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Reproductive Biology of Goldspotted Grenadier Anchovy, *Coilia dussumieri* from the Mid-Southern Coast of Bangladesh

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ABSTRACT

This study, conducted from January to December 2023, investigated the reproductive biology of Coilia dussumieri in the mid-southern coast of Bangladesh. The length-weight relationship indicates a positive allometric growth (b >3) pattern within the species. The highest fecundity (10780) was observed in a fish with a total length of 14.89 cm, body weight of 11.64g and gonad weight of 1.19 g. The lowest fecundity (1040) was found in a fish with a total length of 10.95 cm, body weight of 5.9 g and gonad weight of 0.1 g. Fecundity showed a linear relationship with body weight, total length, and gonad weight. The monthly variation of GSI values occurred in August to March, with September having the highest GSI value. The findings of the present study would be very helpful for further research and provide valuable information for sustainable management and conservation of the species in the coastal regions of Bangladesh.

Keywords: *Coilia dussumieri*, Length-weight relationship, GSI, Fecundity

1 | Introduction

Coilia dussumieri, goldspotted grenadier anchovy, belongs to the family Engraulidae of the order Clupiformes and is mainly found in coastal waters and estuaries in Bangladesh, Indonesia, Malaysia, Myanmar, Pakistan, Singapore, Srilanka, Thailand, and Vietnam. This ray-finned fish species is locally known as mandeli in Bombay "Oluua maach", and "Boiragi" in coastal districts of Bangladesh. This saline water fish species breed in coastal areas where eggs can be spread (Verghese, 1961) and sufficient food is available there (Riede, 2004). In gravid and spent fish's highest percentage of proteins (16:85%) and moisture (78.24%) were noticed while the highest rate of carbohydrates (0.06%), fats (238%), and ash (3.48%) were seen in mature fish (Towhid, 1994). *Coilia dussumieri* has supported important subsistence and commercial fisheries, as well as being a major prey item for several other fish species. The fresh fish has a huge demand among the people of coastal regions.However, this species is facing threats from direct and indirect anthropogenic activities including overexploitation, pollution, obstructions in the migratory routes, and climate change. Investigation of gonad development through observation of morphological changes, gonadosomatic index, fecundity, and spawning season can prevent their extinction from nature (Sivakumaran *et al.*, 2003). However, very limited

studies have been conducted on the reproductive biology of this species. Therefore, the overall investigation will explore the reproductive biology as well as the gonadosomatic index, fecundity, and stages of gonadal development through gonadal histology for determining the peak breeding season to ensure the proper management and conservation of this species in coastal waters.

2 | Materials and Methods

Samples of *Coilia dussumieri* were collected for twelve months from the local fish markets of Kalapara, Patuakhali, Bangladesh which were harvested from the Andharmanik, Golachipa, and Payra rivers from January to December 2023. In each month twenty samples were collected in fresh condition. The length of each fish was measured by measuring tape and weighted by analytical balance respectively. Samples were dissected and gonads from each specimen were removed intact. Then matured ovaries were weighted. Three samples, each were taken from the anterior, middle, and posterior regions of each ovary and kept in petri-dish. All ovaries were preserved in 5% formalin solution. After some hours eggs became large and separated from each other. The number of eggs in each of the sub-samples was counted under a magnifying glass.

2.1 Length-weight relationship

The length-weight relationship was estimated by using the equation:

$W = aL^b$

where W is the weight of fish (g), a is the regression constant or intercept, and b is the regression coefficient or slope.

2.2 Fecundity estimation

The absolute fecundity of the collected fish species was estimated by the gravimetric method as described by Blay (1981). The absolute fecundity was calculated using the following formula.

F = N × total ovary weight/sub-sample weight

where F is the absolute fecundity and N is the number of eggs in the sub-sample.

2.3 Gonadosomatic index (GSI)

The obtained good consensus sequences from Sanger sequencing were selected for analysis based on chromatogram peak clarities with the help of Chromas Lit. Bioinformatic analyses of the sequences were performed using CLC Workbench,

$$GSI = \frac{\text{Weight of the Gonad}}{\text{Weight of the fish}} \times 100$$

2.4 Histology

Gonads of *Coilia dussumieri* were weighed to the closest 0.01 g and wiped with tissue paper for histological analysis. For twenty-four hours, fresh tissues from the gonads' anterior, middle, and posterior regions were preserved in Bouin's solution. After that, the samples were dehydrated in alcohol (70%, 90%, and absolute alcohol) and xylene. Later, paraffin was used to embed them. A microtome machine (Microm HM-315, Thermo Scientific, United States) was used to segment the implanted samples to a thickness of 5 µm. The sections were mounted in DPX for additional histological analysis after being stained with hematoxylin and eosin (H-E technique). At last, the slides were viewed using a microscope with light (iScope-1153-PLi/SLC, Euromex, Netherlands) that was connected to a computer with a viewer.

2.5 Statistical analysis

Microsoft Excel was used to store all of the captured data. Microsoft Excel 2021 and Statistics 10 served as tools with a 5% level of significance to identify linear and nonlinear relationships and coefficient determination (r^2).

3 | Results

3.1 Length-Weight relationship

The length-weight relationship scatter plot is presented for *Coilia dussumieri* (Fig. 1) where the b value was determined to be 3.14. The b value indicates a positive allometric growth pattern within the species.

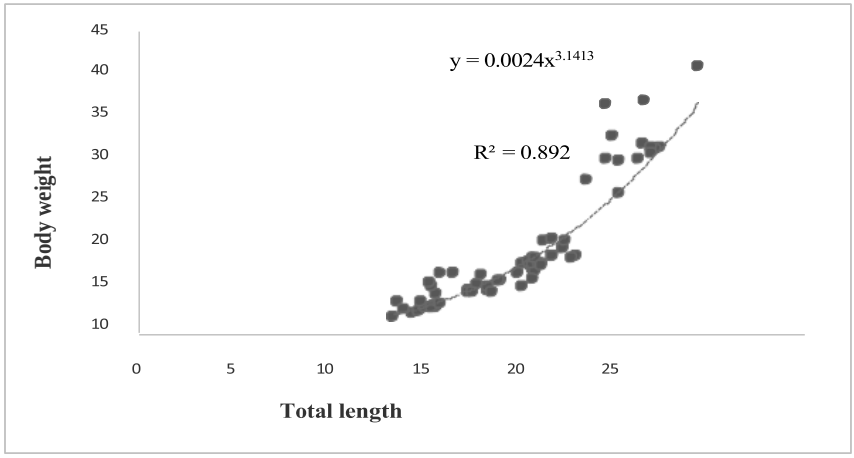

Figure 1 | Relationship between length and weight of *Coilia dussumieri*.

3.2 Gonadosomatic index (GSI)

The gonadosomatic index (GSI) varied between 0.49 to 4.2. GSI of *Coilia dussumieri* was higher in September and December where September was the peak. GSI began to rise from July to September, fall from October to November, rise again and peak in December, January and again decline in March to June (Fig. 2).

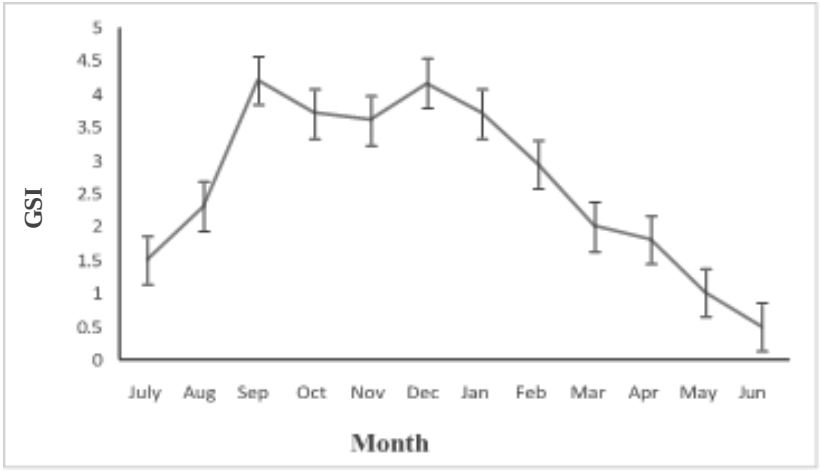

Figure 2 | Monthly variation of GSI of *Coilia dussumieri*.

3.3 Fecundity

A sample of 96 mature females were studied. Fecundity in *Coilia dussumieri* ranged from 1,040 to 10,780 eggs with an average of 4,758.16 ± 3,142.98. The lowest fecundity (1,040) was recorded in a specimen measuring 10.95 cm in total length, weighing 5.9 g, with a gonad weight of 1.19 g. In contrast, the highest fecundity (10,780) was observed in a fish with a total length of 14.89 cm, body weight of 11.64 g and gonad weight of 0.1 g (Fig. 3).

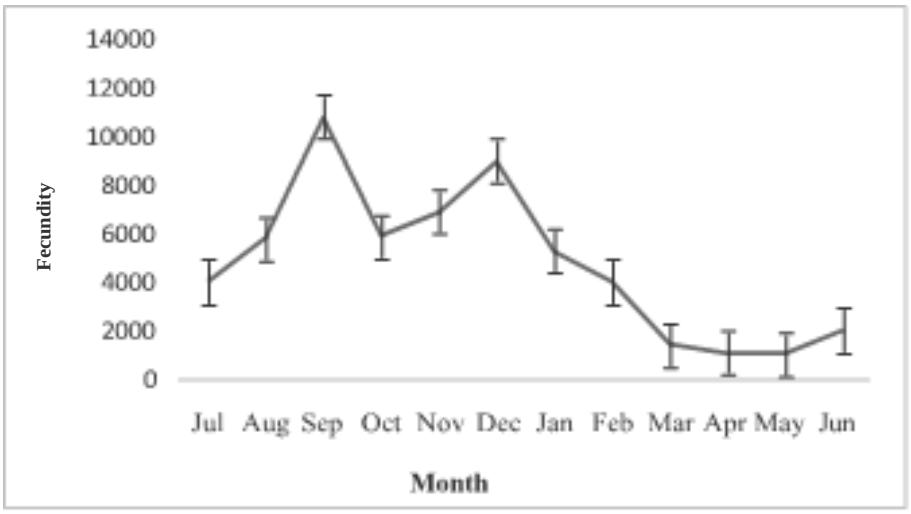

Figure 3 | Monthly variation of fecundity of *Coilia dussumieri*.

3.4 Relationship between Fecundity and other parameters

Linear and positive co-relationships were obtained between fecundity and total length and expressed as y = 1411.7x -11256; (R^2 = 0.915), fecundity and body weight showed as y = 1419.6x - 6852.1; (R^2 = 0.862); fecundity and gonad weight were also found linear and expressed as y = 8716.3x + 1220.8; (R^2 = 0.9663) (Fig. 4-6).

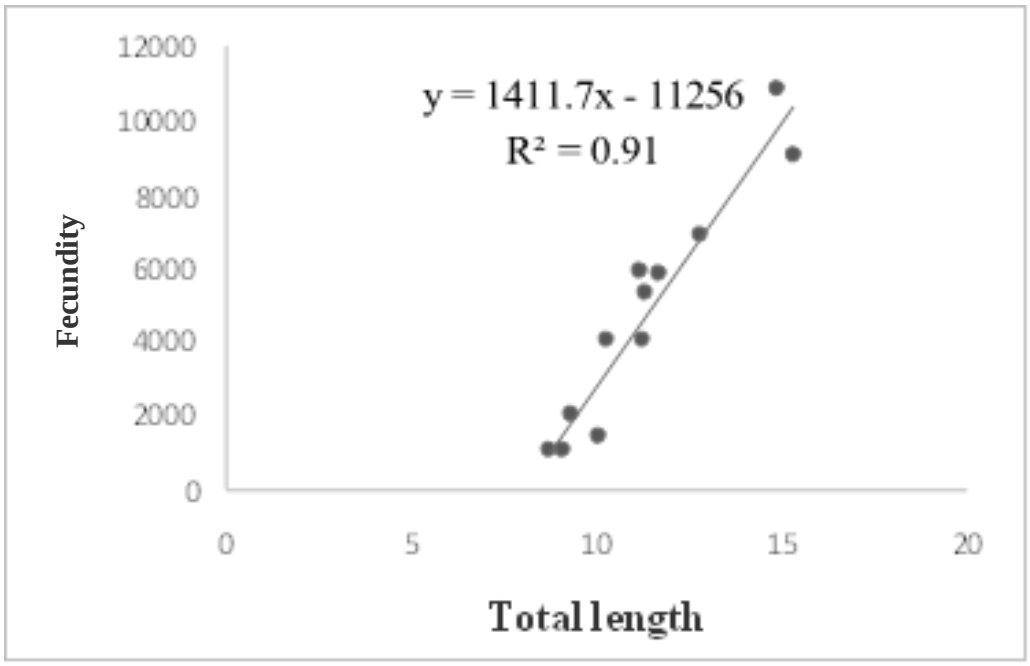

Figure 4 | Relationship between fecundity and total length.

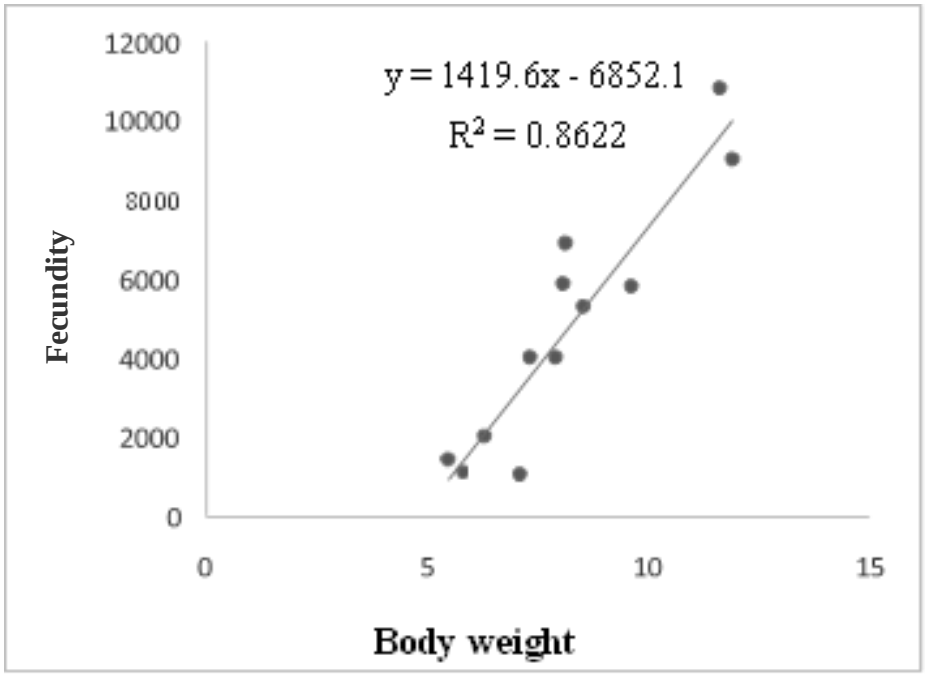

Figure 5 | Relationship between fecundity and body weight.

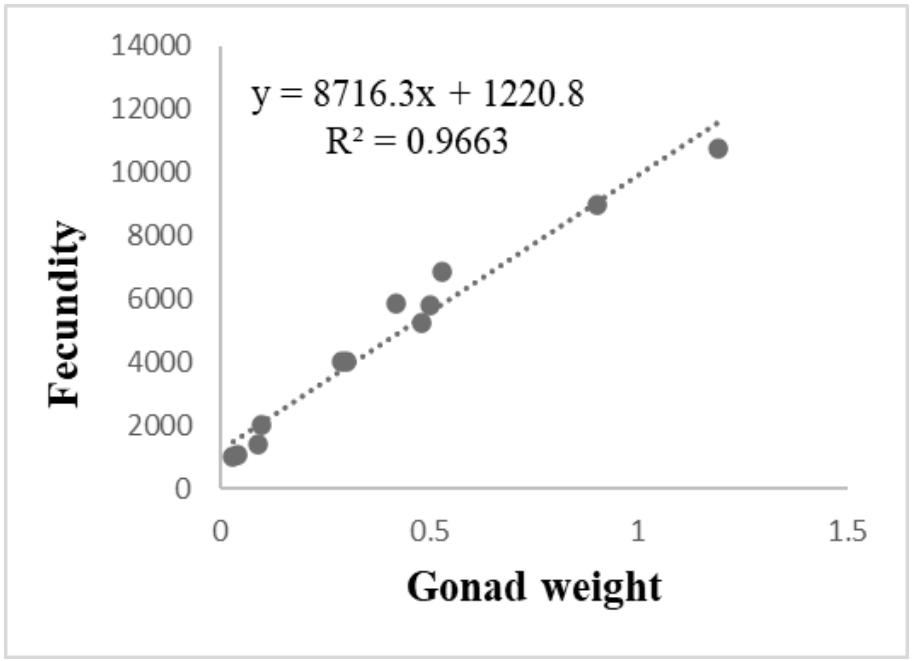

Figure 6 | Relationship between fecundity and gonad weight.

3.4 Histological study

Ovarian developmental phases were divided into 5 phases based on the oocyte prevalence percentage: Immature (Stage 1), Maturing (Stage 2), Mature (Stage 3), Ripe (Stage 4), and Spent (Stage 5). The immature stage oocytes were found in April, May, June. The maturing stage was observed in July, August. The mature stage was noticed in September, December, and January. The ripe stage was observed in November and February. In March and October, the highest percentage of the spent stage of the ovary was seen.

Table 1 | Developmental stages of *Coilia dussumieri* ovary under macroscopic observation.

Stages of ovary	Macroscopic observation	Duration
1. Immature	Transparent elongated ovaries small ovary, thin, poorly developed	April, May, June,
2. Maturing	Granular, slightly enlarged ovaries, transparent, immature ova	July, August
3. Mature	flat and gray, densely packed with easily distinguishable eggs.	September, December, January
4. Ripe stage	Sizable, round egg	November, February
5. Spent	Flaccid, bloodshot, and contracted	March, October

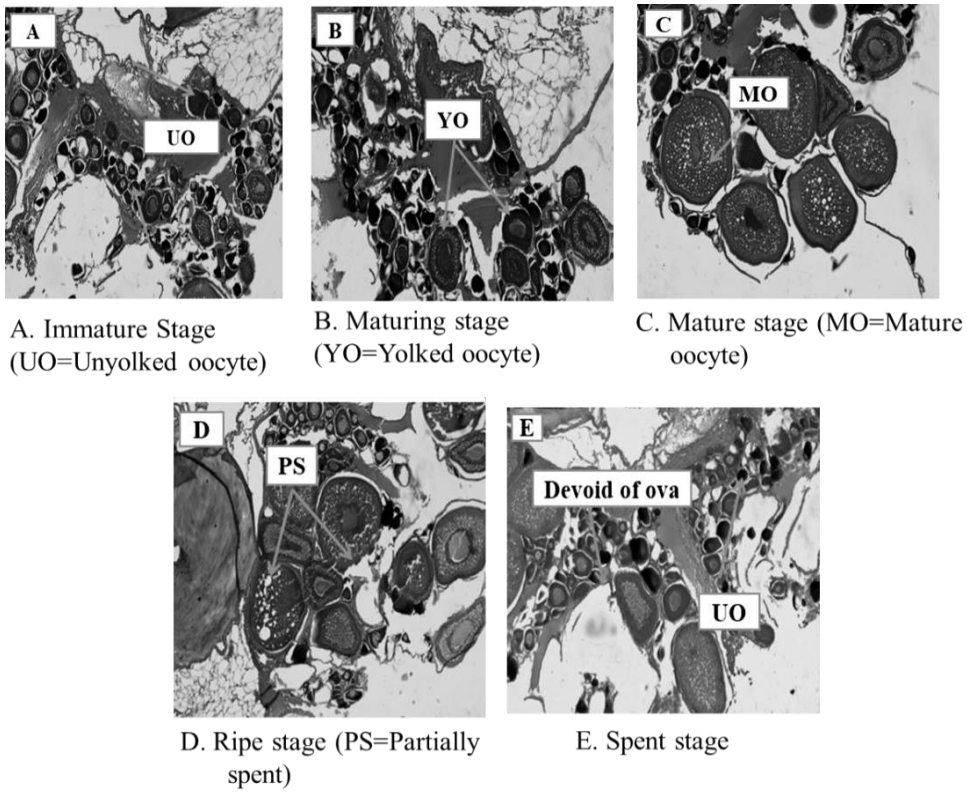

Figure 7 | Photomicrographs of different ovarian stages of the female *Coilia dussumieri* at various stages in gamete development.

4 | Discussion

To develop an artificial breeding technique, it is essential to understand the reproductive biology of a fish, including factors such as fecundity, gonadosomatic index (GSI), and stages of gonadal development. (Mithu *et al*., 2013). According to (Le Cren, 1951) As the fish progresses toward maturity, the gonadosomatic index rises, peaks at full maturity, and then drops rapidly after spawning when the fish becomes spent. In our study, the gonadosomatic index of *C. dussumeiri* was noticed to increase as the fish reached the maturity stage and declined gradually after the spawning stage.

The overall GSI value ranged from 0.49 to 4.2 for females. The monthly variation of the gonadosomatic index reflects the ovarian activity of the species. Moreover, the results of the present

investigation indicated that the gonadosomatic index of *C. dussumeiri* was high during September when the fish reached the maturing stage. During this period of analysis, the highest GSI value in September indicates the fact that *C. dussumeiri* may have a peak breeding season during September. Naung (2018) reported that in Ye River Estuary highest gonadosomatic index (GSI) found between August and March suggests a wide spawning period between late winter and late summer, was serial spawner which is similar to our present findings. On the other hand, (Gadgil, 1967) also reported that the peak breeding season *C. dussumeiri* is from August to March while September was the peak and spawning occurs thrice during the season which is also similar to our present findings. According to Hunter *et al.* (1992), fecundity is an important parameter that explores variations in the level of production, success of induced breeding, and breeding cycle of fish species. Generally, the fecundity of the fish varies from species to species, depending on age, length, weight, environmental conditions, climatic conditions, nutritional conditions, and genetic potential (Biswas, 1982; Bromage *et al.*, 1992). An increase in fecundity with the increase in body weight was also reported in various fishes notably, *Mastacembelus pancalus* by (Karim and Hossain 1972), *Puntius sarana* (Mustafa *et al.,* 1983) and *Sarotheradon nilotica* (Mian and Dewan, 1984). In this case, fecundity was estimated based on the method described by (Blay, 1981). It was observed during this present investigation that the fecundity increases with the increase in total length, body weight, and gonad weight of the species. Monthly variation in the fecundity of *C. dussumeiri* ranged from 1040-10780 eggs. The highest fecundity with a peak value of 10780 eggs was recorded during the month of September and the lowest fecundity value of 1040 eggs was recorded during the month of April. Moreover, Gadgil (1967) also reported that the fecundity of *C. dussumieri* ranged from 1200-4200. Naung (2018) reports Fecundity ranged from 100 to 5000 eggs/female (females 15.7 to 19 cm total length). As shown in Fig-3, the fecundity in the present study is much higher than the estimated fecundity given by (Gadgil, 1967; Naung, 2018). Variation in fecundity is common in fish because it depends on multiple factors, including the fish stock, nutritional status, and intrinsic characteristics such as size, age, and sex, as well as environmental conditions and the availability of space and food.The study of fecundity indicated a linear relationship with total length, body weight, and gonad weight. Similar relationships have also been observed earlier by Banu *et al.* (1984) in *Liza parsia*.

5 | Conclusion

This study highlights the reproductive characteristics of *Coilia dussumieri* from the mid-southern coast of Bangladesh. This study demonstrates that *Coilia dussumieri* exhibits positive allometric growth (b = 3.14), high fecundity (1040–10780 eggs), and a prolonged breeding season from August to March, with a peak in September. The species is a multiple spawner, with larger individuals contributing more significantly to reproduction. Based on these findings, effective management measures should include implementing a seasonal fishing ban during peak spawning months, particularly September, and possibly extending from August to October. Establishing minimum catch size limits to protect immature individuals and conserving key coastal and estuarine breeding habitats are also recommended. These measures will help ensure sustainable exploitation and long-term conservation of *Coilia dussumieri* in Bangladesh.

Author Contributions

Farhana Yasmin, Md. Monjurul Hasan, Md. Rahamat Ullah, Aovijite Bosu, and Mousumi Akhter: Conceptualization, data collection, data analysis, interpretation, manuscript writing and editing. Abu Bakker Siddique Khan and Mohammed Ashraful Haque: Conceptualization, data collection, data analysis, fund acquisition, manuscript writing and editing. Md. Amirul Islam: Conceptualization, data collection, data analysis, supervision. Anuradha Bhadra: Conceptualization, data collection, data analysis, 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.

References

Banu, N., Ali, S., & Bhakta, N. C. (1984). *The fecundity of Colisa fasciata (Bloch and Schneider) (Perciformes Anabantidae) of Dharmic Para, Dhaka District* [Paper presentation]. Fourth National Zoological Conference, Dhaka, Bangladesh.

Biswas, S. P. (1982). *Studies on certain aspects of the biology of Labeo pangusia and Labeo dero in North-East India* [Doctoral dissertation, North Eastern Hill University].

Blay, J. (1981). Fecundity and spawning frequency of *Sarotherodon galilaeus* in a concrete pond. *Human and Social Science*, 54.

Bromage, N., Jones, J., Randall, C., Thrush, M., Davies, B., Springate, J., Duston, J., & Baker, G. (1992). Brood stock management, fecundity, egg quality and the timing of egg production in the rainbow trout (*Oncorhynchus mykiss*). *Aquaculture*, *100*(1-4), 141–166.

Gadgil, M. (1967). On some aspects of the biology of *Coilia dussumieri* (Cuv. and Val.). *Journal of the Bombay Natural History Society*, *64*(1), 55–69.

Hunter, J.R., Macewicz, B.J., Lo, N. C. H., & Kimbrell, C. M. (1992). Fecundity, spawning and maturity of female Dover Sole, *Microstomus pacificus*, with an evaluation of assumptions and prediction. *Fishery Bulletin*, *90*(1), 101–108.

Karim, M. A., & Hossain, A. (1972). Studies on the biology of *Mastacembelus pancalus* (Spiny eel) in artificial ponds: Part II. Sexual maturity and fecundity. *Bangladesh Journal of Biological and Agricultural Sciences*, *1*, 15–18.

Lagler, K. F. (1962). *Freshwater fishery biology* (2nd ed.). WMC Brown Company Publishers.

Le Cren, E. D. (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in perch. *Journal of Animal Ecology*, *20*(2), 201–219.

Mian, A. M., & Dewan, S. (1984). Studies on the fecundity of *Sarotherodon nilotica* (Linnaeus) in a fish pond. *Bangladesh Journal of Zoology*, *12*(2), 99–103.

Mithu, M. M., Alam, M. J., Siddique, M. A. T., Sukhan, Z. P., Kabir, M. S., Hossain, M., & Rashid, H. (2013). *An investigation of the reproductive physiology of endangered mud eel Monopterus cuchia* [Paper presentation]. 4th International Conference on Environmental Aspects of Bangladesh, Fukuoka, Japan.

Mustafa, G., Islam, K. R., Ali, S., & Ashraftil-Alain, A. K. M. (1983). Some aspects of the biology of *Puntius sarana* (Hamilton): 1. Food and feeding habits in relation to fish size and fecundity. *Bangladesh Journal of Zoology*, *10*, 92–100.

Naung, N. O. (2018). Early life distribution of gold spotted grenadier anchovy *Coilia dussumieri* Valenciennes, 1848 at Ye River Estuary, southern

Mon coastal water. *Journal of Aquaculture & Marine Biology*, *7*(2), 114–119.

Riede, K. (2004). *Global register of migratory species: From global to regional scales* (Final Report of the R&D-Project 808-05-081, Vol. 3). Federal Agency for Nature Conservation.

Sivakumaran, K. P., Brown, P., Stoessel, D., & Giles, A. (2003). Maturation and reproductive biology of female wild carp, *Cyprinus carpio*, in Lake Victoria, Australia. *Environmental Biology of Fishes*, *68*(3), 321–332.

Towhid, F. A. (1994). *On the study of gold-spotted grenadier anchovy Coilia dussumieri Cuv. and Val. 1848 from the landing centers and markets of Chittagong* [Master's thesis, University of Chittagong].

Verghese, T. J. (1961). Some observations on the biology of *Coilia borneensis* (Bleeker). *Indian Journal of Fisheries*, *8*(2), 312–325.