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Sturgeon fish and related impressing factors

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Abstract: In this paper, the data reported were collected by two different types of fishing gears: fixed gillnet with different specify mesh size range and beach seine. The sample size ranged from 35 cm for Acipenser nudiventris to 361 cm for Huso huso. The b value ranged between 2.780 for Acipenser stellatus and 2.972 for Acipenser nudiventris. The coefficient of determination (r^2) was very significant for all the species. To the authors' knowledge, all weight-length relationships presented in this paperare reported for the first time from the South of Caspian Sea, and in the case of Acipenser persicus is the first references worldwide.

Key words: Weight-length; Sturgeon; Caspian Sea

1. Introduction

Among various biometric relations in fishes, the weight–length relationships (WLR) are greatly presented by authors as functional tools with several applications in the fields of fisheries research, ecology, population dynamics, and stock assessment (Pauly, 1993; Erzini, 1994; King, 1995; Petrakis and Stergiou, 1995; Santos et al., 2002; Ferreira et al., 2008). The weight-length relationships (WLR) have 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).

The available information on fish population biology (including length-weight relationship) in Iran is 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; Hydarnejad, 2009). Six species of Sturgeon species in the Caspian Sea have been identified including: beluga (*Huso huso*), Persian sturgeon (*Acipenser persicus*), Russian sturgeon (*Acipenser gueldenstaedti*), ship sturgeon (*Acipenser nudiventris),* stellate sturgeon (*Acipenser stellatus*) and starlet (*Acipenser ruthenus*).

Sturgeon populations are declining all over the world, due to over-fishing, pollution and habitat degradation. These "living fossils" are highly valuable due to their caviar and meat. Also, despite the existence of some studies about sturgeon population in the south Caspian Sea, the information available on W-L relationships is very dispersed and limited. The aim of the present study was to determine WLRs and condition factors for Sturgeon species in the fishing grounds of Southeast Caspian Sea.

2. Materials and methods

The Caspian Sea is a brackish lake that it has been costal in, Iran, Russia, Azerbaijan, Turkmenistan and Kazakhstan. The Caspian Sea has a 77,000 km^3 volume and surface area is about 436,000 km^2 (Aladin and Plotnikov, 2004).

At each site, samples were obtained monthly from January 2009 to December 2010, with the exception of June, August and September (the latter two months due to the closed season) (Fig. 1).

A total of 361 samples was caught by two different types of fishing gears, (i) fixed gill nets of mesh sizes, 100, 150 and 250 mm (ii) beach seines of mesh sizes 30, 33mm. Fixed gillnets were placed in winter, late summer and autumn in the depths of 3-10 m, and also were placed in spring in the depths of 1-6 m. Also; Samples were obtained as by catch from the beach seine in the samples collected considered to adequately representing the spatial of the region.

For each specimen, the Total length (TL) was measured to the nearest 0.1 cm, and body weight was measured on a digital scale with 0.1 g accuracy. The W-L relationship was estimated by using the equation:

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

Where W is the whole body weight (g), L is fork length (cm). Parameters a and b of the weight-length

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relationship was estimated by linear regression analysis based on logarithms:

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

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);

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

Where t_s is the t-test value, b the slope and s_b the standard error of the slope (b). Comparison between obtained values of t-test and the respective critical values table allowed for determination of b values statistically significant, and their replacement in the isometric range (b=3) or allometric range (negative allometric; b<3 or positive allometric; b>3).

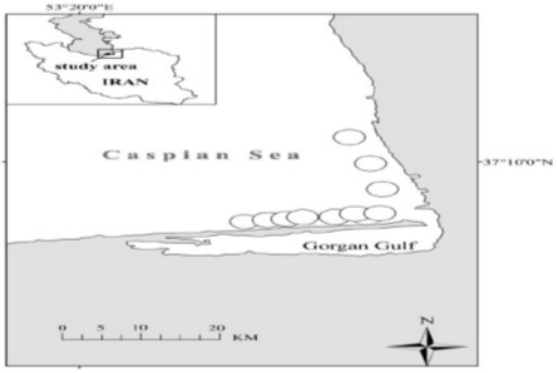

Fig. 1. Location of study and sampling positions in Caspian Sea, Circles showed sampling study area

Where, t_s is the t-test value; b is the slope and s_b is the standard error of the slope (b). Comparison between obtained values of t-test and the respective tabled critical values give the determination of the b values statistically significant, and their inclusion in the isometric range (b=3) or allometric range (negative allometric; b<3 or positive allometric; b>3).

The relative condition factor (K_{rel}) for each individual was calculated according to Le Cren (1951) equation:

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

Where W is the body weight (g), and L, fork length (cm), and a and b, the parameters of the WLR. Fulton's condition factor K was calculated by the formula (Htun-Han, 1978):

$$K = 100\frac{W}{L^3} \qquad (5)$$

3. Results

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 with are shown in Table 1. These results displayed that there was a significant relationship between length and weight for all species ($P < 0.001$). In this study, the b value ranged from 2.780 (*A. stellatus*) to 2.972(*A. nudiventris*) and Coefficient of determination (r2) ranged between 0.824 in *Huso huso* and 0.910 in *A. nudiventris*.

The growth was negative allometric (b<3, P<0.05) for A. *persicus. Huso huso*, A. gueldenstaedti, A. nudiventris and A. stellatus indicated isometric growth (b =3, P > 0.05) (Table 2).

Relative condition factor (Kn) and Fulton's condition factor (K) showed in Table 3. In this study, the K_n was ranged from 1.009 ± 0.008 (*A. stellatus*) to 1.156 ± 0.033 (*A. nudiventris*). The minimum and maximum of Fulton's condition factors (K) was 0.3516 and 0.7826 for *A. stellatus and Huso huso* respectively.

4. Discussion

In our study, the results showed a suitable estimation of weigh-length relationship, whereas parameter b lied between the expected ranges of 2.5-3.5 (Froese, 2006). The present study used a large number of Specimens with different body sizes captured by some traditional fishing gears. However, it was not possible to catch fishes smaller than 35 cm TL. The absence of small sized fishes (<35 cm TL) was associated with the selectivity of the fishing gear rather than the absence of small sized individuals in the study area. Therefore, the use of these W-L relationships should be limited to the size ranges applied in the estimation of the exponential regression equation.

Length-weight relationships are not constant over the year and Length-weight relationships

parameter may vary significantly due to biological, food availability, temporal and sampling factors, health and sex (Bagenal and Tesch, 1978; Froese, 2006) all of which were not considered for in this study. Since all the specimens were collected over several season, data are not representative of a specific season of the year. The parameters *a* and *b* in this study should only be considered as mean annual values.

Table 1
Descriptive statistics and W-L relationship parameters for sturegeon of the southestern Caspian Sea

Length (cm)						*WLR* parameters and statistics						
Family/species	n	Mean	S.E	Min	Max	*a*	SE(*a*)	95%CL(a)	*b*	SE(*b*)	95%CL(*b*)	r^2
Acipenseridae Huso huso	72	257.15	6.180	75	255	0.0139	0.152	0.0069-0.0270	2.807	0.102	2.672-2.941	0.824
A. nudiventris	35	170.73	5.078	116	211	0.0068	0.393	0.0010-0.0436	2.972	0.176	2.611-3.334	0.910
A. stellatus	70	156.41	3.839	95	250	0.0104	0.261	0.0031-0.0346	2.780	0.119	2.541-3.019	0.901
A. gueldenstaedti	71	150.71	4.680	35	225	0.0097	0.246	0.0034-0.0310	2.880	0.113	2.653-3.107	0.902
A. persicus	361	171.72	1.047	72	255	0.0139	0.152	0.0069-0.0270	2.807	0.060	2.672-2.941	0.827

Table 2
Type of growth for five sturgeons of the Caspian Sea

Family/species	n	T (value)	*b*	Growth type
Acipenseridae Huso huso	72	1.892	2.807	isometric
A. nudiventris	35	0.159	2.972	isometric
A. stellatus	70	1.848	2.780	isometric
A. gueldenstaedti	71	1.090	2.880	isometric
A. persicus	361	3.216 (P < 0.001)	2.807	allometric

Since *A. nudiventris* is exposed danger of extinction highly, little samples were obtained. For *A. persicus*, no relationship was available in FishBase (Froese and Pauly, 2008).

Table 3
Relative condition factors (Kn) and Fulton's condition factors (K) of five sturgeon from the Caspian Sea, during January 2009 to Desember 2010.

Fulton's condition factor (K)						*Relative condition factors (K_n)*					
Family/species	n	Mean	S.E	Min	Max	95%CL	Mean	S.E	Min	Max	95%CL
Acipenseridae Huso huso	72	0.7826	0.017	0.5508	1.4232	0.0338	1.062	0.021	0.7441	1.808	0.0418
A. nudiventris	35	0.6010	0.017	0.4188	0.8329	0.0345	1.156	0.033	0.8036	1.585	0.0669
A. stellatus	70	0.3516	0.008	0.237	0.7047	0.0159	1.019	0.024	0.6843	1.922	0.0478
A. gueldenstaedti	71	0.5629	0.025	0.2827	0.4188	0.0498	1.050	0.042	0.5077	3.297	0.0838
A. persicus	361	0.5243	0.004	0.2449	0.9602	0.0786	1.009	0.008	0.4310	1.634	0.0157

Table 4 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 4. The difference of *a* and *b* can be affected area, sex, season, degree of stomach fullness, gonad maturity, health, habitat, nutrition (Tesch, 1971).

Table 4
The a and b parameters of length-weight relationships of selected species obtained from other parts of the

species	Min-Max (length)	*a*	*b*	Location	References
Huso huso	121 - 270	0.0136	2.879	Volga river	Belyaeva, et al. 1989
	224 - 224	0.0073	3	Sea of Azov	Crawford, R. 1993
	18 - 263	0.0040	3.163		Chugunov, N.L. and N.I. Chugunova 1964
A. nudiventris	102 - 198	0.0443	2.597	Ural river	Belyaeva, et al. 1989
A. stellatus	82 – 133	0.0192	2.284	Danube	Chugunov, N.L. and N.I. Chugunova 1964
	13 - 188	0.0340	2.584	Sea of Azov	Ceapa, C., P. Williot and N. Bacalbasa-Dobrovici 2002
A. gueldenstaedti	18 - 183	0.0085	2.994	Sea of Azov	Chugunov, N.L. and N.I. Chugunova 1964
	91 – 210	0.0039	3.056	NW Black Sea	Ambroz, A.I. 1964

5. Conclusion

This study presented the basic information on the Weight-length relationships and condition factors for five Sturgeon 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 conditions factors currently in the Fish Base for these species and therefore, our results may contribute to this invaluable database.

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