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Fecundity of *Glyptothorax telchitta* (Hamilton, 1822) from Tamor River, Nepal

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Abstract

The present study assesses the fecundity of *Glyptothorax telchitta*, a hill stream fish from the Tamor River, Nepal. A total of 60 specimens were collected from the Tamor River, with the help of local fishermen between March 2019 and February 2020. The absolute fecundity ranged from 3385 to 14298 eggs with the mean absolute fecundity of 9448.469 ± 607.783. The fish was found to be a medium fecund fish. Relative fecundity ranged from 151 to 529 eggs per gram body weight with mean relative fecundity of 371.38 ± 15.72. Fecundity showed significant positive correlations with ovary weight (r = 0.858) total length (r = 0.844) and total weight (r = 0.825). This indicated that fecundity dependent is mostly on ovary weight. Gonado-somatic index scored the peak values during March (15.15%) and May (15.01%), indicating the fish's spawning period during the spring season. Egg sizes varied from 0.382 mm to 1.149 mm. The appearance of various sizes of eggs in a single ovary indicated that the fish was a fractional spawner. The ovaries occupied maximum space in the abdomen during the breeding season.

Keywords: fecundiGanadolative fecundity, Gonado-somatic index, Egg size

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Introduction

Glyptothorax telchitta is a dirty brown coloured catfish having spindle shaped body covered with rough skin. It is an inhabitant of comparatively cold and hyperoxic waters of the hill streams of Nepal (Subba, 1999). It inhabits the freshwater bodies Southern Asia in the countries like Bangladesh, Srilanka and Pakistan (IUCN, 2010) and also native species of Nepal (Shrestha, 2008). Fecundity is defined as the number of eggs contained in the ovary prior to spawning period. Absolute fecundity is the number of eggs in the ovary of an individual fish. Relative fecundity is the number of eggs per kilogram weight of female fish.

Rajkant *et al.,* (2016) defined fecundity as the measure of reproductive capacity of a species and is studied to determine the productivity dynamics of a species concerned. Fecundity is an important aspect of fish biology and the knowledge of fecundity is essential for management of the fish population, cryopreservation of eggs, fish breeding, undertaking larval rearing etc. which are necessary for undertaking conservational measures (Bhattacharya & Banik, 2015). Fecundity is an important biological parameter that plays a significant role in evaluating the commercial potential of fish stocks (Gomez-Marquez, 2003). Gonado-somatic index (GSI) is an index that is widely used to indicate the maturity and periodicity of the spawning in the fish. The

variation observed in GSI provides a reasonable indicator of reproductive seasonability of fish (Jan & Ahmed, 2016). The knowledge of fecundity and spawning habit of fish is important to make efforts for increasing the amount of fish yield (Borthakur, 2018). Fecundity and GSI are the important parameters for the study of reproductive biology of any species that helps for the conservation and management of the particular species. Various factors like ecological conditions of rivers and arrival of monsoon affects the maturations of fishes (Rajbanshi *et al*., 2021).

Despite being abundance and kept in least concern of IUCN Red list (IUCN, 2010), very few information is available related to *Glyptothorax telchitta*. Thus, the present study attempts to explore the knowledge on fecundity, gonado-somatic index (GSI), egg size and also relationship of fecundity with body parameters. This would be a useful tool for the conservation and management of the specific species.

Materials and methods

Study area

Tamor River of eastern Nepal that lies between $26^0 54' 47''$ N and $87^0 09' 30''$ E is a major habitat of various hill stream fishes (Fig. 1). Tamor River is one of the major tributaries of Giant Saptakoshi river of Nepal. The river has a total length of 190km with a catchment area 5817 km^2 (Shrestha et al., 2009). The samples were collected from Yakchanaghat of Tamor River.

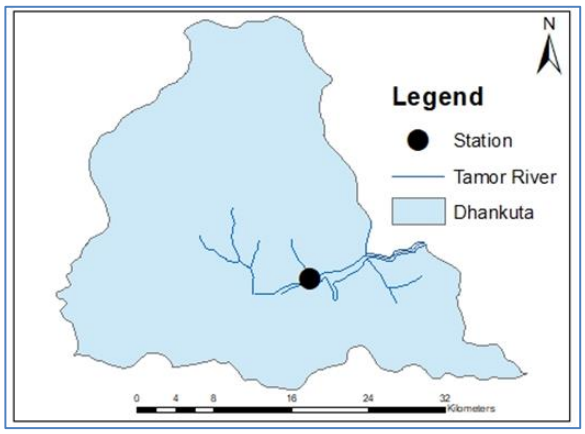

Figure 1. Study area showing different sampling site.

Sample collection

Fish sampling was done every month with the help of local fishermen from March 2019 to February 2020. A total of 60 fishes were collected from their natural habitat using different fishing gears like Cast net having mesh size of 0.5 cm, 3 m diameter and 2 kg weight, gill net, hooks and also fishing traps. The collected samples were than preserved in 8-10% formaldehyde solution and brought to the laboratory of Post Graduate Campus, Biratnagar for further study.

Study of biometric indices

Total length and total weight of each fish specimen were measured using measuring scale and digital weighing balance to the nearest 0.01cm and 0.01g respectively. Fishes were dissected ventrally in order to expose ovaries. The ovary of each fish was carefully taken out and soaked with blotting paper then weighed in weighing balance.

Fecundity assessment

A total of 32 matured female fish were studied for fecundity assessment. Fecundity was estimated using Gravimetric method (Simpson, 1959). The bi-lobed ovary was separated by cutting into three parts namely anterior, middle and posterior. Each part was weighed separately. Then from each bulky part, 0.05g of sample was taken and kept in Gilson's fluid for 5-7 days. The Gilson's fluid was prepared in the laboratory. The Gilson's fluid loosens the tissue surrounding the eggs further making easy for separation. The separated eggs were counted using brush, pointed needle and hand lens. The total number of eggs in the ovary i.e. fecundity was calculated using formula,

$$F = \frac{Ovary\ weight\ x\ number\ of\ eggs\ in\ the\ sub-sample}{Weight\ of\ Sub-Sample}$$

Furthermore, relative fecundity was estimated by dividing absolute fecundity with body weight of individual fish.

Gonado-somatic index

The gonado-somatic index (GSI) of each specimen was calculated and recorded with respect to months. Mathematically, GSI of each fish was calculated by using the formula,

$$GSI = \frac{Ovary\ weight}{Total\ weight\ of\ fish} \times 100$$

Data analysis

Pearson's correlation coefficient r (P<0.05) and regression equations were used to determine the strength and significance of the connections

between absolute fecundity, total length and weight, and gonad weight. All the data were analyzed in R (R core team, 2019) and Microsoft Excell 2010 software.

Results

The absolute fecundity ranged from 3,385 to 14,298 eggs in fish of total length ranged of 11.5 cm to 19.3 cm, total weight ranged of 9.59 g to 31.69 g and ovary weight ranged of 1.31 gm to 5.56 gm (Table 1). The highest fecundity was found to be 14,298 eggs in the fish measuring 19.3 cm in total length, 31.69 gm in total weight and 5.56 gm in ovary weight while the lowest fecundity was counted 3,385 eggs in the specimen measuring 11.5 cm in total length, 9.59 gm in total weight and 1.31 gm in ovary weight. The mean value of fecundity was found to be 9448.469±607.783 with a mean total length of 15.83±0.34 cm, mean total weight of 24.94±1.02 gm, mean ovary weight of 3.67±0.23 gm. The relative fecundity ranged from 151.77 for a fish measuring total weight 26.02 gm to 529.93 for a fish measuring total weight 21.92 gm. Mean relative fecundity was found to be 371.38±15.72.

Table 1. Total length, body weight, ovary weight and absolute fecundity of sampled female *Glyptothorax telchitta* from Tamor River, Nepal

S.N.	Fish length (cm)	Fish weight (gm)	Ovary weight (gm)	Absolute fecundity	Relative fecundity
1	13.9	18.1	2.8	5894	325.64
2	16.6	26.67	4.5	9381	351.74
3	17.1	28.14	4	10779	383.05
4	18.1	22.8	4.5	11365	498.46
5	17.4	30.18	4.5	12669	419.78
6	16.8	29.52	3.62	11200	379.40
7	19.1	29.17	4.9	13561	464.90
8	15.1	26.09	2.86	7006	268.53
9	12	14.8	1.6	3400	229.73
10	16.5	26.39	4.6	12056	456.84
11	18.1	28.75	4.4	13200	459.13
12	15	24.05	2.93	7537	313.39
13	16.8	31.23	4.5	11063	354.24
14	15.8	26.02	1.85	3949	151.77
15	16	30.5	4.86	12666	415.28
16	11.5	9.59	1.31	3385	352.97
17	14.1	19.98	5.4	8886	444.74
18	16.2	22.32	2.07	8033	359.90
19	19.3	31.69	5.56	14298	451.18
20	16.2	27.89	5.34	11200	401.58
21	17.5	31.45	5.49	13566	431.35
22	14.2	16.38	1.35	4092	249.82
23	15.1	21.92	4.39	11616	529.93
24	13	13.95	1.87	3422	245.30
25	18.2	29.98	4.8	10478	349.50
26	15.4	30.26	2.75	9805	324.03
27	16.4	25.73	2.19	11896	462.34
28	16.9	26.79	4.65	12701	474.09
29	13.5	17.62	3.88	6062	344.04
30	12.7	23.36	2.03	5924	253.60
31	17.2	30.22	4.73	12971	429.22
32	15.1	26.85	3.22	8290	308.75
Mean	**15.83±0.34**	**24.94±1.02**	**3.67±0.23**	**9448.469±607.783**	**371.38±15.72**

The GSI value reached peak during the month of March (15.15%) followed by May (15.01%) which decreased to 1.01% in the month of June (Fig. 2). The monthly variation of GSI showed that the spawning season of fish is from March to May. During the egg size study, the smallest egg size observed was 0.382 mm (April) and largest egg size observed was 1.149 mm (May).

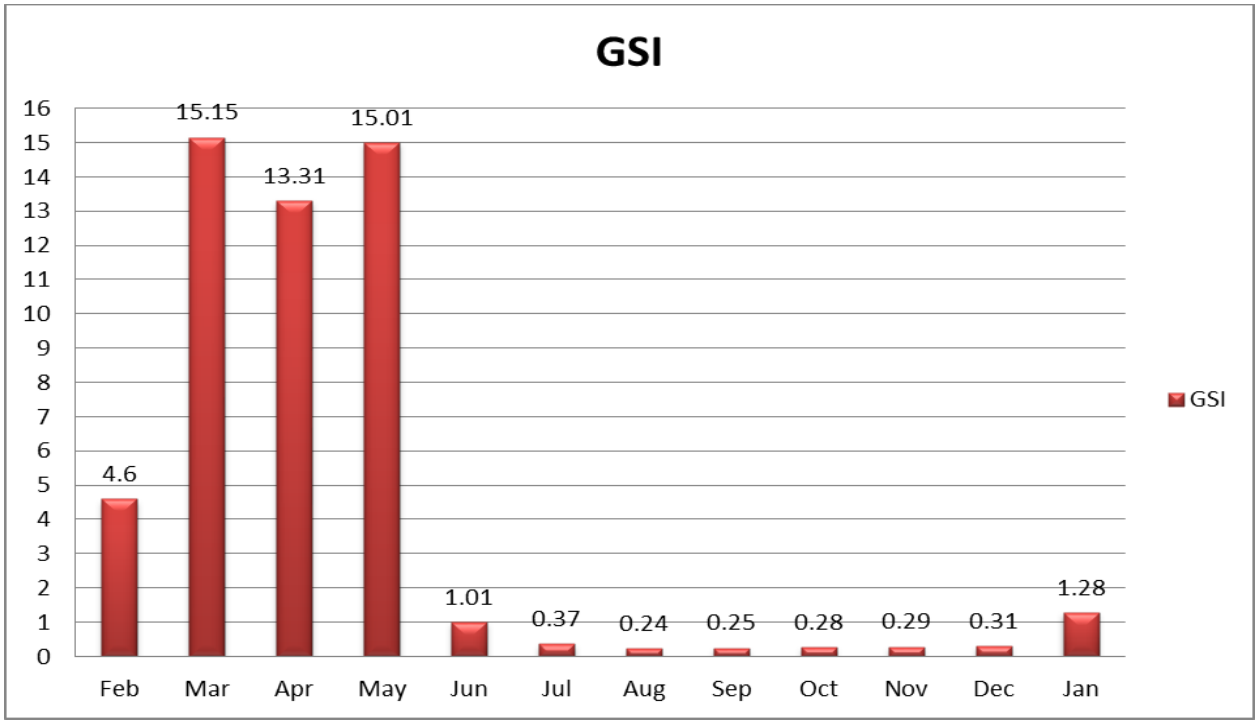

Figure 2. Monthly Gonado-somatic index (GSI) of *Glyptothorax telchitta*

Relationship between fecundity (F) and total length (TL)

Fecundity of fish varied from 3385 to 14298 in the fish measuring 11.5 cm to 19.3 cm in total length (Fig. 3). The correlation coefficient (r) was obtained 0.844 which implied a positive significant relationship between fecundity and total length of fish. The regression equation was obtained as, Y=2.954x+0.929

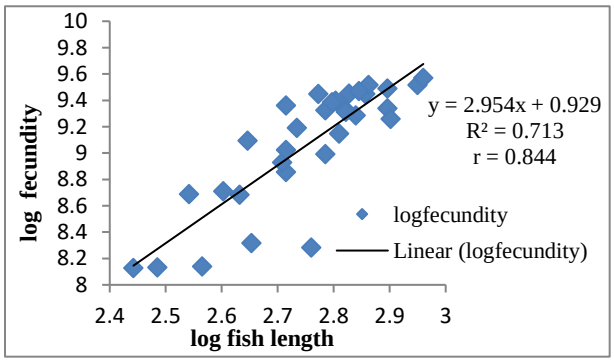

Figure 3. Relationship of fecundity with total length of *Glyptothorax telchitta*

Relationship between fecundity (F) and total weight (TW)

Fecundity of fish varied from 3385 to 14298 in the fish measuring 9.59 gm to 31.69 gm in total weight (Fig. 4). The correlation coefficient (r) was obtained 0.825 which indicated a positive significant relationship between fecundity and body weight of fish. The regression equation was obtained as, Y=1.333x+4.822

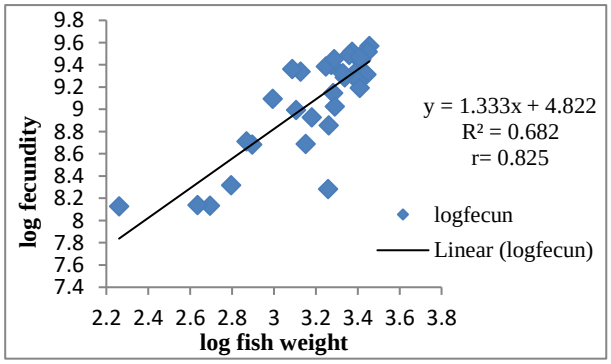

Figure 4. Relationship of fecundity with total weight of *Glyptothorax telchitta*

Relationship between fecundity (F) and ovary weight (OW)

Fecundity of fish varied from 3385 to 14298 in the fish having ovary weight 1.31 gm to 5.56 gm (Fig. 5). The correlation coefficient (r) was obtained 0.858 which implied a positive significant relationship between fecundity and ovary weight of fish. The regression equation was obtained as, Y = 0.888x+7.985

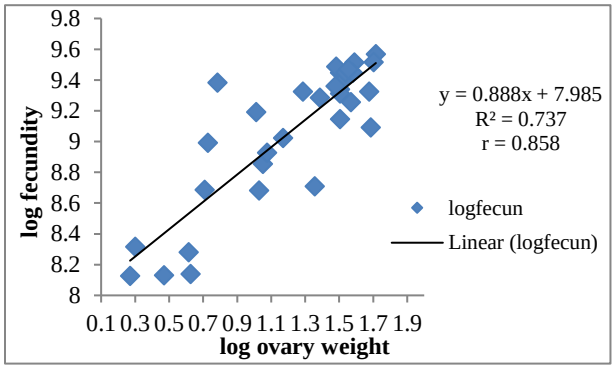

Figure 5. Relationship of fecundity with ovary weight of *Glyptothorax telchitta*

Discussion

Dobrial & Singh (2019) studied on the reproductive biology of a hill- stream catfish, *Glyptothorax madraspatanum* from Garhwal Central Himalaya, India and reported the range of fecundity 1640 to 6830 eggs which was quite low in comparison to the present study. They reported that *G. madraspatanum* spawned once in a year which was similar to that of *G. telchitta* but the spawning time they have mentioned is July-August whereas, *Glyptothorax telchitta* showed the spawning time starting from March-May. Fecundity relied mostly on ovary weight of *Glyptothorax madraspatanum.* Similar result was obtained in case of *Glyptothorax telchitta* also. Gupta & Gupta (2017) stated that breeding season of *G. telchitta* begins from the month of July and lasts upto September, which was totally different from the fish of Tamor river where the fish spawns from March to May. This agrees that the change in ecological condition of stream plays a major role in development and maturation of fish (Thapliyal & Balodi, 2015).

Dobriyal & Singh (1989) noted the total fecundity as 1710 to 8050 in *Glyptothorax pectinopterus* which made the fish to be moderately fecund and was quite different from the present study which did not corroborate the findings made in *Glyptothorax telchitta* (3385 to 14298 eggs). This supported the view of Cushing (1968) that fecundity is known to vary within species with latitude and location. Gandotra et al., (2009) stated *Schizothorax richardsonii* as a medium fecund fish with the fecundity ranging from 3032 to 13321 eggs which was similar range to the finding of *G. telchitta* of present study.

On comparison to other low fecund fishes such as *Neomacheilus montanus* (Bahuguna & Khatri, 2009), *Xenontedon cancila* (Borthakur, 2018), *Neolissochilus morhe* (Kharat & Khillare, 2013), *Botia dayi* (Kumar et al., 2006) and high fecund fishes such as *Schizothorax curvifrons* (Qadri et al., 2015) and *Schizothorax niger* (Hussain et al., 2018), *Glyptothorax telchitta* was discovered to be a medium fecund fish.

All the relationship between fecundity and body parameters were linear indicating positive significant relationship in the present study. This supported with the several fishes in *Salmo trutta fario* (Rasool & Jan, 2013), *Garra lamta* (Kanwal, 2017), *Noemacheilus montanus* (Bahuguna & Khatri, 2009). The fecundity depended on ovary weight rather than other body parameters in *Glyptothorax telchitta.* Similar result have been obtained by Soomro et al., (2012), Qadri et al., (2015), Borthakur (2018), Bahuguna & Khatri (2009). This is somewhat in disagreement with those of Wagle (2014) and Bhattacharya & Banik (2015) in *Schizothorax plagiostomus* and *Ompak pabo* respectively where fecundity relied mostly on body length and Kingdom & Allison (2011) in *Pellonula leonensis* where fecundity relied mostly on body weight.

The peak values of GSI indicated that *G. telchitta* breeds once a year. So, can be called as an annual breeder. Similar type of breeding behavior was reported in *Botia almorhae* (Joshi & Pathani, 2009), *Garra lamta* (Kanwal, 2017), *Bangana dero* (Pandey et al., 2018). Different from these, some fishes were found to breed twice a year such as *Scorpaena notata* (Munoz et al., 2005), *Nemacheilus moreh* (Kharat & Khillare, 2013), *Schizothorax richardsonii* (Wagle, 2014).

One mature female fish specimen of total length 19.1 cm, body weight 52.77 gm and ovary weight 2.43 gm was recorded with the fecundity of 9504

eggs and was excluded from fecundity correlation analysis as the body weight was quite abnormal from the range estimated and obtained among other fishes. Similar difference was seen by Soomro et al., (2012) on *Eutropiichthys vacha.* This difference in body weight might be due to the physiological disorder of the individual fish. The different size groups of eggs in the mature ovaries of fish suggests that fish spawns more than one time in a single breeding season and is called as a fractional spawner (Subba, 2018). This supports the findings of *G. telchitta* in the present study also.

The increased rate of illegal electrofishing in Tamor River has become threat to the fish population. The fisherman's right have been abused by illegal electrofishing done by outsiders. So, proper public awareness along with strict rules and regulations should be implemented in order to protect the fish and fisherman's right.

Conclusion

The study highlights reproductive biology of *Glyptothorax telchitta* from the snow-fed Tamor River. The fecundity and egg-diameter of 32 mature female and Gonadosomatic index of all collected specimens was calculated. The absolute fecundity ranged from 3,385 to 14,298 with an average of 9448±607. Relative fecundity ranged from 151.77 to 529.93 with the mean of 371.38±15.72. The highest mean gonadosomatic index was reported in the month of March (15.15%) followed by May (15.01%) which decreased to 1.01% in the month of June. The monthly variation of GSI showed that the spawning season of *Glyptothorax telchitta* falls between March to May. During the egg size study, the smallest egg size observed was 0.382 mm (April) and largest egg size observed was 1.149 mm (May).

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