Marine Biology Research

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/smar20

A new species of *Metacirolana* Kussakin, 1979 (Crustacea: Isopoda: Cirolanidae) from the coral reefs of Viti Livu, Fiji, with a revised diagnosis to the genus

Niel L. Bruce & Eknarin Rodcharoen

To cite this article: Niel L. Bruce & Eknarin Rodcharoen (2021) A new species of *Metacirolana* Kussakin, 1979 (Crustacea: Isopoda: Cirolanidae) from the coral reefs of Viti Livu, Fiji, with a revised diagnosis to the genus, Marine Biology Research, 17:7-8, 680-691, DOI: 10.1080/17451000.2021.2015391

To link to this article: https://doi.org/10.1080/17451000.2021.2015391

MARINE BIOLOGY RESEARCH
2021, VOL. 17, NOS. 7–8, 680–691
https://doi.org/10.1080/17451000.2021.2015391

A new species of *Metacirolana* Kussakin, 1979 (Crustacea: Isopoda: Cirolanidae) from the coral reefs of Viti Livu, Fiji, with a revised diagnosis to the genus

Niel L. Bruce[a,b] and Eknarin Rodcharoen[c]

[a]Biodiversity & Geosciences, Queensland Museum, South Brisbane, Australia; [b]Water Research Group (Ecology), Unit for Environmental Sciences and Management, North West University, Potchefstroom, South Africa; [c]Aquatic Science and Innovative Management Division, Faculty of Natural Resources; and Discipline of Excellence for Sustainable Aquaculture, Prince of Songkla University, Hat Yai, Thailand

ABSTRACT

Metacirolana nicosmiti sp. nov. is described from coral reefs at Viti Lifu, Fiji. The species is characterized by a unique ornamentation of prominent ridges on the head forming a 'diamond' shape, three longitudinal ridges on the pleotelson and a broad subtruncate pleotelson posterior margin (among other characters). A revised genus diagnosis is given to *Metacirolana*, together with discussion of the characters of the 'Eurydicinae', that is those cirolanid genera with a blade-like clypeus. We conclude that while the subfamilies of the Cirolanidae remain phylogenetically untested the characters that they present are relevant in assessing generic characters within the family and are useful in facilitating the identification of genera.

http://zoobank.org:pub:9EAC6EF8-3882-480C-BE7B-48BFDB35B40A

ARTICLE HISTORY
Received 1 December 2021
Accepted 2 December 2021
Published online 24 December 2021

SUBJECT EDITOR
Carolin Löscher

KEYWORDS
Cirolanidae; coral reefs; Eurydicinae; *Metacirolana*; taxonomy; western Pacific

Introduction

The isopod fauna of the tropical Pacific island nations remains minimally documented, in many regions effectively unstudied. In the late 1800s through to the mid-1900s there are scattered reports and occasional papers by various authors. This pattern of documenting continued with one exception, the work of the German taxonomist Hans-Georg Müller, who described 33 new species from the tropical Pacific as well as recording several known species, notably from French Polynesia (see Müller 1989–1994; Müller and Salvat 1993; Bruce and Müller 1991). These Pacific islands are for the most part surrounded by coral reefs, and as such the lack of data is a huge gap in knowledge of isopod diversity and distribution. Fiji is no exception in this regard, with a total of a mere 20 recorded species and eight publications dating from 1946 (see Table I).

There are two groups of species within *Metacirolana* – a small group of three 'rugose' species, typically with pleonal and pleotelson ridges and a larger group of 16 species termed the '*serrata* group' that are smooth bodied, usually with abundant chromatophores; there are also 15 species that belong to no group (see Sidabalok & Bruce, 2018). *Metacirolana nicosmiti* sp. nov. belongs with the rugose species.

Methods

Material was collected with permission from Ministry of Fisheries and Forest, Fisheries Department, export permit C947/2005, granted to Dr Sammy De Grave and the first author to collect marine Crustacea in 2005. The species description was prepared using a generalized Cirolanidae species character set in DELTA (Descriptive Language for Taxonomy; Dallwitz, 1980; Dallwitz et al. 1997, 2006; Coleman et al. 2010); the DELTA output zero counts are left as such rather than rewriting as 'without' or 'no'; minor details qualifying a coded character state are given in parentheses. Classification follows Brandt & Poore (2002). In the genus diagnosis 'key' characters, possibly apomorphic, are in bold.

Abbreviations. QM – Queensland Museum; BL – total body length; PMS – plumose marginal setae; RS – robust seta/e.

Taxonomy

Cymothoida Wägele, 1989
Family Cirolanidae Dana, 1852
Genus *Metacirolana* Kussakin, 1979
Metacirolana Nierstrasz, 1931: 147 (*nomen nudum*).

CONTACT Niel L. Bruce niel.bruce@qm.qld.gov.au Biodiversity & Geosciences, Queensland Museum, PO Box 3300, South Brisbane, Queensland 4101, Australia; Water Research Group (Ecology), Unit for Environmental Sciences and Management, North West University, Private Bag X6001, Potchefstroom, 2520, South Africa

Metacirolana Kussakin, 1979: 212.– Bruce, 1981a: 950, Figs 1F–I, 2C–F, 3C–D, 4B, 5E–G; 1986: 31; 1996: 157.– Kensley, 1984a: 33 (Remarks).– Kensley & Schotte, 1989: 153.– Brusca, Wetzer & France, 1995: 64.– Schotte & Kensley, 2005: 1236.– Sidabalok & Bruce, 2018: 520.

Paracirolana Nierstrasz, 1931: 147 (*nomen nudum*; junior synonym).

Type species: *Cirolana japonica* Hansen, 1890; by subsequent designation (Kussakin 1979). Given the wide-ranging localities and depth range reported for this species (see Bruce, 1986, pp. 35–37), and the increased level of detail in species description in recent decades, the possibility that there is more than one species held under this name should be considered.

Included species: Thirty-seven species are included in the genus, including the *Metacirolana nicosmiti* sp. nov. An annotated list of the included species was given by Sidabalok and Bruce (2018).

Diagnosis (male). Head with rostral point. Pereonites 1 and 2 subequal in length. **Pleon 21–35% of BL**. Pleonites with free lateral margins, often expressed laterally (rather than ventrally); pleonite 5 lateral margins not laterally enclosed by pleonite 4, with at least posterolateral angle free (not overlapped or wholly enclosed by pleonite 4). Antennula peduncle articles colinear, **article 2 longest or subequal to article 3**. Antenna peduncle 5-articulate. Frontal lamina ventrally flat, anterior margin dilated, freely projecting; posterior margin not abutting clypeus, with posterior stem; clypeus with ventrally or antero-ventrally projecting triangular blade. Mandible incisor with 3 major cusps; **left mandible incisor with small mesial cusp**; maxillula endopod RS relatively slender, feebly or not plumose. Maxilliped endite with one coupling hook; **maxilliped palp article 5 lateral and mesial margins straight converging to narrow or subtruncate apex**. Pereopod 1 propodus sub-prehensile, moderately curved, as long or slightly shorter than palm; pereopods 5–7 slender, with few setae and acute RS; inferior margins of pereopods 1–3 with acute RS, without molariform setae. Paired, flat penial processes present. Pleopods distally rounded, only endopod of pleopod 5 without setae. Pleopod 1 rami sub-similar in length, endopod about 2/3 width exopod, peduncle wider than long. **Pleopod 2 appendix masculina inserted sub-basally, 'flask-shaped' in mature males**. Uropod peduncle medial margin produced, rami with setae on all margins.

Additional characters. Body generally twice as long as wide, posterior pereonites, pleon and pleotelson may be dorsally ornamented with nodules or carinae. Antennula 4-articulate, articles co-linear. Antenna peduncle articles 1–3 short 4 and 5 long, article 5 longest. Maxilla palp and exopod tending to be reduced in size. Maxilliped palp articles slender, quadrate or subquadrate, weakly or not lobate; endite with single coupling hook. Pereopods 1–3 short, merus anterodistal margin not produced; pereopod 1 with RS opposing base of dactylus usually complex (with serrations); pereopods 4–7 with articles not flattened, usually slender; dactylus with secondary unguis feeble or absent. Pleopods undifferentiated, rami similar; peduncle broader than long, without lobes. Pleotelson and uropod margins

Table I. Marine Isopoda from Fiji. All species marine unless otherwise stated.

Family	Genus and Species	Habitat	Reference
Anthuridea	*Amakusanthura mana* (Kensley, 1979)	Coral rubble, fringing reef	
	Apanthura childi (Kensley, 1979)	Coral rubble, fringing reef	
	Apanthuroides fijiensis (Kensley, 1979)	Coral rubble, lagoon	
	Mesanthura adrianae Negoescu, 1999		
	Stygocyathura fijiensis Wägele, Coleman, & Hosse, 1987	Freshwater	
Leptanthuridae	*Leptanthura vitilevui* Negoescu, 1999		
Paranthuridae	*Paranthura astrolabium* Kensley, 1979	Algal rubble, coral reef; 3–15 m.	Negoescu 1999
	Paranthura brucei Negoescu, 1999	marine, intertidal	
Expanthuridae	*Expanthura collaris* (Kensley, 1979)	Coral Rubble, reef flat	Negoescu 1999
Cirolanidae	*Natatolana nukumbutho* Bruce & Olesen, 1995	Deep water (~500 m)	
	Cirolana sp.	As *Cirolana cranchii*; 'barrier reef'	Nordenstam 1946
Corallanidae	*Alcirona insularis* Hansen, 1890	Shallow, 'among corals'	Nordenstam 1946
	Alcirona maldivensis Stebbing, 1904		Nordenstam, 1946
	Argathona macronema (Bleeker, 1857)	Among corals	Nordenstam 1946
Limnoriidae	*Limnoria insulae* Menzies, 1957	Serua, Fiji; also Guam, Palmyra and Caroline Islands	
Tridentellidae	*Tridentella vitae* Bruce, 1984	Deep water (~350 m)	
Gnathiidae	*Gnathia nicembola* Müller, 1989c	Marine, coral reefs	
Serolidae	*Myopiarolis koro* Bruce, 2009	Fiji, Koro Sea, 1216–1226 m	
Cymothoidae	*Anilocra gigantea* (Herklots, 1870)	Fish parasite; 240 m	Bruce & Harrison-Nelson 1988

usually feebly plumose, usually serrate, without or occasionally with RS.

Female. Generally similar to the male, except sexually mature males (see dimorphism). Difference in dorsal nodules and carinae between males and females is not well documented for the genus.

Dimorphism. Though not widely documented it is apparent that at least in some species fully mature males have larger eyes, longer antennula and antenna and a longer pleon than females or immature males: e.g. *Metacirolana agujae* Müller, 1991d; *Metacirolana halia* Kensley, 1984a; *Metacirolana serrata* (Bruce, 1980a) (Bruce 1986) and *Metacirolana japonica* (Hansen, 1890) (Kim & Yoon, 2019). This character is shared with the genera *Eurydice* Leach, 1815 and *Pontogelos* Stebbing, 1910.

Remarks. *Metacirolana* belongs within the group of genera distinguished from other genera of Cirolanidae by the posteriorly stemmed frontal lamina, clypeus with a ventrally or anteroventrally projecting blade, all pleonites with free lateral margins, presence of prominent flat penial processes and pleopod 2 with the appendix masculina attached (in marine species) subbasally or medially (*Eurydice*). Further distinguishing characters are that these genera have a 'long' pleon that is usually more than 20% of the total body length, and a 'short' pereonite 1 that is medially subequal to pereonite 2; and, where recorded, mature males and females are usually dimorphic.

The defining and putatively apomorphic characters for *Metacirolana sensu strictu*, within the context of this group of genera (see 'Discussion') are: antennula peduncle article 2 longest or subequal to article 3 (shared only with *Sululana* Bruce & Shimomura, 2019); left mandible incisor with small fourth mesial cusp; and maxilliped palp articles weakly lobed, with palp article 5 with lateral and mesial margins straight forming a subtruncate or narrowed apex. These characters, together with the long pleon, and pleonite 5 with free lateral margins are consistent within the genus, with a few exceptions (see Discussion).

The most similar genus to *Metacirolana* is *Arubolana* Botosaneanu & Stock, 1979, a Caribbean cave-water genus that despite a variable pereopod and uropod morphology, differs primarily from *Metacirolana* in having the male pleopod 2 appendix masculina in a sub-apical position rather than sub-basal or medial. Iliffe & Botosaneanu (2006) recognized that the highly diversified morphology of pereopods and uropods in cave-dwelling cirolanids is a consequence of adapting to live in cave waters, but that in itself should not obscure the affinities between genera.

***Metacirolana nicosmiti* sp. nov.**

(Figures 1–4)

Material examined

Holotype, ♀ (3.0 mm), Vatubari Point Reef, 'The Pipe', 18°17.242′S, 177°52.305′E, 30.IX.2005, dead coral and encrusting algae, 24 m, stn VLF 13, coll. N.L. Bruce & S. de Grave (QM W29510).

Paratypes: 2♀ (3.0 mm [slightly damaged, dissected], 2.9 mm [uropod drawn]) same data as holotype (QM W209511). ♀ (3.0 mm), Serua Reef pass, 'Tukeni', 18°17.861′S, 177°55.830′E, 3.X.2005, dead coral on bommie, 12 m, stn VLF 20, coll. N.L. Bruce & M. Kaz (QM W20512).

Description. *Body* 1.9 times as long as greatest width, widest at pereonites 5 and 6, dorsal surfaces sparsely punctate, lateral margins weakly ovate. *Rostral point* present, projecting anteriorly, not ventrally folded. Eyes separated by about 0.58% width of head, each eye made up of ~7 transverse rows of ommatidia, each row with ~8 ommatidia; eye colour black. *Pereonite 1 and coxae* 2 and 3 each with posteroventral angle acute, posteriorly produced; coxae 5–7 with incomplete oblique carina; posterior margins of pereonites 5–7 smooth. *Pleon* with pleonite 1 largely concealed by pereonite 7; pleonites 3–5 with 3 prominent dorsal nodules forming longitudinal ridges; posterolateral angles of pleonite 2 forming acute point, not posteriorly produced; pleonite 3 with posterolateral margins not extending to posterior margin of pleonite 5, acute; posterolateral margin of pleonite 4 acute, not extending beyond posterior margin of pleonite 5. *Pleotelson* 0.6 times as long as anterior width, dorsal surface with 3 longitudinal carinae (median carina longest); lateral margins straight, margins smooth, posterior margin broadly truncate, without median point, with 18 serrations, interspersed with single setae; RS absent.

Antennula peduncle articles 1 and 2 distinct, articulated; article 2 1.1 times as long as article 1, articles 3 and 4 0.3 times as long as combined lengths of articles 1 and 2; article 3 2.0 times as long as wide; flagellum with 7 articles, extending to posterior of pereonite 1. *Antenna* peduncle article 4 2.5 times as long as wide, 2.3 times as long as article 3, inferior margin with 1 plumose seta, without short simple setae; article 5 1.4 times as long as article 4, 4.4 times as

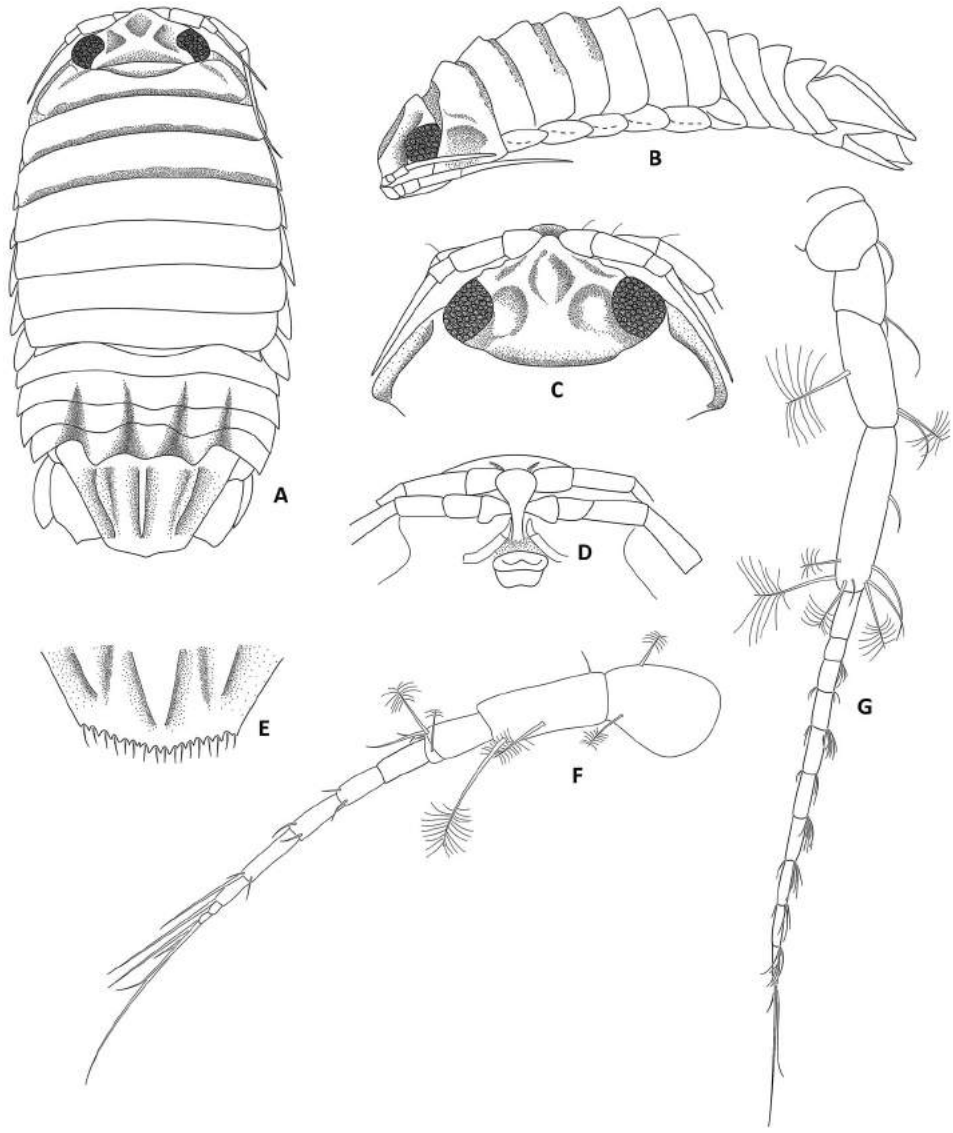

Figure 1. *Metacirolana nicosmiti* sp. nov. A–E, holotype, QM W29510; F, G, paratype 3.0 mm, QM W209511. A, dorsal view; B, lateral view; C, head, dorsal view; D, underside of head; E, pleotelson posterior margin; F antennula; G, antenna.

long as wide, inferior margin without pappose setae, anterodistal angle with cluster of 1 pappose, 2 slender setae, posterodistal angle with 1 short simple seta; anterodistal angle with cluster of 3 long simple setae (pappose); flagellum with 10 articles, extending to middle of pereonite 3.

Frontal lamina anteriorly broadly rounded, ventral surface entirely flat, longer than greatest width, lateral margins concave, without small median point.

Mandible molar process anterior margin with 10 flat teeth; without proximal cluster of long simple setae; right and left mandible spine row each composed of 3 spines; palp article 2 with 5 distolateral biserrate setae and 1 long simple mesial seta; palp article 3 with 7 stout biserrate setae (distalmost 2 setae longest). *Maxillula* mesial lobe with 3 large circumplumose RS and 2 simple setae; lateral lobe with 11 RS. *Maxilla* lateral lobe with 2 long simple setae; middle lobe reduced (effectively absent) with 1 long simple seta; mesial lobe with 3 distal simple setae (1 long, 2 short), with 1 proximal simple and large circumplumose seta. *Maxilliped palp* article 2 mesial margin without slender setae, lateral margin distally with 1 slender seta; article 3 mesial margin with 3 distolateral slender setae, lateral margin with 1 slender seta; article 4 mesial margin with 5 slender setae, lateral margin with 1 slender seta; article 5 distal margin 5 setae, lateral margin with 2 setae; endite with 3 long CPS, and 1 coupling seta.

Pereopod 1 basis 3.9 times as long as greatest width, superior distal angle with cluster of 0 acute setae, inferior distal angle with 1 short slender setae; *ischium* 0.5 times as long as basis, inferior margin with 3 short setae,

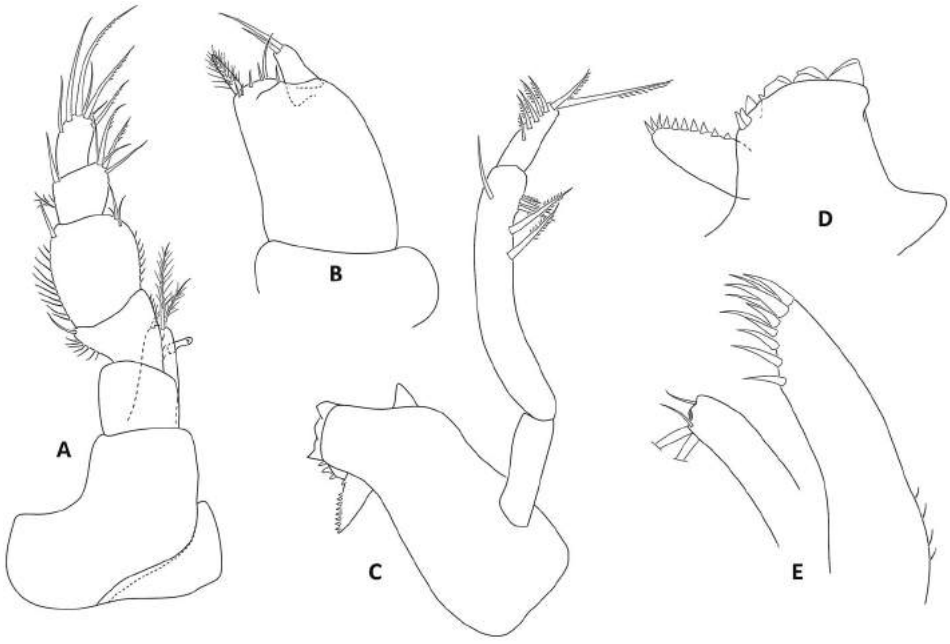

Figure 2. *Metacirolana nicosmiti* sp. nov. All figs paratype 3.0 mm, QM W209511. A, maxilliped; B, maxilla; C, left mandible; D, right mandible, incisor; E, maxillula.

inferodistal margin with 0 RS, superior distal margin with 1 simple seta; *merus* inferior margin with 2 simple setae, inferodistal margin with 0 RS, superior distal angle with 2 setae; *carpus* inferior margin with 1 acute RS, inferior margin with 1 long simple seta; *propodus* 2.7 times as long as wide, inferior margin with 1 acute RS, inferodistal margin with 1 acute serrate RS and 3 simple setae, superodistal margin with 2 simple setae; dactylus 0.54 as long as propodus. *Pereopod 2* basis 5.4 times as long as greatest width; *ischium* inferior margin with 1 stout, bluntly rounded RS, 0 long acute RS, 2 simple setae; distal margin with 0 RS; superodistal margin with 0 long simple setae; 0 RS; *merus* inferior margin with 0 stout RS, inferodistal margin with 1 stout acute RS, superior distal margin with 0 stout RS, superior distal margin with 2 acute slender setae; *carpus* inferior margin lobate, with 1 long simple seta, distal margin with 1 RS; *propodus* 3.6 as long as wide; inferior margin with 1 RS; inferodistal margin with 2 long RS; inferodistal margin with 1 simple setae; dactylus 0.8 as long as propodus. *Pereopod 3* similar to pereopod 2. *Pereopod 6* similar to pereopod 7. *Pereopod 7 basis* 7.1 times as long as greatest width, superior margin weakly convex, inferior margin with 1 palmate seta; ischium 0.5 as long as basis, inferior margin with 2 setae, superior distal angle with 0 RS, inferior distal angle with 0 RS; *merus* (Fig. 3D) 0.5 as long as ischium, 2.6 times as long as wide, inferior margin with 0 RS, superior distal angle with 4 RS (2 biserrate, 2 simple) and 1 palmate seta, inferior distal angle with 2 RS (1 serrate, 1 simple); *carpus* (Fig. 3H) 0.9 as long as ischium, 5.0 times as long as wide, inferior margin with 2 serrate RS, superior distal angle with 6 RS (2 long, biserrate) and 2 slender setae, inferior distal angle with 2 RS; *propodus* 1.1 as long as ischium, 6.8 times as long as wide, inferior margin with 1 cluster of RS (of 2), superior distal angle with 3 slender 1 palmate setae and inferior distal angle with 1 RS; dactylus 0.4 as long as propodus.

Pleopod 1 exopod 1.2 times as long as wide, distally broadly rounded, mesial margin weakly convex, with PMS from distal margin only, with ~20 PMS; endopod 1.9 times as long as wide, distally broadly rounded, lateral margin weakly concave, with PMS from distal one-third, mesial margin with PMS from distal one-third, endopod with ~15 PMS; peduncle 2.3 times as wide as long; mesial margin with 4 coupling setae. *Pleopod 2* exopod with ~24 PMS, endopod with ~14 PMS. *Pleopod 3* exopod with ~20 PMS, endopod with ~12 PMS. *Pleopod 4* similar to pleopod 3. *Pleopod 5* exopod with ~14 PMS. Pleopods 2–5 peduncle distolateral margin without prominent acute RS, 3–5 endopods without distomesial serrate scales.

Uropod peduncle ventrolateral margin without RS, lateral margin without medial short acute robust seta; posterior lobe about one-half as long as endopod; rami not extending beyond pleotelson, apices acute. *Endopod* apically sub-bifid, medial process prominent; lateral margin proximally convex; mesial margin strongly convex, strongly serrate, without RS. *Exopod* not extending to end of

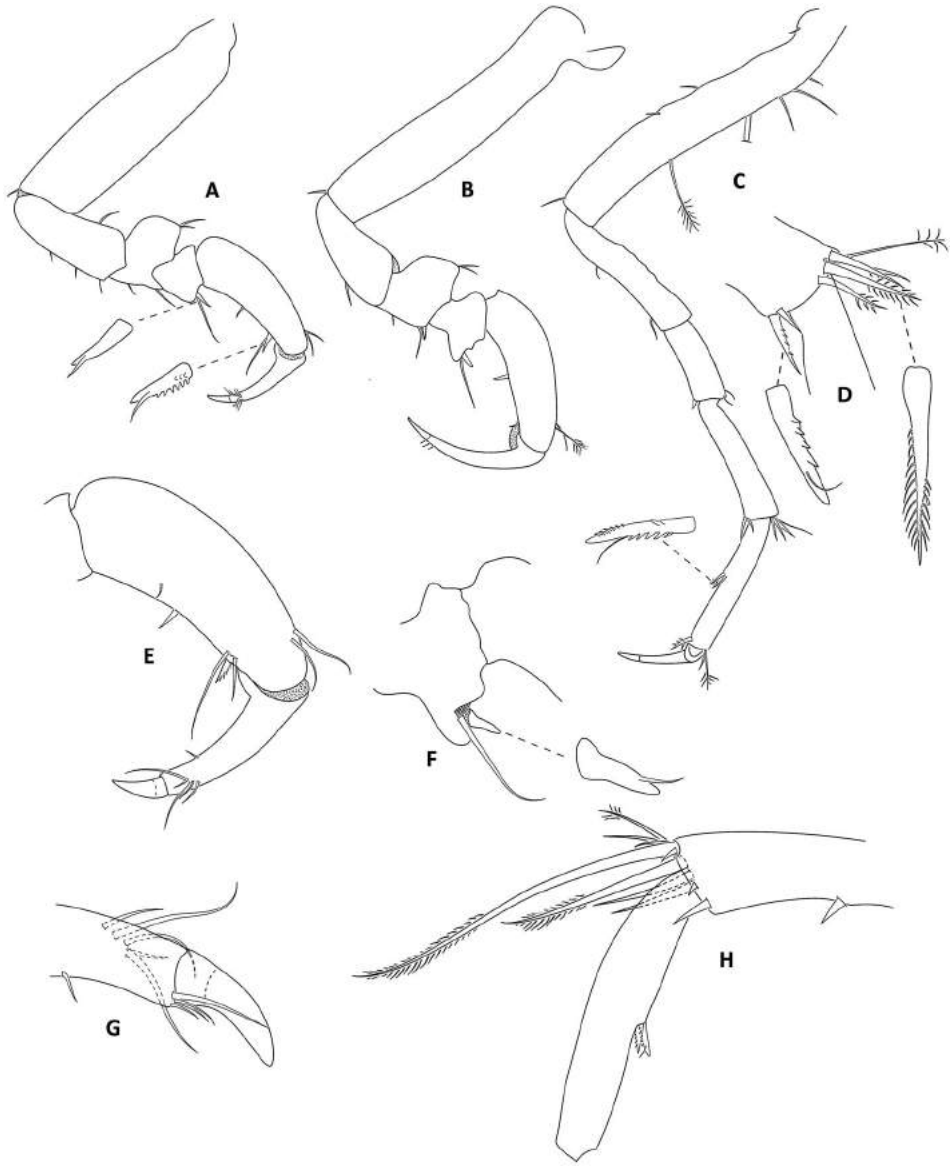

Figure 3. *Metacirolana nicosmiti* sp. nov. All figs paratype 3.0 mm, QM W209511. A, pereopod 1; B, pereopod 2; C, pereopod 7; D, pereopod 7, merus distal margin; E, pereopod 1, propodus, F, pereopod 2, carpus; G, pereopod 1, dactylus tip; H, pereopod 7, carpus distal margin.

endopod, 3.1 times as long as greatest width, apically sub-bifid, medial process prominent; lateral margin weakly convex, without RS, distal half strongly serrate; mesial margin straight, distally convex, without 0 RS, distal third deeply serrate.

Male. Not known.

Colour. When fresh, translucent white, dorsum with sparse red (rust) coloured chromatophores, roughly following the pattern of the nodules.

Remarks. *Metacirolana nicosmiti* is distinctive within the genus with a unique head ornamentation of ridges (or depressions) forming a diamond-like shape, a wide sub-truncate pleotelson posterior margin; and near carpo-chelate pereopods 2 and 3.

Several species of *Metacirolana* have prominent pleonal nodules and longitudinal carinae on the pleotelson as in *M. nicosmiti*, namely *Metacirolana costata* Nunomura, 1999 (Japan), *Metacirolana mbudya* Bruce, 1981b (Tanzania) and *Metacirolana rugosa* (Bruce, 1980a) (Great Barrier Reef). All of these are shallow-water species, and only *M. costata* is not from coral reefs. *M. costata* is the least 'nodular' species with a single median carina on the pleotelson. *Metacirolana mbudya* has a similar pattern of nodules and carinae on the pleon and pleotelson, but also has sublateral nodules on pereonites 4–7; *M. rugosa* has more bulbous

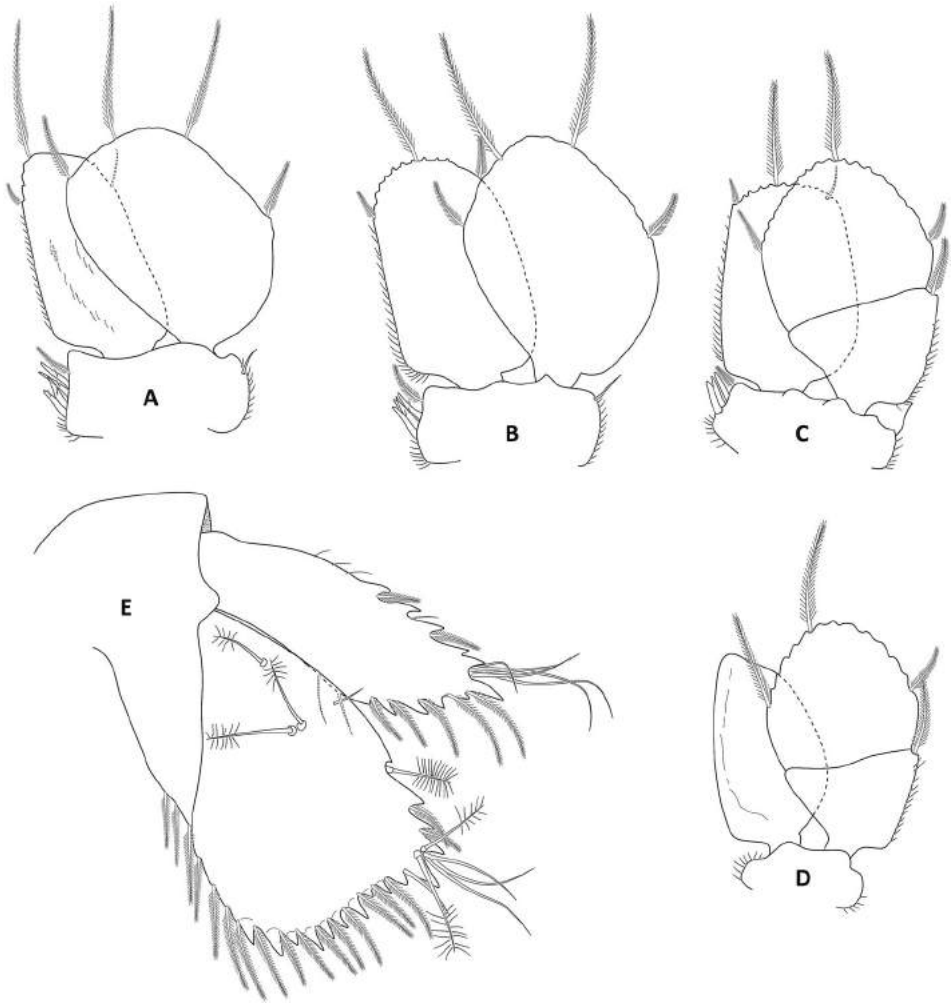

Figure 4. *Metacirolana nicosmiti* sp. nov. A–D, paratype 3.0 mm, QM W209511, pleopods 1–3, 5 respectively; E, uropod. paratype 2.9 mm, QM W209511.

margins on pereonite 1–3, and the lateral carinae on the pleotelson are shorter than the median carina.

Etymology. The epithet honours Professor Nico Smit, in recognition of both his contribution to knowledge of the Isopoda, primarily fish parasites, of southern Africa, and to his influence as a colleague and mentor to numerous young scientists.

Discussion

Kensley & Schotte (1989) placed a number of genera into the subfamily Eurydicinae Stebbing, 1905. The other subfamilies defined by Kensley & Schotte (1989) were the Cirolaninae Dana, 1852 and Conilerinae Kensley & Schotte, 1989, formalizing the earlier undefined divisions of Botosaneanu et al. (1986). In describing *Xylolana* Kensley, 1987, Kensley commented 'With no phylogenetic analysis at the generic level, there is no way of knowing which characters are apomorphic and which plesiomorphic'. A situation that remains largely unchanged today. There have been analyses of specific cirolanid genera, both morphological (Riseman & Brusca, 2002; Moore & Brusca, 2003) and molecular (Baratti et al. 1999, 2010), but these have not changed the overall phylogenetic vacuum that exists for the genera of Cirolanidae. At this point there is sufficient inconsistency in characters to be wholly uncertain as to whether or not any of the groups is monophyletic. We consider it useful to draw attention to these divisions within the Cirolanidae and to the characters shared by the 'eurydicinine' genera, in part to encourage the description and capture data of these characters in cirolanid descriptions.

Characters for the 'eurydicinine' genera include (Kensley & Schotte 1989): clypeus with a projecting blade, pleonite 5 with lateral margins wholly or partly free (except *Xylolana*), prominent penial processes and the male pleopod 2 appendix masculina attaching sub-basally, medially or sub-apically. We would further

add that most of the genera have a 'long' pleon that is 15% or more of total body length, and the frontal lamina usually has a posterior stem, not directly abutting against the clypeus. Of these characters only the clypeus blade, prominent penial processes and insertion of the appendix masculina are fully consistent. The genera with these characters are listed below.

Metacirolana was diagnosed in detail by Bruce (1981a, 1986) and later by Brusca et al. (1995). Brusca et al. (1995) and Moore & Brusca (2003) considered that the genus was not monophyletic, commenting that some of the diagnostic characters of the genus were inconsistent among the contained species, and that the genus had no unique characters. *Aphantolana* Moore & Brusca, 2003 was established for three species removed from *Metacirolana* on the basis of several consistent characters. Nonetheless, *Metacirolana* s. str. does present a consistent assemblage of characters that unite the taxon, and with the removal of those species now in *Aphantolana* the genus has one unique character, putatively apomorphic, namely the antennula peduncle article 2 being longest, a character that is rarely reversed in the genus. A further two characters shared with *Aphantolana* and *Arubolana* are the mandible palp article 5 with straight margins ('quadrate'), and the left mandible incisor with a 4th mesial cusp.

Two further characters require further consideration in how they are interpreted, namely the clypeus blade and the morphology of the pleonites, in particular pleonites 3–5. These characters, particularly in small species, are often not recorded or not precisely recorded. All forms of the clypeal blade may not be homologous. In genera such as *Metacirolana* and *Eurydice* (Brusca et al. 1995, fig. 31C) the blade appears to be posteroventral at the base, or simply a flat blade (Brusca et al. 1995, fig. 59) whereas in genera such as *Excirolana* and *Eurylana* the blade appears to form by the anterior margin being anteriorly and ventrally produced. Moore & Brusca (2003) identified the lack of pleonite epimera as a distinguishing character for *Aphantolana*, but one that is also shared by several other genera such as *Eurydice* and *Metacirolana*. The form of pleonites 3, 4 and 5 again needs careful re-examination. While pleonite 5 in a few species of this group of genera is overlapped by pleonite 4, the morphology and arrangement of the overlap of pleonite 5 by pleonite 4 is not homologous with, for example, genera such as *Cirolana* and *Natatolana* Bruce, 1981. In species such as *Metacirolana anatola* Bruce, 1986 and *M. japonica* while pleonite 5 may seem to be overlapped by pleonite 4, the posterolateral angles are free, and the lateral margins of pleonite 5 are not contained under pleonite 4.

Metacirolana caeca (Hansen, 1916) (see Svavarsson & Bruce, 2000), *M. fornicata* (Mezhov, 1981) and *M. neocaledonica* Bruce, 1996, all deep-water species from depths greater than 1700 m, have the antennula peduncle article 2 short and article 3 long; these species otherwise agree with *Metacirolana*, with the left mandible fourth cusp being present, as well as the maxilliped palp shape and other characters. The elongation of the antennular article 3 may be a character reversal associated with low light, deep-water habitats. One further species, *Metacirolana costaricensis* Brusca, Wetzer & France, 1995, from surface pelagic samples taken over 2000 m depth, also has antennular peduncle article 3 longest.

Four species, again all agreeing with the characters for *Metacirolana*, have the posterolateral angles of pleonite 5 not free and appear contained laterally by pleonite 4: *Metacirolana arnaudi* Kensley, 1989 and *Metacirolana nana* (Bruce, 1980) have the posterolateral angles of pleonite 5 visible; *Metacirolana convexissima* (Kensley, 1984) and *Metacirolana anocula* (Kensley, 1984b) accord wholly with the genus except that pleonite 5 is manifestly overlapped by pleonite 4. In these species the coxae and pleonites 2–4 are strongly laterally expressed, lack pleonite epimera and while pleonite 5 is laterally overlapped, the form of pleonites 3 and 4 is not homologous to that shown by for example *Cirolana* Leach, 1818 or *Natatolana* Bruce, 1981.

Aphantolana Moore & Brusca, 2003 appears to be the most similar genus to *Metacirolana*, in particular those species of the genus with dorsal nodules and carinae. There are numerous differences between the two genera, as documented by Moore & Brusca (2003): critical in *Aphantolana* is the large posteriorly produced pereonite 7 coxae that laterally overlaps the pleon, pereonite 1 being medially longer than pereonite 2, the short pleon (10–12% BL), pleonite 5 laterally largely or entirely overlapped by pleonite 4, strongly sinuate pleotelson lateral margins that converge to a narrowly rounded apex, the antennula peduncle article 3 longest, and pereopod characters of pereopod 1 carpus inferodistal angle with complex seta and pereopod 1 carpus inferodistal angle forming a notched lobe (this latter character also being shared with *Metacirolana nicosmiti* sp. nov.). Several characters are shared with *Metacirolana*, including the putatively apomorphic characters of the left mandible with a fourth small mesial cusp and maxilliped palp article 5 with straight margins. Other characters shared with *Metacirolana* as well as other genera in the 'eurydicine group' of genera include sexual dimorphism between mature males and females, prominent penial process, and the sub-basal insertion of the appendix masculina.

List of the genera of Cirolanidae with a projecting clypeus blade

This list includes all 'eurydicine group' genera with the primary character of a projecting blade on the clypeus: pleonite 5 with free lateral margins or at least lateral angles free, posteriorly narrowed frontal lamina, prominent penial processes and male pleopod 2 with the appendix masculina attaching in a sub-basal, medial or sub-apical position; most genera have a 'long pleon' of between 15–35% BL. Exceptions noted for each genus. Species totals all taken from WoRMS (2020).

Annina Budde-Lund, 1908. Six species. Primarily northern Indian Ocean, in mangroves and muddy estuarine habitats; species often with dorsal processes on head and pereonite 1. Frontal lamina posteriorly narrowed, in some species abutting clypeus. Pleon 14–25% BL.

Aphantolana Moore & Brusca, 2003. Four species. Shallow water tropical oceans. Pleon 10–12% of total body length; pleonite 5 narrower than pleonite 4, with free or overlapped lateral margins.

Arubolana Botosaneanu & Stock, 1979. Four species. Caribbean cave waters. The genus shows a diversity of pereopod and uropod morphology, but is otherwise close to *Metacirolana*, notably with a fourth small cusp on the left mandible incisor and similar maxilliped palp morphology. Pleon 19–33% BL, with pleonite 5 lateral angles free.

Atarbolana Bruce & Javed, 1987. North-western Indian Ocean and eastern Mediterranean; intertidal habitats, the setation of the pereopods suggesting at least some species are sand dwelling. Five species plus one undescribed species in Kenya (NLB pers. obs). Pleon short in immature males and females (10–12% BL), longer in mature males (15% BL); pleonite 4 posteriorly produced and expanded, completely enclosing the lateral margins of pleonite 5; frontal lamina posteriorly abutting clypeus, not narrowed (in those species where this character has been described).

Colopisthus Richardson, 1902. Five species. Caribbean, one species from Cape Verde Islands, eastern Atlantic and subtropical Atlantic. Pleon very short, with two dorsally visible pleonites (four species) or three (one species); pleon 5–10% BL.

Eurydice Leach, 1815. Fifty-seven species. World oceans; intertidal sandy beach to more than 2000 m depth. A very uniform genus, with a distinctive antennula peduncle morphology in which article 2 is set at right angles to article 1; the uropod peduncle lacks a produced mesial lobe. Pleon 18–33% BL, but most 20–31% BL (sources: Bruce 1986; Bruce & Soares, 1996; Brusca et al. 1995; Kensley & Schotte 1989).

Eurylana Jansen, 1981. Three species. New Zealand and Australia; one species introduced to Pacific USA (Bowman et al. 1981). Frontal lamina not markedly narrowed posteriorly, abutting clypeus. Pleon 15–18% BL.

Excirolana Richardson, 1912. Fourteen species. Sandy beaches, mangroves; shallow waters; world oceans, mostly tropical or subtropical. Frontal lamina not markedly narrowed posteriorly, abutting clypeus. Pleon 12–26% BL.

Metacirolana Kussakin, 1979, Thirty-one species. World oceans; primarily tropical and temperate waters; to 2000 m. Pleon 21–35% BL.

Pontogelos Stebbing, 1910. Monotypic. Pelagic; world oceans. Pleon 35% BL.

Pseudaega Thomson, 1884. Five species. Endemic to New Zealand (Jansen, 1978). Pleon 12–17% BL. Frontal lamina not markedly narrowed posteriorly, abutting clypeus.

Pseudolana Bruce, 1980b. Seven species. Sandy beach habitats in Australia and eastern New Guinea. Frontal lamina linear. Pleon 16–22% BL.

Xylolana Kensley, 1979. Monotypic. Mangroves, Caribbean. Pleonite 5 entirely enclosed laterally by pleonite 4. Pleon 9% BL.

Two cave-water genera, lacking an obvious clypeus blade, have pleonite 5 with free lateral margins, prominent penial processes and pleopod 2 appendix masculina inserted sub-basally to medially. These genera are *Cirolanides* Benedict, 1896 (two species – see Schwartz et al. 2019) and *Bahalana* Carpenter, 1981 (seven species – see Botosaneanu & Iliffe 2002, 2003). The recently described deep-water genus *Sululana* Bruce & Shimomura, 2019, also lacking a clypeus blade, was regarded as being closer to *Metacirolana* than to other genera on the basis of antennula peduncle article 2 being longest and the characters of the pleon, maxilliped, pereopods.

In conclusion, the subfamilies Cirolaninae Dana, 1852 and Conilerinae Kensley & Schotte, 1989 and Eurydicinae Stebbing, 1905, while not having been phylogenetically tested, do each present consistent distinguishing characters. It is therefore considered important that these characters be referred to and recorded for all cirolanid taxa as appropriate. In addition, the subfamily characters provide a pragmatic tool in both generic characterization and identification, and should not be ignored.

Acknowledgements

I thank Dr Sammy de Grave, Oxford University Zoological Museum for the opportunity to participate in this expedition, funded from the UK Millennium Commission, through the Oxford University Museum of Natural History, UK. Mr Sunia

Lavuki, USP. This is NWU-Water Research Group contribution number 522.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

Baratti M, Burchi A, Messana G, Yacoubi-Khebiza M. 1999. Inferring phylogenetic history of five taxa of the genus *Typhlocirolana* (Isopoda Cirolanidae) by 12S sequence. Preliminary data. Mémoires de Biospéologie. 26:59–64.

Baratti M, Filippelli M, Nardi F, Messana G. 2010. Molecular phylogenetic relationships among some stygobitic cirolanid species (Crustacea, Isopoda). Contributions to Zoology. 79:57–67. doi:10.1163/18759866-07902001

Benedict JE. 1896. Preliminary descriptions of new genus and three new species of crustaceans from an artesian well at San Marcos, Texas. Proceedings of the United States National Museum. 18:615–617. doi:10.5479/si.00963801.18-1087.615

Bleeker P. 1857. Recherches sur les Crustacés de L'Inde Archipelagique. II. Sur les Isopodes Cymothoadiens de L'Archipel Indien. Natuurkundige vereeniging in Nederlandsche-Indie, Batavia, Verhandelingen. 2:20–40.

Botosaneanu L, Bruce NL, Notenboom J. 1986. Isopoda: Cirolanidae. In: L. Botosaneanu, editor. Stygiofauna Mundi. A faunistic, distributional, and ecological synthesis of the world fauna inhabiting subterranean waters (including the marine interstitial). Leiden: E.J. Brill; p. 412–422.

Botosaneanu L, Iliffe TM. 2002. Stygobitic isopod crustaceans, already described or new, from Bermuda, the Bahamas, and Mexico. Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie. 72:101–111.

Botosaneanu L, Iliffe TM. 2003. A new species of the stygobitic cirolanid isopod genus *Bahalana* from the Caicos Islands in the Caribbean (Isopoda: Cirolanidae). Travaux du Muséum d'Histoire Naturelle 'Grigore Antipa'. 45:83–93.

Botosaneanu L, Stock JH. 1979. *Arubolana imula* n. gen., n. sp., the first hypogean cirolanid isopod crustacean found in the Lesser Antilles. Amsterdam Expeditions to the West Indian Islands, Report 6. Bijdragen tot de Dierkunde. 49:227–233. doi:10.1163/26660644-04902004

Bowman TE, Bruce NL, Standing JD. 1981. Recent introduction of the cirolanid isopod crustacean *Cirolana arcuata* into San Francisco Bay. Journal of Crustacean Biology. 1:545–557. doi:10.2307/1548131

Bruce NL. 1980a. Cirolanidae (Crustacea: Isopoda) of Australia. Heron Island and the Capricorn Group. Bulletin of Marine Science. 30:108–130.

Bruce NL. 1980b. The Cirolanidae (Crustacea: Isopoda) of Australia: the genus *Pseudolana* from the Queensland coasts with description of three new species. Pacific Science. 34:153–164.

Bruce NL. 1981a. Cirolanidae (Crustacea: Isopoda) of Australia: diagnoses of *Cirolana* Leach, *Metacirolana* Nierstrasz, *Neocirolana* Hale, *Anopsilana* Paulian & Debouteville, and three new genera – *Natatolana, Politolana* and *Cartetolana*. Australian Journal of Marine and Freshwater Research. 32:945–966. doi:10.1071/MF9810945

Bruce NL. 1981b. New records of Cirolanidae (Crustacea: Isopoda) from the Tanzanian coast of East Africa. Journal of Crustacean Biology. 1:457–460. doi:10.2307/1547976

Bruce NL. 1984. A new family for the isopod crustacean genus *Tridentella* Richardson, 1905, with description of a new species from Fiji. Zoological Journal of the Linnean Society. 80:447–455. doi:10.1111/j.1096-3642.1984.tb02555.x

Bruce NL. 1986. Cirolanidae (Crustacea: Isopoda) of Australia. Records of the Australian Museum, Supplement. 6:1–239. doi:10.3853/j.0812-7387.6.1986.98

Bruce NL. 1996. Crustacea isopoda: some Cirolanidae from the MUSORSTOM Cruises off New Caledonia. Résultats des Campagnes MUSORSTOM, Volume 15. Mémoires du Muséum National d'Histoire Naturelle, Paris. 168:147–166.

Bruce NL, Javed W. 1987. A new genus and two new species of cirolanid isopod Crustacea from the northern Indian Ocean. Journal of Natural History. 21:1451–1460. doi:10.1080/00222938700770911

Bruce NL, Müller H-G. 1991. A new family for the isopod crustacean genus *Hadromastax* Bruce, 1988, with a description of a new species from the Society Islands. Zoological Journal of the Linnean Society. 101:51–58. doi:10.1111/j.1096-3642.1991.tb00885.x

Bruce NL, Olesen J. 1995. *Natatolana nukumbutho*, a new species (Crustacea: Isopoda: Cirolanidae) from deep water off Suva, Fiji. Proceedings of the Biological Society of Washington. 108:212–219.

Bruce NL, Shimomura M. 2019. A new genus and species of deep-water marine cirolanid isopod (Crustacea: Isopoda: Cirolanidae) from the Philippines. Raffles Bulletin of Zoology. 67:1–13. https://doi.org/10.26107/RBZ-2019-0001

Bruce NL, Soares AG. 1996. Taxonomy and ecology of sandy beach *Eurydice* (Crustacea, Isopoda, Cirolanidae) from the West coast of South Africa. Cahiers de Biologie Marine. 37:77–98.

Brusca RC, Wetzer R, France SC. 1995. Cirolanidae (Crustacea: Isopoda: Flabellifera) of the tropical eastern Pacific. Proceedings of the San Diego Society of Natural History. 30:1–96.

Budde-Lund G. 1908. Isopoda von Madagaskar und Ostrafrika mit Diagnosen verwandter Arten. Wissenschaftliche Ergebnise. Reise in Ostafrika. 2:265–308.

Carpenter JH. 1981. *Bahalana geracei* n.gen., n.sp., a troglobitic marine cirolanid isopod from Lighthouse Cave, San Salvador Island, Bahamas. Bijdragen tot de Dierkunde. 51:259–267.

Coleman CO, Lowry JK, Macfarlane T. 2010. DELTA for beginners. An introduction into the taxonomy software package DELTA. ZooKeys. 45:1–75. doi:10.3897/zookeys.45.263

Dallwitz MJ. 1980. A general system for coding taxonomic descriptions. Taxon. 20:41–46. doi:10.2307/1219595

Dallwitz MJ, Paine TA, Zurcher EJ. 1997. User's guide to the DELTA system. A general system for processing taxonomic descriptions. Canberra: CSIRO Division of Entomology; p. 1–160.

Dallwitz MJ, Paine TA, Zurcher EJ. 2006. User's guide to the DELTA system: a general system for processing taxonomic descriptions. http://delta-intkey.com/.

Dana JD. 1852. On the classification of the Crustacea Choristopoda or Tetradecapoda. American Journal of Sciences and Arts. 2:297–316.

Hansen HJ. 1890. Cirolanidae et familiae nonnulae propinquae Musei Hauniensis. Det Kongelige Danske Videnskabernes Selskab Skrifter. Naturvidenskabelig og Mathematisk. 6:237–426.

Hansen HJ. 1916. The order Isopoda. In: Crustacea Malacostraca. Danish Ingolf Expedition, vol. 3. Copenhagen: Zoologisk Museum; p. 1–262.

Herklots JA. 1870. Deux nouveaux genres de Crustacés vivant en parasites sure des poissons—*Epichthys* et *Ichthyoxenos*. Archiv Neerlandaise Sciences Exact et Naturelle. 5:120–137.

Iliffe TM, Botosaneanu L. 2006. The remarkable diversity of subterranean Cirolanidae (Crustacea: Isopoda) in the peri-Caribbean and Mexican Realm. Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie. 76:5–26.

Jansen KP. 1978. A revision of the genus *Pseudaega* Thomson (Isopoda: Flabellifera: Cirolanidae) with diagnoses of four new species. Journal of the Royal Society of New Zealand. 8:143–156. doi:10.1080/03036758.1978.10429387

Jansen KP. 1981. *Eurylana*, a new genus of Cirolanidae (Isopoda: Flabellifera) with two species *Eurylana cookii* (Filhol) and *Eurylana arcuata* (Hale). Journal of the Royal Society of New Zealand. 11:5–10. doi:10.1080/03036758.1981.10419448

Kensley B. 1984a. The Atlantic barrier reef ecosystem at Carrie Bow Cay, Belize, III: new marine Isopoda. Smithsonian Contributions to the Marine Sciences. 24:1–81. doi:10.5479/si.01960768.24.1

Kensley B. 1984b. The South African Museum's *Meiring Naude* cruises. Part 15. Marine Isopoda of the 1977, 1978, 1979 Cruises. Annals of the South African Museum. 93:213–301.

Kensley B. 1987. Further records of marine isopod crustaceans from the Caribbean. Proceedings of the Biological Society of Washington. 100:559–577.

Kensley B. 1979. New species of anthurideans from the Cook and Fiji Islands (Crustacea: Isopoda: Anthuridea). Proceedings of the Biological Society of Washington. 92:814–836.

Kensley B, Schotte M. 1989. Guide to the Marine isopod crustaceans of the Caribbean. Washington, DC: Smithsonian Institution Press; p. 308.

Kim SH, Yoon SM. 2019. First records of two cirolanid species (Isopoda, Cymothooidea, Cirolanidae) from Korean waters. Animal Systematics, Evolution and Diversity. 35:168–181. http://doi.org/10.5635/ASED.2019.35.4.034

Kussakin OG. 1979. Marine and brackishwater likefooted Crustacea (Isopoda) from the cold and temperate waters of the Northern Hemisphere. Suborder Flabellifera. Leningrad [In Russian]: Izdatel'stvo Nauka; p. 1–472.

Leach WE. 1815. A tabular view of the external characters of four classes of animals which Linné arranged under *Insecta* with the distribution of the genera composing three of these classes into orders, and description of several new genera and species. Transactions of the Linnean Society of London. 11:306–400. doi:10.1111/j.1096-3642.1813.tb00065.x

Leach WE. 1818. Cymothoadées. In: F. Cuvier, editor. Dictionnaire des Sciences Naturelles, vol. 12. Paris: Strasbourg et Levrault; p. 338–354.

Menzies RJ. 1957. The marine borer family Limnoriidae (Crustacea, Isopoda). Part I. Northern and Central America: systematics, distribution, and ecology. Bulletin of Marine Science of the Gulf and Caribbean. 7:101–200.

Mezhov BV. 1981. Isopoda. In: Benthos of the submarine mountains Marcus-Necker and adjacent Pacific regions. Moscow: P. P. Shirshov Institute of Oceanology. Academy of Sciences of the U.S.S.R; p. 62–82.

Moore W, Brusca RC. 2003. A monograph on the isopod genus *Colopisthus* (Crustacea: Isopoda: Cirolanidae) with the description of a new genus. Journal of Natural History. 37:1329–1399. doi:10.1080/00222930110108335

Müller H-G. 1989a. Joeropsidae from Bora Bora and Moorea, Society Islands, with descriptions of four new species (Isopoda: Asellota). Bijdragen tot de Dierkunde. 59:71–85. doi:10.1163/26660644-05902002

Müller H-G. 1989b. *Munnogonium polynesiensis* n. sp. from coral reefs at Bora Bora and Moorea, Society Islands (Isopoda: Asellota: Paramunnidae). Bulletin Zoölogisch Museum Universiteit van Amsterdam. 12:57–62.

Müller H-G. 1989c. A new species of marine isopod of the genus *Gnathia* from the Fiji Islands, the South Pacific. Publications of the Seto Marine Biological Laboratory. 34:31–35. doi:10.5134/176160

Müller H-G. 1989d. Two new species of *Gnathia* Leach from coral reefs at Moorea, Society Islands, with redescription of *Gnathia margaritarum* Monod, 1926 from Panama Pacific (Isopoda: Cymothoidea: Gnathiidae). Bulletin Zoölogisch Museum, Universiteit van Amsterdam. 12:65–78.

Müller H-G. 1990a. Two new species and a new genus of coral-reef-inhabiting Munnidae from Bora Bora and Moorea, Society Islands (Crustacea: Isopoda). Revue Suisse de Zoologie. 97:361–371. doi:10.5962/bhl.part.79742

Müller H-G. 1990b. Two new species of *Eisothistos* and *Anthomuda* from coral reefs at Moorea and Bora Bora, Society Islands (Isopoda, Anthuridea: Hyssuridae, Paranthuridae). Zoologische Abhandlungen Staatliches Museum für Tierkunde Dresden. 45:111–119.

Müller H-G. 1991a. Corallanidae from Bora Bora and Moorea, Society Islands, with description of a new species of *Corallana* (Crustacea: Isopoda: Cymothoidea). Cahiers de Biologie Marine. 32:451–468.

Müller H-G. 1991b. Sphaeromatidae from coral reefs on the Society Islands, French Polynesia (Crustacea: Isopoda). Cahiers de Biologie Marine. 32:83–104.

Müller H-G. 1991c. Three new species and a new genus of eyeless isopods from coral reefs at Moorea, Society Islands (Crustacea: Isopoda: Hyssuridae, Gnathostenetroididae). Senckenbergiana Biologia. 71:289–301.

Müller, H.-G., 1991d. Description of *Metacirolana aguja* n.sp., and redescription of *M. agaricicola* Kensley, 1984, from the Caribbean Sea of Colombia (Isopoda: Cirolanidae). *Bijdragen tot de Dierkunde*. 61: 17–30.

Müller H-G. 1992a. Anthuridae from coral reefs ar Bora Bora and Moorea, Society Islands, with descriptions of three new species. Senckenbergiana Biologia. 72:353–371.

Müller H-G. 1992b. *Halacarsantia kussakini* n.sp. from a coral reef in French Polynesia (Isopoda: Asellota: Santiidae). Cahiers de Biologie Marine. 33:263–267.

Müller H-G. 1993. Paranthurid isopods from French Polynesian coral reefs, including descriptions of six new species (Crustacea: Peracarida). Cahiers de Biologie Marine. 34:289–342.

Müller H-G. 1994. Janiridae from coral reefs at the Society Islands, French Polynesia (Crustacea: Isopoda). Zoologische Abhandlungen Staatliches Museum für Tierkunde Dresden. 48:1–13.

Müller H-G, Salvat B. 1993. Cirolanidae (Isopoda) from French Polynesian coral reefs: description of three new species. Crustaceana. 64:197–220. doi:10.1163/156854093X00243

Nierstrasz HF. 1931. Isopoda genuina. II. Flabellifera. In: M. Weber, L.F. De Beaufort, editor. Die Isopoden der Siboga-Expedition, vol. 19 (32c). Leiden: E.J. Brill; p. 123–233, pls 110–111.

Nunomura N. 1999. Sea shore isopod crustaceans collected from the Izu Islands, Middle Japan. Bulletin of the Toyama Science Museum. 22:7–38.

Negoescu I. 1999. Isopoda Anthuridea (Crustacea) from the Fiji Islands. Three new species. First record of primary and secondary males in Paranthuridae family. Travaux du Muséum d'Histoire Naturelle 'Grigore Antipa'. 41:199–280.

Nordenstam Å. 1946. Marine Isopoda from Professor Dr. Sixten Bock's expedition 1917–1918. Arkiv för Zoologi. 37A:1–31.

Richardson H. 1902. The marine and terrestrial isopods of the Bermudas with descriptions of new genera and species. Transactions of the Connecticut Academy of Arts and Sciences, New Haven. 11:277–310.

Richardson HS. 1912. Descriptions of a new genus of isopod, and of two new species from South America. Proceedings of the United States National Museum. 43:201–204. doi:10.5479/si.00963801.43-1929.201

Riseman SF, Brusca RC. 2002. Taxonomy, phylogeny and biogeography of *Politolana* Bruce, 1981 (Crustacea: Isopoda: Cirolanidae). Zoological Journal of the Linnean Society. 134:57–140. doi:10.1046/j.1096-3642.2002.00002.x

Schotte M, Kensley B. 2005. New species and records of flabelliferan isopod crustaceans from the Indian Ocean. Journal of Natural History. 39:1211–1282. doi:10.1080/00222930400005757

Schwartz BF, Hutchins BT, Schwartz SG, Hesse AJ, Bonett RM. 2019. *Cirolanides wassenichae* sp. nov., a freshwater, subterranean Cirolanidae (Isopoda, Cymothoida) with additional records of other species from Texas, United States. Zootaxa. 4543:498–514. doi:10.11646/zootaxa.4543.4.2

Sidabalok CM, Bruce NL. 2018. Two new species and a new record of *Metacirolana* Kussakin, 1979 (Crustacea: Isopoda: Cirolanidae) from Indonesia. Zootaxa. 4370:519–534. doi:10.11646/zootaxa.4370.5.4

Stebbing TRR. 1904. Marine crustaceans. XII. Isopoda, with description of a new genus. In: Gardiner JS, editor. Fauna and geography of the Maldive and Laccadive archipelagoes. Cambridge University Press; p. 699–721.

Stebbing TRR. 1905. Report on the Isopoda collected by Professor Herdman, at Ceylon, in 1902. Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar, 1905. Supplementary Report 4:47–64.

Stebbing TRR. 1910. Isopoda from the Indian Ocean and British East Africa. The Percy Sladen Trust Expedition to the Indian Ocean under the leadership of Mr J. Stanley Gardiner. Volume III. Transactions of the Linnean Society of London. 2nd Series: Zoology. 14:83–122, pls 125–111. doi:10.1111/j.1096-3642.1910.tb00525.x

Svavarsson J, Bruce NL. 2000. Redescription of the cosmopolitan meso- and bathypelagic cirolanid *Metacirolana caeca* (Hansen, 1916) comb. nov. (Crustacea, Isopoda). Steenstrupia. 25:147–158.

Thomson GM. 1884. Descriptions of new crustaceans. Transactions of the New Zealand Institute, Zoology. 16:234–240.

Wägele J-W. 1989. Evolution und phylogenetisches System der Isopoda. Stand der Forschung und neue Erkenntnisse. Zoologica. 140:1–262.

Wägele J-W, Coleman O, Hosse U. 1987. Two new hypogean species of *Cyathura* from Melanesia (Crustacea, Isopoda, Anthuridea): further Tethyan relicts? Stygologia. 3:89–106.