

**LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF THE ENDEMIC
CURMUCA BARB, *PUNTIUS CURMUCA* (HAMILTON 1807) OF PAMPA RIVER,
KERALA**

K.S. Anila Kumary*¹ and Karthika E.S.²

¹Department of Zoology, Kuriakose Gregorios College, Pampady, Kottayam, Kerala 686502, India.

²College of Applied Life Sciences, Mahatma Gandhi University Regional Centre, Pathanamthitta, Kerala, 689645, India.

*Corresponding Author: Dr. K.S. Anila Kumary

Department of Zoology, Kuriakose Gregorios College, Pampady, Kottayam, Kerala 686502, India.

Article Received on 10/03/2017

Article Revised on 30/03/2017

Article Accepted on 20/04/2017

ABSTRACT

The length-weight relationship and condition factor of the endemic curmuca barb, *Puntius curmuca* of Pampa river, Kerala was calculated to assess the significance of allometric factor and the well being. The study was carried out using a total of 200 specimens ranging in total length from 10 to 19.5 cm and in total weight from 12 to 49 g comprised of 128 mature males, 24 mature females and 48 immature fishes. The length-weight relationship calculated for the total fishes was $W = 0.00019 L^{2.637}$. The slope value was significantly lower than the critical isometric value of 3 exhibiting negative allometric growth in all categories analyzed. The condition factor of *Puntius curmuca* varied from 0.57 to 1.31 with a mean value of 0.95 implicating that the fishes are not in a good condition in the environment. The proportion females in the population are alarmingly low in the river.

KEYWORDS: Length-weight relationship, Condition factor, *Puntius curmuca*.

INTRODUCTION

India has a rich diversity of fresh water fishes and the Western Ghats is the richest region with a large number of endemic fresh water fishes. Rivers of Kerala originating from Western Ghats have distinct entity of harboring diversified endemic fishes and are freshwater sites of exceptional biodiversity. While this diversity has been in continual decline and the fresh water habitats and its species are considered among the most threatened in the world. Curmuca barb *Puntius curmuca* (Hamilton 1807), commonly known as Kooral, is an endemic fresh water fish belong to Cyprinidae family. *Gonoproktopterus curmuca*, *Barbus curmuca* and *Hypselobarbus curmuca* are the synonyms of the species. The species has commercial value as a potential ornamental variety due to its attractive colour and appearance as well as a food fish. Their distribution is restricted to a few west flowing rivers from the Western Ghats in the states of Kerala and Karnataka (Jayaram, 1999). Due to restricted distribution, loss of habitat, destructive fishing practices and over exploitation for ornamental fish trade, the species is considered as "endangered".

The study of length – weight relationship in fishes is of primary importance in all fishery biological investigations. The measurement of the exact

relationship of length and weight form an important tool in growth and production comparisons (Brown, 1957). Individual variations for general length – weight relationship have also been studied under the general name condition (Lecren, 1951) which is an expression of the ratio of length and weight. Fluctuations in condition factor has been used as a tool for determination of many factors like fatness, onset of maturity, spawning period etc. by many fishery biologists.

Pampa is one of the major rivers of Kerala and is productive in terms of indigenous fish varieties. *Puntius curmuca* is an endemic fish species in the upper and middle reaches of Pampa River and is facing serious endangerment (Padmakumar *et al.*, 2014). Often growth is estimated by measuring length and weight and since the study of length – weight relationship assumes great importance in fishery biology research for adopting effective management measures, the present study aimed at the estimation of length – weight relationship and condition of *Puntius curmuca* inhabiting Pampa river.

MATERIALS AND METHODS

Samples of *Puntius curmuca* for the present study were collected from Pampa River at Attathodu in Pathanamthitta district. A total of 200 specimens ranging in total length from 10 to 19.5 cm and in total weight

from 12 to 49 g were used for the study. The collected specimens comprised 128 mature males, 24 mature females and 48 immature fishes. The length-weight relationship was calculated by the cube law separately for mature males, mature females, immature fishes, total fishes and for two size categories 10-15 cm and 15-20 cm length groups using the data analysis package in MICROSOFT EXCEL after log-transformations. The relationship between length and weight was expressed by the modified equations of cube law (LeCren, 1951) in the form of the non-linear type as $W = a L^b$ and its logarithmic form $\log W = \log a + b \log L$, where

W= Weight of fish in grams

L= Total length of fish in centimeters

a= Exponent describing the rate of change of weight with length

b= The slope of the regression line which is referred to as the allometric growth coefficient

The significance of differences in the 'b' value from the expected value of 3 for the isometric growth was tested by Bailey's t-test (Snedecor and Cochran, 1967) using the formula

$t = (b-3)/sb$ where

b= regression coefficient of log transformed data

sb= standard error of b

The measure of well-being or plumpness of fish was calculated as Condition factor (K) following the equation of Faulton (1904), assuming that the weight of fish is proportional to the cube of length as

$K = (W/L^3) \times 100$ where

W= body weight of the fish

L= total length of the fish

RESULTS AND DISCUSSION

Length-weight relationship studies of fishes provide the mathematical relation between the two variables which is useful in assessing the well being of the individuals in a population. The length-weight relationship of an ideal fish follow the cube law and the value of the exponent 'b' will be exactly 3 if the fish retains the same shape and specific gravity and grows isometrically during their life time (Wootton, 1990). But such an ideal fish with 'b' value exactly 3 is difficult to observe in natural conditions due to change in body form and specific gravity during growth. So in majority of fishes the 'b' value will be either less than or greater than 3, representing negative or positive allometric growth respectively. The change in 'b' value mostly reflects the change in the body form when the weight of fish gets affected by the environmental factors such as temperature, food supply etc. and the factors related to the fish such as age, sex, reproductive period etc. (Ricker, 1973; Bagenal and Tesch, 1978; Wootton, 1990).

The present length-weight relationship study on *Puntius curmuca* showed high degree of correlation between total length and total weight, 0.8018 in mature males, 0.8531 in mature females and 0.7623 in the immature fishes.

The difference in length and weight of male and female *Puntius curmuca* was found to be minor. 200 samples of *Puntius curmuca* analyzed in the study varied in total length from 10 cm to 19.5 cm and in total weight from 12 g to 49g (Table I). The sex ratio of *Puntius curmuca* revealed interesting pattern. The number of males is exceedingly higher than the females and the male: female ratio for the Pampa river stock of the species was 1:0.19. The proportion of mature fishes in the habitat was also high and the majority analyzed belonged to the 10-15 cm size category (76%).

Regression equations revealed that the values of 'b' are significantly different from 3 indicating that the length-weight relationship of the species depart significantly from isometry (t test, $p < 0.05$). Fig.1 illustrates the length-weight relationship (total fishes) in *Puntius curmuca* of Pampa River. The slopes (b) of the regressions were less than 3 for both sexes, hence growth in the individual sex was found to be negative allometric. The logarithmic form and the corresponding parabolic equations of length-weight relationship obtained for *Puntius curmuca* in the present study were as follows

Total fishes: $\log W = -4.2798 + 2.637 \log L$;

$W = 0.00019 L^{2.637}$

Mature males: $\log W = -4.8388 + 2.431 \log L$;

$W = 0.00069 L^{2.431}$

Mature females: $\log W = -4.2304 + 2.806 \log L$;

$W = 0.00017 L^{2.806}$

Mature pooled: $\log W = -4.3010 + 2.756 \log L$;

$W = 0.00020 L^{2.756}$

Immature fishes: $\log W = -3.5441 + 1.864 \log L$;

$W = 0.0035 L^{1.864}$

10-15 cm size group: $\log W = -4.4472 + 2.676 \log L$; $W = 0.00028 L^{2.676}$

15-20 cm size group: $\log W = -4.7853 + 2.566 \log L$; $W = 0.00061 L^{2.566}$

According to Wotton (1992) allometric growth is negative ($b < 3$) if the fish gets relatively thinner as it grows larger, and positive ($b > 3$) if it gets plumper as it grows larger. In general the value of b may range between 2.5 and 3.5 in most fishes (Pauly and Gyanilo, 1997). The relationship reveals that the females are slightly heavier than the males and the fish becomes thinner as it grows larger.

Individual variations from the general cube law governing length-weight relationship is also studied under the general name condition (LeCren, 1951), which is the ratio of length and weight. The fish is said to have a better condition when this ratio is large. In the present study, mature fishes maintained a better condition than that of immature ones (Table II). Basically, condition factor represents the quality of individuals, which is actually the result of the interactions between biotic and abiotic factors and their effect on the physiological condition of fish. But primarily it reflects the state of sexual maturity and degree of nourishment. Condition factor observed for *Puntius curmuca* of Pampa river in

the present study fluctuated from 0.57 to 1.31 and the values (mean) were comparatively higher in mature fishes than in immature ones, in females than in males and in smaller size category analyzed than in the largest size category. Fluctuations in condition factor were reported earlier in various species of fishes in relation to reproductive cycle, feeding rhythms, age, physiological state and Physico-chemical factors of the environment (Kurup and Samuel, 1987; Kurup, 1990; Kalita and Jayabalan, 1997; Alex Nehemia *et al.*, 2012; Preetha G.Nair *et al.*, 2015; Anila Kumary and Smrithy raj, 2016; Anila Kumary and Pooja Moncy 2017). The variations in condition factor in the various categories analyzed can be attributed to factors such as life stages, faster growth rate

of young ones, differences in food reserves, food preferences and sample size variations.

The present study has revealed that there is significant deviation in the slope value from the critical isometric value of 3 in *Puntius curmuca* inhabiting the Pampa river of Kerala. The species exhibits significant negative allometric growth in the river and shows low condition factor in the environment. Information on allometric relationships form an import input for proposing management measure for *Puntius curmuca* fishery in the river. The proportion females in the population are also alarmingly low in the river. Effective management measures should be adopted for the conservation of this endemic and endangered species.

Table I. Statistics of the length- weight relationship of *Puntius curmuca* for the various categories

Category	No.of fishes	Range of length(cm)	Range of weight(g)	Regression coefficient	'a' value
Total fishes	200	10-19.5	12-49	2.637	0.00019
Mature fishes	152	11-19.5	12.8-49	2.756	0.00020
Immature fishes	48	10-14.2	12-23.52	1.864	0.0035
Mature males	128	11-19.5	12.8-47.1	2.431	0.00069
Mature females	24	12.2-18.2	14.3-49	2.806	0.00017
10-15 cm	152	10-14.8	12-35.8	2.676	0.00028
15-20 cm	48	15.1-19.5	28.1-49	2.566	0.00061

Table II. Range and mean values of condition factor in *Puntius curmuca* for the various categories

Category	Condition Factor		Mean
	Minimum	Maximum	
Total	0.57	1.31	0.95
Mature	0.71	1.31	0.98
Immature	0.57	1.20	0.93
Males	0.71	1.30	0.97
Females	0.93	1.31	1.04
10-15 cm	0.57	1.31	1.02
15-20 cm	0.71	1.28	0.98

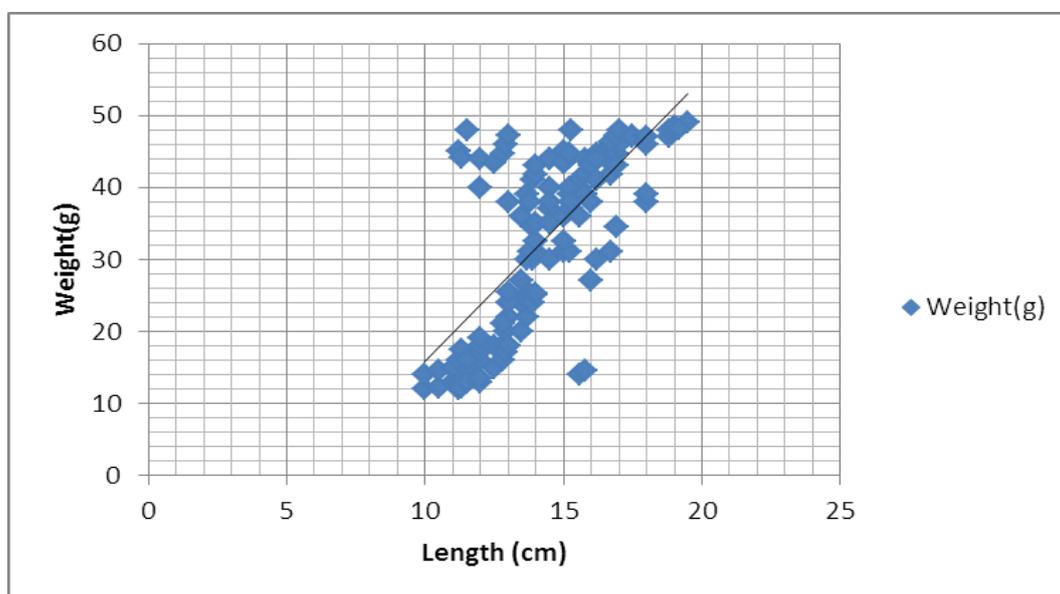


Fig.1. Length-weight relationship in *Puntius curmuca* of Pampa river

REFERENCES

1. Alex Nehemia, Justin D Maganira and Cyrus Rumisha, 2012 Length-weight relationship and condition factor of tilapia species grown in marine and fresh water ponds, *Agriculture and Biology Journal of North America*, 3(3): 117-124.
2. Anila Kumary, K.S. and Smrithy Raj, 2016 Length-weight relationship and condition of Climbing perch *Anabas testudineus* Bloch population in Kuttanad, Kerala, *Int. J. Adv. Res. Biol. Sci.*, 3(9): 21-26.
3. Anila Kumary, K.S. and Pooja Money, 2017 The condition factor, length-weight relationship and relative condition of *Labeo dussumieri* (Valenciennes, 1942) from Meenachil river, Kottayam, Kerala. *ejbps*, 4(3): 278-282.
4. Bagenal T.B. and W. Tesch 1978 Age and Growth. In: *Methods for the assessment of fish production in fresh waters*. 3rd edition. Blachwell Scientific Publication, 101-136.
5. Brown, M.E. 1957 Experimental studies on growth. In: *The physiology of fishes*, Vol.1 (M.E. Brown ed.) Academic Press, New York: 361-400.
6. Faulton, T.W. 1904 The rate of growth of fishes. *Twenty- second Annual report, Part III Fisheries Board of Scotland, Edinburgh*, 141-241.
7. Jayaram, K.C. 1999 *The fresh water fishes of the Indian region*. Narendra Publishing house, New Delhi, India.
8. Kalita, N. and N. Jayabalan, 1997 Age and growth of the Karangid *Alepes para* (class: Osteichthyes) from mangalore coast, *Indian J. Mar. Sci.*, 26: 107-108.
9. Kurup, B.M. 1990 population characteristics, bionomics and culture of *Labeo dussumieri* (Val). *Final report submitted to Indian Council of Agricultural Research*, 108pp.
10. Kurup, B.M. and C.T. Samuel 1987 Length-weight relationship and relative condition factor in *Daysciaena albida* (Cuv.) and *Gerres filamentoses* (Cuv.), *Fishery Technology* 24: 88-92.
11. Le Cren, E.D. 1951 Length-weight relationship and seasonal cycle in gonad-weight and condition in the perch (*Perca fluviatilis* L) *J. Anim. Ecol.*, 20: 201-219.
12. Padmakumar, K.G., L.Bindu, P.S.Sreelekha, Nitta Joseph, P.S. Manu and Anuradha Krishnan 2014 First report on captive breeding of endemic red tailed shark *Gonoproktopterus curmuca* (Cyprinidae: Hamilton-Buchanan 1807). *International Journal of Research in Fisheries and Aquaculture*, 4(4): 156-160.
13. Pauly, D. and F.C. Gayanilo Jr. 1997 An alternative approach to estimating the parameters of a Length-weight relationship from length frequency samples and their bulk weights. *ICLARM*, Manila, Philippines, 88pp.
14. Preetha G.Nair, Shoji Joseph and V.N.Pillai, 2015 Length-weight relationship and relative condition of *stolephorus commersonii* (Lacepede 1803) exploited along Kerala coast. *J.Mar. Biol. Ass. India*, 57(2): 27-31.
15. Ricker, W.E. 1973 Linear regression in fishery research. *Journal of the Fisheries Research Board of Canada*, 30: 409-434.
16. Snedecor, G.W. and W.G. Cochran, 1967 *Statistical Methods* The Iowa State University Press, Ames, Iowa.
17. Wootton, R.J. 1990 *Ecology of teleost fishes*. Chapman and Hall, London, 404pp.
18. Wootton, R.J. 1992 *Fish Ecology*, tertiary level biology. London Backie Scientific.