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Maamingidae, a new family of proctotrupoid wasp (Insecta : Hymenoptera) from New Zealand

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Abstract. The new family Maamingidae is proposed for *Maaminga*, gen. nov., comprising two species, *M. rangi*, sp. nov. and *M. marrisi*, sp. nov., from New Zealand. The delicate and slender *M. rangi*, sp. nov. is common in forest, particularly kauri forests of the northern part of the North Island. The more robust and stocky *M. marrisi*, sp. nov., which is polymorphic for wing size (brachyterous and fully winged), appears to be associated with coastal scrub and forest, particularly on offshore islands, but is also found in alpine snow tussock. Maamingidae is nominally placed within the Proctotrupeoidea, and is probably related to the Diapriidae and Monomachidae. However, its relationships are unclear, at least in part due to the lack of phylogenetic resolution among the proctotrupoid families and other Proctotrupomorpha *sensu* Rasnitsyn. The relationships of Maamingidae are briefly discussed in the light of current morphological and molecular phylogenetic hypotheses.

Introduction

The recognition of new family level taxa among terrestrial arthropods has been an uncommon event over the last 40–50 years, given that the majority of families are morphologically distinct and were mostly diagnosed using modern concepts by the middle of the twentieth century. However, there are exceptions to this situation. For terrestrial arthropods, the largest number of new families have undoubtedly been described for the Acarina, with at least five new families diagnosed for Australia and New Zealand in the last few years (*viz.* Acucapitidae, Eriorhynchidae, Heatherellidae, Pezidae, Yurebillidae) and several more from other regions of the world (M. S. Harvey personal communication). This has largely occurred because of accelerated interest in this group and the discovery of many new taxa using refined collected techniques.

Among the insects there have been far fewer new family level taxa recognised. Two notable recent additions to the Australian fauna based on previously undescribed species are the Cooloolidae (Orthoptera) (Rentz 1980, 1986) and Rhinorhipidae (Coleoptera) (Lawrence 1988). In comparison to the other major groups of insects the largest number of new families has been described for the

Hymenoptera. These include: three families of Proctotrupeoidea, the Austroniidae (Rasnitsyn 1975; Kozlov 1981) and Peradeniidae from south-eastern Australia (Naumann and Masner 1985) and Renyxidae from the eastern Palaearctic (Kozlov 1994), the chalcidoid family Rotoitidae from New Zealand and Chile (Boucek and Noyes 1987; Noyes and Valentine 1989; Gibson and Huber 2000); the cynipoid group Austrocynipidae from Australia (Riek 1971; Ronquist 1995); and the ichneumonoid family Paxylommatidae from the Holarctic (Mason 1981), the latter now being considered a subfamily of Ichneumonidae (Sharkey and Wahl 1992).

Notably, four of these six new families of Hymenoptera (Austroniidae, Peradeniidae, Austrocynipidae, Rotoitidae) are apparently restricted to temperate parts of Gondwanaland, and three are members of the Proctotrupeoidea. Here we describe another new family of proctotrupoid wasp, which is apparently endemic to New Zealand and, therefore, is also restricted to part of Gondwanaland. The recognition of this new family also serves to highlight the uniqueness of the New Zealand hymenopteran fauna. Significantly, this fauna has a higher proportion of reduced-winged species, a distinct paucity of sawflies and aculeates, and a disproportionate number of

Diapriidae and Mymaridae relative to other families (Austin 1988; Naumann 1988; Berry in press).

The new family is based on two previously undescribed species, the head, mesosoma and wings of which indicate similarities with the Diapriidae (and possibly the Monomachidae). However, the construction of the petiole and metasoma are unlike those of any known diapriids or other proctotrupoid families, and it shows none of the synapomorphies of other apocritan superfamilies. The new genus *Maaminga* and family Maamingidae are erected to accommodate these species. Information is presented on their distribution and apparent habitat preferences, but their host biology remains unknown. The possible relationships of Maamingidae are discussed in the light of current morphological and molecular phylogenetic hypotheses, which indicate that the Proctotrupeoidea as recently defined (e.g. Naumann and Masner 1985; Masner 1993, 1995) is not a monophyletic assemblage.

Materials and methods

Specimens for SEM were first washed in concentrated detergent, dehydrated in an alcohol series, air-dried and coated with palladium. They were then examined under a Phillips XL30SEG scanning electron microscope at an accelerating voltage of 5–25 kV. Terminology for morphology and wing venation is largely that used by Naumann and Masner (1985) except for the abbreviations 'T' and 'S', which here refer to abdominal tergites and sternites, respectively. Terminology for surface sculpturing follows that proposed by Eady (1968). The two-letter abbreviations for locality data and geographical distribution within New Zealand follow Crosby *et al.* (1976). Acronyms for institutions are those in Arnett *et al.* (1997):

AMNZ	Auckland Museum, Auckland, New Zealand
ANIC	Australian National Insect Collection, CSIRO, Canberra, Australia
BMNH	The Natural History Museum, London, UK
CNCI	Canadian National Collection of Insects, Agriculture Canada, Ottawa, Canada
LUNZ	Department of Entomology and Animal Ecology, Lincoln University, Canterbury, New Zealand
MONZ	Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand
NZAC	New Zealand Arthropod Collection, Landcare Research, Auckland, New Zealand
SMNH	Swedish Museum of Natural History, Stockholm, Sweden
UCDA	Bohart Museum, University of California, Davis, USA
USNM	National Museum of Natural History, Washington, DC, USA
WFBM	William F. Barr Museum, University of Idaho, Moscow, Idaho, USA

Family MAAMINGIDAE, fam. nov.

Type genus: *Maaminga*, gen. nov.

Diagnosis

Antennal formula 13:12 (female: male); antennae inserted on frontal shelf, with large, curved trichoid sensilla, which

are recessed into shallow grooves; palpal formula 2–2. Pronotal neck short. Lateral pronotum subrectangular and striate, separated from mesopleuron by membranous area. Macropterous or brachypterous. Fore wing lacking vein C; costal cell open and narrow; postmarginal vein long. Hind wing narrow; submarginal vein complete; basal vein absent. Tibial spur formula 1–2–2. Petiole inserted low on propodeum, small. Syntergite and synsternite absent. Spiracle present on T8, cercus on T9.

Description

Female

Body and pubescence. Predominantly smooth, non-metallic, generally rather weakly sclerotised and brown to pale yellow. Macropterous or brachypterous. Vertex with sparse, long, anteriorly directed setae; frons glabrous; face with short setae. Anterior scutum with long, sparse, posteriorly directed setae, which continue down lateral margins and notauli, otherwise glabrous; scutellum glabrous medially, with fine, short setae laterally; propodeum glabrous anteriorly, with fine, short setae posteriorly; lateral pronotum and mesopleuron largely glabrous. Anterior lateral corners of metasoma setose, tergites largely glabrous except for posterolateral margins; posterior margins of sternites and hypopygium (female) more densely setose than tergites.

Head (Figs 5, 6). In dorsal view approximately as wide or somewhat wider (48:35) than long. Hypognathous: occipital carina absent. Post-occiput not defined. Genal carina not extending dorsally beyond extremity of oral fossa. Oral fossa and foramen magnum separated by small, transverse sclerite. Postgenal bridge absent. OD less than OOL. Antennal sockets mid-face to slightly below mid-face, widely separated from distinct fronto-clypeal suture, not overhung by frontal lamella, situated on distinct prominence and opening dorsally; inner margins of sockets produced dorsally to form arch-like septum. Frons without grooves for reception of A1 or grooves connecting antennal sockets to anterior tentorial pits. Anterior tentorial pits distinct. Compound eye moderate sized, suboval, inner orbits convex, outer orbits straighter, inner orbits not strongly convergent ventrally. Clypeus well developed, wider than long. Malar space broad, equal to or slightly greater than basal width of mandible. Subocular suture prominent, complete. Labrum transverse, ribbon-like, weakly arched dorsally. Mandible distinctly tapering, dorsal and ventral edges carinate, endodont, bidentate with upper tooth slightly longer than lower tooth and slightly overlapping opposite mandible; with sharp, longitudinal inner carina connecting base with lower tooth. Maxillary palp 2-segmented. Labial palp 2-segmented.

Antennae (Figs 4, 16). Long, slender, 13-segmented. A1 long, cylindrical, approximately 5–10 times longer than wide; apically slightly enclosing A2 externally, emarginate

internally permitting reflex of A2, side flanges moderately developed. Anellus absent. A3–A13 without carinae, emarginations or smooth surfaces; more distal segments with one surface slightly flattened but these segments at most only very slightly expanded; setae generally short, dense, felt-like; curved trichoid sensilla large, distinct, recessed into shallow grooves, absent from flattened surfaces; basiconic and placode (multiporous plate) sensilla absent.

Mesosoma (Figs 2, 6–8). Higher than wide, short relative to head and metasoma. Pronotum without acute, re-entrant declivity; posterolateral corner reaching tegula; posterior margin deeply concave, not broadly overlapping or in the same plane as mesoscutum; medially short, almost or completely vertical; epomia strong; lateral panel concave, with striate microsculpture; lateral panel flexibly connected to anterior margin of mesopleuron by broad membranous area. Spiracle situated behind pronotum, just below level of tegula. Prepectus absent. Cervical sclerites absent. Propleura middorsally separated by membrane, posteroventrally extending between fore coxae. Mesoscutum strongly vaulted; with percurrent, parallel or subparallel notauli; lateral margins posteriorly convergent; anteromedially without transverse, postmarginal carina; skaphion absent; parapsidal lines absent. Transscutal suture complete, straight. Mesoscutellum longer than wide, anteromedially with weak depression; axillar pit large, well defined, longer than wide; axilla not produced into hook or spine; disc rectangular, posteromedially with a semi-lunar, lens-shaped or subrectangular smooth area enclosed by transverse, more-or-less crescent-shaped, dark, subcuticular line, carina or crenulate groove. Mesopleuron higher than long, strongly expanded ventrally; acetabular carina and sternaulus both absent; with oblique dark, subcuticular line running from below mid point of anterior margin to mid point of posterior margin; mesepimeron weakly indicated, without line of pits. Metapleuron triangular; indicated by dark, subcuticular line. Metanotum represented by smooth, transverse band; dorsellum absent. Propodeum short, almost vertical, smooth, without carinae or areolae; nucha not differentiated; spiracle small, circular, simple, without prominent rim or carinae, separated from metanotum by approximately its own diameter; petiolar foramen circular, without adjacent processes or flanges and positioned low, in part between hind coxae.

Wings, macropterous form (Figs 1, 19). Fore wing very large, much longer than body; hind wing slender, especially basal 0.3. Marginal fringes well developed. Discal setae well developed, moderately dense, uniformly distributed, except sparser at extreme base. Fore wing with row of modified erect setae opposing distal hamuli. Vein C absent; costal cell open anteriorly; submarginal vein (Sc+R) tubular over most of its length, nebulous for short length immediately basad of junction with basal vein, thickened and very darkly pigmented over parastigmal intercept; basal vein (Rs+M)

tubular, very darkly pigmented, curved, becoming nebulous nearer anal margin; marginal vein long, linear, subequal to intercept of submarginal vein basad of basal vein, tubular, radial component sometimes discernible slightly remote from costal margin; postmarginal vein long, longer than marginal and extending well beyond apex of radial cell; stigmal vein slender, perpendicular to marginal, ending in triangular area with line of 4–6 clear circular spots; Rs spectral but indicating radial cell, not forked; M and Cu1 spectral with folds along these lines of pigmentation. Hind wing elongate and narrow, basal half forming a stalk; hind margin of apical half with fringe of long setae, setae longer than wing width; submarginal vein tubular and complete.

Wings, brachypterous form (Fig. 18). Fore wing shorter than body, reaching almost to tip of metasoma; rounded to slightly acuminate apically. Fore wing as for macropterous form but postmarginal vein never longer than marginal and apically swollen/thickened; stigmal vein obliquely angled to marginal, short, broad and triangular in shape; Rs spectral and indicating the posterior margin of a small radial cell; M and Cu1 barely indicated by weak pigmentation. Hind wing as for macropterous form.

Legs. Fore coxa widely separated from mid coxa; mid coxa close to hind coxa. Trochantellus present on all legs. Tibial spur formula 1–2–2; foretibial spur slightly curved, bifid; hind tibia not grossly swollen distally. Tarsal formula 5–5–5, basitarsus the longest; tarsal claws simple, not pectinate; with single orbicular type A sensilla trichodea, type B trichodea in single row.

Metasoma (Figs 9–11, 14). Abdominal segment 2 (petiole) strongly reduced, largely concealed by segment 3. T2 and S2 fused to form petiole; suture between tergite and sternite not visible. Petiole an obliquely, strongly truncate cylinder, anterodorsally forming narrow, transverse bridge with thickened, raised, extreme anterior margin; posterior to bridge with prominent dorsolateral spine on each side, these abutting propodeum adjacent to foramen when metasoma flexed dorsally; bridge separated from anterior margin of T3 by triangular or subcircular membranous region (Fig. 9); posteroventrally forming tapering process fused to S3 so that no flexion is possible, its margin with S3 indicated by narrow zone of weakening, posteromedially merging with S3 without suture and without overlapping S3 (although petiole readily fractures away from S3 here on dissection; see Figs 10, 11). Syntergite and synsternite absent. T3 transverse, convex, sloping abruptly anteriorly, almost vertical, concealing petiole in dorsal view, not entering petiole, with differentiated median area, each anterolateral corner of median area articulating with petiole by condyle (but little movement possible); median area either broad, trapezium-shaped, wider posteriorly than anteriorly, weakly differentiated from lateral areas or Y-shaped, strongly sclerotised and distinctly differentiated from remainder of tergite; anterolateral extremities of T3 sometimes (*M. rangi*)

hook-shaped, with desclerotised area between median and lateral areas; posterior margin slightly indented. S3 heart-shaped, on each side with internal anterolateral ridge, parallel and adjacent to zone of weakening; anteriorly ridge ending near end point of articulation of T3 on S2, posteriorly ridge giving rise to short apodeme. T4 anteromedially with broadly rounded process, flanked by submedian emarginations; posterior margin straight. Anterior margins of T5 and T6 straight. T3–T9 laterally with prominent, black spot without visible apodeme. T3–T7 without even rudimentary spiracles. T8 with pair of functional spiracles. T9 with straight anterior margin; cercus dome-shaped, with long, suberect setae; posterior margin excavate around each cercus and forming a truncate projection between cerci. T10 not visible. S4–S6 transverse, with straight anterior and posterior margins; anterolateral corner of S4 slightly produced. Apical sternite (hypopygium) plough-shaped, posteriorly very acute. S4–S6 and hypopygium each with a black dot on each side, serially homologous with apodeme of S3 and similar in appearance to dots on tergites. Ovipositor issuing apically, straight, slender, distally setose, slightly longer than hypopygium, its apical 0.3–0.4 extending beyond tip of hypopygium. Fenestra absent. Internal articulation not present within gonocoxite 2. Valvulae absent. Sheaths reaching posterior extremity of dorsal and ventral valves.

Male

Differs from female as follows.

Head. In dorsal view wider than long (37:32, 46:33, 42:30). Frontal prominence weaker.

Antenna (Figs 3, 15). Slender, 12-segmented, proportions of segments different (see species descriptions). Sex segments absent. No segments expanded or flattened. Setae of A3–A12 slightly longer.

Wings, brachypterous form (Fig. 17). Similar to female but fore wing often more rounded at tip.

Metasoma (Figs 12, 13). Anterior margin of T4 either with triangular, median process flanked by deep emarginations or slightly convex. S4–S8 similar, gradually decreasing in size posteriorly. Posterior margin of S9 convex. Paramere slender, tapering, bare except for apical pair of setae. Aedeagus with blunt apex. Parameres and aedeagus separate. Volsellae present, discrete.

History of discovery

Information on the Maamingidae has been published previously in several papers dealing with the fauna of New Zealand. It was first referred to as a 'New family' and illustrated as a half-tone photograph in Grehan (1990), while Early (1995) later describes it as a 'Parasitic wasp, undescribed family' (see under *M. rangi*). There are now numerous other references to 'undescribed proctotrupoid family' or 'undescribed New Zealand family' in recent phylogenetic studies on the Hymenoptera (e.g. Basibuyuk

and Quicke 1997, 1999a; Dowton *et al.* 1997; Basibuyuk *et al.* 2000).

The first specimen of Maamingidae was discovered in the early 1970s by Annette Walker and Errol Valentine of the then Entomology Division of the DSIR, New Zealand, while sorting samples extracted from leaf litter of montane shrubs from Dansey's Pass in the South Island. A second species was collected from North Island forest by S. and J. Peck of Ottawa in 1978. As interest in the New Zealand hymenopteran fauna and the use of specialist collecting techniques developed during the 1980s, so did the number of specimens, until now when both species are known to be abundant.

Distribution

Endemic to New Zealand (Figs 20, 21).

Comments

We have refrained here from including a key to families of Proctorupoidea because this group is arguably not monophyletic and the families previously or currently included in it are not distinguishable by a single character or set of characters. However, in the key to proctotrupoid families by Naumann and Masner (1985), specimens of Maamingidae will run to couplets 8 and 9, depending on how the abdominal/metasomal tergites are counted. Of the three families that come out at these couplets, Maamingidae can be easily separated from Monomachidae and Austroniidae on the shape of the metasoma (among other characters); in addition, these families do not occur in New Zealand. Maamingidae is closest to the third family, Diapriidae, and a detailed discussion and comparison of them is provided below under 'Phylogenetic relationships'.

Maaminga, gen. nov.

Type species: *Maaminga rangi*, sp. nov.

Diagnosis and description

As for family (above).

Etymology

Maaminga is a Maori word, which can mean 'a trickster' and 'mystifying', referring to the puzzling combination of characters that made the initial, superfamily placement of this genus uncertain. Gender to be considered feminine.

Key to species of *Maaminga*

- (1) Macropterous, fore wings 1.4–1.6× as long as body (Fig. 1); antennae longer than body; postmarginal vein long, nearly reaching wing tip at 0.8× length of wing, about twice as long as marginal vein, its abscissa beyond apex of radial vein about twice length of radial cell (Fig. 1); head and body uniformly brown. *M. rangi*, sp. nov.

- (2) Brachypterous or macropterous (Figs 17–19), fore wings 0.6–1.3× as long as body; antennae shorter or subequal in length with body; postmarginal vein not reaching past 0.7× wing length, less than 1.5× as long as marginal vein, its abscissa beyond apex of radial vein about as long as radial cell (Figs 17–19); head and mesosoma orange, in contrast with darker brown metasoma *M. marrisi*, sp. nov.

***Maaminga rangi*, sp. nov.**

(Figs 1–4, 14, 20)

Material examined

Holotype. ♀, New Zealand BR, L. Rotoiti, 2000', 26.xii.1979–4.i.1980, A.K. Walker, pan trap in *Nothofagus* forest (NZAC).

Paratypes. **ND**: 11♂, Maungataniwha Ra, Mangamuka Summit, SH1, 400 m, 15.xii.1993, J. W. Early, podocarp–broadleaf forest, swept (AMNZ); 19♂, 2♀, Omahuta Forest, Kauri Sanctuary, 320 m, 15.xii.1993, J. W. Early & M. L. Barrell, *Agathis australis*–broadleaf forest, swept (AMNZ); 25♀, Omahuta Forest, Kauri Sanctuary, Pukekohe Stream Track, *Agathis* forest, yellow pan trap (AMNZ); 2♂, Puketū Forest, Forestry HQ, 300 m, 16.xii.1993, J. W. Early, swept in forest (AMNZ); 1♂, Puketū Forest, Manginangina Scen Res, 320 m, 16.xii.1993, J. W. Early, swept in kauri forest (AMNZ); 3♂, 10♀, Puketū Forest, 4.ii.1995, L. LeSage, swept, broadleaf forest (CNCI); 1♀, Waipoua Forest, Yakas Tree Trail, 350 m, 11–14.iv.1980, A. Newton & M. Thayer, broadleaf–podocarp forest (CNCI); 3♂, 3♀, Waipoua Forest, Yakas Tk, 360 m, 14–18.xii.1993, *Agathis australis* forest, yellow pan trap (AMNZ); 31♂, 7♀, Waipoua Forest, Yakas Tk, 300–360 m, 14.xii.1993, J. W. Early, *Agathis australis* forest, screen sweep (AMNZ); 43♂, 12♀, same data but 7.xii.1995 (AMNZ, ANIC, BMNH, SMNH, UCDA, USNM); 81♂, 6♀, Waipoua Forest, 11–12.xii.1983, L. Masner, screen sweep (CNCI); 8♂, 23♀, Waipoua Forest, 6–10.ii.1995, L. LeSage, yellow pan trap in broadleaf forest (CNCI); 1♂, 2♀, same data but in secondary forest (CNCI); 25♂, 2♀, ND, Waipoua SF, 13.xii.1983, A. K. Walker, swept mixed vegetation (NZAC); 4♂, Waipoua Forest, Lookout Rd, Toatoa walk, 280 m, 14.xii.1993, J. W. Early, podocarp forest, swept (AMNZ); 3♂, 3♀, same data, 14–18.xii.1993, yellow pan trap (AMNZ); 5♂, Waipoua Forest, Lookout Rd, 200 m, 14.xii.1993, J. W. Early, regenerating podocarp forest, swept (AMNZ); 4♂, 2♀, Waipoua Forest, nr Tane Mahuta, 340 m, 14–18.xii.1993, J. W. Early, podocarp–broadleaf forest, yellow pan trap (AMNZ); 1♀, same data, Malaise trap (AMNZ); 1♀, Waima Forest, Hauturu Tk, 140–220 m, 25.iii.1993, J. W. Early, broadleaf forest, screen sweep (AMNZ). **AK**: 1♀, Birkenhead, Jan 1981, J. F. Longworth, Malaise trap in second growth bush (NZAC); 1♀, Titirangi, Dec 1980, P. A. Maddison, Malaise trap in garden (NZAC); 2♂, Waitakere Ra, Nov 1980, J. Noyes (NZAC). **CL**: 1♂, 19 km E of Tapu, 31.i.1981, J. S. Noyes (NZAC); 22♂/♀, Coromandel Penn., 10 km E. Thames, 22–29.i.1999, S. A. Marshall, YPT (CNCI). **BP**: 1♀, Mamaku Plateau 27 km W of Rotorua, Galaxy Rd, 6–11.iii.1978, S. & J. Peck (CNCI); 1♂, Lottin Pt Rd, Waenga Bush, 100 m, 27.i.1993, J. W. Early, lowland podocarp–broadleaf forest, screen sweep (AMNZ); 1♀, Te Koau, track to Hovell's Watching Dog, 240–300 m, puriri–nikau–broadleaf forest, screen sweep (AMNZ). **TO**: 1♂, Pihanga Scen Res, nr summit of saddle above power scheme, 13.i.1972, G. W. Ramsay, litter 72/4 (NZAC); 1♀, Upper Tongariro R.S.E. corner of N.P., 28.xii.1970–3.i.1971, Malaise trap in *Nothofagus* forest (NZAC). **TK**: 1♂, Mt Messenger, 15.xii.1983, L. Masner, screen sweep (CNCI); 1♂, 3♀, Mt Egmont Natl Pk, 16.xii.1983, L. Masner, screen sweep (CNCI). **SD**: 1♂, Mt Stokes Scen Res, Okoha Saddle, 31.xii.1988, J. W. Early, swept in mixed forest (NZAC); 4♂, 5♀, Mahau Sd, Putanui Pt, 30 m, 28.xii.–13.i.1993, J. W. Early, *Nothofagus* forest, yellow pan trap (AMNZ); 3♂, Mahau Sd, Putanui Pt, 5–100 m,

13.i.1993, J.W. Early, *Nothofagus* forest, swept (AMNZ). **MB**: 1♂, Pelorus Bridge Scen Res, 30 m, 24.xii.1981, J. W. Early, sweeping ferns in beech–podocarp–broadleaf forest (LCNZ). **NN**: 6♂ 8♀, Whangamoa Saddle, 27.i.–3.ii.1979, A. K. Walker, yellow pan trap in *Nothofagus* bush (CNCI, NZAC). **BR**: 2♂, L. Rotoiti, 2000', 26.xii.–4.i.1980, A. K. Walker, *Nothofagus* forest, pan trap (CNCI); 1♂, Nelson Lakes Natl Pk, L. Rotoiti, 10.xii.1983, L. Masner, screen sweep (CNCI);

Other material. **CL**: Coromandel State Forest Park, Maumapaki Track, 480 m, 12.ii.1993, J.W. Early & R. F. Gilbert, swept in mixed broadleaf forest. **TK**: Waitaanga Plateau, 14,15.xii.1983, J. W. Early, swept in mixed *Nothofagus menziesii*–podocarp forest. **NN**: Aniseed V Scen. Res, Hackett Ck, 21.xii.1983, J. W. Early, swept in mixed *Nothofagus*–broadleaf forest.

Description

Female

In addition to family description as follows.

Body. Length 1.1–1.5 mm; small and delicate; body smooth and shining, yellowish brown to dark brown, weakly sclerotised; setae on metasoma darker than tergites and sternites on specimens in alcohol.

Head. As wide as long and as wide as high, 1.2–1.5× wider than mesoscutum; POL/OD = 2.3–3.0, POL/LOL = 1.8–2.0, OOL/POL = 1.2–1.6; frontal prominence well developed; septum between antennal sockets continued ventrally as a weak medial carina, sometimes not apparent; antennae longer than body, A1 10–11× as long as wide, A3 1.2–1.7× as long as A2, A4–A12 becoming progressively slightly shorter and wider, A13 longer than A12, ratios 14:12:10:10:9:9:8.5:8.5:8:13; curved trichoid sensilla present on A3–A13 but more prominent and numerous on apical segments.

Mesosoma. Lateral panel of pronotum paler than mesopleuron, silvery in dry specimens; dorsal view as shown in Fig. 2; mesoscutellum with either a single, wide, shallow depression or two smaller depressions anteromedially;

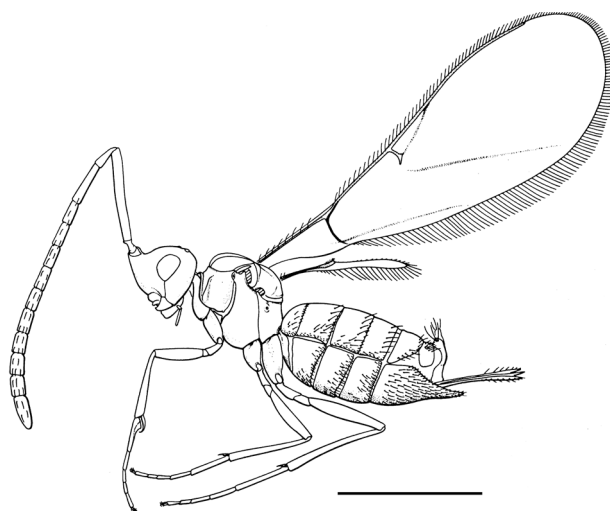
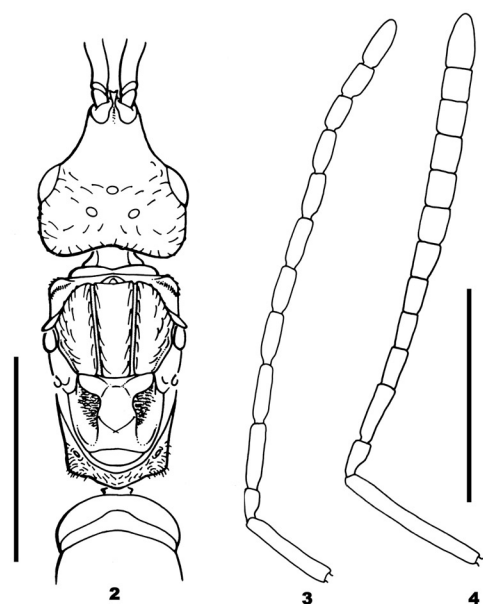


Fig. 1. *Maaminga rangi*, sp. nov., female, lateral habitus. Scale bar = 0.5 mm.



Figs 2–4. *Maaminga rangi*, sp. nov. 2, Female, dorsal view of head and mesosoma; 3, male, antenna; 4, female, antenna. Scale bars: 2 = 0.25 mm; 3, 4 = 0.5 mm.

posterior region of disc rounded with lens-shaped area enclosed by subcuticular lines, without carina or crenulate groove.

Wings. Fore wings 1.4× as long as body; stigmal vein perpendicular to anterior wing margin, as wide/thick as marginal vein; postmarginal vein long, nearly reaching wing tip at 0.8–0.9× length of wing, about 2× as long as marginal vein, its abscissa beyond apex of Rs about 2× length of radial cell; Rs spectral, complete, ending on postmarginal; M spectral, extending from near apex of stigmal vein to posterior wing margin; Cu₁ spectral, very weakly indicated.

Metasoma. Medial area of T3 strongly sclerotised, like upside down Y, with desclerotised area between median and lateral areas; posterior margin weakly indented; anterior margin of T4 with broadly rounded medial process flanked by submedian emarginations.

Male

Differing from female as follows: length 1.0–1.4 mm; head 1.0–1.2× as wide as long; ocelli larger and raised more prominently; POL/OD = 1.7–1.8, POL/LOL = 1.8–2.3, OOL/POL = 1.0–1.2; antennae (Fig. 3) with A3 1.7–2.2× as long as A2, A4–A11 gradually becoming shorter, A12 subequal to A4, A3–A12 length ratios 19:15:15:14:14:13:12:11:10:15; anterior margin of T4 with triangular median process flanked by submedian emarginations.

Comments

This species has been recorded from the North Island (ND, AK, CL, BP, TO, TK) and northern South Island (SD, MB,

NN, BR) (Fig. 20) but has not been found in WD and FD despite intensive collecting effort in those regions. *Maaminga rangi* lives in forest of various types (*Agathis*–podocarp–broadleaf, broadleaf–nikau palm, *Nothofagus*, mixed *Nothofagus*–podocarp/broadleaf). It is particularly abundant and easily collected in pan traps and by sweeping ferns and ground cover in the *Agathis*–podocarp forests north of Auckland. It is found throughout the summer but is more common earlier in the season (December). Hosts are unknown.

Etymology

The species is named for ‘Rangi’, the sky father of the Maori creation myth, and is to be regarded as a noun in apposition.

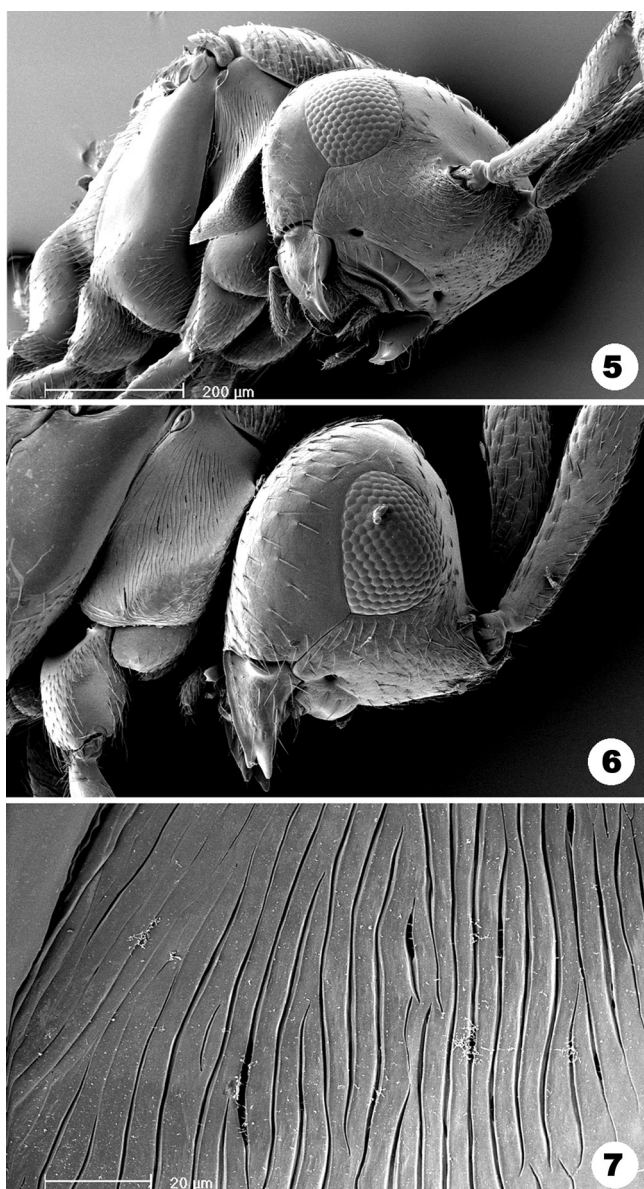
Maaminga marrisi, sp. nov.

(Figs 5–13, 15–19, 21)

Material examined

Holotype. **SD:** ♀, The Brothers, North Brother I., 20–22.xi.1993, J. W. M. Marris, pitfall traps in *Hebe*, *Coprosma*, *Disphyma* and *Sarcocornia* vegetation (AMNZ 17769).

Paratypes. **CL:** 24♂, 28♀ (macropters), Cuvier I., Tower Hill, 90 m, 13–18.xi.1999. J. W. Early & S. E. Thorpe, coastal *Metrosideros* forest, yellow pan trap (AMNZ, NZAC, LUNZ, WFBM); 1♂, 4♀ (macropters), The Aldermen Is, Ruamahua I., 5 m, 5–11.xii.1994, J. W. Early & R. F. Gilbert, shoreline taupata–karo–ngaio–*Hymenanthera* scrub, yellow pan trap (AMNZ); 1♂ (macropter), The Aldermen Is, Ruamahua I., 40 m, 5–11.xii.1994, J. W. Early & R. F. Gilbert, mahoe–kawakawa–karo forest; yellow pan trap (AMNZ). **BP:** 1♀, Te Koau, 243 m, ?xii.1992–31.i.1993, R. M. Emberson, podocarp–broadleaf forest, pitfall trap (AMNZ). **HB:** 2♀ (macropters), Puketitiri, 7.xi.81, T. H. & J. M. Davies (NZAC). **WN:** 7 m, 2♀, Wellington Harbour, Somes I., 6.xii.1987, J. R. Grehan, pitfall trap (AMNZ, LUNZ). **SD:** 5♂, 1♀, Chetwode Is, Te Kakaho, 11–16.ii.1988, C. A. Muir, yellow pan trap in shoreline *Coprosma repens* (LUNZ); 2♀, same locality, 17.ii.1988, C. A. Muir, swept from ferns (AMNZ); 1♀, The Brothers, North Brother I., 10.ii.1993, J. W. M. Marris & A. B. Freeman, litter ex petrel burrows from *Coprosma*–*Hebe* scrub area (AMNZ); 2♀, The Brothers, North Brother I., 10.ii.1993, J. W. M. Marris, litter, *Coprosma repens*–*Hebe elliptica* scrub (AMNZ); 3♂, 5♀, The Brothers, North Brother I., 7–10.ii.1993, J. W. M. Marris, *Hebe* and *Coprosma* scrub, pitfall trap (AMNZ, LUNZ, MONZ, USNM); 5♂, 3♀, The Brothers, North Brother I., 7–10.ii.1993, J. W. M. Marris, low *Coprosma*–*Disphyma* vegetation, pitfall trap (AMNZ); 1♂, 1♀, The Brothers, North Brother I., 7–10.ii.1993, J. W. M. Marris, in *Disphyma*–*Sarcocornia* vegetation (AMNZ); 35♂, 12♀, same data as holotype (AMNZ, ANIC, BMNH, CNCI, SMNH, UCDA); 1♀, The Brothers, North Brother I., 22.xi.1993, J. W. M. Marris, *Hebe* and *Coprosma* scrub litter, Berlese extraction (AMNZ); 1♀, Stephens I., 18–20.ii.1994, J. W. M. Marris, mahoe–ngaio–nikau forest, yellow pan trap (AMNZ). **MC:** 1♂, 1♀, Birdlings Flat, 17.xi.1976, J. S. Dugdale, litter 76/97 (*Coprosma* and *Muehlenbeckia*) (NZAC); 1♂ (macropter), Banks Peninsula, Prices V., 22.xi.–1.xii.1988, J. W. Early, yellow pan trap in podocarp–broadleaf forest remnant (AMNZ); 1♂ (macropter) 1♀ (brachypter), same locality, 11.ix.2000, J. B. Johnson, ex berlese sample from podocarp angio. bush (AMNZ). **MK:** 1♀, L. Pukaki, Te Kohai I., 27.i.1976, C. Smith, pitfall trap (NZAC). **CO:** 1♂ (macropter), Dansseys Pass, 9.xi.1968, J. I. Townsend, litter 68/166 (*Podocarpus nivalis*) (NZAC);



Figs 5–7. *Maaminga marrisi*, sp. nov. 5, Female, anterolateral view of head and mesosoma (wings removed); 6, female, lateral view of head and pronotum; 7, female, sculpturing of lateral pronotum.

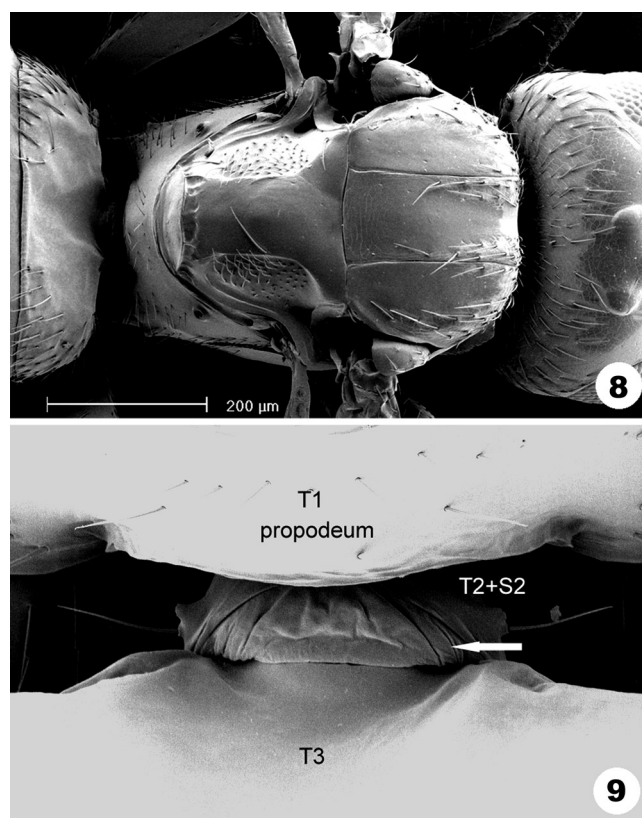
2♀, Rock and Pillar Ra, 700–800 m, 1999, C. Rufaut, pitfall trap in snow tussock *Chionochloa rigida* (AMNZ). SL: 1♀, Cannibal Bay, E of Owaka, 18.i.1978, G. Kuschel, litter 78/41 (*Podocarpus totara* with *Muehlenbeckia australis* and *Carex secta*, behind beach) (NZAC).

Description

Female

Differing from *M. rangi* as follows.

Body. Length 1.6–1.8 mm; body stocky and robust; head, A1 and A2, and mesosoma except lateral panel of pronotum orange-brown; A3–13, lateral panel of pronotum and metasoma darker brown; head and mesosoma finely



Figs 8, 9. *Maaminga marrisi*, sp. nov. 8, Male, dorsal view of mesosoma; 9, male, dorsal view of petiole (membrane arrowed).

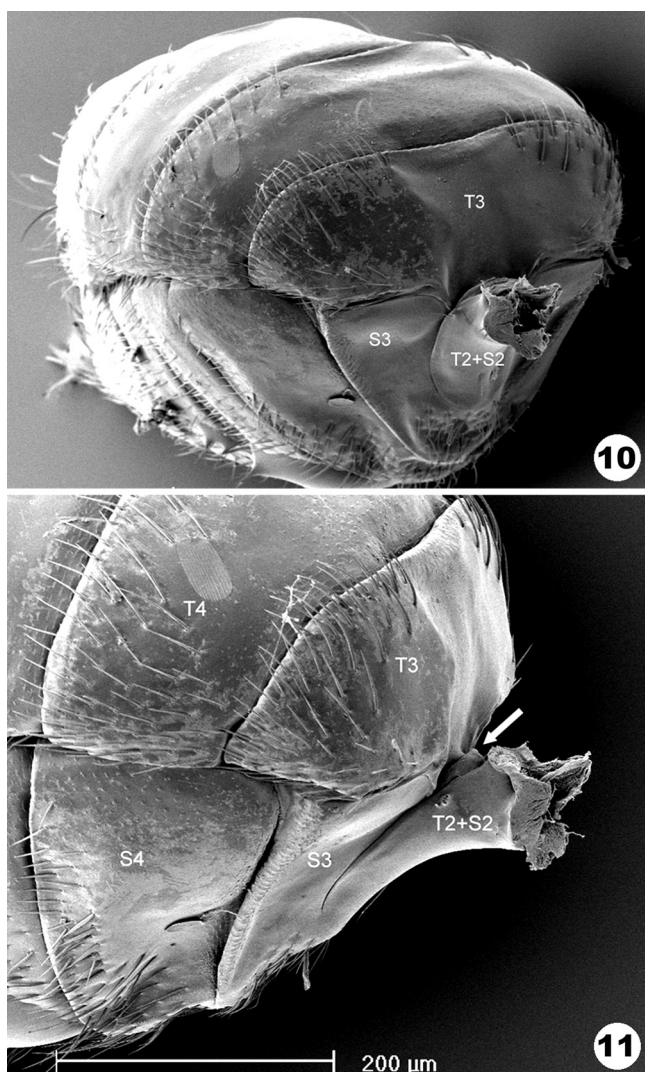
textured (appearing coriaceous); setae of metasoma paler than tergites and sternites on specimens in alcohol.

Head. 1.3–1.4× as wide as long, 0.9× as long as high, 1.2× as wide as high, 1.3–1.6× as wide as mesoscutum; POL/OD = 3.0–4.4, POL/LOL = 1.8–2.2, OOL/POL = 1.0–1.3; antennae (Fig. 16) shorter than body, A1 5.0–6.0× as long as wide, A3 1.1–1.2× as long as A2, A4–A12 subequal, A13 1.8× as long as A12.

Mesosoma. Lateral panel of pronotum darker than mesopleuron, its striations as shown in Figs 5–7; mesoscutellum without anteromedial depression; posterior region of scutellar disc truncate with transverse rectangular weakly crenulate groove bounded posteriorly by carina; posterior face of scutellum almost vertical, trapezoidal to crescent shaped, bounded by carinae (Fig. 8).

Macropterous form. Fore wing 1.0–1.6× body length, rounded at tip, with fringe of long setae but less dense than in brachypterous forms; postmarginal vein not reaching past 0.7× wing length, less than 1.5× as long as marginal vein, its abscissa beyond apex of radial vein about as long as radial cell; Rs spectral so as to indicate radial cell.

Brachypterous form. Fore wing 0.6–0.8× body length, rounded to slightly acuminate at tip; anterior margin with dense fringe of setae; submarginal vein with six long, stout, erect setae; marginal and postmarginal veins thick,



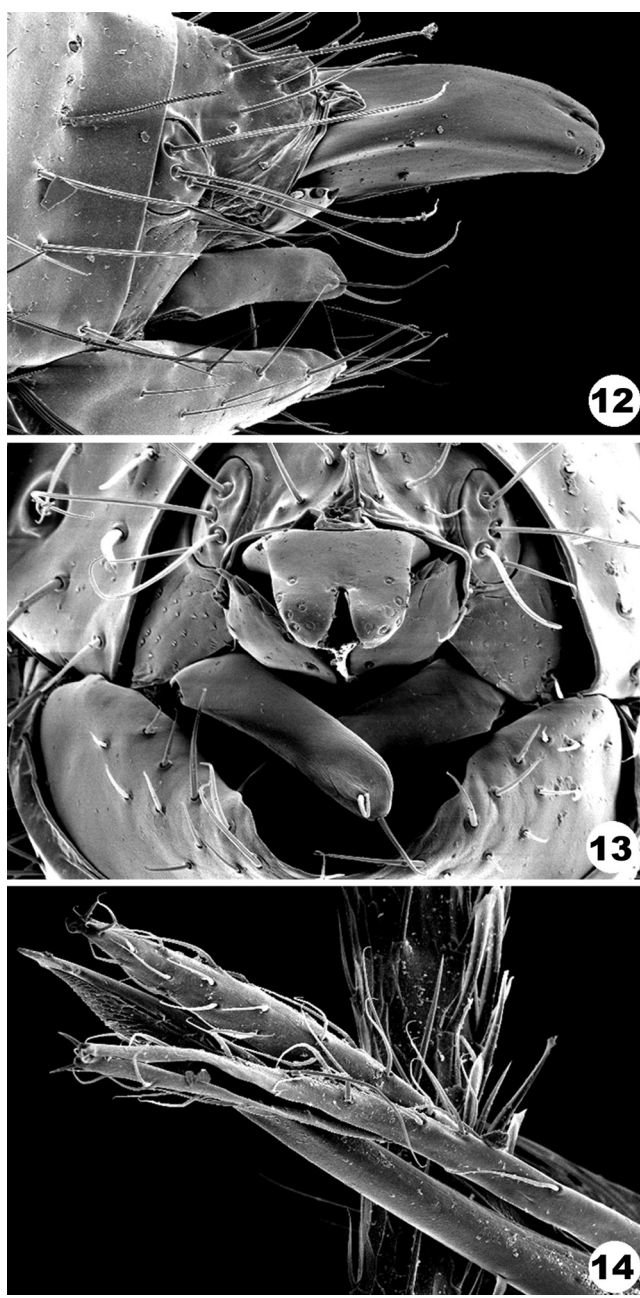
Figs 10, 11. *Maaminga marrisi*, sp. nov. 10, Male, anterolateral view of metasoma; 11, male, lateral view of petiole and metasoma (membrane arrowed).

postmarginal swollen in apical half; stigmal vein thick, oblique, more-or-less triangular, with 4–6 round clear spots; radial vein short, barely indicated by pigmentation.

Metasoma. Medial area of T3 trapezoidal, wider anteriorly than posteriorly, weakly differentiated from lateral areas; anterior margin of T4 entire, weakly convex; posterior margin of T9 incised between cerci; ovipositor 1.4× length of hypopygium, at rest exceeding apex of hypopygium by approximately half hypopygium length.

Male

Differing from female as follows: length 1.3–1.8 mm; head 1.4–1.5× as wide as long; antennae with A3 1.6–1.9× as long as A2; proportion of segments as in Fig. 12; fore wing rounded at tip, not acuminate; metasoma with anterior margin of T4 transverse to weakly convex.



Figs 12–14. Genitalia of *Maaminga* spp. 12, *Maaminga marrisi*, sp. nov., dorsolateral view of male genitalia; 13, *Maaminga marrisi*, sp. nov., posterior view of male genitalia; 14, *Maaminga rangi*, sp. nov., female, ovipositor and sheaths (N.B. ovipositor is bare and sheaths have apical and subapical setae).

Comments

This species is known from the North (CL, BP, HB, WN) and South Islands (SD, MC, MK, CO, SL) (Fig. 21), and is sympatric with *M. rangi* at East Cape (Te Koau, BP). *Maaminga marrisi* is a leaf litter inhabitant of bushy scrub in exposed sites, from near the shoreline (various islands, Banks Peninsula, Birdlings Flat) to montane shrubs and

snow tussock at about 800 m (Lake Pukaki, Danseys Pass, Rock and Pillar Ra.); only a few specimens have been found in forest. Coastal sites are under the strong maritime influence of wind and salt spray, and can be hot and dry in summer. The higher altitude sites are all inland, but are exposed to strong winds, hot dry summers and periodic winter snow cover.

Most specimens were taken from small offshore islands in low tangled coastal scrub close to the shoreline, similar to the type locality (North Brother I. in Cook Strait; Fig. 22). This habitat is also home to the tuatara (*Sphenodon punctatus* (Gray) and *S. guntheri* Buller, Reptilia: Rhynchocephalia) and nesting seabirds (various petrels and shearwaters (Procellariiformes) and penguins (Sphenisciformes)). Reduced wings and long hind legs are common among New Zealand proctotrupoid and platygastroid wasps and indicate adaptations to inhabiting leaf litter (Austin 1988; Naumann 1988). Specimens are best collected using yellow pan traps, pitfall traps and Berlese extraction. Hosts are unknown, possibly Phoridae (Diptera) which abound in the same habitat on the small offshore islands.

The distinction between brachypterous and macropterous morphs is arbitrary. While it is clear at the extremes of the range, the ratio of wing to body length is a continuum from 0.6–1.3. All specimens from the most northern recorded localities (Cuvier I., The Aldermen Is) are macropterous while the majority from more southern localities are brachypterous.

This is the species illustrated by Grehan (1990) and referred to by Early (1995).

Etymology

Maaminga marrisi is named for John Marris, congenial field companion of J. E. on several expeditions, who collected the first reasonable series of specimens while searching for rare beetles on inhospitable islands: proof that coleopterists have their uses.

Phylogenetic relationships

Superfamily status

Maaminga is excluded from all apocritan superfamilies (except the Proctotrupoidea *s. str.*) on the following grounds:

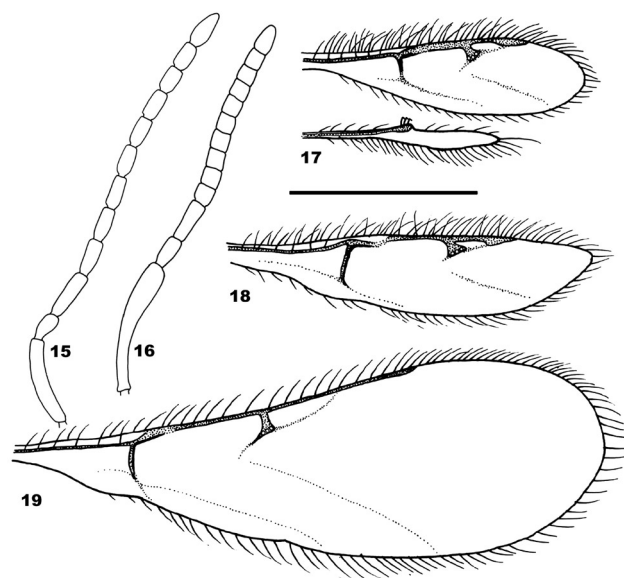
- (1) Insertion of metasoma low on the petiole between the hind coxae (excluded from Evanioidea).
- (2) Absence of vein C in fore wing, hence costal cell is open (excluded from Evanioidea, Stephanoidea, Trigonaloidea, Megalyroidea, Ichneumonoidea, Chrysoidea (except Chrysoidea: Lobescelidiinae), Vespoidea, Apoidea).
- (3) Only one foretibial spur, presence of open costal cell, absence of syntergite, presence of metasomal spiracle (excluded from Ceraphronoidea).
- (4) Absence of placoid sensilla on antennae (excluded from Ichneumonoidea, Cynipoidea, Chalcidoidea).

- (5) Single segment to petiole, head without bellows-like structure, wings not reticulate (excluded from Mymarommatoidea).
- (6) Ovipositor not detached from terminal metasomal segments and not retracted internally within a desclerotised tubular part of abdominal segment 9 (excluded from Platygastroidea).

Given the apparent similarity of *Maaminga* to Diapriidae (see below), the Proctotrupoidea is then the only likely candidate for the superfamily placement of the genus. However, there are no characters that unite this superfamily and, as indicated above, the placement of Maamingidae in this group is based more on the absence of synapomorphies that define the other superfamilies of Apocrita. Further, there is now mounting evidence that the Proctotrupoidea as recognised by previous authors (e.g. Naumann and Masner 1985; Masner 1993, 1995; Gauld and Bolton 1996) is polyphyletic (see discussion below).

Family level status of Maamingidae

The two recorded species of *Maaminga* represent a unique combination of characters. In particular, the form of the head, antennae, some features of the mesosoma, and wings resemble members of the Diapriidae. However, the metasoma, subgenital plate and external ovipositor are reminiscent of the Ichneumonoidea. Nominally, Maamingidae and Diapriidae can be allied on the basis of two putative synapomorphies, the antennae inserted onto a prominent frontal shelf, and the presence of obvious curved



Figs 15–19. *Maaminga marrisi*, sp. nov. 15, Male, antenna; 16, female, antenna; 17, fore and hind wing of brachypterous male, from Somes Is.; 18, fore wing of brachypterous female, from North Brother I.; 19, fore wing of macropterous female, from The Aldermen Is. Scale bar = 0.5 mm.

trichoid sensilla on the antennae. However, the presence of a facial shelf may be a synapomorphy for Diapriidae + Maamingidae + Monomachidae, although in the latter family this character is not as obvious and it may be homoplasious (but see below) given that a frontal shelf is also known to occur in other groups of Hymenoptera, e.g. orthocentrine ichneumonids and Embolemidae. One proposition is to recognise *Maaminga* as a subfamily of Diapriidae, although this would require significantly broadening of the morphological limits to this family, which is otherwise easily identified and well defined morphologically. Further, recent molecular studies do not support a direct sister group relationship between *Maaminga* and Diapriidae, and the two groups differ in several important characters as follows.

- *Maaminga* female:male antennal segments 13:12; male antenna without a sex segment; palpal formula 2:2; occipital carina absent; lateral pronotum striated; junction between lateral pronotum and mesopleuron membranous and flexible; metasoma unspecialised, T3 and S3 not enlarged.
- Diapriidae female:male antennal segment number variable, never 13:12; male antenna often with a sex segment; palpal formula 5:3; occipital carina present; lateral pronotum not striated; suture between lateral pronotum and mesopleuron rigid; T3 and S3 enlarged.

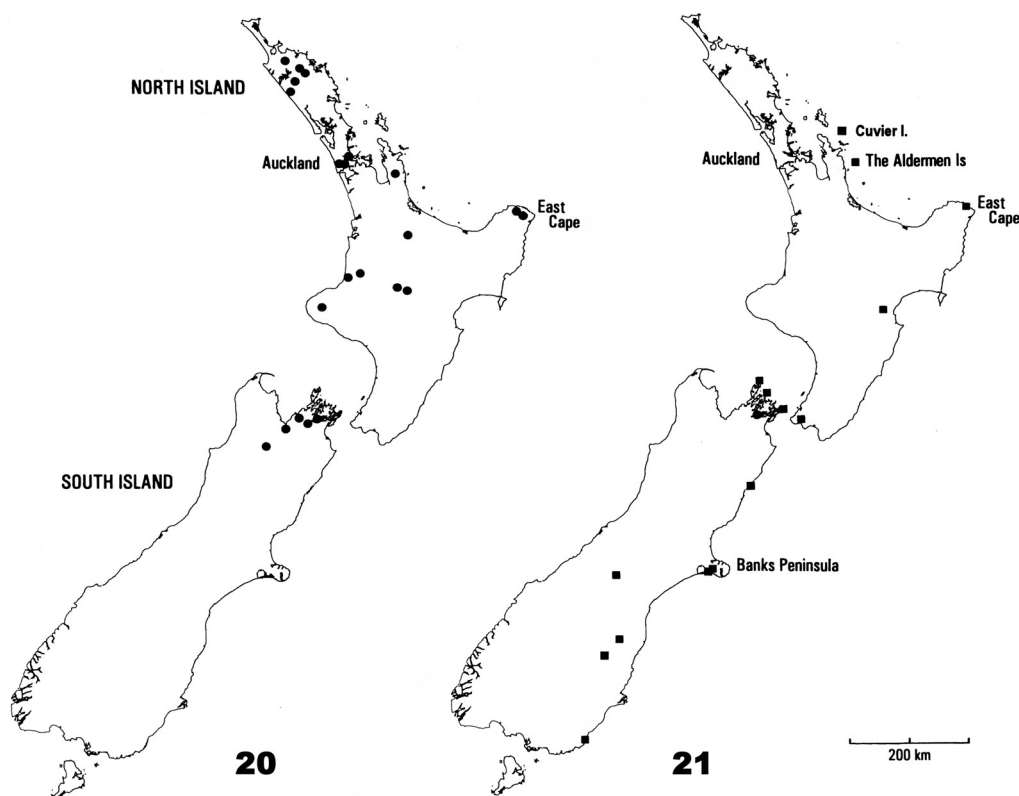
In summary, although the currently available data are not particularly robust, there are reasonable grounds to place

Maaminga in a new family separate to the Diapriidae, until the relationships of the proctotrupoid complex are better resolved.

Overview of recent studies on the Proctotrupoidea

Rasnitsyn's (1988) phylogeny of the Hymenoptera initiated substantial interest in the relationships among families, particularly the non-aculeate Apocrita. Recent studies have focused primarily in two areas: (1) detailed comparative morphological studies of various new character systems, the ultimate aim of which is to develop a comprehensive data-set amenable to rigorous analysis, and (2) the generation of mitochondrial and nuclear sequence data to be analysed in parallel and combined with available morphological information. Such studies have been underway for several years (and are ongoing), and although these are not yet complete, the available data do shed some light on the status of the Proctotrupoidea. One thing to emerge from these studies is that the Proctotrupoidea is rendered polyphyletic without inclusion of at least the Chalcidoidea, Platygastroidea and Cynipoidea, and is thus synonymous with Rasnitsyn's (1988) concept of the superfamilies that comprise the infraorder Proctotrupomorpha.

Although several morphological studies have focused on or considered relationships among the proctotrupoid families (see Gibson 1985; Naumann and Masner 1985; Gauld and Hanson 1995; Ronquist 1999 for reviews), only



Figs 20, 21. Distribution of *Maaminga rangi*, sp. nov. (20) and *Maaminga marrisii*, sp. nov. (21).

that of Ronquist *et al.* (1999), which utilises a reinterpreted version of the data presented in Rasnitsyn (1988), has been evaluated within a parsimony framework. Depending on the parameters of the analysis, the position of the proctotrupoid families vary significantly. For instance, the Diapriidae are placed as the sister group to the Cynipoidea + (Chalcidoidea + (Platygastridae + Ceraphronoidea)) or are nested within a clade containing these superfamilies as the sister group to the Cynipoidea. Further, the Monomachidae are variously placed as the sister to these four superfamilies, or as the sister to the Austroniidae within a grade comprising the other proctotrupoid families. Even though the results of these parsimony analyses are variable, they also differ significantly from the relationships postulated by Rasnitsyn's (1988) intuitive tree. The latter study places the Ceraphronoidea in a completely different part of the apocritan tree (i.e. within the Evaniomorpha, a group also comprising the Stephanidae, Magalyridae, Trigonalidae and Evanioidea). Further, the Cynipoidea are placed in a separate clade to the Chalcidoidea + Platygastridae, with the proctotrupoid families forming a grade below the Cynipoidea with the Diapriidae as its sister group.

Several recent studies have examined single character systems including behaviour (e.g. Basibuyuk and Quicke 1997, 1999a, 1999b; Basibuyuk *et al.* 2000) in support of developing a better understanding of hymenopteran relationships. These have not been particularly instructive by themselves for inferring relationships among the Proctotrupoidea, although they may be so when analysed as part of a more comprehensive and integrated study (see Quicke *et al.* 2000). Two of these studies (on hamuli and orbicula sensilla associated with the tarsal claws) predict putative relationships for the Maamingidae. The presence of a row of modified erect setae opposing the distal hamuli is a putative synapomorphy for the Chalcidoidea, Ceraphronoidea, Diapriidae and Maamingidae (Basibuyuk and Quicke 1997), while the presence of particular types of orbicula sensilla (Basibuyuk *et al.* 2000) provides some tentative support for the grouping of Chalcidoidea, Mymaromatidae, Diapriidae and Maamingidae, or for these families in addition to Cynipoidea, Platygastridae (not Scelionidae) and Ceraphronoidea. However, these characters may also be homoplasious as a consequence of small body size typical of the majority of species in these groups. Again, the results of these studies need to be incorporated into a more complete cladistic analysis before proctotrupoid relationships can be properly assessed.

Dowton *et al.* (1997) investigated relationships within the Proctotrupomorpha and Evaniomorpha using partial sequence data from the mitochondrial 16S rRNA gene. Their results tentatively indicated Maamingidae + Heloridae as a possible sister group to Diapriidae + (Platygastridae + Chalcidoidea). However, their data were limited and relationships among the proctotrupoid families were far

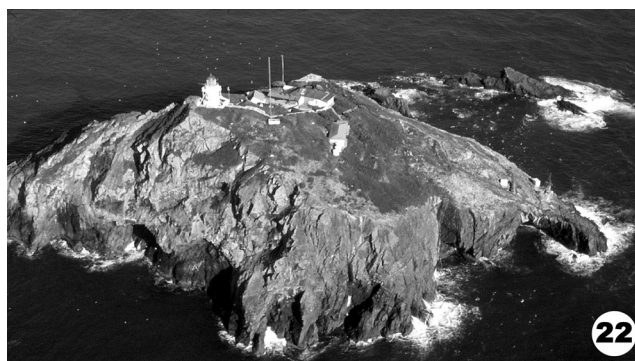


Fig. 22. North Brother I., type locality of *Maaminga marrisi*.

from robust. A more extensive study has recently been completed (Dowton and Austin in press), again to address relationships within the Proctotrupomorpha. This study has examined nearly three times the number of taxa, and has utilised sequence data from three genes, viz. nuclear 28S rDNA (see Dowton and Austin 1998), cytochrome oxidase I (see Dowton and Austin 1995) and mitochondrial 16S rDNA (see Dowton and Austin 1994; Dowton *et al.* 1997). A range of analyses recovered the Maamingidae generally as the sister group to the Monomachidae, with this clade being the sister group to the Diapriidae (Dowton and Austin in press). Although the monophyly of these three families is relatively stable, their precise position relative to each other is not, with some analyses placing the Maamingidae as the sister group to the Monomachidae + Diapriidae. Interestingly, the addition of the morphological dataset of Ronquist *et al.* (1999) does not disrupt the affiliation of these three families.

Acknowledgments

We thank John Grehan, John Marris, Cathy Rufaut and James (Ding) Johnson for collecting specimens of *M. marrisi*, Mark Dowton and Gary Gibson for discussions about the molecular and morphological relationships among proctotrupoid wasps, respectively, Yan Jing for assistance with SEM, and Nick Stevens and Muhammad Iqbal for assistance with finalising the manuscript. For nearly 20 years we have sought and received many opinions on the affinities of the species described in this paper. Accordingly, we extend our warm thanks to countless colleagues for their insights, suggestions and encouragement.

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