Checklist of the bees (Hymenoptera, Apoidea) of New Caledonia

Marie Zakardjian[‡], Hervé Jourdan[§], Thomas Cochenille[‡], Prisca Mahé[§], Benoît Geslin[‡]

‡ Aix Marseille Univ, Avignon Univ, CNRS, IRD, IMBE, Marseille, France
§ Aix Marseille Univ, Avignon Univ, CNRS, IRD, IMBE, Nouméa, France

Corresponding author: Marie Zakardjian (marie.zakardjian@imbe.fr), Benoît Geslin (benoit.geslin@imbe.fr)

Academic editor: Bertrand Schatz

Abstract

Background

In a world where insects and notably bees are declining, assessing their distribution over time and space is crucial to evaluate species status and highlight conservation priorities. However, this can be a daunting task, especially in areas such as tropical oceanic islands where exhaustive samplings over time have been lacking. This is the case in New Caledonia, an archipelago located in the southwest Pacific. Historical records of bee species are piecemeal and, although contemporary samplings have significantly advanced our knowledge of the bee fauna of New Caledonia, the status of several species remains to be elucidated.

New information

Here, we provide an updated checklist of the 51 bee species recorded for New Caledonia using previous publications and personal samplings. We documented their distribution, origin (i.e. endemic, native or alien) and the year and location of their occurrences. Based on the year of their first capture and the year of their last capture, we determined an occurrence status for each species. Thus, 10 years after the last checklist of the New Caledonian bee fauna, the literature review and recent samplings allowed us to add six new species to the list. Half of them are recently introduced species including one firstly mentioned in this paper (i.e. *Hylaeus albonitens*). We consider here that 30 species are effectively present on the territory and the presence of 21 species could not be determined due to a lack of data, which highlights the need to increase sampling efforts across New Caledonia. Given the difficulty of exhaustively sampling the entire archipelago, we would recommend taking, as a starting point, altitude environments and areas where data-deficient species were captured. In a broader perspective, biomolecular analyses are crucial to confirm species identifications. This is also needed

to make comparisons between archipelagoes and thus clarify the distribution and status of species at the scale of the southwest Pacific.

Keywords

bee distribution, occurrences, alien species, island ecosystem

Introduction

Insects and notably bees are declining worldwide (Wagner 2020, Zattara and Aizen 2021). For 50 years, many studies have reported a decrease in their abundance and species richness, even in protected areas (Hallmann et al. 2017, Seibold et al. 2019). The magnitude and rate of this biodiversity loss have urged taxonomists and naturalists around the globe to exhaustively assess species diversity and their distribution over time and space (Orr et al. 2021). This baseline information is crucial to evaluate species status and provide informative tools for conservation, such as IUCN Red Lists (Rodrigues et al. 2006, Potts et al. 2010, Cardoso et al. 2011, Fox et al. 2019). While in developed countries, where bee species have been studied for a long time, the status of bee populations is already difficult to assess - as a single example, the European Red List of Bees did not evaluate the status of more than a half of the 2000 species present on the continent due to a lack of data (Nieto et al. 2014) - this issue is all the more relevant in other parts of the world where bee species have been seldomly sampled, notably in oceanic tropical and subtropical islands, such as New Caledonia (Orr et al. 2021).

New Caledonia is located in the southwest Pacific. This French overseas archipelago is part of the Australasian biogeographic realm. Historically, the archipelago went through a total submersion event between 75 and 60 Mya and likely at least a partial submersion event between 34 and 25 Mya (Maurizot and Campbell 2020) and has been isolated from any continent since, allowing an important species radiation (Grandcolas et al. 2008 , Nattier et al. 2017). The archipelago covers 18 519 km² with a mosaic of edaphic and topographic conditions supporting a high diversity of habitats. Notably, a third of the main island is covered by ultramafic soils, originating from the overlap of peridotites on the continental crust during an obduction event in the late Eocene (Pelletier 2006, Pillon et al. 2020). These soils are characterised by a low nutrient availability and high concentrations of metals and metalloids, strongly constraining plant growth. As such, plants growing on ultramafic substrates present a very high rate of endemism. Thus, New Caledonia is considered as one of the main biodiversity hotspots at global scale for vascular plants with an endemic rate of 74%, up to 96.7% in ultramafic habitats (Morat et al. 2012, Isnard et al. 2016, Munzinger et al. 2022). However, regarding animals, while some groups also display a remarkable diversity and a high rate of endemism (e.g. Squamata; Bernstein et al. (2021), Slavenko et al. (2023)), others, such as bees, appear remarkably poor, illustrating a convincing example of island disharmony (Vargas 2012).

From the end of the 19th century to the middle of the 20th century, very few mentions and descriptions of bees were published for New Caledonia (Vachal 1897, Friese 1905, Vachal 1907, Vachal 1908, Cockerell 1911, von Schulthess 1915, Turner 1919, Cockerell 1929, Cockerell 1939, Cheesman 1953, Donovan 1983). These records are fragmentary and mostly based on the examination of old collections. The first review of the bee species of New Caledonia is attributed to Michener in 1965, who listed nine species (previously mentioned in the literature) and one new species retrieved from an unexamined collection (Michener 1965). Following this, Donovan (1983) made additional captures between 1979 and 1981 and updated the number of New Caledonian bee species to 28, unfortunately naming only two of them. This number did not change until 2003, when Pauly & Muzinger updated this list to 22 species, based on specimens stored in collections and additional captures realised between 1998 and 1999 (Pauly and Munzinger 2003). An important step in the knowledge of the New Caledonian bee fauna was achieved by Donovan et al. (2013), who studied plant-bee interactions using previous collections and additional captures realised between 1979 and 2008. This substantial work resulted in a two-fold increase in the number of bee species recorded for New Caledonia. However, amongst the 43 bee species listed, 24 were undetermined species at this stage. Subsequently, the works of Pauly et al. (Pauly et al. 2013a, Pauly et al. 2013b, Pauly et al. 2015) on the description and revision of New Caledonian *Austronomia*, *Lasioglossum* and *Homalictus* genera allowed a species name to be given to 15 of them. Since then, no review has provided an updated assessment of the bees of New Caledonia.

For the last ten years, we have realised three bee sampling campaigns and opportunistic captures in several localities through New Caledonia (e.g. Zakardjian et al. (2020), Zakardjian et al. (2023a)) and we felt the lack of an updated checklist clarifying the advances of the last 50 years. For example, many bee species recorded for New Caledonia during the 20th century have not been seen for several decades, if not since their first detection. Conversely, new alien bee species did enter the territory (see below). This is why, in this paper, we provide an updated checklist of the bee fauna of New Caledonia. We provide their status, distribution and main synonymies. We also provide every occurrence (date and location) found in the literature and in our samplings, together with a comprehensive list of the plant species they visit.

Materials and methods

Literature search

The checklist provided here results from: i) a review of existing literature and ii) additional data from recent field samplings.

Reviewed publications were retrieved from three methods. First, we retrieved 15 publications from GoogleScholar using the key words “New Caledonia” and “bees”. Then, eight were retrieved from the personal library of H. Jourdan. Finally, we retrieved 14 additional publications of interest (i.e. mentioning New Caledonian bee species) cited

in the former publications. In total, we scanned 37 publications. Amongst them, 23 were of interest and used in this work (Suppl. material 1). In those publications, we looked for mentions of bee species in New Caledonia. For each bee species, we gathered information concerning their taxonomy (i.e. genus, subgenus, species, subspecies, synonymies and past combinations), occurrences in New Caledonia (i.e. localities and dates of capture), plant species visited, distribution outside New Caledonia if not endemic and original status (i.e. endemic, native, alien). In order to increase the reliability of this information, we verified the valid name and synonymies of each species according to the INPN's (French National Inventory of the Natural Patrimony, https://inpn.mnhn.fr) taxonomic repository TaxRef (Gargominy et al. 2022). For example, one species was named *Lasioglossum instabilis* (Cockerell 1914) in the publications reviewed (Pauly et al. 2013b). However, according to TaxRef, this name is a synonym and its valid name is *Lasioglossum instabile* (Cockerell, 1914). Therefore, this species appears as *L. instabile* in this checklist. We also systematically verified species distribution outside New Caledonia using GBIF (Global Biodiversity Information Facility, www.gbif.org) and completed the information based on our own expertise (Hervé Jourdan, pers. com.). We noted every country in which each species has been observed.

Additional samplings

In addition to the occurrences retrieved from the existing literature, we implemented new occurrences and plant species visited from our personal published (Zakardjian et al. 2020) and unpublished datasets and opportunistic samplings - all realised between 2017 and 2023.

The first dataset comes from a sampling conducted in 2017, from March to May, in Ouvéa, Tiga, Koumac and Belep Islands areas. In each area, bees were captured along 24 transects of 50 m placed to represent their diversity of environments (e.g. forest, coastal vegetation, fallow land, shrubland and subsistence agriculture). Each transect was walked for 25 min during which bees interacting with flowers were captured using nets. In addition, in each site, 16 pan traps (4 blue, 4 red, 4 white and 4 yellow) were distributed during 48 h.

The second dataset comes from a sampling conducted in 2019, from February to April, in Nouméa and the Tontouta Valley. Nouméa is the main city of the archipelago, with 99,926 inhabitants for an area of 45.7 km². Within the city, three sites were sampled, separated by at least 3 km. These three sites were: (i) the park of the French National Research Institute for Sustainable Development (Institut de Recherche pour le Développement); (ii) the Parc Zoologique et Forestier Michel Corbasson and (iii) the Tjibaou Cultural Centre. The Tontouta Valley is located 30 km north of Nouméa. Within the Tontouta Valley, three sites were sampled, separated by at least 3 km. In each site, the plant species presenting the most abundant floral resources were sampled. Depending on the number of available flowering species, up to four plant species were observed during each sampling session. For each plant species, bees contacting flowers in a 1 m² quadrat were captured using

nets during 10 minutes. In total, each Tontouta Valley site was sampled 10 times and each Nouméa site 11 times.

The third dataset comes from a sampling realised in 2022, from March to June, in 14 sites along an urbanisation gradient running from Nouméa to the Col de Mouirange (Suppl. material 2). In each site, the plant species presenting the most abundant floral resources were sampled. Depending on the number of available flowering species, up to five plant species were observed during each sampling session. For each plant species, bees contacting flowers in a 1 m² quadrat were captured using nets during 10 minutes. Each site was sampled four times.

Records retrieved those additional samplings have bee published through GBIF (Zakardjian et al. 2023b) and are provided within this checklist together with historical data.

Occurrence status

For each bee species, we determined an occurrence status in New Caledonia, based on the year of first capture and the year of last capture. Species were determined as "present" if individuals were captured in more than one year including at least one during the last 50 years (i.e. later than 1973) or "data deficient" if individuals were captured in only one year.

Origin status

Information on the distribution of species was used to determine or correct species origin status. Indeed, for most of the species listed here, their status does not appear in the reviewed publications or may not be valid anymore. For example, *Megachile albomarginata* was mentioned as endemic to New Caledonia in Pauly and Munzinger (2003). However, a subsequent work showed that this species is also present in Fiji (Davies et al. 2013). Thus, *M. albomarginata* appears as native to New Caledonia in the present checklist. Species present elsewhere than in New Caledonia without any mention of an alien origin in the archipelago were categorised as native. Then, native species only present in New Caledonia were categorised as endemic here. Finally, for alien species, we used the definition given by Russell and Blackburn (2017), according to which a species is considered as alien if its presence is due to a geographical displacement through anthropogenic activities (e.g. voluntary importation, accidental transport via commercial trade). Thus, species that naturally colonised New Caledonia were not considered as alien in this checklist. First, species mentioned as alien or likely alien in literature were systematically categorised in the same way in the checklist. Then, species that were recorded for the first time during our additional samplings were considered as alien.

Doubtful species

Species for which taxonomic validity and/or for which effective presence in New Caledonia could not be acknowledged with a high degree of confidence (i.e. undetermined species and data-deficient species) are indicated by an asterisk in the checklist.

Apidae

Amegilla (*Zonamegilla*) *pulchra* (Smith, 1854)

Nomenclature:

Anthophora holmesi Rayment, 1947;

Anthophora parapulchra Rayment, 1947;

Anthophora perpulchra wallaciella Rayment, 1947;

Anthophora pulchra townleyella Rayment, 1947;

Anthophora pulchra Smith, 1854;

Anthophora salteri Cockerell, 1905;

Anthophora shafferyella Rayment, 1947;

Amegilla holmesi (Rayment, 1947);

Amegilla parapulchra (Rayment, 1947);

Amegilla salteri (Cockerell, 1905);

Amegilla shafferyella (Rayment, 1947);

Amegilla townleyella (Rayment, 1947);

Amegilla wallaciella (Rayment, 1947)

Feeds on: Acanthaceae: *Ruellia simplex* (alien); Apocynaceae: *Nerium oleander* (alien); Convolvulaceae: *Evolvulus* sp. (alien), *Ipomoea* sp. (alien); Lamiaceae: *Plectranthus* sp. (alien); Lythraceae: *Cuphea* sp. (alien); Rubiaceae: *Hamelia patens* (alien), Rutaceae: *Murraya paniculata* (alien); Solanaceae: *Solanum lycopersicum* (alien), *Solanum torvum* (alien); Verbenaceae: *Stachytarpheta cayennensis* (alien), *Duranta erecta* (alien) (new records).

Native status: Alien

Distribution: The subgenus *Zonamegilla* - Popov, 1950 - is mostly present in Australia (reviewed by Leijs et al. (2017)). This species is therefore present in Australia, but also in Fiji and French Polynesia where it is an alien species (Groom et al. 2017, Groutsch et al. 2018).

Historical data in New Caledonia: Nouméa: Anse Vata, IRD Park, 14 Mar 2019, one female; 16 Mar 2019, one male; two Apr 2019, two males; Parc Zoologique et Forestier, 6 Apr 2019, two males; Rivière Salée, 14 Mar 2022, one individual; 16 Mar 2022, two individuals; Tuband, 16 Mar 2022, five individuals; 25 Mar 2022, one individual; Maison Célières, 18 Mar 2022, five individuals; Normandie, 18 Mar 2022, one individual. Païta: Plaine aux cailloux, Haute Karikouié, pépinière Eriaxis, 05 May 2019. Dumbéa: RM 15, Pépinière Botanea, 05 Feb 2020, two individuals. Mont Dore: Vallon Dore, 30 Mar 2022, one individual; 20 Apr. 2022, one individual (Zakardjian et al. 2023b).

Notes: First detected in Nouméa in 2016, the species is now established in the city and has started to spread north along the west coast (Hervé Jourdan, pers. com.).

Apis mellifera subsp. *mellifera* L., 1758

Feeds on: A large range of endemic, native and alien plants (including invasive ones).

Native status: Alien

Distribution: Cosmopolitan subspecies. Ubiquitous in New Caledonia, but absent from Belep Islands and Tiga.

Notes: Before the arrival of Europeans, there were no social bees or honey bees in New Caledonia. *Apis mellifera mellifera* was first introduced in 1848 from France by priests on Lifu Island for the production of wax candles. It subsequently spread to the mainland and the Isle of Pines in 1853, as well as to Maré during the same period (Lamaignere 2001, Hervé Jourdan, pers. com.). To our knowledge, *Apis mellifera* is still absent from Belep Islands and Tiga and abundant elsewhere in the archipelago.

Apis mellifera subsp. *ligustica* Spinola, 1806

Feeds on: A large range of endemic, native and alien plants (including invasive ones).

Native status: Alien

Distribution: Cosmopolitan subspecies. Ubiquitous in New Caleodnia, but absent from Belep islands and Tiga.

Notes: *Apis mellifera ligustica* was introduced periodically by the end of the 19th and the beginning of 20th centuries on the mainland as mentioned by von Schulthess (1915), but most of colonies were brought from Australia and New Zealand between 1985 and 1988 on the mainland, following American foulbrood outbreaks (Thevenon et al. 1989, Lamaignere 2001).

Braunsapis puangensis (Cockerell, 1929)

Nomenclature:

Allodape puangensis Cockerell, 1929

Feeds on: Anacardiaceae: *Schinus aroeira* (ex. *Schinus terebinthifolius*) (alien); Araliaceae: *Polyscias scutellaria* (alien); Asteraceae: *Sphagneticola trilobata* (alien); Lamiaceae: *Ocimum basilicum* (alien), *Plectranthus* sp. (alien); Lythraceae*: Cuphea* sp. (alien); Portulacaceae: *Portulaca umbraticola* (alien); Rubiaceae: *Hamelia patens* (alien); Solanaceae: *Solanum torvum* (alien); Verbenaceae: *Clerodendrum ugandense* (alien), *Duranta erecta* (alien), *Stachytarpheta cayennensis* (alien) (new records).

Native status: Alien

Distribution: Native range: India, Malaysia, Myanmar, Singapore, Thailand. Alien range: Fiji (da Silva et al. 2016), French Polynesia (Groom et al. 2017).

Historical data in New Caledonia: Nouméa: Anse Vata, IRD park, 16 Mar 2019, one female; 19 Mar 2019, one female; 21 Mar 2019, one male; 23 Mar 2019, one individual; 2 Apr 2019, two females; 10 Apr 2019, two females. Rivière Salée, 16 Mar 2022, two individuals; Tuband, 16 Mar 2022, one individual. Musée de la Ville, 18 Mar 2022, two individuals; 24 Mar 2022, one individual; 27 Apr 2022, three individuals. Magenta Tours, 29 Mar 2022, four individuals; 31 Mar 2022, one individual. Dumbéa: RM 15, Pépinière Botanea, 05 Feb 2020. Four females. Mont Dore: Saint Michel, 20 Apr 2022, four individuals; Vallon Dore, 20 Apr 2022, seven individuals; 21 Apr 2022, one individual; La Conception, 23 Mar 2022, one individual (Zakardjian et al. 2023b).

Notes: This species was first detected in New Caledonia in 2019 (Zakardjian et al. 2020). This carpenter bee nests in twigs (Groom et al. 2014b) and displays a casteless sociality (da Silva et al. 2016).

Ceratina (*Neoceratina*) *dentipes* Friese, 1914

Feeds on: Verbenaceae: *Stachytarpheta australis* (alien), *S. cayennensis* (alien) (Donovan et al. 2013); Euphorbiaceae: *Euphorbia tannensis* (alien); Goodeniaceae: *Scaevola sericea* (native); Lythraceae: *Cuphea* sp. (alien); Passifloraceae: *Turnera ulmifolia* (alien); Portulacaceae: *Portulaca umbraticola* (alien), *Tribulus repens* (alien) (new records).

Native status: Alien. This species is known to have been introduced in the southWest Pacific (Groom et al. 2017).

Distribution: Native range: Hong Kong, Indonesia, Malaysia, Taïwan, Thailand. Alien range: Hawaii, Cook islands, French Polynesia, Mauritius, Vanuatu, Solomon, Fiji, Samoa (Groom et al. 2017, Shell and Rehan 2019).

Historical data in New Caledonia: 16 km SE La Foa, 20-22 Dec 1991, one female. Dec 1979-Sep 2008, three females (Donovan et al. 2013). Tiga, 9 Apr 2017, four females. Koumac, 1 May 2017, one male and one female. Nouméa: Musée de la Ville, 24 Mar 2022, one individual; 27 Apr 2022, one individual; Magenta Tours, 22 Apr 2022, one individual (Zakardjian et al. 2023b).

Notes: This carpenter bee nests in twigs. Several individuals may be observed in the same tunnel (i.e. pseudo-social behaviour, see Rehan et al. (2009)).

Colletidae

*Euhesma sp.**

Feeds on: Cunoniaceae: *Codia albifrons* (native); Dilleniaceae: *Hibbertia heterotricha* (native), *Hibbertia pulchella* (native), *Hibertia* sp. (native); Myrtaceae: *Syzygium quadrangulare* (native) (Donovan et al. 2013).

Distribution: Historical data in New Caledonia: Mont Koghi, 4-6 Oct 1967, one male. Dec 1979-Sep 2008, five females, no location (Donovan et al. 2013).

Notes: This species is named *Euhesma* sp. indet. One in Donovan et al. (2013).

No precise location in Donovan et al. (2013). However, the list of plant species described in the latter and the presence of a male in the Mont Koghi suggests that the species can be observed in forested or maquis areas on ultramafic substrates.

*Euryglossina sp. 1**

Feeds on: Sapindaceae: *Litchi chinensis* (alien) (Donovan et al. 2013).

Distribution: Historical data in New Caledonia: 3 Jul 1980, one male and one female. Dec 1979-Sep 2008, one male and one female, no location (Donovan et al. 2013).

Notes: This species is named *Euryglossina* sp. indet. One in Donovan et al. (2013).

*Euryglossina sp. 2**

Distribution: Historical data in New Caledonia: Thio: Forêt de Sailles, 9 Dec 2001, two females (Donovan et al. 2013).

Notes: This species is named *Euryglossina* sp. indet. Two in Donovan et al. (2013).

Occurrence status: data deficient.

Hylaeus (*Gnathoprosopis*) *albonitens* (Cockerell, 1905)*

Nomenclature:

Prosopis albonitens Cockerell, 1905;

Prosopis albipes, 1924

Feeds on: Myrtaceae: *Callistemon* sp. (alien) (new record).

Native status: Alien

Distribution: Native range: Australia.

Alien range: Hawaii.

Historical data in New Caledonia: Voh, near the cemetary, 8 Dec 2022, one male and three females (Zakardjian et al. 2023b).

Notes: Likely a new alien species, potentially introduced via the Vavouto industrial harbour facility. We nevertheless cannot exclude that one of the three below-mentioned *Hylaeus* morphospecies (Donovan et al. 2013) may also fit with *H. albonitens*.

Occurrence status: data deficient.

*Hylaeus sp. 1**

Distribution: Historical data in New Caledonia: Ouen Toro, 15 Jan 1972, three females (Donovan et al. 2013).

Notes: This species is named *Hylaeus* sp. indet. One in Donovan et al. (2013).

Occurrence status: data deficient.

*Hylaeus sp. 2 **

Distribution: Historical data in New Caledonia: Port Laguerre, 11 Apr 2001, one female (Donovan et al. 2013).

Notes: This species is named *Hylaeus* sp. indet. Two in Donovan et al. (2013).

Occurrence status: data deficient.

*Hylaeus sp. 3**

Distribution: Historical data in New Caledonia: Thio: Forêt de Sailles, 3 Dec 2001, one female (Donovan et al. 2013).

Notes: This species is named *Hylaeus* sp. indet. Three in Donovan et al. (2013).

Occurrence status: data deficient.

Leioproctus (*Lamprocolletes*) *pacificus* Michener, 1965

Feeds on: Araliacea: *Myodocarpus fraxinifolius* (native); Celastraceae: P*eripterygia marginata* (native) (Donovan et al. 2013).

Native status: Endemic

Distribution: Historical data in New Caledonia: Nepoui Valley, Jul 1940, one male (Pauly and Munzinger 2003, Donovan et al. 2013). Dec 1979-Sep 2008, one male and one female, no location (Donovan et al. 2013).

Notes: This species has been recorded in forested or maquis areas including in altitudes (up to 900 m). The recorded host plants and known localities are restricted to ultramafic substrates.

Leioproctus (*Lamprocolletes*) *sp.**

Notes: This species is named *Leioproctus* sp. indet. Two in Donovan et al. (2013).

Occurrences: Mont Khogis, 1 Nov 1992, one male (Donovan et al. 2013).

Occurrence status: data deficient.

Palaeorhiza (*Palaeorhiza*) *flavomellea* Cockerell, 1910

Feeds on: Anacardiaceae: *Mangifera indica* (alien), *Schinus aoeira* (alien); Arecaceae: *Cocos nucifera* (alien); Combretaceae: *Terminalia catappa* (alien); Elaeocarpaceae: *Elaeocarpus angustifolius* (native); Hernandiceae: *Hernandia nymphaeifolia* (native), *Hernandia ovigera* (native) (Donovan et al. 2013); Hernandiaceae: *Hernandia guianensis* (alien) (Pauly and Munzinger 2003); Anacardiceae: *Schinus aroeira* (ex. *Schinus terebinthifolius*) (alien); Araliaceae: *Polyscias scutellaria* (alien); Rubiaceae: *Hamelia patens* (alien) (new records).

Native status: Likely alien. Donovan (1983) hypothesised that this species could be alien because individuals were captured in a few localities in the vincinity of Noumea, suggesting a recent establishment.

Distribution: Australia.

Historical data in New Caledonia: Nouméa, 27 May 1977, three males and two females (Pauly and Munzinger 2003, Donovan et al. 2013). Nouméa, 17 Feb 1999,

five males (Pauly and Munzinger 2003). Dec 1979-Sep 2008, 14 males and two females, no location (Donovan et al. 2013). Ouvéa: Hwadrilla, Hotel Beaupré, 9 Mar 2017, two males and one female. Mont Dore: Rue André Burck, 13 Apr 2022, two individuals. Nouméa: Tuband, 19 Apr 2022, three individuals; Musée de la Ville, 27 Apr 2022, one individual (Zakardjian et al. 2023b).

Notes: The alien status remains to be confirmed.

Halictidae

Austronomia cheesmanae (Michener, 1965)

Nomenclature:

Lipotriches cheesmanae (Michener, 1965);

Nomia cheesmanae Michener, 1965;

Nomia nuda Cheesman, 1953

Feeds on: Myoporaceae: *Myoporum crassifolium* (native) (Donovan et al. 2013); Arecaceae: *Cocos nucifera* (alien) (new record).

Native status: Endemic

Distribution: Historical data in New Caledonia: Lifou, Cap des Pins, 18 Nov 1949-18 jan. 1950, one female. Lifou, We, 30-31 Jan 1962, one female; Feb 1962, two males; 16-18 Feb 1963, two males and 3 females. Ouvea, Fayaoué, Jan 1969, two males. Maré, 13 Nov 2002, one female. Lifou, 2006, four females. Lifou, Koumo, 7 Dec 2006, two males and two females (Pauly et al. 2013a). Lifou, 18 Nov 1950, one female. Dec 1979-Sep 2008, one female (Donovan et al. 2013). Ouvéa: Hwadrila 7 Mar. 2017, one female (Zakardjian et al. 2023b).

Austronomia doensis Donovan, Pauly & Munzinger, 2013

Feeds on: *Senna occidentalis* (alien) (Donovan et al. 2013); *Senna* sp. (Pauly et al. 2013a); Polygonaceae: *Antigonum leptotus* (alien) (new records).

Native status: Endemic

Distribution: Historical data in New Caledonia: Dec 1979-Sep 2008, one female (Donovan et al. 2013). Mt Do, 15 Dec 2000, one female (holotype). Sarraméa, forêt du col d'Amieu, 30-31 Dec 2005, four males and one female (paratype; Pauly et al. 2013a). Koumac, 1 May 2017, one female (Zakardjian et al. 2023b).

Austronomia loyali Donovan, Pauly & Munzinger, 2013

Native status: Native

Distribution: Vanuatu

Historical data in New Caledonia: Lifou, Cap des Pins, 18 Nov 1949-18 Jan 1950, two males. Lifou, We, 30-31 Jan 1962, 32 females; Feb 1962, two males and five females; 16-18 Feb 1963, two females; 1 Aug 2003, two females. Ouvea, Fayaoue, Feb 1963, one female. Lifou, 26-27 Mar 1968, one female (holotype; Pauly et al. (2013a)).

Austronomia neocaledonica Donovan, Pauly & Munzinger, 2013 *

Native status: Endemic

Distribution: Historical data in New Caledonia: Rivière Bleue, 3 Nov 1992, one male and one female (paratypes). Mt Koghis, 17 km NE Nouméa, 22 Dec 1992, one male (holotype; Pauly et al. (2013a)).

Notes: Occurrence status: data deficient.

Austronomia sicheli (Vachal, 1897)

Nomenclature:

Nomia sicheli Vachal, 1897;

Nomia wilmattae Cockerell, 1929

Feeds on: *Polyscias pancheri* (Schlessman et al. 1990); Melastomataceae: *Melastoma denticulatum* (native) *;* Violaceae: *Agatea longipedicellata* (native); *Babingtonia* sp., *Myoporum crassifolium*, *Poinsettia* sp., *Eugenia* sp., *Scaevola* sp., *Styphelia pancheri* (native) (Pauly & Muzinger 2003); Anacardiaceae: *Schinus terebinthifolia* (alien); Apocynaceae: *Parsonsia crebriflora* (native); Araliaceae: *Polyscias sessiliflora* (native), *Polyscias* sp. (native), unknown (native); Asteraceae: *Ageratum conyzoides* (alien); Celastraceae: *Peripterygia marginata* (native); Combretaceae: *Lumnitzera racemosa* (native); Connaraceae: unknown (native); Cunoniaceae: *Codia discolor* (native); Dilleniaceae: *Hibbertia bouletii* (native), *Hibbertia lucens* (native), *Hibbertia pancheri* (native), *Hibbertia pulchella* (native), *Hibbertia* sp. (native); Ericaceae: *Dracophyllum verticillatum* (native), *Styphelia* cf. *cymbulae* (native); Escalloniaceae: *Argophyllum montanum* (native); NA: *Cassia fistula* (native), *Cassia* sp. (native), *Storckiella pancheri* (native), *Storckiella* sp. (native); Euphorbiaceae: *Euphorbia* sp. (alien); Goodeniaceae: *Scaevola beckii* (native), *Scaevola cylindrica* (native), *Scaevola erosa* (native), *Scaevola montana* (native); Joinvilleaceae: *Joinvillea* sp. (native); Lamiaceae: *Mentha* sp. (alien); Loganiaceae: *Geniostoma densiflorum* (native); Malpighiaceae: *Tristellateia*

australasiae (native); Melastomataceae: *Melastoma malabathricum* (native); Mimosaceae: *Acacia spirorbis* (native); *Leucaena leucocephala* (alien), *Mimosa diplotricha* (alien); Myodocarpaceae: *Myodocarpus fraxinifolius* (native); Myrsinaceae: *Tapeinosperma oblongifolium* (native); Myrtaceae: *Cloezia artensis* (native), *Cloezia* sp. (native), *Melaleuca gnidioides* (native), *Melaleuca quinquenervia* (native), *Myrtastrum rufopunctatum* (native), *Myrtus* sp. (native), *Psidium guajava* (alien), *Sannantha* leratii (native), *Sannantha* sp. (native), *Syzygium jambolanum* (alien), *Syzygium lateriflorum* (native), *Syzygium quadrangulare* (native), *Tristaniopsis calobuxus* (native), *Tristaniopsis glauca* (native), *Tristaniopsis vieillardii* (native), *Uromyrtus emarginata* (native), unknown 1 (native), unknown 2 (native); Phrymaceae: *Mimulus* sp. (alien); Proteaceae: *Grevillea exul* (native), *Stenocarpus milnei* (native), *Stenocarpus umbelliferus* (native), *Stenocarpus* sp. (native); Rhamnaceae: *Alphitonia neocaledonica* (native); Rubiaceae: *Normandia neocaledonica* (native); Sapindaceae: *Guioa villosa* (native), *Litchi chinensis* (alien), *Storthocalyx pancheri* (native); *Senna occidentalis* (alien); Solanaceae: *Solanum torvum* (alien), unknown (alien); Verbenaceae: *Stachytarpheta indica* (alien); Convolvulaceae: *Ipomoea* sp. (Donovan et al. 2013); *Antigonum leptotus*, *Arytera arcuata*, Croton, *Euphorbia cyathophora*, *Gymnostoma poissonianum*, *Myrtopsis* sp., *Xanthostemon* sp. (new records).

Native status: Endemic

Distribution: Historical data in New Caledonia: Nouméa, 23 Jan 1914. Baie Ngo, 10 Feb 1914. Baie Ouemo, 28 Mar 1914 (Turner 1919). Plum Farm, 30 May 1927, one female; 4 Jun 1927, two females. Rivière Bleue, 10 Jan 1999, seven males and 13 females; 11 Jan 1999, three males and 8 females. Mandjelia, 28 Jan 1999, one female. Prony, 10 Feb 1999, two females. Paagoumene, 12 Mar 1999, one male (Pauly and Munzinger 2003). Mt Tinchialit, Sep 1945, three females. Puébo, two females. Cap des Pins, 18 Nov 1950, two males and two females (Cheesman 1953). Near Yaté, 30 Dec 1979, one individual (Donovan 1983). Dec 1979-Sep 2008, 42 males and 147 females (Donovan et al. 2013). Rivière Bleue, Nov-Dec 1985 (Schlessman et al. 1990). Belep: Île Art, 28 Feb 2017, two males and three females; 25 Apr 2017, one male, two females and one individual; 27 Apr 2017, three females; (no date), one male and one female. Ouvéa, 7 Mar 2017, one male; 8 Mar 2017, one individual. Tiga, 8 Apr 2017, four females; 9 Apr 2017, two females; 11 Apr 2017, one male. Koumac, 30 Apr 2017, one male; 1 May 2017, one female. Païta - La Tontouta: Tontouta Valley, 15 Mar 2019, one female; 29 Mar 2019, one female; 1 Apr 2019, one female. Nouméa: Parc Zoologique et Forestier, 30 Mar 2019, one male and two females; 06 Apr 2019, 2 females; Anse Vata, IRD Park, 21 Mar 2019, 1 female. (Zakardjian et al. 2023b).

Homalictus aponi (Cheesman & Perkins, 1939)

Feeds on: Amaranthaceae: *Achyranthes aspera* (alien); Anacardiaceae: *Schinus terebinthifolia* (alien); Araliaceae: *Polyscias* sp. (native); Asteraceae: *Bidens pilosa*

(alien), *Blumea lacera* (native), *Conyza* sp. (alien), *Calendula* sp. (alien), *Emilia sonchifolia* (alien), *Tridax procumbens* (alien), *Tridax* sp. (alien), *Youngia japonica* (alien); Brassicaceae: *Lepidium virginicum* (alien); Caesalpiniaceae: *Crotalaria* sp. (alien); Cunoniaceae: *Geissois* sp. (native), *Pancheria billardierei* (native); Dilleniaceae: *Hibbertia deplancheana* (native), *Hibbertia lucens* (native), *Hibbertia podocarpifolia* (native), *Hibbertia pulchella* (native), *Hibbertia tontoutensis* (native), *Hibbertia* sp. (native); Ericaceae: *Styphelia* cf. *cymbulae* (native); Euphorbiaceae: *Euphorbia hypericifolia* (alien), *Euphorbia lophogona* (alien), unknown (native); Goodeniaceae: *Scaevola beckii* (native), *Scaevola montana* (native), *Scaevola* sp. (native); Loganiaceae: *Geniostoma densiflora* (native); Malpighiaceae: *Acridocarpus austrocaledonicus* (native); Malvaceae: *Sida acuta* (alien), *Sida rhombifolia* (alien); Mimosaceae: *Acacia spirorbis* (native), *Leucaena leucocephala* (alien), *Mimosa diplotricha* (alien); Myrtaceae: *Melaleuca quinquenervia* (native), *Metrosideros operculata* (native), *Sannantha leratii* (native), *Sannantha virgata* (native), *Xanthostemon* sp. (native); Onagraceae: *Bougainvillea* sp. (alien), *Ludwigia octovalvis* (native); Orchidaceae: *Eriaxis rigida* (native); Papaveraceae: *Argemone mexicana* (alien); Proteaceae: *Stenocarpus phyllodineus* (native); Rubiaceae: *Normandia neocaledonica* (native); Sapotaceae: *Leptostylis petiolata* (native); Solanaceae: *Solanum lycopersicum* (alien), *Solanum torvum* (alien), *Solanum* sp. (alien); Tiliaceae: *Corchorus* sp. (native); Verbenaceae: *Duranta erecta* (alien), *Stachytarpheta indica* (alien), *Verbena* sp. (alien); Violaceae: *Agatea longipedicellata* (native); Zygophyllaceae: *Tribulus cistoides* (alien) (Donovan et al. 2013).

Native status: Native

Distribution: Vanuatu

Notes: This bee appears as the most common native bee in New Caledonia. It has been observed in a wide range of habitats (including urban, non-ultramafic, ultramafic and altitude environments) in the whole archipelago.

Potential confusion with *Homalictus urbanus* from Australia; Pauly and Villemant (2009) highlighted a slight difference between the specimens of Vanuatu and New Caledonia compared to specimens from Australia. Based on preliminary biomolecular analysis (unpublished data), we confirm that *H. aponi* is a different species from *H. urbanus* and we confirm its status as a native species from Vanuatu and New Caledonia.

Homalictus cocos Pauly & Munzinger, 2003

Feeds on: Anacardiceae: *Schinus aroeira* (ex. *Schinus terebinthifolius*) (alien); Araliaceae: *Meryta* sp. (native); Arecaceae: *Cocos nucifera*; Schinus aoeira; Euphorbiaceae: *Euphorbia* sp. (alien); Verbenaceae: *Verbena* sp. (alien) (Donovan et al. 2013); Euphorbiaceae: *Euphorbia* sp. (ex. *Poinsettia* sp.) (alien) (Pauly and Munzinger 2003); Araliaceae: *Meryta* sp. (endemic); Malvaceae: *Hibiscus tiliaceus* (native) (Pauly et al. 2015); Euphorbiaceae: *Erythrina* sp. (alien) (new record).

Native status: Endemic

Distribution: Historical data in New Caledonia: Saint Louis, 17 Aug 1940, one female (Donovan et al. 2013, Pauly et al. 2015). Ile des Pins, 23 Oct 1940, three males; 24 Oct 1940, one male and one female; 25 Oct 1940, one male and two females; 26 Oct 1980, 12 males and three females. Nouméa, Feb 1959, one male. Lifou, We, 30-31 Jan 1962, one male and two females. Tao, 8-10 Feb 1963, one male. Anse Vata, 27 Feb 1963, one female; 26 Mar 2006, one female. Ile des Pins, Point SW Kuto, 17 Aug 1979, one male and one female. Bourail, plage de Poé, 3 Jan 2006, six males and five females. Saint Louis, 4 Sep 2007, one female. (Pauly et al. 2015). Nouméa, 23 Apr 1965, one female; 15 Aug 1966, one female; 4 Apr 1969, one female; 27 May 1977, one female (Pauly and Munzinger 2003). Dec 1979-Sep 2008, three males and nine females (Donovan et al. 2013). Nouméa: Centre culturel Tjibaou, 21 Mar 2019, one male. Anse Vata, IRD Park, 27 Mar 2019, one female (Zakardjian et al. 2023b).

Homalictus curvistriae Donovan & Pauly, 2015

Feeds on: Asteraceae: undetermined species (alien); Cunoniaceae: *Pancheria robusta* (endemic); Dilleniaceae: *Hibbertia lucens* (native), *Hibbertia trachyphylla* (native); Ericaceae: *Dracophyllum involucratum* (endemic); Goodeniaceae: *Scaevola beckii* (endemic); Loganiaceae: *Geniostoma densiflorum* (endemic); Myrtaceae: Metrosideros operculata (native), Metrosideros punctata (endemic); Rubiaceae: Normandia neocaledonica (endemic), Psychotria rupicola (endemic); Rutaceae: *Zanthoxyllum* sp. (endemic) (Donovan et al. 2013); Ericaceae: *Dracophyllum verticillatum* (endemic), *Styphelia* cf *cymbulae* (endemic); Melastomataceae: *Melastoma malabathricum* (ex. *Melastoma denticulatum*) (native) (Pauly et al. 2015); Goodeniaceae: *Scaevola montana* (endemic) (new records).

Native status: Endemic

Distribution: Historical data in New Caledonia: Mt Panié, 8-9 Feb 1963, two males and three females. Rivière Bleue, 14 Nov 1963, one female. Tchambouenne 7 km S, 28 Jan 1964, one female. Mt Koghi, 23-27 Oct 1967, one male. W. of Ponerihouen, 31 Jul 1971, one female. Dumbea, 19 Dec 1979, one female. Montagne des sources, 29 Dec 1979, three males and one female. Mont Dzumac, 11 Oct 1980, one female. Montagne des Sources, 22 Oct 1980, one female. Montagne des Sources, 25 Oct 1980, seven females. Koum Riv., 23 Nov 2001, one female. Haute Vallée de la Ni, 23 Oct 2004, one male and one female. Col de Yaté, 14 Nov 2004, one male. Vallée de la Tchamba, 26 Jul 2005, one male. Prony, 21 Aug 2005, one female. Haute Kuébuni, 25 Mar 2007, one female. Boulinda, 2 Sep 2009, one female. Aoupinié, 3 Sep 2010, one female (Pauly et al. 2015). Dec 1979-Sep. 2008, two males and 12 females (Donovan et al. 2013). Mont Dore, 10 May, 2022, four individuals; 17 May 2022, five individuals; 18 May 2022, two individuals (Zakardjian et al. 2023b).

Notes: This species has been observed in forested areas, on ultramafic subtrates, but also volcano sedimentary substrates, mostly in altitudes (> 500 m).

Homalictus heliotropiae Pauly & Donovan, 2015

Feeds on: Arecaceae: *Cocos nucifera* (alien); Boraginaceae: *Heliotropium foertherianum* (ex. *Argusia argentea*) (native); Myrtaceae: Sannantha leratii (native) (Donovan et al. 2013).

Native status: Endemic

Distribution: Historical data in New Caledonia: Dec 1979-Sep 2008, one male and two females. Mou, 25 Dec 1979, three females. Houailou, 25 Dec 1979, one male (Donovan et al. 2013). Yaté, gîte de Port Boisé, 19 Jan 2006, one female (paratype). Presqu'île de Kuébuni, 19 Aug 2007, one female (holotype; Pauly et al. (2015)).

Notes: According to known host plant species, this species was observed on south and east coastal habitats on calcareous uplifted reefs.

Homalictus hienghenensis Donovan & Pauly, 2015*

Native status: Endemic

Distribution: Historical data in New Caledonia: Hienghène, 25 Nov 1958, two females (holotype and paratype; Pauly et al. (2015)).

Notes: Occurrence status: data deficient.

Homalictus koghiensis Donovan & Pauly, 2015*

Native status: Endemic

Distribution: Historical data in New Caledonia: Mts Koghis, Jan 1969, three males (holotype and paratypes; Pauly et al. (2015)).

Notes: This species was observed in altitudinal (> 500 m) forested areas on ultramafic substrates.

Occurrence status: data deficient.

Homalictus mcphersoni Donovan & Pauly, 2015

Feeds on: Araliaceae: *Polyscias sessiliflora* (endemic), *Schefflera vieillardii* (endemic); Arecaceae: *Cyphokentia cerifera* (endemic); Cunoniaceae: *Cunonia balansae* (endemic), *Geissois racemosa* (endemic); Myrtaceae: *Metrosideros* sp. (endemic) (Donovan et al. 2013), Myrtaceae: *Longetia buxoides* (Pauly et al. 2015).

Native status: Endemic

Distribution: Historical data in New Caledonia: Mt Koghi, Dec 1963, one female. Yiambi, NE, 14 Oct 1967, one female. Mts des Koghis, Jan 1969, one female. Col des Roussettes, 3 Feb 1971, one female. Mt Dzumac, 24 Feb 1980, three females (including holotype). Mandjelia Forest, 12 Apr 1980, one female. Mt Khogis, 25 Jan 1996, (no number of individuals). Kaala, 8 Dec 2000, six females. Col d'Amos, 16 Nov 2002, one female. Dzumac, 27 Oct 2004, one female. Forêt Nord, 4 Jan 2005, one female. Ponérihouen, forêt de l'Aoupinié, 12-24 Jan 2006, five females. Sarraméa, forêt du col d'Amieu, 14-27 Jan 2006, one female. Plateau de Boakaine, 27 Feb 2013, two females (paratypes; Pauly et al. 2015). Dec 1979-Sep 2008, six females (Donovan et al. 2013).

Notes: This species has been observed in forested areas on both volcano-sedimentary and ultramafic substrates, mostly in altitudes (> 500 m).

Homalictus melanasiae Donovan & Pauly, 2015

Feeds on: Asteraceae: *Argeratum* sp. (alien); Araliaceae: *Polyscias sessiliflora* (endemic), *Polyscias* sp. (endemic); Myodocarpaceae: *Myodocarpus* sp. (endemic); Rhamanaceae: *Alphitonia neocaledonica* (endemic); Sapindaceae: *Guioa villosa* (endemic), *Litchi chinensis* (alien) (Donovan et al. 2013).

Native status: Endemic

Distribution: Historical data in New Caledonia: Thi River Valley, 6 Nov 1940, one female. Mt Koghi, 1 Feb 1961, one female; 8 Oct 1969, four females. Mt Dzumac, 24 Feb 1980, one female. Thy Valley, 18 Jun 1980, one female; 3 Jul 1980, one female; 5 May 1981, five females (including holotype). Col de Mouirange, 10 Oct 1980, one female. Mts Koghis, Auberge, 23 Jul 2003, one female. Houailou, 30 Jul 2003, one female (paratypes). Haute Vallée de la Ni, 29 Apr 2004, one female. Piste Ni-Dzumacs, 7 May 2004, one female (Pauly et al. 2015). Dec 1979-Sep 2008, 11 females (Donovan et al. 2013).

Notes: This species has been observed in ultramafic substrates in both maquis and forested areas.

Homalictus projectio Donovan & Pauly, 2015

Native status: Endemic

Distribution: Historical data in New Caledonia: Col des Roussettes, 4-6 Feb 1963, one female (holotype). Mt Dzumac, 11 Oct 1980, one female (paratype; Pauly et al. (2015)).

Notes: This species has been observed in forested areas on both ultramafic and volcano sedimentary substrates, in high altitudes (450 to 900 m).

Homalictus risbeci (Cockerell, 1929)

Nomenclature:

Halictus crotalariae Cockerell, 1929;

Halictus risbeci Cockerell, 1929

Feeds on: *Crotalaria* sp. (alien) (Cockerell 1929); Araliaceae: *Polyscias sessiliflora* (native), *Polyscias* sp. (native), unknown (native); Asteraceae: *Blumea lacera* (native); Cunoniaceae: *Geissois* sp. (native), *Pancheria alaternoides* (native), *Pancheria billardierei* (native), *Pancheria phylliraeoides* (native), *Pancheria* sp. (native); Dilleniaceae: *Hibbertia lucens* (native), *Hibbertia pancheri* (native), *Hibbertia* sp. (native); Ericaceae: *Dracophyllum verticillatum* (native); *Acacia spirorbis* (native); Goodeniaceae: *Scaevola beckii* (native), *Scaevola cylindrica* (native), *Scaevola montana* (native), *Scaevola* sp. (native); Laxmanniaceae: *Cordyline* sp. (native); Liliaceae: *Rhuacophila javanica* (native); Linaceae: *Hugonia penicillanthemum* (native); Malpighiaceae: *Tristellateia australasiae* (native); Malvaceae: *Melochia odorata* (native); Melastomataceae: *Melastoma malabathricum* (native); Myrtaceae: *Cloezia floribunda* (native), *Melaleuca quinquenervia* (native), *Metrosideros operculata* (native), *Sannantha leratii* (native), *Syzygium* sp. (native), *Tristaniopsis calobuxus* (native); Onagraceae: *Ludwigia octovalvis* (native); Proteaceae: *Grevillea* sp. (native), *Stenocarpus phyllodineus* (native); Rhizophoraceae: *Rhizophora apiculata* (native); Rubiceae: *Normandia neocaledonica* (native); Sapindaceae: *Cupaniopsis myrmoctona* (native), *Guioa villosa* (native); Surianaceae: *Suriana maritima* (native); Asteraceae: *Cosmos sulphureus* (alien); Brassicaceae: *Brassica* sp. (alien); *Cassia fistula* (alien); *Leucaena leucocephala* (alien); *Mimosa diplotricha* (alien); Lythraceae: *Lagerstroemia indica* (alien); Rutaceae: *Citrus* sp. (alien); Verbenaceae: *Stachytarpheta* sp. (alien) (Donovan et al. 2013); *Babingtonia leratii* (Pauly and Munzinger 2003), *Arytera arcuata*, *Erythrina* sp., *Gymnostoma poissonianum* (new records).

Native status: Endemic

Notes: This species is widespread in the archipelago and has a broad range of host plants, including endemic, native and alien species. It can be found from low to high altitudes on both ultramafic and volcano sedimentary substrates.

Homalictus risbeci subsp. *crotalariae* (Cockerell, 1929)

Feeds on: *Alectryon carinatum*, *Brassica* sp., *Eugenia* cf. *gacognei*, *Rhizophora apiculata*, *Xanthostemon* sp. (Pauly et al. 2015).

Native status: Endemic

Distribution: Historical data in New Caledonia: Ile de Mouac, 19 Oct 1958, one male. Maré, La Roche, Mar 1959, six males and three females. Lifou, We, 30-31 Jan 1962,

three males and one female; Feb 1962, one male and nine females; 16-18 Feb 1963, one female; 1 Aug 2003, one female. Poum, Golone, 29 Jul 2005, one female. Ile Leprédour, 22 Jan 2008, one female; two females. Poum, 3 Apr 2012, one female (Pauly et al. 2015). Belep: Île Art, 28 Feb 2017, seven females; 1 Mar 2017, one female; two Mar 2017, two females; 27 Apr 2017, four females. Ouvea, 16 Mar 2017, one female (Zakardjian et al. 2023b).

Notes: The status of *H. risbesci crotalariae* as a subspecies remains to be confirmed through molecular analysis.

*Homalictus sp. 1**

Distribution: Historical data in New Caledonia: Île Mouac, 19 Oct 1958, one male (Donovan et al. 2013)

Notes: This species is named *Homalictus* sp. indet. Eleven in Donovan et al. (2013).

Occurrence status: data deficient.

*Homalictus sp. 2**

Distribution: Historical data in New Caledonia: Monts des Koghis, Jan 1969, three males (Donovan et al. 2013).

Notes: This species is named *Homalictus* sp. indet. Seven in Donovan et al. (2013).

Occurrence status: data deficient.

Lasioglossum (*Austrevylaeus*) *sp.**

Notes: This species is mentioned in Donovan (1983) based on a personal communication. Pauly and Munzinger (2003) stated that they did not examine the species which, therefore, needs confirmation.

Occurrence status: data deficient.

Lasioglossum (*Chilalictus*) *alticola* Pauly, Walker, Munzinger & Donovan, 2013

Feeds on: Apocynaceae: *Parsonsia* sp. (endemic); Araliaceae: *Polyscias dioica* (endemic); Dilleniaceae: *Hibbertia nana* (endemic); Ericaceae: *Dracophyllum involucratum* (endemic); Liliaceae: *Rhuacophila javanica* (native); Phellinaceae: *Phelline lucida* (native) (Donovan et al. 2013); Asphodelaceae: *Rhuacophila javanica* (endemic); Phellinaceae: *Phelline lucida* (endemic); Proteaceae: *Beauprea pancheri* (endemic) (Pauly et al. 2013b). According to pollen analysis, it also visits Arecaceae, Myrsinae, Rubiaceae and Eleocarpaceae (Pauly et al. 2013b).

Native status: Endemic

Distribution: Historical data in New Caledonia: Dec 1979-Sep 2008, one male and 11 females (Donovan et al. 2013). Mt Ouin, 2 Dec 2000, one female. Aoupinié, 3-23 Nov 2001, one male and eight females. Forêt de Saille, 9 Dec 2001, one female (holotype). Mt. Humboldt, 5-8 Nov 2002, six females. Mont Kouakoué, 25 Nov-2 Dec 2002, four females. Monts Dzumac, 4 Dec 2002, two females. Mont Mou, 17 Jan 2004, three females. Haute-Ni, 25 Oct 2004, one female. Kouakoué, south face, 13 May 2006, one female. Canala, Prokoméo, 17 Dec 2006, one male. Pass on mining road from Poro to Kouaoua, one female (no date; Pauly et al. (2013b)).

Notes: This species has been observed in high altitude (up to 1350 m) maquis and forested areas on ultramafic substrates and high altitude (up to 850 m) forested areas on volcano sedimentary substrate.

Lasioglossum (*Chilalictus*) *instabile* (Cockerell, 1914)*

Nomenclature:

Halictus elliottii Rayment, 1929;

Lasioglossum instabilis (Cockerell, 1914)

Native status: Native

Distribution: Australia

Historical data in New Caledonia: Mt Koghis, 22 Dec 1992, one male and one female (Pauly et al. 2013b).

Notes: Occurrence status: data deficient.

Lasioglossum (*Chilalictus*) *lanarium* (Smith, 1853)*

Nomenclature:

Halictus mitchelli Cockerell, 1906;

Halictus lanuginosus Smith, F., 1879

Native status: Native

Distribution: Australia

Historical data in New Caledonia: Upper Vallée La Ni, 2 Nov 1992, two females (Pauly et al. 2013b).

Notes: Occurrence status: data deficient.

Lasioglossum (*Chilalictus*) *polygoni* (Cockerell, 1929)

Feeds on: *Polygonum* sp., *Agatea longipedicellata* (Pauly and Munzinger 2003), *Schinus terebinthifolius* (new records).

Native status: Native

Distribution: Australia

Notes: This species was first described from New Caledonia before being discovered in Australia. The status of the three subspecies should be confirmed through molecular analysis.

Lasioglossum (*Chilalictus*) *polygoni* subsp. *austrocaledonicum* Pauly, Walker, Munzinger & Donovan, 2013

Feeds on: Araliaceae: *Polyscias dioica* (native), *Polyscias sessiliflora* (native), *Polyscias* sp. (native); Asteraceae: *Ageratum conyzoides* (alien); Cunoniaceae: *Pancheria sebertii* (native); Dilleniaceae: *Hibbertia nana* (native); Elaeocarpaceae: *Elaeocarpus dognyensis* (native), *Elaeocarpus speciosus* (native); Ericaceae *: Styphelia* cf *cymbulae* (endemic); Goodeniaceae: *Scaevola beckii* (endemic); Mimosaceae: Leucaena leucocepala (alien); Myrtaceae: *Syzygium quadrangulare* (native); Sapindaceae: *Cupaniopsis oedipoda* (endemic), *Cupaniopsis* sp. (native), *Guioa villosa* (native), *Litchi chinensis* (alien) (Donovan et al. 2013); Araliaceae: *Polyscias bracteate*; Cunoniaceae: *Pancheria ternate*; Dilleniaceae: *Hibbertia lucens, Hibbertia virotii* (native); Ericaceae: *Dracophyllum ramosum* (endemic); Mimosaceae: *Leucaena leucocephala* (alien); Myrtaceae: *Syzygium tetragonum* ; Phellinaceae: *Phelline lucida* (endemic); Sapindaceae*: Ageratum conyzoides*, *Elaeocarpus dognyensis*, *Elaeocarpus speciosus* (Pauly et al. 2013b).

Native status: Native

Distribution: Australia

Historical data in New Caledonia: Thi River Valley, 8 Nov 1940, one female. Mt Koghi, 28 Nov 1963, one female. Montagne des Sources, 29 Dec 1979, one female; 22 Oct 1980, one female; 25 Oct 1980, two females; 29 Jul 1981, one female. Mt Dzumac, 24 Feb 1980, one female; 4 Dec 2002, three females (including holotype). Thy Valley, 28 May 1980, two females; 18 Jun 1980, 3 females; 3 Jul 1980, six females; 8 Oct 1980, one female; 5 May 1981, 10 females. Thy Valley, Park entrance, 9 Oct 1980, two females. 2 km E Col de Mouirange, 10 Oct 1980, one female. Thy Valley Park, 12 Oct 1980, two females. Mt Koghis, 17 km NNE Nouméa, 24-26 Dec 1991, one female. Upper La Ni Valley, 2 Nov 1992, one female. Rivière Bleue Provincial Park, Trail to Upper Rivière Bleue, 5-16 Nov 1992, one female. Rivière Bleue, 16-17 Nov 1992, one female. Rivière Bleue Provincial Park, Rivière Bleue road, 20-28 Nov 1992, five

females. Province Sud, Mt Ouin, 2 Dec 2000, one female. Mont Koghis, 4 Nov 2002, one female. Piste Ni-Dzumac, 7 May 2004, one male. Konguaoulou Nord, 27 Sep 2004, one female. Haute-Ni, 23 Oct 2004, two females; 25 Oct 2004, two females. Goro, embouchure de la Kuébuni, 14 Oct 2005, two females. Mont Koghis, 13 Jan 2007, one female (Pauly et al. 2013b). Dec 1979-Sep 2008, 25 females. Haute-Ni, 23 Oct 2004, one female (Donovan et al. 2013).

Notes: This species was observed in forested areas on ultramafic substrates including in high altitude (> 500 m).

Lasioglossum (*Chilalictus*) *polygoni* subsp. *delobeli* Pauly & Munzinger, 2003

Feeds on: Verbenaceae: *Lantana* sp. (alien) (Pauly & Muzinger 2003); Araliaceae: *Polyscias dioica* (native); Arecaceae*: Cyphokentia cerifera* (endemic); Cunoniaceae: *Geissois racemosa* (native); Dilleniaceae: *Hibbertia lucens* (native); Ericaceae: *Dracophyllum ramosum* (native); Melastomaceae: *Melastoma malabathricum* (native); Myrtaceae: *Myrtastrum rufo-punctatum* (endemic); Phellinaceae: *Phelline lucida* (native); Sapindaceae: *Litchi chinensis* (alien) (Donovan et al. 2013); Sapindaceae: *Litchi chinensis* (ailen) (Pauly et al. 2013b).

Native status: Endemic

Distribution: Historical data in New Caledonia: Col d'Amieu, 21 Jul 1977, three females (Pauly and Munzinger 2003, Donovan et al. 2013). Thy Valley, 3 Jul 1980, one female. Mt Aoupinie, 12 Dec 1980, one female. 6km NW Sarramea, 14-23 Nov 1992, four females. Rivière Bleue, 19-28 Nov 1992, one female. Col d'Amieu, 27 Nov 1992, one female. 9.3 km NW Sarraméa, 15 Jan 1996, one female. 9.1 km NW Sarraméa, 18-19 Jan 1996, one female. Mt Do, 15 Dec 2000, three females. Tchingou, 31 Mar 2001, one female. Koum River, 23 Nov 2001, one female. Haute Tchamba, 9 Nov 2002, one female. Col d'Amoss, 16 Nov 2002, two females. Towen, tribu de Tiendanite, 17 Nov 2002, two females. Mont Goroaté, 18 Nov 2002, three females. Pic du Grand Kaori, 21 Nov-29 Jan 2002, one female. Aoupinié, 25 Jul 2005, one female; Aoupinié, 15 Nov 2007, eight females; 11 Sep 2008, eight females. Vallée de la Tchamba, 26 Jul 2005, four females. Tchamba, 29 Oct 2005, one female. Hienghène Tao Mt Panié East Side, 9-26 Jan 2006, one male. Ponérihouen, forêt de l'Aoupinié, 12-13 Jan 2006, one female (Pauly et al. 2013b). Dec 1979-Sep 2008, one male and 29 females (Donovan et al. 2013).

Notes: This species has been observed in forested areas on both utramafic and volcano sedimentary substrates, with altitudes ranging from 5 to 1100 m.

Lasioglossum (*Chilalictus*) *polygoni* subsp. *polygoni* (Cockerell, 1929)

Feeds on: Asteraceae: *Blumea lacera* (native); Eleocarpaceae: *Elaeocarpus angustifolius* (native); Malvaceae: *Sida acuta* (alien); Polygonaceae: *Antigonon*

leptopus (alien), Polygonum sp. (alien); Solanaceae: *Solanum torvum* (alien); Violaceae: *Agatea longipedicellata* (endemic) (Donovan et al. 2013).

Native status: Native

Distribution: Australia

Historical data in New Caledonia: Bourail, 27 May 1927, one female; 1929, one female. Prony, 10 Feb 1999, one female (Pauly and Munzinger 2003). Dec 1979-Sep 2008, one male and seven females (Donovan et al. 2013). Oua Tom, 29 Apr 1981, 22 females. Koumac, 30 Apr 1981, one female. Prony, 10 Feb 1999. Magenta, 26 Apr 2001, one male. Païta, 28 May 2005, two females (Pauly et al. 2013b). Mont Dore: Rue des Trocas, 13 Apr 2022, two individuals; Saint Michel, 20 Apr 2022, one individual (Zakardjian et al. 2023b).

Lasioglossum (*Chilalictus*) *tchambae* Pauly, Walker, Munzinger & Donovan, 2013

Feeds on: Melastomataceae: *Melastoma malabathricum* (native) (Donovan et al. 2013, Pauly et al. 2013b).

Native status: Endemic

Distribution: Historical data in New Caledonia: Dec 1979-Sep 2008, one male and one female (Donovan et al. 2013). Vallée de la Tchamba, 26 Jul 2005, one female (holotype). Aoupinié, (no date), two females (Pauly et al. 2013b).

Notes: This species has been observed in forested areas mostly in altitudes (> 500 m), on volcano-sedimentary substrates.

Lasioglossum (*Chilalictus*) *webbi* Pauly, Walker, Munzinger & Donovan, 2013*

Native status: Endemic

Distribution: Historical data in New Caledonia: Ni Valley, 2 Nov 1992, one female (holotype). Mt Koghis, 22 Dec 1992, one male (paratype; Pauly et al. (2013b)).

Notes: Occurrence status: data deficient.

Lasioglossum (*Parachilalictus*) *neocaledonicum* Pauly, Walker, Munzinger & Donovan, 2013

Feeds on: Ericaceae: *Styphelia* cf *cymbulae* (endemic) (Donovan et al. 2013, Pauly et al. 2013b).

Native status: Endemic

Distribution: Historical data in New Caledonia: Dec 1979-Sep 2008, one female (Donovan et al. 2013). Plateau de Dogny, 14 Nov 1992, one female. Mt Khogis, 25 Jan 1996, one female (paratype). Haute-Ni, 23 Oct 2004, one female (holotype; Pauly et al. (2013b)).

Notes: This species has been observed in forested areas on both volcano-sedimenatry and ultramafic substrates, mostly in altitudes 400-1000 m.

Lasioglossum (*Parasphecodes*) *sulthicum* (Smith, 1853)*

Native status: Native

Distribution: Australia

Historical data in New Caledonia: Mont Kogis, 30 Oct 1992, one female (Donovan et al. 2013, Pauly et al. 2013b).

Notes: Occurrence status: data deficient.

Megachilidae

Lithurgus (*Lithurgus*) *scabrosus* (Smith, 1859)

Nomenclature:

Lithurgus albofimbriatus froggatti Cockerell, 1914;

Lithurgus albofimbriatus Sichel, 1867;

Lithurgus guamensis Cockerell, 1914;

Megachile scabrosus Smith, 1859

Feeds on: Convolvulaceae: *Ipomoea* sp. (native) (Cockerell 1929), *Ipomoea pescaprae* (native) (Pauly and Munzinger 2003); Convolvulaceae: *Ipomoea* sp. (Donovan et al. 2013).

Native status: Likely alien. Pauly & Villemant (2009) hypothesised that this species could have been accidentally introduced.

Distribution: Native range: Indonesia, Malaysia.

Alien range: Cook Islands, Fiji, French Polynesia, Guam, Hawaï, Micronesia, northern Mariana Islands, Papua New Guinea, Solomon Islands, Vanuatu.

Historical data in New Caledonia: Nouméa, Jul 1900. Dec 1979-Sep 2008, three males and four females (Donovan et al. 2013). Bourail, 26 May 1927, eight males and two females. Dge, Ile Uen, 6 Jun 1927, one female (Cockerell 1929). Koumac: Paagoumene, 12 Mar 1999, two males and one female (Pauly and Munzinger 2003).

Ouvea, 9 Mar 2017, one male. Koumac, 2 May 2017, two females (Zakardjian et al. 2023b).

Megachile (*Aethomegachile*) *laticeps* Smith, 1853

Nomenclature:

Megachile gadara Cameron, 1903;

Megachile mcgregori Cockerell, 1918;

Megachile metallescens Cockerell, 1918;

Megachile otriades Cameron, 1902;

Megachile penangensis Cockerell, 1918;

Megachile robbii Ashmead, 1904;

Megachile semperi Friese, 1905;

Megachile subignita Cockerell, 1918;

Megachile varidens Cameron, 1905;

Megachile caecina Cameron, 1903;

Megachile cinyras Cameron, 1902

Feeds on: *Duranta repens* (Pauly and Munzinger 2003); Convolvulaceae: *Ipomoea pes-caprae* (native); Myrtaceae: *Sannantha pinifolia* (native); Verbenaceae: *Duranta erecta* (alien) (Donovan et al. 2013); *Antigonon leptopus*, *Cosmos* sp., *Cuphea hyssopifolia*, *Duranta erecta*, *Ossinum basilicum*, *Schinus terebinthifolius*, *Tridax* sp. (new records).

Native status: Likely alien. Pauly & Munzinger (2003) hypothesised that this species could be alien because it was captured in Noumea, while visiting an alien plant species.

Distribution: Native range: India to Malaysia, Nepal, Vietnam.

Alien rage: Singapore, Maldives, South Africa (remains to be confirmed), widely distributed in the Pacific Region (Vanuatu, Fiji, French Polynesia).

Historical data in New Caledonia: Nouméa, Jul 1957, one female. Dec 1979-Sep 2008, one male and one female (Donovan et al. 2013). Nouméa, 5 Feb 1999 one male and one female (Pauly and Munzinger 2003). Nouméa: Parc Zoologique et Forestier, 27 Feb 2019, one individual; 23 Mar 2019, one female; 04 Apr 2022, one individual; 22 Apr 2022, one individual; Centre culturel Tjibaou, 23 Mar 2019, two females; Rivière Salée, 14 Mar 2022, one individual; 16 Mar 2022, one individual; Petite Normandie, 29 Mar 2022, two individuals; 14 Apr 2022, one individual; Magenta Tours, 31 Mar 2022, four individuals; 12 Apr 2022, one individual; Tuband, 19 Apr 2022, one individual. Païta - La Tontouta: La Tontouta, 5 Apr 2019, one

female. Mont Dore: La Conception, 23 Mar 2022, one individual; Rue André Burck, 1 Apr 2022, one individual; Vallon Dore, 20 Apr 2022, one individual (Zakardjian et al. 2023b).

Megachile (*Callomegachile*) *rambutwan* Cheesman, 1936*

Nomenclature:

Chalicodoma rambutwan (Cheesman, 1936)

Native status: Native

Distribution: Vanuatu

Historical data in New Caledonia: Nouméa, Aug 1900, one male (Donovan et al. 2013).

Notes: Occurrence status: data deficient.

Megachile (*Callomegachile*) *umbripennis* Smith, 1853

Nomenclature:

Megachile domesticum Perkins, 1899;

Megachile lerma Cameron, 1908;

Megachile schauinslandi Alfken, 1898;

Megachile umbripennis var. *atriventris* Friese, 1903;

Chalicodoma umbripenne (Smith, 1853);

Megachile aureobasis Cockerell, 1919.

Feeds on: *Duranta repens* (Pauly and Munzinger 2003); Asteraceae: *Bidens pilosa* (alien); Polygonaceae: *Antigonon leptotus* (alien); Protaceae: *Stenocarpus* sp. (native); *Cytisus cajan* (alien) (Donovan et al. 2013).

Native status: Likely alien. Pauly & Munzinger (2003) hypothesised that this species could be alien because it was captured in Noumea, while visiting an alien plant species.

Distribution: Native range: China, India, Malaysia, Myanmar, Nepal, Laos.

Alien range: United States, Singapore, Sri Lanka, Thailand, many Pacific islands including Cook Islands, Fiji, French Polynesia, northern Mariana Islands, Tonga, Hawaii (Ascher et al. 2016).

Historical data in New Caledonia: Dec. 1979-Sep 2008, eight males and two females. Noumea, 15 Oct 1980, two females (Donovan et al. 2013). Nouméa, 7 Feb 1999, two

males (Pauly and Munzinger 2003). Koumac, 30 Apr 2017, two females. Mont Dore: La Conception, 23 Mar 2022, one individual (Zakardjian et al. 2023b).

Megachile (*Eutricharaea*) *albomarginata* Smith, 1879

Feeds on: Violaceae: *Agatea longipedicellata* (native), *Agatea rufotomentosa* (native); Verbenaceae: *Duranta erecta* (alien) (Pauly and Munzinger 2003); Apocynaceae: *Parsonsia crebriflora* (native), *Rauvolfia semperflorens* (native), unknown (native); Araliaceae: *Tieghemopanax* sp. (native); Asteraceae: *Ageratum* sp. (alien), *Bidens* sp. (alien), *Cosmos* sp. (alien), *Tridax procumbens* (alien); Connaraceae: unknown (native); Dilleniaceae: *Hibbertia podocarpifolia* (native), *Hibbertia lucens* (native), *Hibberta* sp. (native); Goodeniaceae: *Scaevola beckii* (native), *Scaevola erosa* (native), *Scaevola montana* (native); Lamiaceae: *Ocimum gratissimum* (alien); Mimosaceae: *Albizia* sp. (alien), *Leucaena leucocephala* (alien), *Mimosa diplotricha* (alien); Myrtaceae: *Callistemon* sp. (alien), *Psidium guajava* (alien), *Syzygium lateriflorum* (native); Proteaceae: *Stenocarpus* sp. (native); Tiliaceae: *Triumfetta rhomboidea* (alien); Verbenaceae: *Stachytarpheta indica* (alien) (Donovan et al. 2013); Apocynaceae: *Polygala paniculata* (new records).

Native status: Native

Distribution: Fiji

Historical data in New Caledonia: Nouméa, 22 Jan-1 feb 1914, two females. Mt Mou, 12 Mar 1914, two females. Baie Ouemo, 28 Mar 1914, three males and seven females (Turner 1919). Houailou, 28 Oct 1925, two females (Cockerell 1939). Bourail, May 1927, two males and 14 females (Cockerell 1929). Dec 1979-Sep 2008, 14 males and 38 females (Donovan et al. 2013). Mont Koghi, 24 Feb 1986, one female. Rivière Bleue, 10 Jan 1999, four females; 11 Jan 1999, three females. Mandjelia, 27 Jan 1999, one female; 28 Jan 1999, one female. Nouméa, 7 Feb 1999, one male. Prony, 10 Feb 1999, one female and one male (Pauly and Munzinger 2003). Belep: Art Island 28 Feb 2017, two females. Païta - La Tontouta - La Tontouta, 22 Mar 2019, one female (Zakardjian et al. 2023b).

Megachile (*Eutricharaea*) *australasiae* Dalla-Torre, 1896*

Native status: Native

Distribution: Its presence in Australia and Papua New Guinea remains to be confirmed.

Historical data in New Caledonia: Coinde, 12 Jan 1912, three males and one female. Bourail, 23 Jan 1912, three females (von Schulthess 1915).

Notes: The presence of this species is doubtful in New Caledonia as it was only mentioned by von Schulthess (1915) who spent one year on a field trip in New

Caledonia between 1911 and 1912. As pointed out by Cockerell (1929), it is hard to understand how Sarasin and Roux could have collected this species and yet failed to find common endemic species (*Megachile australis* or *Megachile albomarginata*). We then hypothesise that those individuals are misidentified individuals of *M. albomarginata*.

Occurrence status: data deficient.

Megachile (*Eutricharaea*) *australis* Lucas, 1876

Feeds on: Aizoaceae: *Sesuvium portulacastrum* (native); *Wedelia trilobata* (Pauly and Munzinger 2003); Amaranthaceae: *Achyranthes aspera* (alien); Apocynaceae: *Melodinus* sp. (native), *Rauvolfia semperflorens* (native); Asteraceae: *Bidens* sp. (alien), *Cosmos sulphureus* (alien), *Cosmos* sp. (alien), *Sphagneticola trilobata* (alien), *Tridax procumbens* (alien); Convolvulaceae: *Ipomoea pes-caprae* (native); Dilleniaceae: *Tetracera billardieri* (native); Euphorbiaceae: *Cleistanthus stipitatus* (native), *Euphorbia* sp. (alien); Goodeniaceae: *Scaevola sericea* (native); Labiatae: *Premna serratifolia* (native); Mimosaceae: *Leucaena leucocephala* (alien), *Mimosa diplotricha* (alien); Myrtaceae: *Melaleuca quinquenervia* (native), *Metrosideros operculata* (native), *Psidium guajava* (alien), *Sannantha* sp. (native); Onagraceae: *Ludwigia octovalvis* (native); Poaceae: *Stenotaphrum secundatum* (alien); Santalaceae: *Santalum austrocaledonicum* (native); Surianaceae: *Suriana maritima* (native); Tiliaceae: *Triumfetta rhomboidea* (alien); Verbenaceae: *Stachytarpheta australis* (alien); Zygophyllaceae: *Tribulus cistoides* (alien); *Desmodium incanum* (native) (Donovan et al. 2013); *Poinsettia* sp. (Cockerell 1929), *Antigonum leptotus*, Orchidaceae, *Scaevola* sp. (new records).

Native status: Endemic

Distribution: Historical data in New Caledonia: Nouméa, Jun 1900, one female. Dec 1979-Sep 2008, 23 males and 32 females (Donovan et al. 2013). Nouméa, 23 Jan 1914, one male. Mt Canala, 12 Jun 1914, one female (Turner 1919). Bourail, May-Jun 1927, one male and three females. Mueo, May-Jun 1927, one male and four females. Tontouta, 28 May 1927, two males. Plum Farm, 4 Jun 1927, two males. Ile Nou, 10 Jun 1927, one female (Cockerell 1929). Plage du Mont Dore, 6 Feb 1999, one male, one female (Pauly and Munzinger 2003). Belep: Île Art, 2 Mar 2017, one female; 26 Apr 2017, one female; 27 Apr 2017, one female. Ouvea: 9 Mar 2017, one female. Tiga, 13 Apr 2017, one female. Koumac, 2 May 2017, two females. Nouméa: Petite Normandie, 31 Mar 2022, one individual; 12 Apr 2022, one individual (Zakardjian et al. 2023b).

Megachile (*Eutricharaea*) *fullawayi* Cockerell, 1914*

Native status: Native

Distribution: Guam, Hawaï

Historical data in New Caledonia: Nouméa, Jul 1914, one male (Donovan et al. 2013).

Notes: Occurrence status: data deficient.

Megachile (*Eutricharea*) *similis* Smith, 1879*

Nomenclature:

Megachile zingowli Cheesman, 1936;

Megachile similis zingowli Cheesman, 1936

Native status: Native

Distribution: Vanuatu (Pauly and Villemant 2009).

Historical data in New Caledonia: Belep, Île Art, 2 Mar 2017, one male (Zakardjian et al. 2023b).

Notes: This species was previously considered as endemic to Vanuatu (Pauly and Villemant 2009). At this stage, it is difficult to know if it is native to New Caledonia and it has remained undetected since 2017 or if its presence is due to a recent human-induced displacement or a natural range expansion.

Occurrence status: data deficient.

Megachile (*Hackeriapis*) *aurantiaca* Friese, 1905

Nomenclature:

Chalicodoma aurantiaca (Friese, 1905);

Megachile quodi Vachal, 1907.

Feeds on: Violaceae: *Agatea rufotomentosa* (endemic) (Pauly and Munzinger 2003); Apocynaceae: unknown (native); *Nephrodesmus ferrugineus* (native); Flacourtiaceae: *Homalium betulifolium* (native); Liliaceae: *Dianella* sp. (native) (Donovan et al. 2013); *Acacia spirorbis*, *Polygala paniculata* (new records).

Native status: Endemic

Distribution: Historical data in New Caledonia: Dumbéa, 19 Dec 1979, one male. Dec 1979-Sep 2008, two males and six females (Donovan et al. 2013). Mandjelia, 27 Jan 1999, one male and two females; 28 Jan 1999, one female (Pauly and Munzinger 2003). Belep: Île Art, 28 Feb 2017, one male and two females; 1 Mar 2017, one female. (Zakardjian et al. 2023b).

Megachile ventralis Smith, 1861 *

Native status: Native

Distribution: Solomon Islands, Indonesia

Historical data in New Caledonia: Canala, 2 Jan 1912, one female (von Schulthess 1915).

Notes: Occurrence status: data deficient.

Discussion

We found 23 publications, dated from 1897 to 2020, mentioning bee species in New Caledonia (Suppl. material 1). From the first published mention of New Caledonian bees to the present day, 51 bee species have been recorded, including 10 undetermined ones. Halictidae is the most represented family (26 species), followed by Megachilidae (11 species), Colletidae (10 species) and Apidae (4 species).

Occurrence status

Based on their first and last year of capture, we applied occurrence status to each species. Thus, we can confirm the presence of 30 species in the archipelago and we lack data to do so for the remaining 21 species (i.e. data-deficient species).

Amongst the 21 data deficient species, 17 have been captured only once, three have been captured twice during the same year (i.e. *Lasioglossum webbi* in 1992) and one is recorded for New Caledonia, based on personal communication with no specimen reported (i.e. *Lasioglossum (Austrevylaeus)* sp.). As bee samplings in New Caledonia prior to the 21st century have been piecemeal and far from exhaustive, it is difficult to adjudicate on their current presence. Several hypotheses may explain why those species went unrecorded during recent samplings. First, several species may have been misidentified. For example, *Megachile australasiae* may be, in fact, a misidentification of *Megachile albomarginata* (Cockerell 1929). Thus, this species should no longer be considered as present in New Caledonia. Then, some species may be cryptic and contemporary samplings may have not covered their period of activity and/or their New Caledonian range. Finally, we cannot exclude the possibility that some species may have become extinct. However, the lack of exhaustive samplings of the New Caledonian bee fauna does not allow us to discriminate between the two last hypotheses.

A significant part of the bee species of New Caledonia needs clarification (41%). An exhaustive sampling of the entire territory at different times of the year would provide a more precise picture of the New Caledonian bee fauna and potentially allow new species to be detected. A starting point to such a project could be to realise further samplings at periods and locations where data-deficient species were captured. This first step could

provide additional information to support the presence or absence of these species. Moreover, it seems crucial to apply biomolecular analysis to the New Caledonian bee fauna. Bee species recorded from the archipelago have been described and identified exclusively, based on morphological criteria. This may have induced an over- or underestimation of the actual number of species (e.g. Praz et al. (2022)).

Origin status

Amongst the 41 identified bee species recorded in New Caledonia, 20 were categorised as endemic, 12 as native and nine as alien. However, the status of endemic and native species may evolve over time. First, it is possible that some species considered as endemic to date actually have a wider distribution across the Pacific. For example, *Megachile albomarginata* was considered endemic in Pauly and Munzinger (2003), but a later work showed that this species is also present in Fiji (Davies et al. 2013). Part of the southwest Pacific bee fauna remains unrecognised, as shown by the checklist of the bees of Vanuatu, in which five of 21 species are undetermined (Pauly and Villemant 2009). Thus, it would not be surprising if future studies reveal a wider distribution of certain species.

Concerning native bee species, biomolecular analysis could clarify the origin of certain species, notably megachilid bees. Biomolecular analysis suggested that Fijian megachilid bees are mostly, if not entirely, the result of anthropogenic displacements (Davies et al. 2013). Thus, the number of alien bee species in New Caledonia could be underestimated.

For now, alien bee species account for almost 20% of the New Caledonian bee fauna. Within the last seven years, three new alien bee species have entered the territory and established themselves (i.e. *Amegilla pulchra* in 2016, *Braunsapis puangensis* in 2019 and *Hylaeus albonitens* in 2022). New arrivals of alien bee species will likely continue in the years to come (Seebens et al. 2017) and their establishment raises serious concerns for native species. Alien bees may negatively impact native pollinators in a multitude of ways (i.e. competition for food and nesting resources, transmission of diseases and parasites, hybridation; Zakardjian et al. (2022)). Moreover, they may disrupt plant-pollinator interactions and impact native and alien plant reproductive success (Dohzono and Yokoyama 2010). While most native bees in New Caledonia are short-tongued species, almost all alien ones (except *Hylaeus albonitens*) are long-tongued species. This morphological trait may allow alien bees to effectively pollinate alien plants that are poorly pollinated by native bees (i.e. awakening of sleeper weeds; Groom et al. (2014), Groom et al. (2017)). Additionally, if alien bees show morphological mismatches with native plant flowers, they may visit them without effectively transporting pollen, potentially disrupting their reproductive success.

Conclusion

As in other Pacific islands (see Pauly and Villemant (2009) for Vanuatu and Naaz et al. (2021) for Fiji), the New Caledonian bee fauna is relatively poor, despite a remarkable and highly endemic plant diversity. Amongst the 51 species recorded through previous publications and recent samplings, only 30 are certainly or likely present. In order to have a more accurate picture of the New Caledonian bee fauna, there is a need to confirm species identifications and their original status through biomolecular analysis. Additionally, further samplings covering wider periods and areas are crucial to detect cryptic species and to potentially highlight local extinctions.

References

- Ascher J, Risch S, Soh Z, Lee J, Soh E (2016) *Megachile* leaf-cutter and resin bees of Singapore (Hymenoptera: Apoidea: Megachilidae). Raffles Bulletin of Zoology 32: 33-55.
- Bernstein J, Jackman T, Sadlier R, Wang Y, Bauer A (2021) A novel dataset to identify the endemic herpetofauna of the New Caledonia biodiversity hotspot with DNA barcodes. Pacific Conservation Biology 28 (1): 36-47. https://doi.org/10.1071/pc20055
- Cardoso P, Borges PV, Triantis K, Ferrández M, Martín J (2011) Adapting the IUCN Red List criteria for invertebrates. Biological Conservation 144 (10): 2432-2440. https://doi.org/10.1016/j.biocon.2011.06.020
- Cheesman LE (1953) Bees of New Caledonia. Annals and Magazine of Natural History 6 (69): 713-716. https://doi.org/10.1080/00222935308654474
- Cockerell TD (1911) The bees of the Solomon Islands. Proceedings of the Linnean Society of New South Wales 36: 160-178. https://doi.org/10.5962/bhl.part.21897
- Cockerell TD (1929) Descriptions and records of bees. CXIV. Annals and Magazine of Natural History 3 (14): 195-204. https://doi.org/10.1080/00222932908672959
- Cockerell TD (1939) Studies of the Pacific bees in the Collection of Bishop Museum. Occasional Papers of Bernice P. Bishop Museum 15 (11): 133-140.
- da Silva CRB, Groom SVC, Stevens MI, Schwarz MP (2016) Current status of the introduced allodapine bee *Braunsapis puangensis* (Hymenoptera: Apidae) in Fiji. Austral Entomology 55 (1): 43-48. https://doi.org/10.1111/aen.12149
- Davies O, Groom SC, Ngo H, Stevens M, Schwarz M (2013) Diversity and origins of Fijian leaf-cutter bees (Megachilidae). Pacific Science 67 (4): 561-570. https://doi.org/10.2984/67.4.7
- Dohzono I, Yokoyama J (2010) Impacts of alien bees on native plant-pollinator relationships: A review with special emphasis on plant reproduction. Applied Entomology and Zoology 45 (1): 37-47. https://doi.org/10.1303/aez.2010.37
- Donovan B, Munzinger J, Pauly A, McPherson G (2013) Flower-visiting records of the native bees of New Caledonia. Annals of the Missouri Botanical Garden 99 (1): 19-43. https://doi.org/10.3417/2010076
- Donovan BJ (1983) Comparative biogeography of native Apoidea of New Zealand and New Caledonia. GeoJournal 7: 511-516.

- Fox R, Harrower C, Bell J, Shortall C, Middlebrook I, Wilson R (2019) Insect population trends and the IUCN Red List process. Journal of Insect Conservation 23 (2): 269-278. https://doi.org/10.1007/s10841-018-0117-1
- Friese H (1905) Neue Bienenarten aus Chile (Hym.). Zeitschrift für systematische Hymenopterologie und Dipterologie 5: 137-141.
- Gargominy O, Tercerie S, Régnier C, Dupont P, Daszkiewicz P, Antonetti P, Léotard G, Ramage T, Idczak L, Vandel E, Petitteville M, Leblond S, Boullet V, Denys G, De Massary JC, Dusoulier F, Lévêque A, Jourdan H, Touroult J, Rome Q, Le Divelec R, Simian G, Savouré-Soubelet A, Page N, Barbut J, Canard A, Haffner P, Meyer C, Van Es J, Poncet R, Demerges D, Mehran B, Horellou A, Ah-Peng C, Bernard J-, Bounias-Delacour A, Caesar M, Comolet-Tirman J, Courtecuisse R, Delfosse E, Dewynter M, Hugonnot V, Lavocat Bernard E, Lebouvier M, Lebreton E, Malécot V, Moreau PA, Moulin N, Muller S, Noblecourt T, Noël P, Pellens R, Thouvenot L, Tison JM, Robbert Gradstein S, Rodrigues C, Rouhan G, Véron S (2022) TAXREF v16.0, référentiel taxonomique pour la France. PatriNat (OFB-CNRS-MNHN), Muséum national d'Histoire naturelle, Paris. URL: https://inpn.mnhn.fr/telechargement/referentielEspece/taxref/16.0/menu
- 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: Biological Sciences 363 (1508): 3309-3317. https://doi.org/10.1098/rstb.2008.0122
- Groom SC, Ngo H, Rehan S, Skelton P, Stevens M, Schwarz M (2014) Multiple recent introductions of apid bees into Pacific archipelagos signify potentially large consequences for both agriculture and indigenous ecosystems. Biological Invasions 16 (11): 2293-2302. https://doi.org/10.1007/s10530-014-0664-7
- Groom SC, Stevens M, Ramage T, Schwarz M (2017) Origins and implications of apid bees (Hymentopera: Apidae) in French Polynesia. Entomological Science 20 (1): 65-75. https://doi.org/10.1111/ens.12230
- Groutsch JK, Miller NC, Tuiwawa M, Hayes S, Stevens MI, Schwarz MP (2018) Not all exotic pollinator introductions are bad: an introduced buzz-pollinating bee *Amegilla pulchra* (Hymenoptera: Apidae) in Fiji indicates little potential for enhancing the spread of weeds. Austral Entomology 58 (3): 533-539. https://doi.org/10.1111/aen.12346
- Hallmann C, Sorg M, Jongejans E, Siepel H, Hofland N, Schwan H, Stenmans W, Müller A, Sumser H, Hörren T, Goulson D, de Kroon H (2017) More than 75 percent decline over 27 years in total flying insect biomass in protected areas. PLOS One 12 (10). https://doi.org/10.1371/journal.pone.0185809
- Isnard S, L'huillier L, Rigault F, Jaffré T (2016) How did the ultramafic soils shape the flora of the New Caledonian hotspot? Plant and Soil 403: 53-76. https://doi.org/10.1007/s11104-016-2910-5
- Lamaignere H (2001) L'apiculture en Nouvelle-Calédonie. Université de Toulouse, 107 pp.
- Leijs R, Batley M, Hogendoorn K (2017) The genus *Amegilla* (Hymenoptera, Apidae, Anthophorini) in Australia: A revision of the subgenera *Notomegilla* and *Zonamegilla*. ZooKeys 653: 79-140. https://doi.org/10.3897/zookeys.653.11177
- Maurizot P, Campbell HJ (2020) Palaeobiogeography of New Caledonia. Geological Society, London, Memoirs 51 (1): 189-213. https://doi.org/10.1144/m51-2019-31
- Michener C (1965) A classification of the bees of the Australian and South Pacific regions. Bulletin of the American Museum of Natural History 130: 1-362. URL: http://zoobank.org/86d564b3-e724-4c56-b5bc-f1ae717e0324

- Morat P, Jaffré T, Tronchet F, Munzinger J, Pillon Y, Veillon J, Chalopin M, Birnbaum P, Rigault F, Dagostini G, Tinel J, Lowry P (2012) Le référentiel taxonomique Florical et les caractéristiques de la flore vasculaire indigène de la Nouvelle-Calédonie. Adansonia 34 (2): 179-221. https://doi.org/10.5252/a2012n2a1
- Munzinger J, Morat P, Jaffré T, Gâteblé G, Pillon Y, Rouhan G, Bruy D, Veillon J, Chalopin M (2022) FLORICAL: Checklist of the vascular indigenous flora of New Caledonia. http://publish.plantnet-project.org/project/florical. Accessed on: 2022-12-31.
- Naaz ZT, Bibi R, Dorey J (2021) Current status of bees in Fiji - geographical distribution and role in pollination of crop plants. Oriental Insects 56 (2): 271-297. https://doi.org/10.1080/00305316.2021.1982043
- Nattier R, Pellens R, Robillard T, Jourdan H, Legendre F, Caesar M, Nel A, Grandcolas P (2017) Updating the phylogenetic dating of New Caledonian biodiversity with a meta-analysis of the available evidence. Scientific Reports 7 (1). https://doi.org/10.1038/s41598-017-02964-x
- Nieto A, Roberts SP, Kemp J, Rasmont P, Kuhlmann M, García Criado M, Biesmeijer JC, Bogusch P, Dathe HH, De la Rúa P, De Meulemeester T, Dehon M, Dewulf A, Ortiz-Sánchez FJ, Lhomme P, Pauly A, Potts SG, Praz C, Quaranta M, Radchenko VG, Scheuchl E, Smit J, Straka J, Terzo M, Tomozii B, Window J, Michez D (2014) European Red List of bees. European Commission, Luxembourg. [ISBN 978-92-79-44512-5] https://doi.org/10.2779/77003
- Orr M, Hughes A, Chesters D, Pickering J, Zhu C, Ascher J (2021) Global patterns and drivers of bee distribution. Current Biology 31 (3): 451-458. https://doi.org/10.1016/j.cub.2020.10.053
- Pauly A, Munzinger J (2003) Contribution à la connaissance des Hymenoptera Apoidea de Nouvelle-Calédonie et de leurs relations avec la flore butinée. Annales de la Société entomologique de France (N.S.) 39 (2): 153-166. https://doi.org/10.1080/00379271.2003.10697370
- Pauly A, Villemant C (2009) Hyménoptères Apoidea (Insecta) de l'archipel du Vanuatu. Zoosystema 31 (3): 719-730. https://doi.org/10.5252/z2009n3a16
- Pauly A, Donovan B, Munzinger J (2013a) Les *Austronomia* Michener, 1965 de Nouvelle-Calédonie et de l'archipel du Vanuatu (Hymenoptera: Apoidea: Halictidae: Nomiinae). Belgian Journal of EntomologyLes 11: 1-29.
- Pauly A, Walker K, Munzinger J, Donovan B (2013b) Endémisme insulaire et cleptoparasitisme chez les *Lasioglossum* Curtis 1833 (Hymenoptera: Apoidea: Halictidae) de Nouvelle-Calédonie. Annales de la Société entomologique de France (N.S.) 49 (2): 127-153. https://doi.org/10.1080/00379271.2013.815036
- Pauly A, Donovan B, Munzinger J (2015) Les abeilles du genre *Homalictus* Cockerell, 1919 en Nouvelle-Calédonie (Hymenoptera: Apoidea: Halictidae). Belgian Journal of Entomology 34: 1-30.
- Pelletier B (2006) Geology of the New Caledonia region and its implications for the study of the New Caledonian biodiversity. In: Payri CE, Forges BRd (Eds) Compendium of marine species from New Caledonia. Documents Scientifiques et Techniques. IRD, Nouméa, 17-30 pp.
- Pillon Y, Jaffré T, Birnbaum P, Bruy D, Cluzel D, Ducousso M, Fogliani B, Ibanez T, Jourdan H, Lagarde L, Léopold A, Munzinger J, Pouteau R, Read J, Isnard S (2020) Infertile landscapes on an old oceanic island: the biodiversity hotspot of New Caledonia.

Biological Journal of the Linnean Society 133 (2): 317-341. https://doi.org/10.1093/biolinnean/blaa146

- Potts S, Biesmeijer J, Kremen C, Neumann P, Schweiger O, Kunin W (2010) Global pollinator declines: trends, impacts and drivers. Trends in Ecology & Evolution 25 (6): 345-353. https://doi.org/10.1016/j.tree.2010.01.007
- Praz C, Genoud D, Vaucher K, Bénon D, Monks J, Wood T (2022) Unexpected levels of cryptic diversity in European bees of the genus *Andrena* subgenus *Taeniandrena* (Hymenoptera, Andrenidae): implications for conservation. Journal of Hymenoptera Research 91: 375-428. https://doi.org/10.3897/jhr.91.82761
- Rehan S, Richards M, Schwarz M (2009) Evidence of social nesting in the *Ceratina* of Borneo (Hymenoptera: Apidae). Journal of the Kansas Entomological Society 82 (2): 194-209. https://doi.org/10.2317/jkes809.22.1
- Rodrigues AL, Pilgrim J, Lamoreux J, Hoffmann M, Brooks T (2006) The value of the IUCN Red List for conservation. Trends in Ecology and Evolution 21 (2): 71-76. https://doi.org/10.1016/j.tree.2005.10.010
- Russell JC, Blackburn TM (2017) Invasive Alien Species: Denialism, Disagreement, Definitions, and Dialogue. Trends in Ecology & Evolution 32 (5): 312-314. https://doi.org/10.1016/j.tree.2017.02.005
- Schlessman M, Lowry P, Lloyd D (1990) Functional dioecism in the New Caledonian endemic *Polyscias pancheri* (Araliaceae). Biotropica 22 (2). https://doi.org/10.2307/2388405
- Seebens H, Blackburn T, Dyer E, Genovesi P, Hulme P, Jeschke J, Pagad S, Pyšek P, Winter M, Arianoutsou M, Bacher S, Blasius B, Brundu G, Capinha C, Celesti-Grapow L, Dawson W, Dullinger S, Fuentes N, Jäger H, Kartesz J, Kenis M, Kreft H, Kühn I, Lenzner B, Liebhold A, Mosena A, Moser D, Nishino M, Pearman D, Pergl J, Rabitsch W, Rojas-Sandoval J, Roques A, Rorke S, Rossinelli S, Roy H, Scalera R, Schindler S, Štajerová K, Tokarska-Guzik B, van Kleunen M, Walker K, Weigelt P, Yamanaka T, Essl F (2017) No saturation in the accumulation of alien species worldwide. Nature Communications 8 (1). https://doi.org/10.1038/ncomms14435
- Seibold S, Gossner M, Simons N, Blüthgen N, Müller J, Ambarlı D, Ammer C, Bauhus J, Fischer M, Habel J, Linsenmair KE, Nauss T, Penone C, Prati D, Schall P, Schulze E, Vogt J, Wöllauer S, Weisser W (2019) Arthropod decline in grasslands and forests is associated with landscape-level drivers. Nature 574 (7780): 671-674. https://doi.org/10.1038/s41586-019-1684-3
- Shell W, Rehan S (2019) Invasive range expansion of the small carpenter bee, *Ceratina dentipes* (Hymenoptera: Apidae) into Hawaii with implications for native endangered species displacement. Biological Invasions 21 (4): 1155-1166. https://doi.org/10.1007/s10530-018-1892-z
- Slavenko A, Allison A, Austin C, Bauer A, Brown R, Fisher R, Ineich I, Iova B, Karin B, Kraus F, Mecke S, Meiri S, Morrison C, Oliver P, O'Shea M, Richmond J, Shea G, Tallowin OS, Chapple D (2023) Skinks of Oceania, New Guinea, and Eastern Wallacea: an underexplored biodiversity hotspot. Pacific Conservation Biology https://doi.org/10.1071/pc22034
- Thevenon J, Vassart M, Cotte F (1989) Etude des maladies contagieuses du rucher néo-calédonien. Rec. Méd. Vet. 165 (11): 899-903.

- Turner R (1919) XXI.—On the Hymenoptera collected in New Caledonia by P. D. Montague in 1914. Annals and Magazine of Natural History 3 (9): 229-240. https://doi.org/10.1080/00222931908673817
- Vachal J (1897) Quelques espèces nouvelles, douteuses ou peu connues du genre Nomia Latr. (Hym.). Miscellanea Entomologica 5: 72-88.
- Vachal J (1907) Hyménoptères de la Nouvelle-Calédonie rapportés par le lieutenant Quod. Revue d'Entomologie 26: 113-12.
- Vachal J (1908) Deuxième note sur les Hyménoptères de la Nouvelle-Calédonie. Revue d'Entomologie 27: 23-26.
- Vargas P (2012) Evolucion en islas. In: Vargas P, Zardoya R (Eds) El árbol de la vida: sistemática y evolución de los seres vivos. 1.
- von Schulthess A (1915) Hymenopteren von Neu-Caledonien und den Loyalty-Inseln. Nova Caledonia. Forschungen in Neu-Caledonien und auf den Loyalty-Inseln. Recherches scientifiques en Nouvelle-Calédonie et aux iles Loyalty. A. Zoologie 2.
- Wagner D (2020) Insect declines in the Anthropocene. Annual Review of Entomology 65 (1): 457-480. https://doi.org/10.1146/annurev-ento-011019-025151
- Zakardjian M, Geslin B, Mitran V, Franquet E, Jourdan H (2020) Effects of urbanization on plant-pollinator interactions in the tropics: An experimental approach using exotic plants. Insects 11 (11). https://doi.org/10.3390/insects11110773
- Zakardjian M, Jourdan H, Le Féon V, Geslin B (2022) Assessing the impact of alien bees on native ones. In: Kevan P, Chan SW (Eds) Promoting pollination and pollinators in farming. Burleigh Dodds Science Publishing https://doi.org/10.19103/AS.2022.0111.17
- Zakardjian M, Mahé P, Geslin B, Jourdan H (2023a) Plant-pollinator interactions networks in ultramafic and non-ultramafic substrates in New Caledonia. Botany Letters. https://doi.org/10.1080/23818107.2023.2204134
- Zakardjian M, Jourdan H, Cochenille T, Mahé P, Geslin B (2023b) Apoidea of New Caledonia 2017-2022. GBIF https://doi.org/10.15468/qmn3za
- Zattara E, Aizen M (2021) Worldwide occurrence records suggest a global decline in bee species richness. One Earth 4 (1): 114-123. https://doi.org/10.1016/j.oneear.2020.12.005

Supplementary materials

Suppl. material 1: Database of the bee species recorded for New Caledonia and references associated

Authors: Zakardjian M, Jourdan H, Cochenille T, Mahé P, Geslin B
Data type: Taxonomy, occurrences, origin status, references
Brief description: The sheet "references" compiles the publications reviewed to produce the checklist of the bees of New Caledonia. Each publication of interest is associated with an ID number.
The sheet "species" compiles the bee species and subspecies recorded for New Caleodnia, together with information on their taxonomy and occurrences ("first_occ" and "last_occ", respectively, refer to the first and last known date of capture of each species). The column "references" contains the ID numbers of the publications mentioning the according bee.
Download file (19.51 kb)

Suppl. material 2: Map of the 14 sites sampled to produce the third dataset

Authors: Zakardjian M, Jourdan H, Cochenille T, Mahé P, Geslin B
Data type: Sampled sites
Brief description: Black squares represent the sampled sites, distributed from Nouméa (delimited by the bold black line) to the Col de Mouirange at the extreme East of the map. Ultramafic substrates appear in brown and non-ultramafic substrates in beige.
Download file (87.35 kb)