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Seasonal variations in Length-weight relationship and Condition factor of Indian oil sardine *Sardinella longiceps* (Valenciennes, 1847) from Balochistan Coast

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Abstract: The length-weight relationship and condition factor of *Sardinella longiceps* fish from Balochistan coast was studied for twelve months from August 2005 to July 2006. Fish samples were collected from fishermen who used cast nets and gill nets. The fish ranged from 13 - 22cm in total length (TL) and 40 - 90 g in weight. The parameters *a* and *b* of the length-weight relationships were analyzed using equation $W = aL^b$ and condition factor $K = 100W/L^3$ for the *S. longiceps* fish recorded in this study. The mean values of *b* in the length -weight relationship were 2.1795 while intercept *a* being -1.2853. The coefficient of determination (r^2) in different size classes showed very high degree, indicating positive strong relationship. The condition factor showed higher values in small fish while lower in large fish.

Keywords: Body length –weight relationship, condition factor, fish, Balochistan Coast

1. INTRODUCTION

Sardinella longiceps fish is endemic to northern and western parts of Indian Ocean i.e. from Gulf of Aden, Gulf of Oman eastward to southern part of India and on eastern coast to Andhra but apparently not found in Red Sea or the Persian Gulf (Froese and Pauly, 2015).

Commercially a very important species, it is reported from Pakistan coast by Qureshi (1957), Siddiqi (1956), Jalil and Khalil (1972, 1981), Bianchi (1985), Hoda (1985, 1988), Majid *et al.* (1992), Hussain (2003), Froese and Pauly (2015), without specifically mentioning about any particular area. It is also reported from other waters by Day (1878, 1889), Aitken (1907), Sorley (1932), Fowler (1941), Anonymous (1953), Misra (1962), Whitehead (1985), Abildgaard and Khan (1994). It is known from Indus delta (Hashmi and Khan, 2003; Misra, 1962; Niazi, 2001) and from Sindh creeks (Niazi, 1976).

From Balochistan it was reported by Anonymous (1953), Day (1878, 1889), Whitehead (1985), and Zugmayer (1913). It is also reported from Makran (Ahmed *et al.*,1962), Anonymous (1953, 1955), Misra (1962), Qureshi (1952). Aitken (1907), Day (1878, 1889), Sorley (1932) and Zugmayer (1913) as *Clupea longiceps.*

2. MATERIALS AND METHODS

Fish specimens were obtained from fishermen's catch collected by using cast nets and gill nets. A total of 500 fish specimen were collected during the study period. The fish samples were collected in four seasons from August 2005 to July 2006. Length of the fish was taken as total length (TL) that was measured between terminal ends of mouth and caudal fin. A measuring board was used and measurement was recorded in centimeter (nearest to millimeter). The weight of fish was taken after removal of excess using paper towels. Weight was taken with a table top weighing balance, nearest to milligram.

The LWR was calculated using the expression: W= a Lb, where W is the total body weight (BW, g), L the total length (TL, mm), *a* and *b* are the parameters of regression analysis. Parameters *a* and *b* of the LWR were estimated by linear regression analysis based on natural logarithms: ln (W) = ln (a) + b ln (L).

Additionally, 95% confidence limits of the parameters *a* and *b* and the statistical significance level of r (correlation coefficient) were estimated. The later was estimated as an indicator of the quality of linear regressions (Hossain *et al.*, 2009). In this study, prior to the regression analysis of ln BW on ln TL, ln-ln plots of length and weight values were performed for visual inspection of outliers, with extremes being excluded from the regression analyses.

3. RESULTS AND DISCUSSION

A total of 500 specimens of *S. longiceps* were analyzed. The length of the samples collected ranged from 13 to 23cm (Table 1). These appear to represent

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two year classes the younger group comprised mainly of juveniles ranging from 13 to 15cm. the length in the older group ranged from 15.5 to 17.5cm.

In Indian oil *Sardinella* the condition factor (*K*) reflects, through its difference, information on the physiological condition of fish in relation to its welfare. The condition factor values (mean±SD = 1.09±0.30) which was counted according to the length groups in the seasonal specimens of *S. logiceps*. As it was seen here, the condition factors of each sample shows difference in the season and the length groups. The variation between fish in the same season as in the same length group was determined statistically. It was observed that more the length of the fish got more the condition factor decrease. The mean condition factor value was generally higher (1.6) in smallest fish groups of all seasons (Tables 2-5). The large fish group on the other hand, showed lowest *K* value (0.92). No significant differences in condition factor were seen in different seasons.

Table 1. Seasonal variations of *Sardinella longiceps* in the length-weight relationships ($W= aL^b$). coefficient of determination (r^2) intercept (a) and exponent (b).

Seasons	n	$W = aL^b$	*r*	*a*	*b*
Pre south-west monsoon calm period (Spring)	120	$W = -1.339 L^{2.116}$	0.940	-1.339	2.116
Post south-west monsoon calm period (Autumn)	100	$W = -1.277L^{2.195}$	0.942	-1.277	2.193
North-east monsoon calm period (Winter)	80	$W = -1.242 L^{2.233}$	0.947	-1.242	2.233
South-west monsoon period (Summer)	200	$W = -1.283 L^{2.176}$	0.930	-1.283	2.176

Table 2. Seasonal variations of *Sardinella longiceps*, mean length (TL), mean weight (W), mean condition (K) values and standard deviation during pre-south west monsoon calm period (spring).

Total Length Group (cm)	Pre south west monsoon calm period (Spring)			
	n	TL (cm)	W (g)	K
13-15	10	14.0±.74	46.1±2.3	1.67±0.17
15.5-17.5	35	16.6±.57	57.2±1.8	1.2±0.09
18-22	75	19.5±1.07	69.8±2.03	0.92±0.05

Table 3. Seasonal variations of *Sardinella longiceps*, mean length (TL), mean weight (W), mean condition (K) values and standard deviation during post south west monsoon calm period (autumn).

Total Length Group (cm)	Post south west monsoon calm period (Autumn)			
	n	TL (cm)	W (g)	K
13-15	10	14.0±0.74	46.3±1.9	1.6±0.17
15.5-17.5	35	16.6±0.61	57.5±1.8	1.2±0.10
18-22	55	19.3±1.13	68.3±9.8	0.94±0.06

Table 4. Seasonal variations of *Sardinella longiceps*, mean length (TL), mean weight (W), mean condition (K) values and standard deviation during north east monsoon calm period (winter).

Total Length Group (cm)	North east monsoon calm period (Winter)			
	n	TL (cm)	W (g)	K
13-15	10	14.0±0.74	45.6±2.57	1.6±0.184
15.5-17.5	30	16.5±0.58	56.7±1.90	1.2±0.09
18-22	40	19.2±1.1	66.7±9.64	0.94±0.069

Table 5. Seasonal variations of *Sardinella longiceps*, mean length (TL), mean weight (W), mean condition (K) values and standard deviation during south west monsoon period (summer).

Total Length Group (cm)	South west monsoon period (Summer)			
	n	TL (cm)	W (g)	K
13-15	10	14.0±0.74	45.4±2.5	1.6±0.18
15.5-17.5	75	17.0±0.58	57.8±2.7	1.1±0.69
18-22	115	19.6±0.96	67.8±2.91	0.90±0.52

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