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LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR IN *SARDA ORIENTALIS* (TEMMINCK & SCHLEGEL, 1844) (FAMILY-SCOMBRIDAE) FISH FROM KARACHI FISH HARBOUR

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ABSTRACT: *Sarda orientalis* (Family-Scombridae) of assorted length (cm) and weight (gm) were obtained from Karachi fish harbor during January to December (2019) for measurement of length-weight relationship (LWR's) and Fulton's condition factor (K). The range of length (57-60.8) and weight (2123-2641) were estimated. Total mean length (cm) (gm) (59.14±0.94) and weight (gm) (2336.32±114.21) were measured. LWR was estimated as $W = 0.08166134 \times L^{2.5149}$ (log W = -1.088 + 2.5149log L). The highest mean of condition factor (K) (1.15±0.02) were measured in post-monsoon season. Assorted (ANOVA) analysis indicates that there is a significant correlation between weight, length, and season (p0.05).

KEYWORDS: *Sarda orientalis,* length-weight relationship, Karachi fish harbour

INTRODUCTION

Family, Scombridae is one of the substantial and most economically imperative fish families due to their high financially viable values and wide-ranging for international trade. In total, 54 species belong to 15 genera, including tunas, mackerels, and bonitos (Collette and Chao 1975; Fricke *et al.*, 2020). The striped bonito (*Sarda orientalis*) belongs to the family-scombridae, distributed across the Indo-Pacific and East Pacific. Striped bonitos have been observed in depths between 1 and 167 metres (3 ft 3 in to 547 ft 11 in) (Froese *et al.*, 2010). Bodies of *S. orientalis* are wholly covered with extremely small scales posterior to the corselet. Back with narrow oblique stripes. Swim bladder lacking and spleen enormous and distinguished in ventral view. Feeds on smaller fish, particularly clupeoids and also small crustaceans and squids (Froese *et al.*, 2013).

The length-weight relationships (LWRs) and condition factors are essential data for evaluating the population stock, biomass and age of fishes (Froese 2006). The LWRs in fishes is frequently defined by an exponential function $W = aL^b$. The growth of fish is isometric when $b = 3$. A variety of factors can affect it, including gender, gonad maturity, differences in environmental conditions over time, food availability, season, fishing gear, and sample size (Le Cren 1951; Mozsar *et al.*, 2015). Roonjha *et al.*(2021), Ahmed *et al.*(2014 a, b) and Ahmed *et al.*(2016), studied on length-weight relationships (LWRs) and condition factors on family-scombridae from Pakistan coast. The aim of this study is to quantify the LWRs and condition factor (k) estimates for the first time in *S. orientalis* fish from Pakistan coast during January to December 2019.

MATERIALS AND METHODS

Fish samples of various length (cm) and weight (g) were obtained from Karachi fish harbor during January to December 2019. A total of 224 *Sarda orientalis* were collected seasonally, pre-monsoon (March, April), monsoon (August, September) and post monsoon (October). To measure the length and weight of the fish, the samples were immediately placed in an icebox and transported to the laboratory. Fish species identified by field guide book (FAO, 2016). The fish lengths (cm) were measured from the tip of the anterior part of the mouth (tip of the snout) to extended tip of the caudal fin. After blotting drying with a piece of clean/wipe, fish were measured for their fresh body weights (g). The fresh body weights (W) was (gm) measured by using digital electronic balance to the nearest 0.01 g.

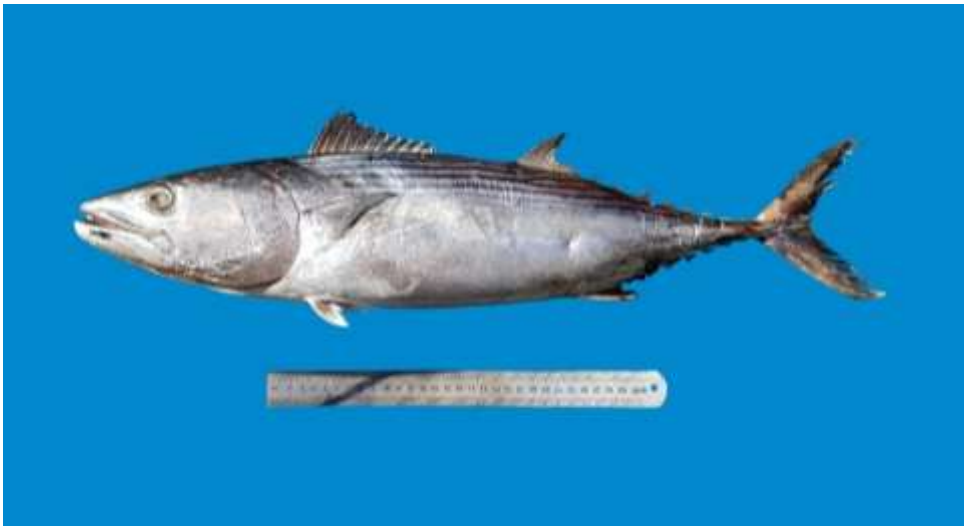

Fig. 1. *Sarda orientalis* (Temminck and Schlegel, 1844).

The length-weight relationship (LWRs) were measured by using the equation of (Le Cren, 1951; Pauly, 1983)

$$\mathbf{W = a\ L^{b}}$$

Where, W = total weight of fish in (gm)

'a' = Coefficient, intercept

'b' = Coefficient Regression, exponent

L = total length of fish in (cm).

The value of 'b' indicates,

Isometric growth = when close to 3.

Positive allometric growth = when more than 3; and

negative allometric = when 'b' is less than 3.

The parameters '*a*' and '*b*' were estimated by linear regression analysis based on the natural logarithms:

Log W = log a + blog L

The coefficient of determination r^2 was estimated.

The Fulton's condition factor (*K*) for each fish has been calculated using the Formula, Froese (2006):

$K = (W/L^3) \times 100$

Where K is the condition factor

W is the weight of fish (g)

L is the length of fish (cm).

Microsoft Excel and IBM SPSS (version 21) were used for statistical analysis (mean length, mean weight, standard error, variance, frequency distribution, LWRs, graphs). Statistical analysis of variances (ANOVAs) was performed in relation to fish length and weight, which were compared between seasons ($p > 0.05$).

RESULTS AND DISCUSION

Total mean length (cm) (99.51±9.77) and weight (g) (2336.32±114.21) were measured. The range of length (57.0-60.8 cm) and weight (2123.0-2641.0 g) shown in Table 1. The length and weight relationship of *S. orentalis* in pre-monsoon was $W = 0.00000002 \times L^{6.2426}$ (log W = -7.7023 + 6.2426log L); in monsoon $W = 0.00000002 \times L^{6.2381}$ (log W = -6.9193 + 5.8274log L); in post-monsoon $W = 0.00779338 \times L^{3.0966}$ (log W = -2.1083 + 3.0966log L) and overall was $W = 0.08166134 \times L^{2.5149}$ (log W = -1.088 + 2.5149 log L) (Table 2, Figure 2). In *S. orientalis*, the highest mean of condition factor (K) (1.15±0.02) and the lowest (1.10±0.01) were measured in monsoon and post-monsoon season (Figure 3 and 4).

Table (3) exhibits analysis of deviation (ANOVA) among length (cm) and season (F=82.998), and weight (gm) and seasons (F= 95.145) for *S. orentalis*.

Table 1. Seasonal distribution of total body Length (cm) and weigh (gm) of fish *Sarda orientalis* (Temminck & Schlegel, 1844) were collected from Karachi fish harbor during January to December, 2019.

Season	n	Min-Max	Length (cm) Mean ±SD	Min-Max	Weight (gm) Mean ±SD
Pre-monsoon	72	59-59.5	59.11±0.19	2200-2374	2278.59±52.47
Monsoon	60	60-60.8	60.36±0.28	2350-2641	2463.71±81.22
Post-monsoon	92	57-59	58.38±0.72	2123-2492	2298.42±103.68
Total	224	57-60.8	59.14±0.94	2123-2641	2336.32±114.21

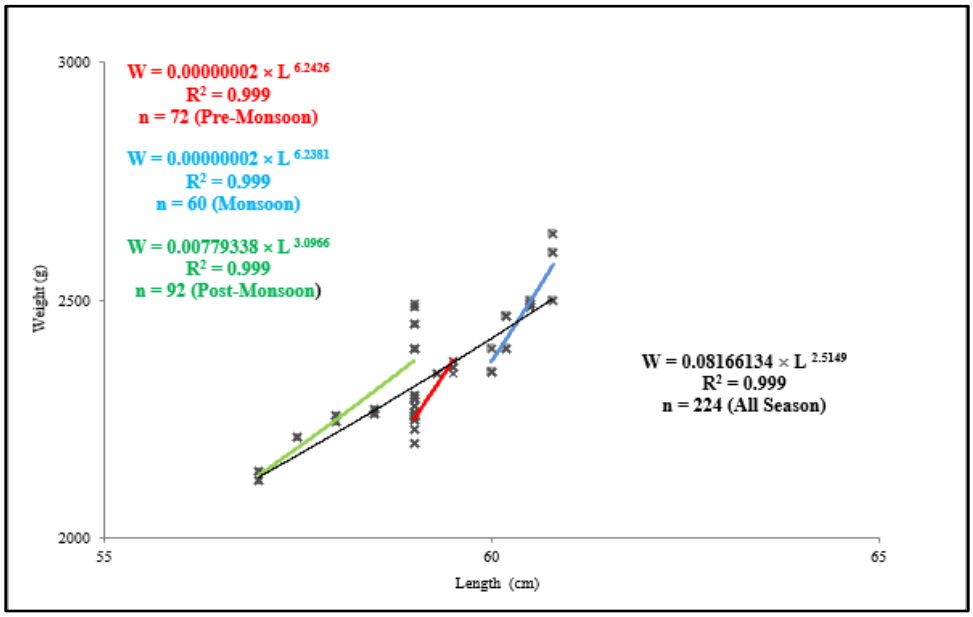

Fig. 2. Seasonal length-weight relationship (Red: Pre-Monsoon, Blue: Monsoon; Green:Post-Monsoon, Black: All Season) of *Sarda orientalis* during January to December, 2019.

Table 2. Length and weight relationship of *Sarda orientalis* from Karachi fish harbor during January to December, 2019.

Seasons	Length and Weight Equations	Correlation
Pre-Monsoon	$W = 0.00000002\times L^{6.2426}$ $\log W = -7.7023 + 6.2426\log L$	0.999
Monsoon	$W = 0.00000002 \times L^{6.2381}$ $\log W = -6.9193 + 5.8274\log L$	0.999
Post-Monsoon	$W = 0.00779338\times L^{3.0966}$ $\log W = -2.1083 + 3.0966\log L$	0.999
Overall	$W = 0.08166134 \times L^{2.5149}$ $\log W = -1.088 + 2.5149\log L$	0.999

Table 3. Analysis of variance (ANOVA) between length (cm), weight (gm) and seasons of *Sarda orientalis* during January to December, 2019.

ANOVA Table							
			Sum of Squares	df	Mean Square	F	Sig.
Length vs. Season	Between Groups	(Combined)	142.915	2	71.457	82.998	.000
	Within Groups		55.803	221	0.253		
	Total		198.718	223			
Weight vs. Season	Between Groups	(Combined)	1345815	2	672907.6	95.145	.000
	Within Groups		1563018	221	7072.48		
	Total		2908833	223			

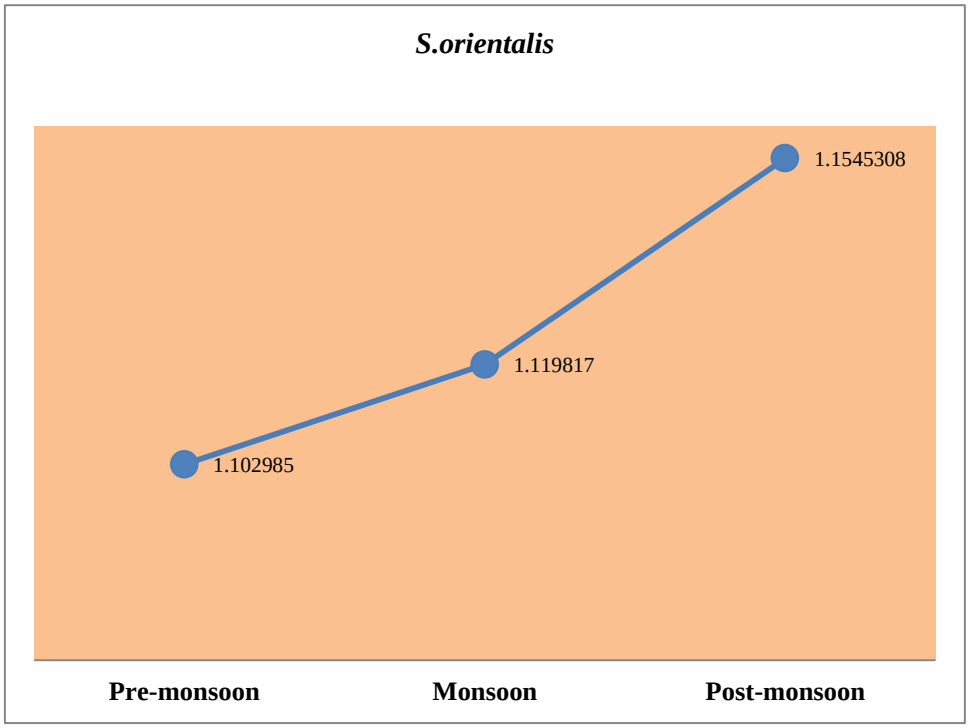

Fig. 3. Seasonal variation in condition factor (K) of fish *S. orientalis* collected from Karachi fish harbor during January to December-2019.

In this study, we attempted to measure the LWRs and condition factors of *S. orientalis* from Pakistan coast for the first time. Data on the LWR along with the condition factor was scanty, thus we comapred our (LWRs) and condition factors in *S. orentalis* with other bonitos species (*Sarda Sarda*). Ekrem *et al.* (2014) reported age, growth, and reproductive biology of *Sarda sarda* from Turkish coasts of the Black Sea and the Sea of Marmara. As a result of the investigation, the fork lengths of all sampled individuals ranged from (7.0 to 63.0 cm) and the length-weight relationship was calculated as W = 0.01 L3.085. The indicated values of *b* shows positive allometry growth. However present results indicated that the total lenght-weight relationship W = 0.08166134 × L $^{2.5149}$ grew isometrically.

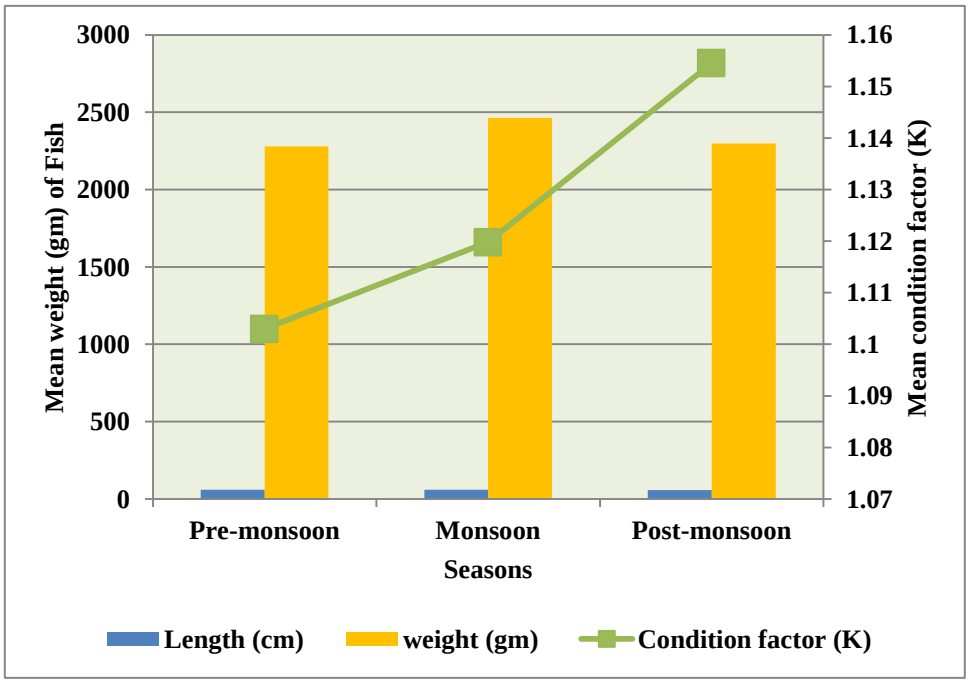

Fig. 4. Seasonal variation in length (cm) weight (gm) and condition factor (K) in fish *Sarda orientalis.*

In the eastern Middle Adriatic Sea, Zorica and Sinovcic (2008) examined length-length and length-weight relationships of juveniles and adults of Atlantic bonito, *S. sarda*. The length-weight relationships of juveniles and adults were indicated that (W = 0.0033LF$^{3.424)}$ and (W = 0.0149LF $^{2.984}$) respectively. Juveniles of *S. sarda* showed a positive allometry in relation to the fork length (*b* = 3.424), whereas the adults grew isometrically (*b* = 2.984). Growth and biometry analysis of the Atlantic Bonito *S. sarda* (Bloch, 1973), in the Southern Coast of Morocco. Correlation (r^2 =0.9139) were measured in between the weight and the size of the *S.sarda* with an allometric coefficient close to 3. Results indicated that isometric growth between fork length and weight in *S.*

sarda. According to Tester (1939) and Kesteven (1947), weight for length variations is typically linked to changes in form or volume, rather than specific mass. The condition factor has been used to study such kinds of variation in condition. The present study shows that the highest mean of condition factor (K) (1.15±0.02) and the lowest (1.10±0.01) were measured seasonally. Seasons and environmental conditions may influence the variation in condition factor in fish species (Braga 1986; Gomiero and Braga 2003).

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