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INVESTIGATION ON SHELTER COMPETITION BETWEEN NARROW-CLAWED CRAYFISH *ASTACUS LEPTODACTYLUS* (ESCH.) AND NOBLE CRAYFISH *ASTACUS ASTACUS* L.

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Abstract

A. ZAIKOV, I. PISKOV and I. ILIEV. 2010. Investigation on shelter competition between Narrow-Clawed crayfish *Astacus leptodactylus* (Esch.) and Noble crayfish *Astacus astacus* L. *Bulg. J. Agric. Sci.*, 16: 369-375

The aim of this study was to investigate the competitive relations in the occupation of shelters between *Astacus leptodactylus* (Esch.) and *Astacus astacus* L. in laboratory conditions. A total of 240 crayfish were used in the experiment, including 120 individuals of each species and 60 individuals of each gender. Three different groups of experiments were conducted in order to fully investigate the shelter competition. The study shows that the species belonging of the individuals has a predominant significance in shelter occupation. In all variants investigated, the noble crayfish have a dominant position compared to the narrow-clawed crayfish, and gender and body weight of the specimen investigated has no effect in this regard.

Key words: noble crayfish, narrow-clawed crayfish, shelters, competition

Introduction

In nature there are various intra- and inter-species competitive relations between individuals, inhabiting the same biotope. Concerning freshwater crayfish the shelter competition is considered as normal behavior during their life. The reason for this is that shelters are important for their protection from the numerous enemies. Without shelters the crayfish are at considerable risk of becoming prey to various predators or other individuals of their own species, especially during molting.

Usually shelter occupation is associated with emergence of competition. This often occurs at a higher density of the population of one species or popula-

tions of two or more species or when there is limited number of shelters (Blank and Figler, 1996; Vorburger and Ribi, 1999).

The cases of sympatric populations of *Astacus leptodactylus* (Esch.) and *Astacus astacus* L. are rare. In most cases *Astacus leptodactylus* (Esch.) inhabits water bodies with silty or sand-clay bottom with preference to slow flowing or standing water. *Astacus astacus* L. avoids this type of water bodies and inhabits mainly fast-flowing rivers and streams with rocky bottoms, and in most cases its great numbers correlate with the presence of various shelters.

Until now there are no known cases of sympatric populations of *Astacus leptodactylus* (Esch.) and *Astacus astacus* L. in Bulgaria, however, Stucki and

Romer (2001) announce that similar cases were observed in Switzerland. This gives reason to believe that, in certain regions of our country as well, it is possible for the two species to inhabit the same biotope, which will inevitably lead to competition for occupying shelters. In regard to this it is of interest which of these two species dominates in the occupation.

The competition for shelters between crayfish is investigated by many authors. Some of them investigate the intra-species competition, including the influence of the body weight and gender in relation to shelter occupation (Ranta and Lindstrom, 1993; Peeke et al., 1995; Figler et al., 1999; Zaikov et al., 2001; Zaikov et al., 2004). Other authors study the inter-species competition and establish the dominant positions of some species during occupation of shelters (Blank and Figler, 1996; Vorburger and Ribic, 1999; Zaikov, 2005). Usually, the more aggressive species are dominant and they succeed in occupying the shelters (Blank and Figler, 1996).

Studies on the competitive relations in the occupation of shelters between *Astacus leptodactylus* (Esch.) and *Astacus astacus* L. have not been carried out, which is the main reason for conducting this study.

Materials and Methods

The experiments were carried out in 20-litre experimental tanks (static system). During the experimental period, when the crayfish position in relation to the shelters was reported, water temperature varied within narrow limits (17.1-20.3°C). The quantity of oxygen dissolved in the water was 3.4-3.8 mg.l⁻¹ and saturation with oxygen was 38 to 42%. Permanently fixed PVC tubes with length of 80 mm and 45 mm diameter were used as shelters. In each aquarium with only one shelter mounted, pre-selected and pre-weighed specimens of the respective couple were introduced. The specimen position in relation to the shelters was reported in the following intervals: 5, 10, 15, 30, 60, 120, 240, 1200, 1440 min, which were in conformity with the decreasing motive activity of the crayfish participating in the experiment. The total du-

ration of each of the variants was 1440 min (24 h).

240 crayfish in total were used in the experiment, including 120 individuals of each species and 60 individuals of each gender. The noble crayfish was caught in the river of Razhdavets, Troyan Municipality, the Balkan Mountains, and the narrow-clawed crayfish in the Kardzhali dam-lake, by means of crayfish-traps. Crayfish with soft shells or with only one claw were not used in this experiment. By the beginning of the experiment both species were stored in tanks with constant water-flow and water aeration by means of micro-compressors.

In order to investigate shelter competition between the noble crayfish and the narrow-clawed crayfish, the following 12 variants (three groups) were experimented:

I. Group: noble crayfish and narrow-clawed crayfish of the same gender and different body weight

Variant 1: female small noble crayfish (fsa) and female large narrow-clawed crayfish (flf).

Variant 2: female large noble crayfish (fla) and female small narrow-clawed crayfish (fsl).

Variant 3: male (m) small noble crayfish (msa) and male large narrow-clawed crayfish (mll).

Variant 4: male large noble crayfish (mla) and male small narrow-clawed crayfish (msl).

II. Group: noble crayfish and narrow-clawed crayfish of different gender and different body weight

Variant 5: female small noble crayfish (fsa) and male large narrow-clawed crayfish (mll).

Variant 6: female large noble crayfish (fla) and male small narrow-clawed crayfish (msl).

Variant 7: male large noble crayfish (mla) and female small narrow-clawed crayfish (fsl).

Variant 8: male small noble crayfish (msa) and female large narrow-clawed crayfish (flf).

III. Group: noble crayfish and narrow-clawed crayfish with same body weight

Variant 9: male noble crayfish (ma) and male nar-

Table 1
Average body weight (g) and crayfish position in the end of the experiment

Variant	Species	Body weight, g	Crayfish position, number (n)			
			Single individual into the shelter, n	Both individuals into the shelter, n	Both individuals out of the shelter, n	Single individual out of the shelter, n
1. Variant	<i>A. leptodactylus</i>	10.54	2	0	0	8
	<i>A. astacus</i>	21.16	8	0	0	2
2. Variant	<i>A. leptodactylus</i>	19.63	1	0	0	9
	<i>A. astacus</i>	36.68	9	0	0	1
3. Variant	<i>A. leptodactylus</i>	31.88	3	1	0	6
	<i>A. astacus</i>	19.45	6	1	0	3
4. Variant	<i>A. leptodactylus</i>	23.77	2	0	2	6
	<i>A. astacus</i>	42.80	6	0	2	2
5. Variant	<i>A. leptodactylus</i>	32.0	1	2	0	7
	<i>A. astacus</i>	18.94	7	2	0	1
6. Variant	<i>A. leptodactylus</i>	22.04	0	0	1	9
	<i>A. astacus</i>	35.7	9	0	1	0
7. Variant	<i>A. leptodactylus</i>	20.88	4	0	0	6
	<i>A. astacus</i>	46.65	6	0	0	4
8. Variant	<i>A. leptodactylus</i>	34.62	3	1	0	6
	<i>A. astacus</i>	21.13	6	1	0	3
9. Variant	<i>A. leptodactylus</i>	29.83	2	1	0	7
	<i>A. astacus</i>	30.03	7	1	0	2
10. Variant	<i>A. leptodactylus</i>	29.82	2	0	1	7
	<i>A. astacus</i>	29.81	7	0	1	2
11. Variant	<i>A. leptodactylus</i>	31.78	0	0	0	10
	<i>A. astacus</i>	31.98	10	0	0	0
12. Variant	<i>A. leptodactylus</i>	25.90	1	0	1	8
	<i>A. astacus</i>	25.60	8	0	1	1

row-clawed crayfish (ml).

Variant 10: male noble crayfish (ma) and female narrow-clawed crayfish (fl).

Variant 11: female noble crayfish (fa) and male narrow-clawed crayfish (ml).

Variant 12: male noble crayfish (fa) and female narrow-clawed crayfish (fl).

Results and Discussion

The average body weight of crayfish participating in the experiment and their positions at its end are given in Table 1. The shelter occupation dynamics is shown in Figures 1-12.

As regards the first group of the crayfish investigated (variant 1-4, Figures 1-4), the gender depen-

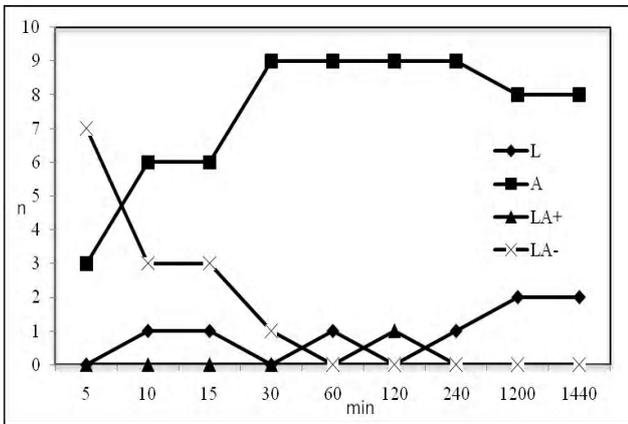


Fig.1. Number of female small noble crayfish (fsa) and female large narrow-occupying shelters during the experiment (L - *A. leptodactylus*; A - *A. astacus*; LA+ occupied shelters by both species LA- unoccupied shelters)

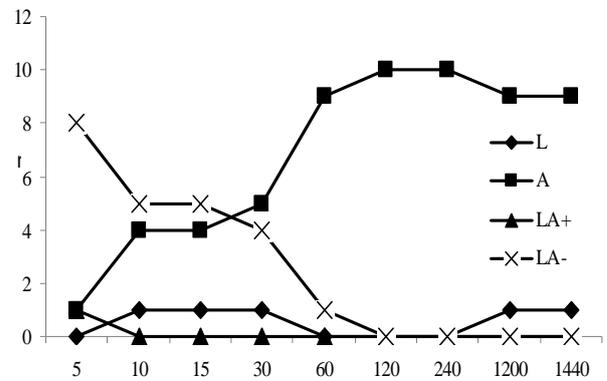


Fig. 2. Number of female large noble crayfish (fla) and female small narrow-occupying shelters during the experiment (L - *A. leptodactylus*; A - *A. astacus*; LA+ occupied shelters by both species LA- unoccupied shelters)

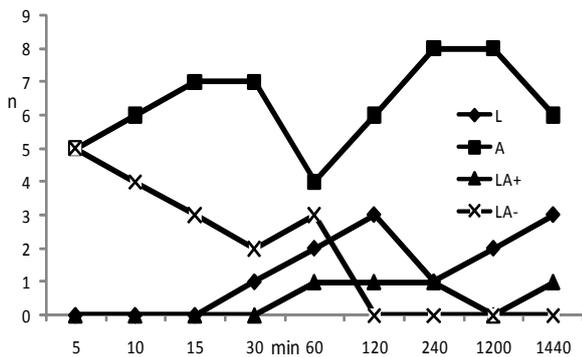


Fig. 3. Number of male small noble crayfish (msa) and male large occupying shelters during the experiment (L - *A. leptodactylus*; A - *A. astacus*; LA+ occupied shelters by both species LA- unoccupied shelters)

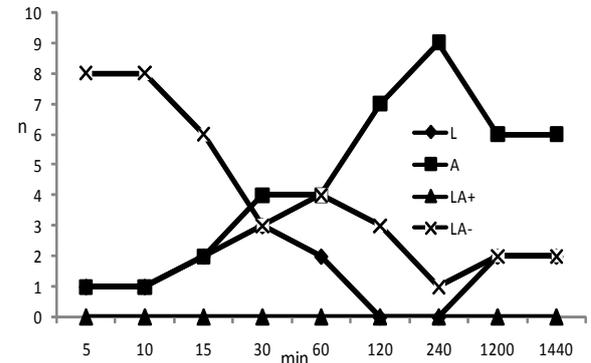


Fig. 4. Number of male large noble crayfish (mla) and male small occupying shelters during the experiment (L - *A. leptodactylus*; A - *A. astacus*; LA+ occupied shelters by both species LA- unoccupied shelters)

dence was ignored and the couples formed, were only of male or only female specimens. The body weight and the species belonging can have an influence upon shelter occupation.

The female noble crayfish from variant 1 (Figure 1), which have a smaller body weight, occupy 3 shelters by the 5th minute, while the first specimen of narrow-clawed crayfish enters them up to 10th minute, when the number of noble crayfish has reached 6.

The ratio in favor of the noble crayfish, which is evident at the beginning of the experiment, is preserved until its end, the ratio being 8 to 2 in their favor.

As regards variant 2 (Figure2), in which the noble crayfish have a greater body weight, almost the same dynamics can be observed. The noble crayfish orient faster for shelter occupation, and at the 2nd and 4th hour they are able to occupy all shelters. The final result is also in their favor (9:1), and in this variant,

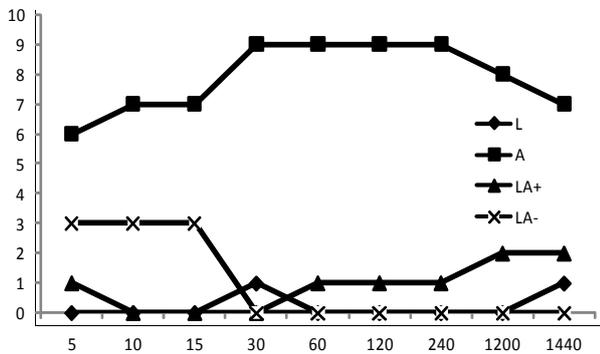


Fig. 5. Number of female small noble crayfish (fsa) and male large narrow-clawed crayfish (mll) occupying shelters during the experiment (L - *A. leptodactylus*; A - *A. astacus*; LA+ occupied shelters by both species LA- unoccupied shelters)

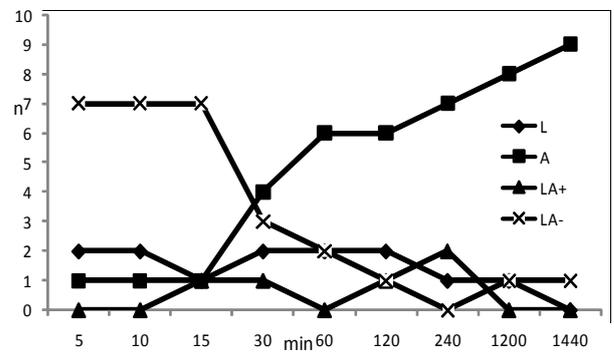


Fig. 6. Number of female large noble crayfish (fla) and male small narrow-clawed crayfish (msl) occupying shelters during the experiment (L - *A. leptodactylus*; A - *A. astacus*; LA+ occupied shelters by both species LA- unoccupied shelters)

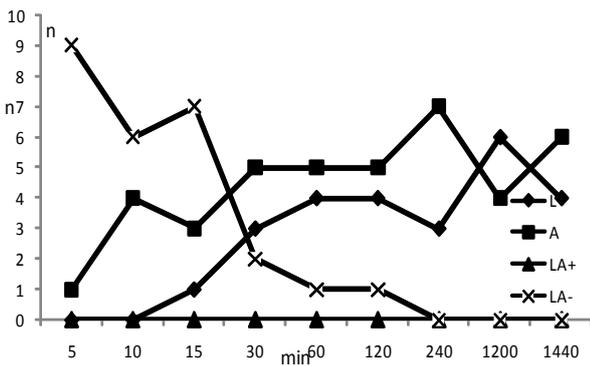


Fig. 7. Number of male large noble crayfish (mla) and female small narrow-clawed crayfish (fsl) occupying shelters during the experiment (L - *A. leptodactylus*; A - *A. astacus*; LA+ occupied shelters by both species LA- unoccupied shelters)

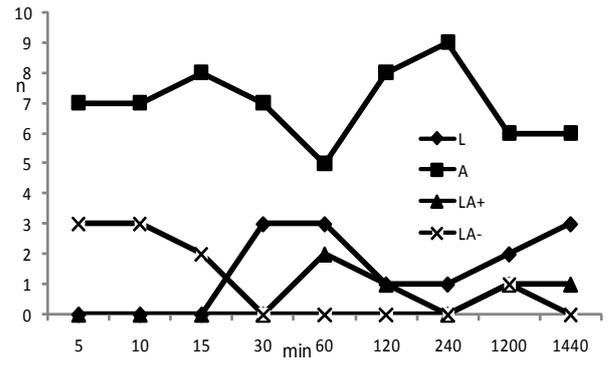


Fig. 8. Number of male small noble crayfish (msa) and female large narrow-clawed crayfish (flf) occupying shelters during the experiment (L - *A. leptodactylus*; A - *A. astacus*; LA+ occupied shelters by both species LA- unoccupied shelters)

one shelter is occupied by the 5th minute by both species, however the narrow-clawed crayfish is pushed out very quickly.

The male small noble crayfish from variant 3 (Figure 3) occupy quickly greater number of shelters in comparison to the narrow-clawed crayfish with a larger body weight, and at the 2nd hour 8 of them are occupied by the noble crayfish and only 1 by the narrow-clawed crayfish, the final result being 6:3 in their

favor. In variant 4 (Figure 4), after 24 hours, a greater number of shelters are occupied by the noble crayfish, however the dynamics during their occupation differs from the previous 3 variants. Up to the 30th minute, there is parity in their occupation, after which the predominance of noble crayfish (6:2 in their favor) becomes evident. In all variants discussed by now, the species belonging has the greatest influence on shelters occupation, while the body weight does

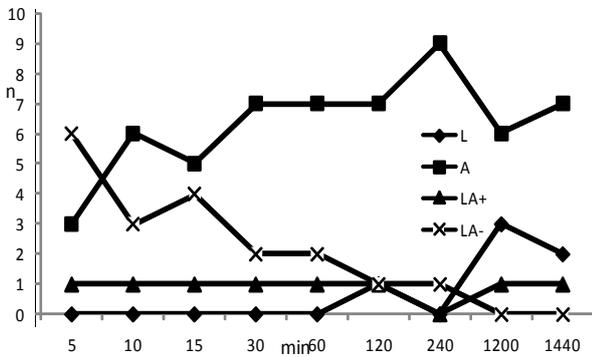


Fig. 9. Number of male noble crayfish (ma) and male narrow-clawed crayfish (ml) occupying shelters during the experiment (L - *A. leptodactylus*; A - *A. astacus*; LA+ occupied shelters by both species LA- unoccupied shelters)

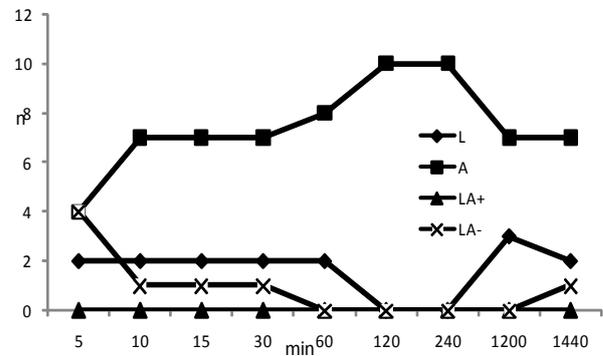


Fig. 10. Number of male noble crayfish (ma) and female narrow-clawed crayfish (fl) occupying shelters during the experiment (L - *A. leptodactylus*; A - *A. astacus*; LA+ occupied shelters by both species LA- unoccupied shelters)

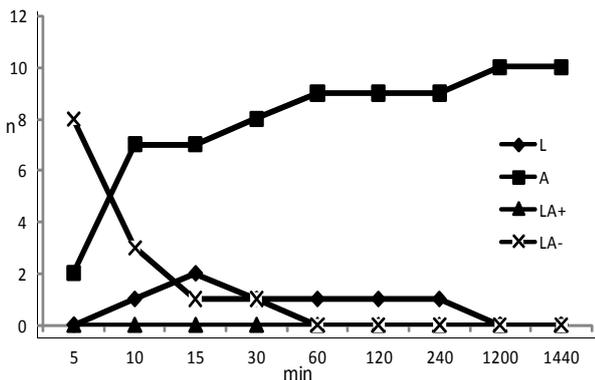


Fig. 11. Number of female noble crayfish (fa) and male narrow-clawed crayfish (ml) occupying shelters during the experiment (L - *A. leptodactylus*; A - *A. astacus*; LA+ occupied shelters by both species LA- unoccupied shelters)

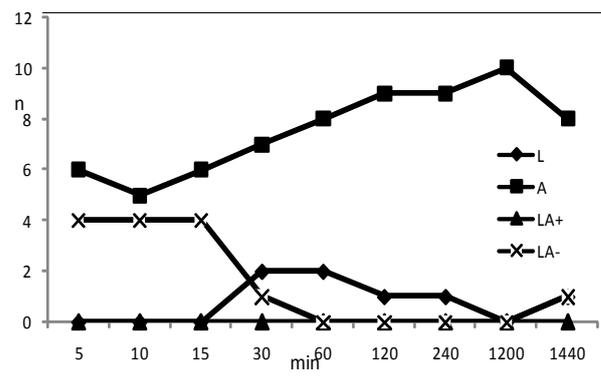


Fig. 12. Number of male noble crayfish (fa) and female narrow-clawed crayfish (fl) occupying shelters during the experiment (L - *A. leptodactylus*; A - *A. astacus*; LA+ occupied shelters by both species LA- unoccupied shelters)

not directly influence occupation. The noble crayfish regardless of their body weight orient faster towards their occupation.

In the second group - noble crayfish and narrow-clawed crayfish with different gender and different body weight (variant 5-8, Figures 5-8), the results show that the noble crayfish are predominant in shelters occupation. This can be seen in variant 5 (Figure

5) and especially in variant 6 (Figure 6), where at the end of the experiment 9 shelters are occupied by the noble crayfish and only 1 by the narrow-clawed crayfish. It is interesting to note the fact that in variant 5 (Figure 5), up to the 5th minute the noble crayfish were the first to orientate towards the shelters and preserve their predominance until the end of the experiment, while in variant 6 (Figure 6) this was reported at the

30th minute. As regards the remaining two variants, the noble crayfish are also predominant in shelters occupation; however, it is more weakly expressed. In this group of experiments (variants 5-8, Figures 5-8) the effect of species belonging has also a decisive significance in shelter occupation.

In the third group (variant 9-12, Figures 9-12) - crayfish with practically identical body weight of the same or different gender, the results show that the gender do not have any effect on shelter competition. This is clearly expressed from the beginning until the end of the experimental period, since at certain times all ten shelters are occupied by the noble crayfish. Within the limits of the group studied the gender does not have any effect on shelter competition and only the species belonging of the individuals is decisive.

The analysis of the results obtained shows that in all of the experimental variants both gender and body weight do not have any effect on the competition for shelters. The greatest significance in shelter competition has specimen species belonging. The noble crayfish in all variants show predominance in shelters occupation and stay in the shelters for a longer period of time, regardless of their gender and body weight. The reason for this is the dominating position of the noble crayfish compared to the narrow-clawed crayfish, as well as its greater affinity for shelter occupation.

Conclusion

The study on shelters competition between the noble crayfish (*Astacus astacus* L.) and the narrow-clawed crayfish (*Astacus leptodactylus* Esch.) shows that the species belonging of the individuals has a predominant significance in shelter occupation. In all variants investigated, the noble crayfish have a dominant position compared to the narrow-clawed crayfish, and gender and body weight of the specimen investigated has no effect in this regard.

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