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Reproductive Biology of the Near-Threatened Loach, *Somileptes gongota* (Balachata), in Northern Bangladesh

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ABSTRACT

This study investigated the reproductive parameters of *Somileptes gongota* (Balachata), a near-threatened freshwater species in Bangladesh, with the aim of establishing baseline information necessary for its conservation and captive propagation. Broodfish were collected from the Chikli River and adjacent local sources and reared from January to December 2019 at the Bangladesh Fisheries Research Institute (BFRI), Freshwater Sub-Station, Saidpur. Monthly sex ratio and gonadosomatic index (GSI) were assessed to determine reproductive seasonality and maturity patterns. The annual sex ratio revealed slight male dominance (female: male = 1:0.94), with significant deviations ($p < 0.05$) observed in August, October, and December. Female GSI values increased steadily from January, reached a peak of 13.55 in May, and declined thereafter, indicating a distinct spawning season extending from April to June. Absolute fecundity ranged from 8,960 ± 1,635 eggs in the smallest females (7.25 ± 0.33 g) to 42,760 ± 1,820 eggs in the largest females (17.40 ± 1.30 g), showing a strong positive correlation with body weight, gonad weight, and GSI. The findings confirm that *S. gongota* is a single-spawning species with a well-defined reproductive cycle. Successful evaluation of its reproductive biology provides critical information required for developing induced breeding protocols and conserving this declining species in natural and captive conditions.

Keywords: Ovary morphology, Sex ratio, GSI, Fecundity, *S. gongota*

1 | Introduction

Somileptes gongota (Balachata) is a small indigenous freshwater fish belonging to the family Cobitidae and is currently assessed as Near Threatened in Bangladesh (IUCN, 2015). This species is locally known by several names—balachata, mukhroch, pahari ghutum, ghorpuiya, bagha ghutum, and telcopi—reflecting its broad cultural familiarity across different regions (Rahman, 2005). Morphologically, *S. gongota* possesses an elongate cylindrical body, dorsally positioned eyes, a horseshoe-shaped mouth, three pairs of barbels, minute scales, and an undivided caudal fin. The species exhibits a brownish to yellowish coloration with irregular bands on the dorsum (Rahman, 1989; Rahman & Ruma, 2007). The fish is naturally distributed across diverse freshwater habitats, including canals, beels, rivers, and hill streams of Bangladesh, India, and Nepal (Talwar & Jhingran, 1991). In Bangladesh, it is recorded from the rivers Padma and its tributaries, Choto Jamuna, Someshwari, Kongsho, Surma, Piyain, Baral, Kortoa, Atrai, and Mahananda, as well as many small rivers in the northern region, including Nilphamari (Mohsin & Haque, 2009; Galib et al., 2013; Ahmed, 2015). *S. gongota* prefers sandy or muddy substrates in shallow, slow-moving streams and is known for its burrowing behavior when disturbed (Rahman & Ruma, 2007). Despite its ecological importance and unique behavioral traits, the abundance of *S. gongota* has declined significantly in recent years due to habitat destruction, pollution, indiscriminate use of pesticides, unplanned water management structures, overfishing, and siltation. These pressures have contributed to the species being declared Near Threatened (IUCN, 2015; Hasan et al., 2017). Although several studies have examined the ecology and biometrics of related loach species (Gopalakrishnan & Ponniah, 2000; Haque & Biswas, 2014; Hossen, 2014), information on the reproductive biology, breeding behavior, and captive propagation of *S. gongota* is extremely limited. Only a few studies have reported fecundity and gonadal maturity of *S. gongota* from natural habitats (Saha & Saha, 2011), highlighting the need for comprehensive reproductive investigations. Understanding reproductive biology—including sex ratio, gonadosomatic index (GSI), fecundity, and spawning season—is essential for effective fishery management, stock assessment, and conservation (Lagler et al., 1962; Reddy, 1979). Such information is particularly crucial for species like *S. gongota*, which show declining populations and have specific habitat requirements. Determining its reproductive cycle will support the development of induced breeding techniques, thereby enabling mass seed production for conservation aquaculture and replenishment of wild stocks.

The study of some aspects of reproductive parameters of *S. gongota* in natural sources of water has not been estimated. There is no rich information on life history, food and feeding habits, age and growth, sexuality and reproduction, breeding behavior, etc. Length-weight relationships of *S. gongota* (Hamilton, 1822) from the Haora River, Tripura, India, were estimated by Pradyut et al. (2018). This fish has been gaining importance not only as a food fish but also as an aquarium fish for its body shape and behavior (Hasan et al., 2017). However, the fish have been disappearing from the wild in Bangladesh. Reasons may include siltation, pollution, poisoning, loss of habitat, overexploitation, destructive fishing, and introduction of alien species. Information on reproductive characteristics will be helpful to conserve this fish in the wild condition. It is easy to ascertain the spawning season of a fish by studying the seasonal changes of the fecundity and gonadosomatic indices. Considering the conservation and aquaculture essential of the *S. gongota*, this study has been conducted with the following objectives: To compare the monthly sex ratio and gonadosomatic index (GSI) of *S. gongota* in natural sources.

Therefore, the present study was undertaken to investigate the key reproductive parameters of *S. gongota* in natural populations of northern Bangladesh. Specifically, the study aimed to assess monthly variations in sex ratio and gonadosomatic index (GSI), identify peak spawning periods, and generate essential baseline information required for conservation and future captive breeding programs.

2 | Materials and Methods

2.1 Study area and study period

The experiment was conducted at the Bangladesh Fisheries Research Institute (BFRI) Freshwater Sub-Station, Saidpur, Nilphamari, located between 22°38' and 22°59' north latitudes and in between 90°54' and 91°15' east longitudes (Fig. 1), for a period of 12 months from January to December 2019.

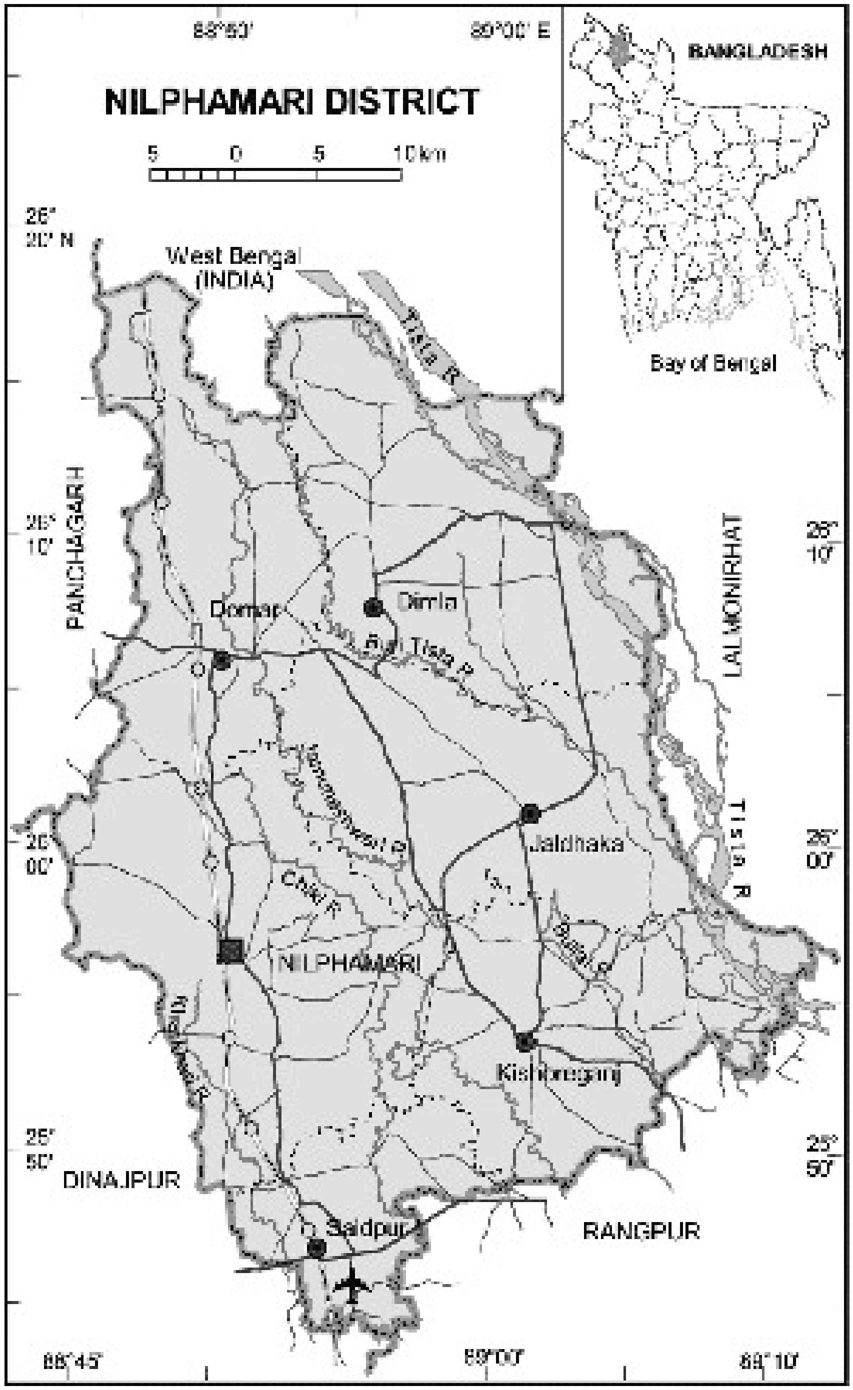

Figure 1 | Map showing the experimental site of the research work

2.2 Collection of fish

The *S. gongota* was collected from Local Chikli, Burikhora River, Barati River, and Saidpur fish market. The samples were collected every month during the study period for estimation of reproductive parameters of the fish. Each month 50-60 fish species were taken randomly for estimation of sex ratio, and 20-25 fish were dissected every month for calculation of GSI.

2.3 Study of reproductive parameters

2.3.1 Sample collection

The *S. gongota* samples were collected from the local Chikli River and Saidpur fish market. The samples were collected every month during the entire study period for estimation of reproductive parameters of the fish. Each month 50-60 specimens were randomly sampled for estimation of sex ratio, and 20-25 fish were dissected every month for calculation of GSI. Fecundity was calculated in the peak season of *S. gongota*. Around 75 fish species were used for estimation of absolute and relative fecundity.

2.3.2 Observation and preservation

After collection of the specimens, color, fins, sex, and abdomen were checked, observed, and recorded. Some of the fishes' sex were checked on the spot, and those were difficult to identify by their appearance were Then collected fish sample were immediately preserved in 10% formalin in plastic box and transfer to the Bangladesh Fisheries Research Institute Freshwater Sub-Station, Saidpur, Nilphamari Laboratory for estimation of reproductive parameters.

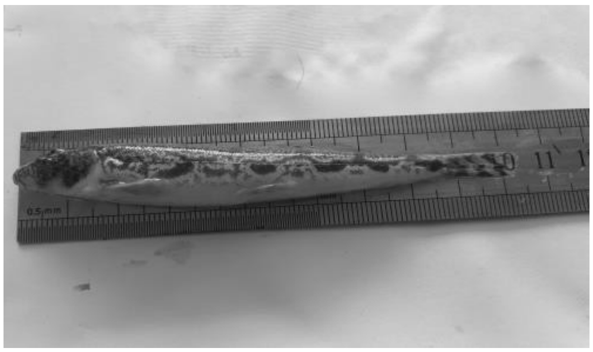

Figure 2 | Measurement of (a) Length and (b) Weight of *S. gongota*

2.3.3 Measurement of length and weight

The total length and body weight of each specimen were recorded separately to the nearest centimeter scale and gram, respectively. The total length was measured from the anterior part of the head with the jaws closed to the posterior end of the caudal fin. The weight of the specimens was taken by a digital electric balance, and weights were recorded to the nearest gram for the accuracy of weighing; excess moisture attached to the fish was dried off with the help of blotting paper before taking the weight (Fig. 2).

2.3.4 Collection of gonads

The collected fishes were dissected out by scissors starting from the anus to the lower jaw, and the belly was opened. The whole mass (stomach, intestine, and ovary) was removed carefully from the ovarian wall by means of fine forceps and a soft brush (Fig. 3). The paired ovary of the individual fish was removed and carefully placed on a Petri dish. The ovary was washed and cleaned with distilled water. The weight and length of the ovary were taken by using a digital electric balance and scale, respectively. The ovary was then kept in boiling water for 10 minutes, and the ovary was then preserved in 10% formalin for a fecundity study.

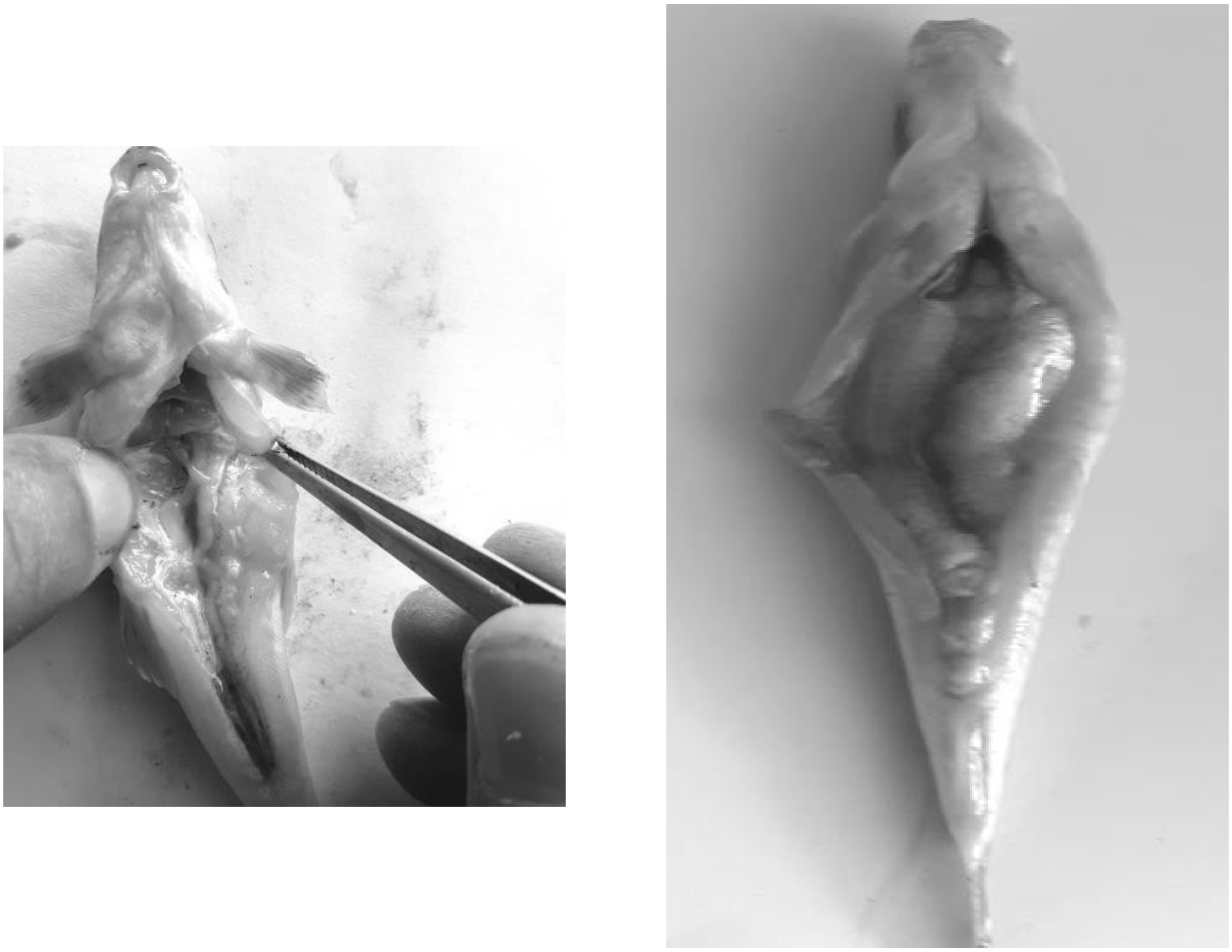

Figure 3 | Showing the testis of (a) male and (b) female Ovary of *S. gongota*

2.3.5 Determination of sex ratio and gonadosomatic index (GSI)

The sex determination of *S. gongota* is uncompromising except for the spawning season. Based on physical and visual observation of secondary sexual characteristics by observing the abdomen and anal opening, the male and female fishes were differentiated. According to Martinez (2014), sex ratio and size structure constitute the stock population's basic information and biological management.

This is the simplest way to express the sex ratio as a comparison between the number of males and females.

Sex ratio = Number of females / Number of males (Wedekind, 2017)

The Gonadosomatic Index (GSI) is a measure used to determine the reproductive maturity of fish. The relative weight of the gonads relative to the total body weight of the fish is calculated. Increased GSI indicates more significant maturation, peaking during the fish's maximum maturity period. The GSI is calculated using the following formula (Ahammad et al., 2021).

GSI = (Weight of gonad / Weight of fish) × 100

This index helps identify the breeding season and reproductive health of fish."

2.3.6 Estimation of fecundity

The gravimetric method (Galo et al., 2015) was used to estimate the fecundity of *S. gongota*. The ovaries were carefully dissected using scissors, and the external connective tissues were removed from their surface. The moisture was then blotted off using blotting paper. The weight of each ovary was measured using a digital electronic balance. Samples were then taken from each lobe's anterior, middle, and posterior sections. The number of mature and maturing eggs in each section was counted separately. The average number of eggs was calculated and then multiplied by the total weight of the ovary, which gave the total number of eggs, that is, the fecundity of the respective fish. This was done using the following formula:

$F = N \times$ Gonad weight (g) / Sample weight (g), where F = Fecundity of fish and N = Number of eggs in the sample.

2.4 Statistical analysis

One-way analysis of variance (ANOVA) (Duncan, 1993) was conducted by SPSS 20 (Chicago, USA) to detect the significance differences among the treatments at a 5% significance level. "ANOVA for GSI differences (Shapiro-Wilk normality $p>0.05$, Levene's homogeneity $p>0.05$); χ^2 for sex ratios. The values were given with means ±SD, and differences were considered significant at the subset for alpha = 0.05 ($p \leq 0.05$). Sex ratio data were analyzed using the chi-square (χ^2) test to determine whether the observed male-to-female ratio significantly deviated from the expected 1:1 ratio. The calculated χ^2 values were used to test statistical significance, and the corresponding p-values were reported to indicate the probability level at which the null hypothesis was rejected. Differences were considered statistically significant at $p < 0.05$.

3 | Results

The experiment was conducted at the hatchery of Bangladesh Fisheries Research Institute (BFRI), Freshwater Sub-station, Saidpur, Nilphamari, from January to December 2019 to determine the reproductive response of *S. gongota* by using synthetic and natural hormones with different doses.

3.1 Identification of male and female Somileptes gongota

Table 1 | Body features of *S. gongota* for identification of male and female during experiment.

Female	Male
Older females grow noticeably larger than males and apparently develop a deeper body shape.	Smaller than the female
Female individuals with as lamina circularis (structure formed by two or more fused rays)	Male individuals lack of a lamina circularis (structure formed by two or more fused rays)
The female fish was comparatively less colored (Fig. 4).	Greenish above and yellowish white below. Back usually with irregular bands descending up to the lateral line. (Fig. 4).
The abdomen of the female fish was swollen and soft	The abdomen is straight
Blunt, round genital opening	Genital papilla pointed
Brownish eggs came out by gentle pressure over the abdominal region from the anterior to the posterior direction.	White milt comes out when gently pressed over the abdomen

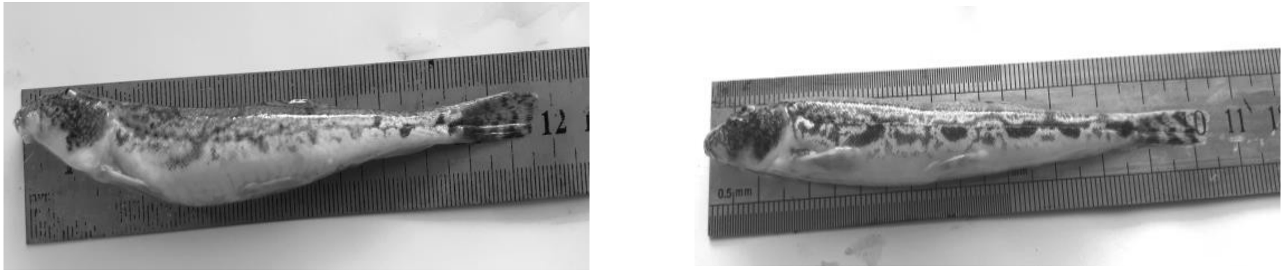

Figure 4 | Pictorial view of (A) Female and (B) Male of *S. gongota*

3.2 General body feature of Somileptes gongota

The body is subcylindrical and posteriorly tapering. The upper profile of the snout is nearly straight or a little concave. Eyes are close together, situated high up at the middle of the head. Lips are thick, lower with papillae, with 4 rostral and 2 maxillary barbels. A small erect pair presents above nostrils. Anterior nostrils are tubular; posterior nostrils are simple holes. Scales are small. The lateral line is present. The dorsal fin starts at the center between the anterior margin of the eye and the root of the caudal fin. Pelvic originates slightly in advance of that of dorsal; caudal rounded. Body color and decoration: greenish above and yellowish white below (Fig. 5).

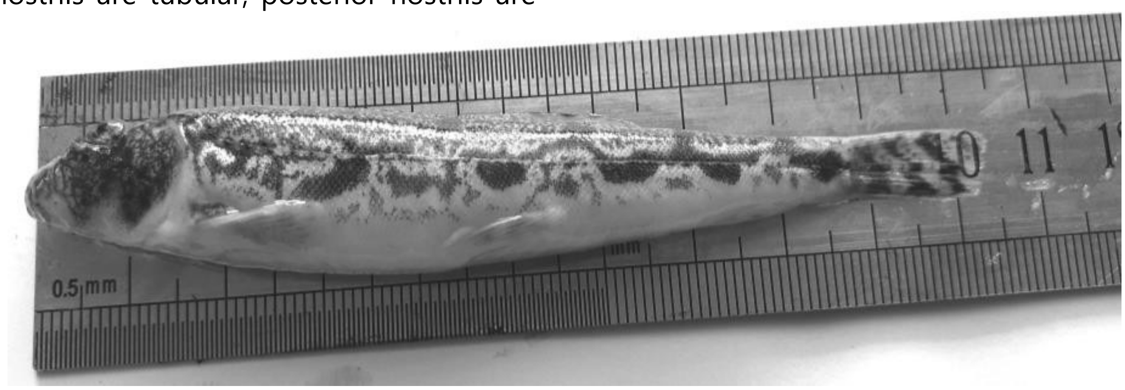

Figure 5 | External views of *Somileptes gongota*

3.3 Sex differentiation

About 20-40 matured fish of *S. gongota* were randomly taken for the study. Sex differentiation of *S. gongota* is difficult; based on physical and visual examination of secondary sexual characteristics by observing the abdomen and anal opening, the male and female fishes were differentiated.

3.4 Sex ratio

In the present study there were 207 males and 194 females. This gives a female and male ratio of 1:0.94 in favor of the males. Sex ratios from the month of January to December 2019. In the months of June to August and October and November, the sample of males was dominant; on the other hand, from January to May and September and December, females were dominant. The male and female ratio varies significantly ($P<0.05$) in the months of August, October, and December, but in other months the male and female ratio round the year did not deviate significantly from parity (Table 2).

Table 2 | Year-round sex ratio (male: female) of collected *Somileptes gongota*

Month	**No of fish**	Male	Female	Sex ratio (male: female)	**P-value**	**Chi square**
January	20	08	12	1:1.50	0.37	0.80
February	24	10	14	1:1.40	0.41	0.67
March	26	11	15	1:1.36	0.43	0.61

Month	No of fish	Male	Female	Sex ratio (male: female)	P-value	Chi square
April	36	13	23	1:1.77	0.09	2.77
May	36	16	20	1:1.25	0.50	0.44
June	27	14	13	1:0.93	0.84	0.03
July	27	17	10	1:0.59	0.17	1.81
August	63	44	19	1:0.43	0.001	9.20*
September	45	19	26	1:1.37	0.29	1.08
October	47	34	13	1:0.38	0.002	9.38*
November	20	12	08	1:0.67	0.37	0.80
December	30	09	21	1:2.33	0.02	4.8*
Total	401	207	194	1:1.98	3.493	32.9
Average				1:0.94	0.29	2.69

P = Probability; X2 = Chi square; NS = Non-Significant; S* = Significant at 5% level

3.5 General morphology of gonad

A total of 250 matured male and female *S. gongota* were studied throughout the year. The male and female GSI values are given in Fig. 6. The female gonad, consisting of a pair of ovaries, was found attached dorso-laterally to the gut. From December to January the ovary was in the pre-reproductive stage. The ovary of *S. gongota* was paired and elongated, lying dorsal to the elementary canal. The ovaries were found to extend along the body cavity. Both the ovaries were elongate, larger at the middle than the extremities, and were nearly equal both in shape and size. The length of the ovaries of mature females ranged from 3.5 to 5.6 cm, and the weight of the ovaries ranged from 0.53 g to 3.06 g. The month-wise average length and weight of the ovary showed peaks in the present study. The color of the ovaries was yellowish or whitish or brown. The mature ova were randomly distributed throughout the length of the individual ovary.

3.6 GSI of female

The GSI value of females varies month to month, and the highest mean GSI value was found to be 13.55 in May (Fig. 6). The trend of GSI showed that the reproductive period extends from April to June. The GSI value increased gradually from January and reached a peak in May, then gradually declined. The GSI value of females was found to be higher in the months of March, April, May, and June; then the rest of the months declined, indicating the existence of ripe gonads. This month can be interpreted as the peak breeding season of *S. gongota*.

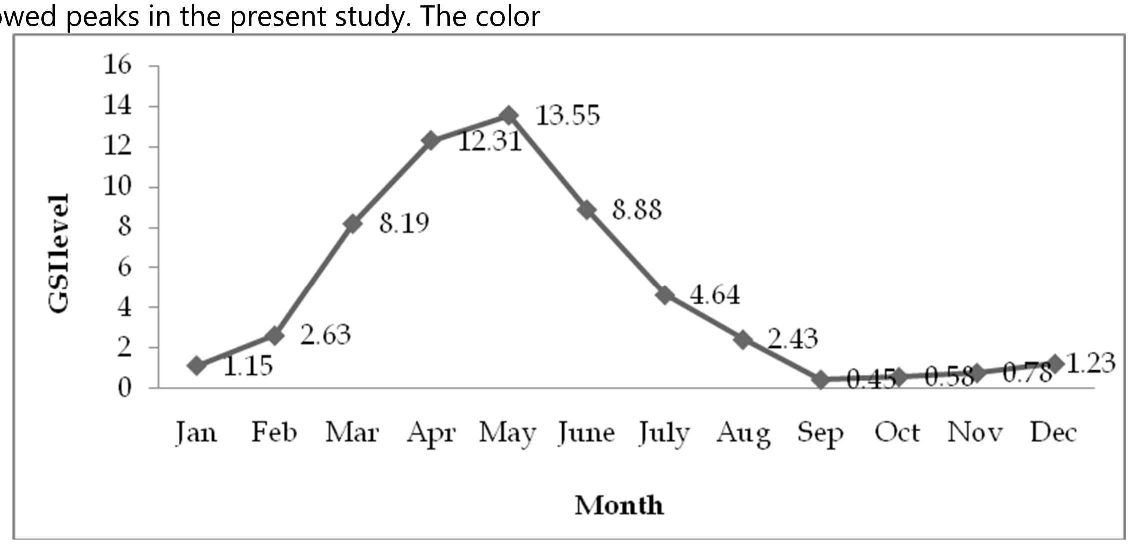

Figure 6 | Monthly GSI values of *S. gongota* in case of female

3.7 Estimation of fecundity

Absolute fecundity of *S. gongota* showed a strong positive association with the body weight (BW), gonad weight (GW), and gonadosomatic index (GSI). The average body weight of the sampled females ranged from 7.25 g to 17.40 g, and a consistent increasing trend in absolute fecundity was observed with increasing body size. The lowest average fecundity (8,960 ± 1,635 eggs) was recorded in smaller females weighing 7.25 ± 0.33 g, with an average GSI of 0.85 ± 0.20%. Females with intermediate body weight (9.30 ± 0.26 g) exhibited a markedly higher fecundity of 20,450 ± 1,935 eggs, corresponding to a GSI of 2.35 ± 0.40%. Larger females weighing 11.56 ± 0.70 g and 13.70 ± 0.50 g produced significantly higher fecundity values of 30,960 ± 1,878 eggs and 35,634 ± 2,070 eggs, respectively. The highest fecundity was recorded for the largest size groups (15.20 ± 1.30 g and 17.40 ± 1.30 g), showing 38,530 ± 1,749 and 42,760 ± 1,820 eggs, respectively (Table 3). Their GSI values (2.87–4.18%) were also comparatively higher.

Table 3 | Absolute fecundity in terms of average body weight of *S. gongota*

Av.BW (g)	Av.GW (g)	Av. Absolute Fecundity (g-1 bw)
7.25±0.33	0.85±0.20	8960±1635
9.30±0.26	2.35±0.40	20,450±1935
11.56±0.70	2.45±0.16	30,960±1878
13.70±0.50	2.70±0.45	35,634±2070
15.20±1.30	2.87±0.57	38,530±1749
17.40±1.30	3.10-4.18	42.760±1820

4 | Discussion

Understanding reproductive biology, including sex ratio, gonadal development, and fecundity, is essential for the conservation and management of threatened freshwater fishes. In the present study, monthly variations in the sex ratio of *S. gongota* fluctuated around parity, with an annual ratio of approximately 1:0.94 (male:female), indicating a slight predominance of males. Significant male dominance observed during August, October, and November may be associated with ecological or behavioral factors such as differential habitat utilization, gear selectivity, or sampling bias during collection. Similar male-biased sex ratios have been reported in other small indigenous fishes, including *Mystus tengara* (Gupta and Banerjee, 2013) and several small catfish species of South Asia (Mitra et al., 2007). Conversely, female dominance observed during January–May, September, and December may reflect increased availability of mature females during pre-spawning and spawning periods. Although direct field sampling provides the most controlled representation of natural populations, fishery-dependent sampling, such as collection from commercial landing sites and local markets, is routinely used in fish biology studies to obtain sufficient sample sizes for life-history and reproductive parameter estimation when target species are scarce or difficult to sample directly (Schemmel, 2022, FAO Sampling Methods Manual). Seasonal changes in ovarian morphology, size, and coloration clearly indicated the reproductive cycle of *S. gongota*. Ovarian development progressed from immature and developing stages during December–January to fully mature stages during April–June. This progression corresponded closely with the increase in the gonadosomatic index (GSI), suggesting active gonadal maturation during this period. In the present study, the ovary length of mature females ranged from 3.5 to 5.6 cm, and ovary weight ranged from 0.53 g to 3.06 g. These values are comparable to those reported by Saha and Saha (2011), who documented gonadal weights ranging from 0.11 to 4.40 g and gonadal lengths from 2.6 to 6.6 cm in *S. gongota* populations inhabiting the Someswari River in the

Netrokona district of Bangladesh. Distinct seasonal variation in ovary coloration was also observed. Ovaries appeared cream-colored during January, February, November, and December, representing early developmental stages, whereas orange-colored ovaries were recorded from May to July, indicating advanced maturation and readiness for spawning. Similar seasonal variation in ovarian coloration has been documented in *S. gongota* populations from northeastern Bangladesh (Saha et al., 2006), supporting the present observations. The highest mean GSI value (13.55) was recorded in May, indicating peak reproductive maturity. Comparable seasonal peaks in GSI have been reported for several small freshwater fishes of South Asia. For instance, *Mystus vittatus* exhibits peak GSI values during the pre-monsoon months (Hossain et al., 2006), while cobitid loaches also show reproductive peaks during the early monsoon period (Kiran and Puttaiah, 2003). These seasonal patterns are commonly associated with environmental cues such as rising water temperature, increased rainfall, and changes in water flow, which stimulate gonadal maturation and spawning activity in riverine fishes. The reproductive season of *S. gongota* in the present study appears to extend from April to June, with the highest reproductive activity occurring in May. The presence of gravid females during April–July and the distinct peak in GSI suggest a relatively short and well-defined spawning period. However, although these observations strongly indicate a single major spawning peak, confirmation of a true single-spawning strategy would require histological examination of oocyte development or direct observation of spawning events, as emphasized in reproductive studies of small freshwater fishes (Murua & Saborido-Rey, 2003; Lowerre-Barbieri et al., 2011). Fecundity analysis revealed a strong positive relationship between female body weight, gonad weight, and absolute fecundity, indicating that larger females contribute disproportionately to reproductive output. In this study, females weighing 15–17 g produced approximately 38,000–42,000 eggs, demonstrating that reproductive capacity increases with body size. Similar size-dependent fecundity patterns have been reported for many small indigenous species of Bangladesh. When compared with other benthic loaches, *S. gongota* exhibits relatively high fecundity. For example, *Lepidocephalichthys guntea* typically produces 1,200–3,500 eggs depending on body size and habitat conditions (Rahman et al., 2016; Hossain et al., 2015). The comparatively lower fecundity of *L. guntea* is partly related to its smaller body size, with mature females generally weighing 3–6 g. While both species show a positive relationship between body size and fecundity, their reproductive strategies appear to differ. *L. guntea* tends to produce fewer eggs per spawning event and may spawn multiple times during a breeding season, whereas *S. gongota* appears to invest in a higher number of eggs during a relatively short reproductive period. These differences highlight species-specific reproductive adaptations among small indigenous fishes. The relatively high fecundity and seasonal spawning pattern observed in *S. gongota* suggest that successful recruitment depends heavily on favorable environmental conditions during a limited breeding period. Consequently, disturbances such as habitat degradation, water pollution, or excessive fishing during the spawning season could significantly reduce reproductive success and population recruitment.

From a conservation and fisheries management perspective, the findings of this study provide valuable baseline information. The identification of the peak reproductive period (April–June) suggests that protective measures, such as seasonal fishing restrictions during peak spawning months, could help safeguard breeding populations. In addition, knowledge of size-dependent fecundity highlights the importance of protecting larger mature females, which contribute disproportionately to egg production. These findings may also assist in broodstock selection and captive breeding programs, which are important strategies for the conservation and sustainable utilization of threatened small indigenous fish species in Bangladesh. (Hossain et al., 2015; Rahman, 2005). Overall, the reproductive characteristics of *S.*

gongota documented in this study contribute to a better understanding of its life-history strategy and provide useful information for developing effective conservation and management plans for this species. A quantitative comparison with other small indigenous fishes and loach species further clarifies the reproductive characteristics of *S. gongota*. In the present study, the maximum gonadosomatic index (GSI) reached 13.55, which is relatively higher than that reported for *Mystus vittatus* (approximately 8–10) (Hossain et al., 2006) and *Lepidocephalichthys guntea* (about 6–9) (Rahman et al., 2016). Similarly, the absolute fecundity of *S. gongota* ranged from approximately 38,000 to 42,000 eggs in larger females, which is substantially higher than the fecundity reported for *L. guntea* (1,200–3,500 eggs) and *Amblypharyngodon mola* (6,000–12,000 eggs) (Hossain et al., 2015; Rahman, 2005). These quantitative differences suggest that *S. gongota* follows a relatively high fecundity reproductive strategy, where larger females produce many eggs during a short breeding season. In contrast, several small indigenous fishes with smaller body sizes tend to produce fewer eggs per spawning event and may reproduce multiple times during a breeding period. Such interspecific variation reflects differences in life-history strategies and ecological adaptation among small freshwater fishes.

5 | Conclusion

The present study demonstrates that S. gongota exhibits a clear seasonal reproductive pattern in northern Bangladesh, with peak gonadal maturity (GSI = 13.55) observed in May. The presence of mature and gravid females from April to June indicates a relatively short spawning period with a distinct reproductive peak during the pre-monsoon season. The overall sex ratio showed a slight male predominance (female:male = 1:0.94). Absolute fecundity ranged from 8,960 to 42,760 eggs and increased significantly with female body weight (7.25–17.40 g), indicating a strong size-dependent reproductive capacity. These baseline data on sex ratio, gonadosomatic index (GSI), spawning seasonality, and fecundity provide important biological information for broodstock management, induced breeding, and conservation planning for this Near Threatened species. Further studies on hormonal induction, early embryonic development, and nursery rearing techniques are recommended to facilitate large-scale seed production and support stock enhancement programs in natural habitats.

Author Contributions

Fatema Akter Sumi: Data collection, data analysis, interpretation, manuscript writing, and editing. Saokat Ahamed: Conceptualization, data collection, data analysis, manuscript writing, and editing. Maliha Hossain Mou: data collection and data analysis. Md. Khandaker Rashidul Hasan: Conceptualization, supervision, manuscript writing, and editing; fund acquisition supervision, manuscript writing, and editing. All authors have read and approved the final published article.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

All data generated and analyzed during this study are included within the manuscript. No additional datasets are available.

Ethics Statement

Not applicable.

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