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ARAS REZERVUAR (İRAN)'INDA YAŞAYAN TATLISU ISTAKOZU (*ASTACUS LEPTODACTYLUS*)'NUN CİNSİYET ORANI, UZUNLUK VE AĞIRLIK DAĞILIMI

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ÖZET

Tatlısu ıstakozu (kerevit) ticari olarak avcılığı yapılan önemli krustasea türlerinden biridir. Bu canlıların besin değerleri de oldukça yüksektir. Kerevitler bentik organizmalar olup, yaşamlarının büyük bölümünü su ortamlarının tabanlarında geçirirler. Bu çalışmada, Aras baraj göletinde yaşayan *Astacus leptodactylus*'un 2011 ilkbaharı ile 2012 kış mevsimleri arasında cinsiyet oranı ve bazı biyometrik özellikleri araştırıldı. Kerevitlerin ortalama toplam uzunluğu ve ağırlığı sırasıyla 106,26±12,9 mm ve 38,79±15,5 g olarak bulundu. Bulgular, yakalanan kerevitlerden sadece %13,67'sinin standart ticari uzunluğun (120 mm) ve %19,9'unun standart ticari ağırlığın (50 g) üzerinde olduğunu gösterdi. Bulgular ayrıca, erkek bireylerin dişi bireylere oranının azda olsa daha yüksek olduğunu gösterdi (erkek: dişi, 1.07:1). Sonuç olarak, bu çalışmada elde edilen bulgular, Aras baraj göletinde daha önceden yapılan çalışmalarla karşılaştırıldığında, *A. leptodactylus'un* yakalanan miktarında ve yakalanan bireylerin büyüklüğünde azalmanın olduğunu, ortamda yaşayan kerevitin durumunun birkaç yıl öncesine göre daha iyi olmadığını, ortaya çıkarmaktadır. Bu nedenle, Aras baraj göletinde yaşayan *A. leptodactylus*'un korunması ve stok yoğunluğunun arttırılması için çalışmaların yapılmasının gerektiği düşünülmektedir.

Anahtar kelimeler: uzunluk ağırlık frekansı, cinsiyet oranı, kerevit, *Astacus leptodactylus*, Aras baraj gölü

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SEX RATIO, LENGTH AND WEIGHT FREQUENCY OF FRESHWATER CRAYFISH (*ASTACUS LEPTODACTYLUS*) INHABITING IN ARAS DAM LAKE, IRAN

ABSTRACT

Freshwater crayfish are one of the important commercially caught aquatic organisms. Their nutritional values are also considerably important. Crayfish are benthic organisms which spends most of their life on the bed of aquatic habitats. In the present study, sex ratio and some biometric characteristics of crayfish (*Astacus leptodactylus*) inhabiting in Aras dam lake was investigated seasonally between spring 2011 and winter 2012. The mean total length and weight for the crayfish were 106.26±12.9 mm and 38.79±15.5 g, respectively. The results revealed that only a 13.67% of the captured crayfish exceeded than the standard commercial size (120 mm) and only 19.9% of the samples had higher weight than the standard commercial weight (50 grams). The results also revealed that male crayfish slightly dominated in captured samples (male: female, 1.07:1). Under the light of this study, it can be concluded that decreased catch value and crayfish size in comparison to previous studies carried out last decade, *A. leptodactylus* has a critical condition in Aras dam lake. Therefore, it is thought that further researches on the conservation and improving stocking density of this species in Aras dam lake are urgently required.

Key word: length-weight frequency, sex ratio, crayfish, *Astacus leptodactylus*, Aras dam lake

1. INTRODUCTION

Decapods are among the largest groups of crustaceans constitute nearly 1200 genera and 10000 species which have been identified and reported worldwide. However, only 10 % of them live in freshwater and one percent is terrestrial (Bowman and Abele, 1982). They include three families from which Astacidae and Cambaridae distributed in northern hemisphere and Parastacidae in southern hemisphere (Abele, 1982). Freshwater crayfish are one of the economic and edible aquatics and considered as a eutroph waters refiner. Therefore, a lot of research have been carried out on

it for several years (Holdich and Lowery, 1988; Ackefors, 2000; Harlıoğlu ve Holdich, 2001; Wickins ve Lee, 2002).

Astacus leptodactylus is the only species from the genus *Astacus* in Iran. It is distributed in 3 habitats namely Aras dam lake, Anzali lagoon and Caspean Sea. This species is included 4 subspecies: *Astacus leptodactylus leptodactylus,Astacus leptodactylus salinus*, *Astacus leptodactylus cubanicus* and *Astacus leptodactylus eichwaldi* (Köksal, 1988; Harlıoğlu, 2004) where Aras dam lake and Anzali lagoon are the habitats of *A.l.leptodactylus*, and Caspean Sea is the habitat of *A.l..eichwaldi* (Mohammadi *et al*., 2007). However, there is a controversy on the taxonomic characteristics of *A.l. eichwaldi* (Starobogatov, 1995).

Bioassay indices are important factors coming into account in stock assessment of *A. leptodactylus* (Vladykov, 1964; Mehraban, 1999). Studies on length and weight frequency in an ecosystem determine the statistical groups for economic exploitation and provide a suitable pattern for fisheries management of freshwater crayfish habitat. For example, *A. leptodactylus* individuals higher than 100 mm and heavier than 30 g are permissible for harvest and export (Vladykov, 1964). In some cases commercially economic harvest length is considered as 80-90 mm, but majority of countries allow at least the length of 100 mm for harvesting (Vladykov, 1964; Westman *et al*, 1990). On the other hand, the fisheries department of West Azarbaijan Province in Iran has recognized permissible length and weight as higher than 120 mm and 50 g respectively for freshwater crayfish (Karimpour, 2003).

Sex ratio is also an important factor in stock assessment so that reproductive balance and regeneration capacity of species is directly influenced by its sex ratio in the ecosystem. Sex ratio for different populations of freshwater crayfish has been determined as 1:1 (Cobb and Wang, 1985). Disruption of gender balance in freshwater crayfish indicates the increased fishing pressure on the genus and or its vulnerability at unsuitable ecological condition that may destroy the reproductive capacity of that ecosystem in the future. Therefore, the aim of present study was focused to determine the sex ratio, length and weight frequency of *A .leptodactylus* harvested from Aras dam lake in 2011 and 2012.

2. MATERIALS AND METHODS

Astacus leptodactylus was sampled by fyke net from Aras dam lake (Figure 1) between 2011 and 2012. All samples were transferred to the laboratory of Artemia Research Center, Urmia, Iran, and their sex ratios were determined and biometrical characteristics including total length and body weight were recorded. Samples were categorized according to their length and weight. The mean of length and weight of samples was compared seasonally with one-way ANOVA and significant differences were identified using Tukey's HSD post hoc tests. Data were analysed using SPSS software.

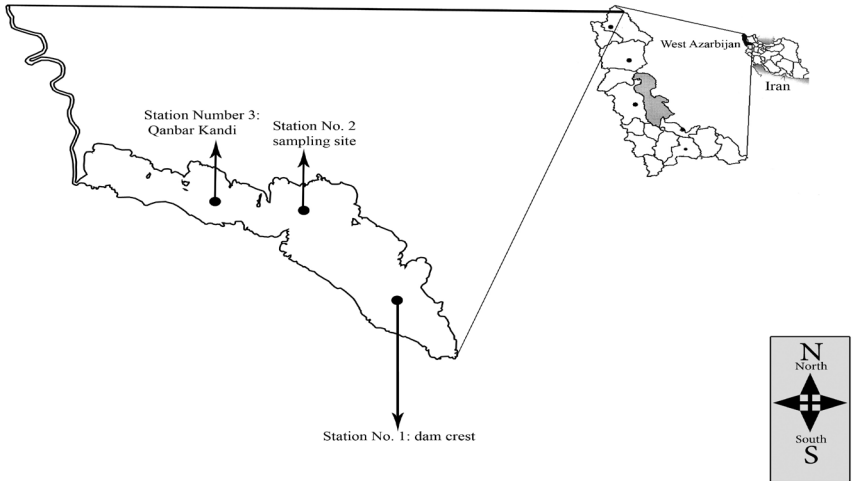

Figure 1. The location of Aras dam lake and sampling sites

3. RESULTS AND DISCUSSION

The number and mean total length (TL) of *A.leptodactylus* captured in different seasons are shown in Table 1.

Table 1. The number, mean TL (± SD), maximum and minimum TL of captured *A. leptodactylus* from Aras dam lake between spring 2011 and winter 2012

Season	Spring	Summer	Fall	Winter	Total
Number of crayfish (n)	4907	2166	3865	812	11750
Mean TL (mm)	105.98±13.34 [a]	107.76± 13.19 [b]	108.71± 14.88 [c]	102.58± 10.14 [abc]	106.26±12.9
Maximum TL (mm)	163.4	157.17	171.13	146.14	171.13
Minimum TL (mm)	83.06	65.76	65.11	81.19	65.11

The various letters in each row shows a significant difference ($p<0.05$).

Maximum and minimum mean TL were observed in the fall (108.71±14.88 mm) and in the winter (102.58±10.14 mm), respectively. Statistical analysis revealed that there was a significant difference in the mean TL between the crayfish caught in different seasons ($p<0.05$) (Table 1).

The mean total weight (TW, g) of *A. leptodactylus* caught in different seasons of 2012 is shown in Table 2. Maximum and minimum TW were observed in the fall (40.87 g) and in the winter (34.74 g), respectively. Statistical analysis showed that there was not a significant difference among mean TW ($p>0.05$), but there was a significant difference between seasons ($p<0.05$).

Table 2. Mean TW (± SD), maximum and minimum TW of captured *A. leptodactylus* from Aras dam lake between spring 2011 and winter 2012

Season	Spring	Summer	Fall	Winter	Total
Number of crayfish (n)	4907	2166	3865	812	11750
Mean TW (g)	39.63±16.18 [a]	39.93± 16.44 [b]	40.87± 17.22 [c]	34.74± 12.33 [abc]	38.79±15.5
Maximum TW (mm)	216	143	158	106	216
Minimum TW (mm)	12	16	13	18	12

[a]The various letters in each row shows a significant difference ($p<0.05$).

The percentage of length groups higher than the permitted standard value for commercial harvest (120 mm) were obtained as 17.94 %, 15.98%, 16.22% and 4.42% for the spring, summer, fall and winter, respectively The indicator groups (101-120 mm) were 54.96%, 58.12%, 62.30 % and (55.66%) for the spring, summer, fall and winter, respectively. However, totally 13.67% of the captured samples were bigger than 120 mm (Table 3 and Figure 2).

Table 3. Percentage of crayfish in length groups caught in different seasons between spring 2011 and winter 2012

Season groups / Length (mm)	Spring	Summer	Fall	Winter
60-80	1.35	1.06	0.78	1.23
81-100	24.36	23.73	19.72	38.54
101-120	54.96	58.12	62.30	55.66
121-140	17.94	15.98	16.22	4.42
141-160	1.39	1.11	0.98	---

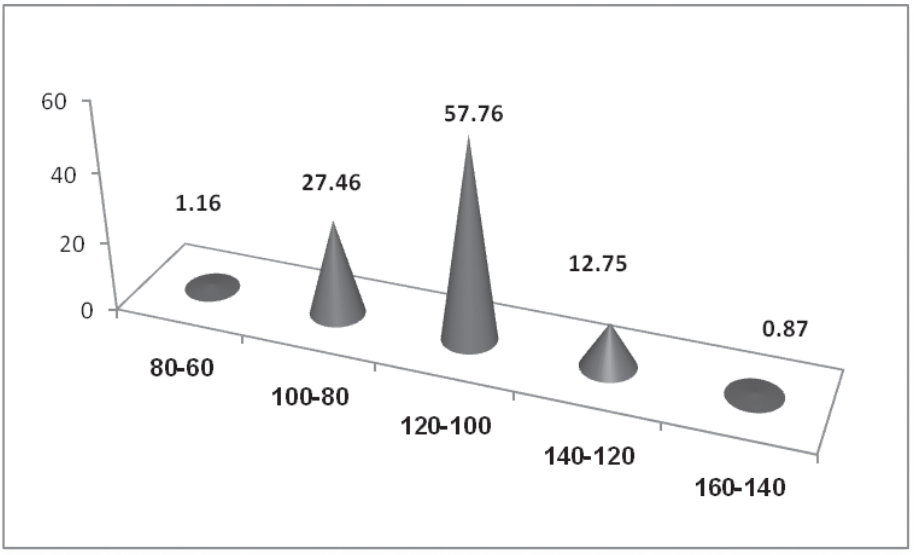

Figure 2. Percentage of crayfish in length groups caught in different seasons between spring 2011 and winter 2012

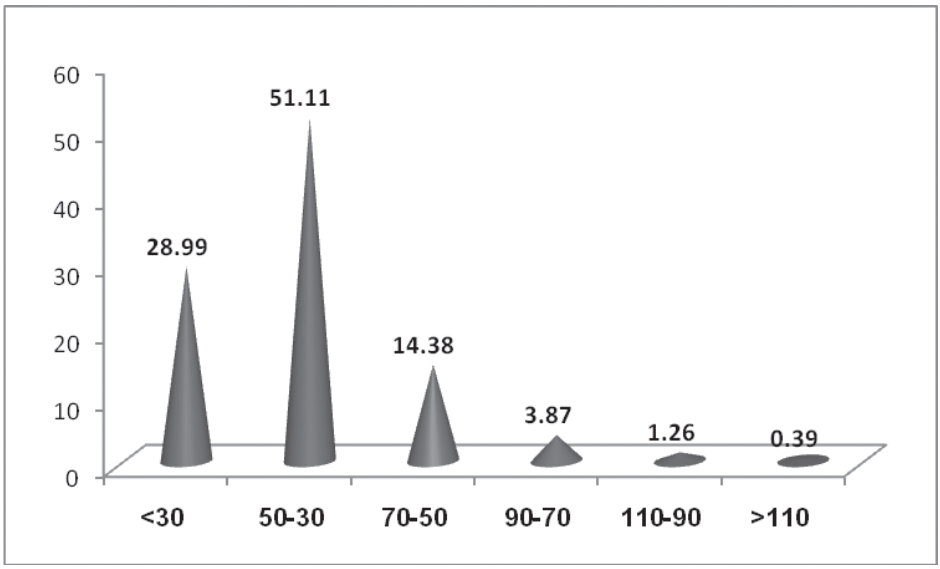

Figure 3. Percentage of crayfish in weight groups caught in different seasons between spring 2011 and winter 2012

The results showed that the weight groups higher than export level (50g) in the spring, summer, fall and winter were 27.63 %, 20.6%, 20.41% and 10.97%, respectively. However, weight of 19.9 % of crayfish was higher than that of the crayfish accepted for export (50 g) (Table 4 and Figure 3).

Table 4. Percentage of crayfish in weight groups caught in different seasons between spring 2011 and winter 2012 ,

Season / Weight groups (g)	Spring	Summer	Fall	Winter
10-30	24.21	30.49	23.34	37.90
31-50	48.16	48.90	56.26	51.11
51-70	19.9	14.22	14.04	9.63
71-90	5.8	4.51	4.32	0.86
91-110	1.75	1.6	1.22	0.48
111-220	0.47	0.27	0.83	---

In the present study, the maximum percentage of females was found 58.82% in fall and the minimum percentage was 28.16% in spring. The

maximum percentage of males was 71.84% in the spring and the minimum percentage was 41.18% in the fall (Figure 4).

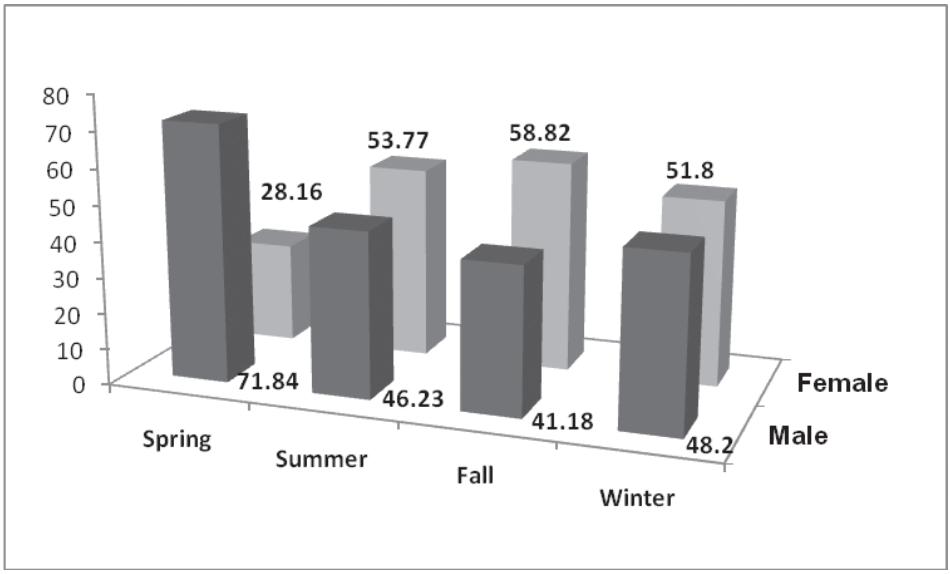

Figure 4. Percentage of male and female caught in different seasons in 2012

Population biology of freshwater crayfish in Northern beaches of Caspian Sea was studied by Romiantsef (1989). Romiantsef reported 4 length groups for Caspian crayfish: small group (smaller than 100 mm), average group (100-120 mm), large group (120-140 mm) and extra large group (longer than 140 mm). With the same criterion the crayfish of Volga delta (Russia) took the values as follows: 2.8%, 28.9%, 57% and 11.3 %, respectively. In Anzali lagoon (Iran), another habitat of crayfish, 99.9% were categorized as small and average groups (Karimpour *et al*., 1991). Similarly, these values for *A. leptodactylus* living in Aras dam lake were reported as 16.7%, 34.3%, 32% and 17 % in 1999 by Karimpour and Hosseinpour (2000) and 5.07%, 24.81%, 44.02% and 26.09% for the same population in 2002 by Karimpour (2003). In 2009, on the other hand, these values were 47.07%, 33.94%, 15.57% and 3.42 % for the dam lake (Mohsenpour Azari *et al*., 2011). In the present study, these values were obtained as 28.57%, 57.76%, 12.75% and 0.93 %, respectively.

Mean total length of Turkish crayfish,for Volga Delta, Torkamanestan beaches, Anzali lagoon, Caspean Sea and Anzali port was reported as 120 mm, 109 mm, 102 mm, 107.18 mm and 125.6 mm, respectively (Köksal, 1988; Romiantst,1989; Karimpour *et al*., 1991; 2004). Also, mean total length for Aras dam lake were reported as 120.50 mm, 128.41 mm and 106.43 mm in 2000, 2003 and 2011, respectively (Karimpour and Hoseinpour, 2000, Karimpour, 2003, Mohsenpour Azari *et al*., 2011).

Karimpour and Hoseinpour (2000) suggested that Aras dam lake crayfish population has a positive growth rate. However, in another research it has been suggested that the situation of *A.leptodactylus* was better in 2002 than 1996 (Karimpour, 2003). Similarly, the present study showed that *A. leptodactylus* stock in Aras dam lake is in crisis. The mean total length was decreased to 106.26 mm that is lower than the permitted level for export (120 mm)..

Weight of crayfish is considered as one of the most important factors for population dynamics. Low weight status in *A.leptodactylus* populations may come from capture pressure. The mean weight in *A.leptodactylus* caught from Aras dam lake were estimated as 41.02 g in 1991 (Baradaran naviri, 2001) while that of *A.leptodactylus* caught from Anzali port - Caspian Sea was 60.6 g in 2001 (Karimpour *et al*., 2004). These values were higher than export permission level. Mean weight of *A.leptodactylus* caught from Aras dam lake was 54.68 g and 68.75g in 1996 and 2002, respectively (Karimpour and Hoseinpour, 2000, Karimpour, 2003). The results revealed that in a few last years the growth condition of *A.leptodactylus* in Aras dam lake was suitable (i.e., mean weight was higher than export standards (50 g)). However, mean weight for *A.leptodactylus* from Aras dam lake was 35.81 g and 38.79 g in 2009 (Mohsenpour Azari *et al*., 2011) and 38.79 g in this study that both are lower compared to that of a few last years. In other words, in both latter periods the mean weights were lower than the export standard (50 g).

Köksal (1988) measured the growth coefficient of Turkish crayfish as 3.33 and 2.82 for male and female respectively. The coefficients were as follows for some populations of *A. leptodactylus*: 3.22 for male and 2.75 for female for Anzali port crayfish in 2002 (Karimpour et al., 2004), 3.22

for male and 2.62 for female for Caspian Sea crayfish in 1991 (Karimpour et al., 1991), 3.40 for male and 3.08 for female for Aras lake population in 1996 (Baradaran naviri, 2001; Karimpour and Hoseinpour, 2000), 3.09 for male and 3.02 for female for Aras lake population in 2003 (Karimpour, 2003), respectively. The results revealed that males had higher values than the females. In a comparative study of growth coefficients Mohsenpour Azari *et al*. (2011) found that the males of crayfish had a higher weight gain compared to length that could be due to the larger claws in males.

In the present study it was found that a sex ratio fluctuation occurs in *A. leptodactylus* caught in different seasons. According to Woodland (1967) more physical activity of males, sedentary lifestyle of females carrying eggs, and time difference of molting between male and female are the main factors affecting on sex ratio differences in different seasons. In general, in reproduction period the ratio of captured females was lower than that of males probably due to their sedentary lifestyle, but after reproduction period this ratio was 1:1 (Bayrak, 1985; Köksal, 1988). Contrary to maintained studies, in the present study it was found that male to female ratio was higher in captured samples in the present study. Similar results were found in captured *A.leptodactylus* from Aras dam lake by Mohsenpour Azari *et al*. (2011).

The length has a crucial role in aquatic organisms' stock assessment. Studies on the length structure of *A.leptodactylus* in different region led to different results. For example, in the lower parts of Volga, 57.5% (Lvano, 2000) of crayfish were higher than 120 mm in Anzali beaches. This value was 68.94% for the crayfish caught from Aras dam lake (Karimpour, 2003). In addition, 49% and 70.12% of *A.leptodactylus* caught from Aras dam lake were bigger than 120 mm in 1991 and 2002, respectively (Karimpour and Hosseinpour, 2000; Karimpour, 2003). On the other hand, in 2009, crayfish population of Aras dam lake with lengths higher than 120 mm was decreased to 18.99% (Mohsenpour Azari *et al*., 2011) and in our study it was determined that this value decreased to 13.67% between spring 2011 and winter 2012. This indicates that during last decade *A.leptodactylus* stocks in Aras dam lake has largely been weakened that may be attributed to fishing pressure, illegal fishing, unfavorable ecological conditions and recent droughts.

An increase in weight gain and a stopping downward trend in length of *A.leptodactylus* caught from Aras dam lake was observed by Mohsenpour Azari *et al*. (2011). However, present study showed that *A.leptodactylus* stocks in Aras dam lake has relatively been improved compared to Mohsenpour Azari *et al*. (2011)'s study. For example, the percentage of crayfish in different weight groups higher than 30 g was 71.01% in this study, but it was 48.10% in 2011 (Mohsenpour Azari *et al*., 2011) . Similarly, the percentage of crayfish in different length groups higher than 100 mm were 71.4% in this study. It was found to be 52.93% in 2009 by Mohsenpour Azari *et al*. (2011). It is thought that the current improvement in population structure can be attributed to the application of a better management strategy in the region (i.e., close supervision in harvest season to crayfishermen).

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REFERENCES

Abele, L.G., (1982). The Fossil Record and Biogeography of Crustacea. Academic Press, New York.

Ackefors, H., (2000). Freshwater crayfish farming technology in the 1990s: a European and global perspective. Fish and Fisheries 1: 337-359.

Baradaran naviri, Sh., (2001). Length and weight comparision of *A.leptodactylus* in Khazar lake and Aras reservoir habitats, *Paghohesh and Sazandegi*, 52: 94-97.

Bayrak, M., (1985). Research on fecundity and growth of freshwater crawfish (*A. leptodactylus*. Esch., 1823) in Morgan Lake. Ph.D. Thesis, Ankara University, Turkey.

Bowman, T.E. and Abele, L.G., (1982). Classification of the Recent Crustacea. Academic Press, New York.

Cobb, J. S., and D. Wang., (1985). Fisheries biology of lobsters and crayfishes. Ch. 3. pp. 167-247. In, A. J. Provenzano (ed.), the Biology of Crustaceans. Vol 1. pp 206-208.

Harlıoğlu M.M., (2004). The present situation of freshwater crayfish, *Astacus leptodactylus* (Eschscholtz, 1823) in Turkey, Aquaculture, Volume 230, Number 1, pp. 181-187(7).

Harlıoğlu, M.M., Holdich, D.M., (2001). Meat yields in the introduced crayfish, *Pacifastacus leniusculus* and *Astacus leptodactylus*, from British waters., Aquaculture Research, 32, 411-417.

Holdich, D.M and Lowery, R.S., (1988). An Introdaction. In Freshwater Crayfish (eds: Holdich and Lowery). Croom Helm, London. pp 1-7.

Karimpour, M., Hossein pour, S.N., (2000). Length structure, sex ratio, and CPUE of *A.leptodactylus* in Aras reservoir, *Iranian Journal of Fisheries Research*, 9(1): 49- 64.

Karimpour, M., Khanipour, A., Taghavi Motlagh, S., (2004). Some biological characteristics of Khazar *A.leptodactylus* in Anzali port beaches, *Iranian Journal of Fisheries Research*, 13(1): 129- 148.

Karimpour, M., (2003). Final project report of stock monitoring of *A.leptodactylus* in Aras reservoir, Bony Fishes Research Center of the Caspian Sea, Anzali port, pp. 44.

Karimpour, M., Hosseinpour, S.N., Haghighi, D., (1991). Some studies on freshwater crayfish of Anzali lagon, Iranian Fisheries Organization, pp.22.

Köksal, G., (1988). *Astacus leptodactylus* in Europe. In: Freshwater crayfish: biology, management and exploitation, Holdich D.M., Lowery R.S. (Eds.), 365-400, Croom Helm, London.

Mehraban, H., (1999). Absolute fecundity of lobster, B.S.c. Thesis, National Resources University of Zabol, p. 33.

Mohammadi, Gh.H., Keivan, A., Vosoghi, Gh.H., Matinfar, A., (2007). The comparision of meristic characteristics of *A.leptodactylus leptodactylus* in Anzali lagon and Aras reservoir habitats. *Pazhohesh and Sazandegi*, 75: 171-180.

Mohsenpour Azari, A., Yahyazadeh, M.Y. Mohebbi, F., Ahmadi, R.,Moniri,Y. Gangi,S., Shiri, S., (2011). Final project report of the study of environmental factors effects of Aras river and its reservoir on growth of freshwater crayfish, Iranian Fisheries Research Organization , p.172.

Romiantsef, V., (1989). The riverin cray fishes (crabs) of Caspean Sea (in Russian), translated by Holchik, Zh., translated in Persian: Hossein pour, S.N., 1991, Gilan Fisheries Research Center, Anzali port, p.12.

Starobogatov, Ya.I., (1995). Crustaceans. Inventory of Freshwater Invertebrates in Russia. V.2: 177-180 (in Russian).

Vladykov, V. D., (1964). Inland Water Fisheries Resources of Iran Especially of the Caspian Sea with Special Reference to Sturgeon. 51. FAO Report, 1818. Rome.

Westman, K., Pursiainen, M. & Westman, P., (1990). Status of crayfish stocks, fisheries, diseases and culture in Europe. Report of the FAO European Inland Fisheries Advisory Commission (EIFAC) Working Party on Crayfish. Helsinki.

Wickins, J.F. and Lee, D.O'C., (2002). Crustacean Farming Ranching and Culture. Blackwell Science, Oxford. 446 pp. ISBN 0-632-05464-6.

Woodland, D.J., (1967). Population study of a freshwater crayfish. Ph.D. Thesis, University of New England, Australia.