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A new freshwater amphipod species, *Gammarus obruki* sp. nov., from Turkey (Amphipoda: Gammaridae)

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Abstract: A new species of freshwater amphipod, *Gammarus obruki* sp. nov., collected from İnderesi Cave, Bartın Province, Turkey, is described and illustrated. The new species belongs to the *Gammarus pulex* group. The most discriminant characters of this species are the presence of prolonged extremities, a very long antenna 1 (up to 52 segmented flagellum), densely setose fifth peduncle and flagellar segments of antenna 2, and a fourth peduncle segment that has no long setae. A detailed morphological description and illustrations of the new species are provided and differences from related species are discussed.

Key words: *Gammarus*, new species, freshwater, Bartın, Turkey

Introduction

Gammarus is probably the amphipod genus with the highest number of epigean freshwater taxa (Karaman and Pinkster, 1977a). The genus *Gammarus*, with 223 known species worldwide, is widespread across the Holarctic and accounts for a significant part of the Palaearctic epigean diversity. The distribution of *Gammarus* is centered in the Western Palearctic but extends to China and North America; it includes several taxa that live in coastal marine waters (Väinölä et al., 2008). The *Gammarus* fauna of Europe and the Middle East has been revised in several studies (Karaman and Pinkster, 1977a, 1977b, 1987; Özbek, 2007; Zamanpoore et al., 2011), while the *Gammarus* species from North America were listed by Bousfield (2001) and by Holsinger (1972).

The amphipod fauna of Turkish freshwaters has been intensively studied in recent decades and comprises 38 species belonging to the genus *Gammarus* (Özbek, 2011). In addition, a new species, *Gammarus katagani*, has recently been described from a fountain in Kütahya Province, Turkey (Özbek, 2012), and another new species from a cave in Bartın Province, northern Anatolia, Turkey, is described in this study.

Materials and methods

The specimens were collected with a fine-mesh hand net, fixed in 70% ethanol in the field, examined and dissected under a stereomicroscope, and examined under a compound microscope. The body length of the specimens was recorded by holding the specimen straight and measuring the distance along the dorsal side of the body from the base of the first antennae to the tip of the telson.

Illustrations were made with the aid of a drawing tube mounted on an Olympus CX31 compound microscope, and then they were scanned with a conventional HP scanner. A digitizer board LaPazz

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WP8060 was connected via the USB port and a standard inking pen from LaPazz was used to digitally drawing the scanned figures.

All of the specimens were deposited in the Museum of Faculty of Fisheries, Ege University, İzmir, Turkey (ESFM).

Results and discussion

Taxonomy

Family: Gammaridae Leach, 1813

Genus: *Gammarus* Fabricius, 1775

***Gammarus obruki* sp. nov.** (Figures 1-6)

Material: Holotype: Male, 21.0 mm (ESFM-MALI/09-01), collected with a fine-mesh hand net from the İnderesi Cave, Amasra, Bartın Province, northern Anatolia (41°42′53.33″N, 32°26′14.01″E), 01.vii.2009; collected by M. Eğrikavuk.

Paratypes: Allotype female, 11.9 mm (ESFM-MALI/09-02), same data as holotype. Four males and 3 females (ESFM-MALI/09-03), same data as holotype.

Diagnosis: A large species (max. length: 21.0 mm). Well-developed kidney-shaped eyes, very long antenna 1 (36 to 52 segmented flagellum), fourth peduncle segment without long setae, fifth peduncle segment and flagellar segments of antenna 2 very densely setose, anterior margins of pereopod 5 to 7 with a few setae as long as or slightly longer than the spines, posterior margins of merus and carpus of pereopod 3 densely setose, flat urosomites, inner ramus-to-outer ramus ratio of third uropod 0.9.

Description of holotype male: Head (Figure 2): Inferior antennal sinus deep. Eyes reniform, as long as diameter of first peduncle segment of antenna 1.

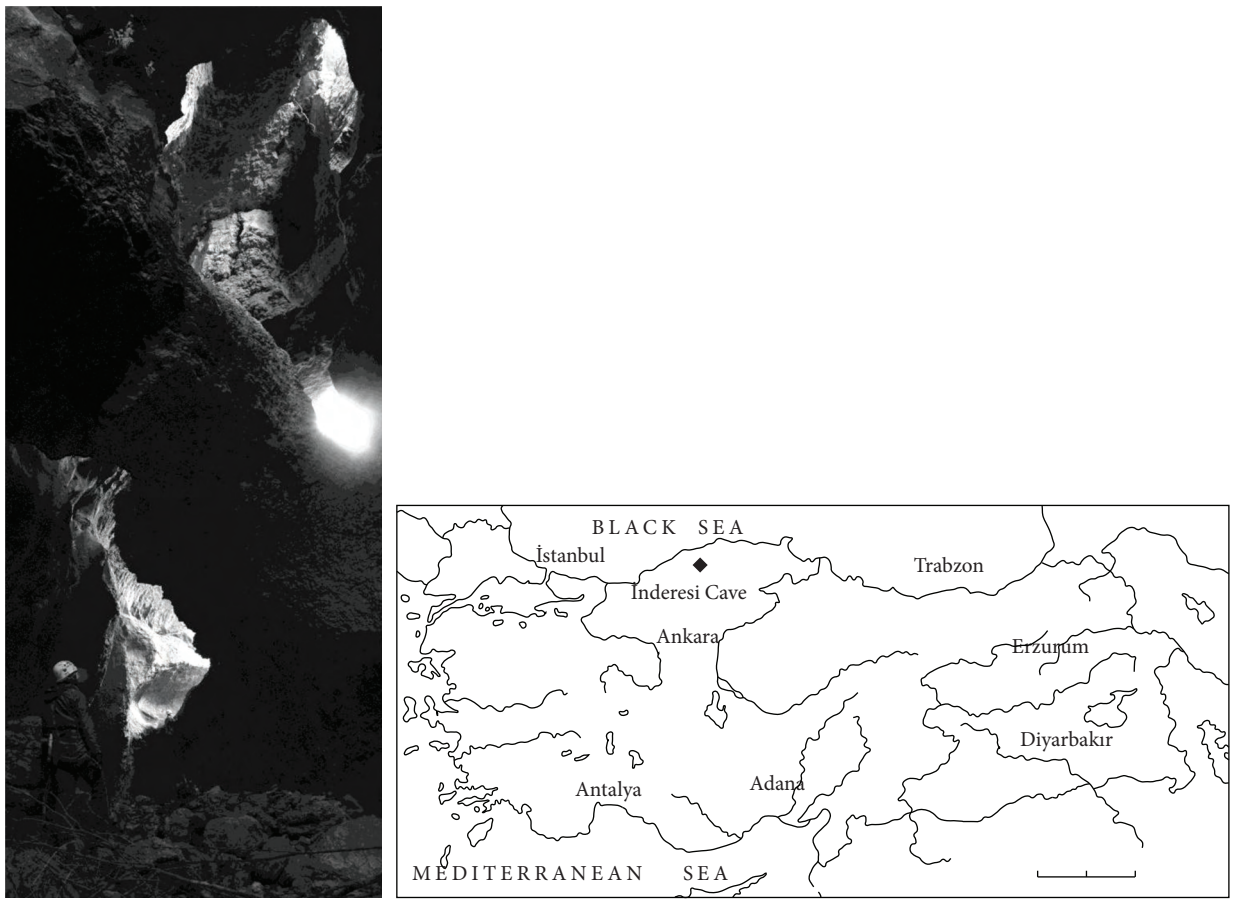

Figure 1. Geographical location and the entrance of İnderesi Cave (Photo: Ç. Çankırılı).

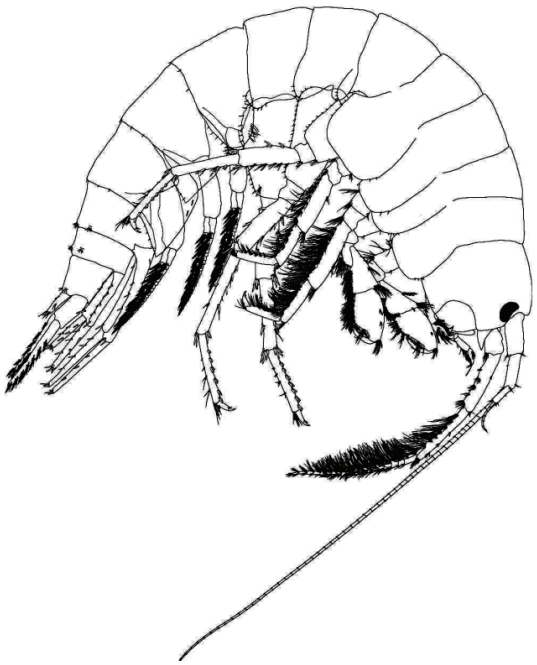

Figure 2. *Gammarus obruki* sp. nov. Holotype male, lateral view.

Antenna 1 (Figure 3F): Longer than half the body length; setation weak, peduncular segments bear a few distal setae shorter than diameter of segment where they implanted; article 1 stout; primary flagellum with 52 articles; accessory flagellum with 6 articles.

Antenna 2 (Figure 3G): Ventral margins of peduncular segments armed with 5-7 groups of setae. Setae on fourth peduncle segment are shorter than diameter of segment; setae on fifth peduncular segment more than twice as long as diameter of segment; setae on dorsal side of both peduncular segments much shorter; flagellum comprises up to 17 segments; ventral parts of segments with many long setae (more than 3 times longer than segment); flagellar segments not swollen; calceoli absent.

Left mandible (Figure 3C): Incisor with 5 teeth; lacina mobilis with 4 dentitions; molar triturative; second article of palp bears 16 setae; third segment armed with 37 D-setae, 5-6 E-setae; 1 group of A-setae, 1 group of B-setae; C-setae absent.

Right mandible (Figure 3B): Incisor 4-dentate, lacina mobilis bifurcate.

Maxilla 1 (Figures 3J and 3K): Inner plate with 18 plumose setae, outer plate with 11 serrated spines, article 2 of palp with 10 sharp spines, 4 stiff setae; article 2 of right palp stout, with 6 blunt spines in distal part, 1 stiff seta on inner margin, 2 stiff setae, 3 simple setae on outer margin.

Lower lip (Figure 3A): Inner lobe absent.

Upper lip (Figure 3I): Convex, with minute setae on distal part.

Maxilla 2 (Figure 3D): Inner plate with diagonal row of 21 plumose setae.

Maxilliped (Figure 3H): Inner plate with 3 apical spines 1 subapical spine, outer plate with row of 14-16 spines on medial margin 5-7 pectinate apical setae.

Coxal plate 1 (Figure 4A): Slightly dilated on distal margin, with 4 setae on anterodistal margin and 1 seta on posterodistal margin.

Figure 3. *Gammarus obruki* sp. nov. Holotype male: A) lower lip, B) detail of right mandible, C) left mandible, D) maxilla 2, E) telson, F) antenna 1, G) antenna 2, H) maxilliped, I) upper lip, J) palp of right maxilla, and K) left maxilla.

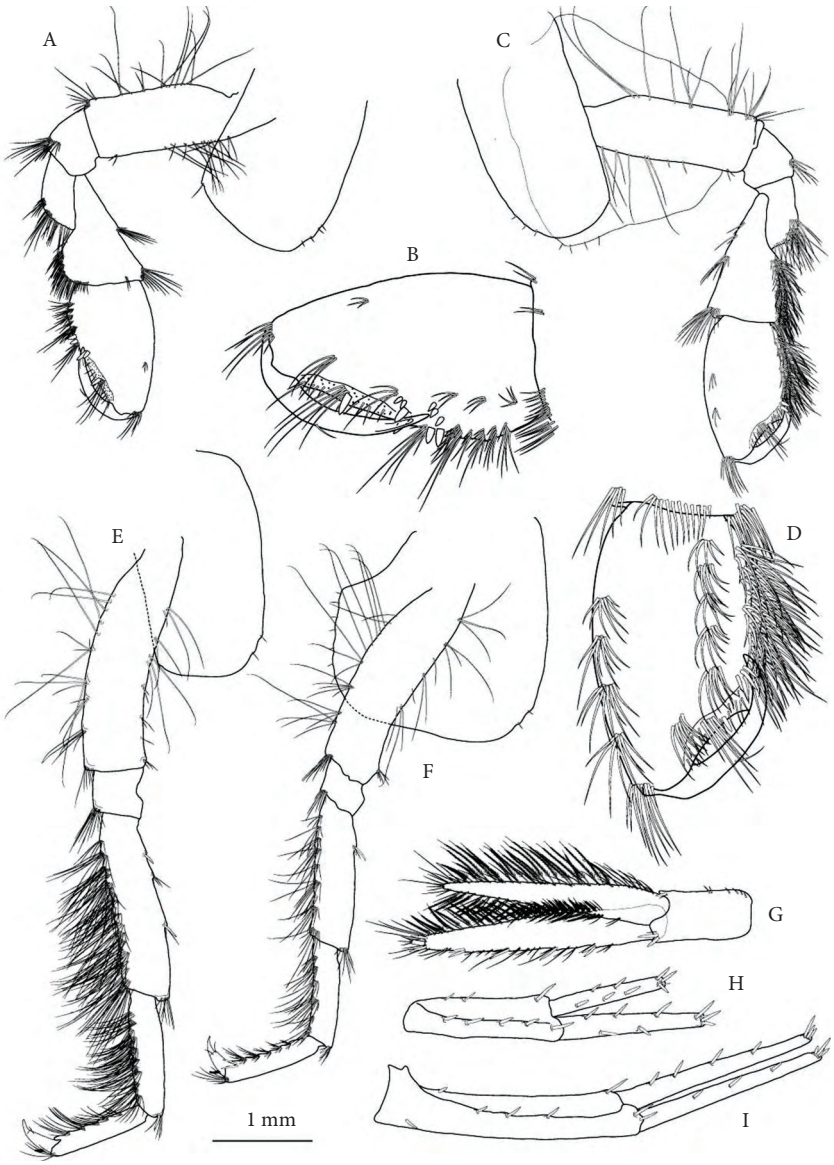

Figure 4. *Gammarus obruki* sp. nov. Holotype male: A) gnathopod 1, B) propodus of gnathopod 1 (inner view), C) gnathopod 2, D) propodus of gnathopod 2 (inner view), E) pereopod 3, F) pereopod 4, G) uropod 3, H) uropod 2, and I) uropod 1.

Coxal plates 2 and 3 (Figures 4C and 4E): Subrectangular. Coxal plate 2 with 3 short setae on anterodistal corner, 1 seta on posterodistal corner. Coxal plate 3 with 2 short setae on anterodistal corner, 1 seta on posterodistal corner. Ventral margin of coxal plate 4 almost flat (Figure 4F), with 2 setae on anterodistal corner, 6 setae on posterior margin.

Coxal plates 5 and 6 (Figures 5A and 5B): Bilobate. Anterior lobe of coxal plate 5 small with 1 seta, posterior lobe with 5 setae on posterodistal corner. Coxal plate 6 with 4 setae on posterodistal corner.

Coxal plate 7 (Figure 5C): With 7 setae on posterior margin. Coxal gills 2-7 present.

Gnathopod 1 (Figures 3A and 3B): Basis with long setae (up to 1.5 times longer than diameter of segment) on both anterior and posterior margins; carpus and propodus elongate; propodus with 1 group of setae on anterior margin, palm oblique, bearing 1 blunt median spine, 4 (2 + 2) palmar angle spines in addition to some small spines on posterodistal margin of the segment; dactylus with 1 seta on its outer margin.

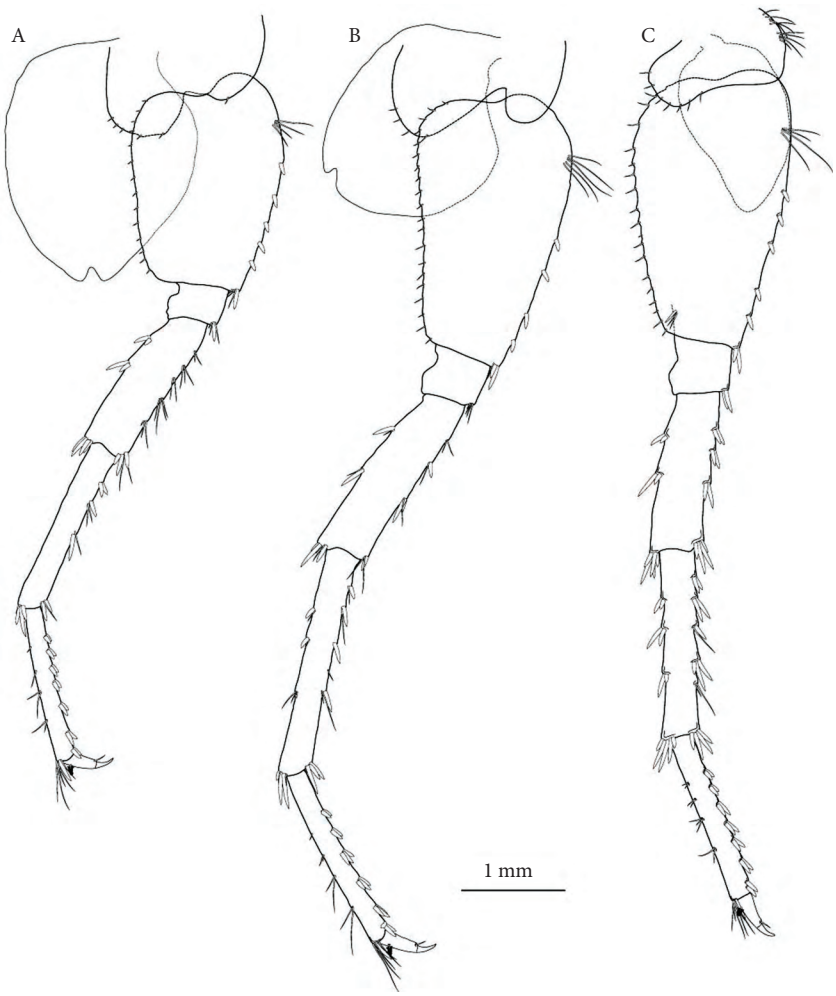

Figure 5. *Gammarus obruki* sp. nov. Holotype male: A) pereopod 5, B) pereopod 6, and C) pereopod 7.

Gnathopod 2 (Figures 4C and 4D): Basis with long setae (up to 2 times longer than diameter of segment) on anterior and posterior margins; anterior margin of carpus with 3 groups of setae; propodus subrectangular, with 2 groups of short setae on outer surface of anterior margin and many long setae on posterior margin; inner margin with 4 groups of setae on anterior part; median spine present, with 3 spines on posterodistal margin; dactylus with 1 seta on outer margin.

Pereopod 3 (Figure 4E): Slender; anterior and posterior margins of basis bear many long setae (up to twice longer than diameter of segment); merus and carpus densely setose along their posterior margins, setae on posterior margins long (up to 1.8 times longer than diameter of segment where implanted); dactylus with 1 serrated seta on outer margin, 2 setae at joint of unguis.

Pereopod 4 (Figure 4F): Slender; anterior and posterior margins of basis with many long setae; posterior margins of merus and carpus bear few groups of long setae (shorter and sparser than those of pereopod 3); dactylus with 1 serrated seta on outer margin, 2 setae at joint of unguis.

Pereopods 5-7 (Figures 5A-5C): Subequal in length; basis of pereopod 5 subrectangular; bases of pereopods 6 and 7 quadrangular and relatively elongated, anterior margins with 3-5 short spines, posterior margins with 14-20 short setae; articles 4-6 slim, with 2-4 groups of spines on anterior and posterior margin of each segment; anterior margin of segments 3 and 4 with a few setae as long as or

slightly longer than spines; dactylus with 1 seta on outer margin, 2 setae at joint of unguis.

Epimeral plates 1-3 (Figure 2): Epimeral plate 1 with 9-10 setae on anterior corner; epimeral plate 2, posterodistal corner is rectangular or slightly pointed, with 2 spines on anteroventral margin; epimeral plate 3, posterodistal corner slightly pointed (never in the form of sharp hook), with 2 spines on anteroventral margin.

Pleopods 1-3 (Figure 2): Subequal; peduncle with some setae, bearing 2 retinacula accompanied by a few setae; rami with about 19 segments, fringed with plumose setae.

Urosomites 1-3 (Figure 2): Almost flat; each urosomite bears a dorsomedian and 2 dorsolateral groups of armaments on their posterior margins. Dorsolateral groups of first and second urosomites consist of a spine and 2-4 setae. The dorsomedian group of urosomite 1 consists of 2-3 spines and 2-4 setae, similar to urosomite 2. Third urosomite bears no spine (2-3 short setae only) in its dorsomedian group.

Uropod 1 (Figure 4I): Peduncle longer than rami, with 1 spine on base and 3 spines on outer margin; inner margin with 1 marginal and 1 distal spine; outer ramus slightly shorter than inner ramus (about 0.9 times as long as inner ramus), with 3 spines on inner margin; inner ramus with 4 spines on inner margin.

Uropod 2 (Figure 4H): Peduncle with 4 and 2 marginal spines on inner and outer margin, respectively, in addition to 2 distal spines; outer ramus shorter than inner ramus (about 0.8 times as long as inner ramus); outer ramus with 2 spines on outer margin; inner ramus with 3 spines on inner margin.

Uropod 3 (Figure 4G): Peduncle with 4-6 distal spines; inner ramus slightly shorter than outer ramus (about 0.9 times as long as outer ramus), with many plumose setae and some shorter simple setae on both margins; article 1 of outer ramus with 4 groups of spines on outer margin together with a few simple setae; inner margin with many plumose setae, first segment of outer ramus bears 3-4 distal spines, article 2 as long as adjacent spines.

Telson (Figure 3E): Deeply cleft; each lobe with 1-2 distal spine together with 4-5 longer distal setae and 2-3 lateral setae; the length of distal and lateral setae can be about 0.4 and 0.2 times as long as length of telson, respectively.

Description of allotype female: Antenna 1 (Figure 6A): Peduncle segments with few short setae shorter than diameter of the segment where they implanted; primary flagellum with 34-36 segments; accessory flagellum with 3-4 segments.

Antenna 2 (Figure 6B): Peduncle segments bear some groups of short setae on dorsal margin; setae on ventral margins almost twice as long as the diameter of the segment where they implanted; primary flagellum with 13-14 segments; the setation of flagellar segments is rich and the segments are not swollen; calceoli absent.

Gnathopod 1 (Figure 6C): Basis with 10 and 20 long setae on both anterior and posterior margins, respectively; setae can be up to 2 times longer than the diameter of basal segment on anterior margin and those on posterior margin up to 3 times longer than the diameter of the segment; propodus ovate with 3 groups of setae on anterior margin, palm not as oblique as that of male, with 2 spines on posterior corner, dactylus with 1 seta on outer margin.

Gnathopod 2 (Figure 6D): Carpus and propodus elongate, propodus subrectangular, medial palmar spine absent, bearing 3-4 spines on posterior corner and some spines on inner margin.

Pereopods 3-7 (Figures 6E-6I): Similar setation to those of male.

Uropod 3 (Figure 6M): Inner ramus shorter than outer ramus (about 0.7 times as long as outer ramus); inner ramus with many plumose setae on both margins and 1 spine on outer margin; article 2 of outer ramus slightly longer than the spines on distal part of first article; inner margin of outer ramus with many plumose setae; outer margin of outer ramus with 4 groups of spines accompanying some simple setae longer than the spines. Oostegites are broad, ovate, and occur on pereopods 2 to 5.

Etymology: The new species name "OBRUK" is derived from the name of the Cave Research Team whose members collected the amphipod samples from the İnderesi Cave.

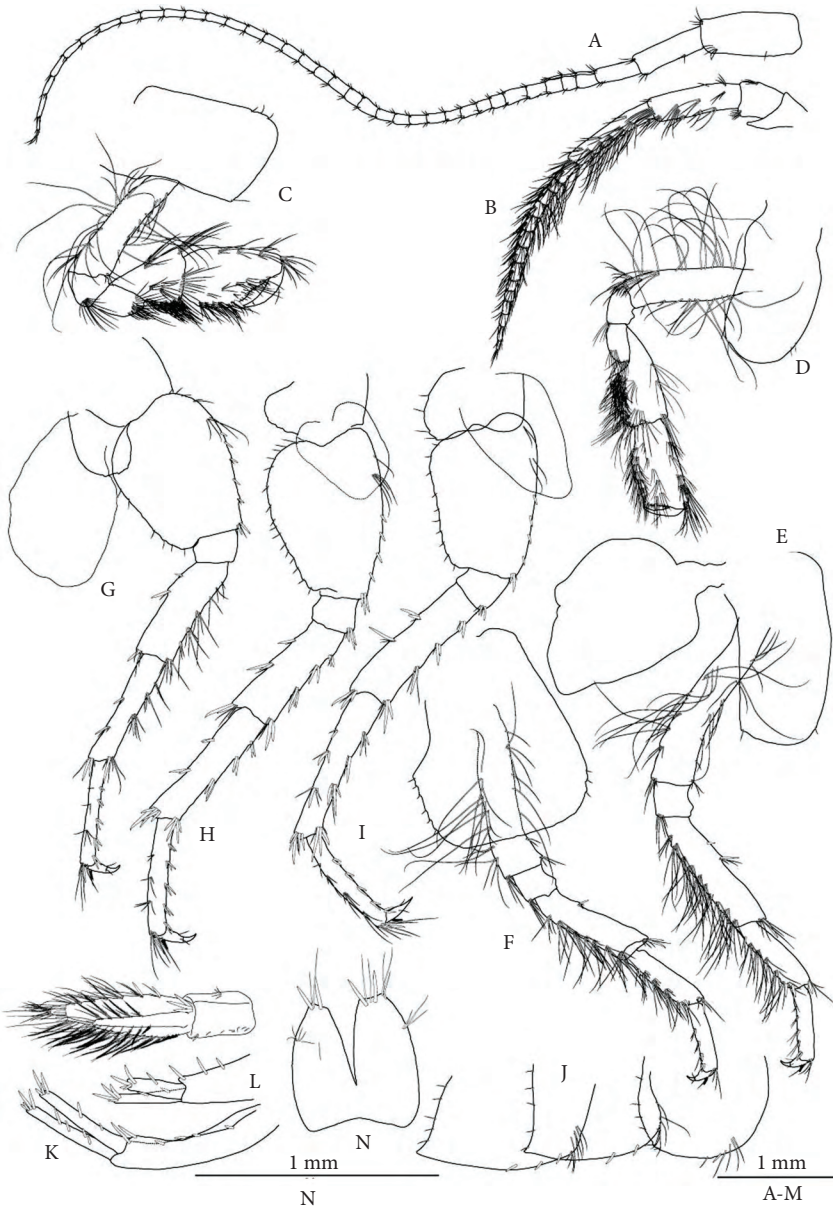

Figure 6. *Gammarus obruki* sp. nov. Allotype female: A) antenna 1, B) antenna 2, C) gnathopod 1, D) gnathopod 2, E) pereopod 3, F) pereopod 4, G) pereopod 5, H) pereopod 7, I) pereopod 6, J) epimeral plates, K) uropod 1, L) uropod 2, M) uropod 3, and N) telson.

Habitat: Specimens were sampled from the dark zone of the İnderesi Cave. The new species is known from the type locality only.

Remarks: At first sight, this species looks similar to *Gammarus komareki* Schäferna 1922, mainly because of its densely setose antenna 2. However, the presence of an increased number of flagellar segments of both antenna 1 and 2, the absence of long setae on the fourth peduncular segment, and the absence of plumose setae on the outer margin of the outer ramus of uropod 3 are characteristic features of the new species (see Table). Moreover, the adult males of the new species are larger in size and have bigger eyes than those of *G. komareki*.

This new species also resembles *G. pretzmanni* Mateus & Mateus 1990, *G. parthicus* Stock et al.

Table. Comparison of some distinct characters of *Gammarus obruki* sp. nov. with similar congeners.

Character	*G. obruki* sp. nov.	*G. komareki*	*G. pretzmanni*	*G. parthicus*	*G. balutchi*	*G. sepidannus*	*G. shirazinus*	*G. loeffleri*	*G. hegmatanensis*	*G. sirvannus*	*G. monspeliensis*
Maximum body length	21 mm	15 mm	12 mm	19 mm	12.5 mm	19 mm	23 mm	14 mm	18 mm	16.2 mm	21 mm
Number of articles in primary/accessory flagellum of antenna 1	36-52/6	31-39/3-5	25/3	30-36/4	23-28/3-4	18-29/2-3	30-36/3	27-30/3-4	25-27/4	26/4	45-50/6
Number of articles in flagellum of antenna 2	14-17	10-13	10	14	10-12	11-14	10-16	11-16	8-10	11	15
Setosity of fourth peduncular segment	3-5 groups of short setae	Very densely setose	Very densely setose	4-5 groups of long setae	Very densely setose	Very densely setose	Densely setose	Very densely setose	Densely setose	Very densely setose	3-5 groups of short setae
Setosity of fifth peduncular segment	Densely setose	Very densely setose	Very densely setose	Densely setose	Very densely setose	Very densely setose	Very densely setose	Very densely setose	Densely setose	Very densely setose	3-5 groups of short setae
Setosity of merus and carpus of pereopod 3	Very densely setose	Densely setose	Merus with a few long setae	Densely setose	Very densely setose	Very densely setose	Very densely setose	Densely setose	Densely setose	Densely etose	Very densely setose
Setosity of anterior margins of pereopods 5-7	Spines with a few onger setae	Few setae longer than spines	Few setae longer than spines	Spines with a few short setae	Spines with a few short setae	Spines with a few short setae	Spines with very long setae	Spines with very long setae	Spines with a few longer setae	Spines with a few setae	Spines with a few setae
Endopod-to-exopod ratio of uropod 3	About 9/10	About 3/4	About 3/4	About 3/4	About 2/5	About 1/2	About 3/4	About 3/5	About 4/5	About 2/3	About 3/4

1998, *G. balutchi* Khalaji-Pirbalouty & Sari 2006, *G. sepidannus* Zamanpoore et al. 2009, *G. shirazinus* Zamanpoore et al. 2010, *G. loeffleri* Zamanpoore et al. 2010, *G. hegmatanensis* Hekmatara et al. 2011, and *G. sirvannus* Hekmatara et al. 2011 in having densely setose antenna 2, but the new species differs from all of them by the presence of the prolonged flagellum of antenna 1 in addition to other character combinations (see Table).

The new species also resembles *G. monspeliensis* Pinkster 1972 in having long antenna 1, but *G. obruki* differs from it by the setation of peduncular segments of antenna 2, by the shape of epimeral plates, and by the absence of well-developed urosomites (see Table).

Variability: Variability can be found in the number of flagellum segments of antenna 1 in males. Larger specimens have longer antenna 1 and this character seems to be age-dependent. Among the male paratypes, the number of flagellum segments of antenna 1 varies between 36 and 52.

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