CONTRIBUTIONS TO THE KNOWLEDGE OF THE MORPHOLOGY OF THE ASTACID CRAYFISHES FROM ROMANIA

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On présente la morphologie et le dimorphisme sexuel de trois Astacidae des eaux de Roumanie: *Astacus astacus*, A. *leptodactylus* et *Austropotamobius torrentium*. Ont été considérés 17 caractères somatiques, représentant des régions, segments du corps et certains appendices thoraciques, pour trois lots d'écrevisses (comprenant entre 20 et 37 exemplaires). Pour *Astacus astacus* et *A. leptodactylus* on a effectué (sur du matériel vivant) aussi la différenciation biochimique, à l'aide de l'électrophorèse (Fig. 2). Les données biométriques sont présentées dans les tableaux 1—3.

Three species of astacid crayfishes are present in the fresh and brackish waters of Romania, two of which belong to genus *Astacus (Astacus astacus* and *Astacus leptodactylus)*, and another to *Austropotamobius (Austropotamobius torrentium)*.

Morphobiometric, as well as biological studies on crayfishes have been undertaken mainly by east European carcinologists, Imre, 1943; Brodskii, 1979 and Kossakowski, 1962. Such studies have been published rather recently by a few authors, Imre, 1943, Kossakowski, 1962, on two of the three species dealt with in the present paper, but these authors have considered only a small number of somatic characters.

MATERIAL AND METHODS

In order to know the morphological variability and the sexual dimorphism of the three crayfish species from Romania, a number of 20—37 individuals from three populations, each belonging to another species have been biometrically studied. The localities are: Bicaz Dam-lake, on Bistrița River, Moldavia (eastern Romania): *Astacus astacus;* Iacubova Lake (Pardina complex of lakes), Danube Delta: *Astacus leptodactylus;* Sușara Brook, tributary of Nera River, southern Banat: *Austropotamobius torrentium*. The specimens have been initially preserved in formalin, being later transferred in alcohol. 17 somatic characters have been measured (Fig. 1) regions of the body thoracic and abdominal segments, some thoracic appendices. The measurements, in % of the body or of the cephalothorax, are presented in Table 1—3, for each species.

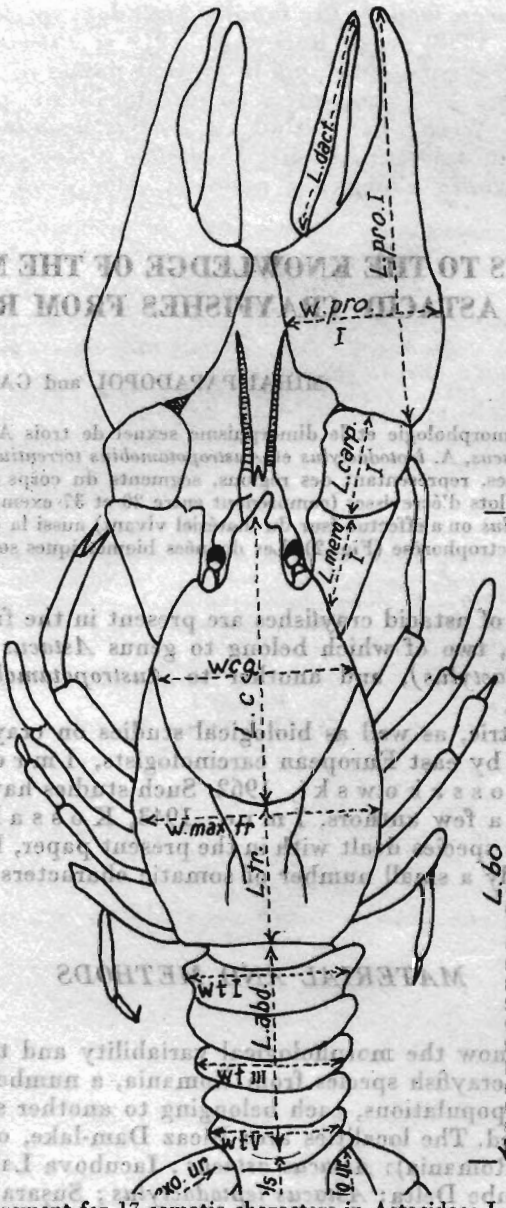

Fig. 1. — The measurement for 17 somatic characters in Astacidae: L.cf = length of cephalothorax; L.tr. = length of thorax; L.abd. = length of abdomen; L.bo. = body length; L.c. = length of cephalic region; W.cg. = width at the level of cervical groove; W.max.tr. = maximum width of thorax; W.t I = width of I abdominal segment; W.t III = width of III-rd abdominal segment; W.t V = width of V-th abdominal segment; L.tels. = length of telson; L.exo.u. = length of uropod exopodite; L.end.ur. = length of uropod endopodite; L. dact. I = length of dactylopodite I; L.pro. I = length of propodite I; L.carp. I = length of carpopodite I; L.mero. I = length of meropodite I; W. pro. I = width of propodite I. (Orig.).

The biochemical differences were also established, for the two *Astacus* species (from which living specimens were available) through electrophoresis on amidon-gel for the muscle proteins. One male and one female were used for each species (*A. astacus* from the Bicaz Dam-Lake, *A. leptodactylus* from the Puiu lake, Danube Delta).

RESULTS AND DISCUSSION

The sexual dimorphism is well marked in all Decapoda. Constant differences between males and femalese have been found by previous authors in the three crayfish species analysed here. The data presented in tables I—3 for certain characters such as the length (L) of the chelae and the width (À) of the abdominal segments are consistent with the results of preceding authors (Băcescu, 1967; Brodskii, 1979; Imre, 1943; Kossakowski, 1962) concerning the differences between the two sexes. One remarks quite easily that the average relative values of propodite I are, in all three species, much higher in males, those of L. dactylopodite I (Fig. 1) being also higher in males (Tab. 1—3).

Table 1

VALUES OF THE MORPHOLOGICAL CHARACTERS IN THE INDIVIDUALS OF *ASTACUS ASTACUS* FROM BICAZ LAKE (3—30. V. 1972)

Somatic character	Values			
	Males		Females	
	Average	Variation	Average	Variation
Body length (mm)	113.6	97 —131	99.2	83 —112
In % of body length				
L. of cephalothorax	53.2	50.9—54.9	51.1	49.4—52.5
L. of abdomen	46.8	45.1—49.1	48.9	47.5—50.6
In % of L. cephalothorax				
L. cephalic region	67.2	65.5—69.3	68.5	66.0—71.4
L. thorax	32.8	30.7—34.5	31.5	28.6—34.0
w. at the level of cervical groove	44.4	42.6—47.0	42.8	40.0—45.0
w. maximum of thorax	52,9	49.2—57.1	51.5	47.6—55.5
L. dactylopodite	52.8	44.6—62.8	42.4	35.7—47.2
L. propodite	90.9	78.3—108.6	71	57.1—81.1
L. carpopodite	24.4	21.3—26.8	19.5	16,6—22.2
L. meropodite	36.7	34.2—39.3	33.4	30.0—35.5
In % of L. abdomen				
w. I abdominal segment	47.7	46.0—50.9	51.2	44.0—56.4
w. III-rd abdominal segment	45.3	43.0—49.0	49	42.7—54.5
w. V-th abdominal segment	41.3	39.0—44.2	42.9	39.0—46.0
L. telson	27.4	25.0—29.8	26.9	24.4—29.8
L. uropod exopodite	27.6	25.0—30.2	27.1	24.4—29.8
L. uropod endopodite	21.1	19.0—23.1	21.9	20.0—24.0
w. uropod exopodite	19.9	18.0—21.1	20.1	18.6—22.0
Nr. individuals		20		17

L = length: w = width

The average values of the width of the three abdominal segments are on the contrary higher in females; the difference between the two sexes is however well marked for the first segment, being on the contrary but slight for the second and third segment. As a general rule the values of the somatic characters here given in % of the cephalothoracal length (L. propodite I, L. dactylopodite I, L. carpopodite I, L. meropoditeI) are constantly higher in males, while those of the characters in % of the abdominal length (L. telson, L. uropod exopodite, L. uropod endopodite, W. telson) are higher in females (for all three species). Other values — the minimum width at the level of the cervical groove and the maximum width of thorax are similar in the two sexes. The body size in the Romanian populations of the three species are the same with those mentioned by previous authors for other countries (*A. astacus* and *A. leptodactylus* above 100 mm, *A. torrentium* about 60 mm) (Tab. 1—3).

Table 2

VALUES OF THE MORPHOLOGICAL CHARACTERS IN THE INDIVIDUALS OF *ASTACUS LEPTODACTYLUS* FROM PARDINA LAKE (DANUBE DELTA) 8—9. IX. 1977

Somatic character	Values			
	Males		Females	
	Average	Variation	Average	Variation
Body length (mm)	119	98 —140	116.3	98 —129
In % of body length				
L. of cephalothorax	51.9	50.4—53.6	49.6	48.3—50.9
L. of abdomen	48.1	46.9—49.6	50.4	49.1—51.7
In % of L. cephalothorax				
L. cephalic region	66.1	64.8—67.6	65.3	62.5—67.9
L. thorax	33.9	32.4—35.2	34.7	32.1—37.5
w. at the level of cervical groove	39.3	36.5—44.6	39.9	37.5—42.4
w. maximum of thorax	58.7	53.3—75.0	57.8	50.0—64.6
L. dactylopodite	46.7	34.6—58.5	36.3	32.7—38.7
L. propodite	77.1	53.8—92.3	61.2	56.3—66.7
L. carpopodite	19.7	17.3—21.5	20.3	18.6—21.9
L. meropodite	34.5	30.7—36.9	30.5	28.6—33.3
In % of L. abdomen				
w. I abdominal segment	46.8	43.1—50.0	52.9	46.2—60.3
w. III-rd abdominal segment	46.0	41.9—50.9	51.3	44.6—58.7
w. V-th abdominal segment	42.6	40.3—44.6	45.0	41.1—48.4
L. telson	26.9	25.5—28.3	27.3	25.9—28.5
L. uropod exopodite	27.9	26.2—30.4	28.8	27.4—31.7
L. uropod endopodite	22.2	20.0—23.1	23.9	21.0—26.7
w. uropod exopodite	20.2	18.5—21.5	19.9	19.0—21.0
Nr. individuals	10		10	

L = length; w = width

Table 3

VALUES OF THE MORPHOLOGICAL CHARACTERS IN THE INDIVIDUALS OF *AUSTROPOTAMOBIUS TORRENTIUM* FROM SUŞARA RIVER (July 1966)

Somatic character	Values			
	Males		Females	
	Average	Variation	Average	Variation
Body length (mm)	59.5	44.0—84.0	56.1	28.5—80.0
In % of body length				
L. of cephalothorax	51.4	49.0—58.4	49.4	47.3—56.4
L. of abdomen	48.6	41.6—51.0	50.6	43.6—52.7
In % of L. cephalothorax				
L. cephalic region	65.2	62.8—68.2	66.0	63.6—70.6
L. thorax	34.8	31.8—37.2	34.0	29.4—36.4
w. at the level of cervical groove	44.5	41.0—46.5	45.5	43.0—48.3
w. maximum of thorax	51.8	49.2—56.2	51.7	49.0—55.7
L. dactylopodite	44.8	38.2—55.8	39.0	32.3—42.6
L. propodite	77.2	66.0—100.0	68.5	59.0—75.6
L. carpopodite	28.4	22.7—33.7	26.5	23.2—29.0
L. meropodite	36.5	32.0—50.0	34.2	31.0—37.0
In % of L. abdomen				
w. I abdominal segment	39.1	34.6—52.6	38.4	35.3—50.0
w. III-rd abdominal segment	48.1	42.3—60.8	50.5	43.2—63.7
w. V-th abdominal segment	38.8	27.3—52.6	39.8	32.4—50.0
L. telson	29.2	26.0—38.6	29.8	23.5—41.6
L. uropod exopodite	27.4	23.1—36.0	25.8	21 4—33.3
L. uropod endopodite	21.7	18.0—28.1	23.3	19.0—29.2
w. uropod exopodite	21.3	19.2—28.1	20.3	17.5—27.0
Nr. individuals		13		13

L = length; w = width

By comparing the average values of some somatic characters (in % of the length of the cephalothorax) in the three species, one finds some marked differences, these values being characters of interspecific differentiation: for example maximum width of thorax reaches much higher values in *A. leptodactylus*, **L.** dactylopodite and **L.** propodite **I**; in *A. astacus*, **L.** carpopodite **I**; in *A. torrentium* than in the other species, while other values are similar in all species (for example **L.** of cephalothorax and **L.** thorax; **W.** at the level of cervical groove; **L.** carpopodite **I** etc.) (Tables 1—3).

Remarkable is also the amplitude of variation of the values of certain characters. By comparing the individual variation of the 17 somatic characters in the three species, one can distinguish: (a) A relatively high amplitude of variation: 10—20% or even more than 20%: **L.** propodite **I** in the males of all three species (more than 20%); **L.** dactylopodite **I** in both *Astacus* species; **W** III-rd abdominal segment and **W.** V-th abdominal segment in *A. torrentium* etc. (b) A moderate amplitude of variation (5—10%), for example: **W.** at the level of cervical groove, **W.** maximum of thorax in all three species;

L. of cephalothorax, L. of abdomen in *A. torrentium;* W.: I abdominal segment and W: V-th abdominal segment, L: carpopodite I L, meropodite I in both *Astacus* species. (c) A reduced amplitude of variation (1—5%) — for example L. of cephalothorax, L. abdomen, L. telson, L. uropod endopodite in both *Astacus*.

Several biochemical differences between the two *Astacus* species were found by using the electrophoretic method. The two species share a number of common bands having the same intensity and swiftness of migration (bands 7, 5 and 6), (Fig. 2), this fact confirming that they belong to the same genus. *A. astacus* has 12 proteic bands (1—5 with high, 6—11 with moderate, 12 with reduced mobility), while *A. leptodactylus* has only six bands, differing from those of the preceding species and belonging to the same categories (four with high mobility, similar to those of *A. astacus*, band 5 with moderate and 6 with reduced mobility, as mentioned previously) (Fig. 2).

Fig. 2. — The electrophoretic analysis (electrophoretical models) of *Astacus astacus* and *Astacus leptodactylus*. (Orig.)

CONCLUSIONS

The following conclusions can be derived from the morphometric comparison of the three species of crayfish present in Romania: *Astacus astacus* (Bicaz Dam-Lake), *A. letopdactylus* (Pardina lake, Danube Delta) and *Austropotamobius torrentium* (Suşara brook, Banat):

1. The three species differ in more characters than those recorded in the literature: the maximum thoracal width reaches higher values in *A. leptodactylus*, the length of the dactylopodite and of the propodite in *A. astacus* and the length of the I-st carpopodite in *A. torrentium* (Fig. 1, tab. 1—3).

2. The sexual dimorphism affects more characters than those already mentioned: for example the width of cephalothorax, the length of the thorax, of the carpopodite and meropodite I have higher values in males while the length of the telson and of the uropod exopodite and the width of uropod exopodite show higher values in females (Fig. 1, tab. 1—3).

3. According to their amplitude of variation, three groups of characters can be distinguished: with high amplitude of variation (10—20%) — the length of the dactylopodite, carpopodite, meropodite I etc., in *A. torrentium*, the width of first abdominal segment, the length of the telson, the width of the uropod exopodite and of the uropod endopodite etc., in *A. astacus* and *A. leptodactylus*; width moderate amplitude of variation (5—10%) — the width at the level of cervical groove and the maximum thoracal width in all species and with reduced amplitude of variation (less than 5%) — the length of the cephalothorax and of the abdomen etc. (Tab. 1—3).

4. The electrophoretic analysis of muscular proteins in *A. astacus* and *A. leptodactylus* confirmed the morphometric data (Fig. 2).

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CONTRIBUŢII LA STUDIUL MORFOLOGIEI ASTACIDELOR DIN APELE ROMÂNIEI

REZUMAT

Lucrarea tratează cele 3 specii ale familiei Astacidae din apele României, dintre care 2 aparţin genului *Astacus (A. astacus* şi *A. leptodactylus)*, iar a treia genului *Austropotamobius (A. torrentium)*. Pentru cunoaşterea variabilităţii morfologice şi dimorfismului sexual al celor 3 specii, au fost cercetate biometric 3 loturi de raci, din lacul Bicaz, din Delta Dunării (sahana Iacubova, complexul Pardina) şi din rîul Suşara (Banat) cuprinzînd între 20 şi 37 exemplare. Analiza biometrică a fost realizată după o schemă în mare parte originală, luînd în consideraţie 17 caractere somatice (faţă de 9—10 folosite de

alți autori). Deasemenea, electroforeza efectuată la cele 2 specii de *Astacus* a permis separarea lor pe baza acestui procedeu biochimic. Compararea modelelor electroforetice ale proteinelor musculare la *A. astacus* din lacul Bicaz cu *A. leptodactylus* din ghiolul Puiu (Delta Dunării) (Fig. 2), a permis punerea în evidență a unor benzi comune, de aceeași intensitate și viteză de migrare, ca urmare a apartenenței lor la același gen (banda 7 și 5, și respectiv 6). Datele și cifrele, privitoare la variabilitatea morfologică și dimorfismul sexual al celor 3 specii, sînt cuprinse în tabelele 1—3 și indicate pe schiță (Fig. 1.).

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