvenile *T. ilisha* increased from February and reached the peak in March. The CPUE value then remained low from the April (Figure 2). In the riverine nursery ground, the abundance of Juvenile *T. ilisha* was observed from November to April and reached the peak in March in the year (Rahman et al 2018a) which supports the findings of the present study. The present study CPUE's was measured as individuals/100 m gill net/30 minutes because of to understand the juvenile *T. ilisha* abundances for future management in the major rivers of Bangladesh which will be recruited as future catch and mature *T. ilisha*. Several studies measured CPUE of *T. ilisha* and their juveniles as their catchment amount (kg). In addition, Amin et al (2008) estimated 192, 58 metric ton juvenile *T. ilisha* catch in 2000 while total catch was 229,714 metric ton. They also found 45.7 and 33.5 kg/boat/day CPUE for adult and immature *T. ilisha* during the peak period (September-October) in Ramgoti of Meghna River. Amin et al (2006) assessed 45.70 kg/boat/day and 166.63 tons/day CPUE of *T. ilisha* in the lower Meghna river of Bangladesh in the peak period of September-October. Rahman et al (2017) used experimental *T. ilisha* net and estimated CPUE of 3.25 kg/100 m net/hour during 22 days from October to November 2016 in major spawning ground. Rahman et al (2018b) found the overall mean CPUE of *T. ilisha* of  $7.93 \pm 6.03$  kg/gillnet/day while  $11.63 \pm 1.21$  kg/gillnet/day was peaked in January 2016 with a minimum of  $3.63 \pm 0.83$  kg/gillnet/day and in March 2016 in Bangladesh waters.

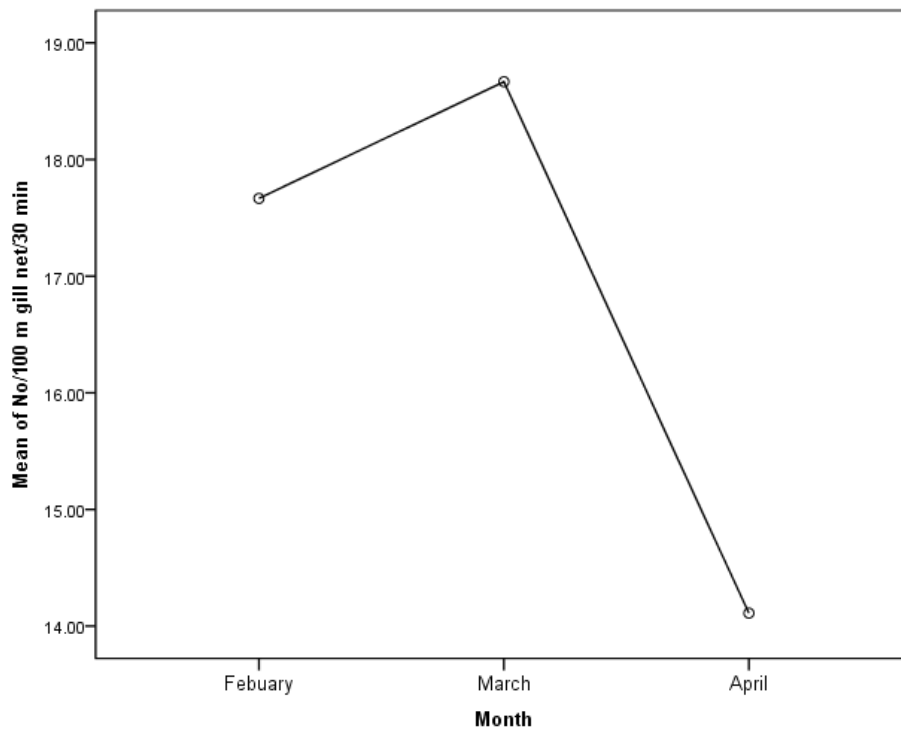


Figure 2. Temporal abundance of juvenile *Tenulosa ilisha*.

**Distribution of juvenile *T. ilisha*.** The length range of juvenile *T. ilisha* in the study area varied between 6.00 and 25.00 cm in which Ramgati, Nalchira and Charking designated 6.00-24.00 cm, while in Monpura, Tajumuddin and Chandpur was 9.00-24.00 cm and Daulatkhan was 10.00-24.00 cm. The results presented that almost all sizes of individuals dominated the Ramgati, Nalchira, Charking, Monpura, Tajumuddin and Daulatkhan areas which exist in lower Meghna estuary areas as well as the near most of the sea. There were no juveniles recorded in Sunamganj, Osmaninagar, Sariakandi and Godagari areas during the study period which are the most upper part of the study area. According to Mohammed & Wahab (2013) Meghna river system from Chandpur, Lakshmipur and Bhola are investigated as the major river nursery ground where juvenile *T. ilisha* size ranged from 2 to 12 cm and occurred from November to June. They also found that comparatively larger size juvenile *T. ilisha* ranged from 11 to 15 cm at Kuakata (Patuakhali) and Dubla Island (Khulna) during November to January. Rahman et al (2018a) estimated juvenile *T. ilisha* size from 4 to 16 cm in the Padma, Meghna and in the estuaries in Bangladesh from December to May. Our findings are agreed with their studies. The weight of *T. ilisha* juvenile was also noted varied between 6.00 and 156.00 g in which at Charking and Nalchira was 6.00-128.00 g, at Ramgati and Chandpur was 6.00-130.00 g, Tajumuddin, Daulatkhan and Monpura was prominent of 10.00-128 g. Comparatively bigger size juvenile *T. ilisha* were found at Gazaria (22.00-24.00 cm), Goalandah (17.00-24.00 cm), Sujanagar (20.00-24.00 cm), Kazipur (22.00-24.00 cm), Sarail (23.00-25.00 cm) and Vairab (23.00-24.00 cm) areas which are located in the upper part of the river. The results indicated that comparatively large individuals migrates to upper of the river for their growing and feeding purposes when the juvenile *T. ilisha* fishing is banned during the March and April of the year in Bangladesh. The average total length of juvenile in February, March and April was  $9.18 \pm 0.10$  cm,  $15.94 \pm 0.17$  cm and  $22.11 \pm 0.18$  cm respectively in the study areas. Meanwhile, the mean weight (g) of juveniles in February was  $9.88 \pm 0.25$  g while it was  $41.16 \pm 1.48$  g in March and  $100.94 \pm 1.29$  g in April during the study period. The study showed that the average size and weight of juveniles is smaller in February than in March and April (Figure 3 & 4). The results indicated that comparatively larger individual migrates from downstream to upper of the river for their growing and feeding purposes when the juvenile *T. ilisha* catch are banned on the March and April of the year in Bangladesh. The

migratory movement of *T. ilisha* into and from the river was studied recently in the Hooghly River at Diamond Harbour and marine zone of the estuary off Frazerganj (Utpal et al 2011) where fishing of *T. ilisha* by the gill net was observed during January to March and the recruitment pattern of the fishery in Bangladesh waters from March to July (Amin et al 2001) which supports the findings of the present study. Zaher et al (2013) reported that juvenile *T. ilisha* starts migrating from November in coastal region to freshwater region until April. About 45-65% juvenile *T. ilisha* are caught during the month of March and April in Bangladesh waters, which also supports our findings.

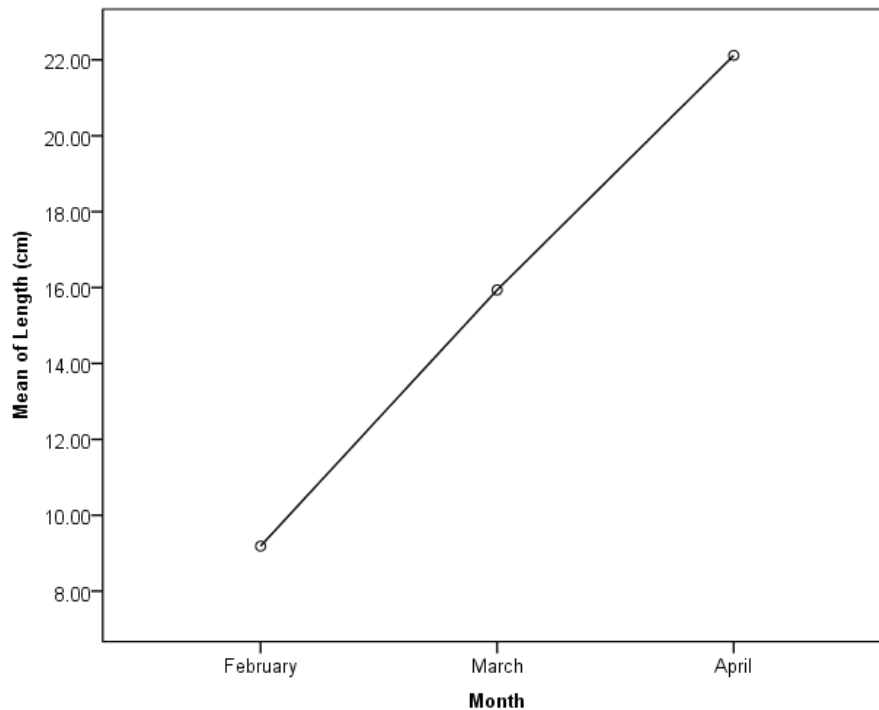


Figure 3. Monthly length distribution (Mean±SE) of juvenile *Tenualosa ilisha*.

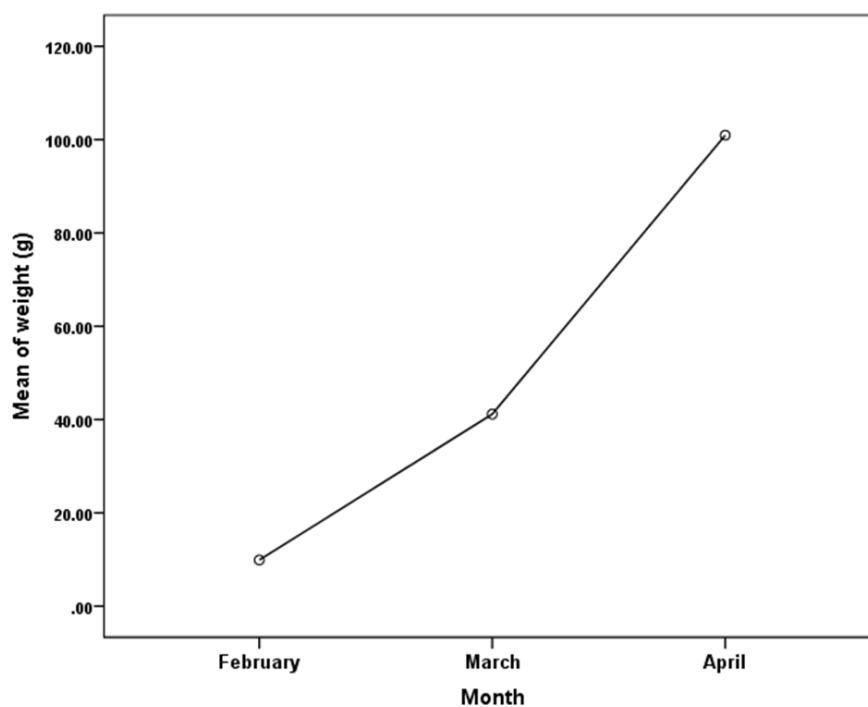


Figure 4. Monthly weight distribution (Mean±SE) of juvenile *Tenualosa ilisha*.

**Conclusions.** The study indicated that juvenile *T. ilisha* was found in the lower to middle part of the Meghna River which may have recruited as mature in estuaries to marine environment and further migration would occurred from brackish to fresh water bodies in Bangladesh. Therefore, the study spatiotemporal distribution of juvenile *T. ilisha* and their abundances in different riverine system of Bangladesh could help to understand proper recruitment pattern in fresh-brackish-marine environment and management for sustainable *T. ilisha* fisheries. The current knowledge could help in establishing the new sanctuaries, in implementing sustainable management and further *T. ilisha* fishing regulation to avoid over-fishing of the species.

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