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Short Communication

FECUNDITY OF *LABEO ROHITA* (TELEOSTEI: CYPRINIDAE) REARED IN EARTHEN POND IN LAHORE

*Zafar Iqbal and Arfaa Batool
Department of Zoology, University of the Punjab, Lahore 54590, Pakistan

ABSTRACT

In this study, ripe and mature females *Labeo rohita* (Hamilton) were sampled from Punjab University Research Fish Farms Lahore, in June and July 2009. Mean body weight and mean total length of fish was 559.20±175.31g and 35.04±3.27cm respectively. The mean ovary weight was 88.76±30.71grams. The ovaries were extracted, dried and weighed individually. Mean number of eggs/g ovary and number of eggs/g fish were 891.50±126.32 and 142.47±37.22 respectively. The mean absolute fecundity was 80290±32955 and mean relative fecundity was 142466±37226. These values were higher in June than in July sample. Two ovaries from fishes of same body weight (460g) contained different number of eggs (78876 and 75850). The highest value of gonadosomatic index (22.68) was recorded in June, indicating breeding and spawning period of *L. rohita.* Fish weight was significantly correlated to total length (r = 0.780) and ovary weight (r = 0.710). The relationship between fecundity and fish total length, fish weight, ovary length and ovary weight showed positive linear correlation and the correlation coefficient values for these relationships were 0.543; 0.698; 0.536 and 0.914 respectively. The fecundity of *L. rohita* of present stock was significantly correlated to fish total length and body weight; ovary length and ovary weight. However, the ovary weight is the most reliable and better index of fecundity than total length and weight of the fish.

Keywords: *Labeo rohita,* fecundity, gonadosomatic index, culture condition.

INTRODUCTION

Fecundity is defined as the capacity of an individual fish to produce ripe eggs in one spawning season. This must be known to assess the reproductive and commercial potential of a fish stock (Das *et al*., 1989). For efficient fish culture and effective management it is important to know the fecundity of fish (Mian and Dewan, 1984). Studies on fecundity and its relationship with various body parameters viz. total body weight, total length, ovary length and ovary weight are very useful and important in increasing the fish production, stock management and assessment in any water body (Das *et al*., 1989).

Labeo rohita is a very popular food fish in Pakistan and has high consumers demand, because it is very delicious and nutritious and has high market value. It is extensively cultured in polyculture system under semi intensive conditions. This fish become adult at the age of 1.5 year and attain maturity at the end of 2nd year in ponds (Jhingran, 1986). Data on various aspects of biology and culture of *L. rohita* is available in literature. Several studies have been done on fecundity of warm water fishes by Khan (1972), Sinha (1972), Joshi and Khanna (1980), Nautiyal (1985), Somdutt and Kumar (2004), Joshi (2008), Bahuguna and Khatri (2009), Lone and Hussain (2009), Alam and Phathk (2010), Bhat (2011) and Lone *et al*. (2012).

Lone and Hussain (2009) reported 817094 eggs in 406g ovary of *L. rohita* (2012.25 eggs/g ovary) where the average body weight was 1738.76g. Alam and Pathak (2010) reported mean fecundity as 66823±4312.39 in *L. rohita* (mean body weight 315.64±16.59g). According to Bhat (2011) the correlation coefficient between weight and length of *L. rohita* was 0.98 and suggested that these two variables are highly correlated and significant (P <0.001). Most of these studies on fecundity of *L. rohita* have been done on wild fish populations. A recent study suggests that, the wild *L. rohita* is exhibiting decreasing trend in individual weight and population size in some water bodies in Punjab, Pakistan (Khan *et al*., 2011). It is important to know the expected number of eggs from brood fish, for proper planning to meet the fish seed production targets of hatcheries and nurseries. The aim of present study was to assess fecundity and its relation with various body parameters and calculate gonadosomatic index of *L. rohita* reared in earthen pond under semi intensive culture condition.

MATERIALS AND METHODS

The experimental fish, *L. rohita* was obtained from

*Corresponding author email: dr.zafariqbal.pu@gmail.com

Punjab University Research Fish Farm Lahore in June and July 2009. Fishes were packed in icebox and brought to Fish Disease and Health Management laboratory. They were washed with clean tap water before examination within two hours after arrival in the laboratory. Total length (Tl) and total body weight (Wt) of each fish was recorded in fresh condition to the nearest 0.1cm and 0.1g. The fishes were dissected, ovaries were separated carefully and the moisture was dried with blotting paper. Ovaries were weighed and measured individually. The dry ovaries were preserved in 5% formalin solution for 24 hours (Bahuguna and Khatri, 2009). This helped to separate eggs from walls of ovary easily. Ten samples, of one gram portion of ovary from each lob were weighed on Electronic Scale. The egg samples were placed in Petri dish separately. Small amount of distilled water was added to each Petri dish containing eggs. This procedure hydrates and completely separates the eggs. The total number of eggs in each sample were counted carefully and recorded for further calculations. Absolute fecundity was calculated according to formula by Lone and Hussain (2009);

$$F = n\,G/g$$

F = fecundity; n = mean numbers of eggs in all sample; G=weight of ovary; g=weight of sample. The numbers of eggs/kg body weight of the fish (relative fecundity) and number of egg per fish (absolute fecundity) was also calculated by using simple algebraic formula. Gonadosomatic Index (GSI) was calculated according to formula by Singh and Srivastava (1991).

$$GSI = \text{Gonads weight (g)}/\text{Weight of fish (g)} \times 100.$$

The relationship of fecundity with fish weight, fish total length and ovary weight and ovary length was calculated by regression analysis with computer package Minitab.

RESULTS

Body weight, body length, body width, ovary weight and ovary length of *Labeo rohita*

In this study, 30 female *L. rohita* were studied. The mean body weight of fish was 559.20 ± 175.51g (Table 1). In June the ovaries were large and fully developed. In July the mean body weight was low, which is attributed to regression of the ovaries. The mean total body length was 35.040 ±3.272 cm, whereas, the mean standard length and mean width was 27.085±2.765cm and 8.7532±1.008cm respectively. The mean ovary weight was 88.767±30.71g. In June this value was 97.80 ± 32.759g and in July it was 79.733±26.58g. The higher ovary weight in June indicates the development of ovaries towards the peak breeding period of the fish. The mean ovary length was 16.138±1.504cm which was comparable to June value (16.917±1.421cm) but it was less in July 15.358±1.668cm (Table 1).

Gonadsomatic Index (GSI) and Fecundity of *Labeo rohita*

The mean gonadosomatic index was 15.940±3.33. GSI was higher in June (16.117±4.24) but low in July (15.762±2.22) (Table 1). The highest individual GSI value 22.68 was observed in June, which again points to peak breeding period of *L. rohita.* The number of eggs/g ovary was 891.50±126.32 and number of eggs/ g fish was 142.47±37.226. Absolute fecundity was 80290±32955 and relative fecundity was 142466±37226. Number of eggs/kg ovary, were assessed as 891500±126319 (Table 1). In June sample the number of eggs/g ovary was 965.40 ± 60.829; absolute fecundity 94316±33077 and relative fecundity 152087±22908. The number of eggs varied from 38584 (for 379.3g fish) to 180224 (for 1165.5g fish)

Table 1. Body parameters and fecundity of female *Labeo rohita.*

Month/sample size	June 2009 (n=15)		July 2009 (n=15)		Total
Parameters	Mean ± sd	Range	Mean ± sd	Range	Mean± sd
Body weight (g)	619.53±188.8	421.3-1165.5	498.87±142.15	379.3-942.0	559.20±175.51
Total length (cm)	36.847±2.921	33.9-43.0	33.23±2.579	29.9-40.2	35.040±3.272
*Sd. length (cm)	29.640±2.372	27.1 – 35.0	26.200±3.022	17.9-32.1	27.085±2.765
Body width (cm)	9.0867±1.109	7.5-11.0	8.4200±0.906	7.1-10.6	8.7532±1.008
Ovary weight (g)	97.800±32.759	66.6-176.6	79.733±26.58	56.2-120.4	88.767±30.71
Ovary length (cm)	16.917±1.4217	9.4 – 12.75	15.358±1.668	15.16-19.72	16.138±1.047
GSI	16.117±4.24	12.41-22.68	15.762±2.22	8.97-19.43	15.940±3.33
Eggs/g. ovary	965.40±60.829	830-1084	817.60±132.85	651-1009	891.50±126.32
Absolute fecundity	94316±33077	56724-180224	66265±27093	38584-117519	80290±32955
Eggs /g. fish	152.09±22.90	114.8-192.72	132.84±46.30	64.95-249.06	142.47±37.226
Relative fecundity	152087±22908	114860-192720	132845±46340	64950-249064	142466±37466
Eggs/kg ovary	965400±60829	830000-1084000	817600±132853	651000-1009000	891500±126319

*Sd. length. Standard length

per fish. However, in July all these fecundity values were less than June (Table 1). Interestingly, ovaries of two fishes with same body weight (460g), contained different number of eggs (78876 and 75850).

The relationships between various body parameters:

The relationship between fish body weight (Wt) and fish total length (Tl) can be expressed as:

$$Wt = -1112.1+4.77\ Tl\ (r=0.780)$$

The body weight of the fish was directly proportion to the fish length. The regression equation is linear. The correlation coefficient (0.780) correspond to significant positive correlation (P=0.000).

The relationship between ovary weight (OWt) and fish body weight (Wt) can be expressed as:

$$OWt = 6.2 +0.148Wt\ (r=0.710).$$

The ovary weight was directly proportion to the fish weight. The regression equation is linear and correlation coefficient (0.710) correspond to a positive significant correlation (P=0.000).

Relationship between fecundity (F) and fish total length and fish body weight

The relationship between fecundity and total length of fish can be expressed as:

$$F = -179668 +7419\ Tl\ (r = 0.543).$$

The fecundity of the fish was directly proportion to the total length of fish. The regression equation is linear and the correlation coefficient (0.543) indicate moderate positive significant correlation (P=0.000).

The relationship between fecundity and fish body weight can be expressed as:

$$F = -10735+158\ Wt\ (r = 0.698).$$

Fecundity is directly proportional to the fish body weight. The relationship between fecundity and fish body weight is linear and significant with 0.698 correlation coefficient (P=0.000).

The Relationship between fecundity and ovary length (Ol) and ovary weight (OWt)

The relationship between fecundity and ovary length can be expressed as:

$$F = -178454+16034\ Ol\ (r = 0.536).$$

A significant relationship between fecundity and the ovary length exist. This relationship is linear and significant with 'r' value 0.536 (P= 0.000).

The relationship between fecundity and ovary weight can be expressed as:

$$F = -5762+961\ OWt\ (r= 0.914).$$

A significant relationship between fecundity and the ovary weight exist. Fecundity is directly proportional to ovary weight. This relationship is linear and significant (r=0.914) (P= 0.000).

DISCUSSION

The correlation coefficient values between fish body weight and total length of *L. rohita* and ovary weight and fish body weight indicated that the fish is well maintained. Fecundity in *L. rohita* has been found to increase with increasing fish length, fish weight as well as ovary weight (Table 1). In the present study 965.40±60.829 eggs/g ovary and 152.09 ± 22.90 eggs/g fish were observed. Khan (1972) reported 1335 egg/g ovary and 535 eggs/g fish in two years old fish. Khan and Jhingran (1975) observed 1230 eggs/g ovary and 211 eggs/g fish. Jain and Mitra (1994) reported 307±29 eggs/g fish. Lone and Hussain (2009) observed 2012.55 eggs/g ovary and 469.93 eggs/g fish. The difference of fecundity observed by Lone and Hussain (2009) and in the present study may be associated with difference in mean body weight of fish in two studies. This difference in fecundity may also be attributed to the level of fish pond management at two sites. On the other hand, fish in pond show low fecundity and fail to spawn due to the stress of captivity, insufficient food and higher stocking density as stated by Billard (1995). It is reasonable to conclude that *L. rohita* reared under culture condition show variable fecundity as compared to natural population.

The ovaries of two fish with same body weight, contained different number of eggs. Alam and Pathak (2010) also reported that two same size *L. rohita*, contained different number of eggs. If these two studies are considered carefully, it can be concluded that *L. rohita* can produce eggs at a small size (Wt= 60g, OWt 2.4g and fecundity 25230, Alam and Pathak, (2010); and Wt=379g, OWt= 34g, fecundity 24616 present study). This variable fecundity may also be associated with genetic diversity in *L. rohita*, indicating that different strains mature and spawn at various body weight and size in its geographical range and is influenced by ecological factors. Lone and Hussain (2009) reported that, in fishes like *L. rohita*, water temperature, photoperiod and rainfall appear to affect growth and development of ovary.

GSI increases with maturation of fish and is highest during spawning season and after spawning it decline (Lone and Hussain, 2009; Alam and Pathak, 2010). Another study, Lone and Hussain (2009) reported maximum GSI value (22.73±0.94) in June in *L. rohita*. Alam and Pathak (2010) observed the highest GSI value 7.5 in August in *L. rohita.* In the present study the highest GSI value (22.68) was recorded in June. The variation in GSI values in *L. rohita* in these studies may be due to fish body weight and ovarian weight in respective fish.

Photoperiod and water temperature have been shown to correlate with gonadal weight and gonadosomatic index, and water temperature and long day length influence beginning and conclusion of spawning season in fish like major carps (Day *et al.*, 2004, 2005; Bhattacharyya and Maitra, 2006, Mylonas and Zohar, 2007).

Linear relationships exist between fecundity and fish length, fish weight, ovary length and ovary weight of *L. rohita*. Similar linear relationships have been reported in different freshwater fish species by various workers; Singh and Srivastava (1982), Sharaf *et al.* (1997), Somdutt and Kumar (2004), Joshi (2008) and Bahuguna and Khatri (2009). Fecundity of *L. rohita* was more closely related to the ovary weight (Alam and Pathak, 2010). Fecundity and ovary weight of *L. rohita* was strongly correlated than to weight of fish and length of fish and length of ovary as observed in this study. Hence, it is fair to conclude that ovary weight is a better index to estimate fecundity than total length and body weight. When fishes are kept in captivity for culture purpose they show some degree of reproductive dysfunction (Lone and Hussain, 2009) which may be due to low quality feed given to fish. Hence, the necessity of incorporating an optimum level of animal protein (up to 35%) in the diet of a fish *Beta splendens* (Regan) for maximum reproductive performance has been stressed by James and Sampath (2003). But one thing is very clear that with the onset of maturity, *L. rohita* with highest body weight and body length contain maximum number of eggs as observed in present study. In addition to this, ovary weight is the most reliable and the best index of fecundity than total length and weight of the fish. It is suggested that genetically more diverse brood stock may be used to produce good and high quality fish seed.

CONCLUSION

The present study has directed our attention to a point that the fish examined probably belonged to more than one genetic strains; where one strain matured at small size (<500g) and second strain matured at larger size (<1000g). This needs to be investigated.

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