Iranian Journal of Fisheries Sciences 19(1) 496-500 2020
DOI: 10.22092/ijfs.2019.118323

Length-weight relationship and Fulton's condition factor of *Macrobrachium nipponense* (De Haan, 1849) in Anzali lagoon of Iran

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Received: April 2017 Accepted: September 2017

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Keywords: Length-weight relationship (LWR), Condition factor (CF), *Macrobrachium nipponense*, Anzali lagoon.

Introduction

The Anzali Lagoon is located on the southern coast of the Caspian Sea in the Guilan Province and has four basins, namely the Western, Eastern, Central, and South Western (De Grave and Ghane, 2006). These four sections are distinguished from each other by having different physicochemical, ecological and geographical parameters and hence, represent different ecosystems.

The Oriental river prawn (*Macrobrachium nipponense*) is natively distributed in China, Japan, Korea, Vietnam, Myanmar, and Taiwan while in Iran, Uzbekistan and Iraq is introduced (New *et al*., 2010). The same species were reported in the Anzali Lagoon in Iran in 2006 (De Grave and Ghane, 2006). In the present study, three types of traps (e.g. cylindrical pot, opera house trap, and hokkaido pot) were used for catching oriental river prawn in the Anzali Lagoon.

Understanding length-weight relationships (LWR) in aquatic organisms such as fish are important in fishery management (Khanipour and Melnikov, 2007). Its importance is in assessing the average weight of a given length as well as the condition of a population (Abowei *et al*., 2008). The condition factor for fish has also been widely used as an index of their growth and feeding intensity. The value of this index decreases with any increase in length and has an impact on the reproductive cycle of the fish (Abowei, 2010). The aim of this study was to evaluate the length-weight relationship (LWR) of *M. nipponense* in the Anzali Lagoon.

Materials and methods

Specimens of *M. nipponense* were collected from the three sites of the lagoon, namely Site 1 (Talab gharb) (37°27'9446.43"N and 49°22'9944.18"E), Site 2 (Siah darvishan) (37°25'026.42"N and 49°27'307.12"E) and site 3 (Sorkhankol) (37°25'2998.45"N and 49°24'6902.1"E) (Fig. 1), which is a preferred habitat for the species. A total of 10441 prawn specimens were sampled.

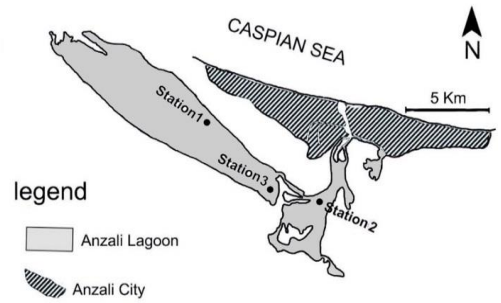

Figure 1: Location of the study area. Black circles are sampling sites.

The length-weight relationship of prawns was estimated by using linear regression statistics (Pauly, 1983) according to the following equation:

$W = aL^b$

Where, W=Weight (g); L=Length (cm); a=Intercept (Regression constant); b=Slope (Regression coefficient) (Pauly, 1983; Sparre *et al*., 1989).

The condition factor for *M. nipponense* was calculated using the following equation (Enin, 1994):

$CF=100*W/L^3$

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

The Shapiro-Wilk test was used to determine the normality of the data. Analysis of Variance (ANOVA), with the Tukey Post Hoc Test, was used to indicate whether the differences obtained were significant. All statistical analyses were done using SPSS (Version 16), while figures were produced using Excel (Version 2016).

Result and discussion

The mean weight and length of shrimps were 2.97±0.03 g and 58.85±0.1 mm, respectively. The majority of prawns were sexually mature and the male/female ratio was 0.81:1 there was a significant difference ($p \leq 0.05$) in the total length of prawns collected from Stations 1 and 2. The length of the prawns collected from these two respective stations were however, not significantly different ($p > 0.05$). Also, the body weight of the prawns sampled from the two stations did not differ significantly ($p > 0.05$) from each other for the different sampling times. However, the Condition factor of the shrimps from both stations, differed significantly for sampling times (Table 1).

Table1: Biological data of examined specimens in Anzali lagoon (Guilan Province).

Station	M/F ratio	Weight(gr) ±SE	Length(mm) ±SE	Condition factor± SE
1	5/11	2.46 ± 0.026[a]	55.9 ± 0.19[a]	1.26 ± 0.03[a]
2	9/11	3.58 ± 0.03[a]	62.9 ± 0.2[b]	1.38 ± 0.08[b]
3	3/7	2.86 ± 0.03[a]	58.33±0.2[ab]	1.32 ± 0.05[b]

Plots of the LWR of male, female and both sexes of *M. nipponense* are shown in Fig. 2. A strong positive relationship was observed between prawn length and weight for males (r^2=0.95) in Station 3, as well as the length and weight for females (r^2=0.92) in Station 2. Also, the length and weight for shrimps in all stations (r^2=0.91) showed a strong relationship. The regression coefficient and correlation coefficient factors are given in Table 2.

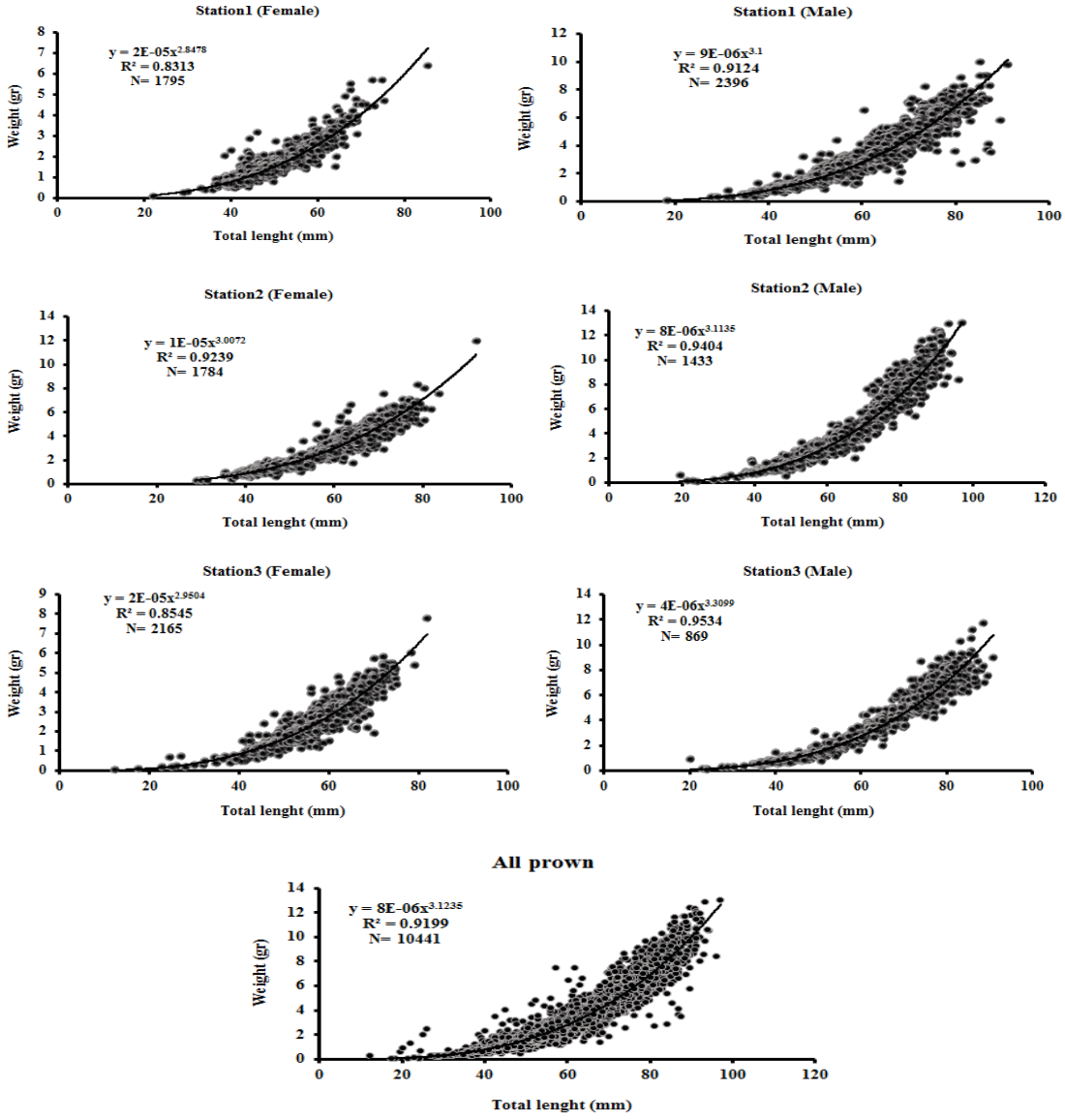

Figure 2: Length-weight relationship in *Macrobrachium nipponense* from Anzali lagoon of Iran.

Table 2: Regression coefficient (b) and correlation coefficient (R2) of length-weight relationship of Macrobrachium *nipponense*.

Station	Female		Male	
	R^2	b	R^2	b
1	0.8541	2.9126	0.9249	3.1103
2	0.9239	3.00	0.9376	3.1108
3	0.8513	2.9208	0.9534	3.3099

Analysis of the LWR of *M. nipponense* samples revealed a highly significant correlation between the total length and weight of individuals. The b values exceeded 3, with both sexes showing allometric growth pattern which is in agreement with the studies conducted by Andem *et al.* (2013) and New *et al.* (2010). The slight variation in the values of b and r is understandable because the LWR of a species could vary according to local factors such as temperature, pH, and the abundance of food and consumption of shrimp species (Abrahamsson, 1966; Zhang *et al*., 2014). Environmental changes affected not only the growth but also the shape of *L. vannamei* (Chow and Sandifer, 1991). Moreover, better biological conditions and availability of more energy is important for optimal growth. Hence, the Condition factor determines the health status of the population (Wootton, 1990; Jones *et al*., 1999). Therefore, according to ecological conditions, Station 2 had a higher Condition factor for prawn than the other stations in the lagoon. Knowledge on length-weight relationships and the Condition factor of introduced or invaded prawn species are essential for assessment and appropriate management of alien and native species in an aquatic system, especially for niches in lagoons (Javid *et al*., 2014).

In conclusion, both sexes of *M. nipponense* followed an allometric growth pattern in water bodies located at the Anzali Lagoon. On the other hand, the high value of the correlation coefficient "r" indicated a strong correlation between the length and weight of the shrimps sampled. At the end, the high value of the coefficient of determination "r^2" indicated that the model used for the analysis fitted the data that confirms the fitness of the model.

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