Length-Weight Relationship and Fulton's Condition Factor of *Macrobrachium nipponense* (De Haan, 1849) in Southern Coasts of the Caspian Sea, Iran

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Abstract: The Length-Weight Relationship (LWR) and Condition Factors (CF) of 180 the oriental river prawn *Macrobrachium nipponense* collected from Southern coasts of the Caspian sea from May through September 2012 were studied. Shrimp samples were taken and immediately transferred to the laboratory of fish biology at University of Guilan for further analyses. Length, weight and other external features of all specimens were measured. The total length and body weight of *M. nipponense* ranged from 1.58-8.8 cm and 0.41-6.27 g, respectively. A strong positive relationship was observed between the shrimp length and weight in both sexes (r = 0.81). There were significant differences in the condition factors of males and females (p<0.05). The lowest CF value was observed in June (CF = 0.89±0.03) and the highest in July (CF = 1.90±0.33). In this study, the regression coefficient (b) was <3.0 for males, females and combined sexes which was reflecting allometric growth of the *M. nipponense*.

Key words: Length-Weight Relationship (LWR), Condition Factor (CF), *Macrobrachium nipponense*, Caspian sea, combined

INTRODUCTION

The Oriental river prawn or *Macrobrachium nipponense* has been imported accidentally and been able to successfully establish local populations in several parts of the country. The species belongs to the Phylum: Arthropoda; Class: Crustacea; Subclass: Malacostraca; Series: Eumalacostraca; Order: Decapoda; Suborder: Natantia; Section: Caridea; Family: Palaemonida; Genus: *Macrobrachium*; Species, *M. nipponense*. The species are omnivorous. Spawning takes place in Spring and Summer when males with a hard shell and females with a soft one mate. Temperature has an important influence in the reproduction. Significant differences exist between the male and female. Mature males are considerably larger than females. *Macrobrachium nipponense* was first observed in Anzali Lagoon in 2008 and later on spread in water basins of the Northern Iran. Successful adaptation of the species in various water bodies lies in high tolerability and relatively easy reproduction and breeding potentials in the region. Shrimps and prawns of the genus *Macrobrachium* and *Penaeus* are highly appreciated by the people in the world. They are used as condiments in the preparation of food because of their high protein value (Umoh and Bassir, 1977; Marioghae, 1990).

Although, the species is important for aquaculture and its introduction could be considered positive to some extent but its introduction has increased competition for space and food with local species mainly freshwater crayfish. The introduction and subsequent competition has seriously deteriorated stocks of local species. Having this in mind it is necessary to investigate into the current situation of both *M. nipponensse* and local species in the region.

Study on ecological, behavioral, conservation aspects and management of water resources for better exploitation of stocks is essential in aquatic ecosystems. Understanding length-weight relationships in aquatic organisms, e.g., of fish is important in fishery management. Its importance is pronounced in assessing the average weight at given length group and in assessing the condition of fish population (Abowei *et al.*, 2008). Condition factor also has widely been used as an index of growth and feeding intensity. This figure decreases with any increase in length and has an impact on fish reproductive cycle (Abowei, 2010). In present study, researchers examined growth, age and Length-Weight Relationship (LWR) of *Macrobrachium nipponense* in Guilan Province in Southern basins of the Caspian sea.

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MATERIALS AND METHODS

Specimen sampling: The *Macrobrachium nipponense* specimens were collected from the Jirdeh river in Eastern part of Guilan Province (Southern coasts of the Caspian sea) which is a major habitat for the species. Samples were collected from April 2012 through September 2012. In total 180 shrimp specimens were sampled.

Growth pattern (length and weight): All collected samples were immediately placed in ice boxes and transported to the laboratory of fish biology at University of Guilan for further analyses. Samples sorted into male and female.

Total length (the distance from the tip of the rostrum to the end of telson) and the carapace length (the distance from the base of rostrum to the first body segment) was measured for each sample with a Vernier caliper to the nearest 0.1 mm. The shrimps were then weighed with an Ohaus balance to the nearest 0.1 g. Samples taken in each month were measured and preserved separately.

The length-weight relationship of shrimps was estimated using linear regression (Pauly, 1983). The technique is incorporated in the FAO ICLARM, Stock Assessment Tool (FiSAT) (Gayanilo and Pauly, 1997) which is routinely used in fisheries. The Length Weight Relationship (LWR) was obtained from the following relationship (Pauly, 1983; Sparre and Venema, 1998):

$$W = aL^b$$

Where:
W = Weight (g)
L = Length (cm)
a = Intercept (Regression constant)
b = Slope (Regression coefficient)

The values of a and b were given a logarithm transformation according to the following equation (Pauly, 1983):

$$\log W = \log a + b \log L$$

Condition Factor (CF): The Condition Factor (CF) reflects the effects of seasonal and habitat difference in the robustness and general wellbeing of the species. Condition Factor (CF) was determined for samples taken in each month separately. The condition factor for *M. nipponense* was calculated using the equation (Enin, 1994):

$$CF = 100 \times \frac{W}{L^3}$$

Where:
CF = Condition Factor
L = Length (cm)
W = Weight (g)

Statistical analysis: Normality of the data were tested by Shapiro-Wilk normality test. ANOVA followed by Tukey post hoc test were used to examine the significance of differences. All statistical analysis were carried out by SPSS Version 16 and figures were produced by Excel 2003.

RESULTS

Mean weight and length of shrimps were 1.73±0.07 g and 5.51±0.1 cm, respectively and the carapace length was 1.01±0.02 cm. Majority of shrimps were sexually mature and male/female ratio was 0.58:1. The Condition Factor (CF) was 1.44±0.14 and 1.09±0.09 in male and female, respectively. The highest condition factor for males equal to (CF = 1.73) was recorded in July while the lowest CF (0.87) in June and lowest condition factor (CF = 0.8) in females recorded in May and the highest (CF = 1.09) in July. There was significant statistical differences in condition factor between sexes (p<0.05). There was also significant difference in total length between samples collected in September with other months (p<0.05). Body weight did not show significant differences in different sampling times while condition factor and carapace length showed significant difference as sampling times were compared (Table 1).

Plots of the Length/Weight Relationship (LWR) of male and female *M. nipponense* from South-West Caspian sea are shown in Fig. 1-3. A strong positive relationship was observed between the shrimp length and weight for males ($r^2 = 0.73$), length and weight for females ($r^2 = 0.72$) and length and weight in all specimens ($r^2 = 0.74$) in 2012. The respective a, b and r values are given in Table 2.

Table 1: Biological data of examined specimens in South-West Caspian sea (Guilan Province)

Months	F/M	Weight (g) ±SE	Length (cm) ±SE	Condition factor±SE	Carapace length (cm) ±SE
May	14/11	1.66±0.12[a]	5.56±0.23[a]	1.14±0.19[ab]	0.84±0.03[b]
June	16/10	2.69±0.27[a]	6.58±0.23[a]	0.89±0.03[b]	0.91±0.04[b]
July	22/15	1.76±0.22[a]	5.15±0.33[a]	1.90±0.33[a]	1.76±0.22[a]
Aug.	33/13	1.57±0.07[a]	5.69±0.13[a]	0.90±0.050[b]	1.13±0.04[b]
Sep.	29/17	1.36±0.05[a]	4.97±0.12[b]	1.22±0.08[ab]	1.01±0.04[b]

Table 2: Respective a, b and r values

Sex	N	a	b	r^2	r	$W = aL^b$
Female	114	-0.89	1.49	0.72	0.78	$-0.89L^{1.49}$
Male	66	0.60	0.61	0.73	0.80	$0.6L^{0.61}$
Both sexes	180	-0.81	1.38	0.74	0.81	$-0.81L^{1.38}$

Total number of samples (N), Regression constant (a), Regression coefficient (b) and Ranges (r) of total length-total weight relationship of *M. nipponense*
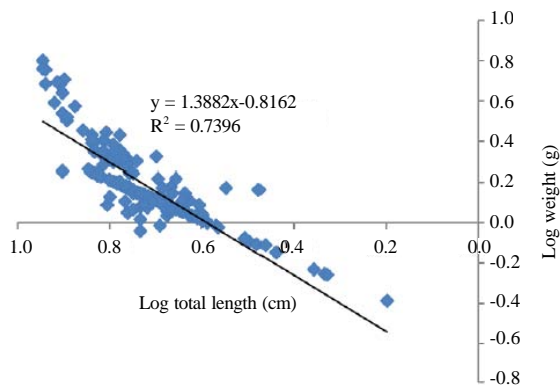
Fig. 1: Length-weight relationship in *M. nipponense* from South-West Caspian sea 2012
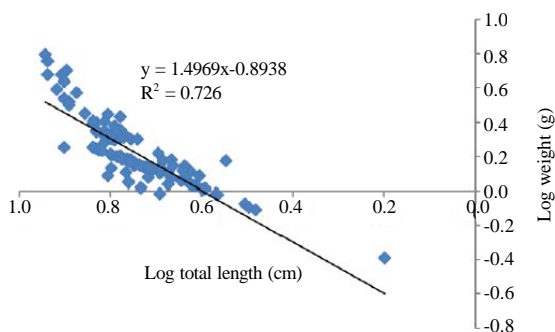

Fig. 2: Length-weight relationship in female *M. nipponense* from South-West Caspian sea 2012
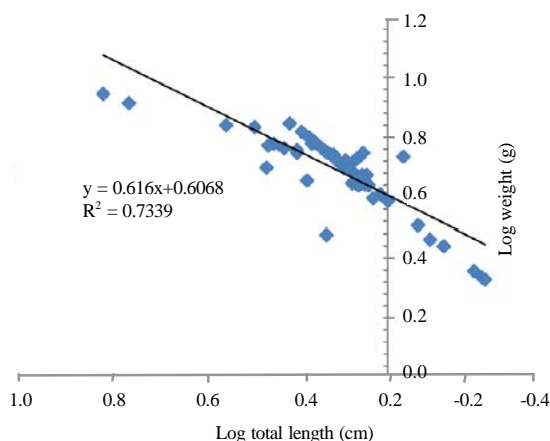

Fig. 3: Length-weight relationship in male *M. nipponense* from South-West Caspian sea 2012

DISCUSSION

Analysis of the Length/Weight Relationship (LWR) of *M. nipponense* samples revealed a highly significant correlation between the total length and weight. The b-values did not exceed 3 which means both sexes of *M. nippnense* follow an allometric growth pattern which is an agreements with the studies conducted by Andem *et al.* (2013) and Deekae and Abowei (2010) on *Macrobrachium macrobrachion* and Lawal-Are and Akinjogunla (2012) on *Penaeus notialis* who also reported allometric growth pattern. The slight variation in the values of b and r is understandable because length-weight relationship of a species could vary according to local factors such as salinity, temperature and fish health, sex, stage of maturity, length range of the species, food and time of year season (Yakub and Ansa, 2007). The correlation coefficient observed in present study (r = 0.81) shows a strong association between length and weight. The high value of coefficient of determination r^2 indicted that the model applied for analysis fits the data.

Condition factor significantly varied between sexes which may be attributed to the presence of ovigerous females. Similar results were reported by Dineshbabu (2006) who compared condition factor of male and female *Metapenaeus monoceros* from Bhidiya. Another study conducted by Andem *et al.* (2013) has also reported that condition factor significantly varied males and females of *Macrobrachium macrobrachion* from great Kwa river. They attributed these differences to feeding regime, time of the year and higher weight of female gonad. Knowledge on length-weight relationships and also condition factor of introduced or invaded species are essential for assessment and appropriate management of alien and native species in an aquatic system, e.g., lagoon or the Caspian sea itself.

CONCLUSION

Both sexes of *Macrobrachium nipponense* follow an allometric growth pattern in water bodies located at the southern coasts of the Caspian sea. The high value of correlation coefficient r indicates a strong association between length and weight. High value of co-efficient of determination r^2 indicated that the model used for the analysis fits the data which confirms the fitness of the model.

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