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SEASONAL VARIATION OF CONDITION FACTOR AND WEIGHT - LENGTH RELATIONSHIP IN *THRYSSA HAMILTONII* GRAY, 1835 (CLUPEIFORMES: ENGRAULIDAE) COLLECTED FROM THE BALOCHISTAN COAST OF THE ARABIAN SEA, PAKISTAN

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ABSTRACT: Present study deals with the effects of seasonal variation on condition factor (CF) and weight - length relationships (WLRs) of *Thryssa hamiltonii*, sampled during pre and post- monsoon seasons in 2011 from the Balochistan coast of the Arabian Sea. The results showed that *T. hamiltonii* has isometric growth characteristics in pre and post-monsoon. The value of *b* was calculated as 3.2364 in pre-monsoon, as 3.0499 in post-monsoon season and as 3.1346 in combined data with not significantly different from 3 (Pauly' t test, $P > 0.05$) Moreover, the mean CF was calculated between 0.13 - 0.60 (mean: 0.26±0.010) in pre-monsoon season and between 0.19 - 0.90 (mean: 0.39±0.017) in post-monsoon season. The calculated CF showed statistically difference among the pre-monsoon, post-monsoon and combined data (One way ANOVA, P = 5.47E-08).

KEYWORDS: Length - weight relationships, condition factors, Hamilton's thryssa, *Thryssa hamiltonii*, Balochistan coast, Arabian Sea.

INTRODUCTION

Hamilton's thryssa, *Thryssa hamiltonii* Gray, 1835 is an Indo-Pacific pelagic fish and also seen in estuaries. Fisheries of this species conduct generally by seine gillnet and trawl. Knowledge on quantitative aspects such as weight-length relationships (WLRs), condition factor (CF), growth, recruitment, and mortality of fish are important tools for the study of fish biology. The WLRs have many applications in fish stock assessments and ecological studies. These are also useful for fisheries research because they: (*i*) allow the conversion of growth in length equations to growth in weight for use in stock assessment models; (*ii*) allow the estimation of biomass from length observations; (*iii*) allow to estimate the condition of the fish; and (*iv*) use for region comparison of life histories of certain species (Stergiou and Moutopoulos, 2001). CF and WLRs parameters can be applied in different factors such as age, reproduction period, gonad activities, amount of food, seasons etc. In Pakistan during the monsoon period from June to September, monsoon winds carry moisture from the Indian Ocean and bring heavy rains. More than 50% of annual precipitation occurs in the monsoon period, especially during

July and August (Hussaina *et al.*, 2010). The pre and post monsoon seasons affect the sea water and mobilize sea life. Therefore, these changes affect directly or indirectly to the life of marine fish. The present study deals with the seasonal variation of the CF and WLRs in *Thryssa hamiltonii*, sampled from the Balochistan coast in the Arabian Sea, Pakistan.

MATERIALS & METHODS

Sample Collection:

Fish samples were obtained from the commercial fishermen that were collected from the exclusive economic zone (EEZ) of Balochistan coast in the Arabian Sea by seines and gillnets. A total of 100 fish of *T. hamiltonii* were collected during five months (January - May) of pre-monsoon and four months (September - December) of post-monsoon season in 2011 from the Balochistan coast in the Arabian Sea.

Weight - Length Relationships (WLRs):

The total length (*TL*) of the fish was measured from the tip of anterior part of mouth to the tip of caudal fin and the body weight (W0) was measured after blot drying with a piece of clean towel. These were measured to the nearest 0.1 cm and 0.01 g, respectively.

Least squares regression analysis with MS Excel software was used to calculate the weight length relationship parameters of all specimens. The weight length relationship was estimated as:

$$W = aTL^b;$$

where *W* is the body weight (g), *TL* is the total length (cm), *a* is the intercept, and *b* is the slope of the regression line.

Comparison of the difference of slope value from *b* = 3 (isometric growth) for all species, Pauly's *t*-test was performed (Pauly 1984). Pauly's *t*-test statistic was calculated as:

$$t' = \frac{Sd_{\log TL}}{Sd_{\log W}} \frac{|b-3|}{\sqrt{1-r^2}} \sqrt{n-2}$$

where Sd_{logTL} is the standard deviation of the log *TL* values, Sd_{logW} is the standard deviation of the log *W* values, n is the number of specimens used in the computation. The value of *b* is different from *b* = 3 if calculated *t* value is greater than the tabled *t* values for n-2 degrees of freedom (Pauly, 1984).

Comparison of the difference of correlation coefficient (*r*) from zero *t*-test (Snedecor and Cochran, 1989) was calculated as:

$$t' = \frac{r * \sqrt{(n-2)}}{\sqrt{(1-r^2)}}$$

where *n* is the number of garfish used in the computation and *r* is the correlation coefficient. The value of correlation coefficient is different from zero if *t* value is greater than the tabled *t* values for n-2 degrees of freedom.

Condition Factor: Condition factor was calculated as:

$$'CF = \frac{W}{TL^b} * 100$$

where *W* is the body weight (g), *TL* is the total length (cm), *CF* is the condition factor (%) and *b* is the slope of regression line for pre-season (*b* = 3.2364), post-season (*b* = 3.0499) and combined data (*b* = 3.1346). The condition factors difference among the pre-monsoon, post-monsoon and all data, were presented as mean±standard error (SE) and analyzed using one-way ANOVA followed by Tukey multiple range test to compare the means between the different experimental diet groups in PAST ver 1.75b software package (Hammer *et al.,* 2001). Differences were considered statistically significant when $P < 0.05$.

RESULTS & DISCUSSION

Mean total length of *T. hamiltonii* was calculated between 11.0 - 23.4 cm (mean: 17.1±0.46 cm, n = 46) in pre-monsoon season and between 10.0 - 23.0 cm (mean: 17.2±0.39 cm, n = 54) in post-monsoon season. Moreover, mean total length was calculated between 10.0 - 23.4 cm (mean: 17.2±0.30 cm, n = 100) both in pre-monsoon and post- monsoon seasons (Table 1). The mean length (F and T tests; $P = 0.8401$) and length frequency distribution (Kolmogorov-Simirnov test; $P = 0.563283$; d = 0.153784) between the pre-monsoon and post-monsoon were not significantly different.

Table 1. Seasonal length and weight results of *T. hamiltonii* collected from Balochistan coast in pre-monsoon and post-monsoon seasons (2011). L_{mean} = mean length, L_{min} = lowest length, L_{max} = highest length, L_{SE} = Standard error of length. W_{mean} = mean weight, W_{min} = lowest weight, W_{max} = highest weight, W_{SE} = Standard error of weight.

Seasons		Length (cm)				Weight (g)			
	n	L_{mean}	L_{SE}	L_{min}	L_{max}	W_{mean}	W_{SE}	W_{min}	W_{max}
Pre-monsoon	46	17.1	0.46	11.0	23.4	28.2	2.42	5.1	66.6
Post-monsoon	54	17.2	0.39	10.0	23.0	25.7	2.23	6.1	70.9
All	100	17.2	0.30	10.0	23.4	26.8	1.64	5.1	70.9

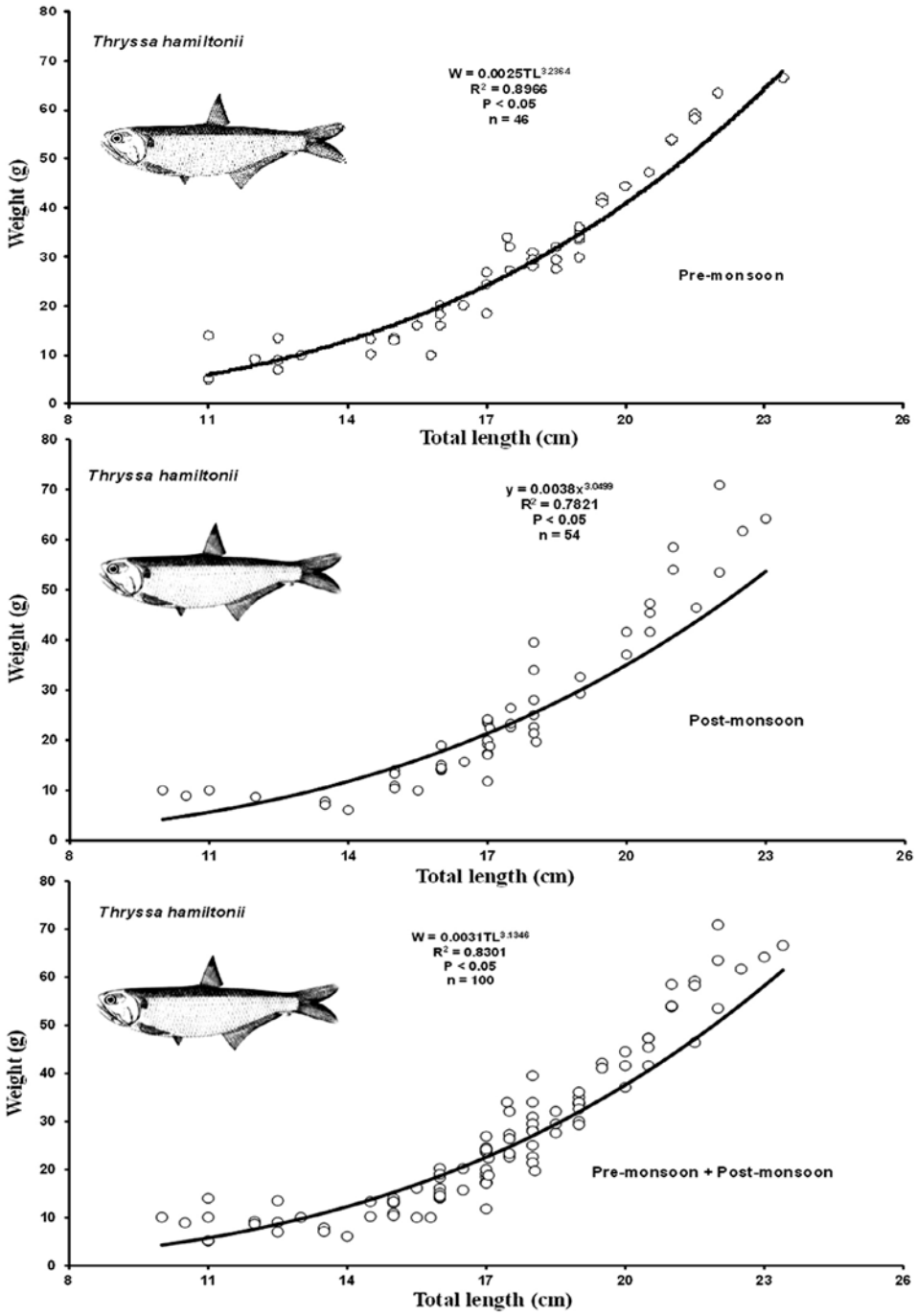

Fig. 1. Total length weight relationships of *Thryssa hamiltonii* collected from Balochistan coast in pre-monsoon and post-monsoon seasons (2011).

Similar pattern to the size parameters were statistically obtained for weight parameters. Namely, the mean weight (F and T tests; $P = 0.44083$) and weight frequency distribution (Kolmogorov-Simirnov test; $P = 0.0741228$; d = 0.250403) between the two seasons were not significantly different. In addition to this, the total weight of *T. hamiltonii* was calculated between 5.1 - 66.6 g (mean: 28.2±2.42 g, 95% conf.: 23.3 - 33.1, n = 46) in pre-monsoon season and between 6.1 - 70.9 g (mean: 25.7±2.23 g, 95% conf.: 21.2 - 30.1, n = 54) in post-monsoon season. Moreover, mean weight was calculated between 5.1 - 70.9 g (mean: 26.8±1.64 g, 95% conf.: 23.6 - 30.1, n = 100) both in pre-monsoon and post- monsoon seasons.

Table 2. Weight - length parameters of *Thryssa hamiltonii* from different regions.

Sex	*a*	*b*	r^2	$L_{min\text{-}max}$	Locality	References
unsexed	0.00506	3.164	0.96	6.0-18.0	Daya Bay	Froese and Pauly, 2011
unsexed	0.00268	3.640	0.84	8.3-13.8	Chi-gu	Froese and Pauly, 2011
unsexed	0.00310	3.135	0.83	10-23.4	Balochistan coast	Present study

Weight - length relationships (WLRs):

Weight - length relationships (WLRs) of *T. hamiltonii* sample collected during pre-monsoon and post-monsoon seasons in 2011 from the Balochistan coast in the Arabian Sea were showed that *T. hamiltonii* showed isometric growth characteristics for all seasons (Pauly' t test, $P > 0.05$). LWRs of *T. hamiltonii* between seasons showed below and in figure 1.

$W = 0.0025TL^{3.2364}$, $r^2 = 0.8966$, $Sd_{logL} = 0.084966$, $Sd_{logW} = 0.290408$, N = 66, Pauly' t test = 1.42676, $P > 0.05$, isometric growth (pre-monsoon season).

$W = 0.0038TL^{3.0499}$, $r^2 = 0.7821$, $Sd_{logL} = 0.078199$, $Sd_{logW} = 0.269676$, N = 54, Pauly' t test = 0.223529, $P > 0.05$, isometric growth (post-monsoon season).

$W = 0.0031TL^{3.1346}$, $r^2 = 0.8301$, $Sd_{logL} = 0.080993$, $Sd_{logW} = 0.278661$, N = 100, Pauly' t test = 0.939578, $P > 0.05$, isometric growth (all data without seasons).

Despite the small number of specimens (e.g. 46 in pre-monsoon, 54 in post-monsoon) and narrow length range, the values for the exponent (*b*) remain mostly within the expected range of 2.5 - 3.5 and the parameters can be used safely within the indicated

length range. Similar results were reported for 18 species of the families by Froese (1998).

Two studies (Table 2) on the WLRs for *T. hamiltonii*, are available in Fish Base 2011 (Froese and Pauly, 2011). Therefore, Froese (1998) urged that the exponent (b) of the WLRs should fall within the expected range of 2.5–3.5. The WLRs parameters (*a* and *b* values) are consistent with the present results.

for pre-monsoon, post-monsoon seasons and combined (pre+post monsoon) in 2011 from the Balochistan coast.

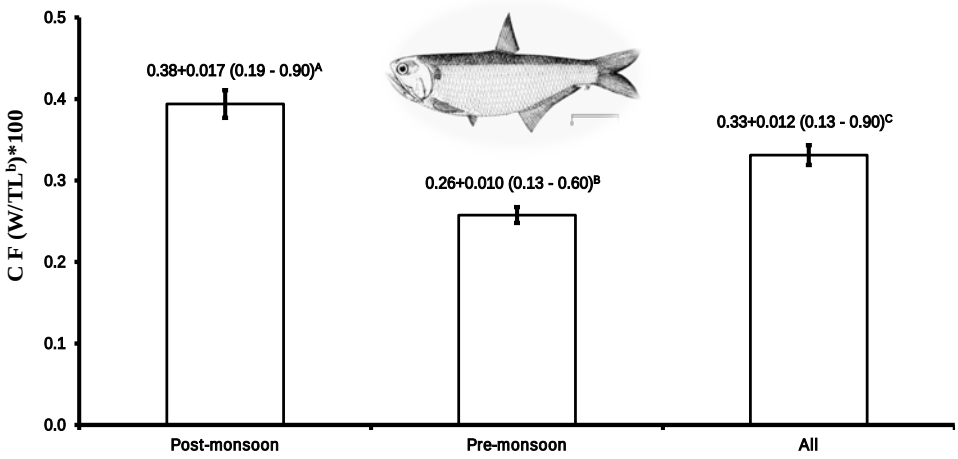

Fig. 2. Condition factors of *T. hamiltonii* in pre-monsoon and post-monsoon seasons and combined (pre+post monsoon) in 2011. The exponential different letters refers to the statistical difference.

Condition Factor (CF):

Condition factors of *T. hamiltonii* for pre-monsoon, post-monsoon seasons and combined seasons in 2011 showed in figure 2. Mean condition factor of *T. hamiltonii* was calculated between 0.13 - 0.60 (mean: 0.26±0.010, n = 46) in pre-monsoon season and between 0.19 - 0.90 (mean: 0.39±0.017, n = 54) in post-monsoon season. Moreover, mean condition factor was calculated between 0.13 - 0.90 (mean: 0.33±0.012, n = 100) both in pre-monsoon and post- monsoon seasons (combined data). One way ANOVA test showed that condition factors were statistically difference among the pre-monsoon, post-monsoon and combined data (P = 5.47E-08).

The CF is an index showing interactions between biotic and a-biotic factors in the physiological condition of fish. The CF gives also information about feeding and spawning activity of a species. The present results showed that *T. hamiltonii* had statistically higher CF in post-monsoon (0.38±0.017) than pre-monsoon (0.26±0.010). This may be due to the effect of monsoon on the increasing primary (phytoplankton) and secondary production (zooplankton) in the Arabian Sea. After the monsoon (pos-monsoon) *T. hamiltonii* find more food, especially zooplankton such as copepods (Bapat and Bal, 1950). Due to the seasonal variations of the oceanographic conditions, it has

been assessed that monsoon should affect the condition factor in terms of enhancing effects of the condition factor.

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