Study of Length-weight relationship and the condition factors of *Lepidocephalichthys guntea* (Hamilton, 1822) from Kangsabati river of district West Midnapore, West Bengal, India.

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1.Abstract:

The Peppered loach, Lepidocephalichthys guntea is the least concerned freshwater species, commonly found in India, Pakistan, Nepal, and Bangladesh. In West Bengal, it is popularly known as "Guntey" & it has commercial and food value. The current study aimed to the estimation of the length-weight relationship, condition, and relative condition factor (Kn) of the fish species Lepidocephalichthys guntea, habitats of Kangsabati river in the District West Midnapore, West Bengal, India. Total 161 numbers of species were collected between August 2019 to July 2020 and considered for examination. The fishes ranged from 5.4 to 10.7 cm in total length & 0.72 to 9.73 g in weight. The scatter diagram exhibits a linear relationship between the log length & log weight. The female species has a higher "b" value (b=3.452, P<0.05), which is greater than 3 which justifying a positive allometric growth. The parabolic equation among total length and weight of L. guntea is labeled as $W= 0.008744991\ L^{2.7496}$ *for males,* $W= 0.002153098\ L^{3.452}$ *for females &* $W= 0.007575793\ L^{2.8155}$ *for the combination of male and female species. Higher* r^2 *(0.859, P<0.05) value in combined of male & female justifying a strong relationship between length and weight. The mean condition(K) & relative condition factor (Kn) values were found to be the height in the male category with "K" value 0.654 & "Kn" value1.174 respectively indicating the well-being of the species. Although, this species does not sternly follow the cube law & shows a well status of health condition in their natural habitat.*

2.Keyword:

Lepidocephalichthys guntea, Length-weight relationship, Kangsabati River, Condition factor.

3.Introduction:

The essential chef source of protein is taken for consideration is “the fish”. It also provides a source of income to many peoples all over the world. Fishes are cultured in ponds, rivers, reservoirs, and marine(cage culture). Besides capture fisheries, agriculture sector and urbanization also escalating very high, due to that reasons overfishing, agricultural & urban waste runoff are increasing and wetlands area are decreasing. These factors affecting fish stocks and health very seriously. To know about the health conditions of fishes there are many characters to study, one of them is the Length-weight relationship study. The condition factor (K) & relationship between length-weight (LWR) are two imperative needles in the supervision of the culture systems as it delivers information’s on the precise conditions of the growing environments of fish(Araneda et al., 2008). The quantitative parameter condition factor is assessed based on the length-weight statistics, which designates the wellbeing states of any fish (Hossain et al., 2006). The data of fish Length-weight are requiring standard outputs of the sampling programs (Morato et al., 2001). It is also required to estimate the rate of growth, age, and length structures of fish populations dynamic (Kolher et al., 1995). The Length-weight

relationships are needed for comparing the morphological aspects and life history of inhabiting populations in different regions (Goncalves et al., 1997; Stergiou and Moutopoulos, 2001). The information about length-weight relationships (LWR) is a vital means for the passable management of any species of fish, that have been pragmatic in fish stocks and populations assessment (King, 2007; Lopez et al. 2020). It is also suitable in interregional & local morphological contrast of populations (Froese, 2006; Ali et al., 2013). The Length-weight relationship (LWR) information of fishes is convenient for biologists (Martin-Smith, 1996) in the assessment & proper management of fish populations. The study of Length-weight relationships also give baseline information about growth pattern estimation of the fish stocks, and strategies for conservation (Ortega-Garcia et al. 2017) The biology use length-weight relationship for numerous purposes like to envisage weight from measurements of length for the assessment of yield, the standing crops biomass calculation, estimation of age concerning the weight of the fish, fish population well-being index evaluation, to evaluate age structure & function of the fish populations, studies the growth, differentiation of stock, ecological modeling and for the acoustic survey(Pauly, 1993; Petrakis and Stergiou, 1995; Haimovici and Velasco, 2000; Ozaydin et al., 2007; Froese 2006; Siddique et al. 2016; Eduardo et al. 2019). The LWR has been cast-off to get the information about the fish condition to estimate whether the somatic growth is allometric or isometric (Gurkan and Taskavak, 2007; Ujjania et al., 2012). In general, the fishes follow the cube law of growth pattern (Brody, 1945; Lagler, 1952). It may vary from fish to fish depend upon their health condition and different environmental factors (Le Cren, 1951). The relationship among Length-weight & condition factors of several fishes has been reported previously (Le Cren, 1951; Lal and Dwivedi, 1965; Narasimham, 1970; Pathak,1975; Soni and Kathal, 1979; Shrivastava and Pandey, 1981; George et.al., 1985; Dasgupta,1988; Dhasmana and Lal, 1993; Azad and Nasar, 1996; Narezo et.al., 2002; Zaydın et. al. 2007; Pal et. al.(2013, 2014) Iqbal et. al.(2018); Amponsah et. al. 2021; Habib et.al. 2021; Panicker, B.A., & Katchi, VI 2021). The species named *Lepidocephalichthys guntea* (Hamilton, 1822)have been categorized into the Cypriniformes order and Cobitidae family, it has commercial food and ornamental values in India. The species *Lepidocephalichthys guntea* is locally known by the name “Guntay” in West Bengal(India). The common name of the species in English are the Peppered loach, Scavenger loach, and Guntea loach and is categorized under “least Concern” in IUCN red data book(www.iucnred.list). The species are distributed over Pakistan, central, east, and northern India, Bangladesh, Nepal and it also recorded from Thailand & Mayanmar (www.iucnred.list), they are generally habitat on the bottoms of swamp, streams, flooded fields, lakes, ponds, canals in the stream of Brahmaputra and Ganges river (Havird and Page, 2010).

In previous, several researchers have studied the LWR of *Lepidocephalichthys guntea.* (Dhakal and Subba 2003; Hossain 2010; Gohain and Deka 2017; Kumar et. al. 2017). Nevertheless, so far no data has been published on LWRs of *Lepidocephalichthys guntea,* from the state West Bengal(India) as IUCN declared this species as "Least Concern". This study has been carried out to estimate the length-weight relationship of *Lepidocephalichthys guntea,* which was found in the kangsabati river and its tributaries (small narrow canals).

4.Materials and methods:

A total of 161 numbers of freshly caught species were collected from the Gate Bazar, a major fish market of Midnapore city in West Bengal, India during the periods August 2019 to July 2020. Through a market survey, it was coming to known that, all the species (*Lepidocephalichthys guntea*)(Plate 1.a) were caught from the river kangsabati and its tributaries.

The collected species were stocked in two rectangular cemented tanks in the Department of Fishery Sciences of Vidyasagar University. A complete study has been carried out in the laboratory of the Fishery science department. Fish species were identified and differentiated sexually following the

described characteristic according to Talwar and Jhingran (1991) and Havird and Page (2010). Without any time laps the freshly caught species from their natural habitat the length and weight were measured on the same day of collection. The body color may get faded, a health condition may weekend with the time, when fishes are taken out of their natural habitats, for this reason, an immediate study of sexual dimorphism and length-weight data has been recorded. The length was measure nearer to 0.01 mm total length (TL), with digital Vernier caliper (Aerospace Plate 1.b) & weight was measured nearest to 0.01 g total weight (TW) using digital mini heng pocket scale(MH-696)(Plate 1.d). The relationship between the length and weight of the fishes was calculated using the equation $W = a L^b$ (Le Cren, 1951 and Froese, 2006), in which W is the measure of total body weight(in grams) & L is the measure of total length (TL) in cm. Using the linear regression equation of length-weight relationships (Log TW = log a + b log TL), a and b regression parameters were estimated.

Condition Factor:

Fulton condition factor of the species (Fulton, 1904) was estimated using the equation $K = 100 W/L^3$ (Where W is species weight in grams, L is species total length in centimeter). The Relative condition factor was estimated using the following formula: $Kn = W/aL^b$, (Where W denotes species total weight in grams, L denotes species total length in centimeter, a and b are the regression parameters).

Data analysis:

The correlation among the variables was figured by the coefficient "r^2 " determination (regression). The level significance of r^2 was assessed by the ANOVA test in Excel (Microsoft word, Version 2010). To determine the significant level of b value the student's t-test (ts) was used (i.e., $p<0.05$).

5.Result:

A total 161 number of male and female species of *Lepidocephalichthys guntea* were taken up into account for the estimation of the length-weight relationship. Out of the collected species, three categories were made following male, female, and combination of male and female species for examination. Male species are distinguishable from the female through the observation of lamina circularis shaped by the fusion of the 7^{th} and 8^{th} pectoral rays (Present only in males)(Plate 1.c). Males are higher in numbers then the female among the collected species. The minimum and maximum values of length & weight with standard deviations of them have been

tabulated in **Table 1**. Female species have been recorded of highest length and male species of lowest length, in other hand female species were recorded with lowest & highest value of weight.

Plate:

(1.a)

(1.b)

(1.c)

(1.d)

Plate 1: (1.a) Species *Lepidocephalichthys guntea*, (1.b) Length measurement in digital vernier caliper, (1.c) Lamina circularis formed by the fusion of the 7th and 8th pectoral-fin rays, (1.d) Weight measurement of the species.

Table 1: The length and weight measurements of *Lepidocephalichthys guntea.*

Category	Number of species	Total length in cm				Bodyweight in gm			
		Min.	Max.	Mean	SD	Min.	Max.	Mean	SD
Male	84	5.4	7.1	6.07 ± 0.40		0.95	2.24	1.47 ± 0.29	
Female	77	5.9	10.71	8.03 ± 1.14		0.72	9.73	3.08 ± 1.93	
Combination of male & female	161	5.4	10.71	7.07 ± 1.9		0.72	9.73	2.44 ± 1.91	

*****Min. : Minimum, Max. : Maximum, SD: Standard Deviation.

Through the statistical analysis, it was observed that female species show higher b value greater than 3 (b = 3.452, P<0.05), that signify that female grows positive allometrically. Where, male(b= 2.7496, P<0.05) and combination of male and female(b = 2.8155, P<0.05) grows negative allometrically with b value less than 3. Among the three categories, a combination of male and female shows the highest "r^2" value (r^2 = 0.859) followed by male & female (**Table 2**). The all r-square values were greater than 0.80, which indicates a strong correlation between length and weight. The logarithmic & parabolic equations for the length-weight relationship of the species *Lepidocephalichthys guntea* were tabulated in **Table 3**.

Table 2: Descriptive statistics of regression parameters of the species.

Category	Regression Parameters					
	a	b	t-test value of b	Multiple R	R Square	Adjusted R Square
Male	0.008744991	2.7496	(P<0.05)	0.915	0.838	0.836

Female	0.002153098	3.452	(P<0.05)	0.899	0.808	0.805
Combination of male & female	0.007575793	2.8155	(P<0.05)	0.927	0.859	0.858

*a: intercept, b: slope, R: coefficient correlation.

Table 3: Descriptive logarithmic and parabolic equations of the species.

Category	Logarithmic equations	Correlation coefficient	Parabolic equations
Male	Log W = - 2.05824 + 2.7496 log TL	0.838	$W = 0.008744991\ L^{2.7496}$
Female	Log W = -2.66693 + 3.452 log TL	0.808	$W = 0.002153098\ L^{3.452}$
Combination of male & female	Log W = -2.12057 + 2.8155 log TL	0.859	$W = 0.007575793\ L^{2.8155}$

*TL: Total length, W: Weight, L: Length.

Table 4: Descriptive condition factor of the species.

Category	Condition Factors (K)					
	Condition Factor (Fulton, 1904)			Relative condition factor (Le Cren, 1951)		
	Min.	Max.	Mean SD	Min.	Max.	Mean SD
Male	0.544	0.757	0.654 ± 0.05	1.017	1.362	1.174 ± 0.09
Female	0.336	0.957	0.539 ± 0.14	0.636	1.566	0.979 ± 0.24
Combination of male & female	0.336	0.957	0.612 ±0.12	0.641	1.934	1.155 ± 0.23

*****Min. : Minimum, Max. : Maximum, SD: Standard Deviation.

As, male species has logarithmic equation Log W = - 2.05824 + 2.7496 log TL and parabolic equation $W = 0.008744991\ L^{2.7496}$.The health conditions of a fish species could be estimated by observing the K-value, known as the condition factor. The average Fulton condition factor was found to be higher in the male category (K= 0.654) and lower in the female category (K = 0.539). The average relative condition factor was higher in males (1.174) and lower in females

(0.979). The Fulton and Relative condition factors were found to be varied maximum in female categories with SD values 0.14 & 0.24 respectively **(Table 4).** On intrigue the observed log weight of *Lepidocephalichthys guntea* contrary to the observed log length, a linear straight line was obtained which shows the strong relationship among length and weight with r square range from 0.808 to 0.859, a combination of male and female show the highest correlation (0.859, P<0.05) and female categories show the lowest correlation (0.808, P<0.05) (**Fig. 1, 2, and 3**).

Fig 1: Length-weight relationship of male species (Log value).

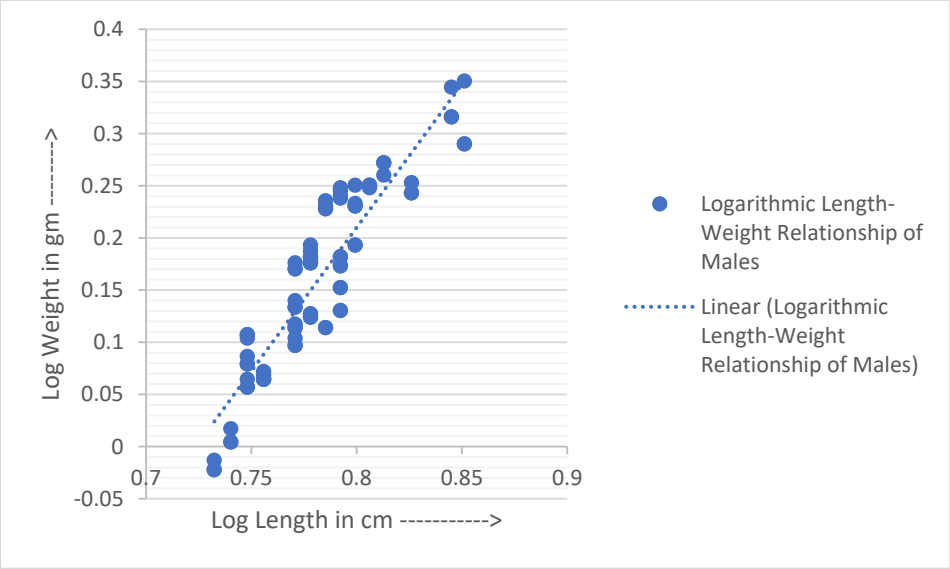


Fig 2: Length-weight relationship of female species (Log value).

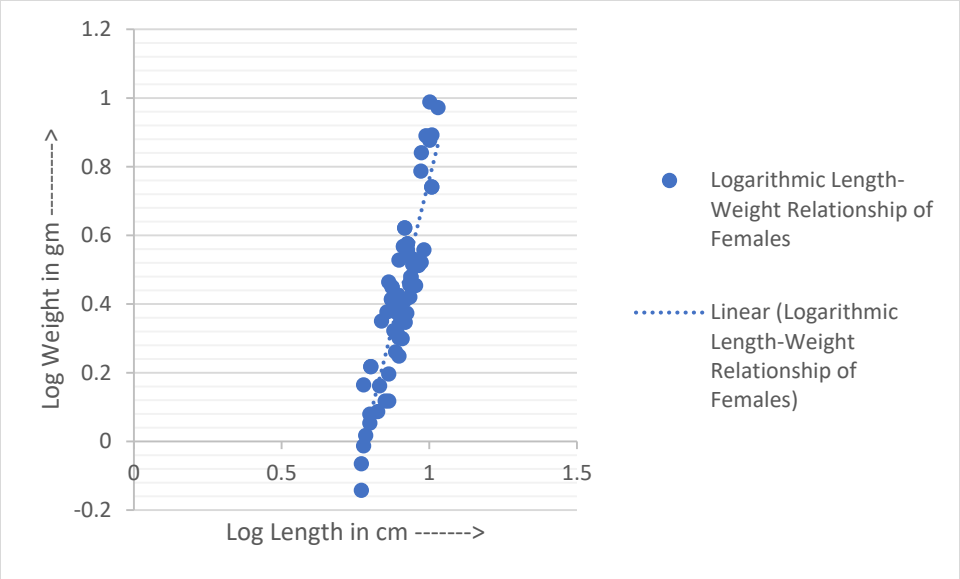
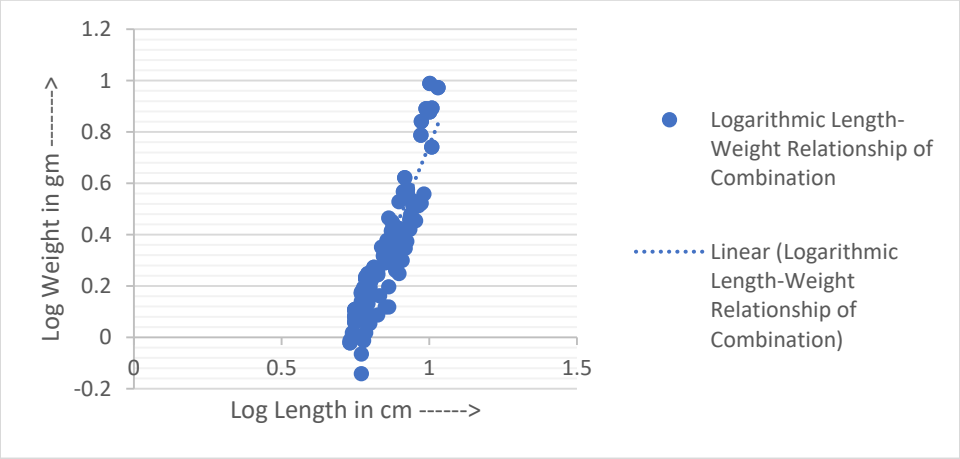


Fig 3: Length-weight relationship of combination of male & female species (Log value).



6.Discussion:

The relationship between length-weight is a very significant tool in the assessment of fisheries (Haimovidici and Velasco, 2000; Arslan et al., 2004) and also biomass of standing crop can be assessed grounded on length-weight value (Morey et al., 2003). The present study was carried out using a total 161 number of male and female species of *Lepidocephalichthys guntea.* As the population of this species decreasing day by day in their natural habitat, to know the growth pattern and health of this species, an examination has been done on the length-weight relationship from the Kangsabati river at West Midnapore district of West Bengal. From the study, it was observed that the numbers of male species were more than that of female species out of the collected species. The minimum size was observed in the male population and

maximum size in the female population with varying weight, because at maturity within the same length group of males & females, the female species show greater weight due to the development of ovary in the breeding season (Dhakal and Subba, 2003). Indeed the "b" value was found to be highest in the female category following combined categories and lower in the male categories. In the female, the "b" value was greater than 3 which is 3.452($P<0.05$), which employs positive allometric growth with more increases in weight than the length. The grater "b" value is due to an increase in the weight of females in contrast to the upsurge in length because massive growth of gonads in the breeding season which was also similar to the previous finding of Dhakal & Subba (2003) (b=3.18). The gonadal developmental stages of female species, particularly the ovary which affect the weight (Weatherly, 1972 and Hile, 1936)of different species populations (Jhingran, 1968) and the state of maturity (Frost, 1945). In the male category, the "b" value was found to be less than 3, that is 2.7496($P<0.05$) which employs negative allometric growth. An alike pattern of negative allometric growth was reported in *C. carpio* from the amalgamated fish culture unit of Himachal Pradesh with the "b" values of 2.9002 (Jhingran,1952), open water system like from Gobindsagar with "b" value 2.42(Sharma,1986), Dal lake with "b" value 2.98 (Sunder,1984). By observing the "b" value of males it could be said that, increase in weight in males is not proportional to the rise in length of the body, the reason may be due to the energy losses for gonadal development rather than the somatic body development (Bura gohain and Goswami, 2013). In the case of the combination of male and female species the "b" value was found to be slightly greater than male and lesser than female, which is 2.8155($P<0.05$) & shows negative allometric growth. Rahman et al., 1997 conveyed that, the “b” value of *Lepidocephalichthys guntea* for females (3.23), male (3.32), and combined (3.27) in Bangladesh. Some authors also itemized different “b” values of this species, specifically Hossain, 2010 (b=3.64), Ferdaushy and Alam, 2015 (b=2.84), Hossain et al., 2009 (b=3.25),. The degree of alteration of "b" value depends on the sex of the species (Hile and Jobes, 1940), feeding habit & rates (Le Cren, 1951), gonadal developmental stages, specifically the ovary of female effect the weight of species (Weatherly, 1972 and Hile, 1936) diverse species population (Jhingran, 1968) and maturity state (Frost, 1945). The "a" & "b" value differed among the same species reliant on the sex, maturity stages, and food habits (Qasim, 1973 and Bal & Rao, 1984).

Among all the three categories the coefficient of correlation found to be higher in combination of male and female($r^2= 0.859$, $P<0.05$), male($r^2= 0.838$, $P<0.05$) & female($r^2= 0.808$, $P<0.05$) category, showing a strong length-weight relationship ,that are positively correlated & vice versa(Fig. 1,2, & 3) which are similar to the finding of Dhakal & Subba (2003). In the natural habitat, the “K” (condition factor) or "Kn" (relative condition factor) value also governs the well-being of any fish species. According to Le Cren (1951), the “Kn” value greater than 1 specified the good condition of the fish species. The average relative condition factor of the male category was found to be greater than 1 and highest among the three categories, that is "Kn" value of 1.174 followed by combined male & female category("Kn" value 1.155). The female category shows "Kn" value less than 1 but nearer to 1, that is 0.979 & this "Kn" is nearly similar to the finding of Gohain and Deka (2017), The lower 'Kn' values of females may be due to low gonadal maturity(Das et. al, 2019). The reflection is similar to the finding of DaCosta(2003) and proposed that a larger portion of the energy is owed for the growth and evacuation of ovaries leads to relatively lesser "Kn" values. So, the male category shows higher well-being condition among the three categories, which were taken into consideration for the examination of length-weight relationship & condition factor.

7.Conclusion:

The current study it is revealed that the *Lepidocephalichthys guntea* from the river Kangsabati at West Bengal shows an allometric growth pattern with a "b" value not equal to 3. So, it can be concluded that this species did not follow the proposed cube law strictly. This species shows a strong relationship among the length & weight in this river system. The condition factor & relative condition factor were found to be in a standard position to keep the well-being of the fish species in a healthy condition. This study has fulfilled the projected aim set for it, & the presented data might create a valuable recommendation for founding forthcoming biometric studies for the fish collected over the Kangsabati River.

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