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Original paper

On the endemic subterranean amphipod *Niphargus versluysi* S. Karaman, 1950 (Fam. Niphargidae) in Greece (Contribution to the Knowledge of the Amphipoda 297)

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Summary. The partially known taxon *Niphargus longicaudatus versluysi* S. Karaman, 1950 (Amphipoda, Gammaridea, fam. Niphargidae) was described from the subterranean waters of Scophos spring on Zakynthos Island (= Zante), Ionian Sea, Greece, and later cited (S. Karaman, 1960) from central Greece (Delphi-Gravia). During our studies of Greek Amphipoda fauna, we established this species for the springs along the road Arilas-Perdika, Epirus, and springs near Zakynthos town (Zakynthos Island). As this taxon was only partially known and described, we redescribed and figured this taxon in detail (males and females). Based on relevant taxonomical characters, it is elevated to the rank of a distinct species, *Niphargus versluysi* S. Karaman, 1950 and its taxonomical characters and relation to other *Niphargus*-taxa from Greece and adjacent regions are discussed.

Keywords: Amphipoda, endemic, Greece, Niphargidae, *Niphargus versluysi*, redescription.

INTRODUCTION

Greece is mostly a mountainous country covering a total area of 131,957 km^2, having a maximum elevation of 2.637 m a.s.l., with nearly 3.000 islands in the Ionian, Mediterranean and Aegean Sea, and provided with various rivers and lakes, springs, caves and other karstic phenomena. Because of its geological history and ecological and climatic conditions, biodiversity in the epigean and subterranean waters of Greece is very rich and highly endemic.

Despite the fact that hydrobiological investigations in this country have been conducted by numerous domestic and foreigner researchers, the subterranean fauna of Amphipoda is only partially known (S. Karaman 1934, 1950, 1956; Pesce et al. 1978; Pesce and Maggi 1983; G. Karaman 2015, etc.). Regarding the family Niphargidae, three genera are known from Greece (*Niphargus* Schiödte, 1849, *Exniphargus* G. Karaman, 2016a, *Niphargobatoides* G. Karaman, 2016a): the last two being endemic.

From the subterranean waters of Greece, nearly 15 *Niphargus* species are known, most of them endemic, and probably numerous other taxa remain undiscovered. This increase in the number of known species suggests a need for more detailed morphological investigations of each taxon (males and females), to facilitate recognition of single taxa and identify the limits of their morphological variability. During the last half century, the number of morphological characters used in taxonomy has doubled, renewing the need for redescription of many taxa that have previously only been briefly described and figured.

Some recent investigations have underestimated morphological taxonomy, relying almost entirely on molecular and genetic taxonomy and erroneously assuming that each molecular and genetic difference automatically represents a distinct new taxon. It is widely accepted that each morphological difference established in one population does not automatically represent a new taxon. The same problem now appears to be relevant in genetic and molecular taxonomical investigations of various populations. The conclusion that certain species can be distinguished based only on genetic and molecular data, without a detailed study of the morphological characters of males, females, juveniles and the variability of those characters (to show that there are no any differences among them), is scientifically very doubtful and uncertain.

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Only a combination of morphological, genetic, ecological and other data will solve the problem of differentiation of different taxa and avoid creating taxa based on only one type of data.

Based on various material, during our recent studies of Amphipoda from Greece, we established the presence of *Niphargus longicaudatus versluysi* S. Karaman, 1950 in some new localities in Greece. As this taxon was only partially described and figured, and many of its taxonomical characters were unknown, in the present study we decided to redescribe and figure it in more details. Based on our investigations, this taxon was elevated to the rank of a distinct species as *Niphargus versluysi* S. Karaman, 1950, n. stat.

MATERIAL AND METHODS

Samples were preserved in 70% ethanol. The studied specimens were dissected using a WILD M20 microscope and drawn using a camera lucida attachment. All appendages were temporarily submerged in a mixture of glycerin and water for study and drawing. The body length of examined specimens was measured from the tip of the head to the end of the telson. After the end of the study, the dissected body parts were submerged in Liquid of Faure and covered by a thin cover glass for permanent slides collection. All illustrations were inked manually.

Some morphological terminology and seta`s formula follow Karaman`s terminology (Karaman G. 1969, 2012): for last mandibular palpus (A = setae on outer face; B = setae on inner face; C = additional setae on outer face; D = lateral marginal setae; E = distal long setae) and for propodus of gnathopods 1 and 2 (S = corner S-spine; L = lateral L-spines; M = facial M-setae; R = subcorner R-spine). Terms "setae" and "spines" are used based on its shape, not origin. All studies were provided based on morphological, ecological and zoogeographical data.

TAXONOMICAL PART

Family Niphargidae

Niphargus versluysi S. Karaman, 1950, n. stat.

(Figs 1-9)

Niphargus longicaudatus versluysi, n. ssp., S. Karaman,1950: 44, Figs 11-20; G. Karaman, 1972: 7; Pesce & Maggi, 1983, 58; G. Karaman & Ruffo, 1986, 527;

Supraniphargus longicaudatus versluysi, S. Karaman 1956: 5, Fig. 7;

Niphargus longicaudatus versluyi (sic!), Barnard & Barnard, 1983: 693;

Niphargus (*Supraniphargus*) *longicaudatus versluysi*, S. Karaman 1960: 83.

Material examined

Greece

IV/30-34 = Spring Skophos on Zakynthos island (= Zante) (slides, holotype, paratype);

S-6370 = (G-183) Zakynthos Island (= Zante), along the seashore, S. of Zakinthos (inside of Monastery), 8.4.1979, 5 exp. of 7 mm (leg. G. Pesce and D. Maggi);

S-6376 = (G-182) Zakynthos Island (= Zante), along the seashore S. of town Zakinthos, 10 m from the seacoast; 8.4.1979, 1 exp. (leg. G. Pesce and D. Maggi);

GE-5 = Arillas-Perdika, Epirus, spring, 7 small exp., 28.2.1976 (leg. G. Pesce and Bianco);

G-14 = Along road Arillas-Perdika (Epirus), 28.2.1976, 12 exp. (leg. G. Pesce and Bianco).

Diagnosis

Metasomal segments are with scarce number of dorsoposterior marginal setae; coxae short, coxa 4 without posterior lobe. Epimeral plates 1-3 more or less subrounded. Gnathopods 1-2 relatively small, with propodus not exceeding size of corresponding coxa, trapezoid; L-spines are sitting laterally of S-spine, dactylus with row of single median marginal setae along outer margin. Maxilla 1 inner plate with 2-3 setae, outer plate with 7 spines bearing mainly one lateral tooth. Maxilliped inner plate short, with 2-3 distal spines. Dactylus of pereopods 3-7 strong, with one spine at inner margin near basis of the nail. Article 2 of pereopods 5-7 unlobed. Pleopods 1-3 with 2 retinacula, peduncle of pleopod 3 with several additional lateral setae. Uropod 1 in males elongated, with inner ramus up to more than twice longer than outer one, both rami provided with lateral bunches of simple setae. Uropod 3 in males with elongated outer ramus bearing second article up to almost as long as first one, inner ramus and peduncle rather elongated; in females uropod 3 shorter. Telson deeply incised, bearing distal, lateral and facial short spines. Sexual dimorphic characters well developed (uropod 1, uropod 3, coxae).

Description

Based on specimens of Arillas-Perdika.

Male 12.0 mm. Body slender, metasomal segments 1-3 with 3-4 dorsoposterior marginal setae each (Fig. 3F); urosomal segment 1 on each dorsolateral margin with one seta; urosomal segment 2 on each dorsolateral margin with one seta; urosomal segment 3 naked. Urosomal segment 1 on each ventroposterior corner with one spine near basis of uropod 1 peduncle (Fig. 5E).

Epimeral plates 1-3 with subrounded ventroposterior corner marked by corner spine-like seta; posterior margin of epimeral plates 1-3 convex, bearing several short setae (Fig. 3F). Epimeral plate 1 with slightly concave ventral margin;

epimeral plates 2 and 3 with convex ventral margin, plate 2 with 2 subventral spines, plate 3 with 3 subventral spines (Fig. 3F).

Head with short rostrum and short subrounded lateral cephalic lobes and ventral excavation, eyes absent (Fig. 5A).

Antenna 1 reaching almost half of body, peduncular articles 1-3 moderately slender, progressively shorter towards article 3 (ratio: 53:40:21), scarcely setose (Fig. 1A); main flagellum consisting of 20 articles scarcely setose (most of articles with one short aesthetasc). Accessory flagellum 2-articulate, nearly reaching half of peduncular article 3 (Fig. 1A).

Antenna 2 moderately slender; peduncular article 3 at ventrodistal corner with bunch of setae (the longest setae exceeding diameter of article itself). Peduncular article 4 is rather longer than article 5 (ratio: 68:60); article 4 at ventral margin with 3 bunches of long setae, along dorsal margin with 4-5 bunches of short setae. Article 5 along ventral margin with several bunches of long setae (Fig. 1B), along dorsal margin with 4 bunches of short setae (the longest setae are shorter or nearly as long as diameter of article itself); flagellum moderately slender, longer than last peduncular article and consisting of 9 articles (the length of flagellar setae decreasing towards the tip of flagellum). Antennal gland cone short (Fig. 1B).

Mouthparts well developed. Labrum broader than long, slightly convex distally (Fig. 4A).

Labium with entire outer lobes, inner lobes small but well developed (Fig. 4B).

Mandible with triturative molar. Left mandible with 7 rakers, incisor with 4 teeth, lacinia mobilis bifurcate, with several teeth. Right mandible with 7 rakers, incisor with 5 teeth, lacinia mobilis with 4 teeth. Mandibular palpus article 1 naked; article 2 with 14 setae (Fig. 1C); articles 2 and 3 with nearly equal length. Article 3 subfalciform, provided with nearly 21 marginal D-setae and 5 distal E-setae, on outer face is attached one bunch of 5-6 A-setae (Fig. 1D), on inner face appear 4 groups of B-setae (2-2-1-1) (Fig. 1C).

Maxilla 1: inner plate with 3 setae; outer plate with 7 spines (6 spines with one lateral tooth, one spine with 3 lateral teeth) (Fig. 1E), or: 4 spines with one lateral tooth, one spines with 2 teeth, 2 spines with 3 lateral teeth) (fig. 1F); palpus 2-articulated, not reaching distal tip of outer plate spines and provided with 5-6 setae (Fig. 1E).

Maxilla 2 with well developed both plates bearing marginal setae only (Fig. 3A).

Maxilliped: inner plate short, not exceeding distal inner tip of palpus article 1 and provided with 3 pointed spines and several setae (Fig. 1G); outer plate not exceeding half of palpus article 2 and bearing 12 mesial pointed spines and several setae; palpus article 3 at outer margin with one median and one distal bunch of setae; palpus article 4 at inner margin with 2 setae near basis of the nail.

Coxae 1-4 relatively short. Coxa 1 slightly broader than long (ratio: 55:43) with nearly 7 marginal setae (Fig. 2A). Coxa 2 is broader than long (ratio: 64:55), with nearly 10 unequal marginal setae (Fig. 2D). Coxa 3 is poorly broader than long (ratio: 68: 57), at margin with nearly 10 unequal setae (Fig. 3B). Coxa 4 is remarkably broader than long (ratio: 70:57), with nearly 9 marginal setae, posterior lobe is not developed (Fig. 3D).

Coxae 5-7 are short. Coxa 5 bilobed, broader than long (ratio: 73:42), with anterior lobe almost as long as coxa 4 (Fig. 4C), segment above coxa (pereon) with one ventroposterior seta (Fig. 4C). Coxa 6 slightly smaller than coxa 5, bilobed, broader than long (ratio: 63:34), segment above coxa (pereon) with 2 ventroposterior marginal setae (Fig. 4E). Coxa 7 entire, broader than long (ratio: 57:25), segment above coxa (pereon) with 4 setae at ventroposterior margin (Fig. 4G).

Gnathopods 1 and 2 relatively small, with propodus nearly as large as corresponding coxa (Fig. 2B, D). Gnathopod 1: article 2 along anterior and posterior margin with numerous long setae; article 3 at posterior margin with one bunch of setae; article 5 shorter than propodus (ratio: 40:55), along anterior margin with distal bunch of setae (Fig. 2A). Propodus is trapezoid, slightly longer than broad (ratio: 84:69), along posterior margin with 7 transverse rows of setae (Fig. 2B); palm slightly convex, inclined nearly half of propodus-length, defined on outer face by one corner S-spine accompanied laterally by 3 serrate L-spines and 5 facial M-setae (Fig. 2C), on inner face by one subcorner R-spine (Fig. 2C). Dactylus reaching posterior margin of propodus, along outer margin with 6 single median setae, along inner (mesial) margin with several short setae (Fig. 2B).

Gnathopod 2 is only slightly larger than gnathopod 1: article 2 along anterior and posterior margin with long setae; article 3 at posterior margin with one bunch of setae; article 5 slightly shorter than propodus (ratio: 48:57), at anterior margin with one distal bunch of setae (Fig. 2D). Propodus trapezoid, slightly longer than broad (ratio: 84:78), along posterior margin with 9 transverse rows of setae (Fig. 2E); palm inclined nearly half of propodus-length, defined on outer face by one corner S-spine accompanied laterally by 3 slender serrate L-spines and 4 facial M-setae (Fig. 2F), on inner face by one subcorner R-spine (Fig. 2F). Dactylus reaching posterior margin of propodus, along outer margin with 6 median single setae, along inner (mesial) margin with several short setae only (Fig. 2E).

Pereopods 3-4 moderately slender. Pereopod 3: articles 4-6 of unequal length (ratio: 58:42:47); article 2 along anterior margin with 5 long proximal and 6-7 short mediodistal setae (Fig. 3B), along posterior margin with numerous long setae. Article 4 along posterior margin with 4 bunches of setae (the longest setae exceeding the diameter of article itself); article 5 along posterior margin are with 3 bunches of long setae (Fig. 3B); posterior margin of article 5 is provided with 5 groups of short spines and single short setae. Dacty-

lus is moderately strong, much shorter than article 6 (ratio: 19:47), at inner margin with slender spine near basis of the nail, at outer margin with one median plumose seta (Fig. 3C); nail is shorter than pedestal (ratio: 20:27).

Pereopod 4: articles 4-6 of unequal length (ratio: 50:37:43); pilosity of articles 2-6 rather similar to that of pereopod 3 (Fig. 3D); article 5 along posterior margin with 3 groups of short spines and single setae. Dactylus is much shorter than article 6 (ratio: 16:43), at inner margin with one spine near basis of the nail, at outer margin with one median seta; nail shorter than pedestal (ratio: 22:28) (Fig. 3E).

Pereopods 5-7 are moderately stout. Pereopod 5 is rather shorter than pereopods 6 and 7 (Fig. 4C, E, G). Article 2 dilated, longer than broad (ratio: 70:49), along anterior margin with row of 4 longer medial spine-like setae, along posterior poorly convex margin with nearly 12 short setae (Fig. 4C), ventroposterior lobe missing, ventroanterior corner is not elongated. Articles 4-6 of unequal length (ratio: 40:45:43), articles 4 and 5 with short spines and single setae; article 6 along anterior margin with 3 bunches of short spines; article 6 is shorter than article 2 (ratio: 70:43). Dactylus is much shorter than article 6 (ratio: 15:43), moderately strong, at inner margin with one spine near basis of the nail, along outer margin with one median plumose seta (Fig. 4D); nail is poorly shorter than pedestal (ratio: 24:26).

Pereopod 6: article 2 dilated, longer than broad (ratio: 83:52), along anterior margin with row of single or paired longer spine-like setae, along posterior almost straight margin with nearly 12 short setae, ventroposterior lobe absent (Fig. 4E). Articles 4-6 of unequal length (ratio: 50:62:63), along margins with short spines and short setae not exceeding the diameter of articles themselves. Article 2 is longer than article 6 (ratio: 83:63). Dactylus is much shorter than article 6 (ratio: 17:63), along inner margin with one spine near basis of the nail, along outer margin with one median plumose seta (Fig. 4F); nail is shorter than pedestal (ratio: 30:43).

Pereopod 7: article 2 is dilated, longer than broad (ratio: 87:55), poorly tapering ventrally, along anterior margin with row of several spine-like setae, along posterior margin with nearly 11 short setae, ventroposterior lobe absent (Fig. 4G). Articles 4-6 of unequal length (ratio: 50:70:80), along both margins with bunches of short spines and short setae. Article 2 is slightly longer than article 6 (ratio: 87:80). Dactylus is much shorter than article 6 (ratio: 25:80), along inner margin with one spine near basis of the nail, along outer margin with one median plumose seta (Fig. 4H); nail is shorter than pedestal (ratio: 30:52).

Pleopods 1-3 with 2 retinacula each. Peduncle of pleopod 1 at distoanterior margin with 2 setae (Fig. 5B); peduncle of pleopod 2 with 2 distoanterior short setae (Fig. 5C); peduncle of pleopod 3 along posterior margin with 3 short setae, and along lateral margin with 2 long setae (Fig. 5D).

Uropod 1 is elongated: peduncle with dorsointernal row of short slender spine-like setae and dorsoexternal row of strong spines (Fig. 5E). Inner ramus is much longer than peduncle, along inner (mesial) margin with 7 bunches of long simple setae accompanied by 0-1 spine, along outer margin with 3-4 short single spines; at tip of the ramus appear 4 short spines (Fig. 5E). Outer ramus hardly more than twice as short as inner ramus, bearing along outer margin 3 lateral groups of long simple setae and 0-1 short spine, along inner (mesial) margin 2 groups of short spines; at the tip of the ramus appear 5 short spines (Fig. 5E).

Uropod 2: peduncle with several lateral and distal spines; inner ramus is provided with 3 lateral spines and distal 5 unequal short spines; outer ramus is distinctly shorter than inner ramus and provided with 2 lateral and 5 distal short unequal spines (Fig. 5F).

Uropod 3 is very long; peduncle is longer than broad (ratio: 58:30), bearing several very short lateral setae and single distal short spines (Fig. 5G). Inner ramus is remarkably elongated, hardly longer than peduncle, much longer than broad (ratio: 62:14), bearing several short lateral spines and setae and 4 distal simple setae (Fig. 5G). Outer ramus is 2-articulated, narrowed, long; first article along outer margin with 6 groups of short simple setae, along inner (mesial) margin with 6-7 groups of short spines mixed with single long plumose setae; second article only poorly shorter than first article (ratio: 80:85), along both margins and tip with bunches of short simple setae (Fig. 5G).

Telson is relatively short, slightly longer than broad (ratio: 82:74), slightly tapering distally and deeply incised (Fig. 5H); each lobe is provided with 2-3 distal and 1-2 outer marginal short spines. Along inner (mesial) margin of each lobe appear 1-2 spines, 2 single spines appear on dorsal face and a pair of unequal short plumose setae appear near the middle of outer margin (Fig. 5H).

Coxal gills on gnathopod 2 are short, ovoid (Fig. 2D); gills on pereopods 3 and 4 are longer and hardly exceeding ventral margin of corresponding basipodit (Fig. 3B, D). Coxal gills on pereopods 5 and 6 are shorter than basipodit of corresponding pereopod (Fig. 4C, E).

Female 7.2 mm with setose oostegites and 6 eggs in marsupium.

Metasomal segments like these in male, with 4 dorsoposterior short marginal setae each (Fig. 7C). Urosomal segment 1 on each dorsolateral side with one seta; urosomal segment 2 on each dorsolateral side with one spine and one seta; urosomal segment 3 naked. Urosomal segment 1 on each ventroposterior corner with one slender spine near basis of uropod 1 peduncle (Fig. 6E).

Epimeral plates 1 and 2 subrounded, with remarkably convex posterior margin bearing several short setae and defined by corner spine-like seta; ventral margin of epimeral plate 1 slightly concave ventrally (Fig. 7C). Epimeral plate 3 obtusely angular, with slightly convex posterior margin bearing 6-8 marginal setae; ventroposterior corner is marked

with spine-like seta, ventral margin is convex; epimeral plates 2 and 3 are with 3 subventral spines each.

Head like that in male. Antenna 1 like that in male, reaching nearly half of the body-length; peduncular articles 1-3 are moderately slender, scarcely setose, progressively shorter towards article 3; main flagellum is consisting of 19-20 articles (most of them with one short aesthetasc); accessory flagellum 2-articulated, like that in male.

Antenna 2 like that in male regarding shape and pilosity of all articles; flagellum is consisting of 9 articles; antennal gland cone is short.

Mouthparts mainly like these in male (labrum, labium, maxilla 2). Mandibular palpus article 1 is naked, palpus article 2 with 10 setae; palpus article 3 subfalciform, bearing nearly 21 D-setae and 5 E-setae; on outer face appear one group of 3-4 A-setae, on inner face are attached 3 single B-setae (1-1-1).

Maxilla 1: inner plate is provided with 2 setae, outer plate with 7 spines (6 spines with one lateral tooth, one spine with 3-4 very small lateral teeth); palpus article 2 with 5 distal setae.

Maxilliped: inner plate short, reaching inner tip of first palpus article and bearing 2 distal pointed spines accompanied by several setae; palpus article 2 along inner (mesial) margin with 9 pointed smooth spines and several setae. Palpus article 3 is provided with 2 groups of setae along outer margin; article 4 at inner margin with 2 setae near basis of the nail.

Coxae are relatively short, but rather longer than these in male. Coxa 1 is rather broader than long (ratio: 45:37), with subrounded ventroanterior corner and bearing nearly 7 short marginal setae (Fig. 6A). Coxa 2 is rather longer than broad (ratio: 52:48), provided with nearly 10 unequal marginal setae (Fig. 6C). Coxa 3 is remarkably longer than broad (ratio: 60:54), along margins with nearly 11 unequal setae (Fig. 7A). Coxa 4 is scarcely longer than broad (ratio: 56:54), or almost as long as broad, bearing nearly 10 unequal marginal setae, ventroposterior lobe absent (Fig. 7B).

Coxae 5-7 are short. Coxa 5 bilobed, broader than long (ratio: 64:45), with anterior lobe nearly as long as coxa 4 (Fig. 8A); segment above coxa (pereon) with one ventroposterior marginal seta (Fig. 8A).

Coxa 6 is smaller than coxa 5, bilobed, broader than long (ratio: 50:33) (Fig. 8B), segment above coxa (pereon) with one ventroposterior marginal seta (Fig. 8B). Coxa 7 shallow, entire, much broader than long (ratio: 48:24); segment above coxa (pereon) with 4 ventroposterior marginal setae (Fig. 8C).

Gnathopods 1 and 2 relatively small, with propodus up to as large as corresponding coxa. Gnathopod 1: article 2 with numerous long setae along anterior and posterior margin (Fig. 6A); article 3 at posterior margin with one bunch of setae; article 5 rather shorter than propodus (ratio: 30:40) (Fig. 6A), at distoanterior corner with one bunch of setae. Propodus trapezoid, longer than broad (ratio: 84:71), along posterior margin with 5 transverse rows of setae (Fig. 6B). Palm poorly convex, inclined nearly to half of propodus-length, defined on outer face by one corner S-spine accompanied laterally by 3 L-spines and 3 facial M-setae (Fig. 6B), on inner face by one subcorner R-spine. Dactylus reaching posterior margin of propodus, with row of 5 single median setae along outer margin and several short setae along inner (mesial) margin (Fig. 6B).

Gnathopod 2 is hardly larger than gnathopod 1 (Fig. 6A, C); article 2 along both margins with long setae; article 3 at distoposterior margin with one bunch of setae. Article 5 is shorter than propodus (ratio: 35:40), at distoanterior corner with one bunch of setae (Fig. 6C). Propodus trapezoid, longer than broad (ratio: 85:80), along posterior margin with 6 transverse rows of setae (Fig. 6D); palm slightly convex, inclined nearly half of propodus length, defined on outer face by one corner S-spine accompanied laterally by 3 slender L-spines and 4 facial M-setae (Fig. 6D), on inner face by one subcorner R-spine. Dactylus reaching posterior margin of propodus, along outer margin with 5 median single seta, along inner (mesial) margin with several short setae (Fig. 6D).

Pereopods 3 and 4 moderately stout. Pereopod 3: article 2 at anteroproximal margin with 2-3 long setae, at anterodistal margin appear row of short setae (Fig. 7A); posterior margin is provided with row of long setae, setae are longer in proximal part, and shorter in distal part of article. Article 3 is at distoposterior corner with one bunch of setae. Articles 4-6 of unequal length (ratio: 44:24:36); articles 4 and 5 along both margins with setae not exceeding diameter of articles themselves; article 6 along posterior margin with 4 groups of short spines and single short setae; dactylus much shorter than article 6 (ratio: 15:36), at inner margin with one spine near basis of the nail, along outer margin with one median plumose seta; nail is shorter than pedestal.

Pereopod 4 is similar to pereopod 3 in shape and pilosity.

Pereopod 5 is remarkably shorter than pereopods 6 and 7; article 2 dilated, longer than broad (ratio: 60:40), along anterior margin with row of longer spine-like setae, along posterior almost straight margin with nearly 9 short setae, ventroposterior lobe not developed (Fig. 8A). Articles 4-6 of unequal length (ratio: 32:38:40), articles 5 and 6 along both margins with bunches of short spines. Article 2 is longer than article 6 (ratio: 60:40). Dactylus is strong, much shorter than article 6 (ratio: 17:40), along inner margin with one spine near basis of the nail, along outer margin with one median plumose seta, nail is shorter than pedestal.

Pereopod 6: article 2 is longer than broad (ratio: 75:47), along anterior margin with row of longer spine-like setae, along posterior poorly convex margin with nearly 11 short setae, ventroposterior lobe absent (Fig. 8B). Articles 4-6 of unequal length (ratio: 40:56:61), article 4 along anterior margin with setae not exceeding the diameter of article itself;

articles 5 and 6 along both margins with bunches of short spines. Article 2 is longer than article 6 (ratio: 75:61). Dactylus is much shorter than pedestal (ratio: 26:61), at inner margin with spine near the basis of the nail, at outer margin with one median plumose seta (Fig. 8B).

Pereopod 7: article 2 is longer than broad (ratio: 78:50), along anterior margin with row of longer spine-like setae, along posterior margin with nearly 12 short setae, ventroposterior lobe absent. Articles 4-6 of unequal length (ratio: 40:55:69); articles along both margins with bunches of short spines mixed sometimes with single short seta (Fig. 8C). Article 2 is longer than article 6 (ratio: 78:69). Dactylus strong, much shorter than article 6 (ratio: 28:69), at inner margin with one spine near basis of the nail, along outer margin with one median plumose seta; nail is shorter than pedestal (ratio: 30:57) (Fig. 8D).

Pleopods 1-3 with 2 retinacula each. Peduncle of pleopod 1 with 3 unequal setae at distoanterior margin and with 2 lateral short setae (Fig. 8E). Peduncle of pleopod 2 with distoanterior seta (Fig. 8F). Peduncle of pleopod 3 with 3 unequal lateral setae and one posterior marginal seta (Fig. 8G).

Uropod 1: peduncle longer than rami, with dorsointernal row of 2 median setae and one subdistal spine-like seta, and with dorsoexternal row of spines (Fig. 6E). Inner ramus is with 2 small lateral and 5 distal short spines, as well as with one bunch of distolateral simple setae (Fig. 6E); outer ramus is shorter than inner ramus, provided with 3 lateral and 4 distal short spines as well as one lateral bunch of long simple setae.

Uropod 2: peduncle is provided with 1-2 lateral and 2-3 distal short spines (Fig. 6F); outer ramus is poorly shorter than inner ramus or almost subequal, bearing 2 lateral spines and 5 distal unequal short spines.

Uropod 3 is not elongated, with peduncle longer than broad (ratio: 40:25) bearing several distal short spines (Fig. 7D). Inner ramus is short, scale-like, remarkably shorter than peduncle and provided with distal spine and 1-2 simple setae. Outer ramus is 2-articulated: first article slightly dilated, along outer margin with 4 bunches of short spines mixed with simple setae, along inner margin are attaches 3 median groups of spines accompanied by single long plumose setae (Fig. 7D); distal article is much shorter than first one (ratio: 38:115), bearing nearly 9 lateral and distal simple setae.

Telson is relatively short, deeply incised, slightly broader than long (ratio: 75:68), each lobe is provided with 3-4 distal short spines, 0-1 spines along outer margin and 0-1 spine at inner (mesial) margin; 1-2 spines are attached on the dorsal face of each lobe; a pair of short unequal plumose setae are attached at external medial margin of each lobe (Fig. 7E).

Coxal gills 1-6 are relatively small, ovoid, not reaching ventral tip of corresponding article 2 of legs (Figs 6C, 7A, 8A, B).

Oostegites are very broad, appear on gnathopod 2 and pereopods 3-5, bearing numerous setae along margin (Figs 6C, 8A).

Variability

The figured male of 12.0 mm was a "senile" specimen [in the final stage] with all characteristics of this stage: subrounded epimeral plate 3, very long inner ramus of uropod 1 and distal ariicle of uropod 3 outer ramus, long setose inner ramus of uropod 1.

Other adult males (not "senile") have obtusely angular epimeral plate 3, shorter peduncle and inner ramus of uropod 3; distal article of outer ramus reaching 70-95 percent of first article; inner ramus of uropod 1 is provided with less number of lateral simple setae.

Gnathopods 1 and 2 are similar in males and females, as well as pereopods 3-7. Urosomites 1-2 in both sexes with similar number of spines and/or setae.

Male of 6.5 mm: is provided with obtusely angular epimeral plate 3, distal article of uropod 3 outer ramus exceeding only slightly half of first article, inner ramus of uropod 1 is only slightly longer than outer one, both rami of uropod 2 are of equal length.

Male of 7.8 mm: was similar to figured male, with epimeral plate 3 broadly obtusely subrounded, uropod 1 with outer ramus reaching only 45% of inner ramus, but with only scarce number of simple setae; uropod 3 and peduncle of pleopods 1-3 are similar to these of figured male.

The smallest adult female with eggs in marsupium was 6.2 mm long.

The specimens from Zakynthos (S-6370) have obtusely angular epimeral plate 3 and dactylus of all pereopods with one spine at inner margin near basis of the nail. Telson is provided with 3-4 distal and single lateral and/or facial spines, spines are relatively short.

The specimens from locus typicus: S. Karaman mentioned that he observed only one specimen with 2 spines on the dactylus of pereopod 6 or on pereopod 7; in all other specimens only one spine was observed. Other taxonomical characters agree with those from Arillas-Perdika.

S. Karaman mentioned again (1956) *N. versluysi* from a small torrent on a road from Delphi (= Delphes), toward Gravia (W. of Parnassos) nearly 600-700 m a.s.l., (one male 15 mm) having an inner plate of maxilla 1 provided with 2 setae, short antenna 1, body slender, inner ramus of uropod 1 much longer than outer one, uropod 3 outer ramus in males with subequal both articles; elongated inner ramus of uropod 3; small and quadrate propodus of gnathopods 1-2 with slightly inclined palm; lobes of telson rather gapping, with 3-4 distal short spines and facial and lateral marginal spines; dactylus of pereopods 3-7 with one spine at inner margin near basis of the nail.

Locus typicus: Spring Skophos on Zakynthos Island (Zanthe Island), Greece.

Localities cited: Zakynthos Island, spring Skophos, Greece, Ionian Sea (S. Karaman 1950; present paper); small torrent along road Delphi (Delphes) towards Gravia, on 600-700 m a.s.l., central Greece (S. Karaman 1956); springs along the road Arillas-Perdika, Epirus; springs near town Zakynthos town (present paper) (Fig. 9).

Distribution: Greece, endemic.

Remarks and affinities

Stanko Karaman (1950) described this species under the name *Niphargus longicaudatus versluysi* from Zante (= Zakynthos) Island. Later (1956) he cited this species from continental Greece (Delphi) under the name *Niphargus* (*Supraniphargus*) *longicaudatus versluysi* and added some morphological data, mentioning that all specimens in hand from this locality were without additional spines on dactylus of pereopods 3-7.

The specimens in hand from Arillas-Perdika and Zakynthos agree with the description of *N. versluysi* of Stanko Karaman (1950, 1956) despite the fact that all specimens in hand are with only one spine along inner margin of dactylus in pereopods 3-7. Epimeral plates 1-2 are subrounded; epimeral plate 3 in male of final stage ("old") is subrounded (Fig. 3F), in smaller specimens epimeral plate 3 can be obtusely angular, like that in females (Fig. 7C).

S. Karaman also mentioned and figured an obtusely angular epimeral plate 3 in males, and we observed that the smaller male specimens of Zantkynthos Island have an obtusely angular epimeral plate 3.

An elongated inner ramus of uropod 3 in males was also observed in specimens of some other *Niphargus* taxa (*Niphargus karamani* Schellenberg 1935 from Podčetrtek, Croatia; *Niphargus rotundus* G. Karaman 2016b from Montelupo, Italy, *N. longicaudatus* (Costa 1951) from Napoli, etc.).

Niphargus versluysi is very similar to *Niphargus longicaudatus* Costa 1851 (loc. typ.: Napoli), species widely distributed over southern Italy, Sicily and Sardinia (G. Karaman 1986), but differs from specimens of type-locality (Napoli) by differences in the pilosity of pleopod peduncles, shape of gnathopods, pilosity of uropods, urosomal segments in females, etc. Therefore, we consider specimens from Greece as a distinct species.

Although various very similar taxa are known from France, Spain, Balkan Peninsula, etc, it is evident that *Niphagus longicaudatus*-complex contains numerous morphologically very similar taxa. On the other hand, many populations of this complex are in various degrees still in the process of isolation and probably recognition of a single taxa of this complex remains open and vague, and requires a multilateral approach using morphological, genetic, and other investigations.

CONCLUSIONS

Niphargus versluysi S. Karaman, 1950, endemic for Greece, is very similar to *Niphargus longicaudatus* (Costa, 1851) from Italy, but differs from the later by distinct characters. The *Niphargus longicaudatus*-complex of taxa, mentioned throughout Europe, consists of morphologically very similar taxa and must be reexamined using a combination of morphological, genetic and other methods, in order to establish their taxonomical position within the genus *Niphargus*. We redescribed *N. versluysi* from the morphological point of view, trying to help further studies on this Complex.

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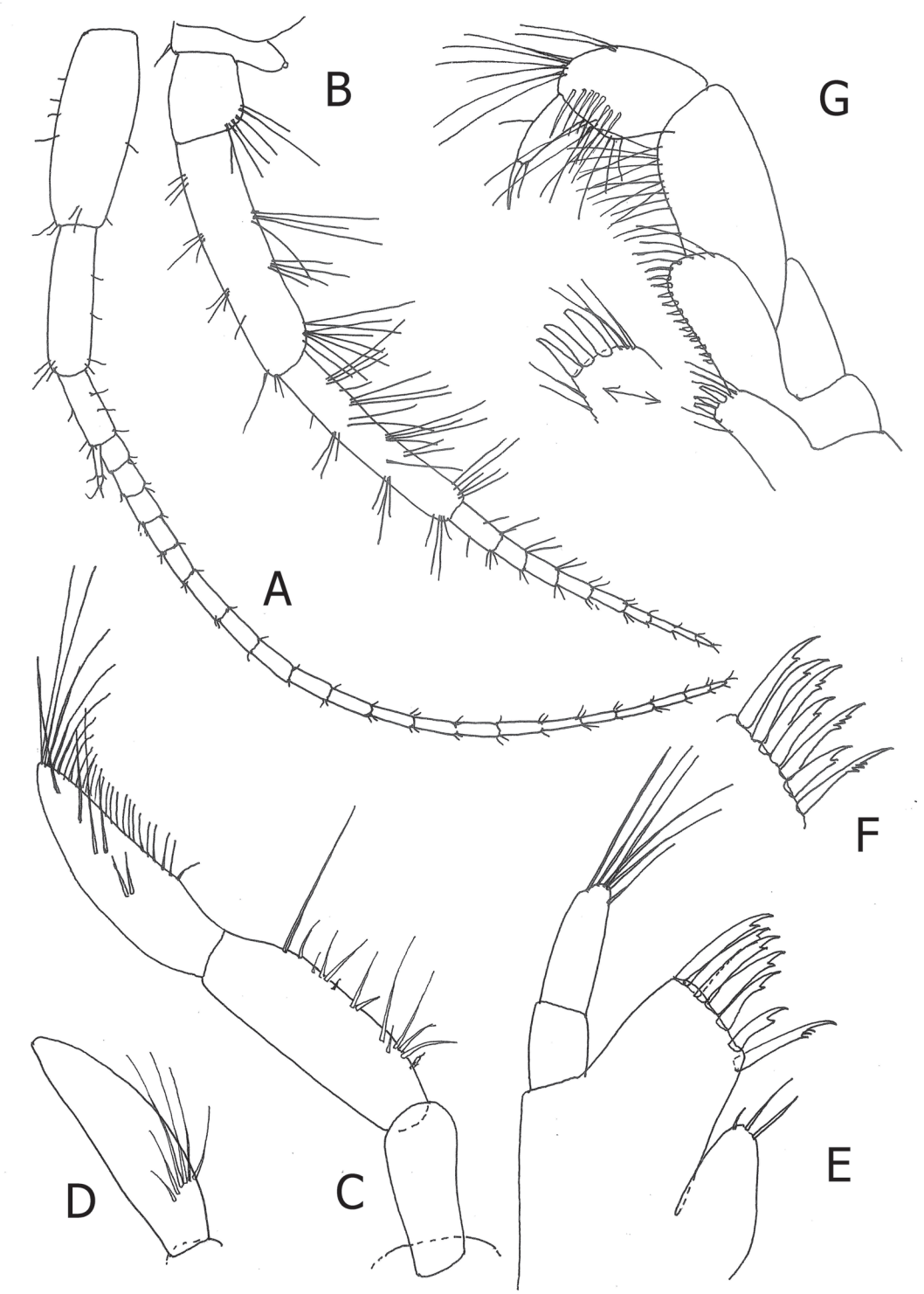

Fig. 1. *Niphargus versluysi* S. Karaman, 1950, Arillas-Perdika, Epirus [G-14], male 12.0 mm (holotype): **A** = antenna 1; **B** = antenna 2; **C** = mandibular palpus, inner face with facial B-setae; **D** = mandibular palpus article 3, outer face with facial A-setae; **E** = left maxilla 1; **F** = distal tip of right maxilla 1 outer plate; **G** = maxilliped.

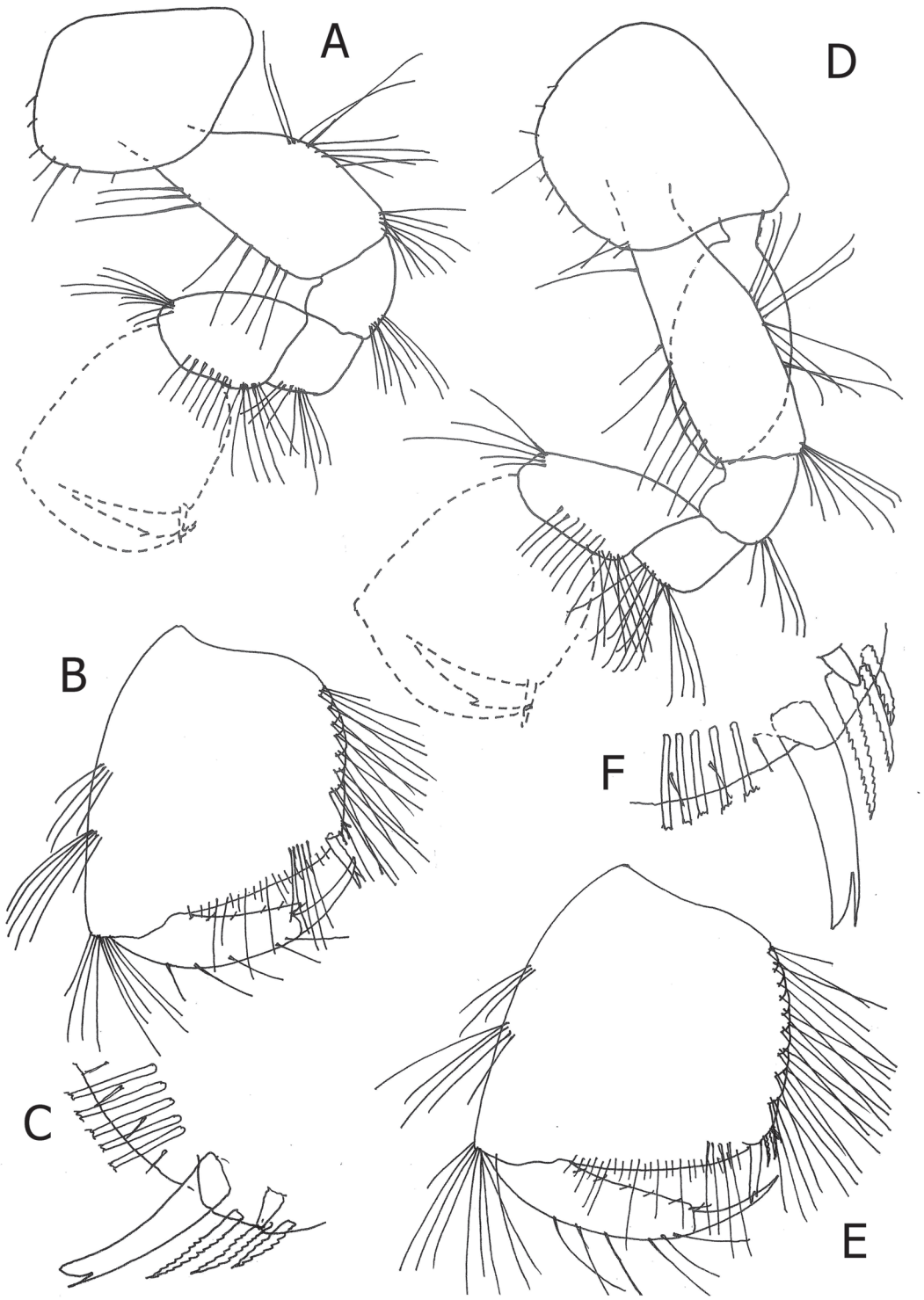

Fig. 2. *Niphargus versluysi* S. Karaman, 1950, Arillas-Perdika, Epirus [G-14], male 12.0 mm: **A-B** = gnathopod 1, outer face; **C** = distal corner of gnathopod 1 propodus, inner face with S, R and L-spines and facial M-setae; **D-E** = gnathopod 2, outer face; **F** = distal corner of gnathopod 2 propodus, inner face with S, R and L-spines and facial M-setae.

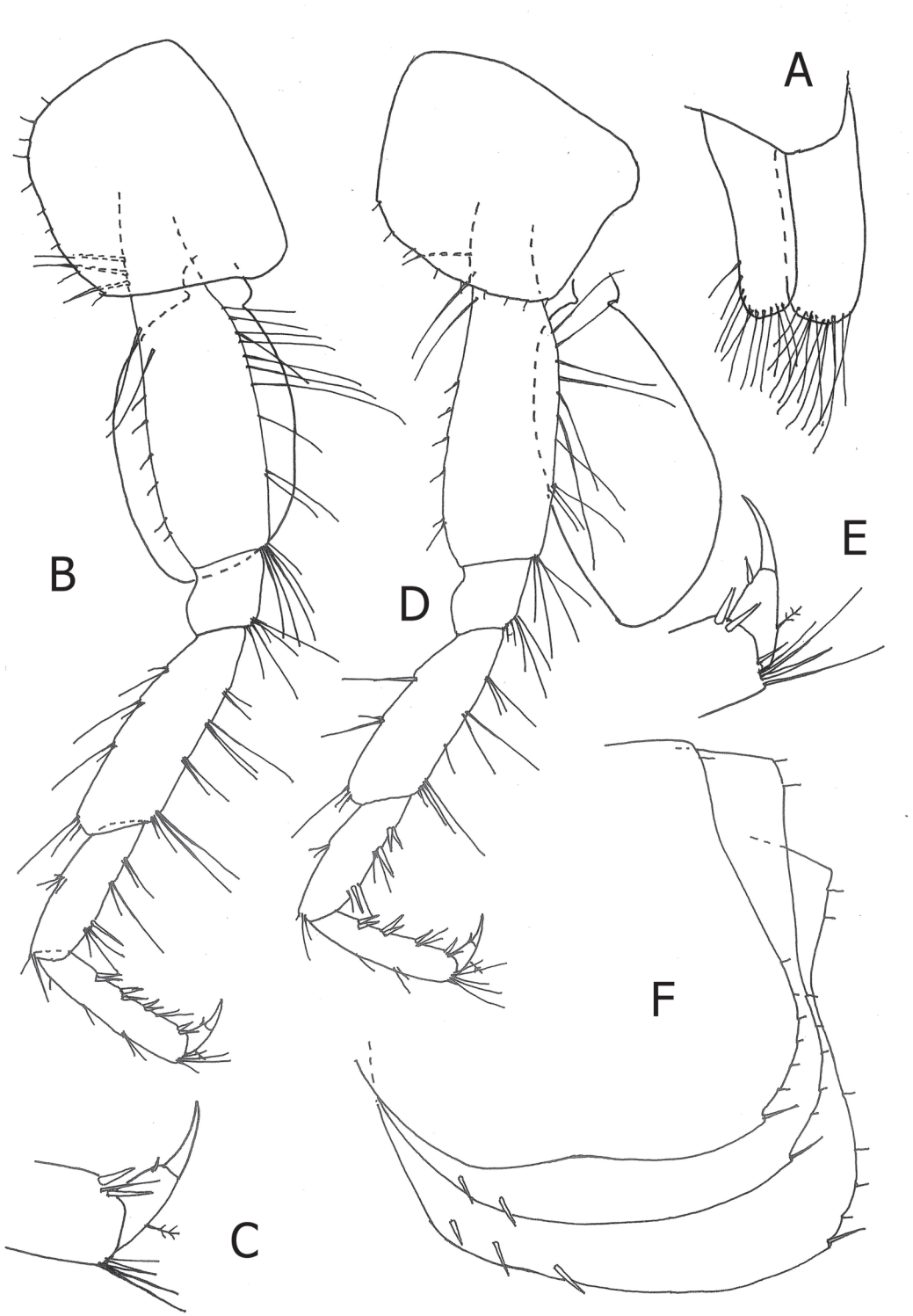

Fig. 3. *Niphargus versluysi* S. Karaman, 1950, Arillas-Perdika, Epirus [G-14], male 12.0 mm: **A** = maxilla 2; **B-C** = pereopod 3; **D-E** = pereopod 4; **F** = epimeral plates 1-3.

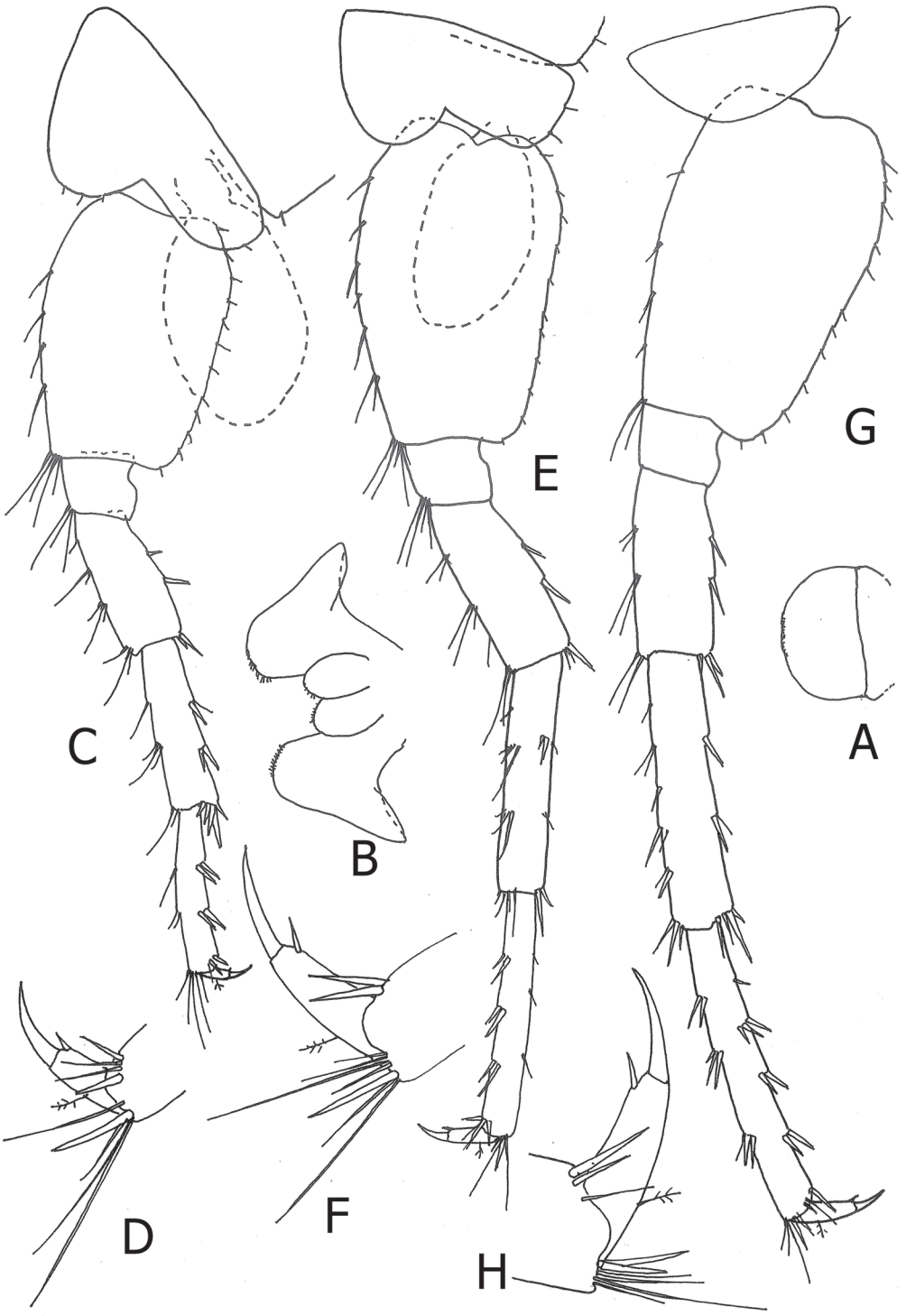

Fig. 4. *Niphargus versluysi* S. Karaman, 1950, Arillas- Perdika, Epirus [G-14], male 12.0 mm: **A** = labrum; **B** = labium; **C-D** = pereopod 5; **E-F** = pereopod 6; **G-H** = pereopod 7.

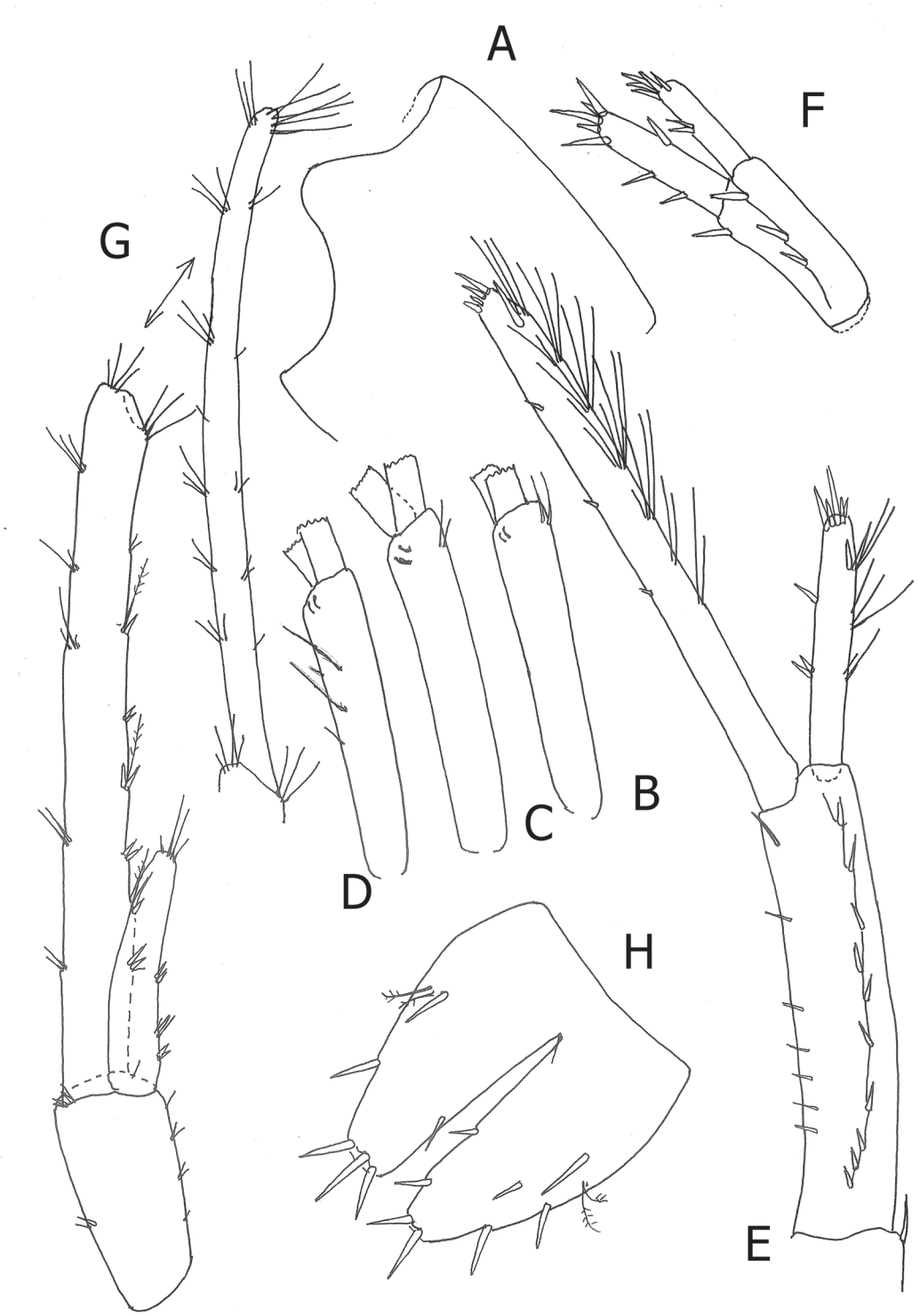

Fig. 5. *Niphargus versluysi* S. Karaman, 1950, Arillas-Perdika, Epirus [G-14], male 12.0 mm: **A** = head; **B** = peduncle of pleopod 1; **C** = peduncle of pleopod 2; **D** = peduncle of pleopod 3; **E** = uropod 1; **F** = uropod 2; **G** = uropod 3; **H** = telson.

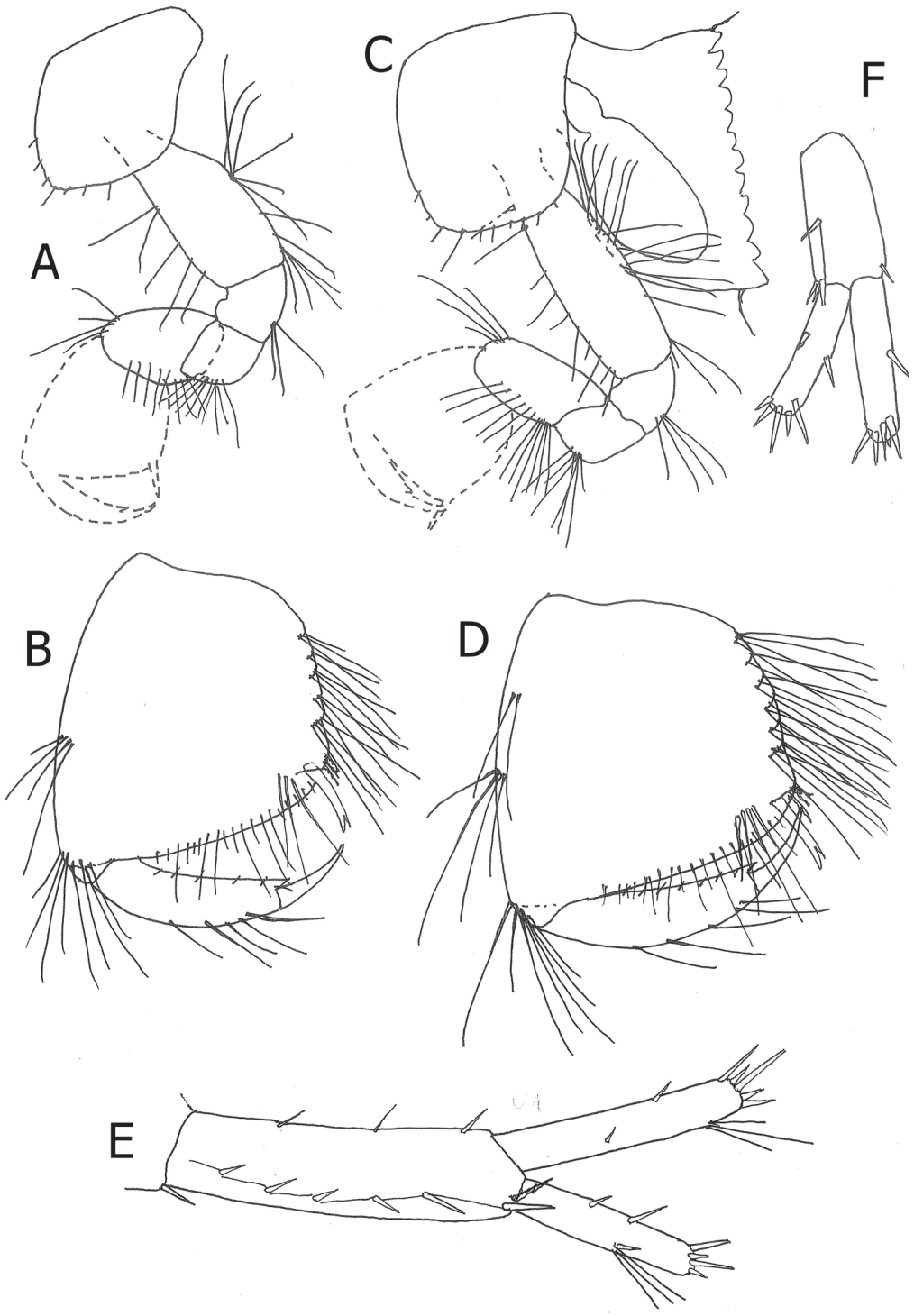

Fig. 6. *Niphargus versluysi* S. Karaman, 1950, Arillas-Perdika, Epirus [G-14], female 7.2 mm: **A-B** = gnathopod 1, outer face; **C-D** = gnathopod 2, outer face: **E** = uropod 1; **F** = uropod 2.

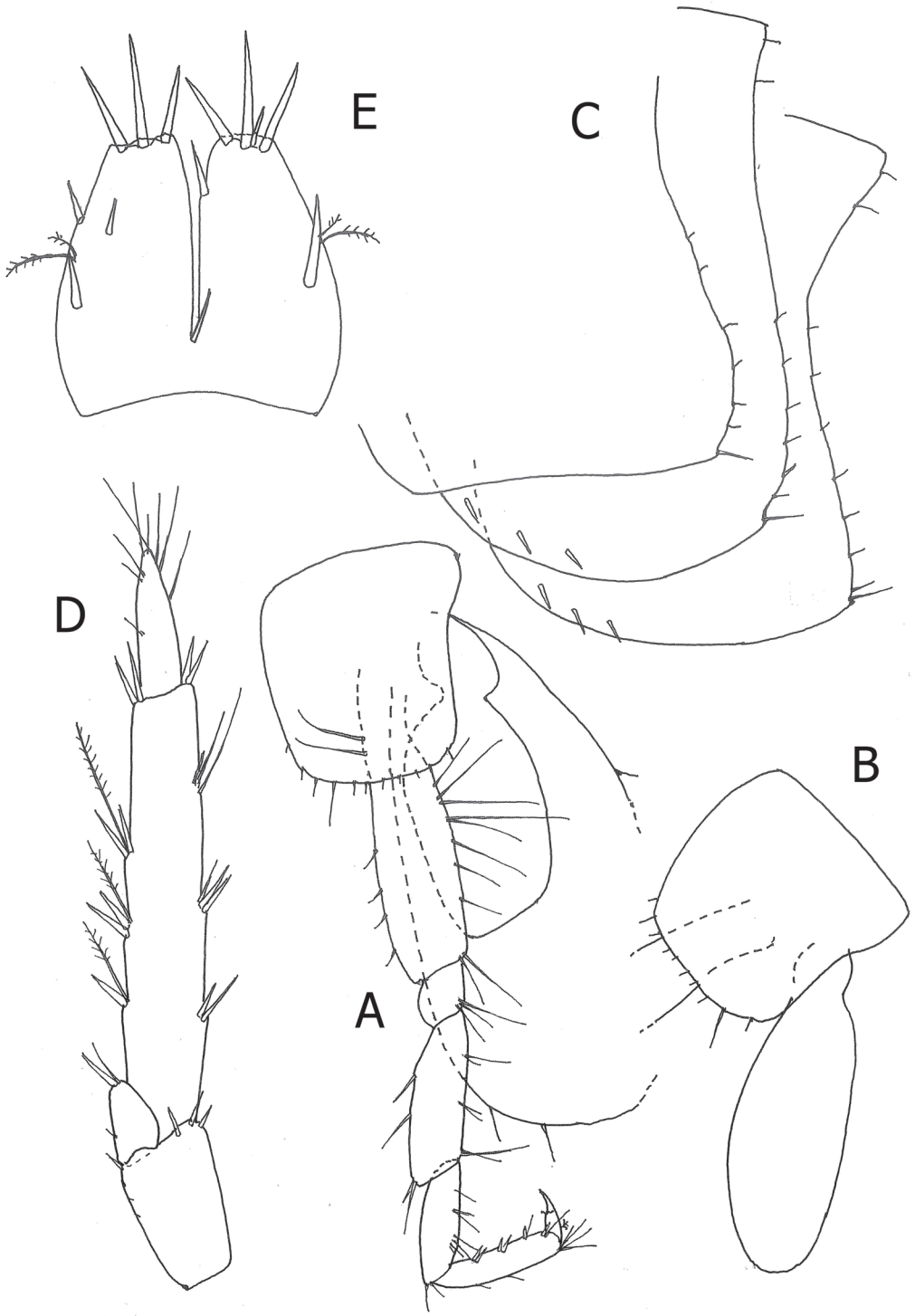

Fig. 7. *Niphargus versluysi* S. Karaman, 1950, Arillas-Perdika, Epirus [G-14], female 7.2 mm: **A**= pereopod 3; **B**= coxa 4 with coxal gill; **C**= epimeral plates 1-3; **D**= uropod 3; **E**= telson.

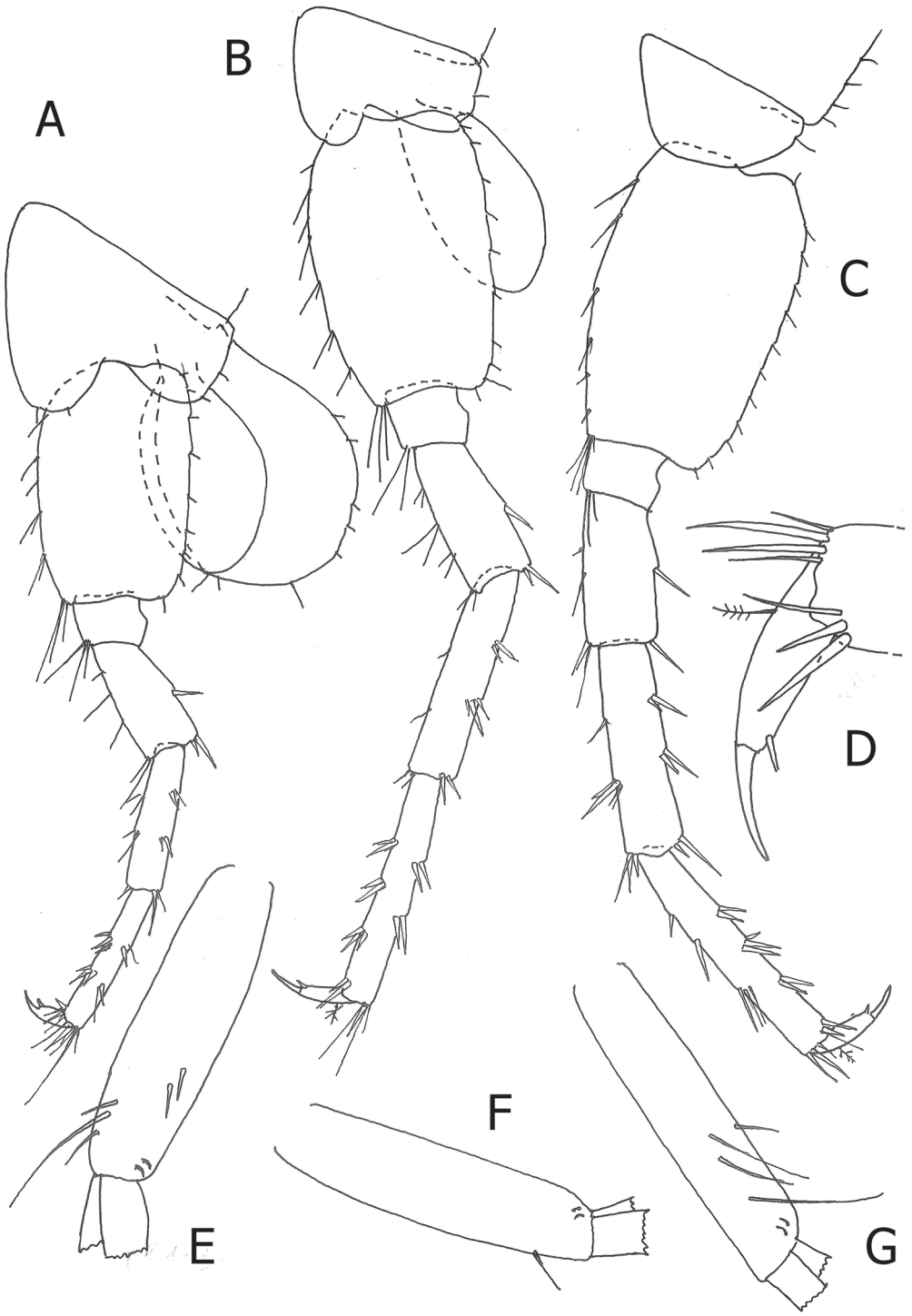

Fig. 8. *Niphargus versluysi* S. Karaman, 1950, Arillas-Perdika, Epirus [G-14], female 7.2 mm: **A** = pereopod 5; **B** = pereopod 6; **C-D** = pereopod 7; **E** = peduncle of pleopod 1; **F** = peduncle of pleopod 2; **G** = peduncle of pleopod 3.

Fig. 9. Distribution of *Niphargus versluysi* S. Karaman 1950 in Greece: 1 = Zakynthos; 2 = Delphi-Gravia; 3 = Arillas-Perdika (Epirus). (Original map of Greece: http://d-maps.com/m/europa/grece/grece09.pdf (modified)).

REFERENCES

Barnard JL, Barnard CM. 1983. Freshwater amphipods of the World. I. Evolutionary patterns. II. Handbook and bibliography. Mt. Vernon, Virginia: Hayfield Associates.

Costa A. (Chille). 1851. In: Catalogo dei Crostacei italiani e di molti altri del Mediterraneo per Fr. Gugl. Hope. Napoli, F. Azzolino, pp. 1-48.

Karaman G. 1969. XXVII. Beitrag zur Kenntnis der Amphipoden. Arten der Genera *Echinogammarus* Stebb. und *Chaetogammarus* Mart. an der jugoslawischer Adriaküste. Glasnik Republičkog zavoda za zaštitu prirode i Prirodnjačke zbirke u Titogradu. 2:59–84.

Karaman G. 1972. Le probleme du Genre *Niphargus* en Yougoslavie. Actes du Ier Colloque International sur le genre *Niphargus*. Verona, 15-19 Aprile 1969, Museo Civico di Storia Naturale, Verona, Memorie fuori serie. 5:1-10.

Karaman G. 1986. Redescription of subterranean Gammaridean Species *Niphargus longicaudatus* (Costa 1851) based on topotypic material (Contribution to the Knowledge of the Amphipoda 161). Fragmenta Balcanica, Musei Macedonici Scientiarum Naturalium, Skopje. 13(4/282):27-42.

Karaman G, Ruffo S. 1986. Amphipoda: *Niphargus*-Group (Niphargidae sensu Bousfield, 1982). In: Botosaneanu L, editor: Stygofauna Mundi, A Faunistic, Distributional, and Ecological Synthesis of the World Fauna inhabiting Subterranean Warers (including the Marine Interstitial). Leiden: E. J. Brill/ Dr. W. Backhuys, pp. 514-534.

Karaman G. 2012. Further investigations of the subterranean genus *Niphargus* Schiödte, 1849 (fam. Niphargidae) in Serbia. (Contribution to the Knowledge of the Amphipoda 264). Agriculture and Forestry, Podgorica. 58(2):45-64.

Karaman G. 2015. New data of genus *Niphargus* Schiödte, 1849 (Fam. Niphargidae) from Greece (Contribution to the knowledge of the Amphipoda 284). Agriculture and Forestry, Podgorica. 61(4):43-60.

Karaman G. 2016a. Two new genera of the family Niphargidae from Greece (Contribution to the Knowledge of the Amphipoda 287). Agriculture and Forestry, Podgorica. 62(1):7-27.

Karaman G. 2016b. On two new *Niphargus* species (Fam. Niphargidae) from Italy (Contribution to the Knowledge of the Amphipoda 288). Ecologica Montenegrina, Podgorica. 5:70-89.

Karaman S. 1934. Weitere Beiträge zur Kenntnis griechischer Süsswasser-Amphipoden. Zoologischer Anzeiger, Leipzig. 105(7/8):215-219.

Karaman S. 1950. Novi amfipodi podzemne faune Grcke. [Neue Amphipoden der unterirdischen Fauna Griechenlands] Rad, Jugoslavenska akademija znanosti i umjetnosti, 280 (Odjel za prirodne i medicinske nauke) Zagreb. 3:106-114, figs. 1-20 (pp. 43-50, figs. 1-20).

Karaman S. 1956. III. Beitrag zur Kenntnis griechischer Niphargiden. Folia Balcanica, Zavod za Ribarstvo na N. R. Makedonija, Skopje.1(1):1-8.

Karaman S. 1960. Weitere Beiträge zur Kenntnis der Jugoslavischen Niphargiden. Glasnik Prirodnjačkog Muzeja Beograd, Ser. B. 15:75-90.

Pesce GL, Maggi D, Ciocca A, Argano R. 1979. Biological research on the subterranean phreatic waters of northern Greece. Ier Symposium Intern. Zoogeograph. et ecologie Greece et regions avoisinantes, Athenes, Avril 1978. Biologia Gallo-Hellenica. 8:109-126 (1978).

Pesce GL, Maggi D. 1983. Ricerche faunistiche in acque sotterranee freatiche della Grecia Meridionale ed insulare e stato attuale delle conoscenze sulla stygofauna di Grecia. Natura, Milano. 74(1-2):15-73.

Schellenberg A. 1935. Schlüssel der Amphipodengattung *Niphargus* mit Fundortangaben und mehreren neuen Formen. - Zoologischer Anzeiger. 111(7-8):204-211.