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ORIGINAL ARTICLE

Morpho-meristic parameters, length-weight relationships and condition factor of three ambassid fishes from Chalan Beel, Bangladesh

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Abstract

Length-weight correlations and condition measures are important in fish biology to determine individual health and potential variations among stocks of the same species. Length-length, length-weight relationships, morpho-meristic characteristics and condition factor were documented for three small indigenous species (*Chanda nama, Parambassis lala* and *Parambassis ranga*) equally totaling 600 individuals collected in 'Chalan Beel' using a seine net (mesh size 0.5-1cm) from July 2020 to December 2020. Body weight was determined with an accuracy of 0.01g, and length was calculated to the nearest 0.1cm. The mean body weights of *C. nama, P. lala* and *P. ranga* were calculated as 1.75±0.61g, 0.55±0.16g and 0.88±0.31g and their average total lengths were 5.50±0.68cm, 3.18±0.28cm and 3.71±0.42cm, respectively. Standard morphometric and meristic traits were found throughout all three studies species and a strong relationship between length and weight (P<0.05) was observed. The final '*b*' values for TL and BW were recorded at 2.52, 3.03 and 3.14 for *C. nama*, *P. lala* and *P. ranga*, respectively, indicating negative allometric growth for *C. nama*, isometric growth for *P. lala* and positive allometric growth for *P. ranga*. Furthermore, condition factors (>1) demonstrated that these species were in excellent condition in their natural habitats. The present observations would be an effective tool to help identify these fish species in varied aquatic environments across Bangladesh and nearby regions, enabling their optimal management and conservation.

Keywords: Allometric growth, Isometric growth, Regression coefficient, Length-weight relationship.

INTRODUCTION

'Beels' (Floodplain wetlands) in Bangladesh are considered one of the most potential freshwater fisheries resources having high nutrient contents and serving as the nursing and spawning grounds of many indigenous freshwater fish species. The "Chalan Beel" is the biggest beel in Bangladesh, covering a total area of more than 350km^2 during the rainy season and nearly 90km^2 during the dry season where the total fish production is 105659 MT in 2019-20 (DoF 2020). It is primarily made up of flooded areas, a considerable number of tiny beels, and canals (Galib et al. 2009). In contrast to diversification, species distribution, habitat, water level, hydrogeology, physiochemical properties, and ecological circumstances, the 'Chalan Beel' offers many important fish species with appropriate feeding, breeding, and rearing habitats (Karim et al. 2020).

Chanda nama (Hamilton 1822), *Parambassis lala* (Hamilton 1822) and *Parambassis ranga* (Hamilton 1822) are among the most popular small indigenous species having high protein, mineral, and vitamin A contents (Hossain et al. 2015; Hossen et al. 2020). These species have also high market demand among ornamental fish hobbyists. Unfortunately, there is a scarcity of information on basic biology of these species.

Length-weight relationships (LWRs) provide valuable information on fish growth, its fitness and aids for fishery management and conservation (Mouludi-Saleh et al. 2023; Secer et al. 2022; Abbasi et al. 2019; Paul et al. 2021). First documented LWRs

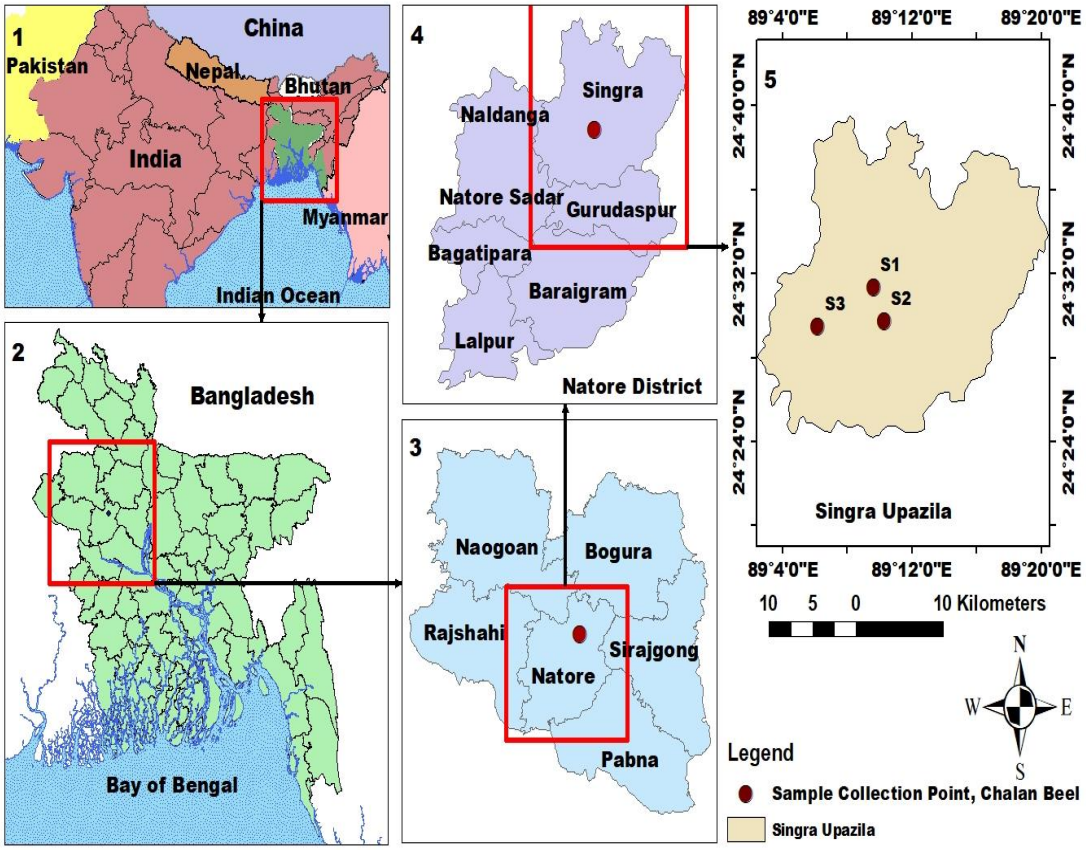

Fig.1. Sampling sites of Chalan Beel, Natore, Bangladesh.

and LLRs of these species from the Ganges River of northwest Bangladesh (Hossain et al. 2016). Habitat conditions, regional distribution along with other environmental factors have a great influence on the LWRs and other morphometric traits as well (Dinh et al. 2022; Narzary & Khangembam 2023). 'Chalan Beel' is an area of diverse resource-sharing zone where those ambassid species required special attention on systematic biological approach which leads to documenting the detail morpho-meristic characteristics and LWRs of *C. nama*, *P. lala* and *P. ranga*.

MATERIAL AND METHODS

A total of 600 individuals (200 of each species *C. nama, P. lala, P.* ranga) were collected from different locations of 'Chalan Beel' in Natore districts (Fig. 1) from the commercial fisherman using seine net (mesh size 0.5-1cm) from July 2020 to December 2020. Specimens were washed thoroughly, immediately fixed in 5% formaldehyde solution and brought to the laboratory. Species level was confirmed followed by Talwar & Jhingran, 1991 and Rahman, 2005. Digital slide calipers having ±0.01mm accuracy (EAGems-B00Z5KETD4) were employed to take different lengths (Fig. 2) and an electronic balance having ±0.01g accuracy (EK600Dual) was used to document body weight (BW). Meristic traits were performed using a magnifying lens. Six morphometric and five meristic characters along with the condition factor were documented.

The length-length relationship with standard length among varied body lengths were calculated using the least squares method (Erguden & Turan 2011) Y= a+bX; where, Y= different body lengths, X= fork or standard or total length, a= proportionality constant and *b*= regression coefficient. The LWRs were expressed by using the equation $W= aL^b$ (Le Cren 1951; Froese 2006); where *W*= Weight of fish (g), *L*= Total length of fish (cm), *a*= constant (intercept), *b*= constant (slope of regression line). The '*a*' and '*b*' value were calculated by linear regression analyses based on natural logarithms as $\ln W = \ln(a) + b \ln(L)$. Fulton's condition factor (K_f) was calculated using the

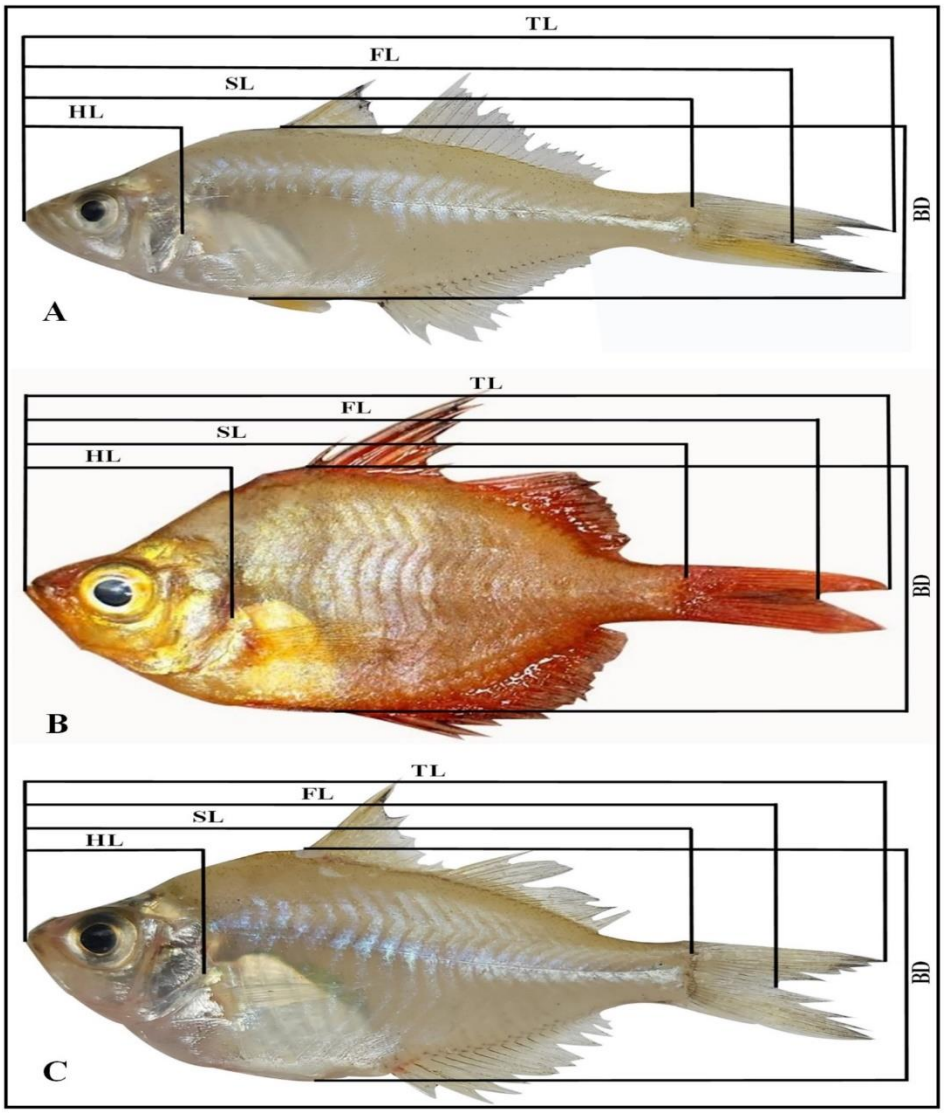

Fig.2. Showing the morphometric characters of three fish species, (A) *Chada nama*, (B) *Parambassis lala* and (C) *Parambassis ranga* (TL: total length in cm, FL: fork length in cm, SL: standard length in cm, HL: head length in cm, BD: body depth in cm, MG: mouth gape in cm).

equation given by Htun-Han (1978) as $K_f = 100\times(W/L^3)$; where K_f is Fulton's condition factor, W is the body weight (BW) in g, L is the total length (TL) in cm. Allometric condition factor (K_a) was calculated using the equation of Tesch (1968) as $K_a = W/L^b$; where, Where, K_a is the allometric condition factor, W is the body weight (BW) in g, L is the total length (TL) in cm and b is the LWR parameter. All statistical analyses were conducted using the software SPSS version 22 (IBM®, New York, USA) at 5% level of significance ($P<0.05$).

RESULTS

Chanda nama had a heavily compressed, laterally flattened body with partially visible lateral line. The body was clear yellowish-white with a smattering of small black dots. A little black mark could be detected near the base of the anal fin. The lower jaw was larger. *Parambassis lala* featured an orange-yellow body color with three dorsoventrally extending longitudinal dark bands, lozenge-shaped morphological traits, typical perciform fins and a semitransparent structure. *Parambassis ranga* a silvery belly with grey color in back and many parallel close-set faint bars on the back; both caudal-fin lobes had broad dusky margins (Fig. 2).

Morphometric data (body weight, total length, fork length, standard length, head length, and body depth)

Table 1. Morphometric Characters used for analysis of *Chada nama*, *Parambassis lala* and *Parambassis ranga* from Chalan Beel, Bangladesh.

Species		BW (g)	TL (cm)	SL (cm)	FL (cm)	HL (cm)	BD (cm)	MG (cm)
C. nama	Min	0.67	4.11	3.24	3.56	0.91	0.96	0.34
n = 200	Max	3.16	6.94	5.40	5.92	1.65	1.71	1.03
	Mean±SD	1.75±0.61	5.50±0.68	4.40±0.57	4.85±0.62	1.29±0.19	1.35±0.20	0.83±0.13
	95% Cl	1.66-1.84	5.41-5.59	4.33-4.48	4.77-4.94	1.26-1.31	1.32-1.37	0.81-0.85
	% TL	—	100	80.12	88.2	23.39	24.49	15.09
P. lala	Min	0.31	2.67	2.12	2.41	0.72	1.01	0.10
n = 200	Max	1.02	4.03	3.10	3.67	0.10	1.61	0.50
	Mean±SD	0.55±0.16	3.18±0.28	2.47±0.22	2.87±0.26	0.84±0.07	1.32 ± 0.15	0.39±0.06
	95% Cl	0.53-0.57	3.14-3.22	2.44-2.50	2.84-2.91	0.83-0.85	1.30-1.34	0.38-0.40
	% TL	—	100	81.84	90.46	26.35	41.59	12.26
P. ranga	Min	0.35	2.78	2.14	2.48	0.75	1.08	0.32
n = 200	Max	1.66	4.56	3.49	4.15	1.13	1.93	0.57
	Mean±SD	0.88±0.31	3.71±0.42	2.89±0.33	3.37±0.39	0.94±0.09	1.51±0.20	0.43±0.05
	95% Cl	0.84-0.93	3.65-3.77	2.84-2.93	3.31-3.42	0.93-0.95	1.48-1.53	0.42-0.44
	% TL	—	100	82.11	90.68	25.31	40.54	11.59

Table 2. Estimated parameters of the length-length relationships.

Species	n	Regression parameters							
		Equation	A	b	95% CI of a		95% CI of b		r
					L_{CI}	U_{CI}	L_{CI}	U_{CI}	
C. nama		TL = a + b × FL	0.74	0.98	0.42	1.06	0.92	1.05	0.90
		TL = a + b × SL	0.46	1.15	0.20	0.71	1.09	1.21	0.94
	200	FL = a + b × SL	0.50	0.99	0.18	0.83	0.92	1.07	0.88
		HL = a + b × TL	-0.06	0.25	-0.17	0.05	0.23	0.27	0.87
		BD = a + b × TL	-0.04	0.25	-0.15	0.07	0.23	0.27	0.87
		MG = a + b × TL	0.01	0.15	-0.08	0.10	0.13	0.17	0.80
P. lala		TL = a + b × FL	0.13	1.06	0.07	0.20	1.04	1.08	0.99
		TL = a + b × SL	0.02	1.28	-0.04	0.80	1.25	1.30	0.99
	200	FL = a + b × SL	-0.06	1.19	-0.13	0.002	1.16	1.21	0.99
		HL = a + b × TL	0.11	0.23	0.07	0.14	0.22	0.24	0.95
		BD = a + b × TL	-0.19	0.48	-0.29	-0.10	0.45	0.51	0.91
		MG = a + b × TL	-0.04	0.14	-0.12	0.04	0.11	0.16	0.61
P. ranga		TL = a + b × FL	0.11	1.07	0.03	0.19	1.05	1.10	0.99
		TL = a + b × SL	0.07	1.26	0.01	0.13	1.24	1.28	0.99
	200	FL = a + b × SL	0.05	1.15	-0.04	0.14	1.12	1.18	0.98
		HL = a + b × TL	0.15	0.21	0.12	0.18	0.21	0.22	0.97
		BD = a + b × TL	-0.18	0.45	-0.26	-0.10	0.43	0.48	0.94
		MG = a + b × TL	0.06	0.10	0.02	0.10	0.09	0.11	0.79

were acquired for three ambassid species (Table 1). The mean body weights of *C. nama, P. lala*, and *P. ranga* were 1.75±0.61g, 0.55±0.16g and 0.88±0.31g, respectively, while their mean total lengths were 5.50±0.68cm, 3.18±0.28cm, 3.71±0.42 cm. According to the percentage of TL, the head length and body depth of *P. lala* were higher (26.35% and 41.59%) than others. However, we discovered that the body depth of *P. ranga* was larger (1.51 cm) than that of other species. The fin formula was: D. 22–24 (VIII/14–16); P_1. 10–12 (2/8–10); P_2. 6 (I/5); A. 18–20 (III/15–17); C. 22–24 (4/18–20) for *C. nama*, D. 20–22 (VIII/12–14); P_1. 8–9 (2/5–7); P_2. 6 (I/5); A. 16–18 (III/13–15); C. 20–22 (4/16–18) for *P. lala* and D. 20–22 (VIII/12–14); P_1. 10–11 (2/8–9); P_2. 6 (I/5); A. 17–20 (III/14–17); C. 22–24 (4/18–20) for *P. ranga*.

In the present study, the computational length-length relationship showed that *C. nama, P. lala,* and *P. ranga* seemed to have the highest coefficient of correlation values (r) for TL and SL, including values of 0.94, 0.99, and 0.99, respectively (Table 2). Corresponding to this, for BW-TL and BW-SL

Table 3. Estimated parameters of the length-weight relationships.

Species	n	Regression parameters							
		Equation	a	b	95% CI of a		95% CI of b		r
					L_{CI}	U_{CI}	L_{CI}	U_{CI}	
C. nama		BW = a + b × TL	-3.78	2.52*	-4.17	-3.40	2.29	2.74	0.84
		BW = a + b × FL	-3.28	2.40*	-3.62	-2.93	2.18	2.62	0.84
	200	BW = a + b × SL	-3.08	2.43*	-3.40	-2.75	2.21	2.65	0.84
		BW = a + b × HL	0.03	1.94*	-0.04	0.09	1.71	2.18	0.76
		BW = a + b × BD	-0.15	2.25*	-0.20	-0.10	2.09	2.41	0.89
		BW = a + b × MG	0.79	1.44*	0.73	0.85	1.22	1.66	0.68
P. lala		BW = a + b × TL	-4.12	3.03	-4.24	-4.02	2.93	3.13	0.97
		BW = a + b × FL	-3.69	2.91	-3.82	-3.57	2.80	3.03	0.96
	200	BW = a + b × SL	-3.36	3.03	-3.46	-3.27	2.93	3.13	0.97
		BW = a + b × HL	-0.04	3.24*	-0.07	-0.02	3.10	3.38	0.96
		BW = a + b × BD	-1.25	2.29*	-1.28	-1.23	2.19	2.39	0.96
		BW = a + b × MG	-0.15	0.51*	-0.30	-0.01	0.35	0.66	0.42
P. ranga		BW = a + b × TL	-4.28	3.14*	-4.40	-4.17	3.05	3.22	0.98
		BW = a + b × FL	-3.87	3.05	-3.99	-3.74	2.94	3.15	0.97
	200	BW = a + b × SL	-3.41	3.05	-3.51	-3.31	2.96	3.15	0.98
		BW = a + b × HL	0.05	3.60*	0.04	0.07	3.47	3.72	0.97
		BW = a + b × BD	-1.27	2.70*	-1.30	-1.24	2.63	2.78	0.98
		BW = a + b × MG	1.93	2.49*	1.71	2.15	2.23	2.76	0.80

Asterisk (*) for the b values indicate significant differences at 95% confidence interval (alpha=0.05) from theoretical b=3.

in context of *P. lala*, the highest r value (0.97) was discovered. Besides that, BW-TL was found to have the highest r value (0.98) in *P. ranga* (Table 3). All of these values demonstrated a strong positive association. The final '*b*' values for TL and BW were recorded at 2.52, 3.03 and 3.14 for *C. nama*, *P. lala* and *P. ranga*, respectively (Table 3). In our research, both the allometric condition factor and Fulton's condition factor for three species were estimated. The values of the allometric condition factor were 2.31, 1.57 and 1.40 as well as values for Fulton's condition factor of 1.03, 1.63 and 1.66 for *C. nama, P. lala,* and *P. ranga* respectively (Table 4).

In particular, the length-length relationships throughout all three fish species revealed a more substantial positive correlation than the length-weight relationship (Tables 2 and 3). Slope divergence can be related to sample number deviation, stage of life variability, and atmospheric variables (Froese 2006).

DISCUSSION

The regulation and effective use of fishery resources depend on length-weight relationship measurements. The present study revealed that standard morphometric trends of those fish species from 'Chalan' Beel were dissimilar than those of other studies (Hossen et al. 2020; Sheikh et al. 2017) due to habitat and environmental condition. The meristic attributes of an organism are established during its early embryonic development and remain constant throughout its lifespan. Therefore, they do not undergo any alterations (Mitu et al. 2019).

According to Wootton (1998), positive allometric growth transpires when the weight of an organism increases at a greater rate than its length ($b>3$), whereas negative allometric growth transpires when the length of an organism increases at a greater rate than its weight ($b<3$). Despite various influential factors such as sex, health condition, gonad maturation, and age, as well as external factors like seasonality, habitat, geographic region, sample size, and collection and preservation process, the parameter '*b*' for the length-weight relationship (LWRs) fell within the suggested range of 2.5-3.5 (Froese 2006; Zamani et al. 2015; Keivany et al. 2016; Sheikh & Ahmed 2019; Hossen et al. 2020) indicating negative allometric growth for *C. nama*, isometric growth for

P. lala and positive allometric growth for *P. ranga* considering pooled sex. A condition factor exceeding one indicated a healthy state of fish across diverse environmental circumstances (Zamani et al. 2015; Ahmadi 2021). The findings of this study indicate that the condition factors of the examined fish specimens in the 'Chalan Beel' ecosystem were indicative of favorable health conditions. It is recommended to undertake further investigation utilizing samples of varying magnitudes. To date, our findings provide valuable insights for further investigation and the effective administration of fisheries resources in the 'Chalan Beel' region.

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مقاله کامل

پارامترهای مورفو-مریستیک، رابطه طول و وزن و شاخص وضعیت سه گونه شیشه‌ماهی از تالاب چالان، بنگلادش

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گروه شیلات و علوم دریایی، دانشکده علوم، دانشگاه علوم و فناوری نوخالی، نوخالی ۳۸۱۴، بنگلادش.

چکیده:

در زیست‌شناسی ماهی، رابطه طول-وزن و شاخص‌های وضعیت برای تعیین سلامت فردی و تغییرات بالقوه در بین ذخایر همان گونه مهم هستند. روابط طول-طول، طول-وزن، ویژگی‌های مورفو-مریستیک و شاخص وضعیت برای سه گونه بومی کوچک (*Chanda nama*، *Parambassis lala* و *Parambassis ranga*) به‌طور برابر مجموعاً ۶۰۰ قطعه جمع‌آوری‌شده از جولای ۲۰۲۰ تا دسامبر ۲۰۲۰ در تالاب چالان با استفاده از یک تورگوشگیر (اندازه چشمه توری ۰/۵ تا ۱ سانتی‌متر) گزارش شد. وزن بدن با دقت ۰/۰۱ گرم و طول با دقت ۰/۱ سانتی‌متر تعیین شد. میانگین وزن بدن گونه *C. nama*، *P. lala* و *P. ranga* به‌ترتیب به‌صورت ۱/۷۵±۰/۶۱، ۰/۵۵±۰/۱۶ و ۰/۸۸±۰/۳۱ گرم محاسبه و میانگین طول کل آن‌ها ۵/۵±۰/۶۸، ۳/۱۸±۰/۲۸ و ۰/۸۸±۰/۳۱ سانتی‌متر برآورد شد. صفات مورفومتریک و مریستیک استاندارد در هر سه گونه مورد مطالعه یافت شد و رابطه قوی بین طول و وزن ($P<0/05$) مشاهده شد. مقادیر "b" نهایی براساس طول کل و ورن کل به‌ترتیب ۲/۲۵۲، ۳/۰۳ و ۳/۱۴ برای *C. nama*، *P. lala* و *P. ranga* ثبت شد که نشان‌دهنده رشد آلومتریک منفی برای *C. nama*، رشد ایزومتریک برای *P. lala* و رشد آلومتریک مثبت برای *P. ranga* است. علاوه بر این، شاخص وضعیت (<۱) نشان داد که این گونه‌ها در زیستگاه‌های طبیعی خود در شرایط عالی قرار دارند. مشاهدات حاضر ابزار مؤثری در راستای شناسایی این گونه‌های ماهی در محیط‌های آبی مختلف در سراسر بنگلادش و مناطق مجاور خواهد بود و مدیریت و حفاظت بهینه آن‌ها را ممکن می‌سازد.

کلمات‌کلیدی: رشد آلومتریک، رشد ایزومتریک، ضریب همبستگی، رابطه طول و وزن.