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Comparative age and growth of Indian major Carp (catla catla ham. 1822) in Selected water bodies of Southern Rajasthan, India

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Abstract

In present paper, growth performance of Indian major carp (Catla catla, Ham. 1822) was studied using key scales in three different sized water bodies namely Mahi Bajaj Sagar (MBS), Survania Dam (SD) and Aasan Pond (AP) situated in the tribal dominated Banswara district of Rajasthan. The annual rings or annuli (+6 to +7) and growth data in samples were observed and used to estimate selected growth parameters. High value of correlation coefficient 'r' 0.946 (MBS), 0.912 (SD) and 0.911 (AP) evident and speak for strong correlation in total length of fish and scale radius. The growth parameters such as Index of species average size (Øh) 12.515, 11.557 and 11.000, Index of weight growth ($ØC_w$) 96.610, 103.126 and 87.554 for MBS, SD and AP respectively were computed. Growth performance estimation in this study on the basis of key scales exhibited that growth of carps in the water bodies of southern Rajasthan could be divided into two phases: the first, phase of sexual immaturity, which lasts up to two years and second, phase of sexual maturity.

Keywords: Indian major carp, catla, maturity, growth, scales and rajasthan.

Introduction

Catla catla is known as 'Bhakur' or 'Catla' in Hindi belongs to family Cyprinidae and constituting bulk in the commercial catch and is well known as the fastest growing species among carps[1]. Growth rate of a fish can be enumerated from the estimations of age and growth characteristics. Jhingran[2] provided a comparative account of growth of C. catla, L. rohita and C. mrigala. Chogunovas[3] has given a descriptive account of age and growth in fishes. Scales are frequently used to determine the age of fish[4- 7], Seshappa[8] reviewed the literature on age determination of Indian fishes using scales and other hard parts. Ricker[9] considered the scale method as the most reliable method compared to others. Menon[10] has initially reviewed the literature on age and growth study of fishes from tropical and subtropical waters. Growth rate of C. catla and C. mrigala from various river systems of the country were estimated using scales[11-16]. Khandker and Haque[17] have determined age of L. rohita with the use of scales. Johal and Tandon[18] interpreted that riverine populations of C. catla have a better rate of growth than the population of reservoirs using the scales.

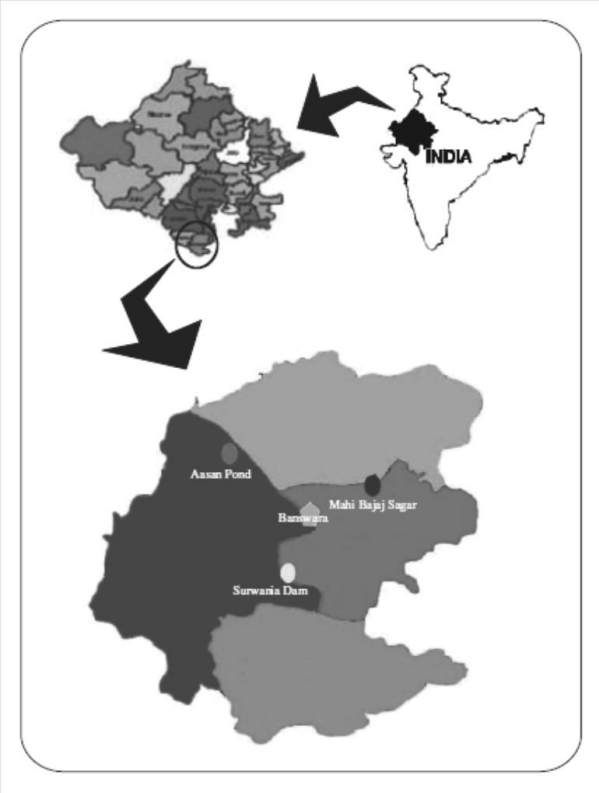
Age and growth studies are the most important aspects of fish biology because such studies can give information on stock composition, age and maturity, life span, mortality, growth, production, management and conservation etc. Johal and Tandon[19] studied age and growth of C. catla and C. mrigala from Lake Sukhna, Chandigarh with the use of scales found that the growth rate of these fishes was the lowest as compared to the populations of other localities. Prakash and Gupta[20] studied the growth rate in C. catla, L. rohita and C. mrigala of Govindgarh Lake by means of scales and found that the growth rate in these species is relatively faster for the first five years of life after which growth increment is very little. Singh and Sharma[21] studied the age and growth of a Himalayan teleost Schizothorex richardsonii from the Garhwal hills. Ujjania[22] studied the similar aspects in the chichlid fish Tilapia from Jaisamand Lake using key scales. Singh[7] have studied the key scale of L. Rohita for finding information on age, growth and harvestable size from Lake Jaisamand. Jain[23] has studied the biology and fisheries of C. catla, L. rohita and C. mrigala of Siliser reservoir. Deepak[24] have studied the age and growth profile of catla using scales.

Material and Methods

Collection of scale samples: Scale samples of *C. catla*[25] were randomly collected from selected three sized water bodies of southern Rajasthan (figure - 1). From total 150 fish specimens, 5-10 scales were collected quarterly from commercial fish catch during the January, 2000 to June 2001.These collected scales were preserved in paper envelops with key data such as Total Length, Standard Length, Body Weight, date of scale collection and signature of scale collector.

Analysis of scale samples: For the age and growth study, preserved scales were dipped in 1 % KOH solution for 5 minutes and washed with tap water 2-3 times with gentle

rubbing by fingertips to remove mucus and other dust material.



The scales measurements comprised of radius of scale and radius of all the annuli from the focal point and were studied in dry mountings using VEB microfilm reader with the magnification of 10.5 'X' at the department of zoology, Punjab University, Chandigarh.

The back calculation of fish length at the time of formation of annuli could be estimated using following relationship given by Bagenal and Tesch[26]:

$$L_n = a + \frac{S_n (L - a)}{S}$$

Where: L_n = Length of fish when the annulus 'n' was formed, L = Length of fish when scale sample was obtained, S_n = Radius of annulus 'n' , S = Total scale radius, a = Correction factor (intersecting point between T L and Scale Radius)

Growth parameters based on scale analysis: The length-weight relation was calculated using formulae[19, 27]. The growth parameters such as growth characteristics (C_{th}), specific linear growth (C_l), growth constant (C_{lt}), specific rate of weight increase (C_w), index of species average size (Øh) and index of population weight growth intensity ($ØC_w$) were calculated as suggested[28].

$$W = aL^b$$

$$\text{Log } W = \text{Log } a + b \text{ Log } L$$

$$C_{th} = \frac{\text{Log } L_n - \text{Log } L_{n-1}}{0.4343} \times L_{n-1}$$

$$C_{lt} = \frac{\text{Log } L_n - \text{Log } L_{n-1}}{0.4343} \times \frac{t_2 + t_1}{2}$$

$$C_l = \frac{L_n - L_{n-1}}{L_{n-1}} \times 100$$

$$C_w = \frac{W_n - W_{n-1}}{W_{n-1}} \times 100$$

$$Øh = \frac{\sum h = 1}{n_{j+a}}, \qquad h = n_{j+a}{}^{27}$$

$$ØC_w = \frac{\sum C_w = 1}{n_{j+a}}, \qquad C_w = n_{j+a}{}^{27}$$

Where: L_n, L_{n-1}= total length of fish at ultimate and penultimate age, W_n, W_{n-1} = Weight of fish at ultimate and penultimate age, j = juveniles, a = adult, h = absolute increase in length, t_1, t_2 = time intervals between ultimate and penultimate age.

Results and Discussion

Age and growth rates of C. catla from MBS, SD and AP were estimated on the basis of scale radius (plates 1, A to F). Correlation among total length of fish and scale radius was also determined for these species separately and highly significant correlation ($P< 0.01$) was observed (table - 1). C. catla attained maximum weight (17000 gm) in MBS as compared to (9800 gm) in SD and (6800 gm) in AP. Interestingly growth rate during first two years was observed higher in case of SD (table - 2).

On the other hand Specific rate of linear growth (C_l) was observed to decrease with increasing age while, specific rate of weight increase (C_w) was observed to increase with age. Growth constant average ($C_{lt(Av)}$) was more at first year of age being 0.539, 0.600 and 0.499 in MBS, SD and AP, respectively.

Further, it was observed that growth constant average reduced in subsequent years of age. Annual length increment (h) did not show any regular pattern as it was observed in case of annual weight increment (w) increase. Index of species average size (∅h) of 11.577 (SD) was much closer to 11.000 (AP) as compared to 12.515 observed for MBS.

Table-1
Regression of scale radius on total length of Catla catla from Mahi Bajaj Sagar, Surwania dam and Aasan pond

Waterbody	N	TL± SE	Wt ± SE	SR ± SE	a ± SE	b ± SE	r*
MBS	50	46.5 - 97.0 (71.700 ± 2.441)	1200 - 17000 (6492.335 ± 2.811)	7.4 - 18.7 (13.41 ± 0.5.5)	-1.419 ± 0.891	0.207 ± 0.013	0.946
SD	50	40.0 - 83.0 (66.883 ± 2.230)	1000 - 9800 (4570.0 ± 448.484)	6.9 - 15.3 (11.393 ± 0.457)	-1.713 ± 1.283	0.205 ± 0.020	0.912
AP	50	39.0 - 75.0 (62.50 ± 1.704)	900-6800 (4096.0 ± 278.971)	6.7-14.1 (10.72 ± 0.316)	-0.894 ± 1.017	0.186 ± 0.016	0.911

MBS: Mahi Bajaj Sagar, SD: Surwania Dam and AP: Aasan pond, N: Number of fish scales, TL: Total length, Wt: Weight, SR: Scale radius * All the values of 'r' are significant at P< 0.01

Table -2 (A)
Growth rate of C. Catla of Mahi Bajaj Sagar, Surwania Dam and Aasan Pond

Water bodies	Parameters	L_1	L_2	L_3	L_4	L_5	L_6	L_7
MBS	**L**	25.485	36.504	47.380	56.985	64.999	77.187	87.603
	H	25.485	11.019	10.876	9.605	8.014	12.187	10.416
	Øh	**12.515**						
	C_l	43.237	29.794	20.273	14.063	18.750	13.495	
	C_{th}	9.157	9.519	8.746	7.498	11.170	9.771	
	C_{lt}	0.539	0.391	0.277	0.197	0.258	0.190	
	$C_{lt(av)}$	**0.539**	**0.263**					
	W	236.537	717.258	1549.614	2886.835	4397.420	7532.994	11333.575
	w	236.537	480.720	832.357	1337.221	1510.584	3135.574	3800.581
	Cw	203.232	116.047	86.294	52.327	71.305	50.452	
	ØCw	**96.610**						
SD	**L**	22.716	33.895	42.899	51.022	60.439	69.345	
	h	22.716	11.179	9.004	8.123	9.417	8.906	
	Øh	**11.557**						
	C_l	49.214	26.565	18.934	18.457	14.735		
	C_{th}	9.091	7.985	7.439	8.642	8.308		
	C_{lt}	0.600	0.353	0.260	0.254	0.206		
	$C_{lt(av)}$	**0.600**	**0.268**					
	W	190.318	629.554	1289.645	2110.128	3478.322	5270.614	
	w	190.318	439.236	660.092	820.482	1368.194	1792.292	
	Cw	230.790	104.851	63.621	64.839	51.527		
	ØCw	103.126						

Table -2 (B)
Growth rate of C. Catla of Mahi Bajaj Sagar, Surwania Dam and Aasan Pond

AP	**L**	23.623	32.944	41.484	51.068	59.433	66.003	
	h	23.623	9.321	8.540	9.584	8.365	6.570	
	Øh	11.000						
	C_l	39.458	25.922	23.104	16.380	11.054		
	C_{th}	7.857	7.593	8.623	7.746	6.231		
	C_{lt}	0.499	0.346	0.312	0.228	0.157		
	$C_{lt(av)}$	**0.499**	**0.261**					
	W	214.592	566.251	1111.357	2077.054	3222.823	4369.334	
	w	214.592	351.659	545.106	965.697	1145.769	1146.512	
	Cw	163.873	96.266	86.894	55.163	35.575		
	ØCw	87.554						

L : Back calculated length in cm; **W** : Calculated weight in gm; **h** : Annual length increment in cm; **w** : Annual weight increase in gm; **Øh** : Index of species average size; C_w : Specific rate of weight increase **;** C_l : Specific rate of linear growth; $ØC_w$: Index of weight growth intensity; C_{th} : Growth characteristics; $C_{lt(Av)}$: Growth constant average; C_{lt} : Growth constant

Growth estimation of C. catla from these selected three water bodies suggest of population variability. Though all the growth related parameters in the present study were observed to follow standard trends true for Indian major carps, a high degree of correlation was found between total length and lateral scale radius. Johal and Tandon[18] also reported a high degree of correlation between these two variables for C. catla of Gobind Sagar and Harike reservoirs.

Gradual decrease in the values of the specific rate of linear growth and the specific rate of weight increase with the increase in age vividly suggests that growth rate of carps is more at the early stage of life and gradually decreases as the age advances. Johal and Tandon[18] reported three growth phases for C. catla on the basis of observed growth constants and in the present study however, only two growth phases were observed for all the three stocks from these three water bodies. According to Chugunovas[3] majority of fish populations show only two growth phases of life corresponding to sexual immaturity and sexual maturity.

Singh[7] observed that with increase in age there is decrease in the specific rate of linear growth and specific rate of weight increase. In present study, high values of annual length increment (h) of C. catla were observed at sixth year, fifth year and fourth year in the fish of MBS, SD and AP, respectively. Tandon and Johal[28] also observed the phenomenon of growth compensation in C. Mrigala and L. rohita from river Ghaghar at Rangmahal, in age classes six and five, in C. catla from Gobind Sagar Lake in the age class four and in L. rohita from river Satluj in the age classes six and eight years. Prakash and Gupta[20] in their study on the comparative growth rates of C. catla, L. rohita and C. mrigala of Govindgarh Lake reported that growth rates in these species were rapid at the first year after that it was very little. The growth increment was maximum in C. catla, less in L. rohita and the least in C. mrigala. However, in the present study varied results were obtained for the catla of these water bodies. The growth increments were higher in C. catla of SD, while it was moderate in case of SD and AP. Comparatively, high growth of C. Catla of SD amongst all the water bodies could be attributed to the higher standing crop of zooplankton, while in AP and MBS lower growth can be reasoned for low level of planktonic biomass.

Conclusion

The growth estimations on the basis of scale studies indicated that the growth rate of the Indian major carp (Catla catla) was very low in initial years but it was compensated by fast growth on an average by fourth year onwards. On the basis of age and growth studies the Indian major carp (Catla catla) of waterbodies situated in southern Rajasthan could be divided primarily into two phases, the first being the phase of sexual immaturity which lasts up to two years and followed by the phase of sexual maturity.

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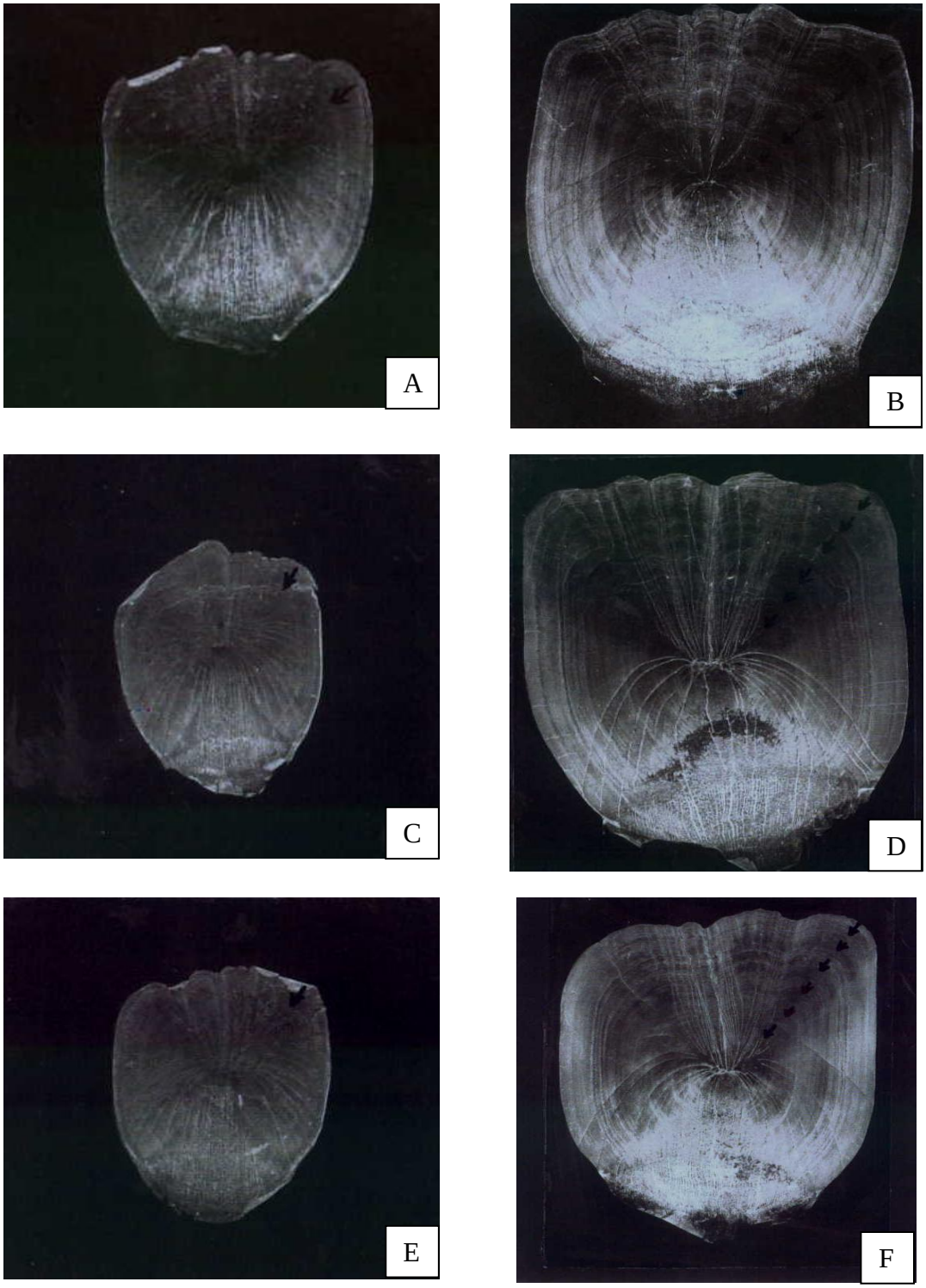

Plate 1. Scale readings

A = +1 year class and B = +7 year class of *C. catla* of Mahi Bajaj Sagar, C = +1 year class and D = +6 year class of *C. catla* of Surwania Dam, E = +1 year class and F = +6 year class of *C. catla* of Assan pond