

## Length-weight and some Morphometric Relationships of Hababir (*Lutjanus ehrenbergii*) from Sudanese Red Sea Coast

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### ABSTRACT

Length-weight relationship is an essential biological parameter needed to appreciate the suitability of the environment for any fish species. That is why many fishery biological studies give an importance to it. The relationships between total length and body depth and girth are very important in estimating the allowable catch and appropriate mesh size to be used in a fishery. length-weight relationship in addition to power and linear equations of some morphometric relationships (depth-total length, girth-total length and dorsal fin length and anal fin length-total length) were calculated for *Lutjanus ehrenbergii* (local name Hababir) (Lutjanidae) from the commercial catches landed at Port Sudan Fish Market during February 2010 to January 2011. Previous Sudanese studies on this fish focused mainly on classification. Local biological studies are absent because of the relatively low commercial value of this fish. Values of R<sup>2</sup> were high in all cases. The length-weight relationship indicate a negative allometric growth ( $W = 0.028L^{2.768}$  for males,  $W = 0.035L^{2.704}$  for females and  $W = 0.031L^{2.735}$  for sexes combined). Concerning the relationships of depth-total length, girth-total length and dorsal fin length and anal fin length-total length. The power equations have higher R<sup>2</sup> than the straight line equations and hence better describe these relationships. The results of this study will provide valuable information for the online (FishBase) database and contribute to fisheries research, management and conservation in Sudanese Red Sea coast.

**Key Words:** Body depth, Body girth, Length-weight relationship.

### INTRODUCTION

*Lutjanus ehrenbergii* is a small size fish. Thus, its laterally compressed body and very small scales recommend it for use in preparing Tarkeen (native fish paste), a popular food in Sudan.

The relationship between the length and weight of a fish is used by fisheries researchers and managers for two main purposes (Le Cren, 1951).

First, it is used to predict the weight from the length of a fish. This is particularly useful for computing the biomass of a sample of fish from the length-frequency of that sample. Second, the parameter estimates of the relationship for a population of fish can be compared to average parameters for the region, parameter estimates from previous years, or parameter estimates among groups of fish to identify the relative condition or robustness of the population. By convention, this second purpose is usually generically referred to as describing the condition of the species. It is originally used to provide information on the condition of fish and to determine whether somatic growth was isometric or allometric (Le Cren, 1951 and Ricker, 1975). In fisheries biology, length-weight relationships are useful in determining weight and biomass when only length measurements are available, as indications of condition and to allow for comparisons of species growth between different regions. Length-weight relationships have been reported for marine (Petракis and Stergiou, 1995 and Stergiou and Moutopoulos, 2001) and freshwater (Kleanthidis *et al.*, 1999) species but data for estuarine fish are inadequate.

Fish body length, depth and girth are important morphological parameters for biological, ecological and fisheries assessment studies. In particular, both length and girth are related to other biological parameters, such as condition and swimming capability (Wootton, 1999). Moreover, both parameters determine whether a gape-limited predator can ingest a particular fish, thus defining predator-prey relationships and the ecological position of fishes within the food webs in which they are embedded (Hambright, 1991 and Pauly, 2000). Finally, all these parameters strongly influence the retention of a fish by a fishing gear and describe gear selection patterns (e.g. Kawamura, 1972 and Hamley, 1975).

In practice, the use of morphometric measurements (body length, body girth, head length, fins length, eye diameter and jaw length) and meristics (fin ray, scale, teeth, gill raker and lateral line pore counts) to identify and classify fish is common. Morphometric measurements are generally presented as a proportion of total, standard and fork length, body weight and condition factor (Naeem *et al.*, 2010, and 2011a, b). The aims of this work were to determine:

1. Length-weight relationship of *Lutjanus ehrenbergii*.
2. Body depth-total length relationship of *Lutjanus ehrenbergii*.
3. Body girth-total length relationship of *Lutjanus ehrenbergii*.
4. Dorsal and anal fins-total length relationships of *Lutjanus ehrenbergii*.

## MATERIALS AND METHODS

Random samples of about 30 fish of *Lutjanus ehrenbergii* were collected monthly from the commercial catches landed at Port Sudan Fish Market from February 2010 to January 2011. Total length was measured to the nearest mm and total weight to the nearest 0.1 gm, then the data was entered to Excel package and the curve of the relationship between them was plotted. Values of the constants (a) and (b) were obtained from the relationship according to Abd El Razik (1987) and Gulland (1985) using the equation:

$$W = a L^b$$

Where:

W = total weight in grams

L = total length in cm

b = a constant of the relationship represents the slope of the equation.

a = a constant of the relationship represents the intersect part of the "y" axis.

Total length, body depth, body girth, dorsal fin length and anal fin length of *Lutjanus ehrenbergii* were measured to the nearest mm then the data was entered to Excel package and the curve of the relationships between the four later parameters and total length were plotted. Values of the constants (a) and (b) for each relationship separately were obtained using power and linear equations as follow:

$$B = a L^b \text{ (Power equation)}$$

$$B = aL + b \text{ (Linear equation)}$$

**Where:**

B = One of these parameters body depth, body girth, dorsal fin length or anal fin length in cm.

L= Total length in cm.

## RESULTS

### 1. Length-weight relationship:

The relationships between length and weight of *Lutjanus ehrenbergii*. were relatively stronger in males than in females. Their sexes combined relationship was closely related to the females one (Figure 1).

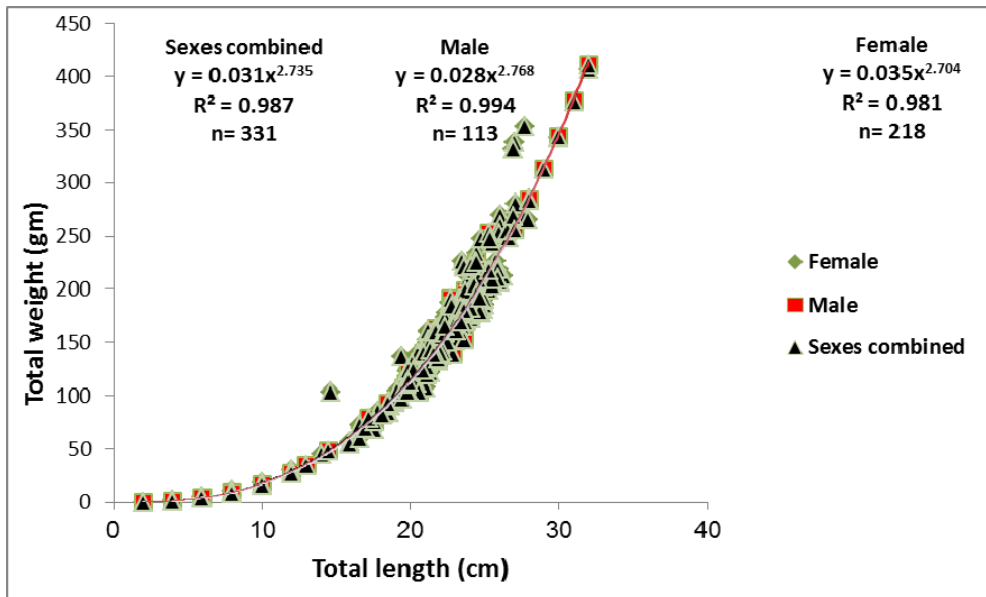


Fig. 1 Length-weight relationship for males, females and sexes combined  
of *Lutjanus ehrenbergii*

## 2. Body depth and body girth

The relationships between total fish length and body depth and girth are shown in Figures 2 a-d for the two sexes.  $R^2$  is relatively high in all cases. The power equations have higher  $R^2$  ( $R^2 = 0.804$  and  $0.806$ ) than the straight line equations ( $R^2 = 0.775$ ) and hence better describe the Total length vs. body depth relationship. The same is true for the relationships between total length and body girth.  $R^2$  is higher in the power equation than in the linear equation and therefore power equation describe better the relationship.

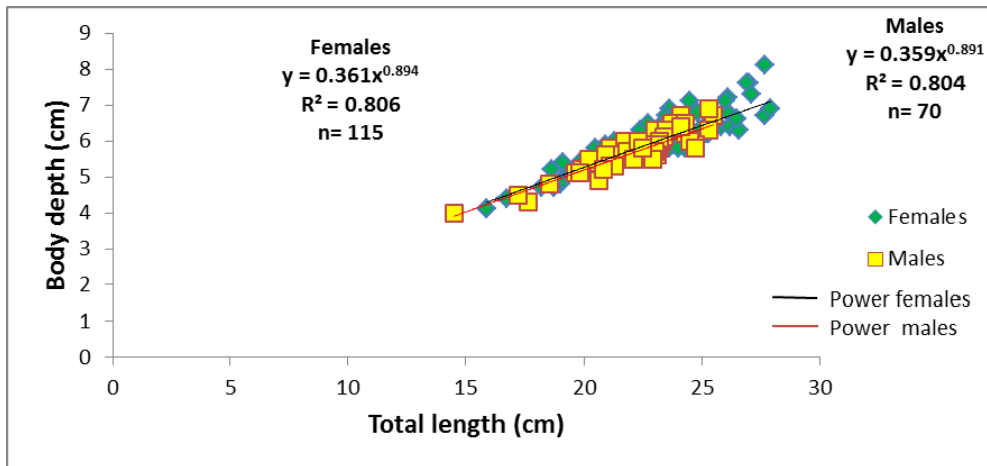


Fig. 2 a. Power relationship between total length and body depth of males and females of *Lutjanus ehrenbergii*

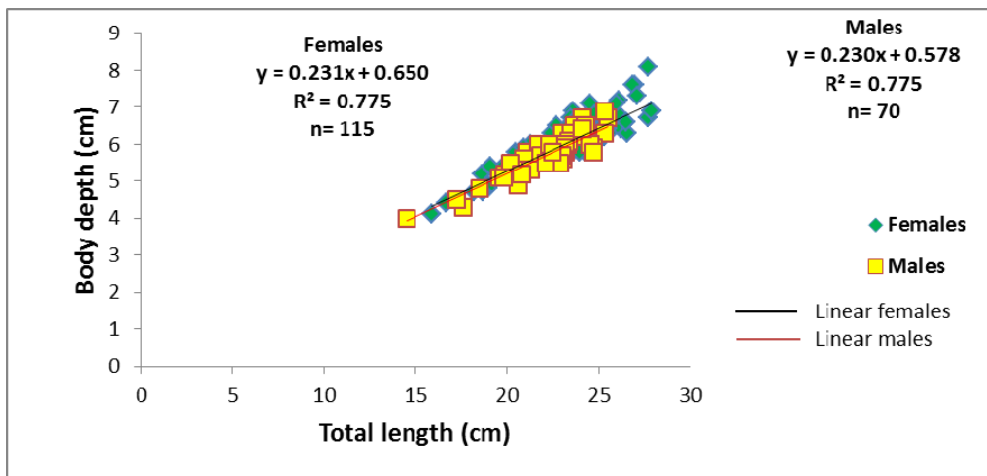


Fig. 2 b. Straight line relationship between total length and body depth of males and females of *Lutjanus ehrenbergii*

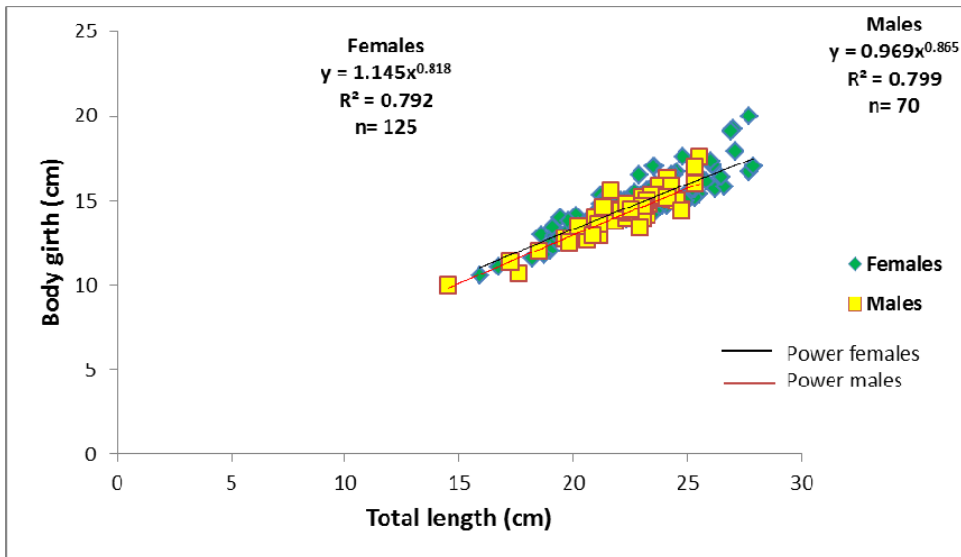


Fig. 2 c. Power relationship between total length and body girth of males and females of *Lutjanus ehrenbergii*

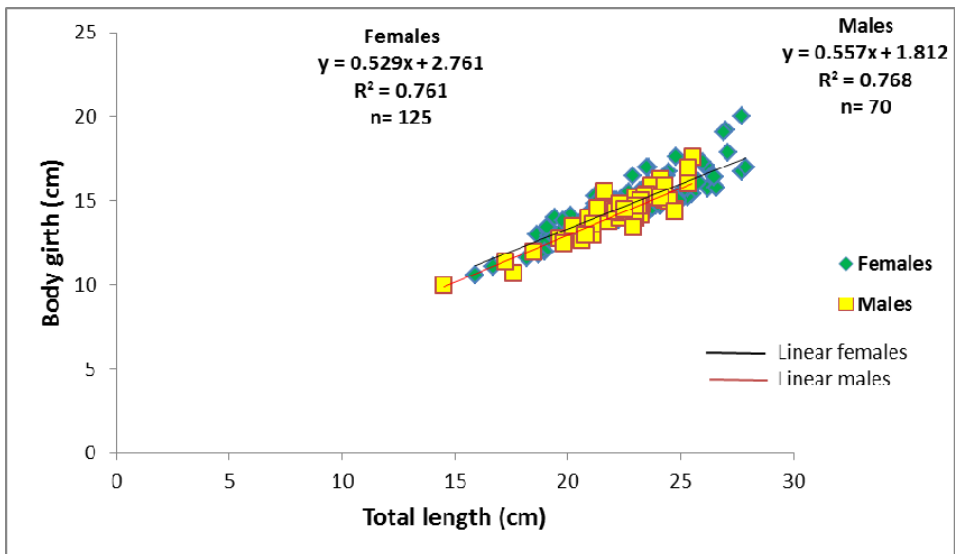


Fig. 2 d. Straight line relationship between total length and body girth of males and females of *Lutjanus ehrenbergii*

### 3 - Dorsal and anal fins:

The relationships between total length and dorsal fin length, and anal fin length, are shown in Figures 3 a-d. The power equations have higher  $R^2$  than the linear equations and are therefore more appropriate.

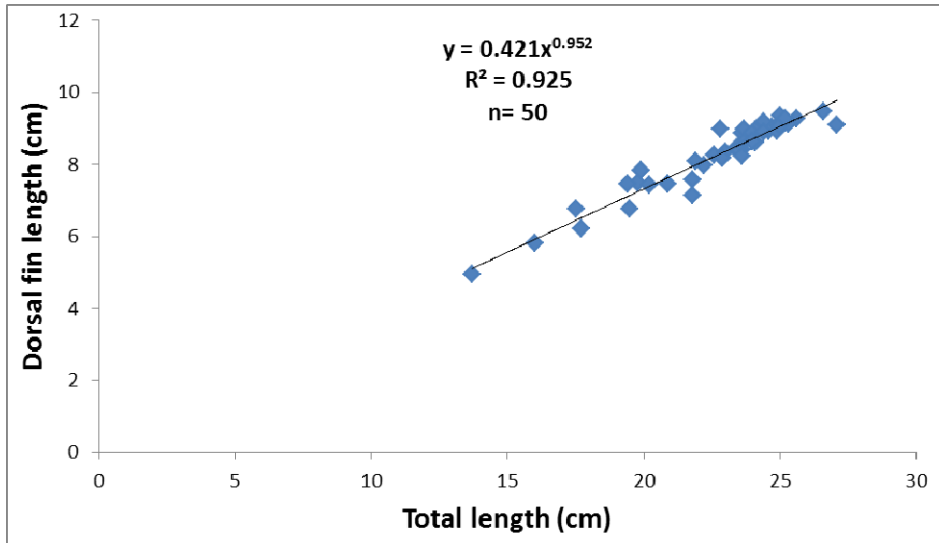


Fig. 3 a. Power relationship between total length and dorsal fin length of sex combined of *Lutjanus ehrenbergii*

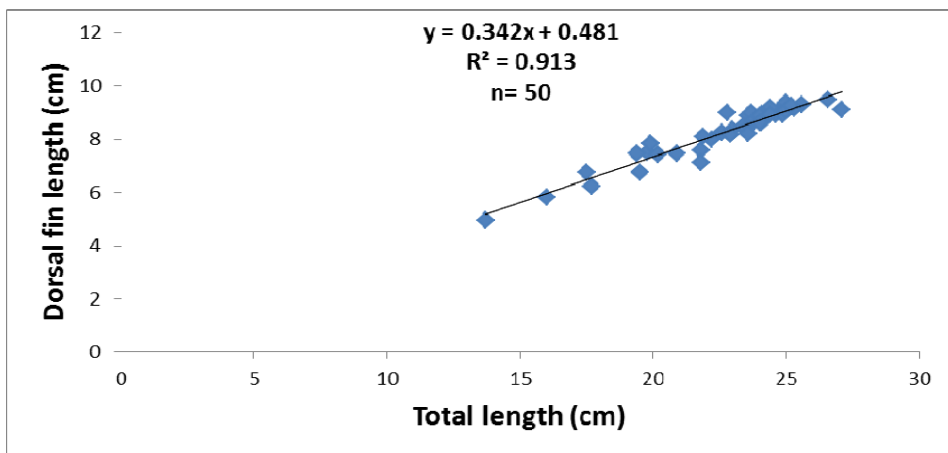


Fig. 3 b. Straight line relationship between total length and dorsal fin length of sex combined of *Lutjanus ehrenbergii*

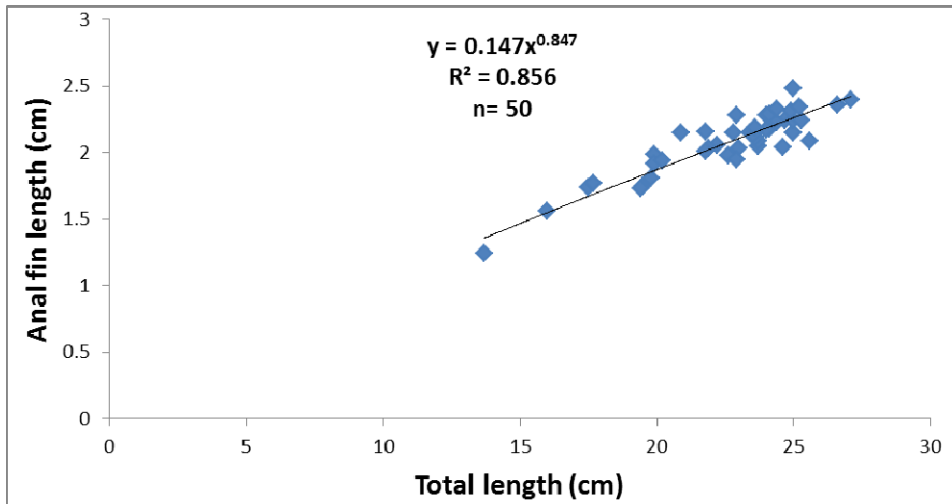


Fig. 3 c. Power relationship between total length and anal fin length of sex combined of *Lutjanus ehrenbergii*

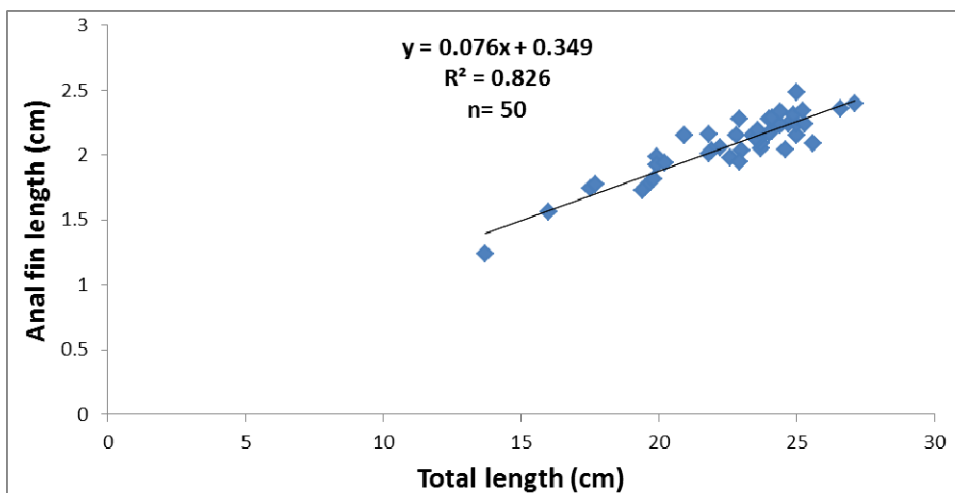


Fig. 3 d. Straight line relationship between total length and anal fin length of sex combined of *Lutjanus ehrenbergii*

## DISCUSSION

Length-weight relationship is an important parameter in the study of the biology of fish species. In spite of this fact there are many fish species for which this relationship has not been determined. Fishes of the genus *Lutjanus* in Sudanese Red Sea are not much studied and for *Lutjanus ehrenbergii* there is no any estimation for this relation in the literature. In the present study the length-weight relationship for males and females of



*Lutjanus ehrenbergii* were described by negative allometric growth ( $W=0.028L^{2.768}$  for males,  $W=0.035L^{2.704}$  for females and  $W=0.031L^{2.735}$  for sex combined). The relationship was very strong in males ( $R^2=0.994$ ) and females ( $R^2=0.981$ ). This disagrees with the result of unsexed *Lutjanus ehrenbergii* in Philippines where growth was positive allometric ( $W=0.0026L^{3.335}$ , www.Fish base.org). The disagreement may be due to differences in environmental conditions (Rounsefell and Everhart, 1953 and Nikolsky, 1963). Baeck *et al* 2013 studied the length-weight relationship of four species of righteye flounder from south coast of Korea they found that all relations were highly significant ( $P < 0.001$ ), with  $R^2$  values ranged from 0.934 to 0.989. Khalifa (2007) estimated length-weight relationship for *Valamugil seheli* from Abu Hashish area, Portsudan. He found that this relationship was significantly high in both sexes and the (b) value for females and males were 2.775 and 2.808 respectively. Moorthy *et al.* (2003) estimated this relationship for *V. seheli* from Mangalore region-India to be  $W=0.0373L^{2.6294}$  for males and  $W=0.0502L^{2.5283}$  for females.

The relationships between total length and body depth and girth are very important in estimating the allowable catch and appropriate mesh size to be used in a fishery. They were relatively strong correlation ( $R^2$  ranged from 0.761 to 0.806) for both males and females of *Lutjanus ehrenbergii* used in the present study. Values of body depth and body girth increased with the increase of total length. Their averages for females and males were 6.05 and 14.9 cm, and 5.78 and 14.23 cm, respectively. This indicates that the two parameters do not differ much between the two sexes. The relationship of total length-body depth seems to be similar in males and females, but really differ to some extent between sexes. This may be due to the increase of females' girth before and during the spawning period.

Fin lengths are usually used in fish classification. The fin length is calculated as proportion of fish total length (FAO, 1984) because of the strong relation between the two parameters. In the present study the relationship between total length and dorsal fin length of *Lutjanus ehrenbergii* was very strong ( $R^2=0.93$ ), but the relationship between total length and anal fin length was less strong ( $R^2=0.86$ ). This may be due to the location of the dorsal fin which enables easy and more accurate measuring than the anal fin which has a critical position for measuring, also the dorsal fin is wider than the anal fin (maximum – minimum length = 1.24 cm for anal fin and 4.52 cm for dorsal fin length). This results in only small increases in anal fin length for the corresponding total fish lengths, which reflects negatively in their relationship.

Both power and linear equations were found to describe with relatively equal strength (have comparable  $R^2$ ) the relationship of total length with weight, body girth, and length of anal and dorsal fins for males and females of *Lutjanus ehrenbergii*. For the relationship of total length with depth power relations were stronger.

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## علاقة الطول بالوزن وبعض العلاقات المورفومترية للهاببر (*Lutjanus ehrenbergii*) من ساحل البحر الأحمر السوداني

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### الملخص

علاقة الطول بالوزن عامل بيولوجي أساسي يستخدم لتقييم ملائمة البيئة لأي نوع من الأسماك. ولهذا فإن الدراسات البيولوجية لمصائد الأسماك تعطيها أهمية. والعلاقات بين الطول الكلي و عرض الجسم ومحيطه مهمة في تقدير الصيد المسموح به وحجم عين الشبكة الملائم للاستخدام في مصيد ما. علاقة الطول بالوزن بالإضافة إلى المعادلات الأسية والخطية لبعض العلاقات المورفومترية (عرض الجسم - الطول الكلي، محيط الجسم الطول الكلي وطول كل من الزعنفة الظهرية والزعنفة الشرجية - الطول الكلي) تم إيجادها ل *Lutjanus ehrenbergii* (الاسم المحلي هباببر) (*Lutjanidae*) من عينات من المصيد التجاري المنزل بسوق بورتسودان للأسماك خلال الفترة من فبراير 2010م وحتى يناير 2011م. وقد ركزت الدراسات السودانية في السابق بصورة رئيسية على التصنيف. بينما غابت الدراسات البيولوجية للقيمة التجارية المنخفضة نسبياً لهذه السمكة. وتبين من هذه الدراسة أن قيم  $R^2$  كانت عالية في كل الأحوال. وأن علاقة الطول بالوزن أوضحت نمواً متناقصاً ( $W = 0.028L^{2.768}$ ) للذكور،  $W = 0.035 L^{2.704}$  للإناث،  $0.031L^{2.735}$  للجنسين معاً. فيما يتعلق بعلاقات عرض الجسم - الطول الكلي، محيط الجسم الطول الكلي وطول كل من الزعنفة الظهرية والزعنفة الشرجية - الطول الكلي، وأن المعادلات الأسية كانت لها قيم  $R^2$  أعلى من المعادلات الخطية. مما يوفر معلومات قيمة على قاعدة معلومات شبكة المعلومات (FishBase) ويسهم في بحوث وإدارة مصائد الأسماك والمحافظة عليها في ساحل البحر الأحمر السوداني.

الكلمات المفتاحية: عرض الجسم، علاقة الطول بالوزن، محيط الجسم.