

Short Communication

Length-weight and length-length relationships in populations of *Garra rufa* from different rivers and basins of Iran

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Abstract: This study describes the length-weight and length-length relationships for 28 populations of *Garra rufa* in different basins of Iran, including Tigris, Karkheh, Karun, Persis and Hormuz. The length-weight relationships from most localities are reported here for the first time. For most populations the *b* value was not significantly different from 3, indicating an isometric growth, in a few, it was significantly bigger than 3, indicating a positive allometric growth, and in some, it was significantly smaller than 3, indicating a negative allometric growth. In the whole samples, it was not significantly different from 3, indicating an isometric growth.

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Introduction

The length-weight (LWR) and length-length (LLR) relationships are useful for the prediction of weight from length, assessment of fish stocks and give information on the condition and growth patterns of fish (Radkhah and Eagderi, 2015), and are widely used in fish biology. Herein, we provide LWRs and LLRs of doctor fish, *Garra rufa*, for populations from 28 rivers and 5 basins of Iran. There is some biological information available on this species. Esmaeili et al. (2005), Abedi et al. (2011) and Geremew et al. (2015) studied the reproductive biology of this fish in central and southwestern Iran. Gozukara and Cavas (2004) and Gorshkova et al. (2012) studied the karyology of *G. rufa* in Eastern Mediterranean of Turkey and Jordan, respectively. Patimar et al. (2010) studied some life history aspects of this species in western Iran. Shabani et al. (2013) studied the microsatellite loci of *G. rufa* to determine its population structure in Khuzestan Province, Iran. Stiassny and Getahun (2007) studied the phylogenetic placement of the Afro-Asian genus

Garra. Teimori et al. (2011) studied the micro-structure of the adhesive organ in *G. rufa* from Bushehr Basin. Vazirzadeh et al. (2015) studied the spawning induction of *G. rufa* using Ovaprim and captive rearing of the obtained larvae. Also, Esmaeili and Ebrahimi (2005), Bibak et al. (2013), Gerami et al. (2013), Hamidan and Britton (2013) and Hashemzadeh et al. (2015) studied the LWR of this fish in southern Iran. However, the length-weight and length-length relationships from many localities are reported here for the first time.

Materials and Methods

The specimens were collected during April 2010 to August 2011 by different types of fishing gears, including hand net, gill net with a mesh size of 5 mm and cast net with a mesh size of 15 mm. The samples were anesthetized in 1% clove oil solution and fixed in 10% buffered formalin and transferred to the Ichthyology laboratory of Isfahan University of Technology for further examinations. For each specimen, total length (TL), fork length (FL) and

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Table 1. Number, mean total length and weight of *Garra rufa* from different rivers and basins of Iran collected during April 2010 to August 2011.

Basin	River	Counts	Total Length (mm)		Weight (g)	Length-weight		
			Min-Max	Mean±SD	Mean±SD	<i>a</i>	<i>b</i>	<i>r</i> ²
Tigris	Alvand	12	68.09-122.83	102.25±16.00	13.72±5.00	0.0126	2.98	0.99
	Chamgordalan	30	54.30-106.84	79.11±15.00	7.29±4.00	0.0120	3.05	0.99
	Doirej	26	58.37-97.85	70.36±10.16	3.99±1.80	0.0179	2.75	0.95
	Godarkhosh	7	40.89-89.55	55.37±18.00	2.63±2.80	0.0121	2.98	0.99
	Kangir	5	56.87-65.88	62.66±3.00	2.92±0.50	0.0110	3.04	0.97
	Little Zab	6	50.45-77.25	61.74±9.00	2.92±1.00	0.0056	3.40*	0.98
	Mimeh	31	62.86-98.30	79.63±9.69	5.45±1.90	0.0116	2.95	0.94
	Sirvan	16	57.61-78.99	69.31±6.00	3.90±1.10	0.0115	2.99	0.96
	Zimakan	14	32.19-80.15	60.15±14.91	2.72±1.60	0.0061	3.30*	0.99
	All basin	147	32.19-122.83	74.29±16.56	5.49±4.10	0.0093	3.10	0.97
Karkheh	Chaghalvandi	24	43.17-131.30	87.89±29.69	11.84±9.60	0.0094	3.14	0.99
	Chardavol	7	19.82-104.31	43.07±35.10	2.92±4.00	0.0121	2.99	0.99
	Gamasiab	10	30.63-104.69	68.59±19.83	4.73±4.090	0.0094	3.14	0.99
	Kakareza	58	48.73-127.20	89.78±15.78	9.86±5.35	0.0121	3.01	0.98
	Kashkan	17	56.23-172.85	117.82±32.74	22.25±15.40	0.0140	2.91	0.97
	Saymareh	5	82.31±43.65	0.79-46.72	12.24±19.50	0.0076	3.19*	0.99
	All basin	121	19.82-172.85	88.59±29.37	11.26±10.20	0.0115	3.02	0.99
	Karun	Beshar	33	36.94-113.13	79.74±20.74	6.80±4.70	0.0114	2.99
Karun		10	81.61-130.93	106.69±18.00	15.44±6.90	0.0171	2.85*	0.97
Katola		4	50.36-96.35	72.45±22.00	5.14±4.00	0.0094	3.08	0.99
Marbor		15	55.40-127.58	80.98±21.77	7.53±7.00	0.0076	3.18*	0.98
All basin		62	36.94-130.93	83.92±22.64	8.26±6.00	0.0099	3.06	0.98
Persis	Ahram	9	58.63-98.52	71.36±12.25	4.83±3.00	0.0142	2.92*	0.98
	Bahoosh	8	60.30-72.43	66.90±4.65	3.77±0.80	0.0099	3.11	0.78
	Darolmizan	11	29.25-65.24	49.22±10.64	1.55±0.80	0.0094	3.12	0.99
	Karzin	16	22.45-58.02	31.72±7.91	00.41±0.40	0.0132	2.83*	0.99
	Mond	17	61.95-106.09	74.07±10.96	4.55±2.50	0.0060	3.27*	0.93
	Safid	5	32.02-85.61	60.73±19.48	2.86±2.00	0.0097	3.04	0.99
	Shahpour	4	55.04-100.36	78.60±19.82	5.20±3.00	0.0209	2.63*	0.99
	Sheldan	33	39.49-68.47	49.05±5.96	1.30±0.50	0.0096	3.06	0.98
	All basin	103	19.82-172.85	51.37±17.42	2.01±2.20	0.0095	3.06	0.98
Hormuz	Axe Rostam	19	33.48-75.74	54.57±12.00	2.00±1.00	0.0059	3.34*	0.99
	Total	452	19.82-172.85	72.05±25.80	6.19±7.10	0.0092	3.11	0.99

standard length (SL) to the nearest 0.01 mm and whole body wet weight to the nearest 0.01 g was measured.

The relationships between body length parameters were calculated by the method of least squares to fit a linear regression as: $Y = a + bX$, where, Y is standard and fork lengths, X is total length, a is proportionality constant and b is regression coefficient (Le Cren 1951; Haddon, 2011.). The length-weight relationship was estimated with log-transformed equation: $W = \alpha L^b$ and $\log(W) = \log(\alpha) + b \log(L)$, where W is the whole body weight (g), L is the total length (cm), α is intercept i.e. coefficient related to the body, and b is an exponential

expressing relationship between length-weight. Prior to regression analyses, log-log plots of the length-weight pairs were performed to identify outliers (Froese, 2006; Froese et al., 2011). Extreme outliers attributed to data error were excluded from the analyses.

Results and Discussion

Length-weight and length-length relationships of the selected populations and related statistics are presented in Tables 1 and 2. The exponent b in length-weight relationships should normally fall between 2.5 and 3.5 (Froese, 2006). In this study, the exponent b for all the populations was within this

Table 1. Length-length relationships for populations from different basins in Iran.

Basin	Equation	LWR parameters		
		<i>a</i>	<i>b</i>	<i>r</i> ²
Tigris	FL= <i>a</i> + <i>b</i> ×TL	0.058	0.910	0.99
	SL= <i>a</i> + <i>b</i> ×TL	0.128	0.851	0.98
Karkheh	FL= <i>a</i> + <i>b</i> ×TL	0.026	0.930	0.99
	SL= <i>a</i> + <i>b</i> ×TL	0.069	0.839	0.99
Karun	FL= <i>a</i> + <i>b</i> ×TL	0.080	0.922	0.99
	SL= <i>a</i> + <i>b</i> ×TL	0.182	0.823	0.98
Persis	FL= <i>a</i> + <i>b</i> ×TL	0.012	1.125	0.99
	SL= <i>a</i> + <i>b</i> ×TL	0.080	0.740	0.98
Hormuz	FL= <i>a</i> + <i>b</i> ×TL	0.072	0.933	0.99
	SL= <i>a</i> + <i>b</i> ×TL	0.474	0.728	0.99
All	FL= <i>a</i> + <i>b</i> ×TL	0.933	0.074	0.99
	SL= <i>a</i> + <i>b</i> ×TL	-0.114	0.850	0.99

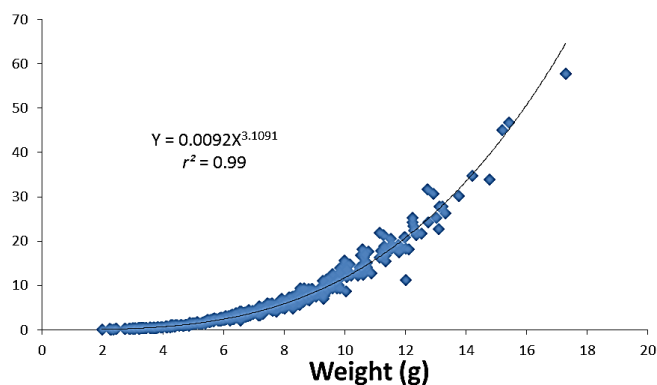


Figure 1. Length-length relationships for populations from different basins in Iran.

range and therefore, the parameters can be used within the referred length ranges. In most populations, the *b* value was not statistically different from 3, indicating an isometric growth. In some populations, it was significantly smaller than 3, indicating a negative allometric growth and in a few, it was significantly bigger than 3, indicating a positive allometric growth. In the whole samples, it was not significantly different from 3, indicating an isometric growth (Fig. 1). However, length-weight relationships may vary due to changes in food availability, stage of sexual maturity and other factors such as sampling and preservations techniques (Froese, 2006; Alavi-Yeganeh et al., 2011; Daneshvar et al., 2013; Hasankhani et al., 2013, 2014; Ghanbarifardi et al., 2014), none of which were considered in this study. In conclusion, this study provides basic information on LWRs and

LLRs for this species that would be useful for fishery biologists and managers in Iran.

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چکیده فارسی

روابط طول-وزن و طول-طول جمعیت‌های *Garra rufa* در رودخانه‌ها و حوضه‌های آبریز مختلف ایران

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چکیده:

این مطالعه روابط طول-وزن و طول-طول ۲۸ جمعیت ماهی *Garra rufa* در حوضه‌های آبریز ایران شامل دجله، کرخه، کارون، بوشهر و هرمز را توصیف می‌نماید. روابط طول-وزن بیشتر مکان‌های نمونه‌برداری در این مطالعه برای اولین بار گزارش می‌شود. در بیشتر جمعیت‌ها، مقادیر ضریب b تفاوت معنی داری را از عدد ۳ یعنی الگوی ایزومتریک نشان نداد، در تعداد اندکی از جمعیت‌ها این ضریب به طور معنی داری بزرگ‌تر از ۳ بود که بیانگر رشد آلومتریک مثبت آن‌ها بود، و در برخی از جمعیت‌ها نیز مقدار این ضریب به طور معنی داری کمتر از عدد ۳ بود که بیانگر الگوی رشد آلومتریک منفی آن‌ها می‌باشد. در کل نمونه‌ها، این ضریب تفاوت معنی داری از عدد ۳ نداشت که نشان‌دهنده الگوی رشد ایزومتریک این گونه در حوضه‌های مورد بررسی است.

کلمات کلیدی: کپورماهیان، دکتر ماهی، رشد، چرخه‌حیات.