A New Species of the Henicopid Centipede *Dichelobius* (Chilopoda: Lithobiomorpha) from Southeastern Australia and Lord Howe Island

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The genus *Dichelobius* Attems, 1911, based on *D. flavens* Attems, 1911, from the southwest of Western Australia, has its only other previously assigned species in New Caledonia and Chile. The Tasmanian type species of the monotypic *Tasmanobius* Chamberlin, 1920, is regarded as a member of *Dichelobius*. *Dichelobius giribeti* n. sp. represents the genus in eastern mainland Australia (southeastern New South Wales, the Australian Capital Territory, and northeastern Victoria) and on Lord Howe Island. *Dichelobius bicuspis* Ribaut, 1923, is widely distributed in New Caledonia.

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KEYWORDS: Anopsobiinae, Chilopoda, *Dichelobius*, Henicopidae, Lithobiomorpha.

INTRODUCTION

The subfamily Anopsobiinae is a group of minute centipedes (Chilopoda) in the predominantly southern temperate family Henicopidae. Anopsobiinae is distributed chiefly in the Southern Hemisphere, with species described from Patagonian Argentina and Chile (Silvestri 1899, 1909a-b; Verhoeff 1939; Chamberlin 1962), the Falkland Islands (Eason 1993), New Zealand (Silvestri 1909a; Archey 1917, 1937), New Caledonia (Ribaut 1923), Tasmania (Chamberlin 1920), New South Wales (Edgecombe 2003), southwest Western Australia (Attems 1911), and the Cape region of South Africa (Attems 1928). Four Gondwanan genera have been named: *Anopsobius* Silvestri, 1899, *Catanopsobius* Silvestri, 1909b, *Dichelobius* Attems, 1911, and *Tasmanobius* Chamberlin, 1920. Four additional anopsobiine genera, all monotypic, occur in the Northern Hemisphere, namely *Anopsobiella* Attems, 1938, *Ghilaroviella* Zalesskaja, 1975, *Shikokuobius* Shinohara, 1982, and *Rhodobius* Silvestri, 1933. In total, 17 species and subspecies of Anopsobiinae have been described.

Silvestri (1909a) cited the occurrence of an anopsobiine from Sydney, but formal descriptions of Anopsobiinae in eastern Australia are limited to *Tasmanobius relictus* Chamberlin, 1920, based upon a single specimen from Tasmania, and *Anopsobius wrighti* Edgecombe, 2003, from northern New South Wales. Mesibov (1986) indicated the presence of two species of Anopsobiinae in Tasmania. The present study continues a systematic treatment of Anopsobiinae of Australia by documenting a new species of *Dichelobius* from New South Wales, the Australian Capital Territory, Victoria, and Lord Howe Island (Fig. 1).

For electron microscopy, specimens were photographed on a Leo 435VP using a Robinson backscatter detector. Digital images were assembled into plates with Photoshop. Morphological terminology is as summarised by Edgecombe (2001:203), with terminology for the mandible as in Edgecombe et al. (2002:40, Fig. 4).

The following abbreviations are used for repositories of specimens examined:

AM - Australian Museum, Sydney
ANIC – Australian National Insect Collection, Canberra
MCZ – Museum of Comparative Zoology, Harvard University, Cambridge, MA
MNHN – Museum National d'Histoire Naturelle, Paris
NMW – Naturhistorisches Museum Wien
QM – Queensland Museum, Brisbane
WAM – Western Australian Museum, Perth.

Other abbreviations: Berl., ANIC Berlesate; CBCR, Australian Museum Centre for Biodiversity and Conservation Research; Ck, Creek; Mt, Mountain; NP, National Park; rf, rainforest; SF, State Forest.

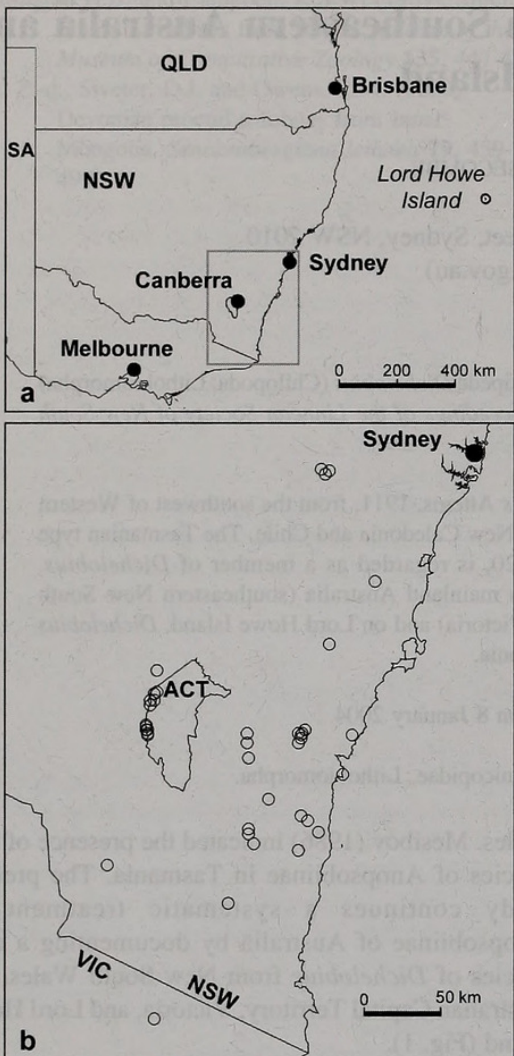

Figure 1. a, southeastern Australia and Lord Howe Island. Inset shows location of map in b, indicating records of *Dichelobius giribeti* n. sp. (open dots) in New South Wales, the Australian Capital Territory, and Victoria.

Collectors: GBM – G.B. Monteith; JFL – J.F. Lawrence; RJB – R.J. Brooks; RWT – R.W. Taylor.

Order LITHOBIOMORPHA Pocock, 1902
Family HENICOPIDAE Pocock, 1901
Subfamily ANOPSOBIINAE Verhoeff, 1907
Genus DICHELOBIUS Attems, 1911

Tasmanobius Chamberlin, 1920 **n. syn.**

Type species

Dichelobius flavens Attems, 1911; by monotypy.

Assigned species

Dichelobius relictus (Chamberlin, 1920) n. comb.; *D. bicuspis* Ribaut, 1923; *D. schwabei* Verhoeff, 1939; *D. giribeti* n. sp.

Diagnosis

Anopsobiinae with spiracle on segments 3, 10 and 12, variably present on segment 14.

Discussion

The Gondwanan genera *Dichelobius*, *Tasmanobius* and *Anopsobius* share several apomorphic characters relative to Northern Hemisphere Anopsobiinae. These include coxal pores confined to legs 14 and 15, a ventrodistal spur on the prefemur of legs 14 and 15, an elongate longitudinal median furrow on the head shield, the basal article of the female gonopod extended as a short process bearing the spurs, and indistinct scutes on the proximodorsal part of the pretarsal claws (Edgecombe and Giribet 2003). Considering previous concepts of *Dichelobius* (Attems 1928; Verhoeff 1939; Shinohara 1982), reduced spiracles are the only morphological character that unites its members to the exclusion of *Anopsobius* as delimited by Chamberlin (1962) and Edgecombe (2003). The *Dichelobius* distribution of spiracles is shared by the eastern Australian species *D. giribeti*. The cladistic reliability of a diminished number of segments with spiracles can be questioned because other genera of Anopsobiinae have been diagnosed based on having spiracles confined to segments 3, 10 and 12 (*Tasmanobius*), 3, 12 and 14 (*Rhodobius*) or 3 and 10 only (*Catanopsobius*). However, molecular sequence data provide independent support for a close relationship between *D. flavens* and *D. giribeti*, with the implication that their shared spiracle distribution can be considered a synapomorphy (Fig. 2a). Parsimony analysis of five molecular loci as well as combination of the molecular data and morphology unite *D. flavens* and *D. giribeti* to the exclusion of *Anopsobius* species under many explored gap costs and transversion:transition ratios (Edgecombe and Giribet 2003) (Fig. 2c). An alternative relationship between *D. giribeti* and *Anopsobius* (Fig. 2b) is discussed below.

Verhoeff (1925) cited the presence of a median suture in the maxillipede pleural band as an additional character by which *Dichelobius* is distinguished from *Anopsobius*. The presence of a median suture (see Fig. 6j) is a plesiomorphic character, shared with Henicopinae, and is thus not useful for defining *Dichelobius* as a clade.

Tasmanobius relictus Chamberlin, 1920, is considered to be a member of *Dichelobius* as grouped

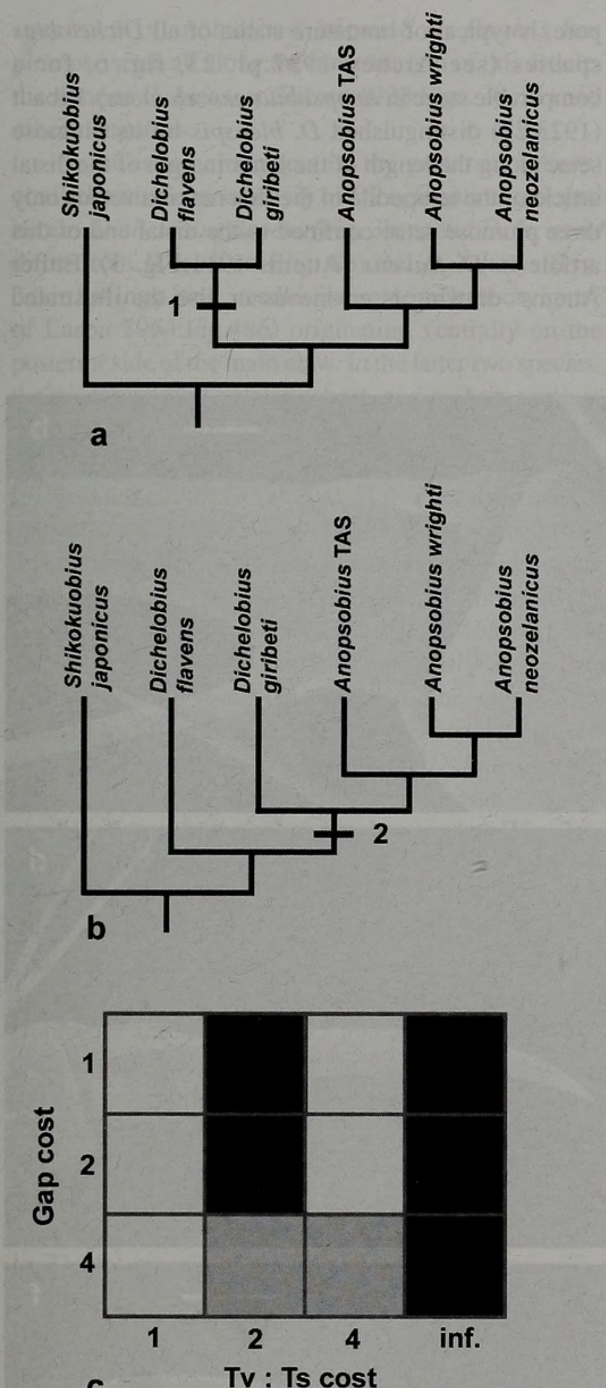

Figure 2. a, b, alternative cladograms for Anopsobiinae based on combined morphological and molecular data (Edgecombe and Giribet 2003). Character 1, absence of spiracles on segment 8; character 2, short posteroventral spine on pretarsal claw; c, summary of 12 analyses for combined morphological and molecular data with different gap costs (gap:substitution = 1:1, 2:1, 4:1) and transversion:transition costs (1:1, 2:1, 4:1, infinity). Black squares, parameters that resolve cladogram a (*Dichelobius* monophyletic); white squares, parameters that resolve cladogram b (*Dichelobius* paraphyletic); grey square, cladograms a and b of equal length.

herein (with *Tasmanobius* consequently being a junior subjective synonym of *Dichelobius*). *Tasmanobius relictus* was described as having spiracles on segments 3, 10, and 12, as in *Dichelobius*. Mesibov (1986) suggested that a widespread Tasmanian anopsobiine species (Anopsobiine sp. 2 of Mesibov 1986) may be *Tasmanobius relictus*, and that species closely resembles *Dichelobius giribeti*. The holotype and sole type specimen of *T. relictus* (MCZ 14533) is in poor condition, and lacks locality data more specific than Tasmania, making the identification of any other specimen as this species problematical. The description by Chamberlin did not note a spiracle on segment 14 which is present in the Tasmanian *Dichelobius*, though this is not obvious in contracted specimens, as noted by Mesibov (1986). A spiracle being absent on segment eight in *T. relictus* and the colour being "nearly chestnut" (Chamberlin 1920) make it probable that this species is identical with the Tasmanian *Dichelobius* (=Anopsobiinae sp. 2 of Mesibov 1986) rather than the northwestern Tasmanian *Anopsobius* (=Anopsobiinae sp. 1 of Mesibov 1986), which has a spiracle on segment 8 and is more orange-yellow than orange-brown. Accordingly, the name *Dichelobius relictus* (Chamberlin, 1920) is applied to Anopsobiinae sp. 2 of Mesibov (1986).

Attems' (1928:74) key to anopsobiine genera followed Chamberlin's (1920) in distinguishing *Dichelobius* and *Tasmanobius* based on the former having a 1-jointed tarsus 13 and the latter a 2-jointed tarsus 13. This distinction is inconsistent with the referral of *D. bicuspis*, which has a 2-jointed tarsus 13 (even *fide* Attems 1928:77). The supposed difference between these species seems to be nothing more than a terminological difference in what constitutes a "joint", since *D. flavens*, *D. bicuspis* and *D. relictus* are, upon direct comparison, identical with respect to the segmentation of leg 13. All have a distinct articulation on the tarsus of leg 13, though it is less flexed than is the articulation on leg 14.

Other ambiguities concerning Attems' description and illustrations of *Dichelobius flavens* have plagued previous interpretations of the genus, and exaggerated differences between *D. flavens* and other species. Interpretation of *D. flavens* is based on examination of syntypes from Lion Mill (WAM), Freemantle and Eradu (NMW), and large new collections from the southwest of Western Australia (AM, ANIC, WAM). *Dichelobius bicuspis* and *D. schwabei* were distinguished from *D. flavens* by the first two species having two coxal pores on legs 14 and 15 in the female, versus a single pore on each of the coxae in *D. flavens*. This cannot be upheld, since large females of *D. flavens* characteristically have two coxal pores on both legs 14 and 15. Attems' (1911:157, Fig. 10) described and figured a single spur on the female gonopod in *D. flavens*, which Ribaut (1923) and Verhoeff (1939) cited as a distinction from the pair of spurs in *D. bicuspis* and *D. schwabei*, respectively. Large specimens of *Dichelobius flavens* resemble congeners (and indeed all other Anopsobiinae) in having a pair of spurs. The specimen drawn by Attems, with a single spur and single coxal pore, is typical of immature stadia of all *Dichelobius* species (see Archey 1937:pl. 23, fig. 6, for a comparable stage in *Anopsobius neozelanicus*). Ribaut (1923:27) distinguished *D. bicuspis* by its plumose setae along the length of the inner margin of the distal article of the telopodite of the first maxilla versus only three plumose setae confined to the distal end of this article in *D. flavens* (Attems 1911:Fig. 3). Either Attems' drawing is erroneous or else the illustrated

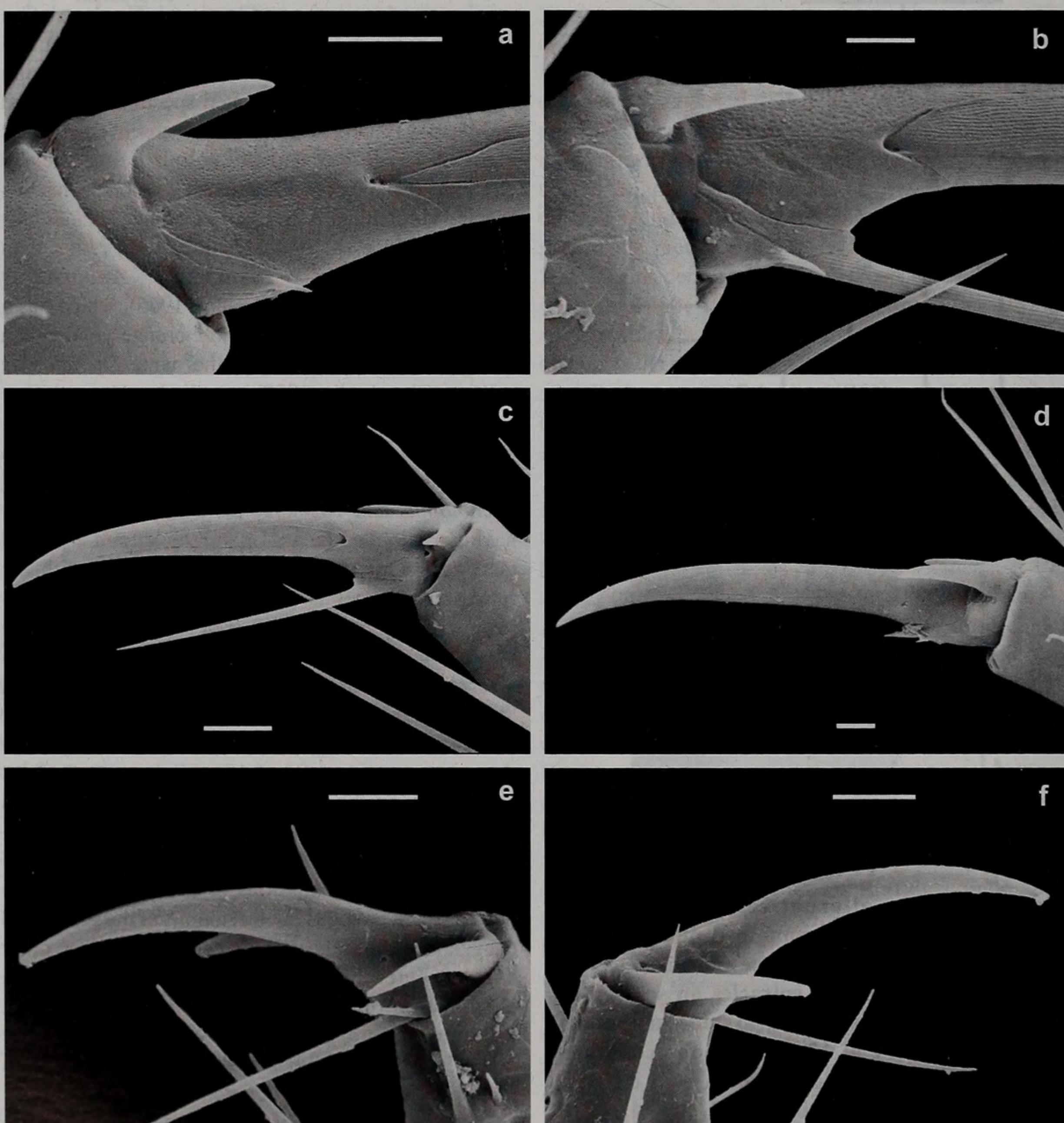

Figure 3. Pretarsal claws in Anopsobiinae. a, *Dichelobius relictus* (Chamberlin, 1920). Leg 14, posterior side. b, c, *Dichelobius flavens* Attems, 1911. Leg 14, posterior and anterior sides. d, *Anopsobius neozelanicus* Silvestri, 1909. Leg 14, posterior side. e, f, *Shikokuobius japonicus* (Murakami, 1967). Leg 13, posterior and anterior sides. Scales 10 µm except b, 5 µm.

specimen is anomalous, because *D. flavens* has plumose setae all along the inner margin of this article, the same as *D. bicuspis* (Ribaut 1923:Figs. 30, 31) and other congeners.

Certain characters of the pretarsus (claws) conflict with the monophyly of *Dichelobius* as grouped herein. *Dichelobius flavens* (Fig. 3b, c) and *D. bicuspis* differ from *D. giribeti* (Fig. 8b) and *D. relictus* (Fig. 3a) in having a long, needle-like spine (="sensory spur" of Eason 1964:Fig.486) originating ventrally on the posterior side of the main claw. In the latter two species, the posteroventral spine is short, and a short spine is shared by species of *Anopsobius*, such as *A. neozelanicus* Silvestri, 1909a (Fig. 3d) and *A. wrighti* (Edgecombe 2003:Figs.30, 31). The short spine appears to be apomorphic within the Gondwanan group of Anopsobiinae (i.e., a clade composed of *Anopsobius* + *Dichelobius*) because the Japanese anopsobiine *Shikokuobius japonicus* resembles *Dichelobius flavens* and *D. bicuspis* in possessing a greatly elongated posteroventral spine (Fig. 3e, f). The cladogram implied by this character, in which *D. giribeti* is more closely related to *Anopsobius* than to *D. flavens* (Fig. 2b), is retrieved under several parameter sets for combined morphological and molecular data (Fig. 2c). This cladogram would favour the assignment of *D. giribeti* to another genus. Should this topology find further support from additional data, *Tasmanobius* Chamberlin, 1920, could be rediagnosed to receive *D. giribeti*. A rediagnosed concept of that genus might emphasise the shared 14-15 antennal articles, short pretarsal posteroventral spine, absence of a distal spinose projection on the tibia of leg 12, and lack of spiracles on segments 5 and 8.

Key to *Dichelobius* species

1a. Dental margin of maxillipede coxosternite lacking median notch .... *schwabei* Verhoeff, 1939 [Chile]
1b. Dental margin of maxillipede coxosternite with median notch...... 2

2a. 14-15 (usually 15) antennal articles; pretarsus with short posteroventral spine, not more than one-eighth length of main claw (Fig. 8b)...... 3
2b. 17 antennal articles; pretarsus with needle-like posteroventral spine nearly as long as main claw (Fig. 3c)..... 4

3a. Spiracle absent on segment 14...... *giribeti* n. sp. [southeastern Australia, Lord Howe Island]
3b. Spiracle present on segment 14...... *relictus* Chamberlin, 1920 [Tasmania]

4a. Tibia of leg 12 with short, blunt distal projection...... *flavens* Attems, 1911 [Western Australia]
4b. Tibia of leg 12 with spinose distal projection...... *bicuspis* Ribaut, 1923 [New Caledonia]

Dichelobius giribeti n. sp.

Dichelobius sp. Edgecombe, 2004:Fig. 38A.
Dichelobius sp. ACT. Edgecombe and Giribet, 2003:Figs. 1-3.

Etymology

For Gonzalo Giribet, my collaborator in henicopid phylogeny, who sequenced DNA from this species.

Diagnosis

Dichelobius usually with 15 antennal articles; head pale orange, tergites orange-yellow; four to six (most commonly five) teeth on each dental margin of maxillipede; spiracle lacking on segment 14; two coxal pores on legs 14 and 15 in females, one or two pores on both legs in males; short posteroventral spine on pretarsus.

Type material

Holotype: AM KS 82628, female (Fig. 4b), Badja SF, NSW, Peters Rd, 36°08'52"S 149°32'09"E, J. Tarnawski and S. Lassau, 13.iii.1999; length of body 5.1 mm. Paratypes, all from type locality, same collection: AM KS 82629, male (Fig. 4c), KS 82630, male (Fig. 5b-e), KS 82631, female (Figs. 6a-g, 7a, b, d, h, j-l, 8k), KS 82632, female (Fig. 8i, j, n), KS 82633, male (Fig. 8l), KS 82634, 10 females, 1 male.

Other material

NSW: AM KS 82635, Kanangra-Boyd NP, Empress Fire Trail turnoff, 33°59'S 150°08'E, M. Gray, G. Hunt and J. McDougall, 27.iii.1976, *Eucalyptus pauciflora*; AM KS 82636, female (Figs 4a, 5a), KS 82637, female (Fig. 8b, e), KS 82638, male (Fig. 6i, j), Monga SF, NSW, Link Rd, 35°34'04"S 149°54'14"E, R. Harris and H. Smith, 16.iii.1999; AM KS 82639, Buckenbowra SF, Macquarie Rd, 70 m S from junction with Milo Rd, 35°38'15"S 149°53'27"E, 1020 m, L. Wilkie and R. Harris, 16.iii.1999; AM KS 82640, Tallaganda SF, South Forest Way, 35°42'50"S 149°32'20"E, J. Tarnawski and S. Lassau, 15.iii.1999; AM KS 82641, Dampier SF, Coomerang Rd, 36°04'01"S 149°54'57"E, R. Harris and H. Smith, 11.iii.1999; AM KS 82642, Badja SF, Wiola Ck Fire Trail, 36°05.56'S 149°35.09'E, J. Tarnawski and S. Lassau, 13.iii.1999; AM KS 82643, Badja SF, Burkes

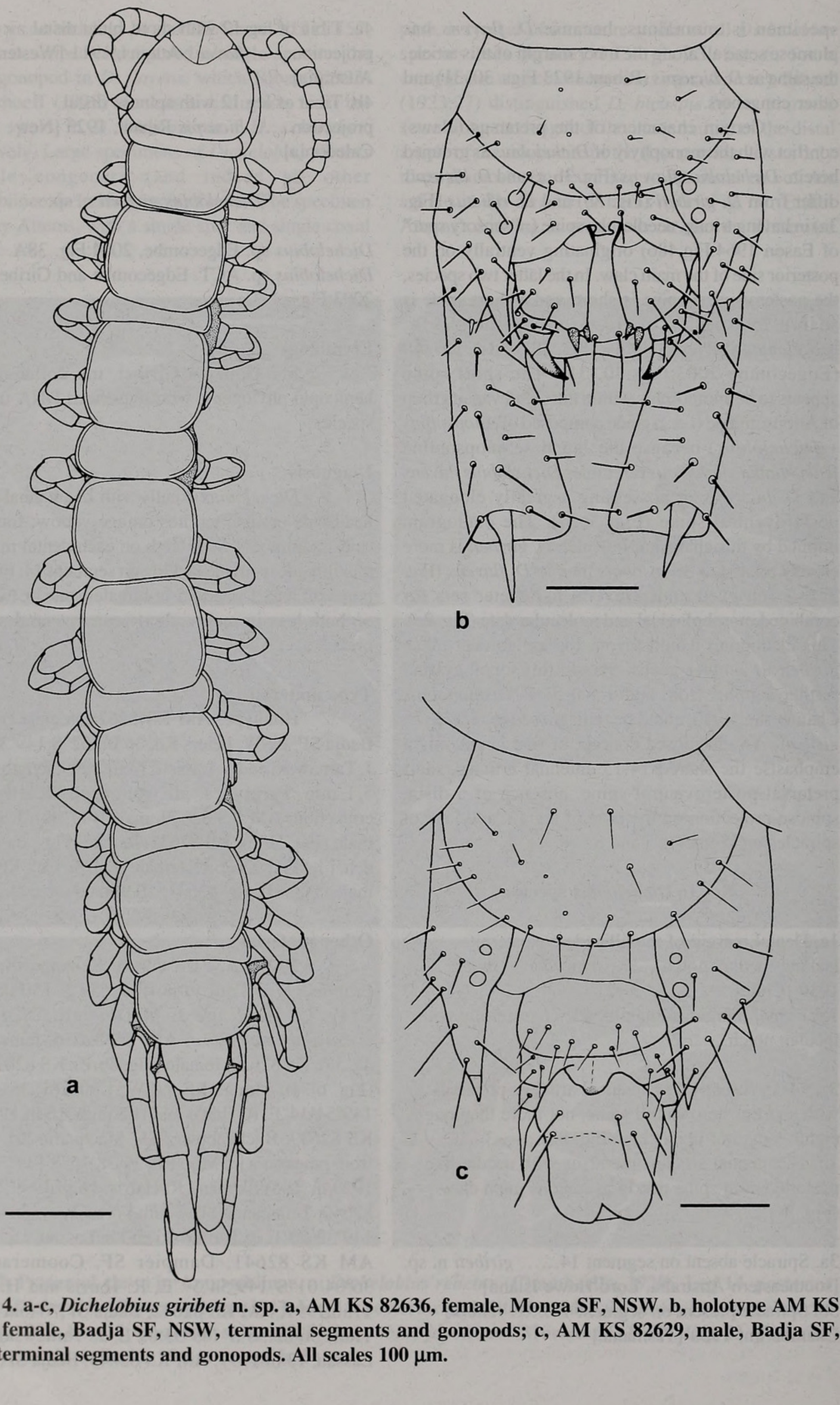

Figure 4. a-c, *Dichelobius giribeti* n. sp. a, AM KS 82636, female, Monga SF, NSW. b, holotype AM KS 82628, female, Badja SF, NSW, terminal segments and gonopods; c, AM KS 82629, male, Badja SF, NSW, terminal segments and gonopods. All scales 100 μm.

Rd, 36°10'33"S 149°31'58"E, J. Tarnawski and S. Lassau, 13.iii.1999; AM KS 82644, Badja SF, Burkes Rd, approx. 1.3 km E from junction with Peters Rd, 36°10.55'S 149°31.97'E, 992 m, J. Tarnawski and S. Lassau, 13.iii.1999; AM KS 82645, Bodalla SF, 300 m along Reservoir Link Rd from junction with Big Rock Rd, 36°07.25'S 150°2.82'E, 121 m, L. Wilkie and R. Harris, 09.iii.1999; AM KS 82646, Bodalla SF, Orange Ridge Rd, 36°16'55"S 149°53'31"E, R. Harris and H. Smith, 12.iii.1999; AM KS 82647, Wadbilliga NP, 9.6 km N on Bumberry Ck Fire Trail, 36°14.33'S 149°33.60'E, 1059 m, L. Wilkie and R. Harris, 13.iii.1999.

ANIC (ex. Berl. 855), Kanangra-Boyd NP, W Morong Creek, 33°58'S 150°04'E, 1200 m, L. Hill, 03.x.1982; ANIC (ex. Berl. 829), Kanangra-Boyd NP, Kanangra Brook and Rocky Spur, 34°00'S 150°06'E, L. Hill, 20.iii.1982, closed forest; ANIC (ex. Berl. 852) Twin Falls, 14 km SE Moss Vale, 34°39'S 150°28'E, 600 m, L. Hill, 11.vii.1982; ANIC (ex. Berl. 663), Pigeon House Range via Nerriga, 35°02'S 150°08'E, J.C. Cardale, 22.xi.1979; ANIC (ex. Berls 2, 18, 34, 78A, 206A, 222, 246, 468, 657, 851), Clyde Mt, 35°33'S 149°57'E, 500-c. 800 m, various collections 1966-1982, dry sclerophyll, wet sclerophyll, rf; ANIC (ex. Berl. 877), 2 km N Monga, 35°34'S 149°56'E, M.S. Harvey, 18.ix.1983, wet sclerophyll; ANIC (ex. Berl. 594), Monga, 35°35'S 149°55'E, JFL and T. Weir, 10.iii.1978, wet sclerophyll; ANIC (ex. Berl. 739), Tallaganda SF, 7 km ENE Captains Flat, 35°34'S 149°31'E, W. Allen, 29.viii.1981; ANIC (ex. Berl. 1069), Kioloa SF, 35°35'S 150°18'E, JFL and N. Lawrence, 4-5.iii.1986; ANIC (ex. Berl. 927), Milo Forest Preserve, 1.6 km S Monga, 35°36'S 149°55'E, L. Hill, 25.xii.1983; ANIC (ex. Berl. 218), 8.8 km ESE Captains Flat, 35°38'S 149°31'E, 940 m, RWT, 10.i.1970, dry sclerophyll; ANIC (ex. Berl. 891), Rosedale, 35°49'S 150°14'E, R.J. Moran, 20.xi.1983, eucalypt litter; ANIC (ex. Berl. 933), Kosciusko NP, 1 km ENE Mt Sunrise, 36°22'S 148°29'E, L. Hill, 4.ii.1984; ANIC (ex. Berl. 935), Kosciusko NP, 4 km NNE Mt Perisher, 36°22'S 148°29'E, L. Hill, 4.ii.1984; ANIC (ex. Berl. 10), Brown Mt, 36°36'S 149°23'E, c. 3000 ft., RWT, 5.i.1967, wet sclerophyll; ANIC (ex. Berl. 20), Brown Mt, c. 2800 ft., RWT and R.J. Bartell, 30.iii.1967, rf; ANIC (ex. Berl. 24), Brown Mt, 2500-3000 ft., RWT and R.J. Bartell, 11.iv.1967; ANIC (ex. Berl. 41), Brown Mt, Rutherford Creek, 2700 ft., RWT and RJB, 9.xii.1967, rf; ANIC (ex. Berl. 42), Brown Mt, c. 3000 ft., RWT and RJB, 9.xii.1967, rf.

ACT: ANIC (ex. Berl. 283), Black Mt, eastern slope, 35°16'S 149°06'E 750 m, J. Simmons, 26.v.1970, dry sclerophyll; ANIC (ex. Berl. 228), Uriarra to Piccadilly Circus, 35°19'S 148°51'E, 700 m, RWT, 27.i.1970, dry sclerophyll; ANIC (ex. Berl. 225), Uriarra to Piccadilly Circus, 35°20'S 148°50'E, 500 m, RWT, 16.i.1970, wet sclerophyll; ANIC (ex. Berl. 231), Uriarra to Piccadilly Circus, 35°20'S 148°50'E, 1000 m, RWT, 16.i.1970, wet sclerophyll; ANIC (ex. Berl. 999), Wombat Creek, 6 km NE Piccadilly Circus, 35°19'S 148°51'E, 750 m, JFL, T. Weir and M.-L. Johnson, 30.vi.1984, open forest; ANIC (ex. Berl. 1001), Piccadilly Circus, 35°22'S 148°48'E, 1240 m, JFL, T. Weir and M.-L. Johnson, 30.vi.1984, subalpine eucalypt litter; ANIC (ex. Berl. 1000), Blundells Creek, 3 km E Piccadilly Circus, 35°22'S 148°50'E, 850 m, JFL, T. Weir and M.-L. Johnson, 30.vi.1984, open forest; ANIC (ex. Berl. 821), Brindabella Range, Franklin Rd, N end Moonlight Hollow, 2 km SW Bulls Head, 35°24'S 148°48'E, M.S. Harvey and R.J. Moran, 3.iv.1983; ANIC (ex. Berl. 926), Ginini Flat, 2 km NE Mt Ginini, 35°31'S 148°46'E, 1580 m, L. Hill, 20.viii.1983; ANIC (ex. Berl. 659), Mt Ginini, 35°32'S 148°46'E, 1660 m, JFL and T. Weir, 16.x.1979; ANIC (ex. Berl. 1068), 1 km S Mt Ginini, 35°33'S 148°46'E, JFL, 11.xi.1986; ANIC (ex. Berl. 704, 705), 1 km N Mt Gingera, 35°33'S 148°47'E, A.A. Calder, 18.ii.1981; ANIC (ex. Berl. 26), Mt Gingera, 35°34'S 148°47'E, c. 5500 ft., E.B. Britton, 13.iv.1967, wet sclerophyll; ANIC (ex. Berl. 50), Mt Gingera, summit, E.B. Britton and Misco, 19.vii.1967; ANIC (ex. Berl. 661), Mt Gingera, E.C. Zimmerman, 20.xi.1979; ANIC (ex. Berl. 830, 831), Mt Gingera, 1620-1700 m, L. Hill, 6.iii.1982; ANIC (ex. Berl. 1084), Snowy Flat Creek, 0.5 km NE Mt Gingera, 35°35'S 148°47'E, A.A. Calder, 28.vi.1988.

VIC: ANIC (ex. Berl. 1045), Cobb Hill, 14 km SE Bonang, Goonmirk Ra, 37°18'S 148°50'E, JFL and N. Lawrence, 24.xi.1985.

LORD HOWE ISLAND: AM KS 35592, NE area of Mt Gower summit, moss forest near campsite, 31°35.2'S 159°04.7'E, 855 m, M.R. Gray, 12-15.ii.1971; AM KS 35589, creek crossing above Boat Harbour, 31°33.5'"S 159°05.5'E, 60 m, M.R. Gray, 8.ii.1971; AM KS 82998, female (Figs. 6h, 8a, d, f, g), KS 82999, male (Figs. 6k, l, o, 7g, m, 8c, h, m), KS 83000, male (Figs. 6m, n, 7c, e, f, i), west end of Mt Gower summit on south edge, 31°35.32'S 159°04.2'E, I. Hutton, 15.v.2001; AM KS 84206-84233, additional localities/samples on Mt Gower, AM KS 84234-84237, four localities on Mt Lidgbird, I. Hutton and CBCR, 2000-2002; AM KS 84238, North Hummock, trail to Intermediate Hill, 31°32'54"S 159°04'58"E, CBCR, 3.xii.2000, mixed rf; AM KS 84239, western slope of Malabar Ridge, 31°30'57"S 159°03'31"E, CBCR, 24.xi.2000, broad megaphyllous closed sclerophyll forest; AM KS 84240, Transit Hill, 31°32'01"S 159°04'40"E, I. Hutton, 14.iv.2002; AM KS 84241, Little Island, below Far Flats, 31°34'08"S 159°04'32"E, I. Hutton, 10.viii.2001, under *Ficus* *columnaris*.

Description

Length (anterior margin of head shield to telson) up to 6.6 mm; length of head shield up to 0.7 mm; leg 15 33-40% length of body. Colour: head shield and maxillipede pale orange; antenna and most tergites orange-yellow, T14 and tergite of intermediate segment deeper orange; legs 1-13 pale yellow to pale orange, legs 14 and 15 may be deeper orange.

Head shield (Fig. 5a) smooth, of equal length and width, slightly wider than T1, median notch contributing to biconvex anterior margin; longitudinal median furrow incised to transverse suture, about one-third length of head shield; posterior two-thirds of region distal to antennocellar suture desclerotised; setae on head shield arranged with bilateral symmetry, four larger pairs anterior to antennocellar suture, ten pairs behind suture, including four evenly spaced submarginal pairs; head shield lacking posterior and lateral borders.

Antenna 27-32% length of body, 2.5-3.3 times length of head shield, composed of 14 or (usually) 15 articles; basal two articles enlarged, most articles in distal half moniliform, sclerotised part generally of subequal length and width; ultimate article about twice length of penultimate. Basal article bearing about a dozen sensilla microtrichoidea proximally on dorsal side (Fig. 6a). Trichoid sensilla arranged in three whorls per article; one or occasionally two curved,

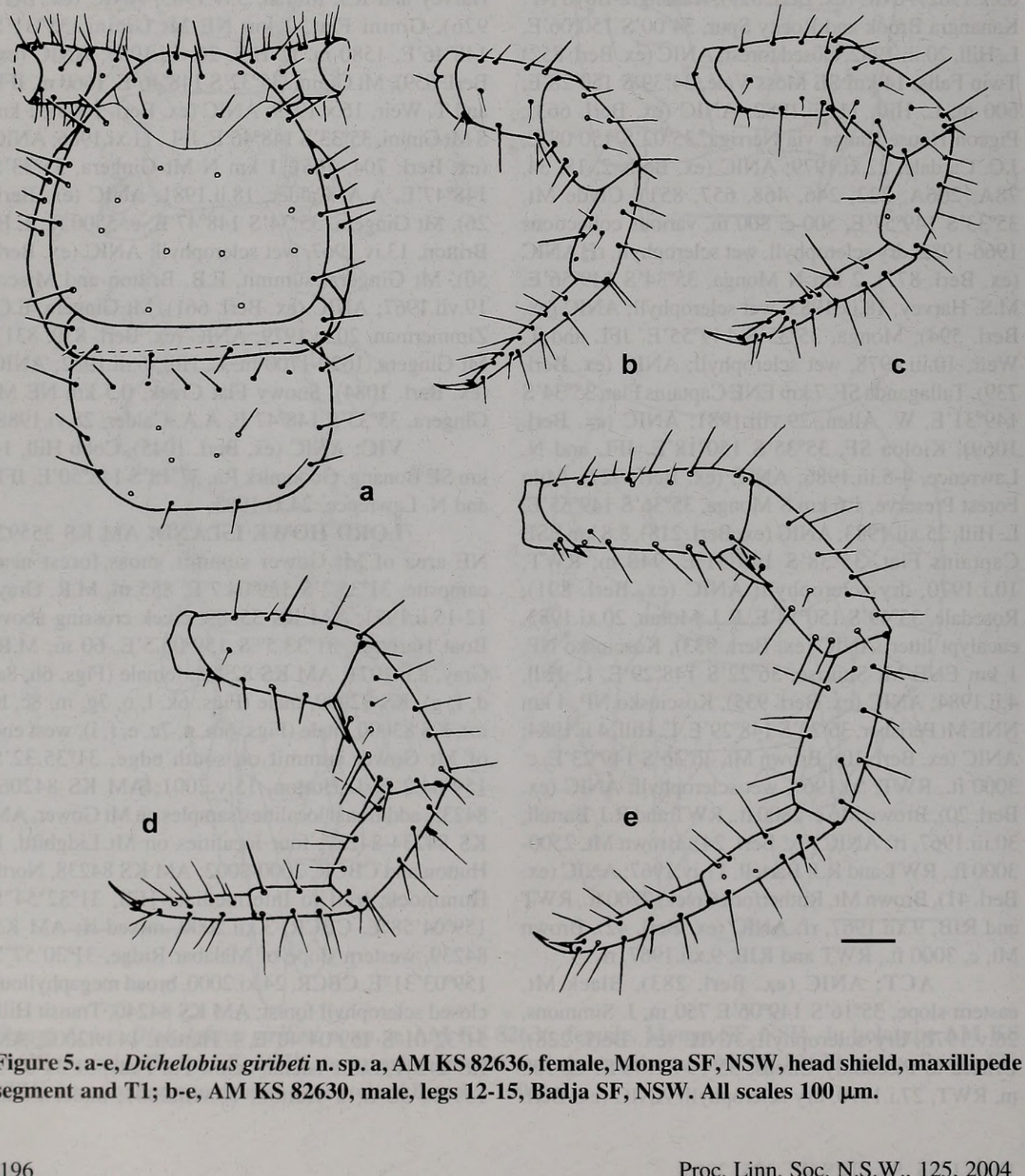

Figure 5. a-e, *Dichelobius giribeti* n. sp. a, AM KS 82636, female, Monga SF, NSW, head shield, maxillipede segment and T1; b-e, AM KS 82630, male, legs 12-15, Badja SF, NSW. All scales 100 µm.

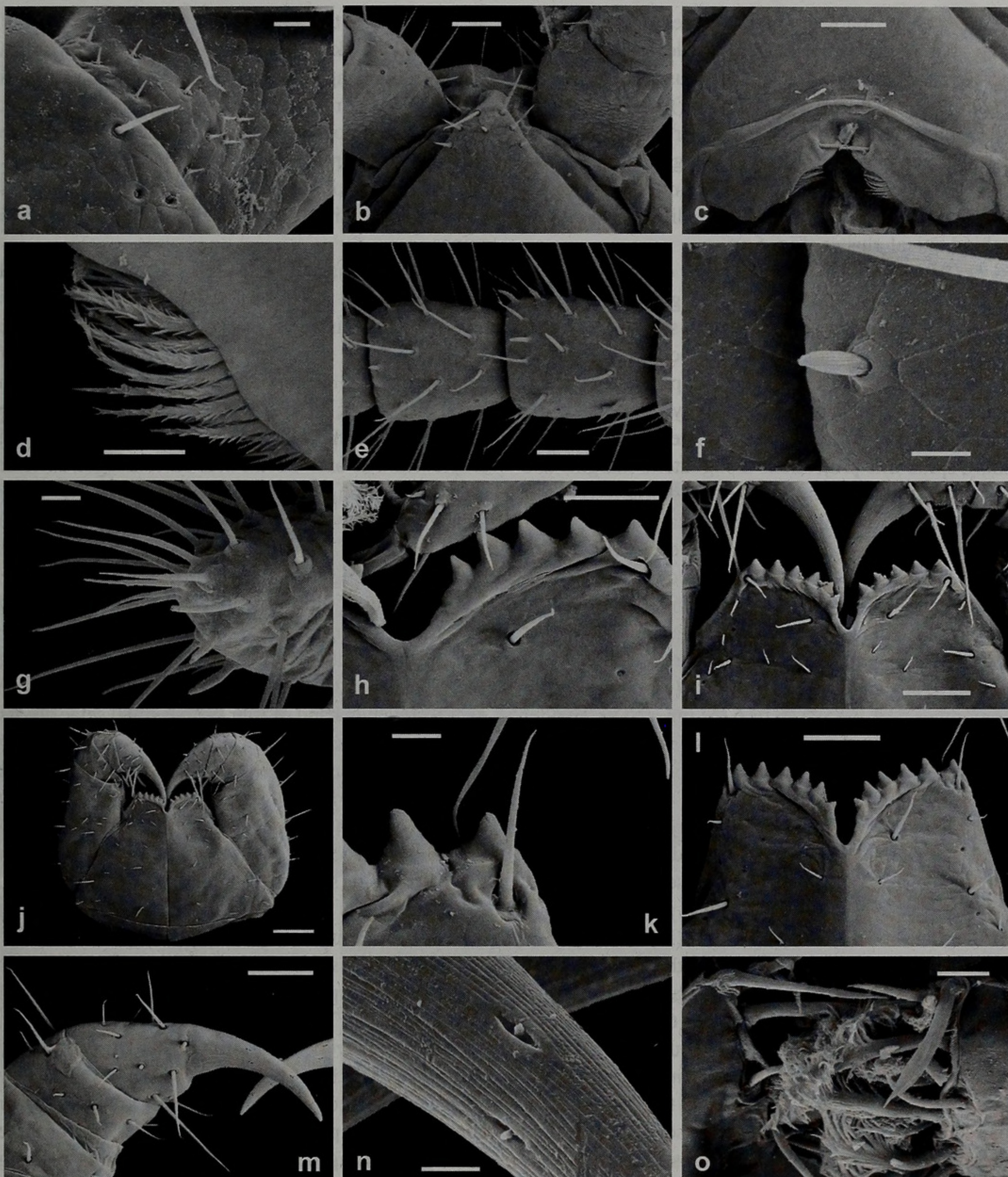

Figure 6. ***Dichelobius giribeti*** **n. sp. Scanning electron micrographs. a-g, Badja SF, NSW; h, k-o, Mt Gower, Lord Howe Island; i, j, Monga SF, NSW. a-g, AM KS 82631, female. a, cluster of sensilla microtrichoidea on proximal part of antenna, dorsal side, scale 10 μm; b, clypeus, scale 50 μm; c, posterior part of clypeus and labrum, scale 50 μm; d, labral margin, scale 10 μm; e, antennal articles 10-13, dorsal side, scale 30 μm; f, basiconic sensillum at anterior edge of antennal article 12, dorsal side, scale 5 μm; g, tip of terminal antennal article, scale 10 μm. h, AM KS 82998, female, dental margin of maxillipede, scales 100 μm, 30 μm. i, j, AM KS 82638, male, dental margin and ventral view of maxillipede, scales 50 μm, 100 μm. k, l, o, AM KS 82999, male. k, porodont, scale 10 μm. l, dental margin of maxillipede, scale 50 μm. o, anterior angle of telopodite of first maxilla, scale 10 μm. m, n, AM KS 83000, male, telopodite of maxillipede and detail of tarsungulum, showing sensilla coeloconica, scales 50 μm, 5 μm.**

digitiform sensilla near anterior edge on dorsomedial side of a few, variable antennal articles (Fig. 6e); four or five articles with a single, short, fusiform sensillum at anterior edge on dorsal side (Fig. 6f), most consistent on articles 11, 12 and 14; digitiform and fusiform sensilla sometimes cooccur on a single article (article 7 or 9); ultimate article with cluster of 8 or 9 trichoid sensilla at apex, one or two curved, digitiform sensilla behind apical cluster (Fig. 6g).

Clypeus with apical cluster of three setae on ventral side near lateral margin, single seta medially (Fig. 6b); transverse band of four setae in front of labrum, outer pair slightly to distinctly smaller than inner (Fig. 6c); transverse seta projecting from sidepiece; labral margin moderately concave where cluster of 7-13 bristles projects; bristles with numerous short, spine-like projections along lateral margins and on ventral surface along their lengths (Fig. 6d). Tömösváry organ large, longitudinally ovate, outer edge at lateral margin of cephalic pleurite (Fig. 8k).

Maxillipede (Figs 6h-n): coxosternal width across dental margin 39-44% maximum width; lateral margin flexed inward at base of dental projections and less convergent than against posterior part; each dental margin convex, usually with 5+5, 4+5 or 5+4 teeth, sometimes 4+4, 6+5, 5+6 or 6+6; inner tooth smaller than others, its apex well posterior to base of outer tooth; median notch varying from broadly V-shaped (Fig. 6h) to deeply parabolic (Fig. 6l); porodont of similar length and thickness to largest coxosternal setae, its socket at posterolateral edge of outermost tooth (Fig. 6k); setae relatively sparsely, fairly evenly scattered on coxosternite; tarsal and pretarsal parts of tarsungulum of about equal length (Fig. 6m). Dorsal and ventral sides of tarsungulum with several sensilla coeloconica (Fig. 6n). Bands of pleural collar separated by longitudinal median suture (Fig. 6j).

Mandible: Six curved aciculae (Fig. 7j), all with many (up to 18) short, blunt denticles along both margins (Fig. 7i) on distal half to two-thirds. Four paired teeth, dorsal three with accessory denticle field delimited by deep groove; dorsalmost tooth and basal part of second and third teeth composed of densely tuberculate rhomboid and polygonal scales (Fig. 7l), becoming denticulate near furry pad (Fig. 7m). Fringe of branching bristles terminates against dorsalmost acicula (Fig. 7f); ventralmost bristles in fringe with flattened bases lacking spines, distal two-thirds with short spines along both margins and on outer face; bristles multifurcating at their distal tips, with three or four spines that are longer and thicker than those more proximally (Figs 7f, k); more dorsal bristles gradually become more uniformly spinose to their broader bases, with more numerous distal spines (Fig. 7k), grading into wide scales that form a nearly continuous double-fringe of hair-like spines, each scale composed of a narrow outer fringe and a wider inner fringe, each with 12-15 spines per scale (Fig. 7l); fringe terminates at edge of dorsalmost tooth, against a large, smooth scale that separates dentate lamina from furry pad (Fig. 7m). Furry pad composed of a few scales with distal spines and cluster of six or seven mostly simple, elongate spines.

First maxilla: sternite indistinctly delimited from coxa (Fig. 7a), short, wide. Coxal projections tapering, with rounded apex bearing four or five simple setae; one small seta along inner margin near base of coxal projection. Telopodite strongly delimited from coxal projection; basal article of telopodite with single marginal seta anterolaterally or lacking setae; distal article with one or two setae near outer margin, anterior angle terminating as a long, stout spine; entire inner margin fringed with row of six or seven plumose setae (Fig. 7b), paired in posterior part of row, with slender branchings along more than half of their length (Fig. 7c); five shorter simple setae inserting near bases of plumose setae on ventral side; anterior plumose setae fringed on dorsal side by a few elongate spines.

Second maxilla: anterior margin of coxa gently concave; band of four or five small setae across anterior part of coxa. Inner edge of tarsus with a row of five or six brush-like setae with abundant, slender branchings nearly to their bases (Fig. 7d, h). Claw composed of up to five digits with concave, scoop-like inner surfaces (Fig. 7g); large, curved medial digit with furrows or sutures running along its length (Fig. 7e); outer digits shorter, separated from medial digit by a slender, spine-like digit.

Tergites smooth, all with rounded posterior angles, lacking projections; T1 about 85% width of widest tergite (TT10 or 12). Posterior margins of TT1, 3, 5 and 7 transverse (Fig. 4a); TT8, 10 and 12 gently concave; TT9, 11, 13 and 14 transverse to weakly concave; tergite of intermediate segment transverse or gently concave, posterior angle rounded. Two or three moderately long setae on lateral margins of long tergites, usually with short setae between these; posterior margins of tergites fringed with four to twelve setae, generally more abundant on more posterior segments (maximal number typically on T13); setae on inner part of long tergites include transverse band of up to six setae across anterior third, two or three pairs in two bands behind this.

Legs 12-15 (Fig. 5b-e) with length ratios 1: 1.1 : 1.3-1.4 : 1.7. Leg 15 basitarsus 85-115% length of distitarsus (Fig. 5e); basitarsus 70-75% length of tibia; tibia 2.9-3.4 times longer than maximal width, basitarsus 3.4-4 times, distitarsus 5.2-5.7 times.

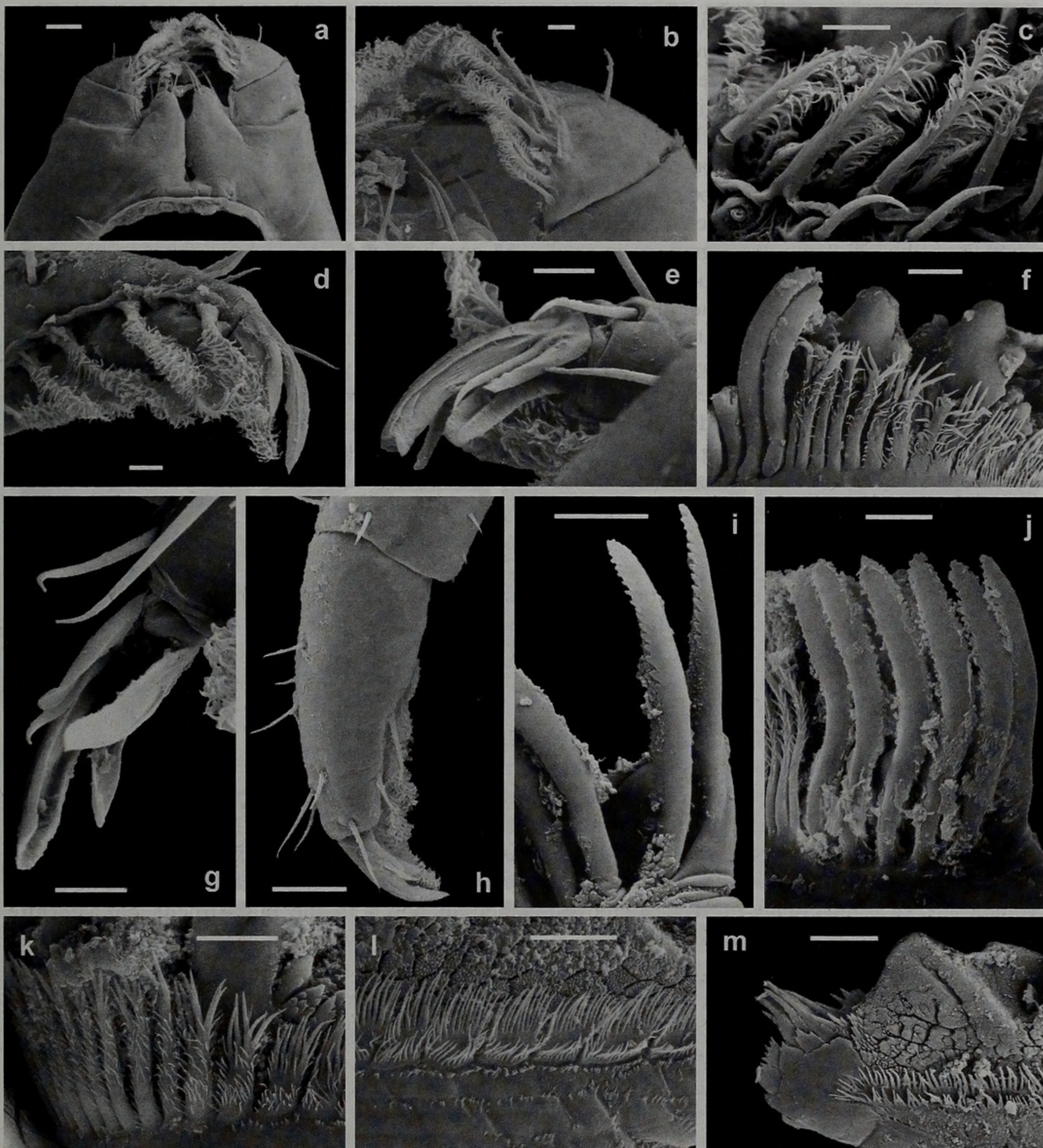

Figure 7. *Dichelobius giribeti* n. sp. Scanning electron micrographs. Scales 10 µm except where indicated. a, b, d, h, j-l, AM KS 82631, female, Badja SF, NSW; c, e-g, i, m, Mt Gower, Lord Howe Island. a, ventral view of first maxillae, scale 50 µm; b, distal article of telopodite of first maxilla; d, h, tarsus and claw of second maxilla, scales 10 µm, 30 µm; j, aciculae; k, l, ventral and dorsal parts of fringe of branching bristles on mandible. c, e, f, i, AM KS 83000, male. c, plumose setae on inner margin of telopodite of first maxilla; e, claw of second maxilla; f, aciculae and fringe of branching bristles on mandible; i, aciculae. g, m, AM KS 82999, male. g, claw of second maxilla, scale 10 µm; m, dorsalmost tooth of mandible and furry pad.

Basitarsus 90% length of distitarsus on leg 14 (Fig. 5d). Coxal projections on leg 15 tapering (in ventral view) at about 25-30 degrees; terminal spine with distinct (Fig. 8e) or indistinct (Fig. 8i) basal joint, its surface with fine longitudinal grooves and ridges like those on pretarsal claws. Trochanter of leg 15 with small ventrodistal spur (Figs 5e, 8h). Prefemur of legs 14 and 15 with large ventrodistal spur; leg 15 spur with basal width about 25% maximum width of prefemur (Fig. 4b). Sharp distal spinose projections on tibiae of legs 1-11, absent on legs 12-15. Two tarsomeres of leg 13 defined by distinct constriction in width and weak articulation without flexure; articulation between tarsomeres stronger on leg 14. Setae fairly evenly distributed on all podomeres along leg, tarsal setae only slightly more slender than those on prefemur-tibia; proximo-distal gradient in setal thickness enhanced on legs 14 and, especially, 15, with distinctly thickened prefemoral setae, including on dorsal side of leg. Anterior and posterior accessory claws present on all legs, 25-40% length of main claw (Fig. 8a, b); accessory claws with closely-spaced linear ridges on their surface except for pitted proximoventral part separated by a shallow suture (Fig. 8c). Main claw curved, subdivided by sutures; deepest sutures define an elongate scute on both lateral sides of claw, proximal end of this scute at about distal end of shorter accessory claw; large pore or pair of pores at proximal end of scute on both sides of leg (Fig. 8c); strong suture extends from lateral pore across ventral surface of main claw (Fig. 8d), defining proximal end of an elongate, triangular ventral scute (Fig. 8g). Proximal part of main claw densely pitted; on ventral side of claw, ornament changes abruptly at suture delimiting lateral scute, becoming linear grooves and ridges as on accessory claws (Fig. 8d), with these lineations well developed on lateral scute and along length of claw on dorsal side; change from pitted to linear ornament gradual on dorsal side of claw, with pits irregular proximally, becoming aligned as rows of pits, then linear grooves. Pair of distally-directed spines proximoventrally, at distal end of a curved suture (Fig. 8d); larger spine not more than not more than one-eighth length of main claw, with tiny subsidiary spine at its base (Fig. 8b).

Coxal pores: on legs 14 and 15; 2,2/2,2 in females (Fig. 4b), 1,1/1,1 in small males, either 1,1/1,1 or 2,2/2,2 (Fig. 4c) in large males, occasionally one and two pores on opposing sides of either leg or 1,2/1,2; pores round, separated by less than their diameter when paired; inner pore often smaller than outer pore in male, inner pore sometimes larger than outer pore in female.

Female (Fig. 4b): Sternite of segment 15 gently convex posteromedially, fringed by a submarginal setal band that extends along entire posterolateral and posterior margin; several setae scattered on inner part of sternite. Posterior margin of first genital sternite moderately embayed between gonopod articulations, sternite bearing 6-11 setae. Gonopod with pair of spurs at terminus of a short (Fig. 8n) to moderately long (Fig. 8e, f) projection; bases of spurs nearly touching each other; inner spur substantially shorter and narrower than outer spur, both bullet-shaped, pointed (Fig. 8n); four or five setae on basal article of gonopod, three large setae on second article, one large seta on third (Fig. 8j); second and third articles variably with one and two smaller setae, respectively, on ventromedial face (Fig. 8n); claw simple.

Male (Fig. 4c): Posterior margin of sternite 15 evenly convex; 10-13 setae fringing margin of sternite, 10-12 additional setae scattered over its ventral surface; first genital sternite entire medially, bearing 6-12 setae aligned in two imprecisely-defined transverse rows; gonopod bearing two or three setae on first article, two on second article, none or one on third article, which grades into long, flagelliform terminal process, up to 80% length of rest of gonopod (Fig. 8l); terminal process bearing numerous slender spines proximally (Fig. 8m).

Larvae: five larval stadia (ANIC Berl. 18 and 231) identified as L0-LIV by comparison to limb development in other Lithobiomorpha (Table 1). LI with 11 antennal articles; LII-LIV all with 14 articles. LII and LIII with 2+2 teeth on dental margin of maxillipede; LIV with 3+3 teeth.

Discussion

Specimens from Lord Howe Island resemble those from the Australian mainland in all meristic characters and in fine detail. Intrapopulation variation is observed with respect to the number of teeth on the maxillipede coxosternal margin, the depth of the median notch in the maxillipede coxosternite (relatively shallow in Fig. 6h, relatively deep in Fig. 6l), the concavity of the posterior margins of the short tergites, and the length of the spur-bearing process on the female gonopod. Samples vary in the frequency with which large males have either one or two coxal pores on legs 14 and 15 (usually two in Lord Howe specimens versus one in the large sample from Clyde Mountain, NSW, but also two in large specimens from the type locality and in the Brindabella Range, e.g., Piccadilly Circus, Mt Gingera and Mt Ginini).

Distinction from other congeners is indicated in key above. *Dichelobius relictus* and *D. giribeti* are consistently distinguished by the presence of a spiracle on segment 14 in the former, and *D. relictus* is generally a deeper brown colour. The two species share minute details of mandibular and maxillary structure, indeed to the extent that description of the mouthparts for *D. giribeti* serves for *D. relictus* as well.

The early larval stadia of *Dichelobius giribeti* differ in detail from those of Lithobiidae and Henicopinae (see Table 1) with respect to limb development. Segmentation of L0 is matched by

Figure 8. ***Dichelobius giribeti*** **n. sp. Scanning electron micrographs. a, c, d, f-h, m, Mt Gower, Lord Howe Island; b, e, Monga SF, NSW; i-l, n, Badja SF, NSW. a, d, f, g, AM KS 82998, female. a, pretarsus of leg 14, scale 10 µm. d, g, ventral views of pretarsus of leg 14, scales 10 µm; f, gonopods, scale 30 µm. b, e, AM KS 82637, female. b, pretarsus of leg 14, posterior view, scale 10 µm; e, ventrolateral view of first genital sternite and gonopods, scale 100 µm. c, h, m, AM KS 82999, male. c, pretarsus of leg 15, detail of anterior accessory claw, scale 5 µm; h, prefemur of leg 15, anterior side, scale 100 µm; m, terminal process on gonopod, scale 10 µm. i, j, n, AM KS 82632, female. i, leg 15 coxal process, scale 30 µm; j, n, lateral and ventral views of gonopod, scales 50 µm, 10 µm. k, AM KS 82631, female, cephalic pleurite with Tömösváry organ, scale 50 µm. l, AM KS 82633, male, gonopod, scale 30 µm.**

Table 1. Comparison of limb development in larval stadia of Lithobiomorpha. Modified from Andersson (1979:Table II), adding data for *Dichelobius giribeti*.

	Lamyctes emarginatus Lithobius 8 spp.			*Lamyctes coeculus*			*Dichelobius giribeti*		
	Pairs of			Pairs of			Pairs of		
Stadium	Legs	half-developed legs	Limb-buds	Legs	half-developed legs	Limb-buds	Legs	half-developed legs	Limb-buds
LO	7	——	1 large	6	——	2 large	6	——	2 large
LI	7	1	2 small	6	2	——	6	2	2
LII	8	——	2	8	——	2	8	——	2
LIII	10	——	2	10	——	2	10	——	2
LIV	12	——	3	12	——	3	12	——	3

Lamyctes coeculus, but larval stadium LI has a unique combination of half-developed legs and limb-buds in *D. giribeti*. Segmentation of stadia LII-IV is as in other lithobiomorphs. Four larval stadia identified by Eason (1993) for *Anopsobius macfaydeni* have seven, eight, ten and twelve pairs of legs, the last three obviously being LII-LIV. The taxonomic significance of the distinction between six- and seven-legged first larval stages in *Dichelobius giribeti* and *Anopsobius macfaydeni* is unclear without additional data for Anopsobiinae.

Dichelobius bicuspis Ribaut, 1923

Dichelobius bicuspis Ribaut, 1923:24, Figs. 27-34.
Dichelobius bicuspis: Würmli, 1974:526.

Material

NEW CALEDONIA: PROV. NORD: AM KS 83001, 1 female, 1 male, Mt Panié, nr summit, 20°34'S 164°46'E, 1500 m, C. Burwell, 9.xi.2001, rf; MNHN, 1 female, 1 larval stadium LIV, Mt Panié, 20°34'53"S 164°45'38"E, 1350 m, J. Chazeau, A. & S. Tillier, 18.xi.1986, wet *Agathis* forest; QM S60653, 1 female, Pic d'Amoa, N slopes, 20°58'S 165°17'E, 500 m, GBM, 10.xi.2001, rf; QM S60654, 1 male, Me Maoya, summit plateau, 21°12'S 165°20'E, 1400 m, GBM, 12.xi.2002, rf. PROV. SUD: MNHN, 3 females, Mt Do, 21°45'37"S 165°59'33"E, 840 m, A. & S. Tillier & Monniot, 2.iv.1987, wet *Araucaria* forest; QM S60655, 1 male, Mt Humboldt refuge, 21°53'S 166°24'E, 1300 m, GBM, 7-8.xi.2002, rf; AM KS 83002, 1 male, R Bleue, Pourina Track, 22°04'S 166°38'E, 900 m, GBM, 18.xi.2001, rf; AM KS 83003, 1 male, Mt Ouin, 22°01'S 166°28'E, 1100 m, GBM, 9.xi.2002, rf; AM KS 83004, 1 female, 1 male, QM S60656, 1 male, Mt Mou base, 22°05'S 166°22'E, 200 m, GBM, 30.x.2001, 15.xi.2001, rf; MNHN, 3 females, 1 juvenile, Rivière Bleue, 22°06'13"S 166°39'16"E, 160 m, A. & S. Tillier, 1.viii.1986-30.iv.1987; QM S60657, 1 male, Mt Koghis, 22°11'S 166°01'E, 750 m, GBM, 29.xi.2000, rf; AM KS 83005, 1 female, Yahoué, 22°12'S 166°30'E, 100 m, GBM, 4.xi.2001, rf.

Remarks

Dichelobius bicuspis was based on a few specimens from Mt Humboldt (the type locality) and Mt Canala, New Caledonia, with Würmli (1974) adding a record at Nékliai. New collections are listed above to indicate that the species has a more widespread distribution.

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