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A Research on the Hatching Possibilities of Ovigerous Females of Crayfish (*Astacus leptodactylus Esch*. 1823) Obtained from Lakes in Bafra and Crayfish Larvae Farming in Sinop Region

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Abstract: The research has been carried out at a carp farm in Cobanlar village which is 18 km far from Sinop using ovigerous females of 20 crayfish (*Astacus leptodactylus Esch.* 1823) from Bafra Fish Lakes. The larvae has been hatched at an average water temperature of 23.9±0.24°C in 19.05.1994. After hatching, the larvae have left the females after 10 days. Afterwards two ponds of earth with dimensions of 2×3×0.9 m were used in order to observe the growth performance. About 250 individuals of larvae of crayfish were placed into each pond. Farm dung was used in one of earth ponds in order to enrich the natural food in the environment and the young individuals of the first group were fed on natural food while trout pellets were used in the second group which was maintaned in the other pond. According to the end of study, it has been recorded that growth in the pond where trout pellets were used proved. T-test controls showed that the difference is considerable ($p<0.05$).

Key words: *Astacus leptodactylus*, crayfish growing, decapoda, brachyura, larvae, Sinop

INTRODUCTION

Many types of crayfish are seen in lakes, rivers and dams in various parts of the world. However, there has been a decrease in crayfish production over the years due to damage caused by various pathogens especially in the early 19th century. Crayfish is enjoyed in many countries and therefore many studies are conducted towards development of techniques related to hatching of crayfish in artificial environment formation of new crayfish population by using the larvae produced in artificial environment and restoration of fresh water resources where crayfish population is low.

First production of crayfish larvae using an artificial method was realized by Soubeiran in 1959 in France. Today, sale of crayfish larvae for commercial purposes like in fishery industry have been performed in countries such as United States of America, Sweden and Russia (Abrahamsson, 1972; Avault, 1973, 1975; Lindqvist, 1977; Laurent, 1978; Arringnon, 1981).

Crayfish farming has developed in 2 ways. First of these is hatching of ovigereous females of crayfish and larvae production and the second one is growing of larvae until they are eligible to live in natural water resources (Cukerzis, 1973; Westman, 1973; Arringnon, 1981). Although restoration of water resources by mature crayfish is cheap and technically easy, there are some disadvantages such as they tend to have difficulty in adopting their natural habitat have certain food to have the possibility of spreading diseases. Therefore, youngsters of crayfish are more preferred than mature male and female crayfish as well as ovigerous females in the restoration of natural fresh water resources where crayfish population is low (Abrahamsson, 1973; Arringnon, 1981; Cukerzis, 1984). Newly hatched crayfish should be grown at least for a summer's period before they are released to natural water resources since the rates of death reach to 90% of the released crayfish under natural conditions in the first summer (Tcherkashina, 1977). High rates of death under natural conditions stress the need to larvae production under artificial conditions.

MATERIALS AND METHODS

Studies conducted in Turkey on crayfish have mostly concentrated on systematic, morphological and biological examination of crayfish (Geldiay and Kocatas, 1970; Erdemli, 1983), larva production (Erencin and Koksal, 1977; Koksal, 1982, 1983, 1984, 1985a, b) and larva farming (Koksal, 1983, 1984, 1985a, b; Koksal, 1988; Koksal *et al*., 1992).

Conducted research has examined hatching possibilities of ovigerous female crayfish obtained from lakes in Bafra and development phases of crayfish kept in two different ponds and under different feeding environments. Furthermore, importance of larvae farming in Sinop region for the restoration efforts of freshwater resources where crayfish population is low has been stressed since youngster crayfish have more advantages than ovigerous female crayfish such as easy adaptation to environment and protection from the hunters.

RESULTS AND DISCUSSION

Findings related to larvae development: The larvae started to hatch in May in the water at a temperature of 23.9°C . It was observed that the larvae left the ovigerous female crayfish after 10 days. During that time ovigerous female crayfish without larvae were taken to a different environment.

As it is shown in Table 1 and 2, there was a slow down of the crayfish larvae length and weight developments in both environments starting from October and during the months of November and December.

The research concluded that every youngster crayfish (male and female) in the pond where natural conditions were established reached to 42.54±5.23 mm in total average length and 2.38±0.09 g in average weight. Furthermore, youngster crayfish in the pond where trout pellet was used reached to 47.6±0.23 mm total average length and 2.6±0.10 g average weight. Regression curves were drawn and correlation coefficients were calculated based on measurement results obtained in both pond environment and by establishing regression equations.

Regression equations and correlation values calculated according to gender are as follows: For the male crayfish larvae where farm dung was used:

$$W = 0.00074\ L^{2,1143}, \quad r = 0.93$$

For the female crayfish larvae where farm dung was used:

$$W = 0.00078\ L^{2,0937}, \quad r = 0.93$$

For the male crayfish larvae where trout pellet was used:

$$W = 0.00134\ L^{1,9638}, \quad r = 0.95$$

A significant relationship was found between length and weight according to the calculated correlation coefficient. So it was observed that the more the length increased the weight increased as well.

Water used for larvae farming of crayfish should meet specifications of quality and temperature depending on the type of crayfish that is produced (Clark *et al*., 1975; Romaire *et al*., 1978; Arringnon, 1981). Cobanlar Village Carp Fish Production Facilities where we conducted the research was suitable for larvae of *Astacus leptodaclylus* type. It was observed in the study that the crayfish larvae which were kept in the pond where trout pellet was used grew better in relation to their length and weight than the larvae which were kept in the pond where farm dung was used. It was found significant in the conducted t-test controls ($p<0.05$). Although it was observed that male grew more than female individuals according to t-test controls the significance was found insignificant ($p>0.05$).

Table 1: Findings related to development of crayfish larvae in the pond where farm dung was used to feed the larvae

Months	Sex	Number	Parameters	$X \pm S_x$	Min.-Max.	Values (%)
First	Female +	50	Weight g)	0.06±0.01	0.05-0.090	16.05
Measure	Male		Total leght (mm)	11.12±0.55	10.00-13.00	5.02
June	Male	28	Weight (g)	0.25+0.04	0.19-0.320	16.07
			Total leght {mm)	19.64+0.98	17.00-21.00	5.03
	Female	22	Weight (g)	0.20+0.05	0.14-0.310	27.50
			Total leght (mm)	19.00±1.37	17.00-22.00	7.25
July	Male	17	Weight (g)	0.61±0.09	0.50-0.800	18.98
			Total leght (mm)	28.21+2.02	25.00-33.00	7.18
	Female	33	Weight (g)	0.59+0.11	0.38-0.880	18.98
			Total leght mrny	27.94±2.16	24.00-32.00	7.74
August	Male	25	Weight (g)	0.90+0.16	0.69-1.420	17.73
			Total leght (mm)	32.92+2.73	28.00-39.00	8.31
	Female	25	Weight (g)	0.85+0.12	0.66-1.070	14.43
			Total leght (mm)	32.04+2.52	27.00-37.00	S.80
September	Male	27	Weight (g)	1.39+0.26	0.99-1.930	19.15
			Total leght (mm)	37.18+1.30	34.03-39.00	3.50
	Female	23	Weight (g)	I .35±Õ.27	0.96-1.910	20.53
			Total leght (mm)	36.30+1.25	34.00-39.00	3.46
October	Male	26	Weight (g)	2.22±0.30	1.7&-2.79	Î3.86
			Total leght (mm)	42.15±2.97	35.00-47.00	7.05
	Female	24	Weight (g)	2.06±0.31	1.40-2.700	15.43
			Total leght (mm)	41.41±2.14	38.00-45.00	5.17
November	Male	30	Weight (g)	2.44±0.47	1.62-4.010	19.52
			Total leght (mm)	42.62±2.63	37.00-51.03	6.18
	Female	20	Weight (g)	2.22+0.44	1.46-2.880	19.89
			Total leght (mm)	41.75+2.23	36.00-47.00	5.34
December	Male	26	Weight (g)	2.4S±0.47	1.69-4.050	18.90
			Total leght (mm)	43.17±2.95	37.00-52.00	6.84
	Female	22	Weight (g)	2.27+0.44	1.48-2.930	19.30
			Total leght (mm)	42.09+2.15	36.00-47.00	5.03

Table 2: Findings related to development of crayfish larvae in the pond where trout pellet was used to feed the larvae

Months	Gender	Number	Parameters	X±S,	Min.-Max.	Values(%)
First	Female +	50	Weight (g)	0.06±0.010	0.04-0.090	18.74
Measure	Male		Total leght (mm)	11.22±0.460	10.00-12.00	4.14
June	Male	28	Weight (g)	0.29±0.040	0.18-0.380	16.97
			Total Leght (mm)	20.35*1.350	18.00-22.00	6.57
	Female	22	Weight (g)	0.25±0.040	0.18-0.320	18.57
			Total leght (mm)	19.86±0.990	18.00-21.00	4.98
July	Male	19	Weight (g)	0.93+0.160	0.69-1.440	18.14
			Total leght (mm)	32.57+2.710	28.00-38.00	8.33
	Female	31	Weight (g)	0.89+0.220	0.55-1.430	24.85
			Total leght (mm)	31.58+1.920	27.00-35.00	6.10
August	Male	25	Weight (g)	1.30+0.230	0.95-2.010	17.91
			Total leght (mm)	37.04+2.130	33.00-43.00	5.75
	Female	25	Weight (g)	1.16±0.120	0.91-1.480	17.26
			Total leght (mm)	36.12+1.610	32.00-40.00	4.47
September	Male	26	Weight (g)	1.77+0.270	1.34-2.350	15.76
			Total leght (mm)	40.88+2.840	37.00-49.00	5.99
	Female	24	Weight (g)	1.56+0.310	0.78-2.050	20.12
			Total leght (mm)	38.70+2.860	29.00-44.00	7.40
October	Male	27	Weight (g)	2.87+0.320	2.00-3.630	11.39
			Total leght (mm)	46.30±1.490	41.00-43.00	3.21
	Female	23	Weight (g)	2.33±0.420	1.77-3.670	18.37
			Total leght (mm)	44.75+2.060	39.00-48.00	4.62
November	Male	29	Weight (g)	3.01+0.630	1.95-4.400	21.12
			Total leght (mm)	47.46+3.290	39.00-53.00	6.93
	Female	21	Weight (g)	2.61±0.390	1.94-3.730	15.00
			Total leght (mm)	45.09+2.040		4.43
December	Male	25	Weight (g)	3.04+0.590	1.98-4.450	18.42
			Total leght (mm)	47.53±3.250	40.00-53.00	6.84
	Female	24	Weight (g)	2.74+0.470	1.95-3.910	17.15
			Total leght (mm)	45.16±1.900	40.00-49.00	4.12

Actually Koksal (1985b) and also stated that male crayfish grow more than female crayfish in their studies. Slow down of growth was observed by the decrease of water temperature in the study. During the months of November and December water temperature feeding of crayfish slowed down and when the water temperature decreased below 10°C the feeding of crayfish stopped and their growth slowed day by day. Muller also states that crayfish stop feeding when the water temperature is below 10°C.

Moreover, a strong relation was found between weight and length by calculation of correlation coefficients. At the end of the study, the results related to pond environment where farm dung was used were found lower than the similar 6 months study of Tcherkashina (1977) in which *Astacus lepiodactylus cubanicus* larvae were used. However, the results were found better than the study of Pursiainen *et al.* (1983) in which *Astacus astacus* type were used in an environment where natural food + farm dung were used for 80 days in earth pond. Moreover, obtained findings stated that the study was better than the studies of Cukerzis *et al.* (1979) in which *Astacus astacus* type of crayfish was used in natural fresh water resources and study in which *Astacus lepiodactylus* was used in natural fresh water resources. Findings of the study regarding the larvae fed by trout pellet were found low compared to Kossman (1973) study in which *Astacus leptodaclylus* larvae were kept and fed by trout pellet, boiled potato and chironomids for 35 days and Koksal *et al.* (1992) study in which *Aslacus leplodactylus* larvae were kept and fed by trout pellet for 4 months in an earth soil.

However, the findings of the study were better than the studies of Meyers *et al.* (1970) in which *Pasifastacus clarkii* was kept and fed by specially prepared crustacean feed for 91 days; Cuellar and Ve Coll's (1978) study in which *Actacus pallipes* larvae was kept and fed by tubifex, daphnia and trout pellet for 2 months period; Koksal's (1982) study in which *Astacus leplodactylus* larvae were kept and fed by trout pellet and green algae for 90 days and Pursiainen *et al.* (1983) study in which *Astacus astacus* larvae were kept and fed by zooplanktons + frozen food (1/3 fish + 1/3 vegetative food + 1/3 shrimp shell) for 80 days. Similar duration or same duration were used for the comparison of the findings of the study in order to compare it with the other studies.

CONCLUSION

As a result, findings of the study put forward that *Astacus leplodactylus* type of crayfish farming can be performed under cultivation conditions in Sinop. Moreover, similar trial studies towards forming new crayfish areas in domestic water resources such as Bektasaga, Tasmanli, Cobanlar, Espiyeli, Katirli, Sarikum, Maruf, Edil, Cemalettin and Kelperenbektas lakes in Sinop can be conducted for ideal larvae farming.

Crayfish populations which have an important place in the fishery products of the country but which were lost due to the damage caused by pathogenic factors should be leveled to its past numbers and controlled crayfish larvae production should be performed for the creation of new crayfish areas for the benefit of Turkish fishery production.

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