# ON AGE AND GROWTH DETERMINATION OF CERTAIN CATFISHES FROM RIHAND RESERVOIR

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## INTRODUCTION

Ability for forecasting accurately age of the fishes by hard parts (scale, otolith, opercular bone, cleithrum, vertebrae, fish spine, fin-rays etc.), Petersen's method and tagging of fish provides a number of information on growth rate, age at maturity, number of spawning periods per life spawn, age at capture, abundance of year classes, longevity and mortality rates. These information are *sine qua non* for rational exploitation of fish stock.

A review of the literature revealed that considerable work has been done on ageing of the fishes throughout the world (Chugonova, 1926, Graham, 1929 Van Oostern, 1929, De Bont, 1967). Petersen suggested that age of the fish can be known through their length frequency distribution. Heincke (1904) established the validity of rings found on the concavities of the vertebral centra of certain fishes (gadoids & flatfishes) which was confirmed by latter workers (Aikawa, 1937; Yasuda, 1940). In India, study on ageing of fishes mainly by Petersen's method has been emphasized on marine fishes (Qasim, 1973). While in inland waters more attention has been paid on major carps age determination through their scales (Jhingran, 1959, Natarajan & Jhingran, 1963; Kamal, 1969) followed by other fishes i.e. *Gudusia chapra* (Jhingran, 1977) and *Notopterus notopterus* (Khan, 1983). Generally, ageing through hard parts is done in case of the non-scaly fishes. Thus, Saigal (1963), Saxena (1964), Ghosh et al. (1977) and Anwar & Siddiqui (1984) determined the age of *Mystus aor, Rita rita, Lates calcarifer* and *M. seenghala* respectively by counting rings on vertebral centra.

It is quite surprising that no attempt till date has been made to age these three important shilbeid fishes i.e. *Silonia silondia, Eutropiichthys vacha* and *Clupisoma garua* despite their commercial importance on account of their culinary value. Keeping this in view, an attempt has been made in the present communication to determine the age of these fishes from Rihand Reservoir, Uttar Pradesh, India.

*Brief description of the locality* : Rihand reservoir was constructed in 1962 by damming river Rend or Rihand in district Sone-Bhadra of U.P. It is having a catchment area of 13,344 km² with 3/4 area in Uttar Pradesh and rest in the Madhya Pradesh (24° 1 N and 83° E). Rihand reservoir basically is meant for electric generation and has an average water-spread area of 30,148 ha (FRL+DSL) with an annual water level fluctuation of about 15 m. It has an average depth of 24
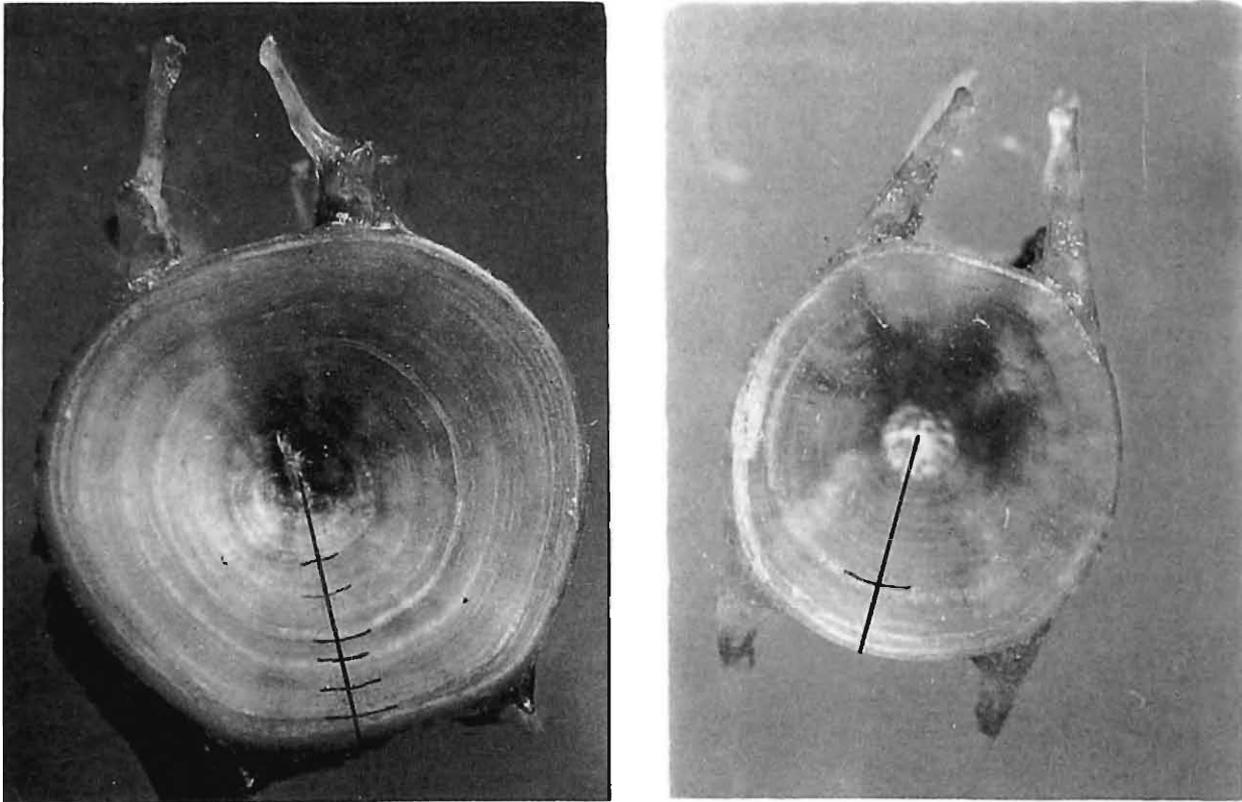
**Fig. 1 a** : Vertebra of *Silonia silondia* (TL = 835 mm, wt = 4400 g) shewing 6 annuli.
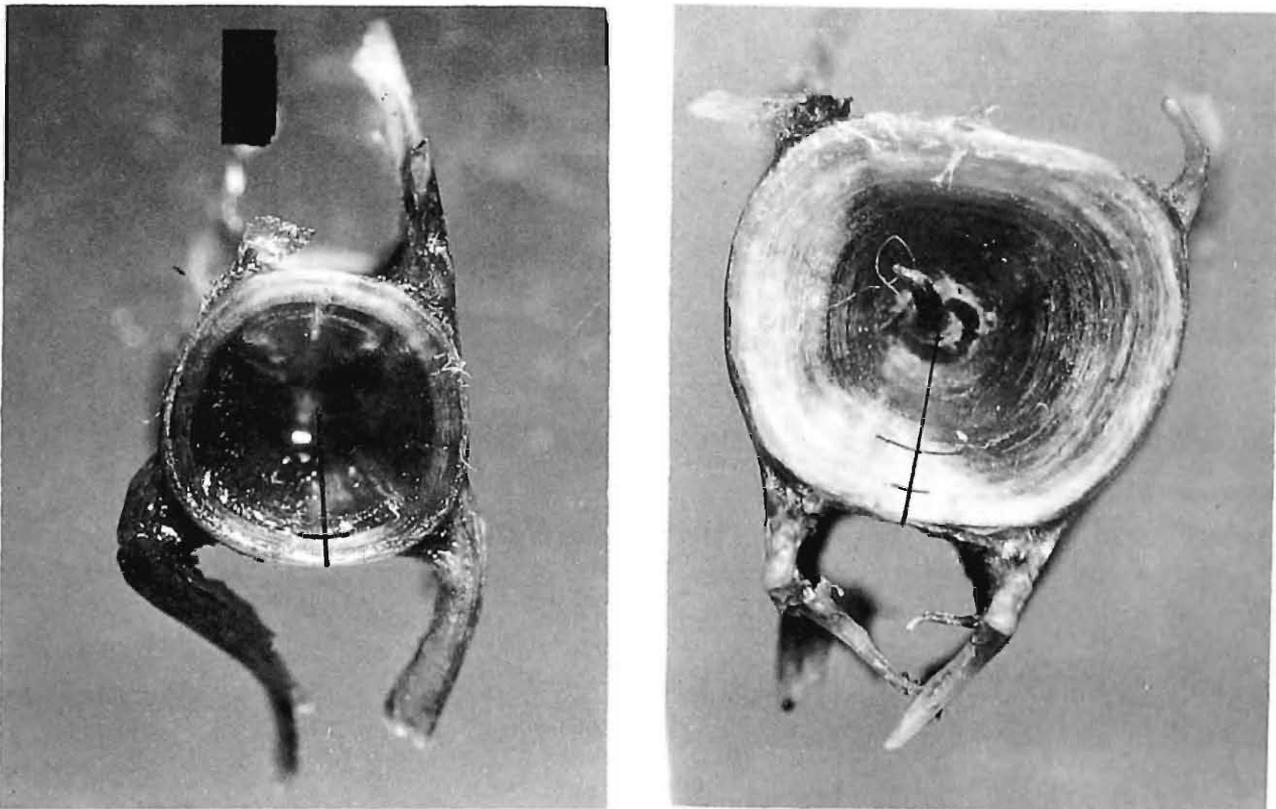**Fig. 1 b** : (TL = 380 mm, wt = 360 g) indicating one annulus.



**Fig. 2 a** : *E. vacha* (TL = 205 mm, wt = 150 g) showing annulus on the vertebra.
**Fig. 2 b** : (TL = 320 mm, wt = 220 g) indicating two annuli.
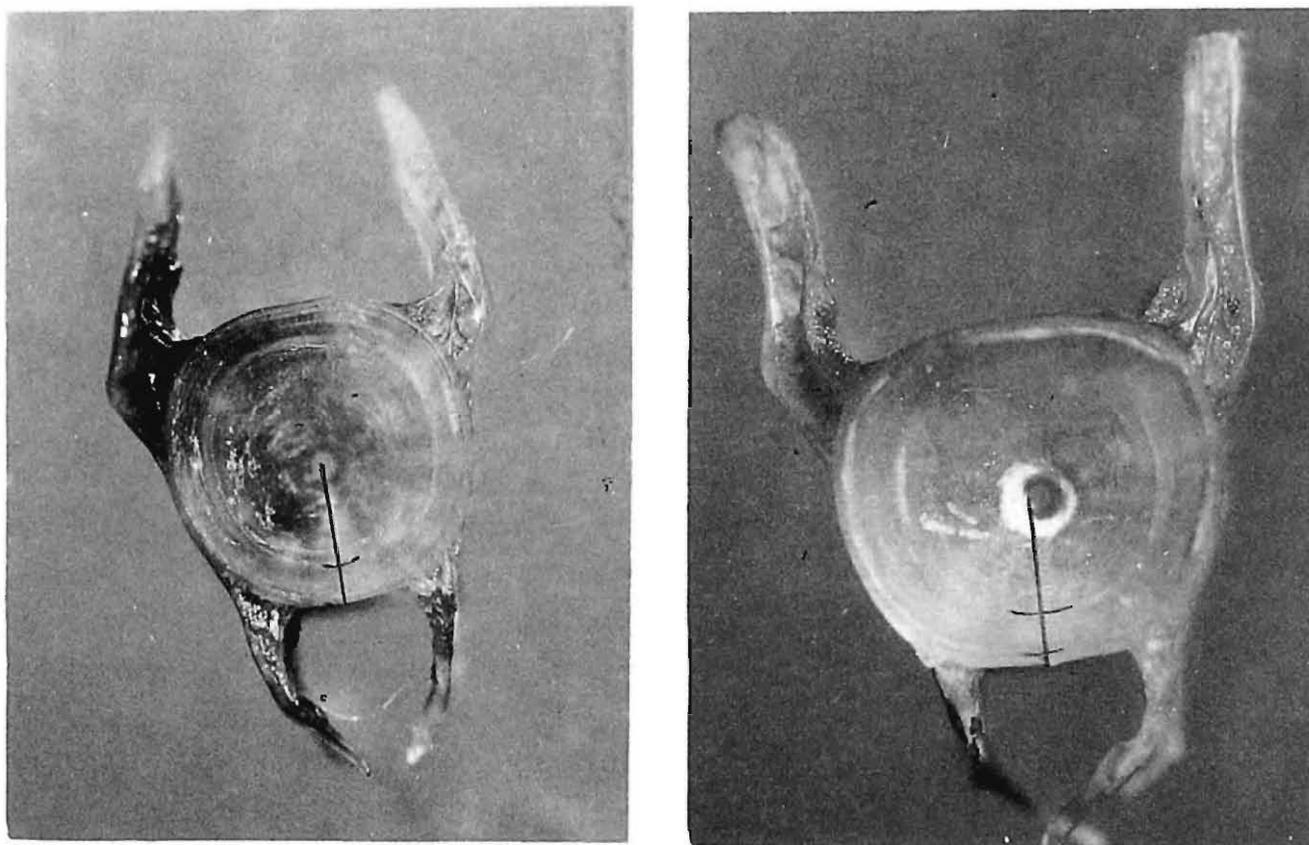
**Fig. 3 a** : Vertebrae of *C. garua* (TL = 205 mm, wt - 110 g) showing one annulus.
**Fig. 3 b** : (TL = 260 mm, wt = 130 g) indicating 2 annuli on vertebra.

m (FRL). The reservoir has a shore line of 561.35 km and a shore development index of 7.04; indicating an irregular shoreline. In early phase after initial filling, the reservoir was supporting a carp dominated fishery (>90%) but as the time lapsed, the catfishes gradually increased their share and at present form more than 85%. Generally, the catfish fisheries predominantly comprised these three species alongwith small quantity of *M. aor, M. seenghala* and *Wallago attu*. This points towards mismanagement of the reservoir and had set up an example to show how a carp dominated reservoir could be transformed into a catfish dominated one due to apathy of officials of the reservoir.

*Material & methods* : Fishes were procured from the experimental fishing conducted in Rihand Reservoir during 1989-90 with multimeshed gill nets. (20 mm - 400 mm mesh-bar) while studying the impact of hot water discharge on aquatic life of the Rihand reservoir. The fishes were weighed upto nearest gram and measured to the nearest millimeter. Freshly procured fishes wre boiled for about half an hour to remove the flesh, then vertebrae were taken out. These were further cleaned with the help of a tough brush and put into a solution made up of 0.2% HCL and 0.2% pepsin for 6-8 hours. Later on samples were soaked in acetone for about 8 hours. The latter treatment successfully removed the adhering fat. A further treatment in absolute alcohol followed by glycerine (Saigal, 1963) rendered the rings present on centra of vertebrae clear and identifiable.

In this manner 28 vertebrae of each fish were cleaned for age study. The weight and length ranges of fishes from which vertebrae were collected were : 40 to 4,400 g and 180-835 mm; 50-330 g and 195-380 mm; and 90-300 g and 205-380 mm for silondia, vacha and garua respectively. Photographs of these vertebrae were also taken as described by Saxena (1964) for back calculation of age and length (Dahl-Lea, 1910, Sinha 1986). This was done after ascertaining that there exists a direct correlation between fish length and vertebral centrum size. The value of coefficient of correlation, was above 0.95 for these three species. The age of the fish was determined independently of its size by counting the narrow zones on the centra of the vertrebrae.

*Results and discussion* : A careful examination of the vertrebral centra by hand lens (10x) and photographs of the 3-species of fish undertaken for age determination revealed concentric circuli/ rings around the centra of the vertebrae. These rings were of two types (1) a dark band comprising widely spaced circuli alternating with (2) closely packed rings giving an appearance of a translucent narrow band. A maximum number of 12 bands (wide and narrow) were observed in silondia of 835 mm (4,400 g) and 4 bands in a fish of 380 mm having a weight of 360 g (Fig. 1). Similarly, in vacha and garua also such types of bands were observed. In vacha, one narrow band was observed in a fish of 205 mm while, two narrow bands, were discernible in a fish of 320 mm (Fig 2 and 3). Similarly, garua of 205 mm showed one narrow band and of 260 mm indicated two narrow bands suggesting one and two years of age respectively. In general, larger the fish more the number of narrow zones, *i.e.* the vertebrae growth is directly related with the fish length. Narrow bands were observed in summer months and their representation go on decreasing in latter months. Similar observations were made by Aikawa (1937) and Saigal (1963) in *Scomber japanicus* and *M. aor* respectively.

A set of narrow and widely spaced band on hard parts of fish has been interpreted as annual increment or an "annulus" by numerous workers (Heinke, 1904; Aikawa, op. cit Saigal, op. cit

Ghosh *et al.*, 1977). These are supposed to be growth checks, indicating seizure of growth due to subdued feeding. A host of workers have given various causative factors for formation of growth checks but most of them are of the opinion that these are formed either due to extrinsic (temperature, dry season and paucity of food) or intrinsic (physiological rhythm such as maturity, spawning etc.). Beckman (1942) attributed annuli formation on the scales of certain game fishes to high water temperature. Kamal (1969) has reported that paucity of food in environment caused cessation of growth in mrigala thus causing annulus formation. Simmilar, view was offered by Seshappa and Bhimachar (1951) on the formation of rings on the scale of malabar soal. Chevey (1930, 1932) while studying age determination in fishes of Indo-China, Cochin, China and Cambodia observed concentrated rings on the scales of certain fishes and stated that a variation of water temperature of 4 to $5^0$ C (23 to $27^0$ C) seems to be sufficient enough to slow down the growth in fish, thus causing annulus formation on the scales. In the present study, a fluctuation of about $18^0$ C was observed in water temperature i.e. from $19.8^0$ C in winter to a high of $37^0$ C in summer. This range of temperature is sufficient to cause growth checks on the hard parts (vertebrae) of the fish (Chevey, loc. cit).

Similarly, internal reasons (maturation of gonads, spawning and loss in Kn) as a cause for formation of annuli on hard parts of fishes have been observed by Holden, 1955; Garrod (1955), Natarajan and Jhingran (1963) and Jhingran (1977). Maturation of gonads due to advancement in maturity results in their elaboration, thus intestine is compressed under pressure of enlarging gonads which manifests in cessation of feeding activity causing slowing down of growth and resulting in formation of an annulus.

In the present study, the formation of annulus may be attributed to the above mentioned factors, because the high water temperature which prevailed in summer is synchronising with maturation of gonads causing strain on fish and resulting in the form of growth checks on the hard parts. This was corroborated by observing annuli in a number of fishes with empty stomachs or with less food. However, maximum food was observed in post-monsoon months (Vass *et al.*, 1997) which was coinciding with greater abundance of widely placed rings on vertebrae suggesting fast growth period. Reverse was the case in summer months, when narrow bands were observed on centra of the vertebrae of these fishes. These findings are in confirmation with the findings of Heincke, 1904 (gadoid fishes); Hiraki-Aikawa, 1937 (Japanese chub mackerel, Yasuda, 1940 (Scombrops chilodipteroides), Saigal, 1963, (*Mystus aor*). Saxena, 1964 (Rita rita) and Ghosh *et al.*, 1977 (*Lates calcarifer*).

False rings as described by many workers such as Natarajan and Jhingran, 1963 (Catla catla), Kamal, 1969 (C. mrigala) Jhingran, 1977 (G. chapra) and Khan, 1983 (N. notoptasus) were also observed on the scales of these fishes. These rings are probably formed due to temporary disturbance in the environment which caused slow growth in fish, resulting in formation of false annuli and when conducive conditions returned then normal growth takes place. Due to this reason false rings denote vague sculpture. False rings were observed on the vertebrae of these fishes too.

For further establishing validity of determination of age, other methods such as Petersen's method of length frequency distribution and von Bertalanaffy's growth equation (von Bertalanaffy, 1937; Beverton and Holt, 1957) were also tried (Table 1). These values have a very good agreement
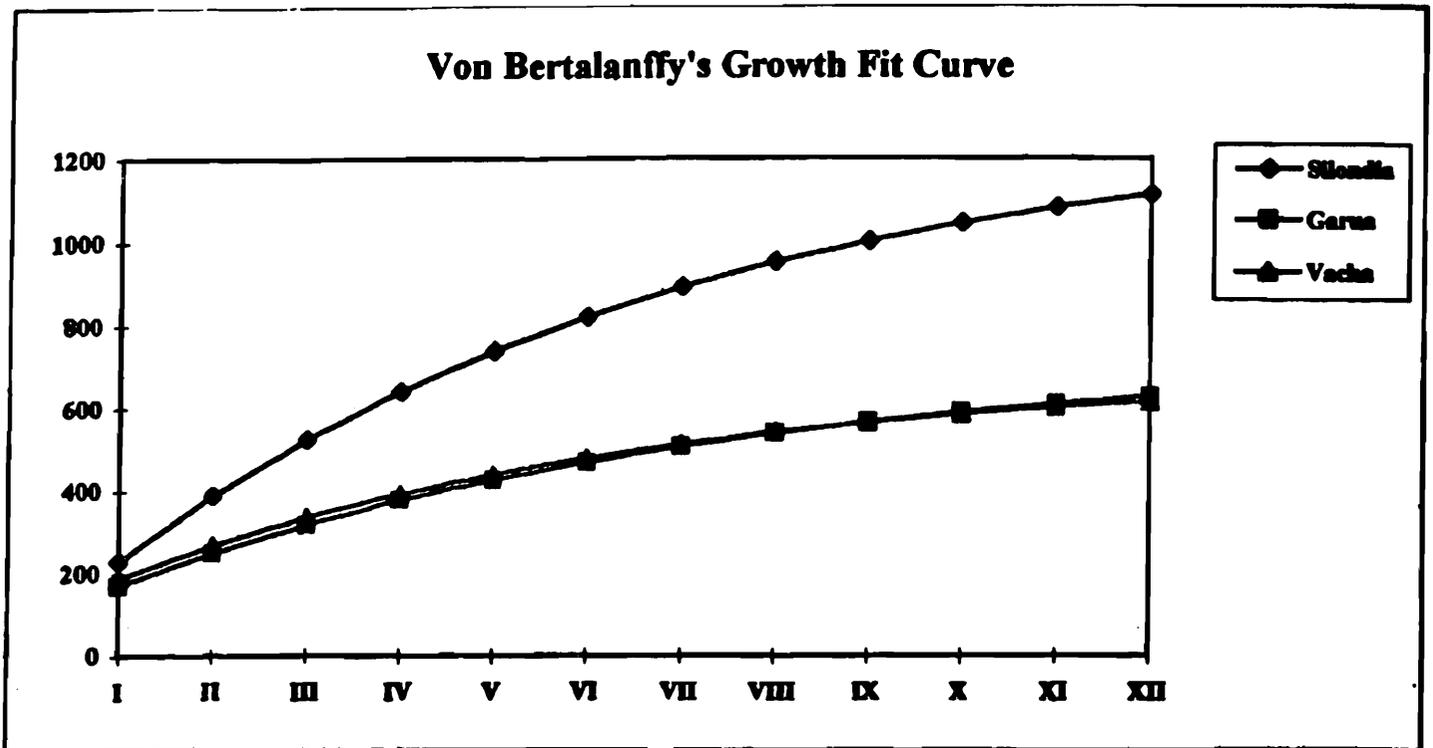
with the values in length at different ages obtained by back calculation methods. In this equation length of fish at any time 't' is given by :

It = L ∞ (1-e$^{-k}$ (t-t$_0$) where :

L ∞ is maximum size towards which the length of the fish is tending,

K = a measure of the rate of which length approximate L ∞ or asymptotic length.

T$_0$ = a parameter indicating the (hypothetical) time at which the fish would have been zero size, if, it had always grown according to above equation. Values of different parameters in the above equation were calculated using standard methods. This equation was observed to hold good for these 3-species too (Fig. 4) and may be written as :

for silondia - It = 1290 {(1-e$^{-0.1632}$ (t-0.1966)}

for garua - It = 733.33 {(1-e$^{-0.1506}$ (t-0.7603)}

for vacha - It = 684.85 {(1-e$^{-0.17694}$ (t-0.7944)}

The largest fishes obtained in the samples were : 1000 mm for silondia and 380 each for garua and vacha. Desai (1993) has observed largest *S. silondia* in Rihand reservoir to the extent of 1130 mm in total length which is well inside asymptotic length (1290 mm) for this fish. While, Hora (1939) stated maximum length attained by garua to 2 feet and Day (1889) remarked that vacha is a medium size fish and could attain a length of upto 350 mm. These observations are with in the range of L∞ of these two fishes estimated during the present study. Srivastava et al. (1992) could rear vacha and garua in a pond at allahabad upto 301 days and recorded average growth of vacha

and garua as 264 and 179 mm respectively with an annual growth increment of 126 mm and 171 mm for the two fishes in the above order. The growth is a little more than estimated in the present study and this may be attributed to supply of supplementary feed as experiment was done under intensive culture condition.

Perhaps, this is the first report on age and growth of these three commercially important schilbeids fishes from open water and will be of utmost utility to the fisheries managers for augmenting fish production from such water bodies.

## SUMMARY

Three species of schilbeid fishes *viz., Silonia silondia, Eutropiichthys vacha* and *Clupisoma garua* were studied for ageing through their veterbrae. It was revealed that in these fishes annuli were laid down in summer months. Spawning stress coupled with high temperature of water and low feeding intensity were found to be the main causative factors for the annuli formation. The lengths and ages derived from vertebrae method were checked against those derived by Petersen's method. von Bertalanaffy's growth equation was also derived which adequately explains growth pattern of these fishes.

## ACKNOWLEDGEMENT

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**Table 1.** Length at ages and growth (mm) of S. silondia, C. garua and E. vacha derived from different methods.

| Age | Silondia | | | Garua | | | Vacha | | | Relative growth | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peterson method | Vertebra method | Von Bertalanffy's growth fit | Peterson method | Vertebra method | Von Bertalanffy's growth fit | Peterson method | Vertebra method | Von Bertalanffy's growth fit | Silondia | Garua | Vacha |
| I | 240 | 230 | 228.84 | 180 | 170 | 170.77 | 190 | 188 | 186.30 | 159.79 | 78.65 | 80.85 |
| II | 410 | 385 | 388.63 | 250 | 255 | 249.42 | 260 | 262 | 267.15 | 135.72 | 67.64 | 67.76 |
| III | 530 | 524 | 524.35 | 320 | 310 | 317.06 | 330 | 340 | 334.89 | 115.29 | 58.21 | 56.75 |
| IV | 640 | 643 | 639.64 | 380 | 378 | 375.27 | 390 | 390 | 391.64 | 97.93 | 50.06 | 47.48 |
| V | — | 739 | 737.57 | — | — | 425.33 | — | — | 439.12 | 83.19 | 43.06 | 39.91 |
| VI | — | 819 | 820.76 | — | — | 468.39 | — | — | 479.03 | 70.65 | 37.15 | 33.37 |
| VII | — | — | 891.41 | — | — | 505.54 | — | — | 512.40 | 60.02 | 31.75 | 27.97 |
| VIII | — | — | 951.43 | — | — | 537.29 | — | — | 540.37 | 50.98 | 27.41 | 23.43 |
| IX | — | — | 1002.41 | — | — | 564.70 | — | — | 563.80 | 43.36 | 23.57 | 19.63 |
| X | — | — | 1045.72 | — | — | 588.27 | — | — | 583.43 | 36.78 | 20.28 | 16.44 |
| XI | — | — | 1082.50 | — | — | 608.55 | — | — | 599.87 | 31.20 | 17.45 | 13.78 |
| XII | — | — | 1113.70 | — | — | 626.00 | — | — | 613.65 | — | — | — |