Zootaxa 2932: 24–32 (2011)
www.mapress.com/zootaxa/

Article

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

Kiwigaster gen. nov. (Hymenoptera: Braconidae) from New Zealand: the first Microgastrinae with sexual dimorphism in number of antennal segments

J. L. FERNANDEZ-TRIANA[1], D. F. WARD[2] & J. B. WHITFIELD[3]

[1]*Biodiversity Institute of Ontario, University of Guelph, Guelph, Ontario, N1G2W1, Canada. E-mail: jftriana@uoguelph.ca*
[2]*New Zealand Arthropod Collection, Landcare Research, Private Bag 92170, Auckland, New Zealand. E-mail: wardda@landcareresearch.co.nz*
[3]*Department of Entomology, University of Illinois, Urbana, IL, 61801 USA. E-mail: jwhitfie@life.illinois.edu*

Abstract

A new and morphologically unusual genus of microgastrine Braconidae, *Kiwigaster* Fernandez-Triana, Whitfield and Ward, with one new species, *K. variabilis* Fernandez-Triana and Ward, is described from New Zealand, where it is widespread. A number of morphological features mark it as unique among Microgastrinae, the most striking being the males and females having different numbers of antennal flagellomeres (females 17, males 18). Other unusual characters suggest this may be the most early-diverging extant species of the subfamily, although comprehensive phylogenetic analyses have yet to be conducted. Nothing is yet known about its host(s) or other aspects of its biology.

Key words: Hymenoptera, Braconidae, Microgastrinae, New Zealand, sexual dimorphism, antennae

Introduction

The Hymenoptera fauna of New Zealand is unusual, particularly in its high diversity of Diapriidae and Mymaridae, near absence of sawflies, and depauperate Aculeate fauna (Valentine & Walker 1991; Early *et al*. 2001; Ward 2011; Ward & Goulet 2011). Endemism is high at the species level, but also present are higher-level endemic taxa; including the family Maamingidae (Early *et al*. 2001).

It is generally accepted that New Zealand split from the remnants of Gondwana c. 80 million years ago (mya), and by 55 mya the modern Tasman Sea was formed (Li & Powell 2001; McLoughlin 2001). During the early Tertiary, New Zealand slowly subsided and by the late Oligocene (25–22 mya) the land had reduced to a very small proportion of its current size; often referred to as the 'Oligocene Drowning' (Fleming 1979; Cooper & Cooper 1995). More recently, Pleistocene glaciations covered much of the present day South Island, restricting taxa to relatively small refugia in isolated areas, and having a profound effect on the distribution of species (Marra & Leschen 2004; Buckley *et al*. 2010).

Because of New Zealand's long isolation and turbulent geological history its fauna is of particular interest. Relictual groups are also important both for phylogenies of Hymenoptera, and also for biogeographical patterns and timelines, for example, the Ambositrinae (Diapriidae) (Naumann 1988).

The literature of the New Zealand Microgastrinae is meagre. At present, the known fauna (18 species –Yu *et al*. 2005) consists predominantly of species purposefully introduced for biological control of lepidopterous pests in the agricultural/horticultural industry. Very few endemic species are described, particularly when the Lepidoptera fauna of New Zealand is estimated at over 2000 species (Dugdale 1988). As part of ongoing studies on the New Zealand fauna of Microgastrinae we found a braconid species that is unique among all known microgastrines in having a different number of antennal segments in the males and females. Other unusual characters suggest this may be the most early-diverging extant species of the subfamily, although comprehensive phylogenetic analyses including this species have yet to be conducted. In this paper we describe the new genus and species and discuss aspects of the phylogeny of the group.

 Accepted by J. Jennings: 15 Jun. 2011; published: 28 Jun. 2011

Methods

Specimens from the following collections were examined:

AMNZ	Auckland War Memorial Museum, Auckland, New Zealand;
CNC	Canadian National Collection of Insects, Ottawa, Canada;
LUNZ	Entomological Museum, Lincoln University, Lincoln, New Zealand;
NZAC	New Zealand Arthropod Collection, Auckland, New Zealand;
INHS	Illinois Natural History Survey, Champaign, Illinois, United States.

Morphological terms follow those of Huber and Sharkey (1993), and Sharkey and Wharton (1997), with some additional measurements following Mason (1981) and Valerio *et al*. (2009). When providing measurements, the first figure is that of the holotype, followed by the range for the rest of the specimens if different. In the description, localities are represented by two-letter area codes following Crosby *et al*. (1998).

Information about the examined specimens is present in the following format: Sex (Institution). Area Code. Locality. Date. Collector. Collecting device and micro-habitat. Specimen Collection Number.

Images and measurements were taken using a Leica DC500 digital camera mounted on a Leica MZ12.5 stereomicroscope. Images were captured with Auto-Montage Pro ver. 5.03.0061 and Leica IM500 Image Manager ver. 4.

Results

***Kiwigaster* Fernández-Triana, Whitfield and Ward, gen. nov.**
(Figures 1–9).

Type species. *Kiwigaster variabilis* sp. nov, by present designation.

Diagnosis. Sexual dimorphism in the number of antennal flagellomeres (17 in females and 18 in males). Anterior tentorial pits enlarged. Lateral face of the scutellum almost completely smooth and polished, with only very small striations on the dorsal edge. Mesoscutum mostly smooth, with notauli well defined as deep, thin sulci that run from the anterior edge of the mesoscutum to the scuto-scutellar sulcus. Fore wing with a large areolet that is more than half as large as the stigma. Metatibial spines extremely short, 0.2X or less as long as the first metatarsus segment.

Description. Head. Anterior tentorial pits enlarged; clypeus semicircular in shape and half as high as wide; antenna with 17 flagellomeres in females, 18 in males. Mesosoma. Pronotum laterally with only the lower furrow; mesoscutum with notauli well defined as deep sulci throughout most of the mesoscutum length, meeting posteriorly; notaular sulci with bridging costulae along its entire length; scutellar lateral face with polished area occupying most of the face height, with striated area barely visible. Fore wing with areolet large, quadrangular, its height subequal to that of stigma and its width half the stigma length. Legs. Metacoxae small, less than 3X as large as mesocoxae and shorter than first metasomal tergite; metatibial spurs very small, 0.2X or less the length of metatarsomere 1. Metasoma. Mediotergite 1 parallel-sided and elongate; mediotergite 2 transverse, subtriangular in shape; hypopygium mostly sclerotized and inflexible, but folded in the ventral 1/3 along the middle line, setting off a more translucent and flexible area; ovipositor sheaths fully setose and about the same length as metatibia.

Distribution. Only known from New Zealand, where it is widely distributed (Fig. 10).

Biology. Unknown.

Putatives autapomorphies. Sexual dimorphism in number of flagellomeres and enlarged tentorial pits.

Comments. The most commonly used key to genera of Microgastrinae in New Zealand is that of Austin and Dangerfield (1992). *Kiwigaster* can be distinguished based on the number of antennal flagellomeres (17 in females and 18 in males). The rest of Microgastrinae have a fixed number of 16 flagellomeres.

Etymology. The name refers to the geographical distribution of the genus, which is only known from New Zealand. The gender of the genus name is masculine.

***Kiwigaster variabilis,* Fernandez-Triana and Ward, sp. nov.**
(Figs. 1–9)

Type locality. NEW ZEALAND: Mataraua Forest, Waoku Coach Road, 400 m, ND.

Type material. Holotype. Female (NZAC), with labels as follows. First label: NEW ZEALAND (ND): Mataraua Forest, Waoku Coach Road, 400 m, 9.ii.1995, Broad leaf forest, L. LeSage NZ-20. Second label: WAM 0515.

Paratypes. 1 ♂ (NZAC). AK. Waitakere Ra. Jan 1981. J Noyes. NZAC04045383. 1 ♂ (NZAC). BP. Waenga Bush. Dec 1992-Jan 1993. RC Henderson. Malaise trap. NZAC04045338. 1 ♂ (NZAC). BP. Waenga Bush. 20/10-24/11/1992. G Hall. Malaise trap. NZAC04044311. 1 ♂ (NZAC). BP. Waenga, Lottin Pt Rd. 27/1/1993. RC Henderson. Litter. NZAC04044327. 1 ♀ (NZAC). BR. L. Rotoiti. 600m. Jan 1981. F Dodge. Malaise trap edge of *Nothofagus* forest. NZAC04044307. 1 ♀ (AMNZ). BP. Orete Forest, Te Puia Hut, 240 m. Jan-1993. JW Early. Screen sweep Podocarp/broadleaf forest. AMNZ71864. 1 ♂ (AMNZ). BP. Te Koau, track to Hovells Watching Dog. 240 m. Jan-1993. JW. Early. Screen sweep puriri-nikau-tawaroa forest. AMNZ71865. 3 ♀ (AMNZ). CL. Cuvier I, West ridge/lookout tk., 180 m. Mar-Apr 2000. JW Early & RF Gilbert. Malaise trap, forest. AMNZ71861, AMNZ71862, AMNZ71863. 4 ♀ (AMNZ). CL. Great Barrier I, Little Windy Hill, 220 m. Feb–Mar 2002, Dec 2002–Jan 2003. P. Sutton. Forest edge, Malaise Trap. AMNZ71857, AMNZ71858, AMNZ71859, AMNZ71860. 1 ♂ (NZAC). GB. Taikawakawa. 18/3-1/5 1993. G Hall. Malaise trap. NZAC04045049. 1 ♂ (NZAC). MC. Banks Peninsula, Prices Valley. Oct 1980. RP Macfarlane. Malaise trap edge of native bush. NZAC04044137. 2 ♂ (NZAC). MC. Banks Peninsula, Prices Valley. Nov 1980. RP Macfarlane. Malaise trap edge of native bush. NZAC04045267, NZAC04045223. 1 ♂ (NZAC). MC. Banks Peninsula, Prices Valley. Apr 1981. RP Macfarlane. Malaise trap edge of native bush. NZAC04045342. 4 ♂ (NZAC). MC. Banks Peninsula, Prices Valley. Nov 1980. RP Macfarlane. Malaise trap edge of native bush. NZAC04044973, NZAC04045113, NZAC04045130, NZAC04044277. 1 ♂ (NZAC). MC. Banks Peninsula, Prices Valley. Feb 1981. RP Macfarlane. Malaise trap edge of native bush. NZAC04045055. 2 ♀, 1 ♂ (LUNZ). MC. Kaituna Valley Scen. Res. 17/02/1979. JW Early. Sweeping *Melicytus* understory. 1 ♂ (LUNZ). NC. Lees V. 550m. 20/01/1984. CA Muir. Sweeping vegetation in *Nothofagus solanderi* forest. 1 ♀ (CNC). ND. Mataraua For., Waoku Coach Rd. 400m. Mid Feb 1993. L LeSage. in a broadleaf forest. WAM 0514, WAM 0515. 2 ♀ (AMNZ). ND. Waima Forest, Hauturu track, 220 m. Mar-1993. JW Early. Screen sweep kauri-broadleaf-nikau forest. AMNZ71855, AMNZ71856. 1 ♂ (CNC). NN. Hardwoods Hole. Mid Feb 1993. L LeSage. in *Nothofagus* forest. GOU 0410. 1 ♂ (NZAC). NN. Nelson. 8/6/1927. ES Gourlay. NZAC04045284. 1 ♂ (NZAC). NN. Nelson, Farewell Spit Rd. 12/1/1966. AK Walker. Beating. NZAC04044449. 1 ♂ (NZAC). SD. Shakespeare Bay. 21/2/1973. J McBurney. Litter. NZAC04044374. 1 ♀ (INHS). TK. Mt Messenger. mid Dec 1983. L Masner. WAM 0319. 1 ♂ (NZAC). TO. Kaimanawa Forest. 31/1/1971. HA Oliver. Malaise trap in *Nothofagus* forest. NZAC04044466.

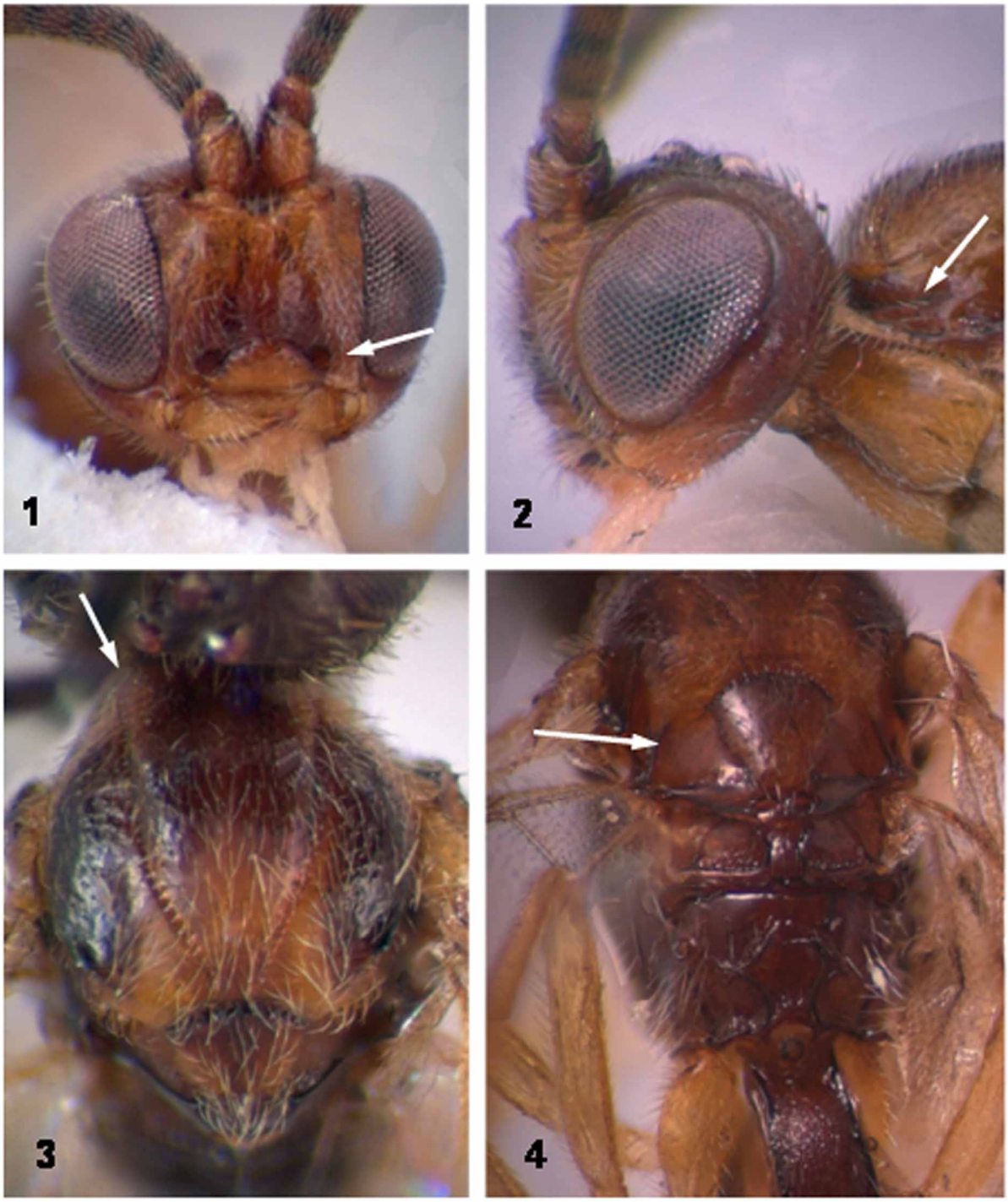
Diagnosis. This is the only known species of *Kiwigaster.*

Description. Female. Antenna length 2.3 mm (2.0–2.7 mm), body length 2.6 mm (2.3– 2.8 mm), forewing 2.4 mm (2.2–3.0 mm).

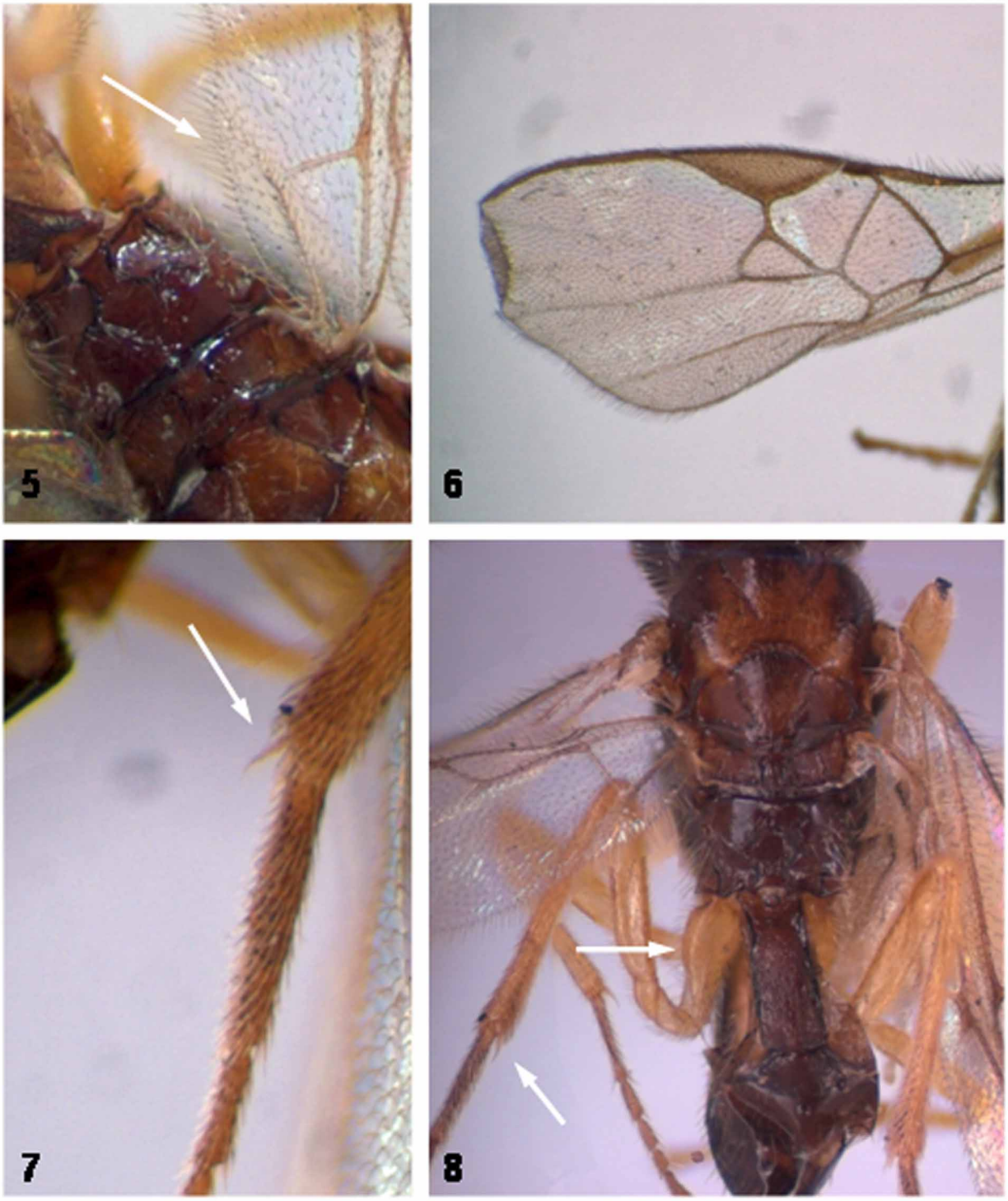
Head. Glossa truncate and short, maxillary palps reaching half the length of mesosoma (Fig. 9). Face with shallow, sparse punctures, and long, sparse, uniformly distributed setae. Face width at antennal base/face width at clypeus edge: 1.1X; intertentorial pit distance/face width at clypeus edge: 0.4X; compound eye height/head height: 0.7X; head height/width: 0.8X; face width at antennal base/head maximum width: 0.5X; malar space/basal width of mandible 0.7X. Clypeus semicircular in shape, its width/height: 2.0X. Anterior tentorial pits enlarged (Fig. 1), 0.25X as large as clypeus width, 0.5X as large as mandibular width at base and 0.8X as large as malar space. Length/width of flagellomeres: 1st (3.2X), 2nd (3.3X), 8th (2.9X), 14th (1.6X), 15th (1.4X). Length of flagellomere 2/flagellomere 14: 2.2X. Ocello-ocular distance/posterior ocelli diameter: 1.8X; distance between posterior ocelli/ocelli diameter: 1.0X.

Mesosoma. Pronotum laterally with only the lower furrow, which is centrally located and only reaching half the length of pronotum (Fig. 2). Mesoscutum 1.1X wider than long, mostly smooth, and covered by sparse, long setae. Mesoscutum with notauli well defined by deep sulcus that are 0.8–1.0X the mesoscutum length and run from the anterior edge of mesoscutum to the scuto-scutellar sulcus, meeting at the end (Fig. 3). Notaular sulci with crossing costulae along their entire length. Scutellum smooth and covered by sparse, long setae. Scutellum length/width at base 1.2X. Scutellar suture as broad as notaular width, deep and with 12 costulae. Posterior band of scutellum polished but interrupted apico-medially by a costula. Scutellar lateral face with smooth and polished area occupying 0.9X or more of the face height, above the smooth area with a barely visible (or not visible at all) small striated

area (Fig. 4). Metanotum with anterior margin straight and closely appressed beneath posterior margin of scutellum, without exposing phragma. Mesopleuron smooth, polished and mostly glabrous (setae mostly on the antero-dorsal and postero-ventral edges of mesopleura); thin, crenulate sulcus separating meso and metapleura. Metapleuron smooth, polished and mostly glabrous, with setae concentrated on the posterior half; metapleuron with a short, crenulate, longitudinal sulcus running from lower margin near metacoxa through spiracle. Metapleural carina with a relatively wide lamella. Propodeum largely smooth and polished, with some striated sculpture mostly on the apical half; propodeal areola well defined by carinae, sometimes with the anterior carinae only partially present – leaving the areola more or less open anteriorly (Figs 4, 5, 8).



FIGURES 1–4. *Kiwigaster variabilis*. Figure 1: Head, frontal. Arrow shows anterior tentorial pit. Figure 2: Head and pronotum, lateral. Arrow shows lower pronotal furrow. Figure 3: Mesoscutum, dorsal. Arrow shows beginning of the notauli. Figure 4: Mesosoma, dorso-lateral. Arrow shows lateral face of scutellum.



FIGURES 5–8. *Kiwigaster variabilis*. Figure 5: Partial mesosoma and base of hind wing, dorso-lateral, Arrow shows vannal lobe. Figure 6: Fore wing, dorsal. Figure 7: Partial metatibia and two first segments of metatarsus, dorso-lateral. Arrow shows metatibial inner spur. Figure 8: Meso and metasoma, dorsal. Arrows show metacoxa and metatibial spur.

Wings. Fore wing vein R1a 1.2X as long as stigma length; length of R1a 8.0–10X as long as the distance between its end and the end of 3RSb. Vein r 0.5–0.6X the maximum width of stigma; areolet (Figs. 6, 9) large, quadrangular, its height subequal to that of stigma and 1.7X the length of vein r; areolet width half the stigma length; vein 2M 6.0X (5.0–7.0X) as long as vein (RS+M)b. Vannal lobe of hindwing (Fig. 6) small and narrow, margin straight centrally and with uniformly long setae which are as long as the vannal lobe width.

FIGURE 9. *Kiwigaster variabilis*. Lateral habitus of female.
FIGURE 10. Distribution of *Kiwigaster variabilis* in New Zealand.

Legs. Metacoxae small, twice as large as the mesocoxae (always less than 3X) and shorter than first metasomal tergite (Fig. 8). Metafemur 4.5X (4.0–5.0X) as long as wide. Metatibial spurs of equal size, their length 0.2X or slightly less than the length of metatarsomere 1 (Figs 7, 8).

Metasoma. Mediotergite 1 parallel sided and elongate; basal width/apical width 1.0X; length/apical width 3.0X (3.0–3.5X); mediotergite 1 with small, smooth, basal depression; apical 3/4 with longitudinally striated sculpture (Fig. 8). Mediotergite 2 transverse, trapezoidal (subtriangular) in shape; basal width/apical width 0.3X (0.3X–0.4X); length/apical width 0.3X (0.2–0.3X); mediotergite 2 with longitudinal striae on most of its surface, sometimes with smooth posterior margin (Figure 8). Mediotergite 3 about twice the length of mediotergite 2. Mediotergite 3 and following unsculptured, polished and uniformly covered by sparse setae. Hypopygium with acute tip slightly protruding beyond apical tergites; hypopygium mostly sclerotized and inflexible, but folded in the ventral 1/3 along the middle line, setting off a more translucent and flexible area. Ovipositor evenly curved downwards (Fig. 9). Ovipositor sheaths fully setose, 1.0X (0.9–1.1X) as long as metatibia length.

Colour. Most of head, scape, pedicel and mesosoma light brown; medio tergites 1–2 and flagellomere mostly dark brown; face, propleuron, pronoto, part of mesoscutum, most of the latero tergites and sternites yellow; legs mostly bright yellowish-white; maxillary and labial palps white; ovipositor sheaths, forewing stigma and most of the wing veins light brown (ovipositor sheaths sometimes with dark spot apically).

Males. Similar to females.

Variation. The general colour pattern of head and mesosoma varies from mostly orange to light brown to dark brown, in all cases with yellow marks that vary in extension. Darker specimens tend to have a yellow spot near the genae contrasting with the rest of head which is mostly brown. There is variation in body size, fore wing length, and length of the notauli sulci. The anterior carinae bounding the propodeal areola are sometimes present or partially absent, giving the areola a variable degree of openness anteriorly. The described variation is sometimes present in specimens of the same locality, and we have not found consistent evidence to consider them as different species.

Biology/hosts. Unknown.

Distribution. Widely distributed in New Zealand (Fig. 10). Records cover most of the North Island (except for its southern tip), as well as the northern half of the South Island. The lack of records in the lower North Island (and perhaps also in the lower half of the South Island) most likely represent under-collecting in those areas rather than true absence.

Etymology. The name refers to the variable number of antennal segments in males and females, as well as other variable characters (e.g. coloration of specimens, extension of the notauli sulci and propodeal carinae).

Discussion

Kiwigaster could be the sister group of the rest of Microgastrinae based on two characters found in other wasps but not in other Microgastrinae: i.e. variable number of antennal segments and enlarged anterior tentorial pits. The flagellum of the antenna being fixed at 16 segments has been considered one the strongest apomorphies defining Microgastrinae (Mason, 1981, 1983) and thought to be unique to the group (Whitfield & Mason 1994). As for the enlarged anterior tentorial pits, within the Microgastroid assemblage (sensu Whitfield and Mason 1994; Murphy *et al*. 2008), they are only present in Mendesellinae and some Ichneutinae (Whitfield & Mason 1994).

However, we still consider *Kiwigaster* to belong to the Microgastrinae because it has most of the other diagnostic subfamily features, e.g. first metasomal tergum with the spiracles on the laterotergites, forewing with reduced venation apically, metatarsus with a median ridge of closely appressed setae, flagellomere with two ranks of placodes (different in a few Microgastrinae), apical margin of clypeus concave, revealing the labrum; labial palps with three segments and maxillary palps with five.

Kiwigaster also has a series of features that could be considered as plesiomorphic within microgastrines based on previous morphology-based phylogenetic analyses, although convincing well-supported phylogenies are not yet available:

1. Metacoxae small, less than 3X the size of the mesocoxae, extending to the posterior end of tergite 1, and not surpassing 1/3 of the metasomal length.
2. Metatibial spines very short, less than half the length of the first segment of metatarsus.
3. Mesoscutum with well defined and deeply impressed notauli with numerous costulae throughout their entire length.

4. Forewing with an enlarged areolet, its length more than half the stigma length, its height almost the width of the stigma.
5. Propodeum with an areola bounded by strong and well defined carinae, although the areola is more or less open anteriorly.
6. Lateral face of scutellum almost completely smooth,.
7. Ovipositor sheaths about the same length as metatibia and fully covered by setae.
8. Hind wing with a small vannal lobe.

Of the abovementioned characters, *Kiwigaster* shares #1–3 with the Microplitini *sensu* Mason (1981), i.e. *Alloplitis*, *Microplitis*, *Philoplitis* and *Snellenius*. Character #5 also seems to be the ground plan for Microplitini (e.g. *Alloplitis*) but the areola has undergone a series of reductions and modifications within this group of genera. Altogether, Microplitini differs from *Kiwigaster* mainly in the hypopygium, ovipositor sheath setosity and length (character #7); this tribe seems to be a group that separated early from the rest of Microgastrinae, and evolved towards parasitizing Macrolepidoptera (Banks & Whitfield 2006).

The large areolet (character #4) is also present in some putatively primitive genera (e.g. *Semionis, Pelicope*) which are difficult to assign to a group of Microgastrinae. The complete areola bounded by carina (character #5) seems to be the ground plan within Microgastrinae, with the areola suffering many stages of reductions/modifications (see Mason 1981 for details; although that account is not complete). The almost completely polished lateral face of the scutellum (character #6) is likely unique. A few species of Microgastrinae have an enlarged smooth area –but not as complete as *Kiwigaster.*

Character #7 mostly fits with the "Microplepidoptera suite" of ovipositor characters (sensu Mason, 1981), although in *Kiwigaster* the hypopygium is mostly inflexible with only a fold ventrally (as in many *Pholetesor* – Whitfield 2006). The Microplepidoptera suite of characters has been the subject of considerable debate and analysis as to which character states are likely to be plesiomorphic (Williams 1985; Austin 1990; Whitfield *et al*. 2002). The small vannal lobe (character #9) is also present in some putatively isolated genera such as *Prasmodon* and *Larissimus*.

A full consideration of the phylogenetic position of *Kiwigaster* can only be realized when a comprehensive phylogenetic analysis, incorporating both morphological and molecular evidence, is conducted. The last taxonomically relatively comprehensive analysis of genera was by Whitfield *et al*. (2002), but that analysis made clear that much larger amount of additional data was needed to resolve relationships. Banks and Whitfield (2006) added additional nuclear protein-coding genes, but with lower taxonomic coverage. With the addition of *Kiwigaster* and a number of other as yet molecularly unsampled genera, and armed with a large battery of genes, we will be in a much better position to provide a strong phylogeny-based classification in the near future.

Acknowledgments

This research was supported by the New Zealand Foundation for Research, Science and Technology through backbone funding of the "Defining New Zealand's Land Biota" programme; and an International Mobility Fund grant awarded to DFW and JFT. The manuscript benefited from the reviews of Andrew Austin and John Jennings (University of Adelaide, Australia).

References cited

Austin, A.D. (1990) Revision of the enigmatic Australasian genus *Miropotes* Nixon (Hymenoptera: Braconidae: Microgastrinae), with comments on the phylogenetic importance of the female ovipositor system. *Systematic Entomology*, 15, 43–68.

Banks, J.C. & Whitfield, J.B. (2006) Dissecting the ancient rapid radiation of microgastrine wasp genera using additional nuclear genes. *Molecular Phylogenetics and Evolution*, 41, 690–703.

Buckley, T.R., Marske, K. & Attanayake, D. (2010) Phylogeography and ecological niche modelling of the New Zealand stick insect Clitarchus hookeri (White) support survival in multiple coastal refugia. *Journal of Biogeography*, 37, 682–695.

Cooper, A. & Cooper, R.A. (1995) The Oligocene bottleneck and New Zealand biota: genetic record of a past environmental crisis. *Proceedings of the Royal Society B: Biological Sciences*, 261, 293–302.

Crosby, T.K., Dugdale, J.S. & Watt, J.C. (1998) Area codes for recording specimen localities in the New Zealand subregion.

New Zealand Journal of Zoology, 25, 175–183.
Dugdale, J.S. (1988) *Lepidoptera-Annotated Catalogue and Keys to Family Group Taxa*. *Fauna of New Zealand 14*. DSIR Publishing, Wellington, 264 pp.
Early, J.W., Masner, L., Naumann, I.D. & Austin, A.D. (2001) Maamingidae, a new family of proctotrupoid wasp (Insecta : Hymenoptera) from New Zealand. *Invertebrate Taxonomy*, 15, 341–352.
Fleming, C.A. (1979) *The Geological History of New Zealand and its Life*. Auckland University Press, Auckland, 141 pp.
Li, Z.X. & Powell, C.McA. (2001) An outline of the paleogeographic evolution of the Australasian region since the beginning of the Neoproterozoic. *Earth Sciences Reviews*, 53, 237–277.
Marra, M. & Leschen, R.A.B. (2004) Late Quaternary paleoecology from fossil beetle communities in the Awatere Valley, South Island, New Zealand. *Journal of Biogeography*, 31, 571–586.
Mason W.R.M. (1981) The polyphyletic nature of *Apanteles* Foerster (Hymenoptera: Braconidae): a phylogeny and reclassification of Microgastrinae. *Memoirs of the Entomological Society of Canada*, 115, 1–147.
McLoughlin, S. (2001) The breakup history of Gondwana and its impact on pre-Cenozoic floristic provincialism. *Australian Journal of Botany*, 49, 271–300.
Murphy, N., Banks, J.C., Whitfield, J.B. & Austin, A.D. (2008) Phylogeny of the microgastroid complex of subfamilies of braconid parasitoid wasps (Hymenoptera) based on sequence data from seven genes, with an improved estimate of the time of origin of the lineage. *Molecular Phylogenetics and Evolution*, 47, 378–395.
Naumann, I.D. (1988) *Ambositrinae (Insecta: Hymenoptera: Diapriidae). Fauna of New Zealand 15*. DSIR Publishing, Wellington, 168 pp.
Valentine, E.W. & Walker, A.K. (1991) *Annotated Catalogue of New Zealand Hymenoptera*. DSIR Plant Protection Report 4, General Printing Services, 84 pp.
Valerio, A.A., Whitfield, J.B. & Janzen, D.H. (2009) Review of world *Parapanteles* Ashmead (Hymenoptera: Braconidae: Microgastrinae), with description of fourteen new Neotropical species and the first description of the final instar larvae. *Zootaxa*, 2084, 1–49.
Ward, D.F. (2011) *Poecilocryptus zealandicus* sp. n. (Hymenoptera: Ichneumonidae: Labeninae) from New Zealand. *New Zealand Entomologist*, 34, 37–39.
Ward, D.F. & Goulet, H. (2011) *Moaxiphia gourlayi* sp. n. (Hymenoptera: Xiphydriidae) a new endemic woodwasp from New Zealand. *New Zealand Entomologist*, 34, 1–4.
Whitfield, J.B. (2006) Revision of the Nearctic Species of the Genus *Pholetesor* Mason (Hymenoptera: Braconidae). *Zootaxa*, 1144, 1–94.
Whitfield, J.B., Mardulyn, P., Austin, A.D. & Dowton, M. (2002) Phylogenetic analysis of relationships among microgastrine braconid wasp genera based on data from the 16S, COI and 28S genes and morphology. *Systematic Entomology*, 27, 337–359.
Whitfield, J.B. & Mason, W.R.M. (1994) Mendesellinae, a new subfamily of braconid wasps (Hymenoptera, Braconidae) with a review of relationships within the microgastroid assemblage. *Systematic Entomology*,19, 61–76.
Williams, D.J.M. (1985) The New World genus *Lathrapanteles* n. gen.: phylogeny and placement in the Microgastrinae (Hymenoptera: Braconidae: Cotesiini). *Canadian Journal of Zoology*, 63, 1962–1981.
Yu, D., van Achterberg, K. & Horstmann, K. (2005) World Ichneumonoidea 2004. Taxonomy, Biology, Morphology and Distribution. CD/DVD. Taxapad, Vancouver, Canada.