ISSN 2250-3153

Study on the fecundity of Cyprinus carpio communis (Linneaus, 1758, introduce)

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Abstract- Mature specimens ranging in weight from 47.00g to 4450g and in length from145mm to 610mm were used. Weight of ovary in the fish fluctuated from 4.0 g to 707 g with a mean value of 33.47. Absolute fecundity of samples varied from 3173 to 629230 and the relative fecundity varied in the range of 21.00 - 223.00 with a mean value of 91.17. The mathematical relationship of fecundity with other variables viz: fish length, fish weight, ovary weight and ovary length, and between fish weight and ovary weight and ovary length was calculated. The computed relationships were found to be highly significant especially between fecundity and fish weight($r=0.953, p<0.01$) and fecundity and ovary weight($r=0.998, p>0.01$).The values of regression coefficient (b) and correlation coefficient (r) were computed separately.

Index Terms- Cyprinus carpio communis, Fecundity, Relationships, Gonadosomatic Index

I. Introduction

The Chinese carp was introduced in Kashmir in 1956 and since then this fish has shown remarkable adaptation in various water bodies of the state, and soon began to constitute a major fishery of flat land temperate waters of Kashmir (Fotedar and Qadri 1974; Vass *et al.,* 1984). According to Das (1970, 91) the hardy mirror carp formed almost 75% of the fish catch in Dal and Wular lakes.

Feeding and breeding biology of Kashmir fish has been attempted by a number of workers (Malhotra, 1966; Das and Subla, 1969; Subla and Das, 1970; Jan and Das, 1970; Jyoti and Malhotra, 1975; Raina, 1978; Sunder, 1984; Sunder *et al.,* 1984; Sunder and Subla,1985; Yousuf and Pandit, 1992;Kulkarni *et al.,* 1994; Yousuf and Firdous, 1997 and 2001; Yousuf *et al.,* Koops *et al.,* 2004). Sindhe and Kulkarni 2005; Shatunovskii 2006; Bhuiyan *et al.,* 2006

The present study was under taken from Dal Lake,which is situated between 34º 5' and 34º6'N latitude and 74º 8' and 74º12' E longitude at an altitude of 1584m above sea level. During the present investigations, eight sites were selected for collection of fish in four different basins of the Dal Lake, one peripheral and one central from each basin viz.;Hazratbal,Nishat,Gagribal and Nageen.

II. Material and Methods

The fisherman used traditional cast net with different mesh sizes. Fish identification was done with the help of standard taxonomic works (Day, 1878; Hora, 1936; Mukerji, 1936; Kullander *et al.,* 1999)

After various body measurements the fishes were sacrificed and both the ovaries were taken out carefully. The moisture was thoroughly wiped out from the ovaries with a blotting paper. The length and weight of ovaries was noted down with complete care. The collected ovaries were then placed in 10% formaldehyde for at least 24 hours to bring hardness of eggs, so as to make easy and accurate calculation of sticky eggs. This was followed by drying of eggs on blotting paper for 1 – 2 hours, three sub-samples of one gram each from anterior, middle and posterior parts of ovary were weighed on a sensitive mono-pan balance (Anamed-Modal No.Mx-730) and then eggs were counted carefully by gravimetric method.The mean number of eggs then was multiplied by gonad weight and the total nuber of eggs per gonad was obtained,i.e absolute fecundity of fish.Relative fecundity was determined by the ratio of total number of ova and total weight of fish.

In order to assess the gonadal development of fish the Gonadosomatic index of the fish was calculated as per formula:

Gonadosomatic Index:

$$\text{Go.S.I} = \frac{\text{Weight of gonad}}{\text{Total weight of fish}} \times 100$$

III. Results

A. The Ovary Features

Ovary of *C.c.communis* was bilobed and the two lobes of the ovary were almost of same size.The shape and size of ovary did not remained same throughout the year but it was found to be dependent on the different stages of sexual maturity of the female.White coloured stripe like gonads were observed during early immature stages which grow in size and ultimately become yellow in colour during mature stages of development. Fish in high state of maturity either ripe or pre-spawning phase was selected for the determination of fecundity

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

The scatter diagram revealed a linear (Figure 1) relationship between fecundity and fish length and the coefficient of correlation was significant at 1% level ($P<0.01$). The relationship between fecundity (F) and total length (TL) is expressed by the equation:

$F = -11617 + 582\ TL \qquad (r=0.742, p < 0.01)$

A logarithmic transformation gives the straight-line regression of log fecundity on Log length,

Log F = -3.53+3.26 Log TL

Fecundity and Fish Weight (FW)
The data pertaining to fish weight (Somatic + gonadal) and absolute fecundity revealed a linear relation (Figure 2) between the two parameters, which was expressed mathematically as:

F = -r219 + 109 FW (r = 0.953, p<0.01)
Log F = 1.80 + 1.05Log FW

Fecundity and ovary length
Fecundity showed an increase with an increase in the length of ovaries (OL). A significant linear relationship was observed (Figure 3) which was expressed by the equation:

F= -37497+779 OL
or
Log F= 0.531+1.96 OL

Fecundity and Ovary Weight (OW)
A highly significant linear relationship was found between the two parameters (Figure 4) which was expressed by the equation,

F = 1271 + 767OW (r = 0.998, P<0.01)
or
Log F = 2.92 + 0.994 Log OW

Ovary weight (OW) and fish weight (FW)
A highly significant relationship was found between the two variables (Figure 5) the obtained equation was as:

OW =- 7.15 + 0.142 FW. (r = 0.954, P< 0.01)
or
Log OW= -1.15 + 1.07 Log FW

Ovary length and fish weight
A significant positive correlation was found between the two variables (Figure 6), expressed by the equation,

OL= -66.1+ 0.0580 FW (r = 0.660, P<0.01)
or
Log OL= -0.977 + 0. 396 Log Fw

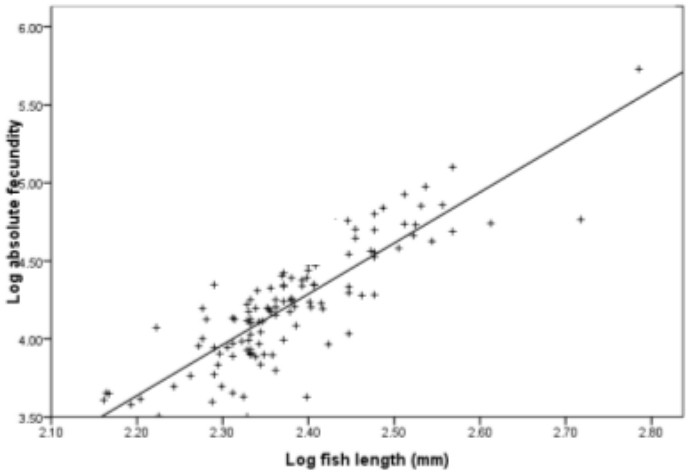

Figure 1: Relationship between fish length and fecundity in C.c. communis

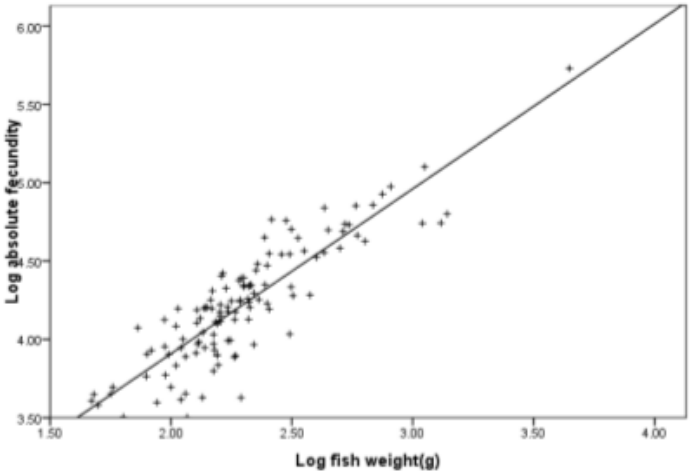

Figure 2: Relationship between fish weight and fecundity in C.c. communis

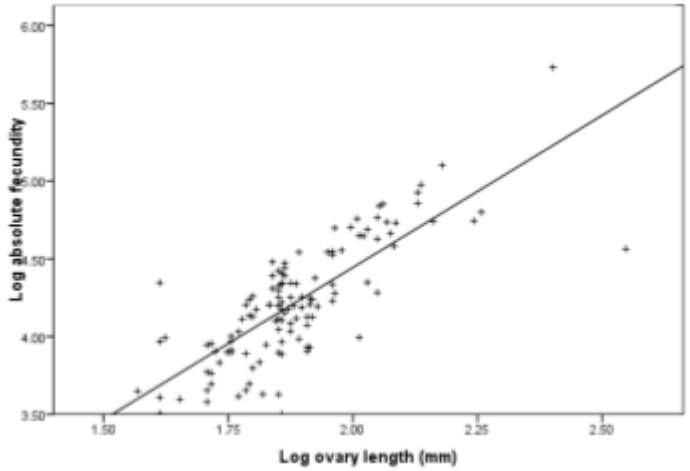

Figure 3: Relationship between ovary length and fecundity in C.c. communis

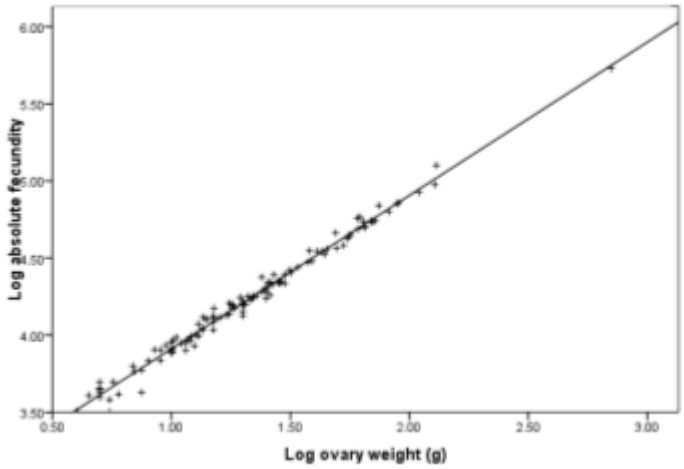

Figure 4: Relationship between ovary weight and fecundity in C.c. communis

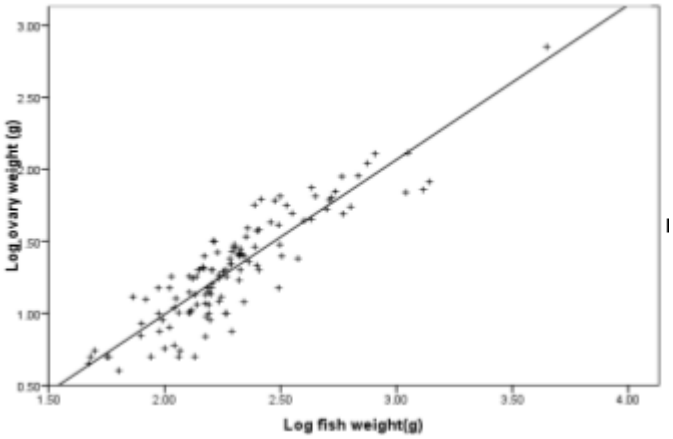

Figure 5: Relationship between fish weight and ovary weight in C.c. communis

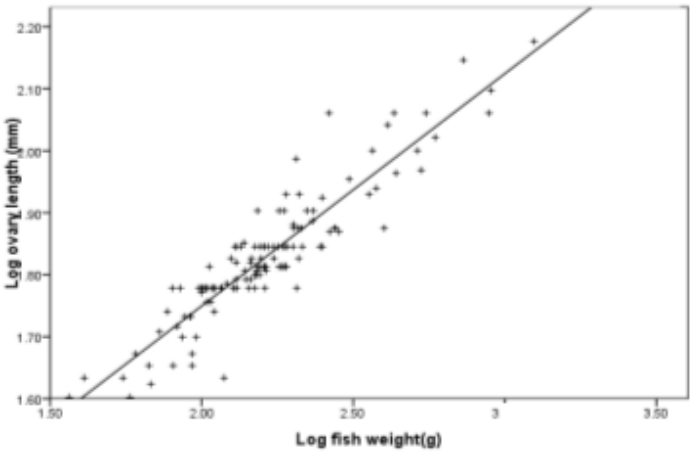

Figure 6: Relationship between fish weight and ovary length in C.c. communis

GONADOSMATIC INDEX

The gonadosomatic index (Go. S.I.) fluctuated from minimum of 2.302 in June to 11.363 in March. As far as the Go. S.I. of this fish was concerned; it exhibited variations in different months of the year (Figure 7).The Go.S.I. values decreases during April to June which suggests that fish has completely spawned and no more gonadal mass lies in the ovary. The length group IV recorded the minimum Go. S.I. value of 5.96, whereas the highest length group VII attained the maximum Go. S. I. of 8.46.

Figure 7 Monthly fluctuations in Go.S.I. of C.c.communis

Table 1: Fluctuation in Go.S.I of various length groups in C. c. communis

Type of index	I	II	III	IV	V	VI	VII
Length groups	141-179	180-219	220-259	260-298	299-336	337-374	375-414
Gonadosomatic index	6.16	7.0	7.57	5.96	6.14	7.216	8.46

IV. DISCUSSION

Study on fecundity forms an important part of fishery science as it has direct bearing on fish production and exploitation. Nikolskii (1965) stated that "fecundity is a specific feature that arises during the evolution of a new species adapted to a certain environment and is directed towards the continuance of the species

The present investigations revealed a significant linear relationship between absolute fecundity and fish weight, fish length, ovary weight and ovary length. Linear relationships of fecundity with body measurements were also reported by Swarup (1962); Jhingran (1968); Varghese (1973), (1976); Rao et al. (1979), and Pathani, (1981);Bhuiyan et al (2006).

Different fishes exhibit different reproductive potential in

terms of fecundity. Norman and Greenwood (1963) reported that Molva produces as many as 28,361,000 eggs; Gadus 6,652,000, while in case of Stickle backs the number of eggs ranges from 30 to 100 per female per season. Fecundity is known to vary within species with latitude and location (Cushing 1968; Mann et.al., 1984) and also with spawning time (Ware, 1975). On the basis of fecundity it was found that C. carpio dominated over the endemic species in terms of reproductive potential (Das and Malhotra 1964; Singh and Das 1969; Bowerman, 1975).

The studied fish was found to spawn during spring although the gonads were fully mature at the start of winter.But because of severe winter of Kashmir the gonads show inactivity or gonadal diapaus(Egami, 1959 and Hisoaka and Firlit, 1962 Malhotra, 1966 and Jyoti, 1973)which remains upto the middle of February.

V. CONCLUSION

In conclusion it can be said that *C. carpio* was the most fecund fish in the lake and showed adaptability to wide range of habitats (Das and Singh, 1969; Malhotra and Jyoti, 1974; Yousuf and Pandit 1992).

The exotic common carp *C. carpio* benefited from the changing environmental conditions in the lake and got well established in the lake within a short span of time. However, recently it has been observed that even this species is declining in number as the pollution level in lake is increasing unabated. While comparing the previous work of Das and Singh, (1969) with the present work there was recorded a decrease in absolute fecundity of *C. c. Communis.*This may be attributed to the declining environmental quality, which leads to physiological stress in the fish.

REFERENCES

[1] Bhuiyan, A, S; Islam K. and Zaman T. (2006). Fecundity and ovarian characteristics of *Puntius gonionotus. J. Biol – Sci*. **14**: 99 – 102.

[2] Bowerman, M. R. (1975). Concern over spread of carp in Southern Australia. *Aust. J. Fisheries.* **34**(3): 4-7

[3] Cushing, D. H. (1968). A study in population dynamics. *Fishery Biology:* Madison, Milwaukee, and London. University of Wisconsin Press. 200.

[4] Das, S. M. and Malhotra, Y. R. (1964). Studies on the comparative fecundity of some Kashmir fishes. *Icthyologica*

[5] Das, S. M. and Subla, B. A. (1963). The ichthyofauna of Kashmir part-I History, topography, origin, ecology and general distribution. *Ichthyologica*, **2**(1-2): 87-106.

[6] Das, S. M. and Subla, B. A. (1969). The mechanism of feeding in nine Kashmir fishes with comparative account of the standard mechanism in a herbivore an omnivore and a carnivore. *Kash. Sci.* **VI**(1 – 2): 121 – 130.

[7] Day, F. (1878). The Fishes of India, being a Natural History of the Fishes known to inhabit the seas and fresh waters of India, Burma and Cylone. Reproduced in 1958,London;Willaim Dowen and sons,778 pp.

[8] Egami, N. (1959) *J. Fac. Sci. Tokyo Univ. Zool*. **8**: 539

[9] Hisaoka, K. K. and Firlit, C. F. (1962), *Copeia*, (4): 788

[10] Hora, S. L. (1936). Yale North Indian Expedition, Article XVIII. Report on fisheries, part I, Cobitidae. *Mem. Conn. Acad. Sci*. **10**: 299-321

[11] Jan, N. A. and Das, S. M. (1970). Qualitative and Quantitative studies on the food of eight fishes of Kashmir Valley. *Ichthyologica* **10**: (1-2): 20 – 26.

[12] Jhingran, V. G. (1968). Synopsis of biological data on *Catla-catla* (Hamilton); *FAO Fisheries Synopsis.* (32). 100pp.

[13] Jyoti, M. K. (1973). Studies on the feeding and gonadal cycles of some fishes of Jammu and Kashmir State. Ph. D. Thesis. University of Jammu, 242.

[14] Jyoti, M. K. and Malhotra, Y. R. (1975). Seasonal variations in feeding of *Nemachelius Kashmirensis* (Hora). *Matsya* **1**: 53-58.

[15] Koops, M. A.; Hutchings, J. A. and McLntyre, T. M. (2004). Testing hypothesis about fecundity, body size and maternal condition in fishes. Blackwell synergy *Fish and Fisheries.* **5** (2): 120 – 130.

[16] Kulkarni, R. S.; Rafiq. D. and Patil. M. (1994) studies on the fecundity of a freshwater fish, *Channa punctatus* (Bloch) from different aquatic bodies. *Him. J. Env. Zool*. **18**: 142-145.

[17] Kullander, S. O. Fang, F.; Delling, B. and Ehlander, E. (1999). The fishes of the Kashmir Valley,pp. 99-168 **In**: *River Jehlum, Kashmir valley*, impacts on the aquatic environment. (Linhart Nyman eds.).

[18] Malhotra, Y. R. (1966). Breeding in some fishes of Kashmir valley. *Ichthyologia* **V**(1-2): 53-58.

[19] Mann, R. H. K; Mills, C. A. and Crisp, D. T. (1984). Geographical variation in the life history tactics of some species of fresh water fish. ***In:*** pp. 17-186. Fish reproduction strategies and tactics, (Potts, G. W.; Wooton, R. J., ed. London, Academic press).

[20] Mukerji, D. D. (1936). Yale North India expedition, Article 18. Report on Fishes part 2 Sisoridae and Cyprinidae. *Mem. con. Acad. Sci*. **10**: 323-359.

[21] Norman and Greenwood (1963). A History of fishes. Lond. (Ernest Benn) 213-216.

[22] Pathani, S. S. (1981). Fecundity of mahaseer *Tor putitora*. *Proc. Indian. Acad. Sci*. (*Anim. Sci.)*. **90**(2): 253 – 260.

[23] Raina, H. S. (1987). A biological note on the introduced common carp in the temperate waters of Kashmir: *Indian. J. Fish,* **34** (1): 114 – 119.

[24] Rao, C.; Nagendra, N. R. and Rahman, K. V. K. (1979). An analysis of the fecundity in the Cyprinid fish *Puntius dorsalis* (Jardon) All India seminar on Icthyology. 11pp.

[25] Shatunovskii, M. I. (2006). Some patterns of age and geographical variation in fish fecundity. *Journal of Biology Bulletin.* **33**(2): 195-198

[26] Sindhe, V R.; Rafiq, Md.; Satish, S V. And Kulkarni, R. S. (2002). Fecundity of the freshwater fish *Channa punctatus* (Bloch) from three aquatic bodies*J. Environ. Biol*. **23** (4): 429-32.

[27] Singh, H. and Das, S. M. (1969). Seasonal changes in the morphology of the ovaries of *Crossocheillus lateus punjabensis* (Heckle) Cypriniformes. *Kashmir Sci*. **VI** (1 - 2): 131 – 136.

[28] Sindhe, V R.; Rafiq, Md.; Satish, S V. And Kulkarni, R. S. (2002). Fecundity of the freshwater fish *Channa punctatus* (Bloch) from three aquatic bodies*J. Environ. Biol*. **23** (4): 429-32.

[29] Singh, V. and Shrivastava, P. (1982). Fecundity study of three Indian Major carps. *Indian Journal.* Zoology. **10** (1): 29 – 36.

[30] Subla, B. A. and Das, S. M. (1970). Studies on the feeding habits, the food and the seasonal fluctuation in feeding in nine Kashmir fishes. *Kash. Sci*. **VII**(1-2): 25-44.

[31] Sunder, S. (1984). Dietary habits of *Schizothorax curvifrons* (Heckel) from river Jehlum Kashmir. *Himalayan Research and Development* **3**(11): 17 – 23.

[32] Sunder, S.; Kumar, K. and Raina, H. S. (1984). Food and feeding habits and length weight relaitonship of *Cyprinus carpio specularis* of Dal Lake, Kashmir. *Indian. J. Fish*. **31**(1): 90 – 99.

[33] Sunder, S. and Subla, B. A. (1985). Food of Juveniles of *Schizothorax curvifrons* (Heckel). *Bull. Env. Sci.* **2** (1): 34-36.

[34] Swarup, K. (1962). The fecundity of Indian Shad, *Hilsa Ilisha*, *J. Zool. Soc.* **13**: 108-112.

[35] Varghese,T. J. (1976). Studies on the fecundity of *Coilia ramcarati* (Ham. – Buch). *Proc . Indian Acad*. **83**: 47-54

[36] Ware, D. M. (1975). Relationship between egg size, growth and natural mortality of larval fish. *J. Fish. Res. Board Cand*. **32**: 2503-2512.

[37] Yousuf, A. R. and Pandit, A. K. (1992). Breeding biology of *Schizothorax niger* (Heckel), pp. 55-62. ***In***: *Current Trends in Fish and Fishery Biology and aquatic ecology*. (Yousuf *et al.*, eds). Kashmir University. Srinagar.

[38] Yousuf, A. R. and Firdous, G. (1997). Food spectrum of crucian carp, *carassius carassius* in Anchar lake. *Oriental Sc*i. *ISSN 0971*-703 X.

[39] Yousuf, A. R. and Firdous, G. (2001). Food spectrum of Mirror carp in a deep mesotrophic Himalayan lake. *J. of Research and Development* **1**: 60 – 66.

[40] Yousuf, A. R.; Bhat, F. A.; Mehdi, D.; Ali, S, and Ahangar, M. A. (2003). Food and feeding habits of *Glyptosternon reticulatum* (McClleland & Griffth) in torrential streams of Kashmir Himalayas. *J. Res. Dev*. **3**: 123-133.

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