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Age, growth and length-weight relationship of *Cirrhinus mrigala* from pong reservoir, Himachal Pradesh, India

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ABSTRACT

Age and growth of *Cirrhinus mrigala* from Pong reservoir of the Kangra district of Himachal Pradesh was studied by using scale method. Length-weight relationship was analyzed by using Le Cren's equation $W=aL^n$ which was further transformed into Log W=log a+n log L. In the present study, Log W was found to be -0.401745082 $L^{3.2848}$. Linear relationship with a high degree of correlation was observed between total length and lateral scale radius. Six age classes (3-8) were reported in the present study. Maximum numbers of specimens were reported in the age class 4. The data on growth characteristics revealed that age class 4 is more vulnerable in the catch. Annual increment (h) and index of species average size (ØL) were also calculated from the data.

Keywords: Age and growth, annuli, *Cirrhinus mrigala*, Pong reservoir.

1. Introduction

In Himachal Pradesh, there are many natural as well as man-made water resources which support a variety of fish life. At present, 97 species of fresh water fishes belonging to 51 genera, 18 families and 6 orders have been reported from Himachal Pradesh [31]. Pong reservoir is one of the Ramsar sites where so many fishes have been reported. It is situated at a latitude of 32º25' North, longitude 76º45' East and altitude 450 MSL. In order to maintain the ecological balance of Pong reservoir, it is necessary to study the commercial and noncommercial fishes so that the ecological health of this wetland can be maintained by using appropriate fishery management practices so that there is no decline in fish diversity and fish catch.

Knowledge of age and growth of a fish is an extremely useful part of population dynamics in fishery biology and fishery management. This provides us the basic information on sexual maturity, harvestable size and environmental conditions of the water body. There are several hard parts which are used for age determination like scales, opercula, vertebrae, frontal bones, cleithra, otolith and fin ray sections. Out of these, scale method is most widely used because scales can be used without sacrificing the fish. The present investigations have undertaken to study the age and growth of *Cirrhinus mrigala* using scale method to study its bionomics and to compare the present study with earlier studies in order to pinpoint any change in the growth pattern of this fish during last one or two decades.

2. Materials and methods

The material for the present investigations was collected from Pong reservoir, Kangra district, Himachal Pradesh, which was visited from the months of October to December, 2008. In total, scales were collected from 139 fishes. 7-10 scales of each fish were removed from the lateral side below the dorsal fin, above the lateral line, preferably from the second or third row of scales. Scales were kept in the ordinary envelops with the following data:, Total length, standard length, weight, date of collection and place of collection and were brought to the laboratory for the further studies. Scales were removed from envelops, washed in tap water and rubbed between the finger tips to remove the mucus and other extraneous matter. The cleaned scales were air dried and again preserved in fresh envelopes. Each scale was mounted between the glass strips and studied using Carl Zeiss (model D 5.3) scale reader at the magnification of 10X. From the magnified image of the scale, total scale radius and the distance between the focus and their respective annuli were measured.

For back calculation following equation was applied: $Ln= Sn/S \times L$

Where,

Ln = Length of the fish when annulus 'n' was formed
Sn = Radius of the annulus 'n' (at the fish length Ln)
S = Total antero-lateral scale radius
L = Total length at the time of capture
The other growth parameters such as annual increment (h), index of species average size and length-weight relationship were also studied. The relationship between length and weight of *C. mrigala* has been determined by using the equation $W= aL^n$ [24].

3. Results and discussion

In the present study the length-weight relationship of *Cirrhinus mrigala* (Hamilton) has been found to be: $W= -0.401745082\ L^{3.2848}$ (Fig. 1, 2).

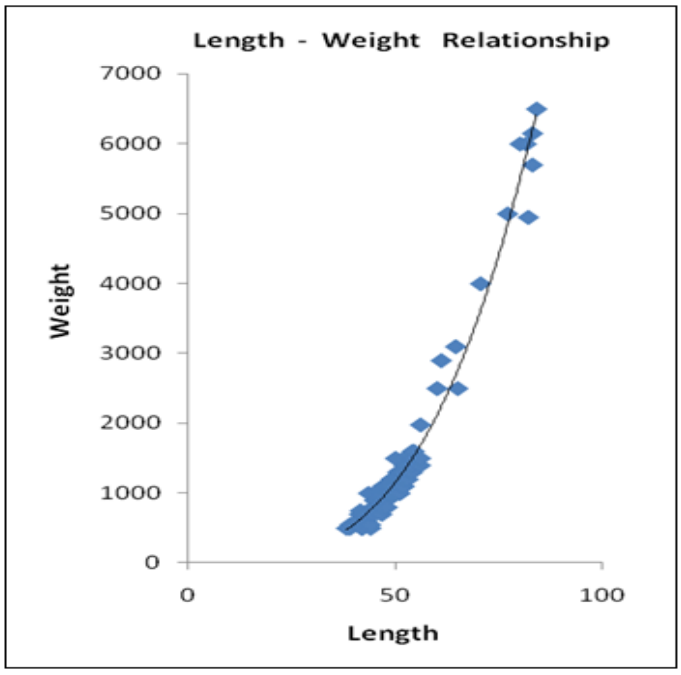

Fig 1: Relationship between total length-weight of *C. mrigala*. Total length (cm) along abscissa and weight (gm) along ordinate

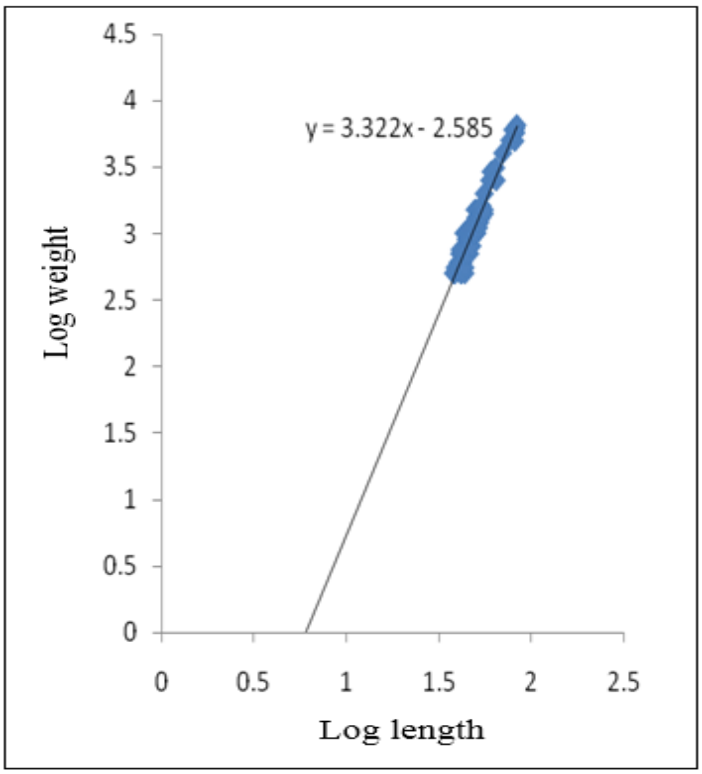

Fig 2: Relationship between log-length and log-weight of *C. mrigala*. Log-length (cm) along abscissa and log-weight (gm) along ordinate

The length-weight relationship of *Cirrhinus mrigala* collected from different localities has also been described by various other workers like Khan and Hussain [21], Jhingran [8, 9], Chakrabarty and Singh [2], Srivastava and Singh [34], Kamal [20], Hanumantharoa [7], Soni and Kaithal [33] and Johal and Tandon [14] (Table 1). According to them, the value of the exponent varies from 2.0976-3.3669. The highest value has been recorded from river populations [2] followed by reservoirs [27] and lakes [34]. However, Devaraj and Natarajan [5] reported the minimum value from paddy fields. Das [4] found that this value is also influenced by the food supply in addition to gonad development and fat deposition. Some of the recent studies in this line are Johal and Tandon [13], Mohan and Sankaran [25], Kurup [23], Johal and Kingara [12], Reddy and Rao [29], Biswas [1], Pandey and Sharma [26], Sarkar *et al.* [30], Sunil [35] and Goel *et al.* [6].

Table 1: Length-weight relationship in *C. mrigala* collected from different localities

Authority	Equation	Locality from where fish studied
1	2	3
Jhingran (1952)	Log W = -4.922212022+ 3.0248352 Log L	Tanks and fort moat at Cuttack
Jhingran (1959)	Log W = -5.54534 + 3.221 Log L	River Ganga at Buxar
Chakrabarty and Singh (1963)	For males : Log W = -5.85919 + 3.33668 Log L For females : Log W = -5.94481+ 3.36690 Log L For juveniles : Log W = -5.3370 + 3.1270 Log L	
Srivastava and Singh (1964)	Log W = -0.45276 + 2.0357 Log L	Ranchi Lake
Kamal (1971)	$W = 1.009x10^{-5} \times L^{2.99552}$ Or Log W = -4.99627 +2.99552 Log L	River Ganga and Yamuna at Allahabad
Khan (1972)	$W = 0.7328 \times 10^{-5} L^{3.0520}$ Or Log W = -5.1350 + 3.0520 Log L	From Fishery waters around Aligarh
Hanumantharao (1974)	$W = 10^{-9} \times 6853 L^{3.0830}$	River Godavari
Pantulu *et al.* (1966)	$W = 0.0011771 L^{3.2931}$ $W = 0.0063183 L^{2.7573}$ $W = 0.0012362 L^{2.6877}$ $W = 0.0287010 L^{2.2841}$	Maithon reservoir Tilaiya reservoir Panchet reservoir Konar reservoir
Devaraj and Natarajan (1973)	Log W = -2.9003 + 2.0976 Log L	Aruputhiodai Paddy fields of Thaunjore District
Present study (2008)	$W= -0.401745082 L^{3.2848}$	Pong reservoir Himachal Pradesh

Earlier reports on length-weight relationship of most of the cyprinid fishes showed that many of them strictly follow cube law while there are many in which the weights of fishes either tend to increase or decrease in proportion to the cube of length [3]. It is considered that at the size of 5 cm, scale made its first appearance on the body of fish. The size of 5 cm appears to be unrealistic because small sized fishes were absent in the sample. As the correction factor has not been applied while calculating the back-calculated lengths and direct proportional has been used. The present material includes six age classes 3-8 (Fig. 4-9). Maximum number of specimens were recorded in the age class 4 followed by 3, 5, 7, 6 and 8. The present studies have indicated that age class 4 is more vulnerable to the gear and is dominant in the catches. Thus the younger and older fish escape or die off due to unknown factors. The mean total length of the sample at the time of capture has been found to be 62.53 cm total fish length. It is observed that growth is maximum during the first year of life and in the subsequent age classes the annual increment follows a declining trend. The annual increment in the age class 3 is 7.48 followed by 6.37, 6.56, 6.50, 10.02, 7.12 and 6.09 cm in the age classes 4, 5, 6, 7 and 8 respectively (Table 2).

Fig 3: Age class 3+

Fig 4: Age class 4+

Fig 5: Age class 5+

Fig 6: Age class 6+

Fig 7: Age class 7+

Fig 8: Age class 8+

Fig 9: Regenerated scale

From the table 2 it is apparent that under normal condition, *Cirrhinus mrigala* showed best growth in first year and moderate in the subsequent years. Further, this fish follows the general growth pattern i.e. the annual increment decreases with the increase in age which is a characteristic feature of most of the carps. The index of species average size has been found to be 10.16 cm total fish length. The age and growth studies using scale method of *Cirrhinus mrigala* have been studied by Jhingran [9, 10], Kamal [19], Jhingran and Khan [11], Johal and Tandon [15, 16] and Kingara and Johal [22] from different water bodies in the past. The linear relationship between total fish length and scale radius is a common phenomenon among Indian major carps, but Poupe [28] recorded curvilinear relationship in Pike, *Esox lucius* from Czechoslovakia. Singh and Sharma [32] observed a strong linear relationship between fish length and lateral scale radius in *Schizothorax richardsonii.* However, linear relationship has been obtained in the present studies (Fig. 3).

Table 2: Back-calculated lengths (cm) of *Cirrhinus mrigala* during the months of October-December, 2008 from Pong reservoir, Himachal Pradesh

Age class	**No. of specimens**		**Average total length (cm) at the time of capture**	**Back calculated total fish lengths (cm) in each year of life**							
				l1	l2	l3	l4	l5	l6	l7	l8
3+	33	Mean	44.21	26.76	33.55	40.64					
		Min.	38.2	16.35	27.53	34.11					
		Max.	61	33.32	40.1	49.7					
4+	73	Mean	48.62	28.21	35.25	42.1	47.28				
		Min	43.5	18.64	28.93	33.33	40.12				
		Max.	56	39.72	44.93	52.46	54.69				
5+	23	Mean	51.24	28.71	34.01	40.22	44.64	48.51			
	A	Min	49	22.27	28.64	32.45	40.09	43.13			
		Max.	60	34.14	40.55	45.96	54.43	58.14			
6+	3	Mean	70.83	35.01	44.87	50.14	57.65	62.52	67.59		
		Min	64.5	32.2	40.09	45.56	50.42	55.28	59.53		
		Max.	83	38.77	49.07	56.95	66.64	73.91	79.97		
7+	4	Mean	77.25	36.25	43.8	50.47	56.29	62.6	69.51	75.15	
		Min	70.5	34.08	40.47	47.59	51.7	57.58	61.69	67.56	
		Max.	81.5	39.78	45.56	51.98	64.17	66.73	74.19	80.94	
8+	3	Mean	83	33.08	41.46	47.57	52.89	59.38	67.71	75.62	81.48
		Min	82	32.09	38.18	41.5	47.03	51.46	61.42	73.59	80.84
		Max.	84	34.07	45.77	50.82	56.59	63.52	72.18	77.38	82.26
	139	Mean	62.53	31.34	38.82	45.19	51.75	58.25	68.27	75.39	81.48
		Min	38.2	16.35	27.53	32.45	40.09	43.13	59.53	67.56	80.84
		Max.	84	39.78	49.07	56.95	66.64	73.91	79.97	80.94	82.26
		Annual Increment (h)		31.34	7.48	6.37	6.56	6.5	10.02	7.12	6.09
		Index of species average size. ØL.			10.16						

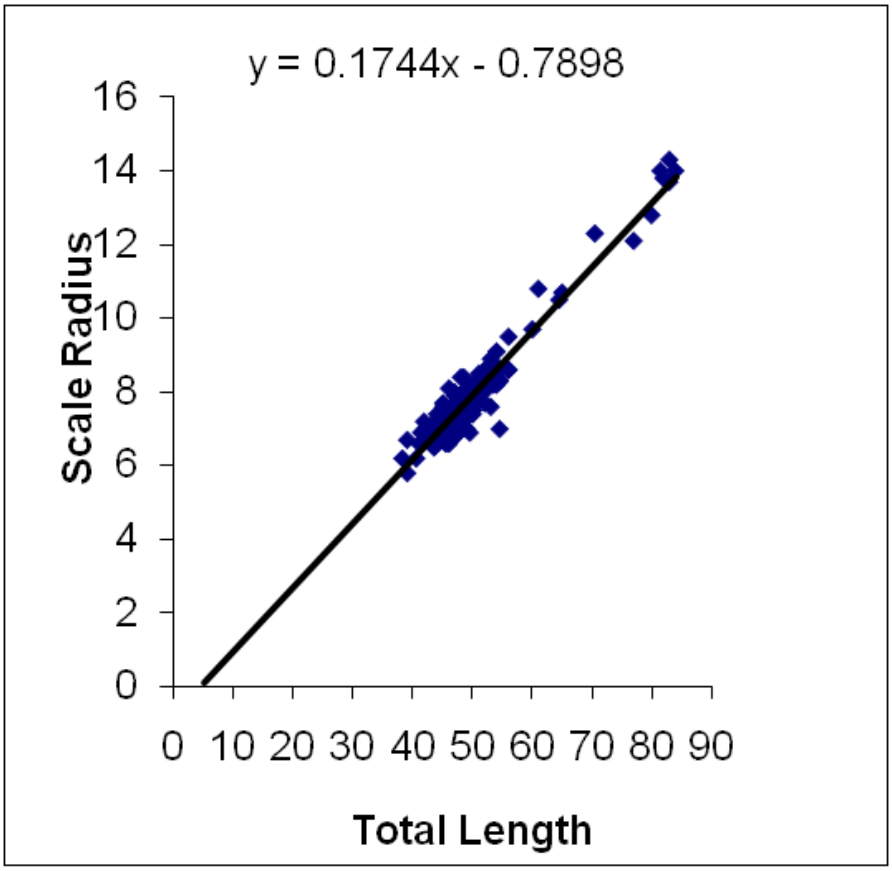

Fig 10: Graph showing linear relationship between total fish length (cm) along abscissa and scale radius (cm) along ordinate

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