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Age And Growth of Puntius Conchonius (Ham.-Buch.) From Mandal River (District: Pauri Garhwal), Uttarakhand, India

Zoology

KEYWORDS : Age and Growth, *Puntius conchonius*, Mandal river

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ABSTRACT

The age estimationof a minor carp, Puntius conchonius from Mandal River,Pauri Garhwal- District, Uttarakhand, India, has been assessed from the 450 specimens collected during July 2003 to June 2005. Using length–frequency method study, it was found that P.conchonius attains model length of 50mm,60mm and 70mm during first, second and third year respectively. Growth rate of P. conchonius determined by the back calculation method based on dorsal spine was observed that the first ring was formed at an average length was 48.55±6.02mm. The second and third ring were appeared at an average length of 62.02±3.29mm and 67.89±6.24mm respectively. The annual increment (h) was 48.55mm, 13.47mm and 5.87during first, second and third year respectively. On the basis of present studies, the age determination from length frequency and dorsal spine method compared very well.

INTRODUCTION

Puntius conchonius (Ham.-Buch.) is a fresh water fish and is commonly known as “Damra” in Uttarakhand region, India.They are growing to more than 85mm total length and are specialized feeders on algae. Most *Puntius conchonius* are strong swimmers, frequently adapted for flowing water. Sexual dimorphism in *P.conchonius* from Mandal River had been studied by Dobriyal et.al, (2007). Bahuguna et.al., (2007) informed on some aspects of the length-weight relationship between body and brainof *P. conchonius*in Garhwal region,India.Several *Puntius* species are considered commercially important in many Indian water bodies.

Age and growth studies are important for the problems associated with management of fisheries. Determination of age in fish helps in determining the age at maturity, studying the population dynamics, estimating the growth and optimizing the harvesting time. Age validation techniques include monitoring of fish of known age, analysis of length frequency models, monitoring of strong year classes, analysis of increment widths and marginal increment analysis. Monitoring of a population of known age require long time and is quite expensive method. The information and methods about age determination and growth estimation in fish has been given by Lee (1920), Jacot (1920),Kesteven (1942), Qasim, 1973),Natrajan and Jhingran (1963), Dobriyal and Singh (1990), Tsikliras et al (2005) and Pathani and Joshi (2006).

MATERIAL AND METHODS

The material for the present study was collected from Mandal River, Pauri Garhwal-District, Uttarakhand-state, India. Atotal of 450 specimens of *P.conchonius* were used for the length-frequency analysis and 100 selected specimens were used for the dorsal spine methods. The total length ranging from 45-85mm was used for the analyses. The fishes were divided into 10mm length groups for length–frequency analysis.

Ageing biology of *P. conchonius* was studied by dorsal spine methods and was confirmed by the length frequency distribution methods. For length frequency distribution, the fish were arranged in different length group’s month wise and finally an assessment is made based on the facts that the fish of same year classes forms a bunching at a proper length group. A total of 100 specimens were considered for this study.Dorsal spines were used as age estimation 100 structures of these spines of *P. conchonius* required the least amount of time for removal. Dorsal spine required significantly finer saw blade. Two sections were taken from the second or third dorsal spine of each fish. Sections were placed on a microscope slide and viewed under a compound microscope with transmitted light.

The fish length and spine radius relationship was calculated with the help of regression analysis, viz.; **Y = a + bx**

Where: X = fish length (an independent variable), Y = spine radius (a dependent variable), a & b = constant

Back calculation for dorsal spine:The growth rate of fish was calculated by back calculation method as suggested by Fraser (1916) after including correction factor to the formula suggested by Lea (1910). The formula read as :$l_n - a = DS_n / DS (l - a)$

Where: l_n= length of fish when annulus “n” was formed, l = length of fish when dorsal spine sample was obtained, DS_n = radius of dorsal spine annulus “n” at l_n, DS = dorsal spine radius, a = correction factor

Growth Parameters: The growth parameters were calculated as suggested by Tandon and Johal (1996). These were includingspecific rate of linear growth, Index of species average size, Growth characteristics, Growth Constant and the age at first Maturity.

Specific rate of linear growth:$C_l = l_n - l_{n-1} / l_{n-1} \times 100$

Index of species average size:$\phi\ h = \sum^{nj+a} h$, $h = l / n_{j+a}$

Growth characteristics:$C_{th} = \log l_n - \log l_n - 1 / 0.4343 \times l_n - 1$

Growth Constant:$C_{lt} = \log l_n - \log l_n - 1 / 0.4343 \times t_2 + t_1/2$

Where l_n and l_n –1 are mean computed total length of fish at ultimate and penultimate year of life. J = Juvenile, a = adults, n = number, h = absolute increment in length, $t_2 + t_1$ are the time intervals between ultimate and penultimate age classes and the value of $t_2 + t_1 / 2$ is equal to 1.5.

OBSERVATIONS

Dorsal spines of 100*P. conchonius* were used as a tool for ageing purpose.Dorsal spines of fish were found very effective for age estimation. The structure of the dorsal spines is ¾ circular (Plate – 1.1, 1.2 and 1.3). The opaque and hyaline zones in the whole spine were clearly visible. Data on the age and growth rate of *Puntius conchonius* based on the various length groups is showed in Table 1.1.

Fish length and Dorsal spine relationship:The relationships between fish length and dorsal spine are presented in Fig 1.1.The relationship between fish length and dorsal spine was calculated to be as:

DSR = -17.1488 + 0.6929 FL, r = 0.68371

Where:DSR = Dorsal spine radius, FL = Fish length,r = Coefficient of correlation

Time of annulus formation:In the present study 3 age rings were counted (Plate – 1.1, 1.2 and 1.3). The spine growth appeared to be minimum between July to Nov and maximum between April to June. Marginal increment analysis showed that a single annulus was formed during the July-August(Fig. 1.2).

Growth rate of fish (back calculation method):Growth rate of *P. conchonius* determined by the back calculation method based on dorsal spine is presented in Table 1.2. It was observed that the first ring was formed at an average length was 48.55m .The second and third ring were appeared at an average length of 62.02mm and 67.89mm respectively. The annual increment (h) was 48.55mm, 13.47mm and 5.87during first, second and third year respectively.

Growth parameters:Summary of the growth parameters of *P.conchonius* is presented in Table 1.3. It indicted that the specific rate of linear growth (C_l) was observed to be 27.74 between first and second year and 9.46 between second and third year. The index of species average size (ϕh) was 22.703. The values of growth constant (C_{lt}) was 0.366 between first and second year and 0.138 between second and third year with an average of 0.252. The values of growth characteristics were 11.514 between first and second year and 5.712 between second and third year with an average of 8.613.

Conformation of result by length frequency distribution (Peterson's methods):Examinations of the length frequency distribution were presented in Fig 1.3. For this purpose about 450 fishes were collected round the year (July-2003 to June 2005). After micro-level examination, it was observed that the fish attends a length of 50mm,60mm and 70mm during first, second and third year respectively.

DISCUSSION

The determination of age in fish depends on annual growth marks in certain skeletal part of fish viz., scales, bones, operculam and otoliths, etc, which are formed as a result of irregular growth and metabolism. On the basis of regression analysis we could obtain straight-line relationships between fish length and dorsal spine radius. Age rings, which were maximum three, were studied by dorsal spine and were confirmed by the length-frequency distribution method. On the basis of minimum width in terminal zone of ring formation in dorsal spine, it was concluded that the months of ring formation were July-August when natural environment was disturbed due to monsoon. Another cause of ring formation may be spawning stress as the fish perform heavy spawning during May-July which might have disturb the growth rate.

Different scientists have calculated this stress on ageing of fish. Their finding may be different on different fishes. Kesteven (1942) has stated that feeding cases for a period during which resorption may occur causing annulas formation in *Mugli dobula*. In general, all fishes have annual cycles of maximum growth corresponding to summer and autumn when temperature and food supply are moderate under the suitable temperate conditions (Qasim, 1973).Jacot (1920) observed that in *Mugil cephalus* the annuli were in the form of "breaks" appeared generally as a wider clear space between the circuli in the basal sector, form either by the cutting off circuli and a difference in their deposition or by their excessive splitting.Natrajan and Jhingran (1963) in *Catla catla*, and Dobriyal and Singh (1990) in *Barilius bendelisis* also identified the growth rings as spawning marks.

Johal and Tondon (1987) worked on *C. mrigala and* Johal and Kingra (1992) in *Catla catla*, found linear relationship with high degree of correlation between total length and scale radius length. The present investigation also showed higher correlation between the fish length and dorsal spine radius length.According to Kohli and Goswami (1989) who worked on the pectoral spine of *H. fossilis*,the annual rings were formed in May-June, which is the spawning period of fish in Assam. It was observed that the feeding intensity was low during this period. Hence, the formation of growth rings can be attributed to the cumulative effect of "nutrition and spawning". Pantulu (1962) has also observed same phenomenon in the use of pectoral spine for the determination of age and growth of *Pangasius pangasius* (Ham-Buch) from India. June and Roithmayer (1960) and Moreau (1974) indicated that the ring formation on scales, spines and otoliths is caused by two important factors i.e. reproductive seasonality and seasonal temperature change. Dorsal fins were sometime also found different to remain objective as a result of the unclear division between the opaque and the hyaline zones. Such sections were immediately disregarded.

Hruska and oliva (1953) and Singh (1978) did not use correction factor but Tandon and Oliva (1977) used it for fish vertebrae relationship in *Silurus glanis*, a sheat sish in Czechoslovakia. In the present study we used the correction factor for dorsal spine studies for back calculation. In the present investigation maximum 3 age rings were noted in dorsal spine structure. The maximum width in terminal zone was observed during April-June for dorsal spine (13-16 Omd), thus indicating these months are most distant months of age ring formation. The probable months of age ring formation were observed to be July-August as the least minimum width in terminal zone was observed in these months. It can be easily concluded that dorsal spine tool of age determination confirm only one frequency of ring formation in *P. conchonius*. During the month of May and June highly mature eggs occurs in the abdominal cavity so, it affects the feeding intensity of fish so low feeding factor was noticed during these months. We can state that like a spawning stress, low feeding was also a causative factor for ageing in *P. conchonius*.

On the basis of back calculation method it was noticed that the first ring was formed at an average fish length of 48.55 ± 6.02 mm dorsal spine. The second ring was formed at an average fish length of 62.02 ± 3.29 mm dorsal spine. The third ring was observed at an average fish length of 67.89 ± 6.24 mm dorsal spine. Lagler (1977) suggested that the length frequency method is based on the expectancy that the frequency analysis of a species of any one age group collected on the same data will show variations around the mean length according to normal distribution. Thus, there will be clumping of fish of successive ages at successive length when sampled at randomly. Age determination based on the length frequency distribution it was recorded that the fish attained a length of 50 mm, 60 mm and 70 mm after first, second and third year of age.

The growth annual increment (h) of *P. conchonius* shows that the length increment was 48.55mm dorsal spine. For second year of life, the length increment (h) was 13.47 mm. Finally third year of life showed that the length increment (h) was 5.87mm for dorsal spine. The specific rate of linear growth (C_l), between first and second year for spine was noticed to be 27.74. The specific rate of linear growth recorded 9.46 between second and third year age for dorsal spine.

The species average size (ϕh) was noted to be 22.63. The value of growth characteristics was (C_{th}) observed for *P. conchonius* in the present investigation showed normal growth 11.514 during first and second year. But very slow growth occurred between second and third year age of *P. conchonius* (8.613). The average growth of *P. conchonius* was noticed 8.613. In the present investigation, it may be concluded that the life span of the *P. conchonius* is maximum three years. The fish matured at a size of 52 mm (male) and 54 mm (Female).

Table 1.1: Data on the Age and Growth of *Puntius conchonius* based on various length groups.

Fish length (mm)	D.S.R. (Ocular Micrometer division) 1 Omd = 0.016mm	$DSRn_1$ (OMD)	$DSRn_2$ (OMD)	$DSRn_3$ (OMD)	$L\ n_1$ (mm)	$L\ n_2$ (mm)	$L\ n_3$ (mm)
46 – 55	15 - 20 17.87 ± 1.55	14 - 15 14.33 ± 0.58	-	-	36.40 - 40.26 39.88 ± 2.38	-	-
56 – 65	18 - 31 26.14 ± 5.05	10 - 24 16.71 ± 5.31	-	-	38.90 - 49.60 47.88 ± 4.79	-	-
66 – 75	20 - 41 35.71 ± 6.41	10 - 26 18.57 ± 4.77	17 - 26 24.5 ± 3.67	25 - 36 30.5 ± 3.87	39.00 - 54.75 52.92 ± 6.54	51.40 - 60.38 59.12 ± 6.54	54.40 - 65.90 63.78 ± 2.99
76 – 85	21 - 55 42.5 ± 13.77	16 - 32 23.87 ± 8.27	30 - 43 36.6 ± 5.59	39 - 49 44.0 ± 4.16	45.40 - 60.19 58.15 ± 9.72	57.78 - 66.05 64.89 ± 9.48	65.36 - 74.16 72.59 ± 3.56

DSR = Dorsal spine radius, $DSRn_1$ = Dorsal spine radius at annulus n_1, $L\ n_1$ = Length of fish at the time of annulus n_1 formation.

Table 1.2: Back calculated length of *P. conchonius* based on age class collected from river Mandal during July 2003 to June 2005.

Age class	No of fish studied	Average fish length at the time of capture (mm)	Ln_1(mm)	Ln_2 (mm)	Ln_3 (mm)
I	25	62.571 ± 12.18	43.38 ± 4.94	-	-
II	27	71.503 ± 5.09	47.14 ± 5.45	58.74 ± 6.54	-
III	18	74.00 ± 5.55	55.13 ± 2.84	65.02 ± 4.93	67.89 ± 6.24
Average values		69.357 ± 6.01	48.55 ± 6.02	62.02 ± 3.29	67.89 ± 6.24
h (annual increment)			48.55	13.47	5.87

Ln_1 = Fish length at the time of annulus formation. n_1.

Table 1.3: Summary of growth parameters of *P. conchonius.*

Parameters	Year of life (Age classes)				
L.(mm)	48.55		62.02		67.89
h (mm)	48.55		13.47		5.87
Φ h (mm)			22.63		
C_l		27.74		9.46	
C_{lt}		0.366		0.138	
			0.252*		
C_{th}		11.514		5.712	
			8.613*		

L = Average length at the time of annulus formation, h= annual growth increment, Φ h= index of species

average size, C_l = Specific rate of linear growth, C_{lt} = growth constant C_{th} = growth characteristics,

* = Average value.

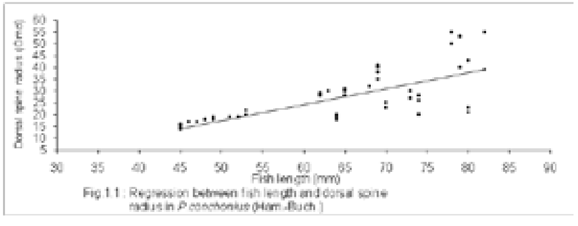


Fig 1.1 : Regression between fish length and dorsal spine radius in *P. conchonius* (Ham.-Buch.)

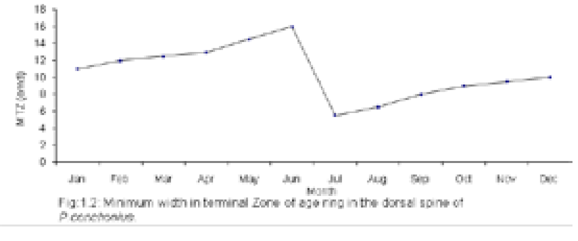


Fig 1.2: Minimum width in terminal Zone of age ring in the dorsal spine of *P. conchonius*

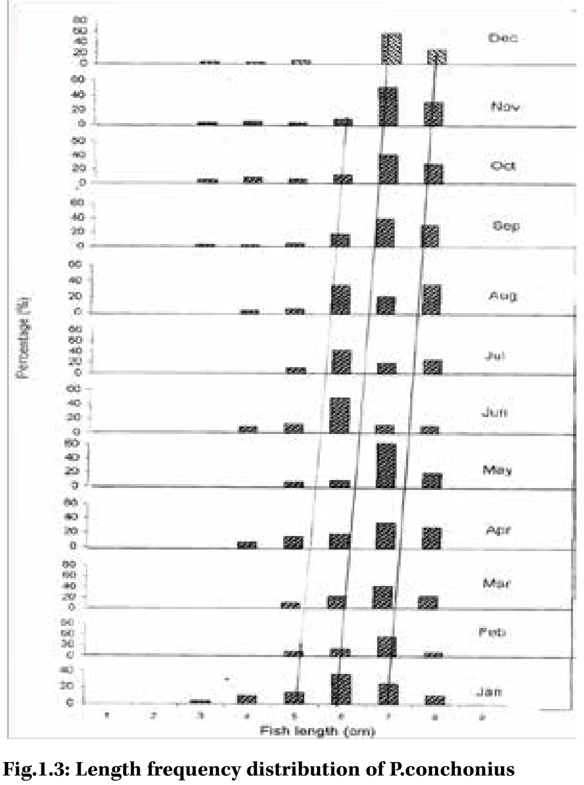


Fig.1.3: Length frequency distribution of P.conchonius

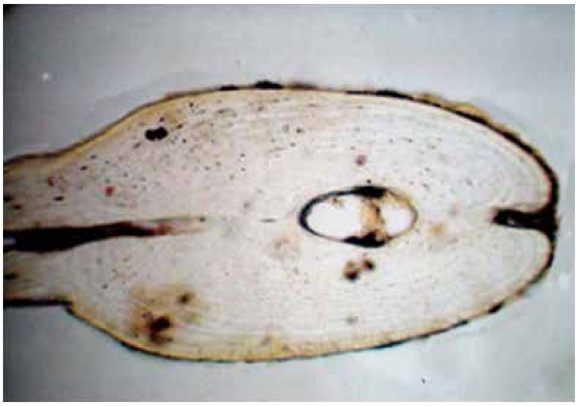


Plate 1.1: One year ageing dorsal spine

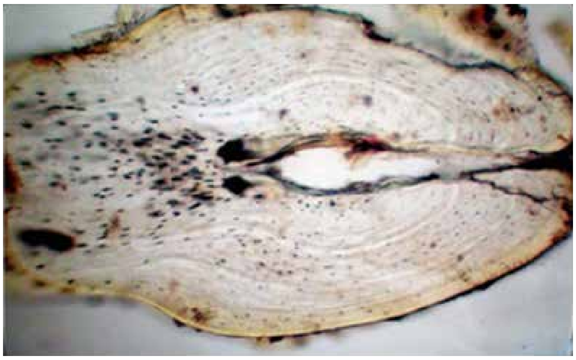


Plate 1.2: Two year ageing dorsal spine

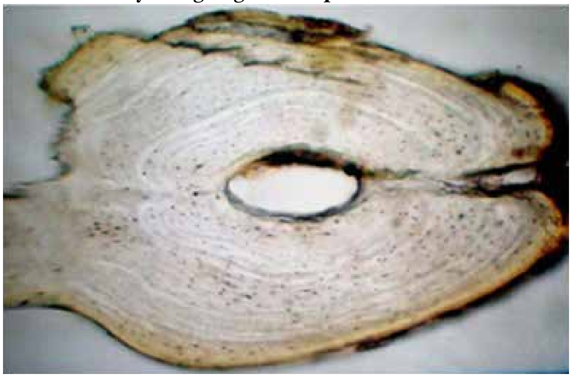
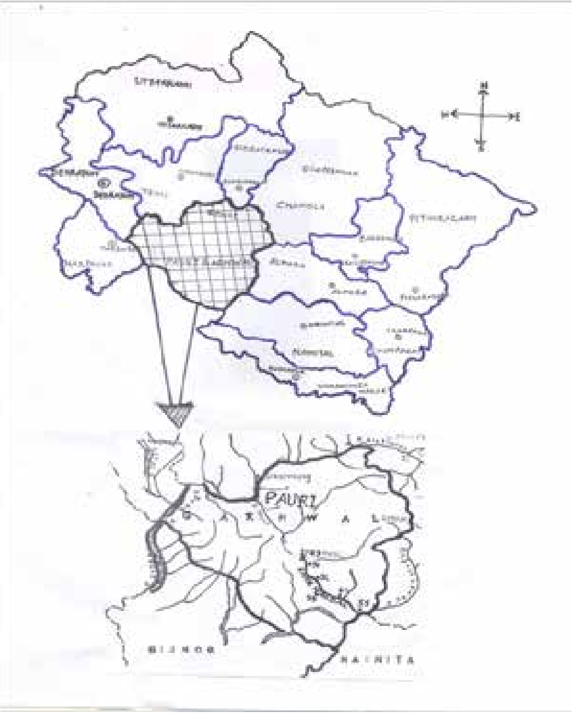


Plate 1.3: Three year ageing dorsal spine



Map.1: Sampling sites of Mandal River.

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