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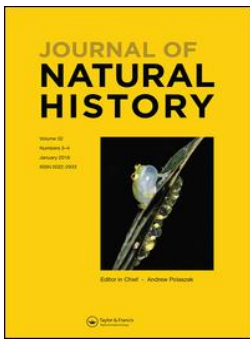
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To cite this article: Sung Joon Song, Pawana Kangtia, Jong Seong Khim & Supawadee Chullasorn (2018) Two new Asian species of the genus *Scottolana* Huys, 2009 (Copepoda: Canuelloida: Canuellidae), *Journal of Natural History*, 52:7-8, 377-403, DOI: [10.1080/00222933.2018.1432777](https://doi.org/10.1080/00222933.2018.1432777)

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Two new Asian species of the genus *Scottolana* Huys, 2009 (Copepoda: Canuelloida: Canuellidae)

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Two new species of the family Canuellidae Lang, 1944, *Scottolana jasani* sp. nov. collected from Gusipo Beach, Korea and *S. huysi* sp. nov. from Kata Beach, Phuket Island, Thailand, are described. So far 14 species are currently known in the genus, of which only two, *S. bulbifera* from Russia, China, and Korea, and *S. geei* from China, have been reported from Asia. The new species, *Scottolana jasani* sp. nov. and *S. huysi* sp. nov., belong to the *longipes*-group, defined by the presence of two postgenital segments in the female, and caudal ramus with a proximal hook-like inner projection. *Scottolana jasani* sp. nov. closely resembles *S. geei*. However, it is easily distinguished by the following characters: (1) number of segments of antennal exopod (8 in the new species, but 9 in *S. geei*); (2) setae I, and II of caudal ramus; (3) shape of genital field in both sexes; (4) segmentation of mandibular exopod; and (5) spinular ornamentation of endopod-2 in P1. *Scottolana huysi* sp. nov. is also closely related to *S. geei*. However, it is unique and different from *S. geei* by (1) indistinctly 4-segmented antennule in the female; (2) 5-segmented male antennule; (3) larger genital field in female; (4) inner long seta on P4 coxa; and (5) the morphology of caudal seta II, being long and plumose, with a bulbiform base in the female only.

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ARTICLE HISTORY

Received 24 December 2017
Accepted 16 January 2018
Online 15 February 2018

KEYWORDS

Canuelloida; *Scottolana*;
Korea; Thailand;
longipes-group

Introduction

Canuellid harpacticoids exhibit a wide range of life styles and habitats. A few genera, *Sunaristes* Hesse, 1867, *Intersunaristes* Becker and Schriever, 1979, *Parasunaristes* Fiers, 1982, and *Echinosunaristes* Huys, 1995, have been recorded in association with invertebrate hosts such as hermit crabs, amphipods, and echinoids (Humes and Ho 1969; Falck and Bowman 1994; Huys 1995; 2016). Some canuellids are epibenthic, while others are interstitial. They live in mud, sand, and in coralline debris, and can be found in the intertidal, in the subtidal, and even in the deep sea down to 2000 m depth (Por 1969; Becker and Schriever 1979; Boxshall and Halsey 2004).

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The genus *Scottolana* Huys, 2009 was proposed by Por (1967) to reallocate three species, *Sunaristes inopinata* Thompson and Scott, 1903, *Sunaristes longipes* Thompson and Scott, 1903, and *Sunaristes curticaudata* Thompson and Scott, 1903. However, the genus name was unavailable because Por (1967) did not designate a type species and his generic diagnosis was not informative to express differential morphological characteristics from other genera (Huys 2009). Huys (2009) proposed and re-established the generic name as *Scottolana* Huys, 2009 in accordance with ICZN art. 16.1, with a new type species, *Scottolana geei* Mu and Huys, 2004 (ICZN Art. 13.3). To date, the genus *Scottolana* accommodates 16 species, including *Scottolana jasani* sp. nov. from Korea, and *Scottolana huysi* sp. nov. from Thailand.

Previously to this paper, only two species of *Scottolana* have been described from Asia, *Scottolana bulbifera* (Chislenko, 1971) from Posset Bay, Russia (Chislenko 1971), Bohai Sea, China (Mu and Huys 2004), and Yellow Sea and South Sea, Korea (Park and Lee 2011), and *S. geei* from Bohai Sea, China (Mu and Huys 2004).

In the present contribution, we provide the detailed morphological description of both sexes of two new Asian species of *Scottolana* collected from Korea and Thailand, respectively. The new species from Thailand was previously recorded by Dexter (1996) as '*Canuella* n. sp.' from seven beaches (including Kata) along the west coast of Phuket Island (R. Huys, pers. commun.).

Materials and methods

Specimens of *Scottolana jasani* sp. nov. were collected with a small plastic vessel from muddy sand sediments (depth 30 cm) at Gusipo Beach, west coast of Korea. Specimens were fixed in 95% ethanol. Specimens were cleared and dissected in lactic acid. Dissected appendages were mounted on slides in lactophenol as mounting medium. Preparations were sealed with transparent nail varnish. All drawings have been prepared using a drawing tube on an Olympus BX53 differential interference contrast microscope equipped with Nomarski optics.

To obtain the specimens of *S. huysi* sp. nov., fine sand sediments were taken at Kata Beach on Phuket Island, Thailand, using a 3.5 cm diameter x 10 cm length plastic hand corer inserted to a depth of 5 cm. The samples were subsequently sieved through 500 µm and 63 µm sieves. The meiofauna remaining on the latter sieve was then fixed for 24 h in a solution of 10% formalin with rose bengal. Copepods were separated, put in vials and fixed in 6% buffered formalin, and subsequently preserved in 70% ethanol. Specimens were cleared in lactic acid. All measurements and dissections were made using a Leica MZ8 stereomicroscope (Wetzlar, Germany). Drawings were made with the aid of a camera lucida mounted on a Nikon BH-2, HFX-DX compound microscope (Tokyo, Japan). Dissected specimens were mounted on slides in glycerol and sealed with transparent nail varnish.

The terminology of the body and appendage morphology follows Huys and Boxshall (1991) and Huys et al. (1996). Abbreviations used in the text are: A1, antennule; A2, antenna; ae, aesthetasc; exp, exopod; enp, endopod; exp-1, first segment of exopod; enp-1, first segment of endopod; P1–P6, first to sixth legs. Total body length was measured from the anterior tip of the rostrum to the posterior margin of the caudal rami. Measurements were made with an ocular and slide micrometer. The type material

of *S. jasani* sp. nov. was deposited in the collections of the Natural Institute of Biological Resources (NIBR), Korea. The type material of *S. huysi* sp. nov. was deposited in the Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA.

Taxonomy

Subphylum **CRUSTACEA** Brünnich
 Class **MAXILLOPODA** Dahl
 Subclass **COPEPODA** H. Milne Edwards
 Order **CANUELLOIDA** Khodami et al. 2017
 Family **CANUELLIDAE** Lang
 Genus *Scottolana* Huys, 2009
Scottolana jasani sp. nov.
 (Figures 1–8)

Type locality

Gusipo Beach, Jeollanam-do in Korea (35°26'36"N, 126°26'01"E), at 30 cm depth from muddy sand sediments; collected by Sung Joon Song.

Type material examined

Holotype female (NIBRIV0000787895): dissected on 16 slides. Allotype male (NIBRIV0000787896): dissected on 17 slides. Paratypes (NIBRIV0000787897): two females and five males preserved in alcohol. All specimens are from the type locality collected by Dr Sung Joon Song on 5 May 2006.

Etymology

The species was named after Jung, Yakjeon's pen name, Jasan, who was a great scholar in the Joseon Dynasty, and recorded 155 marine species from the Heuksan Island, Korea in 1814.

Description of the adult female (holotype)

Habitus (Figure 1(a)). Total body length 1.31 mm measured from anterior margin of rostrum to posterior margin of caudal ramus. Largest width at posterior border of cephalic shield. Body surface with long sensilla. All somites without distinct posterior hyaline frills, except for anal somite with smooth hyaline frill dorsally.

Urosome (Figures 1(a), 2(a)) gradually tapering posteriorly, 4-segmented consisting of P5-bearing somite, genital double-somite, one free urosomite and anal somite. Genital double-somite slightly wider than long; original segmentation marked by paired dorso-lateral and ventrolateral internal cuticular ribs (Figure 2(a)). P6 (Figure 2(c)) represented by 1 long outer seta and 2 internal projections (outer one very small). Anal operculum (Figure 1(a)) weakly developed without ornamentation.

Caudal rami (Figures 1(a), 1(b), 2(a), 2(d)) about twice as long as wide, with hook-like extension on inner margin proximally; outer margin and posteroventral surface with dense clusters of strong spinules of different lengths. Each ramus armed with 7 setae:

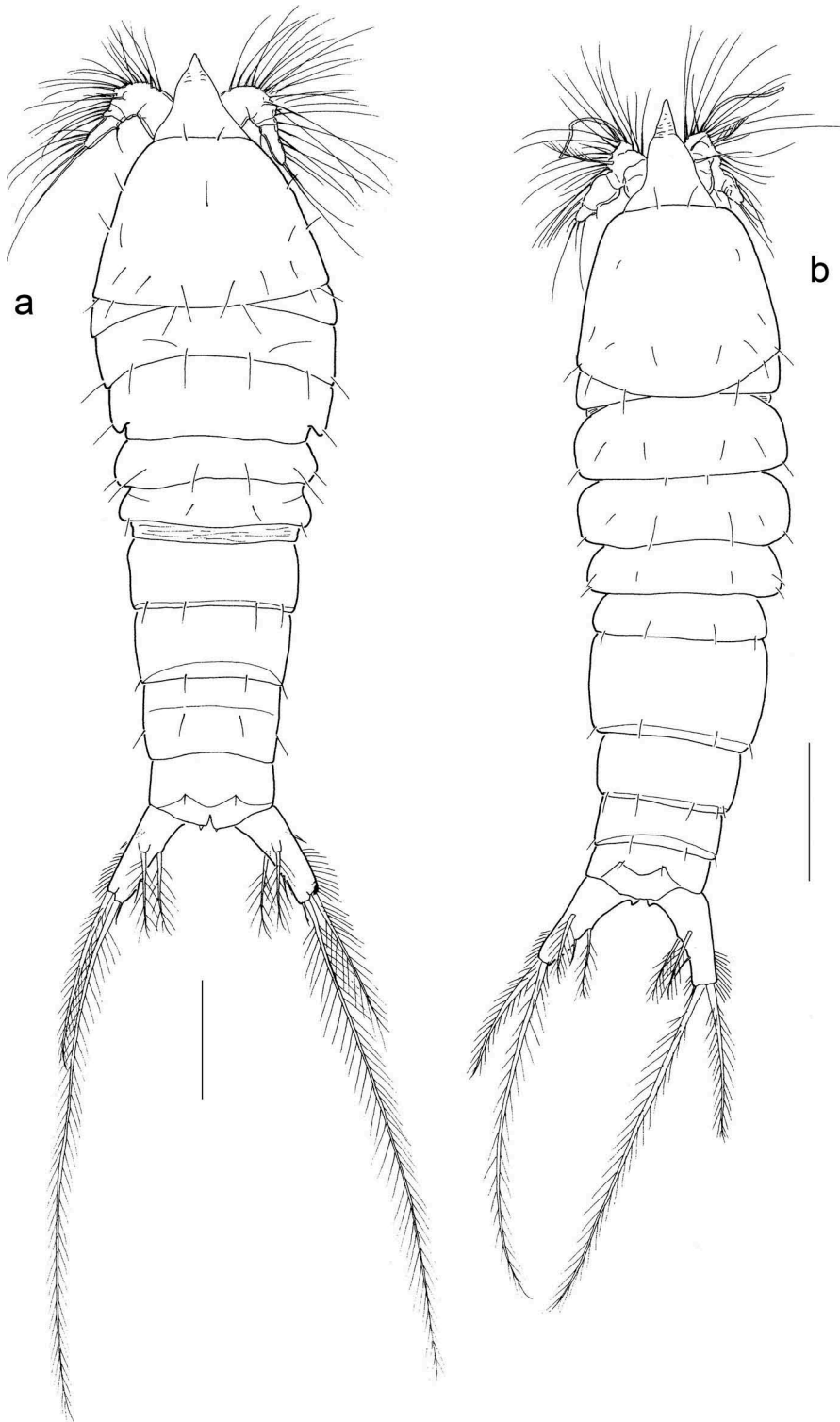


Figure 1. *Scottolana jasani* sp. nov. (a) Female habitus, dorsal view; (b) male habitus, dorsal view (scale: 200 μ m).

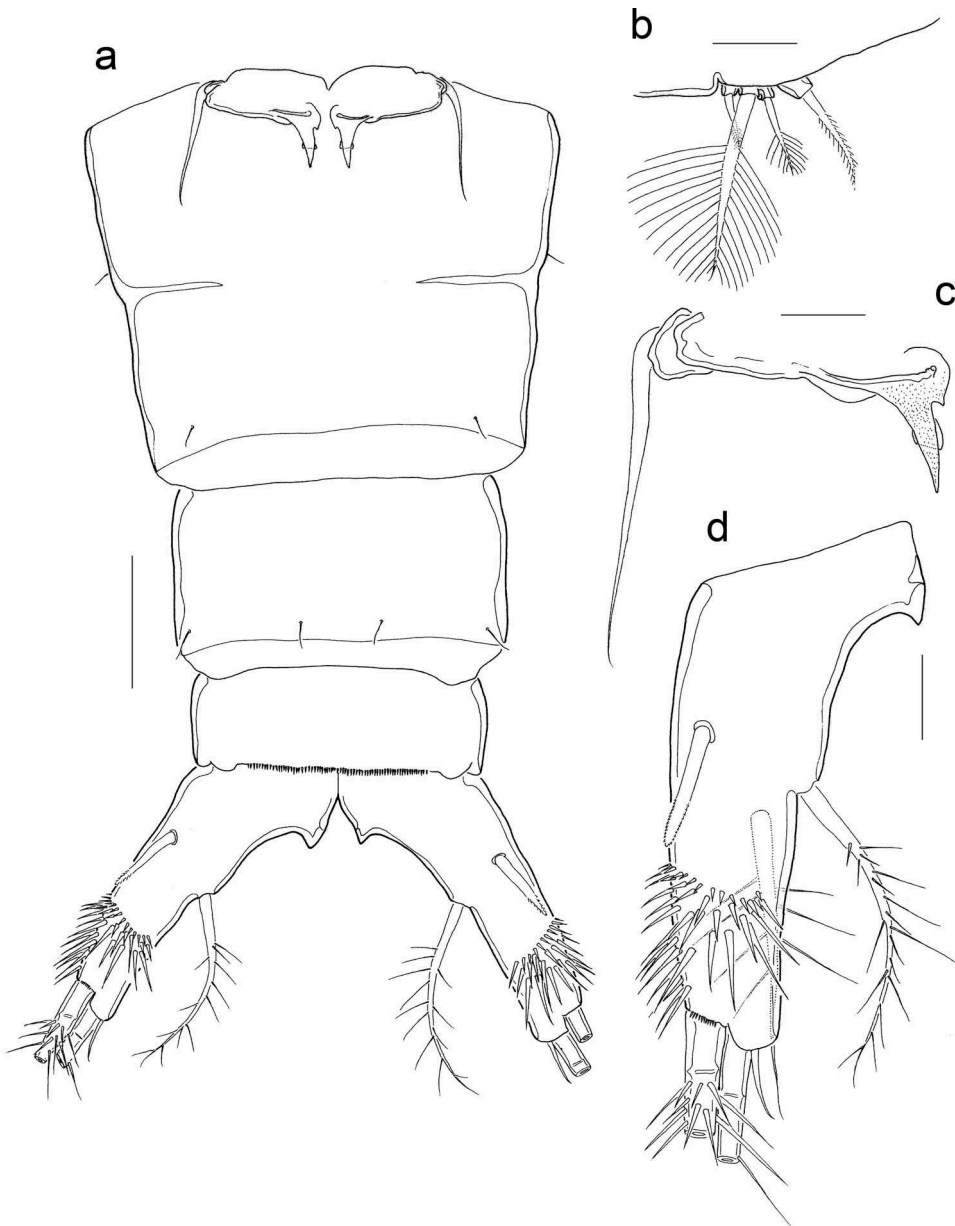


Figure 2. *Scottolana jasani* sp. nov. Female: (a) urosome, ventral; (b) P5, anterior; (c) right genital field; (d) caudal ramus, ventral (scale: a = 100 μ m, b–d = 20 μ m).

seta I strong and with dull at tip, arising ventrally; seta II long, plumose, normal, located halfway the inner margin; seta III plumose, dorsally displaced, issuing halfway the caudal ramus; distal margin of ramus with 3 setae as follows: seta IV and seta V well-developed, strongly spinulose; seta V about 3 times as long as the former (Figure 1(a)); seta VI small and bare; seta VII short and smooth, located on dorsal surface between setae II and VI.

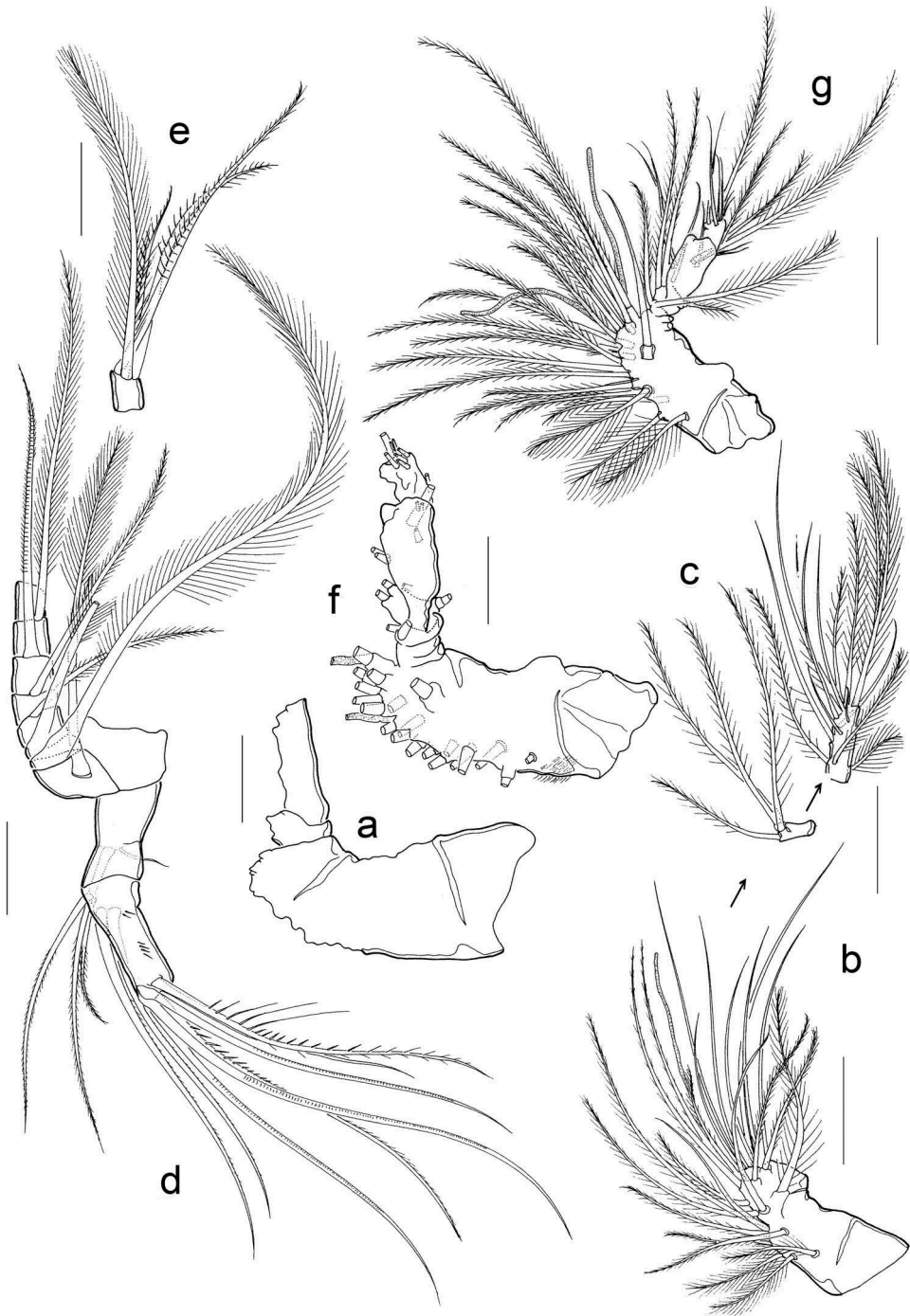


Figure 3. *Scottolana jasani* sp. nov. Female (a–e); male (f–g): (a) antennule without setae; (b) first segment of antennule; (c) second and third segments of antennule; (d) antenna; (e) distal segment of antenna; (f) antennule without setae; (g) antennule with setae (scale: a, d, e, f = 50 μ m, b, c, g = 100 μ m).

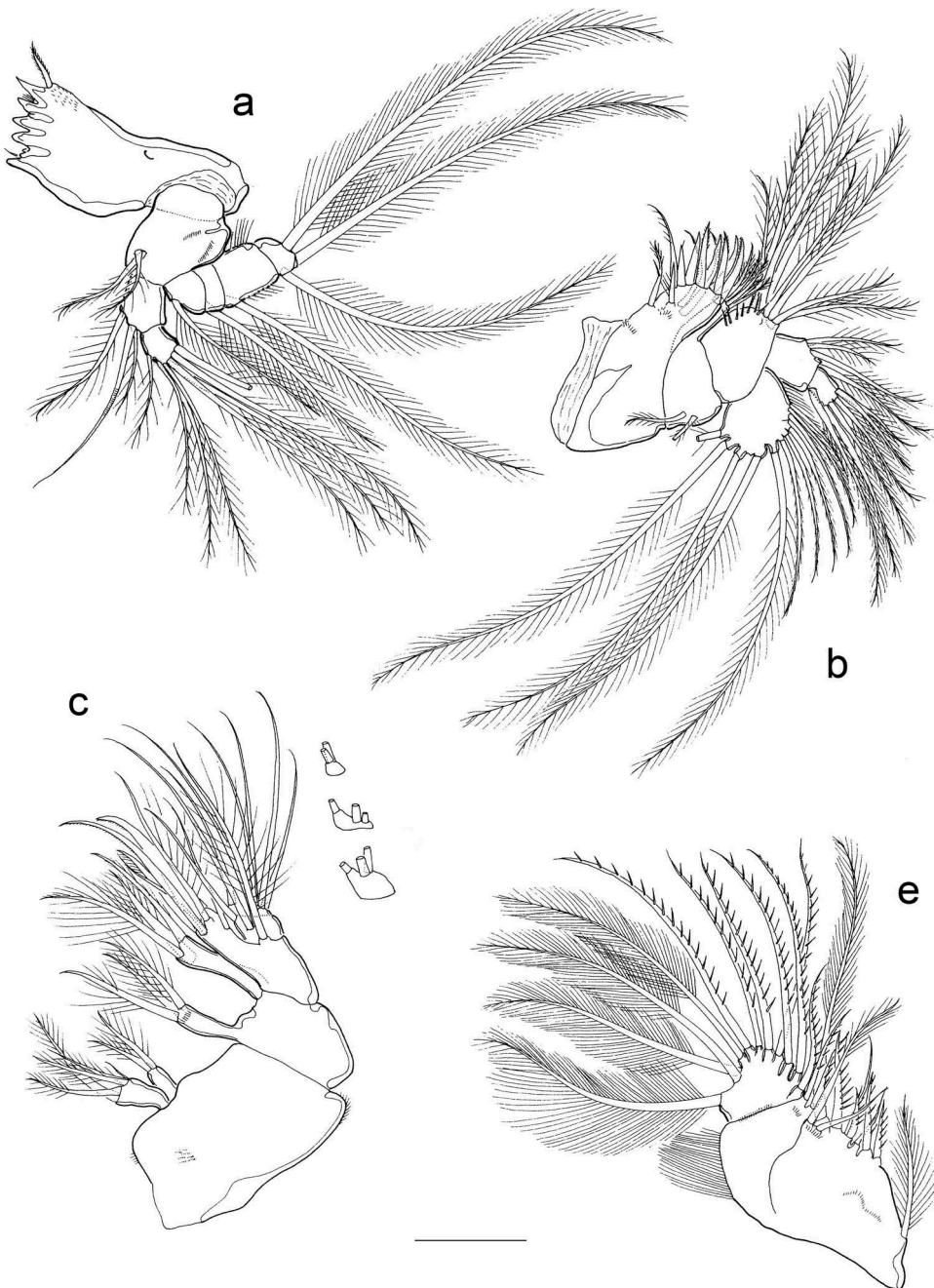


Figure 4. *Scottolana jasani* sp. nov. Female: (a) mandible; (b) maxillule; (c) maxilla; (d) distal three endopodal segments of maxilla; (e) maxilliped (Scale: 50 μ m).

Rostrum (Figure 1(a)) very large, bell-shaped with peaked tip, about 1.4 times as long as wide.

Antennule (Figure 3(a-c)) indistinctly 3-segmented. First segment longest and largest, showing 2 incomplete sutures in posterior margin, with 24 pinnate/smooth setae;



Figure 5. *Scottolana jasani* sp. nov. Female: P1, anterior (scale: 50 μ m).

second segment short, with 4 spinulose setae; distal segment with 14 setae. Armature formula: 1-(24 + 1ae), 2-(4), 3-(14).

Antenna (Figure 3(d), 3(e)) biramous; coxo-basis short. Endopod 2-segmented; enp-1 with 1 minute and 1 long pinnate seta; enp-2 with several setules, with 4 lateral pinnate setae and 6 apical setae. Exopod 8-segmented; segments 1–7 with 1 plumose seta each; segment 8 (Figure 3(e)) with 4 pinnate setae.

Mandible (Figure 4(a)) well-developed gnathobase bearing a row of 5 strong multi-cuspidate teeth and 2 small setae distally; with additional tiny spinules on anterior surface subdistally. Basis with 2 plumose setae and spinular rows as shown. Endopod 2-segmented; enp-1 with 1 bare and 2 plumose setae; enp-2 with 4 subapical and 4 apical setae. Exopod 4-segmented; all setae plumose; each segment with 1, 1, 1, and 3 setae, respectively.

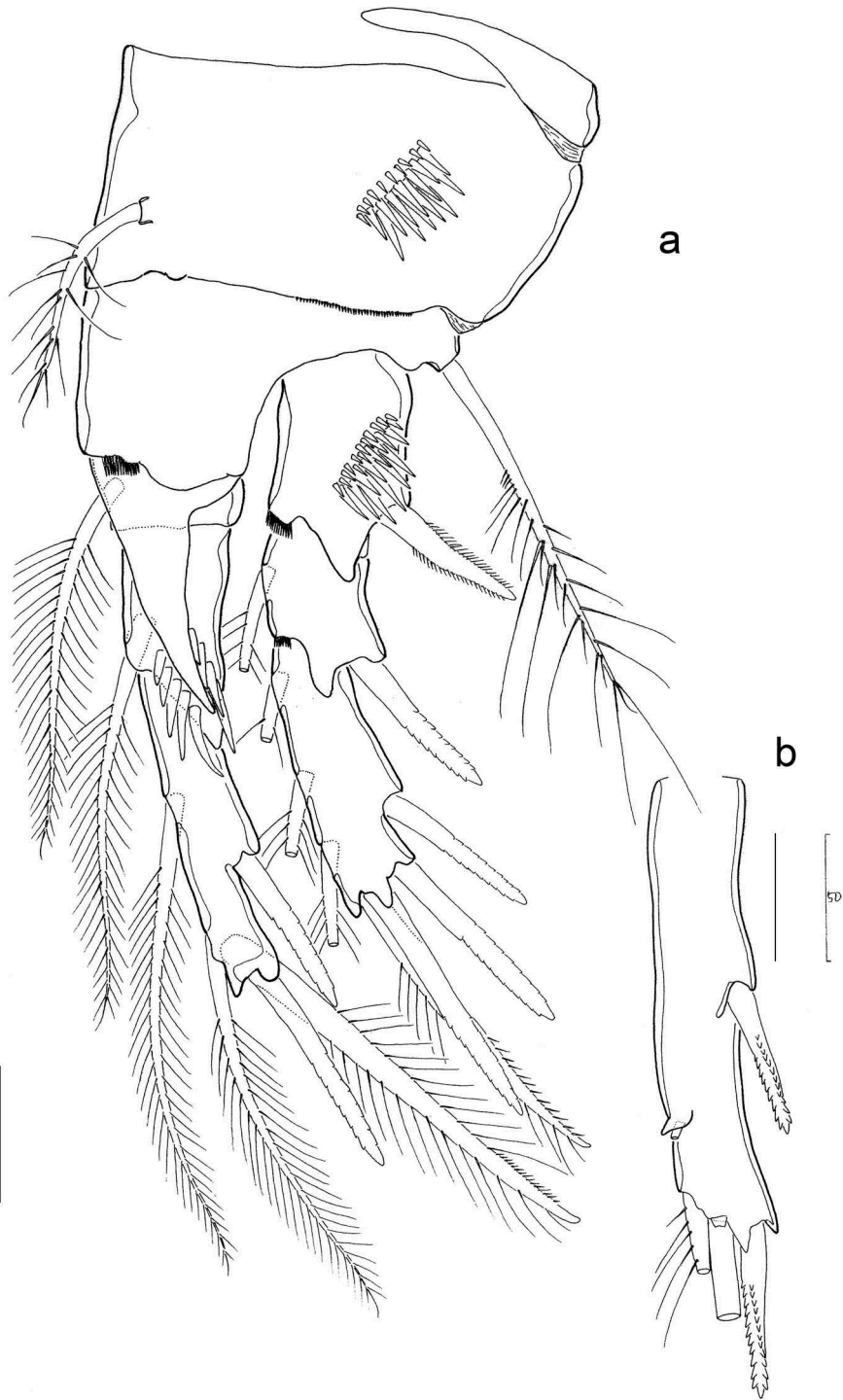


Figure 6. *Scottolana jasani* sp. nov. Female (a); male (b): (a) P2, anterior; (b) P2 enp-3 (scale: 50 µm).

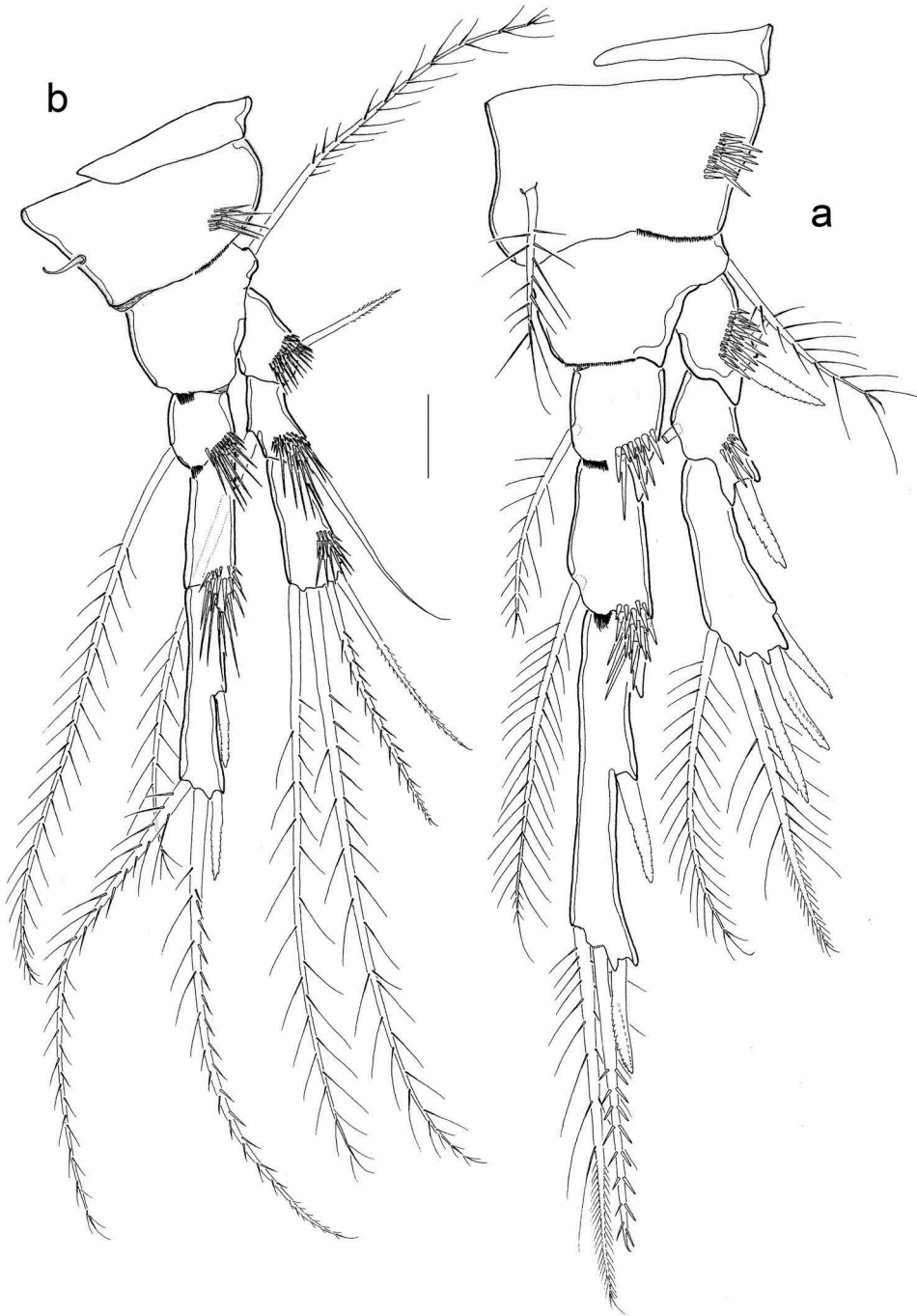


Figure 7. *Scottolana jasani* sp. nov. Female: (a) P3, anterior; (b) P4, anterior (scale: 50 μ m).

Maxillule (Figure 4(b)). Praecoxal arthrite with 8 distal spines, 2 lateral setae, and 2 anterior surface setae; with 2 rows of spinules. Coxa with epipodite represented by 2 plumose setae; endite cylindrical, with 5 pinnate setae. Basis with 8 pinnate setae and

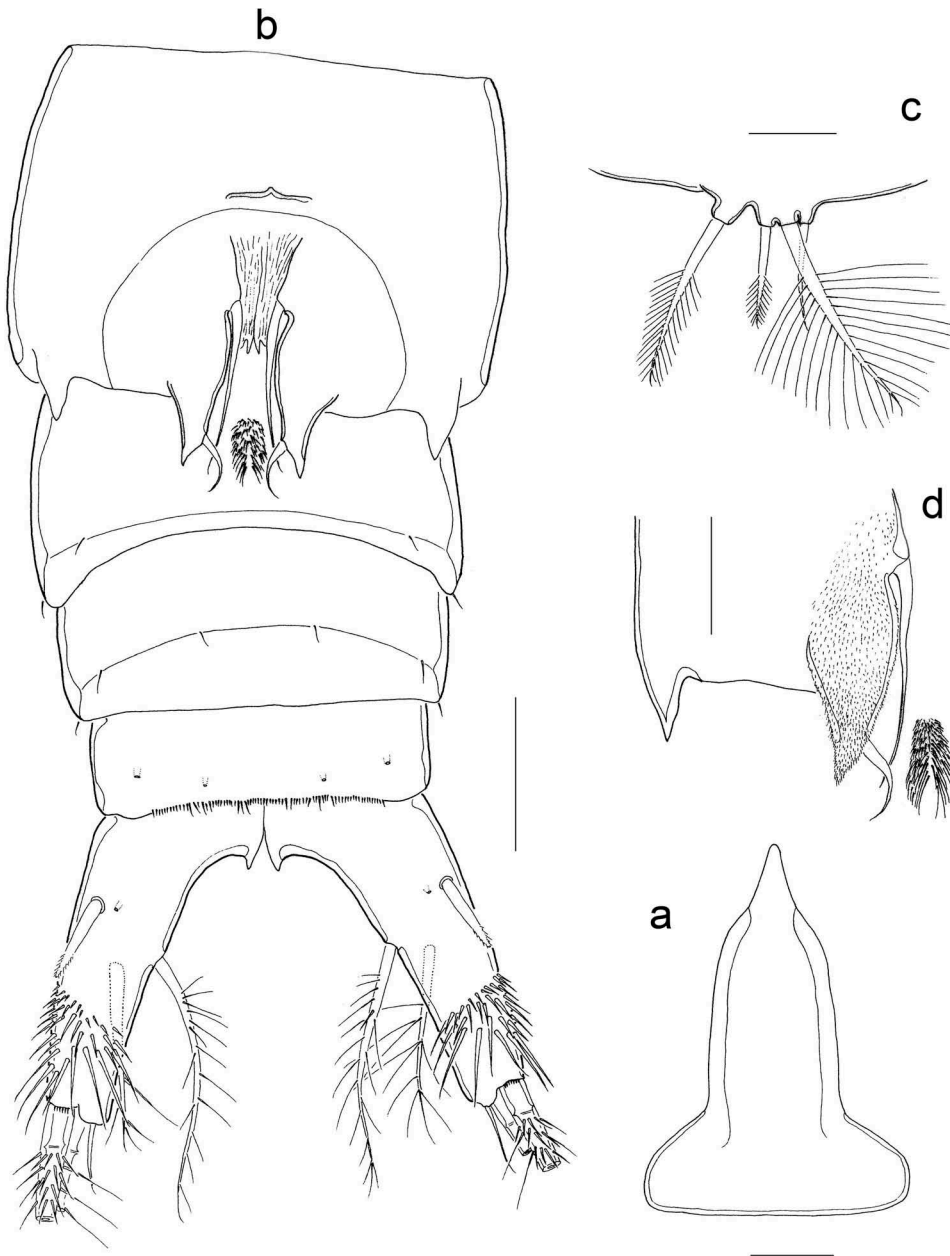


Figure 8. *Scottolana jasani* sp. nov. Female (a); male (b–d): (a) rostrum, dorsal; (b) urosome, ventral; (c) P5, anterior; (d) right genital field (scales: a = 100 μ m, b = 20 μ m, c, d = 50 μ m).

posterior row of spinules. Endopod 2-segmented; enp-1 with 4 pinnate setae laterally; enp-2 with 2 subapical and 4 apical pinnate setae. Exopod rounded, 1-segmented, with longitudinal row of outer setules, with 11 long plumose setae.

Maxilla (Figure 4(c), 4(d)) comprising praecoxa, coxa, allobasis and 3-segmented endopod. Praecoxa with several posterior spinules; with 2 endites; proximal endite with 1 smooth and 4 pinnate setae; distal endite with 2 pinnate setae. Coxa with 2

cylindrical endites, bearing 3 pinnate setae each. Allobasis with 3 strong pinnate spines and 4 pinnate setae. Endopod 3-segmented, all setae smooth; enp-1 and enp-2 with 3 setae each; enp-3 small, with 2 setae.

Maxilliped ([Figure 4\(e\)](#)) phyllopodial, 2-segmented, comprising undivided protopod and 1-segmented endopod; incomplete suture indicating boundary between syncoxa and basis. Protopod with 12 setae/spines (1 praecoxal seta, 9 coxal setae, and 2 basal setae); with rows of surface spinules as illustrated; with outer longitudinal row of long setules subdistally. Endopod 1-segmented with 11 elements (7 inner pinnate setae and 4 outer plumose setae).

P1 ([Figure 5](#)) smaller than other swimming legs. Praecoxa without ornamentation. Coxa with inner longitudinal row of setules, and 6 medial spinules; inner coxal seta spinulose in anterior half and pinnate in posterior half. Basis with 1 pinnate inner spine and 1 spinulose long outer seta, with inner longitudinal row of setules. Exopod 3-segmented; exp-1 with 1 bipinnate outer spine, with outer strong spinules, inner longitudinal row of setules, and minute spinules distally; exp-2 with 1 bipinnate outer spine and 1 plumose inner seta, with setule line distally; exp-3 outwardly directed, with 3 bipinnate outer spines, distally with 1 long, spinulose spine and 1 bipinnate seta, and 2 inner plumose setae. Endopod 3-segmented, as long as exopod; enp-1 with 1 plumose inner seta, and longitudinal row of outer setules; enp-2 with 1 plumose inner seta and strong outer spinules; enp-3 with 2 bipinnate outer spines, 3 long setae, and 1 short spine on distal corner, with outer strong spinules as depicted.

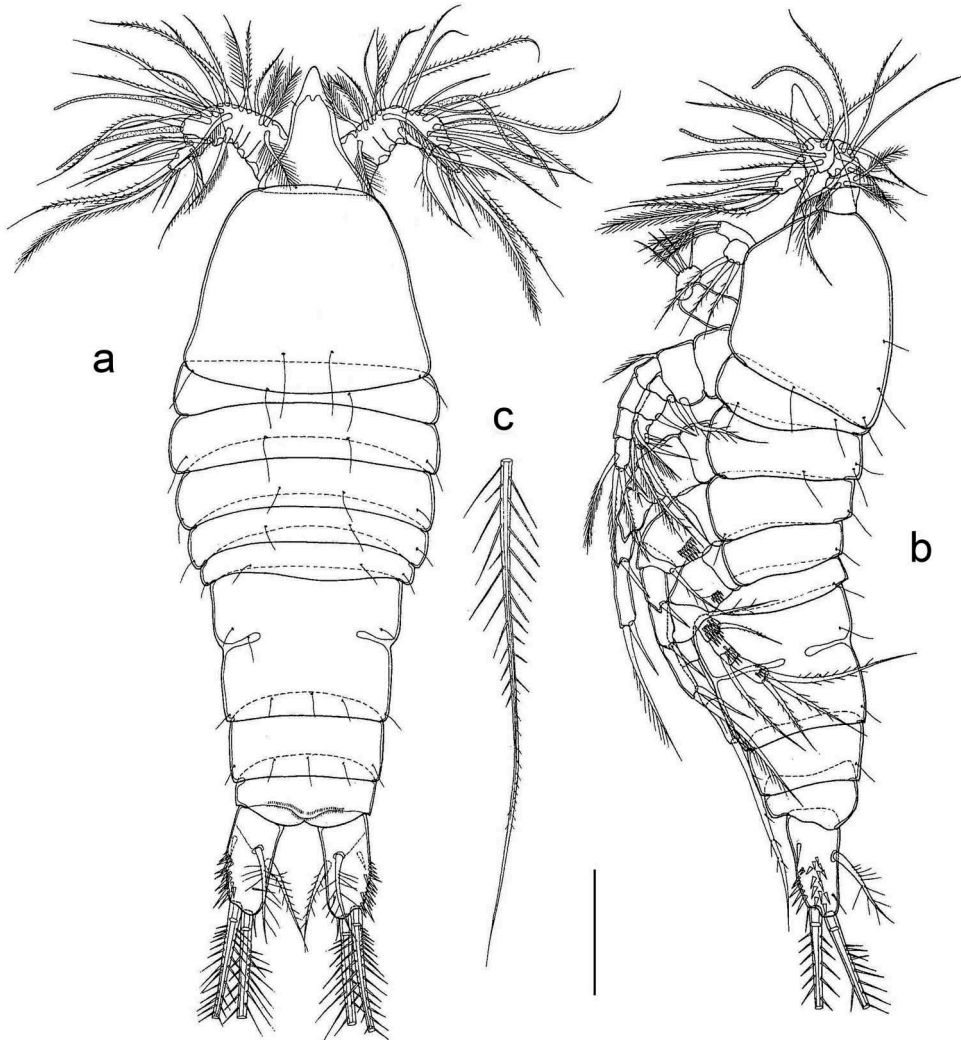
P2 ([Figure 6\(a\)](#)). Praecoxa without ornamentation. Coxa with medial rows of spinules on anterior surface, with 1 inner coxal seta. Basis with spinulose outer seta, inner margin with small sharp process distally. Exopod 3-segmented; exp-1 with bipinnate outer spine, with strong spinules; exp-2 with 1 serrate outer spine and 1 plumose inner seta; exp-3 with 3 outer spines, 1 apical spinulose spine, and 3 plumose inner setae. Endopod 3-segmented; enp-1 smallest, with 1 plumose inner seta, anterior surface produced into long mucroniform process, reaching distal margin of enp-2; enp-2 with 1 plumose inner seta and outer spinular rows as shown; enp-3 with 1 outer spine, 2 distal spines, and 1 inner seta.

P3 ([Figure 7\(a\)](#)). Praecoxa without ornamentation. Coxa with strong outer spinules and with inner spinulose seta. Basis with 1 spinulose outer seta, with minute spinules distally. Exopod 3-segmented; exp-1 with 1 serrate outer spine and strong outer spinules; exp-2 with 1 serrate outer spine, 1 plumose inner seta, with strong outer spinules; exp-3 with 2 outer spines, 2 distal spines, and 1 inner seta. Endopod 3-segmented, much longer than exopod; enp-1 and enp-2 with 1 inner plumose seta, and strong outer spinules; enp-3 with 1 outer spine, 2 distal elements, and 1 inner seta.

P4 ([Figure 7\(b\)](#)). Praecoxa without ornamentation. Coxa with 1 small inner bare seta and several outer spinules. Basis with outer spinulose seta, with minute spinules close to joint with endopod. Exopod 3-segmented; exp-1 with 1 outer pinnate seta and dense patch of outer spinules; exp-2 with 1 outer and 1 inner spinulose seta, with dense patch of spinules; exp-3 with 1 outer pinnate seta, 2 apical spinulose elements, and 1 inner spinulose seta, with spinules as shown. Endopod 3-segmented; enp-1 shortest, with 1 inner spinulose seta and some spinules as shown; enp-2 unarmed, with dense patch of spinules; enp-3 with 2 outer spines and 2 distal spinulose setae. Seta and spine formula of swimming legs of the new species as shown in [Table 1](#).

Table 1. Armature formula of swimming legs of *Scottolana jasani* sp. nov.

	Exopod	Endopod
P1	0, 1, 223	1, 1, 123
P2	0, 1, 313	1, 1, 221
P3	0, 1, 122	1, 1, 121
P4	0, 1, 121	1, 0, 121

**Figure 9.** *Scottolana huysi* sp. nov. Female: (a) habitus, dorsal; (b) habitus, lateral; (c) caudal seta V (scale: 20 μ m).

P5 (Figure 2(b)). Vestigial, incorporated into somite; with 2 pinnate and 2 setulose setae; innermost shortest, second innermost one longest, and outermost one separated from the others.

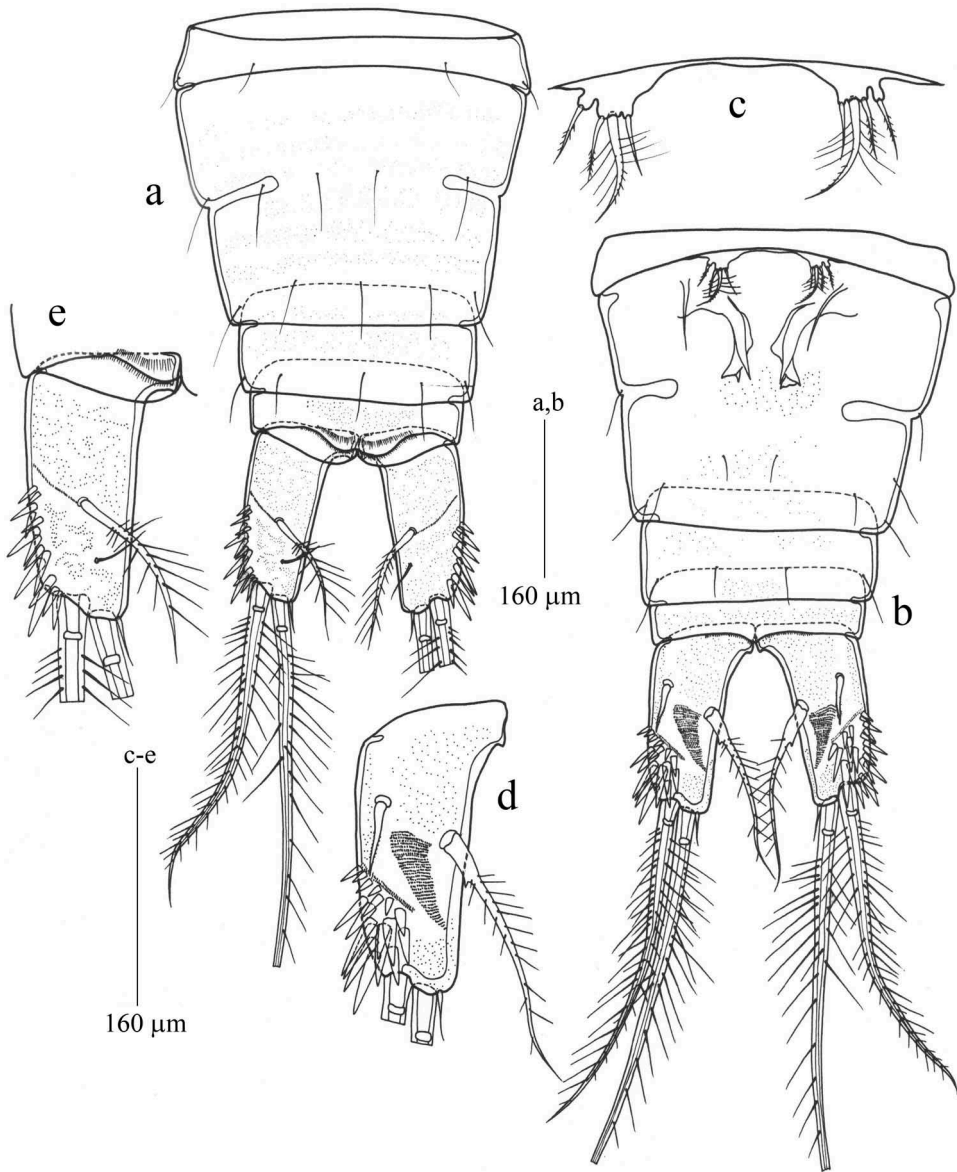


Figure 10. *Scottolana huysi* sp. nov. Female: (a) urosome, dorsal; (b) urosome, ventral; (c) P5, anterior; (d) caudal ramus, ventral; (e) caudal ramus, dorsal (scale: 160 μ m).

Description of the adult male (allotype)

Allotype (Figure 1(b)) slightly smaller and slender than the female. Total body length 1.17 mm. Sexual dimorphism in the antennule, P4, P5, genital somite and caudal ramus.

Urosome (Figure 8(b)) 5-segmented, comprising P5-bearing somite (omitted in Figure 8(b)), genital somite, 3 free abdominal somites. Genital somite largest, with dense patch of tiny spinules as figured, with paired lateral, posteriorly directed pointed extensions.

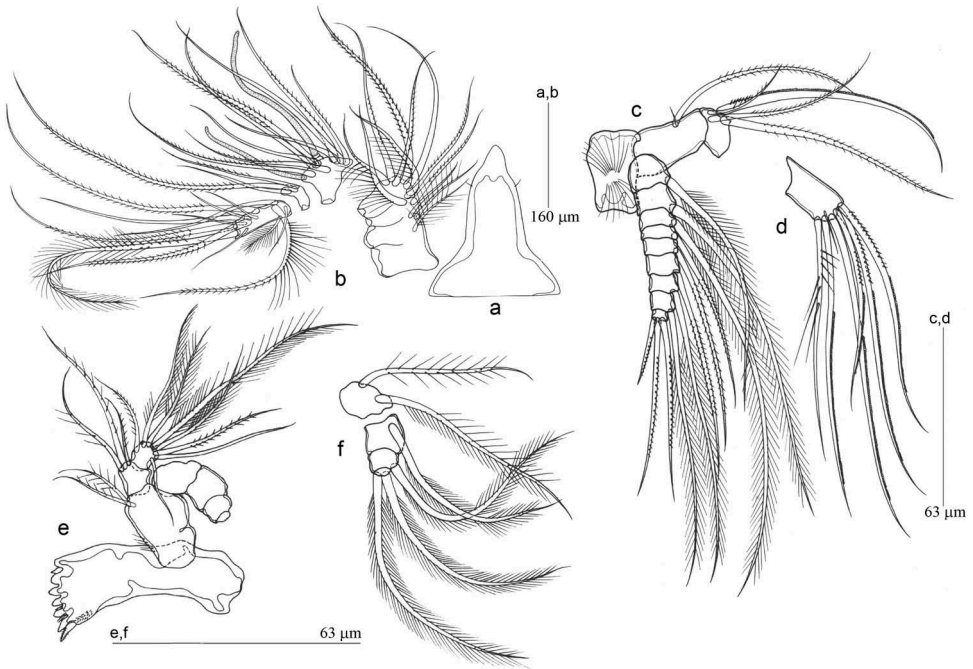


Figure 11. *Scottolana huysi* sp. nov. Female: (a) rostrum, dorsal; (b) antennule; (c) antenna; (d) distal segment of antenna; (e) mandible, ventral; (f) armature of exopodal setae of mandible as shown) (scale: 160 μm).

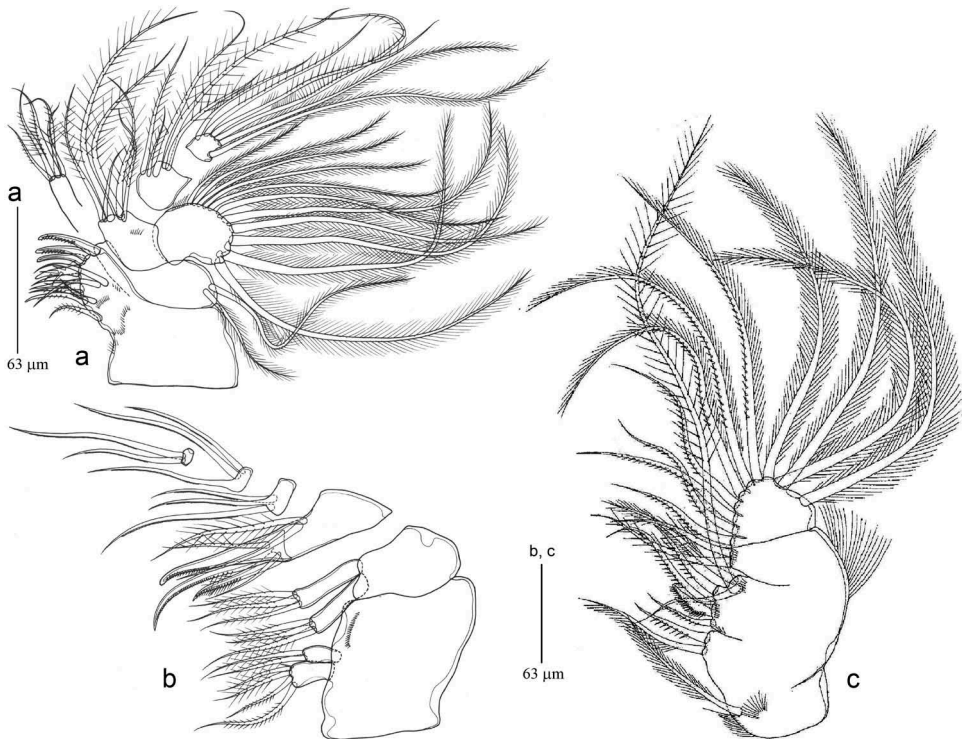


Figure 12. *Scottolana huysi* sp. nov. Female: (a) maxillule; (b) maxilla; (c) maxilliped (scale: a, b = 63 μm , c = 42 μm).

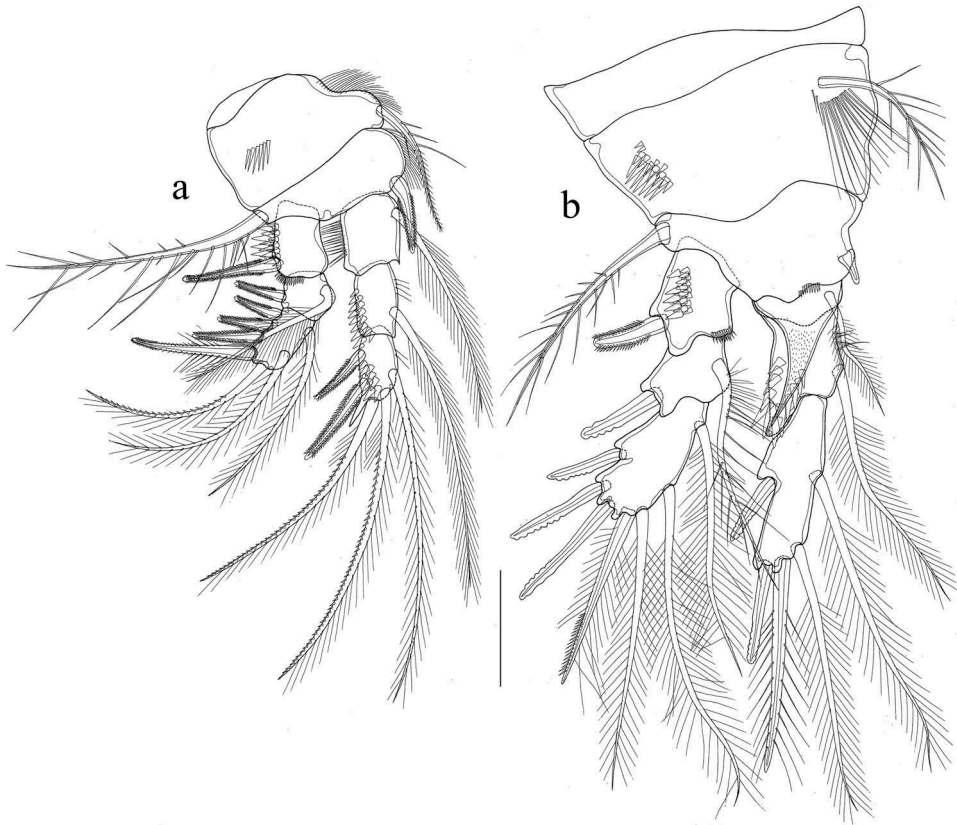


Figure 13. *Scottolana huysi* sp. nov. Female: (a) P1, anterior; (b) P2, anterior (scale: 80 μ m).

Antennule (Figure 3(f), 3(g)) short, 4-segmented. First segment longest and broadest, with posterior patch of setules, with 22 setae and 2 aesthetascs; second segment shortest with 3 setae; third segment with 8 setae; distal segment with 7 apical setae. Armature formula: 1-(22 + 2ae), 2-(3), 3-(8), 4-(7).

Antenna, mandible, maxillule, maxilla, maxilliped, P1, P2 and P4 as in female.

P3 as in female, except for inner border of enp-3, with small, transparent modified tube-pore on inner margin (Figure 6(b)).

P5 (Figure 8(c)) with armature as in female, except for longer outer basal seta.

P6 (Figure 8(b), 8(d)) represented by 1 posteriorly directed pointed projection covered with tiny spinules, with 1 proximal long bare seta, and 1 subapical element (Figure 8(d)).

***Scottolana huysi* sp. nov.**

(Figures 9–18)

Type locality

Kata Beach is situated on west coast of Phuket Island, Thailand (7°49'09"N, 98°17'52"E). The environmental data of the fine sandy beach during low-tide are as follows: dissolved oxygen 7.4 mg l⁻¹, salinity 32 ppt, temperature 32°C, pH 7.64, organic matter 2.30%.

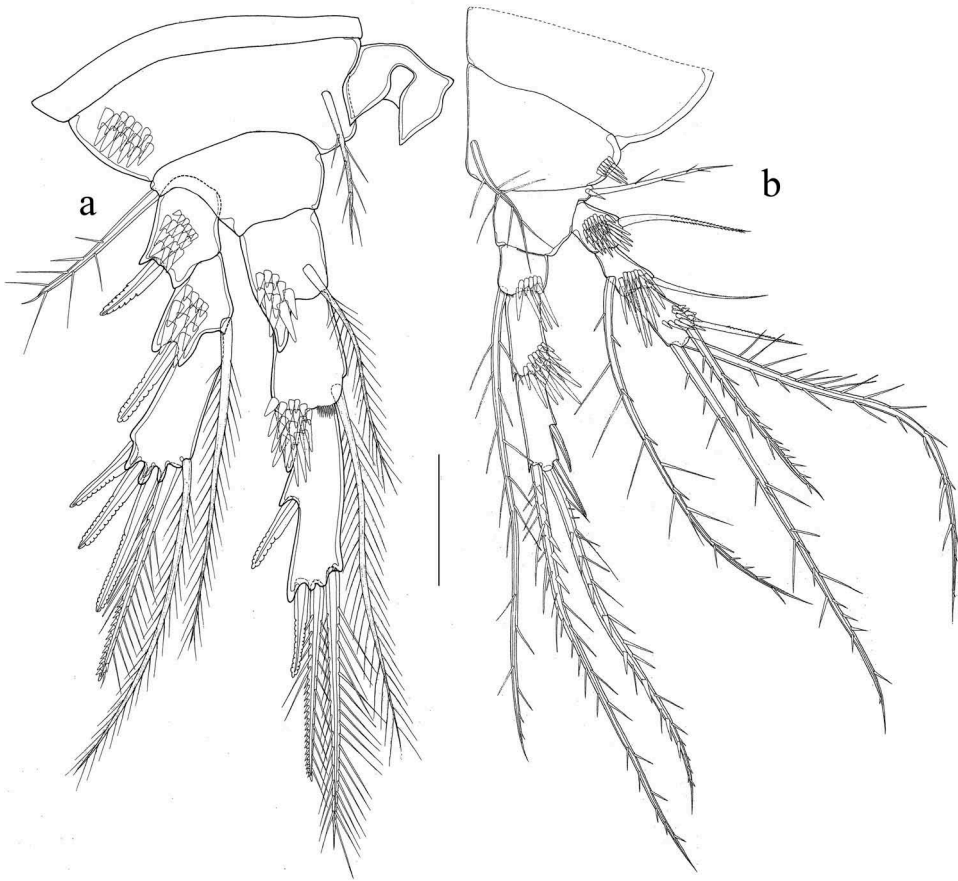


Figure 14. *Scottolana huysi* sp. nov. Female: (a) P3, anterior; (b) P4, anterior (scale: 80 μ m).

Type material examined

Holotype female (USNM1136881): dissected on 9 slides. Allotype male (USNM1136882): dissected on 9 slides. Paratypes (USNM1136883): three females and two males preserved in alcohol. All specimens are from the type locality collected by Supawadee Chullasorn on 20 April 1999.

Etymology

The species was named in honour of Dr Rony Huys, Natural History Museum, London, for his achievements in the study of copepods. The name is a noun in the genitive singular.

Description of adult female (holotype)

Habitus (Figure 9(a), 9(b)). Total body length 1.32 mm measured from anterior margin of rostrum to posterior margin of caudal ramus. Body large, robust, slightly fusiform. Greatest width at posterior border of second pedigerous somite. Body surface ornamented with long sensilla except for anal somite. All somites without distinct posterior hyaline frills, except for anal somite with smooth dorsal hyaline frill.

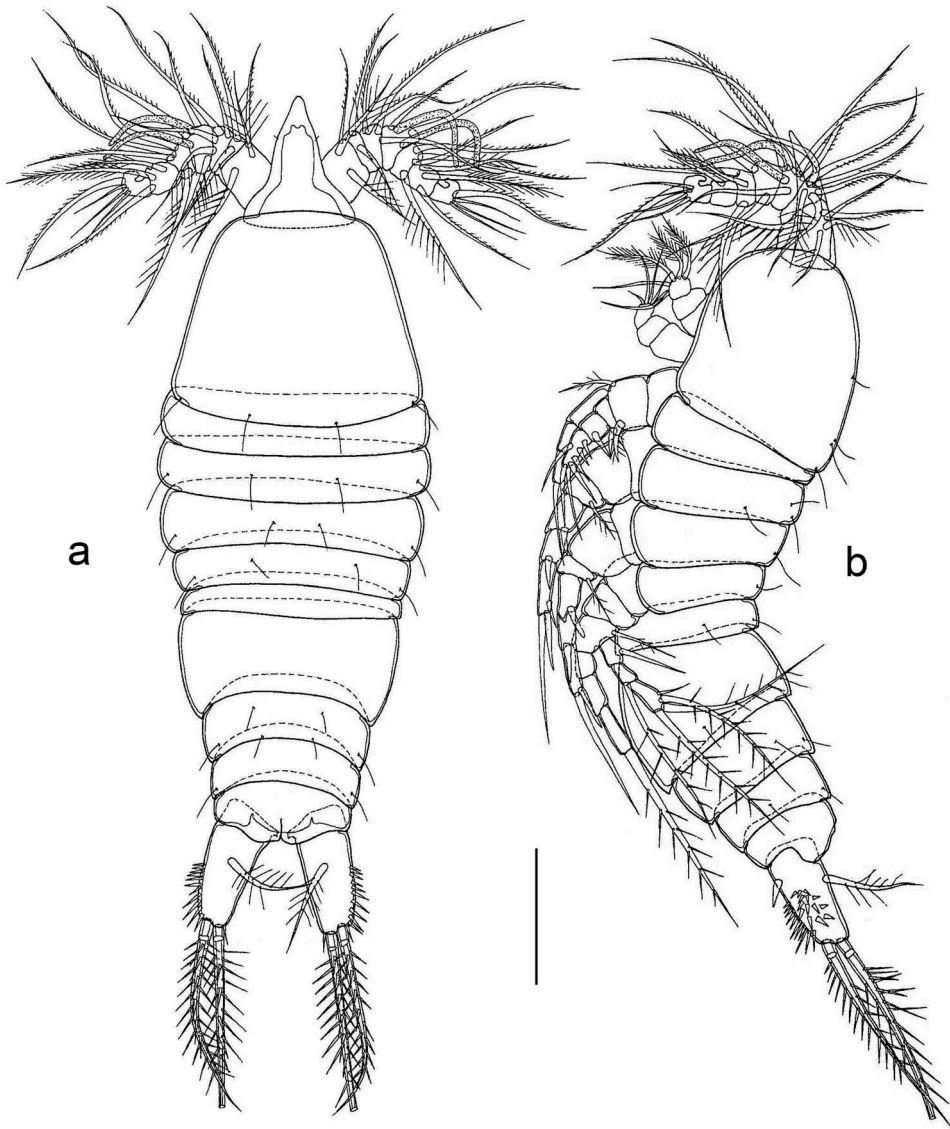


Figure 15. *Scottolana huysi* sp. nov. Male: (a) habitus, dorsal; (b) habitus, lateral (scale: 200 μ m).

Urosome (Figure 10(a), 10(b)) 4-segmented, consisting of P-5 bearing somite, genital double-somite, one free urosomite and anal somite. Genital double-somite slightly wider than long; original segmentation marked by paired dorsolateral and ventrolateral internal cuticular ribs (Figure 10(b)). Genital field large, extending to about halfway down the ventral surface of genital double-somite. Copulatory pores paired, posteriorly displaced to inner margin of wing-like processes. Anal operculum (Figure 9(a)) weakly developed, with transverse row of setules.

Caudal rami (Figure 10(a), 10(b)) subrectangular, about twice as long as wide; dorsal and ventral surfaces scattered with minute spinules, including characteristic triangular area on ventral surface (Figure 10(b)); outer margin and posteroventral surface with

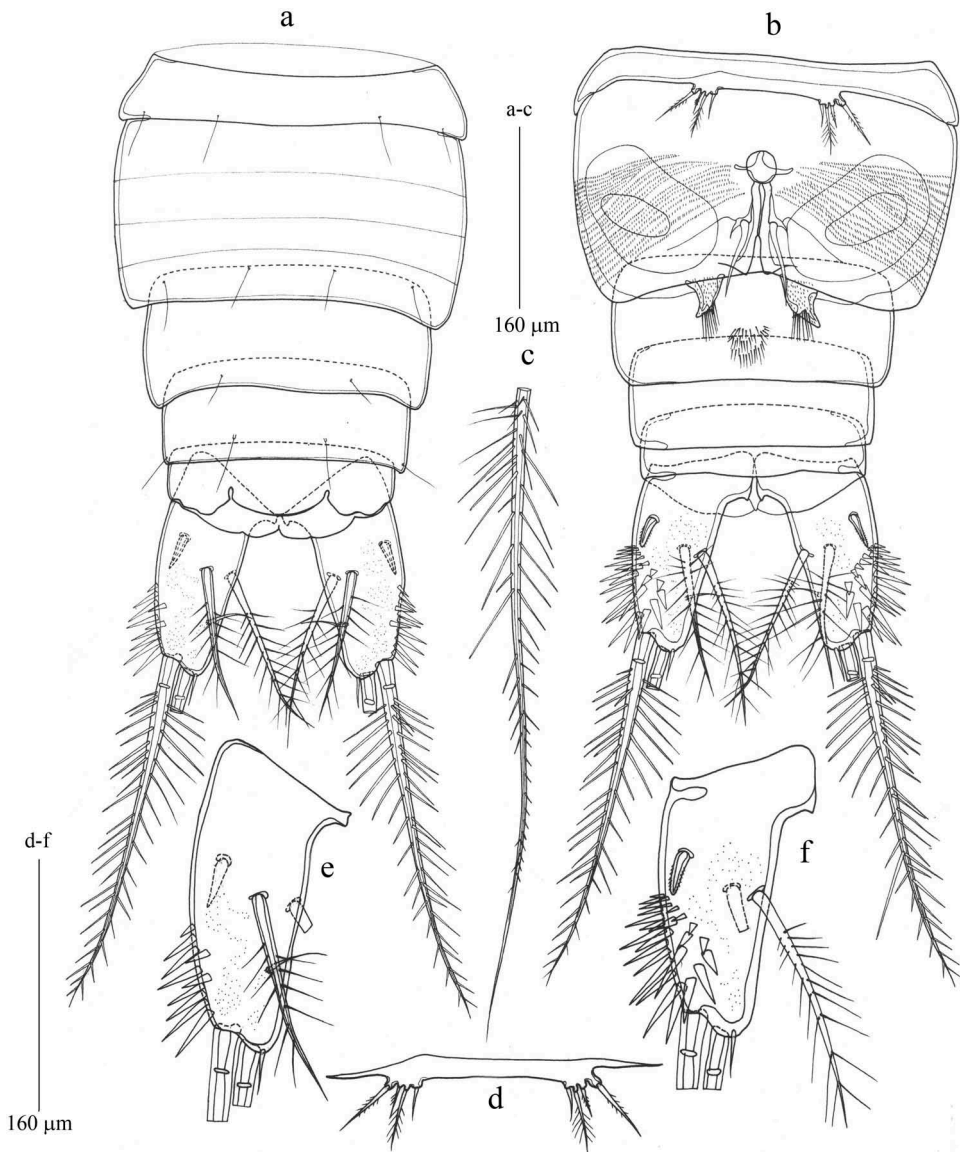


Figure 16. *Scottolana huysi* sp. nov. Male: (a) urosome, dorsal; (b) urosome, ventral; (c) caudal seta; (d) P5, ventral; (e) caudal ramus, dorsal; (f) caudal ramus, ventral (scale: 80 μ m).

dense clusters of strong spinules of different lengths. Each ramus armed with 7 setae: seta I short, spiniform, pinnate, arising ventrally; seta II long, plumose, with inflated base, located halfway inner margin; seta III plumose, displaced dorsally, issuing in the middle of caudal ramus; distal margin of ramus with 3 setae; seta IV and V well developed, strongly spinulose; the latter about 2.5 times longer than the former; seta VI small; seta VII short and smooth, located on dorsal surface between setae II and VI.

Rostrum (Figure 11(a)) very large, bell-shaped, about three-quarters the length of the cephalic shield, with a pair of subapical, tiny sensilla.

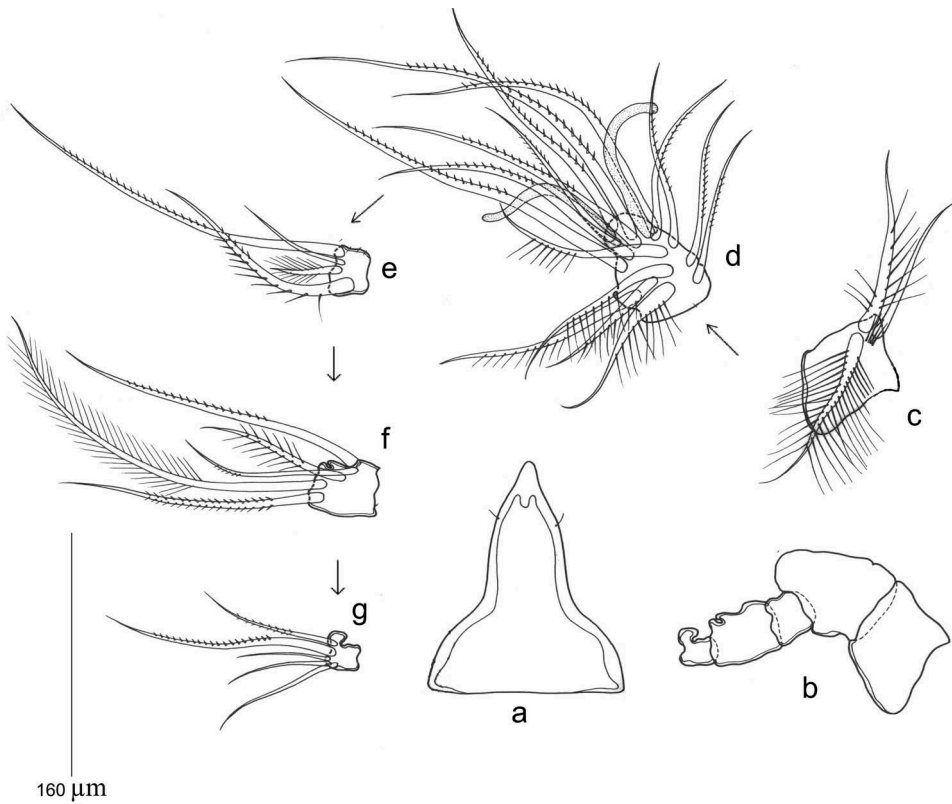


Figure 17. *Scottolana huysi* sp. nov. Male: rostrum + antennule; antennule (disarticulated) (scale: 160 μ m).

Antennule (Figure 11(a)) indistinctly 4-segmented. First segment longest and largest, showing 3 incomplete sutures around the posterior margin with 9 spinulose and 4 smooth setae; second segment short, with 1 smooth and 10 spinulose setae, and 2 aesthetascs of unequal length; third segment very short, with 1 spinulose and 2 smooth setae; distal segment with 5 spinulose, 2 plumose, and 6 smooth setae. Armature formula: 1-(13), 2-(11 + 2ae), 3-(3), 4-(13).

Antenna (Figure 11(b)) biramous; comprising a relatively short coxo-basis, with setular patches as shown. Endopod 2-segmented; enp-1 with 1 minute and smooth seta, and 1 long and pinnate seta; enp-2 with incomplete suture showing original segmentation between second and third segments, with 4 lateral pinnate setae, and 7 apical setae, 6 of them pinnate, 1 short and smooth. Exopod 9-segmented; segments 1–3 and 7–8 with 1 plumose seta each; segments 4–6 with 1 pinnate seta each; terminal segment small with 3 pinnate setae.

Mandible (Figure 11(c)) with well-developed gnathobase bearing 6 strong multicuspitate teeth distally; with additional row of spinules at dorsal margin. Basis with 2 long setae and inner spinular row. Endopod 2-segmented; enp-1 with 1 short and 2 long setae; enp-2 with 2 subapical and 6 apical setae. Exopod 4-segmented; all setae plumose; segments 1 and 4 with 2, segments 2–3 with 1 seta each.

Maxillule (Figure 12(a)). Praecoxa and coxa partly fused. Praecoxal arthrite with 8 spines, 2 pinnate and 2 smooth setae distally; posterior surface with 2 rows of spinules.



Figure 18. *Scottolana huysi* sp. nov. Male: P4, anterior (scale: 80 μ m).

Coxa with epipodite represented by 2 plumose setae; endite cylindrical, with 3 pinnate and 2 plumose setae. Basis with 6 pinnate setae and posterior row of spinules. Endopod 2-segmented; enp-1 with 5 pinnate setae laterally; enp-2 with 3 outer plumose and 3 inner pinnate setae. Exopod rounded, 1-segmented, with 11 long plumose setae.

Maxilla (Figure 12(b)) comprising praecoxa, coxa, allobasis and 3-segmented endopod. Praecoxa with outer row of spinules; with 2 endites; proximal endite with 1 smooth and 4 pinnate setae; distal endite with 2 pinnate setae. Coxa with 2 cylindrical endites, with 3 pinnate setae each. Allobasis with 3 strong pinnate spines, 2 pinnate and 1 smooth seta. Endopod 3-segmented, all setae smooth; enp-1 and enp-2 with 3 setae each; enp-3 small, with 2 setae.

Maxilliped (Figure 12(c)) phyllopodial, 2-segmented, comprising undivided protopod and 1-segmented endopod; incomplete suture indicating boundary between syncoxa and basis. Medial margin of protopod with 12 setae/spines (1 praecoxal, 9 coxal, and 2 basal); with rows of spinules as illustrated; outer margin with row of long setules distally. Endopod 1-segmented, with 11 elements (7 inner pinnate, and 4 outer plumose setae).

P1 (Figure 13(a)) smaller than other swimming legs. Coxa with inner row of setules, and 6 medial spinules; inner coxal seta spinulose and pinnate. Basis with 1 pinnate inner spine, 1 spinulose long outer seta, and row of setules along inner margin. Exopod 3-segmented; exp-1 with 1 bipinnate outer spine, with strong outer spinules and with minute spinules distally; exp-2 with 1 bipinnate outer spine and 1 plumose inner seta; exp-3 outwardly directed, armed with 3 bipinnate outer spines, and 1 long, spinulose spine at outer distal corner, 1 apical and 2 inner plumose setae. Endopod 3-segmented, slightly longer than exopod; enp-1 with 1 plumose inner seta, and long outer setules; enp-2 with 1 plumose inner seta and several inner setules proximally, with outer strong spinules; enp-3 with 2 bipinnate outer spines, 1 spine, 2 apical setae, and 1 inner element, with outer spinules and inner setules as shown.

P2 (Figure 13(b)). Praecoxa without ornamentation. Coxa with rows of spinules and setules as shown; inner coxal seta spinulose. Basis with 1 spinulose outer seta; inner margin with small blunt process. Exopod 3-segmented; exp-1 with bipinnate outer spine, with strong outer spinules; exp-2 with 1 serrate outer spine and 1 plumose inner seta; enp-3 with 4 spines and 3 plumose setae. Endopod 3-segmented; enp-1 smallest, with 1 plumose inner seta, anterior surface produced into long mucroniform process, reaching distal margin of enp-2; enp-2 with 1 plumose inner seta and spinular rows as depicted; enp-3 with 3 spines and 2 plumose setae.

P3 (Figure 14(a)). Praecoxa without ornamentation. Coxa with strong outer spinules; inner coxal seta spinulose. Basis with 1 spinulose outer seta. Exopod 3-segmented; exp-1 with 1 serrate outer spine and strong spinules as shown; exp-2 with 1 serrate outer spine, 1 spinulose inner seta and strong spinules; exp-3 with 4 spines and 1 plumose setae distally. Endopod 3-segmented, longer than exopod; enp-1 and enp-2 with 1 inner plumose seta and strong spinules as shown; enp-3 with 1 outer medial, 1 outer and 1 inner distal, and 1 inner element.

P4 (Figure 14(b)). Praecoxa (not shown) without ornamentation. Coxa with 1 inner spinulose seta and several outer spinules. Basis with 1 outer spinulose seta. Exopod 3-segmented; exp-1 with 1 outer pinnate seta and dense patch of spinules; exp-2 with 1 outer pinnate seta, 1 inner spinulose seta and dense patch of spinules; exp-3 with 1 outer pinnate seta, 2 apical spinulose spines, and 1 inner spinulose seta, with several spinules as shown. Endopod 3-segmented; enp-1 shortest, with 1 very long spinulose inner seta and some spinules distally; enp-2 with dense patch of spinules; enp-3 with 2

Table 2. Armature formula of swimming legs of *Scottolana huysi* sp. nov.

	Exopod	Endopod
P1	0, 1, 223	1, 1, 123
P2	0, 1, 322	1, 1, 221
P3	0, 1, 122	1, 1, 121
P4	0, 1, 121	1, 0, 121

spines and 2 spinulose setae. Seta and spine formula of swimming legs of the new species as shown in Table 2.

P5 (Figure 10(b)). Vestigial, incorporated into somite; with 1 innermost smooth and 3 plumose setae; middle one on distal margin longest and with long setules.

Description of adult male (allotype)

Allotype (Figure 15(a), 15(b)) slightly smaller and slender than the female. Total body length 1.22 mm. Sexual dimorphism in the antennule, P4, P5, genital somite and caudal ramus.

Urosome (Figure 16(a), 16(b)) 5-segmented, comprising P5-bearing somite, genital somite 3rd and 4th urosomites, and anal somite. Genital somite (Figures 15(a), 15(b), 16(a), 16(b)) largest, ornamented with several tiny spinular rows ventrally (Figure 16(b)), with paired lateral, posteriorly directed spinous extensions covered by tiny spinules and with long setules distally. Third urosomite with a bundle of setules ventrally.

Caudal rami (Figure 16(a), 16(b)) as in female, except for seta II with normal base, not inflated.

Rostrum (Figure 17a) as in the female.

Antennule (Figure 17b) short 5-segmented. First segment (Figure 17c) with 2 plumose and 1 smooth setae; second segment (Figure 17d) with 5 plumose and 11 pinnate setae, and 2 aesthetascs; third segment (Figure 17e) with 1 smooth, 1 plumose, 1 spinulose and 1 pinnate setae; fourth segment (Figure 17f) with 2 plumose and 3 pinnate setae; distal segment (Figure 17g) with 3 smooth and 2 pinnate setae. Armature formula: 1-(3), 2-(16+2ae), 3-(4), 4-(5), 5-(5).

Antenna, mandible, maxillule, maxilla, maxilliped, P1, P2, and P3 as in female.

P4 (Figure 18) as in female, except for basis bearing 1 outer smooth seta, and with 4 long setules of unequal length close to joint with endopod, reaching beyond enp-1: from outer 1 pinnate, 1 smooth, 1 longest plumose and 1 short smooth setae.

P5 (Figure 16(b)) with armature as in female, but the outermost basal plumose seta longer.

Discussion

The present two new species, *S. jasani* sp. nov. and *S. huysi* sp. nov. can be assigned confidently to the genus *Scottolana* according to the following key morphological characters of the swimming legs: first pedigerous somite free, P1 exopod 3-segmented, P3 exp-3 with 5 setae/spines, P4 exp-2 with an inner seta, P4 exp-3 with 4 setae/spines, and P4 enp-3 with 4 setae/spines (Huys et al. 1996; Boxshall and Halsey 2004).

Furthermore, the new species proposed herein belong to the *longipes*-group as defined by Mu and Huys (2004) in sharing the following characters: urosome with only two postgenital somites in the female and three in male, outward displacement of P4

exopod in both sexes, elongate inner seta on exp-2 and enp-1 of P4, modified tube-pore on inner margin of P3 enp-3 in male (*S. jasani* sp. nov.), and caudal ramus with proximal inner hook-like process and spinular patch near distal outer corner (extended to inner anterior surface in *S. jasani* sp. nov.).

To date, the *longipes*-group contains six species including the two new species proposed herein (Table 3): *S. geei* from Bahai Sea, *S. dissimilis* Fiers, 1982 from Papua New Guinea, *S. uxoris* Por, 1983 from Gulf of Eilat, Red Sea, *S. longipes* (Thompson and Scott, 1903) from Gulf of Manaar, Sri Lanka (Thompson and Scott 1903), from Mediterranean coast of Israel (Por 1964), from Inhaca Island, Mozambique (Wells 1967), and from Andaman Island (Wells and Rao 1987), *S. jasani* sp. nov. from the Yellow Sea, Korea, and *S. huysi* sp. nov. from Phuket, Thailand. Of these, three species were recorded from the Pacific Ocean (*S. geei*, *S. dissimilis* and *S. jasani* sp. nov.), three species from the Indian Ocean (*S. longipes*, *S. longipes sensu* Wells (1967), *S. longipes sensu* Wells and Rao (1987), *S. uxoris* and *S. huysi* sp. nov.), and one from the Mediterranean (*S. longipes sensu* Wells (1967)). Only *S. longipes* has been reported from two regions as mentioned above and has a wide range of body lengths in both sexes. In most females, body lengths range around 1.3 mm. *Scottolana geei* is the smallest with about 0.9 mm total body length. Within this group, all species have the same setal formula of P1–P4, except for *S. dissimilis* (without inner seta on P2 enp-1). With regard to their habitat, most species were collected from shallow water at a depth of about 5 to 30 cm. *Scottolana geei* was collected at an average depth of 20 m, and *S. longipes* was recorded from sublittoral muddy sands and the bathyal zone as well (Por 1964).

Scottolana jasani sp. nov. is most closely related to *S. geei* from China. However, it can be distinguished by (1) A2 exp with eight-segmented (vs. nine-segmented in *S. geei*); (2) long and strong seta I of caudal ramus (vs. short in *S. geei*); (3) seta II with long hairs (vs. pinnate seta in *S. geei*); (4) normal base of seta II in female (vs. bulbiform in *S. geei*); (5) shape of the female (Figure 2(a)) and male (Figure 8(b)) genital fields (vs. Figure 2(a), 2(c) in female and Figure 10(a) as shown in Mu and Huys (2004); (6) exopod of mandible consisting of four segments (but without complete segment boundaries, as in Mu and Huys (2004, fig. 5(a)); and (7) P1 enp-2 with strong spinules on outer surface (vs. not strong in *S. geei*).

Scottolana huysi sp. nov. appears to be most closely related to *S. geei* than to any other species of the genus *Scottolana*. These two species share (1) the antenna with distinctly nine-segmented exopod; (2) caudal ramus length to width ratio (2.0 times) as long as wide; (3) outer distal corner of caudal ramus with dense patch of strong spinules; (4) caudal seta II plumose with bulbiform base in the female; and (5) caudal setae IV and V well developed and ornamented with pinnate strong spinules. However, it differs from *S. geei* in (1) its entire body surface being ornamented with longer sensilla; (2) female antennule indistinctly four-segmented (three-segmented in *S. geei*); (3) genital field of female large, copulatory pores displaced to inner margin of wing-like processes (vs. internal chitinous rib laterally in *S. geei*); (4) genital somite of male with paired lateral, posteriorly directed spinous extensions (vs. without lateral spinous extensions in *S. geei*); (5) P1 enp-2 and enp-3 each with two rows of strong spinules along the outer margin (not strong, one row in *S. geei*); (6) P4 basis of male with four basal long setules on inner margin (five spinules in *S. geei*).

Table 3. Morphological characters of the species within *longipes*-group of genus *Scottolana*.

	<i>S. dissimilis</i>	<i>S. geei</i>	<i>S. longipes</i>	<i>S. uxoris</i>	<i>S. jasanji</i> sp. nov.	<i>S. huysii</i> sp. nov.
Ro	Round	Sharp and long	Round	Sharp and short	Sharp and long	Sharp and long
CR l/w	3.5	2.0	3.0	1.25	1.8	2.0
Caudal seta II	Very short (♀), normal (♂)	Bulbiform	Very short (♀), normal (♂) <i>sensu</i> (Por, 1964)	Normal	Normal	Bulbiform
A1 ♀ seg.	6	3	6–7	7	3	4
A1 ♂ seg.	?	4	7?	11	4	5
A2 exp.	8	9	8	8	8	9
P5 seta (longest)	4 (1)	4 (3)	?	4 (1)	4 (3)	4 (3)
Mxl. enp.	10	11	10	10	11	11
Mxl. coxal epipodite	2	2	0 (Wells 1967), 2 (Wells and Rao 1987)	2	2	2
P3 enp-3, ♂	Normal	Modified tube-pore	Pore (Wells and Rao 1987)	Normal	Pore	?
Body length, ♀	1.3	0.88	1.50 (Thompson & Scott, 1903) 0.88–1.01(Wells 1967)	1.30–1.50	1.31	1.32
Body length, ♂	1.2	0.83–1.06	1.21(Wells and Rao 1987) 0.81–0.98(Wells 1967)	1.30–1.50	1.17	1.22
Distribution and reference	Papua New Guinea (Fiers 1982)	Bohai Sea, China (Mu and Huys 2004)	Gulf of Manaar, Sri Lanka (Thompson and Scott 1903); Mediterranean coast of Israel (Por 1964); Inhaca Is., Mozambique (Wells 1967); Andaman Island (Wells and Rao 1987)	Gulf of Eilat, The Red Sea (Por 1983)	Yellow Sea, Korea (present study)	Phuket Is., Thailand (present study)
Habitats	5 cm, shallow pool	Average 20 m depth, muddy sand/mud	Washings from invertebrates (T. & A. Scott, 1903); sublittoral (muddy sand/mud)/bathyal (Por 1964); detritus sand/sand (Wells, 1967); 20 cm, algal sand (Wells and Rao 1987)	Intertidal shallow sandy bottom	30 cm, muddy sand bottom	5 cm, fine sand

Scottolana huysi sp. nov. was found in several sandy beaches on Phuket Island, such as Kata Beach, Nai Yang Beach, and Patong Beach. The species seems to occur at these localities all year round and seems to be restricted to clean sandy beaches. The wide distribution of *S. huysi* sp. nov. on Phuket Island was first reported by Dexter (1996) who found the species (as *Canuella* n. sp.) at Nai Yang, Sai Kaew, Mai Khao, Nai Yang, Naithon, Surin, Kamala, Patong, Kata, and Nai Harn beaches. According to Dexter's (1996) observations, ovigerous females were present throughout the year and the species was abundant mainly during the wet season.

Acknowledgements

The authors would like to thank two anonymous reviewers for their critical comments and great improvement of the manuscript.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This research was financially supported by the Discovery of Korean Indigenous Species Project, NIBR (National Institute of Biological Resources) (SJS). This research was a contribution supported by the Biodiversity Research and Training Program of Thailand [BRT141039]. This work was supported by projects entitled "Marine ecosystem-based analysis and decision-making support system development for marine spatial planning" [20170325] funded by the Ministry of Oceans and Fisheries of Korea (MOF) granted to JSK. This work was also supported by the project entitled "Densities of meiobenthic fauna in various habitats of Phuket Island".

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