

Weight-Length Relationship for *Clupeonella cultriventris caspia* (Svetovidov, 1941) in Iranian Waters of the Southwest Caspian Sea

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ABSTRACT

The aim of this study was to record the weigh-length relationship (*WLR*) parameters for *Clupeonella cultriventris caspia* of Iranian coastal waters of Caspian Sea. Samples were taken during fishing surveys using conical lift nets during the summer and autumn of 2010. Total length (TL in cm) and body weight (BW in g) were measured. The lowest and highest *b* value was obtained for males, 2.372, and during summer time, 2.699. Linear regressions of length–weight relationships were significant for *C. cultriventris caspia*. The *b* value of the length-weight relationships showed negatively allometric growth both in males ($b = 2.37$) and females ($b = 2.57$). Similar growth pattern (negative allometric) was also observed in summer and autumn. The Analysis of co-variance (ANCOVA) revealed significant difference in *WLRs* between sexes and seasons for *C. cultriventris caspia* in the Guilan coastal waters (Southwest Caspian Sea, Iran).

Keywords: *Weight-length relationships; Kilka fish (clupeonella); Caspian Sea; Clupeonella cultriventris caspia.*

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1. INTRODUCTION

Caspian Sea is a brackish lake which its coastal region are shared by Iran, Russia, Azerbaijan, Turkmenistan and Kazakhstan. The Caspian Sea has a volume of 77,000 km³ and a surface area of about 436,000 km² (Aladin and Plotnikov, 2004). Three species of kilka (*Clupeonella* spp.) are commercially important in the Caspian Sea and in the past decade they account more than 80% of the total catch (Mamedov, 2006).

This species are anchovy kilka (*Clupeonella engrauliformis*, Bordin, 1904), bigeye kilka (*Clupeonella grimmi*, Kessler, 1877) and common kilka (*Clupeonella cultriventris caspia*, Svetovidov, 1941).

The weight-length relationship use for comparing the condition, fatness, reproduction history, life cycle and the general health of fish species, assessing population (Tesch, 1968; Pauly, 1993; Froese, 2006; Hossain et al., 2006). The weight-length relationship (WLR) has also been used for estimating the weight at a given length. In some studies, the condition factors were applied for comparing the condition, fatness, or well-being of fish (Froese, 2006; Hossain et al., 2006).

The available information on fisheries biology (including the weight-length relationships) in Iranian waters are limited to some reports on commercially important marine and freshwater fishes (Hosseini, 2002; Naddafi et al., 2002; Shokri et al., 2005; Esmaeili, 2006; Esmaeili and Ebrahimi, 2006; Heydarnejad, 2009). Additionally, a number of studies including length-weight relationships from the coast of Azerbaijan, Caspian Sea (Mamedov, 2006), population dynamics and biological characteristics from southeastern coast of the Caspian Sea (Mazandaran waters, Babolsar) (Karimzadeh et al., 2010) and natural, fishing and total mortality, survival and exploitation rates from the southeast Caspian Sea (Babolsar) (Karimzadeh, 2011) of this species have been conducted. However, a detailed studies on weight-length relationship (WLR) on the kilka species from the southwest Caspian Sea are still lacking. Therefore, the present study was aimed to determine WLR for *Clupeonella cultriventris caspia* (Bordin, 1904) in the fishing grounds of Southwest Caspian Sea (Guilan coastal waters).

2. MATERIALS AND METHODS

2.1 Collection of Samples

Data were collected during seven fishing surveys of the southwest Caspian Sea (37° 29' N 49° 17' E) (Guilan coastal waters) (Figure 1). The surveys were carried out during the summer and autumn of 2010. Samples were caught at the depths of 12 to 43 m by lift nets equipped with underwater electric lights. A total of 100-150 specimens were randomly selected during at each sampling and transferred to the laboratory where they were identified to the lowest taxonomic level using morphometric and meristic characteristics (Berg, 1948).

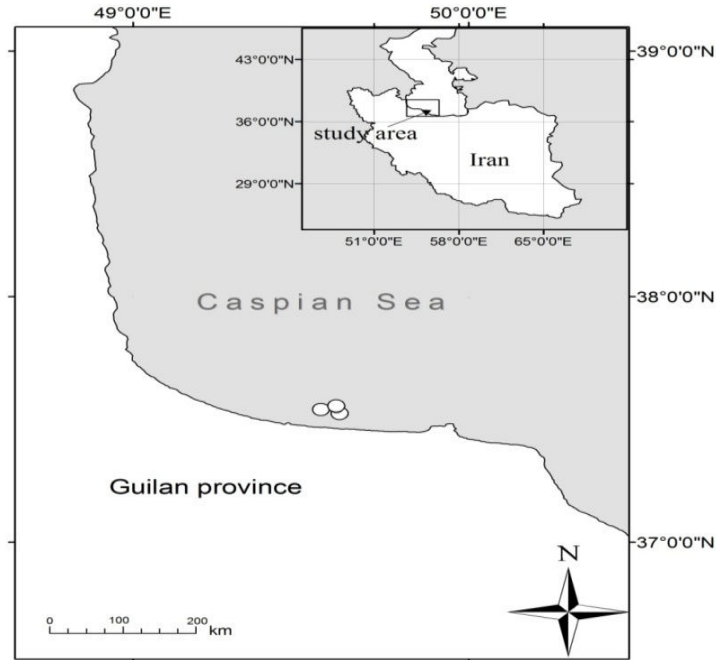


Fig. 1. Map of the study area in the Caspian Sea.
White circles indicate locations of sampling

2.2 Data Analysis

The collected samples were considered to adequately representing the spatial of the region (Fig. 1). Total length (cm) and whole body weight (g) were measured for all samples. The W-L relationship was estimated by using the equation:

$$W = aL^b$$

Where W is the whole body weight (g), L is fork length (cm). Parameters *a* and *b* of the weight-length relationship was estimated by linear regression analysis based on logarithms:

$$\log(W) = \log(a) + b \log(L).$$

The 95% confidence limits of parameters *a* and *b* and the coefficient of determination R^2 were also calculated. To demonstrate significant difference of obtained *b*-value in equation from the isometric value 3, a t-test was used, expressed by the following equation (Sokal and Rohlf, 1987);

$$t_s = \frac{b-3}{s_b}$$

Where t_s is the t-test value, *b* the slope and s_b the standard error of the slope (*b*).

Comparison between obtained t-test values and the respective tabled critical values allowed the determination of the *b* values statistically significant, and their inclusion in the isometric

($b=3$) or allometric range (negative allometric; $b<3$ or positive allometric; $b>3$) (Hossain, 2010). The WLRs were determined for sexes and seasons separately.

ANCOVA was used to determine if there were significant differences in the *WLR* between the sexes and seasons (Zar, 1999).

3. RESULTS AND DISCUSSION

Descriptive statistics on the length and sample size (N), regression parameters a and b of the *WLR*, 95% confidence intervals of a and b , the coefficient of determination (r^2) of 5 analyzed species are shown in Table 1. The results indicated a significant relationship ($P<0.001$) between length and weight of *C. cultriventris caspia*.

The calculated b values for males, females and overall population were 2.37, 2.57 and 2.52, respectively.

The result shows that increasing rate of body length and body weight is not proportional, as compared to the $b= 3$. This is a negative allometric growth ($b<3$, $P<0.001$) for males, females and overall population which is similar to the b values (2.588) previously recorded for *C. cultriventris caspia* (Mamedov, 2006).

ANOVA of length-weight relationships was significant between sexes and seasons for *C. cultriventris caspia*. The significant differences in slope of length-weight relationships between females and males could be due to this difference of length and weight in sexes. Also, weight-length relationships may present temporal variations due to water temperature, food availability and reproductive activities (Weatherly and Gill, 1987; Wootton, 1992).

There have been some studies on length-weight relationships of *C. cultriventris caspia* in the Caspian Sea and other locations (Mamedov, 2006; Tarkan et al., 2006; Karimzadeh et al., 2010) and the b values reported in these studies are presented in Table 3. Our results mostly agreed with the study done by Mamedov (2006) (Table 2). Nevertheless, Tarkan et al. (2006) recorded the positive allometric growth in the Marmara region (NW-Turkey), which is not accordance with the present study. However, the variations in the b values may be attributed to differences in ecological conditions of the habits or variation in the physiology of animals, or both (Hossain et al., 2009), due to sex and season (Hossain et al., 2006), feeding rate, gonadal development and growth phase (Hossain et al., 2011) all of which were not accounted for the present study.

Most specimens did not include very small fish due to the selectivity size of fishing gear. Therefore, the use of these W-L relationships should be limited to the size ranges applied in the estimation of the exponential regression equation.

Table 1. Descriptive statistics and W-L relationship parameters for *Clupeonella cultriventris caspia* according to the sexes and the seasons

Factors	N	Length (cm)				WLR parameters and statistics						
		Mean	S.E	Min	Max	a	SE(a)	95%CL(a)	b	SE(b)	95%CL(b)	R ²
Male	158	10.98	0.07	8.21	13.24	0.0276	0.092	0.0181-0.0422	2.37	0.089	2.196-2.549	0.909
Female	182	10.99	0.07	7.48	13.83	0.0169	0.068	0.0123-0.0230	2.57	0.066	2.439-2.700	0.946
Overall	340	10.96	0.05	7.36	13.87	0.0189	0.054	0.0147-0.0242	2.52	0.052	2.420-2.627	0.933
Summer	196	11.00	0.07	7.68	13.84	0.0123	0.062	0.0092-0.0163	2.70	0.060	2.580-2.818	0.954
Autumn	144	10.92	0.08	7.72	12.91	0.0352	0.092	0.0231-0.0536	2.27	0.089	2.094-2.446	0.906

(N: sample size, S.E: standard error; Min: minimum, Max: maximum, a and b: parameters of equation $W = aL^b$, 95%CL: confidence limits, R²: coefficient of determination)

Table 2. Results of length-weight relationship for fish species in different area

Species	Length Min-Max	a	b	Location	References
<i>Clupeonella cultriventris caspia</i>	6-11.5 8.9-10.7	0.0257 0.0034	2.588 3.380	West Caspian Sea Marmara region	Mamedov, Elchin V, 2006 Tarkan, A.S., Gaygusuz, O. Acipinar, H. Gürsoy, C. and Ozulug, M. 2006

4. CONCLUSION

Most specimens did not include very small fish due to the selectivity size of fishing gear. Therefore, the use of these W-L relationships should be limited to the size ranges applied in the estimation of the exponential regression equation.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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