



The gasteruptiid wasp fauna of New Caledonia, with description of three new species of *Gasteruption* (Hymenoptera: Evanioidea: Gasteruptiidae)

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Abstract

The rarely collected gasteruptiid wasp fauna (Evanioidea: Gasteruptiidae) of New Caledonia is reviewed. Previously only two species of *Pseudofoenus* (Hyptiogastrinae) were known. Here, we record the subfamily Gasteruptiinae from New Caledonia for the first time and describe three new species of *Gasteruption*: *G. lacoulee* Jennings, Krogmann & Parslow, **sp. nov.**, *G. maquis* Jennings, Krogmann & Parslow, **sp. nov.**, and *G. sarramea* Jennings, Krogmann & Parslow, **sp. nov.** An identification key to the Gasteruptiidae of New Caledonia is provided.

Key words: Gasteruptiinae, Hyptiogastrinae, *Gasteruption*, new species, taxonomy, predator-inquiline

Introduction

For decades the New Caledonian biota has been viewed as a Gondwanan ‘museum’ with many relictual taxa, but Grandcolas *et al.* (2008) suggested that the biota are not that of a continental island which has retained many relict groups, but is that of an oceanic island with a rich local biota dominated by recent radiations following many dispersal events. Recent reviews and studies, including those by Grandcolas *et al.* (2008), Murienne (2009), Espeland & Murienne (2011) and Cruaud *et al.* (2012), have revealed complex scenarios which might explain the origin of the New Caledonian biota, including the ‘museum model’ or ‘Noah’s Ark model’ which implies that the origin and diversification of New Caledonian lineages predates any submersion event(s), or diversification after submersion(s) of New Caledonia, either with or without a series of mountain and/or island refugia and long-distance dispersal. Murienne (2009) concluded that all three models could exhibit identical phylogenetic patterns. Molecular dating, such as with *Angustonicus* cockroaches (Murienne *et al.* 2005), could at least discern between the first and last models.

The Hymenoptera fauna of New Caledonia has been reviewed recently and illustrates such disharmonic patterns regarding the composition of the fauna (Jennings *et al.* 2013). The fauna appears to have strong Australasian affinities as well as links with the rest of the south-west Pacific, including Vanuatu and Fiji. Symphytans and several apocritan superfamilies are under-represented in the New Caledonian fauna, but Jennings *et al.* (2013) suggest that species numbers in groups such as Apoidea, Chalcidoidea, Evanioidea, Platygastroidea, and Vespoidea are probably low as a result of under-collecting.

Evanioidea are represented in New Caledonia by Aulacidae, Evaniidae and Gasteruptidae, with each family known only from a few species (Balhoff *et al.* 2013; Jennings & Austin 2013).

The Gasteruptiidae (Evanioidea) is a distinctive family of wasps easily recognised by a slender, subclavate metasoma, elongate, neck-like propleura, and clavate hind tibia (Jennings & Austin 2002). Gasteruptiids are predator-inquilines of solitary bees (*Apidae s.l.*) and possibly aculeate wasps (*Sphecidae* and *Vespidae*) (Crosskey 1951; Jennings & Austin 1997, 2002, 2004; Jennings & Deans 2006). Gasteruptiidae is represented by perhaps

1,500 species worldwide (Jennings and Austin 2002) of which about 500 are described. In Australia, there are some 114 described species (Jennings 2010; Jennings & Parslow 2014), however this probably represents less than 30% of the Australian fauna (Jennings unpubl.). Jennings & Austin (2002) and Macedo (2009) have reviewed the taxonomic history of the family.

The family is divided into two monophyletic units, Hyptiogastrinae and Gasteruptiinae (Jennings & Austin 2000). The Hyptiogastrinae comprise two genera—*Hyptiogaster* Kieffer and *Pseudofoenus* Kieffer—the former being confined to Australia (Jennings & Austin 1997). *Pseudofoenus* are almost entirely Australasian (Australia, Fiji, New Caledonia, New Guinea, New Zealand, and Vanuatu), except for two species from South America (Jennings & Austin 2002). Two species of *Pseudofoenus* are known from New Caledonia; *P. caledonicus* Jennings & Austin and *P. ritae* (Cheesman). Most species of Gasteruptiinae belong to the large and cosmopolitan genus *Gasteruption* L., although several Central and South American species have been assigned recently to three small genera; *Plutofoenus* Kieffer (3 spp.—southern South America), *Spinolafoenus* Macedo (1 sp.—Chile) and *Trilobitofoenus* Macedo (3 spp.—Central and South America) (Macedo 2009).

To date, no Gasteruptiinae have been described from New Caledonia. Here we review the rarely collected gasteruptiid fauna of New Caledonia, describe three new species of *Gasteruption* listed in the catalog of New Caledonian Hymenoptera by Jennings *et al.* (2013), and provide a key for their identification.

Material and methods

Prior to image capture, specimens were cleaned using absolute ethanol applied with a fine brush to remove obvious dirt and debris. Images were taken using a Visionary Digital BK+ imaging system with either a Canon EOS 5D Mark II camera or Canon EOS 7D Mark II camera. Images were produced using Zerene Stacker, Zerene Systems LLC, software and cropped and resized in Photoshop CS5.

Morphological terminology follows that of Sharkey & Wharton (1997) except for surface sculpturing which follows Harris (1979). The abbreviations T1, T2, etc are used for metasomal tergites; ts1 to ts5 are used in the descriptions for tarsomeres.

The authors searched various insect collections for specimens, particularly those of the Institut de recherche pour le développement, Nouméa, New Caledonia; Muséum national d'Histoire naturelle (MNHN), Paris; and Queensland Museum (QM), Brisbane. The QM houses material collected from a survey by Monteith *et al.* (2006) of four conservation reserves in southern New Caledonia. All type material is deposited in MNHN.

Key to the Gasteruptiidae of New Caledonia

1. Mandibles long and broadly overlapping when in closed position; prefemur absent; first discal cell formed by fore wing vein 1-Rs+M intersecting basal cell about one-quarter to one-third distance from M+Cu (Fig. 5) or (rarely) first discal cell absent and veins 1-Rs+M and 1-Cu(b) fused to form Rs+M+Cu(b), veins 1-M and m-cu absent; female subgenital sternite simple; ovipositor short and usually hidden (exserted in *Hyptiogaster* from Australia) (Hyptiogastrinae) 2
2. Mandibles short and not broadly overlapping when in closed position; prefemur generally present, sometimes indicated by a slightly differentiated basal swelling; first discal cell generally formed by fore wing veins 1-Rs+M, 1-Cu, 2-Cu and 1m-cu (Figs 2–4) or (rarely) first discal cell absent; fore wing vein Rs+M+Cu generally very short (Figs 2–4), sometimes forming a node with 1-Rs, M+Cu, 1-Cu and 1-Rs+M; fore wing vein 1-M absent; female subgenital sternite notched; ovipositor exserted (Gasteruptiinae) 3
2. Two distinct medial teeth on mandible; frontal carina present; head and body dark brown to black; body length 9.4 mm (8.7–10.0 mm) *Pseudofoenus caledonicus* Jennings & Austin
- Single weak medial tooth on mandible; frontal carina absent; head and body red-brown; body length 8.0 mm (range 7.5–8.5 mm) *Pseudofoenus ritae* (Cheesman)
3. Large species, length 25.7 mm; fore wing vein 2-M tubular in apical third, tubular portion ending with small node (Fig. 3); hind wing with 2m+Cu melanised, 1-Cu, 1-m and r-m present (Fig. 3) *Gasteruption maquis* **sp. nov.** Jennings, Krogmann & Parslow
- Small species, length less than 12 mm; fore wing vein 2-M tubular in apical third, tubular portion not ending with small node (Figs 2, 4); hind wing with not melanised 2m+Cu, 1-Cu, 1-m and r-m absent (Fig. 2)
4. Head more or less quadrate, 0.94 x as long as wide when viewed dorsally; propleuron short, 0.84 x length pronotum (Figs 6, 12); frontal carina present *Gasteruption lacoulee* **sp. nov.** Jennings, Krogmann & Parslow
- Head elongate, 1.48 x longer than wide when viewed dorsally; propleuron long, 1.64 x length pronotum (Figs 10, 16); frontal carina absent *Gasteruption sarramea* **sp. nov.** Jennings, Krogmann & Parslow

Systematics of Gasteruptiidae from New Caledonia

Family Gasteruptiidae Ashmead, 1900

Subfamily Hyptiogastrinae Crosskey, 1953

See Jennings & Austin (2002) for taxonomic history.

Pseudofoenus Kieffer, 1902

See Jennings & Austin (2002) for taxonomic history.

New Caledonian species:

Pseudofoenus caledonicus Jennings & Austin 2005: 416.

Pseudofoenus ritae (Cheesman 1936): 176; Jennings & Austin 2005: 417 [compared with *P. caledonicus*].

Subfamily Gasteruptiinae Ashmead, 1900

Gasteruptioninae (in part) Ashmead, 1900: 7–8.

Gasteruptiinae (in part): Schulz, 1906: 133 [emendation]. See Crosskey (1962) for taxonomic history and list of synonyms, and Macedo (2009) for recent taxonomic changes.

Gasteruption Latreille, 1796

Gasteruption Latreille, 1796: 113–114 [description]. See Crosskey (1962) and Carlson (1979) for taxonomic history and list of synonyms.

Gasteruption lacoulee sp. nov. Jennings, Krogmann & Parslow

Figs 1, 2, 6–7, 12–13

Material examined. *Holotype*: ♂, “New Caledonia: Bank La Coulee River, 22 14.153S, 166 34.155E, sweeping, 29.xi.2009, J.T. Jennings” (MNHN). Missing right fore tarsi, left fore leg ts2–5 and claw, right mid leg ts3–5 and claw, left mid leg trochanter onwards, entire left hind leg; metasoma in gelatine capsule; genitalia not visible.

Male. *Length.* 9.60 mm.

Colour. Black, except antennae and metasoma dark brown, mandibles largely cream except brown at apex and base; fore and mid legs brown, lateral tibia white, and basitarsus white, ts2 brown; hind leg brown, inner lateral surface of tibia paler, basitarsus cream in apical half, ts2–ts4 cream, ts5 and claws brown; wings hyaline, veins and pterostigma brown.

Head. More or less quadrate in dorsal view, 0.94 x longer than wide; face and frons punctulate, with long pubescence, indistinct frontal carina; vertex punctulate, short pubescence; occipital carina narrow; gena punctulate, with long pubescence; malar space 0.10 x height eye; clypeus 5.08 x as wide as high, margin sinuate, with long setae; mandibles broad, with one large medial tooth; distance from lateral ocellus to eye margin 0.65 x distance between lateral ocelli; scape 0.70 x length pedicel; first flagellomere 0.70 x as long as scape, 0.56 x length second flagellomere.

Mesosoma. Propleuron 0.88 x length pronotum, punctulate, dense long pubescence; pronotum punctulate, pubescent; mesoscutum (Figs 6–7) in lateral view rounded antero-dorsally, medial and lateral lobes punctulate, with short pubescence, parapsidal lines indistinct; notauli more or less V-shaped, crenulated (Fig. 7); mesoscutellum and axillae punctulate; mesopleuron and metapleuron areolate-rugose; mesopleural groove broad, rugose (Fig 7); propodeum areolate-rugose, posterior margin weakly scrobiculate medially; hind coxa strigate-

rugose; hind trochanter rugulose, groove present; femur imbricate, with very short pubescence; prefemur small, about one-third length of trochanter; hind tibia imbricate, generally short pubescence, longer near apex; hind femur 1.03 x length hind tibia; hind tibia and tarsi without ventro-apical pecten of short robust spines; hind ts1, 3.15 x length ts2; ts2, 1.60 x length ts3; ts3, 1.20 x length ts4; ts4 0.63 x length ts5; hind tarsal claw 0.50 x length ts5; fore wing with first discal cell subtrapezoidal, formed by veins 1-Rs+M, 1-Cu, 2-Cu and 1m-cu; fore wing vein 2-M tubular in apical third, tubular portion not ending with small node, remaining two-thirds nebulous (Fig. 2); hind wing with only vein R+Rs (Fig. 2), two hamuli on right wing and three equidistant hamuli on left wing.

Metasoma. 3.36 x length of mesosoma; tergites punctulate.

Female Unknown

Etymology. This species is named after the type locality, La Coulée River, Grand Terre, New Caledonia.

Comments. *Gasteruption lacoulee* **sp. nov.** and *G. sarramea* **sp. nov.** are similar in size (9.6 and 10.5 mm respectively), but both species are much smaller than *G. maquis* **sp. nov.** (25.7 mm). The former two species can be readily distinguished from each other by the more or less quadrate head in *G. lacoulee* (Figs 12–13) versus the distinctive elongate head in *G. sarramea* (Figs 16–17).

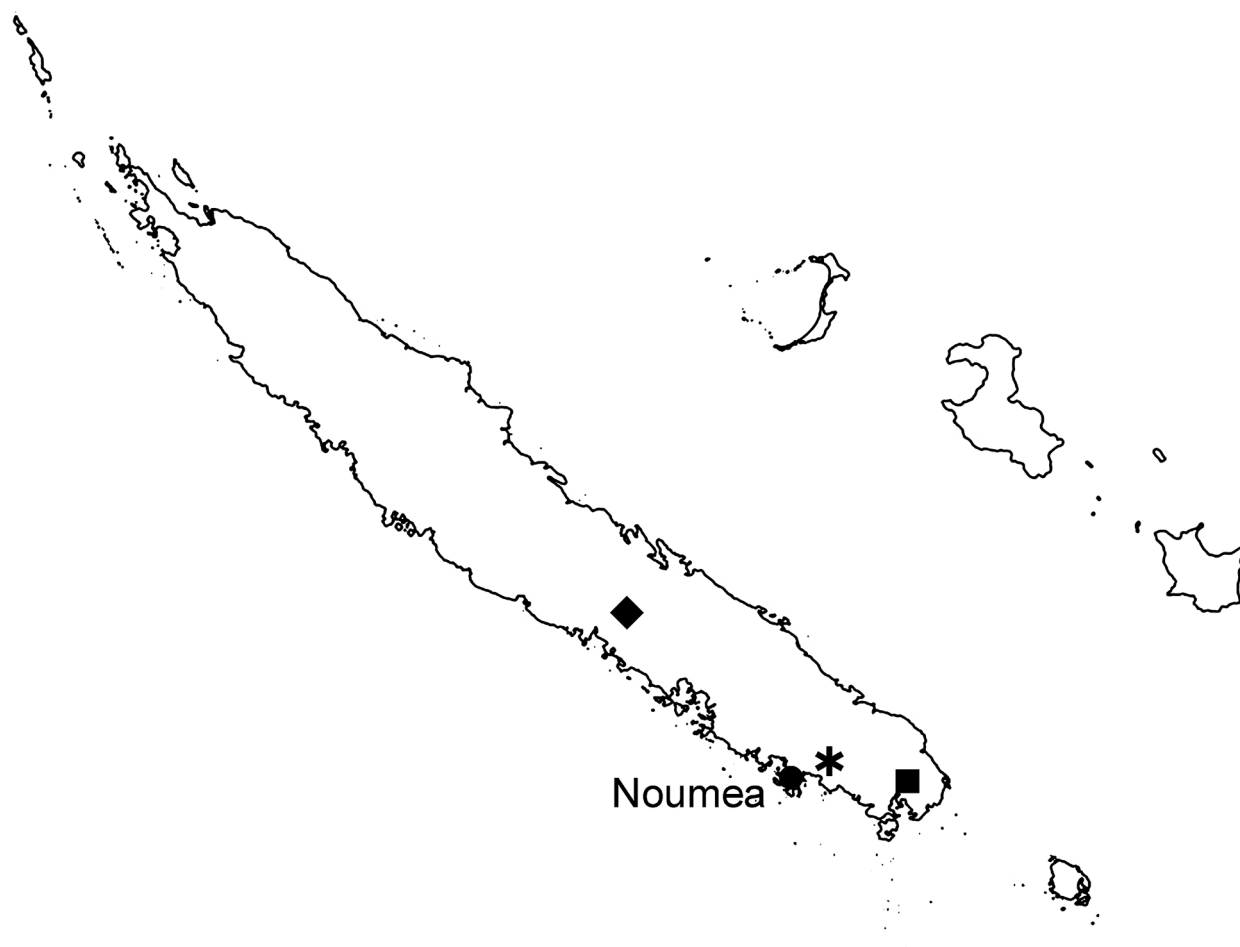
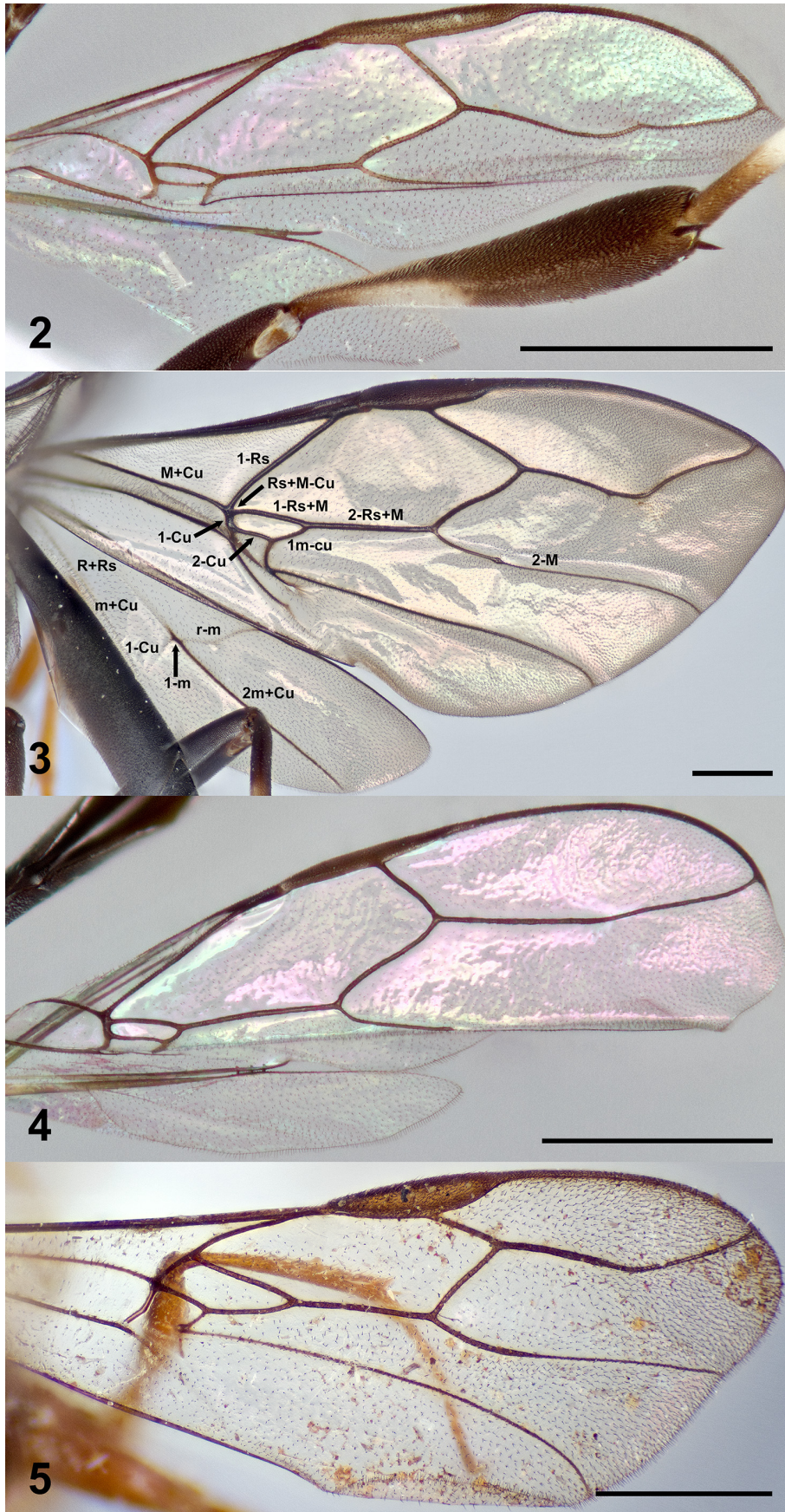


FIGURE 1. Map of New Caledonia showing type localities of *Gasteruption lacoulee* **sp. nov.** (*), *G. maquis* **sp. nov.** (■), and *G. sarramea* **sp. nov.** (◆).

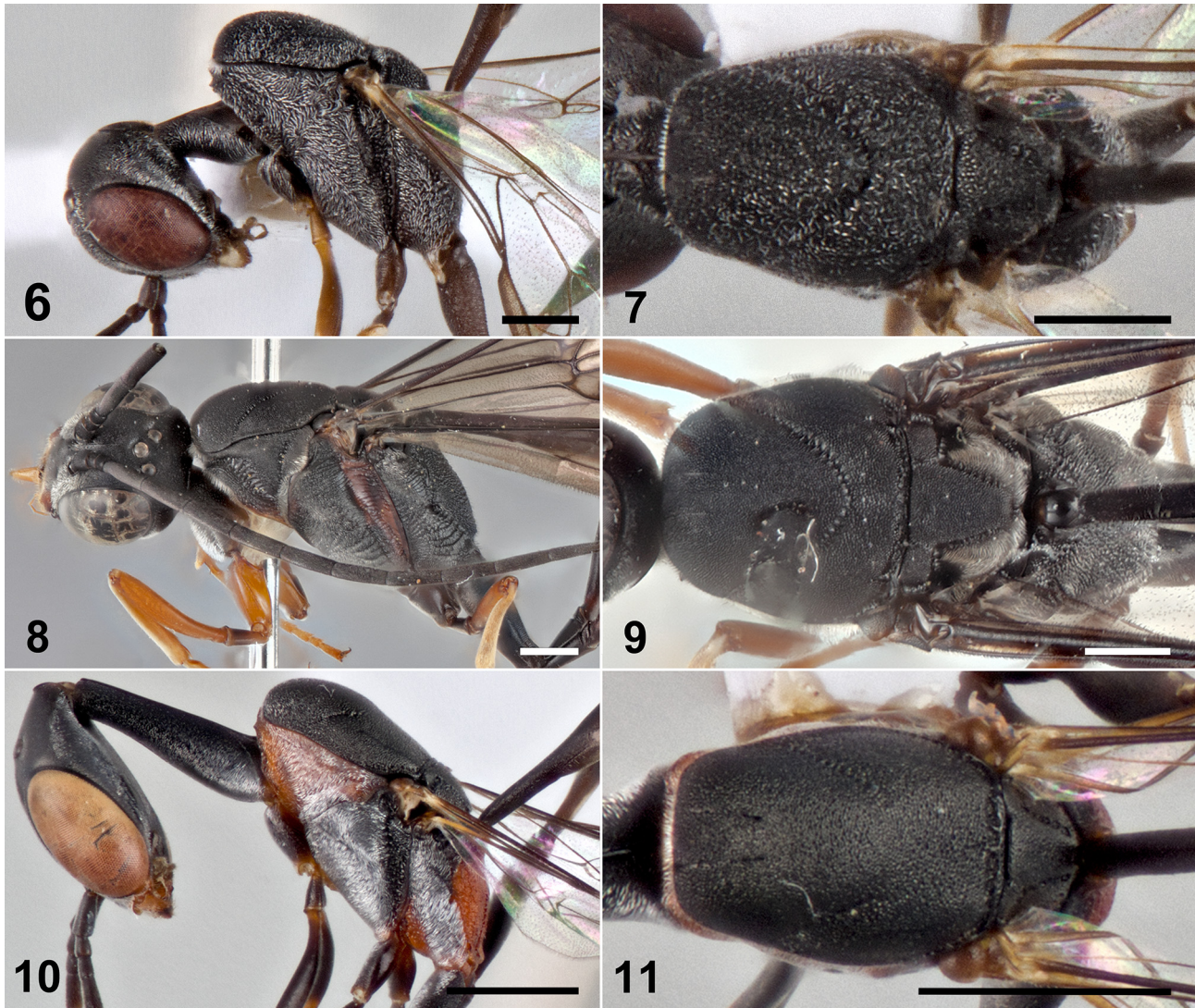
***Gasteruption maquis* sp. nov. Jennings, Krogmann & Parslow**

Figs 1, 3, 8–9, 14–15

Material examined. *Holotype*: ♂, “NEW CALEDONIA, 11844, 22° 17’S X 166° 53’E, 250m Pic du Grand Kaori, site 2, 1Dec2004, S.G. Wright”, Hand netting, maquis” “Photog. spm. PS0986 QM” (MNHM). Right antenna missing flagellomeres four to tip and left hind leg missing T5 and claw.



FIGURES 2–5. Right wings of (2) *Gasteruption lacoulee* sp. nov., (3) *G. maquis* sp. nov., (4) *G. sarramea* sp. nov., (5) *Pseudofoenus ritae*. Scale bar = 1 mm.



FIGURES 6–11. Lateral head and mesosoma of *Gasteruption lacoulee* sp. nov. (6), *G. maquis* sp. nov. (8) and *G. sarramea* sp. nov. (10); dorsal mesosoma of *G. lacoulee* sp. nov. (7), *G. maquis* sp. nov. (9) and *G. sarramea* sp. nov. (11). Scale bars 6–7 = 0.5 mm; 8–11 = 1 mm.

Male. Length. 25.7 mm.

Colour. Head, mesosoma and metasoma black; lateral clypeus and mouthparts orange-brown, mandibles slightly darker; fringe of golden brown hairs on margin of clypeus; mesopleural groove brown; fore leg orange-brown; mid leg dark brown, except apical half of femur, tibia and basal half of basitarsus orange-brown; hind leg dark brown, slightly lighter near join of femur and tibia, apical half of basitarsus and remainder of tarsus cream; wings hyaline, with veins and pterostigma dark brown.

Head. More or less quadrate in dorsal view, 0.90 x longer than wide when viewed dorsally; face punctulate, pubescent laterally (Fig. 15); frons with frontal carina, punctulate; vertex punctulate, with short setae; gena punctulate, pubescent; malar space 0.14 x height eye; clypeus 3.22 x as wide as high, margin slightly concave; mandibles broad, with one large medial tooth; distance from lateral ocellus to eye margin 0.73 x distance between lateral ocelli; scape 1.60 x length pedicel; first flagellomere 1.97 x as long as scape, 0.77 x length second flagellomere.

Mesosoma. Propleuron 0.80 x length pronotum, punctulate, pubescence long at base and near apex; pronotum rugose ventrally, punctulate dorsally, divided by scrobiculate groove; mesoscutum (Figs 8–9) in lateral view rounded antero-dorsally, medial and lateral lobes punctulate, with short setae, divided by crenulated U-shaped groove (Fig. 9); parapsidial lines distinct; notauli indistinct, percurrent; mesoscutellum and axillae punctulate; mesopleuron and metapleuron punctulate-strigate, coarser in meso- and metepisterna; mesopleural groove broad

(Fig 8), smooth, weakly strigate dorsally grading to punctulate-rugose antero-ventrally; propodeum areolate-rugose, posterior margin weakly scrobiculate; hind coxa imbricate, dorsally finely strigate; hind trochanter imbricate, groove present; femur imbricate, pubescence short; prefemur small, about half length of hind trochanter; hind tibia imbricate, pubescence short, dense; hind femur 0.61 x length hind tibia; hind tarsomeres 1-5 with ventro-apical pecten of short robust spines, ts1, 3.34 x length ts2; ts2, 1.37 x length ts3; ts3, 1.90 x length ts4; ts4, 0.47 x length ts5; hind tarsal claw 1.45 x length ts5; fore wing with first discal cell subtrapezoidal, formed by veins 1-Rs+M, 1-Cu, 2-Cu and 1m-cu; fore wing vein 2-M tubular in basal third, tubular portion ending with small node, remaining two-thirds nebulous (Fig. 3); hind wing, vein M+Cu mostly nebulous, with short apical portion tubular where it joins 1-Cu, r-m nebulous, 2M+Cu tubular, 1-M tubular and 1-Cu spectral, with three hamuli, not equidistant, basal hamulus separate from other two.

Metasoma. 3.96 x length of mesosoma; tergites punctulate; aedeagus about same length as basiparameres.

Female. Unknown

Etymology. The species is named after the sclerophyllous scrubland (maquis minier) of Grand Terre, New Caledonia in which the type specimen was caught.

Comments. With a body length of 25.7 mm, *G. maquis* sp. nov. is much larger than the other two New Caledonian species, both of which are less than 12 mm in length. Of the three New Caledonian species, *G. maquis* is the only species with a more or less complete hind wing venation (Fig. 3). *Gasteruption maquis* can also be distinguished by the tubular portion of the fore wing vein 2-M ending with a small node, whereas in the other two species (Figs 2, 4), the node is absent.

***Gasteruption sarramea* sp. nov. Jennings, Krogmann & Parslow**

Figs 1–2, 8–9, 14–15

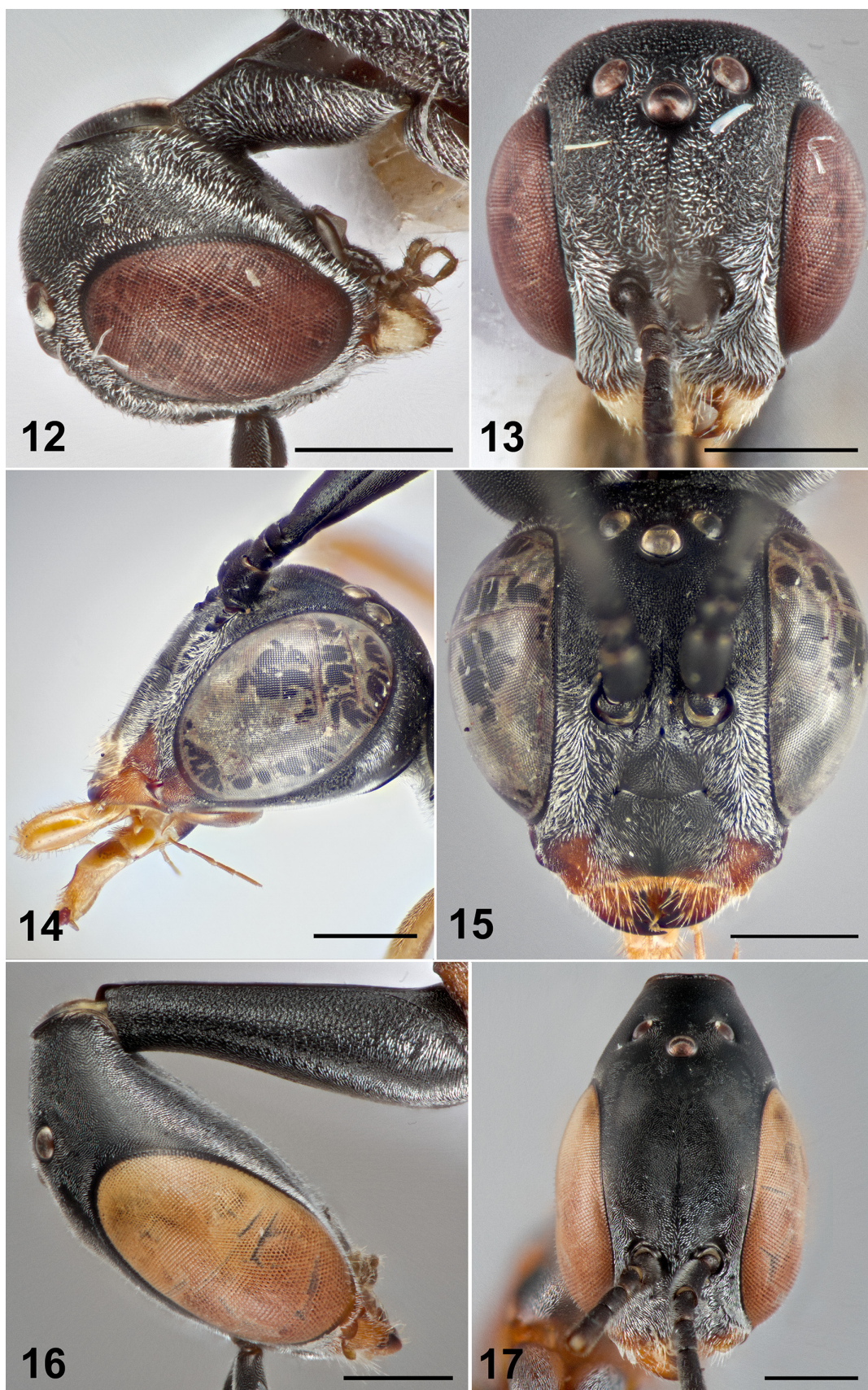
Material examined. *Holotype*: ♀, “New Caledonia: near Sarramea. Sweeping, 21 39.506S, 165 49.672E. 28.xi.2009, J.T. Jennings” (MNHN). Antenna, legs and ovipositor sheaths broken off; in gelatine capsule.

Female. *Length*. 10.5 mm, excluding ovipositor.

Colour. Head black, antennae dark-brown, mandibles orange-brown, apical tooth dark brown; lateral clypeus orange-brown; metasoma black dorsally, pronotum orange-brown, mesopleuron and metepimeron black, metapleuron black, except anterior lower third metepisternum orange; propodeum orange; legs generally dark brown; fore legs pale orange on apex of coxa, apex and base of trochanter, femur and tibia, dorsal surface of fore tibia pale orange; posterior surface of mid coxa orange-brown, basal third and dorsal surface mid tibia cream; inner basal surface hind coxa with orange spot, hind tibia cream basally inner surface, basal half basitarsus cream; wings hyaline; wing veins and pterostigma dark brown; ovipositor brown, sheaths dark brown, tip cream.

Head. Head elongate, 1.48 x longer than wide when viewed dorsally; face punctulate, pubescent; frons without frontal carina, punctate near antennal scrobes, with punctulate microsculpture, pubescence denser near scrobes; vertex with punctulate microsculpture; occipital carina narrow; gena with scattered punctures, punctulate microsculpture, and short pubescence; malar space 0.04 x height eye; clypeus 3.04 x as wide as high, margin sinuate, with scattered long setae; mandibles broad, with one large medial tooth; distance from lateral ocellus to eye margin 1.00 x distance between lateral ocelli; scape 2.00 x length pedicel; first flagellomere 0.49 x as long as scape, 0.57 x length second flagellomere.

Mesosoma. Propleuron 1.64 x length pronotum (Figs 10, 16); propleuron and pronotum with three distinct lobes, punctulate microsculpturing, and dense, short pubescence; mesoscutum (Figs 10–11) in lateral view rounded antero-dorsally, medial and lateral lobes with punctulate microsculpture, and very short setae; parapsidial lines distinct; notauli U-shaped, scrobiculate, indistinct (Fig. 11); mesoscutellum and axillae with punctulate microsculpture; mesopleuron and metapleuron areolate-rugose, except mesepimeron punctulate, dense, short pubescence; mesopleural groove broad, rugose (Fig. 10); propodeum areolate-rugose, flattened medial carina, posterior margin weakly scrobiculate medially; hind coxa punctate-rugulose; trochanter rugulose, groove present; hind femur imbricate with a few scattered punctures, pubescence short; prefemur small, about one-third length of trochanter; hind tibia imbricate with a few scattered punctures, pubescence short; hind femur 0.76 x length hind tibia; hind tibia without ventro-apical pecten of short robust spines; hind tarsomeres 1–5 with ventro-apical pecten of short robust spines, ts1, 3.46 x length ts2; ts2, 1.41 x length ts3; ts3, 1.70 x length ts4; ts4 0.48 x length ts5; hind



FIGURES 12–17. Lateral head of (12) *Gasteruption lacoulee* sp. nov., (14) *G. maquis* sp. nov. and (16) *G. sarramea* sp. nov. and frontal head of (13) *G. lacoulee* sp. nov., (15) *G. maquis* sp. nov. and (17) *G. sarramea* sp. nov. Scale bars 12–13, 16–17 = 0.5 mm; 14–15 = 1 mm.

tarsal claw 0.62 x length ts5; fore wing with first discal cell subtrapezoidal formed by veins 1-Rs+M, 1-Cu, 2-Cu and 1m-cu; fore wing vein 2-M tubular in basal third, not ending with small node, remaining two-thirds nebulous (Fig. 4); hind wing with only vein R+Rs, three equidistant hamuli.

Metasoma. 2.64 x length of mesosoma; T1 punctate-rugulose; T2 with imbricate microsculpture with a few small punctures dorso-posteriorly, remaining tergites with imbricate microsculpture, scattered punctures dorsally, pubescence short; subgenital sternite with Y-shaped notch; exerted part of ovipositor 1.57 mm.

Male. Unknown.

Etymology. This species is named after the type locality, Sarramea, Grand Terre, New Caledonia.

Comments. *Gasteruption sarramea* **sp. nov.** has a distinctive elongate head (Figs 10, 16–17), making it readily distinguishable from both *G. lacoulee* **sp. nov.** (Figs 12–13) and *G. maquis* **sp. nov.** (Figs 14–15), both of which have a more-or-less quadrate head when viewed dorsally. Also, the propleuron of *G. sarramea* (Figs 10, 16) is much longer than the propleuron in either *G. lacoulee* (Figs 6, 12) or *G. maquis*.

Discussion

Jennings *et al.* (2013) cataloged the hymenopteran fauna of New Caledonia and compared it with that of Australia and New Zealand. They listed a total of 188 described species of Gasteruptionidae from Australia (113 Gasteruptioninae [now 114 species—Jennings & Parslow 2014], 75 Hyptiogastrinae), five from New Zealand (three Gasteruptioninae and two Hyptiogastrinae), and two Hyptiogastrinae (*Pseudofoenus*) from New Caledonia. *Pseudofoenus caledonicus* is endemic to New Caledonia, whereas *P. ritae* is also found on Vanuatu (Jennings & Austin 2002, 2005). Jennings & Austin (2002) found a close relationship between these two *Pseudofoenus* species, as well as others from Fiji and New Guinea, although they formed a trichotomy with strictly Australian taxa. Jennings and Austin (2002) suggested that the fauna from New Caledonia has resulted from dispersal events from mainland Australia and/or New Guinea.

With the addition of three new *Gasteruption* species, the gasteruptionid wasp fauna of New Caledonia is now the same size as that of New Zealand. However, we expect that additional collecting will lead to the discovery of further species.

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References

- Ashmead, W.H. (1900) Classification of the ichneumon flies, or the superfamily Ichneumonoidea. *Proceedings of the U. S. National Museum*, 23, 1–220.
<http://dx.doi.org/10.5479/si.00963801.23-1206.1>
- Balhoff, J.P., Mikó, I., Yoder, M.J., Mullins, P.L. & Deans, A.R. (2013) A semantic model for species description, applied to the ensign wasps (Hymenoptera:Evaniidae) of New Caledonia. *Systematic Biology*, 62 (5), 639–59.
<http://dx.doi.org/10.1093/sysbio/syt028>
- Carlson, R.W. (1979) Superfamily Evanioidea. In: Krombein, K.V., Hurd, P.D., Smith, D.R. & Burks, B.D. (Eds.), *Catalog of the Hymenoptera in America North of Mexico. Vol. 1. Symphyta and Apocrita (Parasitica)*. Smithsonian Institution Press, Washington, D.C., pp. 1109–1118. [total page number: 1198 pp.]
- Cheesman, L.E. (1936) Hymenoptera of the New Hebrides and Banks Islands. *Transactions of the Royal Entomological Society London*, 85, 169–196.
<http://dx.doi.org/10.1111/j.1365-2311.1936.tb00131.x>
- Crosskey, R.W. (1951) The morphology, taxonomy, and biology of the British Evanioidea (Hymenoptera). *Transactions of the Royal Entomological Society London*, 102, 247–301.
<http://dx.doi.org/10.1111/j.1365-2311.1951.tb00749.x>
- Crosskey, R.W. (1953) A revision of the genus *Hyptiogaster* Kieffer (Hymenoptera : Gasteruptionidae), with descriptions of two new genera and three new species. *Transactions of the Royal Entomological Society, London*, 104, 347–84.

- <http://dx.doi.org/10.1111/j.1365-2311.1953.tb01261.x>
- Crosskey, R.W. (1962) The classification of the Gasteruptiidae (Hymenoptera). *Transactions of the Royal Entomological Society London*, 114, 377–402.
<http://dx.doi.org/10.1111/j.1365-2311.1962.tb01071.x>
- Cruaud, A., Jabbour-Zahab, R., Genson, G., Ungricht, S. & Rasplus, J.Y. (2012) Testing the emergence of New Caledonia: fig wasp mutualism as a case study and a review of evidence. *PLoS ONE*, 7 (2), e30941.
<http://dx.doi.org/10.1371/journal.pone.0030941>
- Espeland, M. & Murienne, J. (2011) Diversity dynamics in New Caledonia: towards the end of the museum model? *BMC Evolutionary Biology*, 11 (1), 254.
<http://dx.doi.org/10.1186/1471-2148-11-254>
- Grandcolas, P., Murienne, J., Robillard, T., Desutter-Grandcolas, L., Jourdan, H., Guilbert, E. & Deharveng, L. (2008) New Caledonia: a very old Darwinian island? *Philosophical Transactions of the Royal Society B*, 363, 3309–3317.
<http://dx.doi.org/10.1098/rstb.2008.0122>
- Harris, R.A. (1979) A glossary of surface sculpturing. *Occasional papers in Entomology*, 28, 1–31.
- Jennings, J.T. (2010) Family Gasteruptiidae. Available from: <http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/taxa/GASTERUPTIIDAE> (accessed 1 January 2014)
- Jennings, J.T. & Austin, A.D. (1994) Revision of the genus *Pseudofoenus* Kieffer (Hymenoptera: Gasteruptiidae), a hyptiogastrine wasp genus endemic to New Zealand. *Invertebrate Taxonomy*, 8, 1289–1301.
<http://dx.doi.org/10.1071/it9941289>
- Jennings, J.T. & Austin, A.D. (1997) Revision of the Australian endemic genus *Hyptiogaster* Kieffer (Hymenoptera: Gasteruptiidae), with descriptions of seven new species. *Journal of Natural History*, 31, 1533–1562.
<http://dx.doi.org/10.1080/00222939700770821>
- Jennings, J.T. & Austin, A.D. (2000) Higher level phylogeny of Aulacidae and Gasteruptiidae (Hymenoptera). In: Austin, A.D. & Downton, M. (Eds.), *The Hymenoptera: Evolution, Biodiversity and Biological Control*. CSIRO Publishing, Melbourne, pp. 155–164.
- Jennings, J.T. & Austin, A.D. (2002) Systematics and distribution of world hyptiogastrine wasps (Hymenoptera : Gasteruptiidae). *Invertebrate Systematics*, 16, 735–811.
<http://dx.doi.org/10.1071/it01048>
- Jennings, J.T. & Austin, A.D. (2004) Biology and host relationships of aulacid and gasteruptiid wasps (Hymenoptera: Evanioidea): a review. In: Rajmohana, K., Sudheer, K., Girish Kumar, P. & Santhosh, S. (Eds.), *Perspectives on biosystematics and biodiversity. Prof. T.C. Narendran commemoration volume*. University of Calicut, Kerala, pp. 187–215. [India]
- Jennings, J.T. & Austin, A.D. (2005) *Pseudofoenus caledonicus*, a new species of hyptiogastrine wasp (Hymenoptera : Gasteruptiidae) from New Caledonia. *Australian Journal of Entomology*, 44, 415–419.
<http://dx.doi.org/10.1111/j.1440-6055.2005.00512.x>
- Jennings, J.T. & Deans, A.R. (2006) Gasteruptiidae. Version 22 May 2006. The Tree of Life Web Project. Available from: <http://tolweb.org/Gasteruptiidae/23535/2006.05.22> (accessed 31 March 2015)
- Jennings, J.T., Krogmann, L. & Burwell, C. (2013) A review of the hymenopteran fauna of New Caledonia together with a checklist of species. *Zootaxa*, 3736 (1), 001–053.
<http://dx.doi.org/10.11646/zootaxa.3736.1.1>
- Jennings, J.T. & Parslow, B. (2014) *Gasteruption youngi*, sp. nov. (Hymenoptera: Evanioidea: Gasteruptiidae) from South Australia; a species with unusual setose ovipositor sheaths. *Zootaxa*, 3872 (1), 95–100.
<http://dx.doi.org/10.11646/zootaxa.3872.1.9>
- Latreille, P.A. (1796) *Précis des caractères génériques des Insectes, disposés dans un ordre naturel*. Prévôt, Paris, 201 pp.
<http://dx.doi.org/10.5962/bhl.title.58411>
- Macedo, A.C.C. (2009) Generic classification for the Gasteruptiinae (Hymenoptera: Gasteruptiidae) based on a cladistic analysis, with the description of two new Neotropical genera and the revalidation of *Plutofoenus* Kieffer. *Zootaxa*, 2075, 1–32.
- Monteith, G.B., Burwell, C.J. & Wright, S. (2006) *Inventaire de L'Entomofaune de la forêt humide de quatre réserves spéciales botaniques du Grand Sud de la Nouvelle Calédonie*. Queensland Museum, Brisbane, 49 pp.
- Murienne, J. (2009) Testing biodiversity hypotheses in New Caledonia using phylogenetics. *Journal of Biogeography*, 36, 1433–1434.
<http://dx.doi.org/10.1111/j.1365-2699.2009.02143.x>
- Schulz, W.A. (1906) *Spolia Hymenopterologica*. Jungfermannsche Buchhandlung, Albert Pape, Paderborn, 355 pp.
<http://dx.doi.org/10.5962/bhl.title.59757>
- Sharkey, M.J. & Wharton, R.A. (1997) Morphology and terminology. In: Wharton, R.A., Marsh, P.M. & Sharkey, M.J. (Eds.), *Manual of the New World genera of Braconidae (Hymenoptera)*. *Special Publication of the International Society of Hymenopterists*, 1, pp. 19–38. [total page range: pp. 1–439]