

## A new species of the genus *Parathalestris* (Copepoda: Harpacticoida: Thalestridae) from dead staghorn corals on Tao Island, southern Thailand

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**Abstract.** A new harpacticoid species of the genus *Parathalestris* Brady & Robertson, 1873 was collected from dead staghorn corals (*Acropora* spp.) on Tao Island in Surat Thani Province, southern Thailand. Specimens of both sexes of *Parathalestris yeemini*, new species, are described herein. Sexual dimorphism is expressed in the antennules, P1, P2, P5, P6 and urosomites. *Parathalestris yeemini*, new species, is most closely related to *P. parviseta* Chang & Song, 1997 from Korea and *P. mourei* Masunari, 1988 from Brazil in sharing nine-segmented female antennule, specific structure of female genital field, P1 basis of male blunt, curved, and directed upwards, and P2 endopod II of male strongly modified. However, it can be easily distinguished by the body shape which is more robust, ornamented with more fine spinules and sensillae; female with pores close to distal margin of exp III and enp III of P2–P4. Female P5 of the new species has five marginal smooth setae on baseoendopod, of which the innermost one is separated much further from others than in *P. parviseta* and *P. mourei*. P5 exopod of female has six marginal smooth setae, of which 2nd, 3rd, and 6th setae are small and strong, while there are 5 long marginal setae in *P. parviseta* and *P. mourei*. Caudal seta V is slightly swollen at base. These characters are suggested as autapomorphies of the new species.

**Key words.** Taxonomy, *Parathalestris*, staghorn corals, Tao Island, southern Thailand

### INTRODUCTION

The taxonomic studies of marine harpacticoid copepods of Thailand started in the early 1990s. Chertoprud et al. (2009) reviewed the harpacticoid (Copepoda) fauna of the South China Sea based on their collected samples and data from the literature. Before the Second World War, in 1935, only three species of benthic harpacticoids from Thailand were recorded: *Nitokra platypus bakeri* Chappuis, 1930 (Ameiridae), collected from Gulf of Siam; *Schizopera longirostris* Daday, 1901 (Miraciidae), collected from the Chao Prai River delta, and *Onychocamptus mohammed* (Blanchard & Richard, 1891) (Laophontidae), collected from the estuaries of Thailand. Fifty years later, Gee (1998) added a new cletodid, *Limnocletodes mucronatus* Gee, 1998, from muddy sediments in Southeast Asian mangrove forests. After 2000, a series of studies on free-living harpacticoid species from various marine habitats of Thailand were

carried out, with the following species being described: *Longipedia thailandensis* Chullasorn & Kangtia, 2008, from sediments in brackish water treatment pond, Samut Sakhon Province; *Typhlamphiascus higginsii* Chullasorn, 2009, from a seagrass bed of *Enhalus acoroides* (Linnaeus) at Banpaklok, Phuket Island; *Tisbe thailandensis* Chullasorn, Dahms & Schizas, 2009, from sandy Bangsaen Beach, Chonburi Province; *Paramphiascella dahmsii* Chullasorn, 2010, and *Paramphiascella ferrarii* Chullasorn, 2010, from the sediments in brackish water pond, Samut Sakhon Province; *Paramphiascella choi* Chullasorn, Anansatitporn & Kangtia, 2011, associated with green alga, *Ulva clathrata* (Roth) C. Agardh at the Eastern Marine Fisheries Development Center, Rayong Province; *Tigriopus thailandensis* Chullasorn, Ivanenko & Dahms, 2012, from sandy Bangsaen Beach, Chonburi Province; *Tigriopus sirindhornae* Chullasorn, Dahms & Klangsin, 2013, collected from brown alga, *Padina* sp. in Rayong Province; and *Nitokra karanovici* Chullasorn, Kangtia & Klangsin, 2014, from sandy Bangsaen Beach, Chonburi Province.

The harpacticoid family Thalestridae Sars, 1905, accommodated 25 genera (sensu Boxshall & Halsey, 2004). However, the number of genera was reduced by Wells (2007) to seven, which are accommodated in two subfamilies. The genus *Parathalestris* Brady & Robertson, 1873, comprises 21 species according Boxshall & Halsey (2004), 26 species according Wells (2007) and 27 species according Song & Hwang (2010).

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During a survey of meiobenthic samples collected from coralline sand on Tao Island of Surat Thani Province, southern Thailand, several specimens of harpacticoid copepods were obtained and taxonomically examined. The aim of the present study is to describe a new species, *Parathalestris yeemini*, with detailed figures. This presents the first thalestrid species reported from Thailand's marine environments.

## MATERIAL AND METHODS

Samples were collected during low-tide from dead staghorn corals (*Acropora* spp.) and coralline sand. Specimens were fixed in 5% formalin. Only adults of *Parathalestris yeemini*, new species, were sorted out from the samples by means of stereomicroscope at 40× magnification. Before dissection the specimens were suspended in W15 (embedding medium of Carl Zeiss Co.). The habitus of several specimens were drawn from whole mounts and total length measurements were made with an Olympus SZ38. Dissected parts were mounted on slides in glycerin. Broken glass fibers were added to prevent the animal and appendages from being compressed by the cover glass and to facilitate rotation and manipulation, to allow observation from all aspects. Drawings were prepared using a camera lucida on a Nikon BH-2, HFX-DX compound microscope at a magnification of 1000×. Measurements were made with an ocular micrometer, from the tip of the rostrum to the posterior margin of the caudal ramus. Type material was preserved in 95% ethanol, and deposited in the National Institute of Biological Resources (NIBR), Korea, and the Lee Kong Chian Natural History Museum, National University of Singapore (ZRC) respectively.

The main references for the morphological description of the new species of *Parathalestris* were Lang (1948), Huys & Boxshall (1991), Chang & Song (1997) and Song & Hwang (2010). The terminology of the body and appendage morphology follows that of Huys & Boxshall (1991). Abbreviations used in the text and figures are: R = rostrum; A1 = antennule; A2 = antenna; Md = mandible; Mx1 = maxillule; Mx2 = maxilla; Mxp = maxilliped; P1–P4 = first to fourth swimming legs, respectively; P5 = leg 5; P6 = leg 6; enp I, II, III = endopod I, II, III, respectively; exp I, II, III = exopod I, II, III, respectively; ae = aesthetasc; Uro 4, 5, 6 = urosomite 4, 5, 6, respectively; caudal seta V = fifth caudal seta.

## TAXONOMY

### Family Thalestridae Sars, 1905

### Genus *Parathalestris* Brady & Robertson, 1873

#### *Parathalestris yeemini* new species (Figs. 1–11)

**Material examined.** Holotype, female, dissected (NIBRIV0000325273), allotype, male, dissected (NIBRIV0000325274), on dead staghorn corals and coralline sand, Tao Island, Surat Thani Province, southern Thailand (10°4'47"N, 99°49'47"E), collected by Sittiporn Pengsakun,

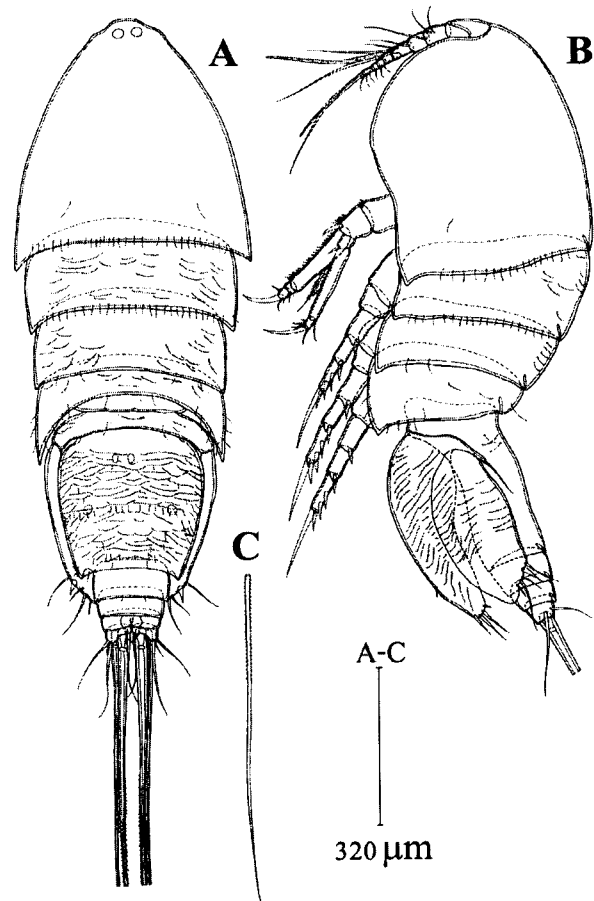


Fig. 1. *Parathalestris yeemini*, new species, holotype, female (NIBRIV0000325273). A, habitus, dorsal view; B, habitus, lateral view; C, caudal seta V.

26 March 2010. Paratypes: 2 females, 2 males, undissected (NIBRIV0000325273), 1 female, 1 male, undissected (ZRC 2016.0343), same data as holotype & allotype.

**Etymology.** The species name honours Dr. Thamasak Yeemin, Assistant Professor at Ramkhamhaeng University, Thailand, for his achievements in the study of corals.

**Description of female.** Total length of holotype female, 1.29 mm (Fig. 1A, B); total length of paratype females 1.20 mm – 1.32 mm (n=3, mean = 1.27 mm). Body fusiform, somewhat depressed laterally, with row of sensillae along posterior margin of cephalosome and first prosomite. Nauplius eye conspicuous. Prosome four-segmented, comprising cephalosome and three free pedigerous somites. Cephalosome almost as long as three prosomites combined, the latter ornamented with many rows of very fine spinules scattered on dorsal surface. Rostrum (Fig. 3A) small, articulating with cephalic shield, triangular shape with one pair of sensillae in the distal fifth.

Urosome (Fig. 2A, B): five-segmented, comprising P5 bearing-somite, genital double-somite, and three free abdominal somites. Genital double-somite ornamented with

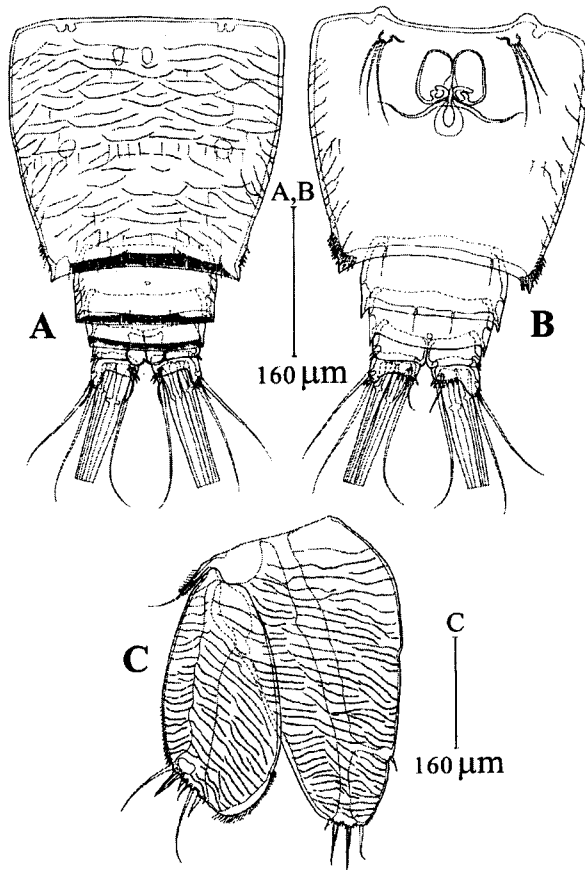


Fig. 2. *Parathalestris yeemini*, new species, holotype, female (NIBRIV0000325273). A, urosome, dorsal view; B, urosome, ventral view; C, P5.

very fine spinules scattered on dorsal surface. Genital field distinct, ventrally with two copulatory apertures and with P6. Third urosomite with pore on dorsal surface. Posterior margins of genital double-somite, third and fourth urosomites ornamented with hyaline frills dorsally. Anal operculum rectangular and smooth. Caudal rami short, much wider than long, slightly swollen at base, ornamented with some spinules dorsally and ventrally, with the customary seven elements: seta V (Fig. 1C) longest about 2.5 times longer than seta IV, seta I shortest, seta II almost as long as seta III and seta VI, seta VII slightly longer than seta I.

Antennule (Fig. 3B): nine-segmented; first segment ornamented with rows of spinules; surface of second to ninth segments smooth. Length of two proximal segments almost as long as five apical segments combined. Fourth and last segment with one large and one small aesthetasc, respectively. Armature formula: 1-(1), 2-(11), 3-(6), 4-(1+acrothek), 5-(2), 6-(3), 7-(1), 8-(1), 9-(3+acrothek). Acrothek consisting of one aesthetasc and two setae.

Antenna (Fig. 3C): coxa short. Allobasis elongate bearing exopod, armed with one smooth abexopodal seta in distal quarter of inner edge. Exopod two-segmented; first segment shorter with one plumose and one bipinnate setae; second

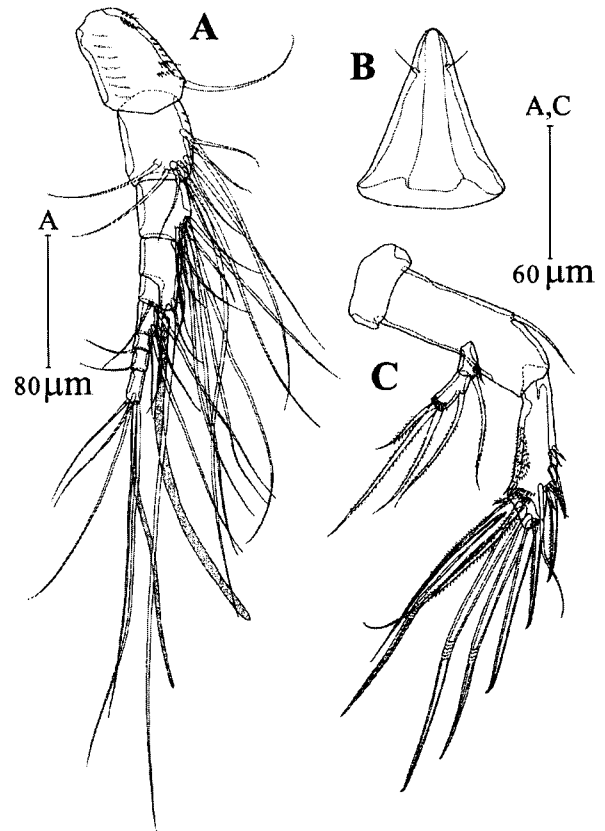


Fig. 3. *Parathalestris yeemini*, new species, holotype, female (NIBRIV0000325273). A, rostrum, dorsal view; B, right antennule; C, right antenna.

segment longer with one bipinnate seta laterally, and one short and two-bipinnate setae apically, several tiny spinules on subapical corner. Free endopodal segment shorter than allobasis, ornamented with several rows of minute spinules along inner margin and subapically. Lateral armature consisting of two unipinnate spines and one slender seta. Apical armature consisting of one unipinnate spine, one smooth seta, and three geniculate setae (of which one has a common base with outermost unipinnate seta), and one slender bipinnate seta.

Mandible (Fig. 4A): coxa well developed with some spinules on surface. Gnathobase bearing several multicuspidate teeth on three distinct distal lobes and one unipinnate long seta on distal corner. Basis elongate, ornamented with curved row of spinules on proximal surface, with one plumose and two bipinnate setae distally. Endopod bilobed with two bipinnate setae on inner lobe, four bipinnate and one smooth setae on outer lobe. Exopod with three apical and two lateral bipinnate setae.

Maxillule (Fig. 4B): praecoxa bare, arthrite strongly developed with spinular row on surface, bearing six strong apical spines and small teeth distally, one lateral bipinnate seta, and two smooth anterior surface setae. Coxa with cylindrical process bearing two unipinnate and two smooth

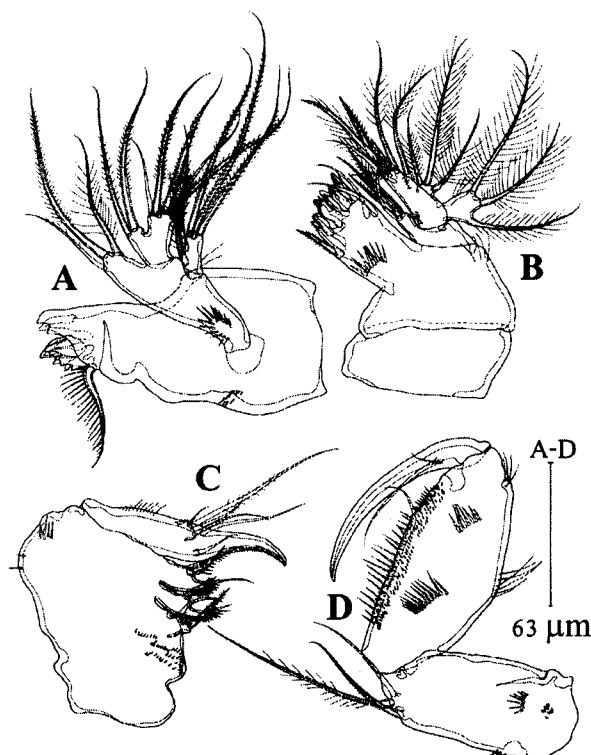


Fig. 4. *Parathalestris yeemini*, new species, holotype, female (NIBRIV0000325273). A, mandible; B, maxillule; C, maxilla; D, maxilliped.

setae. Basis with one pinnate spine and six plumose setae. Exopod and endopod one-segmented, bearing three plumose setae each.

Maxilla (Fig. 4C): syncoxa with several rows of tiny spinules on surface, and with three endites: proximal bilobed with one bipinnate and one slender setae, middle and distal endites with one spiniform spine and one slender seta each. Basis with one inner smooth seta on a strong pectinate claw, and one bipinnate seta, and four slender bare setae near base of claw.

Maxilliped (Fig. 4D): syncoxa and basis well developed. Syncoxa with one unipinnate, one plumose and one smooth setae at inner distal corner; row of spinules on anterior surface. Basis with rows of spinules on anterior surface and some minute spinules along outer margin, with median slender seta. Endopod with one large naked claw and one conical process bearing one short and one long setae.

P1 (Fig. 5A): praecoxa bare, coxa with row of spinules on anterior surface and row of setules along outer margin. Basis with one pore and spinular ornamentation pattern as figured; one inner and one outer bipinnate spines. Endopod slightly shorter than exopod; both rami three-segmented. Endopod I much longer than enp II and enp III combined, with one plumose seta and row of spinules along outer margin; enp II as short as enp III, with one inner very small seta; enp III with one median strong outwardly curved claw-like smooth spine, one outer smooth spine, and two inner small

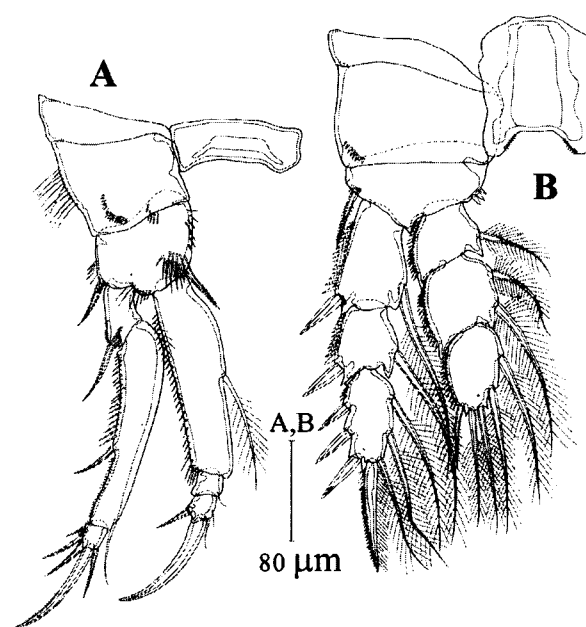


Fig. 5. *Parathalestris yeemini*, new species, holotype, female (NIBRIV0000325273). A, right P1; B, right P2.

smooth setae. Exopod II much longer than exp I and exp III combined, exp I ornamented with fine spinules along outer margin and some spinules close to base of outer smooth spine; exp II elongate, ornamented with longer spinules along proximal half of outer margin and short spinules along distal half of it, with one smooth spine almost at midlength; one seta on inner distal edge; exp III shortest, with one median outwardly curved claw-like unipinnate spine, three outer and one inner spines.

P2 (Fig. 5B): praecoxa bare, coxa with some spinules on anterior surface. Basis with several spinules at base of outer bipinnate spine. Endopod shorter than exopod, both rami three-segmented. Endopod I with row of spinules along outer margin, and one inner plumose seta; enp II with row of spinules along outer margin, and two plumose inner setae; enp III with one pore, two median plumose setae, one outer bipinnate spine, and two inner plumose setae. Exopod I and exp II with row of spinules along outer margins, one outer strong smooth spine, and one inner plumose seta each; exp III with one pore, one median strong unipinnate spine, three outer strong smooth spines, and three inner plumose setae. P3 (Fig. 6A): praecoxa and coxa bare. Basis with some spinules along inner margin, and few spinules at base of outer slender seta. Endopod shorter than exopod, both three-segmented. Endopod I and enp II ornamented with row of spinules along outer margin, and one inner plumose seta each; enp III with one pore, two median plumose setae, one outer bipinnate spine, and three inner plumose setae. Exopod I and exp II with row of spinules along outer margin, one outer strong bipinnate spine, and one inner plumose seta each; exp III with one pore, three outer strong bipinnate spines, one median strong unipinnate spine, one plumose seta, and three inner plumose setae.

Table 1. Seta and spine formula of swimming legs of *Parathalestris yeemini*, new species.

	Exopod	Endopod
P1	I-0; I-1; II,II,1	0-1; 0-1; I,II,1
P2	I-1; I-1; II,II,3	0-1; 0-2; I,2,2
P3	I-1; I-1; III,I,1,3	0-1;0-1; I,2,3
P4	I-1; I-1; III,I,1,3	0-1;0-1; I,2,2

Arabic numbers represent setae, Roman numbers represent spines.

P4 (Fig. 6B): as P3, except for enp III with two inner plumose setae.

Seta and spine formula of swimming legs of the new species as shown in Table 1.

P5 (Fig. 2C): baseoendopod and exopod foliaceous, extending beyond the distal margin of genital-double somite. Both baseoendopod and exopod with very fine spinules on surface. Baseoendopod with one basal slender seta, and four apical smooth setae, one inner short spiniform seta at  $\frac{1}{4}$  distance from apex. Exopod ornamented with two spinules and fine setules along inner margin, and minute spinules along outer margin, bearing three bare setae and three short spines, of which third outermost one shortest and second innermost one longest.

P6 (Fig. 2B) represented by three long smooth setae of unequal length; the innermost one longest.

**Description of male.** Total length of allotype male, 1.05 mm (Fig. 7A, B), total length of paratype males 0.87–1.15 mm ( $n = 3$ , mean = 1.04 mm). Body surface smooth, body shape in general similar to females, except slightly smaller.

Sexual dimorphism expressed in A1, P1, P2, P5, P6 and urosomites.

**Urosome (Fig. 8A, B):** six-segmented, comprising P5-bearing somite, genital somite, three abdominal and anal somites. In dorsal view, Uro 3 to Uro 5 with hyaline frills at posterior margin, Uro 1 to Uro 5 with rows of fine spinules, Uro 3 with one pair of pores and Uro 5 with one pore. In ventral view, Uro 3 and Uro 4 ornamented with strong spinules along posterior margin; Uro 3 to Uro 5 with pores on each segment. Anal operculum bare.

**Antennule (Fig. 9A):** haplocerate, eleven-segmented, without ornamentation. First segment with one plumose seta, geniculation between seventh and eighth segments. Armature formula: 1-(1), 2-(11), 3-(4+acrothek), 4-(2), 5-(5+acrothek), 6-(1), 7-(0), 8-(1), 9-(2), 10-(2), 11-(5+acrothek). Acrothek consisting of one aesthetasc and two setae.

Antenna and mouthparts as in female.

P1 (Fig. 10A): as in female, except basis with one curved spine on inner margin, directed upward.

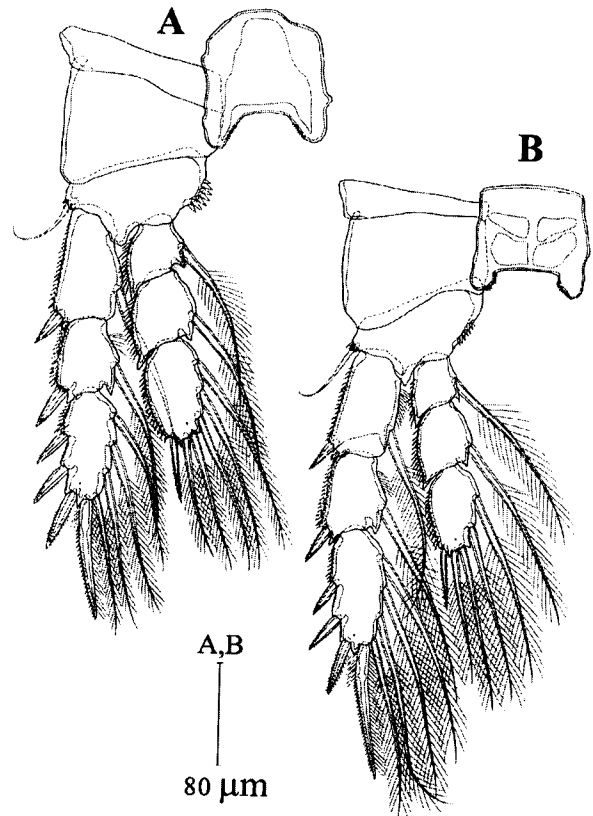


Fig. 6. *Parathalestris yeemini*, new species, holotype, female (NIBRIV0000325273). A, right P3; B, right P4.

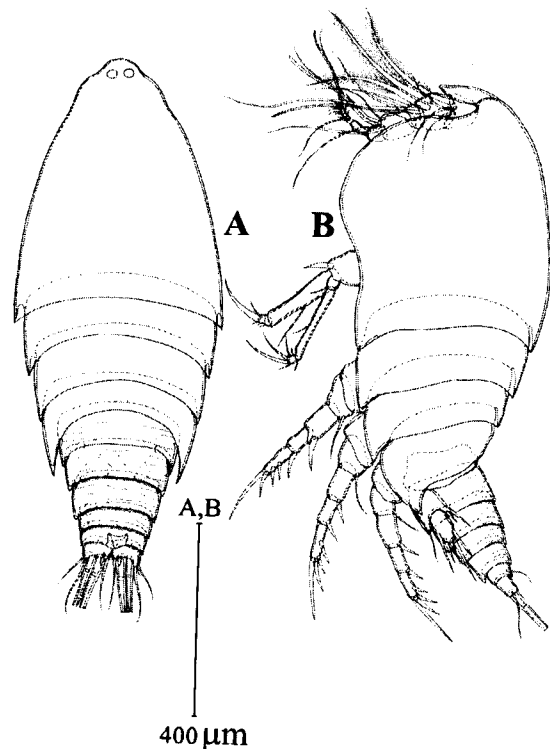


Fig. 7. *Parathalestris yeemini*, new species, allotype, male (NIBRIV0000325274). A, habitus, dorsal view; B, habitus, lateral view.



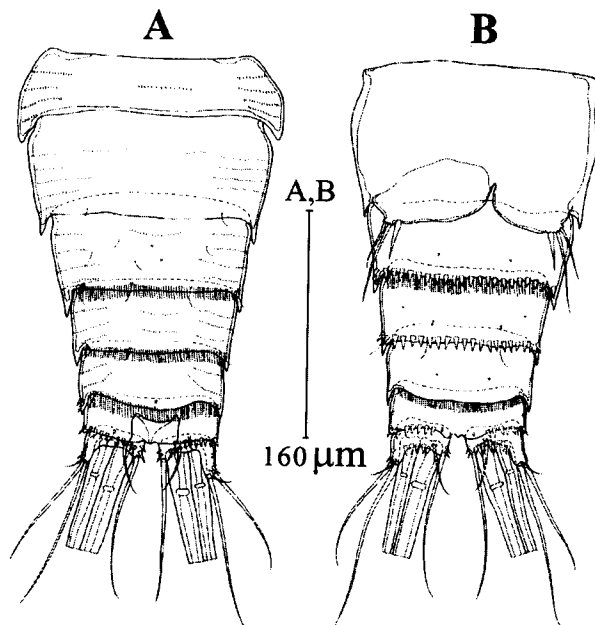


Fig. 8. *Parathalestris yeemini*, new species, allotype, male (NIBRIV0000325274). A, urosome, dorsal view; B, urosome, ventral view.

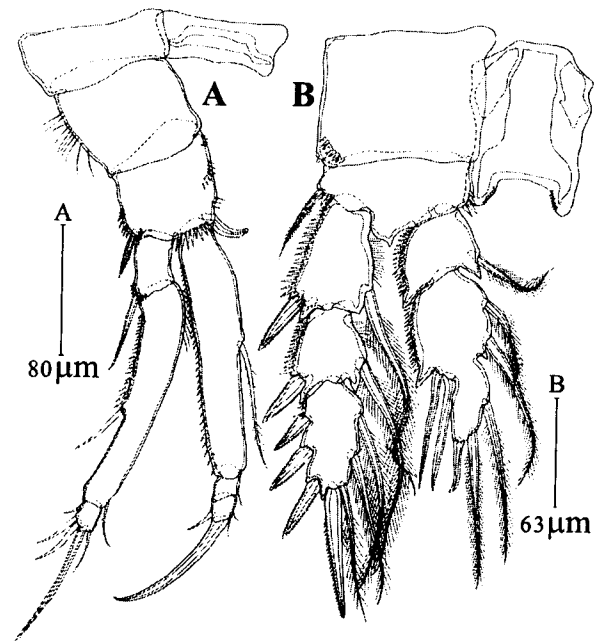


Fig. 10. *Parathalestris yeemini*, new species, allotype, male (NIBRIV0000325274). A, right P1; B, right P2.

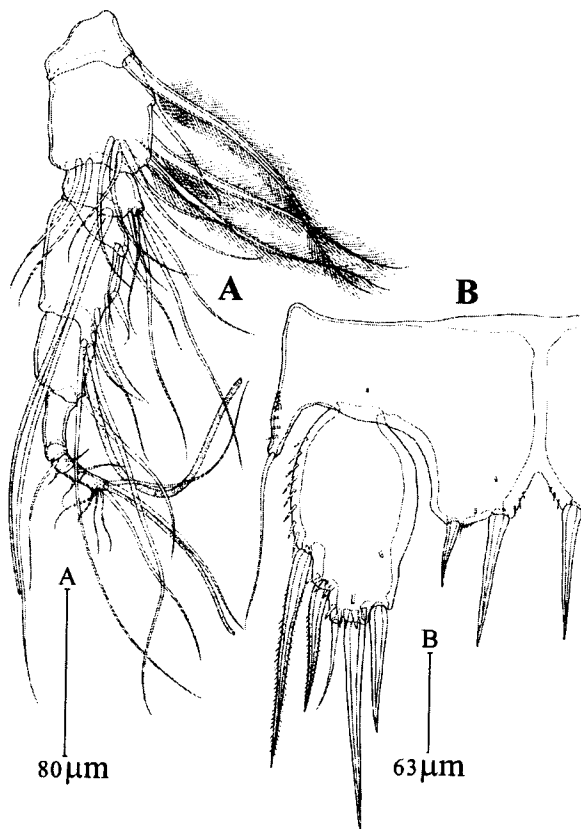


Fig. 9. *Parathalestris yeemini*, new species, allotype, male (NIBRIV0000325274). A, right antennule; B, P5.

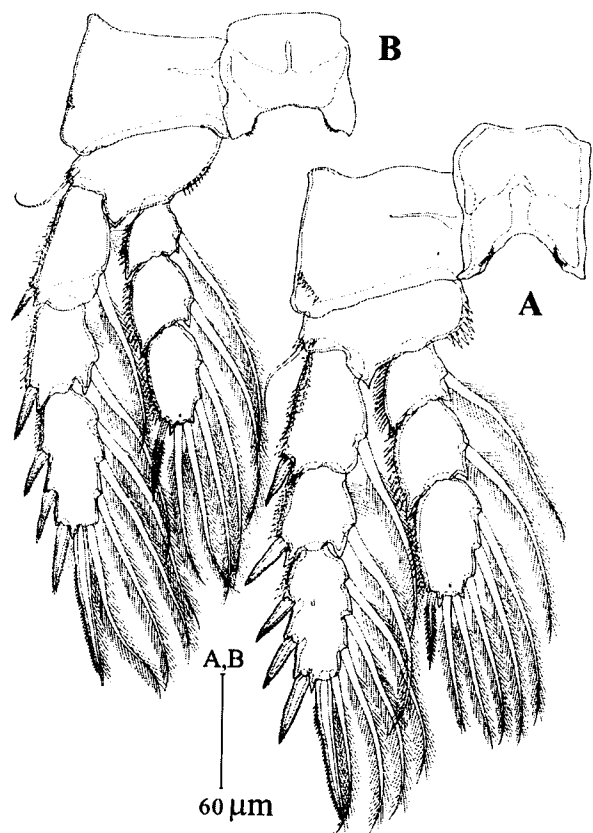


Fig. 11. *Parathalestris yeemini*, new species, allotype, male (NIBRIV0000325274). A, right P3; B, right P4.

P2 (Fig. 10B): endopod two-segmented; enp I with one inner plumose seta; enp II strongly modified, with reduced terminal segment completely coalesced with the middle segment; two smooth spines equal in length on outer margin; apically one smooth spine, slightly curves, almost half length of outer spines; two plumose setae on proximal part of inner margin, two plumose setae on distal part of inner margin. Exopod three-segmented; armed as in female.

P3 and P4 (Fig. 11A, B): as in female.

P5 (Fig. 9B): baseoendopods completely fused medially, outer margin with smooth slender seta; and with three pores on surface. Each baseoendopod on inner margin armed with two smooth spines, inner one twice as long as outer one, and one minute seta close to base of the outer spine. Exopod oval, about twice as long as wide, with distal margin well overreach posterior margin of baseoendopod. Distally two pores and several spinules along outer margin. Armature of five elements, unequal in length: two innermost spines smooth, robust; two outermost bipinnate, robust; median seta smooth and weak.

P6 (Fig. 8B) represented by two asymmetrical plates, with three elements; two outer slender setae, unequal length, and one inner small spine, about 1/2 length of inner slender seta.

**Remarks.** Boxshall & Halsey (2004) stated that the majority of thalestrids occur in marine, shallow water epibenthos, sometimes in association with macroalgae. *Parathalestris croni* (Krøyer, 1842) is commonly collected in plankton samples (Boxshall, 1979), although it is typically associated with floating macroalgal clumps (Ingólfsson & Ólafsson, 1997). In contrast, *P. yeemini*, new species, was found by the authors on coralline sand, the first such record of *Parathalestris* in this kind of sediment.

Wells (2007) pointed out three important characters useful to separate the species of *Parathalestris*, which are found on the P1, the female antennule, and the male P2 endopod: (1) in the P1: the exp II and enp I are elongate, always much longer than other segments (Lang, 1965); the exopod and endopod are approximately the same length; (2) the female antennules are eight- or nine-segmented; and (3) the male P2 endopod is two-segmented, with enp II strongly modified, fused distal two segments with three spines and four setae. In addition, other species-specific characters for the genus *Parathalestris* are the female P5, male P2 enp II and male P5.

*Parathalestris yeemini*, new species, shares the same generic characters with its known congeners: (1) the body is fusiform and depressed laterally; (2) the female antennule has nine segments; (3) the A2 has a two-segmented exopod; (4) the allobasis of the antenna has abexopodal seta; (5) the baseoendopod and exopod of the female P5 are forming foliaceous rami; and (6) the male P2 has a two-segmented endopod, with enp II strongly modified as mentioned above.

Females of *Parathalestris yeemini*, new species, are unique in having a combination of the following characters: (1) the

whole body is ornamented with many rows of fine spinules dorsally, with a row of sensillae along the posterior margin of the cephalosome and first prosomite; (2) the first segment of the antennule is ornamented with rows of spinules, and the surface of the second to ninth segments are smooth; (3) the basis of the mandible is elongate, ornamented with a curved row of spinules on its proximal surface; (4) the arthrite of the maxillule is strongly developed, bearing six strong apical spines and small teeth distally; (5) the middle and distal endites of the maxilla are with one spiniform spine each; (6) the endopod of the maxilliped has one large, naked claw; (7) the P1 endopod is slightly shorter than the exopod; and (8) the female P5 baseoendopod and exopod are forming foliaceous rami extending beyond the distal margin of genital double-somite.

Female of *Parathalestris yeemini*, new species, share with their morphologically closest relatives (*P. parviseta* Chang & Song, 1997, from an algal bed near a small breakwater in Goeje Island of Korea and *P. mourei* Masunari, 1988, collected from a calcareous alga, *Amphiroa beauvoisii* in Santos Bay, Brazil), the same general appearance and the following characters: (1) nine-segmented female antennules, first segment with one seta; (2) caudal ramus short in both sexes; (3) basis of male P1 with blunt, curved upwardly directed spine at the inner distal corner; (4) female genital field with two copulatory apertures ventrally and with P6; and (5) seta and spine formula of P1–P4 of female (Table 1).

*Parathalestris yeemini*, new species, differs from *P. parviseta* and *P. mourei* as follows: (1) female antennule has several rows of spinules on the surface of first segment (no row in *P. parviseta*, and one row in *P. mourei*); (2) enp I of female P1 reach about 2/3 of exp II (as long as in *P. parviseta*, and 3/4 in *P. mourei*); (3) inner seta of enp I of female P1 is long and reach end of the segment (very short and not reach end of the segment in two species); (4) female P5 reach end of urosome (end of genital double-somite in two species); (5) baseoendopod of female P5 has five marginal smooth setae, the innermost seta separated much far from others than *P. parviseta* and *P. mourei* respectively; (6) exopod of female P5 has six marginal smooth setae, of which three spines, 2nd, 3rd, and 6th one are small and strong (six long marginal setae in two species); (7) distal endopod of male P2 has two outer spines of subequal length, however outer spine is longer than inner one in two species; and (8) baseoendopod of male P5 reach middle of exopod, with two spines + one minute seta (3/4 of exopod, and one spine + two small setae in *P. parviseta*; end of exopod, and one spine + two small setae in *P. mourei*).

So far eight species of *Parathalestris* have been recorded from the Asian region, particularly eastern Russia, Japan and Korea. Two species, *P. verrucosa* Itô, 1970, and *P. areolata* Itô, 1972, were collected from Akkeshi Bay, on the Pacific coast of Hokkaido, and later these two species were also recorded from Korean waters (Chang & Song, 1997; Back & Lee, 2011). In Russia, Chislenko (1971) added one new species, *P. pacificus* Chislenko, 1971, which was collected from Possjet Bay, East Sea. As mentioned in Song & Hwang

(2010), all eight species were recorded from Korean waters including three described from there, viz. *P. infestus* Ho & Hong, 1988, collected from the cultivated brown seaweed, *Undaria pinnatifida*, at Soando Island, *P. parviseta* Chang & Song, 1997, collected from an algal bed near a small breakwater at Myongsa, Geoje Island, and *P. jejuensis* Song & Hwang, 2010, collected from macroalgal beds on sandy bottom in Jeju Island. All species reported from Asia inhabit shallow waters within 10 m depth, and are associated with macroalgae. The present new species represents the first occurrence of *Parathalestris* on coralline sand, and is also the first species recorded from Tao Island in Surat Thani Province, southern Thailand.

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## LITERATURE CITED

- Back J & Lee W (2011) Redescription of two species of *Parathalestris* (Copepoda: Harpacticoida: Miraciidae) in Korea. *Bulletin of National Institute of Biological Resources*, 2(2): 85–97.
- Blanchard R & Richard J (1891) Faune des lacs salés d'Algérie. Cladocères et Copépodes. *Mémoires de la Société zoologique de France*, 4: 512–535.
- Boxshall GA (1979) The planktonic copepods of the northeastern Atlantic Ocean: Harpacticoida, Siphonostomatoida and Mormonilloida. *Bulletin of the British Museum (Natural History), Zoology*, 35: 201–264.
- Boxshall GA & Halsey SH (2004) An introduction to copepod diversity. 2 vols. London, The Ray Society, 966 pp.
- Brady GS & Robertson D (1873) Contributions to the study of the Entomostraca. No. viii. On marine Copepoda taken in the west of Ireland. *Annals and Magazine of Natural History*, 4(12): 126–142.
- Chang CY & Song SJ (1997) Marine harpacticoid copepods of genus *Parathalestris* (Copepoda, Harpacticoida, Thalestridae) from Korea. *Korean Journal of Systematic Zoology*, 13: 221–231.
- Chappuis PA (1930) Copepoda Harpacticoida von der Insel Luzon, Philippinen. *Philippine Journal of Science*, 41: 143–147.
- Chertoprud E, Gómez S & Gheerardyn H (2009) Harpacticoida (Copepoda) fauna and the taxocene diversity of the South China Sea. *Oceanology*, 49(4): 488–498.
- Chislenko LL (1971) New common forms of harpacticoids (Copepoda, Harpacticoida) from Possjet Bay of the Sea of Japan. *Issledovaniya Fauny Morei*, 8: 151–161.
- Chullasorn S & Kangtira P (2008) *Longipedia thailandensis* sp. nov. (Copepoda: Harpacticoida) from a brackish water treatment pond, Samut Sakhon, Thailand. *Crustaceana*, 81(2): 207–225.
- Chullasorn S (2009) A review of *Typhlamphiascus* Lang, 1944 with the new species *Typhlamphiascus higginsii* (Copepoda: Harpacticoida: Miraciidae) from Phuket Island. *Zoological Studies*, 48(4): 493–507.
- Chullasorn S (2010) Two new species of the genus *Paramphiascella* Lang, 1944 (Copepoda, Harpacticoida, Miraciidae) from a brackish water pond in Thailand. *Zootaxa*, 2634: 1–24.
- Chullasorn S, Anansatitporn W, Kangtira P, Klangsin P and Jullawateelert R (2011) Review of naupliar development among Miraciidae (Copepoda: Harpacticoida) with a naupliar description of *Paramphiascella chui* sp. nov. from Thailand. *Hydrobiologia*, 666: 21–43.
- Chullasorn S, Dahms H-U & Klangsin P (2013) A new species of *Tigriopus* (Copepoda, Harpacticoida, Harpacticidae) from Thailand with a key to the species of the genus. *Journal of Natural History*, 47(5-12): 427–447.
- Chullasorn S, Ivanenko VN, Dahms H-U, Kangtira P and Yang W-Xi (2012) A new species of *Tigriopus* (Copepoda, Harpacticoida, Harpacticidae) from Thailand with description of its naupliar development. *Helgoland Marine Research*, 66: 139–151.
- Chullasorn S, Kangtira P & Klangsin P (2014) A new species of *Nitokra* Boeck, 1865 (Copepoda: Harpacticoida: Ameiridae) from a brown alga in Thailand. *Proceedings of the Biological Society of Washington*, 127(1): 122–137.
- Daday E (1901) Mikroskopische Süßwasserthiere aus Deutsch-Neu-Guinea. *Természeti Füzetek*, 24: 1–56.
- Gee JM (1998) A revision of the genus *Limnocolletes* Borutsky, 1926 (Copepoda: Harpacticoida: Cletodidae) with a description of a new species from Southeast Asian mangrove forests. *The Raffles Bulletin of Zoology*, 46(2): 399–418.
- Ho JS & Hong JS (1988) Harpacticoid copepods (Thalestridae) infesting the cultivated wakame (brown alga, *Undaria pinnatifida*) in Korea. *Journal of Natural History*, 22: 1623–1627.
- Huys R & Boxshall GA (1991) Copepod Evolution. The Ray Society, London. The Gresham Press, UK, 468 pp.
- Ingólfsson A & Ólafsson E (1997) Vital role of drift algae in the life history of the pelagic harpacticoid *Parathalestris croni* in the northern North Atlantic. *Journal of Plankton Research*, 19(1): 15–27.
- Itô T (1970) Descriptions and records of marine harpacticoid copepods from Hokkaido, III. *Annotationes Zoologicae Japonenses*, 44: 117–124.
- Itô T (1972) Descriptions and records of marine harpacticoid copepods from Hokkaido, IV. *Journal of the Faculty of Science, Hokkaido University, Series VI, Zoology*, 18: 516–531.
- Krøyer H (1842) Crustacés. In: Gaimard P, editor. *Atlas de Zoologie. Voyages de la Commission Scientifique du Nord en Scandinavie, en Laponie, aux Spitzberg et aux Féroë pendant les Années 1838, 1839, et 1840 sur la Corvette La Recherche, Commandée par M. Frabvre*. Paris: Arthus Bertrand. Pp. 41–43.
- Lang K (1948) *Monographie der Harpacticiden*. Håkan Ohlsson, Lund, 2 vols, 1682 pp.
- Lang K (1965) Copepoda Harpacticoida from the Californian Pacific coast. *Kungliga Svenska Vetenskapsakademiens Handlingar* 10, 1–560.
- Masunari S (1988) *Parathalestris mourei*, a new species seaweed-dwelling copepod (Harpacticoida, Thalestridae) from Santos Bay, Brazil. *Crustaceana*, 54: 104–112.
- Sars GO (1905) An account of the Crustacea of Norway. Volume V. Copepoda Harpacticoida, parts 7–10: 81–132. Plates XLVIII–LXXX, Bergen Museum, Bergen.
- Song SJ & Hwang UW (2010) *Parathalestris jejuensis* sp. nov. Harpacticoida, Thalestridae) from Macroalgal beds from Korea. *Crustaceana*, 83(11): 1337–1348.
- Wells JBJ (2007) An annotated checklist and keys to the species of Copepoda Harpacticoida (Crustacea). *Zootaxa*, 1568: 1–872.

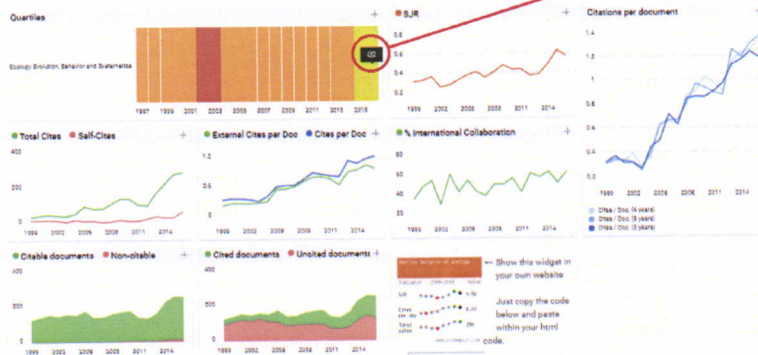


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H Index

Country	Singapore
Subject Area and Category	Agricultural and Biological Sciences Ecology, Evolution, Behavior and Systematics
Publisher	National University of Singapore
Publication type	Journals
ISSN	02172445
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**Scope** The Raffles Museum of Biodiversity Research (RMBR) has its origins in the Raffles Museum which was founded in 1849 as a result of an idea mooted by Sir Stamford Raffles, an eminent naturalist. RMBR inherited the natural history collection when the Raffles Museum was renamed the National Museum and is now part of the Department of Biological Sciences (DBS) at the National University of Singapore (NUS). (source)



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