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FIRST DISCOVERY OF *NIPHARGUS DECUI* G. KARAMAN & SARBU 1995 (CRUSTACEA, FAM. NIPHARGIDAE) IN BULGARIA, WITH REMARKS TO ITS VARIABILITY (CONTRIBUTION TO THE KNOWLEDGE OF THE AMPHIPODA 328)

SUMMARY

The subterranean species *Niphargus decui* G. Karaman & Sarbu 1995 (Crustacea Amphipoda, fam. Niphargidae) known so far only from type locality in Romania (Vama Veche village, 10 km south of Mangalia), is discovered at the first time in Bulgaria (subterranean waters of Shabla, Tolbuhin region). The species is redescribed and figured, and variability of the specimens from type-locality and these from Bulgaria is discussed. Morphological relation of this species regarding some other *Niphargus* species in Bulgaria and some adjacent regions is presented.

Keywords: Amphipoda, *Niphargus decui*, taxonomy, subterranean waters, Bulgaria, Romania.

INTRODUCTION

The subterranean fauna of Bulgaria is only partially known, including Amphipoda also. Amphipods in Bulgaria settled numerous caves, springs and various types of the subterranean waters, (wells, subterranean lakes, etc.) from the sea shore to the high mountain springs and caves. Among them, family Niphargidae is the most numerous, presented in Bulgaria by almost 20 known taxa.

The most of *Niphargus* species discovered in Bulgaria are endemic for Bulgaria because of specific geological history, geomorphological, climatic, ecological and hydrological conditions. The partially knowledge of the subterranean Amphipoda fauna in the adjacent regions of Balkan limited more detailed recognition of taxonomical relation of Bulgarian subterranean Amphipoda fauna with that of surrounding countries.

During our study of Balkan subterranean Amphipoda fauna, the species *Niphargus decui* G. Karaman & Sarbu, 1995. not endemic, but new for the

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Bulgarian fauna, is discovered and redescribed in this work. By this way, the morphological variability of this species based on specimens from Bulgaria and from type-locality (Romania) is presented and new diagnosis of *N. decui* is made. Some morphological relations between this species and some more or less similar species from Bulgaria and adjacent regions is given.

MATERIAL AND METHODS

The studied material was preserved in the 70% ethanol. The specimens were dissected using a WILD M20 microscope and drawn using camera lucida attachment. Body-parts were submersed in the mixture of glycerin and water for study and drawing by camera lucida; later transferred to Liquid of Faure as permanent slides. All illustrations were inked manually.

Some morphological terminology and setal formulae follow G. Karaman's terminology (Karaman, G. 1969; 2012) for the last mandibular palpus article [A= A-setae on outer face; B= B-setae on inner face; C= additional C-setae on outer face; D= lateral marginal D-setae; E= distal long E-setae], and for propodus of gnathopods 1 and 2 [S= corner S-spine; L= lateral slender serrate L-spines; M= facial corner M-setae; R= subcorner R-spine on inner face]. Terms "setae" and "spines" are used based on shape, not origin. Our studies were based on the external morphology, ecology and zoogeography of animals.

TAXONOMICAL PART

AMPHIPODA SENTICAUDATA

Family NIPHARGIDAE

NIPHARGUS DECUI G. Karaman & Sarbu 1995

Figures 1-6

MATERIAL EXAMINED:

BULGARIA: BU-11= Shabla, Tolbuhin region [nearly 65 km NE of Varna], 3.11.1978, sondage, 10 exp. (leg. L. Cvetkov);

.ROMANIA: S-5221: Vama Veche village, 10 km south of Mangalia, well, July 24, 1994, many specimens (holotype and paratypes) (leg. M. Sarbu).

DIAGNOSIS.

Body moderately slender, metasomal segments with 4 dorsoposterior marginal setae, urosomal segments 1-2 with dorsolateral spines; epimeral plates 1-3 slightly pointed, plates 2 and 3 with several subventral spines. Head with short lateral cephalic lobes, eyes absent, maxilla 1 inner plate with 2 setae, outer plate spines mainly with one or more lateral teeth; maxilliped with 6 distal spines on inner plate. Coxae 1-4 longer than broad, coxa 4 with ventroposterior lobe, coxa 5 much shorter than coxa 4.

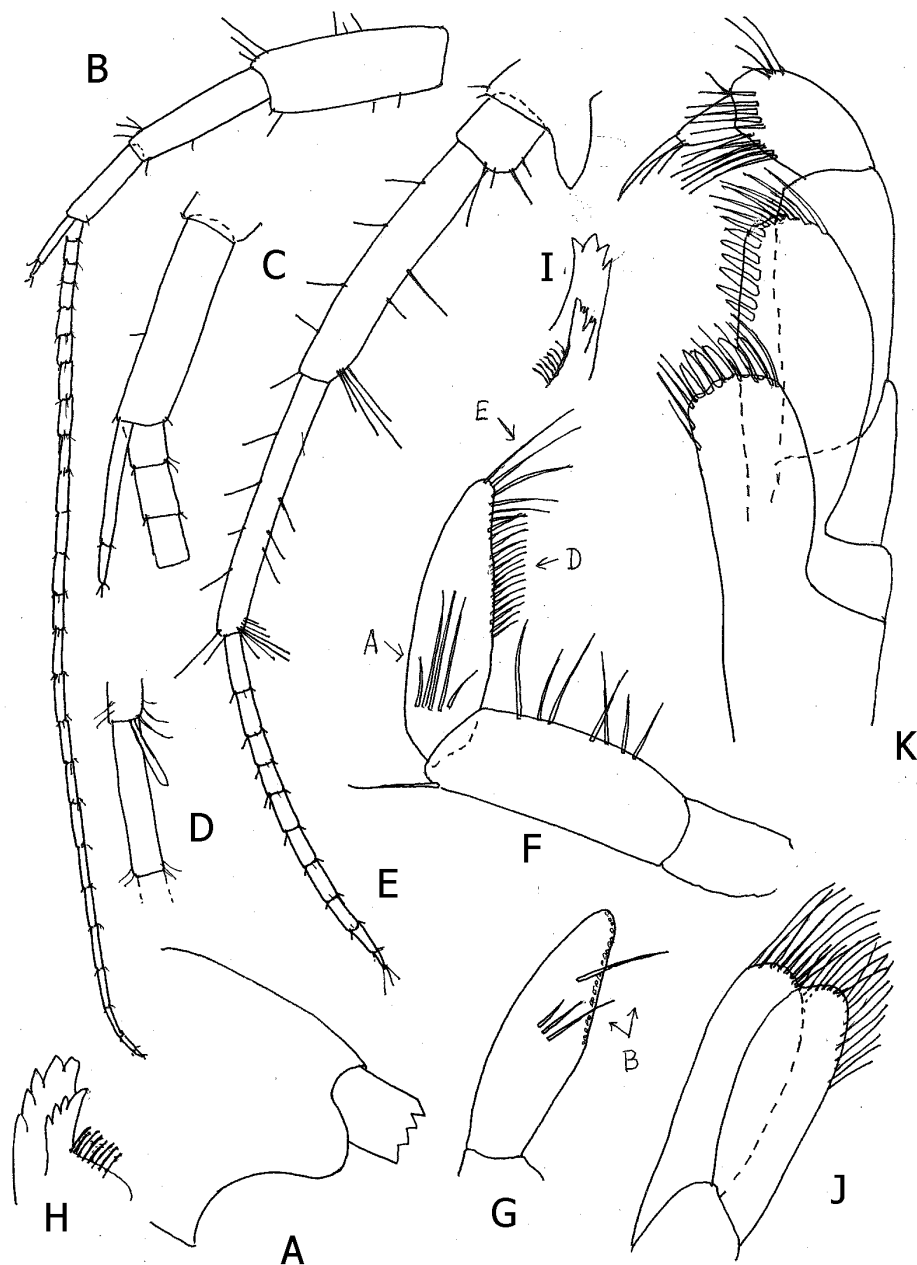


Fig. 1. *Niphargus decui* G. Karaman & Sarbu, 1995, Shabla, Bulgaria, female 7.0 mm: A= head; B= antenna 1; C= accessory flagellum; D= aesthetasc; E= antenna 2; F= mandibular palpus outer face (A= facial A-setae; D= marginal D-setae; E= distal E-setae); G= palpus article 3, inner face (B= facial B-setae); H= left mandible (incisor, lacinia mobilis, rakers); I= right mandible (incisor, lacinia mobilis, rakers); J= maxilla 2; K= maxilliped.

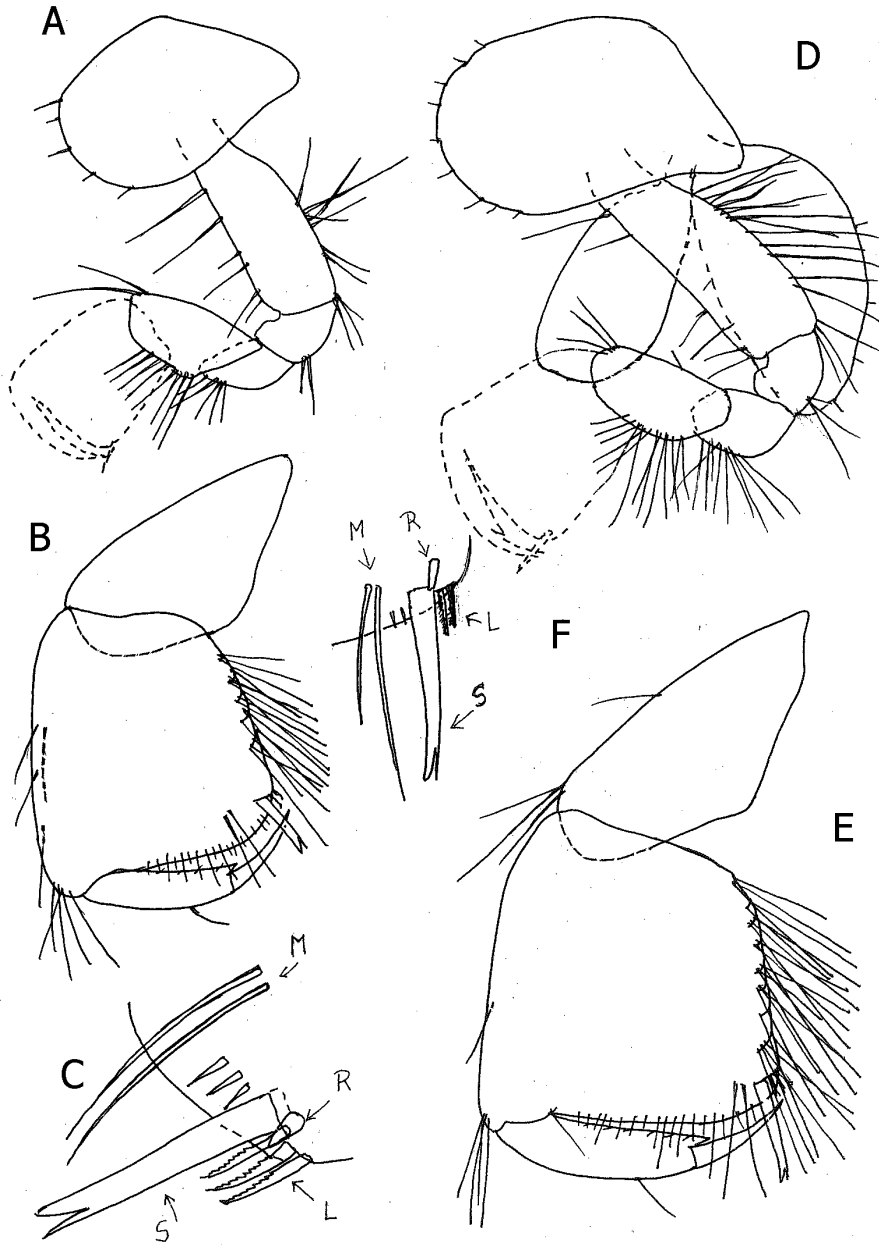


Fig. 2. *Niphargus decui* G. Karaman & Sarbu, 1995, Shabla, Bulgaria, female 7.0 mm: A-B= gnathopod 1, outer face C= distal corner of gnathopod 1-propodus (S= corner spine; L= lateral spines; M= corner facial M-setae; R= subcorner spine on inner face); D-E= gnathopod 2, outer face; F= distal corner of gnathopod 2-propodus (S= corner spine; L= lateral spines; M= corner facial M-setae; R= subcorner spine on inner face).

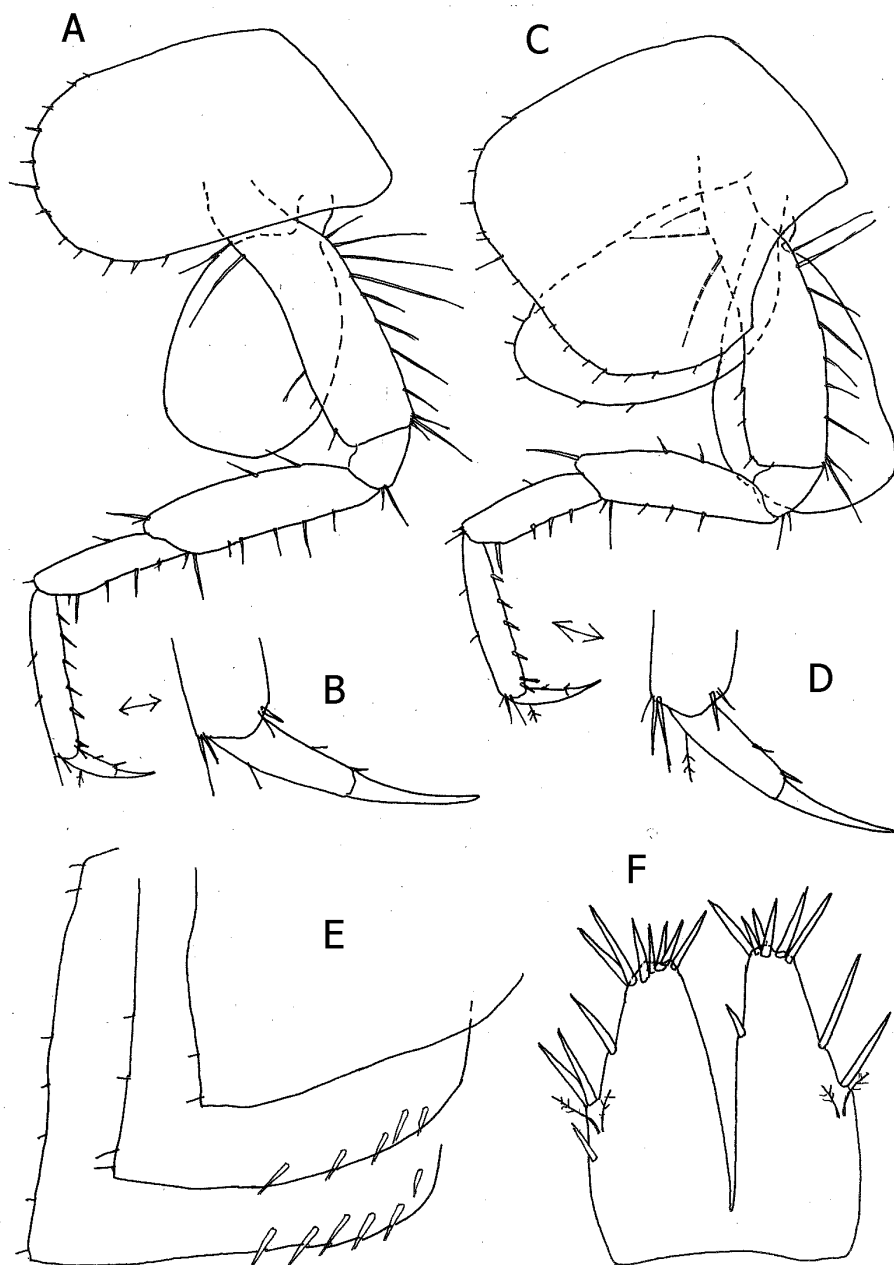


Fig. 3. *Niphargus decui* G. Karaman & Sarbu, 1995, Shabla, Bulgaria, female 7.0 mm: A-B= pereopod 3; C-D= pereopod 4; E= epimeral plates 1-3; F= telson.

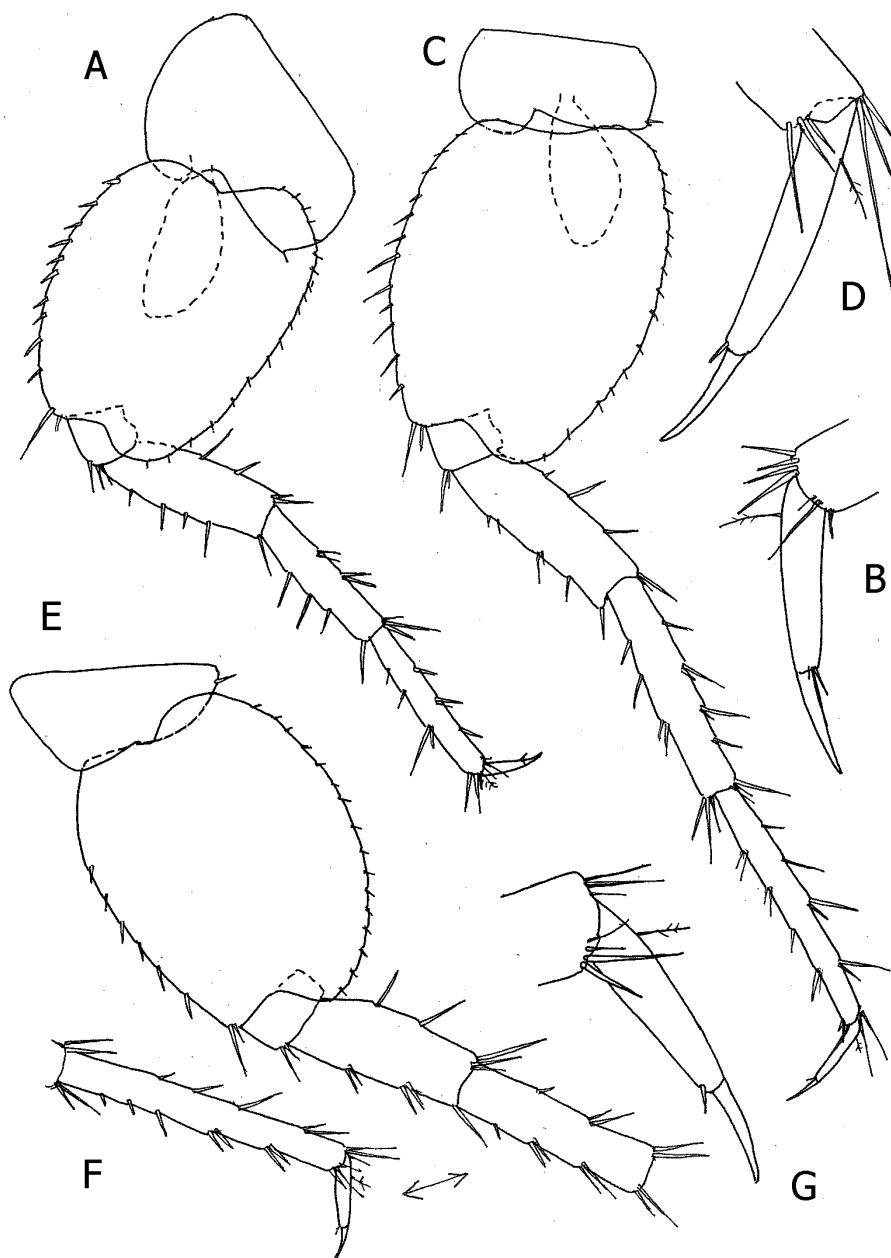


Fig. 4. *Niphargus decui* G. Karaman & Sarbu, 1995, Shabla, Bulgaria, female 7.0 mm: A-B= pereopod 5; C-D= pereopod 6; E-G= pereopod 7, female 6.9 mm

Gnathopods 1-2 *kochianus*-type, with dactylus bearing one median seta at outer margin. Pereopods 3-4 with slender dactylus bearing 1 or 2 slender spine-like setae at inner margin. Pereopods 5-7 with large ovoid article 2 with ventroposterior lobe, dactylus slender, with one slender spine at inner margin. Pleopods 1-3 with almost naked peduncle provided with 4-6 retinacula. Uropod 1 with nearly equal rami, uropod 2 inner ramus longer than outer one. Uropod 3 short and strong, spinose, second article of outer ramus very short. Telson deeply incised, with distal and marginal spines, facial spines absent. Coxal gills ovoid, larger in gnathopod 2 and pereopods 3-4, smaller in pereopods 5-6. Oostegites broad, with long marginal setae.

DESCRIPTION:

Female 7.0 mm with oostegites from Shabla: Body moderately slender, head with short rostrum and subrounded lateral cephalic lobes, ventroanterior sinus developed, eyes absent (fig. 1A). Mesosomal segments naked; metasomal segments 1-3 with 2+2 short dorsoposterior marginal setae (fig. 3E). Urosomal segment 1 with one dorsolateral strong spine on each side; urosomal segment 2 with 2 strong dorsolateral spines on each side, urosomal segment 3 naked (fig. 6D).

Epimeral plates 1-3 slightly pointed, with more or less inclined posterior margin bearing several short setae; epimeral plate 2 with 5 subventral spines, epimeral plate 3 with 6 subventral spines (fig. 3E).

Antenna 1 slender, slightly exceeding half of body-length; peduncular articles 1-3 progressively shorter (ratio: 53:42:27), covered by single short setae each (fig. 1B). Main flagellum very slender, consisting of 25 articles bearing single short setae (most of articles with one aesthetasc) (fig. 1D). Accessory flagellum slightly elongated, 2-articulated, reaching $\frac{3}{4}$ of last peduncular article (fig. 1C).

Antenna 2 shorter than antenna 1, relatively slender, peduncular article 3 short, with 4 short ventral setae; articles 4 and 5 of equal length; article 4 with bunch of long distoventral setae and several other setae along dorsal and ventral margin (the longest setae remarkably exceeding diameter of article itself); article 5 with distal dorsal and ventral group of setae, along both margins appear several shorter or longer setae. Flagellum slender, rather longer than last peduncular article, consisting of 10 scarcely setose articles (fig. 1E). Antennal gland cone short (fig. 1E).

Mouthparts well developed. Labrum broader than long (fig. 5A). Labium broader than long, inner lobes well developed, short; outer lobes entire, rounded distally (fig. 6A).

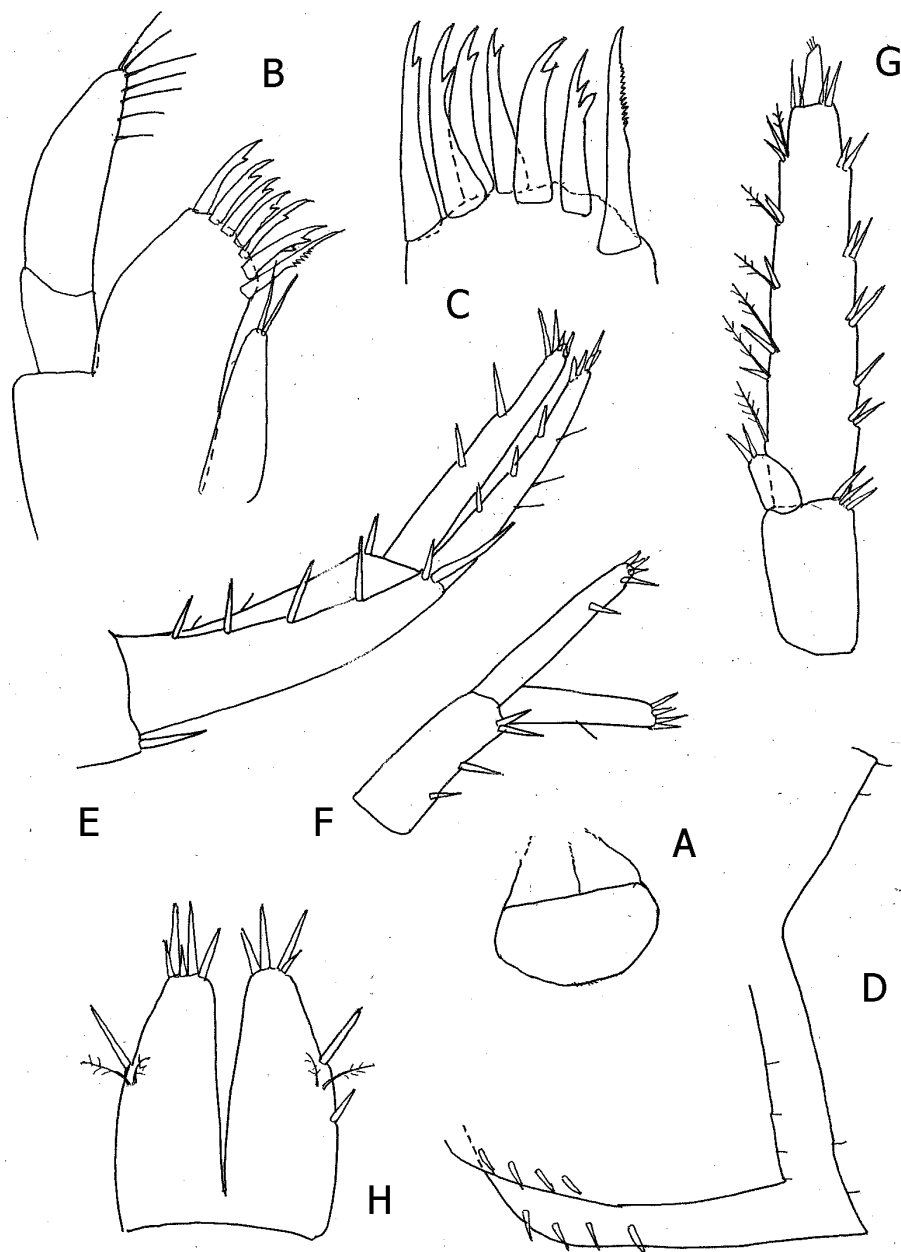


Fig. 5. *Niphargus decui* G. Karaman & Sarbu, 1995, Shabla, Bulgaria, female 7.0 mm: A= labrum; B-C= maxilla 1; E= uropod 1; F= uropod 2; G= uropod 3. Female 6.9 mm: D= epimeral plates 2-3; H= telson.

Mandibles with triturative molar. Left mandible: incisor with 5 teeth, lacinia mobilis with 4 teeth, accompanied by 8 rakers (fig. 1H). Right mandible: incisor with 4 teeth, lacinia mobilis serrate, accompanied by 7 rakers (fig. 1I). Palpus mandibulae well developed, 3-articulate: first article naked; second article with 7 setae; third article subfalciform, scarcely longer than article 2 (ratio: 79:71), bearing 16 marginal D-setae, 5-6 distal long E-setae, on outer face appear row of 5 medial A-setae (fig. 1F), on inner face are attached 2 groups of B-setae (3+1) (fig. 1G).

Maxilla 1: inner plate long, with 2 distal setae; outer plate with 7 spines [5 spines with one lateral tooth, one spine with 2 lateral teeth, inner spine with finely serrate distal margin] (fig. 5C); palpus 2-articulated, slightly exceeding distal tip of outer plate-spines and provided with 7 distal setae (fig. 5B).

Maxilla 2 with longer plates bearing distal setae, inner plate with distolateral marginal setae also (fig. 1J).

Maxilliped rather longer, inner plate strong, reaching outer tip of first palpus article, bearing 6 distal spines mixed with single setae; outer plate slightly shorter than palpus article 2 and bearing 10-12 distolateral strong spines and row of distal setae; palpus article 3 outer margin with bunch of setae, inner margin with setae; article 4 with one outer marginal median seta, at inner margin with 2 setae near basis of the nail; nail relatively long (fig. 1K).

Coxae 1-4 moderately long. Coxa 1 rather longer than broad (ratio: 53:46), ventroanterior corner subrounded, margin with 5 setae (fig. 2A). Coxa 2 distinctly longer than broad (ratio: 73:50), strongly convex margin with 9 setae (fig. 2D). Coxa 3 longer than broad (ratio: 86:54), margin with 11 setae (fig. 3A). Coxa 4 with well developed ventroposterior lobe, rather longer than broad (ratio: 89:85), margin with 16 short setae (fig. 3C).

Coxae 5-7 moderately short. Coxa 5 much shorter than coxa 4, bilobed, broader than long (ratio: 67:44), anterior lobe short (fig. 4A). Coxa 6 remarkably smaller than 5, bilobed (ratio: 54:28), anterior lobe small (fig. 4C). Coxa 7 entire, broader than long (ratio: 57:29) (fig. 4E).

Gnathopods 1 and 2 relatively small, with propodus smaller than corresponding coxa (fig. 2A, D). Gnathopod 1: article 2 with row of 6 long marginal setae along anterior margin and bunches of setae at posterior margin; article 3 with distoposterior bunch of 2 setae (fig. 2A); article 5 nearly as long as propodus, with 2 groups of setae at anterior margin and numerous setae at posterior margin. Propodus rather *kochianus*-type, longer than broad (ratio: 78:65), posterior margin with 5 transverse rows of setae; palm straight in the middle, convex at corner (fig. 2B), defined on outer face by corner S-spine accompanied laterally by 3 serrate L-spines and 2 facial subcorner M-setae (fig. 2C), on inner face by one subcorner R-spine. Dactylus reaching posterior margin of propodus, with one median seta at outer margin and 5-6 small submarginal setae along inner margin (fig. 2B).

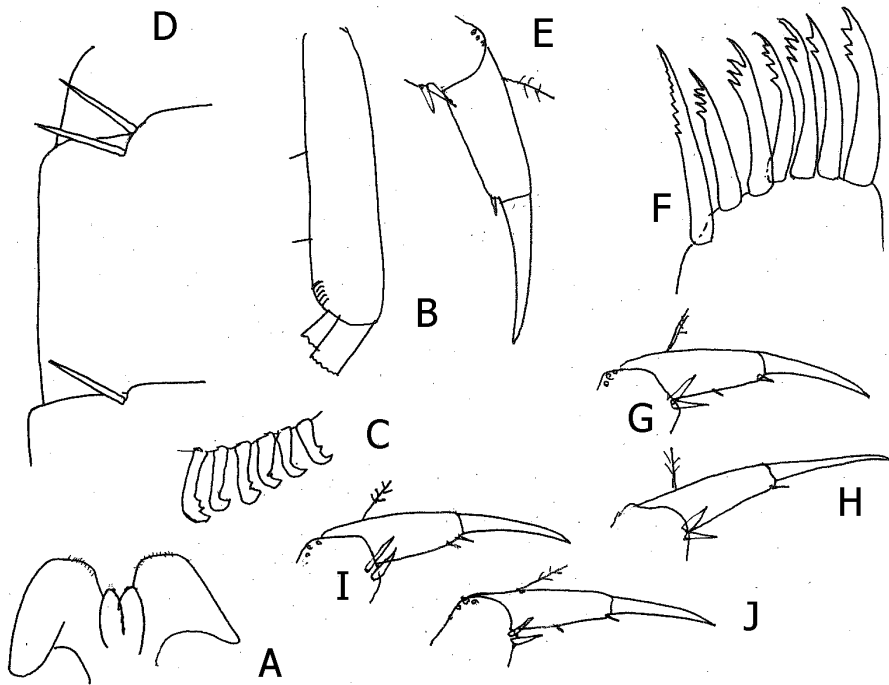


Fig. 6. *Niphargus decui* G. Karaman & Sarbu, 1995, Shabla, Bulgaria, female 7.0 mm: A= labium; B= pleopod 3; C= retinacula of pleopod 3; D= urosomites 1-2; E= pereopod 3 dactylus;

Female 6.0 mm (paratype), Vama Veche, Romania: F= maxilla 1 outer plate; G-H= left and right pereopod 3 dactylus; I-J= left and right pereopod 4-dactylus.

Gnathopod 2 distinctly larger than gnathopod 1: article 2 with row of shorter setae along anterior margin and numerous long setae along posterior margin; article 3 at posterior margin with distal bunch of 3 setae; article 5 almost as long as propodus, anterior margin with one median seta and distal bunch of setae, posterior margin with numerous setae (fig. 2D). Propodus trapezoid, rather longer than broad (ratio: 85:80), at posterior margin with 8 transverse rows of setae (fig. 2E); palm straight in the middle and convex at corner, defined on outer face by corner S-spine accompanied laterally by 2 serrate L-spines and 2 subcorner facial M-setae, on inner face with one subcorner R-spine (fig. 2F). Dactylus reaching posterior margin of propodus, at outer margin with one median seta, along inner margin with row of short submarginal setae (fig. 2E).

Pereopod 3 moderately slender, article 2 with several setae at anterior margin and row of long setae along posterior margin, setae diminishing towards distal part of article itself; article 3 with 2 distal posterior setae. Articles 4-6 of different length (ratio: 56:37:45); article 4 with 3-4 setae at anterior margin and 6-

8 stronger setae along posterior margin; article 5 with 2 anterior marginal setae and 4-5 stronger setae along posterior margin (setae usually not exceeding diameter of article); article 6 with 3 single anterior marginal setae, and 6 short slender single spines at posterior margin (fig. 3A); dactylus slender, much shorter than article 6 (ratio: 25:45), at inner margin with 2 single slender spines, at outer margin with one median plumose seta; nail long, but rather shorter than pedestal (ratio: 35:40) (fig. 3B).

Pereopod 4 rather similar to pereopod 3: article 2 at anterior margin with 3 proximal long and 3 short setae in distal part, posterior margin with long setae; article 3 with distoposterior group of 2 setae. Articles 4-6 of different length (ratio: 47:37:44); article 4 along both margins with several short single setae; article 5 at anterior margin with one median and 2 distal short setae, at posterior margin with 4 single slender spines; article 6 at anterior margin with 2-3 short setae, along posterior margin with row of 5 single short spines (fig. 3C). Dactylus slender, shorter than article 6 (ratio: 33:44), at inner margin with 2 single slender spines, at outer margin with one median plumose seta (fig. 3D); nail shorter than pedestal (ratio: 33:38).

Pereopods 5-6 relatively short. Pereopod 5: article 2 very large, ovoid (ratio: 84:63), with well developed ventroposterior lobe; anterior margin strongly convex but not produced, bearing row of 11-12 short spines; posterior margin strongly convex, provided with row of nearly 19 short setae (fig. 4A); article 3 short, with 2 distal spines. Articles 4-6 of poorly different length (ratio: 46:44:47), bearing at both margins short and long slender spines (the longest spines are remarkably longer than diameter of article itself). Article 2 remarkably longer than article 6 (ratio: 84:47). Dactylus slender, remarkably shorter than article 6 (ratio: 19:47), at inner margin with one slender spine near basis of the nail, at outer margin with one median short plumose seta (fig. 4B), nail shorter than pedestal (ratio: 30:55).

Pereopod 6 distinctly longer than pereopod 5; article 2 ovoid, large, rather longer than broad (ratio: 96:72), ventroposterior lobe well developed (fig. 4C), anterior strongly convex margin with row of 10 slender spines, posterior remarkably convex margin with 16 short setae. Article 3 short, with distoanterior long spine-like seta and short seta. Articles 4-6 of unequal length (ratio: 52:63:71), article 4 along anterior and posterior margin with single slender spines not exceeding width of article itself. Articles 5-6 along anterior and posterior margin with several slender spines of unequal length (the longest spines exceeding width of article itself, especially on article 7). Article 2 is remarkably longer than article 6 (ratio: 96:71). Dactylus slender, shorter than article 6 (ratio: 30:71), at inner margin with one slender spine near basis of the nail, at outer margin with one median short plumose seta (fig. 4D); nail shorter than pedestal (ratio: 32:73).

Pereopod 7 missing, and described here of **female 6.9 mm**: Article 2 very large and ovoid, longer than broad (ratio: 90:71), with well developed ventroposterior lobe, anterior convex margin with 7-8 spines, posterior strongly convex margin with 16 short setae (fig. 4E, F). Articles 4-6 of different length

(ratio: 47:55:81), along both margins with spines shorter or longer than diameter of articles themselves. Article 2 only rather longer than article 6 (ratio: 90:81). Dactylus shorter than article 6 (ratio: 30:81), at inner margin with one slender spine near basis of the nail, at outer margin with one median plumose seta (fig. 4G); nail shorter than pedestal (ratio: 57:30).

Pleopods 1-3 peduncle almost naked, that of pleopod 3 with 2 posterior marginal short simple setae (fig. 6B). Peduncle of pleopod 1 with 4 retinacula; that of pleopod 2 with 5 retinacula; peduncle of pleopod 3 with 6 retinacula (fig. 6C), at posterior margin with 2 short single setae.

Uropod 1: peduncle longer than rami, with dorsoexternal row of strong spines and dorsointernal row 1-2 spine-like setae and distal strong spine. Outer ramus as long as inner one, with 3 lateral and 4 distal spines, including 4 short simple setae at outer margin (fig. 5E); inner ramus with 2 lateral and 4 distal spines.

Uropod 2: peduncle rather shorter than inner ramus, bearing 4 spines; outer ramus shorter than inner ramus, bearing one lateral short simple seta and 4 distal spines; inner ramus with 2 lateral and 4 distal spines (fig. 5F);

Uropod 3 short and strong, peduncle rather longer than broad (ratio: 40:25); inner ramus short, scale-like, with 2 distal slender spines. Outer ramus 2-articulate: first article along outer margin with 6 groups of spines, along inner (mesial) margin attached 6 single or paired spines mixed with single longer plumose setae (fig. 5G); second article shorter than width of first article proximal part, bearing 1-2 distal short simple setae.

Telson rather longer than broad (ratio: 85:73), deeply incised, lobes tapering distally, with 6-7 distal spines each, along outer margin with 3 groups of spines (1-2-1), along inner margin with 0-1 short spine; facial spines absent; a pair of short plumose setae appears near the middle of outer margin (fig. 3F).

Coxal gills moderately large, on gnathopod 2 and pereopods 3-4 not exceeding distal margin of corresponding pereopod (figs. 2D, 3A, C); gills on pereopod 5 and 6 remarkably shorter (fig. 4A, C).

Oostegites large, with short marginal setae (figs. 2D; 3C).

MALES from *Shabla* unknown.

VARIABILITY (female only).

Female 6.9 mm: Urosomal segment 1 with one dorsolateral spine, urosomal segment 2 with 2 strong dorsolateral spines on each side, urosomal segment 3 naked.

Telson lobes with 4-5 distal and 1-2 outer marginal spines (fig. 5H), mesial marginal and facial spines absent. Maxilla 1 like that in female of 7.0 mm, with 5 spines on outer plate bearing one lateral spine only, one spine with 2 teeth, inner spine finely serrate.

Epimeral plates 2 and 3 with 4 subventral spines, epimeral plate 3 slightly more pointed (fig. 5D). Pleopods 1-3 with elevated number of retinacula like that

in female of 7 mm. Peduncle of pleopod 3 with 3 short posterior marginal setae. Urosomal segment 1 with one dorsolateral spine, urosomal segment 2 with 2-3 dorsolateral spines on each side.

Supplementary short seta at inner margin of pereopods 3-4 dactylus absent (fig. 6E). Dactylus of pereopods 5-7 always without additional spine-like seta or spine.

The presence of that additional small spine-like seta on pereopods 3-4 was overlooked in previous description of this species from Romania, because is present on only nearly 10 % of specimens in both localities.

Oostegites in **female of 6.8 mm** are with long marginal setae.

Female of 6 mm (Vama Veche): Dactylus of pereopod 3 with 1-2 spine-like setae; both dactyls of pereopod 4 were with 2-spine-like setae (fig. 6G, H, I, J).

The specimens from Shabla are morphologically quite similar to these from Vama Veche except the different number of lateral teeth on maxilla 1 outer plate (fig. 6F); based on this difference only, we consider specimens from Shabla identical with these of Vama Veche (Romania).

LOCUS TYPICUS: Vama Veche, village, 10 km south of Mangalia, Romania.

DISTRIBUTION: Romania; Bulgaria (new)

REMARKS AND AFFINITY

In Bulgaria were known two species with additional spines on dactylus of pereopods, *Niphargus valachicus* Dobreanu & Manolache 1933 [loc. typ.: Bucharest, Romania], and *Niphargus bulgaricus* Andreev 2001 [loc. typ.: surface waters from the Bolata Marsh, Bulgaria, mentioned later (Vidinova et al., 2016) from the subterranean waters of Shabla Lake). Both species are characterized by presence of several spines on inner margin of dactylus in all pereopods, strongly pointed epimeral plates and large strongly inclined propodus of gnathopods 1-2 provided with several median setae along outer margin of dactylus.

Several *Niphargus* species from Bulgaria are with only one external median seta on dactylus of gnathopods 1-2 propodus, like *N. decui*:

N. cvetkovi Kenderov & Andreev 2015 [loc. typ.: water source “Cheshma Gorgoritsa” near the village Novi Han, E. of Sofia, Bulgaria] characterized by elevated number of retinacula and equal rami of uropod 1 in female, like these in *N. decui*, but provided with narrowed article 2 of pereopods 5-7, short coxae 1-4 and absence of ventroposterior lobe on coxa 4, not “*kochianus*” shape of propodus of gnathopods 1-2, etc.

N. georgievi S. Karaman & G. Karaman, 1959 [loc. typ.: Ourouchka peštera Cave near village Krochouna, Lovetsch Mt., Bulgaria], species with elevated number of retinacula, telson and uropod 1 like that in *N. decui*, but provided with narrowed article 2 of pereopods 5-7, strongly inclined palm of gnathopods 1-2 propodus, etc.

Niphargus melticensis Dancau & Andreev 1973 [loc. typ.: well in Sokolovo, Lowetch district, Bulgaria] with slender dactylus of pereopods, equal rami of uropod 1 in female, coxa 4 with ventroposterior lobe, article 2 of pereopod 7 broad, lobed, short uropod 3 similar to these in *N. decui*, but differs by 2 retinacula only, strongly narrowed propodus of gnathopods 1-2 and elongated article 5 of gnathopod 2.

N. pecarensis pecarensis S. Karaman & G. Karaman 1059 [loc. typ.: Pečara Dupka Cave near Belogradčik, Bulgaria) with equal rami of uropod 1 and elevated number of retinacula, differs by surrounded epimeral plates 1-3, short unlobed coxa 4, absence of lateral spines on telson, narrowed article 2 of pereopods 5-7, etc.

Very large ovoid article 2 of pereopods 5-7 is present in some species from subterranean waters of SW part of Balkan peninsula: *Niphargus asper* G. Karaman 1972 [loc. typ.: wells in Podgorica, Montenegro], *Niphargus numerus* G. Karaman & Sket 1990 [loc. typ. Vjetrenica Cave in Popovo polje, Bosnia and Herzegovina], *N. factor* G. Karaman & Sket 1990 [loc. typ.: cave Čavlinska pećina near Obrovac, Croatia], *N. brevirostris* Sket 1971 [loc. typ.: Ličko Lešće in Lika, Croatia], *Niphargus cymbalus* G. Karaman 2017a (loc. typ.: Glikorizo, Arta, Greece), *Niphargus fautor* G. Karaman 2017b [loc. typ.: Glikorizo, Arta, Greece), but all these species differs distinctly from *N. decui* by presence of 2 retinacula on pleopods 1-3.

In Romania are known various species with more or less broad lobed article 2 of pereopods 5-7, but never as large as that in *N. decui*. Many of these species are not described in detail to recognize clearly their taxonomical relations with other *Niphargus* species from Balkan (Carausu et al., 1955).

The broad article 2 of pereopods 5-7 indicated living of these animals in slowly running or not running subterranean waters.

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