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Determination of Age and Growth Rate of Fresh Water Fish *Labeo rohita* (Ham. 1822) by Using Cycloid Scales

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ABSTRACT

Growth of organism means a change in length or weight or both with increasing age. Age and growth are closely linked. Scales from, fresh specimens preserved in the freezer were collected from about the middle flank of the fish just under the dorsal fin and above the lateral line. The scales were cleaned with cold water and will be observed under a binocular microscope. The number of growth rings on scales was counted. A total of 22 fishes were collected ranging in length between 26cm to 51cm in total length. The age was recorded 1 to 1+ year in group 1 (20cm to 30cm), 1+ to 2 years for group 2 (31cm to 40cm), 2, 2+ and 3 years for group 3 (41cm to 50). The age ranges from 1 to 3 years in examined material. The Length weight equations were computed, during the period of March to May 2014. The sample was ranged between 26 to 51 cm length and 150 to 1600 g weight of Labeo rohita obtained from the various fishermen. The correlation coefficient was 0.978 and it was highly significant (p<0.001). This indicated a close relationship between length and weights. The condition factor (K) was calculated from pooled data for different length groups. The minimum and maximum values of 'K' were observed between 0.85 to 1.34. The average weight 775.82 gm was noticed. The maximum value of condition factor was observed in the 41.3 cm length and weight 950 gm which may be attributed to the maturity.

Keywords: *Scales, Labeo rohita, Condition factor, Correlation coefficient*

INTRODUCTION

Age and growth are closely linked. Age determination is an age-old practice. Age determination is a central part of all work directed to the rational exploitation of a fish stock [1,2, 3]. Knowing the age of fish provides a clue to its longevity, age of first maturity, age recruitment and growth[4]; more over the age-length key, or age composition data, allows the development of catch curves from which the annual mortality rates can be calculated. So, ageing fish accurately is in dispensable to the understanding of the dynamics of their stocks [5, 6]. Age and growth studies are important for the problems associated with management of fisheries. Age determination of fish from scales, otolith, vertebrae, fins, spines, fin rays and other structures a matter of routine with most exploited fish stocks. Monitoring of a population of known age require long time and is quite expensive method. Hence, the best validation method for age determination is to study of annulus formation of fish seems to be marginal growth analysis[7]. The age of fish can be estimated indirectly by analyzing the length - frequency distribution, from which we can obtain the mean length of each age group, or directly (individual age) by counting the annual growth marks in calcified structures, such as scales, otoliths, opercular bones and fin rays of each specimen .The second of these two methods is the more precise and gives more information on the population dynamics[8].

Age determination in fish can be carried out using the anatomical method (counting the regular growth marks formed in hard tissues such as scales, otoliths, vertebrae, spines, and tail bones), length-frequency analysis (monitoring the progression through time of the identifiable modes in size classes), or direct measurement .

The study of weight-length has its applied value in fish biology. Significance of the study in fishes is to assess the growth of fish in different environments. For instance, while defining a population, fish length is measured and predicted average weight is assigned to all fish in a given length group. This is often faster and more convenient than weighing fish individually, especially when large number of live fish is sampled. Weight length relationship is used on commercial scales in population assessments. Several authors described the importance of length weight relationship on various fish species[9]. Length-weight relationship provides information on the changes in the well being of the fishes that happens during their life cycle. This can be estimated by comparing the expected weight estimated by using the length-weight relationship with actual weight of fish. Like other morphometric measurements, length-weight relationships may change during the events of life cycle like metamorphosis, growth and onset of maturity. Length-weight relationships can be used as character for differentiation of taxonomic units. An already established length weight relationship will be useful for assessing the data that contains only length frequency measurements. This relationship can be used in setting up of yield equations, estimate the number of fishes landed and for comparing the population over space and time.

The purpose of this study is to calculate the age of *Labeo rohita* by scales, establishing length-weight relationship and relationship between the scale size and the body size.

MATERIAL AND METHODS

Method for counting annuli

Scales from, fresh specimens preserved in the freezer were collected from about the middle flank of the fish just under the dorsal fin and above the lateral line. Key scales were regarded as those lying directly below the posterior end of the dorsal fin and on the first row of scales above the lateral line. The scales were cleaned with cold water (as warm water disintegrates them) and will be observed under a binocular microscope. The number of growth rings on scales was counted. When inspection is not made on same day, the scales were fixed in-between two slides held with cello tape for observation later.

Length-weight relationship

The formula given by Lacey and cretin for length-weight relationship of different species of fish is:

$$\frac{\text{Length and one third length} \times \text{Girth squared in inches}}{1000} = \text{Weight}$$

1¼ length of fish multiplied by square of the girth in inches and divided by 1,000 gives the weight of fish in pounds.

Direct Proportion-Body -Scale relationship method

This method holds that the growth of scale and that of the body are at the same proportional rate (isogonic growth rate). However, the calculated body lengths are found to be lower than the empirical lengths. This is explained by the fact that fish attains somebody length before the formation of scales. A modified formula is therefore used which is expressed by the equation:

$$\frac{S'}{S} = \frac{L'}{L} \qquad L' = \frac{S'}{S} \times L$$

S′ = length of scale radius to annulus x

S = length of total scale radius.

L = length of fish when scale sample was obtained.

L′ = length of fish when annulus x was formed.

Condition factor (K) was determined for different length groups using length and weight data following the equation given by LeCren (1951):

K = (W x 100) / L3

RESULTS AND DISCUSSION

Age Determination by Scales

A total of 22 fishes were collected ranging in length between 26cm to 51cm in total length. The scales of *L. rohita* were cycloid and were distinguished into true ring, false ring and larval marks besides radii. Annual growth rings were clearer and sharper in scales thereby producing lesser errors in age estimation. The focus, which represents the initiation of growth in scales, is located near the anterior field of the scale; while, the larval marks appear in the first year age class and are situated not far from the focus. Marks presumed to be annuli were counted under the simple microscope. The age was recorded 1 to 1+ year in group 1 (20cm to 30cm), 1+ to 2 years for group 2 (31cm to 40cm), 2, 2+ and 3 years for group 3 (41cm to 50). The age ranges from 1 to 3 years in examined material.

Length-weight Relationship of *Labeo rohita*

The Length weight equations were computed, during the period of March to May 2014. The sample was ranged between 26 to 51 cm length and 150 to 1600 g weight of *Labeo rohita* obtained from the various fishermen and presented in (Table 1). A graph of weight against length on double logarithmic paper, however, yielded a straight line as expected. The correlation coefficient was 0.978 and it was highly significant ($p<0.001$). This indicated a close relationship between length and weights. The condition factor (K) was calculated from pooled data for different length groups. The minimum and maximum values of ‘K’ were observed between 0.85 to 1.34. The average weight 775.82 gm was noticed. The maximum value of condition factor was observed in the 41.3 cm length and weight 950 gm which may be attributed to the maturity. The fluctuation in the value of ‘K’ in fish has been mainly assigned to dependency on many factors such as feeding intensity, fish size and availability of fish [10]. In the present investigation with the help of back calculation method it was noticed that the first, ring was formed at 52mm length of fish.

Direct Proportion: Body-Scale Relationship

From Fig. 2 it is clear that there was an isogonic growth rate. However, the calculated body lengths were found to be lower than the empirical lengths. The fishes show a linear but not directly proportional body: scale relationship (Table 3). The minimum value of scale radius to annulus was 8mm and length at that time was 52mm (by back calculation method). The maximum value of scale radius to annulus was recorded 25mm and the length at that time was 180.7mm (by back calculation method). Same values have been obtained like 2.99 for *Catla catla*[11] , 3.02 for *Tor putitora*[12]. According to researcher in general, all fishes have annual cycles of maximum growth corresponding to summer and autumn when temperature and food supply are moderate and suitable ambient conditions[13].

Table 1. Length-Weight and Age Relationship

S. No.	Length (cm)	Weight (g)	Age (yrs)
1	35	432	1+
2	34	390	1+
3	36.5	470	1+
4	41	800	2+
5	26	150	1
6	29	290	1+
7	28	250	1
8	44.5	1150	2+
9	51	1600	3
10	39.5	736	1+
11	27	188	1
12	41.3	950	2
13	46.6	1250	2+

14	43	1000	2
15	44	1100	2
16	45	1180	3
17	43.5	1100	2
18	43.2	1000	2
19	47	1270	3
20	40	760	1+
21	41.5	830	1+
22	26.3	172	1

Table 2: Length and Weight Relationship

	No of fishes	Length (cm)	Average Weight (g)
1	5	25-30	210
2	5	30-40	557.6
3	9	40-45	1012.2
4	3	45-51	1373.3

Table 3: Body-Scale Relationship

Length of scale radius to annulus X (S´)	Length of fish when annulus X was formed (L')
14	98
10	62.9
12	79.6
15	99.1
08	52
11	70.8
09	60
23	167.5
13	93.3
15	101.2
25	171.1
15	112.6
24	177.5
12	80.6
22	144.4
24	156.5
12	79
16	106.3
25	180.7
14	101.8
15	111.1
10	65.7

Fig. 1: Sample 1, Length 35 cm; Weight 432g

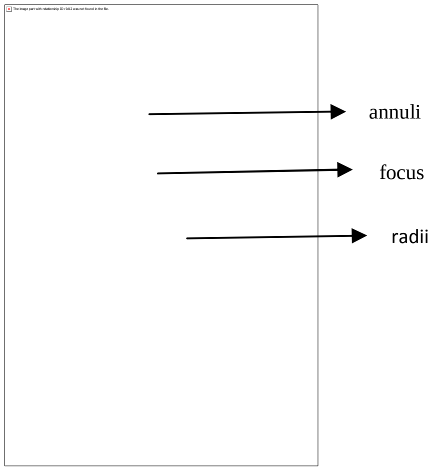

Fig. 2: sample 2, length 34cm; weight 390g

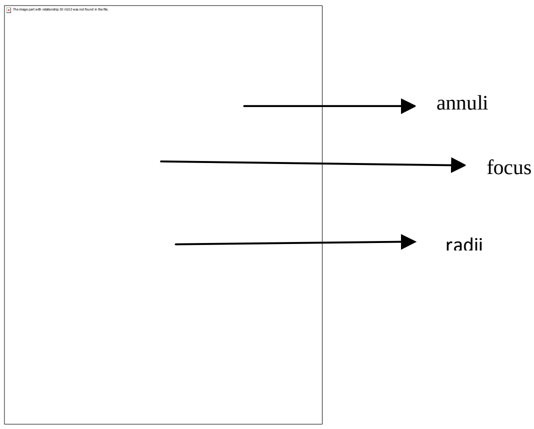

Fig. 3: sample 3, length 36.5 cm; weight 470g

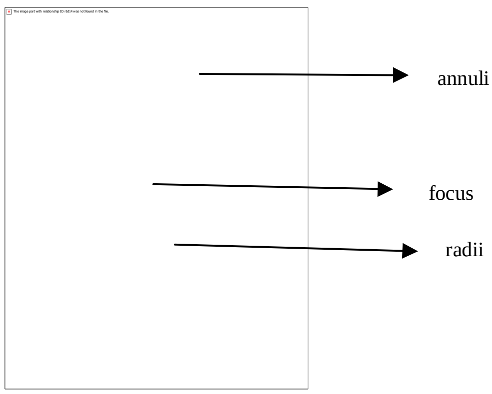

Fig. 4: sample 4; length 41cm, weight 800g

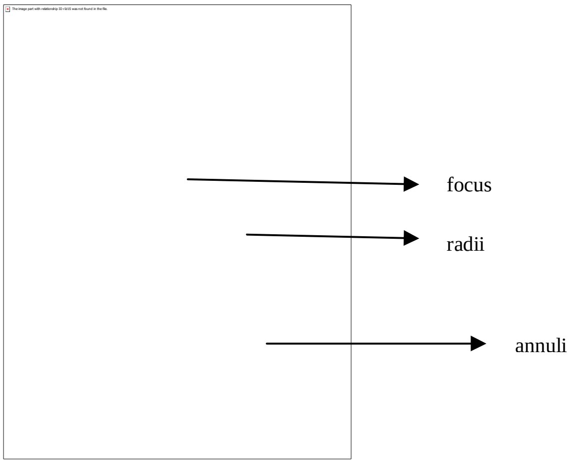

Fig. 5: sample 5: length 26 cm, weight 150g

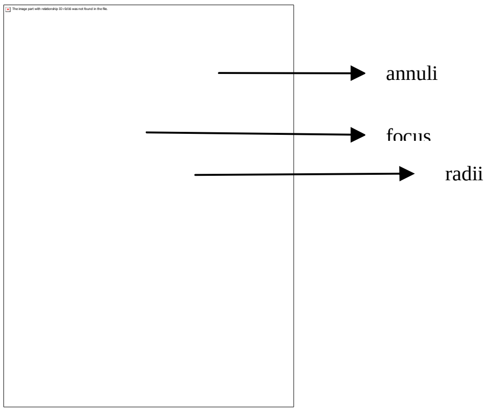

Fig.6: sample 6; length 29cm, weight 290g

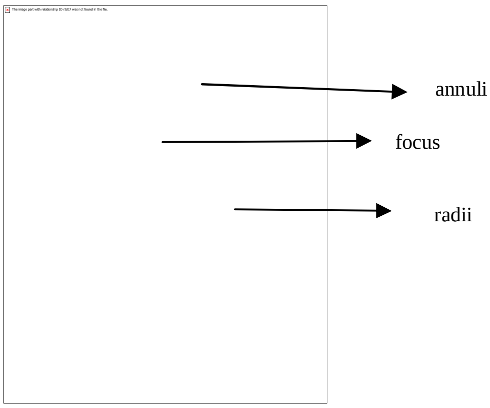

Fig.7:sample7, length 28cm; weight 250g

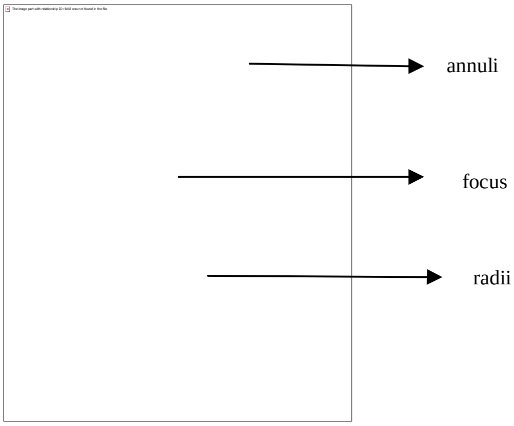

Fig.8: sample 8, length 44.5; weight 1150g

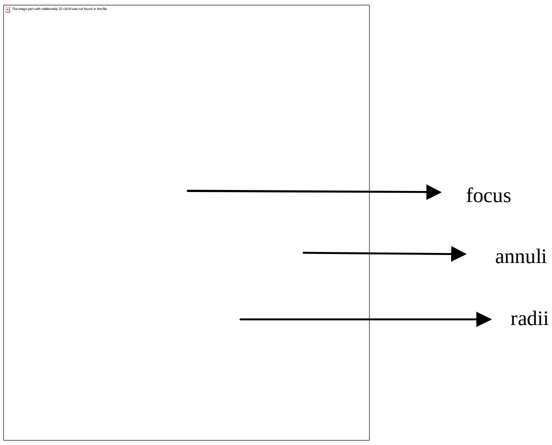

Fig. 9: sample 9, length 51 cm; weight 1600g

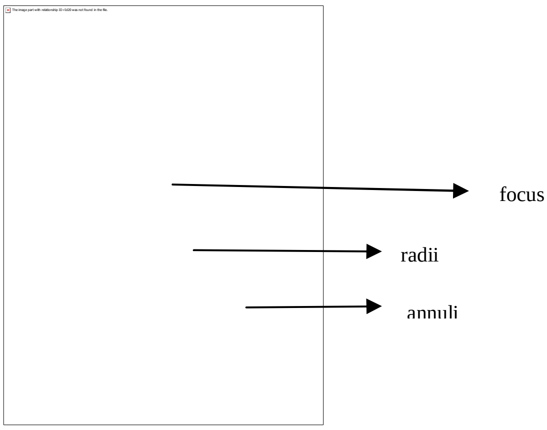

Fig. 10: sample 10, length 39.5cm; weight 736g

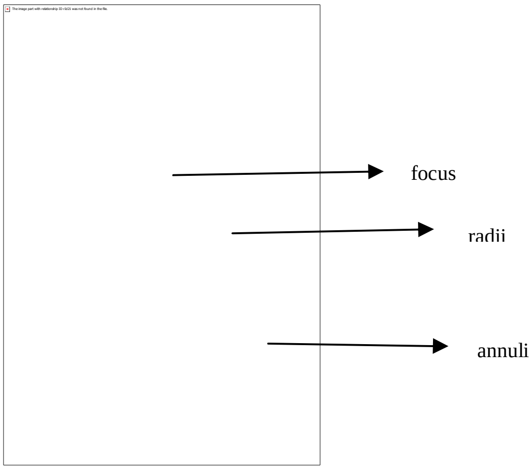

Fig. 11: sample 11, length 27cm; weight 188g

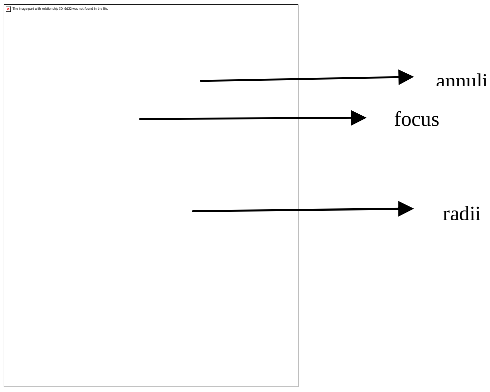

Fig. 12: sample 12, length 41.3; weight 950g

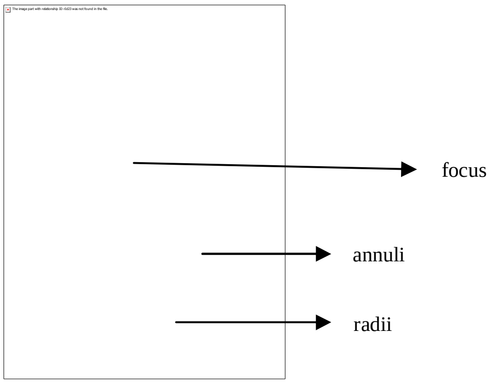

Fig. 13: sample 13, length 46.6cm; weight 1250g

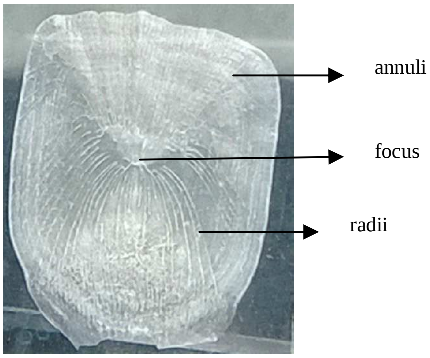

Fig. 14: sample 14, length 43cm; weight 1kg

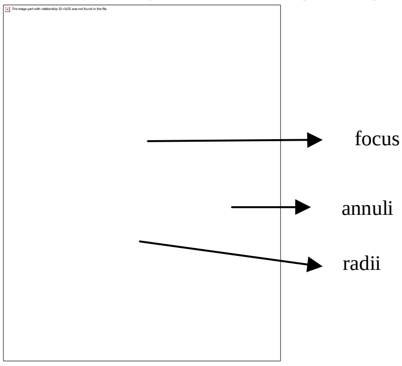

Fig. 15: sample 15, length 44cm; weight 1100g

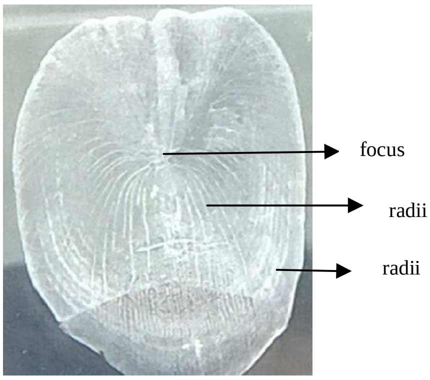

Fig. 16: sample 16, length 45cm; weight 1180g

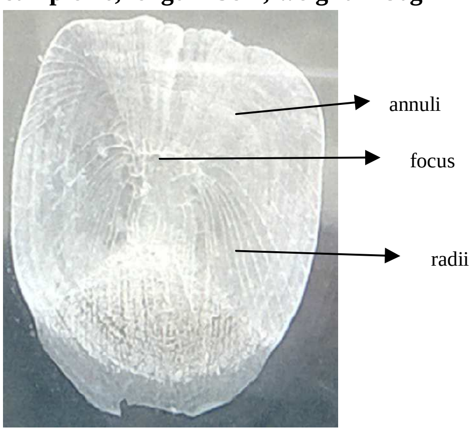

Fig. 17: sample 17, length 43.5; weight 1100g

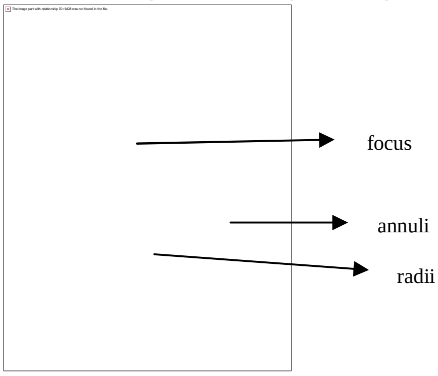

Fig. 18: sample 18, length 43.2; weight 1 kg

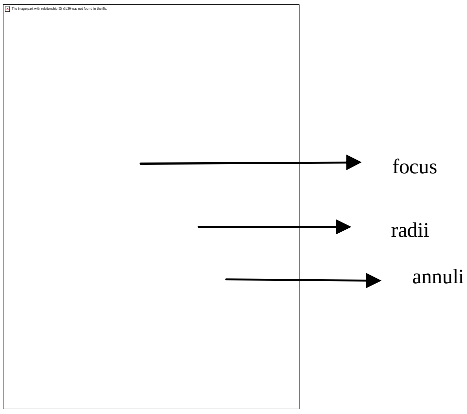

Fig. 19: sample 19, length 47cm; weight 1270g

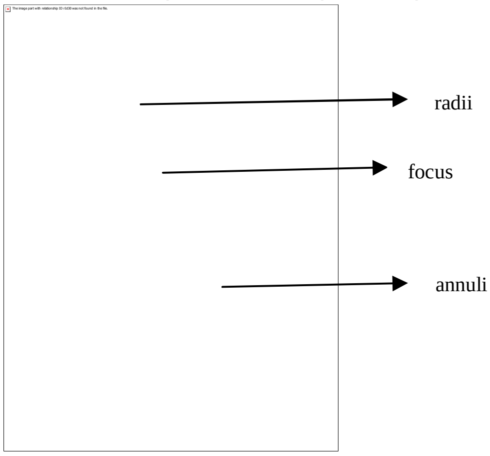

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Fig. 20: sample 20, length 40cm; weight 760g

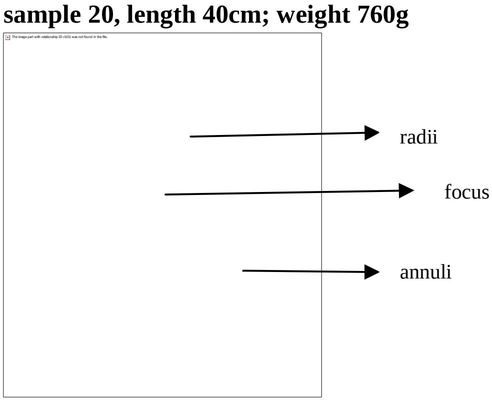


Fig. 21: sample 21, length 41.5; weight 830g

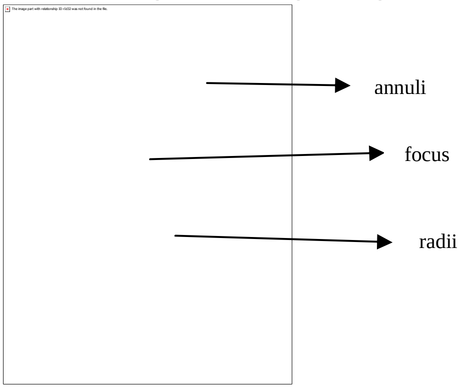
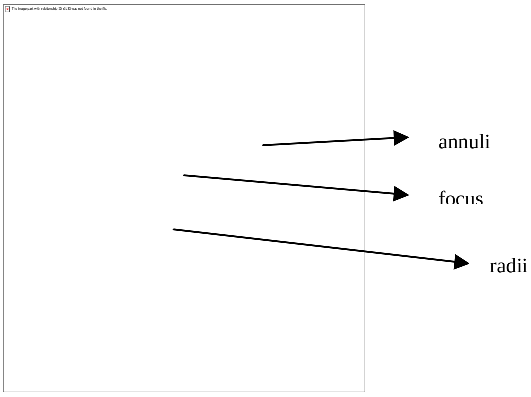


Fig. 22: sample 2, length 26.3; weight 172g



CONCLUSION

The overall results indicate that *Labeo rohita* showed an almost isometric pattern of growth in the present habitat and the condition factor values showed that it is in good condition or health and the present condition existing in the collection site is conducible for the feeding and optimum growth of fish. This study will help biologists to know the status of this fish and develop culture technology in natural waters and will be useful for the fishery biologists and conservation biologist, for successful development, management, production and ultimate conservation of the most preferred food fishes of the states.

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