



Reproductive Capacity and Sex-Ratio of *Noemacheilus multifasciatus* Day from Mandal River, India.

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Abstract: Present communication deals with the reproductive capacity and sex ratio of a hill stream ornamental fish, *Noemacheilus multifasciatus* Day from river Mandal of Garhwal region, Uttarakhand, India. A total 151 specimens were collected for this investigation from Mandal River during October 2020 to September 2021. The morphometric measurements were made within 2-3 days of collection which were total length (TL) fish body weight (F.B.W) ovary length and ovary weight. For the assessment of reproductive capacity, anterior, middle and the posterior part of ovary were taken and number of ova in each sample was counted with the help of binocular microscope. The reproductive capacity in terms of absolute fecundity was calculated as $F = S.O.W/100$. Sex ratio was calculated for whole period of study and its signification was tested by Chi-Square test (χ^2). The length of fishes ranged from 56mm to 80mm whereas fish body weight varied from 2138mg to 6347 mg.. The lowest reproductive capacity (175 eggs) was observed for the fish length 56mm, and body weight 2138mg, whereas highest reproductive capacity (3476 eggs) was estimated in fish measuring 80 mm length and fish body weight 6347mg. The reproductive capacity was more dependent on the ovary length ($r=0.9894$) and fish weight ($r=0.9812$), than the fish ovary weight (0.9786) and fish length (0.9248). The average ratio was 1.16 for female: 1.0 for male.

Key words: *Noemacheilus multifasciatus*, reproductive capacity, sex-ratio, river Mandal.

Introduction

Noemacheilus multifasciatus Day is a beautiful hill stream loach inhabiting the small streams and river of Garhwal Himalaya. The knowledge on the reproductive biology is essential in understanding life history, stock management and successful culture of a fish species. The fecundity indicates the reproductive potential of a fish during one spawning season. Several ichthyologists have reported a variety of information on the breeding biology of hillstream fishes (Dobriyal 1988, 2012; Dobriyal et.al, 2004, 2010; Bahuguna et.al, 2007, 2009, 2010;

2021a-b; Joshi et.al 2010, 2013; Bahuguna and Kumar, 2011a; Krishan et.al, 2011a; Bahuguna 2012; Rashid and Dobriyal, 2020; Rayal et.al, 2021c), The Sex-Ratio of fish has also been studied by several authors which is an important aspect of fish biology (Dobriyal and Singh, 1989; Kumar et.al, 2006; Dobriyal 2011; Bahuguna and Kumar, 2011b; Krishan et.al, 2011b; Bahuguna et.al 2010a-b-f, 2011; Bahuguna and Balodi 2015; Joshi et.al, 2014; Rayal et.al 2021d). Sexual dimorphism is another aspect to be evaluated under breeding biology (Badola et.al, 1982; Dobriyal et.al 2007; Bahuguna et.al; 2010c) of Indian fishes. Present communication deals with the



reproductive capacity and sex ratio of a hill stream ornamental fish, *Noemacheilus multifasciatus* Day from river Mandal of Garhwal region, Uttarakhand, India.

Material and Methods

Fishes was collected by way of the traditional fishing gears (Bahuguna et.al, 2010e; Bahuguna and Joshi, 2012; Bahuguna 2020, 2021; Rayal et.al., 2021a-b). The samples were immediately preserved with 5% formalin solution. A total 151 specimens were collected for this investigation from Mandal River during October 2020 to September 2021.

Laboratory Work: The morphometric measurements were made within 2-3 days of collection which were total length (TL) fish body weight (F.B.W) ovary length and ovary weight. For the assessment of reproductive capacity, anterior, middle and the posterior part of ovary were taken and number of ova in each sample was counted with the help of binocular microscope. The reproductive capacity in terms of absolute fecundity was calculated as $F = S \cdot OW/100$

Where, F = Fecundity, OW = Total weight of ovary, S = Average number of ova from samples of 100 mg each (anterior, middle and the posterior part of ovary) The mathematical relationship between Reproductive capacity and other body parameters were obtained by least square test, using the formula as $Y = a + bx$, where Y = (Reproductive Capacity, dependent variable), x = Body parameters (independent variable); a = Slope and b = Intercept.

Sex ratio was calculated for whole period of study and its signification was tested by Chi-Square test (χ^2) using the following equation-

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Where; O = Observed value, E = Expected value. Significance was determined by using table value at $F_{0.05}$ variable..

Result s and Discussion

The Reproduction capacity and different body parameters are presented in the Table 1. The length of fishes ranged from 56mm to 80mm whereas fish body weight varied from 2138mg to 6347 mg.. The lowest reproductive capacity (175 eggs) was observed for the fish length 56mm, and body weight 2138mg. whereas highest reproductive capacity (3476 eggs) was estimated in fish measuring 80 mm length and fish body weight 6347mg.

The relationships of reproductive capacity with different independent body parameters (F.L., F.W., O.L. & O.W.) were observed straight and presented in Fig 1 to 4. Mathematical equations obtained were as follow: The equation ($RC = a + b \cdot x$).

$$R.C = -6447.4 + 115.71 FL, r = 0.9248; r^2 = 0.8553 \text{ (Fig.1)}$$

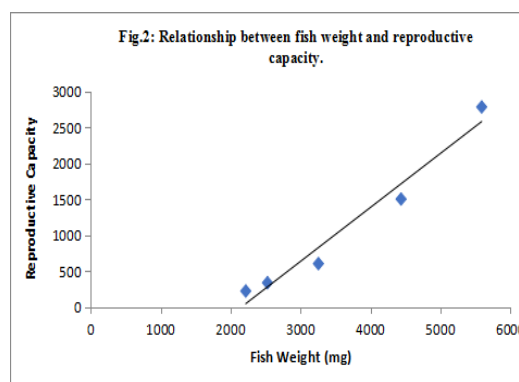
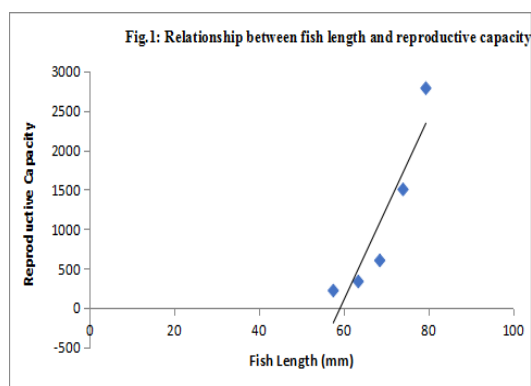
$$R.C = -1626.1 + 00.753 FW, r = 0.9812; r^2 = 0.9629 \text{ (Fig.2)}$$



Table 1: Reproductive Capacity of hill-stream loach *Noemacheilus multifasciatus* Day from Mandal River.

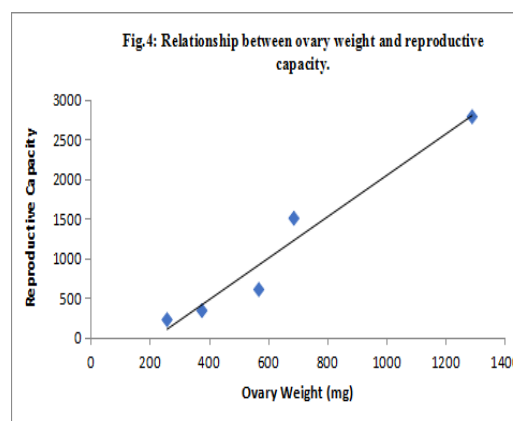
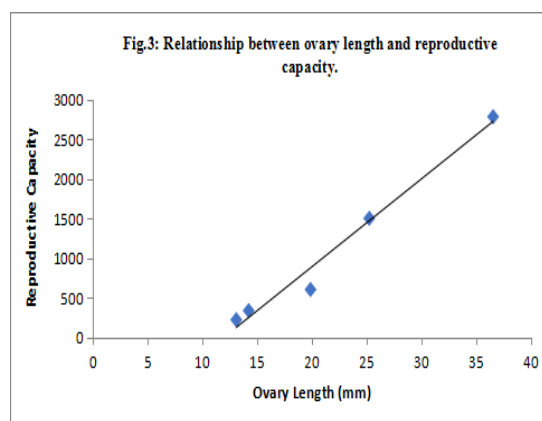
Fish Size (mm)	Fish Length (mm)	Fish weight (mg)	Ovary Length (mm)	Ovary weight (mg)	Reproductive capacity	No. of fish
55-60	56-59	2138-2314	11-15	231-273	175-242	04
	57.54±1.05	2217±119.20	13.09± 1.45	258.6± 17.11	219.11±20	
61-65	62-65	2454-2654	13-16	307-454	276-397	05
	63.44±0.40	2527.2±89.57	14.22 ± 1.10	376.5± 29.89	334.21±43.9	
66-70	67-70	2897-3673	17-22	460-661	384-795	05
	68.52±1.08	3255.15±189.7	19.87± 1.20	568.70± 29.40	601± 89	
71-75	72-75	3893-4785	23-28	543-877	786-1978	08
	74.01± 0.20	4436.42±227.3	25.24± 1.75	687.2± 76.37	1502± 309	
76-80	77-80	4876 – 6347	34-39	1043-1576	2168-3476	05
	79.40±0.11	5589±479.50	36.55 ± 2.15	1289.78± 157.42	2786.3 ± 542	

Min – Max* Average ± SD



$R.C = -1331.8 + 111.06 OL, r = 0.9894; r^2 = 0.9791$ (Fig.3)

$R.C = - 577.83+ 2.6194 OW, r = 0.9786; r^2 = 0.9578$ (Fig.4)



(Where R.C = Reproductive Capacity, FL = Fish length, FW = Fish weight, OL= Ovary length, OW = Ovary weight and r= coefficient of correlation).



The reproductive capacity was more dependent on the ovary length ($r= 0.9894$) and fish weight ($r = 0.9812$), than the fish ovary weight (0.9786) and fish length (0.9248).

The sex-ratio of *Noemacheilus multifasciatus* observed from river Mandal during October 2020 to September 2021 is presented in Table 2. A total 156 (72 Male and 84 female fish) number of fishes were collected during the field work. The percentage of female fishes were 53.85 and male fishes were 46.15, the average ratio was 1.16 for female: 1.0 for male.

Hill stream fishes show a variation in their reproductive potential. Absolute reproductive capacity of *Noemacheilus multifasciatus*

ranged from 2138 to 3476 eggs which increases with an increase in all independent body parameters. According to Ritu and Nair (1979) in *Noemacheilus triangularis*, the average fecundity ranged from 800 to 2126 eggs. The breeding capacity of *B. bendelisis* was observed from 900-5048 in the fish measuring 7.5-11.5 cm and ovary weighing from 700mg to 2.42gm (Dobriyal and Singh, 1987). *Noemacheilus botia* (Ham.) in the Khoh river was observed by Singh (2004) with its fecundity ranging from 447-1631 in the fish measuring just 51-80mm. Bahuguna et.al, (2007) observed that fecundity varies from 360 to 1727 for *Puntius conchoni* (Ham-Buch).

Table 2: Monthly variation in the sex-ratio of *Noemacheilus multifasciatus* Day during October 2020 to September 2021 from River Mandal.

Month	Total no of fish examine d	No. of male fish	No. of female fish	% of Male fish	% of female fish	Sex ratio male	Sex ratio female	Chi-square	Remarks
Oct., 2020	06	03	03	50.00	50.00	1.0	1.0	0.000	NS
Nov., 2020	09	04	05	44.45	55.55	1.0	1.25	0.111	NS
Dec., 2020	10	06	04	60.00	40.00	1.5	1.0	0.400	NS
Jan., 2021	09	04	05	44.45	55.55	1.0	1.25	0.111	NS
Feb., 2021	09	05	04	55.55	45.45	1.25	1.0	0.111	NS
Mar., 2021	11	05	06	44.55	54.56	1.0	1.2	0.090	NS
Apr., 2021	10	05	05	50.00	50.00	1.0	1.0	0.000	NS
May., 2021	15	06	09	40.00	60.00	1.0	1.14	0.600	NS
Jun., 2021	21	09	12	42.86	57.14	1.0	1.33	0.428	NS
July., 2021	25	09	16	36.00	64.00	1.0	1.77	1.960	NS
Aug., 2021	19	08	11	42.11	57.89	1.0	1.37	0.473	NS
Sep., 2021	07	04	03	57.14	42.86	1.33	1.0	0.285	NS
Total	151	67	84	44.37	55.63	1.0	1.25	1.913	NS

X² = values are no significant at either level (d.f.1 on p= 0.05 is 3.84): M= male, F= Female. NS= non-significant.

The fecundity of *Tor chelynotoides* (McClelland) has been calculated as 1265 to



9284 in the fish measuring 7.5-11.5 cm and ovary weight 1-15.6 g from the spring fed river Western Nayar (Uniyal, 2003). The fecundity of *Botia dayi* ranged from 2,225 to 8,840 for the fish measuring 10.1 to 14.5cm and weighing 17.72gm. to 38.6gm. (Kumar et.al., 2006). The fecundity of *Barilius vagra* was estimated by Bahuguna et.al. (2009) from Garhwal region oscillated from 510 to 7214 eggs in fish measuring 55mm to 89mm in total length and 407mg to 4260 mg ovarian weight. In the present study, an overall average sex ratio of 1.00 Male: 1.25 female was found in *Noemacheilus multifasciatus* from Mandal River. Overall average sex ratio was found to be non-significant. The *N. triangularis* male and female fish are present in more or less equal number as out of the total of 507 fish sexed, 269 (1.13 Ratio) are Male and 238 (1 Ratio) female noticed by Rita Kumari and Nair (1979) in Kallar River. Dobriyal et.al,(2004) observed the sex ratio of 1.00 male: 1.028 female during their study in *Crossocheilus latius latius* from the river Mandakini which was very close to the natural population ratio.

The sex composition of *Garra lamta* was 1 Male : 1female in the spring feed water body from Pithoragarh district in Kumaun Region (Bahuguna et.al, 2010). Bahuguna and Balodi (2015) reported a 1.171 Male: 1.00 female sex ratio in *Labeo dyocheilus* from the western Ram Ganga River which was significant. *B. barna* sex-ratio composition was noticed 1.00 male : 1.08 female in river Tamsa from Doon valley, India (Bahuguna et.al, 2021a). The

optimum sex ratio may vary drastically by numerous factor and it may also depend on different population inhabiting different regions which show difference in sex-ratios (Nikolsky 1956,80).

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