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On the condition factor of fish species: a case study

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ABSTRACT

In this study the length-weight relationship, relative condition factor (K_{rel}) and relative weight (W_r) for three fish species in Iranian coastal waters of the Caspian Sea is recorded. Fish sampling was carried out in the beach seine fishing grounds in autumn and winter seasons for two years (2007 and 2009). 14104 specimens were measured and weighed. The values of the exponent b in the length-weight relationships (LWRs) were 2.8449 for Cyprinus carpio, 2.8844 for Liza aurata and 2.9077 for Rutilus frisii kutum. Relative condition factor (K_{rel}) values were ranged from 1.017±0.002 to 1.071±0.002. In addition, Relative weight (W_r) ranged from 0.929±0.002 to 1.740±0.004.

1. Introduction

The Caspian Sea is the largest lake in the world that Iran is associated with that via the coasts of Guilan, Mazandaran and Golestan provinces (Alizadeh, 2004). This lake has a rich diversity of aquatic species. One of the common methods of fishing in this lake is the beach seine fishing which accounts for about 60 percent of total fishing in the area (Iranian Fisheries Statistic Yearbook, 2008).

Rutilus frisii kutum (Kamensky, 1901), *Liza aurata* (Risso, 1810) and *Cyprinus carpio* (Linnaeus, 1758) are the most important fish species in fishing composition and they account for more than 95 percent of the beach seine fishing. In terms of economic, employment and income the three species mentioned before play a significant role in people's lives and livelihoods (Abdolmalaki and Ghaninejad, 2005). *R. frisii kutum* is the most valuable species in this fishing method and it is widely reproduced artificially in reproduction and breeding farms in Iran, and release into the Caspian Sea every year (Razavi sayad, 1999). This species lives only in the basin southern Caspian Sea and so far, it hasn't been reported its length-weight relationships in Fish base and neither the other two species (*L. aurata* and *C. carpio*) in Iran (Froese and Pauly, 2012).

In this study, length-weight relationship (LWR), relative condition factor (*Krel*) and relative weight (*Wr*) for these three species is discussed. Although some research has been conducted to estimate length-weight relationships for this species of the world's fisheries (Carlander, 1969; Stergiou and Moutopoulos, 2001; Borges et al, 2003; Dulcic and Glamuzina, 2006) but no research have not looked at the situation in Iran. The aim of the present study was to determine WLRs, Relative condition factors and Relative weight for this three species in the beach seine fishing grounds of Caspian Sea.

2. Materials and methods

2.1 Data collection

Fish specimens were collected monthly from 130 fishing grounds beach seine with a net mesh size of 28-33 mm STR (48° 52′ E, 38° 19′ N to 53° 45′ E, 36° 25′ N, Iran) in autumn and winter seasons for two years (2007 and 2009). There was no sampling in, spring and summer because they are close seasons for beach seine fishing in Iran. Numbers of different sizes were separated of combination fishing randomly and then the fresh specimens measured and weighed using the total length (TL, nearest 0.1 cm) and body weight (BW, nearest 1 g) respectively. Total data were pooled together in each species without sexing.

2.2. Data Analysis

The length-weight relationships were estimated by using following equation (Froese, 2006):

$$W = aL^b \quad (1)$$

Where W is the body wet weight (g), L is the total length (cm), a is the intercept of the regression and b is the regression coefficient (slope).

The parameters a and b of the length-weight relationships were estimated by the least-squares method based on logarithms:

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$$Log\ (W)\ =\ log\ (a)\ +\ b\ log\ (L) \qquad (2)$$

A t-test was used for comparison the b values obtained from the linear regressions with isometric values (Sokal and Rohlf, 1987):

$$t_s = \frac{(b-3)}{S_b} \qquad (3)$$

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

The comparison between the obtained values of t-test and the respective tabled critical values allowed the determination of the b values statistically significant, and their inclusion in an isometric (b=3) or allometric range (negative allometric; b<3 or positive allometric; b>3).

In addition, for each individual, the relative condition factor (K_{rel}) and the relative weight (Wr) were calculated by following the equations (Le cren, 1951 ; Froese, 2006 ; Wege and Anderson, 1978):

$$K_{rel} = \frac{W}{aL^b} \qquad (4)$$

$$W_{rm} = 100\frac{W}{a_m L^b} \qquad (5)$$

$$W_r = \frac{W}{W_S} \qquad (6)$$

Where W is the body wet weight (g), L is the total length (cm), a and b are the parameters of length-weight relationships, W_s is a standard weight representing the 75th percentile of observed weights at that length, a_m is geometric mean a and b_m is geometric mean b. Statistics were performed using the R software version 2.11.0.

3. Results and discussion

A total of 14104 specimens of three fish species were collected from the fishing grounds beach seine Iranian coastal waters of Caspian Sea during the present study. The number of individuals sampled (n), the length and weight ranges, parameters a and b of the length-weight relationships, the standard error of b value and the determination coefficient (r^2) for the three species are given in Table 1. In this study the exponent b for length-weight relationships of all caught species were within the range of 2.8449-2.9077 (Fig. 1). Therefore, the parameters can be used in the referred length range (Froese, 2006).

Table 1
Descriptive statistics and length-weight parameters for the three fish species in the fishing grounds beach seine Iranian coastal waters of Caspian Sea.

		Length (cm)				WLR parameters and statistics						
Species	n	Mean	S.E	Min	Max	a	SE(a)	95%CL(a)	b	SE(b)	95%CL(b)	r^2
Rutilus frisii kutum	4870	41.95	0.094	20.5	62.5	0.0179	0.022	0.0161-0.0198	2.9077	0.0139	2.8803-2.9350	0.91
Cyprinus carpio	2090	46.08	0.181	22.7	72.4	0.0314	0.029	0.0275-0.0358	2.8449	0.0175	2.8104-2.8793	0.93
Liza aurata	7144	36.55	0.075	21.3	60.5	0.0157	0.019	0.0144-0.0172	2.8844	0.0124	2.8599-2.9088	0.93

In this study, relative weight was obtained for *R* (Table 2). *frisii kutum* 0.929±0.002. Several factors influence in the growth of the fish such as hereditary characteristics, food reserves, environmental factors, pollution, etc. Investigations carried out indicate that growth *R. frisii kutum* in the recent years has decreased (Abdolmalaki and Ghaninejad, 2005). This can be mainly attributed to artificial breeding and restocking programs carried out every year by the Iranian Fisheries Organization. Over fishing and the elimination of larger individuals of this species due to the use of inappropriate fishing gears have also contributed to this situation. Considering that there is no selection involved in choosing male and female spawners for artificial breeding programs, the gene bank of this species is gradually shifting. Thus providing the required conditions for natural spawning in rivers where this species migrates to and or the semi-natural breeding of *R. frisii kutum* in earthen ponds where the selection of breeders is allowed even if only of a small size is stressed more than before (Khanipour and Valipour, 2009).

A result of present study isn't in agreement with reports of Stergiou and Moutopoulos (2001) and Carlander (1969) and is in agreement with reports of Tarkan et al (2006).

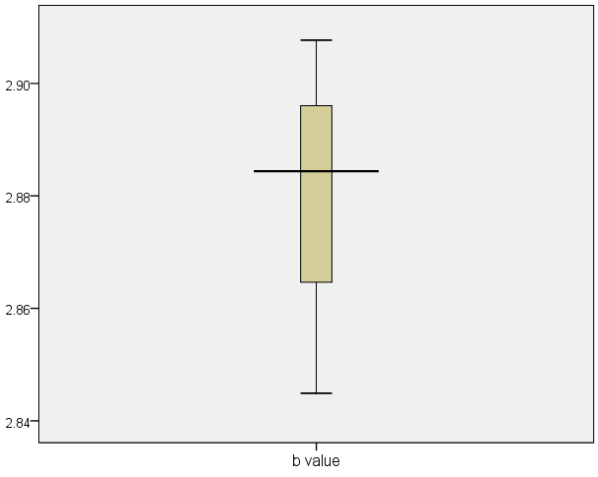

Fig. 1. Box plots of exponent b values of the length-weight relationships for three fish species caught in Beach seine fishing grounds Iranian coastal waters of Caspian Sea. The box includes 50% of the data values. The central liner shows the median, and the vertical line represents the range of values.

In studies of population dynamics high condition factor values shows of favorable environmental conditions (such as: habitat and prey availability) and low values indicate less favorable environmental conditions (Blackwell et al., 2000). Relative condition factor (*Krel*) is commonly factor for indicate the condition of fish species. In our study, *Liza aurata* (1.071±0.002) had best performance, while Krel value in *Rutilus frisii kutum* (1.017±0.002) was lowest across caught species.

Table 2
Relative condition factor (K_{rel}) (±S.E) and Relative weight (W_r) (±S.E) for the three fish species in the fishing grounds beach seine Iranian coastal waters of Caspian Sea.

	Relative condition factor (K_{rel})			Relative weight (W_r)		
Species	Mean	Max	Mean (S.E)	Mean	Max	Mean (S.E)
Rutilus frisii kutum	0.43	2.57	1.017±0.002	0.38	2.32	0.929±0.002
Cyprinus carpio	0.45	2.91	1.029±0.004	0.69	4.30	1.594±0.006
Liza aurata	0.38	3.28	1.071±0.002	0.62	5.25	1.740±0.004

Table 3
Length-weight relationships obtained from other parts of the world for L. aurata and C. carpio.

Species	Location and references	Type of length	Length (cm)	sex	*a*	*b*
Liza aurata	Portugal; Algarve, (Borges et al, 2003)	TL	20.1-40.5	unsexed	0.0078	3.006
	Croatia; Eastern Adriatic, (Dulcic and Glamuzina, 2006)	TL	21.5 - 44.2	unsexed	0.0181	2.925
	Greece; G. Saronikos, (Stergiou and Moutopoulos, 2001)	SL	15.5 - 21.0	mixed	0.0078	3.320
Cyprinus carpio	Japan; Shioda Plain, Nagano Prefecture, (Carlander, 1969)	TL	31.5 - 57.0	unsexed	0.0060	3.210
	Turkey; Lake Iznik, Marmara, (Tarkan et al, 2006)	TL	14.2 - 48.8	unsexed	0.0250	2.830
	Spain; Araquil River, Navarra, (Miranda et al, 2006)	TL	7.1 - 59.0	mixed	0.0120	3.070

Table 3 indicates the *a* and *b* parameters of Weight-length relationships of selected species obtained from other parts of the world. Our results mostly agreed with the sturgeon species studies given in Table 3. The difference of *a* and *b* can be affected area, sex, season, degree of stomach fullness, gonad maturity, health, habitat, nutrition (Tesch, 1971).

4. Conclusion

This study presented the basic information on the weight-length relationships, condition factors and relative weight for three species fish species from the Caspian Sea, north of Iran, which would be useful for fishery managers as well as the sustainable management of its stocks in the region. Moreover, there are no condition factors and relative weight currently in the Fish base for these species and therefore, our results may contribute to this invaluable database.

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