Punjab Univ. J. Zool., Vol. 24 (1-2), pp. 31-39, 2009

FECUNDITY OF *CIRRHINUS MRIGALA* (HAMILTON) REARED IN EARTHEN POND

ZAFAR IQBAL AND SUMAIRA KAUSAR

Department of Zoology, University of the Punjab, Quaid-e-Azam Campus, Lahore 54590. Pakistan.

Abstract: The present study was conducted to investigate the fecundity and gonadosomatic index of a carp species, *Cirrhinus mrigala* (Hamilton) reared under semi-intensive culture conditions in earthen pond. Mean body weight of fish was 840.6±48.3g and mean total length of fish was 42.15±0.89cm (n=25). Mean ovary weight was 140.28±9.17g. Mean number of eggs in ovary were 942.6±13.9. The absolute fecundity was 132,129±8481 which ranged from 34,122 (in 342g fish) to 228,000 (in 1133g fish). The relative fecundity was 155,879± 6269. Eggs/kg ovary were estimated as 942613. The relationships between fecundity and fish total length, fish weight and ovary weight were linear. The correlation coefficient (r) of fecundity and total length (0.543); fecundity and fish weight (0.648) and fecundity and ovary weight was 0.950. The ovary weight is better index of fecundity estimation than other body parameters. The GSI ranged from 9.65 to 22.62 observed in July.
Key words: Fish, fecundity, gonadosomatic index, reproductive potential

INTRODUCTION

Carp culture is the largest and most wide spread practice of animal aquaculture in the world (Desilva, 2003). Carp culture is economically viable and is composed of three major carps; *Labeo rohita* (Hamilton), *Gibelion catla* (Hamilton) and *Cirrrhinus mrigala* (Hamilton) and two Chinese carps, *Ctenopharyngodon idella* (Valenciennes) and *Hypophthalmicthys molitrix* (Valenciennes). These carp species are characterized by fast growth and well adaptability in confined waters (Singh *et al.,* 2006).

Cirrrhinus mrigala is an important component of polyculture with other native species. It is natural inhabitant of rivers and streams of South

0079-8045/09/0031-0039 $ 03.00/0

East Asian countries. In natural waters, this fish show rapid growth in first four years of its life (Jhingran and Pullin, 1985). *C. mrigala* grow more slowly than two other major carps and attains 600-700g weight in first year under culture conditions (Jena *et al.,* 1998). The rearing period in captivity is usually confined to a maximum of two years and the fish attain maturity in one to two years (Hora and Pillay, 1962; FAO, 2005). This is a highly fecund fish and its fecundity increases with age. The eggs of *C. mrigala* are non-floating and non-adhesive type, round 5.5 mm in diameter, brownish in colour.

Fecundity is the measure of fertility, such as sperm or egg count of an organism. Fecundity must be known to assess the reproductive potential and to evaluate the commercial potential of a fish stock and for the efficient fish culture and effective management (Mian and Dewan, 1984; Das *et al*., 1989). Fecundity has a vital role in the selection of brooders for production purposes (Prasad *et al*., 2005). Considerable work has been done on fecundity of fishes in many countries by Clark (1934), Begenal (1967), Chonder (1977), Joshi and Khanna (1980), Singh and Srivastava (1982), Nautiyal (1985), Somdutt and Kumar (2004) Bahuguna and Khatri (2009), Lone and Hussain (2009). There is not much data available on fecundity and reproductive potential of *C. mrigala* under culture condition in Pakistan. The aim of present study was to look into the fecundity and Ganadosomatic Index (GSI) of *C. mrigala* reared under semi intensive culture conditions.

MATERIALS AND METHODS

Twenty five ripe and mature female *C. mrigala* specimens were obtained from Punjab University Fish Research Farm in June and July 2009. Fishes were brought live to Fish Disease and Health Management Laboratory examined thoroughly for any parasitic and fungal infection. The fishes were weighed and measured before dissection and removal of ovaries. The Total length (tl) and weight of fishes (wt) were recorded. Ovaries were removed gently and separated carefully from the other tissues, spread on a wet blotting paper sheet in original form. The ovary weight (owt) was recorded. The dissected ovary was preserved in 5% formalin solution for 24 hours.

A small piece of ovary was taken. After cleaning and drying, 10 samples of one gram each were weighed separately in Petri dish. A few drops of water were added to weighed eggs to separate them. After that, total number of eggs in each sample were counted and recorded. Mean number of eggs was calculated in each fish. Absolute fecundity was calculated according to formula (Lone and Hussain, 2009), F=nG/g where, F is Fecundity; n is mean numbers of eggs in all samples, G is weight of ovaries; g is weight of samples. The numbers of eggs per kg weight of the fish (relative fecundity) was also calculated by using simple algebraic formula. Gonadosomatic Index (GSI) was calculated according to Singh and Srivastava (1991) formula: GSI=Gonads weight/Weight of fish × 100

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

RESULTS

The body parameters of *C. mrigala* and the fecundity of the fish is given in Table I, II.

Mean ovary weight and gonado-somatic index was higher in July compared to June. This indicates that ovary grow and gain weight from June onward. This also influences the increase in GSI value in July (Table I). In June, the number of eggs per gram ovary was high as compared to July. But the number of eggs per fish (absolute fecundity) and number of eggs per kg fish (relative fecundity) were higher in July (Table II).

Table I: Body parameters (mean ± sd.) of female *Cirrhinus mrigala.*

Sample	body weight (g)	Length cm)	Body width(cm)	Ovary weight (g)	GSI
June (n=10)	860.1± 242.96	42.53± 4.1923	9.56±1.086	134.40±45.33	15.391±1.56
July (n=15)	823,53± 2485	41.89± 4.7357	9.19±1.19	144.2± 47.4	17.51±3.92

Table II: Fecundity of *C. mrigala* in relation to fish body and ovary weight.

Sample	Eggs/g ovary	Absolute fecundity	Relative fecundity
June	963.40±91.543	129987±53725	147256±25911
July	928.73±49.097	133557±44629	161629±34117

Fecundity of C. mrigala population:

The mean body and ovary weight of fish was 840.6±48.3g and 140.28±9.17g respectively. Ovary weight ranged from 33g to 212g in this population. Mean number of eggs g ovary was 942.6±13.9. Mean eggs per fish were 132129±9481 (absolute fecundity) and it ranged from 34,122 (in 33g ovary, 342g fish) to 228,000 (in 200g ovary, 1133g fish). The relative fecundity in *C. mrigala* was 155879±6269/kg body weight (relative fecundity) which ranged from 99771 to 215766. Gonadosomatic Index (GSI) values ranged from 9.65 to 22.62. Both of these minimum and maximum values were recorded in July.

Relationships between body parameters of C. mrigala:

The relationship between weight of fish (wt) and total length of fish (tl) can be expressed as:

$$Wt = -1393 + 53.0\ Tl \quad (r=0.947).$$

The weight of fish was more or less directly proportional to the total length of the fish. The regression equation is linear. The correlation coefficient (0.947) was highly significant

The relationship between weight of the fish and ovary weight (owt) can be expressed as:

$$OWt = 12.8 + 0.152\ wt \quad (r=0.641).$$

The ovary weight was more or less directly proportional to the weight of the fish. The regression equation is linear. The 'r' value (0.641) is significant and positive correlation.

Relationship between fecundity and total length of fish:

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

$$F = -199405 + 7867\ Tl. \quad (r=0.543).$$

Fecundity was directly proportional to the total length of the fish. The 'r' value (0.543) indicates a moderate positive correlation.

Relationship between fecundity and weight of fish:

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

$$F = 393 + 158\ Wt \quad (r=0.648).$$

Fecundity is directly proportional to the body weight. The regression equation is linear and highly significant. The 'r' value (0.648) is significant and indicates a positive correlation.

Relationship between fecundity and ovary weight of fish:

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

$$F = -9243 + 1008\ OWt\ (r=0.950).$$

Fecundity is directly proportional to the ovary weight. The 'r' value (0.950) indicates a strong positive correlation.

DISCUSSION

The total weight and total length of fish ranged from 342g to 1133g and 33.7 to 48.8cm respectively. The weight of ovary ranged from 33g to 212g. The absolute fecundity of *C. mrigala* observed in the present study was from 34,122 to 228,000. The weight of ovaries, GSI, number of eggs per fish and number of eggs per kg body weight of fish were high in July than in June. In June and July the water temperature in the fish pond rises up to 28-30 ºC. The photoperiod is maximum in these months (14 hours day light) and annual monsoon rainfall also starts in July in Lahore. Water temperature and photoperiod have been correlated to the gonadal weights and hence with GSI (Mananos *et al.,* 1997*;* Mylonas and Zohar*,* 2007; Lone and Hussain, 2009). In those fishes, such as carps which spawn in summer, water temperature and long day length play a key role in initiating and concluding the spawning season (Sen *et al*., 2002; Day *et al.,*2004; Bhattacharyya and Maitara, 2006; Lone and Hussain, 2009). This study shows that *C. mrigala* have high reproductive potential and fecundity in July.

The relationships between fecundity and length of fish (0.543), fish weight (0.648) and ovary weight (0.950) were linear, moderate to strong and significant. Many workers have reported similar relationships between fecundity and total length, fish weight and ovary weight in *C. mrigala* and other fishes, Chaudhuri, (1963); Chakrabarty and Singh, (1963), Hanumantharao (1971), Singh and Srivastava (1982), Somdutt and Kumar (2004), Lashari *et al.,*(2007), Joshi (2008), Bahuguna and Khatri (2009), Lone and Hussain (2009). High fecundity has been reported by earlier workers from natural populations of *C. mrigala* than observed in the present study. According to Simpson (1951), the fecundity of an individual female varies in relation to many factors including age, size, species and environmental conditions, such as food availability, water temperature and

salinity. It seems fair to consider believe that moderate fecundity in *C. mrigala* observed in this study might be due to the genetic makeup of fish stock; overstocking, or improper and underfeeding of fish in pond which affected the growth of fish and indirectly the gonadal development. May be some of these factors have influenced and affected the fecundity of *C. mrigala* observed in the present study. It may be concluded that *C. mrigala* reared in pond showed lower fecundity than reported from wild stock of the same fish size. The growth of the fish was moderate, as 72% of the fish examined in this study attained less than 1000g weight in two year and 28% of the fish examined was above 1000g in weight. In Pakistan fish less than one Kg weight has low consumer's demand and low market value.

The findings of this study direct our attention to the role of hatchery manager, who need to use healthy, good quality and genetically improved brooders to produce fish seed. This practice will eventually have good impact on fish production in pond. Better growth rate of fish also influence the size of ovary. Weight of fish and ovary weight has shown strong linear relationship (r=0.641) in this study. Fecundity increased with the increase in total length, body weight and ovary weight in *C. mrigala*. However, the ovary weight is better index, to estimate fecundity than other body parameters.

REFERENCES

BAHUGUNA, S. N AND KHATRI, S., 2009. Studies on fecundity of Hill Stream Loach *Noemacheilus montanus* (McClelland) in relation to total length, total weight, ovary length and ovary weight. *Our Nature,* **7**: 116-121.

BEGENAL, T. B. 1967. A short review of fish fecundity in *The Biological Basis of Fresh water Fish Production* . (ed. S. D Gerking). Blackwell Scientific, Oxford. pp, 89-111

BHATTACHARYYA, S AND MAITRA, S.K., 2006. Environmental correlate of testicular events in major carps *Catla catla* in an annual reproductive cycle. *Biol. Rhythem Res.,***37**:87-110.

CHAKRABARTY, R.D, AND SINGH, S.B., 1963. Observations on some aspects of the fishery and biology of the Mrigal, *Cirrhinus mrigala* (Hamilton) from Allahabad. *Indian J. Fish.,***10**(1)**:** 209-232

CHAUDHURI, H., 1963. Induced breeding of Indian carps. *Proc. Nat. Inst. Sci .India*, Part B, **29**(4): 478-487.

CHONDER, S.F. 1977. Fecundity and its role in racial studies of *Gudusia chapra. Proc .Ind. Acd. Sci.,* **86**: 245-254.

CLARK, F.N. 1934. Maturity of California sardine *Sardinella caerulea*, determined by ova diameter measurement. *Fish. Bull,* 42: 1-49.

DAS, M., DEWAN, S. AND DEBNATH, S.C., 1989. Studies on fecundity of *Heteropneustes fossilis* (Bloch) in a mini pond of Bangladesh. Agriculture University Mymensingh. *Bangladesh J. Agric. Sci.,* **16**: 1-6.

DAY, R., BHATTACHARYYA, S AND MAITRA, S.K. 2004. Temporal pattern of ovarian activity in a major carp *Catla catla* and its possible environmental correlates in an annual cycle. *Biol. Rhythem Res.,* **35**: 329-353.

DESILVA, S., 2003. Carps. In: *Aquaculture Farming Aquatic Animals and Plants* (eds J.S. Lucas and P. C, Southgate) Fishing News Book, UK. pp 68-73.

FAO, 2005. *Aquaculture Production, 2004. Year book of Fishery Statistics* - Vol. 96/2. FAO Rome, Italy, pp.1-7.

HANUMANTHARAO, L., 1971. Studies on the Biology of *Cirrhinus mrigala* (Hamilton) of the River Godavari. India. *J. Fish*. **21**(2):303-322.

HORA, S. L., AND Pillay, T.V.R., 1962. *Handbook on fish culture in the Indo-Pacific Reagion*. FAO Fish Tech.Pap.14. pp.204.

JENA, J. K., ARAVINDAK SHAM, P.K. AND SINGH, W.J. 1998. Nursery rearing of Indian major carp fry under different stocking densities. *Indian J. Fish.,* **45**(2): 163- 168.

JHINGRAN, V.G. AND PULLIN, R.S.V., 1985. *A Hatchery Manual of Chinese and Indian major carps*. Asian Development Bank. Manila, Philippines. pp 1-18.

JOSHI, S.K. 2008. Fecundity of freshwater teleost, *Botia almorhae* (Day). *J. Environ. Bio. Sci*., **89**: 493-503

JOSHI, S.N AND KHANNA, S.S 1980. Relative fecundity of *Labeo gonis* (Ham.) from Nanak Sagar reservoir. *Proc. Ind. Acad. Sci*., **89:** 493-503.

LASHARI, P.K., NAREJO, N.T., LAGHARI, M.Y., AND MASTOI, A.M., 2007. Studies on the Gonadosomatic Index and fecundity of

carp *Cirrhinus reba* (Hamilton) from fish ponds of District Jacobabad, Sindh, Pakistan. *Pakistan J. Zool.*, **39**(2): 95-98, 2007.

LONE, K.P AND HUSSAIN, A., 2009. Seasonal and Age related variations in the ovaries of *Labeo rohita* (Hamilton, 1822): A Detailed Gross and Histological Study of Gametogenesis, Maturation and Fecundity. *Pakistan J. Zool*., **41**(3): 217-239.

MANANOS, E.L., ZANUY, S. ANDCARRILLO, M. 1997. Photoperiodic manipulations of reproductive cycle of sea bass (*Diccentrarchus labrrax)* and their effects on gonadal development, and plasma 17β-estradiol and vitellogenin level. *Fish Physiol. Biochem.,* **16:** 211-222.

MIAN, A.M. AND DEWAN, S., 1984. Studies on the fecundity of *Sarotherodon milotica* (L.) in a fish pond. *Bangladesh J. Zool.,* **12:** 99-103.

MYLONAS, C.C. AND ZOHAR, Y. 2007. Promoting oocyte maturation, ovulation and spawning in farmed fish. In: *The fish oocyte: from basic studies to biotechnological applications* (eds. P.J. Babin, J. Cerda and E. Lubzens), Springer, Dordrecht. pp. 437-474.

NAUTIYAL, P. 1985. Fecundity of Garhwal Himlayan mahseer *Tor putitora* (Ham.). *J. Bombay Nat. Hist. Soc.,* **82**(2): 253-257

PRASAD, B.B, AHMED, N., EQBAL, M.D.Z., 2005, Analytical Data on Fecundity, Gonadosomatic Index and ova Diameter of a weed fish, *P. ticto* found in a Tropical Lake, in Fish Biology. (Ed, A. Kumar) A.P.H. Publishing corporation, New Dehli. pp 209-218.

SEN, U., BHATTACHARYYA,S.P AND MUKHERJEE, D. 2002. Seasonal changes in plasma steroid levels in Indian major carp *Labeo rohita;* influence of homologous pituitary extract and steroid production and development of oocyte maturational competence. *Gen. Comp. Endocrinol.,* 128: 123-134.

SIMPSON, A.C., 1951. *The fecundity of the Plaice Fish.* Invest, London, **17:**1-27

SINGH, R.K., KHANDAGALE, P.A., CHAVAN, S.L., AND SAPKALE, P.H., 2006. The relationship of ova diameter to Fertilization Rates, Hatching Rates, Survival percentage and Specific Growth Rates in the common carp and Indian major carps. *Asian Fish Sci.,* **19:** 257-269.

SINGH, S.R AND SRIVASTAVA, V. K. 1991. Observations on the gonadosomatic index and fecundity of Ganga River prawn *Macrobracium binnanicum Choprai* (Tiwari). *J. Adv. Zool.,* **12**(1): 50-55.

SINGH, V AND SRIVASTAVA, P. 1982. Fecundity study of three Indian Major carps, *Catla catla,Cirrhina mrigala* and *Labeo rohita. Indian J. Zool.,* **110** (1): 30-36.

SOMDUTT, P AND KUMAR. S. 1982. Studies on fecundity of *Puntius sarana* (Ham.) in relation to total length, total weight and ovary weight. *J. Indian Fish. Asso.,* **31:** 81-85.

(Received: 10 April, 2009; Revised: 15 June, 2009)