Age and growth of the Carnatic carp, *Puntius carnaticus* (Jerdon, 1849) from Chalakudy River, Kerala

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ABSTRACT

Based on length composition of commercial landings of *Puntius carnaticus* from the river Chalakudy in Kerala, growth parameters such as asymptotic length ($L_\alpha$), growth co-efficient ($K$) and growth performance index ($\phi$) were estimated using ELEFAN I programme as 493.5 mm, 0.5 and 5.08 per annum in male and 504.6 mm, 0.65 and 5.22 per annum in female respectively. The life span of *P. carnaticus* was estimated to be 4-5 years. Males and females attain 286.9 mm and 345.18 mm respectively at the end of 1 year. The growth co-efficient ‘$K$’ of *P. carnaticus* (male $= 0.5$; female $= 0.65$) was also found to be comparable with many of the freshwater species used in aquaculture. Based on the present study, it can be concluded that along with other favorable characteristics, the higher growth rate of *P. carnaticus* in the first year of its life span makes this species an excellent candidate for freshwater aquaculture.

Keywords: Age, Carnatic carp, Chalakudy River, Growth, *Puntius carnaticus*

The purpose of growth studies in any fish species is to determine the amount of fish that can be produced with respect to time (Qasim, 1973). The age and growth of freshwater fishes of India have been studied by several workers. Some of the recent works on age and growth include those of Kurup (1997) in *Labeo dussumiieri*, Singh et al. (1998) in *Lebeo rohita*, Kamal et al. (2002) in *Lebeo calbasu*, Nautiyal (2002) in *Tor putitora* and Narayani and Tamot (2002) in *Tor tor*.

*Puntius carnaticus*, commonly known as Carnatic carp is an endemic species to the Western Ghats of India. Compared to other members of the *Puntius* genus, this species attains larger size; the maximum size recorded being 12 kg (Talwar and Jhingran, 1991). So far no attempt has been made to study the age and growth of *P. carnaticus*, and hence in the present study an attempt was made in this direction.

Fortnightly sampling of fishes were done from the commercial landings at Peringalkuthu region of Chalakudy River system (Kerala, South India) during April 2001 to March 2003. Monofilament and multifilament gillnets of different mesh sizes (32, 34, 64, 78, 100 and 140 mm) and cast nets (mesh size: 16 and 22 mm) are the gears used for commercial fishing operations in this region. Peringalkuthu is the only landing centre in the entire course of Chalakudy River, where year round fishery for *P. carnaticus* is available. So all the specimens for the present study were collected from Peringalkuthu, which represented the stock at Peringalkuthu dam and the adjacent streams. A total of 882 specimens of *P. carnaticus* comprising of 262 males and 150 females were used for the present study. The specimens were preserved in 8% formalin after making some perforation in the vent region and brought to the laboratory for further investigation. After removing the excess water by blotting, total length (TL) and total weight of the fishes were recorded. Fishes were then dissected out to identify the sex and the condition of gonad. Length-frequency data were grouped into 20 mm class interval. In males as well as females there was representation for all the class intervals in both the years. Growth was estimated separately for males and females. The von Bertalanffy growth formula (VBGF) (Bertalanffy, 1938) was used to describe the growth. The equation in growth in length is given by:

\[ L_t = L_\alpha \left[ 1 - \exp \left( -\frac{K}{K} \right) \right] \]

where, $L_t$ = length at age $t$, $L_\alpha$ = asymptotic length or the maximum attainable length if the organism is allowed to grow, $K$ = growth coefficient, $t_0$ = age at which length equals 0, i.e., the theoretical age at zero length.

The growth parameters for both the sexes were estimated separately using the ELEFAN 1 programme of FISAT software (Gayanilo and Pauly, 1997). Powell-Wetherall method was used to estimate asymptotic length and the ratio of the coefficients of growth $(Z/K)$ using length-frequency data based on Beverton and Holt (1956).

Age length key at 3 months interval was prepared from ELEFAN 1. Estimate of $t_0$ was done using Bertalanffy
(1938) plot in which the results of the regression of: 
$\ln (1 - L_t/L_\alpha)$ against t was used to calculate $t_0$.

$$t_0 = -a/b$$

Since ELEFAN curves showed the existence of only one brood in *P. carnaticus*, estimation of growth parameters was restricted on one cohort only. Growth performance of this single cohort in both male and female was compared by Munro’s PHI prime index, $\phi$ (Pauly and Munro, 1984).

The total length of males of *P. carnaticus* ranged from 232 to 467 mm. The modal length of males during 2001-02 was estimated to be 294 mm, which belonged to the class 280-300 mm TL, whereas the same during 2002-03 was estimated as 303.07 mm in the class 300-320 mm TL.

The length of female population ranged from 270 to 472 mm in total length. During 2001-02 the modal length was 344.62 mm belonging to the size class 340-360 mm TL. While during 2002-03, the modal length showed a slight increase with 372 mm which comes in the size group 360-380 mm TL.

In males, $L_\alpha$ computed following Powell-Wetherall plot in FISAT was 479.033 mm and $Z/K = 0.904$ (Fig. 1). ELEFAN 1 growth curve (Fig. 2) showed that the male population of *P. carnaticus* was composed of a single cohort annually; generated by only one recruitment during August-September. The growth parameters estimated by ELEFAN 1 along with the growth performance index ($\phi$) are given in Table 1. The $L_\delta$ computed from ELEFAN I with highest Rn value (0.181) was 493.5 and $K = 0.5$ yr$^{-1}$ (Fig. 2). The growth performance value obtained by ELEFAN I was 5.08. Based on the values obtained through ELEFAN 1, the von Bertalanffy growth equation (VBGF) of males of *P. carnaticus* can be expressed as:

**Males:** $L_t = 493.5 \left(1 - \exp^{-0.5(t+7448)}\right)$

On applying the average growth coefficients estimated by ELEFAN 1, the males will be attaining an average length of 286.9, 368.2, 417.6, 447.6 and 477 mm at the end of I, II, III, IV and V years respectively (Table 2).

In females, the $L_\alpha$ derived using Powell-Wetherall method was 504.612 mm and $Z/K = 3.173$ (Fig. 3). ELEFAN 1 growth curves (Fig. 4) showed that the female population of *P. carnaticus* was composed of a single cohort annually generated during August-September. The growth parameters estimated by ELEFAN 1 along with the growth performance index, $\phi$ are given in Table 1. The $L_\delta$ computed from ELEFAN I with highest Rn value (0.162) was 504 and $K = 0.65$ yr$^{-1}$ (Fig. 4). The growth performance value obtained by ELEFAN 1 was 5.2. Based on the values obtained from ELEFAN I, the von Bertalanffy growth equation (VBGF) of females of *P. carnaticus* can be expressed as:

**Females:** $L_t = 504 \left(1 - \exp^{-0.65(t+.7802)}\right)$

Compared to males, females showed higher growth rate and attained 345.18 mm, 421.12 mm, 460.85 mm and 481.7 mm respectively at the end of I, II, III and IV years (Table 2).

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**Fig. 1.** Powell-Wetherall plot of males of *P. carnatciucus*
Table 2. Length arrived at various ages in males and females estimated by ELEFAN I method

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>286.91</td>
<td>345.18</td>
</tr>
<tr>
<td>II</td>
<td>368.2</td>
<td>421.12</td>
</tr>
<tr>
<td>III</td>
<td>417.6</td>
<td>460.85</td>
</tr>
<tr>
<td>IV</td>
<td>447.62</td>
<td>481.65</td>
</tr>
<tr>
<td>V</td>
<td>465.87</td>
<td>-</td>
</tr>
<tr>
<td>VI</td>
<td>476.95</td>
<td>-</td>
</tr>
</tbody>
</table>

In the present study, \( L_\alpha \) computed by ELEFAN I and Powell-Wetherall method were almost comparable in both the sexes. Females showed the highest \( L_\alpha \) of 504.612, than males (479.033). The higher values of growth co-efficient in females indicated that females attained asymptotic length at a faster rate than the males.

Based on the results of the present study, it can reasonably be inferred that the longevity of \( P. carnaticus \) is around four to five years. Since majority of the males fall in the length class 280-300 mm and females in 340-360 mm, it can be postulated that the exploited stock of males and females invariably belonged to one year age group. Accordingly, representation of male and female individuals belonging to age group three and above were sparse and sporadic in the exploited stock.

\( P. carnaticus \) has been listed under vulnerable category of fishes based on its biodiversity status following IUCN (Walker and Molur, 1997). The basic principle of fishery resource conservation and sustenance of the fish stock is by allowing a fish to breed at least once in its life time for ensuring the natural recruitment and regeneration. In \( P. carnaticus \), the length at first maturity has been estimated to be 232 mm in males and 270 mm in females (Manojkumar, 2007). It would thus appear that both males and females are getting a chance to complete the maturation and spawn before completing one year of their life cycle. Johal and Tandon (1987) found that the Indian major carps attain sexual maturity only above 300 mm TL during the second or third year of their life span. Singh et al. (1998) reported that \( L. rohita \) attained sexual maturity at a length of 460 mmTL after the third year of their life span. Based on the results of the present study, it can be well recommended that both males and females of \( P. carnaticus \) can be exploited before attaining one year in their life and the growth rate of both the sexes of \( P. carnaticus \) was comparable to any of the Indian major carp species.

\( P. carnaticus \) was found to exhibit fastest increment in length during the first year of its life history which was found to be relatively higher in females when compared to its male counterpart. A drastic reduction in the growth rate
was observed in the second, third and fourth years of age in both the sexes, with males performing better than females during this period. Similar pattern of faster growth rate during the first year and subsequent decline in the succeeding years have been reported in many cyprinids such as *L. calbasu* (Kamal et al., 2002), *L. dussumieri* (Kurup, 1997), *L. rohita* (Singh, et al., 1998) and *T. putitora* (Nautiyal, 2002).

The growth co-efficient (K) of *C. catla* (0.1044), *L. rohita* (0.2551) and *C. mrigala* (0.275) reported by Mathew and Zacharia (1982) are relatively less than that of *P. carnaticus*. However, Harron et al. (2002) recorded higher values of 0.8 in *L. rohita*, 0.73 in *C. catla*, 0.7 in *C. mrigala* and 0.76 in *L. calbasu* collected from beels. The growth co-efficient of *L. dussumieri* estimated as 0.64 for males and 0.81 in females by Kurup (1997) is in...
compliance with the result of the present study, showing better growth rate in females than their male counterpart. Pauly (1984) reported that species with shorter life span have higher ‘K’ value and therefore can reach their Lₐ within one or two years. Conversely, those having low growth rates are characterized by lower ‘K’ values and take more years to reach their Lₐ. In P. carnaticus, the moderate ‘K’ value in both the sexes support a moderate life span of 4-5 years, which is in general agreement with the relationship between ‘K’ values and Lₐ as reported by Pauly (1984).

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References


