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# Assessment of Reproductive Indices Changes in Female Specimens of Channa Punctatus Under Varying Habitats in Tarai Region of Uttrakhand

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## ABSTRACT

The present study was undertaken on the yearlings of female specimens in C. punctatus (Bloch) from two different resources i.e. natural and captive environments. It consisted of the assessment of gonadal development and maturity in the specimens from reservoir and field ponds. Parameters studied were Gonado-somatic indices (GSI) and Hepato-somatic indices (HSI), condition factor (CF) and Somato-condition factor (SCF). The main objective of the study was to compare the gonadal development and associated changes in natural as well as captive conditions. In present study, spawning season in C. punctatus in captive condition and nature varied from April to September possibly due to different ecological as well as food available in different condition might be the most possible reason. GSI in female specimens from both the sources followed an increasing trend and reached at peak during June –August (highest in the month of June i.e. 3.4463 in captive and 3.8393in natural conditions while it was lowest in the month of January i.e. 0.1365 in captive and0.3877 in natural conditions) and has significant difference between spawning and pre spawning phase. The level of higher spawning activity exhibited in nature during March to late June, while in captive condition during June to August. The difference in periods for peak spawning/ maturity/ GSI in nature seem to be correlated with the difference in natural (genuine) food available and physicochemical as well as environmental parameters in both the conditions. HSI values in female sex have negative/inverse relationship (lowest HSI in June 0.7984 in captive conditions and 0.7631in nature while highest during December 1.5925±0.091in captive condition and 2.5103±0.22 in nature) with GSI simultaneously. The condition factor in female specimens from nature and captive conditions was recorded in higher range during pre-spawning to spawning phase while it was observed at its lowest during post spawning phase in both the conditions.

**Key Words:** Captivity, Reproductive indices, C. punctatus and Hepatosomatic index.

## INTRODUCTION

Aquaculture in India, in general, is practiced with the utilization of low to moderate levels of inputs, especially organic-based fertilizers and feed. India utilizes only about 40 per cent of the available 2.36 million hectares of ponds and tanks for freshwater aquaculture and 13 per cent of a total potential of brackish water resource of 1.2 million hectares, in other words there is room for both horizontal and vertical expansion of these sectors. Fisheries and aquaculture sector is recognized as the sunshine sector in Indian agriculture. It stimulates growth of number of subsidiary industries and is the very good source of livelihood for a large section of economically backward population, especially fishermen of the country. It has helped in increasing

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food supply, generating adequate employment opportunities and raising nutritional level. It has a huge export potential and big source of foreign exchange earnings for the country. The present research work was carried out on the yearlings of both sexes of C. punctatus (Bloch) from two different resources (Nature and captive conditions). It incorporated the assessment of gonadal development and maturity in the specimens from reservoir and ponds. Parameters used for assessing the gonadal development were Gonado-somatic indices (GSI) and hapatosomatic indices (HSI), condition factor (CF) and somatocondition factor (SCF). The objective of the study was to compare the gonadal development and associated changes under natural as well as captive conditions.

## MATERIALS AND METHODS

The experiment was carried out at College of Fisheries, G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand). Total experimental period was of 12 months from January to December, 2015. The yearlings of C. punctatus were collected from reservoir and culture pond under captive condition in College of Fisheries, Pantnagar. Sampling was carried out at monthly basis. The yearlings kept in culture pond under captive conditions were fed twice at 10 AM and 6 PM daily with supplementary feed consist of rice bran, fish meal and oil cake (1:1:1) as normal practice.

### Estimation of Biological Indices

### Gonadosomatic index (GSI)

The gonadosomatic index (GSI) was determined for each month of sampling and sex wise in all feeding groups during the period of experimentation as GSI being considered as coefficient of gonadal maturity (Nikolsky, 1963).Yearlings of C. punctatus were dissected and gonad was taken out individually from male and female and weighed on a single pan electronic balance. GSI was calculated by using following formula.

$$GSI = \frac{\text{Weight of gonad (g)}}{\text{Total body weight (g)}} \times 100$$

### Hepatosomatic index (HSI)

The hepatosomatic index (HSI), a measure of relative weight of liver, is correlated differently with growth and reproduction in different fishes. It is often used as an estimate of energy status for growth and gonadal development as liver is an important store of energy reserve in many fishes (Campbell and Love, 1978). Specimens were dissected and liver was taken out and weighed on a single pan electronic balance. HSI was calculated by using following formula

$$HSI = \frac{\text{Weight of liver (g)}}{\text{Total body weight (g)}} \times 100$$

### Condition factor (CF) and somatic condition factor (SCF)

The mathematical relationship between length and weight of the fish is a practical index, suitable for assessing growth, maturity, gonadal and general well being of individuals (Le Cren, 1951). For estimating CF length and weight of specimens in all feeding groups were measured on monthly basis. Changes in such conditions have been analyzed by means of somatic condition factor and condition factor or pondral index which has been calculated by using formula given by Hile (1936) and Beckman (1948).

$$\text{Condition factor (K)} = \frac{\text{Total body weight (g)}}{\text{Length}^3\text{ (cm)}} \times 10^5$$

Somatic condition factor (SCF) is an estimate of changes in somatic weight associated with changes in gonad weight and is expressed relative to length. During present study, SCF was calculated individually for male and female. The somatic condition factor gives an indication of changes in gonad weight.

$$SCF = \frac{\text{Body weight (g)} - \text{Gonad weight (g)}}{\text{Length}^3\text{ (cm)}} \times 10^5$$

As mentioned above 105 is used as a factor

to bring the near unity in values of CF and SCF (Carlander, 1970).

## RESULTS AND DISCUSSION

### Gonado-somatic Index (GSI)

It is most commonly used expression of reproductive effort in Fishes (Calow, 1979). Gonadal development and spawning in many teleost have shown modulated changes by environmental factors. Lowe Mc-Connell (1987) reported in Channa punctatus that spawning activity exhibited during April to August. Maturity in snakeheads depends on type of feed available adequately along with conducible temperature (Jhingran, 1985). Environmental factor such temperature can affect not only the rate of gonadal sex differentiation but also the rate of sex determination (Strussmann and Patino, 1999). The rain fall is normally associated with the spawning of fishes but in particular conditions environmental factor, feed availability has taken the role of sustaining prolongivity in gonadal development in both sexes and close relationships have been indicated by Jhingran (1985).

In present study, spawning season of C. punctatus in captive condition and nature varied from April to September possibly due to different ecological as well as food available in different condition might be the most possible reason. (Table1and 2).

In cyprinids the predominant environmental cues are both temperature and photoperiod among them the photoperiod acts as predominant environmental stimuli for gonadal development in Indian teleost, as well as in cat fish also. It was observed that long daylength and increasing temperature was observed for favoured the gonadal development in L. rohita (Kumar *et al*, 2003). In tropical and subtropical species peak spawning activity is often associated with rainfall and flood (Mishra *et al*, 2018). This supports our observations that there is relationship among day length; temperature and photoperiod with the gonadal development in C. punctatus are in accordance with the previous findings.

The GSI in female specimens from both the sources showed an increasing trend and reached at its peak during June –August (highest in the month of June i.e. 3.4463 in captive and 3.8393in natural conditions while found lowest in the month of

**Table1. GSI, HSI, CF and SCF in female (C. punctatus) under natural condition (nature).**

| Month | GSI | HIS | CF | SCF |
|---|---|---|---|---|
| January | 1.1090±0.027 | 2.2767±0.30 | 1402.52±117.04 | 1387.10±115.31 |
| February | 1.8380±0.205 | 1.5513±0.088 | 1220.69±28.74 | 1198.21±27.68 |
| March | 1.8743±0.127 | 1.0680±0.37 | 1234.91±52.56 | 1211.77±52.00 |
| April | 2.2460±0.427 | 0.9057±0.12 | 985.35±92.01 | 963.16±88.99 |
| May | 3.0193±1.160 | 0.8052±0.037 | 1160.67±6.35 | 1125.66±19.59 |
| June | 3.8393±0.895 | 0.7631±0.07 | 1041.81±45.93 | 1002.08±53.52 |
| July | 1.2735±0.528 | 0.9024±0.34 | 1016.49±139.22 | 1003.68±139.46 |
| August | 0.7409±0.054 | 0.9451±0.14 | 1090.74±82.16 | 1082.60±81.12 |
| September | 0.5326±0.062 | 1.0509±0.08 | 1038.70±125.99 | 1032.98±126.07 |
| October | 0.4970±0.010 | 1.3910±0.04 | 1218.7467±22.7 | 1189.41±38.75 |
| November | 0.4933±0.469 | 1.6795±0.045 | 1107.8933±25.92 | 1102.26±25.66 |
| December | 0.3877±0.058 | 2.5103±0.22 | 1174.4867±38.62 | 1169.91±37.92 |
| Minimum | 0.3877± 0.058 | 0.7631±0.07 | 1016.49±139.22 | 1003.68±139.46 |
| Maximum | 3.8393±0.895 | 2.5103±0.22 | 1402.5±117.04 | 1387.10±115.31 |

Mean±SD

**Table 2. GSI, HSI, CF and S.CF in female (C. punctatus) under captive condition.**

| Month | GSI | HIS | CF | SCF |
|---|---|---|---|---|
| January | 0.1365±0.019 | 1.5925±0.091 | 914.47±79.77 | 913.23±79.79 |
| February | 0.1787±0.009 | 1.2908±0.113 | 1044.48±242.53 | 1042.60±242.48 |
| March | 0.9418±0.013 | 1.3249±0.347 | 1072.50±150.43 | 1062.39±148.88 |
| April | 2.0307±0.046 | 0.9230±0.034 | 906.44±20.59 | 888.03±20.03 |
| May | 3.1357±0.401 | 0.8585±0.116 | 1078.11±242.03 | 1057.24±240.31 |
| June | 3.4463±0.479 | 0.7984±0.058 | 1060.38±86.95 | 1012.63±85.293 |
| July | 3.3120±0.32 | 0.8462±0.116 | 991.02±176.75 | 958.37±172.36 |
| August | 2.7183±0.077 | 0.9200±0.034 | 952.43±75.49 | 926.55±73.78 |
| September | 1.5557±0.130 | 1.1688±0.096 | 1081.60±153.79 | 1064.89±152.7 |
| October | 1.0321±0.110 | 1.2810±0.214 | 953.70±175.08 | 942.21±175.21 |
| November | 0.7660±0.004 | 1.2927±0.008 | 969.40±26.96 | 961.97±26.80 |
| December | 0.1420±0.008 | 1.5856±0.052 | 939.17±29.96 | 937.84±29.99 |
| Minimum | 0.1365±0.019 | 0.7984±0.058 | 906.44±20.59 | 888.03±20.03 |
| Maximum | 3.3120±0.32 | 1.5925±0.091 | 1081.60±153.79 | 1064.89±153.7 |

Mean±SD

January i.e. 0.1365 in captive and0.3877 in natural conditions) and has significant difference between spawning and pre-spawning phase (Table1and 2). Level of higher spawning activity exhibited in nature during March to late June, while in captive condition level of higher spawning activity exhibited during June to August. The difference in periods for peak spawning/ maturity/ GSI in nature seem to be correlated with the difference in natural (genuine) food available and physicochemical as well as environmental condition in both the conditions.

**Hepato-somatic Index (HSI)**

The HSI values in female sex have negative (inverse) relationship (lowest HSI in June 0.7984 in captive conditions and 0.7631in nature while found in highest rang during December 1.5925±0.091in captive condition and 2.5103±0.22 in nature) with GSI simultaneously in nature and captive conditions. During peak maturity/spawning period HSI was at its lowest. The above condition of inverse relationship might have indicated the mobilization of energy reserve in liver for gonadal development during rest of the period (preparatory and pre-spawning phase). In most teleost, the liver can store energy during sexual maturation process (Lalta *et al*, 2011) which is then transferred to the gonadal tissue. Changes in liver weight with progressive maturation have been reported by Mala and Banik (2015). HSI was highly variable and found to be lowest during mature stages and then reached to maximum at the immature stages of testis. The above findings of HSI trend and correlation with GSI in both sexes in experimental conditions have similarities with the findings of several workers (Mishra *et al*, 2013) in Ompak bimaculatus.

**Condition Factor (C.F.) and Somato-condition factor (SCF)**

The condition factor in female specimens from nature and captive conditions was recorded in higher range (1402.50 in January in nature and 1081.60 in captive) during pre-spawning to spawning phase which was at its lowest (1016.49 in July in nature and 906.44 in April in captive) during post spawning phase in both the conditions. The correlation between CF and SCF was positive and significant. Results of CF and SCF indicate the progressive development in maturity influenced with the positive seasonal changes (Table1and 2). Malla and Banik (2015)

expressed that commonly used indirect measures of energy status are condition factor and somatic factor. Sarkar *et al* (2017) reported that CF and SCF were generally high in both males and females specimens of butter catfish Ompak bimaculatus just prior to spawning. The observations of lower CF values under captive condition in present study might be more co-related with either nutritional or local ecological conditions. Condition factor (CF) and somato-condition factor (SCF) being positively correlated in both the conditions was indicative of accrual of somatic component. The CF of fishes was influenced to great extent by the seasonal change in gonads (Kapil *et al*, 2011).

## CONCLUSION

The present study clearly indicated that the spawning season in C. punctatus in captive condition and nature varied from April to September possibly due to different ecological as well as food available in different condition might be the most possible reason. GSI in female specimens from both the sources were in increasing trend and reached at peak during July –August and has significant difference between spawning and pre spawning phase. Level of higher spawning activity exhibited in nature during March to late June, while in captive condition level of higher spawning activity exhibited during June to August.

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