

**GRANDIDIERELLA HALOPHILUS A NEW SPECIES OF THE FAMILY AORIDAE
(CRUSTACEA: AMPHIPODA) FROM THE SALTPANS OF
THE INNER GULF OF THAILAND**

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ABSTRACT. — A new species of *Grandidierella* is described from the Inner Gulf of Thailand. This species inhabits high saline waters of abandoned salt pans from the Samut Sakorn district, Thailand. It appears to be closely related to *Grandidierella propodentata* Moore, 1986, also collected at hypersaline environments, in having an accessory flagellum; and arborescent setae on the inner face of the outer lobe of lower lip. The main diagnostic features of *Grandidierella halophilus* new species are a coxal plate 2 with ventral margin posteriorly produced into triangular expansion; uropod 3 peduncle inflated with ramus bearing a small second article; lower lip with arborescent setae on the inner face of the outer lobe; and bifid robust setae on antennae 1–2, gnathopods 1–2, pereopods 5–7, and uropods 1–2. This combination of characters has not been recorded previously in the *Grandidierella*.

KEY WORDS. — *Grandidierella halophilus*, new species, taxonomy, salt pans, Gulf of Thailand

INTRODUCTION

Species of the genus *Grandidierella* Coutière, 1904, are predominant and widespread in brackish, estuarine and coastal waters worldwide. There is extensive literature on the occurrence of *Grandidierella* species from the marine habitats (Myers, 1970, 1981, 1998; Ren, 2006; Bochert & Zettler, 2010; Azman & Othman, 2012), yet there are only two existing records of *Grandidierella* (*G. propodentata* Moore, 1986 and *G. exilis* Myers, 1981) from hypersaline environments. There are many reports of the 40 described species of *Grandidierella* worldwide. However, only three *Grandidierella* species are reported from the waters of Thailand and adjacent archipelagos, namely *G. gilesi* Chilton, 1921, *G. taihuenensis* Morino & Dai, 1990, and *G. gravipes* K. H. Barnard, 1935 (Chilton, 1925; Bussawich, 1985; Angsupanich & Kuwabara, 1995; Angsupanich et al., 2005; Ruensirikul et al., 2007; Ariyama et al., 2010). In the present study we provide a detailed description of both male and female specimens of *G. halophilus* new species collected from abandoned salt pans in the inner Gulf

of Thailand. Interestingly, although *G. halophilus* is fairly abundant in these salt pans, there has been no detailed study on this organism.

MATERIAL AND METHODS

This study is based upon material collected from various abandoned salt pans of the Samut Sakorn Province (Fig. 1), Inner Gulf of Thailand in Feb.2011. Samples were collected from the host plant (*Ruppia maritima* Linnaeus) and wet sieved through a 0.55-mm mesh sieve. The materials retained on the sieve were then carefully transferred into plastic containers and fixed in 10% buffered formalin. In the laboratory, amphipod specimens were sorted out and stored in 70% alcohol. The animals were then examined under a compound microscope and later selected for dissection. The appendages of the dissected specimens were examined and figures were produced using a Leica DMLB light microscope with a camera lucida. All illustrations were digitally 'inked' following Coleman (2003). Figure legend: A, antenna; G,

gnathopod; HD, head; LL, lower lip; MD, mandible; MX, maxilla; MP, maxilliped; P, pereopod; Pl, pleopod; T, telson; U, uropod; UR, urosome; UL, upper lip; R, right; L, left; ♂, male; ♀, female. Type material is deposited at Prince of Songkla University Zoological Collection with the prefix PSUZC for museum numbers and the Universiti Kebangsaan Malaysia Muzium Zoologi with the prefix UKMMZ for museum numbers.

TAXONOMY

Genus *Grandidierella* Coutière, 1904

Diagnosis. — Eyes small to medium. *Antenna 1*, accessory flagellum minute, 1-segmented. *Maxilla 1*, inner plate vestigial. *Coxae* very small, relatively short of various sizes and shapes. *Gnathopod 1* (male) complexly subchelate and greatly larger than gnathopod 2. *Gnathopod 2* subchelate. *Pereopods 6–7*, dactylus elongate, falcate. *Uropods 1–2* biramous; rami slightly subequal; peduncle with ventrodistal process. *Uropod 3* uniramous. *Telson* entire.

Species composition. — *Grandidierella* contains 41 species: *G. africana* Schellenberg, 1936; *G. bispinosa* Schellenberg, 1938; *G. bonnieroides* Stephensen, 1948; *G. cabindae* (Schellenberg, 1925); *G. chelata* K. H. Barnard, 1951; *G. chaohuensis* Hou & Li, 2002; *G. dentimera* Myers, 1970; *G. elongata* (Chevreux, 1926); *G. exilis* Myers, 1981; *G. fasciata* Ariyama, 1996; *G. gilesi* Chilton, 1921; *G. gravipes* K. H. Barnard, 1935; *G. grossimana* Ledoyer, 1967; ***G. halophilus* new species, 2011**; *G. indentata* Ledoyer, 1979; *G. insulæ* Myers, 1981; *G. ischienoplia* Bochert & Zettler, 2010; *G. japonica* Stephensen, 1938; *G. kanakensis* Myers, 1998; *G. koa* J. L. Barnard, 1977; *G. lignorum* K. H. Barnard, 1935; *G. longidactyla* Ledoyer, 1982; *G. lutosa* K.H. Barnard, 1952; *G. macronyx* K. H. Barnard, 1935; *G. mahafalensis* Coutière,

1904 (**Type species**); *G. makena* J. L. Barnard, 1970; *G. malaccaensis* Azman & Othman, 2012; *G. nottoni* Shoemaker, 1935; *G. nyala* Griffiths, 1974; *G. osakaensis* Ariyama, 1996; *G. palama* J. L. Barnard, 1977; *G. perlata* Schellenberg, 1938; *G. propodentata* Moore, 1986; *G. robusta* Ledoyer, 1982; *G. rhizophorae* Myers, 2009; *G. spinicoxa* Myers, 1972; *G. taihuensis* Morino & Dai, 1990; *G. teres* Myers, 1981; *G. trispinosa* Bano & Kazmi, 2010; *G. unidentata* Ren, 2006; *G. vietnamica* Dang, 1968.

Grandidierella halophilus, new species

(Figs. 2–10)

Type Material. — *Holotype*. Male, THAILAND, Inner Gulf of Thailand, Samut Sakorn (13.5100768°N, 100.3525478°E), abandoned saltpans (associated with *Ruppia maritima* Linnaeus), 24 Feb. 2011, Phenraphai, P., PSUZC-CR-0261.

Allotype. Female, collected with holotype, PSUZC-CR-0262 (adult female, 3.9 mm).

Other material. Same data as holotype, UKMMZ-1431 (10♂; 15♀); PSUZC-CR-0263 (10♂; 20♀).

Description. — **Male** (*holotype*) (Figs. 3–6). Total body length 6.9 mm. *Body* slender and subcylindrical.

Head. *Head* subequal in length to first 2 pereonites; rostrum not developed; inferior antennal sinus moderate and concave, 0.3 times of head length; *eye* distinct. *Antenna 1* (Fig. 3A1) slightly longer than antenna 2, ratio of peduncular articles 1–3 as 1: 1.7: 1.1; article 1 slender, with 2 postero-marginal spines; flagellum with 22 articles, 1.4 times as long as peduncle; accessory flagellum uni-articulate, short. *Antenna 2* (Fig. 3A2) peduncle stout; 4 segmented in ratio of 1: 3: 10: 7; inner margin of article 3 with 3 robust setae and 2 posterodistal robust setae; article 5 shorter than 4; flagellum short, subequal in length to peduncular article 5, composed of 7 articles; flagellum articles 2–7 with a pair of curved bifid robust setae on each article.

Upper lip (Fig. 5UL) or labrum round and broad, with small depression in the middle and pubescent on each lobe. *Lower lip* (Fig. 5LL) inner plates well developed and subtriangular in shape, mandibular process narrow but well developed; outer plate with arborescent setae on the inner face of the outer lobe, covered with thin hairs. *Mandible* (Fig. 5MD), both similar to each other except for number of accessory blades constituting 4 in right and 5 in left ones; right incisor 4 dentates, left incisor 5 dentates; lacinia mobilis armed with 4 teeth on left side and 5 teeth on right; molar process medium, ridged distally and serrate marginally, armed a single seta; palp triarticulate with ratios of 1: 1.2: 1.1, article 3 with apical setae and marginal setae. *Maxilla 1* (Fig. 5MX1), inner plate small; outer plate with 8 apical robust setae; palp extending beyond outer plate, biarticulate with 6 apical spines. *Maxilla 2* (Fig. 5MX2), inner plate with mediofacial row of 25 slender setae and one robust seta located in the middle, outer margin naked; outer plate subequal in size with inner plate. *Maxilliped* (Fig. 5MP), inner plate broad and short, apically provided with several plumose setae and 3 marginal setae; outer plate broad, almost reaching palp

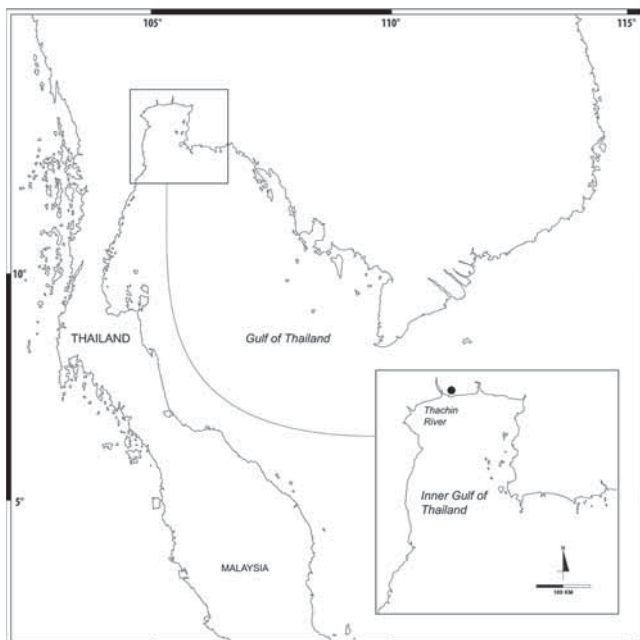


Fig. 1. Map showing the sampling area.

article 2 with 13 marginal spines; palp 4-articulate with ratio of 2: 3: 3.2 : 1.

Pereon. *Gnathopod 1* (Fig. 3G1) carpochele, larger than gnathopod 2; coxal plate subrectangular, inner side bearing ventral process; length ratio of articles from basis to dactylus 7.8: 1: 2.7: 8: 3.5: 3.5; basis slender, anterior margin straight, 3.9 as long as broad, with one fine seta on posterodistal margin; ischium short, subrectangular; merus trapezoidal, anterodistally produced; carpus 1.6 times as long as broad, posterodistal corner produced with tooth and a smaller tooth present on inner face, posterior margin setose with a small tooth; propodus subequal to dactylus in length, 0.5 times length of carpus, posterior margin proximally concave, distally expanded; dactylus fairly curved, distal end concave with 2 robust setae. *Gnathopod 2* (Fig. 3G2) subchelate; coxa plate shallow with ventral margins posteriorly produced into triangular expansion; length ratio of articles from basis to dactylus 4.6: 1: 1.7: 3.8: 3.3: 1.8; basis slender, as long as articles 5 and 6 combined, anterior margin straight with 6 fine setae; ischium subrectangular; merus trapezoidal, posterior distal angle produced, posterior margin bearing long setae; carpus 2.5 times as long as wide, posterior margin crenulate, bearing 25 dense setae; propodus palmar margin transverse, with fine setae, bearing a bifid robust seta at posterodistal corner and 2 bifid robust setae on posterior margin; dactylus

slightly longer than palmar margin, inner margin crenulate with several fine setules.

Pereopod 3 (Fig. 4P3) slender; coxa plate small, subquadrate; length ratio of articles from basis to dactylus 4.8: 1: 2.5: 1.7: 1.7: 1.2; basis slender, sparsely setose on anterior and posterior margins and posterodistal corner; ischium short, subrectangular; merus slightly produced anterodistally; carpus suboval, posterior margin setose; propodus narrow, both margin bearing setae; dactylus long and thin, shorter than propodus. *Pereopod 4* (Fig. 4P4) similar to pereopod 3, coxal plate with ventral margin medially produced triangular; length ratio of articles from basis to dactylus 4.1: 1: 2.5: 1.4: 1.6: 1.1; basis slender, with short setae on anterior margin; ischium short, subrectangular; merus slightly produced anterodistally; carpus oval with setae on both anterior and posterior margins; propodus long and narrow, bearing setae on both anterior and posterior margins; dactylus long and thin. *Pereopod 5* (Fig. 4P5) coxa posteroventrally expanded into long, narrowly obtuse angle; length ratio of articles from basis to dactylus 5.8: 1: 2.2: 1.8: 0.8; basis subrectangular with fine setae along anterior margin; ischium short; carpus with two robust setae along posterior margin and on posterodistally; propodus with four robust setae along posterior margin; dactylus short, strongly curved. *Pereopod 6* (Fig. 4P6) elongate, 1.6 times as long as pereopod 5;



Fig. 2. Photography of *Grandidierella halophilus* new species, holotype, male, (PSUZC-CR-0261), 6.9 mm; allotype, female, (PSUZC-CR-0262), 3.9 mm, Samut Sakorn, Inner Gulf of Thailand.

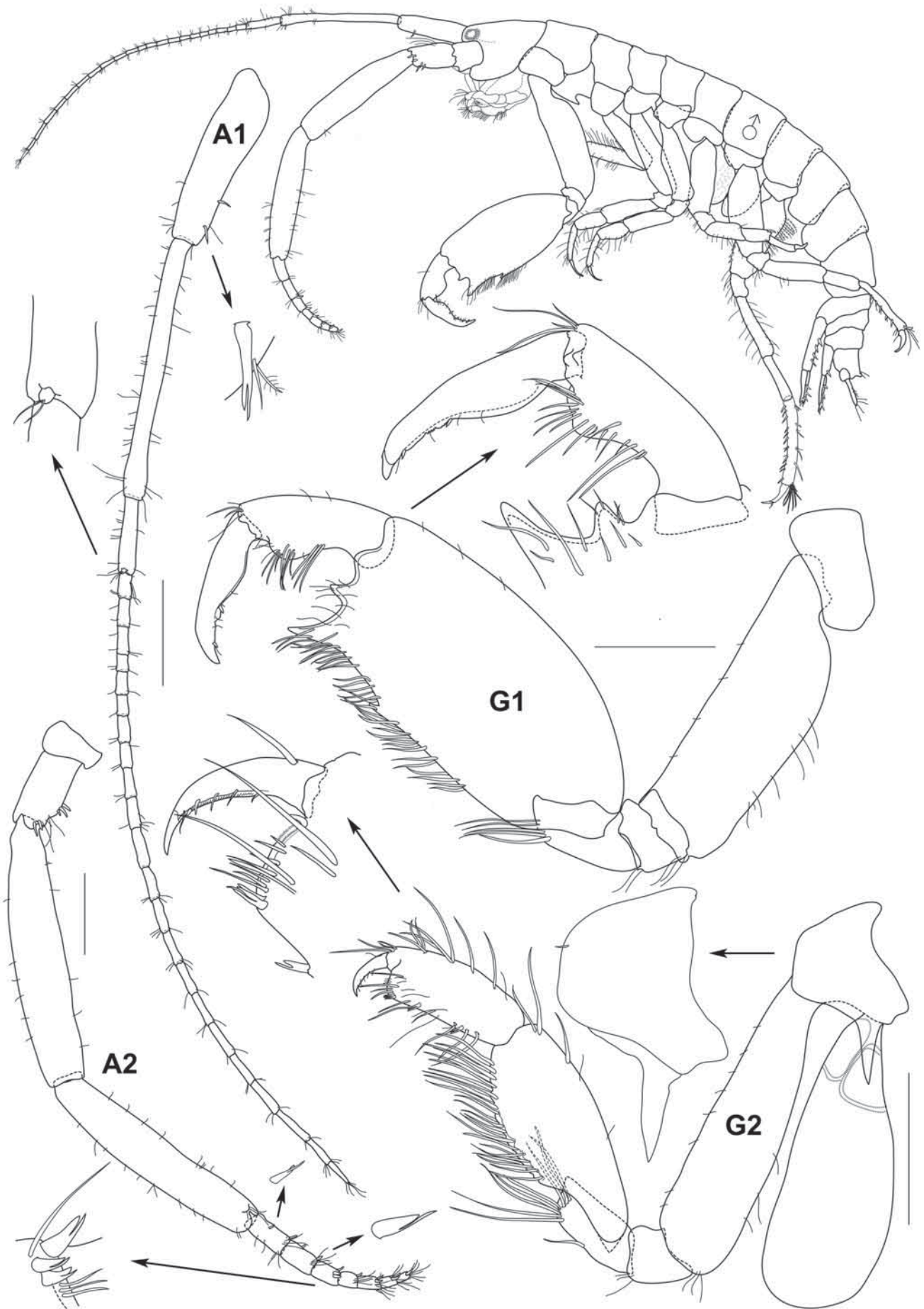


Fig. 3. *Grandidierella halophilus* new species, holotype, male, (PSUZY-CR-0261), 6.9 mm. Samut Sakorn, Inner Gulf of Thailand. All scale bars represent 0.5 mm.

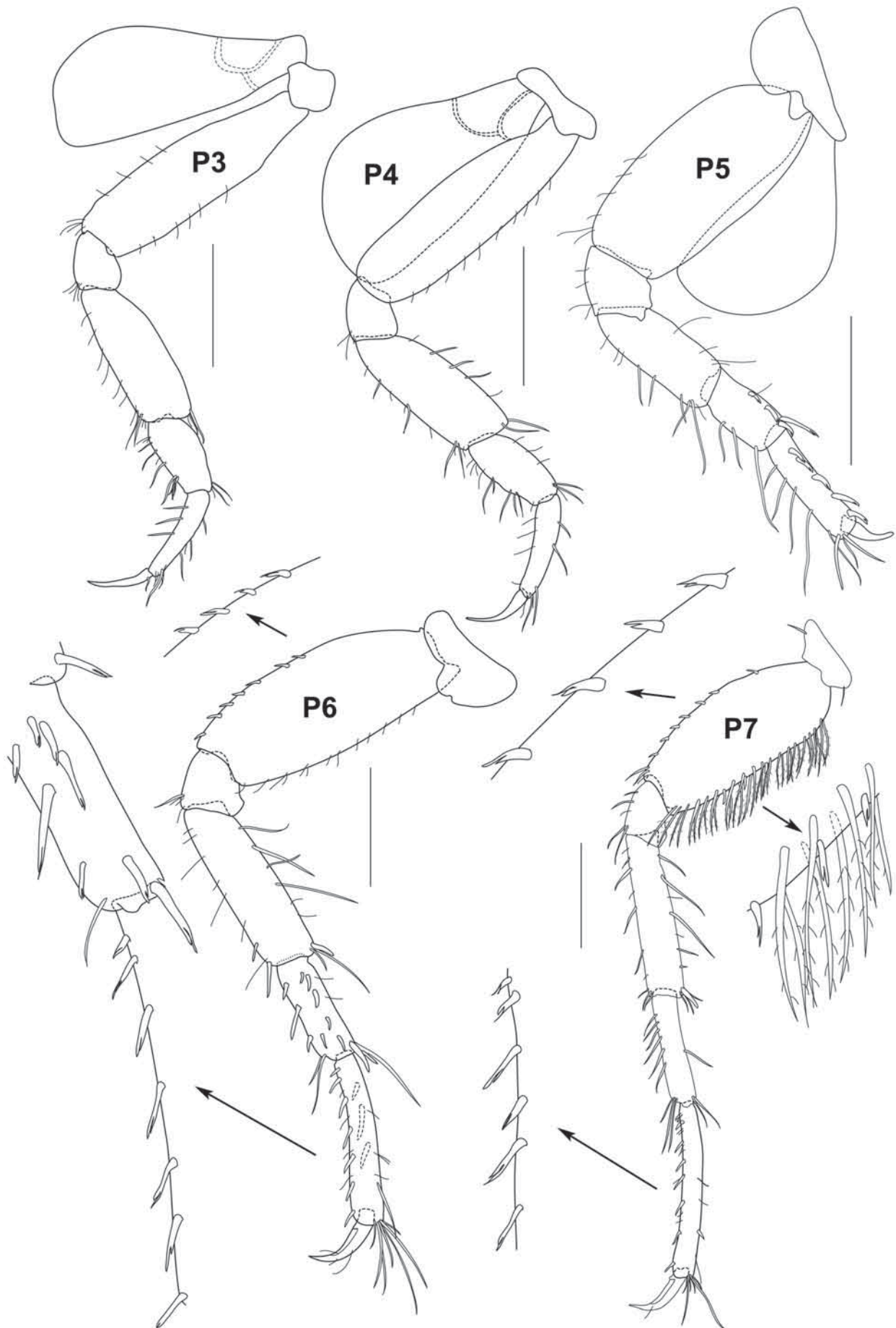


Fig. 4. *Grandidierella halophilus* new species, holotype, male, (PSUZC-CR-0261), 6.9 mm. Samut Sakorn, Inner Gulf of Thailand. All scale bars represent 0.5 mm.

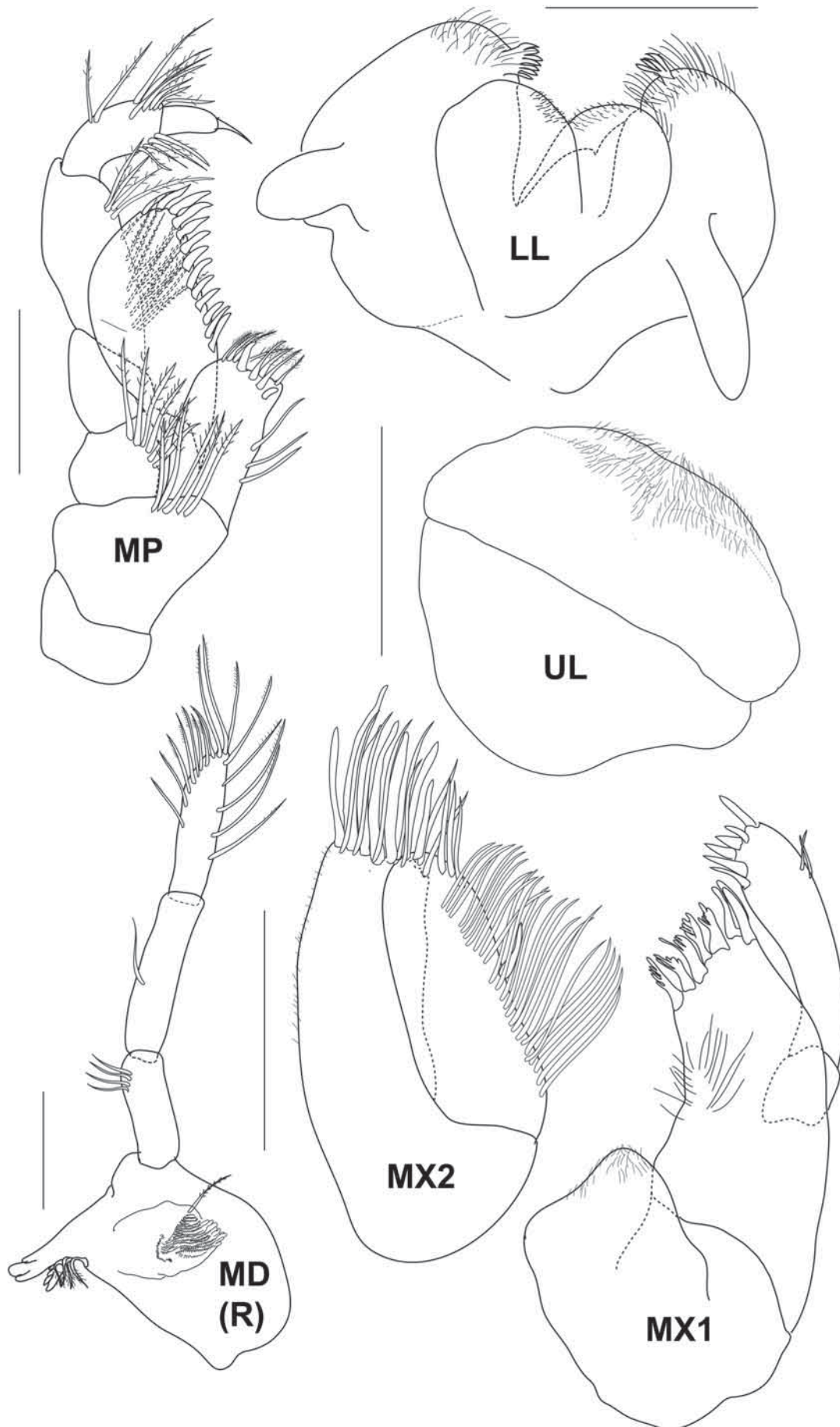


Fig. 5. *Grandidierella halophilus* new species, holotype, male, (PSUZC-CR-0261), 6.9 mm. Samut Sakorn, Inner Gulf of Thailand. All scale bars represent 0.2 mm.

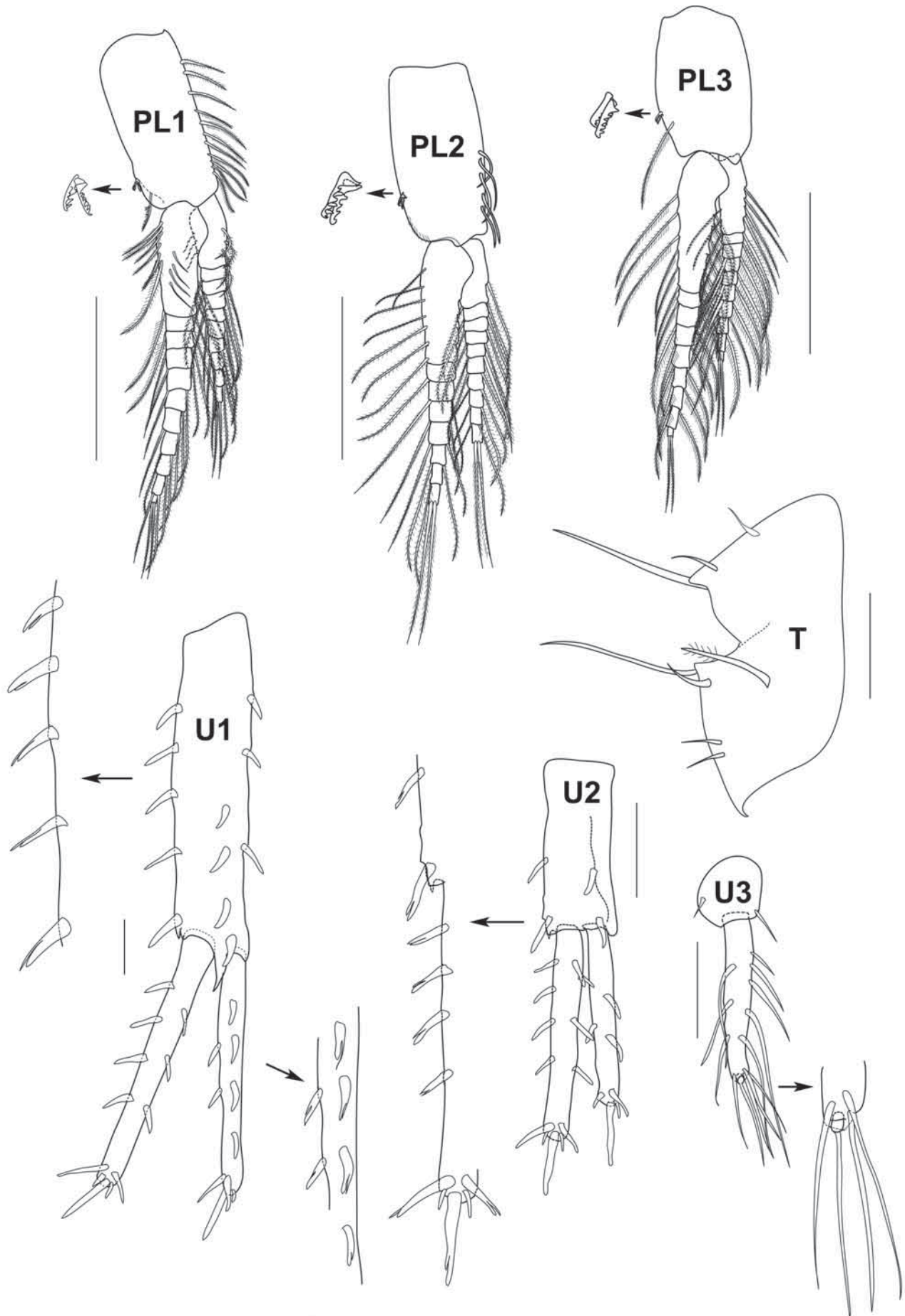


Fig. 6. *Grandidierella halophilus* new species, holotype, male, (PSUZC-CR-0261), 6.9 mm. Samut Sakorn, Inner Gulf of Thailand. Scale bars for U1–U3 represent 0.1 mm; PL1–PL3 represent 0.5 mm; T represents 0.05 mm.

coxa posteriorly produced with rounded lobe; length ratio of articles from basis to dactylus 3.7: 1: 2.7: 1.7: 3.3: 1; basis almost linear, with 7 small bifid robust setae along anterior margin; ischium short with setae on anteroventral corner; merus oblong, with bifid marginal robust setae on both anterior and posterior margins; carpus bearing two rows of bifid robust setae; propodus slender, slightly curved with two rows of marginal robust setae and setose posterodistally; dactylus tapering to a sharply pointed tip, subapex bearing small setae on both sides. *Pereopod 7* (Fig. 4P7) elongate, 1.8 times as long as pereopod 5; coxa bilobed, shallow; length ratio of articles from basis to dactylus 3.3: 1: 2.3: 1.7: 2.7: 1; basis anterior margin with a row of bifid robust setae and posterior margin with long plumose setae bifid robust setae; ischium short and subrectangular; merus elongate with setae on anterior and posterior margins, with one bifid robust seta posterodistally; carpus shorter and narrower than merus with several midlength setae along anterior margin; propodus elongate and slender, slightly curved with bifid robust setae along anterior margin; dactylus tapering to pointed tip, with one thin setae 2/3 from proximal end.

Pleon. *Pleopods 1–3* (Fig. 6PL1-PL3) well developed; peduncles cylindrical, longer than broad and fringed with several plumose setae and a pair of retinaculae on anterior margin; inner ramus slightly longer than peduncle with 9–10 articles, outer ramus shorter than inner ramus, both rami with facial setae.

Uropod 1 (Fig. 6U1) not extending beyond ends of other uropods; peduncle longer than inner and outer rami, fringed with bifid robust setae, peduncular apex bearing a posteroventral process; outer and inner margins of both rami lined with a row of robust setae, distal margins rounded and bearing with several robust setae. *Uropod 2* (Fig. 6U2) slightly longer than uropod 3, peduncle shorter than inner and outer rami, both with two bifid robust setae; outer ramus slightly longer than inner one, both rami lined with a row of bifid robust setae and distal margin bearing short and long robust setae. *Uropod 3* (Fig. 6U3) uniramous, peduncle much shorter than ramus; ramus elongate with short second article, both outer and inner margins with a row of long setae; apex with 4 long stiff setae. *Telson* (Fig. 6T) subtrapezoidal, ending with double pointed apex, each with one long robust seta and one short (thin) seta.

Female. (*allotype*) (Figs. 7–10). Total body length 3.9 mm (from tip of rostrum to apex of telson). – (sexually dimorphic characters).

Antenna 1 (Fig. 7A1) without accessory flagellum, flagellum with 15 articles. *Antenna 2* (Fig. 7A2) peduncular article 3 with 2 bifid robust setae at ventrodistal corner. Maxilla 2, inner plate without robust setae.

Pereon. *Gnathopod 1* (Fig. 7G1) subchelate, smaller than that of male. Coxal plate deeper than those of male; basis more robust, 1.8 times as long as broad; carpus subtriangular, 1.5 times as long as broad, posterior margin setose, with the posterior distal margin produced into a short stout tooth; propodus oval, shorter than carpus, palm oblique and defined

by a large bifid robust seta, palmar margin with short setule, distal end covered sparse plumose setae; dactylus curved with 3 inner marginal short stout robust setae. *Gnathopod 2* (Fig. 7G2) similar to that of male, slightly smaller to gnathopod 1; basis slender; carpus 2.2 times as long as wide; propodus wider than that of male, palm transverse and defined by 2 large bifid robust setae; dactylus curved, grasping margin with fine setule and 5 short stout robust setae.

Etymology. — The specific name “*halophilus*” is a combination of the Greek *halos* = salt and *philus* = friend, loving, referring to the habitat in which this species lives.

Remarks. — The specimens of *Grandidierella halophilus* new species were collected in a hypersaline habitat (~80 ppt) and associated with seagrass (*Ruppia maritima* Linnaeus). To date, only two *Grandidierella* species have been reported from hypersaline environments (*G. propodentata* and *G. exillis*). The former species shows a distinctive similarity with *G. halophilus* in the existence of the unusual arborescent setae on the inner face of the outer lobe of the lower lip (Moore, 1986: Fig. 2e. In addition, several differences also can be seen in comparing with *G. propodentata*, including (1) the spout-like male antenna 2 article 4 (vs. normal) (Moore, 1986: Fig. 2a); (2) the inwardly directed proximal tooth on male gnathopod 1 propodus (vs. posterior margin proximally concave, distally expanded; Moore, 1986: Fig. 1a) and (3) male gnathopod 1 carpus triangular with two large subequal teeth at posterodistal corner (vs. posterodistal corner with produced tooth and posterior margin setose with a small tooth; Moore, 1986: Fig. 1a). The new species differs from *G. exillis* in the presence of an accessory flagellum (Fig. 3A1); presence of the arborescent setae on the inner face of the outer lobe of the lower lip (Fig. 5LL); and by the presence of a second article on uropod 3 ramus (Fig. 6U3).

A sternal process in the male *G. halophilus* new species is seems to be unique among *Grandidierella* members. Only four species, *G. bonnieroides*, *G. exillis*, *G. trispinosa*, and *G. spinicoxa* share this distinct character. The new species, *Grandidierella halophilus*, is similar to *G. bonnieroides* in having the male sternal process; gnathopod 1 carpochele with posterodistal corner with a produced tooth, inner face with a produced small tooth and posterior margin setose with a small tooth. As reported by Myers (1970), in his investigations on material from the Caribbean and Gulf of Mexico, the sternal process in *G. bonnieroides* shows considerable variation between populations, suggesting that most of the populations are genetically distinct. In agreement with Asari & Myers (1982), the south Indian *G. bonnieroides* also exhibits distinct local variations displaying the possibility of group sibling species.

Grandidierella halophilus can be easily distinguished from all other known species of the genus in the combination of the following characters: (1) coxal plate 2 with ventral margin posteriorly produced into triangular expansion (Fig. 3G2); (2) uropod 3 peduncle inflated with ramus bearing a small second article (Fig. 6U3); (3) lower lip with arborescent setae on the inner face of the outer lobe (Fig. 5LL). Moreover, all

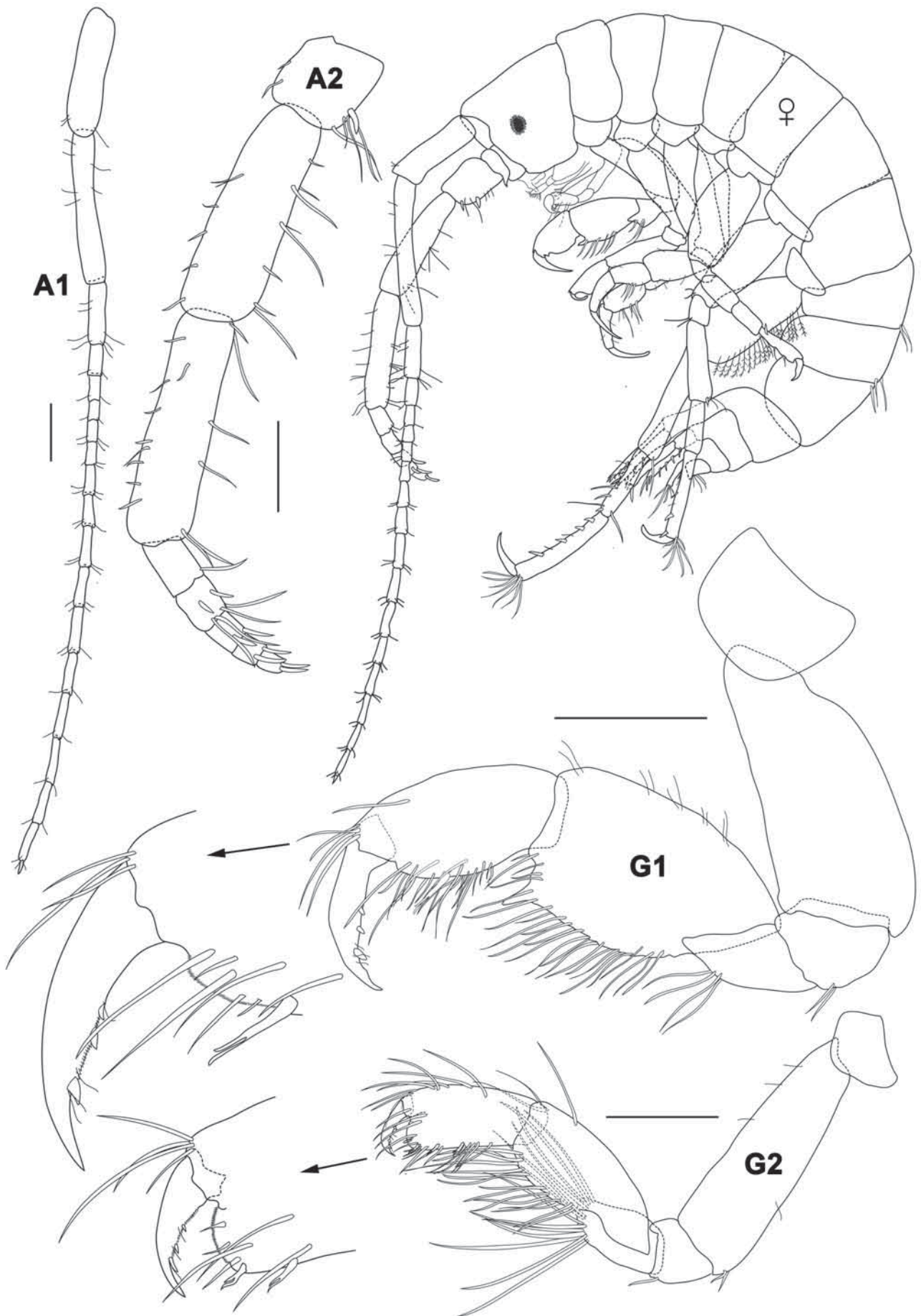


Fig. 7. *Grandidierella halophilus* new species, allotype, female, (PSUZC-CR-0262), 3.9 mm. Samut Sakorn, Inner Gulf of Thailand. All scale bars represent 0.2 mm.

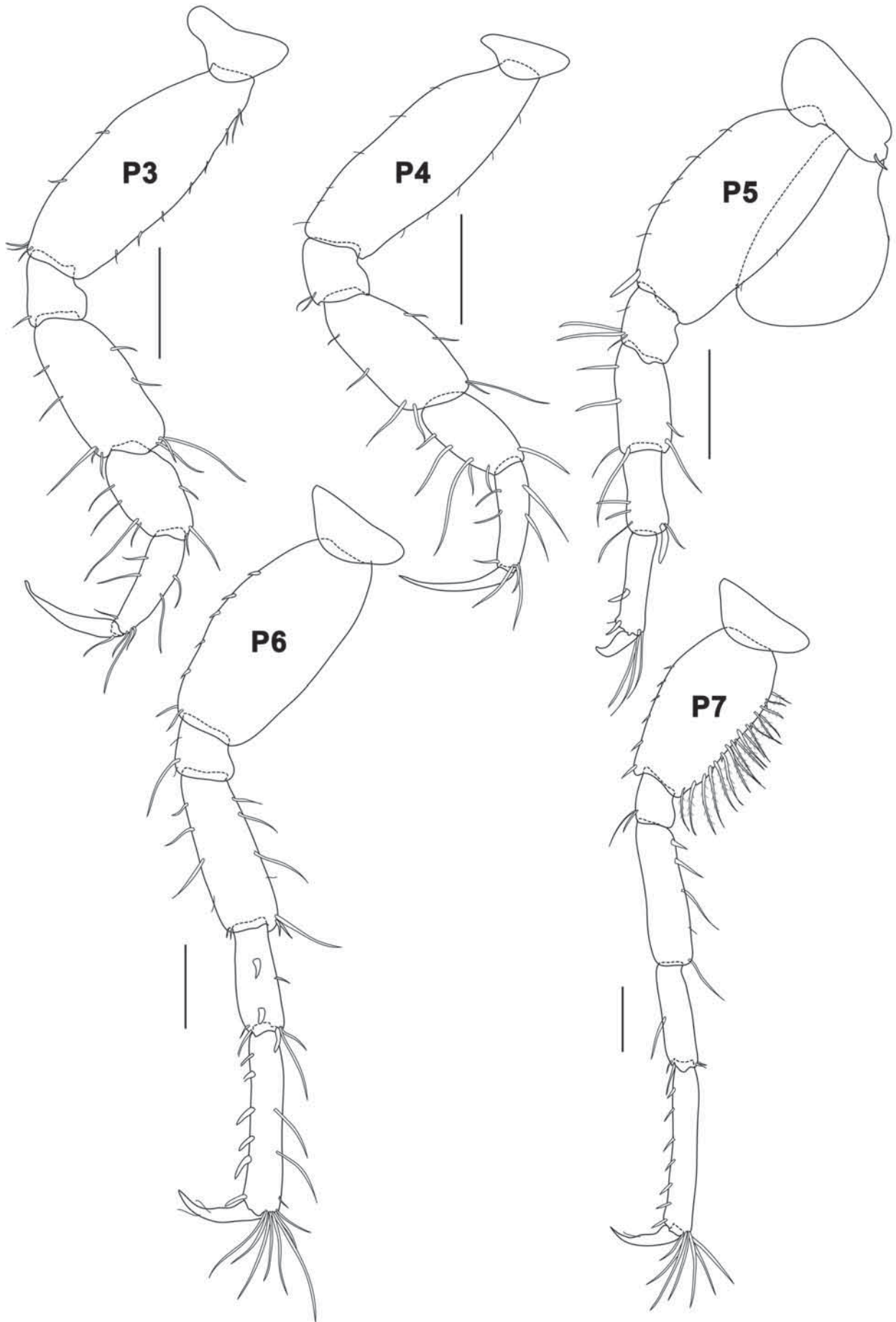


Fig. 8. *Grandidierella halophilus* new species, allotype, female, (PSUZC-CR-0262), 3.9 mm. Samut Sakorn, Inner Gulf of Thailand. All scale bars represent 0.2 mm.

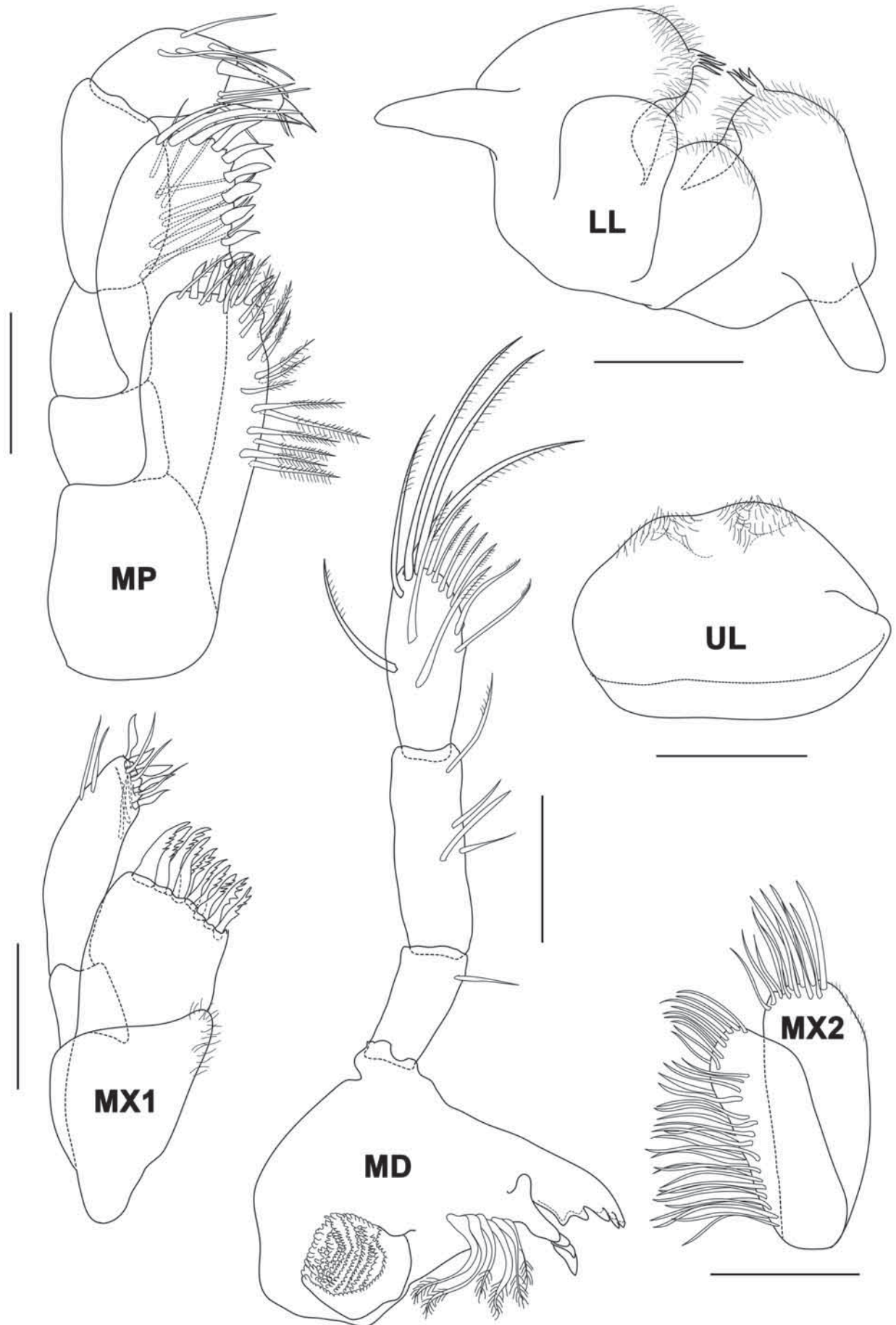


Fig. 9. *Grandidierella halophilus* new species, allotype, female, (PSUZC-CR-0262), 3.9 mm. Samut Sakorn, Inner Gulf of Thailand. All scale bars represent 0.1 mm.

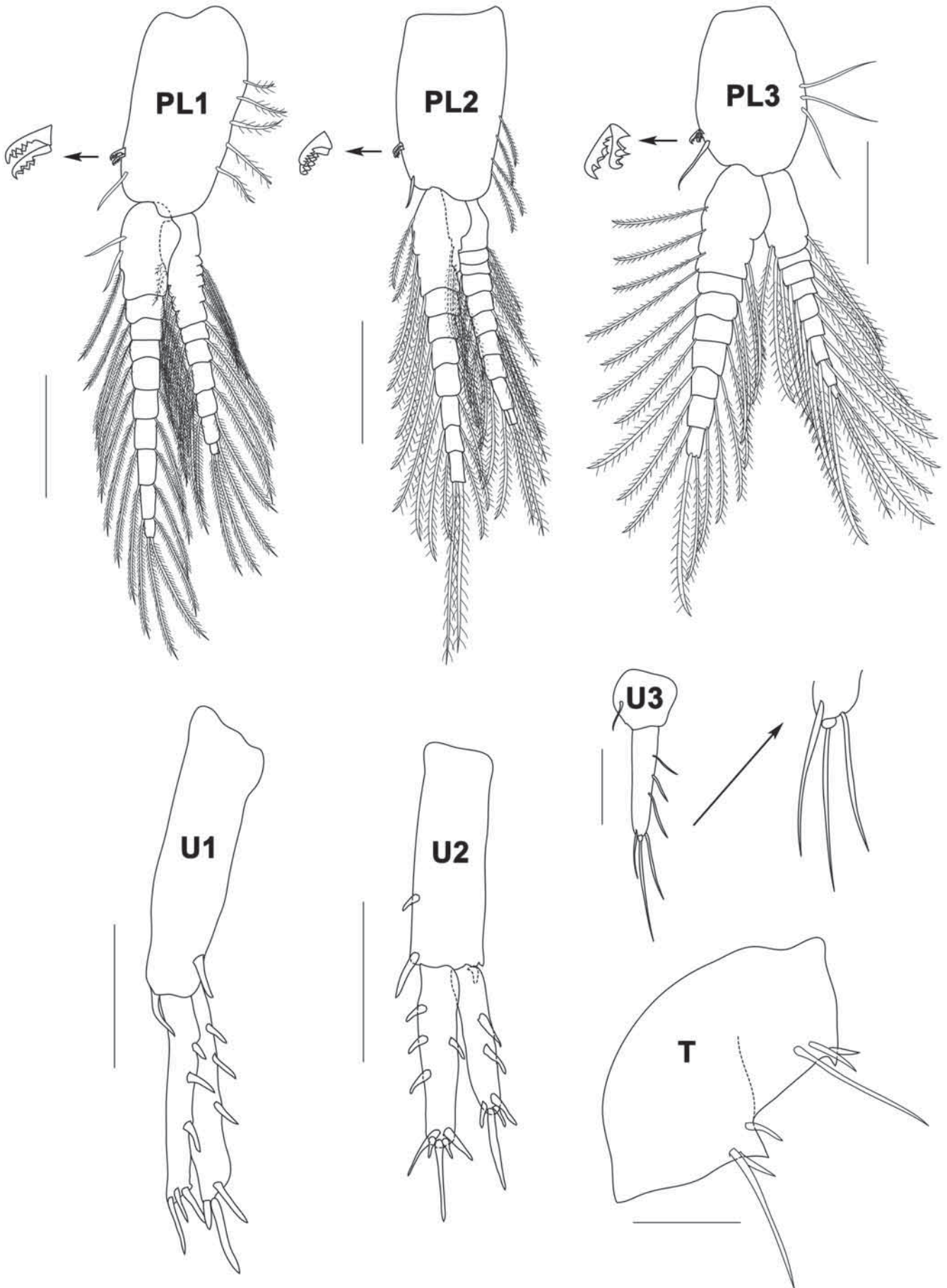


Fig. 10. *Grandidierella halophilus* new species, allotype, female, (PSUZYC-CR-0262), 3.9 mm. Samut Sakorn, Inner Gulf of Thailand. Scale bar for U3 represents 0.05 mm; U2, U3 and T represent 0.1 mm, remaining represents 0.2 mm.

Table 1. Comparison of diagnostic character in some closely related *Granddierella* species.

	Body length (mm)	Accessory flagellum	Lower lip	Sternal spine	Basis of male G1 (Length/Width)	G1 (Carpus: Propodus)	Propodus of male G1	Carpus of G1				
								with a tooth	Basis of G2 (length/width)	Coxae 2-4	Basis of P6 & P7	U3 rami
<i>G. halophilus</i>	6.9	present	outer plate with two finger-like robust setae on lobes	present	slender (4x)	2.9x	posterior margin distally expanded	with a tooth	slender (2.06x) anterior margin smooth	coxa 2 produced anteriorly	anterior with small bifid robust setae	elongate with short second article
<i>G. bispinosa</i> Schellenberg, 1938	4.5	present	outer plate well developed with brittle shoulders	absent	stout (2.18x)	2.25x	posterior margin distally expanded	smooth	slender (2.53x), crenulate anterior margin	coxae 2-4 not produced	anterior with small robust setae	elongate with short second article
<i>G. bonnerioides</i> Stephensen, 1948	4.5	absent	outer plate well developed with brittle shoulders	present	slender (2.25x)	2x	inflated in the middle	with a tooth	slender (3.2x) anterior margin smooth	coxae 2-4 not produced	anterior with small robust setae	elongate with one article
<i>G. exillis</i> Myers, 1981	7.5	absent	outer plate well developed with brittle shoulders	present	slender (2.46x)	2x	inflated in the middle	smooth	slender (5x) anterior margin smooth	coxae 2-4 not produced	anterior margin with long plumose setae	elongate with one article
<i>G. mahafalensis</i> Coutière, 1904	6.7	present	outer plate well developed with brittle shoulders	absent	slender (2.63x)	2.06x	posterior margin distally expanded	with a tooth	slender (3.04x) anterior margin smooth	coxae 2-4 not produced	anterior margin with long setae	elongate with one article
<i>G. propodentata</i> Moore, 1986	8.2	present	outer plate with two finger-like robust setae on lobes	absent	slender (2.76x)	1.46x	with tooth on basal	smooth	slender (4.29x) anterior margin smooth	coxae 2-4 not produced	anterior margin with small setae	elongate with one article
<i>G. spinicoxa</i> Myers, 1972	8.0	present	outer plate well developed with brittle shoulders	present	slender (2.11x)	2.24x	inflated in the middle	smooth	slender (4x) anterior margin smooth	coxa 2-4 produce anteriorly	anterior margin with long setae	elongate with one article
<i>G. trispinosa</i> Bano & Kazmi, 2010	6.6	no data	no data	present	slender (2.9x)	3x	posterior margin distally expanded	smooth	slender (3.6x) anterior margin smooth	coxa 2-4 produced anteriorly	anterior margin with long setae	elongate with one article

of the robust setae occurring on antennae 1–2, gnathopods 1–2, pereopods 5–7 and uropods 1–3 are bifid. This character has not been reported elsewhere in the genus but has been shown in illustrations for *G. mahafalensis* (Ruffo, 1958) and *G. propodentata* (Moore, 1986). A summary of the distinguishing characters of the species discussed here given in Table 1.

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