

Original paper

## Two members of the subterranean genus *Niphargus* (Schiodte, 1849) (Family Niphargidae) from the Balkan Peninsula (Contribution to the knowledge of the Amphipoda 316)

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**Summary.** Two species of the subterranean genus *Niphargus* Schiodte, 1849 (fam. Niphargidae) are described and figured. *Niphargus biljanae* G. Karaman 1998, known from type locality only (Zelenikovo S. of Skopje, North Macedonia) was discovered in the subterranean waters near Raduša village (W of Skopje) and a spring near Gračanica Lake (Kosovo & Metohia reg. Serbia). This species is redescribed and its taxonomical characteristics are discussed. *Niphargus artifex*, sp. n. is described and figured from Paring Mountains, Transylvanian Alps (Romania) and its taxonomical relations to other similar taxa from the Balkan Peninsula are discussed.

**Keywords:** Amphipoda, Balkan Peninsula, new taxon, *Niphargus*, subterranean, taxonomy.

### INTRODUCTION

The subterranean fauna of Amphipoda in the Balkan Peninsula is very rich, containing over two hundred different taxa. Among them, the most numerous are members of the family Niphargidae, which exist in all kinds of subterranean pure freshwater and brackish waters. Intense geological, geomorphologic, hydrological and climatological events in the past have led to a very high level of diversification of the subterranean fauna of Amphipoda in this region, including the family Niphargidae. Multiple penetrations of niphargids into the subterranean waters in various geological periods, enabled diversification and the existence of morphologically very different taxa of this family within various genera. Recent attempts by some authors to fuse many niphargid genera into one, based on limited genetic/molecular studies of

only one part of known taxa, without detailed morphological and zoogeographical analysis, have created even more confusion and uncertainty within the taxonomy of this family and with respect to the delimitation of different taxa.

During a recent study of some *Niphargus* samples I have had in my possession for a long time, I found three samples of significant interest for publication. Two were related to a little-known species from North Macedonia - *Niphargus biljanae* G. Karaman 1998 and one from Paring Mountains (Romania) that represents a new species.

### MATERIAL AND METHODS

The studied material was preserved in 70% ethanol. The specimens were dissected using a WILD M20 microscope and drawn using a camera lucida attachment. All body-parts

were temporarily submersed in a mixture of glycerin and water for study and drawing. Body-lengths of the examined specimens were measured by tracing the length of individual mid-trunks (from the tip of the head to the end of the telson) using a camera lucida. After study, the dissected body-parts were submerged in Liquid of Faure and covered by a thin cover glass to create definitive microscope slides. All illustrations were inked manually. Part of the study material was collected using the Karaman-Chappuis Method (Boxshall et al. 2016).

Some morphological terminology and setal formulae follow G. Karaman's terminology (Karaman G. 1969, 2012) for mandibular palpus article 3 (A-setae = setae on outer face of article; B-setae = setae on inner face of article; D-setae = short setae along lateral margin of article; E-setae = long setae at distal part of article), as well as for distal corner of propodus of gnathopods 1 and 2 (S-spine = corner palmar spine on outer face; L-spines = slender serrate spines sitting near S-spine on outer face; M-setae = row of long facial corner submarginal setae on outer face; R-spine = subcorner spine on inner face). Terms "setae" and "spines" are used based on its shape, not origin.

The present study is based on morphological, ecological and zoogeographical data.

## TAXONOMICAL PART

### Family Niphargidae

#### *Niphargus biljanae* G. Karaman, 1998

(Figures 1-4)

*Niphargus biljanae*, G. Karaman 1998: 24, Figs. I-IV; Marić, D. 2019: 41.

#### Material examined

S-7376 = Spring/torrent near Gračanica Lake, Priština region, Kosovo & Metohia reg., Serbia 2. 08. 1975, one female ovig. (leg. Spasenija Karaman).

S-6060 = Zelenikovo village S. of Skopje, North Macedonia, well, 5. 05. 1978, holotype and juv. paratype (leg. T. Petkovski).

S-4852 = Raduša village W of Skoplje, North Macedonia, collected by Karaman-Chappuis Method, March 1961, 5 exp. juv. (leg. G. Karaman).

#### Diagnosis (female only)

Small species, metasomal segments with dorsomarginal setae; urosomal segment 2 with spine, urosomal segment 3 naked. Epimeral plates 1-2 subrounded, epimeral plate 3 subrounded to obtusely angular. Accessory flagellum 2-ar-

ticated, almost as long as the last peduncular article of antenna 1. Antenna 2 slender, peduncular article 5 shorter than 4, flagellum longer than last peduncular article. Coxae short, coxa 4 unlobed. Gnathopods 1-2 relatively small, propodus trapezoid, with inclined palm and dactylus bearing one median seta at outer margin. Dactylus of pereopods 3-7 at inner margin with short seta near basis of the nail. Pereopods 5-7 with article 2 longer than broad, with ventroposterior lobe not fully developed. Pleopods 1-3 with 2 retinacula each, peduncles scarcely setose or naked. Uropod 1 peduncle with dorsointernal and dorsoexternal row of strong spines. Inner ramus of both uropods slightly longer than outer one, all rami with 5 distal spines each. Telson deeply incised, longer than broad, with 3 distal long spines only. Coxal gills ovoid.

#### Description

**Female 4.0 mm from Gračanica, with setose oostegites:** Body moderately slender, metasomal segments 1-3 with 4 distoposterior marginal short setae (Fig. 1H); urosomal segment 1 with one seta at each dorsolateral side; urosomal segment 2 on each dorsolateral side with one spine (Fig. 4F); urosomal segment 3 naked. Urosomal segment 1 at both ventroposterior corners with one spine near basis of uropod 1-peduncle (Fig. 4F).

Epimeral plates 1-2 subrounded, with convex posterior margin bearing several short setae; epimeral plate 1 with slightly concave ventral margin; epimeral plate 2 with one subventral spine; epimeral plate 3 with obtusely angular ventroposterior corner and slightly convex posterior margin bearing 3-4 setae and with 2 subventral spines (Fig. 1H).

Head with short rostrum and short subrounded lateral cephalic lobes; ventroanterior sinus developed, eyes absent (Fig. 1A).

Antenna 1 slightly exceeding half of body-length (ratio: 42:40); peduncular articles 1-3 progressively shorter (ratio: 62:52:26), scarcely setose, article 2 with 2-3 long setae (Fig. 1B). Main flagellum consisting of 18 articles (some of them with one aesthetasc); accessory flagellum 2-articulated, scarcely shorter than peduncular article 3 (ratio: 22:26) (Fig. 1B).

Antenna 2 moderately slender, peduncular article 3 short, with 2 distal longer setae; peduncular article 4 scarcely longer than 5 (ratio: 60:57), covered by several short marginal setae and several distal longer setae; article 5 with several single setae (many of them longer than the diameter of the article itself); flagellum moderately slender, longer than last peduncular article (ratio: 72:57), consisting of 6 slender articles (Fig. 1C). Antennal gland cone short (Fig. 1C).

Mouthparts basic. Labrum almost twice broader than long (Fig. 1D). Labium broader than long, inner lobes well developed, outer lobes entire (Fig. 1E).

Mandible: molar triturative. Left mandible: incisor with 5 teeth, lacinia mobilis with 4 teeth and several rakers. Right mandible: incisor with 4 teeth, lacinia mobilis pluritoothed. Mandibular palpus 3-articulate: first article naked, second article with 7 setae (Fig. 3B); article 3 subfalciform, longer than article 2 (ratio: 73:57), with 2 A-setae, 2 single B-setae, 14-15 D-setae and 4 distal long E-setae (Fig. 3B).

Maxilla 1: inner plate with one seta, outer plate with 7 spines (6 spines with one lateral tooth, one spine with nearly 4 small teeth) (Fig. 1F); palpus 2-articulated, not reaching distal tip of the outer plate-spines and provided with 4 distal setae.

Maxilla 2: inner plate scarcely shorter than outer one, both plates with distolateral numerous setae (Fig. 3A).

Maxilliped: inner plate short, not reaching distal outer tip of palpus article 1, provided with 2 distal smooth spines and several setae (Fig. 1G); outer plate reaching nearly half of palpus article 2, with a row of pointed spines at mesial margin and tip; palpus article 3 at outer margin with one median and one distal group of setae; article 4 along inner margin with 2 setae near basis of the nail, along outer margin with one median plumose seta; nail shorter than pedestal.

Coxae short. Coxa 1 slightly broader than long (ratio: 55:33), with subrounded ventroanterior corner, bearing nearly 5 marginal setae (Fig. 2A). Coxa 2 nearly as long as broad, with 5-6 marginal setae (Fig. 2D). Coxa 3 nearly as broad as long, with several marginal setae (Fig. 3E). Coxa 4 hardly broader than long (ratio: 55:53), with several short marginal setae and lacking posterior lobe (Fig. 3E).

Coxa 5 bilobed, much broader than long (ratio: 54:32), with short anterior lobe (Fig. 4A). Coxa 6 bilobed, smaller than 5, broader than long (ratio: 44:28) (Fig. 4B). Coxa 7 entire, much broader than long (ratio: 46:20) (Fig. 4D).

Gnathopods moderately small, with propodit not larger than corresponding coxae. Gnathopod 1 only slightly smaller than gnathopod 2 (Fig. 2A, D); article 2 along anterior margin with several short setae, along posterior margin with nearly 10 long setae; article 3 with one distoposterior bunch of setae; article 5 shorter than propodus (ratio: 39:46), along anterior margin with distal bunch of setae, along posterior margin with numerous setae (Fig. 2B). Propodus trapezoid, slightly longer than broad (ratio: 74:68), along posterior margin with 3 transverse rows of setae (Fig. 2B); palm slightly convex, inclined distinctly over half of the propodus-length, defined on outer face by corner S-spine accompanied laterally by 2 L-spines and with 2 facial M-setae, on inner face by one subcorner R-spine (Fig. 2C). Dactylus reaching posterior margin of propodus, along outer margin with one median seta, along inner margin with 4-5 short setae (Fig. 2B).

Gnathopod 2: article 2 along anterior margin with row of short setae, along posterior margin with numerous long

setae; article 3 with one distoposterior bunch of setae (Fig. 2D); article 5 almost as long as propodus, at anterior margin with distal bunch of setae, along posterior margin with numerous setae. Propodus trapezoid, slightly longer than broad (ratio: 82:72), along posterior margin with 6 transverse rows of setae (Fig. 2E); palm slightly convex, inclined nearly half of propodus-length, defined on outer face by corner S-spine accompanied laterally by 2 L-spines and with 2 facial M-setae, on inner face by one subcorner R-spine (Fig. 2F). Dactylus reaching posterior margin of propodus, along outer margin with one median seta, along inner (mesial) margin with several short setae only (Fig. 2E).

Pereopods 3-4 moderately slender. Pereopod 3: article 2 along anterior margin with row of short setae (except proximal long seta), along posterior margin with row of long setae. Articles 4-6 of different length (ratio: 48:32:44), bearing short setae along both margins (Fig. 3C). Dactylus slender, much shorter than article 6 (ratio: 19:44), at inner margin with short seta near basis of the nail, along outer margin with one median plumose seta (Fig. 3D), nail is shorter than pedestal (ratio: 22:32).

Pereopod 4 hardly shorter than pereopod 3, article 2 along anterior margin with several short setae, along posterior margin with long setae (distal setae are rather shorter). Articles 4-6 of different length (ratio: 41:28:40), articles along both margins with short setae (Fig. 3E). Dactylus slender, much shorter than article 6 (ratio: 19:40), at inner margin with one short seta near basis of the nail, along outer margin with one median plumose seta (Fig. 3F).

Pereopods 5-7 moderately slender. Pereopod 5 is remarkably shorter than pereopods 6 and 7; article 2 dilated, longer than broad (ratio: 59:37), along anterior convex margin with row of several short setae, along posterior convex margin with nearly 8 short setae; ventroposterior lobe not fully developed (Fig. 4A); articles 3-4 at margins with short setae; articles 4-7 missing.

Pereopod 6: article 2 much longer than broad (ratio: 71:44), along anterior margin with nearly 6 short setae, along posterior poorly convex margin with nearly 10 short setae, ventroposterior lobe not fully developed (Fig. 4B). Articles 4-6 of different length (ratio: 47:55:65), articles along both margins with short setae and spines mixed on articles 5-6 with single longer spines. Article 2 is longer than article 6 (ratio: 71:65). Dactylus slender, much shorter than article 6 (ratio: 22:65), at inner margin with short seta near basis of the nail, along outer margin with one median plumose seta (Fig. 4C); nail shorter than pedestal (ratio: 22:55).

Pereopod 7: article 2 slightly ovoid, much longer than broad (ratio: 75:48), along anterior slightly convex margin with several spines, along posterior remarkably convex margin with nearly 10 short setae, ventroposterior lobe visible,

but shallow (Fig. 4D). Articles 4-6 of different length (ratio: 43:53:77), along both margins with numerous short and long single spines or groups of spines (the longest spines exceeding the diameter of the articles themselves. Article 2 is rather shorter than article 6 (ratio: 75:77). Dactylus slender, much shorter than article 6 (ratio: 25:77), at inner margin with one short strong seta near basis of the nail, along outer margin with one median plumose seta (Fig. 4E); nail shorter than pedestal (ratio: 23:60).

Pleopods 1-3 with 2 retinacula each. Pleopod 1-peduncle at anterior margin with one median seta (Fig. 3G); pleopod 2-peduncle naked (Fig. 3H); pleopod 3-peduncle at posterior margin with 3 median setae (Fig. 3 I).

Uropods 1-2 relatively short. Uropod 1: peduncle longer than rami, with dorsoexternal and dorsointernal row of strong spines (Fig. 4F); outer ramus only slightly shorter than inner one, with one lateral and 5 distal spines. Inner ramus with 2 lateral and 5 distal short spines.

Uropod 2: outer ramus distinctly shorter than inner one, with 5 distal spines; inner ramus with 2 lateral and 5 distal spines (Fig. 4F).

Uropod 3: peduncle nearly twice as long as broad; inner ramus short, scale-like, with 2 distal spines. Outer ramus 2-articulated: first article rather dilated, along outer margin with 4 bunches of spines (Fig. 3J); along inner margin 4 groups of longer spines mixed with 2 plumose setae are attached. Distal article of outer ramus short, narrowed, much shorter than first one (ratio: 26:140), with 3 distal short setae.

Telson deeply incised, longer than broad (ratio: 83:62), each lobe with 3 distal long spines (the longest spines reaching or hardly exceeding half of telson-length); a pair of short plumose setae are attached laterally on each lobe (Fig. 1 I).

Coxal gills ovoid, neither elongated nor exceeding the ventral margin of the corresponding article 2 (Figs 2D, 3C, E, 4A, B).

Oostegites very large, with marginal setae (Figs 3C, 4A).

**The juvenile specimens** (up to 3 mm long) from **Raduša village W of Skopje** correspond to the description of this species. Epimeral plates like those of Gračanica, telson longer than broad, lobes with 3 long distal spines only. Urosomal segment 1 on each dorsolateral side with one seta; that of uropod 2 with one spine. Uropod 1 peduncle with dorsoexternal and dorsointernal row of spines. Pleopods with 2 retinacula; dactylus of gnathopods 1-2 with one median seta at outer margin.

Males unknown.

### Variability

Epimeral plate 3 more or less subrounded, with marked ventroposterior stronger seta and convex posterior margin. Urosomal segment 1 on each dorsolateral side with one seta,

on ventroposterior corner with one strong spine near basis of uropod 1 peduncle; on urosomal segment 2 appear one spine on each side. Uropod 1 peduncle with dorsointernal and dorsoexternal row of spines. Dactylus of pereopods 3-7 slender, with seta at ventral margin near basis of the nail. Telson longer than broad, always with 3 distal long spines only, lateral and facial spines absent.

### Remarks and affinities

The scarce material and the absence of a male specimen made determination of the sample from Gračanica more difficult. It is very close to *Niphargus biljanae* G. Karaman 1998, from Northern Macedonia (loc. typ. wells in Zelenikovo village S. of Skopje) known also by female only. They are similar by numerous important taxonomical characters (gnathopods, pereopods, pleopods, uropods, retinacula, mouthparts).

The specimen from Gračanica differs from the specimens from Zelenikovo by a slightly more angular epimeral plate 3, a larger number of posterior marginal setae on article 2 of pereopods 5-7, longer distal spines on telson; maxilla 1-palpus slightly shorter and provided with 4 distal setae; the presence of 2 ventral setae on maxilliped palpus article 4 near basis of the nail; slightly different pilosity of pleopod-peduncles.

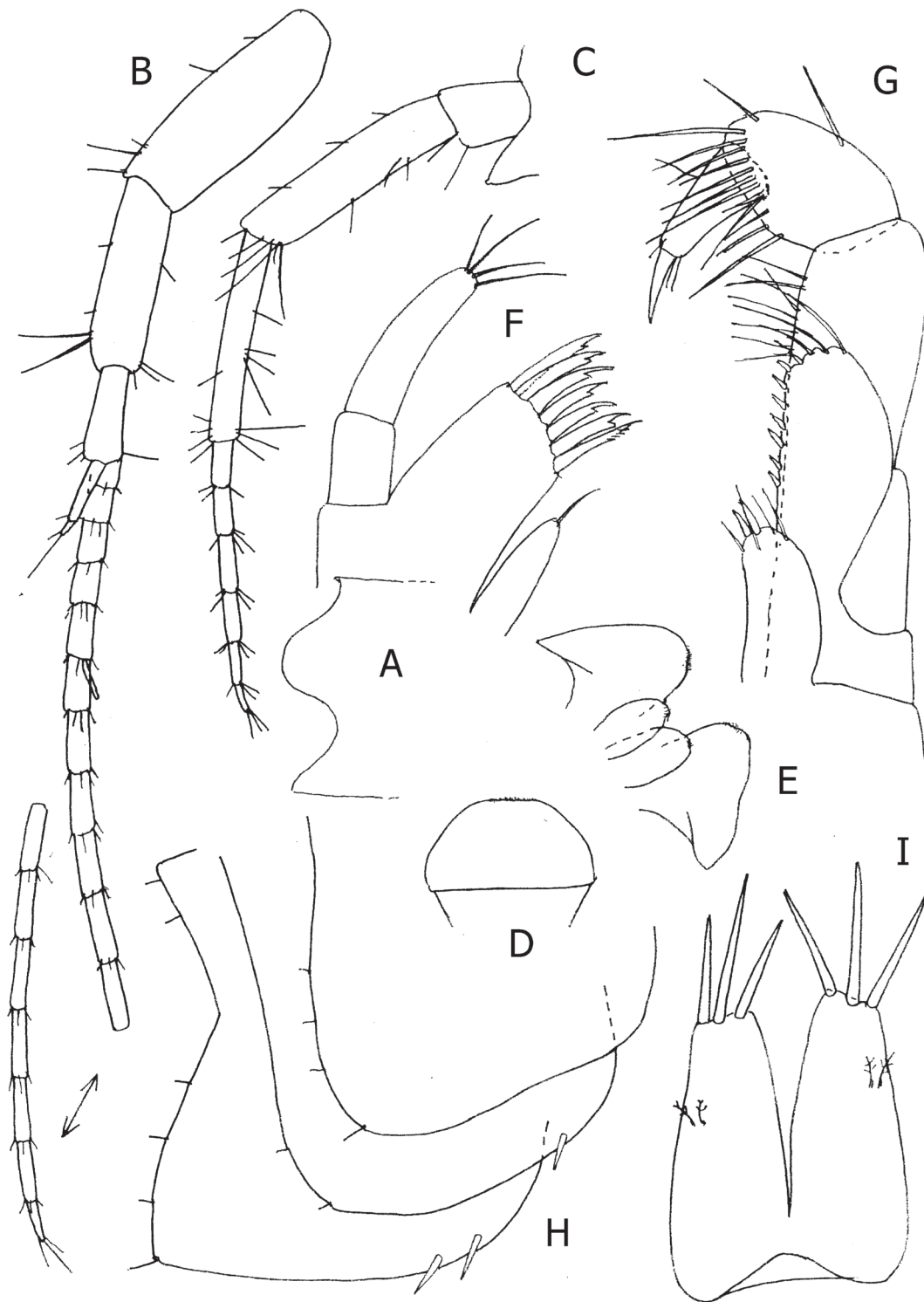
As the female from Gračanica is rather larger than that of Zelenikovo (4: 3.4), maybe some of these differences, number of setae, shape of epimeral plate 3 and palpus of maxilla 1, are caused by size differences between the compared animals. As all other taxonomical characters are identical in ovigerous females from both localities, I consider the specimen from Gračanica as a member of the species *N. biljanae*. Probably the discovery of males and further studies of specimens from both localities will shed new light on the evaluation of the above noted differences.

### Locus typicus

Wells in Zelenikovo village S. of Skopje, Northern Macedonia.

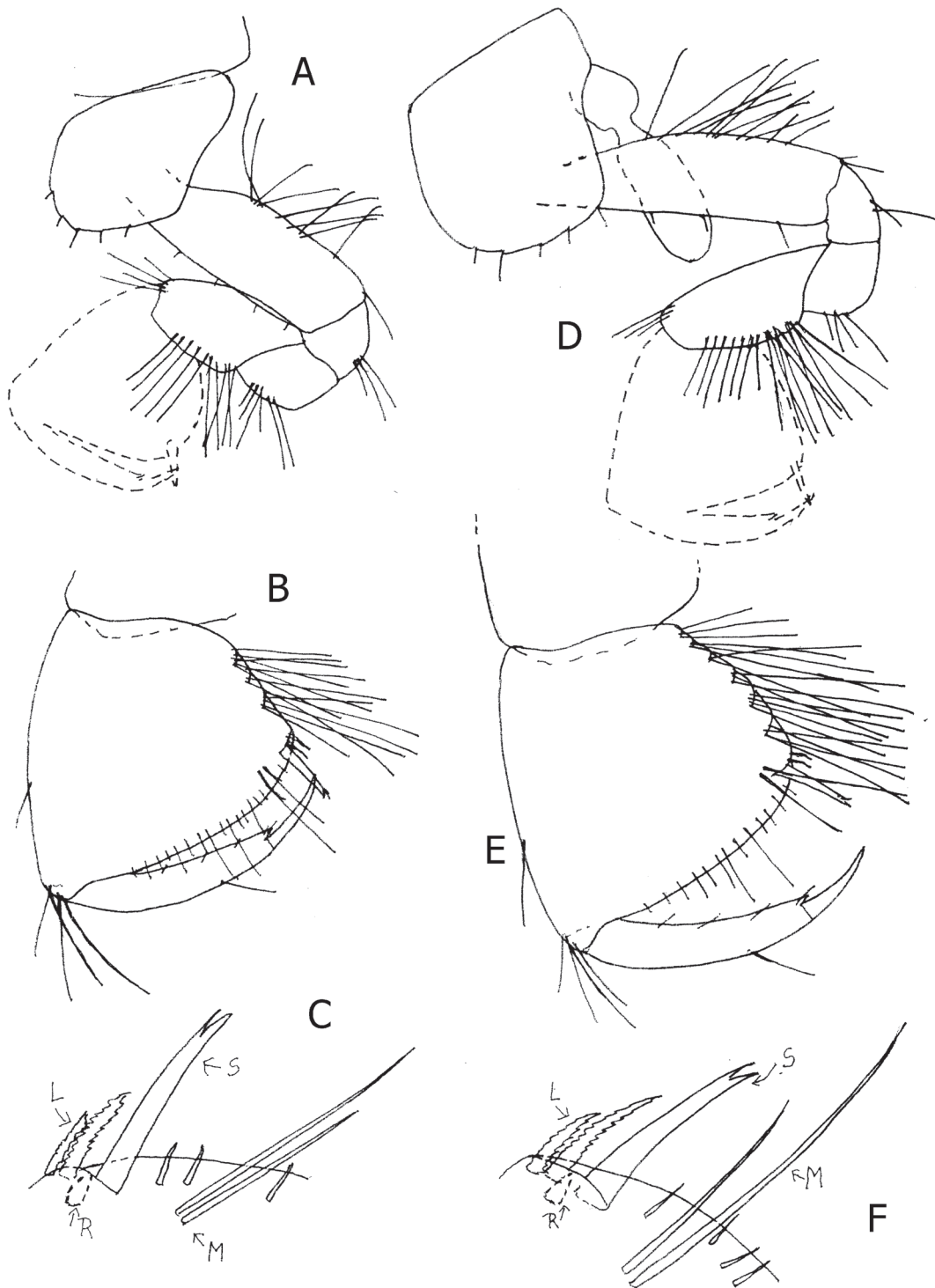
### Distribution

*Niphargus biljanae* has been known only from the type-locality Zelenikovo, whose waters belong to the Aegean watershed. The new locality near Raduša also belongs to the Aegean Sea drainage system, but subterranean waters near Gračanica belong to the Black Sea drainage system (in the region of disjunction between the two mentioned drainage systems).

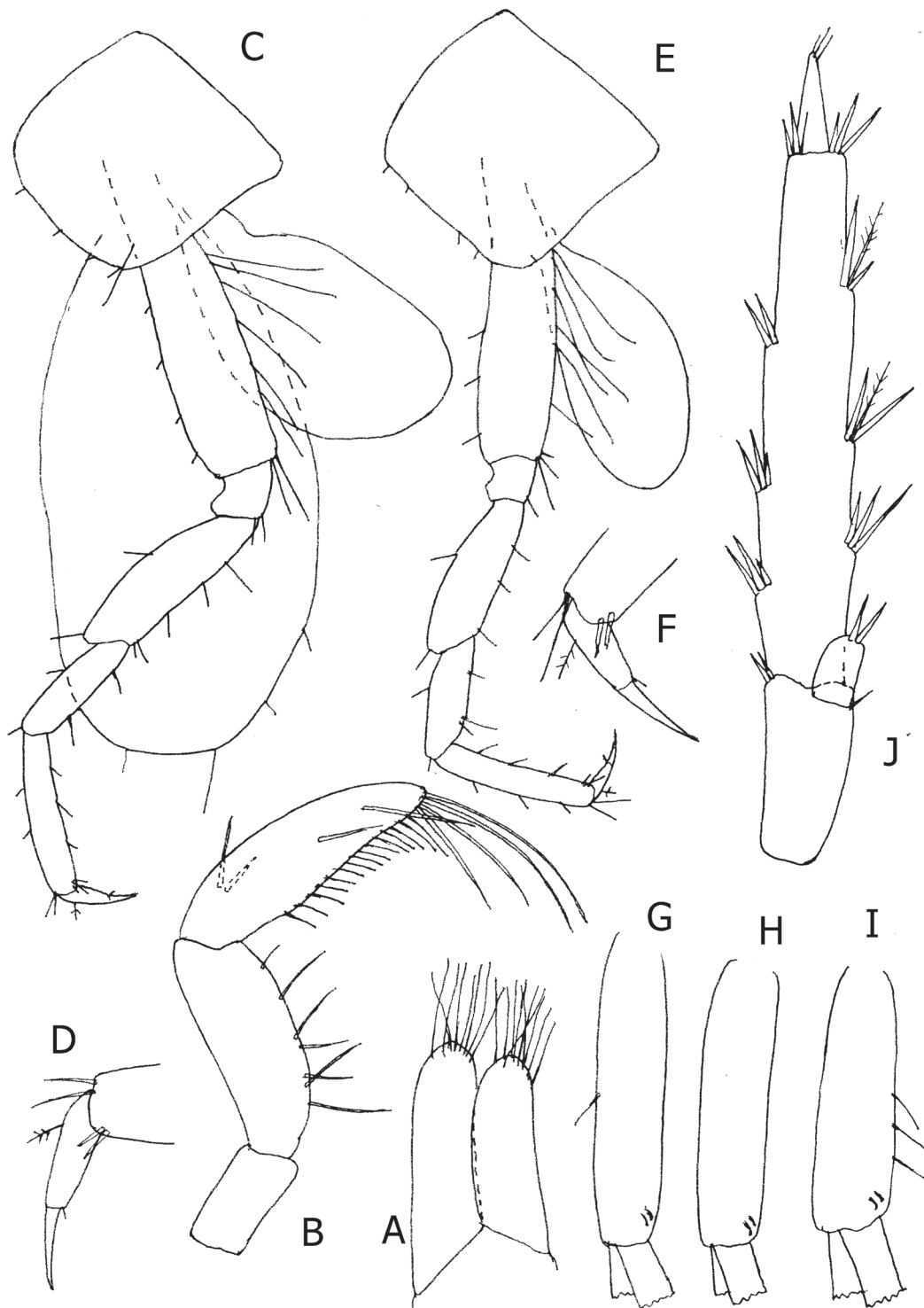


**Fig. 1.** *Niphargus biljanae* G. Karaman 1998, spring near Gračanica Lake, female 4.0 mm. A, head; B, antenna 1; C, antenna 2; D, labrum; E, labium; F, maxilla 1; G, maxilliped; H, epimeral plates 1-3; I, telson.

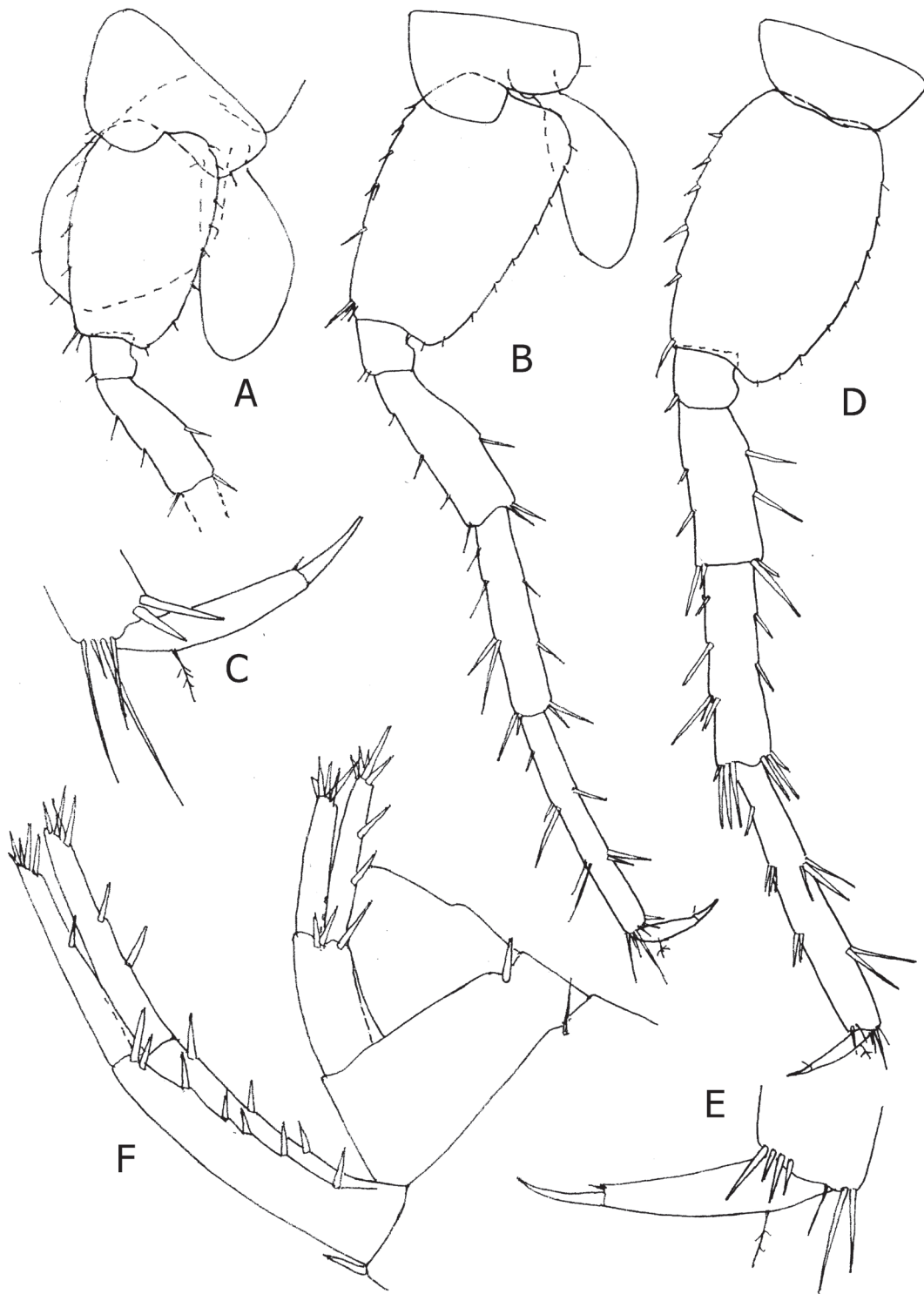




**Fig. 2.** *Niphargus biljanae* G. Karaman 1998, spring near Gračanica Lake, female 4.0 mm. **A**, gnathopod 1, outer face; **B**, gnathopod 1 propodus, outer face; **C**, distal corner of gnathopod 1-propodus (S = corner S-spine; L = lateral L-spines; M = facial M-setae; R = subcorner R-spine); **D**, gnathopod 2, outer face; **E**, propodus of gnathopod 2, outer face; **F**, distal corner of gnathopod 2-propodus (S = corner S-spine; L = lateral L-spines; M = facial M-setae; R = subcorner R-spine)



**Fig. 3.** *Niphargus biljanae* G. Karaman 1998, spring near Gračanica Lake, female 4.0 mm. **A**, maxilla 2; **B**, mandibular palpus, inner face; **C-D**, pereopod 3; **E-F**, pereopod 4; **G-H-I**, peduncle of pleopods 1-2-3; **J**, uropod 3.



**Fig. 4.** *Niphargus biljanae* G. Karaman 1998, spring near Gračanica Lake, female 4.0 mm. A, pereopod 5; B-C, pereopod 6; D-E, pereopod 7; F, urosome with uropods 1-2.



*Niphargus artifex*, sp. n.  
(Figures 5-10)

### Material examined

Romania: S-378 = Paring, Paring Mountains (Parin-gului muntele), Transylvanian Alps (nearly 130 km. NE. of Turnu Severin), 1928, 10 exp. (leg. Hrabe).

### Diagnosis

A relatively small species under 10 mm; metasomal segments 1-3 with 2 dorsoposterior longer setae. Epimeral plates broadly subrounded; urosomal segment 1 at each dorsolateral side with one seta, urosomal segment 2 with one seta or one spine on each dorsolateral side. Maxilla 1 inner plate with one seta, 7 spines of outer plate mainly with one, sometimes 2 lateral teeth. Inner plate of maxilliped with 3-4 spines. Coxae 1-7 short, broader than long in both sexes. Gnathopods 1-2 relatively small, propodus trapezoid, dactylus with one median setae at the outer margin. Dactylus of pereopods 3-7 moderately slender, with one seta or spine-like seta at the inner margin. Article 2 of pereopods 5-7 dilated, longer than broad, without a ventroposterior lobe. Pleopods 1-3 with elevated number of retinacula and scarcely setose peduncle. Uropod 1 rami nearly equally long, slightly paddle-shaped; distal spines on uropods 1-2 rami and spines of telson are long. Uropod 3 elongated in both sexes, plumose setae on outer ramus absent. Telson short, obtuse, with elevated number of long distal spines in both sexes, facial spines absent, single outer marginal spines present. Coxal gills elongated and slightly curved on gnathopod 2 and pereopod 4, other gills shorter, ovoid.

### Description

**Male up to 6.9 mm (holotype):** Body slender, metasomal segments 1-3 with 2 dorsoposterior long setae (Fig. 8G). Epimeral plates 1-3 broadly subrounded, with 4-5 setae along posterior convex margin; epimeral plate 2 with 3 subventral spines, plate 3 with 2 subventral spines (Fig. 8G). Urosomal segments 1 and 2 on each dorsolateral side with one seta (Fig. 8H), urosomal segment 3 naked (Fig. 8H). Urosomal segment 1 on each ventroposterior corner with one slender spine near basis of uropod 1-peduncle (Fig. 8H).

Head normal, with short lateral cephalic lobes (Fig. 8A), ventroanterior excavation developed, eyes absent. Antenna 1 nearly reaching half of body, peduncular articles 1-3 progressively shorter (ratio: 53:38:23), peduncular article 3 short; main flagellum with up to 22 articles (most of them with one aesthetasc (Fig. 8D)); accessory flagellum 2-articulated, shorter than last peduncular article (Fig. 8C).

Antenna 2 normal, peduncular article 5 shorter than 4 (ratio: 45:57); flagellum 11-articulate, much longer than last peduncular article (Fig. 8E), antennal gland cone short (Fig. 8E).

Labrum normal, broader than long, intact (Fig. 5A). Labium broader than long, with well-developed small inner lobes. (Fig 7A).

Mandible: molar triturate; left mandible with incisor with 5 teeth, lacinia mobilis 4 teeth and 6 rakers. Right mandible: incisor with 4 teeth, lacinia mobilis bifurcate, with several teeth and 6 rakers (Fig. 8B). Mandibular palpus article 1 naked, article 2 with 8 setae; palpus article 3 relatively narrow, subfalciform, longer than article 2 (ratio: 68:60), on outer face with one group of A-setae, on inner face with 3-5 B-setae (formula 2-2-1, or 2-1-1 or 2-1) along ventral margin with 10-12 D-setae and distal 4-5 long E-setae (Fig. 8F).

Maxilla 1: inner plate with one seta (Fig. 6A), outer plate with 7 spines (formula of teeth: 7-1-2-1-1-0-1, or 5-1-2-1-2-1-1, or 4-1-1-2-2-0-1, or 4-1-1-1-0-2-1); palpus reaching the distal tip of the outer plate spines, with 6 distal and one distolateral seta (Fig. 6B).

Maxilla 2 longer than broad, inner plate rather shorter than outer one, both with distomarginal setae only (Fig. 5B).

Maxilliped: inner plate short, not reaching outer tip of palpus article 1, right and left plate with 3 distal spines; outer plate reaching nearly half of palpus article 2, with nearly 9 smooth distomarginal spines (Fig. 11), palpus article 3 at outer margin with distal bunch of setae; article 4 along outer margin with one median seta, along inner margin with 2 setae near basis of the nail.

Coxae short, scarcely setose. Coxa 1 much broader than long (ratio: 45:28), with subrounded ventroanterior margin bearing nearly 6 setae (Fig. 5C); coxa 2 broader than long (ratio: 55:40), along margin with 7-8 setae (Fig. 5F). Coxa 3 longer than broad (ratio: 53:40), along ventral margin with nearly 5 setae (Fig. 6C); coxa 4 without ventroposterior lobe, broader than long (ratio: 54:38), with nearly 6-8 marginal setae (Fig. 6E). One of ventroanterior setae is distinctly longer than other setae in all 4 coxae (Figs 5C, F; 6D, E).

Coxae 5-7 shallow. Coxa 5 bilobed (ratio: 56:32), anterior lobe subrounded, not produced (Fig. 7B). Coxa 6 smaller than coxa 5, bilobed, broader than long (ratio: 50:29) (Fig. 7D); coxa 7 entire, much broader than long (ratio: 47:20) (Fig. 7F).

Gnathopods 1-2 relatively small, with propodus not broader than the diameter of the corresponding coxa. Gnathopod 1: article 2 along anterior margin with row of long setae, along posterior margin with row of single or bunches of long setae; article 3 at distoposterior tip with one bunch of setae; article 5 is shorter than propodus (ratio: 35:42), along anterior margin with distal bunch of setae (Fig. 5C).

Propodus trapezoid, longer than broad (ratio: 83:70), along posterior margin with 6 transverse rows of setae (Fig. 5D); palm slightly convex, inclined slightly over half of propodus-length, defined on outer face by corner S-spine accompanied laterally by 3 serrate L-spines and 4 facial M-setae, on inner face by one subcorner R-spine (Fig. 5E). Dactylus reaching posterior margin of propodus, along outer margin with one median seta, along inner margin with several short setae (Fig. 5D).

Gnathopod 2 only slightly larger than gnathopod 1; article 2 along anterior margin with row of single setae, along posterior margin with bunches of long setae; article 3 at posterior margin with distal bunch of setae (Fig. 5F); article 5 as long as propodus, at anterior margin with one median and one distal group of setae. Propodus trapezoid, nearly as long as broad, along posterior margin with 7 transverse rows of setae; palm poorly convex, inclined nearly half of propodus-length (Fig. 5G), defined on outer face by corner S-spine accompanied laterally by 3 L-spines and 4 facial M-setae, along inner margin with one R-spine. Dactylus reaching posterior margin of propodus, along outer margin with one median seta, along inner margin with several short setae (Fig. 5G).

Pereopod 3: article 2 along anterior margin with row of shorter setae and 2-3 proximal longer setae, along posterior margin with row of longer setae. Articles 4-6 of different length (ratio: 50:32:41), articles 4-5 along both margins with 2-3 single or groups of setae and single spines; article 6 along posterior margin with 4 groups of small single spines and setae (Fig. 6C). Dactylus much shorter than article 6 (ratio: 18:41), along inner margin with one seta near basis of the nail, along outer margin with one median plumose seta; nail is rather shorter than pedestal (ratio: 29:35) (Fig. 6D).

Pereopod 4 only scarcely shorter than pereopod 3. Pliosity of articles 2-6 like that of pereopod 3. Articles 4-6 of different length (ratio: 46:30:40) (Fig. 6E); dactylus much shorter than article 6 (ratio: 29:40), along inner margin with one seta near basis of the nail, along outer margin with one plumose seta; nail is slightly shorter than pedestal (ratio: 30:33) (Fig. 6F).

Pereopods 5-7 moderately slender. Pereopod 5 remarkably shorter than pereopods 6 and 7 (Fig. 7B); article 2 dilated, longer than broad (ratio: 57:35), along anterior convex margin with 4 single longer slender spines, along posterior scarcely convex margin with nearly 7 short setae, ventroposterior lobe absent. Articles 4-6 of different length (ratio: 37:43:45), along both margin with groups of short spines and single short setae; article 2 is longer than article 6 (ratio: 57:45). Dactylus shorter than article 6 (ratio: 19:45), along inner margin with one spine-like seta near basis of the nail, along outer margin with one plumose median seta (Fig. 7C), nail is shorter than pedestal (ratio: 25:36).

Pereopod 6: article 2 much longer than broad (ratio: 74:39), along anterior margin with nearly 6 longer slender spines, along posterior margin, straight in the middle, with nearly 9 short setae, ventroposterior lobe absent (Fig. 7D). Articles 4-6 of different length (ratio: 49:58:67), along both margins with several groups or single short spines and single short setae. Article 2 longer than article 6 (ratio: 74:67). Dactylus shorter than article 6 (ratio: 24:67), at inner margin with one spine-like seta near basis of the nail, along outer margin with one median plumose seta (Fig. 7E); nail shorter than pedestal (ratio: 30:55).

Pereopod 7: article 2 much longer than broad (ratio: 79:40), with both margins almost linear, anterior margin with nearly 6 longer spine-like setae, along posterior margin with nearly 9 short setae, ventroposterior lobe not developed (Fig. 7F). Articles 4-6 of different length (ratio: 48:61:70), along both margins with single or pairs of short spines sometimes accompanied by single short seta. Article 2 longer than article 6 (ratio: 79:70). Dactylus shorter than half of article 6 (ratio: 30:70), along inner margin with one spine-like seta or slender spine near basis of the nail, along outer margin with one median plumose seta; nail shorter than pedestal (ratio: 35:55) (Fig. 7G).

Pleopods 1-3 with elevated number of retinacula (formula: 5-5-6). Peduncle of pleopod 1 with 4 setae along anterior margin, peduncle of pleopod 2 with 1-2 anterior marginal seta; peduncle of pleopod 3 with one posterior marginal seta.

Uropod 1: peduncle with dorsoexternal row of spines and dorsointernal row of setae (except distal spine); rami moderately dilated, compressed dorsoventrally, rami approximately of the same length, each ramus with single lateral and 5 distal unequal spines (the longest distal spines exceeding 1/3 of rami-length (Fig. 6G). outer ramus with 3 lateral groups of short simple setae.

Uropod 2: rami normal, inner ramus slightly longer than outer one, bearing one lateral spine: both rami with 5 distal spines each (the longest distal spine nearly reaching half of rami-length (Fig. 6G).

Uropod 3 elongated; peduncle longer than broad (ratio: 42:19), inner ramus scale-like, much shorter than peduncle, bearing 3 distal spines. Outer ramus 2-articulate: first article along outer margin with 3 groups of simple setae mixed with one lateral and 2 distal short spines, inner (mesial) margin with 3 groups of short spines, plumose setae absent; second article elongated, but slightly shorter than first one (ratio: 87:110), with 7 distal short simple setae only (Fig. 7H).

Telson short, deeply incised over 2/3 of telson-length, nearly as long as broad; lobes obtuse distally, provided with 7-8 very long distal spines slightly shorter than telson-length (ratio: 52:70) and 1-2 distolateral long spine-like setae; a pair

of very short plumose setae appears near the middle of each lobe outer margin (Fig. 7I); facial spines absent.

Coxal gills of gnathopod 2 and pereopod 4 long, slightly curved, exceeding ventral tip of corresponding article 2 (Figs 5H, 6E). Coxal gills on pereopods 3, 5 and 6 remarkably shorter, ovoid (Figs 6D, 7B, D). Short ovoid gill on gnathopod 2 in holotype is one anomaly, because all other males in the sample have curved long gills (Fig. 5H).

**Female 5.5 mm with oostegites (paratype):** Body like male but poorly stouter. Metasomal segments 1-3 with 2 long dorsoposterior setae (Fig. 8I), urosomal segment 1 on each dorsolateral side with one seta; on urosomal segment 2 with one spine (Fig. 8H), urosomal segment 3 naked. Urosomal segment 1 on each ventroposterior corner with one weak spine-like seta near basis of uropod 1-peduncle (Fig. 8H).

Epimeral plates 1-3 like those in male, broadly subrounded (Fig. 8I).

Head and antennae like those in male. Antenna 1 main flagellum with 22 articles, many of them with one aesthetasc. Antenna 2 like that in male, flagellum consisting of 9 articles.

Mouthparts like those in male. Mandibular palpus article 2 with 9 setae, article 3 subfalciform, relatively narrowed, longer than article 2 (ratio: 72:62), with 3 A-setae, 2 groups of B-setae (2+1), 9-10 D-setae and 4 E-setae.

Maxilla 1: inner plate with one seta, outer plate with 7 spines bearing mainly one lateral tooth (4-1-1-1-1-2-1; or: 4-1-1-2-2-1-1), palpus with 6 distal setae.

Maxilliped: inner plate with 3 distal spines (Fig. 9E), outer plate with nearly 10 distomarginal smooth spines; palpus article 4 along outer margin with one median seta, at inner margin with 2 setae near basis of the nail (Fig. 9E).

Coxae 1-4 rather similar to those in males, but slightly longer. Coxa 1 broader than long (ratio: 50:30), with subrounded ventroanterior part, bearing 7-8 marginal setae (Fig. 9A); coxa 2 broader than long (ratio: 50:44), with nearly 6 marginal setae (Fig. 9C); coxa 3 broader than long (ratio: 55:49), with nearly 5 marginal setae (Fig. 10B); coxa 4 without posterior lobe, broader than long (ratio: 56:45), with 6 marginal setae (Fig. 10A); all 4 coxae with one ventroanterior seta remarkably longer than other setae (Figs 10A, C).

Coxae 5-7 short. Coxa 5 much broader than long (ratio: 55:35), bilobed (Fig. 10C); coxa 6 smaller than 5, bilobed, broader than long (ratio: 46:29) (Fig. 10D); coxa 7 entire, broader than long (ratio: 45:18) (Fig. 10E).

Gnathopods rather similar to those found in males, with propodus not larger than the corresponding coxae. Gnathopod 1 only slightly smaller than 2, article 2 along anterior margin with shorter setae, along posterior margin with long setae, especially in proximal part; article 3 with one distoposterior bunch of setae (Fig. 9A); article 5 slightly shorter

than propodus (ratio: 37:42), with distoposterior bunch of setae. Propodus trapezoid, longer than broad (ratio: 87:70), along posterior margin with 5 transverse rows of setae (Fig. 9B); palm inclined slightly over half of the propodus-length, defined on the outer face by corner S-spine accompanied laterally by 2 L-spines and 3 corner facial M-setae, on the inner face by one R-spine. Dactylus reaching the posterior margin of the propodus, along outer margin with one median seta, along inner margin with several short setae (Fig. 9B).

Gnathopod 2: article 2 along both margins with longer setae; article 3 with posterodistal bunch of setae (Fig. 9C), article 5 nearly as long as propodus. Propodus trapezoid, scarcely longer than broad (ratio: 88:80), along posterior margin with 6 transverse rows of setae (Fig. 9D); palm inclined slightly over half of propodus-length, defined on outer face by corner S-spine accompanied laterally by 2 L-spines and 3 corner facial M-setae, on inner face by one subcorner R-spine. Dactylus reaching posterior margin of propodus, along outer margin with one median seta, along inner margin with several short setae (Fig. 9D).

Pereopods 3 like that in male. Pereopod 4: article 2 along posterior margin with row of long setae, along anterior margin with short setae. Articles 4-6 of different length (ratio: 47:30:43), bearing short setae and spines along both margins and tip. Dactylus shorter than article 6 (ratio: 18:43), along inner margin with one strong seta near basis of the nail (Fig. 10A).

Pereopod 5 remarkably shorter than pereopod 6, with dilated article 2 longer than broad (ratio: 57:36), along anterior convex margin with 4 single longer spine-like setae, along posterior slightly convex margin with 6-7 short setae, ventroposterior lobe not developed (Fig. 10C). Articles 4-6 of different length (ratio: 35:42:48), along both margins mainly with single or bunches of short spines. Article 2 longer than article 6. Dactylus much shorter than article 6 (ratio: 20:48), at inner margin with one short spine-like seta, along outer margin with one median plumose seta, nail shorter than pedestal (ratio: 9:12).

Pereopod 6: article 2 remarkably longer than broad (ratio: 72:40), along anterior convex margin with 5 longer spine-like setae, posterior margin straight in the middle, with 7-8 short setae, ventroposterior lobe absent. Articles 4-6 of different length (ratio: 47:59:70), provided mainly with single or pairs of short spines and setae (Fig. 10D). Article 6 almost as long as article 2 (ratio: 70:72). Dactylus much shorter than article 6 (ratio: 27:70), at inner margin with one weak spine-like seta, on outer margin with one median seta.

Pereopod 7 missing.

Pleopods 1-3 with 4 retinacula, peduncle scarcely setose, like that in male.

Uropod 1: peduncle with dorsoexternal row of spines



and dorsointernal row of setae (except distal spine) (Fig. 8H); rami normal or very scarcely compressed, nearly of equal length or inner ramus poorly longer; outer ramus with one lateral spine and 2 groups of short simple setae, inner ramus with 2 lateral strong spines; both rami with 5 distal unequal spines (the longest spine nearly 2/5 of ramus-length).

Uropod 2: inner ramus slightly longer than outer one, with 2 lateral spines, outer ramus without lateral spines (Fig. 8H).

Uropod 3 elongated but shorter than that in males. Peduncle twice longer than broad, with distal spines; inner ramus scale-like, much smaller than peduncle (Fig. 10F), with distal spine and seta. Outer ramus 2-articulated: first article along outer margin with 4 groups of spines, inner ramus with 3 groups of spines, plumose setae absent; second article shorter than first one (ratio: 43:108), bearing distal bunch of 5 simple setae only.

Telson as long as broad, deeply incised over 2/3 of telson-length, lobes obtuse distally; each lobe with very long 6-7 distal spines (the longest spines are only slightly shorter than telson (ratio: 57:67), and one outer marginal long spine (Fig. 10G); a pair of very short plumose setae is attached near the middle of the lobes outer margin; facial spines absent.

Coxal gills on gnathopod 2 and pereopod 4 very long and curved, much exceeding the ventral tip of the corresponding article 2 (Figs 9C, 10A); coxal gills on pereopods 3, 5 and 6 shorter, ovoid (Fig. 10C, D).

Oostegites broad (Fig. 10A), appear on legs 2-5.

### Variability

The number of lateral teeth on maxilla 1 outer plate is 1-2 (except inner spine); inner plate of maxilliped with 2-4 distal spines; number of retinacula 4-6.

Stable characters in both sexes: number of dorsoposterior setae on metasomal segments 1-3, absence of spines on urosomal segment 1, rami of uropod 1 nearly of equal length, long distal spines on uropods 1-2 rami, high number of distal long spines on telson; presence of calceola on the main flagellum of antenna 1; absence of plumose setae on uropod 3, subrounded epimeral plate 1-3; in males paddle-shaped rami of uropod 1.

### Locus typicus

Paring, Paring Mountains, Transylvanian Alps, Romania.

**Holotype:** Male 6.9 mm (number S-378/1-3) is deposited in KARAMAN's collection in Podgorica, Montenegro.

**Derivatio nominis:** The name *artifex* is connected with Latin word "artifex" (= master, maestro).

### Remarks and affinities

*Niphargus artifex* belongs to the group of small species from the Balkan Peninsula close to the *Niphargus aquilex-auri* group of taxa living in caves and other subterranean waters, very similar morphologically to each other and differing only by some relatively small differences. We mentioned here the morphological differences of some Balkan taxa with gnathopods 1-2 propodus having one median seta at the outer margin of dactylus, an elevated number of retinacula (except *N. molnari*), the long second article of uropod 3 the outer ramus in males, and the nearly equally long rami of uropod 1 in males, regarding the new taxon, *Niphargus artifex*.

*Niphargus jurinaci* S. Karaman 1950 (loc. typ.: Spring in Crni Lug, W of Ogulin, Croatia) is very similar to *N. artifex* by various morphological characters, but *N. artifex* differs by metasomal segments 1-3 bearing 2 dorsoposterior marginal setae, by the paddle shaped rami of uropod 1 in males, by its rather shorter coxae, by the higher number of distal spines on telson, the fact that the propodus of gnathopods 1-2 are rather more slender and provided by the higher number of transverse rows of setae, etc.

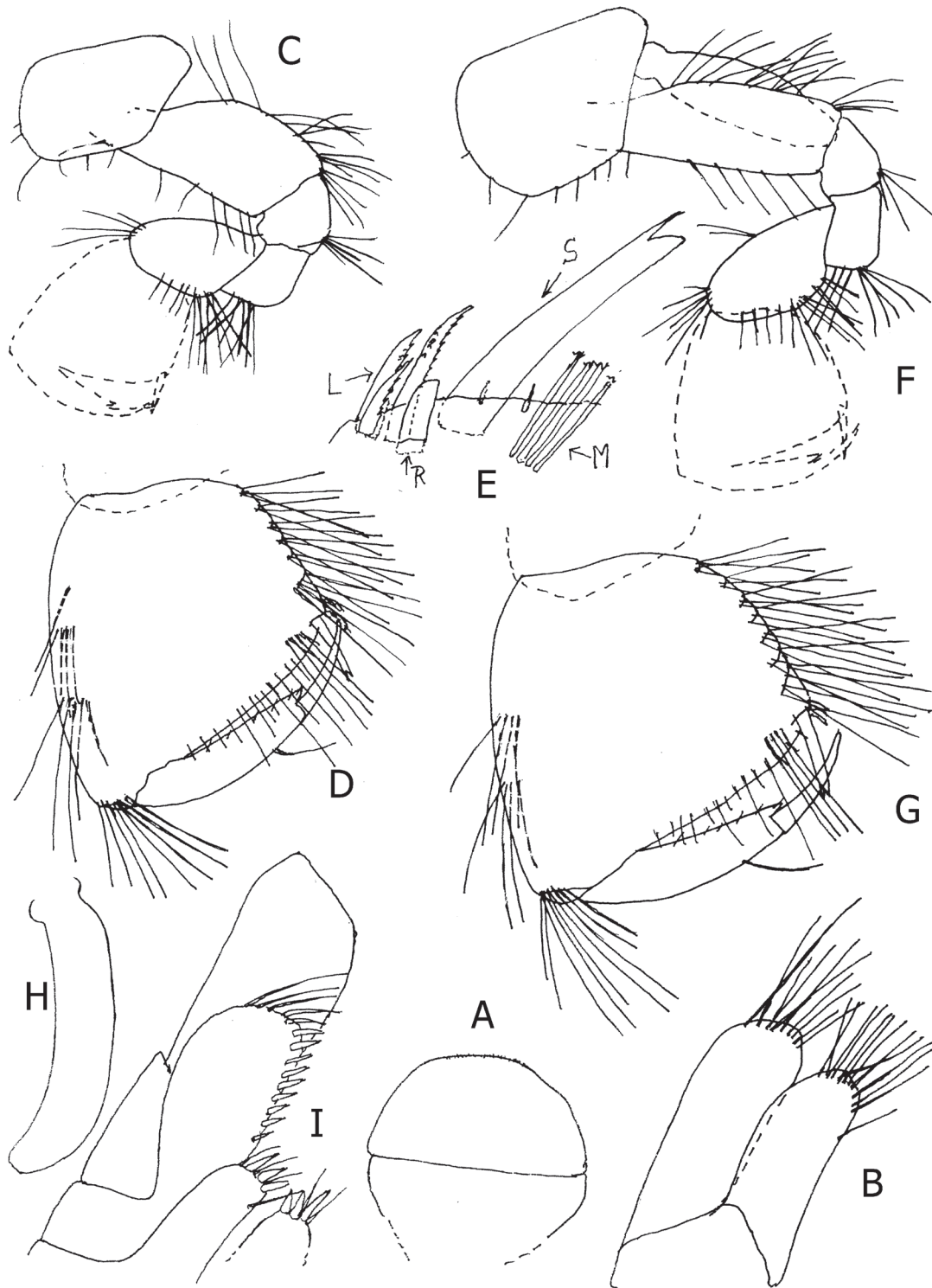
*Niphargus carniolicus* Sket 1960 (loc. typ.: Cave »Jama pri gradu Luknja«, WNW. of Novo Mesto, Slovenia) is also very similar to *N. artifex*, but *N. artifex* differs by its slightly shorter coxae, by paddle shaped rami of uropod 1 in males, by broader propodus of gnathopods 1-2, by broader telson with much longer distal spines, etc.

*Niphargus medvednicae* S. Karaman 1950 (loc. typ.: spring under St. Jakov, Sljeme, Medvednica Mt. near Zagreb, Croatia) is also similar, but *N. artifex* differs by subrounded epimeral plates, article 2 of pereopods 5-7 without a ventroposterior lobe, by rather shorter coxae, and paddle-shaped rami of uropod 1 in males, etc.

*Niphargus pretneri* Sket 1959 (loc. typ.: Gornja Cerovačka pećina Cave near Gračac, Croatia): *N. artifex* differs by more narrowed telson bearing 7-8 very long distal spines on each lobe, etc.

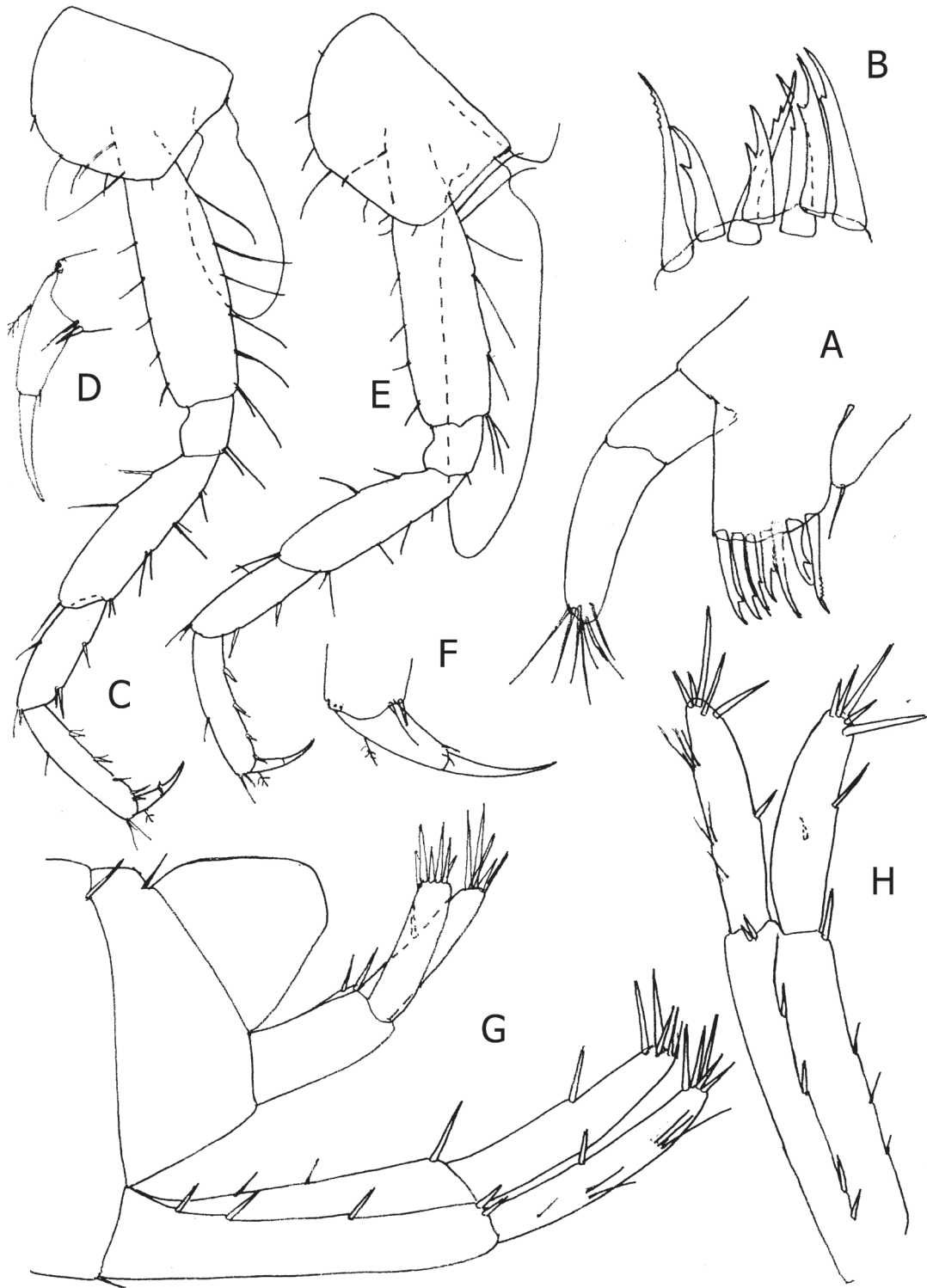
*Niphargus kragujevensis* S. Karaman 1950 (loc. typ.: Kragujevac, Serbia): *N. artifex* differs from it by the fact that both rami are of subequal length in uropod 1, by broader telson with higher number of remarkably longer spines, metasomal segments with 2 dorsoposterior marginal setae; gills on gnathopod 2 and pereopod 4 longer and the broader propodus of gnathopods 1-2, etc.

*Niphargus remus* G. Karaman, 1992 (loc. typ.: Svrljig, fountain above village Prekonoga, Serbia): *N. artifex* differs by the different size and shape of its coxal gills, by long spines on uropods 1-2 and telson; both rami are of subequal length in uropod 1 in males; peduncle of uropod 1 with dorsoexternal row of spines and dorsointernal row of setae

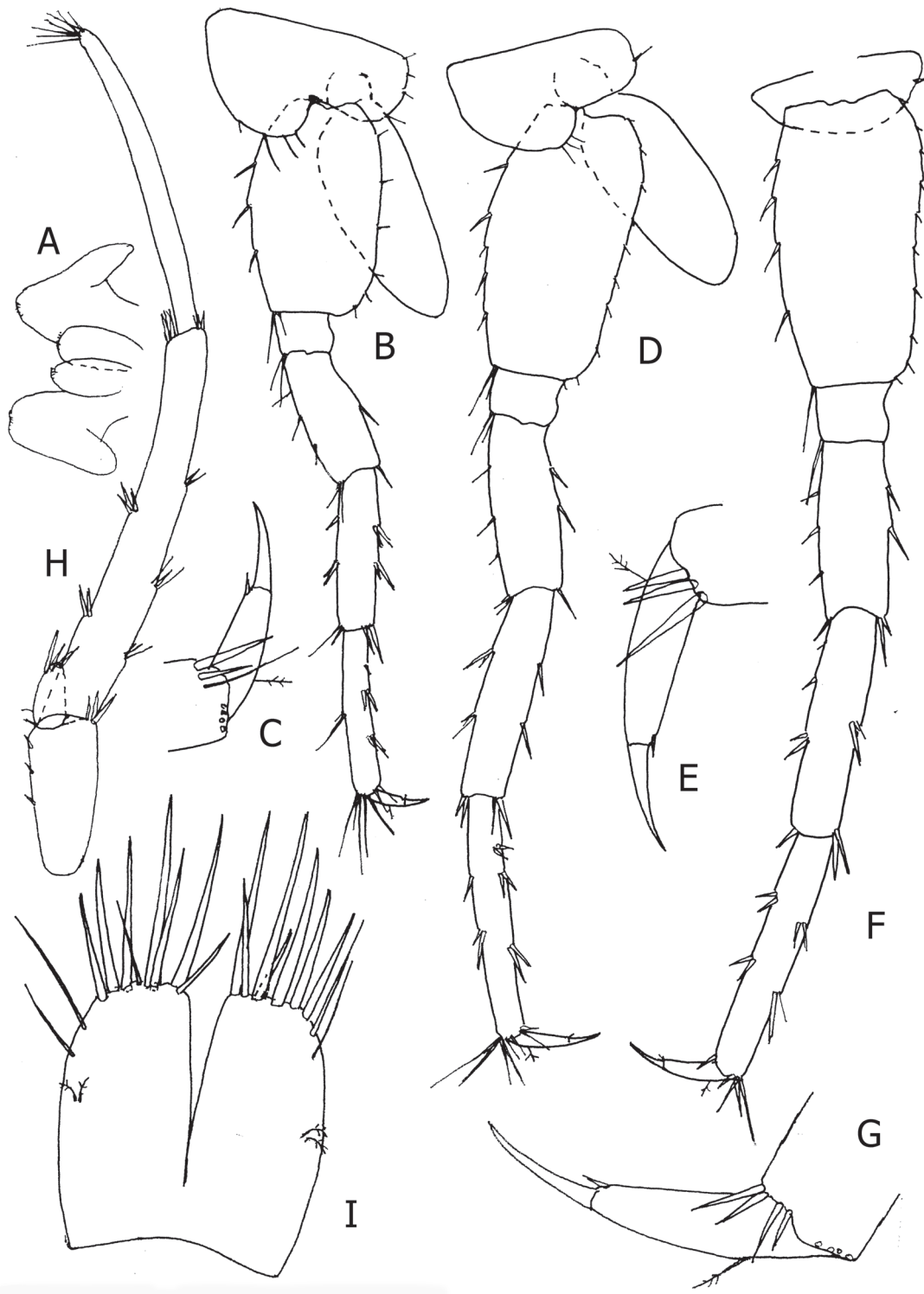


**Fig. 5.** *Niphargus artifex* sp. n., Paring, Paringului Mts., Romania, male 6.9 mm. **A**, labrum; **B**, maxilla 2; **C**, gnathopod 1, outer face; **D**, propodus of gnathopod 1, outer face; **E**, distal corner of gnathopod 1-propodus (S = corner S-spine; L = lateral L-spines; M = facial M-setae; R- subcorner R-spine); **F**, gnathopod 2, outer face; **G**, propodus of gnathopod 2, outer face; **H**, coxal gill of another gnathopod 2; **I**, maxilliped.

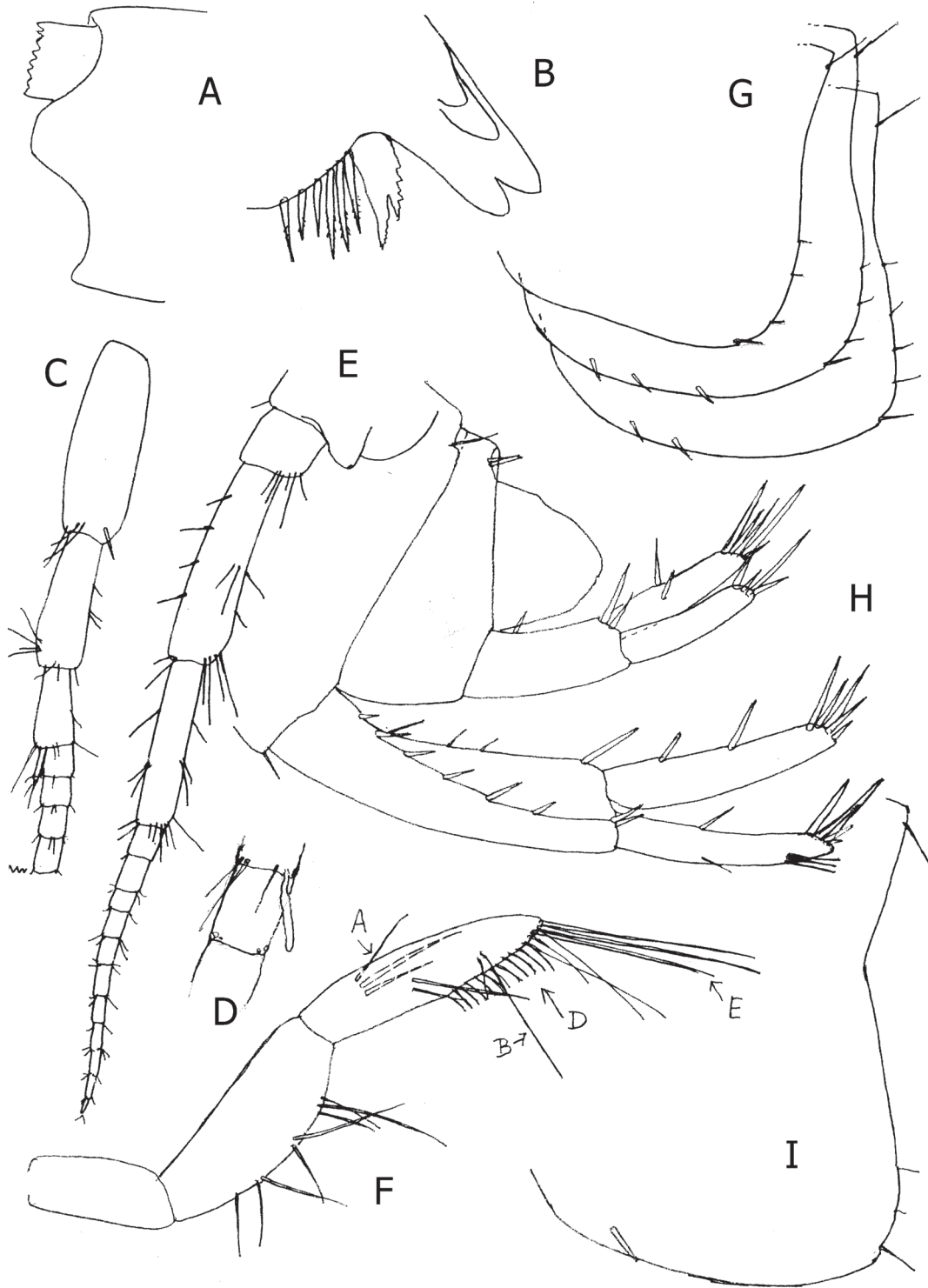




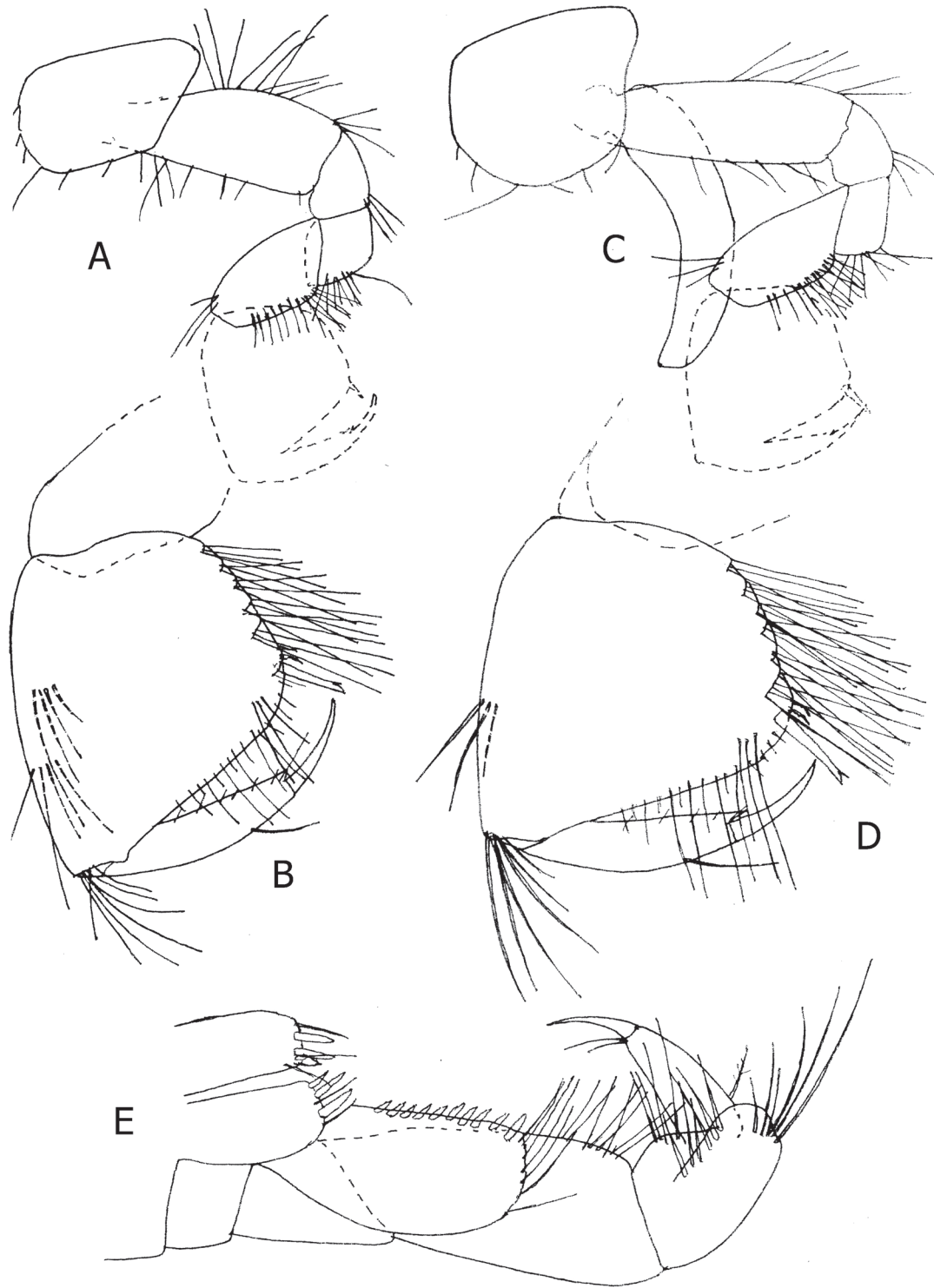
**Fig. 6.** *Niphargus artifex* sp. n., Paring, Paringului Mts., Romania, male 6.9 mm. **A-B**, maxilla 1; **C-D**, pereopod 3; **E-F**, pereopod 4; **G**, urosome with uropods 1-2; **H**, uropod 1.



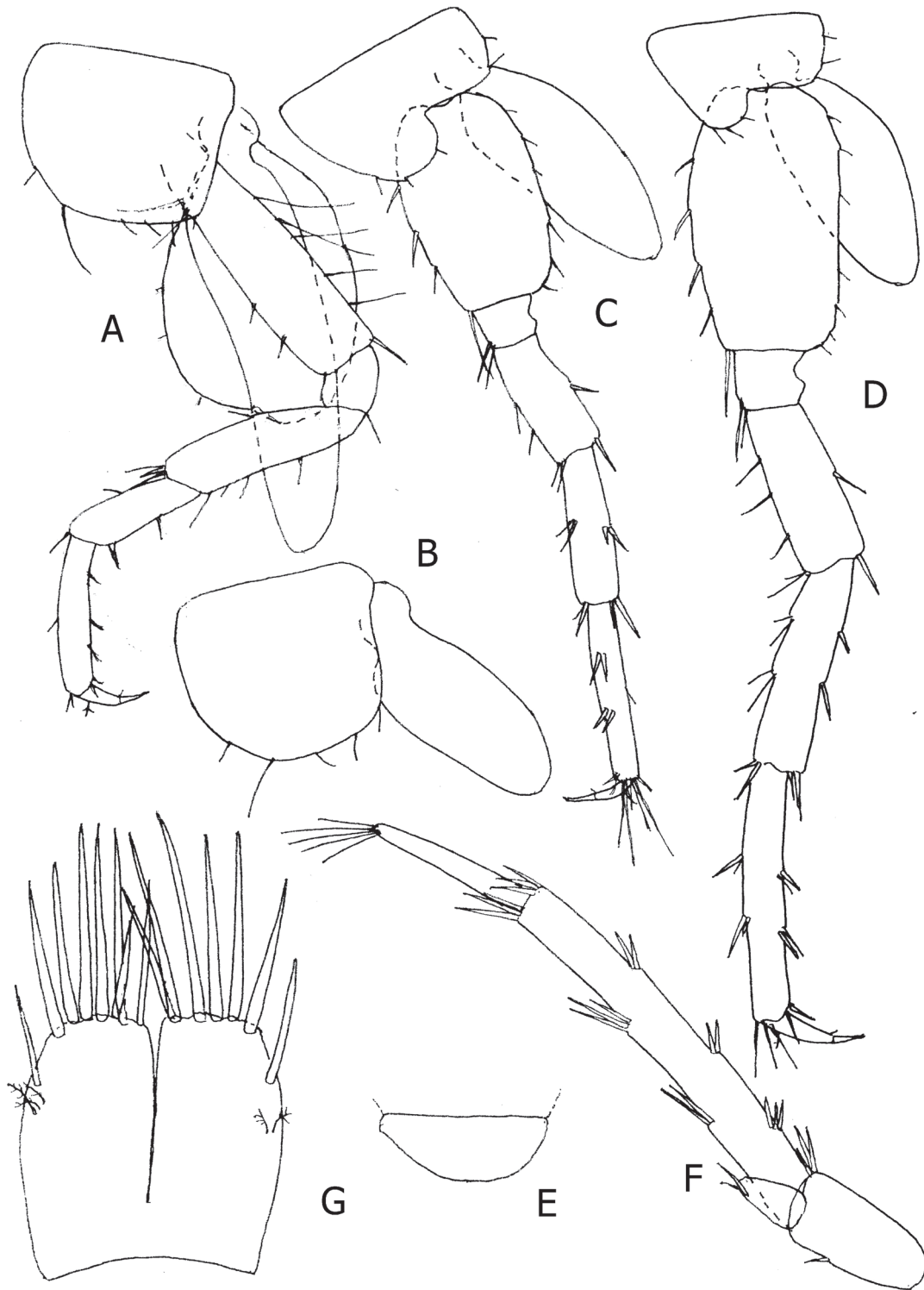
**Fig. 7.** *Niphargus artifex* sp. n., Paring, Paringului Mts., Romania, male 6.9 mm. **A**, labium; **B-C**, pereopod 5; **D-E**, pereopod 6; **F-G**, pereopod 7; **H**, uropod 3; **I**, telson.



**Fig. 8.** *Niphargus artifex* sp. n., Paring, Paringului Mts., Romania, male 6.9 mm. **A**, head; **B**, right incisor with lacinia mobilis and rakers; **C-D**, antenna 1; **E**, antenna 2; **F**, mandibular palpus, inner face (**A** = A-setae; **B** = B-setae; **D** = marginal D-setae; **E** = distal E-setae); **G**, epimeral plates 1-3; **Female** 5.5 mm. **H**, urosome with uropods 1-2; **I**, epimeral plate 3



**Fig. 9.** *Niphargus artifex* sp. n., Paring, Paringului Mts., Romania, female 5.5 mm. **A**, gnathopod 1, outer face; **B**, propodus of gnathopod 1, outer face; **C**, gnathopod 2, outer face; **D**, propodus of gnathopod 2, outer face; **E**, maxilliped.



**Fig. 10.** *Niphargus artifex* sp. n., Paring, Paringului Mts., Romania, female 5.5 mm: **A**, pereopod 4; **B**, coxa 3 with gill; **C**, pereopod 5; **D**, pereopod 6; **E**, coxa 7; **F**, uropod 3; **G**, telson.



in males; uropod 3 broader in males with spines and single simple setae along margins of outer ramus first article; gnathopod 2 propodus in males as long as broad and with a more inclined palm; gnathopod 1 propodus in males with a more inclined palm, etc.

*Niphargus cvetkovi* Kenderov & Andreev 2015 (loc. typ. water source "Cheshma Gorgoritsa" near the village of Novi Han, east of Sofia, Bulgaria) is similar (based on the original description provided by the authors), but *N. artifex* differs from it by the presence of aesthetascs on antenna 1 main flagellum, by shorter coxae in females, by the presence of one seta on maxilla 1 inner plate, longer distal spines on uropods 1-2, longer gills, a higher number and length of distal spines on telson in both sexes, etc.

*Niphargus adbiptus* G. Karaman 1973 (loc. typ.: Ravonica, Cave, Serbia): *N. artifex* differs from it by shorter coxae in males and females, longer distal spines on telson and uropods 1-2, by the higher number of distal spines on telson, stronger dactylus of pereopods, urosomal segment 2 with seta in males, etc.

*Niphargus osogovensis* S. Karaman 1959 (loc. typ.: spring in Osogovo Mt., Northern Macedonia): *N. artifex* differs from it by longer and more numerous distal spines on telson, by narrower article 2 of pereopods 5-7, by the presence of slender spine-like seta on the inner margin of dactylus of pereopods, longer and slenderer mandibular palpus, slightly shorter coxae, etc.

In Romania and Hungary there are also several species similar to *N. artifex*, but these have been only very briefly described (see also Carausu et al. 1955):

*Niphargus transylvanicus* Schellenberg 1934 (loc. typ.: spring near lake Zanoaga, 2020 m a.s.l., in Retyczat Mts., Transylvanian Alps, Romania): *N. artifex* differs by shorter coxae in males and females, by more subrounded epimeral plate 3, broader telson provided with a higher number of longer distal spines, gnathopods 1-2 propodus with a more inclined palm, dactylus of pereopod 7 slightly stronger, etc.

*Niphargus effosus* Dudich 1943 (loc. typ.: subterranean waters of river Koros and spring near Baratka (Kom, Bihar), Romania): *N. artifex* differs by subrounded epimeral plates, narrower article 2 of pereopods 5-7, broader and more spinose telson, higher number of retinacula, etc.

*Niphargus bihorensis* Schellenberg 1940 (loc. typ.: caves in Bihor Mts., Romania): *N. artifex* differs by subrounded epimeral plates, lower number of setae on maxilla 1 inner plate, etc.

*Niphargus korosensis* Dudich 1943 (loc. typ.: hyporheic waters in Crisul Repede, Bratca, reg. Oradea, Romania): *N. artifex* differs by subrounded epimeral plates, broader telson with a higher number of long distal spines and slightly shorter coxae, etc.

*Niphargus pseudokochianus* Dobreanu, Manolache & Puscariu 1953 (loc. typ.: cave near Fata, Roscani, Hunedoara reg., Romania): *N. artifex* differs by the presence of a lower number of setae on maxilla 1 inner plate, article 5 of gnathopods 1-2 shorter and propodus broader; coxae are shorter, maxilliped inner plate with a lower number of distal spines, etc.

*Niphargus molnari* Mehely 1927 (loc. typ.: caves in Mecsek, Hungary): *N. artifex* differs by broader gnathopod 1 propodus rather similar with respect to gnathopod 2, outer plate spines of maxilla 1 with one lateral tooth each, subrounded epimeral plates, pleopods with 2 retinacula only.

*Niphargus gebhardti* Schellenberg 1934 (loc. typ.: cave Abaligeti in Mecsek Mts, Hungary): *N. artifex* differs by maxilla 1-palpus shorter and inner plate with lower number of setae, telson with a much higher number of long spines, etc.

This group of similar species requires detailed revision. The further comparative morphological, ecological, zoogeographical and genetic/molecular studies of all of these taxa will shed more light on the taxonomical position of each of these taxa and their evolutionary relationships.

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