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Study on Spawning Fecundity and its Relation with Body Size of Rainbow Trout (*Oncorhynchus Mykiss*) from Hatchery of Kashmir Himalayas

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Abstract

The present investigations were carried out at Trout Culture Farm Laribal, Srinagar (J&K Govt.) in the month of December 2020. Relationship between length-weight, spawning fecundity and relative fecundity was observed in rainbow trout (*O. mykiss*). The mean length of male rainbow trout (38.77 ± 1.38 cm) while as, mean length for female rainbow trout (38.05 ± 1.32 cm) was observed. The mean weight of male and female rainbow trout recorded was 794.6 ± 49.3 g and 766.3 ± 64.3 g respectively. The spawning fecundity per female ranged from 2002 to 2804 eggs. The relative fecundity ranged from minimum of 2.26/gm body weight to maximum of 3.49/ gm body weight with mean value of 3.13 ± 0.12 / gm body weight. The present study recorded a significant positive correlation between total body length and total body weight of male rainbow trout ($r = 0.938$, $p < 0.05$) and total body length and total body weight of female rainbow trout ($r = 0.989$, $p < 0.05$). Similarly, a significant positive correlation between total body length and spawning fecundity ($r = 0.897$, $p < 0.05$), total body weight and spawning fecundity ($r = 0.845$) was observed. Relative fecundity showed a significant negative correlation between total length, total weight and spawning fecundity. ($r = -0.839$, $p < 0.01$), ($r = -0.900$, $p < 0.01$) ($r = -0.537$, $p < 0.01$) respectively.

Keywords: *Oncorhynchus mykiss*, spawning fecundity, length, weight, relative fecundity.

Introduction

The rainbow trout (*Oncorhynchus mykiss*), introduced in Kashmir in the year 1912, has thrived well since then and is now established in almost all the cold-water streams, lakes and rivers of the valley. Fecundity refers to the number of mature eggs in a female fish's ovary prior to spawning. Fish stock fecundity is a prominent feature of fishery biology as it has a direct impact on fish production, stock recruitment, and stock management, Bagenal and Braum [1]. Estimating fecundity is important not only for these criteria, but also for acquiring knowledge about different races, as different

races have different fecundities and egg diameters, which helps identify whether a population is homogeneous (with a single species) or heterogeneous (with multiple species) [2]. Egg size, diameter, or unit volume of number of eggs spawned, or expressed as the weight of eggs spawned, is a key factor in determining brood stock fecundity [3]. By artificially stripping the eggs from the fish at full maturity, the number of ripe or mature eggs released by salmonid brood fish can be easily determined; this number is known as fecundity. Fecundity is often referred to as total or absolute fecundity, or simply fecundity, when expressed

in terms of the number of eggs produced per brood fish. Alternatively, relative fecundity is defined as fecundity expressed per unit body weight of post-stripped fish. There are scientific objections to using relative fecundity because the number of eggs produced for each unit increase in weight varies significantly [4,5]. With increasing age of the fish, both fecundity and egg size also increase [6] although it is considered that these changes are due mainly to the generally larger size of older fish.

For most salmonids these measures of fecundity are readily made because eggs are artificially stripped from each female at spawning. For many other species of fish, particularly wild populations, which either cannot be stripped or are not readily accessible throughout their life cycles, fecundity has to be estimated from counts of the number of ripe eggs, either in microscope sections of the ovary or in samples of ovary where the oocytes have been separated in Gilson's fluid. This study was aimed to describe the length-weight relationship and spawning fecundity of the fish from Dachigam hatchery in Kashmir valley.

Materials and Methods

Sampling Site

The present study was conducted in the month of December 2020. Healthy parent stocks of male and female rainbow trout were collected from Trout Culture Farm, Laribal, Srinagar (J&K Govt.), which is located around 20 kms from district Srinagar. Relationship between total body length, total body weight, spawning fecundity and relative fecundity was determined. The data were recorded from an aesthetized fish.

Spawning fecundity

Male and female rainbow trout were segregated before stripping. Eggs were stripped in a dry, clean plastic bowls by applying gentle pressure to the abdomen of female rainbow trout. Spawning fecundity was determined by counting total number of stripped eggs per female rainbow trout (*Oncorhynchus mykiss*).

Relative fecundity

It was calculated as total number of stripped eggs divided by weight of fish.

Estimation of total length and total weight

The total length of male and female rainbow trout was determined using a Vernier caliper (Trusize absolute digimatic) (Plate 1). The total weight was calculated using a weighing balance (Thomson electronic weighing scale, D-112) (Plate 2).



Plate 1: Total length measurement of rainbow trout using a vernier caliper.



Plate 2: Total weight measurement of rainbow trout using a digital weighing balance.

Table 1: The data provides the (descriptive) statistical of total length and total weight of male and female *O. mykiss*.

	Female		Male	
	Total Length (cm)	Total Weight (g)	Total Length (cm)	Total Weight (g)
Min	34.5	635	30.3	623
Max	47.4	1237	45.1	1065
Mean	38.05	766.3	38.77	794.6
Std. Error	1.32	64.3	1.38	49.3

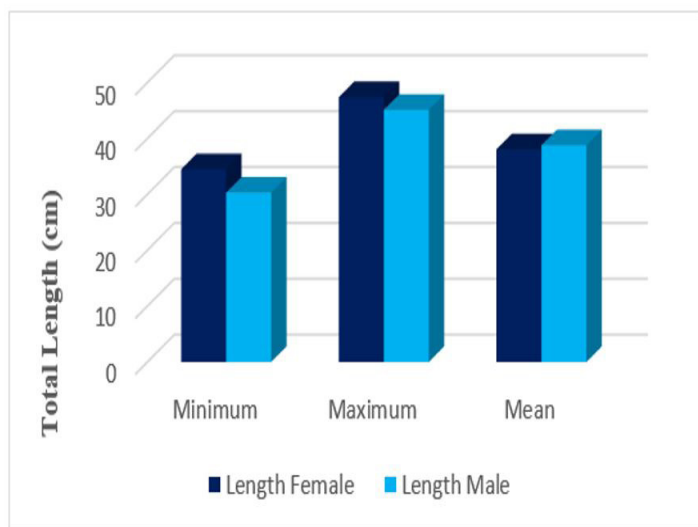


Figure 1: Minimum, maximum & mean values of length of male & female Rainbow trout

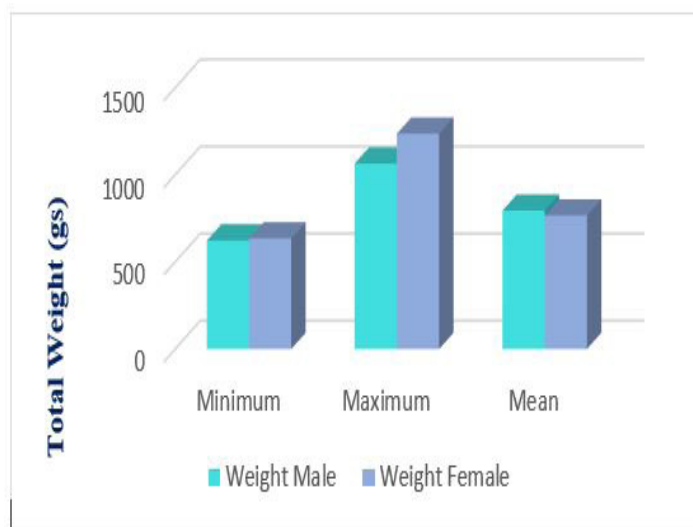


Figure 2: Minimum, maximum & mean values of total weight of male & female rainbow trout

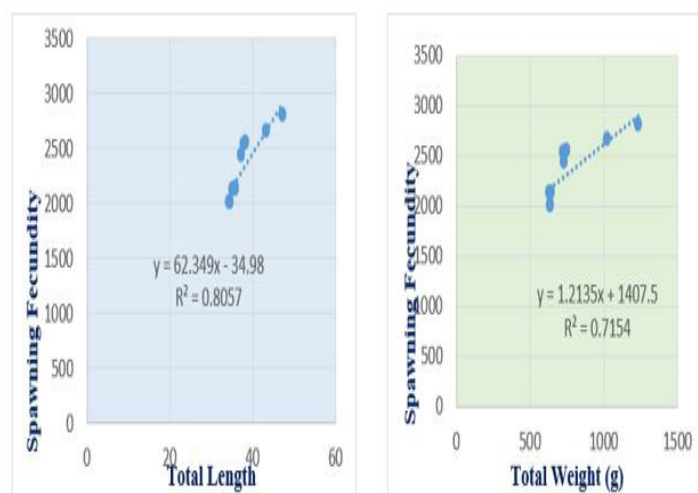


Figure 3: Scatter plot of correlation between spawning fecundity and length, spawning fecundity & total weight.

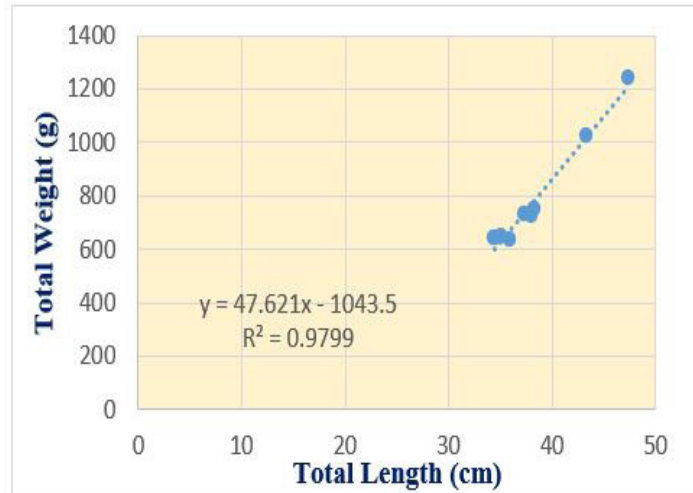


Figure 4: Scatter plot of correlation between total length & total weight.

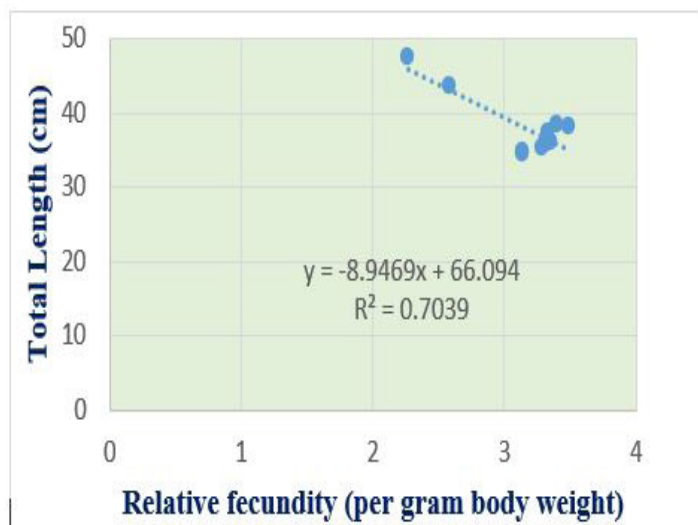


Figure 5: Scatter plot of significant correlation between total length & relative fecundity

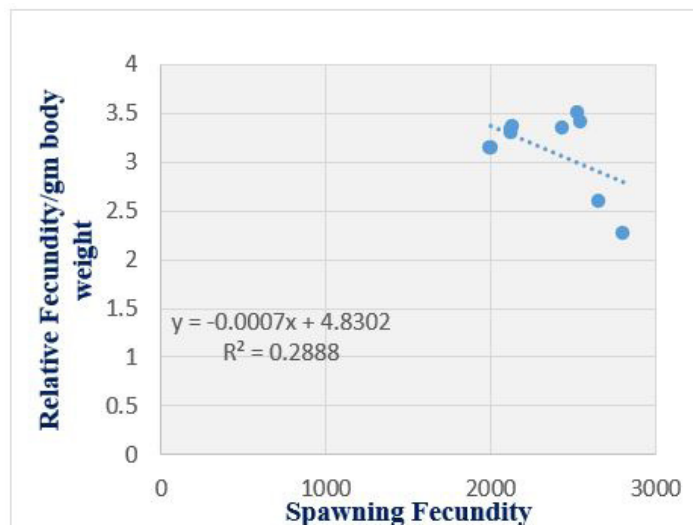


Figure 6: Scatter plot of significant correlation between spawning fecundity & relative fecundity.

Table 2: Pearson's correlation between total length and total weight of male and female rainbow trout.

	Length- Female	Weight- Male
Length- Male		0.938**
Weight- Female	0.989**	

** Significant at 0.01 level of significance

Table 3: The data provides the (descriptive) statistical of total length, total weight, spawning fecundity and relative fecundity of *O. mykiss*.

	Total Length	Total Weight	Spawning fecundity	Relative fecundity
Min	34.5	635	2002	2.266
Max	47.4	1237	2804	3.493
Mean	38.05	766.3	2337.4	3.134
Std. Error	1.32	64.35	92.33	0.124

Results and Discussion

The total length of male rainbow trout ranged from 30.3cm to 45.1cm with a mean value of 38.77 ± 1.38 cm while as for female rainbow trout, the length ranged from 34.5cm to 47.4cm with a mean value of 38.05 ± 1.32 cm. The observed total weight of male rainbow trout ranged from 623g to 1065g with a mean value of 794.6 ± 49.3 g while as the female rainbow trout weighed in the range of 635g to 1237g with a mean value of 766.3 ± 64.3 g (Table 1, Figure 1&2). The spawning fecundity per female ranged from 2002 to 2804 eggs and the mean spawning fecundity of 2337.4 ± 92.33 eggs was observed. The relative fecundity ranged from minimum of 2.26/gm body weight to maximum of 3.49/ gm of body weight with mean value of 3.13 ± 0.12 per gram of body weight somatic weight (Table 3).

The Pearson's correlation between total length and total weight of male and female rainbow trout is given in (Table 2) below. It was found that there was a significant positive correlation between total length and total weight of male rainbow trout ($r = 0.938$, $p < 0.01$) and total length and total weight of female rainbow trout ($r = 0.989$, $p < 0.01$). The Pearson's correlation between total length, total weight and fecundity of rainbow trout is given (in Table 4), there was significant positive correlation between total length and fecundity ($r = 0.897$, $p < 0.01$), total length and total weight ($r = 0.968$, $p < 0.01$) as well as between total weight and fecundity ($r = 0.845$, $p < 0.01$).

Since there is such a wide range of reproductive patterns in teleosts, an accurate definition of fecundity that is acceptable in all circumstances has not been established,

Table 4: Pearson's correlation between total length, total weight and fecundity of rainbow trout.

	Total Length	Total Weight
Total Length		0.989**
Spawning Fecundity	0.897**	0.845**
Total Weight	0.968**	

** Correlation is significant at 0.01 level.

Table 5: Pearson's correlation between total length, total weight and relative fecundity of rainbow trout

	Total weight	Relative fecundity
Total weight		-0.900
Total length	0.989*	-0.839
Spawning fecundity		- 0.537

* Correlation is significant at 0.01 level.

nor is it simple to do so. Individual or absolute fecundity is defined as the number of ripening eggs found in the female shortly prior to spawning. Fecundity estimates for teleosts range from a few hundred to several lakhs. Fish that live in cold-water streams and lakes have a lower fecundity than those that live in warm water streams and lakes Das and Subla (1969) recorded the fecundity of *Crossocheilus diplocheilus* from 6424 to 21432 in the fish length group of 95mm to 128mm. Fecundity estimates of *Tor putitora* from Kumaon lakes revealed that the fish measuring 339 to 517mm in length possessed 7076 to 18525 eggs [7]. The fecundity estimates of brown trout (*Salmo trutta fario*) have been described by several workers. Absolute fecundity of brown trout ranged from 160 to 761 eggs per female [8]. Brown and Kamp [9] found that the average number of eggs produced was 1,285 in brown trout which had an average total length of 388.6mm (15.3 inches). Taube (1975) found that in the length range of 202-354mm (8-14 inches), the average number of eggs produced per female trout by inch group ranged from 241 to 936. When present results are compared with these fecundity estimates, rainbow trout appears to be equally productive having an average fecundity of 2337.4 ± 92.33 in an average total fish length of 38.77 ± 1.38 cm. Fish fertility is usually related to the length, weight, and age of the fish, as well as the length, weight, and volume of the ovary. A straight-line correlation between fish weight and fecundity was found by several researchers [10-13]. In *Salmo trutta fario* also various workers including [14-17] correlated the fish weight and fecundity Allen [14] found this relationship to be linear. Mc Fadden [18] found a direct relationship between egg weight

and fish weight. In *Oncorhynchus mykiss* this relationship is also found to be linear. Linear relationships of fecundity with body measurements were also reported by [19-21]. The findings of the present work are in agreement with these observations.

Bagenal stated that the fecundity increases with the increase in the body measurement in all the cases, a linear relationship was observed between the fecundity and the body parameters. The value of the coefficient of correlation indicated that fecundity was more directly related to ovary weight ($r = 0.996$) and fish length ($r = 0.859$) then the ovary length ($r = 0.828$) and the fish weight ($r = 0.653$). In the present study, the positive correlation between length and fecundity ($r=0.897$), between length and weight ($r=0.968$) as well as between weight and fecundity ($r=0.845$) was found. Hence, both the studies are in proximity with each other. Mohammad et al. 2018, reported relative fecundity showed a significant negative correlation with weight, length and absolute fecundity ($r=-0.747$, $p<0.01$; $r=-0.419$, $p<0.05$ and $r=-0.460$, $p<0.05$ respectively). The close relationship between absolute fecundity and fish length demonstrated here is supported by the works of [22,23,24] and many others. Fecundity generally increased with total length in several fishes. A positive correlation has been observed between total length of females with their fecundity of *Mugil parsia* [25] *Osteogenesis militaria* [26] *Polynemus paradiscus* [27], and *Labeo rohita* [28-31]. These results are in conformity with the present study as relative fecundity showed a significant negative correlation between total body weight & relative fecundity; total length & relative fecundity; spawning fecundity & relative fecundity ($r= - 0.900$, $p<0.01$; $r= - 0.839$, $p<0.01$; $r= - 0.537$, $p<0.05$ respectively).

Conclusion

These findings are important with respect to reproduction life history of the species and many to be interpreted as the species response to improve fitness relating to habitat variations. Overall results of present study demonstrated that spawning fecundity increased with increase in fish length & weight. There was positive correlation between length and fecundity, length and weight as well as between weight and fecundity.

Authors' contribution

Conceptualization and designing of research work (AIB/ THS); Execution of field/lab experiments and data collection (AIB); Analysis of data and interpretation (AIB/ IA); Preparation of manuscript (AIB/NUA).

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