Zootaxa 3613 (4): 380–390
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3613.4.5
http://zoobank.org/urn:lsid:zoobank.org:pub:FC63BB8F-3B2B-491C-A67D-5ACB7F3EB6B0

A new species of the hermit crab genus *Diogenes* (Crustacea: Decapoda: Anomura: Diogenidae) from southern India

TOMOYUKI KOMAI[1], REMA RESHMI[2] & APPUKUTTANNAIR BIJU KUMAR[2]

[1]*Natural History Museum and Institute, Chiba, 955-2 Aoba-cho, Chuo-ku, Chiba, 260-8682 Japan. E-mail: komai@chiba-muse.or.jp*
[2]*Department of Aquatic Biology & Fisheries, University of Kerala, Thiruvananthapuram 695581, Kerala, India. E-mail: resmirema@gmail.com, bijupuzhayoram@gmail.com*

Abstract

A new species of the hermit crab genus *Diogenes* Dana, 1851 (Diogenidae), *D. canaliculatus*, is described and illustrated on the basis of material from off the Kerala State, southern India. It is referred to the *D. edwardsii* (De Haan, 1849) species group, and compared with *D. bicristimanus* Alcock, 1905, *D. fasciatus* Rahayu & Forest, 1995, *D. laevicarpus* Rahayu, 1996 and *D. moosai* Rahayu & Forest, 1995. The characteristically sculptured left chela and the unarmed dorsal margins of the propodi of the second and third pereopods distinguish the new species from these congeners.

Key words: *Diogenes canaliculatus*, Kerala State

Introduction

The diogenid hermit crab genus *Diogenes* Dana, 1851 is typically characterized by the possession of an intercalary rostriform process flanked by ocular acicles, representing a unique feature for Paguroidea, though several species exhibits a tendency for reduction of this process, i.e., "*Troglopagurus* group" (McLaughlin 2005). *Diogenes* is currently represented by 61 species (Asakura & Tachikawa 2010; McLaughlin *et al.* 2010; Komai *et al.* 2012), most of which are distributed in shallow waters in the Indo-West Pacific region. Thanks to recent studies, taxonomic ambiguities of previously described species have been substantially clarified (e.g., McLaughlin & Haig 1996; McLaughlin & Clark 1997; McLaughlin & Dworschak 2001; McLaughlin & Holthuis 2001; McLaughlin 2002; 2005; Siddiqui & McLaughlin 2003; Siddiqui *et al.* 2004; Korn *et al.* 2008; Komai *et al.* 2012), though reappraisal of several specifies still remains necessary. From India and its adjacent waters, the following 19 species of the genus have been recorded: *D. alias* McLaughlin & Holthuis, 2001, *D. avarus* Heller, 1865, *D. bicristimanus* Alcock, 1905, *D. costatus* Henderson, 1893, *D. custos* (Fabricius, 1798), *D. dubius* (Herbst, 1804), *D. fasciatus* Rahayu & Forest, 1995, *D. investigatoris* Alcock, 1905, *D. karwarensis* Nayak & Neelakantan, 1989, *D. klaasi* Rahayu & Forest, 1995, *D. lophochir* Morgan, 1987, *D. maclaughlinae* Nayak & Neelakantan, 1985, *D. manaarensis* (Henderson, 1893), *D. miles* (Fabricius, 1787), *D. persicus* (Nobili, 1905), *D. planimanus* Henderson, 1893, *D. rectimanus* Miers, 1884, *D. tirmiziae* Siddiqui & McLaughlin, 2003, *D. violaceus* Henderson, 1893 and *D. waltairensis* Kamalaveni, 1950 (Henderson 1893; Alcock 1905; Kamalaveni 1950; Nayak & Neelakantan 1985, 1989; Thomas 1989; Siddiqui & McLaughlin 2003; Siddiqui *et al.* 2004; McLaughlin 2005; Reshmi & Bijukumar 2011).

In this paper, we describe one new species of *Diogenes* based on the material collected during the faunal investigation along the coast of the Kerala State, southern India, carried out by the junior authors. *Diogenes canaliculatus* **n. sp.**, is referred to the *D. edwardsii* De Haan, 1849 species group (Asakura & Tachikawa 2010). Affinities of the new species are discussed.

Material examined in this study is deposited in the Natural History Museum and Institute, Chiba (CBM), Japan, and the museum collections of the Department of Aquatic Biology and Fisheries, University of Kerala (DABFUK), India. General terminology follows McLaughlin *et al.* (2007), except for numbering of thoracic

 Accepted by S.T. Ahyong: 28 Dec. 2012; published: 12 Feb. 2013

sternites. Shield length (sl), measured from the tip of the rostrum to the midpoint of the posterior margin of the shield, indicates specimen size.

Taxonomic account

Genus *Diogenes* Dana, 1851

Diogenes canaliculatus n. sp.
(Figs 1–5)

? *Diogenes bicristimanus*. — Tirmizi & Siddiqui 1981: fig. 15; 1982: 52, figs 27, 28. — Siddiqui & Kazmi 2003: 89 (list).

Material examined. Holotype: male (sl 5.4 mm), off Kollam, Kerala State, India 08°27.23'N, 75°15.58'E to 08°35.42'N, 75°40.25'E, 15–20 m, 22 February 2011, CBM-ZC 11428.

Paratypes: 4 males (sl 3.3–4.7 mm), same data as holotype, CBM-ZC 11429; 5 males (sl 3.4–4.9 mm), same data, DABFUK-AR-AN 20–24; 2 females (sl. 2.6, 2.9), same data, DABFUK-AR-AN 25, 26.

Non-type: 3 males (sl 2.5–3.0 mm), same data as holotype, CBM-ZC 11430.

Description. Shield (Fig. 1A) 1.1 times longer than broad, suboctogonal; anterior margin between rostrum and lateral projections slightly concave, smooth or bearing 1–4 tiny tubercles near each base of lateral projection; anterolateral margins sloping, slightly tuberculate; posterior margin roundly truncate; dorsal surface with some transverse spinulose ridges laterally (these ridges bearing short setae). Rostrum obtuse; lateral projections each with small submarginal spinule. Anterior part of branchiostegite with row of about 10 small spines on dorsal margin, anterior angle rounded; lateral surface with scattered tufts of setae.

Ocular peduncles (Fig. 1A) equal in length, about 0.7 times as long as shield, moderately stout, not inflated basally; cornea not dilated, corneal width slightly less than 0.3 of peduncular length, subequal to basal width of ocular peduncle; ocular acicles with straight or slightly concave mesial margins, nearly straight or slightly convex anterolateral margin bearing 4–6 spinules or spines decreasing in size laterally and not extending to entire length of lateral margin. Intercalary rostriform process not reaching distal end of ocular acicles, slightly broadened basally, tapering to slender acute tip.

Antennular peduncle (Fig. 1A, B) overreaching distal corneal margin by 0.8–0.9 length of ultimate segment and extending as far as distal margin of antennal peduncle. Ultimate segment 4.6 times longer than distal width, subequal in length to penultimate segment, with some tufts of setae on dorsal surface; penultimate segment with prominent tuft of long setae on dorsodistal margin; basal segment with row of minute granules on distolateral margin.

Antennal peduncle (Fig. 1A, C) overreaching distal corneal margin by 0.8–0.9 length of fifth segment. Fifth segment with rows of moderately long to long stiff setae on ventral surface; fourth and third segments unarmed; second segment with strong spine at dorsolateral distal angle and small but prominent spine at dorsomesial distal angle, ventrodistal margin with 1 or 2 spinules; first segment with row of denticles on distal margin laterally. Antennal acicle slightly falling short of distolateral margin of fourth segment, terminating in simple or bifid spine, bearing 5–7 strong accessory spines on mesial margin and some tufts of short stiff setae on both lateral and mesial margins. Antennal flagellum (Fig. 1D) more than twice length of shield, articles with paired long, setulose setae and few additional short setae, forming filtering apparatus.

Third maxilliped (Fig. 1E) moderately slender. Carpus unarmed on dorsodistal margin. Ischium-basis fused segment with 4 strong, corneous-tipped spines (2 on ischium and 2 on basis) on mesial margin (Fig. 1F). Coxa with 2 or 3 spinules on mesial margin (Fig. 1F). Exopod slightly overreaching distal margin of merus.

Left cheliped (Fig. 2) moderately large, not particularly elongate in male. Chela strongly compressed. Dactylus distinctly longer than palm; upper margin with double row of small tubercles or spines (these becoming single row in distal half); outer surface usually with deep furrow medially and blunt ridge along cutting edge; cutting edge sinuous, with single row of small blunt calcareous teeth increasing in size proximally; inner surface with median row of tiny tubercles, row of small tubercles adjacent to upper margin, and shallow sulcus proximally. Palm shorter than carpus; upper surface becoming wider distally, with scattered small spines or tubercles; outer surface covered with rounded granules, substantially sculptured with 1 blunt ridge on midline extending onto fixed finger and

shallow depressions or furrows, in particular, lower one-third forming deep furrow extending onto fixed finger; longitudinal row of spines decreasing in size distally along upper one-third of outer surface, sometimes elevated in ridge; a few prominent spines present proximally; lower margin slightly upturned, irregular double or triple row of spines becoming smaller and single row distally, spines around proximo-lower angle particularly prominent; inner surface glabrous, with faint longitudinal sulcus proximal to dactylar articulation. Fixed finger slightly deflexed; cutting edge sinuous, with row of small, blunt, closely-set calcareous teeth. Carpus slightly longer than wide, with single row of spines increasing in size distally on upper margin; outer surface convex, with scattered, numerous small spines or spine-like tubercles and tufts of short stiff setae, dorsodistal margin denticulate; ventrolateral distal angle with 1 or 2 small spines; inner (mesial) surface with cluster of small spines or tubercles adjacent to distomesial angle, otherwise nearly smooth; ventral surface with tiny, low tubercles. Merus distinctly longer than high; dorsal surface rounded, bearing numerous spinules often arranged in short transverse rows and tufts of short stiff setae, dorsodistal margin spinulose mesially; lateral surface with short spinulose ridges (each bearing 2–4 spinules), particularly numerous on upper two-thirds, distolateral margin smooth, ventrolateral margin sinuous, with row of small spines increasing in size distally; mesial surface with several tufts of moderately short setae dorsally and low tubercles ventrally, distomesial margin spinulose, ventromesial margin with row of small spines or tubercles; ventral surface with scattered low tubercles and tufts of setae. Ischium with very low, blister-like protuberances on ventral surface, ventromesial margin minutely denticulate.

Right cheliped (Fig. 3) moderately stout, with numerous tufts of long setae, particularly on dorsal side; broad hiatus between fingers. Dactylus gently arched, about 2.5 times longer than palm; dorsal surface with irregular longitudinal row of spinules along midline in proximal half; mesial surface with several spinules or tubercles adjacent to dorsal margin; ventral surface unarmed; cutting edge with row of tiny calcareous denticles. Palm about half length of carpus; dorsal surface with few minute tubercles mesially, dorsomesial margin with row of spinules; mesial surface with few spinules or short spinulose ridges dorsally, distal margin (base of dactylus) denticulate; ventral surface slightly convex. Fixed finger gently curved, with few spinules on dorsal surface; cutting edge with row of small, often acute, calcareous teeth. Carpus with row of spines increasing in size distally on dorsomesial margin, dorsodistal margin with 1 small spine mesially; dorsolateral surface with several spinules or minute tubercles arranged in 2 irregular longitudinal rows; mesial surface with several short setose ridges dorsally, distomesial margin denticulate ventrally. Merus with short, transverse spinulose ridges or row of spinules and tufts of long setae over entire length of dorsal margin, dorsodistal margin spinose; lateral surface with scattered minute spinules dorsally, ventrolateral margin only delimited in distal part and with 3 or 4 small spines; mesial surface nearly smooth, ventromesial margin with row of tiny spines; ventral surface with scattered very low protuberances and tufts of setae. Ischium with few blister-like protuberances on ventral surface and with row of minute denticles on ventromesial margin.

Ambulatory legs (Figs 4A, B, 5A, B) generally similar, but third pair slightly longer than second pair. Dactyli about 1.3–1.4 times longer than propodi and 7.9–9.0 times longer than wide; dorsal margins unarmed, and each with 2 rows of moderately long stiff setae (merging in single row in distal half); lateral surfaces nearly flat, each with row of tufts of moderately short stiff setae dorsal to midline (second and right third) or with 2 rows of stiff setae flanking midline (left third; ventral setae much shorter than dorsal setae); mesial surfaces slightly convex, each with 2 rows of moderately long, stiff setae dorsally and ventrally; ventral margins each with tufts of or individual stiff setae decreasing in length distally (second and right third) (Fig. 5D) or with row of short bristle-like setae and row of short sparse setae distally (left third) (Fig. 5C). Propodi nearly straight or faintly curved; dorsal surfaces unarmed, with tufts of long stiff setae; lateral and mesial surfaces each with rows of tufts of moderately short to long stiff setae adjacent to dorsal and ventral margins, no conspicuous armature; ventral margin smooth, with sparse tufts of setae (second and right third) or with row of low protuberances (left third). Carpi each with row of small spines and tufts of setae on dorsal margin (spines smaller and fewer in third than in second; dorsodistal spine strongest); lateral surfaces unarmed, with row of tufts of moderately long stiff setae on midline; mesial and ventral surfaces with few setae. Meri with dorsal and ventral tufts of setae; dorsal margins each with row of spinules at least on proximal half (second) or unarmed (third); lateral surfaces unarmed or with few minute spinulose tubercles ventrally; mesial surfaces smooth; ventral surfaces each with row of spinules at least on proximal half (second) or unarmed, ventrolateral distal margin with 1 minute spine (second) or unarmed (third). Ischia with small, blister-like protuberances on ventral surfaces; dorsal margins without conspicuous armature.

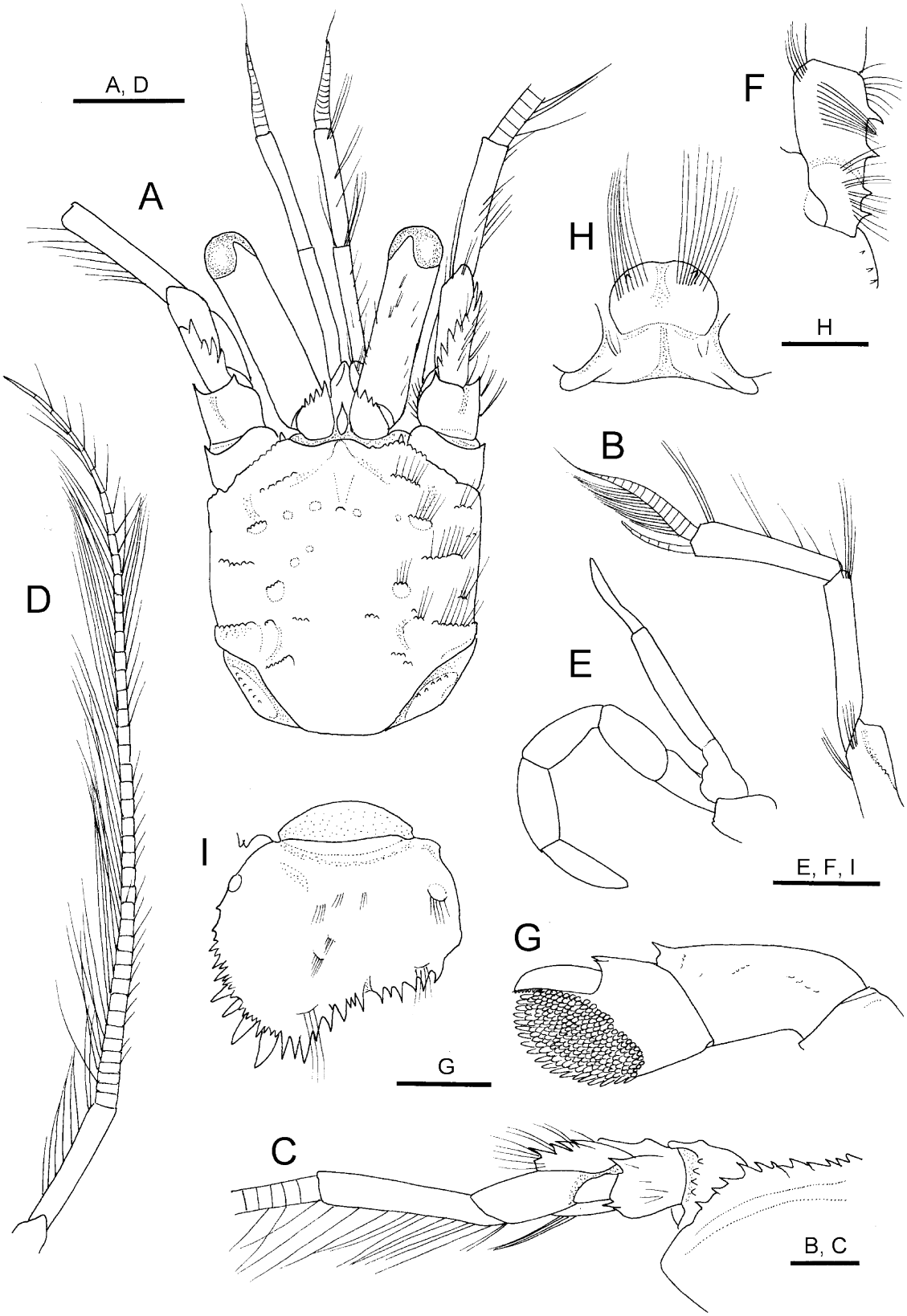

FIGURE 1. *Diogenes canaliculatus* **n. sp.**, holotype, male (sl 5.4 mm), CBM-ZC 11428. A, shield (including accessory lateral lobes) and cephalic appendages, dorsal view (setae on left side omitted; tip of left antennal acicle damaged); B, left antennule, lateral view; C, anterior part of left branchiostegite and antennal peduncle, lateral view; D, fifth segment of left antennal peduncle and antennal flagellum, dorsal view; E, left third maxilliped, lateral view (setae omitted); F, same, ischium-basis and coxa, inner (dorsal) view; G, distal three segments of left fourth pereopod, lateral view (setae omitted); H, sixth thoracic sternite, ventral view; I, telson, dorsal view (marginal setae omitted). Scale bars: 2 mm for A, D, E; 1 mm for B, C, F–I.

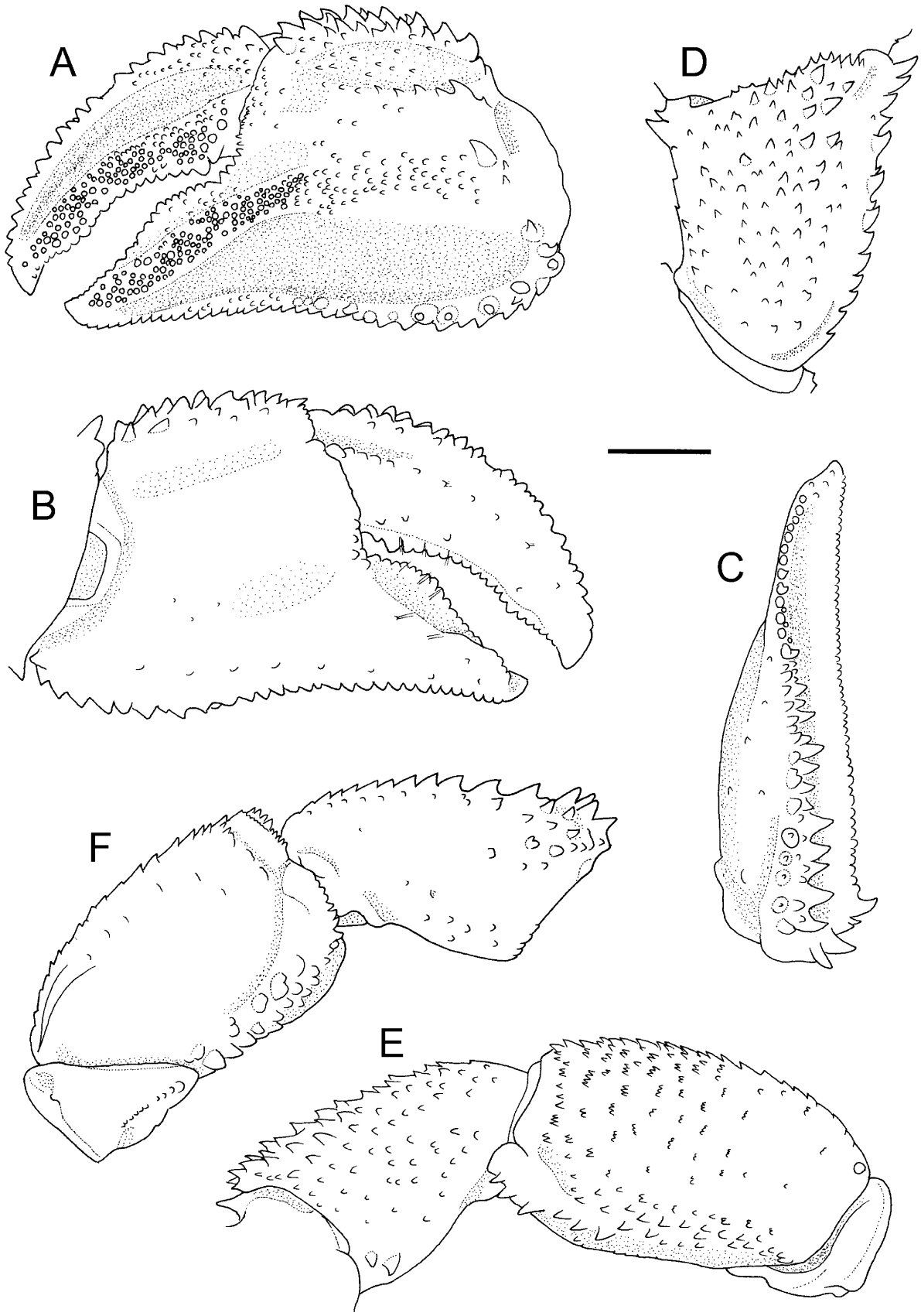

FIGURE 2. *Diogenes canaliculatus* **n. sp.**, holotype, male (sl 5.4 mm), CBM-ZC 11428. A, left chela, outer view; B, same, inner view; C, same, lower view; D, left cheliped, carpus, outer view; E, same, carpus and merus, lateral view; F, same, mesial view. Setae omitted. Scale bar: 2 mm.

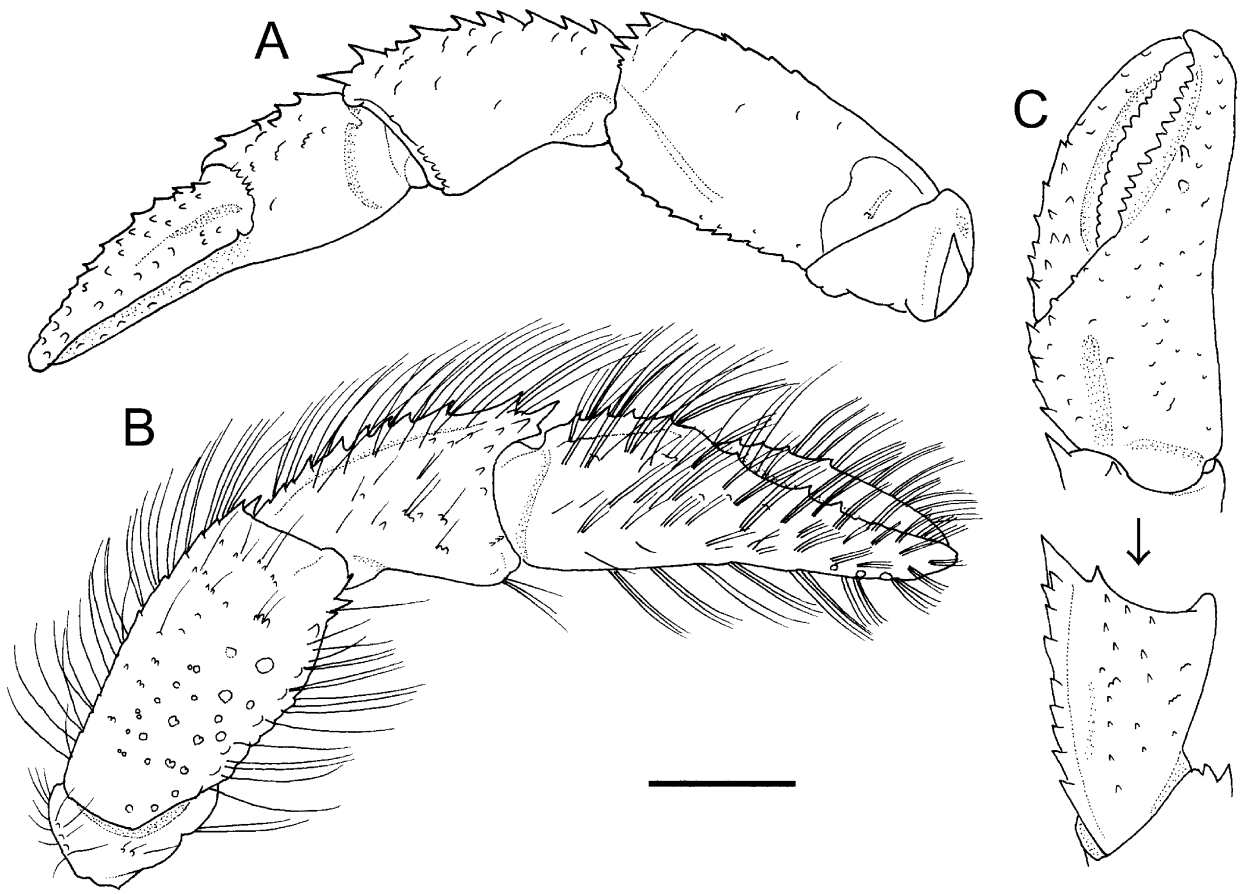

FIGURE 3. *Diogenes canaliculatus* **n. sp.**, holotype, male (sl 5.4 mm), CBM-ZC 11428. A, right cheliped, mesial view; B, same, lateral view; C, same, chela and carpus, dorsal view. Scale bar: 2 mm.

Fourth pereopods chelate (Fig. 1G). Dactyli reaching distal margins of propodi. Propodi each with distinctly produced dorsodistal margin sometimes bearing 1 or 2 small spines; rasp consisting of numerous corneous scales becoming larger marginally. Carpi each with small dorsodistal spine.

Anterior lobe of sixth thoracic sternite (of third pereopods) (Fig. 1H) faintly bilobed, each lobe with 1 or 2 tiny spines anterolaterally and tufts of moderately long setae.

Pleon twisted or straight. Male with unpaired second to fifth pleopods, fifth pleopod longest; endopods absent; exopods divided in 3 or 4 articles. Female with unpaired second to fifth pleopods, second to third unequally biramous, fifth uniramous; second pleopods with endopod divided in 3 subequal articles and exopod divided in 4 unequal articles; third pleopods with endopod divided in 3 articles and exopod divided in 5 or 6 articles; fourth pleopods with endopod divided in 4 articles and exopod divided in 6 or 7 articles.

Telson (Fig. 1I) with small median cleft; terminal margin slightly oblique on left, nearly transverse on right, both with row of numerous spinules or small spines (row of spinules extending onto left lateral margin); left with 4–6 prominent submarginal spines laterally; right with 5 or 6 small spines on terminal margin.

Variation. Three smaller, non-type specimens (sl 2.5–3.0 mm) inhabited in tusk shells, and thus the pleons are straight.

Degree of the sculpture and armature on the outer surface of the left chela is fairly variable among individuals, and in particular, in the two smallest specimens, it is much less pronounced than in other larger specimens (sl 3.0 mm or more). Nevertheless, the sulci on the dactylus and on the lower part of the left palm are distinctly delimited in the larger specimens (sl 3.0 mm or more).

Coloration. In formalin. Shield light brown or tan generally; posterior carapace translucent. Ocular peduncles generally light brown, with tinge of darker brown proximal to base of cornea; no distinct markings otherwise. Antennular and antennal peduncles also light brown, without distinct markings. Chelipeds and ambulatory legs

generally light brown; carpus and merus of left cheliped with tinge of darker brown on lateral to dorsal faces; dactyli of ambulatory legs each with obscure brown spots proximally; propodi each brown transverse band at midlength; carpi each with obscure brown patch on lateral face dorsally.

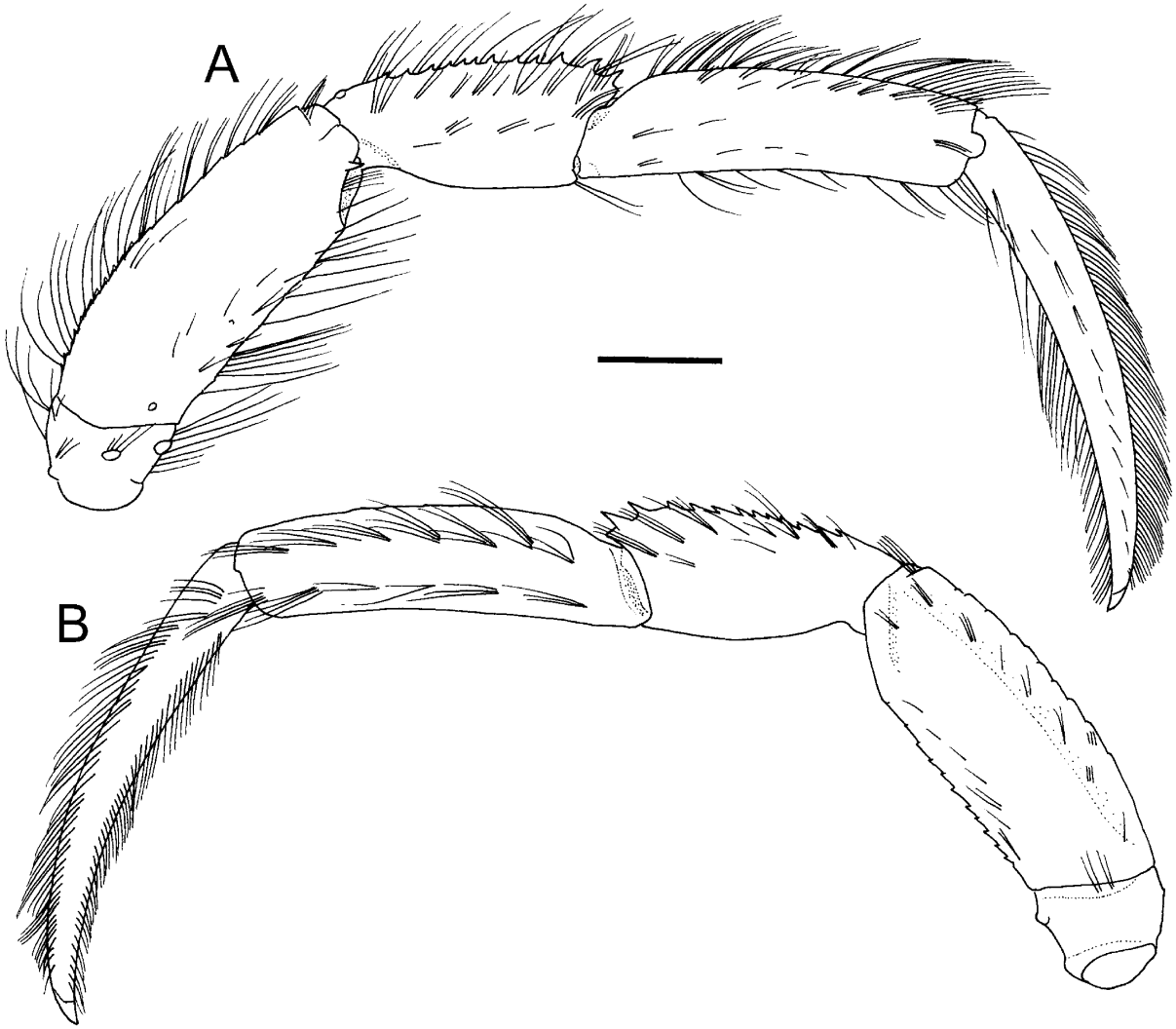

FIGURE 4. *Diogenes canaliculatus* **n. sp.**, holotype, male (sl 5.4 mm), CBM-ZC 11428. A, right second pereopod, lateral view; B, same, mesial view (only mesial setae shown). Scale bar: 2 mm.

Distribution. Known with certainty only from southwest coast of India, depths 15–20 m.

Remarks. *Diogenes canaliculatus* **n. sp.** is referred to the *D. edwardsii* species group because of the simple intercalary rostriform process, the antennal peduncle distinctly longer than the ocular peduncle, and the presence of paired long setae inserted on the ventral surfaces of articles of the antennal flagellum (Asakura & Tachikawa 2010). It appears unique for that informal species group in the combination of the pronounced sculpture on the outer surface of the left chela and the smooth dorsal margins of the propodi of the second and third pereopods. The sculpture of the left chela consists mainly of longitudinal furrows on the outer surface of the dactylus and on the lower part of the outer surface of the palm (extending onto the fixed finger and making the lower margin upturned), a blunt ridge extending from the distal part of the palm to fixed finger, and a short ridge or a row of spines parallel to the upper margin; in addition, there are frequently prominent spines proximally on the outer surface. In addition, the presence of short bristle-like setae on the ventral margin of the dactylus of the left third pereopod may be also characteristic to the new species, since such an armature has not been described for other congeneric species. *Diogenes bicristimanus*, known only from India, is apparently similar to the present new species in the general pattern of the sculpture of the left chela, but in *D. bicristimanus*, the left palm bears a distinct arcuate crest-like

ridge extending from the lower proximal angle to the fixed finger along the midline (Alcock 1905: 72, pl. VII, fig. 1). The antennal acicle reaches or slightly overreaches the base of the cornea in *D. bicristimanus* (cf. Alcock 1905: pl. 7, fig. 1a), rather than falling short of it in *D. canaliculatus* **n. sp.** Furthermore, in *D. bicristimanus*, the antennal flagellum carries only "a few lank setae" (Alcock 1905: 72), and this character sets *D. bicristimanus* apart from members of the *D. edwardsii* species group.

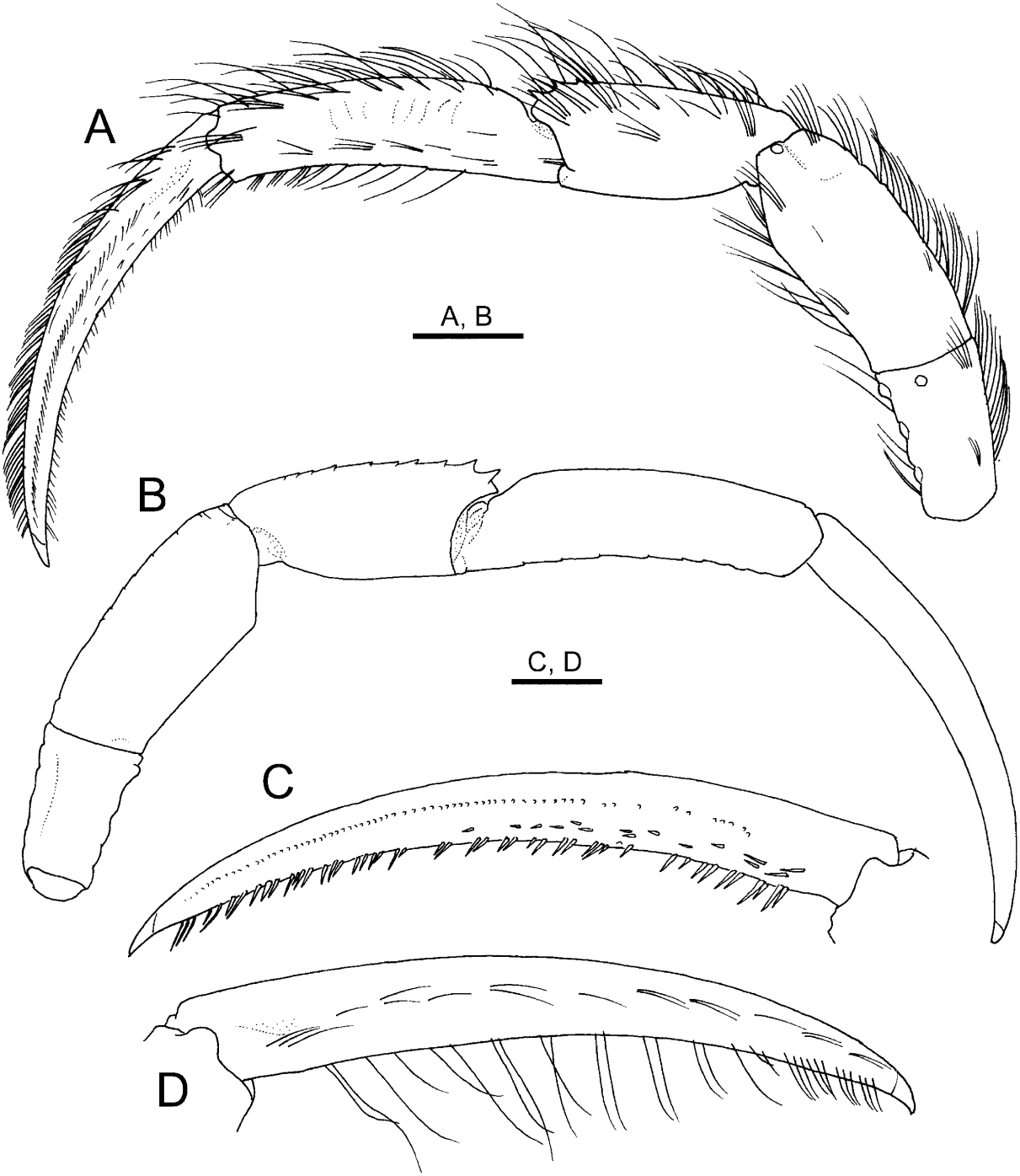

FIGURE 5. *Diogenes canaliculatus* **n. sp.**, holotype, male (sl 5.4 mm), CBM-ZC 11428. A, left third pereopod, lateral view; B, same, mesial view (setae omitted); C, same, dactylus, lateral view (only bristle-like setae shown); D, dactylus of right third pereopod, lateral view. Scale bars: 2 mm for A, B; 1 mm for C, D.

Other species in the *D. edwardsii* species group characterized by the unarmed dorsal margins of the dactyli and propodi of the second and third pereopods and the carpi of second pereopods armed with a dorsal row of spines or

spinules include *D. fasciatus* from Indonesia to the Persian Gulf, *D. laevicaprus* Rahayu, 1996 from Singapore, and *D. moosai* Rahayu & Forest, 1995 from Indonesia. Nevertheless, none of these latter species has a sculptured left chela as in *D. canaliculatus* **n. sp.**

Diogenes fasciatus seems to be characteristic in having a transverse row of proximal spines on the outer surface of the left palm (Rahayu & Forest 1995). In *D. canaliculatus* **n. sp.**, there are some proximal spines, but these spines do not form a distinct transverse row.

Diogenes laevicarpus is readily distinguished from *D. canaliculatus* by the possession of a pronounced curved crest extending from the lower proximal angle to the midline on the outer surface of the left palm, the presence of three longitudinal rows of small spines on the outer surface of the right palm, and the unarmed dorsal margins of the carpi of the third pereopods (except for a small dorsodistal spine) (Rahayu 1996). As described above, in *D. canaliculatus* **n. sp.**, the ridge on the left palm, extending from the lower proximal angle, is not clearly delimited on the palm proper; the right palm is mostly unarmed except for a dorsomesial row of spines; the dorsal margins of the carpi of the third pereopods are armed each with a row of small spines or spinules.

Diogenes moosai differs from *D. canaliculatus* **n. sp.** in the shorter antennal peduncles with a relatively longer antennal acicle, the absence of prominent spines on the proximal outer surface and lower margin of the left palm, the presence of irregular rows of small spines on the dorsal surface of the right palm, and the much more slender dactyli of the ambulatory legs (more than 10 times longer than wide versus 7.9–9.0 times) (Rahayu & Forest 1995). The antennal peduncle overreaches the distal corneal margin by less than half-length in *D. moosai*, rather than more than half length in *D. canaliculatus* **n. sp.**; the antennal acicle overreaches the distal end of the fourth peduncular segment in *D. moosai*, rather than falling short of it in *D. canaliculatus* **n. sp.**

It is worth to mention about *Diogenes avarus*, because the species sometimes lacks dorsal spinules on the propodi of the second pereopods (e.g., McLaughlin & Clark 1997; Rahayu & Komai 2000), though variable. The convex outer surface of the left palm, sometimes elevated in the midline, and the lack of the bristle-like short setae on the ventral margin of the dactylus of the left third pereopod immediately distinguish *D. avarus* from *D. canaliculatus* **n. sp.**

Tirmizi & Siddiqui (1981; 1982) and Siddiqui & Kazmi (2003) recorded *D. bicristimanus* from Pakistan, but these records were later referred to *D. fasciatus* by Siddiqui *et al.* (2004), though the latter authors did not actually examine the specimens used by Tirmizi & Siddiqui (1981, 1982). We have noticed that our new species rather well agrees with the description and figures of *D. bicristimanus* by Tirmizi & Siddiqui (1982), particularly in the sculpture and armature of the left chela and the unarmed dorsal margins of the propodi of the second pereopods. It is possible that the specimens identified with *D. bicristimanus* by Tirmizi & Siddiqui (1982) might actually represent *D. canaliculatus* **n. sp.**

Etymology. Named after the longitudinal furrows on the outer surface of the dactylus and palm of the left chela.

Acknowledgments

We thank Dr. Masayuki Osawa for reviewing the draft of the manuscript and for offering valuable comments and suggestions for improvements. We also thank two anonymous referees for reviewing the manuscript. The junior authors thank the Kerala State Council for Science, Technology and Environment for financial support of the project.

References

Alcock, A. (1905) *Anomura. Fasc. I. Pagurides. Catalogue of the Indian Decapod Crustacea in the Collection of the Indian Museum* 2. Indian Museum, Calcutta, 197 pp. http://dx.doi.org/10.1080/00222930709487239

Asakura, A & Tachikawa, H. (2010) *Diogenes holthuisi*, a new species of hermit crab (Decapoda, Anomura, Diogenidae) from shallow waters of the Ogasawara (Bonin) Islands, Japan. *In*: Fransen C.H.J.M., De Grave, S. & Ng, P.K.L. (Eds.), studies on Malacostraca: Lipke Bjideley Holthuis Memorial Volume. *Crustaceana Monographs*, 14, 133–144.

Dana, J. (1851) Conspectus crustaceorum quae in orbis terrarum cirumnavigatione, Carolo Wilkes e classe reipublicae foederatae duce, lexit et descripcit. *Proceedings of the Academy of Natural Sciences, Philadelphia*, 5, 267–272. http://

dx.doi.org/10.2307/20021092
Fabricius, J.C. (1787) *Mantissa insectorum sistens eorum species nuper detectas adjectis characteribus genericis, differentiis specificis, emendationibus, observationibus*. 1. Hafniae, Copenhagen, xx + 348 pp.
Fabricius, J. C. (1798) *Supplementum Entomologiae Systematicae*. Hafniae, Copenhagen, 572 pp.
Haan, W. de (1833–1850) Crustacea. *In*: Siebold, P. F. von, (Ed.), *Fauna Japonica sive Descriptio Animalium, quae in Itinere per Japoniam, Jussu et Auspiciis Superiorum, qui Summum in India Batava Imperium Tenent, Suscepto, Annis 1823–1830 Collegit, Notis, Observationibus et Adumbrationibus Illustravit*. Lugduni-Batavorum, pp. i–xxxi, ix–xvi, 1–243.
Heller, C. (1865) Crustaceen. *In*: Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859 unter den Befehlen des Commodors B. von Wüllerstorf-Urbair. Zoologischer Theil. 2. Kaiserlich-königlichen Hof-und Staatsdruckerei, Wien, pp. 1–280. http://dx.doi.org/10.1038/001602a0
Herbst, J.F.W. (1804) *Versuch einer Naturgeschichte der Krabben und Krebse* etc. 3(4). Gottlieb August Lange, Berlin und Stralsund, 49 pp.
Henderson, J.R. (1893) A contribution to Indian carcinology. *Transactions of the Linnean Society of London*, 1888–1894, 5 (Zoology), 325–458. http://dx.doi.org/10.1111/j.1096-3642.1893.tb00653.x
Kamalaveni, S. (1950) On hermit-crabs (Family Paguridae) in the collection of the Indian Museum. *Records of the Indian Museum*, 47, 77–85.
Khan, S.A. & R. Natarajan (1984) Hermit crabs of Proto Novo Coast. *Records of the Zoological Survey of India, Occasional Paper*, 67, 1–25.
Komai, T., Liang, J. & Yang, T. (2012) Records of four species of the shallow water hermit crab genus *Diogenes* (Crustacea: Decapoda: Anomura: Diogenidae) from southern China, with description of a new species. *Journal of Natural History*, 46, 1219–1248. http://dx.doi.org/10.1080/00222933.2011.654279
Korn, O.M., Kornienko, E.S. & Komai, T. (2008) A reexamination of adults and larval stages of *Diogenes nitidimanus* (Crustacea: Decapoda: Anomura: Diogenidae). *Zootaxa*, 1693, 1–26.
McLaughlin, P.A. (2002a) *Diogenes pallescens* Whitelegge, *D. gardineri* Alcock and *D. serenei* Forest (Decapoda: Anomura: Paguroidea: Diogenidae): distinct species or morphological variants? *Raffles Bulletin of Zoology*, 50, 81–94.
McLaughlin, P.A. (2002b) A review of the hermit-crab (Decapoda: Anomura: Paguridea) fauna of southern Thailand, with particular emphasis on the Andaman Sea, and descriptions of three new species. *Phuket Marine Biological Center Special Publication*, 23, 385–460.
McLaughlin, P.A. (2004) A description of the first complete specimen of *Diogenes guttatus* Henderson, 1888 (Decapoda: Anomura: Paguroidea: Diogenidae). *Zootaxa*, 466, 1–8.
McLaughlin, P.A. (2005) The "*Troglopagurus* Group" of *Diogenes* (Decapoda: Anomura: Paguroidea: Diogenidae) revisited. *Journal of Crustacean Biology*, 25, 598–619. http://dx.doi.org/10.1651/C-2598.1
McLaughlin, P.A. & Clark, P.F. (1997) A review of the *Diogenes* (Crustacea, Paguridea) hermit crabs collected by Bedford and Lanchester from Singapore, and from the 'Skeat' Expedition to the Malay Peninsula, with a description of a new species and notes on *Diogenes intermedius* De Man, 1902. *Bulletin of the Natural History Museum, London* (Zoology), 63, 33–49.
McLaughlin, P.A. & Dworschak, P. (2001) Reappraisal of hermit crab species (Crustacea: Anomura: Paguridea) reported by Camille Heller in 1861, 1862 and 1865. *Annalen des Naturhistorischen Museum in Wien*, 103B, 135–176.
McLaughlin, P.A. & Haig, J. (1996) A redescription of *Diogenes senex* Heller, 1865, sensu stricto (Decapoda: Anomura: Paguridae: Diogenidae). *Pakistan Journal of Marine Science*, 4, 115–126.
McLaughlin, P.A. & Holthuis, L. B. (2001) In Pursuit of J. F. W. Herbst's species of *Diogenes* (Anomura: Paguridea: Diogenidae). *Journal of Crustacean Biology*, 21, 249–265. http://dx.doi.org/10.1651/0278-0372(2001)021[0249:IPOJFW]2.0.CO;2
McLaughlin. P.A., Komai, T., Lemaitre, R. & Rahayu, D.L. (2010) Annotated checklist of Anomuran decapod crustaceans of the world (exclusive of the Kiwaoidea and families Chirostylidae and Galatheidae of the Galatheoidea) Part 1 – Lithodoidea, Lomisoidea and Paguroidea. *Raffles Bulletin of Zoology*, Supplement, 23, 5–107.
McLaughlin, P.A., Rahayu, D.L., Komai, T. & Chan T.-Y. (2007) *A Catalog of the Hermit Crabs (Paguroidea) of Taiwan*. National Taiwan Ocean University, Keelung, viii + 365 pp.
Miers, E.J. (1880) On a collection of Crustacea from the Malaysian region. Part III. Crustacea Anomura and Macrura (except Penaeidea). *Annals and Magazine of Natural History*, (5) 29, 370–384, pls 6–8. http://dx.doi.org/10.1080/00222938009459429
Miers E.J. (1884) Crustacea. *In*: Report on the Zoological Collections Made in the Indo-Pacific Ocean during the Voyage of H.M.S. 'Alert' 1881–2. British Museum, London, pp. 178–322, 513–575. http://dx.doi.org/10.1080/00222938409459811
Morgan, G.J. (1989) The hermit crabs (Decapoda: Anomura: Diogenidae, Paguridae) of southwestern Australia, with descriptions of two new species. *Records of the Western Australian Museum*, 14, 391–417.
Nayak, V.N. & Neelakantan, B. (1985) *Diogenes maclaughlinae* (Crustacea: Decapoda: Anomura) a new species of hermit crab from Karwar Area with a description of first zoeal stage. *The Indian Zoologist*, 9, 15–21.
Nayak, V.N. & Neelakantan, B. (1989) A new species of hermit crab, *Diogenes karwarensis* (Decapoda: Anomura) from the west coast of India. *Journal of the Bombay Natural History Society*, 86, 71–77.
Nobili, G.J. (1905) Décapodes nouveaux des côtes d'Arabie et du Golfe Persique (Diagnoses préliminaires). *Bulletin du Muséum national d'Histoire naturelle*, 11, 158–164.
Rahayu, D.L. (1996) Notes on littoral hermit crabs (excluding Coenobitidae) (Crustacea: Decapoda: Diogenidae, Paguridae)

from Singapore and peninsular Malaysia. *Raffles Bulletin of Zoology*, 44, 335–355.
Rahayu, D.L. & Forest, J. (1995) Le genre *Diogenes* (Decapoda, Anomura, Diogenidae) en Indonésie, avec la description de six espèces nouvelles. *Bulletin du Muséum national d'Histoire naturelle, Paris*, (4) 16, 383–415.
Rahayu, D.L. & Hortle, K.G. (2002) The genus *Diogenes* (Decapoda, Anomura, Diogenidae) from Irian Jaya, Indonesia, with description of a new species. *Crustaceana*, 75, 609–619. http://dx.doi.org/10.1163/156854002760095633
Rahayu, D.L. & Komai, T. (2000) Shallow water hermit crabs (Crustacea: Decapoda: Anomura: Diogenidae and Paguridae) of Phuket, Thailand. Phuket Marine Biological Center Research Bulletin, 63, 21–44.
Reshmi, R. & Bijukumar, A. (2011) New records of hermit crabs, *Calcinus morgani* Rahayu & Forest, 1999 and *Diogenes klaasi* Rahayu & Forest, 1995 (Crustacea: Anomura: Diogenidae) from India. *Journal of Threatened Taxa*, 3, 1771–1774.
Siddiqui, F.A. & Kazmi, Q.B. (2003) A check list of marine anomurans (Crustacea: Decapoda) of Pakistan, northern Arabian Sea. *Memoirs of Museum Victoria*, 60, 87–89.
Siddiqui, F.A., Kazmi, Q.B. & McLaughlin, P.A. (2004) Review of the Pakistan species of *Diogenes* Dana, 1851 (Decapoda: Anomura: Paguridea: Diogenidae). *Tropical Zoology*, 17, 155–200. http://dx.doi.org/10.1080/03946975.2004.10531205
Siddiqui, F.A. & McLaughlin, P.A. (2003) A new species of the hermit crab genus *Diogenes* (Decapoda: Anomura: Paguroidea: Diogenidae) from Pakistan, with a comparative diagnosis of *D. guttatus* Henderson, 1888. *Proceedings of the Biological Society of Washington*, 116, 956–966.
Tirmizi, N.M. & Siddiqui, F.A. (1981) An illustrated key to the identification of northern Arabian Sea pagurids. *Institute of Marine Biology*, 1, 1–31.
Tirmizi, N.M. & Siddiqui, F.A. (1982) *The Marine Fauna of Pakistan: 1. Hermit Crabs (Crustacea, Anomura)*. University Grants Commission, University of Karachi, Islamabad, 103 pp.
Thomas, M.M. (1989). On a collection of hermit crabs from the Indian waters. *Journal of the Marine Biological Association of India*, 31, 59–79.