Determination of suitable trap type for the Caspian crayfish, *Astacus leptodactylus eichwaldi*, in Anzali coastal area, Iran

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Abstract: The efficiency of different types of traps for catching of the Caspian Sea crayfish, *Astacus leptodactylus eichwaldi,* was investigated from Mar. 2002 to Feb. 2003. Totally 56 traps of four most commonly used types, "Rectangular trap", "Round trap", "Opera house trap" in two colors of "black" and "blue", and "Fathoms plus" only in black were installed in depths of 35, 45, 55 and 65 meters along two transects in Anzali coastal area.

The results revealed no significant differences ($P \geq 0.05$) in the average length, weight and sex ratio among the crayfish in different months and applied traps. However, significant differences ($P < 0.05$) in CPUE of different traps in various months of the study year were observed. Mean annual of CPUE in Opera house traps "blue" was the greatest (5.09±0.29) and the lowest was found in "Fathoms plus" traps (0.28±0.05). In general, all blue color traps performed better catch than the black ones.

Keywords: Crayfish, *Astacus leptodactylus eichwaldi*, Traps, Catch, Efficiency, Sex ratio, Caspian Sea, Iran

Introduction

Being the world largest inland water body, the Caspian Sea is the jewel of two continents Europe and Asia, encompassing some 44% of the volume of the global inland lakes (Kazakhstan Academy of Sciences, 1994). The crayfish inhabits this unique aquatic system with salinity of 5-7ppt in the northern and 11-12.5ppt in *the* middle and southern sections (Ivanov & Sokolsky, 2000). Two species of crayfish (Astacidae), *viz Astacus leptodactylus eichwaldi* and A*astcus pachypus* dwell in the

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Caspian Sea (Rumyantsev, 1989; Kolmykov, 1999; Sokolsky *et al.*, 1999; Ivanov, 2000). Along the Iranian coast *Astacus leptodactylus eichwaldi* has its concentration at depth of 30-70 m in Bandar Anzali area (Noveyri, 1990; Karimpour, 2001). Harvest of crayfish in ex-Soviet Union commenced in 1934. In the past 70 years, the maximum catch of crayfish occurred in 1941 at amount of 80.7 tons; the minimum catch yielded 1.7 tons in 1956. Fluctuation of catch was not linked to stock problem but attributed to poor harvesting technique of fishing effort (Sokolsky *et al.*, 1999). The reason for limited fishing of crayfish in the Caspian Sea, with estimated resources between 900-1000 tons, is also attributed to poor fishing technology development (Ushivtsev, 1999).

Various gears such as drop net, fyke net, seine net, and various types of traps are employed in crayfish fishing around the world. The most common method for crayfish harvesting in Europe applies cylindrical traps with tapering funnel at either end (Holdich, 2002). Crayfish traps made of plastic or manufactured with net and steel frames are the most common gears for crayfish trapping. The entrance part and mesh size could be manipulated in a manner to have selective crayfish fishing by allowing small size crayfish find a loophole to escape (Skurdal & Taugbol, 2002).

The crayfish resources are not yet exploited in the Iranian coastal water of the Caspian Sea. Noveyri (1990) conducted a study to find out the population size of crayfish in various water depths but unsuitable traps application led to no workable solution. Funnel trap is normally applied to catch crayfish in Arass water reservoir and Anzali wetland, (Karimpour *et al.*, 1989; Karimpour & Hosseinpour, 2000).

Catch level of crayfish has fundamental linkage with stock volume and its density in the habitat, subsequently the kind of traps has significant role in capturing (Fjalling, 1995; Bean & Huner, 1978). Many investigations have been conducted with different types of traps to assess their catch ability, size frequency, catch level and gender ratio. It has been proven the type of trap function significantly in economical harvesting of crayfish even for research sampling (Jussila, 1995).

Trap design, shape, type of material and the net color affect the catch efficiency of crayfish (Smallridge & Gray, 1998; Kulesh *et al.*, 1999). The present study was conducted to find a suitable kind of trap that would ensure good harvesting with minimum risk for sub-standard size of crayfish and also the strength of traps with local sea condition concerning water current and wave during rough sea in the study area.

Material & Methods

Sampling was conducted every month from March 2002 until February 2003. Totally 56 traps of four most commonly used types, namely, "Rectangular trap", "Round trap", "Opera house trap" in two colors of "black" and "blue" and with mesh size of 18mm, and "Plastic Fathoms Plus traps" only in black were opted for the experiments (Campbell & Whisson, 2000). Specifications of these traps are as follows:

a- Rectangular trap :dimension of 80×80×120 cm, number of operational traps in field 16 (8 black and 8 blue) (Fig. 1).

b- Round trap: a trap with two unequal circles, the larger one at the base and smaller at top with 60cm and 30cm diameters, respectively; the trap height 35cm, number of operational traps in field 16 (8 black and 8 blue) (Fig. 2).

c- Opera house trap: ellipse shape at bottom (diameters 85 and 50 cm) , arc length measured by an straight line 132cm, middle arc 105cm, height in open condition 55cm, number of operational traps in field 16 (8 black and 8 blue) (Fig. 3).

d- Plastic Fathoms Plus traps: for lobster fishing (made by Fathoms plus), we modified its entrance for our purpose, number of operational traps in field 8 black (Fig. 4).

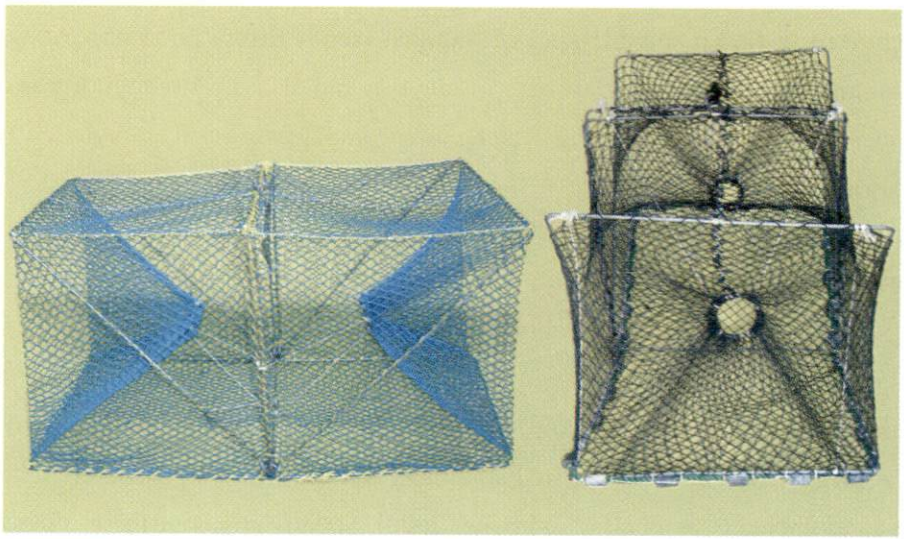

Figure 1: Rectangular traps

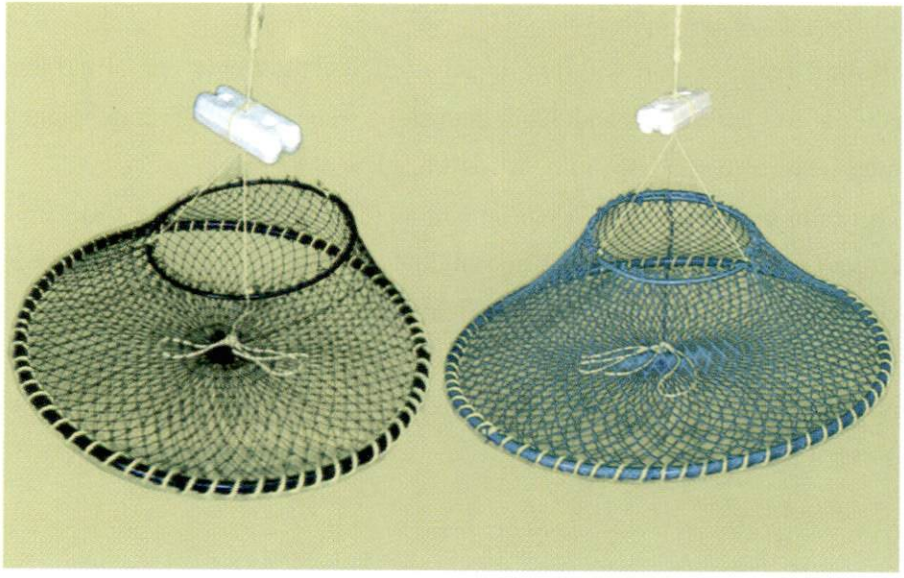

Figure 2: Round traps

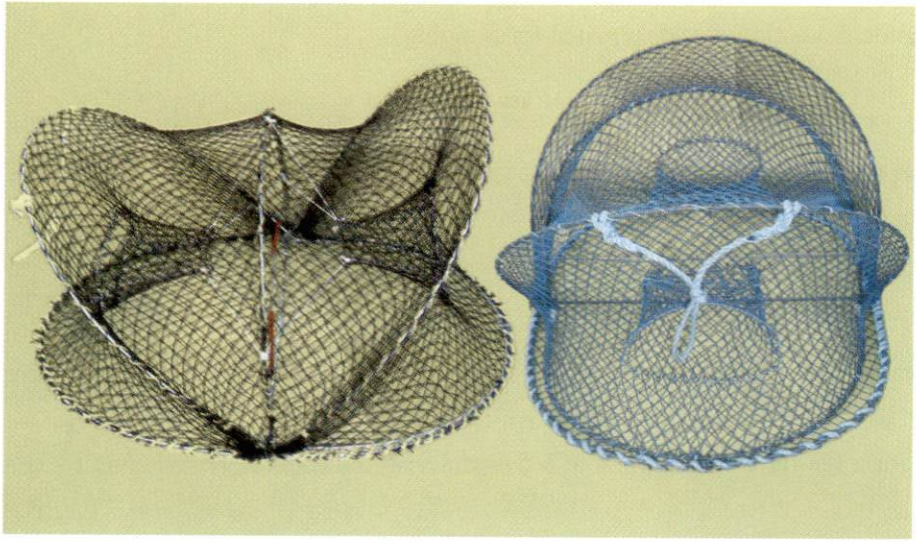

Figure 3: Opera house traps

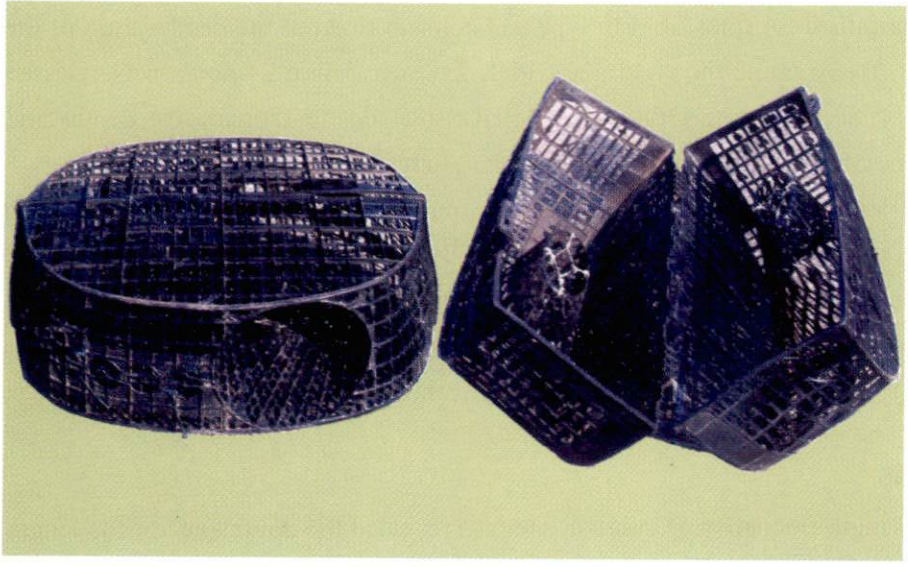

Figure 4: Fathoms plus traps

Considering the previous research by Noveyri (1990) and Karimpour(2001), two study transects in the eastern section of Anzali Harbour with the following geographical position was designated for trapping:

Transect I: 49°, 30' East	Transect II: 49°, 34' East
At 35 m depth: 37°, 33' and 880" North	At 35 m depth: 37°, 32' and 960" North
At 45 m depth: 37°, 34' and 700" North	At 45 m depth: 37°, 33' and 430" North
At 55 m depth: 37°, 35' and 150" North	At 55 m depth: 37°, 33' and 930" North
At 65 m depth: 37°, 35' and 750" North	At 65 m depth: 37°, 34' and 280" North

At each depth, types of trap with its specific colour (7 traps in each depth) were moored by anchor and buoyant. Crayfish fishing was planned for every successive month for a ten-days fishing, and at 5 days interval the traps were searched for the catch.

A piece of 300g catfish was used in each trap as a bait. Biometry of the catch was recorded: the total length measured by precision of a millimeter with a caliper, and total weight by digital scale of one gram accuracy. The sex of the total yield was determined for traps of each type and color to find out the gender ratio of the samples. By counting the yield, the CPUE for each trap in 24 hours was assessed (White, 1987). A Forno GPS and a Royal fish-finder to estimate the depths and location of trap installation were used in this study.

ANOVA statistical test was used to find-out the differences the between average length and weight, sex ratio and CPUE among different types of traps during sampling months. If discrepancy in these variables were meaningful, the Dunkan test was used to find out which type of trap was homogenous with other traps in respect of catch level, sex ratio and average length size.

Results

The length frequency of crayfish samples revealed the dominance of the length group 120-129 mm in all tested traps.The number of commercially standard size (more than 100 mm) samples comprised of 92.11% in "Rectangular black" to 97.65% in "Round black". By and large, "Round trap" trapped higher numbers of

standard size and "Opera house traps" rated second and the least in respect of size caught by "Rectangular traps" (Table 1). The average length and weight during study year in Opera house "blue" were the highest (124.17±1.55mm & 59.33±1.93g) and the lowest (122.42±1.13mm & 54.08±1.58g) were seen in Rectangular "black" (Fig. 5). However, no significant differences ($P \geq 0.05$) in the average length and weight among the crayfish in different months and applied traps were found (Table 2).The largest crayfish with length of 156mm and weight of 111.6g was trapped with Opera house "black" and the smallest length of 84mm and weight of 18.5 g captured by "Fathoms plus trap".

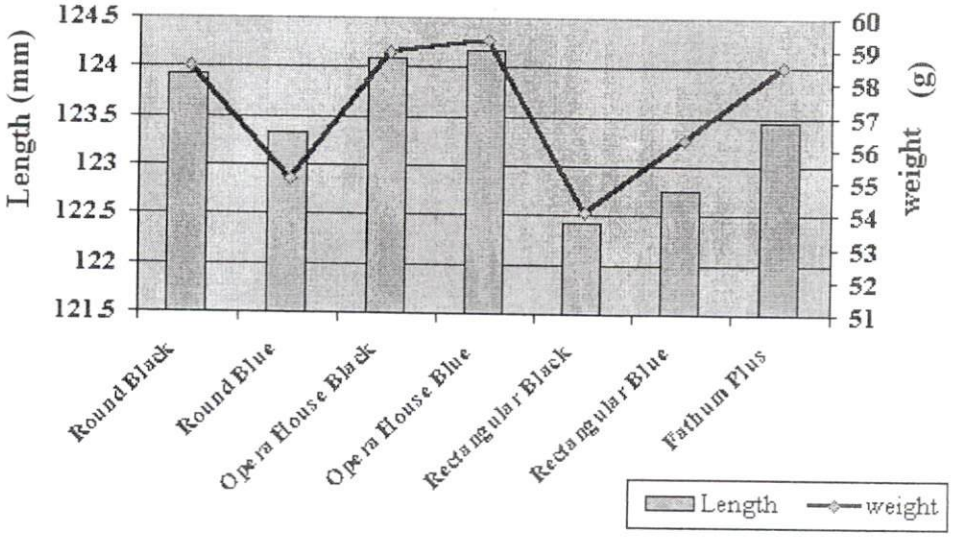

Figure 5: Annual mean length and weight of Caspian Sea crayfish in different types of traps

Table 1: Length frequency of Caspian Sea crayfish in different traps

Length groups (mm)		Types of Traps													
		1		2		3		4		5		6		7	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%
Under size	80-90	-	-	-	-	-	-	2	1.47	2	2.63	1	1.10	1	1.89
	90-99	2	2.35	4	4.35	8	6.61	6	4.41	4	5.26	6	6.59	3	5.66
Commercial sizes	100-109	9	10.59	10	10.87	12	9.92	15	11.03	7	9.21	9	9.89	5	9.43
	110-119	19	22.35	18	19.57	23	19.01	21	15.44	13	17.11	16	17.58	14	26.42
	120-129	28	32.94	32	34.78	39	32.23	48	35.29	29	38.16	32	35.16	18	33.96
	130-139	16	18.82	19	20.65	24	19.83	27	19.85	14	18.42	18	19.78	7	13.21
	140-149	9	10.59	7	7.61	11	9.09	14	10.29	6	7.89	7	7.69	4	7.54
	150-159	2	2.35	2	2.17	4	3.31	3	2.21	1	1.32	2	2.20	1	1.89
	Total	85	100	92	100	121	100	136	100	76	100	91	100	53	100

1: Round Black, 2: Round Blue, 3: Opera House Black, 4: Opera House Blue, 5: Rectangular Black, 6: Rectangular Blue, 7: Fathoms plus

Table 2: Mean total length (mm) and weight (g) in different months for different types of traps

Type of traps		Months											
		Mar 2002	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan 2003	Feb
Round Black	TL	123	121	118	119	119	126	122	128	125	131	128	127
	W	59	55	51	48	50	61	56	62	60	72	65	61
Round Blue	TL	121	119	116	120	117	124	119	125	132	131	130	126
	W	54	50	44	53	41	56	52	58	65	63	59	60
Opera House Black	TL	119	122	123	121	120	118	124	126	127	132	128	129
	W	51	54	56	57	55	52	60	59	63	73	61	63
Opera House Blue	TL	122	117	121	120	118	123	121	128	127	129	135	129
	W	58	49	56	53	55	61	58	62	59	61	76	64
Rectangular Black	TL	117	120	115	119	123	125	122	125	124	126	128	125
	W	46	52	44	50	54	58	56	59	57	56	61	56
Rectangular Blude	TL	115	119	117	122	125	122	119	127	126	129	125	127
	W	47	52	43	58	61	56	53	61	62	64	59	60
Fathoms Plus	TL	118	121	118	124	123	119	124	123	125	132	127	129
	W	51	54	56	60	57	51	61	60	63	73	62	64

Observed CPUE in various months varied in different types of traps from 0.05 individual crayfish in March in "Fathoms plus traps" to 6.72 individuals in Opera house traps "blue" in February. The mean CPUE in the study year in "Opera house trap" produced the highest (5.09±0.29) and the lowest (0.28±0.05) was noticed in the Fathoms plus. ANOVA test demonstrated significant difference ($P<0.05$) in CPUE of different traps in various months of the study year (Table 3). Duncan's test of efficiency placed the three homogeneous groups of traps according to their catch contribution: Group I, Opera house traps (black & blue); Group II, Round traps (black & blue); Group III, Fathoms plus and Rectangular traps (black & blue).

Color comparison among tested traps showed superiority in catches among all blue color traps as compared with black ones (Fig. 6).

Sex ratio varied among different traps from 1:1.23 in Opera house "blue" to 1:1.32 in Fathoms plus. Despite these variations, the cumulative number of samples throughout the sampling period showed the males dominance. On monthly basis, the trapped female specimens dominated the catch in August till November, while the males dominated the other months. The lowest number of trapped males was observed in September and the greatest in February. The highest number of male specimens was trapped with Opera house "black" in March while the lowest number was encountered in September in Round "black" (Table 4). No significant differences ($P\geq0.05$) in sex ratio in all tested traps in various months were encountered.

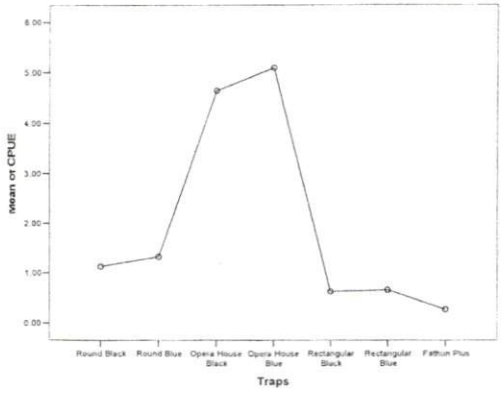

Figure 6: Annual mean of CPUE for Caspian Sea crayfish in different types of traps

Table 3: CPUE (number of Caspian Sea crayfish trapped in each type of trap per 24 hours) in different months

Type of traps	Months											
	Mar 2002	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan 2003	Feb
Round Black	0.84	0.55	0.80	1.28	1.08	1.60	1.44	1.15	1.24	1.31	1.24	1.56
Round Blue	1.04	0.70	1.11	1.44	0.98	1.42	1.24	1.20	1.44	1.52	1.92	1.84
Opera House Black	3.52	2.80	3.32	3.30	4.68	5.48	5.84	4.22	4.48	5.56	5.64	6.16
Opera House Blue	4.31	3.18	4.12	4.48	4.76	5.16	5.72	5.50	4.96	6.09	6.12	6.72
Rectangular Black	0.32	0.20	0.48	0.28	0.65	0.80	0.44	0.47	0.64	0.82	1.22	1.26
Rectangular Blue	0.41	0.32	0.62	0.24	0.52	0.85	0.50	0.51	0.60	1.02	1.28	1.08
Fathoms Plus	0.05	0.10	0.15	0.18	0.25	0.21	0.18	0.26	0.30	0.45	0.65	0.55

Table 4: Sex ratio of the Caspian Sea crayfish in different months and types of traps

Type of traps	Months											
	Mar 2002	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan 2003	Feb
Round Black	2.18	1.73	1.82	1.78	1.09	0.29	0.18	0.21	0.56	1.21	1.50	2.49
Round Blue	2.15	1.89	1.85	1.59	1.18	0.28	0.23	0.25	0.49	1.36	1.29	2.57
Opera House Black	2.62	1.94	1.65	1.73	1.16	0.32	0.22	0.26	0.43	1.25	1.32	2.46
Opera House Blue	2.46	1.82	1.78	1.62	1.29	0.41	0.19	0.28	0.51	1.11	1.18	2.08
Rectangular Black	2.05	1.48	1.93	1.49	1.18	0.44	0.29	0.26	0.47	1.28	1.27	2.29
Rectangular Blue	2.41	1.76	2.01	1.86	1.24	0.39	0.24	0.23	0.55	1.34	1.41	2.16
Fathoms Plus	2.36	1.91	1.83	1.78	1.27	0.35	0.23	0.31	0.61	1.42	1.39	2.35

Discussion

Employment of various types of traps have reportedly yielded catches of different sizes, with some of them being more efficient in catching the larger crayfish (Brown & Brewis, 1978; Daniels *et al.*, 1996; Uris & Martin, 1998; Campbell & Whisson, 2000). In our study, however, no significant differences in types of traps and the size of the catch were observed.

Catch efficiency of different types of traps examined by many authors have proved that the structure and shape of trap exert positive role in capturing crayfish (Fjalling, 1995; Smallridge & Gray, 1998; Campbell & Whisson, 2000). The result of present study was in the line with the previous works. In our study, the CPUE with "Opera house trap" was four time higher in output than "Round trap", 7.5 times more than "Rectangular trap" and 17.5 times higher than "Fathoms plus trap". Therefore, among the tested traps the "Opera house" with blue color recognized as the most suitable trap for the Caspian crayfish trapping.

Abrahamsson (1966) reported some traps would draw greater number of male *Astacus astacus*, which have been also conformed by Brown & Brewis (1978) for *Austropotambius pallips*, Skurdal *et al.* (1995) for *Orconectes virilis* and Frutiger *et al.* (1999) for *Procanbarus clarkii.* But on the whole, the sex ratio in trapped samples is linked to the changes of season, spawning time and molting period. Alekhnovich *et al.* (1999) reported the male *Astacus leptodactylus* in spring and fall dominated the catch. Male *Astacus astacus* in August and September have reportedly been greater in number (Keller, 1999). A greater number of male crayfish in Anzali wetland was captured in November until April and in Arass reservoir in winter and spring (Karimpour *et al.*, 1989; Karimpour & Hosseinpour, 2000). Our finding concerning the gender ratio was in line with the findings of other authors, which emphasized the influence of spawning season. With the beginning of the Caspian crayfish spawning

period during December, the number of males increases. This domination persists until the end of spawning time and miniature releasing time in June. With the termination of spawning, the activities of females specimens increase again and the sex ratio in the catch appear relatively in equilibrium.

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References

Abrahamsson, S.S.A. , 1966. Dynamics of an isolated population of the crayfish *Astacus astacus* (L). Oikos. **17:**96-107.

Alekhnovich, A. ; Kulesh, V. and Ablov, S. , 1999. Growth and size structure of Narrow-clawed crayfish *Astacus leptodactylus* Esch. in its eastern area. Freshwater Crayfish. **12:**550-562.

Bean, R.A. and Huner, J.V. , 1978. An evaluation of selected crayfish traps and trapping methods. Freshwater Crayfish. **4:**141-152.

Brown, D.J. and Brewis, J.M. , 1978. A critical look at trapping as a method of sampling a population of *Austropotamobius* (Lereboullet) in a mark and recapture study. Freshwater Crayfish. **4:**159-164.

Campbell, L. and Whisson, G.J. , 2000. Catch efficiency of five freshwater crayfish traps in south-west Western Australia. Freshwater Crayfish.**13:**58-67.

Daniels, W.H. ; Petrosky, B.R. and Wujtewiez, D.F. , 1996. Size and maturity selectivity of different harvesting methods on the White River crayfish, *Procambarus acutus*. Freshwater Crayfish. **11:**512- 523.

Fjalling, A. , 1995. Crayfish traps in Swedish fisheries. Freshwater Crayfish. **8:** 201-214.

Frutiger, A. ; Borner, S. ; Busser, T. ; Eggen, R. ; Muller, R. ; Muller, S. and Wasmer, H.R. , 1999. How to control unwanted population of *procambarus clarkii* in central Europe? Freshwater Crayfish. **12:**714-725.

Jussila, J. , 1995. On the cost of trapping in central Finland. Freshwater Crayfish. **8:**215-227.

Holdich, D.M. , 2002. Background and functional morphology. *In*: Biology of freshwater crayfish (ed. D.M. Holdich). Blackwell Science. London, UK. pp.3-29.

Ivanov, V.P. , 2000. Biological resources of the Caspian Sea. Caspian Fisheries Research Institute (CaspNIRKH). Astrakhan, Russia. 96P. (in Russian)

Ivanov, V.P. and Sokolsky, A. , 2000. The Caspian Sea crayfish. *In*: Scientific principles of the strategy of the Caspian bioresources protection from oil pollution. The Caspian Fisheries Research Institute (CaspNIRKH). Astrakhan, Russia. pp.78-89 (in Russian).

Karimpour, M. ; Hosseinpour, S.N. and Haghighi, D. , 1989. Preliminary investigation of Anzali Lagoon crayfish (*Astacus leptodactylus*). Guilan Fisheries Research Center. Bandar Anzali, Iran. 18P.

Karimpour, M. and Hosseinpour, S.N. , 2000. Length frequency, sex ratio and relative abundance (CPUE) of *Astacus leptodactylus* in Arass water reservoir. Iranian Journal of Fisheries Sciences. Vol. 9, No. 1, pp.49- 64. (in Persian)

Karimpour, M. , 2001. Some biological aspects of the Caspian Sea crayfish, *Astacus leptodactylus eichwadli*, in Bandar Anzali coastal zone. Guilan Fisheries Research Center. Bandar Anzali, Iran. 128P. (in Persian)

Kazakhstan Academy of Sciences , 1994. Conservation of marine biological diversity in the Caspian Sea. KAS, Kazakhstan. 140P.

Keller, M., 1999. Ten years of trapping *Astacus astacus* for restocking in Lake Bronner a gravelpit in Bavaria. Freshwater Crayfish 12: 518-525.

Kolmykov, V.D. , 1999. Description of the Long-clawed crayfish, population in lower Volga River. Caspian Fisheries Research Institute (CaspNIRKH). Astrakhan, Russia. 13P.

Kulesh, V. ; Alekhnovich, A. and Ablov, S. , 1999. Distribution and size structure of Noble crayfish, *Astacus astacus* (L), population in Belarus. Freshwater Crayfish. **12:**835-845.

Noveyri, B.S. , 1990. Biological study and distribution of the Caspian Sea crayfish *Astacus leptodactylus eichwaldi,* in Bandar Anzali region. Guilan Fisheries Research Center, Bandar Anzali, Iran. 71P. (in Persian)

Rumyantsev, V.D. , 1989. Caspian Sea crayfish. *In*: Caspian Sea fish fauna and commercial resources. Puble. House Nauka, Moskva. 236P. (in Russian)

Skurdal, J. ; Gvenild, T. ; Taugbol, T. and Garnas, E. , 1995. Can catch per until effort data (CPUE) forecast yield in an exploited noble crayfish *Astacus astacus* (L) population? Freshwater Crayfish. **8:**257-264.

Skurdal, J. and Taugbol, T. , 2002. Astacus. *In*: Biology of freshwater crayfish (ed. D.M. Holdich). Blackwell Science. London, UK. pp.467-503.

Smallridge, M. and Gray, L. , 1998. Trap comparisons in commercial Yabbie ponds. SAFISH, Jul-Sep, Vol. 14, No. 1, pp.18-21.

Sokolsky, A. ; Ushivtsev, V. ; Kolmykov, E. and Mikouiza, A.S. , 1999. Perspective of the development of crayfish harvest in the Caspian Sea. Caspian Fisheries Research Institute (CaspNIRKH). Astrakhan, Russia. 11P.

Uris, Z. and Martin, S. , 1998. On depths distribution of crayfish. Poster presented at the 12th Symposium of the International Association of Astacology, Agsburg, Germany, August 1998.

Ushivtsev, V.B. , 1999. Behavior of the crayfish *Pontastacus leptodactylus* and *Caspiastacus pachypus* in the zone of underwater light sources. Caspian Fisheries Research Institute (CaspNIRKH). Astrakhan, Russia. 4P.

White, T.F. , 1987. A fisheries monitoring system for Islamic Republic of Iran. IRA/83/013. FAO, Rome, Italy. 56P.