

A new stygobiotic species of the genus *Proasellus* Dudich, 1925 (Crustacea: Isopoda: Asellidae) from the Black Sea coast of the Caucasus, Russia

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ABSTRACT. A new stygobiotic species of water louses of the genus *Proasellus* Dudich, 1925 (Crustacea: Isopoda), *P. mikhaili* sp.n., is described from springs and groundwaters in the vicinity of the town of Tuapse on the Black Sea coast of the northwestern Caucasus, Russia. Representatives of this genus are reported for the first time from this coastal area. This new species is characterized by a number of unique features that immediately distinguish it from all known other Caucasian species of the genus. At present, this is the only species described from the region that has three connecting hooks in the retinacula of male pleopods I, as well as a shortened exopodite of pleopod V, significantly shorter than the endopodite in length. Among the diagnostic characters of this species are also a poor ornamentation of pereopods I–VII and a specific chetotaxis of the pleotelson represented by a dense covering of thin, hair-like setae. Probably, this species is an endemic of the Tuapsinsky District.

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KEY WORDS: Crustacea, Asellidae, new species, stygobionts, crenobionts, local endemism, Transcaucasia.

Новый стигобионтный вид рода *Proasellus* Dudich, 1925 (Crustacea: Isopoda: Asellidae) с Черноморского побережья Кавказа, Россия

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РЕЗЮМЕ. Новый стигобионтный вид водяного ослика рода *Proasellus* Dudich, 1925 (Crustacea: Isopoda), *P. mikhaili* sp.n., описан из родников и грунтовых вод окрестностей города Туапсе на Черноморском побережье северо-западного Кавказа, Россия. Представители этого рода впервые указываются для данного участка побережья.

Морфология нового вида характеризуется рядом уникальных черт, сразу отличающих его ото всех других известных кавказских видов рода. На данный момент это единственный вид, описанный с территории региона, имеющий три соединительных крючка в ретинакуле плеоподов I самца, а также укороченный экзоподит плеопода V, значительно уступающий эндоподиту в длине. К характерным особенностям морфологического строения данного вида следует отнести также общую обедненность вооружения переопод I–VII и вооружение плеотельсона, представляющее собой густой покров из тонких волосных щетинок. Судя по всему, данный вид является эндемиком Туапсинского района.

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КЛЮЧЕВЫЕ СЛОВА: Crustacea, Asellidae, новый вид, стигобионты, кренобионты, локальный эндемизм, Закавказье, Черноморское побережье.

Introduction

Recently, there has been a significant increase in interest to the stygobiotic fauna of the Caucasus region, with special attention paid to the diversity of waterlouses of the genus *Proasellus* Dudich, 1925 (Palatov, Sokolova, 2019, 2021; Chertoprud *et al.*, 2021; Marin *et al.*, 2021; Marin, Palatov, 2021; Palatov *et al.*, 2023; Palatov, Marin, 2021; Marin, Sinelnikov, 2024). Until 2019, only four species of this genus were known from Caucasus. Since then, four additional species were discovered and described. Notably, all recently described species were found in the northern slope of the Greater Caucasus Range, even though records of the genus were made on the southern slope, but without attempts to describe new species (Sokolova, Palatov, 2015; Turbanov *et al.*, 2016; Marin, Sinelnikov, 2024). Meanwhile, there is evidence that the diversity of *Proasellus* is underestimated in Southern Caucasus (Turbanov *et al.*, 2016; Marin, Sinelnikov, 2024; Saclier *et al.*, 2024).

In this study, we describe a new species of stygobiotic waterlouses of the genus *Proasellus*, in the vicinity of Tuapse city, along the Black Sea coast of the Caucasus. Within the Russian Federation, *P. linearis* (Birštein, 1967) and *P. abini* Marin et Sinelnikov, 2024 are known from the far northwest of the Caucasus region (Gelendzhik District), and *P. ljevuschkini* (Birštein, 1967), *P. similis* (Birštein, 1967). The epigeal species *P. cf. infirmus* (Birštein, 1936) is known from the far southeast of the Caucasus region (Sochi Urban Okrug, Khostinsky

City District) (Birštein, 1936, 1967; Palatov, Sokolova, 2019; Marin, Sinelnikov, 2024). Additionally, *P. infirmus* (Birštein, 1936) was found in Abkhazia (in springs in the lower reaches of the Gumista River), and three species, *P. uallagirus* Palatov et Sokolova, 2021, *P. irystonicus* Palatov et Sokolova, 2021 and *P. precaspicus* Palatov, Dzhampirzoev et Sokolova, 2023, were described from the Eastern and Central parts of Northern Caucasus (Palatov, Sokolova, 2021; Palatov *et al.*, 2023). In subsequent studies, *P. irystonicus* was recognized as a junior synonym of *P. uallagirus* (Marin, Sinelnikov, 2024; Marin, Palatov, 2024).

Material and methods

A new species was discovered in two habitats located on the Black Sea coast in the vicinity of the town of Tuapse. The first habitat is a spring stream (rheokren) on Kadosh Cape, 3.5 km northwest of Tuapse (44°07'37.55"N 39°02'03.92"E), and the second is the Agoy River on the northeastern outskirts of the Agoy village (44°09'05.1"N 39°02'59.7"E). Specimens were collected with a hand net and immediately fixed in 90% ethanol. In the laboratory, photos were made with a digital camera Toupcam 9.0 MP attached to a light microscope Olympus CX21. Scanning Electron Microscope (SEM) images were made using Vega3 Tescan. Body length (bl., mm), *i.e.* dorsal length from the anterior margin of head to the posterior margin of pleotelson without uropods, was used as a standard measurement. Type material is deposited at the collection of Zoological Museum of Moscow State University, Moscow, Russia (ZMMU). Additional material is deposited to the personal collection of DP. New taxon was established based on the

morphological species concepts. The morphological description was compiled using the most widely used terminology by Veronik *et al.* (2009).

Results

Taxonomic account

Order Isopoda Latreille 1816
Suborder Asellota Latreille, 1802
Superfamily Aselloidea Latreille, 1802
Family Asellidae Latreille, 1802
Genus *Proasellus* Dudich, 1925

Proasellus mikhaili sp.n.
Figs 1A, 2–5.

MATERIAL EXAMINED. Holotype: 1 ♂ (bl. 5.0 mm), ZMMU Mc-1464, Russia, Krasnodar krai, Tuapsinsky District. Spring stream (rheokren) on Kadosh Cape, 3.5 km to NW of the Tuapse town, 44°07'37.55"N 39°02'03.92"E (Fig. 1C), 20 July 2020, coll. D.M. Palatov, E.M. Chertoprud.

Paratypes: 1 ♀ (bl. 4.5 mm), ZMMU Mc-1465; 2 ♀♀ (bl. 4.0–4.5 mm), ZMMU Mc-1466, same locality and data as holotype.

Other materials: 4 ♀♀, 2 ♂♂, Russia, Krasnodar krai, Tuapsinsky District. The hyporheic waters of the Agoy River on the northeastern outskirts of the Agoy village, 44°09'05.1"N 39°02'59.7"E, 13 April 2009, coll. D.M. Palatov.

ETYMOLOGY. The species is named in honor of the renowned Russian hydrobiologist Mikhail Vitalievich Chertoprud (30.01.1975–23.02.2023), who spent many years studying aquatic invertebrates in the Krasnodar Territory and repeatedly conducted hydrobiological training courses at Cape Kadosh near Tuapse.

DIAGNOSIS. Medium sized, depigmented species. Antenna I with six to seven flagellar articles, flagellum of antenna II with 42–55 articles. Inner plate of maxillula with five or six apical pappose setae. Propodus I elongate, oval, its inferior margin without a proximal apophysis, with two or three robust spiniform setae. Dactylus I with four or five short robust setae on inferior margin and four to six simple setae on superior margin. Dactyli of pereopods II–VII with two thin simple setae on inferior margins each. Retinacula on medial margin of pleopod I with three hooks. Endopodite of pleopod II in males with a distinct basal apophysis, elongated distal apophysis and with well-expressed goulot with small lips. Endopodite of pleopod II in females subtriangular, with six or seven short marginal simple setae and with a single long marginal seta. Lateral and terminal margins of pleopod III with 23–25 short simple setae, its endopodites about

1.9 times shorter than exopodites. Lateral margin of exopodite of pleopod IV without setae. Endopodite of pleopods IV suboval, about 1.2 times shorter than exopodite. Exopodite of pleopods V ovoid, short, 1.5 times as long as wide, lateral margins without setae. Endopodite elongated, 1.3 times as longer than exopodite. Uropods different in males and females, proto-, endo- and exopodite length relation is 1 : 1.1 : 1.2 in males and 1 : 0.9 : 1.0 in females.

DESCRIPTION. Stygobiotic, blind and depigmented.

Body about four times as long as wide (Fig. 1A), slim, elongated.

Head (Fig. 6A) with frontal margin bisinuate, medially concave, without a rostral process, lateral margins straight, each with small posterolateral protuberance, with several short stiff setae. Pigmented spots absent.

Pereonites (Fig. 6B) depigmented, anterolateral, lateral and posterolateral margins fringed with long and short spiniform setae. Coxopods well developed, margins of all epimerae dorsally visible.

Pleomere I–II small (Fig. 6G, H), their width constitutes only 30% of pereonite VII width, forming a stalk largely covered by posterior margin of pereonite VII. Pleotelson (Figs 5J; 6H) rounded or suboval, with length 1.2–1.3 times of its width, terminal edge bisinuate with an obtusely triangular median prominence. Lateral margins and dorsal surface densely pubescent with numerous and approximately identical thin simple setae (Fig. 6H). Terminal edge with a few short setae, subterminal margin with scarce short setae.

Antenna I (Fig. 2B, C) length 10% of body length, with three peduncular articles. First article robust, with straight superior (longer) and curved inferior (shorter) margin, other two articles cylindrical. First and second article about subequal in length, third article 1.5 times shorter than each of them. Longest setae on articles I and II with length 0.3 of articles length. Flagellum (Fig. 2C) of seven (in holotype) or from six to seven (in paratypes) articles, usually with four to seven articles bearing one aesthetasc. Proximal aesthetascs mainly longer than their parallel articles.

Antenna II (Fig. 2A) length 75–85% of body length, with six peduncular and 55 flagellar articles (in holotype) or 42–55 flagellar articles (in paratypes). Sixth peduncular article 1.5 times as long as fifth, both with long and short setae on superior margins. Flagellum length 70–75% of antenna II length.

Labrum (Fig. 2E) trapezoidal, with fine simple setae at rounded apex, epistome tapering, with fine setae along margin.

Labium (Fig. 2D) wide, subquadrate, divided almost to 2/3 of its length.

Mandible robust (Fig. 2H, I, J): *Pars molaris* (molar process) U-shaped, with a toothed margin and a wrinkled crushing surface. *Pars incisiva* (incisor) formed by four (right mandibular) or five (left



Fig. 1. Map of collection sites for *Proasellus mikhaili* sp.n. in the Black Sea coast of the Caucasus, general view and natural habitats of described species: A — habitus of *P. mikhaili* sp.n., paratype (♂); B — map of collection sites for *Proasellus* in the Black Sea coast of the Caucasus. Numbers refer to: 1 — *P. infirmus*; 2 — *P. linearis*; 3 — *P. ljovuschkini*; 4 — *P. similis*; 5 — *P. abini*; 6 — *P. mikhaili* sp.n.; C — photos of collection sites of *P. mikhaili* sp.n.: 6a — spring stream (rheokrene) on Kadosh Cape, 3.5 km to NW of Tuapse town, 44°07'37.55"N 39°02'03.92"E; 6b — the Agoy River on the NE outskirts of Agoy village, 44°09'05.1"N 39°02'59.7"E.

Рис. 1. Карта мест сбора *Proasellus mikhaili* sp.n. на Черноморском побережье Кавказа, общий вид и природные местообитания описываемого вида: А — общий вид *P. mikhaili* sp.n., паратип (♂); В — карта мест сборов *Proasellus* на Черноморском побережье Кавказа, цифрами обозначены места находок: 1 — *P. infirmus*; 2 — *P. linearis*; 3 — *P. ljovuschkini*; 4 — *P. similis*; 5 — *P. abini*; 6 — *P. mikhaili* sp.n.; С — места находок *P. mikhaili* sp.n.: 6a — родниковый ручей (реокрен) на мысу Кадош, 3.5 км СЗ от города Туапсе, 44°07'37.55"N 39°02'03.92"E; 6b — река Агой, СВ окраина поселка Агой, 44°09'05.1"N 39°02'59.7"E.

mandibula) blunt cusps arranged in semicircle (Fig. 2H). Left *lacinia mobilis* with four cusps, spine row of 11–12 biserrate setae (Fig. 2I), right mandible without *lacinia mobilis*, spine row of 11 biserrate setae (Fig. 2J). Palp of three articles. First and second article of subequal length. First article narrow, with three or four small simple setae on extero-subapical margin. Second article with about four or five robust long and short biserrate setae along external margin. Third article length 0.7–0.8 times of second, with row of about 12–14 robust biserrate setae along external margin.

Maxillula (Fig. 2G) with an inner plate bearing five or six apical pappose setae; outer plate with 13 dentate robust setae and a single simple seta situated subapically on lateral margin.

Maxilla (Fig. 2F) with inner plate longer than outer plate, rounded sub-triangular, with a longer row of ten to eleven serrate robust setae, shorter row of ten bifid setae situated laterally and apically, and with oblique row of 22–25 simple setae; lateral and middle plates with 22 and 13 striated setae, respectively.

Maxilliped (Fig. 2K, L) endite distal margin bearing about 18 serrated robust setae. Mesial margin with about 28–20 biserrate setae, distomesial margin with a setulose fringe and four to six coupling hooks (Figs 2L; 6E), lateral margin with a dense setulose fringe. Palp has five articles. First article short, without setae; second about 2.3 times as long as first, subtrapezoidal, with row of about 9–10 long medially directed simple setae on inner margin and three stout setae on outer margin. Third article length 80% of second article length, less broad, with two short stout setae on outer margin and row of about four to six setae on inner margin. Fourth article 1.5 times as long as third, slender, with row of two and about nine to ten slender setae along inner and outer margins, respectively. Fifth article length 50–52% of fourth article length, ovoid, fringed with ten slender setae and two stiff apical setae. Epipodite subrectangular, lateral margin fringed with about eight (in holotype) to twelve (in paratypes) short setae.

With exception of first pair, seven pairs of pereopods ambulatory and similar in structure, increasing in length towards posterior pairs. Structure of pereopods of females and males differs, they will be described separately below. Description of pereopods of male based on holotype, while description of pereopods of female based on paratype.

Male (based on holotype):

Pereopod I (Figs 3A, B; 6C) with short oval articles, its length 23% of body length, length relation of articles from basis (article I) to dactylus (article VII): 1 : 0.62 : 0.38 : 0.19 : 0.82 : 0.65, unguis length 52% of dactylus length. Propodus I elongate, oval, up to 2.9 times as long as wide, inferior margin without proximal apophysis, straight or weakly convex, armed with three robust spiniform setae. Mesial surface with a two short simple setae. Dactylus (Figs 3B, 6C) with

four or five short robust setae on inferior margin and five or six simple setae on superior margin.

Pereopod II (Fig. 3C, D) with long slender articles, its length 33% of body length, length relation of articles from basis to dactylus: 1 : 0.68 : 0.40 : 0.82 : 0.76 : 0.36, unguis length 49% of dactylus length. Carpus II inferior margin with a row of three to four robust setae. Propodus II inferior margin with row of two or three robust setae, mesial surface with a single robust seta, inferodistal corner with a single stiff acute robust seta, superior margin and submarginal surface with five or six simple setae. Dactylus II (Fig. 3D) inferior margin with two thin simple setae, superior margin distally with three simple setae.

Pereopod III (Fig. 3E, F) with long slender articles, its length 36% of body length, length relations of articles from basis to dactylus: 1 : 0.78 : 0.47 : 0.86 : 0.88 : 0.38, unguis length 50% of dactylus length. Carpus III inferior margin with a row of two robust and five simple setae. Propodus III inferior margin with two small robust setae, mesial surface without setae, inferodistal corner with a single stiff acute robust seta, superior margin and submarginal surface with four or five simple and one single, strong and long setae. Dactylus III (Fig. 3F) inferior margin with two thin simple setae, superior margin distally with three simple setae.

Pereopod IV (Fig. 3G, H) with long slender articles, its length 40% of body length, length relation of articles from basis to dactylus: 1 : 0.76 : 0.45 : 0.82 : 0.87 : 0.37, unguis length 48% of dactylus length. Carpus IV inferior margin with a row of three robust and three simple setae, mesial surface without robust setae. Propodus IV inferior margin with two simple setae, mesial surface without setae, inferodistal corner with a single stiff acute robust seta, superior margin and submarginal surface with six or seven simple setae and with a single long simple seta. Dactylus IV (Fig. 3H) inferior margin with two thin simple setae, superior margin distally with three simple setae.

Pereopod V (Fig. 3I, J) with long slender articles, its length 45% of body length, length relation of articles from basis to dactylus: 1 : 0.78 : 0.44 : 0.89 : 0.90 : 0.37, unguis length 46% of dactylus length. Carpus V inferior margin with a row of six robust setae, mesial surface with three short robust setae. Propodus V inferior margin with a single simple seta, mesial surface without setae, inferodistal corner with a single stiff acute robust seta, superior margin and submarginal surface with seven or eight simple setae. Dactylus V (Fig. 3J) inferior margin with a single simple seta, superior margin distally with four simple setae.

Pereopod VI (Fig. 3K, L) with long slender articles, its length 48% of body length, length relation of articles from basis to dactylus: 1 : 0.88 : 0.67 : 1.09 : 1.00 : 0.40, unguis length 45% of dactylus length. Carpus VI inferior margin with a row of six robust setae, mesial surface with a single short robust setae

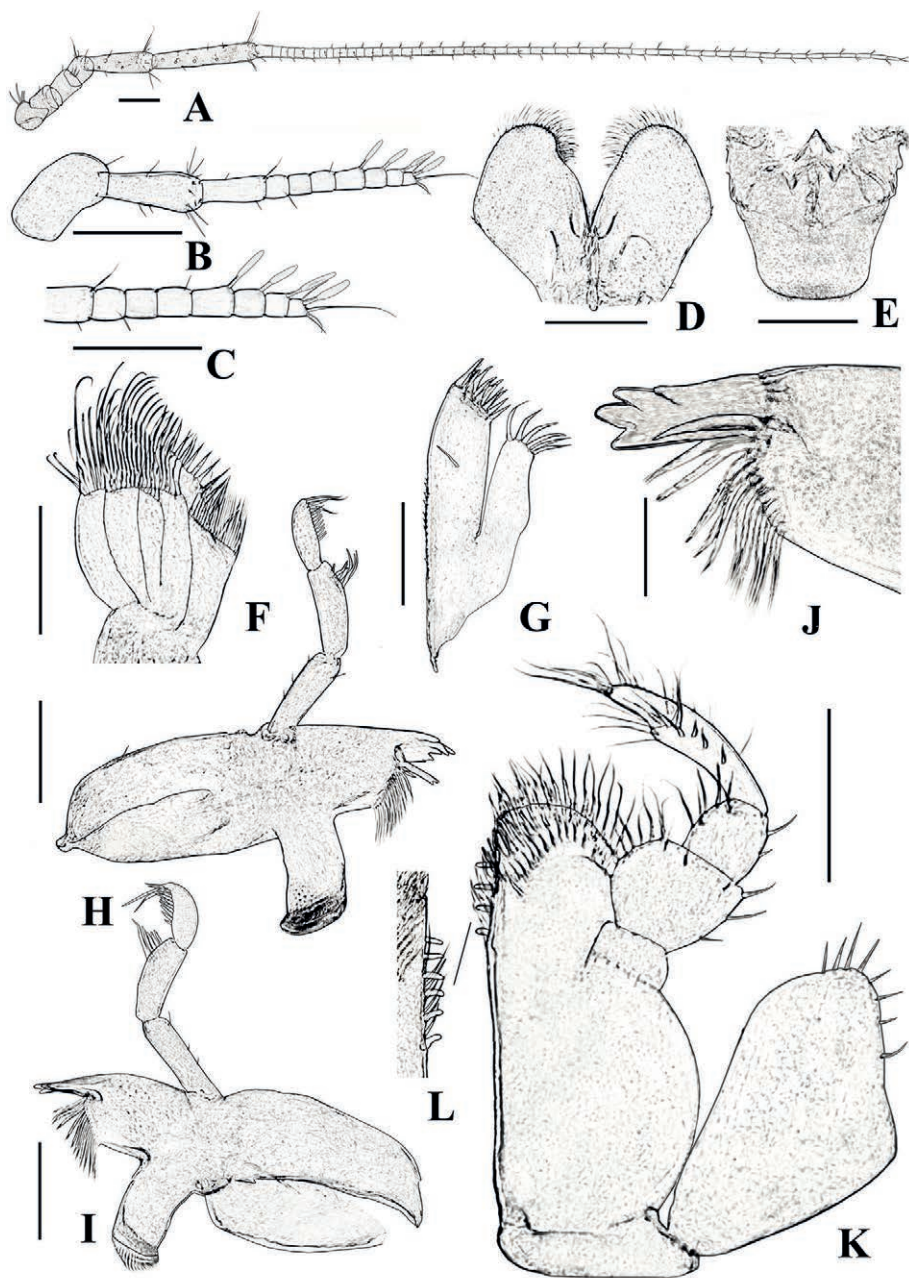


Fig. 2. *Proasellus mikhaili* sp.n. Holotype (♂) from a spring stream (rheokrene) on Kadosh Cape: A — antenna II; B — antenna I; C — flagellum of antenna I; D — labium; E — labrum; F — maxilla; G — maxillula; H — *pars incisiva* (incisor) of right mandible; I — left mandible; J — right mandible; K — left maxilliped; L — fragment of right maxilliped. Scale bars: A–G, I–K — 0.2 mm; H — 0.025 mm.

Рис. 2. *Proasellus mikhaili* sp.n. Голотип (♂) из родникового ручья (реокрена) на мысе Кадош: А — антенна II; В — антенна I; С — жгутик антенны I; D — лабиум (нижняя губа); E — лабрум (верхняя губа); F — максилла; G — максиллула; H — резец (инцизор) правой мандибулы; I — левая мандибула; J — правая мандибула; K — левый максиллипод; L — фрагмент правого максиллипода. Масштабная линейка: А–G, I–K — 0,2 мм; H — 0,025 мм.

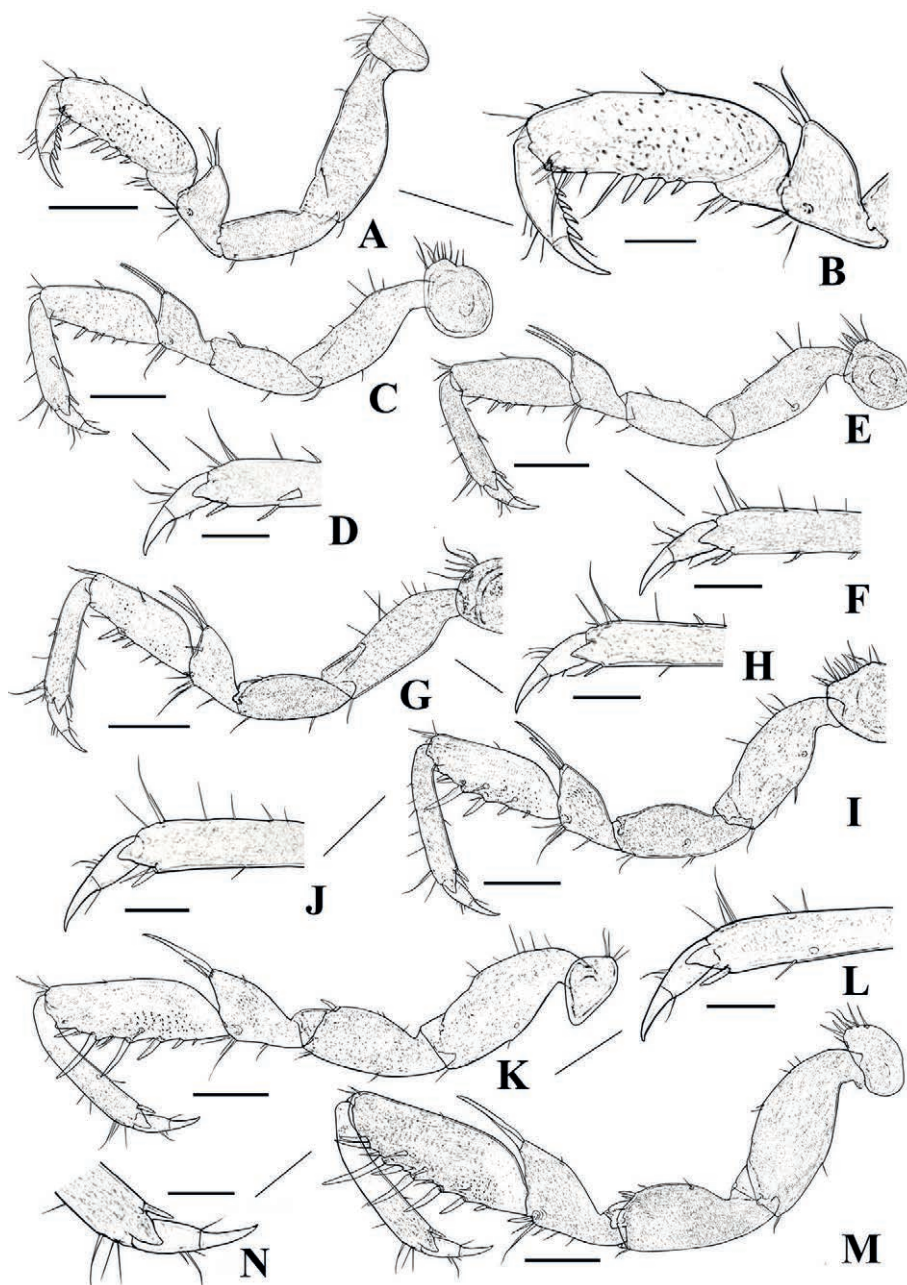


Fig. 3. *Proasellus mikhailli* sp.n. Holotype (♂) from a spring stream (rheokrene) on Kadosh Cape: A — pereopod I; B — dactylus of PI; C — pereopod II; D — dactylus of PII; E — pereopod III; F — dactylus of PIII; G — pereopod IV; H — dactylus of PIV; I — pereopod V; J — dactylus of PV; K — pereopod VI; L — dactylus of PVI; M — pereopod VII; N — dactylus of PVII. Scale bars: 0.2 mm.

Рис. 3. *Proasellus mikhailli* sp.n. Голотип (♂) из родникового ручья (реокрена) на мысе Кадош: А — переопод I; В — дактилус переопода I; С — переопод II; D — дактилус переопода II; E — переопод III; F — дактилус переопода III; G — переопод IV; H — дактилус переопода IV; I — переопод V; J — дактилус переопода V; K — переопод VI; L — дактилус переопода VI; M — переопод VII; N — дактилус переопода VII. Масштабная линейка: 0,2 мм.

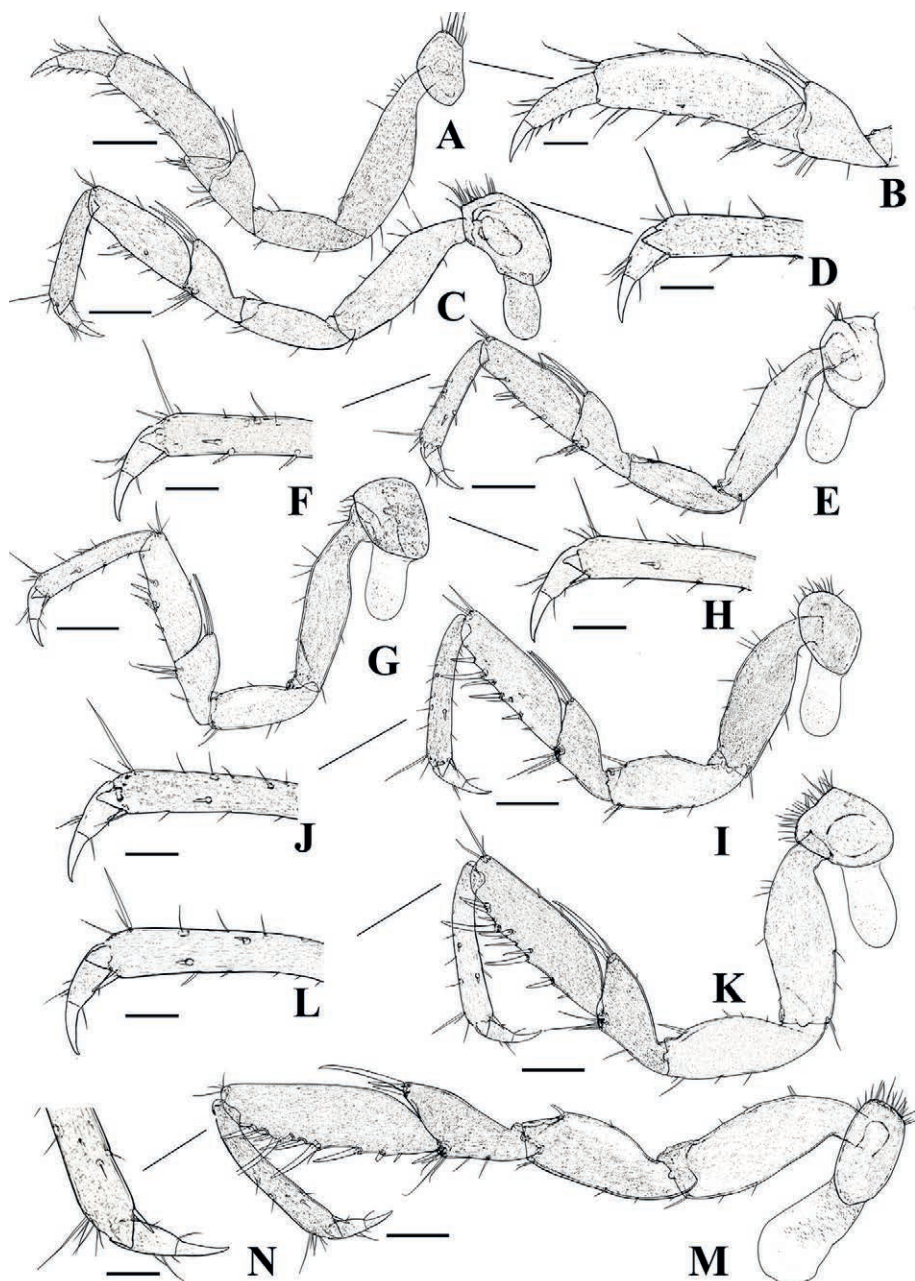


Fig. 4. *Proasellus mikhaili* sp.n. Paratype (♀) from a spring stream (rheokrene) on Kadosh Cape: A — pereopod I; B — dactylus of PI; C — pereopod II; D — dactylus of PII; E — pereopod III; F — dactylus of PIII; G — pereopod IV; H — dactylus of PIV; I — pereopod V; J — dactylus of PV; K — pereopod VI; L — dactylus of PVI; M — pereopod VII; N — dactylus of PVII. Scale bars: 0.2 mm.

Рис. 4. *Proasellus mikhaili* sp.n. Паратип (♀) из родникового ручья (реокрена) на мысе Кадош: А — переопод I; В — дактилус переопода I; С — переопод II; D — дактилус переопода II; E — переопод III; F — дактилус переопода III; G — переопод IV; H — дактилус переопода IV; I — переопод V; J — дактилус переопода V; K — переопод VI; L — дактилус переопода VI; M — переопод VII; N — дактилус переопода VII. Масштабная линейка: 0,2 мм.

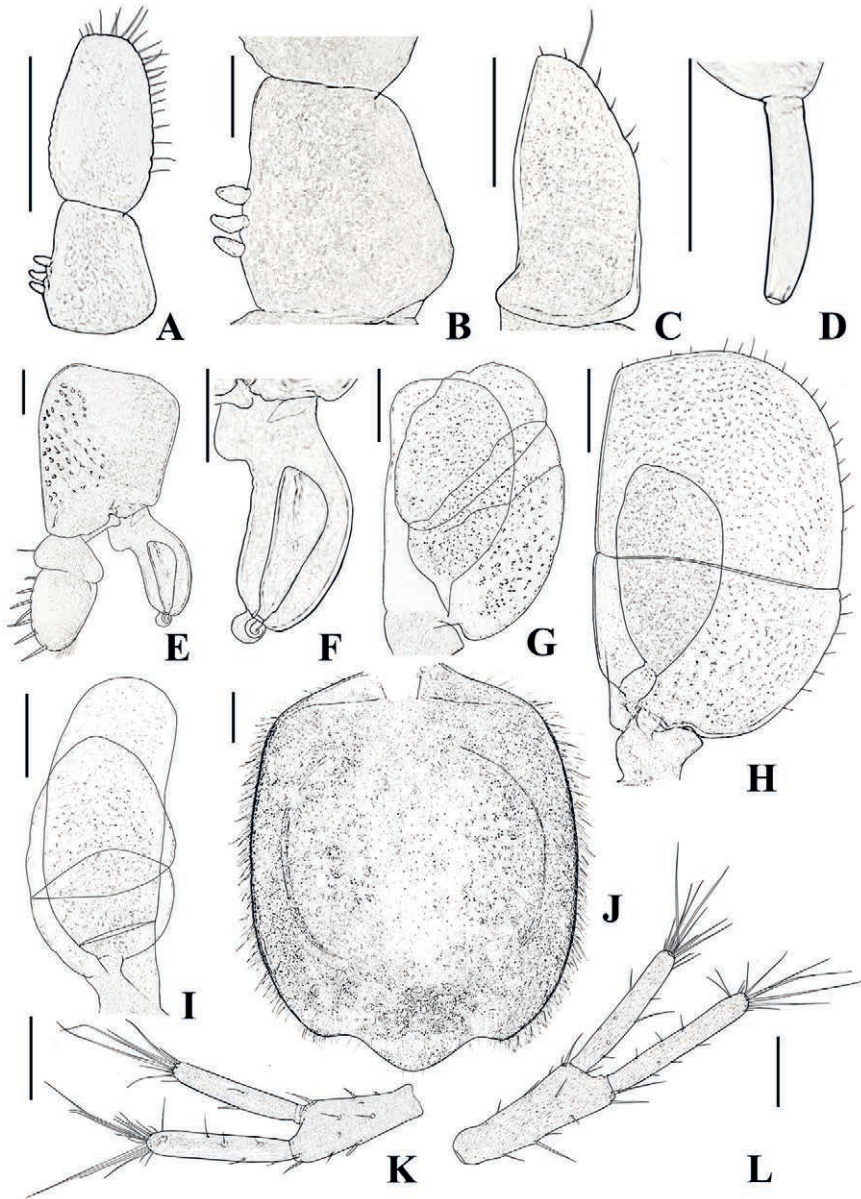


Fig. 5. *Proasellus mikhaiki* sp.n. Holotype (♂) and paratype (♀) from a spring stream (rheokrene) on Kadosh Cape: A — pleopod I (♂ holotype); B — retinacula on medial margin of pleopod I protopodite; C — pleopod II (♀ paratype); D — genital papilla (♂ holotype); E — pleopod II (♂ holotype); F — endopodite of pleopod II (♂ holotype); G — pleopod IV (♂ holotype); H — pleopod III (♂ holotype); I — pleopod V (♂ holotype); J — pleotelson (♂ holotype); K — uropod (♀ paratype); L — uropod (♂ holotype). Scale bars: A, C–E, G–I — 0.1 mm; J–L — 0.1 mm; B, F — 0.025 mm.

Рис. 5. *Proasellus mikhaiki* sp.n. Голотип (♂) и паратип (♀) из родникового ручья (реокрена) на мысе Кадош: А — плеопод I (♂ голотип); В — ретинакула на медиальной поверхности протоподита плеопода I (♂ голотип); С — плеопод II (♀ паратип); D — генитальный сосочек (♂ голотип); E — плеопод II (♂ голотип); F — эндоподит плеопода II (♂ голотип); G — плеопод IV (♂ голотип); H — плеопод III (♂ голотип); I — плеопод V (♂ голотип); J — плеотельсон (♂ голотип); K — уropод (♀ паратип); L — уropод (♂ голотип). Масштабная линейка: А, С–Е, G–I — 0,1 мм; J–L — 0,1 мм; В, F — 0,025 мм.

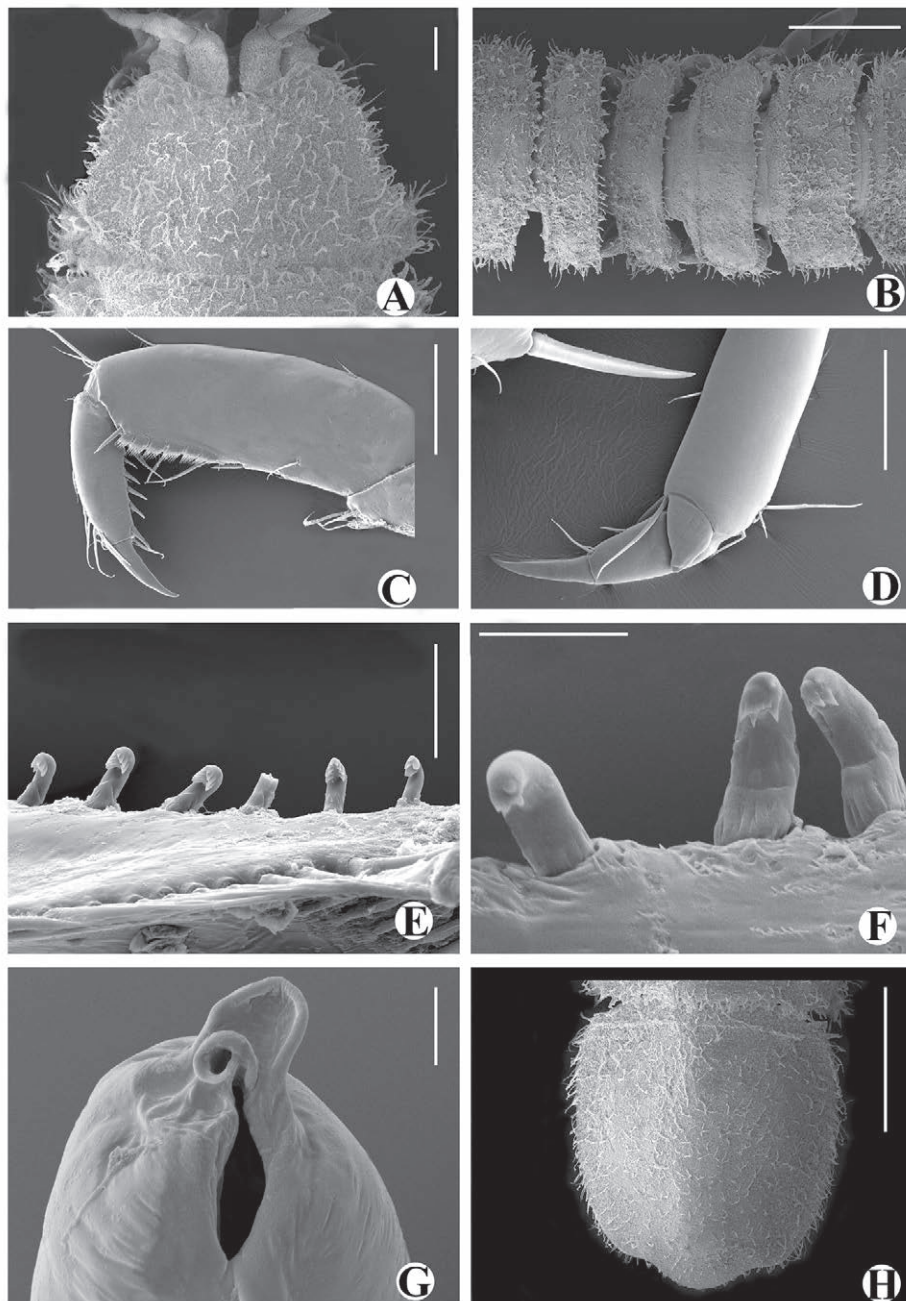


Fig. 6. *Proasellus mikhaili* sp.n., ♂: A — head; B — pereonites II–IV; C — distal part of pereopod I with a dactylus; D — dactylus of pereopod VII; E — coupling hooks of endite of maxilliped; F — hooks of retinacula of pleopod I; G — endopodite of pleopod II; H — pleotelson. Scale bars: A, C, D — 250 μ m; B, H — 500 μ m; D — 100 μ m; E — 50 μ m; G, F — 20 μ m.

Рис. 6. *Proasellus mikhaili* sp.n., ♂: A — голова; B — переониты II–IV; C — дистальная часть переопода I с дактилусом; D — дактилус переопода VII; E — соединительные крючки эндита максиллипеда; F — крючки ретинакулы плеопода I; G — эндоподит плеопода II; H — плеотельсон. Масштабная линейка: A, C — 250 μ m; B, H — 500 μ m; D — 100 μ m; E — 50 μ m; G, F — 20 μ m.

(Fig. 5D). Propodus VI inferior margin with a single simple seta, mesial surface without setae, inferodistal corner with a single stiff acute robust seta, superior margin and submarginal surface with seven or eight simple setae. Dactylus VI (Fig. 3L) inferior margin with a single simple seta, superior margin distally with three simple setae.

Pereopod VII (Figs 3M, N, 6D) with long slender articles, its length 50% of body length, length relations of articles from basis to dactylus: 1 : 0.85 : 0.67 : 1.15 : 0.99 : 0.38, unguis length 48% of dactylus length. Carpus VII inferior margin with a row of eight or nine robust setae, mesial surface with three or four short robust setae. Propodus VII inferior margin with a single simple seta, mesial surface without setae, inferodistal corner with a single stiff acute robust seta, superior margin and submarginal surface with five or six simple setae. Dactylus VII (Figs 3N; 6D) inferior margin with a single simple seta, superior margin distally with three simple setae.

Female (based on paratype):

Pereopod I (Fig. 4A, B) with elongated articles, its length 30% of body length, length relation of articles from basis (article I) to dactylus (article VII): 1 : 0.60 : 0.35 : 0.17 : 0.82 : 0.47, unguis length 53% of dactylus length. Propodus I elongate, oval, up to 2.9 times as long as wide, inferior margin without a proximal apophysis, straight or weakly convex, armed with two small robust spiniform setae. Mesial surface with a single short simple seta. Dactylus (Fig. 4B) with four short robust setae on inferior margin and five simple setae on superior margin.

Pereopod II (Fig. 4C, D) with long slender articles, its length 35% of body length, length relation of articles from basis to dactylus: 1 : 0.65 : 0.39 : 0.78 : 0.75 : 0.34, unguis length 45% of dactylus length. Carpus II inferior margin with a row of two robust and four simple setae. Propodus II inferior margin with two simple setae, mesial surface without setae, inferodistal corner with a single stiff acute robust seta, superior margin and submarginal surface with five or six short simple setae and a single long simple seta. Dactylus II (Fig. 4D) inferior margin with two thin simple setae, superior margin distally with three simple setae.

Pereopod III (Fig. 4E, F) with long slender articles, its length 37% of body length, length relations of articles from basis to dactylus: 1 : 0.64 : 0.41 : 0.76 : 0.73 : 0.32, unguis length 48% of dactylus length. Carpus III inferior margin with row of two robust and three short simple setae. Propodus III inferior margin with two small robust setae, mesial surface with two short robust setae, inferodistal corner with a single stiff acute robust seta, superior margin and submarginal surface with four or five simple and a single strong long setae. Dactylus III (Fig. 4F) inferior margin with a single thin simple seta, superior margin distally with three simple setae.

Pereopod IV (Fig. 4G, H) with long slender articles, its length 40% of body length, length relation of articles from basis to dactylus: 1 : 0.57 : 0.42 : 0.67 : 0.72 : 0.32, unguis length 48% of dactylus length. Carpus IV inferior margin with a row of three robust and a single simple setae, mesial surface with two strong setae. Propodus IV inferior margin with three simple setae, mesial surface with a single short robust seta, inferodistal corner with a single stiff acute robust seta, superior margin and submarginal surface with six or seven simple setae and with a single long simple seta. Dactylus IV (Fig. 4H) inferior margin with two thin simple setae, superior margin distally with three simple setae.

Pereopod V (Fig. 4I, J) with long slender articles, its length 46% of body length, length relation of articles from basis to dactylus: 1 : 0.73 : 0.52 : 0.94 : 0.95 : 0.36, unguis length 47% of dactylus length. Carpus V inferior margin with a row of nine long robust setae, mesial surface with a single long robust setae. Propodus V inferior margin with four short simple setae, mesial surface with three short simple setae, inferodistal corner with a single stiff acute robust seta, superior margin and submarginal surface with seven or eight short simple setae and with a single long simple seta. Dactylus V (Fig. 4J) inferior margin with two thin simple setae, superior margin distally with three simple setae.

Pereopod VI (Fig. 4K, L) with long slender articles, its length 48% of body length, length relation of articles from basis to dactylus: 1 : 0.79 : 0.54 : 1.02 : 0.92 : 0.36, unguis length 43% of dactylus length. Carpus VI inferior margin with a row of eight robust setae, mesial surface with two short robust setae. Propodus VI inferior margin with four short simple setae, mesial surface with two short robust setae, inferodistal corner with a single stiff acute robust seta, superior margin and submarginal surface with five or six short simple setae and with a single long simple seta. Dactylus VI (Fig. 4L) inferior margin with two thin simple setae, superior margin distally with three simple setae.

Pereopod VII (Figs 4M, N; 6D) with long slender articles, its length 50% of body length, length relations of articles from basis to dactylus: 1 : 0.85 : 0.60 : 1.11 : 0.93 : 0.34, unguis length 43% of dactylus length. Carpus VII inferior margin with a row of eight robust setae, mesial surface with two robust setae. Propodus VII inferior margin with four simple setae, mesial surface with two or three short simple setae, inferodistal corner with a single stiff acute robust seta, superior margin and submarginal surface with seven or eight short simple setae and with a single long simple seta. Dactylus VII (Figs 4N; 6D) inferior margin with two thin simple setae, superior margin distally with three simple setae.

Genital papillae of males (Fig. 5D) is thin, cylindrical, slightly curved.

Pleopod I (Figs 5A, B; 6F) with protopodite subtrapezoidal, 1.17 times as long as wide, retinacula on medial margin with three hooks (Figs 5B; 6F). Exopodite elongated ovoid, its width 62% of its length, with 22 simple setae on lateral margin, without concavity on lateral margin.

Pleopod II (Fig. 5E, F) different in males and females.

Pleopod II of male: with protopodite subrectangular, its width 80% of its length. Anteromedial corner without setae. Exopodite suboval, elongated, 1.6 times as long as wide. Distal article rounded, with seven lateral simple setae. Proximal segment of exopodite with a single lateral seta. Endopodite elongated, its width 50% of its length, subequal of protopodite in length, with distinct basal apophysis, elongated distal apophysis and with well expressed goulot with small lips (Figs 5F; 6G).

Pleopod II of female (Fig. 5C) subtriangular, with six or seven short marginal simple setae and with a single long marginal seta.

Pleopod III (Fig. 5H) with exopodite suboval, about 1.6 times as long as wide, with almost straight medial margin. Lateral and terminal margins with 23–25 short simple setae. Endopodite about 1.9 times shorter than exopodite.

Pleopod IV (Fig. 5G) with exopodite broadly ovoid, 1.6 times as long as wide, lateral margins without setae. Linea transversalis well-defined, linea conjungens clearly visible near outer margin only. Endopodite suboval, about 1.2 times shorter than exopodite.

Pleopod V (Fig. 5I) with exopodite ovoid, short, 1.5 times as long as wide, lateral margins without setae. Distal margin rounded. Endopodite elongated, 1.3 times as longer than exopodite.

Uropods (Fig. 5K, L) different in males and females.

Male uropods (Fig. 5L): with long slender articles, as long as 52% of pleotelson. Proto-, endo- and exopodite length relation: 1 : 1.1 : 1.2, respectively. Basis with two stout spiniform setae on inner and outer margins each and with a single distal spiniform seta. Exopodite with a single seta on inner and mesial margins and with terminal group of long simple setae, longest seta length 94% of exopodite length. Endopodite with two short simple setae on inner and outer margins each and with terminal group of long simple setae, longest seta length 90% of exopodite length.

Female uropods (Fig. 5K): with short robust articles, as long as 60% of pleotelson. Proto-, endo- and exopodite length relation: 1 : 0.9 : 1.0, respectively. Basis with three or four simple setae on inner and outer margins and with distal group of five to six long simple setae. Exopodite with one to three short simple setae on inner and outer margins each and with terminal group of long simple setae, longest seta with length 73% of exopodite length. Endopodite with three

short simple setae on inner and outer margins each and with terminal group of long simple setae, longest seta length 71% of exopodite length.

BODY SIZE. The largest collected female had bl. 4.5 mm; the largest male had bl. 5.0 mm.

TAXONOMIC REMARKS. We failed to find any morphological differences between these two populations.

The species can be most easily separated from *Proasellus infirmus* based on the following features: 1) retinacula of pleopod I with three coupling hooks (vs. retinacula of pleopod I with two coupling hooks, see Birštein, 1936, fig. 7); 2) lack of eyes, white depigmented body (vs. eyes consisting of three facets, pigmented body, “brighter than *Asellus aquaticus*”, see Birštein, 1936: 237 and Birštein, 1951: 85 and fig. 112); 3) lack of long plumose setae on pleopod II of female (vs. setae on pleopod II of female is plumose, long, exceed half of its length, see Birštein, 1936, figs 8, 9); 4) exopodite of pleopod V is much shorter than endopodite (vs. exopodite and endopodite of pleopod V are approximately equal in length, see Birštein, 1936, fig. 12).

The species can be differentiated from *P. linearis* by: 1) retinacula of pleopod I with three coupling hooks (vs. retinacula of pleopod I with a single coupling hook, see Birštein, 1967, fig. 1); 2) exopodite of pleopod V is much shorter than the endopodite (vs. exopodite of pleopod V is much longer than endopodite in length, see Birštein, 1967, fig. 1); 3) interior margin of dactyli of pereopods II–VII without strong spiniform setae (vs. inferior margin of dactyli of pereopods II–VII with a single strong spiniform seta, see Birštein, 1967, fig. 1).

The species can be easily separated from *P. ljovuschkini* by: 1) retinacula of pleopod I with three coupling hooks (vs. retinacula of pleopod I with two coupling hook, see Birštein, 1967, fig. 2); 2) lack of a large setae on mesial margin of pleopods III and pleopods II in female (vs. prominent large setae, see Birštein, 1967, fig. 2); 3) anteromedial corner of protopodite of pleopods II of male without setae (vs. anteromedial corner of protopodite of pleopods II of male with two long setae, see Birštein, 1967, fig. 2); 4) exopodite of pleopod V is much shorter than endopodite (vs. exopodite and endopodite of pleopod V are approximately equal in length, see Birštein, 1967, fig. 2).

The species can be easily separated from *P. similis* by: 1) retinacula of pleopod I with three coupling hooks (vs. retinacula of pleopod I with two coupling hooks, see Birštein, 1967, fig. 3); 2) rami of uropod almost parallel (vs arranged at the angle of almost 80°, see Birštein, 1967, fig. 3); 3) pleopod IV wide, its exopodite about 1.6 times as long as wide, without a lateral seta (vs. pleopod IV narrow and blunt pointed apically, its exopodite about 2.20 times as long as wide, with a lateral seta, see Birštein, 1967, fig. 3); 4) dactyli of

pereopods II–VII without strong spiniform setae on inferior margin (vs. dactyli of pereopods II–VII with a single strong spiniform seta on inferior margin each, see Birštein, 1967, fig. 3).

The species can be easily separated from *P. ual-lagyrus* by: 1) dactyli of pereopods II–VII without strong spiniform setae on inferior margin (vs. dactyli of pereopods II–VII with a single strong spiniform seta on inferior margin each, see Palatov, Sokolova, 2021, fig. 4); 2) exopodite of pleopod V is much shorter than endopodite (vs. exopodite and endopodite of pleopod V are approximately equal in length, see Palatov, Sokolova, 2021, fig. 5I); 3) retinacula of pleopod I with three coupling hooks (vs. retinacula of pleopod I with a single coupling hook, see Palatov, Sokolova, 2021, fig. 5B).

The species can be easily separated from *P. pre-caspicus* by: 1) inferior margin of dactyli of pereopods II–VII without strong spiniform setae (vs. inferior margin of dactyli of pereopods II–VII with a single strong spiniform seta, see Palatov *et al.*, 2023, fig. 3); 2) retinacula of pleopod I with three coupling hooks (vs. retinacula of pleopod I with a single coupling hook, see Palatov *et al.*, 2023, fig. 4A); 3) exopodite of pleopod V is much shorter than endopodite (vs. exopodite and endopodite of pleopod V are approximately equal in length, see Palatov *et al.*, 2023, fig. 4I); 4) inferior margin of dactylus of pereopod I with four or five robust stiff setae (vs. inferior margin of dactylus of pereopod I with five to eight robust stiff setae, see Palatov *et al.*, 2023, figs 3B, 5C).

The species can be easily separated from *P. abini* by: 1) inferior margin of dactyli of pereopods II–VII without strong spiniform setae (vs. inferior margin of dactyli of pereopods II–VII with two strong spiniform setae, see Marin, Sinelnikov, 2024, fig. 4B); 2) retinacula of pleopod I with three coupling hooks (vs. retinacula of pleopod I with a single coupling hook, see Marin, Sinelnikov, 2024, fig. 4A, B); 3) exopodite of pleopod V is much shorter than endopodite (vs. exopodite and endopodite of pleopod V are approximately equal in length, see Marin, Sinelnikov, 2024, fig. 5F); 4) inferior margin of dactylus of pereopod I with four or five robust stiff setae (vs. inferior margin of dactylus of pereopod I with ten robust stiff setae, see Marin, Sinelnikov, 2024, fig. 4B).

Thus, our new species differs from all known Caucasian representatives of the genus by a unique combination of morphological features, including presence of three coupling hooks in the retinacula of pleopod I and a shortened exopodite of pleopod V. Additionally, it also differs from most species described from this region by a relatively poor ornamentation of pereopods I–VII and the chetotaxis of the pleotelson, densely covered with fine hair-like setae.

DISTRIBUTION AND ECOLOGY. Currently, the species is known from two habitats in the vicinity of Tuapse, at absolute elevations below 100 meters above

sea level. It was found under very large stones or deep in moist river gravel. Instances of mass emergence of individuals to the surface (more than 50 individuals/m²) were also observed by us, occurring repeatedly after particularly heavy rains.

This species was found in association with other stygobiotic invertebrates, such as *Niphargus* cf. *krasnodarus* Karaman, 2012 and *Niphargus* cf. *magnus* Birštein, 1940. Additionally, together with them, planarians *Dugesia taurocaucasica* (Livanov, 1951) (Tricladida: Dugesiiidae), amphipods *Gammarus* cf. *pulex* (Linnaeus, 1758), and larvae of amphibiotic insects including Ephemeroptera larvae (*Baetis* (*Rhodobaetis*) *rhodani* (Pictet, 1843), *Electrogena* spp., *Habroleptoides pontica* Kluge, 1994), Plecopetra larvae (*Bulgaroperla mirabilis caucasica* Zhiltzova, 1973) and Trichoptera larvae (*Diplectrona juliarum* Grigorenko et Ivanov, 1991, *Plectrocnemia latissima* Martynov, 1913, *Silo proximus* Martynov, 1913, *Goerodes batunicus* (Martynov, 1913), *Schizopelex cachetica* Martynov, 1913) and many others were also discovered.

Discussion

Tuapsinsky District represents a unique transitional zone between the Mediterranean and Colchis landscapes. Several authors identify a high-ranking biogeographical boundary here (Zernov, 2006; Chertoprud, Peskov, 2007). For many freshwater groups of the Mediterranean faunal complex, this area marks the most south-eastern boundary of their range, for example, for *Niphargus* gr. *tauricus* Birštein, 1964 (Marin *et al.*, 2021), stoneflies of the genus *Bulgaroperla* (Teslenko, Palatov, 2019), and *Perla* (Teslenko *et al.*, 2024). Conversely, for several groups of freshwater invertebrates associated with the Colchis lowland, Tuapsinsky District becomes the extreme northwest point of their distribution. This is also true for the amphipod *Niphargus* gr. *magnus* Birštein, 1940 (Palatov, Marin, 2021) or spring snails of the genus *Tschernomorica* (Sokolova, Palatov, 2015; Palatov, Sokolova, 2019). In addition to the transitional state of this region, it is also known by its very pronounced endemism (Palatov, Sokolova, 2019). For example, an extraordinary diversity of the amphipod genus *Lyurella* (Crangonyctidae) (Marin, Palatov, 2021) is found here, which is absent in other areas along the Black Sea coast. Endemic genera of stygobiotic snails are also described from this area (Chertoprud *et al.*, 2021). Our discovery of a new morphologically

distinct and locally distributed species of the genus *Proasellus* is not surprising.

The discovery of a *Proasellus mikhaili* sp.n. in Tuapse area breaks the existing disjunction in the range of this genus along the Black Sea coast of the Caucasus. Apparently, the range of *Proasellus* extends along the coast at least to Sukhum (Abkhazia), with each major valley containing its own endemic species. Based on morphological characters, *Proasellus mikhaili* sp.n. (despite its uniqueness) shows some similarity to *P. ljevuschkini*, particularly in the structure of pereopods II–VII, pereopods I, and uropods. *P. ljevuschkini* was described from hyporheic waters of the lower reaches of the Khosta River, also located on the Black Sea coast. It is possible that these two species are representatives of a group which inhabits the areas located along the seashore.

It is also worth noting that in recent times, the watercourses of Kadosh Cape, where type locality of our species is located, have been experiencing an increasing anthropogenic pressure, including the establishment of a solid waste landfill in the headwaters in one of the streams. The discovery of a new species enhances the conservation value of this area. In our opinion, at least a part of Kadosh Cape warrants a special nature protection regime.

Conflict of interest.

The authors declare that they have no conflict of interest.

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