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Status and Performance of Natural Carp Breeding in Kaptai Lake, Bangladesh

Kazi Belal Uddin [1*] | M.A. Bashar [1] | A.K.M. Saiful Islam [1]

[1]Riverine Sub-Station, Bangladesh Fisheries Research Institute (BFRI), Rangamati Hill Tracts, Bangladesh

Correspondence: Kazi Belal Uddin (belal_bau@yahoo.com)

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ABSTRACT

Bangladesh. The study was conducted to determine the natural reproductive success of major carp in Kaptai Lake. The study was carried out at the four previously identified natural breeding grounds of Kaptai Lake from 2016 to 2018. Based on observed values of Gonadosomatic Index (GSI) of major carp species, it can be regarded that May and June are the peak breeding season in each year. Post-nursing period survey results indicated that fingerlings of different carps (Rui, Catla, Mrigal, Calibaush, Bata) are present in the breeding and nursing grounds. Among the identified species, 28% Rui, 12% Catla, 29% Mrigal, 8% Kalibaush, and 23% Bata. In the present study, investigations were made on a few physical and chemical factors of the water in the breeding grounds of the lake. The recorded values of air and water temperature, pH, water depth, and transparency did not change significantly among the sampling areas ($P>0.05$). Dissolved oxygen (DO) was found higher in the Chengi channel, followed by Rainkhiang, Kasalong, and Barkal channels. Also, higher free CO_2 concentration was found in the Chengi and Rainkhiang channels than in Kasalong and Barkal. The total alkalinity was found higher in the Chengi and Rainkhiang channels, followed by Kasalong and Barkal. The contribution of total hardness was also exhibited higher in the Barkal channel than in those of Chengi, Rainkhiang, and Kasalong. Among Phytoplankton and Zooplankton, the dominant orders were Chlorophyceae and Rotifers, respectively. The highest rainfall in the lake area was found in June and July, which has a direct impact on the natural breeding of carps in Kaptai Lake.

Keywords: Major Carp, GSI, Natural Breeding, Limnology

1 | Introduction

Kaptai Lake (22°29′45″N, 92°13′45″E) is one of the most important inland freshwater fisheries resources in Bangladesh, which plays a significant role in the annual fish production of the country. It is the largest man-made reservoir in South-East Asia, with an area of 68,800 ha when full inundation occurs (Fernando, 1980). Kaptai Lake is one of the important natural habitats and breeding grounds of indigenous fish in Bangladesh. Among 73 species of fish in the Kaptai reservoir, most breed naturally (Ahmed et al., 2006). But in recent years, the natural breeding habitat of the lake has been drastically degraded as a result of indiscriminate fishing practices, use of destructive fishing gear, siltation and erosion of river basins, application of pesticides and herbicides during rice cultivation in adjacent land (Alamgir and Ahammed, 2008).

Fish production from the reservoir has increased steadily from the beginning, and now the total amount of fish production is 10,578 MT (DoF, 2020). But the production of commercially important Indian Major Carps (IMC; Rui, Catla, Mrigal, Kalibaush) decreased dramatically at a very alarming rate. However, every year, a huge number of IMC fingerlings were stocked, but the population of IMC decreased to around 5% in 2009 from 81.4% in 1966 (Ahmed et al., 2006;

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Alamgir and Ahammed, 2008). Several studies were conducted to know the breeding grounds of IMC species of the lake, and four major spawning grounds were identified (Azadi, 1985, ARG, 1986, Hye and Alomgir, 1992). BFRI-RSS (2000) suggests that the natural spawning of important IMC has declined since the 1990s. Ahmed (1999) suspected that siltation due to shifting cultivation, high water level fluctuation, lack of rainfall, and thundershowers at the breeding time are the major causes for reduced natural spawning. Still, low current velocity during the breeding season and fishing pressure are also suspected.

Several investigations were carried out from the beginning of the reservoir establishment to know the limnological parameters of the lake. Investigations on limnological parameters and primary production of the lake were done by Sandercock, 1966; Chowdhury, 1980; Chowdhury and Mazumder, 1981; Chowdhury and Khair, 1982; ARG, 1986; Hye and Alamgir, 1992; Haldar et al., 1992, and Ahmed et al., 1994. Physicochemical parameters were found within suitable ranges for fish in different areas of the reservoir (Moniruzzaman et al., 2015a; Uddin et al., 2014). Still, little variation in total hardness and total alkalinity was found by Bashar et al. (2015b).

Information on the present status of the natural breeding ground of IMC in Kaptai Lake is scanty. In the present study, the status of the natural breeding ground of IMC in Kaptai Lake and its different aspects were studied for developing a comprehensive management plan for the carps of Kaptai Lake.

2 | Materials and Methods

2.1 Study area

The study was conducted in the previously identified four natural breeding grounds of Kaptai lake (Fig. 1). Study areas are as follows: 1) Kasalong Channel: Mynimukh and upwards; 2) Barkal Channel: Jagannathchari and upwards 3) Chengi Channel: Naniarchar and upwards 4) Rainkhiang Channel: Bilaichari to Chakrachari and upwards. The study was carried out in four natural breeding grounds of Kaptai Lake from 2016 to 2018.

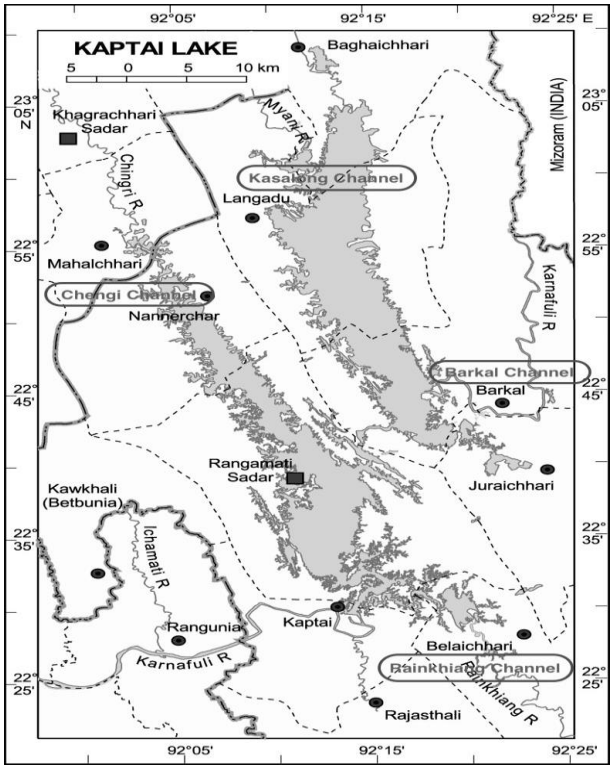

Figure 2 | Map of Kaptai lake with natural breeding ground (shown in red circle)

2.2 Gonadosomatic Index (GSI) and gonadal maturity

Samples of different carps (Rui, Catla, Mrigal, Kalibaush, Bata) broodfish were collected from the local fish market of Kaptai Lake during the peak breeding season to estimate Gonadosomatic Index (GSI) and gonadal maturity. Gonadosomatic index (GSI) of the female fish of the collected samples were determined by the following method.

Gonadosomatic Index (GSI) (%) = Weight of the gonad (g)/Weight of the fish (g) x 100

2.3 Egg collection and species identification

The study was conducted at different natural breeding locations, considering the previously reported breeding grounds. The fertilized eggs were collected directly from different spots of the Kasalong (forest ghat, mastaner tila) and Barkal breeding channel at the time of peak natural breeding season (May- July). Locally made wooden boats were used for egg collection. A nylon-made small mesh net was used as an egg-collecting net. Long bamboo was used for fixing the net around the shallow areas of the channel. Collected fertilized eggs were transferred from the net into the plastic bucket with channel water. Then, the eggs were transported to the pit and circular tank at the Bangladesh Fisheries Development Corporation (BFDC) hatchery for hatching. After hatching, they were released in the nursing creek for fingerling production. Spawn of 4-day age was stocked in the nursery creek. At the end of 45 days of nursing, the species were identified, and the percent composition is known.

2.4 Physicochemical parameters of the breeding ground

Physicochemical parameters viz., air and water temperature (°C), transparency (m), pH, dissolved oxygen (DO; mg/L), hardness (mg/L) and total alkalinity (mg/L) were monitored monthly in the morning between 8.00 and 9.00 a.m. during the whole study period. Water temperature was recorded with a glass Celsius Thermometer; water transparency was recorded with a Secchi disc; water depth was measured manually using a scale; pH was measured using a digital pocket pH meter (model-HI 98107 pHep® HANNA Instruments, Carrollton, TX, USA). Other chemical parameters were measured using a HACH kit box (model FF-2, No. 243001, Loveland, CO, USA).

2.5 Biological Parameters of the breeding ground

A sampling of the plankton assemblage from subsurface water was conducted monthly using a plankton net (20 µm) for qualitative and quantitative analysis. A total of 50 L of water was passed through the plankton net, and the collected sample was then transferred into a 100 mL sample bottle. The sample was preserved immediately in a sample bottle with 5% formalin. After preservation, the plankton samples were carried out to the Soil and Water Quality Laboratory of Riverine Sub-station (RSS), Bangladesh Fisheries Research Institute (BFRI), Rangamati, for further analysis. Taxa of plankton were identified to genus level using the binocular microscope. Identification was completed by following Moniruzzaman (1997). For quantitative analysis of plankton, 1 ml of concentrated plankton sample from each preserved sample was taken by a dropper and then placed on the counting chamber of the S-R (Sedgwick-Rafter) cell. Plankton cells were counted following the simple method described by Vollenweider (1971). The following formula (Rahman, 1992) was used to count plankton:

$$\text{Number of plankton, } N = \frac{A \times C}{F \times V \times L} \times 1000$$

Where, N = number of plankton cells per liter; A = total number of plankton counted; C = volume of final concentration of sample; F = number of field counts; V = volume of the S-R cell field; L = volume of original water. The number of cells per mm was multiplied by a correction factor to adjust the number of organisms per liter (APHA, 1976).

2.6 Hydrological Parameter

The last 10 years of rainfall data during the peak breeding season (May-July) were collected from the local weather department.

2.7 Statistical analysis

The mean values for water quality parameters of different areas were subjected to one-way ANOVA followed by Duncan's New Multiple Range Test. All statistical analyses were performed using IBM SPSS software (SPSS Inc., version 23.0, Chicago, IL, USA). The standard deviation of each parameter and treatment was determined and expressed as mean ± SD. Treatment effects were considered with the significant level at $P<0.05$.

3 | Results and Discussion

3.1 Gonadosomatic Index (GSI) and gonadal maturity

Gonadosomatic Index (GSI) of carps from April to July from Kaptai Lake are presented in Fig. 2. The GSI increased with the maturation of fish and reached its maximum at the peak period of maturity. The GSI of Rui (Labeo rohita), Catla (Catla catla), Mrigal (Cirrhinus cirrhosus), Kalibaush (L. calbasu), and Bata (L. bata) ranged from 5.6 to 11.12, 4.75 to 12.27, 6.34 to 17.42, 2.83 to 16.64, and 4.11 to 12.44, respectively. For Rui, Catla, and Mrigal, the peak GSI was found in June and the minimum in April. However, in the case of Kalibaush and Bata, the GSI was found to peak in July and June, and the minimum GSI was found in April and July, respectively. The high value of GSI is indicative of a mature stage of gonads in the fish. The mature ova are round and heavily laden with yolk. Shaikh and Prakash (2011) recorded GSI in Rui, Catla, and Mrigal fish species collected from Hatnoor reservoir, Maharashtra, India, their peak GSI value was found in June, and the minimum was in January. Mishra and Saksena (2012) found that the GSI of Kalibaush (L. calbasu) ranged from 18.22 to 22.10, found peak in July, then decreased in August in Gohad Reservoir, India. Based on observed values of GSI in carp species of Kaptai Lake, it can be concluded that in a reproductive life cycle of adult major carp fish, May and June are the peak breeding season in each year.

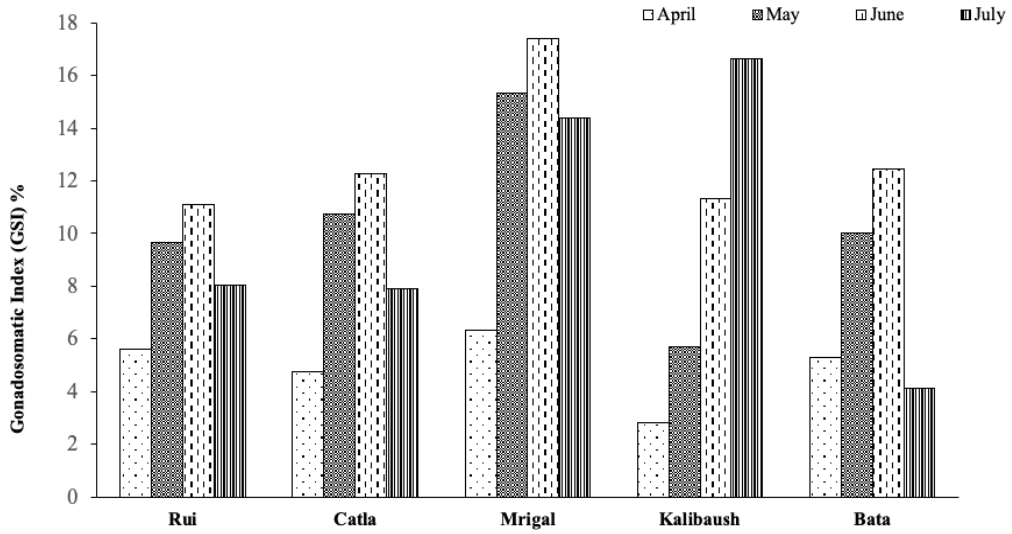

Figure 2 | Gonadosomatic Index (GSI) of Carps during April to July from Kaptai Lake

3.2 Natural breeding, Egg collection, and species identification of major carps in Kaptai Lake

On 2 and 3 June 2017, fertilized eggs of carps were collected from the Kasalong and Barkal breeding channel, which reconfirmed the success of the natural spawning of major carps at Kaptai Lake (Fig. 3). Alamgir and Ahammed (2008) also recorded the natural breeding of carps in June and July months in Kaptai Lake. After nursing, fingerling of different carps (Rui, Catla, Mrigal, Calibaush, Bata) was identified (Fig. 4). Among them, 28% Rui, 12% Catla, 29% Mrigal, 8% Kalibaush, and 23% Bata. Alamgir and

Ahammed (2008) recorded 79% Rui, 13% Catla, 8% Mrigal fingerlings from carps natural breeding in 2003 and 2004. Hye and Alamgir (1992) collected many eggs of carps from the Myani river near Longadu and raised fingerlings from the hatchlings obtained thereby. The natural spawning of all major carps and production of hatchlings was confirmed in Kaptai Lake (Azadi 1985, ARG 1986, and Hye and Alamgir 1992).

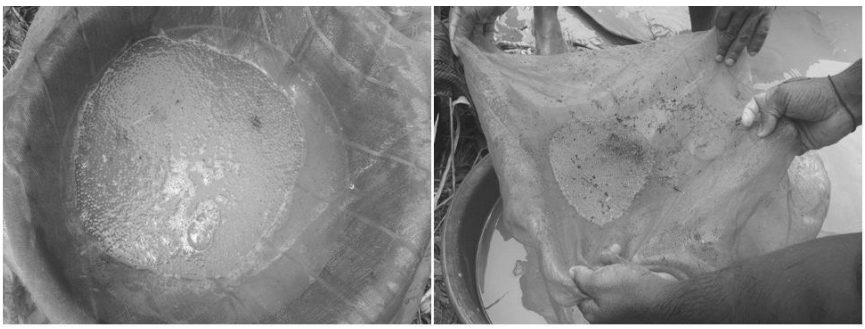

Figure 3 | Fertilized eggs of carps in Kasalong channel at Kaptai Lake

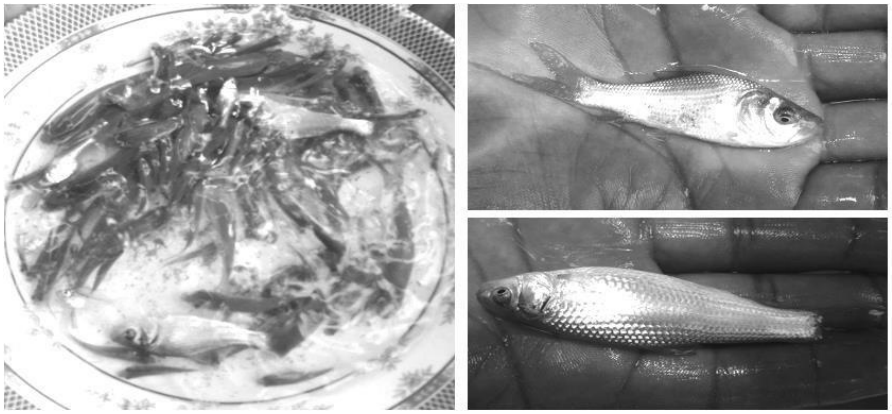

Figure 4 | Fingerling of raised carps from hatchlings.

3.3 The present condition of the breeding channel

a) The depth of the breeding grounds has decreased due to siltation, which may be caused by shifting cultivation practices in the hilly areas. In the Chengi channel, the highest recorded water depth was 8.81 m in October 2016, while the lowest was 1.16 m in May 2017. In the Riankhang channel, the maximum depth was 5.91 m in October 2016, and the minimum was 1.04 m in May 2017. In the Barkal channel, the highest depth was 9.24 m in September 2015, and the lowest was 1.28 m in May 2015. In the Kasalong channel, the maximum depth was 6.16 m in September 2015, whereas the minimum was 1.04 m in May 2015.
b) Fish migration routes, spawning grounds, and feeding areas are likely to be altered or obstructed. As a result, brood fish are unable to complete their pre-spawning migration.
c) The production of carp fingerlings has reportedly declined due to the lack of optimal water flow, which reduces natural spawning rates and decreases natural seed production.
d) A rubber dam was constructed in 2013 at Panchari, in the upper section of the Chengi channel. This structure restricts the pre-spawning migration of major carps and affects the nursing of fry and juveniles. It has also

degraded breeding habitats by reducing water flow during late winter.

3.4 Physicochemical parameters of the breeding ground

In the present study, investigations were also made on a few physical and chemical factors of the water of the breeding ground of Kaptai Lake. Mean values (±SD) and ranges of water quality parameters over the study period from the natural breeding ground of Kaptai Lake are presented in Table 1. Air and water temperatures, pH, water depth, and transparency did not change significantly among treatments ($P>0.05$). The air and water temperature in the experimental areas were found to vary from 20 to 32oC and 19 to 30oC, respectively. These air and water temperatures are supposed to be suitable for the growth of fish. The range of temperature in the experimental areas was within the acceptable ranges for fish, and these findings agree with the findings of Uddin et al., 2015; Uddin et al., 2016; Bashar et al., 2015a; Bashar et al., 2015b; Moniruzzaman et al., 2015a; Moniruzzaman et al., 2015b. For optimal fish growth, DO levels should be above 5 ppm for warm water fish species (Boyd, 1982). The concentration of DO in the experimental areas were found between 5.0 and 9.0 mg/L, which is within the acceptable ranges for fish and coincides with the findings of Uddin et al., 2015; Bashar et al., 2015a; Bashar et al., 2015b; Alamgir, 2004. Among the study areas, significantly higher DO concentration was found in Chengi channel than those of Rainkhiang, Kasalong, and Barkal channel. The result of free CO2 in the experimental sites ranged between 2.13 and 10 mg/L. Among the different study areas of Kaptai Lake, significantly higher free CO2 concentration was found in the Chengi and Rainkhiang channels than those in the Kasalong and Barkal channels ($P<0.05$). In this study, free CO2 was found suitable for fish throughout the study period. In this study, pH ranged from 6.5 to 8.0; the observed pH values were favorable for fish growth and agreed well with the findings of Uddin et al., 2015; Bashar et al., 2015a; Alamgir, 2004; Robert, 1940. The values of pH recorded in this experiment were found within acceptable limits and indicated the water body's productive nature. Total alkalinity of different study areas varied from 17.1 to 68.4 mg/L. Among the different study areas, significantly higher total alkalinity was found in Chengi and Rainkhiang channels than in Kasalong and Barkal channels ($P<0.05$). Natural water, which contains 40 mg/L or more total alkalinity, are considered hard water for biological purposes (Rahman and Marimuthu, 2010). Total alkalinity levels in the present study indicate a medium productive lake (Alamgir, 2004; Bhuiyan, 1970). Total hardness of different areas varied from 34.2 to 119.7 mg/L. Among the study areas, significantly higher total hardness concentration was found in the Barkal channel than those in Chengi, Rainkhiang, and Kasalong channel ($P<0.05$). Water depth and transparency ranged from 1.04 to 9.24 m and 0.34 to 2.53 m, respectively, during the study period.

Table 2 Water quality parameters as obtained from the natural breeding ground of Kaptai Lake during the study period

Water Quality Parameters	Natural Breeding Ground of Kaptai Lake			
	Chengi channel	Rainkhiang channel	Kasalong channel	Barkal channel
Air Temp. (^{0}C)	26.5±3.37^a (20-31)	27.7±2.21^a (24-31)	28.3±2.87^a (24-32)	28.7±2.21^a (25-31)
Water Temp.(^{0}C)	25.4±3.06^a (19-29)	26.7±1.34^a (25-29)	25.8±3.85^a (18-29)	26.4±2.76^a (21-30)

DO (mg/l)	7.3±0.95[a]	6.2±0.79[b]	5.9±0.74[b]	6.5±0.97[b]
	(6-9)	(5-7)	(5-7)	(5-8)
CO_2 (mg/l)	8.1±2.28[a]	7.8±2.49[a]	4.34±2.25[b]	3.48±0.80[b]
	(5-10)	(5-10)	(2.13-10)	(2.36-5)
pH	7.25±0.26[a]	7.25±0.26[a]	7.2±0.35[a]	7.25±0.42[a]
	(7-7.5)	(7-7.5)	(6.5-7.5)	(6.5-8)
Total alkalinity (mg/l)	59.85±12.09[a]	59.85±9.01[a]	41.04±11.96[b]	46.17±14.08[b]
	(34.2-68.4)	(51.3-68.4)	(17.1-51.3)	(17.1-68.4)
Total Hardness (mg/l)	44.46±11.96[a]	41.04±8.83[a]	54.72±15.71[a]	78.66±24.45[b]
	(34.2-68.4)	(34.2-51.3)	(34.2-85.5)	(51.3-119.7)
Water depth (m)	5.79±2.08[a]	4.09±1.51[a]	4.31±1.76[a]	6.29±2.7[a]
	(2.07-8.81)	(1.65-5.91)	(1.04-6.16)	(1.28-9.24)
Transparency (m)	1.25±0.59[a]	1.12±0.64[a]	1.53±0.77[a]	1.44±0.36[a]
	(0.73-2.39)	(0.49-2.26)	(0.34-2.53)	(0.79-1.89)

Values in each row having the same superscripts are not significantly different (P>0.05).

3.5 Biological parameters of the breeding ground

The phytoplankton populations comprise four orders: Euglenophyceae, Cyanophyceae, Bacillariophyceae, and Chlorophyceae. In the Chengi channel, the phytoplankton community was dominated by Chlorophyceae (59%), followed by Cyanophyceae (24%), Bacillariophyceae (10%), and Euglenophyceae (7%) (Fig. 5A). Similarly, the Riankhang channel showed Chlorophyceae (60%) as the dominant group, followed by Cyanophyceae (23%), Bacillariophyceae (11%), and Euglenophyceae (6%) (Fig. 5B). In the Kasalong channel, Chlorophyceae (45%) remained predominant, while Bacillariophyceae (19%) and Euglenophyceae (14%) were comparatively higher, alongside Cyanophyceae (22%) (Fig. 5C). In the Barkal channel, Chlorophyceae (48%) led the population, followed by Bacillariophyceae (23%), Cyanophyceae (19%), and Euglenophyceae (10%) (Fig. 5D). Ahmed et al. (1993) recorded 29 genera of phytoplankton belonging to 13 orders from Kaptai Lake during their study period from June 1990 to May 1991. Among the identified phytoplankton, 77.5% were Chlorophyceae, 17% were Cyanophyceae, 4.4% were Bacillariophyceae, and 1.1% were Euglenophyceae. Additionally, Chlorophyceae was shown to be the predominant phytoplankton order in every study area.

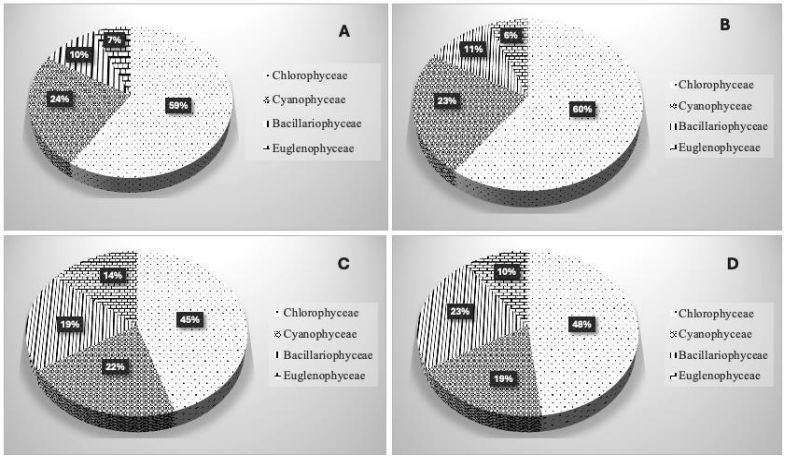

Figure 5 Percentage of phytoplankton obtained from study areas during the study period (A. Chengi channel; B. Rainkhiang channel; C. Kasalong channel; D. Barkal channel)

The zooplankton population includes three orders: Rotifers, Copepoda, and Cladocera. Zooplankton communities in all breeding channels were dominated by Rotifers. In the Chengi channel, Rotifers accounted for 50%, followed by Cladocera (31%) and Copepoda (19%) (Fig. 6A). In the Riankhang channel, Rotifers comprised 56%, with Cladocera (27%) and Copepoda (17%) (Fig. 6B). In the Kasalong channel, Rotifers made up 53%, followed by Cladocera (38%) and Copepoda (9%) (Fig. 6C). In the Barkal channel, Rotifers represented 50%, while Cladocera and Copepoda accounted for 43% and 7%, respectively (Fig. 6D). Ahmed et al. (1993) in their study observed eight genera of zooplankton belonging to three orders from Kaptai Lake from June 1990 to May 1991. They found Rotifers 57.7%, Copepoda 41%, and Cladocera 1.3% throughout the study period. Bashar et al. (2015) found a total of 10 zooplankton genera under three orders were recorded from the five different sampling points of Kaptai Lake during their study period. Our present study also agrees with previous findings. ARG (1986) also reported 99% rotifers from Kaptai reservoir in their study and regarded Kaptai Lake as a "Reservoir of Rotifers." Ahmed et al. (1993) described that plankton production depends on physicochemical and biological factors and reported no significant correlation between zooplankton and any single physicochemical factors.

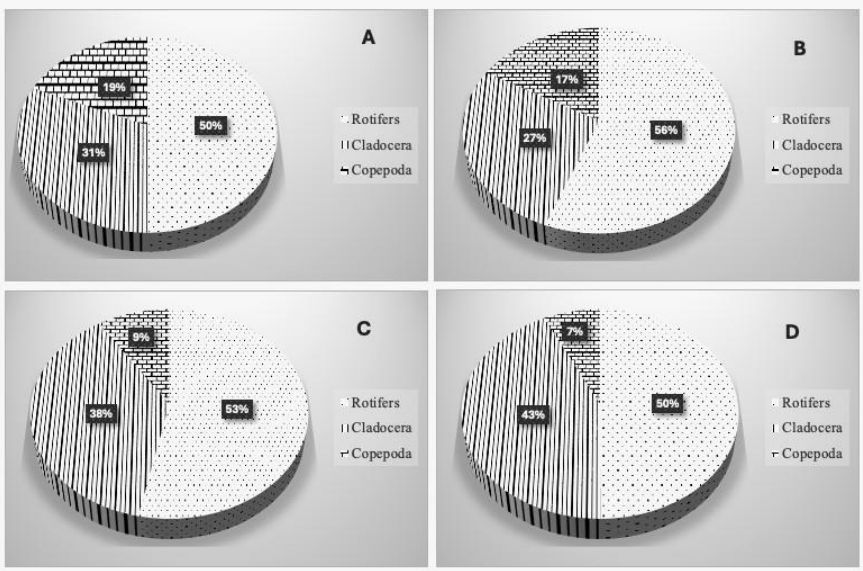

Figure 6 Percentage of zooplankton obtained from study areas during the study period (A. Chengi channel; B. Rainkhiang channel; C. Kasalong channel; D. Barkal channel)

3.6 Hydrological Parameter

The highest rainfall in Kaptai Lake was found in June and July months (Fig. 7). Alamgir & Ahammed (2008) found that rainfall directly impacts the natural breeding of carps in Kaptai Lake. They also recorded the highest rainfall in June and July months.

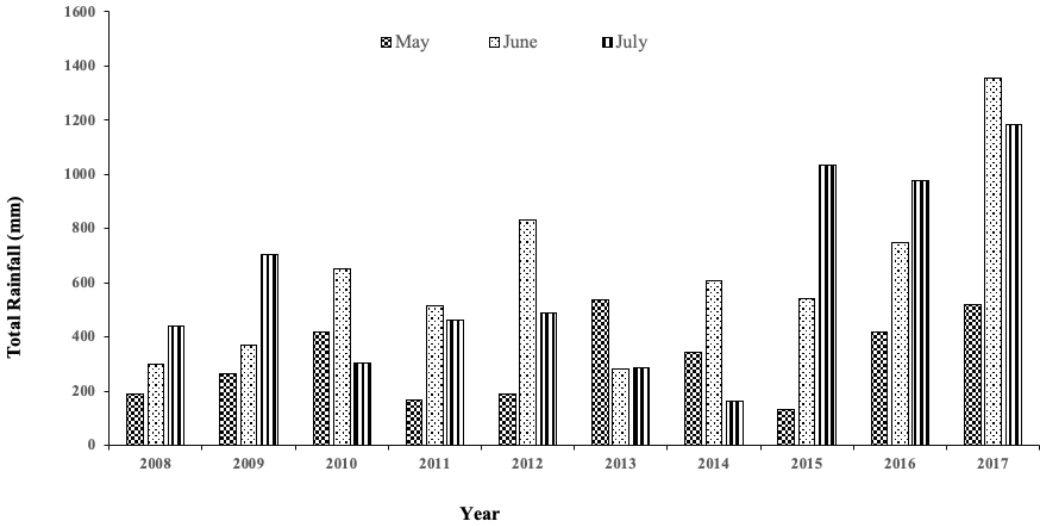

Figure 7 | Ten years rainfall data during peak breeding season of carps

4 | Conclusion

The study confirms that natural breeding of Indian Major Carps (IMC) still successfully occurs in Kaptai Lake, peaking during the high-rainfall months of May and June. While the lake's water quality and abundant plankton populations remain highly favorable for fish growth, the natural sustainability of these carps is under severe threat. Siltation from shifting cultivation has drastically reduced river depths, while physical barriers like the Panchari rubber dam obstruct critical pre-spawning migration routes. To reverse the decline of commercially valuable carps, management strategies must shift from simple fingerling stocking toward protecting these natural breeding channels, restoring water flow, and preventing habitat degradation.

Author Contributions

Kazi Belal Uddin: Conceptualization, data collection, data analysis, interpretation, manuscript writing and editing. M.A. Bashar: Conceptualization, data collection, data analysis, fund acquisition, manuscript writing and editing. A.K.M. Saiful Islam: Conceptualization, data collection, data analysis, supervision. 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

Ahmed, K. K. U. (1999). *Options for the management of major carp fishery in the Kaptai Reservoir, Bangladesh* [Doctoral dissertation, School of Environment, Resources and Development]. Asian Institute of Technology.

Ahmed, K. K. U., Haldar, G. C., Saha, S. B., & Paul, S. K. (1994). Studies on the primary production in Kaptai Reservoir. *Bangladesh Journal of Zoology*, *22*, 69–77.

Ahmed, K. K. U., Halder, G. C., & Saha, S. B. (1993). *Limnological studies on Kaptai Lake* (Final Report, pp. vii+36). Fisheries Research Institute.

Ahmed, K. K. U., Rahman, S., & Ahammed, S. U. (2006). Managing fisheries resources in Kaptai reservoir, Bangladesh. *Outlook on Agriculture*, *35*(4), 281–289.

Alamgir, M. (2004). Impact of physico-chemical parameters on the changing pattern of production potentiality of Kaptai Lake. *Bangladesh Journal of Zoology*, *5*.

Alamgir, M., & Ahammed, S. U. (2008). *Sustainable management techniques of Kaptai Lake fisheries* (71 p.). Bangladesh Fisheries Research Institute (BFRI).

American Public Health Association (APHA). (1976). *Standard methods for the examination of water and waste water*. American Public Health Association.

Aquatic Research Group (ARG). (1986). *Hydrobiology of the Kaptai reservoir* (FAO/UNDP Final Report DP/BGD/79/015-4/FI, 192 pp.). FAO.

Azadi, M. A. (1985a). Hydrological conditions influencing the spawning of major carps in the Halda river, Chittagong, Bangladesh. *Bangladesh Journal of Zoology*, *13*, 163–172.

Azadi, M. A. (1985b). Spawning of commercial freshwater fish and brackish and marine water shrimps of Bangladesh. *Egd. Fish. Int. Bull.*, *2*(2), 1–74.

Bashar, M. A., Basak, S., Uddin, K. B., Islam, A. K. M. S., & Mahmud, Y. (2015a). Seasonal variation of zooplankton population with reference to water quality of Kaptai Lake, Bangladesh. *Bangladesh Research Publications Journal*, *11*(2), 127–133.

Bashar, M. A., Basak, S., Uddin, K. B., Islam, A. K. M. S., & Mahmud, Y. (2015b). Changing trends of physicochemical parameters in Kaptai Lake of Bangladesh. *Research in Agriculture, Livestock and Fisheries*, *2*(2), 319–327.

BFRI-RSS. (2000). *Studies of production potentiality and management of fisheries of Kaptai Lake* (Annual Progress Report 1999–2000). BFRI-RSS.

Bhuiyan, B. R. (1970). Physico-chemical qualities of some ancient tanks of Sibsagar, Assam. *Environmental Health*, *12*, 129–134.

Boyd, C. E. (1982). *Water quality management for pond fish culture* (p. 318). Elsevier.

Chowdhury, S. C. (1980). *A preliminary report on the phytoplankton of Kaptai Lake with reference to some physico-chemical factors* [Master's thesis, University of Chittagong]. University of Chittagong.

Chowdhury, S. C., & Khair, A. (1982). The phytoplankton members of Kaptai Lake, Chittagong Hill Tracts-I: Desmidiaceae. *Chittagong University Studies (Part II)*, *6*, 129–136.

Chowdhury, S. H., & Mazumder, A. (1981). Limnology of Lake Kaptai-I: Physico-chemical features. *Bangladesh Journal of Zoology*, *9*(1), 59–72.

Department of Fisheries (DoF). (2020). *National Fish Week 2020 Compendium* (160 pp.). Ministry of Fisheries and Livestock.

Fernando, C. H. (1980). The fishery potential of man-made lakes in Southeast Asia and some strategies for its optimization. In *BIOTROP Anniversary Publication* (pp. 25–38). SEAMEO Regional Center for Tropical Biology (BIOTROP).

Haldar, G. C., Mazid, M. A., & Ahmed, K. K. (1992). Limnology and primary production of Kaptai lake, Bangladesh. In S. S. De Silva (Ed.), *Reservoir Fisheries of Asia: Proceedings of the 2nd Asian Reservoir Fisheries Workshop* (pp. 2–11). International Development Research Centre (IDRC).

Halder, G. C., Mazid, M. A., Haque, K. I., Huda, S., & Ahmed, K. K. (1991). A review of the fishing fauna of

Kaptai Reservoir. *Bangladesh Journal of Fisheries*, *14*(1-2), 127–135.

Hye, M. A., & Alomgir, M. (1992). Investigation on natural spawning of carps in lake Kaptai. *Bangladesh Journal of Zoology*, *20*(1), 27–33.

Mishra, S., & D. N. Saksena. (2012). Gonadosomatic index and fecundity of an Indian major carp *Labeo calbasu* in Gohad Reservoir. *The Bioscan*, *7*(1), 43–46.

Moniruzzaman, K. (1997). *Practical limnology and systematic of freshwater hydrophytes* (pp. 215–323). Dhaka University.

Moniruzzaman, M., Uddin, K. B., Basak, S., Bashar, M. A., Mahmud, Y., Zaher, M., Lee, S., & Bai, S. C. (2015b). Effects of stocking density on growth performance and yield of Thai silver barb (*Barbonymus gonionotus*) reared in floating net cages in Kaptai Lake, Bangladesh. *AACL Bioflux*, *8*(6), 999–1008.

Moniruzzaman, M., Uddin, K. B., Basak, S., Mahmud, Y., Zaher, M., & Bai, S. C. (2015a). Effects of stocking density on growth, body composition, yield and economic returns of monosex tilapia (*Oreochromis niloticus* L.) under cage culture system in Kaptai Lake of Bangladesh. *Journal of Aquaculture Research & Development*, *6*, 357.

Rahman, M. A., & Marimuthu, K. (2010). Effect of different stocking density on growth, survival and production of endangered native fish climbing perch (*Anabas testudineus*, Bloch) fingerlings in nursery ponds. *Advances in Environmental Biology*, *4*(2), 195–201.

Rahman, M. S. (1992). *Water quality management in aquaculture* (84 p.). BRAC Prokashana.

Robert, C. S., & Grindley, W. E. (1940). *Chemical methods for the study of river pollution*. H.M.S.O. Fishery Investigations Series 1, *4*(2).

Sandercock, F. K. (1966). *Chittagong Hill Tracts soil and land use survey, 1964-65 (Volume 4: Fisheries)* (67 pp.). East Pakistan Agricultural Development Corporation / Canadian Colombo Plan Project F-475.

Shaikh, A. S., & Prakash, S. L. (2011). Biochemical composition and gonadosomatic index of three major carps in Hatnoor Reservoir, Maharashtra, India. *Journal of Ecobiotechnology*, *3*(6), 01–04.

Uddin, K. B., Basak, S., Moniruzzaman, M., Islam, A. K. M. S., & Mahmud, Y. (2015). Impact of brush shelter: A fish aggregating device (FAD) on the production potentiality of Kaptai Lake in Bangladesh. *World Journal of Fish and Marine Sciences*, *7*(4), 288–294.

Uddin, K. B., Islam, A. K. M. S., Basak, S. S., Rahman, M. M., Bashar, M. A., & Mahmud, Y. (2014). Species composition and abundance of fishes in the brush shelter fishery of Kaptai Lake. *Bangladesh Research Publications Journal*, *10*(3), 233–237.

Uddin, K. B., Moniruzzaman, M., Bashar, M. A., Basak, S., Islam, A. K. M. S., Mahmud, Y., Lee, S., & Bai, S. C. (2016). Culture potential of Thai climbing perch (*Anabas testudineus*) in experimental cages at different stocking densities in Kaptai Lake, Bangladesh. *AACL Bioflux*, *9*(3), 564–573.

Vollenweider, R. A. (1971). *A manual on methods for measuring primary production in aquatic environments* (IBP Handbook No. 12, 213 pp.). Blackwell Scientific Publications.