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Short Communication

Length-Weight Relationship of Fingerlings of *Channa stewartii* (Family: Channidae) Reared under Captive Condition

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Abstract: The present study deals with length-weight relationships (LWRs) of fingerlings of *Channa stewartii* (Playfair, 1867) reared under captive conditions in concrete tanks. LWRs analysis revealed negative allometric growth (b=2.78) which was within the expected range of 2.5-3.5. The observed b value indicated a negative relationship between fish condition and its length. High coefficient of determination (r^2=0.96) depicted a strong relationship between length and weight species. Results drawn from the current study further enhances our knowledge on overall biology of the fish that may prove beneficial in their management and conservation in near future.
Key words: allometric growth, captive conditions, expected range, *Channa stewartii*, length-weight relationship

Introduction

Information on fish growth is necessary for management and conservation of fishery resources (Froese *et al.*, 2014). In fishes the basic growth patterns are analyzed through length-weight relationships (LWRs) and length-length relationships (LLRs) that indicate their status in an environment and growth pattern (Kharat *et al.*, 2008). LWRs studies are considered as standard practice in fish biology to determine biological information on fish biomass, general condition, growth, feeding biology, nutritional composition, gonad development and ecology (Hile, 1906; Heincke, 1908; Carlander, 1969; Bolger and Connolly, 1989; Petrakis and Stergiou, 1995; Froese, 2006). These studies are carried out for establishing relationships between length and weight as well as to assess variations from expected weight from single individual length or relevant groups to indicate general well being, gonad development etc. (Le Cren, 1951). Due to the rapidity and accuracy in measurement of fish length than its weight, they are often used to predict fish weight from known lengths through back calculations (Le Cren, 1951). Relationships between length and weight in fishes are expressed through logarithmic linear regression, Log W=log a+ b log L (Froese, 2006). Fishes having same length-weight relationships often lies on a straight line with some scatter plots due to individual size variations that make it possible to observe changes in growth parameters (Le Cren, 1951). On the basis of regression slope, the growth of fish is said to be negative allometry or hypoallometric when b<3, positive allometry or hyperallometric when b>3 or isometric when b=3 (Froese *et al.*, 2011). Scrutinies on deviations of observed b values from expected values and their contributing factors can throw light on species biology and wellbeing in fishes (Ali *et al.*, 2013).

Channa stewartii is an important ornamental and food fish endemic to Brahmaputra basin of India and southern Nepal (Playfair, 1867; Talwar and Jhingran, 1991; Borah *et al.*, 2018; Kalita *et al.*, 2018). They are mostly caught from wild and exported as ornamental fish from India. Due to rampant

collection and trade from natural stocks, there is dearth of information regarding their health and harvest (Raghavan *et al*., 2013). LWRs in this regard can provide pivotal information on their general health and wellbeing of the fishes. Barring a few reports on their biology and taxonomy (Vishwanath and Geetakumari, 2009; Lakra *et al*., 2010; Borah *et al*., 2018; Kalita *et al*., 2018), paucity of knowledge still persists. Information available on this species is mainly on large sized specimens which do not reflect their entire population dynamics. It is observed that inferences drawn from older commercial sized fishes show deviation from expected parameters due to sampling variability (Safran, 1992). Such ambiguity in estimating growth of fishes may lead to inconclusive interpretation of population dynamics. Taking all these into consideration, the current investigation was undertaken to understand the growth pattern *C. stewartii* fingerlings reared under captive conditions. Inferences drawn may provide vital information on their biology, especially to aquaculturist and traders which may be useful in better management as well as conservation of the species in future.

Materials and methods

1. Captive breeding and rearing: Captive breeding of *C. stewartii* was carried out in Dibrugarh University premises, Assam, during Oct 2018 to July 2019 through habitat manipulation. A pair of *C. stewartii* brooders was stocked in a cemented tank with $120\times60\times80cm$ dimensions and reared. Conditions were created to simulate their natural habitat by providing appropriate substratum and hiding habitats. Different aquatic plants such as *Ceratophyllum*, *Eichhornia, Lemna, Ludwigia* etc. were also planted to simulate the natural environment for the fishes. The brooders were fed with live feeds (earthworms, small fishes) twice daily until successful breeding. Different physico-chemical properties of water (dissolved oxygen, alkalinity, hardness, pH, temperature etc.) were regularly monitored following APHA (1985). After successful breeding, the brooders were removed and the larvae were left until their yolk sac dissolved. The larvae were then fed with infusoria for 10 more days. On reaching the fry stage, they were transferred to another concrete tank of same size and acclimatized with live feed such as mosquito larva, chironomus larva etc. which was fed twice on daily basis to monitor their growth pattern. For standardization, 100 fries were randomly selected to monitor their survival rate. Prior to their release, initial fish length and weight (fry stage) were recorded and feeding trials was conducted thereafter for 45 days. After completion of trial period, the length and weight of fishes (fingerlings) were measured to establish length-weight relationship. A total 78 surviving fingerling specimens of *C. stewartii* were collected from rearing tanks and measured to the nearest length (0.1 cm) and weight (0.1g) using digital vernier calliper and precision electronic balance respectively. Specimens were measured in live condition and strict catch and release policy was maintained throughout the experiment.

Survival rate $(\%)=\frac{Number\ of\ fish\ at\ the\ end\ of\ the\ experiment}{Number\ of\ fish\ at\ the\ beginning\ of\ the\ experiment}\times100$

2. Length-weight relationship : Analysis of length-weight relationships was performed using log converted linear regression following Froese (2006):-

$\log W=\log a+ b \log L$

Where W= fish weight in g; L= total length in cm; a = regression intercept and b = regression slope and growth parameter.

Results

Physico-chemical properties of water and survival rate maintained during rearing were recorded and are presented in Table 1. 78% survival rate was observed during the experimentation period. Mean length and weight of studied samples were 4.16±0.78 cm and 0.64±0.37 g respectively. LWRs analysis revealed negative allometric growth (b=2.78) in *C. stewartii* fingerlings as the observed b value was lower than the isometric value of 3. The descriptive statistics on length-weight relationship including sample size (n), minimum and maximum total length, minimum and maximum body weight, regression parameters 'a' and 'b', their 95% confidence limits (CL), and the coefficient of determination (r^2) were also determined and are depicted in Table 2. LWRs studies between total length and fish weight revealed a linear and significant relationship at 95% confidence level ($p \leq 0.05$). High coefficient

Table 1. Water quality parameters and survival rate during the experimentation period.

Experimental set up	Water parameters					Survival Rate (%)
Concrete tank	pH	Temperature (°C)	Dissolved oxygen (mg/L)	Alkalinity (mg/L)	Hardness (mg/L)	
	6.8-7.2	19-25	5.6-5.9	69-71	25-28	78

Table 2. Descriptive statistics and estimated length-weight relationships parameters of fingerlings of *Channa stewartii* reared under captive conditions.

		TL (cm)		BW (g)		Regression parameters				
Species	*n*	Min	Max	Min	Max	*a*	95%CL of *a*	*b*	95%CL of *b*	*r*2
C. stewartii	78	2.7	6.96	0.15	2.22	-1.9548	-2.0328 - -1.8768	2.784	2.6587-2.9111	0.96

Note: *n*: sample size; TL: Total length; BW: body weight; Min: minimum; Max: maximum; *a*: intercept; *b*: slope; CL: confidence intervals; r^2: coefficient of determination.

of determination (r^2=0.96) was observed that indicated a strong relationship between length and weight.

Discussion

The present investigation on LWRs of fingerlings of *C. stewartii* revealed negative allometric growth (Table 2). The observed *b* value (*b*=2.78) was less than the isometric value (*b*=3) but within the expected range of 2.5–3.5 suggested by Carlander (1969). In this regard, Le Cren (1951) had suggested that even though for an ideal fish maintaining same shape, *b*=3 (isometric growth), the *b* value often shows deviation from assumed theoretical value i.e. b '" 3. Safran (1992) and Lleonart *et al.* (2000) later suggested allometric model to be most suitable to describe fish morphometrics. Earlier studies on LWRs of *C. stewartii* by Borah *et al.* (2018) and Kalita *et al.* (2018) had also revealed negative allometry with variations in growth slope (*b* value 2.91 and 2.78 respectively). However, in those studies (Borah *et al.*, 2018; Kalita *et al.*, 2018); inferences were drawn from large specimens contrary to the present investigation where only fingerlings were considered. In this regard, many authors had suggested differences size groups or growth stanzas as a contributing factor in observed variation in growth parameter (Le Cren, 1951; Froese, 2006). Moreover, previous LWRs studies on *C. stewartii* (Borah *et al.*, 2018; Kalita *et al.*, 2018) were performed on wild caught specimens from different geographical locations and habitats. But in the current study, the findings were drawn from

Fig. 1. A photograph of *C. stewartii* at the start of experiment.

Fig. 2. Rearing of *C. stewartii* fries in captive conditions.

Fig 3: A sample photograph of *C. stewartii* fingerling used for estimating length-weight relationships.

specimens reared in captivity which may have resulted in different growth pattern as compared to earlier studies. In conformity to this notion, Froese, (2006) Moutopoulos and

Stergiou (2002) had earlier reported on the influence of differences in seasons, habitats, sex, stomach fullness, preservation methods or health etc. on variations in growth parameters. Apart from these factors, another factor that might have played important role in observed variations is stocking density since specimens were collected from concrete cemented tanks for the present investigation. A host of published reports suggest negative impact of stocking densities on growth rate especially on small sized fishes (Refstie and Kittelsen, 1976; Danielssen and Hjertnes, 1991; Zoccarato *et al.*, 1993; Irwin *et al.*, 1999).

LWR studies are also used to understand the fish condition (*K*) or their general wellness (Tesch, 1968). Earlier Hile (1936) had interpreted the deviation of exponent *b* from threshold value of 3 to indicate the direction and change in fish condition. When $b<3$ there exists a significant negative relationship between *K* and fish length where decrease in *K* occurs with increasing length. Similarly, a positive relationship between *K* and fish length exists when $b>3$ indicating increased *K* with increasing length (Cone, 1989). Findings of our present investigation revealed negative allometry in *C. stewartii* i.e. $b<3$ that highlighted negative relationship between fish's condition and total length. This may be due to the fact that samples used in the present investigation were all fingerling specimens. Fulton (1904) in this regard had earlier noted that fishes tend to grow in length in greater ratio than other dimensions during their early stages. Later, Froese (2006) reported that variation in mean condition as well as differences in small and large specimens, habitats, seasons etc. results in different length-weight relationship. Our results are in adherence to this notion as variation in length weight relationship was observed between present investigation and earlier reports.

Conclusion

The present study provides new information on LWRs of *C. stewartii* that further expands our knowledge on overall biological information of the species. Comparison of growth parameters of LWRs studies of fingerlings with larger specimens of earlier studies showed similar trends (i.e. negative allometry) in growth pattern. The study provides some baseline data on growth parameter of fingerlings of *C. stewartii* that may support future culture and management prospects to meet the requisite demand in food and ornamental fish trade.

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