

MARSH BULLETIN

Comparison of length-weight relationship and condition factor of redbelly tilapia *Coptodon zillii* (Gervais, 1848) from three different locations in Basra, Southern Iraq

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ABSTRACT

Current study was conducted in three locations, the first was floating fish cages, the second was fish earthen pond and the third was Shatt Al-Arab River north Basra Governorate at Hartha District. A total number of 266 fresh redbelly tilapia (*Coptodon zillii*) fishes were collected from the locations using different nets i.e. hand net in the first location and cast net in the second and third locations. The fishes transported to the laboratory of Aquaculture Unit in boxes with crushed ice. Samples were taken from 1/4/2017 to 1/10/2017. Water temperature during sampling period ranged between 17 to 31 °C and salinity between 1.1 to 3.2 ppt. The number of examined fish was 97, 92 and 77 from cages, pond and wild fish respectively. The mean fish total length varied between (16.60, 14.19 and 12.78) cm and weight varied between (109.42, 60.05 and 49.12) g for cages, pond and wild fish respectively. No fish recorded less than 5 cm or more than 25 cm. The values of the exponent 'b' in the length–weight relationship varied between 3.1655, 2.9596 and 2.9978 for cages, pond and wild fish respectively. In this study, *C. zillii* showed to undergo positive allometric growth ($b > 3$) in cages but the pond and wild fish exhibited negative allometric pattern of growth ($b < 3$). Modified condition factor values ranged between 1.34 to 2.04 for cage and wild fish respectively, relative condition factor values were 1.00, 1.00 and 1.01 for cage, wild and pond fish respectively, while Fulton's condition factor values ranged between 1.76 to 2.13 for pond and cage fish respectively. The statistical analysis showed that there were significant differences ($P < 0.01$) in "K" values between the three locations considering modified and Fulton's condition factors, while no such significant differences ($P > 0.01$) found in relative condition factor.

Keywords: Length-weight relationship, Condition factor, Redbelly tilapia, *Coptodon zillii*

Introduction

Tilapia is a common name given to group of fishes within the family Cichlidae (order Perciformes) (Altun *et al.*, 2006).

Tilapias have 1524 species (Eli, 2005); however, Fishbase listed 1699 species according to Eschmeyer *et al.* (2017). Species wise, the fish family Cichlidae is

considered among the richest teleost's families species (Jawad *et al.*, 2018a). Many species of tilapia introduced into many countries for aquaculture. These fishes are at present widespread in water bodies of several tropical and subtropical countries, where they have been cultured (Altun *et al.*, 2006). Currently, tilapia farmed at least in 85 countries that makes it the most widely farmed finfish worldwide and second in volume only to carps (FAO, 2006). Redbelly tilapia *Coptodon zillii* native to Africa, it now has been widely distributed in the Americas, Europe, Australia, and Asia (Froese and Pauly, 2017). Coad (1998) recorded *C. zillii* in Iran and Altun *et al.* (2006) recorded it in Turkey. In the Middle East, it has been reported from Egypt, Jordan, and Lebanon as a native fish and from Saudi Arabia, Syria, Iran and Iraq as an introduced fish (Job, 1967; Mutlak and Al-Faisal, 2009; Khaefi *et al.*, 2014; Froese and Pauly, 2017).

Al-Faisal *et al.* (2014) reported 12 species belong to five families (Cichlidae, Cyprinidae, Heteropneustidae, Pangasiidae and Poeciliidae) as exotic species of fishes were introduced to Iraq for improving local fishery potential and for broadening species diversity in aquaculture programs, whereas control of malaria, research, aquaculture, sport fishing, intentional release of ornamental fishes by local people, and accidental introductions have been the main reasons for these introductions in Iran (Coad, 1996; Esmaili *et al.*, 2010). Saleh (2007) first recorded *C. zillii* in Iraq at Musayib, and mentioned that this species has spread widely and rapidly in Iraqi aquatic environment, especially in the

central regions. Some of the local studies have examined the life and classification of tilapia, which has been found in some of Iraqi water bodies. Three species of tilapia have been recorded in Iraqi waters: *Coptodon zillii*, *Oreochromis aureus*, *Oreochromis niloticus* (Saleh, 2007; Abu Al-Hani *et al.*, 2015; AL-Zaidy, 2013). Mutlak and Al-Faisal (2009) recorded two cichlids *O. aureus* and *C. zillii* from the south of the main outfall drain in Basra City. Jawad *et al.* (2018b) concluded that *C. zillii* is most common tilapia and the southernmost occurrence of it is Abu al-Khaseeb City, south of Basrah, which represents the northern edge of Shatt al-Arab River Estuary.

The external characters like length-weight relationship and condition factors are important tools to study the biology of fishes (Lizama *et al.*, 2002). These used to predict weight from the proportion of length in a certain time (Pauly, 1993). Fish might show different growth patterns in relation to many factors such as water quality, nutrition, habitat, density, sex and time of life stages (Ali *et al.*, 2000). Thus, length-weight relationship and condition factor are also important parameters for evaluating the health condition (Nehemia *et al.*, 2012; Mortuza and Al-Misned, 2013). However Jawad *et al.* (2018b) demonstrate that in Iraq, there is lack of data on the morphological diversities of tilapia species in general and *C. zillii* and *O. aureus* in particular.

The present study aims to provide information concerning the length-weight relationship and condition factor for *C. zillii*

in three different locations of Basra Governorate.

Materials and Methods

Study locations

The study was conducted in three locations, the first one was floating fish cages where thirteen floating cages with dimensions of 3×4 meters and net depths was 3 meters (2 meters under water surface), these cages located in Shatt Al-Arab River bank at Al-Hartha District (Picture, 1). The second was fish earthen pond about 10000 square meters surface area at the same location. This pond was cultivated with six thousands common carp (*Cyprinus carpio*), five hundreds of silver carp (*Hypophthalmichthys molitrix*) and seven hundreds of grass carp (*Ctenopharyngodon idella*). In addition, the third was Shatt Al-Arab River north Basra Governorate opposite of floating cages location. The first and second locations used for carp culture as manufactured fish diet was used in the first location and natural food was the only source of food in the second one. Redbelly tilapia entered to these carp culture sites as untargeted culture species.

Sample collection

A total number of 266 fresh Redbelly tilapia fishes were collected from the three locations using different nets i.e. hand net in the first location and cast net in the second and third locations. The fishes transported to the laboratory of Aquaculture Unit in boxes with crushed ice. Samples were tank from 1/4/2017 to 1/10/2017. The fish were serially numbered and the total length (TL) taken from the tip of the head to the tip of the tail using a meter rule in centimeters. The total body weights measured by using a sensitive electrical balance to the nearest 0.1gram. The water temperature during sampling period ranged between 17 to 31 °C and salinity between 1.1 to 3.2 ppt.

Data Analysis

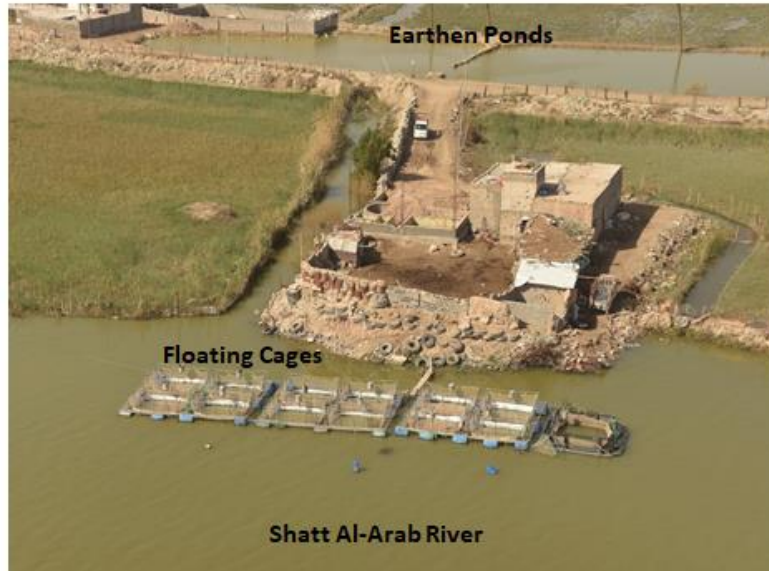
Length-Weight Relationship: The relationship analyzed by using the equation: $W = aL^b$ (Pauly, 1983).

Where by W= weight of fish in gram

L= Length of fish in cm

a = describe the rate of change of weight with length (intercept)

b = weight at unit length (slope)



Picture (1) Three study locations.

When b is equal to three (3), isometric pattern of growth occurs but when b is not equal to 3, allometric pattern of growth occurs, which may be positive if >3 or negative if <3 .

Condition Factor

The condition factor (k) of the Redbelly tilapia fish estimated from three locations using these relationships:

1- Fulton's condition factor, the value of K was calculated following Froese (2006):

$$K_3 = 100 w/L^3$$

2- Modified condition factor (Ricker, 1975) was estimated following Gomiero and Braga (2005):

$$K_b = 100 w/L^b$$

3- Relative condition factor 'Kn' (Le Cren, 1951) was estimated following Sheikh *et al.* (2017)

$$Kn = W / \wedge w$$

Where

W = the actual total weight of the fish in grams.

$\wedge w$ = the expected weigh from length-weight equation formula.

L = the total length of the fish in centimeters.

b = the value obtained from the length-weight equation formula.

Statistical analysis

The analysis of covariance performed to determine variation in 'b' values for each species following method of Snedecor and Cochran (1967). The statistical significance of the isometric exponent (b) was analyzed by a function: $t_s = (b-3) / S_b$ (Sokal and Rohlf, 1987), where it is the 't' student statistics test value, 'b' is the slope and S_b is the standard error of 'b'. The comparison between obtained values of t-test and the respective critical values allowed the determination of the 'b' values statistically significant and their inclusion in the isometric range ($b=3$) or allometric range (negative allometric; $b<3$) (Nehemia *et al.*, 2012). Statistical software SPSS IBM (23) and Excel 2013 were used for analyzing the data.

Results

Length-Weight Relationship

The data on length and weight of *C. zillii* from three locations are shown in Table (1), the number of examined fish was 97, 92 and 77 from cages, pond and wild fish respectively, the mean length varied between 16.60, 14.19 and 12.78 cm and weight varied between 109.42, 60.05 and 49.12 g for cages, pond and wild fish respectively. Figure (1) presented the length frequency of *C. zillii* in all three locations; the most represented length groups is between 11 to 20 cm, no fish recorded less than 5 cm or more than 25 cm, however wild fish exhibit corresponding lengths between 6 to 20 cm.

The length-weight relationships of *C. zillii*, from the three locations are presented in Table (2) and Figure (1). The values of the exponent 'b' in the relationship varied between 3.1655, 2.9596 and 2.9978 for cages, pond and wild fish respectively. In this study, *C. zillii* showed to undergo positive allometric growth ($b > 3$) in cages.

However, the pond and wild fish exhibited negative allometric pattern of growth ($b < 3$), but the value was close to 3 in all locations and there is no significant difference ($P < 0.01$) between b value and the cube value in all locations, this indicates that *T. zillii* follow isometric growth. R^2 values estimated in all three cases were very close to 1, which were significant in all locations ($P < 0.05$) with R^2 values > 0.90 .

Condition factor

Modified condition factor for *C. zillii* are shown in Table (3), it is ranged between 1.34 to 2.04 for cage and wild fish respectively. Relative condition factor values ranged between 1 to 1.01 for cage, wild and pond fish respectively, while fulton's condition factor values ranged between 1.76 to 2.13 for pond and cage fish respectively. The statistical analysis showed that there were significant differences ($P < 0.01$) in "K" values between the three locations considering Modified and Fulton's condition factors, while no such significant differences ($P > 0.01$) found in Relative condition factor.

Table (1) Data on length and weight of *Coptodon zillii* from three locations.

Location	Fish number	Length range (cm)	Weight range (g)	Mean length (cm)	Mean Weight (g)
Cages	97	10.0 - 23.5	20.00 – 291.00	16.60 ± 3.10	109.42± 64.74
Pond	92	8.7 - 25.0	10.01 - 285.34	14.19 ± 3.55	60.05± 50.32
Wild	77	8.8 - 19.5	13.32 - 138.49	12.78 ± 3.47	49.12 ± 38.68
Total	266	8.7 – 25.0	10.1 – 291.00	14.66 ± 3.71	74.96 ± 59.50

Table (2) Equation parameters of Length-weight for *Coptodon zillii* from three locations.

Site	b	a	R ²	t value (calculated)	Significance of t
Cages	3.1655	0.0134	0.92	0.382	Not significant
Pond	2.9596	0.0194	0.97	-0.137	Not significant
Wild	2.9781	0.0203	0.98	-0.1038	Not significant

Table (3) Condition factor of *Coptodon zillii* from three locations.

Location	Condition factors			Mean
	Modified condition factor K= 100 W/ L ^b	Relative condition factor Kn= 100 W/ W [^]	Fulton's condition factor K= 100 W/ L ³	
Cages	1.34 ± 0.12	1.00 ± 0.09	2.13 ± 0.20	1.49
Pond	1.96 ± 0.25	1.01 ± 0.13	1.76 ± 0.22	1.58
Wild	2.04 ± 0.17	1.00 ± 0.08	1.93 ± 0.16	1.66
Mean	1.78	1.00	1.94	1.57

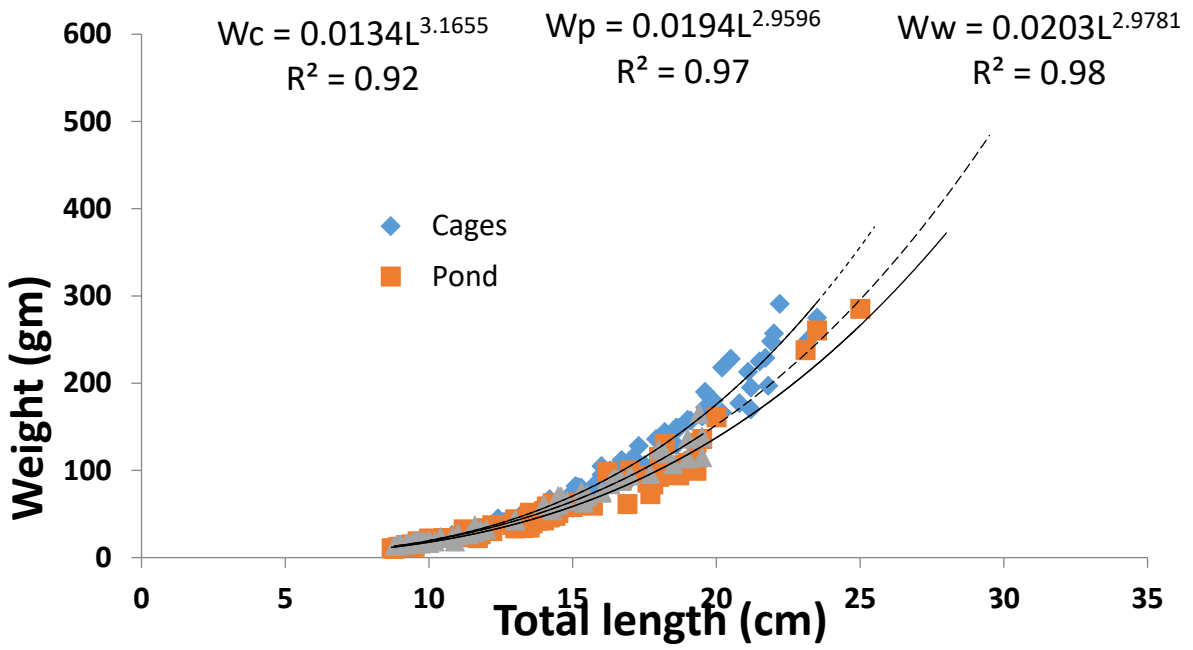


Figure (1) Exponential growth curve of *Coptodon zillii* from three locations.

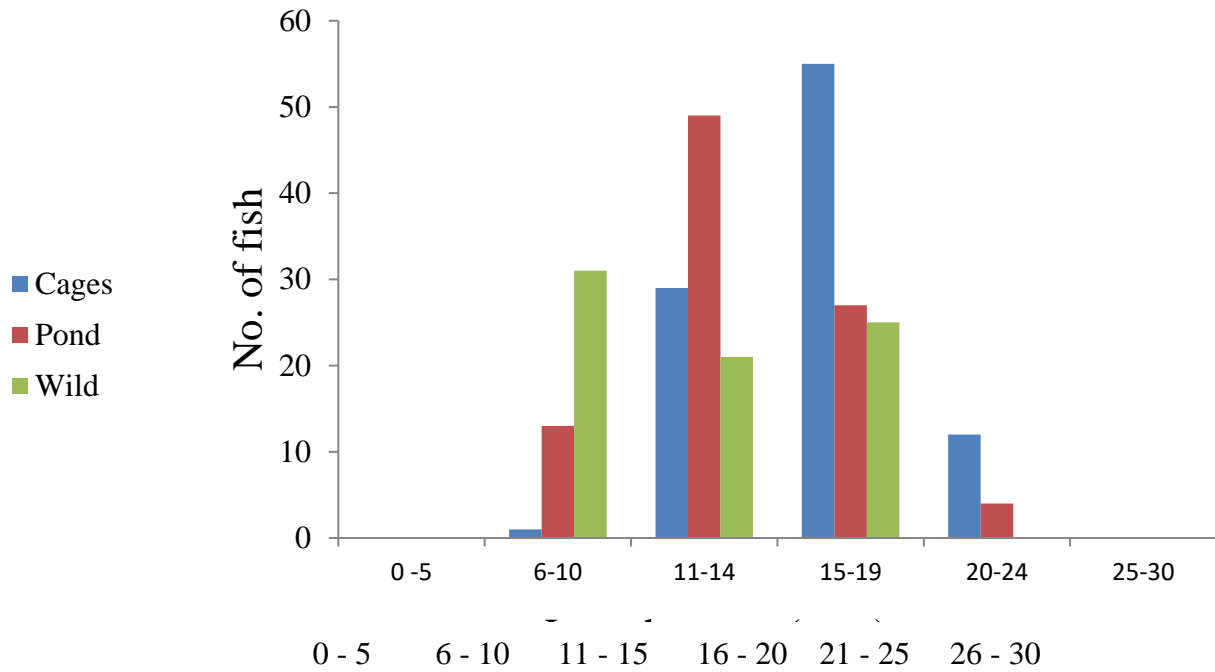


Figure (2) Length frequency of *Coptodon zillii* from three locations.

Discussion

Length–weight relationship

The length–weight relationship is important in fisheries management for comparative growth studies (Moutopoulos and Stergiou, 2002). Also this relationship provides valuable information on the habitat where the fish lives and in modeling aquatic ecosystems (Pauly, 1993; Kulbicki *et al.*, 2005). The result of the present study showed that growth of the *C. zillii* from three locations was allisometric. This means that this fish grow symmetrically. The *b* values in length-weight relationships determine the growth pattern of *C. zillii*. When *b* is equal to 3 or close to 3, growth in the fish be isometric fish becomes more full-bodied with increasing length (Bagenal and Tesch, 1978), but when *b* is extreme less or greater than 3, growth in the fish is allometric, where the fish becomes thinner with increase in length (King, 1996). Dan-Kishiya (2013) recorded negatively allometric *b* value (2.2 – 2.3) for this species in tropical water supply reservoir in Nigeria, while it showed to undergo positive allometric growth at 35 salinity with value of ‘*b*’ being 3.3 and undergo negative allometric growth in fresh water with a ‘*b*’ value of 2.94 (Nehemia *et al.*, 2012). Ajagbe *et al.* (2016) pointed that the growth pattern of tilapia in the Lake Asejire, Nigeria was negative allometric, while Kalu *et al.* (2007) recorded both negative allometric and isometric growth patterns of tilapia in two different locations.

Although in the present study no significant differences ($P > 0.01$) among *b* values in the three locations, the *C. zillii* recorded high weight in cages and pond

compared with wild fish. These difference could not attributed to differences in ecological condition since all locations within the same site, but the main difference could be associated with nutritional and compositional causes. In the case of cages large common carp give little appetite to tilapia to satisfy their feeding needs from artificial food along with the absence of natural food, other fish species entered these cages such as *Poecilia latipinna*, *Carassius gibelio*, *Acanthopagrus arabicus*, *Tenualosa ilisha*, *Acanthopagrus marmid*, *Thryssa mystax* and one species of shrimp, *Macrobrachium nipponense*. The *b*-values recorded of tilapia for all locations in the present study is within the documented range values of 2.5 to 3.5 for tropical fish species (Gayannilo and Pauly, 1997).

Condition factor

Le Cren (1951) proposed the relative condition factor in preference to condition factor as the latter is influenced by many environmental and biological factors. Condition factor also gives information when comparing two populations living in certain feeding, density, climate and other conditions (Lizama *et al.*, 2002). The relationship of length-weight can be use in the estimation of condition factor (*K*) of fish species. In fisheries science, the condition factor is used in order to compare the condition, fatness or wellbeing of fish (Ahmed *et al.*, 2011). It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Bagenal and Tesch, 1978).

Condition factor is also a useful index for monitoring of feeding intensity, age and growth rates in fish (Ndimele *et al.*, 2010). It is strongly influenced by both biotic and abiotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which fish live (Anene, 2005). In the present study the condition factor of *C. zilli* recorded with different formula had a range of 1.00 to 2.13. These values within the recorded data of the same species which was 1.96 – 3.40 (Mosaad, 1990; Ibrahim *et al.*, 2008; Dan-Kishiya, 2013; Iyabo, 2015). While Nehemia *et al.* (2012) documented values less than one with 'K' values of 0.74 and 0.53 in full strength seawater and more than 1 (2.74) in fresh water. The 'K' value recorded in fresh water by Anene (2005) was 4.3. These differences in "K" values may be due to different ecological conditions especially salinity and temperature. Although tilapia in fish cages recorded the highest weight, the wild fish had the highest condition factor value. This could be related to small fish size in the wild samples as Perçin & Akyol, (2009) suggested that health problems in large fish may reduce K values. Decreased K values of large fish were also found in study of Jin *et al.* (2015). Lizama *et al.* (2002) stated a general rule, the highest values of the condition factor occur in the lowest lengths, or rather, in the juvenile classes.

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مقارنة علاقة الطول بالوزن ومعامل الحالة لأسماك البلطي الزيلي (*Coptodon zillii*, Gervais 1848) من ثلاث مواقع مختلفة في محافظة البصرة، جنوب العراق

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المستخلص

اجريت الدراسة الحالية في ثلاثة مواقع وهي الاقفاص العائمة والاحواض الترابية وشط العرب في ناحية الهارثة شمال محافظة البصرة. جمعت 266 فرد من اسماك البلطي الزيلي (*Coptodon zillii*) باستخدام الشبكة اليدوية في موقع الاقفاص العائمة وباستخدام شبكة السلية في الموقعين الآخرين وللفترة من 1-4-2017 لغاية 1-10-2017، ونقلت الاسماك الى مختبر وحدة الاستزراع المائي في كلية الزراعة بحاويات فليينية مزودة بالتلج المجروش. تراوحت درجة حرارة خلال فترة جمع العينات بين 17-31⁰م والملوحة بين 1.1-3.2 جزء بالألف. بلغ عدد الاسماك المفحوصة 97 و92 و77 من الاقفاص والاحواض وشط العرب بالتعاقب. تراوح معدل الطول الكلي للأسماك (16.60 و14.19 و12.78) سم ومعدل الوزن (109.42 و60.05 و49.12) غم للأقفاص العائمة والاحواض الترابية وشط العرب بالتعاقب، ولم تسجل اطوال اقل من 5 سم واكثر من 25 سم. ان قيمة الثابت b في معادلة الطول والوزن تراوحت بين 3.1655 و2.9596 و2.9978 للأقفاص والاحواض وشط العرب بالتعاقب. اثبتت نتائج التجربة ان اسماك الاقفاص العائمة اظهرت نمو غير متناظر موجب (3 > b)، بينما اظهرت اسماك الاحواض وشط العرب نمو غير متناظر سالب (3 < b). بلغت قيم معامل الحالة المحور 1.34 و2.04 لأسماك الاقفاص وشط العرب بالتعاقب وبلغت قيم معامل الحالة النسبي 1.00 و1.00 و1.01 لأسماك الاقفاص وشط العرب والاحواض بالتعاقب، بينما بلغت قيم معامل حالة فولتن بين 1.76 و2.13 لأسماك الاحواض والاقفاص بالتعاقب. اثبت التحليل الاحصائي وجود اختلافات معنوية (P<0.01) في معامل الحالة المحور ومعامل حالة فولتن لأسماك المواقع الثلاث، بينما لم توجد فروقات معنوية (P>0.01) في معامل الحالة النسبي.

كلمات مفتاحية: علاقة طول-وزن، Redbelly tilapia ، *Coptodon zillii*