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The relative condition factor and the Length-weight relationship of Otolithes ruber (Schneider, 1801) from the Iraqi marine waters

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Abstract - Relative condition factor (Kn) and the relationship of length-weight (L-WR) of Tiger Tooth Croaker fish *Otolithes ruber* (Schneider, 1801) were determined from January to August 2017 in the Iraqi marine waters. L-WR data of the fishes (females and males) were calculated separately. The mean of (Kn) for females and males was 1.04 and 0.999, respectively. The value of (Kn) for the females was minimum in January (0.953) and May (0.969), whereas the maximum value was noticed in March (1.06 for females and 1.058 for males). The b value was recorded at 2.9747 for the males and 3.0546 for the females. The results of the statistical t-test showed no significant differences between females and males (t= -0.6021, 1.222, p≤ 0.05, respectively).

معامل الحالة النسبي وعلاقة الطول بالوزن لأسماك النويبي *Otolithes ruber* (Schneider, 1801) من المياه البحرية العراقية

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المستخلص - تم جمع أسماك *Otolithes ruber* (Schneider, 1801) من المياه البحرية العراقية من شهر كانون الثاني إلى شهر آب 2017 لتحديد علاقة الطول بالوزن (L-WR) ومعامل الحالة النسبية (Kn). قيست بيانات طول ووزن الأسماك من الذكور والإناث لحساب العلاقة بين الطول والوزن بشكل منفصل. كان متوسط معامل الحالة النسبية (Kn) لـ *O. ruber* هو 1.04 و 0.999 للإناث والذكور على التوالي. كان الحد الأدنى لقيمة (Kn) 0.953 و 0.969 في شهر كانون الثاني للذكور وفي شهر آيار بالنسبة للإناث، في حين تم ملاحظة الحد الأقصى للقيمة في شهر آذار (1.06 و 1.058) للإناث والذكور على التوالي. سجلت قيمة b وكانت 2.9747 و 3.0546 للأسماك من الذكور والإناث على التوالي. أظهر الاختبار الإحصائي t عدم وجود فروق إحصائية معنوية بين الإناث والذكور ($p \leq 0.05$، 1.222 و 0.6021 - = t) على التوالي.

الكلمات المفتاحية: *Otolithes ruber* ، علاقة الطول بالوزن ، معامل الحالة النسبية ، المياه البحرية العراقية

Introduction

The *Otolithes ruber* belongs to the family Sciaenidae. This family includes 283 species belonging to 66 genera (Eschmeyer and Fong, 2017). The fish of this family are widely disseminated in temperate, tropical, and subtropical area, the Arabian Gulf and the Sea of Oman, China and the Malayan Archipelago, Indian, and Pacific Oceans (Brash and Fennessy, 2005). Toothed croaker *O. ruber* is the most common fish species associated with prawn trawl-fisheries in the Arabian Gulf on a muddy substrate.

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The total landing of these fish was about 1578 tons for the period 2007-2011 which is about 11.8% of the total marine landings of this area (Mohamed and Qasim, 2014). The estimation of relative condition factor (Kn) provides information on the general well-being of the fish life and its development. The values of this factor depend on the physiological features of the fish especially maturity, hatchery, life cycle, environmental factors, and food availability in the water body (Ujjania *et al*., 2012; Dan-Kishiya, 2013). As the length and weight of fish are among the important morphometric characters, they are very useful for taxonomy and ultimately for fish stock assessment (Diaz *et al*., 2000; Moutopoulos and Stergiou, 2000). The L-WR of fish stocks is determined to found a mathematical correlation between length and weight, which enables the calculation of length if weight is known or vice versa. The length-weight relationship helps the fish biologist to estimate the average weight at a given length, it also helps to assess the relative well-being of a fish population (Diaz *et al*., 2000; Moutopoulos and Stergiou, 2000). Beverton and Holtz (1957) mentioned that the L-WR was used to calculate the equations of setting yield to estimate the number of fish landed, relative condition factor, and to compare the population in time and space. It also provides useful information on the dynamics of population and stock valuation studies such as length and age structure, growth estimation (Kolher *et al*., 1995). L-WR is employed to evaluate ontogenetic changes and condition indices (Safran, 1992), the biomass of
the standing stock (Martin, 1996), and growth studies (Haimovici and Velasco, 2000; Moutopoulos and Stergion, 2002). The study of L-WR for species provides an important understanding of the ecology of the species (Froes, 2006). The growth parameters such as length-weight relationship (LWRs) and relative condition factor (Kn) are used to express the demographic differences, biological features, and habitat conditions of fish species (Kovach and Coop, 1996). Furthermore, the length-weight relationship (LWRs) is used to estimate the weight of a specimen from its length and vice versa, studies of growth rate, understanding the life cycle in fisheries (Froese 2006; Jafari-Patcan *et al*., 2018), understanding allometric growth changes in fishes (Eagderi and Radkhah, 2015; Mouludi-Saleh and Kievany, 2018).

The aims of the present study are to identify some of the basic life traits of *Otolithes ruber* in the Iraqi marine waters by estimating (Kn) and L-WR, to study the condition of fish during different stages of growth and different seasons. These data indicate the physiological state and general well-being of fish.

Materials and Methods

Fish samples were monthly collected from the Iraqi marine waters North West Arabian Gulf between longitudes (48˚.50̀ -48˚.45`) E and two latitudes (48˚.29`-45˚.29̀) N from January to June 2017 by fishermen, the gears used are bottom trawl nets.

Fish samples were well preserved in crashed ice for later analysis in the laboratory. The total length (TL) of the fish was measured using the meter rule and to the nearest 0.1 mm. Fish weight was measured with a tabletop weighing balance to the nearest 0.01g of total body weight (BW), after drying with a piece of a clean hand towel. The relationship between the total length (TL) and weight (BW) of fish (L-WR) was expressed by the equation of Ricker (1975).

$$W = aL^b$$

Where;
W= Weight of fish (g)
L = Total length (mm)
a = Exponent describing the rate of change of weighing with length (a= intercept of the regression line on the Y-axis).
b = Slope of the regression line.

The degree of correlation between the length and weight was calculated from the linear regression analysis, correlation (r^2) that is: $R= r^2$. For regression analysis, log-transformed data were used according to Zar (1984).

$$\text{Log } w = \log a + b \log L$$

Where;
a = Constant.
b = The regression coefficient.

Computing b-value (= 3) was estimated by using t-test (Pauly, 1983). Relative condition factors (Kn) were estimated by applying the formula of Dar *et al*. (2012).

$$Kn= W/ \bar{W}$$

Where;
W= The observed weight in (g).
$\bar{W}$= The calculated weight in (g) obtained from the L-WR.

Results

A total of 174 fish were examined, 72 males, 89 females, and 13 immature individuals. The maximum and minimum length of fish sample was 466 and 150mm and the maximum and minimum weights were 875g and 33.5g. Relative condition factor (Kn) was recorded. The specimens Kn value was 0.999 and the equation was $Wt = 0.5998 (TL)^{2.719}$.

The mean Kn values are 1.04 for females and 0.99 for males with the highest value in January (1.17) and lowest in May for females, whereas for the males the highest value in March (1.058) and the lowest in January (0.953) (Table 1).

Table 1. Monthly variation in condition factor of *Otolithes ruber* in Iraqi marine waters during the study period.

Months	kn	
	Female	Male
January 2017	1.17	0.953
February	1.03	0.986
March	1.06	1.058
April	1.047	1.034
May	0.969	1.010
June	1.053	0.986
July	0.982	0.979
August	1.011	0.974

Length-weight relationship ($W = aL^b$) was $W = 0.0000108 L^{2.9747}$ (r^2 =0.9863, n = 72, TL= 150-466 mm) for males (Fig. 1), $W = 0.00000714 L^{3.0546}$,(Fig. 2) for females (r^2 = 0.9817, n = 85, TL= 153-465 mm) and $W = 0.00000797 L^{3.0331}$ (r^2 = 0.9839, n =174 TL= 150-466 mm) for all individuals (Fig. 3).

The results showed that there were no significant differences between the females and males (Statistical t-test) (t= - 0.6021, 1.222, $p \leq 0.05$, respectively), also Statistical test showed that there were no significant differences between the optimum ideal value (b= 3) and the calculated b value 3.0546 and 2.9747 for females and males, respectively (t= 1.079, 2.237, $p> 0.05$) indicating an isometric growth pattern. The co-efficient of determination (r2) for the length

weight relationship was estimated as 0.9839, indicating a high degree of positive correlation between the two elements (length and weight) (Fig. 3).

Discussion

The condition factor (Kn) is an important biological parameter, which indicates the suitability of a given water body for fish growth and the average size index of the species (Alam *et al*., 2014). An increased condition factor is indicative of increased fish health (bigger/fatter), whereas a lower condition factor is indicative of decreased health (smaller, reduced-fat storage) (Raymond *et al*., 2001).

Condition Factor as an Indicator of Growth and Feeding Intensity of fish, Organism-level response, with factors such as nutritional status, pathogen effects, and others stress (Azmat *et al*., 2007). Fluctuations in the Kn values are common in fishes due to differential feeding intensity, size of the fish, and most importantly the sexual cycle (Le-cren, 1951; Thakur, 1975).

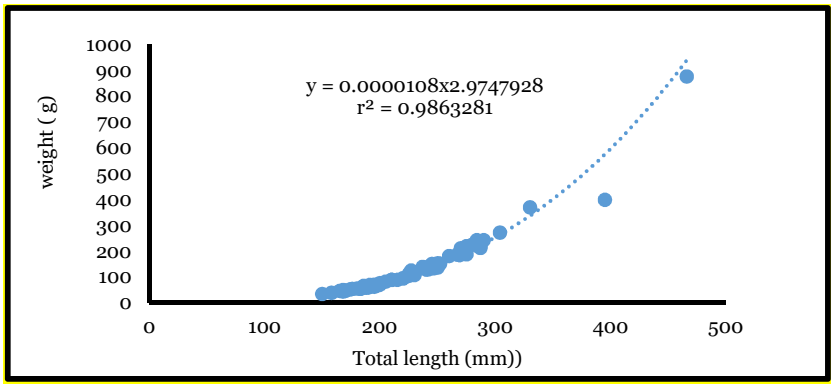

Figure 1. L-WR of male *Otolithes ruber* in the Iraqi marine waters during the study period.

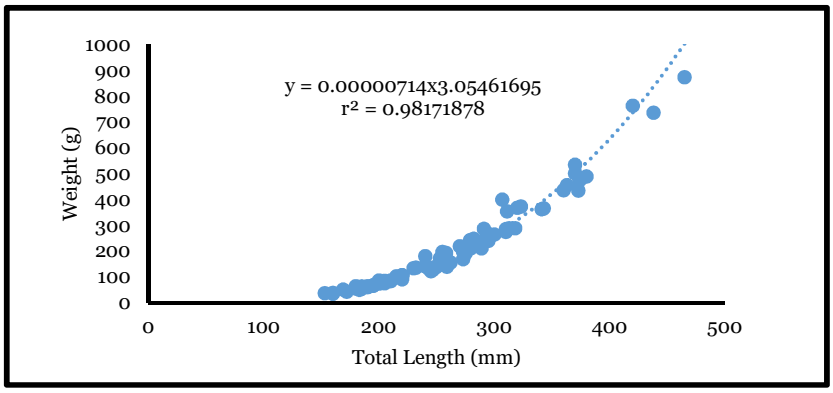

Figure 2. L-WR of female *Otolithes ruber* in the Iraqi marine waters during the study period.

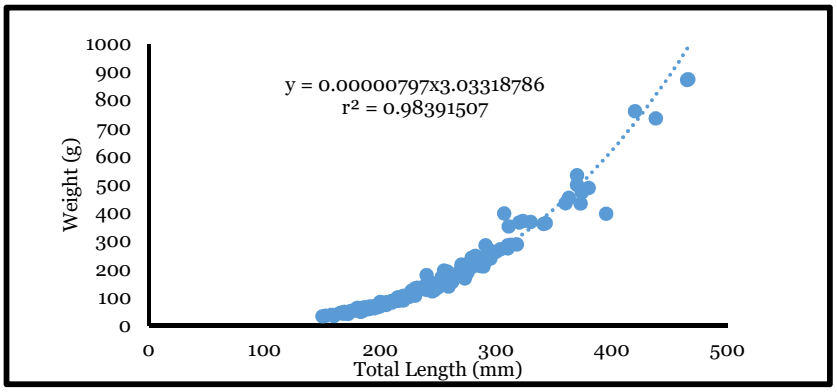

Figure 3. L-WR for male and female of *Otolithes ruber* in the Iraqi marine waters during the study period

The Kn values recorded in the present study indicated that *Otolithes ruber* exhibit healthy condition showing good compatibility with the environment of the Iraqi marine waters North West Arabian Gulf. Changes in the length-weight relationship (L-WR) or condition factor (Kn) can reflect the nutritional status or energy of the fish (Lambert and Dutil, 1997). The L-WR is an essential instrument in fisheries assessment (Garcia *et al*., 1989; Haimovidici and Velasco, 2000; Arslan *et al*., 2004), and also standing crop biomass can be assessed based on this value (Morey *et al*., 2003). Froese (2006) indicated that the value of 'b' should usually lie between 2.5-3.5. The present calculated 'b' value (3.033) showed isometric growth for *O. ruber* and significantly differs from the calculated 'b' value of 2.8347 and b = 2.94 recorded by Santhoshkumar *et al*. (2014), and Farkhondeh *et al*. (2018), respectively for the same fish exhibit allometric growth, whereas it was close to earlier observation (b = 3.2744, b= 3.09) observed by Jayasankar, (1990) and Resen *et al*. (2010), respectively. A previous study on the 'b' value of *O. ruber* 2.916 was published by Hussain and Abdullah (1991) in Kuwait and 2.706 in the Persian Gulf (Kazemi *et al*., 2013), in another location of the world in Bangladesh, Bay of Bengal 'b' value was 2.53 and 2.692 for males and females respectively (Pati, 1981). In other fish species, of the sillaginidae, Panhwar *et al*. (2017) recorded values b of 3.02 and 2.97. The coefficient of determination r^2 was 0.93 and 0.97 for *Sillago sihama* and *Sillaginopodys chondropus* respectively, which predicted a slightly positive allometric growth and strong linearity between the estimated parameters. Generally variations in the parameters may occurred according to food availability, health, sex, season, gonad maturity, habitat type, environmental condition (such as salinity and temperature), differences in the length range of the caught specimens, degree of stomach fullness, fishing gear and sampling procedure (Bagenal and Tesch, 1978; Froese, 2006). Furthermore, field measurement can be variable according to differences in fish surface wetness; boat movements, and other adverse environmental conditions (Gutreuter and Krzoslen, 1994). Gayanilo and Pauly (1997), have recorded an isometric growth pattern for *Eleutheronema tetradactylum*, *Otolithes ruber*, *Parastromateus niger,* and *Pampus argenteus*. Froese (2006) suggested that the isometric growth (b =3) indicated length increases with body weight and small specimens have the same form and condition as large ones. Also, isometric growth indicated that the fish becomes more slender as it increased in weight while positive allometric growth implies the fish becomes relatively stouter or deeper-bodied as it increased in length (Riedel *et al*., 2007).

Conclusion

From the results of the current study, the following can be concluded:

1. The growth of *O. ruber* in the Iraqi marine waters was negatively allometric, the value of 'b' is equal to 3.0546 and 2.9747 for females and males, respectively and the length-weight relationship equation obtained was $W = aL^b$.
2. Condition factor (Kn) which is used as an index for monitoring of feeding intensity, age, and growth rate of fish was recorded with a value of 1.17 for females and 1.058 for males which indicates a moderately well condition of the fish in both sexes.

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