

FECUNDITY OF STONE CRAYFISH *AUSTROPOTAMOBIUS TORRENTIUM* FROM TWO DIFFERENT POPULATIONS IN BULGARIA

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Abstract

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The aim of the study was to establish the sexual maturity, pleopodal egg number and egg size in the stone crayfish from two different biotopes - a dam-lake and a river, at the end of the reproductive period - shortly before larvae hatching. The obtained results are the first data on this species in this country. In both investigated biotopes stone crayfish females seemed to reach sexual maturity at a very closed total length of 62-64 mm and at carapace length of 29 mm. The average egg number of 78 for the females in the Mrachenik River were estimated, while the egg number of the females from Dospat dam-lake are lower - only 29. In Mrachenik River the minimum registered egg number was 21 and the maximum 125. In Dospat dam-lake the minimum registered egg number was 11 and the maximum 66. An average size of 3.2 mm egg diameter and 0.019 mg egg weight for the females from Dospat dam-lake, and an average size of 2.8 mm egg diameter and 0.013 mg egg weight for the females from the Mrachenik River were established. Egg size diameter and weight did not show any significant correlation, neither positive to maternal female size, nor negative to total amount of eggs. The differences in pleopodal egg number and egg size in the both investigated populations are probably in connection with the influence of some environmental factors as temperature, duration of the reproductive period, food and shelters availability and etc.

Key words: stone crayfish (*Austropotamobius torrentium*), sexual maturity, pleopodal egg number, egg size

Introduction

In the world there are over 500 freshwater crayfish species, which inhabit various biotopes (Holdich, 2002). In Europe the number of species is significantly smaller, with only five indigenous species: noble crayfish *Astacus astacus* L., narrow-clawed crayfish *Astacus leptodactylus* Esch., thick clawed crayfish *Caspiastacus pachypus* Rathke, stone crayfish *Austropotamobius torrentium* Schrank and white-

clawed crayfish *Austropotamobius pallipes* Lereboullet (Machino at al., 2006; Soute-Grosset at al., 2006).

Bulgaria is among the few European countries, where there are no introduced freshwater crayfish species (Zaikov and Hubenova, 2007). Common for the astacifauna in the country are 3 species: *Astacus* (*Pontastacus*) *leptodactylus* Esch., *Astacus astacus* L., *Austropotamobius torrentium* Schrank. and *Caspiastacus pachypus* Rathke. The announcement

for existence of the last one (*Caspiastacus pachypus* Rathke) was made by Bulgurkov in the late 1964, and is based on a single crayfish from one single site, which is still unconfirmed (Bulgurkov, 1964). Probably this species is no longer found in the country or the announcement about its existence was based on wrong determination. All three crayfish species found in Bulgaria are under some form of protection, and are included in various legal documents (Zaikov and Hubenova, 2007).

The populations and location areas of the freshwater crayfish are poorly studied in Bulgaria. The most complete research on the species composition was made by Bulgurkov (1961), but the material for his study was gathered mainly in the period between 1940-1960 and the data released is presently not up to date and probably do not match the reality. Some data about crayfish areas, without being the subject of a special study, are found in publications by other authors, which study the epibionts from the *Branchiobdellidae* family on the crayfish (Kozarov et al., 1972; Subchev et al., 1998; Subchev, 2001).

The stone crayfish *Austropotamobius torrentium* Schrank occurs in the Danube river system, from the springs in Bavaria to the Iron Gate in Romania (Machino et al., 2006). It occupies brooks in Bavaria, in the north-east Switzerland, Austria, Slovakia, Hungary, Bulgaria, Romania, and parts of former Yugoslavia. Habitat destruction, pollution and crayfish plague caused by *Aphanomyces astaci* Schikora have led to a rapid decline of the populations.

Like other European crayfish species (*Astacus astacus* Linné, *Austropotamobius pallipes* Lereboullet) the stone-crayfish is considered a threatened species (Bohl, 1989; Troschel & Dehus, 1993). It is listed under the category 'endangered' in the Bulgarian Red List of endangered species and according to the Aquaculture and Fisheries Law since 2006 its catching, moving, transporting and trade was prohibited throughout the whole year. The stone crayfish is listed in the Annex IV of European Community Directives for the Conservation of Natural habitats and wild Flora and Fauna (97/62/EU) as a species re-

quiring special conservation measures. These conservation measures include protection of existing populations, establishment of reserve areas and restocking attempts in suitable habitats. In this connection our study on the reproductive biology of the stone crayfish (fecundity) is a very important point to make future assessment of the population size and restocking activities.

During this long period of 40-50 years up to now there have been major alterations in the ecosystem due to corrections of the riverbeds, construction of new water reservoirs, eutrophication or draining of existing water bodies etc. All this provides sufficient ground to consider that in fact the distribution and structure of the populations of the freshwater crayfish in Bulgaria are not studied.

Beginning from 2001 a research group from the Institute of Fisheries and Aquaculture in Plovdiv re-established the research activities on the freshwater crayfish. The research was focused at first only on the narrow-clawed crayfish *A. leptodactylus* as an object of the aquaculture (Hubenova et al., 2000; Hubenova et al., 2002; Hubenova et al., 2004), but since 2009 the study range over *Astacus astacus* and *Austropotamobius torrentium*.

The aim of the present study was to establish the sexual maturity, pleopodal egg number and egg size in the stone crayfish from two different biotopes - a dam-lake and a river, at the end of the reproductive period - shortly before larvae hatching. The obtained results are the first data on this species in this country.

Material and Methods

Study site

Two different areas of stone crayfish distribution were investigated.

- Dospat dam-lake is located at about 1000 m altitude above sea-level. The studied section of the lake was shallow, near the lake border. The substrate in the dam-lake mainly consists of sandstone and marl. Water temperature at time studied was 20.2° C.

- Mrachenik River is located at 700-800 m altitude above sea-level. The total length of studied sec-

tions was 2 000 m, and the width of the river bed ranged from 1.0 to 3.0 m. The substrate consists mainly of stones with different size. Water temperature in the river was 14.8°C.

Studied animals

Individuals of *A. torrentium* were caught by traps in the end of the reproductive season - on 15 May 2009 in Dospat dam-lake and on 8 May in Mrachenik River. Captured specimens were transported to the laboratory and morphometric measurements were taken from all sampled individuals in order to estimate and compare the size between the both populations.

From all specimens the following 16 measurements were taken using the following schema (Figure 1): carapace length (CL, cm), carapace width (CW, cm), chela length (ChL, cm), chela width (ChW, cm), chela depth (ChD, cm), chela corpulence (ChC, cm), telson length (TelL, cm), telson width (TelD, cm), rostrum length (RL, cm), rostrum width (RW, cm), palm length (PL, cm), abdomen length (AL, cm), abdomen width (AW, cm), dactyl length (DL, cm), were measured to the nearest 0.1 mm using vernier calipers. Total body length (TL, cm) was measured to the near-

est mm using a ruler. Body weight (BW, g) was measured using electronic balances.

Results and Discussion

Sexual maturity of females

The smallest ovigerous female (bearing eggs) from Dospat dam-lake had a total length of 62 mm and body weight of 7.1 g and the largest 94 mm and 27.4 g. The smallest female bearing eggs from Mrachenik River had a total length of 64 mm and body weight of 7.7 g and the largest 83 mm and 22.5 g. In both investigated biotopes stone crayfish females seemed to reach sexual maturity at a very closed total length of 62-64 mm and at carapace length of 29 mm.

The achieved results are similar to the data pointed by other authors. In Austrian rivers females reached sexual maturity at the size class of 59-65 mm total length, respectively at the carapace length of 28.6-31.5 mm (Streissl and Hoedl, 2002). In Croatia the smallest female with pleopodal eggs was 54 mm (Maguire et al., 2005).

In comparison to other European freshwater crayfishes female of *A. torrentium* matures at a relative big size compared to *A. pallipes*. The size at maturity

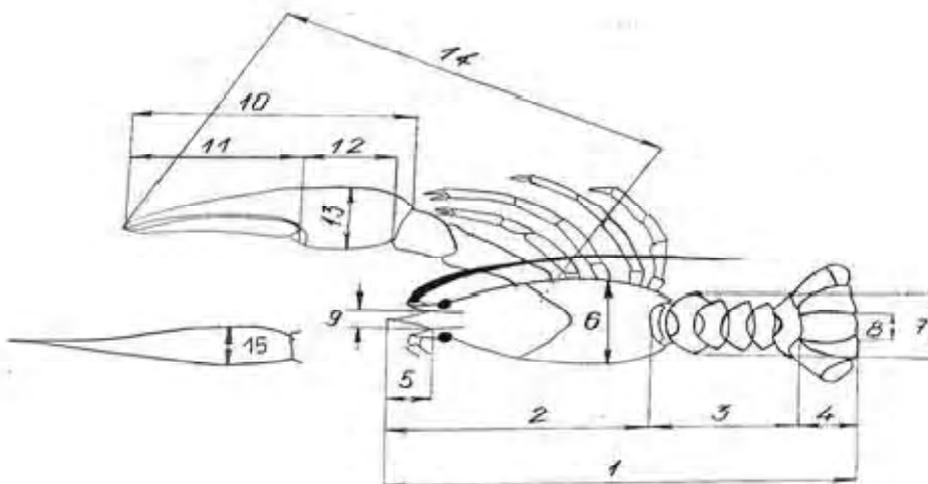


Fig. 1. Investigated exterior features: 1-Total length; 2-Carapace length; 3-Abdomen length; 4-Telson length; 5-Rostrum length; 6-Carapace width; 7-Abdomen width; 8-Telson width; 9-Rostrum width; 10-Chela length; 11-Dactyl length; 12-Length of palm; 13-Chela width; 14-Chela length from carpal joint to its tip; 15-Chela corpulence

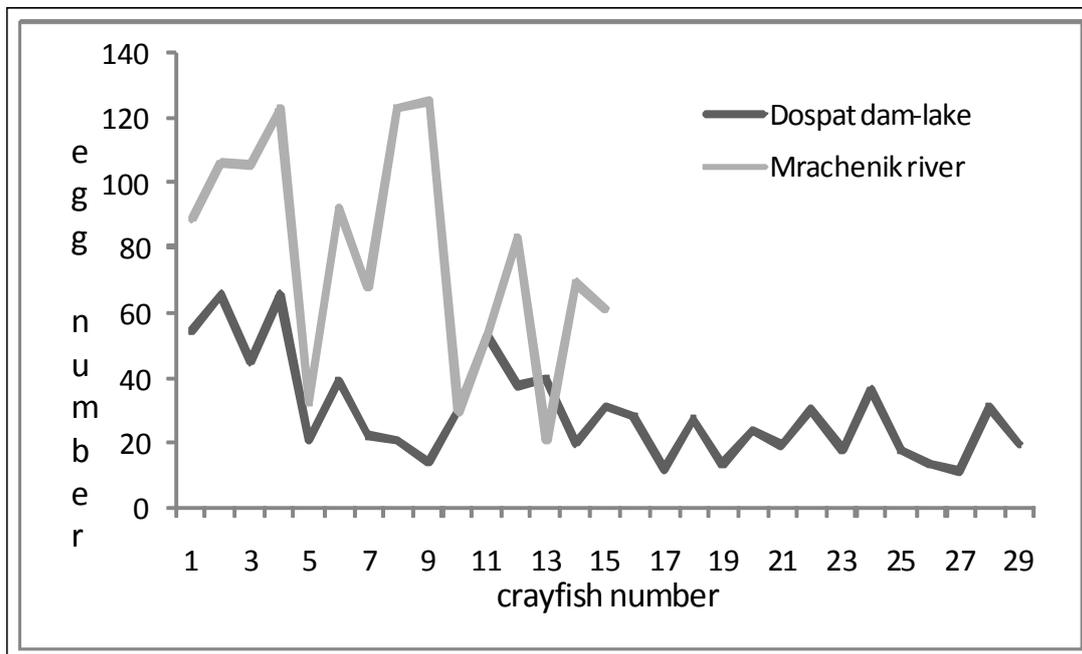


Fig.2. Pleopodal egg number in stone crayfish in Dospat dam lake and Mrachenik River

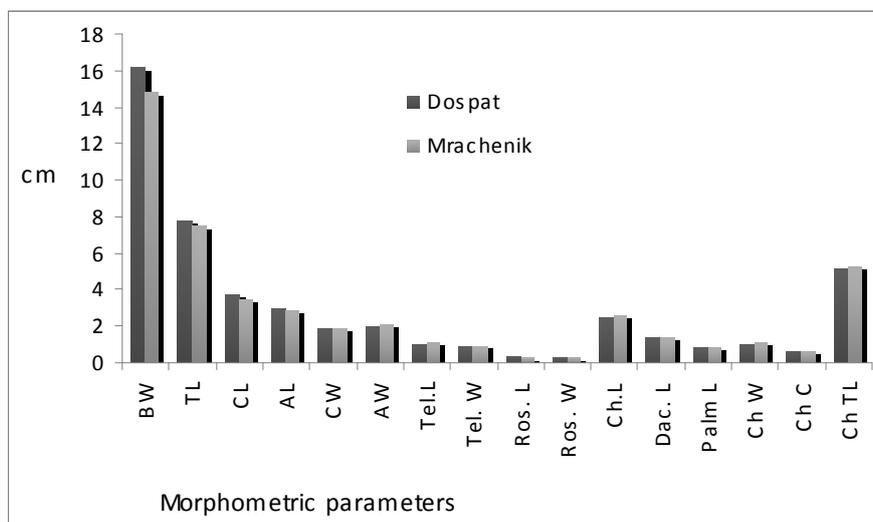


Fig.3. Morphometric parameters (cm) of stone crayfish from Dospat dam lake and Mrachenik River. body weight (BW), total (TL), carapace length (CL), abdomen length (AL), carapace width (CW), abdomen width (AW), telson length (Tel.L), telson width (Tel.W), rostrum length (Ros.L), rostrum width (Ros.W), chela length (Ch.L), dactyl length (Dac.L), palm length (Palm.L), chela width (ChW), chela corpulence (ChC),

of *A. pallipes* is considered to be 22-24 mm carapace length at relative smaller size compared to *A. astacus* and *A. leptodactylus* (Troschel et al.,1993).

The size at which female *A. astacus* attain maturity is 80 mm total body length and the minimal size of female *A. leptodactylus* whit pleopodal eggs is 9.5 g

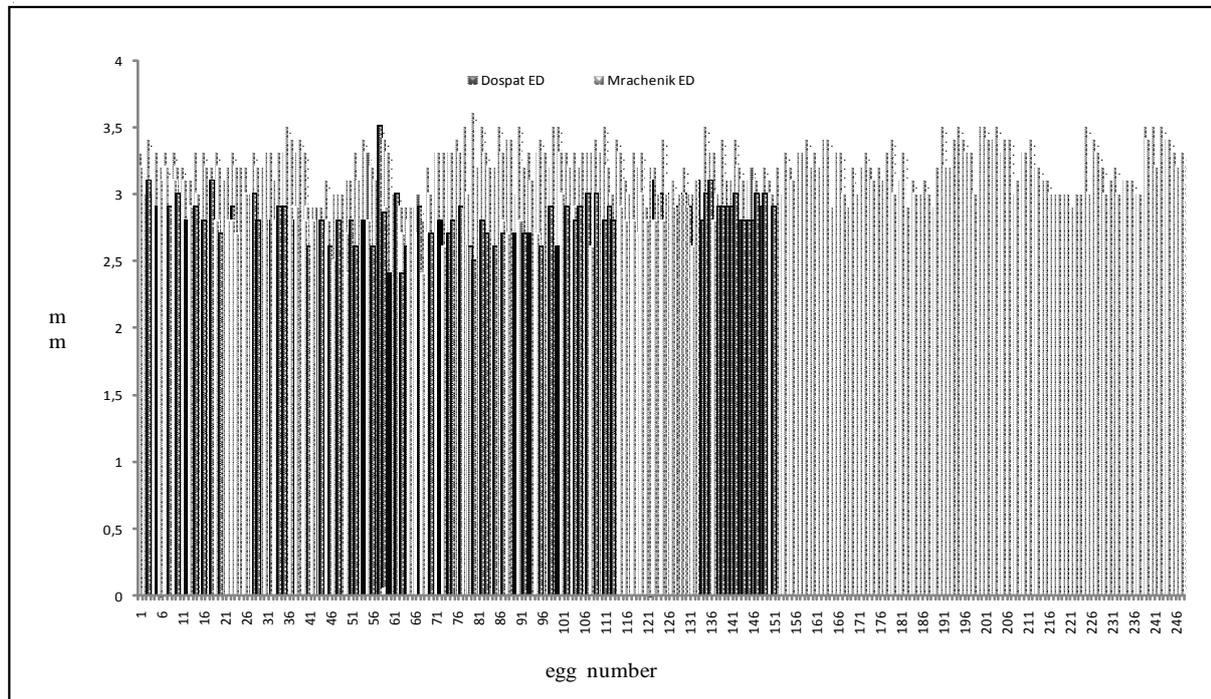


Fig.4. Egg diameter (ED, mm) of stone cray from Dospat dam lake and Mrachenik River

body weight and 70 mm body length (Vasileva et al., 2006).

Pleopodal egg number

In this study during the collecting time - shortly before larvae hatching an average egg number of 78 for the females in the Mrachenik River were estimated, while the egg number of the females from Dospat dam-lake are lower – only 29 (Figure 2). In some Bavarian rivers in May a total of 49 eggs per female were found. The highest number of 108 eggs was estimated in a female with a carapace length of 31 mm. In Croatian rivers the average number per female varied from 1 to 104.

In Mrachenik River the minimum registered egg number was 21 and the maximum 125 (Figure 2). In Dospat dam-lake the minimum registered egg number was 11 and the maximum 66. In Dospat dam-lake most of females have between 10 and 30 eggs. In Mrachenik River most of the females have between 60 and 125 eggs. According to Bohl (1989) A.

torrentium as the smallest of the European crayfish species, shows the lowest fecundity with 50-100 eggs, but hardly more than 60. The data obtained are in accordance with the results given by other authors. Stucki and Romer (2001) reported that in Swiss Lake Aegeri females carried an average of 48 eggs with a diameter of 2.64 mm. Huber and Schubart (2005) found approximately 63 eggs in 25 berried females. In our case the higher egg number of the females in Mrachenik River is probably in connection with the availability of shelters, that offer the river stones for better protection.

The females from the both biotopes do not differ significantly in terms of the investigated morphometric parameters. There was only a slight tendency that large females carried more eggs (Figure 3). At the end of the reproductive period the influence of the environmental factors such as predators, duration of the incubation time, fight for shelters etc., on the egg number is much stronger than the size of females. Shortly after ovulation in October the estimated pleopodal eggs

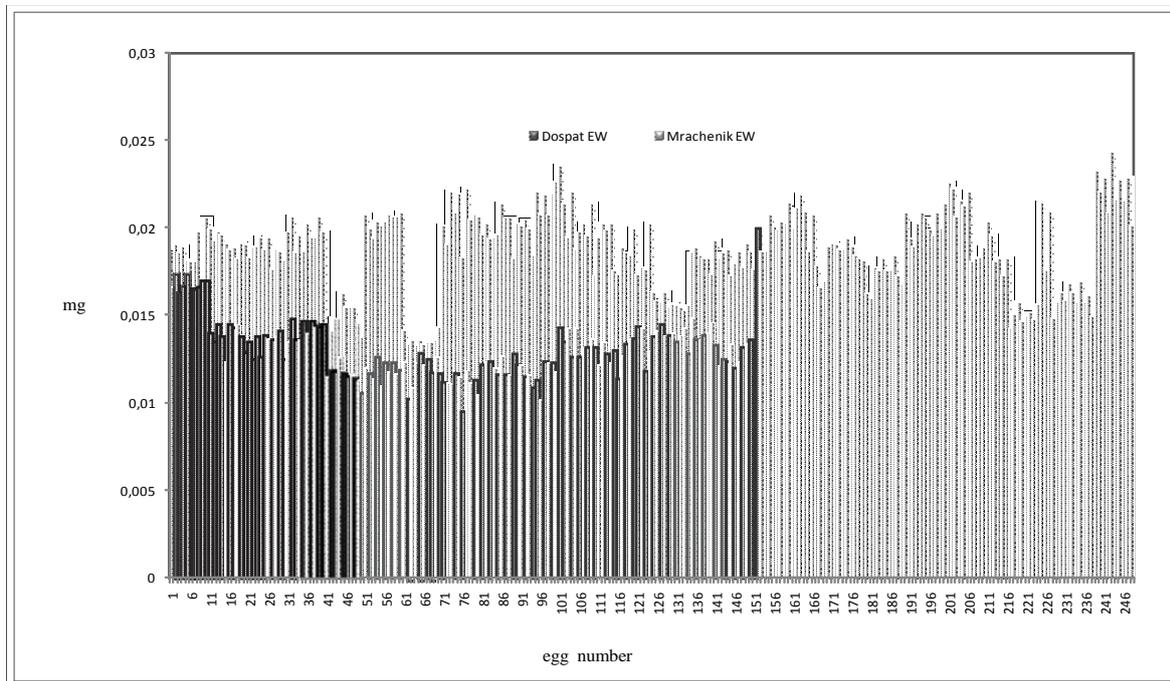


Fig.5. Egg weight (EW, mg) of stone crayfish from Dospat dam lake and Mrachenik River

in females from Dospat dam-lake was between 49 and 100, at average 75. In comparison to the average number registered in May - 29, the egg losses during the long incubation period from October to May-June may be more than 50 %.

Egg size

The data obtained by measuring the egg wet weight and diameters in each of the berried females from the both biotopes resulted in an average size of 3.2 mm egg diameter and 0.019 mg for the females from Dospat dam-lake, and in an average size of 2.8 mm egg diameter and egg weight 0.013 mg for the females from the Mrachenik River (Figures 4 and 5).

Similar data were reported for eggs from females in Bavarian rivers. Shortly before larvae hatching an egg diameter of 2.9 mm was established. In Croatia the diameter of the pleopodal eggs varied from 2.4 to 3.2 mm, mean 2.8 mm.

Egg size diameter and weight did not show any significant correlation, neither positive to maternal female size, nor negative to total amount of eggs.

The bigger weight and diameter of the eggs from the females in Dospat dam-lake is probably in con-

nection with the higher water temperature registered in Dospat in comparison to the temperature in Mrachenik River, which results in an advanced development of the embryos. On the other site the bigger eggs in females from Dospat dam-lake can be influenced by the better natural food basis that offers the dam-lake in comparison to the Mrachenik River.

Conclusions

In both investigated biotopes stone crayfish females seemed to reach sexual maturity at a very closed total length of 62–64 mm and at carapace length of 29 mm. The average egg number of 78 for the females in the Mrachenik River were estimated, while the egg number of the females from Dospat dam-lake are lower – only 29. In Mrachenik River the minimum registered egg number was 21 and the maximum 125. In Dospat dam-lake the minimum registered egg number was 11 and the maximum 66. An average size of 3.2 mm egg diameter and 0.019 mg egg weight for the females from Dospat dam-lake, and an average size of 2.8 mm egg diameter and 0.013 mg egg weight

for the females from the Mrachenik River were established. Egg size diameter and weight did not show any significant correlation, neither positive to maternal female size, nor negative to total amount of eggs. The differences in pleopodal egg number and egg size in the both investigated populations are probably in connection with the influence of some environmental factors as temperature, duration of the reproductive period, food and shelters availability and etc.

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