

## Study on length-weight relationship and condition factor for few freshwater fish species from Southern India

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### Abstract

The present study aimed to estimate the length-weight relationship (LWR) and condition factor for three freshwater fish species: *Puntius vittatus* Day, 1865, *Aplocheilichthys lineatus* (Valenciennes, 1846), and *Pseudosphromenus cupanus* (Cuvier, 1831) which had not been previously documented in FishBase. The study was conducted by collecting of fish specimens weekly from the tributaries of Pechiparai reservoir located in Kanyakumari District of Tamil Nadu, India, between January 2021 to January 2022. The results indicated that the estimated mean allometric coefficient values (b value) ranged from 2.51 to 2.74, while the mean intercept values (a value) ranged from 0.016 to 0.019. Additionally, the mean condition factor (K) ranged from 0.9 to 1.61. It was observed that the b values for all three freshwater fish species were below 3, indicating negative allometric growth. However, these values fell within the recommended range of 2.5-3.5 for healthy fish. Furthermore, K values ranged from 0.9 to 1.61, which also fell within the recommended range for healthy fish. The findings of this study provide valuable information on the basic biology of these fish species, which can contribute to the conservation and management of fishery resources in the Southern Indian regions of Kanyakumari District, Tamil Nadu, India.

**Key words:** Cyprinidae, aplocheilidae, osphronemidae, fish sampling, length and weight, condition factor, pechiparai reservoir.

### Introduction

Fisheries are an essential aspect of many countries' economies and play a crucial role in providing food and income for millions of people worldwide. India is home to a wide variety of freshwater fish species, many of which are economically important and play a significant role in the food security of local communities. However, the sustainability of these fisheries is threatened by overfishing, pollution, habitat destruction, and other factors. One of the fundamental aspects of fisheries management is to understand the basic biology of the fish species, such as their growth, reproduction, and mortality rates. The length-weight relationship (LWR) and condition factor (K) are two essential parameters that provide useful information on the growth and overall health of fish populations (Sekitar *et al.*, 2015; Jisr *et al.*, 2018; Pouladi *et al.*, 2020; Das *et al.*, 2021; Kumar *et al.*, 2023). The LWR provides a simple method of estimating the weight of fish from their length and is widely used in fisheries science to evaluate growth and size at age (Stanislas *et al.*, 2023). The K factor, on the other hand, is

a measure of fish plumpness or condition and can indicate the overall health and wellbeing of fish populations (Arafat *et al.*, 2022)

Recently, there has been increasing interest in studying the LWR and K factor of many fish species across the world, including India (Ali *et al.*, 2014; Ferdaushy *et al.*, 2015; Seiyaboh *et al.*, 2016; Jisr *et al.*, 2018; Batubara *et al.*, 2019; Pouladi *et al.*, 2020; Das *et al.*, 2021; Daniel *et al.*, 2021; Çiçek *et al.*, 2022; Kumar *et al.*, 2023). Despite this, many freshwater fish species lack such information, especially in Southern India. To address this gap, this study aims to estimate the length-weight relationship and condition factor of three freshwater fish species (*P. vittatus*, *A. lineatus*, and *P. cupanus*) which have been scarcely studied and remain unreported in FishBase.

### MATERIALS AND METHODS

During the period from January 2021 to January 2022, fish specimens from four sites [(8°09'08.7"N 77°29'48.9"E); (8°09'09.9"N 77°28'30.1"E); (8°08'42.8"N 77°27'22.4"E); (8°08'28.3"N

77°26'53.3"E)] in Kanyakumari, South India were collected for the purpose of studying the length-weight relationship (LWR) and condition factor of three freshwater fish species. The fish specimens were captured using a hand net with a mesh size of 2mm and brought to the laboratory alive for further analysis. Standard literature was used to confirm the species identity, and measurements of their total length (TL) and weight (W) were taken with an accuracy of 0.1 cm and 0.01 g, respectively. The LWR was calculated using the Lecren formula  $W = aL^b$ , where W is the total weight (g), L is the total length (cm), and a and b are the intercept and slope of the regression curve (Lecren, 1951). To establish the LWR, outliers were excluded by plotting them on a graph (Froese, 2006). The Fulton condition factor (K) was determined using the standard equation  $K = W/L^3 \times 100$ , where W is the body weight in grams, L is the total length in centimeters, and the factor 100 is used to bring K close to unity (Okgerman, 2004). Statistical analysis was performed using Excel 2010.

## RESULTS

In the present study, we established the length-weight relationships for three freshwater fish species (*P. vittatus*, *A. lineatus*, and *P. cupanus*) which is not previously available for these species which are represented in Table 1. The total length of the specimens ranged from 1.4-7 cm and total weight varied from 0.05-2.69 g. The estimated mean 'b' values ranged from 2.51-2.74, and mean 'a' values ranged from 0.016-0.019. Additionally, the results showed a reliable co-efficient determination ( $r^2$ ) ranging between 0.973-0.988, indicating the data's reliability. The study also reports the Fulton condition factor (K) values, ranging from 0.9-1.61, for these three fish species.

## DISCUSSION

The estimation of fish length and weight provides valuable information on their growth patterns in relation to their size. The allometric coefficient (b value) is a useful parameter in this regard, with an optimal range typically falling between 2.5 and 3.5 for most fish species (Froese, 2006). A 'b' value of 3 indicates isometric growth, while 'b' values less than 3 suggest negatively allometric growth

and 'b' values greater than 3 indicate positively allometric growth (Rahman *et al.*, 2021). In this study, we estimated the 'b' value for three freshwater fish species (See Table 1). *P. vittatus* exhibited an estimated 'b' value ranging from 2.69-2.79 with a mean 'b' value of 2.74. *A. lineatus* had an estimated 'b' value ranging from 2.45-2.56 with a mean 'b' value of 2.51. Similarly, *P. cupanus* exhibited an estimated 'b' value ranging from 2.54-2.64 with a mean 'b' value of 2.59.

All three freshwater fish species examined in this study exhibited b values less than 3, indicating negative allometric growth (see Table 1). Nonetheless, these values fall within the recommended range of 2.5-3.5 for fish species suggested by Froese (2006). *P. vittatus*, also known as the Greenstripe barb, belongs to the Cyprinidae family and is predominantly found in inland waters of India, Pakistan, and Sri Lanka. In our study, the estimated 'b' value for *P. vittatus* was 2.74. This value is higher than that reported for *Puntius ticto* (1.8032) from the Aasan River in Uttarakhand, India (Bahuguna *et al.*, 2021), but slightly lower than the 'b' value of *Puntius conchonius* (2.94) from Dal Lake in Kashmir, India, as documented by Shafi *et al.* (2012). Furthermore, the 'b' value of *Puntius sophore* (3.142) from the Ganga River in Bihar, India, as reported by Ahirwal *et al.* (2022) is higher than that of *P. vittatus*. *A. lineatus*, known as the Striped panchax, is a colorful killifish variety belonging to the Aplocheilidae family, mostly inhabiting streams, rivers, swamps, and paddy fields in both freshwater and brackishwater environments. The estimated 'b' value for *A. lineatus* in this study was 2.51. However, no length and weight relationship data were available for comparison with congeners. *P. cupanus*, also referred to as the Spiketail paradisefish, is a colorful freshwater fish belonging to the Osphronemidae family, commonly found in shallow bodies of water characterized by slow-moving or stagnant conditions, such as ditches and paddy fields. Again, no length and weight relationship data were available for comparison with congeners. The negative allometric growth observed in these fish suggests that they tend to become slightly slimmer as their length increases, as noted by Jobling (2002). The variation in b value could be attributed to a combination of factors such as the

number of species examined, the environment in which they reside, fullness index, maturity stages of gonads, sex, and differences in length range of the specimens (Froese, 2006; Li *et al.*, 2014; Sharma *et al.*, 2016). Thus, future studies are warranted to determine the exact cause of the low *b* values observed in these fishes.

**Table 1: Estimated length-weight relationship parameters and condition factor for three freshwater fish species**

Family	Species	N	TL range (cm)	W range (g)	a ( $\pm 95\%$ CI)	b ( $\pm 95\%$ CI)	r <sup>2</sup>	Condition factor (K)
Cyprinidae	<i>Puntius vittatus</i> Day, 1865	150	1.4-4.7	0.05-1.47	0.017 (0.016-0.018)	2.74 (2.69-2.79)	0.988	1.61
Aplocheilidae	<i>Aplocheilus lineatus</i> (Valenciennes, 1846)	230	1.6-7	0.08-2.69	0.016 (0.015-0.017)	2.51 (2.45-2.56)	0.973	1.36
Osphronemidae	<i>Pseudosphromenus cupanus</i> (Cuvier, 1831)	270	1.7-5.5	0.05-1.31	0.019 (0.018-0.020)	2.59 (2.54-2.64)	0.974	0.9

Note: N, sample size; TL range, total length range of a fish; W range, total weight range of a fish; a, intercept value; b, allometric coefficient value; CI, confidence limits; r<sup>2</sup>, coefficient of determination.

The Fulton condition factor (K) is a widely used parameter in fisheries and aquaculture to evaluate the overall health and condition of fish (Seher & Suleyman, 2012). It is calculated by dividing a fish's weight by its length cubed, and provides an indication of the fish's nutritional status and growth potential. In the present study, the K values determined for *P. vittatus*, *A. lineatus*, and *P. cupanus* were 1.61, 1.36, and 0.9, respectively. Typically, fish weight increases as length increases, and low K values suggest inadequate nutrition for proper growth, whereas high K values indicate that the fish are receiving sufficient food in their habitat (Perry *et al.*, 1996). In the present study, K values observed ranged from 0.9 to 1.61, falling within the recommended range for healthy fish. Notably, the estimated K value for *P. vittatus* (1.61) exceeded the value reported for *Puntius sophore* (1.06 for males and 1.22 for females) in the Ganga River, Bihar, India (Ahirwal *et al.*, 2022). However, it was lower than the K value of *Puntius ticto* (0.719) from the Aasan River in Uttarakhand, India (Bahuguna *et al.*, 2021), and slightly lower than the K value of *Puntius conchoni* (ranging from 1.74 to 2.10) in Dal Lake, Kashmir, India (Shafi *et al.*, 2012). K value of  $\geq 1$  suggests that the fish are receiving adequate nutrition and living in favorable environmental conditions (Ujjania *et al.*, 2012). It is important to note that several factors can influence K values, including feeding intensity, food availability, fish size, age, sex, season, maturation stage,

gut fullness, muscle development, fat reserves, and life history (Bagenal and Tesch, 1978; Ujjania *et al.*, 2012; Gupta and Banerjee, 2015). Therefore, it is crucial to consider these factors when interpreting K values in fish.

## CONCLUSION

In conclusion, this study has provided preliminary data on the length-weight relationship and condition factor of three freshwater fish species (*P. vittatus*, *A. lineatus*, and *P. cupanus*) from the tributaries of Pechiparai reservoir, located in the Southern Western Ghats region of Kanyakumari District, Tamil Nadu, India. The data generated in this study serve as baseline data for future efforts in managing and conserving the fishery resources of these three species in their natural habitats.

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