Papua New Guinea possesses among the most remarkable ecosystems in the world in terms of plant species richness and marine biodiversity. During the biotic survey "Our Planet Reviewed – Papua New Guinea 2012-2013" more than two hundred people have explored these ecosystems, from the bottom of the Bismarck Sea to the summit of Mount Wilhelm, its highest peak. Assisted by both local communities and local parataxonomists, researchers, technicians, amateur naturalists and students from 21 different countries have gathered a large amount of specimens and data to attempt answering fundamental questions such as how many living species inhabit our planet or how much biodiversity is generated by elevational turnover of arthropod species. The Mémoires du Muséum publish the second volume about the major outcomes of the terrestrial part of the expedition, pushing forward the study of the arthropod fauna of Mount Wilhelm and presenting the plants collected during the expedition. This volume comprises 14 contributions dealing with diverse groups of insects, with the description of 118 species and 3 genera new to Science.

Tony **Robillard**, Frédéric **Legendre** and Claire **Villemant** are Maîtres de conférences and curators of insects at the Muséum national d'Histoire naturelle in Paris, and Maurice **Leponce** is tropical ecologist at the Royal Belgian Institute of Natural Sciences in Brussels. All four have been involved at various stages of the project supervision, including the sampling protocol design, field collection, and the sorting and identification of specimens involving an international network of taxonomists.

Mémoires du Muséum national d'Histoire naturelle, Tome 214

ISBN: 978-2-85653-836-4
ISSN: 1243-444
89 € TTC

978 285653 836 4

PUBLICATIONS SCIENTIFIQUES
MUSÉUM NAT HIST NATURELLE

Insects of Mount Wilhelm
Papua New Guinea - volume 2

edited by
Tony **ROBILLARD**
Frédéric **LEGENDRE**
Claire **VILLEMANT**
Maurice **LEPONCE**

Mémoires
du Muséum national
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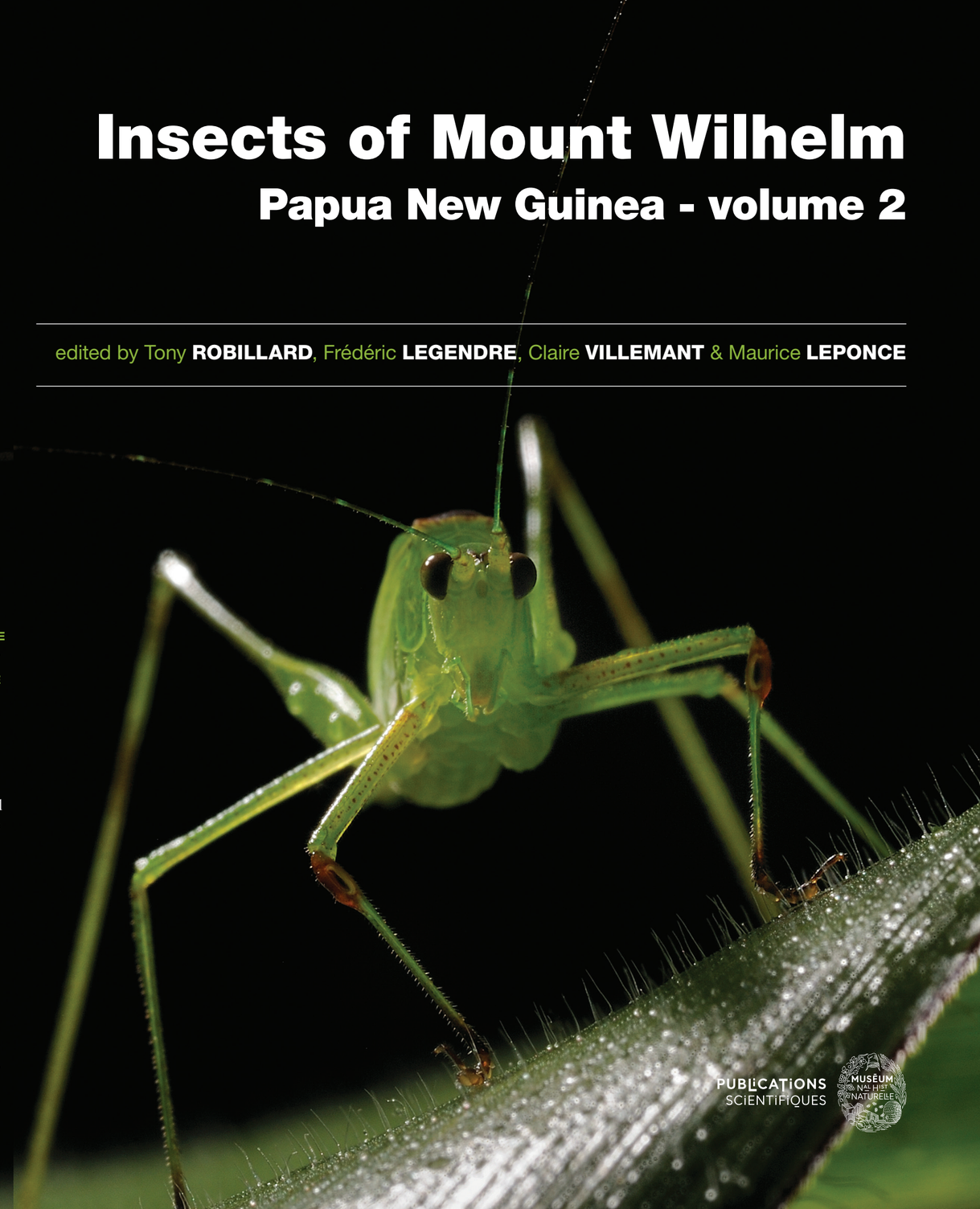
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Cover photographs

First cover: Male katydid of the genus *Phaneroptera*. (Tettigononiidae: Phaneropterinae) on Mt Wilhelm at 700 m a.s.l. (photo © Xavier Desmier; identification: Ming Kai Tan).
Back cover: Collection of botanical samples by Laurent Pierron in the forest canopy of Mount Wilhelm, at 2200 m a.s.l. (Photo © Xavier Desmier).

ISBN : 978-2-85653-836-4
ISSN : 1243-4442
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Insects of Mount Wilhelm

Papua New Guinea - volume 2

Mémoires du Muséum national d'Histoire naturelle
Tome 214

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Publications Scientifiques du Muséum
Paris

2020

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FOREWORD

"There are no safe paths in this part of the world.
Remember you are over the Edge of the Wild now,
and in for all sorts of fun wherever you go."

– J.R.R. Tolkien, The Hobbit

A traveller ascending Mt. Wilhelm, the highest peak of Papua New Guinea (PNG), will be taken from buttressed cauliflorous trees of lowland floodplains through a kaleidoscope of forest types to the heavily bemossed trees bearing epiphytic orchids near the timberline, where the forest fights for space with alpine meadows adorned with tree ferns. That journey is only 35 km long but connects the entire elevation sequence of pristine tropical rainforests, spanning the balmy 27°C lowlands to the chilly 8°C of the forest limits. There are only a few such complete rainforested elevation sequences in the Old World tropics, and a majority of them are found in New Guinea.

Mt Wilhelm is one of the magnificent seven most species-rich areas of the world, at least when counting plant species within 100 x 100 km quadrates. In this way, the unremarkable species richness values of each elevation combine into a truly exceptional total diversity. Bonny Koane, born at Kegesugl, the highest village on the mountain, and his ornithology mentor Katerina Sam found over half of all bird species known from the mainland PNG living on the massif of Mt Wilhelm. Whether the numbers of insect species could be equally impressive remains to be seen, with the second volume of this book providing some answers.

Professional biologists, students, paraecologists and locally recruited field assistants all made essential contributions to the taxonomic research portrayed in this book. Together, they formed an efficient research team with complementary skills, from the theory-dominated knowledge of academics through the highly honed taxonomic and natural history skills of paraecologists to a perfect awareness of their forests by local assistants. Whilst the overseas team members, no matter how excited they may be about tropical rainforests, start to feel discomfited after only a few months spent in the jungle, the Papua New Guineans have been living there all their lives and so do not mind long-term research. The connection with village communities was not only profitable for research, but also inevitable. In PNG, no government permit gets you very far with indigenous landowners. They own the entirety of Mt Wilhelm and evaluate all strangers themselves. The social interface of research was complicated, because the society on the slopes of Mt Wilhelm is complex. Gende language spoken in the lowlands gives way to Kuman and Kandawo languages at higher elevations, and each community fragments into scores of tribes and clans, owning lands within borders demarcated only by the stories passed on from their ancestors. Culturally, and genetically, the differences between our lowland and highland hosts exceed those between the most dissimilar European nations.

The alpine zone of Mt Wilhelm ranks as the second most frequented tourist hotspot in PNG, with an unrelenting stream of approximately three tourists a day. However, the forests below, harbouring the bulk of biological diversity and zero visitor facilities, are entirely neglected by even the most ecological of eco-tourists. Our research team, bringing interesting if often bizarre employment (measuring and tagging trees in the forest or catching and counting small flies therein) has left the local communities interested, if not excited, and yearning for more. People in the small village of Numba slaughtered several pigs for a generous feast that entertained most authors of this book's chapters. This strategic move put the community in a strong position to host further research, and a field station built on their lands soon ensued.

Combining the study provided in this book with the results presented in the first volume, there are no less than 262 new species and nine new genera to science. The research described in this book and in the previous volume played an important role in persuading local communities that setting their forests aside for science could provide twin benefits of keeping the forests pristine and bringing income from visiting researchers. Paraecologists from the New Guinea Binatang Research Center, the PNG partner for the book, have subsequently discussed the matter with the leaders of 39 clans from seven tribes residing on the mountain. They agreed to set aside 19,000 ha of forest across all elevations, creating thus the most species rich conservation area in PNG, although so far only informally declared by the landowners. In the course of three months of serious hiking, landowners painted trees and stones red to mark the boundaries of the conservation area. Their conservation sentiment may or may not have been helped by our unintended experiment that accidentally introduced a new currency and created a social class of bankers in the Mt Wilhelm villages.

The village communities on the slopes of Mt Wilhelm, from Kausi to Kegesugl, live by subsistence agriculture. They plant some of the 92 crops used in the area, from lowland cocoa trees and betel palms to highland onions and strawberries, with the staple crops including sweet potatoes, taro and bananas grown along the entire 2,700 m elevational range of agriculture. The cash income comes seasonally from coffee and other crops, and from a small number of paid jobs, often far away in towns. Our chain of eight research camps, each employing over 20 people, operated for half a year in this environment. Holding cash for salaries in the camps would have been unsafe and so we decided to issue numbered receipts to employees every week instead. They would all be paid to whoever presented them at the end of the project, when we would come with a large bag of cash and an armed police escort. That we duly did, expecting long queues of all our past employees at every camp, each clutching a handful of receipts. To our surprise, we also always received a few large customers, holding tens to hundreds of receipts worth hundreds of dollars. And that is how we learned that our special receipts started to function as a local Mt Wilhelm currency. The workers in need of a quick purchase in a village trade store used receipts instead of cash. The store owners accepted them happily, but at a discount on their face value. The receipts circulated between remote camps and villages, and on at least one occasion some were stolen as valuables, although the thieves never dared to present them for reimbursement. A few people with access to cash also started buying receipts for future reimbursement, for as little as 70% of their nominal value. The communities have thus seen a rapid emergence of a cash economy with bankers as a new profession, spontaneously appearing and quickly accumulating approximately half of all receipts issued by the project during this unintended experiment with raw, unregulated capitalism.

The hut next to the glacial lake Piunde, reincarnated to shelter tourists before they set out for the night climb of the summit, once served as a research station, built in 1966 during colonial times by the Australian National University. Regrettably, that research tradition is no longer alive. In the past 20 years, 18-25 times more research papers (included in the Web of Science) have been published on each of the other prominent high mountains in the tropics, Mt Kinabalu, Mt Cameroon and Mt Kilimanjaro, than on Mt Wilhelm. It is our hope that the present book will help to revive the research tradition at Mt Wilhelm and establish it as one of the world's great elevation rainforest gradients, eminently suitable for the study of biodiversity, rainforest ecology and climate change. Such study would also excite the local communities, help them financially and strengthen their resolve to conserve the forests they own, all the way "from the mountains to the seas", as sung in the Papua New Guinea national anthem.

Vojtech **Novotny**



Twin lakes Aunde and Piunde near the 3700 m site and huts that accommodated the members of the expedition.
(Photo © Xavier Desmier).

Organizing large-scale inventories of biodiversity in the tropics: the genesis and lessons of the project Our Planet Reviewed Papua New Guinea – land component

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ABSTRACT

Large-scale biodiversity inventories are useful for identifying the wide range of components of the forest ecosystem, which is a necessary step in understanding how they function and how they respond to environmental and climate changes. They require the coordination of large teams of experts in the collection and study of a huge variety of taxa surveyed. Here we use the project "Our Planet Reviewed – Papua New Guinea", assessing the biological diversity along a rainforest elevational gradient, as an example to illustrate the challenges of implementing such large-scale studies. We also draw lessons for future similar inventories. The project implementation follows a 10-step standard process: (1) design of the scientific program and aims (often a trade-off between feasible sampling effort and sample representativeness); (2) fundraising from public and private funders; (3) reconnaissance missions and partnerships with local stakeholders; (4) constitution of the field and laboratory research teams; (5) obtaining research and collecting authorizations; (6) preparation of the main survey, including botanical inventories, building insect traps and testing sampling protocols; (7) main survey, *i.e.* collection of specimens with standardized mass collection methods; (8) on-site pre-processing of the material by para-taxonomists and students

LEPONCE M., PASCAL O., BASSET Y. & NOVOTNY V. 2020 — Organizing large-scale inventories of biodiversity in the tropics: the genesis and lessons of the project *Our Planet Reviewed Papua New Guinea* – land component, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 11-40 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

to higher taxonomic levels (*e.g.* orders) and exporting specimens; (9) finer sorting (*e.g.* to family level) by Taxonomic Working Group (« TWiG ») leaders and dispatching of specimens to experts for identification to (morpho-)species level; (10) centralization of data in a collective database. Our experience shows that the main bottleneck in the data flow is the processing of the huge quantity of collected specimens in stages 8, 9 or 10. Solutions include securing sufficient funding for this critical step, training local para-taxonomists to assist main investigators and focusing on a limited number of informative yet tractable taxa. These inventories play an important role as the first step towards habitat conservation, demonstrating their value for biodiversity and providing sustainable local employment when research projects are continued, as is the case at Mount Wilhelm.

RÉSUMÉ

Organiser des inventaires de la biodiversité à grande échelle dans les tropiques : la genèse et les enseignements du projet La Planète Revisitée – Papouasie-Nouvelle-Guinée - volet terrestre.

Les inventaires de biodiversité à grande échelle sont utiles pour identifier les différentes composantes de l'écosystème forestier, ce qui constitue une étape nécessaire pour comprendre leur fonctionnement et leur réponse aux changements environnementaux et climatiques. Ils requièrent la coordination de nombreuses équipes de chercheurs experts dans la récolte ou l'étude des spécimens. Nous utilisons ici le projet «La Planète Revisitée – Papouasie-Nouvelle-Guinée», dont le but est d'évaluer la diversité biologique le long d'un gradient d'altitude, comme exemple pour illustrer la mise en œuvre de telles études à grande échelle. Nous en tirons également des enseignements pour de futurs inventaires du même type. La mise en œuvre du projet suit un processus standard en 10 étapes : (1) conception du programme et des objectifs scientifiques (souvent un compromis entre l'effort d'échantillonnage et sa représentativité) ; (2) collecte de fonds auprès de bailleurs publics et privés ; (3) missions de reconnaissance et partenariats avec les acteurs locaux ; (4) constitution des équipes de recherche de terrain et de laboratoire ; (5) obtention des autorisations de recherche et de récolte ; (6) préparation de l'inventaire principal incluant les inventaires botaniques, la construction de pièges à insectes et les essais des protocoles d'échantillonnage ; (7) l'inventaire principal, consistant en la récolte de spécimens avec des méthodes d'échantillonnage de masse standardisées ; (8) prétraitement sur place du matériel par des para-taxonomistes et des étudiants à des niveaux taxonomiques supérieurs (par exemple, ordres) et exportation des spécimens ; (9) tri plus fin (par exemple, au niveau de la famille) par les responsables des groupes de travail taxonomique (« TWiG ») et envoi des spécimens aux experts pour identification au niveau de la (morpho-)espèce ; (10) centralisation des données dans une base de données collective. Notre expérience montre que le principal goulot d'étranglement dans le flux de données est le traitement de l'énorme quantité de spécimens collectés au cours des processus 8, 9 ou 10. Les solutions consistent à assurer un financement suffisant pour cette étape critique, à former des techniciens de recherche (para-taxonomistes/écologistes) pour assister les chercheurs principaux et à se concentrer sur un nombre limité de taxons informatifs, faciles à traiter. Un rôle important de ces inventaires est qu'ils constituent la première étape vers la conservation des habitats, en démontrant leur valeur en termes de biodiversité et en fournissant des emplois locaux durables lorsque les projets de recherche sont poursuivis, comme c'est le cas au Mont Wilhelm.

INTRODUCTION

This chapter completes the introductory chapter of the first volume of "Insects of Mount Wilhelm - Papua New Guinea" where the general sampling protocol of the land component of the "Our Planet Reviewed – Papua New Guinea" biodiversity survey was presented (Leponce *et al.* 2016). This biodiversity inventory was mainly motivated by the fact that the estimates of the diversity of tropical arthropods (Hamilton *et al.* 2010; Hamilton *et al.* 2013; Stork 2018) are based on the results of studies carried out in lowland forests (Novotny *et al.* 2002) and do not take into account the multiplier effect of the altitudinal factor. To study this effect it was necessary to find a tropical mountain with a continuous forest cover from sea level to the natural limit of forest distribution. Such a system becomes difficult to find nowadays due to the widespread deforestation of lowland forests. Mount Wilhelm, the highest peak in Papua New Guinea (4509 m a.s.l.) was an ideal location for a project of this nature as it possesses a continuum of forests with little or no disturbance. Its elevational gradient spans from "mixed lowland rainforest" up to "upper montane forest" (Johns 1982). Between October and November 2012, we carried out a semi-simultaneous sampling at 8 different altitudes (every 500 m between 200 and 3700 m above sea level) and concentrated over 16 days. Very basic field camps were available at each study site. Five

mass sampling methods were used to collect arthropods. Twenty flight interception traps per altitude were deployed and were specifically aimed at Coleoptera collection (2880 trap-days). Four Malaise traps per altitude were used to collect Diptera, Hymenoptera or Hemiptera (576 trap-days). To specifically catch fruit flies, five Steiner traps with three types of attractants were placed at each altitude (720 trap-days). Vegetation beating, useful for collecting spiders, ants and other understory organisms, was carried out in 5 plots 20x20 m per altitude (10 samples per plot). Three of these plots were used as botanical plots to characterize the vegetation. Localized fumigation of the bark of a total of 324 trees was also carried out. The combination of these protocols allowed the sampling of most major arthropod orders covering a wide range of ecosystem functions (predators, scavengers, decomposers, leaf-chewers, sap-suckers, pollinators). A total of 63 persons (11 nationalities) were involved in the field survey, including 21 para taxonomists/ecologists, 21 international experts, four students (two local and two international), three journalists (film makers, photographers) and a support staff of 11 persons (coordinators, technicians, logisticians and medical doctors).

Here we examine in more details the pre- and post-survey sequence of steps in an attempt to draw general lessons applicable to similar future projects. We have identified 10 main steps in the implementation of such biodiversity inventories.

STEP 1. SCIENTIFIC PROGRAM DESIGN

The premises of the project were conceived in Brussels in December 2009. Back then, a research group of the IBISCA (Investigating the Biodiversity of Soil and Canopy Arthropods) expert network (ML, YB and Bruno Corbara) was working on a proposal to the NGO Pro-Natura International (hereafter "PNI", with OP as biodiversity officer) to carry out a biodiversity study along an altitudinal gradient in West Papua. The aim of this West Papuan project was to conduct a rapid inventory of a few tractable insect groups. It was planned to study 4 localities at different elevations, one of which would serve as a reference site close to an infrastructure facilitating research and subject to more extensive sampling (Figure 1). It was envisaged to collect arboreal ants, wasps and to include some of the monitoring protocols of the ForestGEO Arthropod Initiative to collect termites, butterflies and fruit-flies (Anderson-Teixeira *et al.* 2015; Lamarre *et al.* 2020).

The guiding idea for the scientific program was refined with VN during the annual congress of the Association of Tropical Biology and Conservation which took place in Bali in July 2010. This resulted in a new draft proposal for a project in Papua New Guinea in collaboration with the New Guinea Binatang Research Center (NGBRC). At that time, we were also carrying out a comprehensive analysis of the IBISCA-Panama project. This project had been conceived as a concerted effort between expert researchers focused on a variety of taxonomic groups representing different functions in the ecosystem. It combined a wide range of quantitative collection protocols focused on arthropods (Basset *et al.* 2007). Its results, subsequently published (Basset *et al.* 2012), allowed us for the first time to determine arthropod diversity in a lowland tropical forest in Panama and to demonstrate a relationship between tree and arthropod diversity. Another study, this time in Papua New Guinea, had shown that in lowland forests, insect composition does not change much from place to place, even for sites 500 kilometres apart (Novotny *et al.* 2007). The results of these two studies led to the main question of the nascent project, asking about the magnitude of additional diversity generated by elevation gradient starting from lowland rainforests. Papua New Guinea seemed a perfect place to investigate this question, as there were mountain ranges covered with undisturbed forest from the lowlands to the upper elevational limit of tree distribution (treeline). In addition, a ForestGEO site of 50 ha had just been created in Wanang, a lowland forest site (Vincent *et al.* 2015). Together with the local group of parataxonomists and para-ecologists of the NGBRC (Novotny 2010), we could envisage a large-scale project there. Two mountain systems were considered for the project: Finisterre Mountains (4150 m a.s.l.) and Mount Wilhelm (4509m a.s.l.), both with continuous forest cover from sea level to the treeline. Wanang was an obvious choice as a reference site in the lowlands with the additional benefit of the presence of a biological field station.

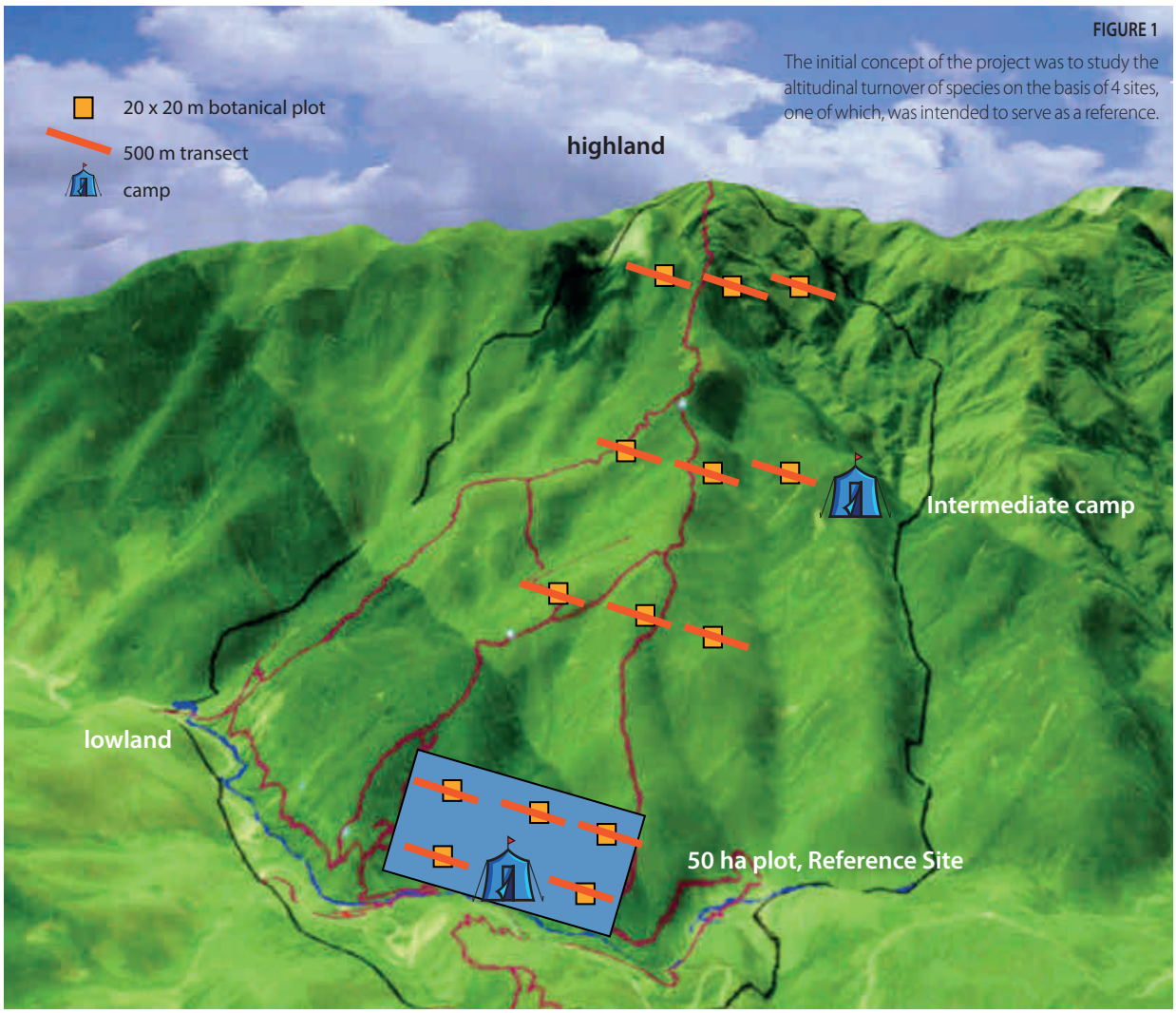


FIGURE 1
The initial concept of the project was to study the altitudinal turnover of species on the basis of 4 sites, one of which, was intended to serve as a reference.

STEP 2. FUNDRAISING

Fundraising by PNI began in the fall of 2010, in partnership with the Muséum national d'Histoire naturelle de Paris (MNHN), as part of the "Our Planet Reviewed" (OPR) program. This program, initiated by the two organizations mentioned above, had already conducted large-scale biodiversity inventories to Vanuatu (2006) and Mozambique-Madagascar (2009-2010) (Bouchet *et al.* 2009; Bouchet *et al.* 2011; Bouchet *et al.* 2012). "Our Planet Reviewed" aimed to gain new knowledge in the world's most biodiversity-rich but hitherto poorly explored regions, in both terrestrial and marine environments. Papua New Guinea was high on the list, being one the three largest forest basins in the world and also a biodiversity hotspot for marine life, lying in the middle of the coral triangle (Veron *et al.* 2011). Analogous to our terrestrial biodiversity inventory, a marine inventory project was then set up by Prof. Philippe Bouchet (MNHN) as an extension of his BIOPAPUA 2010 collection campaign. The two modules made up the joint project "Our Planet Reviewed – Papua New Guinea 2012-2014" (OPR-PNG). In less than two years the necessary funding, amounting to 1.2 million € in cash and 0.7 million € in kind (made available to the oceanographic vessel Alis by the French Research Institute for Development, IRD), had been raised. A separate fund-raising campaign was launched for the use of Canopy Balloons to collect samples from the treetops of the lowland site (Wanang). Donors are listed in the acknowledgements.

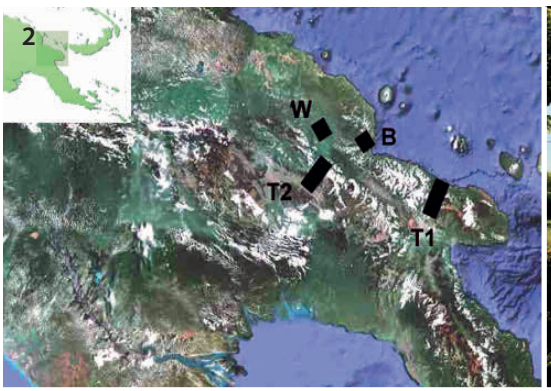
STEP 3. RECONNAISSANCE MISSIONS AND PARTNERSHIPS WITH LOCAL ACTORS

At the end of May 2011, together with Philippe Bouchet (MNHN), Ronan Kirsch (MNHN) and Claude Payri (IRD), we presented the project to the PNG authorities in Port Moresby. During these visits, we met with officials from the PNG National Research Institute (NRI), the Department of Environment and Conservation (DEC), the National Insect Collection of the PNG National Agriculture Research Institute (NARI) and the University of Papua New Guinea (UPNG). We then flew to Madang to visit the headquarters of the NGBRC, our in-country partner, and two of its field stations: Wanang and Yawan (Figure 2). The NGBRC is a biological research and conservation non-profit organization in Papua New Guinea established in 1997 by VN (Figure 3). It is one of the main training organizations for parataxonomists and paraecologists (Schmiedel *et al.* 2016). It is particularly active investigating the field of plant-insects food webs and has extensive reference collections on plants and insects (Figures 4, 5). Its Swire Research Station can be reached by road (Figure 6) then by foot with a stop at Wanang Village (Figures 7, 9). The Wanang Conservation Area is a local initiative of ten clans aimed at conserving 10,000 ha of primary forest in which the research station supporting these conservation actions is located (Novotny 2010; Novotny & Toko 2015). We met with local community leaders to explain our project, including the use of a canopy balloon that was shown in action in a film screened at night followed by the Hollywood blockbuster "Avatar" (Figure 8). At that time, we had selected the Finisterre Mountains for the altitudinal transect. We carried out a reconnaissance mission there by flying by light aircraft to the village of Kotet, near the Yawan research station, in direct proximity to the forest and supplied with electricity by solar panels (Figures 10-15). As in Wanang, we received a warm welcome from the local communities. The forest there was pristine as well.

Following our visit, an official partnership for OPR-PNG was signed between MNHN and PNI in July 2011, and a Memorandum of Understanding (MoU) between MNHN, IRD and UPNG in October 2011. In particular, this MoU included a commitment to collect samples only with the prior and informed consent of customary landowners and other stakeholders, to collect information and specimens only for academic and management purposes, to trace exported samples, to implement national and international regulations, and to participate in the training of Papua New Guinea students and scientists.

A major challenge when organizing a project in mountain terrain in Papua New Guinea is to obtain the consent of all owners to access their land along the elevation gradient. In November 2011, the situation deteriorated in the Finisterre Mountains due to disagreements between two communities. For this reason and because of the high cost of transporting food and equipment by plane, we decided to opt for the alternative option: Mount Wilhelm.

A one-week reconnaissance survey was then organized along Mount Wilhelm in March 2012 (Figures 16-26). Starting from Madang and passing through Goroka (1600 m a.s.l.) and Kundiawa (1500 m) we visited the forest sites and the possibilities of setting up camps between 2700 and 200 m. We were accompanied by two botanists, Jérôme Munzinger (IRD) and Kenneth Molem (NGBRC) (Figure 22). We reached by road to the surroundings of KeglSugl (2500 m). The road being then impassable due to frequent landslides, we had to continue on foot (Figure 18), visiting the abandoned camp of Bruno Sawmill (2700 m). We then spent the night in Konbogl (2400 m) in a thatched hut which was particularly smoky because it had no chimney (Figure 19). On the second day along the altitudinal transect, we reached Sinopas (2200 m). The forest between 2200 m and 2700 m corresponds to a mid-montane forest with majestic *Nothofagus* trees. The village of Sinopas has a beautiful mountain view and a school (Figures 20, 21). On the third day we reached the village of Bundi (1700 m). The path between these two stages was particularly tiring because it passed through a valley going down to 1200 m before going up again. The next day we had the opportunity to visit the lower montane forest with the presence of Fagaceae and Nothofagaceae (Figure 22). The next stage was a 1200 m descent leading us to 500 m, at Gabriel's house (Figure 23). From this place we went back up to visit, under pouring rain, the sites of 700 m and then 1200 m, where we spent the night (Figure 24). The forest at this altitude was a mixed lowland forest. On the last day we went back down, after crossing a river (Figure 25), to the village of Brahmin, passing through the village and the Kausi mixed alluvium forest at 200 m.


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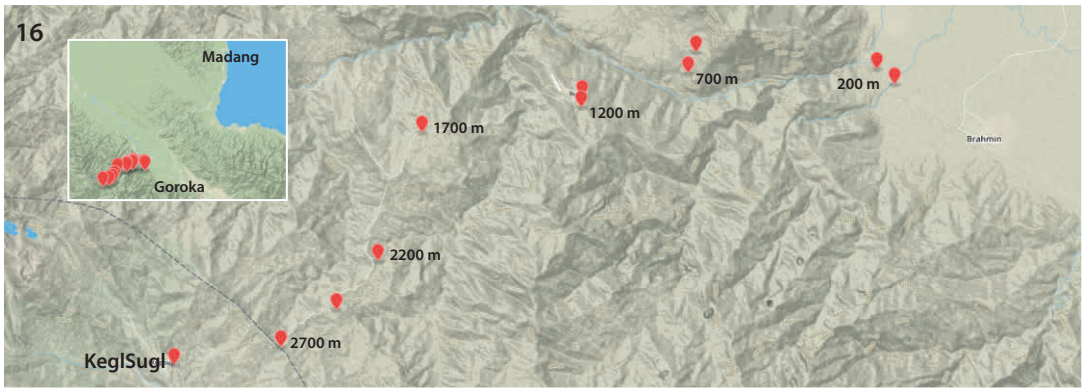

8


9
MANAGING CONSERVATION AREA
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FIGURES 2-15

Step 3. First reconnaissance mission to the Finisterre Mountains in May 2011. **2**, Location of the different pre-selected sites: the PNG Binatang Research Center (BRC) headquarters, the altitudinal transect T1 along the Finisterres Mountains, its alternative, T2, along Mount Wilhelm and the lowland reference site, Wanang (W). **3, 4**, **5**, BRC laboratories. **4**, Discussion on the floristic composition of the sites with the botanist Georges Weiblen surrounded by Ronan Kirsch, Philippe Bouchet and Vojtech Novotny (from left to right). **5**, Entomological and botanical reference collections at the BRC. **6**, On the way to the lowland reference site, Wanang, difficult to access by road in rainy weather. **7**, Wanang village upstream of the Swire research station. **8**, Presentation of the project and previous achievements to the villager of Wanang. **9**, Entrance to the Wanang Conservation Area. **10**, Overview of the altitudinal path of this transect. **11**, fly over the mountains by light aircraft, the only means of resupplying high-altitude sites. **12**, Ubii Research Station built in the traditional village style, on stilts. **13**, Detail of the Ubii station, with solar panels as a power source and an antenna for radio communication. **14**, Light aircraft accessing the surroundings of the village of Toptet. **15**, The co-organizers of the project in full ascent (from left to right, VN, ML and OP). (Photos © Maurice Leponce).









FIGURES 16-19

Step 3 (continued). Reconnaissance mission to Mount Wilhelm in March 2012. **16**, Location of the different study sites, separated by altitudinal steps of 500 m and accessible from above from the village of KeglSugl. **17**, Arrival at the abandoned camp of Bruno sawmill (2700 m). **18**, Departure of the reconnaissance on foot, after having abandoned the vehicles, the road becoming impassable due to the landslides. **19**, Overnight stay in a hut in the village of Konbogl (2400 m).



FIGURES 20-26

Step 3 (continued). Reconnaissance mission to Mount Wilhelm in March 2012. **20**, **21**, arrival at the village of Sinopas (2200 m). **22**, The two botanists of the reconnaissance mission, Kenneth Molem and Jérôme Munzinger at 1700 m. **23**, Stage to Gabriel's House (500 m). **24**, Wet night at the camp at 1200 m. **25**, Crossing of the Ramu River (200 m). **26**, Return to Madang with Mount Wilhelm in the background. (Photos © Maurice Leponce).

STEP 4. CONSTITUTION OF THE TEAM OF FIELD RESEARCHERS

At the end of 2011, we gathered a scientific team comprising 21 international researchers from the organizing institutions (MNHN, IRD) and their partners (Royal Belgian Institute of Natural Sciences, NGBRC, IBISCA), seven scientists from New Guinea (from the PNG Forest Research Institute, the PNG National Agricultural Research Institute, the UPNG), 21 NGBRC para-ecologists and four students (see Table 2 in Leponce *et al.* (2016) for details). The team was set up in order to have a panel of experts covering the major groups of insects and plants collected. Each participant had to provide the organizers with a medical certificate and had to sign a registration form in which he or she agreed to abide by expedition rules (see Appendix 1).

STEP 5. OBTAINING RESEARCH AUTHORIZATIONS

The research proposal with the list of participants was submitted for approval to the National Research Institute (NRI) and the Department of Environment and Conservation (DEC) in November 2011 and accepted in May 2012. Research visas for foreign participants were obtained in September 2012. The consent of indigenous landowners at each site had been obtained during the reconnaissance trips described above.

STEP 6. PREPARATION OF THE MAIN SURVEY: PLOT DELINEATION, REFINEMENT OF THE PROTOCOLS, SHIPMENT OF EQUIPMENT AND CONSUMABLES, LOGISTICS

The botanical plots were established prior to the main expedition, between May and August 2012, and an inventory of all trees with a diameter of more than 5 cm was carried out by a team of NGBRC. Three botany plots per altitude, 20 x 20 m each, were set up for the total of eight altitudes (a total of 24 plots) on Mount Wilhelm. In June 2012, Roland Fourcaud, hired by PNI, did a reconnaissance mission in PNG to organize the logistics of the main survey, contacting food and accommodation providers and helicopter companies to prepare medical evacuation plans. The equipment and consumables were purchased from June 2012 locally or, if not available, ordered from abroad. Technical grade ethanol (400 litres), equipment and food for the camps were purchased locally. Laboratory equipment (12 microscopes, 2 power generators) and consumables (50,000 vials; 35,000 whirlpaks; entomological traps) were shipped from Europe. Additional equipment was posted from Belgium but lost when wrongly posted by the shipping company to Guinea (Africa) instead of Papua New Guinea.

In September 2012, YB and a team of paraecologists tested the main sampling protocols: Malaise traps, Flight Interception Traps, beating of vegetation, insecticide spray on the bark, and fruit fly traps at the Swire research station (Wanang) (Figure 27). Manuals for the use of equipment and sampling protocols have been drawn up for paraecologists, with the sequence of operations to be followed and the equipment to be provided. Inspection of trap catches in Wanang, in particular the abundance of various taxa present, made it possible to define focal taxa and the number of traps to be installed to ensure sound statistical analyses. This means that for a substantial portion of species, the sampling effort at each altitude had to be large enough to reliably detect them so that their absence at a particular altitude was genuine, and not merely the result of undersampling. This led to a five-fold increase in the number of Flight Interception Traps (capturing mainly beetles, a very diverse group) per elevation over the initially planned number. A solution had to be found quickly in order to be able to build 180 traps of this type with the materials available locally.

A timetable has been developed for collecting almost synchronously at 8 altitudes during the main survey (Table 3 in Leponce *et al.* (2016). Two types of permanent labels with unique codes for samples and vials were printed prior to the survey in the hope of minimizing specimen labelling problems afterwards (see figure 16 in Leponce *et al.* (2016)).

STEP 7. THE MAIN SURVEY

All the logistics of the operation were supervised by OP, assisted by Roland Fourcaud and the NGBRC team. This included booking transportation, lodging, porters, food and electricity for all eight camps (Figures 28, 29). To avoid overcrowding in the camps, the botanical and entomological teams were separate and their progress had been staggered over time (table 3 in Leponce *et al.* (2016)).

A team of para-ecologists, assisted by villagers, was stationed at each altitude (Figures 31-38). They had arrived a week before the expedition in order to build the camps. To avoid catching fleas and other undesirables we chose to sleep in hammocks. The villagers had never seen hammocks before and special huts had to be built to hang them up. We then realized quite quickly that it was not such a good idea, as the constructions were collapsing under the weight of the sleepers who, moreover, were freezing at high altitudes where temperatures are low.

The main survey along Mount Wilhelm took place between 13 October and 10 November. As explained in the foreword of this book, we unintentionally provoked an economic experiment in this period of time by creating a new currency that generated the immediate appearance of the concept of trade discount in the Highlands (Figure 30).



FIGURES 27-30

Main survey preparation and implementation. **27**, YB discussing the use of entomological traps with a group of para-ecologists. **28**, Coordination of the teams of para-ecologists before the sampling starts (from left to right: Joseph Kua, Legi Sam, Martin Mogia, VN, Bradley Gewa). **29**, Truck transporting material and food for the camps. **30**, PNGBRC receipts used to pay local salaries during the survey and exchangeable for cash at the end of it. These receipts soon became a local currency on Mount Wilhelm. (Photos © Maurice Leponce).

STEP 8. PRE-PROCESSING AND EXPORT OF COLLECTED SAMPLES

The samples collected during the inventory at Mount Wilhelm were pre-sorted at the Swire research station in Wanang immediately after field sampling had been completed (Figure 39, steps 7 & 8). During this period, the sampling protocol followed in the mountains was also applied at this lowland station. We refer to Volume 1 for a full description of the procedure followed. This pre-sorting of half a million specimens by 23 parataxonomists and two students, supervised by eight experts, was carried out in three weeks and provided a preliminary list of the sample contents. This list was submitted to the DEC, which, on this basis and after inspecting the samples, issued a permit to export the specimens. These specimens transited to Europe by ship in standardized drums for the transport of ethanol (UN1170) and arrived six months later at the MNHN in Paris at the same time as the samples collected during the marine inventory. Some experts present at the pre-sorting, such as Frode Ødegaard who inspected the beating samples, brought the samples directly back to their laboratory for further study. With regard to plants, voucher specimens were exported by IRD botanists in France while duplicates were deposited at the BRC and FRI herbariums.

STEP 9. PROCESSING AND DISTRIBUTION OF SPECIMENS BY TAXONOMIC SUPERVISORS

Upon completion of the pre-sorting of insect trap contents in PNG, samples were separated by major arthropod group (*e.g.*, orders) or by method (*e.g.*, beating, insecticide spray on bark) (Figure 39, step 8). The leader of each Taxonomic Working Group ("TWiG" according to the terminology of Janzen & Hallwachs (1994) then began to work on a finer separation into Families (Figure 39, step 9.1). He or she then contacted specialists in the different families from his or her network of experts. If they were interested in the identification of specimens and adhered to the general conditions specified in the listing form (see Appendix 2), the specimens were sent to them. A finer subdivision of the material was sometimes made by these specialists, redistributing the specimens to subfamily experts (Figure 39, step 9.2). For the Hymenoptera group alone, supervised by Claire Villemant (MNHN), 46 experts of 20 nationalities were involved (Figure 39). The subsequent species identification is a slow and complicated process given that the faunas studied are poorly known and, in some cases, require revisions before new species can be described. To continue with the example of Hymenoptera, specialists were found for about 10,000 of the 13,000 individuals pre-sorted in step 8. Eight years after the expedition about 70% of this material has been identified in 1570 species and 525 genera of which at least 337 species and 43 genera are new (Claire Villemant, pers. com.).

STEP 10. CENTRALIZATION OF DATA IN A COLLECTIVE DATABASE

Each expert of the family or subfamily then sorted the material down to the species or morphospecies level. This information is then sent back to the TWIG leaders who check the quality of the data and fill in a data entry template. This is also the time when the holotypes and paratypes are deposited in major museums. The data is then sent to the database administrator who merges and cleans all the data sheets to create a new version of the database where the specimens are identified at the morphospecies level. Some difficult groups were only sorted to family level and are entered as such in the database. We envision that the final database will contain information on the altitudinal distribution of about 200 plant, 2,500 Araneae, 10,000 Hymenoptera, 18,500 Diptera and over 100,000 Coleoptera specimens, to mention only the major groups.



FIGURES 31-38

31, Participants in projects starting from Betty's Lodge at 2800 m. **32-38**, teams stationed at different altitudes along Mount Wilhelm. (Photos © Maurice Leponce).



FIGURE 39

Overview of collection operations (step 7), pre-sorting and export (step 8), processing of samples by twig leaders down to the family level and distribution to family experts (step 9.1, photo © Juergen Schmidl), possibly redistributing material to sub-family specialists (step 9.2). All data, based on specimen identification and abundance (step 10, photo © Frode Ødegaard), is then encoded in a central database. (Photos © Maurice Leponce).



FIGURES 40-44

40, Collection of ant-plants from a *Canarium indicum* tree by means of the *Cinébulle* électrique (hot air balloon). **41**, Close-up of an ant plant. **42**, *Cinébulle* électrique, hot-air balloon propelled by an electric motor, in flight over Swire Research Station. **43**, Section of an ant plant. **44**, Colony of the ant *Anonychomyrma* sp. PK007 nesting in the ant-plant. (Photos © Maurice Leponce).

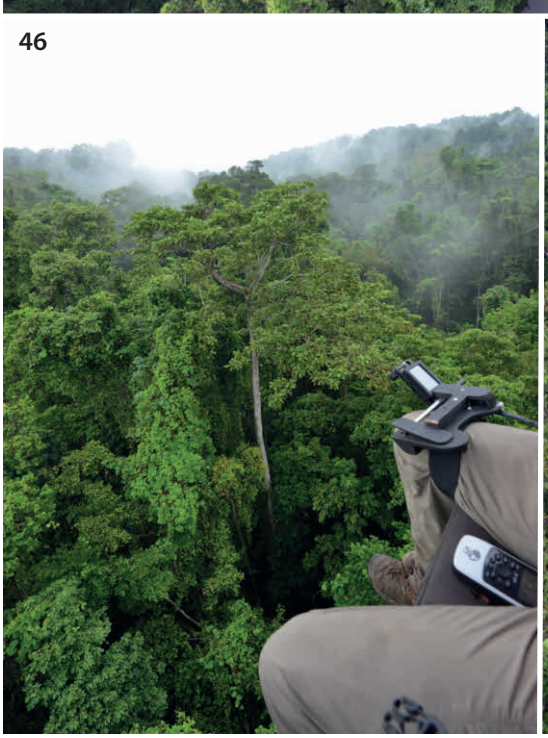
THE POST-SURVEY COMPLEMENTARY STUDIES

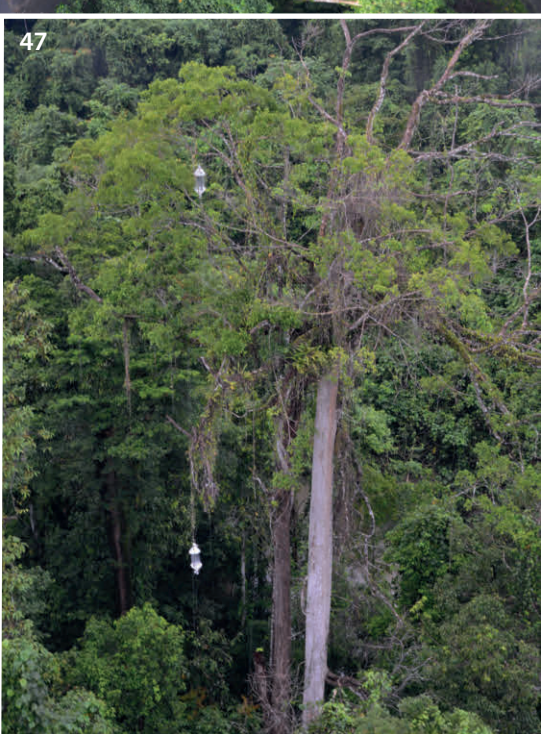
After the Mount Wilhelm main field work session in 2012, balloons surveys took place in Wanang early 2013. Canopy balloons were developed by the French pilot Dany Cleyet-Marrel. They are the only mobile device that allows a scientist to take samples directly from the surface of the canopy. In contrast, helicopters generate a strong downdraft with their propellers that prevents collection. Drones, which are smaller are difficult to handle between branches and are rarely equipped with prehensile arms. For safety reasons, climbers cannot move on thin branches or in tree species with brittle wood. The balloons were used to collect samples from treetops, in particular arboreal ants (Figure 50) and epiphytic myrmecophytes of the genera *Myrmecodia* and *Hydnophytum* (ant-plants) (Figures 40-44) (video: Leponce (2016). They also allowed the installation of insect polytraps in the trees from the ground to the tops of the trees and to map the structure of the canopy (Figures 45-47). A two-seater electrically propelled hot-air balloon ("Cinébulle électrique") was used in 2013 (Figures 40, 42, 46) and a single-seater helium balloon ("Bulle des Cimes") in 2014 (Figures 48-49). Additional collections were carried out in the project framework, notably by D. Bickel in 2013 and 2014 at the Wanang research station and at some study sites of the altitudinal transect on Mount Wilhelm. T. Robillard also collected in the Baitabag forest near Madang after the inventory of Mount Wilhelm in 2012.

SCIENTIFIC OUTPUT

The first volume of Insects of Mount Wilhelm (Robillard *et al.* 2016) contained 20 contributions dealing with diverse groups of arthropods, with the description of 144 species and 6 genera new to science. For 90 of them, the holotype comes from the expedition as well as the type species for all 6 new genera. The current volume contains 14 additional contributions with the description of 118 new species and 3 new genera. For 86 of them, the holotype comes from the expedition as well as the type species for 2 out of the 3 new genera. A total of 176 new species and 8 new genera are therefore described in both volumes and based solely on material from the expedition. It should be noted that the vast majority of these new species described belong to the Hymenoptera (about 75%). This only partly reflects the fact that this order is among the most species-rich and most certainly C. Villemant's formidable work in mobilising the Hymenoptera taxonomic community. It also gives an indirect insight into the vast amount of work that remains to be done for the other groups of arthropods collected during the expedition. In addition to the new species described in the two volumes of Insects of Mount Wilhelm, 43 other new species and 5 new genera are described in 19 other publications (Baker & Dransfield 2017; Belokobylskij & Villemant 2016; Belokobylskij 2013; Bickel 2019; Braet & Van Achterberg 2014; Butcher & Quicke 2014, 2015; Curletti 2017a, 2017b; Fernandez-Triana & Boudreault 2018; Gnezdilov *et al*. 2015; Khalaim & Villemant 2019; Kvifte & Bernal 2018; Maddison & Szűts 2019; Mata-Casanova *et al*. 2015; Peris-Felipo & Belokobylskij 2019; Szawaryn 2018; Szczpanski *et al.* 2018; Vicente *et al.* 2015) and one PhD thesis (Md Yusof 2020). In addition, two theses (Duvot 2013; Moses 2014) and 5 publications related to the project have been published so far in various academic journals. Five of these publications discuss the impact of the altitudinal gradient on species distribution (Chatelain *et al.* 2019; Colwell *et al.* 2016; Le Cesne *et al.* 2015; Orivel *et al.* 2018; Plowman *et al.* 2017) to which we can add two contributions to this volume also dealing with species distribution (Munzinger *et al.* 2020; Roisin 2020) and the contribution of Colinet *et al.*, 2016 in the first volume of Insects of Mount Wilhelm. Four publications on taxonomy are using or citing material from the expedition (Kurina *et al.* 2019; Shaverdo *et al.* 2016, 2019; Shaverdo & Balke 2019) to which we can add the contribution of Vargas & Azevedo (2016) to the first volume of Insects of Mount Wilhelm, 2 publications on ecology and behavioral studies (ter Hofstede *et al.* 2015; Klimes *et al.* 2018) and 4 publications on biogeography and phylogeny (Dong *et al*. 2018 Santos *et al.* 2018; Vicente *et al.* 2017; Zhang *et al.* 2018) give in-depth new knowledge on targeted groups.







FIGURES 45-47

45, Mapping of the canopy structure of the forest by flying over it with the Cinébulle. **46**, Approach of a *Canarium indicum* tree filled with ant plants. **47**, Polytraps, installed at different heights along the trunk, from the balloon. (Photos © Maurice Leponce).







FIGURES 48-50

48, Collecting canopy samples using a single-passenger helium balloon, the *Bulle des cimes*. **49**, View of the balloon from the ground. **50**, *Crematogaster* cf. *irritabilis* ant nest as seen from the balloon. (Photos © Maurice Leponce).

CONCLUSIONS. LESSONS LEARNED FOR FUTURE PROJECTS

Implementing a large-scale biotic inventory is a complex process (Leponce *et al.* 2010). Parallel to the design of the project, partnerships must be established, for example with museums, universities, NGOs. A local partner is essential to assist in the organization, including obtaining authorizations for the collection and export of the material. When presenting the project to the different stakeholders it is very important to underline the particular benefits: academic for scientists, societal for government authorities, in terms of sustainable development or conservation for NGOs, in terms of communication for the media, and a combination of these arguments for public or private sponsors.

The preparation of such a project takes at least two years. The completion of the results is spread over a much longer period, which can exceed a decade. For this reason, it is very important to combine a series of pilot projects with rapid reporting with larger projects such as a global synthesis of results or taxonomic revisions.

Various developments can improve the effectiveness of biodiversity inventories. For sample collections, it would be interesting to continue to develop methods of access to particular environments such as the canopy or subsoil, which are often neglected because of the complexity of reaching these habitats. For the processing of samples, it is essential to develop methods for tracing specimens as the number of sorting operations and the network of stakeholders (sorters, experts) is extensive. An effective system for labelling samples, both at the time of collection and also during sorting and identification, is essential. The system of two pre-printed labels tested in this project (one for the sample code and one for the vial code) created confusion among users. In the future a system with one label with a unique code is to be recommended.

A centralized tracking system, based on a website, will be developed for our future projects. It is important that all project participants are registered in a database. A user account will therefore be created for each of them. This account will only be active when they have read and accepted the "rules of the club" (appendices 1-2). From this account they will have access to all the information concerning the project and will be able to upload their data sets. It will thus be possible to communicate effectively with all stakeholders and to have a global vision of the project's progress. We will also endeavour to pre-sort the samples as accurately as possible in order to provide taxonomists with a list including the sample codes, and the abundance of the specimens sent to them.

Too often the financing of a biodiversity inventory stops at the financing of the field expedition. For the success of the project in a reasonable time frame, it is highly recommended to also provide funding to facilitate the very laborious sorting and identification operations. Training is also an important component, particularly of research technicians (*e.g.* para-taxonomists/ecologists) to assist principal investigators. For larger projects it is highly recommended to include MSc or PhD students, including from the host country, as an efficient combination of training and research. A pragmatic approach is also to focus on the study on informative yet tractable taxa. If the aim is a rapid detection of species in samples, metabarcoding combined with classical barcording presents itself as an alternative approach, in rapid evolution, compared to classical inventories (Hajibabaei *et al.* 2007; Liu *et al.* 2019).

One of the most important lessons of the project has also been that ecologists and taxonomists have different approaches to collecting and processing samples. As ecologists, we tried to place the insect traps randomly in the forest so that we could get an idea of the average density of insects and not favour particular environments. Taxonomists, on the other hand, use to place traps in flight corridors or places preferred by their target group. They also prefer to pool samples by site, which makes subsequent sorting of material less laborious, whereas ecologists are interested in the daily and fine spatial fluctuations in trap catch. Taxonomists are also not very interested in the abundance of individuals of each species, although this is essential data for an ecologist. An ecologist is interested in quantifying the diversity and distribution of organisms while a taxonomist is more interested in discovering new species. Clear communication about the objectives of the project, whether taxonomic or ecological in nature, is therefore essential for its success.

Ultimately, these biodiversity studies should lead to the conservation of habitats and, in this sense, those carried out along Mount Wilhelm have been successful since the local clans themselves decided to create a conservation area (see foreword) (Figure 51).

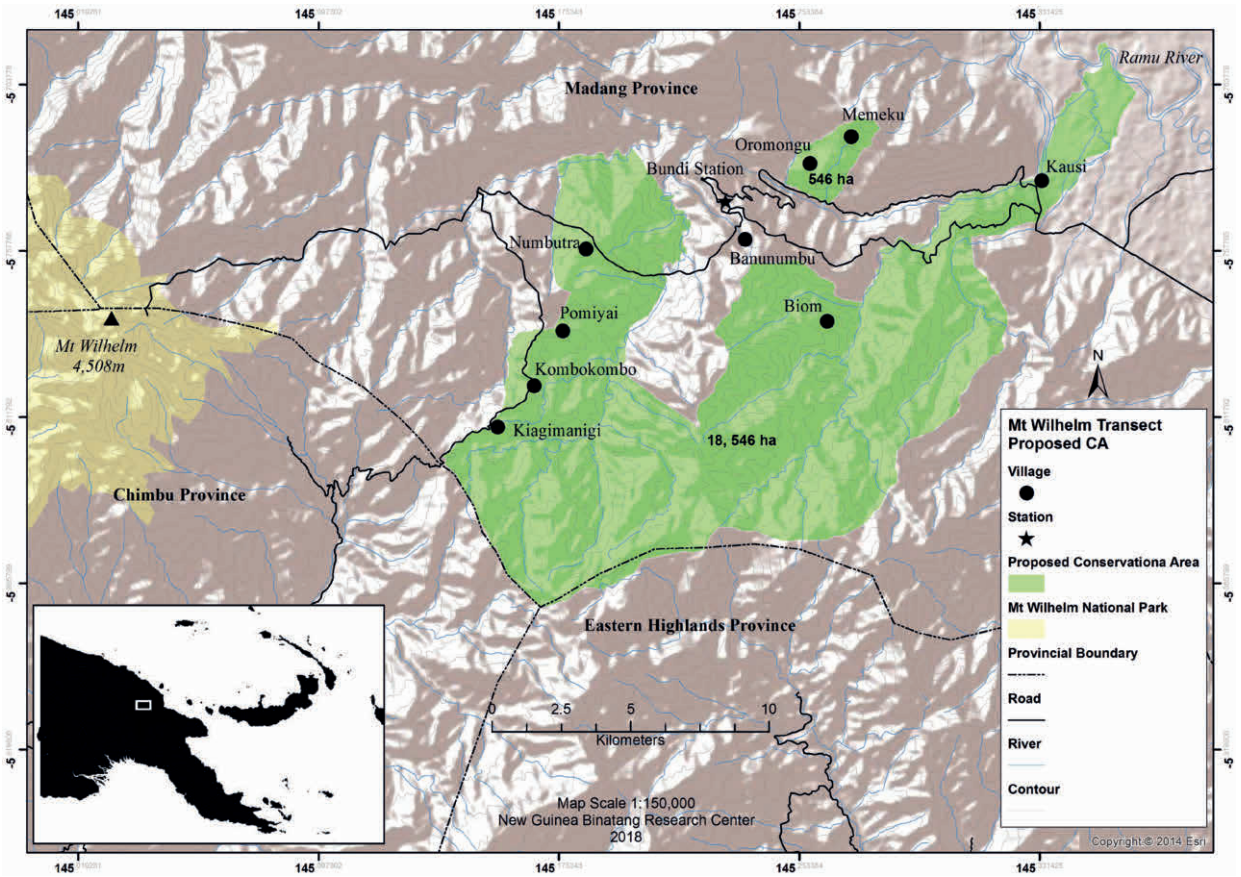


FIGURE 51

Delineation of the conservation area established spontaneously by landowners around the research transect. (Map by Jason Paliau).

ACKNOWLEDGMENTS

We would like to thank the project's TWIG leaders (C. Villemant, A. Soulier-Perkins, J. Schmidl, Y. Roisin, T. Robillard, F. Ødegaard, J. Munzinger, D. De Bakker, D. Bickel) for their fundamental role in the successful completion of the project and for providing useful information for this chapter. We express our gratitude to the Department of Environment and Conservation (DEC, Port Moresby) for issuing the permit # 012297 allowing to export the material collected during this project. This study was conducted in the framework of "Our Planet Reviewed – Papua New Guinea 2012-2013" set up by Pro-Natura International, the National Museum of Natural History (MNHN, France), the Institut de Recherche pour le Développement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the French public "Fonds Pacifique", Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation, FNRS (Belgium). A subsidy from the Belgian National Lottery and a subsidy from the Grant Agency of the Czech Republik (#14-36098G, 19-28126X) allowed the use of the hot air balloon (Cinébulle) and helium balloon (Bulle des Cimes), respectively. YB and ML benefited from a SENACYT mobility grant 01 MOV 2018 (# 266-2018) to the Central America Master Program in Entomology, University of Panama. The IBISCA expert network, the patron for this project, Prof. R.L. Kitching AM, and all other participants in this collective effort are thanked for their contribution.

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APPENDIX 1

Registration form for field participants.

Expédition Papouasie Nouvelle-Guinée 2012-2013

Co-organisateurs :
- **Muséum National d'Histoire Naturelle**
- **Pro-Natura International**
- **Institut de Recherche pour le Développement**

Partenaires en Papouasie Nouvelle-Guinée:
- **University of Papua New Guinea (UPNG)**
- **The Binatang Research Center (BRC)**
- **The Divine Word University (DWU)**

FICHE PARTICIPANT et/ou VISITEUR

CONDITIONS GÉNÉRALES

Je soussigné(e),

……

Adresse personnelle :
……

……

Organisme ou société :

……

Siège (adresse) :

……

……

Nationalité : ……..

Personne à prévenir en cas d'accident (nom, téléphone, email)
……

Intervenant sur la Mission "Papouasie Nouvelle-Guinée 2012-2013" en qualité de :
Participant scientifique / Média / équipe technique / visiteur
(rayer les mentions inutiles)

Déclare avoir pris connaissance et avoir accepté pleinement les dispositions des Conditions Générales jointes (p.2) et dont l'observation conditionne la poursuite de ma participation et/ou de ma visite sur le(s) site(s) de la Mission, sans préjudice de tous dommages & intérêts en cas de non-respect de celles-ci.
Fait à ……

le : …… en deux exemplaires
(dont un à conserver par le participant)
Signature et mention :

(mention manuscrite : "Lu et approuvé, bon pour acceptation des Conditions générales ci-jointes")

Papua New Guinea Expedition, 2012-2013

Co-organizers:
- **Muséum National d'Histoire Naturelle**
- **Pro-Natura International**
- **Institut de Recherche pour le Développement**

Local counterparts :
- **University of Papua New Guinea (UPNG)**
- **The Binatang Research Center (BRC)**
- **The Divine Word University (DWU)**

PARTICIPANT and/or VISITOR FORM

GENERAL CONDITIONS

I, the undersigned (Print name),

……

Personal address:
……

……

Institution or company:

……

Institution/Company address:

……

……

Nationality: ……

Person to be contacted in case of accident (name, telephone, email address)
……

Participating in the "Papua New Guinea 2012-2013" Expedition as a :
Scientific Participant / media / logistical staff / visitor
(circle one)

Declare that I have read and fully accept the General Conditions attached (p.2), and I understand that observing them is a condition for my participation and/or visit to the site(s), and that any infraction on my part may lead to legal action against me.

Prepared in duplicate at (place)……
(one to be kept by the participant)
Date:……..

Signature:

(Please write in your own hand: "I accept the General Conditions" and sign)

CONDITIONS GÉNÉRALES	**GENERAL CONDITIONS**
1 - Les présentes Conditions Générales s'appliquent à toute personne physique ou morale ou au représentant de celle-ci qui participe à la mission « La Planète Revisitée – Expédition Papouasie Nouvelle-Guinée, 2012-2013».	1 -The present General Conditions apply to all individuals and institutions or their representatives who participate in the « Our Planet Reviewed – Papua New Guinea 2012-2013 expedition».
2 - Un permis collectif de recherche et de collecte a été délivré par les autorités de Papouasie Nouvelle-Guinée pour l'expédition PAPUA NIUGINI 2012-2013. Pour satisfaire aux obligations découlant des accords signés par les organisateurs, le participant s'engage à n'accéder au terrain et prélever des échantillons qu'après l'accord préalable des propriétaires coutumiers et autres ayant-droits; il s'engage à ne collecter échantillons et données que pour un but de recherche fondamentale et de gestion. Par "recherche fondamentale et de gestion", sont exclus les finalités commerciales et industrielles.	2 – A research and collecting permit has been issued by the authorities of Papua New Guinea collectively for the PAPUA NIUGINI 2012-2013 expedition. To comply with the agreements signed by the organizers, the Participant/Visitor commits to access sites and collect samples only after prior informed consent of the customary landowners and other stakeholders, and commits to collect information and specimens for academic and management purposes only. Under "academic and management purposes" the parties include any purpose other than commercial and industrial.
3 - Le participant et/ou visiteur devra, avant l'accès au site quel qu'il soit, avoir pris les mesures (notamment les vaccins en cours de validité) indispensables ou nécessaires pour l'immuniser contre les maladies tropicales. Pour la composante terrestre, il devra dans la mesure du possible être pourvu d'une trousse de première nécessité et de ses médicaments personnels en cas de traitement car l'assistance médicale sera limitée sur la mission (un médecin accompagnera les équipes au Mont Wilhelm, mais la station de recherche de Wanang ne dispose pas d'encadrement médical).	3 - Before accessing any site, the Participant/Visitor must take all measures to prevent tropical diseases (especially ensuring that vaccinations are valid and up to date in their International Certificate of Vaccination). For the terrestrial component a personal First Aid Kit is recommended, including personal medications in case of illness or injury. Limited medical assistance will be available during the terrestrial expedition (a physician will accompany the scientific team during the Mt Wilhelm patrol, but not for the Wanang party).
4 - L'Assureur « Responsabilité Civile » des Organisateurs a accepté de renoncer à tout recours contre tout participant et leurs assureurs si le participant est assuré, sous réserve de réciprocité, tant de la part des participants que de la part de leurs assureurs. Les organisateurs ont souscrit pour tous les participants autres que les « visiteurs » une assurance individuelle accident et une assistance rapatriement.	4 – The co-Organizers' General Third Party Insurers have agreed to waive recourse against any Participant and their insurers (if any) subject to the Participant and/or their insurers (if any) reciprocally waiving recourse. The organizers provide all participants (other than "visitors") with a personal accident insurance and with an evacuation / repatriation insurance.
Si le participant a souscrit une assurance assistance couvrant son rapatriement en cas d'accident pour la durée de son déplacement et qu'il souhaite que celle-ci soit activée en priorité, il s'engage à le signaler aux organisateurs et à remettre avant son départ pour l'opération, les coordonnées de cette assistance avec son numéro de garantie et un numéro d'appel 24/24, ainsi que le nom de la personne à contacter en cas de nécessité à : Olivier Pascal oli.pascal@gmail.com pour la composante terrestre et à Sarah Pezet pezet@mnhn.fr pour la composante marine. Les Organisateurs attirent cependant l'attention de tout participant sur le fait que la grande majorité des contrats d'assistance rapatriement ne prenne en charge les victimes qu'à partir d'un aéroport international, (Port Moresby dans le cas de la Papouasie Nouvelle-Guinée). La plupart des contrats ne couvre pas le risque «primaire » et, en général, ne l'organise jamais (évacuation entre le lieu de l'accident et l'aéroport international). Si vous nous demandez d'activer en priorité votre assurance, nous devrons malgré tout (à moins que votre contrat le spécifie autrement) organiser l'évacuation jusqu'à l'aéroport international, lieu à partir duquel, n'importe quelle assurance rapatriement assure l'organisation et la prise en charge de l'évacuation (le risque dit « secondaire »). En aucun cas les organisateurs ne pourront être tenus pour responsable de la non possibilité d'acheminer une victime vers l'aéroport international que ce soit en terme de délais ou de moyens matériels.	If the participant declares to have insurance coverage for his/her repatriation in the event of accident and he/she wants it to be activated as a priority, he/she should notify us and provide us the references and phone number of the relevant insurance before departure from the home country, , and with the name of person(s) to contact in emergency case. This information must be provided to: Olivier Pascal oli.pascal@gmail.com for those participating in the terrestrial component and to Sarah Pezet pezet@mnhn.fr for those participating in the marine component. The co-Organizers draw the Participant's attention to the fact that most Assistance and Repatriation contracts only cover travel from an international airport (Port Moresby for Papua New Guinea). If you have secondary medical travel insurance, you should determine if the coverage covers preexisting conditions or has age restrictions, make sure that the policy provides for medical evacuation and repatriation to your point of departure (in the emergency medical transportation portion of your Policy) and carefully check the exclusions in your contract: we have to know whether the search and rescue and the evacuation costs between the accident site and the international airport are covered. If you ask us to activate your insurance as a priority, we may nevertheless (unless your contract specifies otherwise) have to organize the evacuation to the international airport in Port Moresby, from which place, repatriation insurance normally covers organization and management of the evacuation. Under no circumstances will the co-Organizers be held liable for the non-delivery of a person to an International Airport, either with regard to timing or availability of resources.
5 – Le participant et/ou visiteur s'engage à respecter les consignes des représentants de la direction du projet et celles des responsables désignés dans chaque module.	5 – The Participant/Visitor commits to follow the rules and regulations laid down by the representative of the Organizers.
6 – Le participant s'engage à mettre à la disposition du projet les photographies scientifiques de spécimens pris sur le terrain ou au laboratoire, en particulier pour alimenter le site internet de l'expédition, et d'une manière générale pour participer à la communication sur le projet et à la restitution des résultats en direction des autorités de Papouasie Nouvelle-Guinée. Ces photos seront, le cas échéant, toujours publiées avec le nom de leur auteur. Le participant n'est pas autorisé à donner ou vendre ses photographies auprès des média commerciaux pendant trois ans après la signature de la présente. Les utilisations habituelles des photographies aux fins de recherche, formation et enseignement, y compris sur un site ou un journal institutionnels, ne sont pas restreintes par le présent accord.	6 –The Participant/Visitor agrees to place scientific photographs of specimens taken in the field or in the lab at the free disposal of the project, notably to be used for its web site, and more generally for communication about the project in the media and for repatriation of information to the authorities of Papua New Guinea. All such photos will be attributed to their author. The participant is not allowed to sell or give photographs to commercial media for three years after the signing of this form. Bona fide academic uses, including publication on a web site or in-house magazine, are not restricted by the present agreement.
7 – Le Participant s'engage à ne communiquer qu'auprès des média qui auront été mis en relation avec lui/elle par le service presse de l'expédition.	7 – The Participant/Visitor agrees to communicate with only those media that have been put in touch with him/her by the Organiser's press department.
8 - Toute publication réalisée par le participant et/ou le visiteur relative à son expérience et/ou aux travaux effectués par lui sur le ou les sites et/ou à l'occasion de l'expédition devra faire référence à l'expéditionelle-même sous la dénomination "**Expédition Muséum National d'Histoire Naturelle de Paris / Pro-Natura International / Institut de Recherche pour le Développement – La Planète Revisitée, Papouasie Nouvelle Guinée 2012-2013**". L'auteur devra s'enquérir auprès du/des responsables de l'expédition des mentions additionnelles qui pourraient être nécessaires dans un paragraphe "Remerciements". Cette information figurera également sur les étiquettes et/ou tout autre document accompagnant les échantillons ou d'autres résultats des recherches conduites dans le cadre de la mission « **La Planère Revisitée – Expédition MNHN / PNI / IRD Papouasie Nouvelle -Guinée 2012-2013**».	8 - Any publication by the Participant/Visitor concerning research and/or work performed at the site and/or during the Expedition must cite the Expedition itself with the following denomination "**Muséum National d'Histoire Naturelle de Paris / Pro-Natura International / Institut de Recherche pour le Développement – 'Our Planet Reviewed' Initiative, Papua New Guinea 2012-2103 Expedition**". Authors shall enquire with their theme leaders which additional information must be mentioned under "Acknowledgements". This information must also appear on the labels and/or other documentation accompanying specimens or other research materials collected during the field survey.

APPENDIX 2

Registration form for taxonomists

Our Planet Reviewed – Papua New Guinea

Principal Investigators (PIs): Maurice Leponce (Maurice.Leponce@naturalsciences.be) and Vojtech Novotny (novotny@entu.cas.cz)

Lead organisations: Pro-Natura International, the National Museum of Natural History (MNHN, France), the Institut de Recherche pour le Développement (IRD, France).

Collaborating organisations: Royal Belgian Institute of Natural Sciences (RBINS), the New Guinea Binatang Research Center (BRC), the University of Papua New Guinea (UPNG), and the Divine Word University of Madang .

Funding agencies: Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery.

Official website: http://laplaneterevisitee.org/fr

Webpages with more informations on the land module:

http://cb.naturalsciences.be/ants/ibisca-doc-pw/OPR-PNG.htm

AGREEMENT (taxonomic expert) :

Taxonomic group[1] **:**
Group coordinator:

Name:
Organisation (and address)[2]:
Tel n°.:
Email address:

By signing this document, I declare to agree with the following conditions:

1. To process the samples, and generate a list of (morpho)-species per sample **with the number of specimens from each (morpho-)species** as output, using the *identification list (Excel sheet available on the project webpages)*. This list is returned to the group coordinator and the PIs preferably within **1 year from receipt of the samples at latest**.
2. To respond every 6 months to an **inquiry** by the group coordinator and PIs with a simple state-of-the-art of my progress.
3. To return the samples to the group coordinator without delay if no progress has been made the agreed upon deadline, or - at any given moment - if I do not longer intend to study the samples.
4. To further study, identify/describe the specimens. Updates of the initial identification list are sent to the group coordinator and PIs as the investigations proceed.
5. To provide a pdf file to the group coordinator and PIs of every scientific paper based – fully or in part - on the material concerned here, **as soon as possible after publication** and three months after publication at latest. To include the project name : "Our Planet Reviewed – Papua New Guinea 2012", host organisations / counterparts in the host country and funding agencies in the "Acknowledgements" section of those scientific papers (see the project webpages for more details).
6. A standard label provided by the PIs is added to each specimen or sample (see 7).
7. To return the holotype and/or the number of paratypes, or the number of specimens, as indicated in the return/retainment table to the Taxonomic Group coordinator mentioned above and who is in charge of depositing the material according to the return/retainment table (see p. 2 of this agreement). This is done within six months after the publication of the corresponding scientific paper or the identification of the specimens, and 2 years from receipt of the samples at latest. Mention the final depository of the specimens in your papers.

Date:

[write: "read and approved", and sign]

[1] Add exact taxonomic group you will deal with.
[2] This address will be used as mailing address.

Our Planet Reviewed – Papua New Guinea Expedition, 2012

Principal Investigators (PIs): Maurice Leponce (Maurice.Leponce@naturalsciences.be) and Vojtech Novotny (novotny@entu.cas.cz)

Lead organisations: Pro-Natura International, the National Museum of Natural History (MNHN, France), the Institut de Recherche pour le Développement (IRD, France).

Collaborating organisations: Royal Belgian Institute of Natural Sciences (RBINS), the New Guinea Binatang Research Center (BRC), the University of Papua New Guinea (UPNG), and the Divine Word University of Madang .

Funding agencies: Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery.

Official website: http://laplanetevisitee.org/fr

Webpages with more informations on the land module:

http://cb.naturalsciences.be/ants/ibisca-doc-pw/OPR-PNG.htm (username: *ibis*, password: *canopy*)

Return/retainment table

New species

new species					
no specimens	MNHN & PNG[1]	Retained by the expert	ANIC[1]	British Museum[1]	Bishop Museum[1]
1	HT[1]	-	-	-	-
2	HT + 1 PT[2]	-	-	-	-
3	HT + 1 PT[2]	1 PT	-	-	-
4	HT + 2 PT[2]	1 PT	-	-	-
5	HT + 2 PT[2]	2 PT	-	-	-
6	HT + 3 PT[2]	2 PT	-	-	-
7	HT + 3 PT[2]	2 PT	1 PT	-	-
8	HT + 3 PT[2]	2 PT	1 PT	1 PT	-
9	HT + 3 PT[2]	2 PT	1 PT	1 PT	1 PT
10	HT + 3 PT[2]	3 PT	1 PT	1 PT	1 PT
> 10	HT + at least 50% PT	at most 50%	>1 PT	>1 PT	>1 PT

HT: holotype specimen ; PT: paratype specimens

[1] In accordance to the export permit #012297 delivered by the Department of Environment and Conservation. Holotypes are deposited by default at MNHNor alternatively to RBINS. Holotypes and paratypes must be sent to the Taxonomic Group coordinator who will further distribute the material.

[2] One of the paratype is reserved for return to Papua New Guinea, in accordance to export permit #012297.

Type and paratype material has to be returned mounted.

A representative sample of the species collected has to be returned to the MNHN. One specimen is reserved for return to Papua New Guinea. These specimens must be sent to the Taxonomic Group coordinator.

no specimens		
	MNHN & PNG	Retained by the expert
1	1	0
2	2	0
3	2	1
4	2	2
5	3	2
6	3	3
7	4	3
8	4	4
9	4	5
10	4	6
> 10	Max 10	The rest

Please note that specimens 1 to 5 should preferably be mounted.

Labels to be added to each species sample

Sample code and vial code (according to the project standards, see the webpages). Collection method, site, GPS coordinates, collector, collection date, "Our Planet Reviewed – MNHN/PNI/IRD 2012".

Address of the Taxonomic Group coordinator for return of material :



Forest around 3200 m with tree ferns.
(Photo © Xavier Desmier).

Land module of Our Planet Reviewed – Papua New Guinea: Plants collected along an elevational gradient on Mount Wilhelm

Jérôme **Munzinger** [1], Kipiro **Damas** [2], Jean-François **Molino** [1]
Jean-Christophe **Pintaud**† [3], Kenneth **Molem** [1] & Hansford **Hungito** [4]

[1] AMAP, Université de Montpellier, IRD, CIRAD, CNRS, INRAE, Montpellier, France
jerome.munzinger@ird.fr

[2] Lae Herbarium, Forest Research Institute, P. O. Box 314, Lae, Papua New Guinea

[3] DIADE, Université de Montpellier, IRD, Montpellier, France

[4] The New Guinea Binatang Research Center, Nagada Harbour, P. O. Box 604, Madang, Papua New Guinea

ABSTRACT

Herbarium specimens were collected of 648 plants during the inventory of plots to characterize the forest vegetation on Mount Wilhelm between 200 and 3700 m above sea level. Specimens are deposited mainly at LAE, MPU, P, and The New Guinea Binatang Research Centre. Nearly 93% have been identified to species or "morphospecies" level. The highest species richness diversity was observed among Rubiaceae, with 42 species. Although several botanical expeditions have already visited the site, at least fourteen potentially new species have been collected, showing that the flora of Mount Wilhelm, as that of Papua New Guinea in general, remains poorly known.

RÉSUMÉ

Module terrestre de la Planète Revisitée – Papouasie-Nouvelle-Guinée : Plantes collectées le long d'un gradient altitudinal sur le Mont Wilhelm.

Des spécimens d'herbiers ont été récoltés sur 648 plantes, lors de l'inventaire de parcelles destiné à caractériser la végétation forestière présente sur le Mont Wilhelm entre 200 et 3700 m d'altitude. Les spécimens sont déposés principalement à MPU, P, LAE, et au New Guinea Binatang Research Centre. Beaucoup sont stériles, mais près de 93% ont tout de même pu être identifiés à l'espèce ou à la mor-

MUNZINGER J., DAMAS K., MOLINO J.-F., PINTAUD J.-C. †, MOLEM K. & HUNGITO H. 2020 — Land module of Our Planet Reviewed – Papua New Guinea: Plants collected along an elevational gradient on Mount Wilhelm, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 41-142 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

pho-espèce. La plus grande diversité a été observée chez les Rubiaceae, avec 42 espèces. Bien que plusieurs expéditions botaniques aient déjà parcouru le site, au moins quatorze espèces potentiellement nouvelles ont été récoltées, ce qui montre que la flore du Mont Wilhelm, à l'image de celle de la Papouasie-Nouvelle-Guinée en général, reste méconnue.

INTRODUCTION

The first known botanical collections on Mount Wilhelm date back to the 1940s (Brass 1964), whereas actual vegetation studies begun in the 1950s, with botanical expeditions to the alpine and sub-alpine zones (Hoogland 1958; Brass 1964; Wade & McVean 1969; Keig *et al.* 2019). Walker (1968) made a survey of the non-arboreal vegetation of the Pindaunde Catchment. A check-list of vascular plants of Mt Wilhelm (Johns & Stevens 1971) listed 606 species recorded above 2743 m. About forty species have been more recently added by Smith (1977), who compared the non-forest vegetation characteristics of the eastern and western slopes of the mountain. The history of vegetation has been described from palynological studies (Hope 1976). Corlett (1987) studied post-fire succession in the sub-alpine zone (3300-4000 m), and highlighted the role of anthropogenic fires that began 700 years BP.

Meanwhile, the forest vegetation remains poorly known, especially below the sub-alpine zone. The present botanical work is part of the collective study of the altitudinal biodiversity gradient described in detail in Leponce *et al.* (2016). It aims to characterize the forest vegetation along an altitudinal transect, but also to contribute to general botanical knowledge of Mount Wilhelm.

MATERIALS AND METHODS

All trees were censused on twenty-four 400 m^2 (20 x 20 m) plots that had previously been established by The New Guinea Binatang Research Center (BRC) (led by K. Molem), three at each transect elevation (3700, 3200, 2700, 2200, 1700, 1200, 700, 200 m a.s.l.). Coordinates and description of vegetation type for each elevation are given in Table 1, and a map is provided in Figure 1. Within each plot, all trees of at least 5 cm diameter at breast height (dbh) had been permanently tagged, pre-identified, and their DBH measured by the BRC team. These plots were used as reference for entomological protocols (Leponce *et al.* 2016). During the present work, vouchers were collected on trees that had not been identified with certainty. At least one voucher per species and per elevation was collected, in order to validate field species identifications. In addition, fertile plants outside the plots were collected to help identifying sterile plants inside the plots, and also to improve botanical knowledge of the sites. When possible, four duplicates were made in order to deposit one sheet in LAE, MPU, BRC and P (refer Thiers 2019, except BRC which is not registered in Index Herbariorum). When fertile material was available, additional duplicates were made to be sent to specialists or herbaria with historically important collections from Papua New Guinea (mostly L and K). Leaves preserved in silica gel were also collected, for further phylogenetic studies or identification using molecular tools. Herbarium specimens were pre-identified in the field, and then identified at MPU, P and L. Several specialists provided identifications or advices in their group and are deeply acknowledged: M. Appelhans (Rutaceae); M. van Balgooy (various families); J. Byng (Myrtaceae); M. Callmander (Pandanaceae); M. Coode (Elaeocarpaceae); J. de Muria (Violaceae, *Rinorea*); F. Danet (Ericaceae); D. Frodin (Araliaceae); R.O. Gardner (Piperaceae, *Piper*); H.C. Hopkins (Cunoniaceae); R. Kew (Oleaceae, *Chionanthus*); M.-F. Liu (Annonaceae, *Meiogyne*); P. Lowry II (Araliaceae); L. Lu (Vitaceae, *Tetrastigma*); A. Mouly (Rubiaceae, Gardeniae); P. Petoe (Arecaceae, *Heterospathe*), M. Pignal (Orchidaceae), G. Plunkett (Araliaceae, *Osmoxylon*), G. Rouhan (ferns); A. Schuiteman (Orchidaceae); U. Swenson (Sapotaceae); T. Utteridge (Primulaceae, *Embelia*, Monimiaceae, *Dryadodaphne*); S. Venter (help with completly unidentified); W.J. de Wilde & B. E. E. Duyfjes (Myristicaceae); G. Weiblen (Moraceae); P. van Welzen (Euphorbiaceae).

Some specimens were sequenced, which helped to identify them, thanks to G. Besnard (Oleaceae); S. Buerki (Sapindaceae); C. Gemmill (Lauraceae, Labiatae, Pittosporaceae, Winteraceae); S. Renner (Monimiaceae); U. Swenson (Sapotaceae).

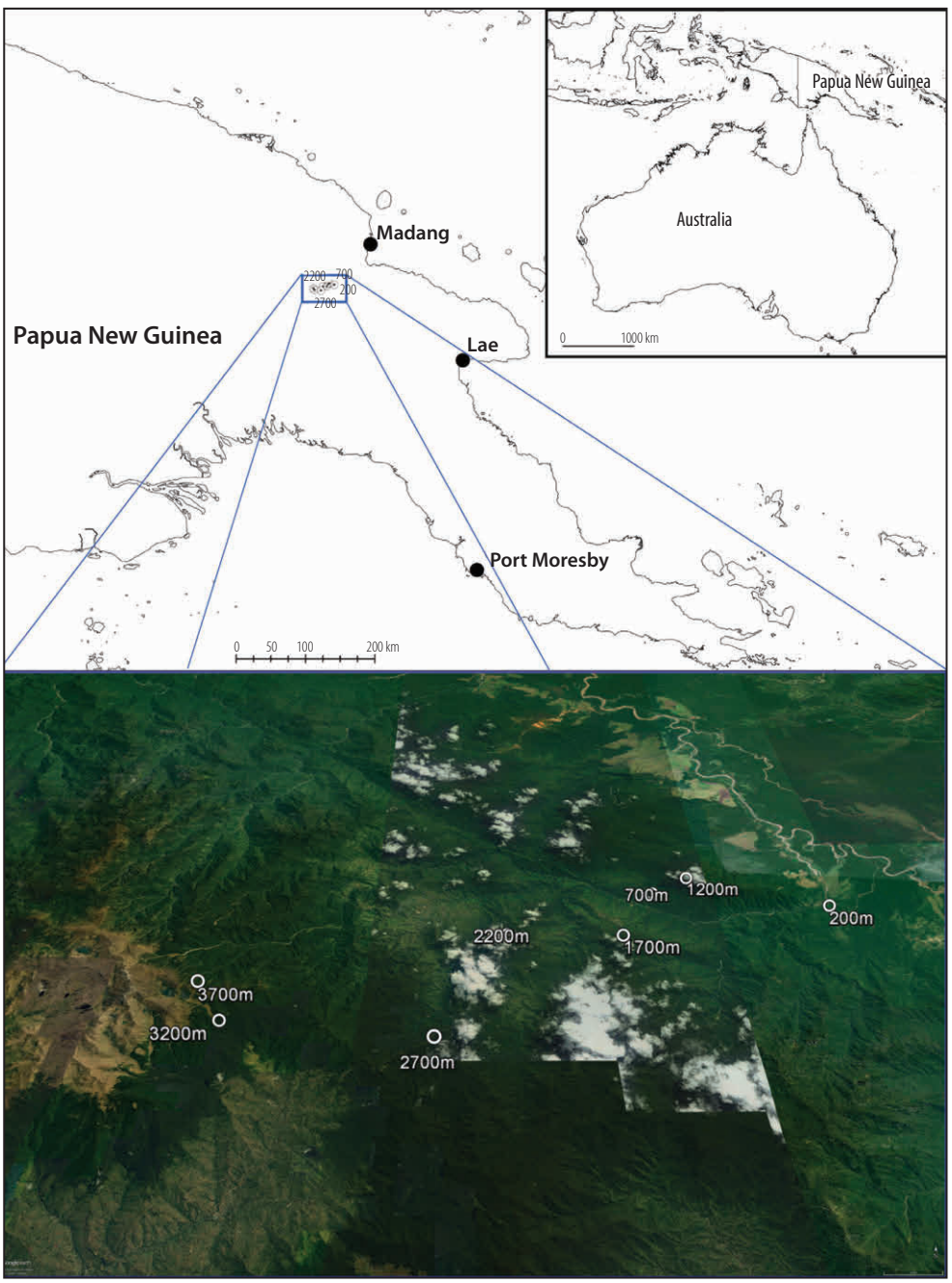


FIGURE 1

General location of the site and the 8 elevations with botanical plots. Image © 2019 DigitalGlobe / Maxar Technologies provided by GoogleEarth.

TABLE 1

Coordinates of each locality (based on botanical plot A), in decimal degrees. The vertical interval between plots along Mt Wilhelm was of 500 m. Simplified from Leponce *et al.* (2016).

ELEVATION (m)	LOCALITY	LATITUDE (°)	LONGITUDE (°)	FOREST TYPE (Johns 1982)	FOREST TYPE (Paijans 1976)
200 m	Kausi	-5.739897	145.329742	Mixed lowland forest	Mixed alluvium forest of plains and fans
700 m	Oromongu	-5.731961	145.252165	Mixed lowland forest	Mixed evergreen forest of foothills and mountains
1200 m	Memeku	-5.720874	145.269465	Mixed lowland forest	Mixed evergreen forest of foothills and mountains
1700 m	Bananumbo	-5.759269	145.235608	Lower montane forest	Mixed lower montane forest
2200 m	Sinopas	-5.758978	145.186067	Mid montane forest	Mixed lower montane forest: "*Nothofagus* forest"
2700 m	Kiangimangi	-5.815272	145.156467	Mid montane forest	Mixed lower montane forest: "*Nothofagus* forest"
3200 m	Kombunomam-buno	-5.806698	145.072923	Upper montane forest	Upper montane forest
3700 m	Pinde-Yaunde Lake	-5.786142	145.059845	Sub-alpine forest	Near the limit tree vegetation

RESULTS

During this field trip, 695 collections were made, corresponding to 95 families, 218 genera and 462 species. However, 47 collections were lost during the drying and/or shipping processes. For these collections, we were therefore unable to confirm or improve field identifications (14 to species, 18 to genus, 12 to family, and 2 indets).

The 648 collections that have been studied (excluding 5 bryophytes) belong to 94 families, 213 genera and 502 specific or infra-specific taxa.

This includes 34 specimens (5.2%) identified only to genus level, 8 to family, and 2, both sterile, not assigned to family.

At the time of writing this study, 93.2% of the 648 collections studied had been identified to species, including 468 with a valid species name, and 136 which, in our opinion, belong to distinct but so far unidentified species (hereinafter referred to as morphospecies).

The most diverse families are Rubiaceae (42 species and morphospecies), Meliaceae (36), Lauraceae (36), Moraceae (31), Myrtaceae (27), Myristicaceae (22), Elaeocarpaceae (22), Orchidaceae (16), Arecaceae (16), Sapotaceae (15), Ericaceae (15), Primulaceae (14), Euphorbiaceae (14), Sapindaceae (13), Cyatheaceae (13).

Specimens are listed below with the corresponding elevation of the collecting site(s), herbarium acronym (and herbarium object number or barcodes when available), taxon, determinator and date of collection. Several taxonomic references were used for identification; they are cited under each taxon in the main list, together with comments when appropriate.

TABLE 2

Number of specimens collected per taxon and altitude during the 2012 expedition. Elevations are those of the transect plots. Specimens collected outside the plots are aggregated to those of the nearest plot (for example, a plant actually collected at 1800 m appears in the "1700 m" class). All author names are following the official names of Botanists (https://www.ipni.org/).

	ELEVATION (m)								
TAXA	**200**	**700**	**1200**	**1700**	**2200**	**2700**	**3200**	**3700**	**TOTAL**
Unidentified family (Magnoliidae)		1	1						**2**
Indet. sp. 2		1							**1**
Indet. sp. 4			1						**1**
Achariaceae	2	1							**3**
Erythrospermum candidum Becc.	2								**2**
Pangium edule Reinw.		1							**1**
Actinidiaceae			2				1		**3**
Saurauia conferta Warb.			1						**1**
Saurauia ilicifolia P.Royen							1		**1**
Saurauia poolei C.T.White & W.D.Francis			1						**1**
Anacardiaceae	1	3							**4**
Anacardiaceae sp. 1		1							**1**
Buchanania macrocarpa Lauterb.		1							**1**
Dracontomelon dao (Blanco) Merr. & Rolfe		1							**1**
Dracontomelon lenticulatum H.P.Wilk.	1								**1**
Annonaceae	2	5	6						**13**
Goniothalamus aruensis Scheff.			1						**1**
Meiogyne n. sp.1			1						**1**
Polyalthia sp. 1			2						**2**
Polyalthia sp. 2	1								**1**
Popowia pachypetala Diels	1	4							**5**
Pseuduvaria sp. 1			1						**1**
Pseuduvaria sp. 2			1						**1**
Pseuduvaria versteegii (Diels) Merr.		1							**1**
Apocynaceae		2	1	1		1			**5**
Hoya magnifica P.I.Forst. & Liddle		1							**1**
Hoya sp. 1				1					**1**
Marsdenia sp. 1			1						**1**
Parsonsia sp. 1						1			**1**
Tabernaemontana orientalis R.Br.		1							**1**
Aquifoliaceae						1	2		**3**
Ilex archboldiana Merr. & L.M.Perry						1	2		**3**
Araceae	1	1							**2**
Epipremnum amplissimum (Schott) Engl.		1							**1**
Rhaphidophora neoguineensis Engl.	1								**1**
Araliaceae			3	3	1	2		1	**10**
Osmoxylon cf. *micranthum* (Harms) Philipson				1					**1**
Polyscias ledermannii Harms				1					**1**
Schefflera schumanniana Harms				1	1				**2**
Schefflera sp. 1 aff. *hirsuta* Philipson			1						**1**
Schefflera sp. 2 aff. *lasiosphaera* Harms			1						**1**
Schefflera sp. 3 aff. *forbesii* Ridl.			1						**1**
Schefflera sp. 4 aff. *schumanniana* Harms						2			**2**
Schefflera sp. 5								1	**1**
Arecaceae	6	3	4	1	2				**16**
Areca macrocalyx Zipp. ex Blume			1						**1**
Calamus sp. 1	3	1							**4**

	ELEVATION (m)								
TAXA	**200**	**700**	**1200**	**1700**	**2200**	**2700**	**3200**	**3700**	**TOTAL**
Calamus pintaudii W.J.Baker & J.Dransf.					1				**1**
Calyptrocalyx sp. 1			1						**1**
Heterospathe elegans (Becc.) Becc. subsp. *humilis* (Becc.) M.S.Trudgen & W.J.Baker			2	1					**3**
Heterospathe muelleriana (Becc.) Becc.					1				**1**
Hydriastele costata F.M.Bailey	1								**1**
Korthalsia zippelii Blume	1								**1**
Licuala lauterbachii Dammer & K.Schum.	1								**1**
Orania sp. 1.		2							**2**
Asparagaceae	2								**2**
Cordyline fruticosa (L.) A.Chev.	1								**1**
Dracaena angustifolia (Medik.) Roxb.	1								**1**
Asteraceae							1	4	**5**
Olearia floccosa J.Kost.								2	**2**
Olearia leptocephala J.Kost.							1		**1**
Olearia spectabilis J.Kost.								2	**2**
Begoniaceae			3						**3**
Begonia sp. 1			2						**2**
Begonia sp. 2			1						**1**
Burseraceae	3	1	2						**6**
Burseraceae sp. 3		1							**1**
Canarium cf. *macadamii* Leenh.			1						**1**
Canarium oleosum (Lam.) Engl.	1								**1**
Canarium cf. *schlechteri* Lauterb.	1								**1**
Canarium sp. 2			1						**1**
Haplolobus floribundus (K.Schum.) H.J.Lam	1								**1**
Cannabaceae	2								**2**
*Celtis latifoli*a Planch.	1								**1**
Celtis philippensis Blanco	1								**1**
Cardiopteridaceae		1							**1**
Citronella suaveolens (Blume) R.A.Howard		1							**1**
Celastraceae	1		1	1			1		**4**
Celastrus novoguineensis Merr. & L.M.Perry							1		**1**
Perrottetia alpestris (Blume) Loes.			1	1					**2**
Siphonodon celastrineus Griff.	1								**1**
Chloranthaceae				1	1	1	1		**4**
Ascarina philippinensis C.B.Rob.					1		1		**2**
Ascarina subsessilis Verdc.				1		1			**2**
Chrysobalanaceae		1							**1**
Parinari papuana C.T.White subsp. *papuana*		1							**1**
Clusiaceae	1		4	1	1				**7**
Garcinia engleriana A.C.Sm.				1					**1**
Garcinia cf. lauterbachiana A.C.Sm.			1						**1**
Garcinia ledermannii Lauterb.	1								**1**
Garcinia maluensis Lauterb.			1						**1**
Garcinia sp. 4 cf. *schraderi* Lauterb.					1				**1**
Garcinia sp. 6			1						**1**
Garcinia teysmanniana Scheff.			1						**1**
Cunoniaceae		1	1	3	1	5			**11**
Opocunonia nymanii (K.Schum.) Schltr.		1							**1**
Pullea glabra Schltr. var. glabra			1						**1**

	ELEVATION (m)								
TAXA	**200**	**700**	**1200**	**1700**	**2200**	**2700**	**3200**	**3700**	**TOTAL**
Pullea mollis Schltr.				2					**2**
Schizomeria ilicina (Ridl.) Schltr.						1			**1**
Schizomeria serrata Hochr.						1			**1**
Spiraeopsis brassii L.M.Perry				1					**1**
Spiraeopsis clemensiae L.M.Perry						2			**2**
Spiraeopsis fulva (Schltr.) L.M.Perry					1				**1**
Weinmannia urdanetensis Elmer						1			**1**
Cupressaceae							1		**1**
Papuacedrus papuana (F.Muell.) H.L.Li							1		**1**
Cyatheaceae		1	1	2	4	1	4		**13**
Alsophila hornei Baker					1				**1**
Alsophila microphylloides (Rosenst.) R.M.Tryon					1				**1**
Alsophila pruinosa (Rosenst.) R.M.Tryon				1	1				**2**
Alsophila rigens (Rosenst.) R.M.Tryon							1		**1**
Alsophila semiamplectens (Holttum) R.M.Tryon							1		**1**
Sphaeropteris aeneifolia (vAvR.) R.M.Tryon							1		**1**
Sphaeropteris auriculifera (Copel.) R.M.Tryon				1					**1**
Sphaeropteris werneri (Rosenst.) R.M.Tryon		1							**1**
Sphaeropteris sp. 1					1				**1**
Sphaeropteris sp. 2							1		**1**
Sphaeropteris sp. 3						1			**1**
Sphaeropteris sp. 4			1						**1**
Cyperaceae			1						**1**
Mapania baccifera C.B.Clarke			1						**1**
Daphniphyllaceae							1		**1**
Daphniphyllum gracile Gage							1		**1**
Dicksoniaceae				1	1				**2**
Dicksonia hieronymi Brause					1				**1**
Dicksonia sciurus C.Chr.				1					**1**
Dilleniaceae			2	1	2				**5**
Dillenia castaneifolia (Miq.) Martelli			1						**1**
Dillenia fagifolia Hoogland			1						**1**
Dillenia sp. 3				1	1				**2**
Dillenia sp. 4					1				**1**
Dipterocarpaceae			2						**2**
Vatica rassak (Korth.) Blume			2						**2**
Dryopteridaceae					2				**2**
Elaphoglossum sp. 1					1				**1**
Elaphoglossum sp. 2					1				**1**
Ebenaceae	1	1	1						**3**
Diospyros hebecarpa A.Cunn. ex Benth.	1								**1**
Diospyros sogeriensis Bakh.		1							**1**
Diospyros subsessilis Kosterm.			1						**1**
Elaeocarpaceae	1	2	1	3	4	8	3		**22**
Elaeocarpus amplifolius Schltr.		1							**1**
Elaeocarpus blepharoceras Schltr.			1						**1**
Elaeocarpus dolichodactylus Schltr.				1					**1**
Elaeocarpus filiformi-dentatus R.Knuth						2			**2**
Elaeocarpus fuscoides R.Knuth					1				**1**
Elaeocarpus kaniensis Schltr.				1					**1**
Elaeocarpus millariae Weibel					1				**1**

	ELEVATION (m)								
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Elaeocarpus myrtoides A.C.Sm. subsp. *vinkii* Coode							1		**1**
Elaeocarpus poculiferus A.C.Sm.						1			**1**
Elaeocarpus polydactylus Schltr.						1	1		**2**
Elaeocarpus ptilanthus Schltr.						1			**1**
Elaeocarpus cf. *womersleyi* Weibel					1				**1**
Sericolea micans Schltr.							1		**1**
Sloanea aberrans (Brandis) A.C.Sm.				1	1				**2**
Sloanea forbesii F.Muell.		1							**1**
Sloanea pulleniana Coode	1					3			**4**
Ericaceae			1	1	7	1		5	**15**
Dimorphanthera microphylla Sleumer								1	**1**
Dimorphanthera nigropunctata Sleumer					1				**1**
Diplycosia morobeensis Sleumer var. morobeensis						1			**1**
Rhododendron anagalliflorum Wernham					2				**2**
Rhododendron gracilentum F.Muell.					2				**2**
Rhododendron cf. *rubrobracteatum* Sleumer				1					**1**
Vaccinium acrobracteatum K.Schum.			1						**1**
Vaccinium crassistylum Sleumer					1				**1**
Vaccinium cyclopense J.J.Sm.					1				**1**
Vaccinium cf. *obedii* Veldkamp								4	**4**
Erythroxylaceae				1					**1**
Erythroxylum ecarinatum Hochr.				1					**1**
Escalloniaceae	1	1	2	1			2		**7**
Polyosma amygdaloides Reeder			1						**1**
Polyosma crassifolia Kaneh. & Hatus.				1					**1**
Polyosma sp. 2			1						**1**
Polyosma sp. 3 "lateralis Schulze-Menz, ined."	1								**1**
Polyosma sp. 5							1		**1**
Polyosma sp. 6 "scyphocalyx Schulze-Menz, ined."							1		**1**
Polyosma subalpina Schulze-Menz ex P.Royen		1							**1**
Euphorbiaceae	1	4	3		2	1	3		**14**
Cleistanthus myrianthus (Hassk.) Kurz			1						**1**
Euphorbiaceae sp. 3		1							**1**
Euphorbiaceae sp. 5			1						**1**
Euphorbiaceae sp. 6		1							**1**
Euphorbiaceae sp. 7						1			**1**
Homalanthus arfakiensis Hutch.							1		**1**
Macaranga barkeriana Whitmore					1				**1**
Macaranga inermis Pax & K.Hoffm.			1						**1**
Macaranga melanosticta Airy Shaw							2		**2**
Macaranga cf. *polyadenia* Pax & K.Hoffm.					1				**1**
Macaranga quadriglandulosa Warb.		1							**1**
Pimelodendron amboinicum Hassk.	1	1							**2**
Fagaceae		1							**1**
Castanopsis cf. *acuminatissima* (Blume) A.DC.		1							**1**
Gesneriaceae	1		3	6	1				**11**
Aeschynanthus cf. *calanthus* Schltr.				1					**1**
Aeschynanthus sp. 1	1								**1**
Agalmyla sp. 1				1					**1**
Cyrtandra sp. 1					1				**1**
Cyrtandra sp. 2				1					**1**

	ELEVATION (m)								
TAXA	**200**	**700**	**1200**	**1700**	**2200**	**2700**	**3200**	**3700**	**TOTAL**
Cyrtandra sp. 3				1					**1**
Cyrtandra sp. 4			1						**1**
Cyrtandra sp. 5			2						**2**
Cyrtandra sp. 6				2					**2**
Gnetaceae	3	2							**5**
Gnetum gnemon L.	1	1							**2**
Gnetum sp. 3		1							**1**
Gnetum sp. 4	1								**1**
Gnetum sp. 5	1								**1**
Himantandraceae				1					**1**
Galbulimima belgraveana (F.Muell.) Sprague				1					**1**
Icacinaceae				1	1				**2**
Platea excelsa Blume				1	1				**2**
Juglandaceae		1		1					**2**
Engelhardia rigida Blume		1		1					**2**
Lamiaceae	1								**1**
Vitex cofassus Reinw. ex Blume	1								**1**
Lauraceae	6	7	11	5	2	4	1		**36**
Actinodaphne cf. *ledermannii* Teschn.			1						**1**
Actinodaphne nitida Teschner	1								**1**
Actinodaphne sp. 1			1						**1**
Beilschmiedia acutifolia Teschn.			1						**1**
Cinnamomum grandiflorum Kosterm.	1								**1**
Cryptocarya aff. *apamifolia* Gamble			1						**1**
Cryptocarya albida Kosterm.				1					**1**
Cryptocarya apamifolia Gamble			1						**1**
Cryptocarya densiflora Blume		1							**1**
Cryptocarya hartleyi Kosterm.			1						**1**
Cryptocarya indenburgensis C.K.Allen				1					**1**
Cryptocarya laevigata Blume				1					**1**
Cryptocarya cf. *nothofagetorum* Kosterm.				1					**1**
Cryptocarya cf. *minutifolia* C.K.Allen						1			**1**
Cryptocarya sp. 11						1			**1**
Cryptocarya sp. 12					1				**1**
Cryptocarya sp. 3					1				**1**
Endiandra carrii Kosterm.			1						**1**
Endiandra engleriana Teschn.			1						**1**
Endiandra euadenia Kosterm.		1							**1**
Endiandra forbesii Gamble			1						**1**
Endiandra sp. 2			1						**1**
Litsea exsudens Kosterm.				1		2	1		**4**
Litsea kauloensis Teschner	4	1							**5**
Litsea ledermannii Teschn.		1							**1**
Litsea sp. 4		1							**1**
Litsea sp. 5		1							**1**
Litsea sp. 6			1						**1**
Litsea tomentosa Blume		1							**1**
Lecythidaceae	3								**3**
Barringtonia calyptrocalyx K.Schum.	3								**3**
Leguminosae	4		1						**5**
Archidendron sp. 1			1						**1**

	ELEVATION (m)								
TAXA	**200**	**700**	**1200**	**1700**	**2200**	**2700**	**3200**	**3700**	**TOTAL**
Intsia palembanica Miq.	1								**1**
Mucuna novoguineensis Scheff.	1								**1**
Pterocarpus indicus Willd.	2								**2**
Loganiaceae			2						**2**
Geniostoma dasyneurum Gilg & Gilg-Ben.			1						**1**
Neuburgia corynocarpa (A.Gray) Leenh.			1						**1**
Magnoliaceae		2							**2**
Magnolia (L.) Figlar & Noot.		1							**1**
Magnolia tsiampacca (L.) Figlar & Noot. var. *tsiampacca*		1							**1**
Malvaceae	1	2	2	1					**6**
Microcos bifida Burret			1						**1**
Microcos tetrasperma Merr. & L.M.Perry			1						**1**
Sterculia cf. *schlechteri* Mildbr.				1					**1**
Sterculia tantraensis Morat	1	2							**3**
Melastomataceae			3	3	4				**10**
Astronidium cuneatum J.F.Maxwell				1	2				**3**
Astronidium morobiense J.F.Maxwell			1						**1**
Medinilla brassii Markgr.			1						**1**
Medinilla cf. *minutifolia* Bodegom					1				**1**
Medinilla setiflora Bodegom					1				**1**
Medinilla cf. *versteegii* Mansf.				1					**1**
Memecylon cf. *hepaticum*. Blume			1						**1**
Poikilogyne callantha (Mansf.) Nayar				1					**1**
Meliaceae	19	10	6		1				**36**
Aglaia Lour.		1							**1**
Aglaia rimosa (Blanco) Merr.	2								**2**
Aglaia silvestris (M.Roem.) Merr.	1								**1**
Aglaia sp. 1					1				**1**
Aglaia sp. 3		1							**1**
Aglaia sp. 4	1								**1**
Aglaia sp. 5			1						**1**
Aglaia tomentosa Teijsm. & Binn.		1							**1**
Aphanamixis polystachya (Wall.) R.Parker	1	1							**2**
Chisocheton sp. 1			2						**2**
Chisocheton ceramicus Miq.	1	1							**2**
Chisocheton lasiocarpus (Miq.) Valeton	1	2							**3**
Chisocheton longistipitatus (F.M.Bailey) L.S.Sm.	1								**1**
Chisocheton sp. 2			1						**1**
Chisocheton sp. 4	1								**1**
Chisocheton sp. 5	1								**1**
Chisocheton sp. 6			1						**1**
Dysoxylum annae Mabb.	2								**2**
Dysoxylum brassii Merr. & L.M.Perry	2	1							**3**
Dysoxylum brevipaniculum C.DC.	1	1							**2**
Dysoxylum excelsum Blume	1								**1**
Dysoxylum longipetalum C.DC.	1								**1**
Dysoxylum papuanum Mabb.	1								**1**
Dysoxylum sp. 4			1						**1**
Dysoxylum sp. 6		1							**1**
Dysoxylum sp. 7	1								**1**
Menispermaceae	2	1							**3**

	ELEVATION (m)								
TAXA	**200**	**700**	**1200**	**1700**	**2200**	**2700**	**3200**	**3700**	**TOTAL**
Strychnos minor Dennst.	2	1							**3**
Monimiaceae			4	2	1	2	1		**10**
Dryadodaphne crassa Schodde ex Philipson						1			**1**
Dryadodaphne novoguineensis (Perkins) A.C.Sm.			1						**1**
Kairoa sp. 1			1						**1**
Kairoa aff. *suberosa* Philipson			1	1					**2**
Palmeria clemensae Philipson			1						**1**
Palmeria scandens F.Muell.					1				**1**
Steganthera chimbuensis Philipson						1			**1**
Steganthera hirsuta Perkins				1					**1**
Steganthera ilicifolia A.C.Sm.							1		**1**
Moraceae	6	4	6	6	5	2	2		**31**
Artocarpus camansi Blanco		1							**1**
Artocarpus lacucha Buch.-Ham.	1			1					**2**
Ficus arfakensis King			1						**1**
Ficus bernaysii King		1							**1**
Ficus endochaete Summerh.					1				**1**
Ficus hispidioides S. Moore	1								**1**
Ficus hombroniana Corner			1						**1**
Ficus microdictya Diels				2	2				**4**
Ficus mollior F.Muell. ex Benth.			1						**1**
Ficus pachyrrhachis K.Schum. & Lauterb.			1						**1**
Ficus pilulifera Corner			1						**1**
Ficus pungens Reinw. ex Bl.	1								**1**
Ficus quercetorum Corner				1					**1**
Ficus robusta Corner		1							**1**
Ficus rubrivestimenta Weiblen & Whitfeld		1							**1**
Ficus sp. 5, n. sp.				1					**1**
Ficus trichocerasa Diels				1					**1**
Ficus wassa Roxb.	2				1				**3**
Ficus xylosycia Diels			1						**1**
Prainea papuana Becc.	1								**1**
Streblus glaber (Merr.) Corner subsp. *urophyllus* (Diels) C.C.Berg					1	2	2		**5**
Myristicaceae	13	5	1	3					**22**
Gymnacranthera farquhariana (Wall. ex Hook.f. & Thomson) Warb. var. *zippeliana* (Miq.) R.T.A.Schouten	2	1							**3**
Horsfieldia basifissa W.J.de Wilde		1							**1**
Horsfieldia pulverulenta Warb.	1								**1**
Horsfieldia sp. 1	4								**4**
Horsfieldia sp. 2	1								**1**
Horsfieldia sp. 3	1								**1**
Myristica crassipes Warb.				2					**2**
Myristica pachyphylla A.C.Sm.				1					**1**
Myristica sp. 1			1						**1**
Myristica sp. 2	1								**1**
Myristica sp. 3		1							**1**
Myristica sp. 4	1								**1**
Myristica sp. 6		1							**1**
Myristica sp. 7	1								**1**
Myristica sp. 9	1								**1**
Myristica subalulata Miq. var. *subalulata*		1							**1**

	ELEVATION (m)								
TAXA	**200**	**700**	**1200**	**1700**	**2200**	**2700**	**3200**	**3700**	**TOTAL**
Myrtaceae	2	4	4	3	5	5	3		**26**
Decaspermum alpinum P.Royen							1		**1**
Decaspermum forbesii Baker f.							1		**1**
Metrosideros cordata (C.T.White & W.D.Francis) J.W.Dawson					1				**1**
Syzygium adelphicum Diels						1			**1**
Syzygium cf. *hylochare* (Diels) Merr. & L.M.Perry			1						**1**
Syzygium homichlophilum Diels					1				**1**
Syzygium longipes Merr. & L.M.Perry		1							**1**
Syzygium madangense T.G.Hartley & L.M.Perry		1							**1**
Syzygium sogerense (Greves) Merr. & L.M.Perry			1						**1**
Syzygium sp. 1		1							**1**
Syzygium sp. 2			1						**1**
Syzygium sp. 3						2			**2**
Syzygium sp. 5		1							**1**
Syzygium sp. 6					1				**1**
Syzygium sp. 7				2					**2**
Syzygium sp. 8	1								**1**
Syzygium sp. 9	1								**1**
Syzygium sp. 11				1					**1**
Syzygium sp. 13					1				**1**
Syzygium sp. 14			1						**1**
Syzygium sp. 17					1				**1**
Xanthomyrtus angustifolia A.J.Scott						2			**2**
Xanthomyrtus bryophila Diels							1		**1**
Nepenthaceae			1						**1**
Nepenthes maxima Nees			1						**1**
Nothofagaceae					1	1			**2**
Nothofagus grandis Steenis					1				**1**
Nothofagus resinosa Steenis						1			**1**
Nyctaginaceae		1							**1**
Pisonia umbellifera (J.R.Forst. & G.Forst.) Seem.		1							**1**
Ochnaceae				1	1		1		**3**
Schuurmansia elegans Blume							1		**1**
Schuurmansia henningsii K.Schum.				1					**1**
Schuurmansia sp. 1					1				**1**
Oleaceae		3		1					**4**
Chionanthus brassii (Kobuski) Kiew				1					**1**
Chionanthus gigas (Lingelsh.) Kiew		1							**1**
Chionanthus sp. 3		2							**2**
Orchidaceae	3	2		4	5	1	1		**16**
Bulbophyllum desmotrichoides Schltr.		1							**1**
Bulbophyllum lepanthiflorum Schltr.		1							**1**
Bulbophyllum manobulbum Schltr.						1			**1**
Bulbophyllum rhodoleucum Schltr.					1				**1**
Ceratostylis Blume					1				**1**
Dendrobium cuthbertsonii F.Muell.					1				**1**
Dendrobium masarangense Schltr.				1					**1**
Dendrobium nardoides Schltr.					1				**1**
Dendrobium sp. 1	1								**1**
Dendrobium sp. 2	1								**1**
Epiblastus sp. 1	1								**1**

	ELEVATION (m)								
TAXA	**200**	**700**	**1200**	**1700**	**2200**	**2700**	**3200**	**3700**	**TOTAL**
Glomera aurea Schltr.					1				**1**
Glomera sp. 1				2					**2**
Mediocalcar bifolium J.J.Sm.				1					**1**
Phreatia ganggapensis P.Royen							1		**1**
Pandaceae		1							**1**
Galearia celebica Koord.		1							**1**
Pandanaceae	1		3	2	4	1			**11**
Freycinetia sp. 1				1					**1**
Freycinetia sp. 2			1						**1**
Freycinetia sp. 3			1						**1**
Freycinetia sp. 4					1				**1**
Pandanus antaresensis H.St.John					1				**1**
Pandanus archiboldianus Merr. & L.M. Perry				1					**1**
Pandanus conoideus Lam.	1								**1**
Pandanus sp. 2					1				**1**
Pandanus sp. 3						1			**1**
Pandanus sp. 4					1				**1**
Pandanus sp. 5			1						**1**
Paracryphiaceae				1		3	1	1	**6**
Quintinia altigena Schltr.						1			**1**
Quintinia montiswilhelmii P.Royen								1	**1**
Quintinia nutantiflora Schltr.						1	1		**2**
Sphenostemon papuanus (Lauterb.) Steenis & Erdtm.				1		1			**2**
Phyllanthaceae		1	3		1	2			**7**
Antidesma excavatum Miq. var. excavatum		1	2						**3**
Glochidion acustylum Airy Shaw					1	1			**2**
Glochidion pachyconum Airy Shaw			1			1			**2**
Piperaceae	1					1			**2**
Piper macropiper Pennant	1								**1**
Piper triangulare Chew						1			**1**
Pittosporaceae			3		2	2	3	1	**11**
Pittosporum sp. 1			1						**1**
Pittosporum berberidoides Burkill						1	2		**3**
Pittosporum pullifolium Burkill subsp. *ledermannii* (E.Pritz.) Schodde					1				**1**
Pittosporum pullifolium Burkill var. *pullifolium*								1	**1**
Pittosporum ramiflorum Zoll. ex Miq.			1				1		**2**
Pittosporum sinuatum Blume			1		1	1			**3**
Podocarpaceae			2		1			2	**5**
Dacrycarpus compactus (Wasscher) de Laub.								1	**1**
Dacrycarpus imbricata Alderw.					1				**1**
Podocarpus brassii Pilg. var. *humilis* de Laub.								1	**1**
Podocarpus sp. 1			1						**1**
Sundacarpus amarus (Blume) C.N.Page			1						**1**
Polygalaceae		2							**2**
Xanthophyllum papuanum Whitmore ex Meijden		1							**1**
Xanthophyllum sp. 1		1							**1**
Polypodiaceae				1					**1**
Selliguea albidosquamata (Blume) Parris				1					**1**
Primulaceae	2	1			3	1	2	5	**14**
Ardisia forbesii S.Moore	2								**2**
Discocalyx latepetiolata (Mez) Sleumer		1							**1**

	ELEVATION (m)								
TAXA	**200**	**700**	**1200**	**1700**	**2200**	**2700**	**3200**	**3700**	**TOTAL**
Embelia cotinoides (S.Moore) Merr.					1				**1**
Maesa haplobotrys F.Muell.							1		**1**
Myrsine leucantha (K.Schum.) Pipoly					1				**1**
Myrsine papuana Hemsl.								1	**1**
Myrsine sp. 2						1			**1**
Myrsine sp. 3					1				**1**
Myrsine velutina (Knoester, Wijn & Sleumer) Pipoly							1	4	**5**
Proteaceae			1	1		1	2		**5**
Helicia coeruleopurpurea P.Royen							2		**2**
Helicia hypoglauca Diels			1						**1**
Helicia odorata Diels				1					**1**
Helicia sleumeri Foreman						1			**1**
Rhamnaceae	1	1							**2**
Ziziphus angustifolia (Miq.) Hatus. ex Steenis	1								**1**
Ziziphus djamuensis Lauterb.		1							**1**
Rhizophoraceae				1					**1**
Gynotroches axillaris Blume				1	1				**2**
Rosaceae					1	2	1		**4**
Prunus brassii Kalkman						1			**1**
Prunus grisea (Blume ex Müll.Berol.) Kalkman var. *microphylla* Kalkman							1		**1**
Prunus oligantha Kalkman					1	1			**2**
Rubiaceae	3	7	15	3	8	1	5		**42**
Atractocarpus macarthurii (F.Muell.) Puttock			1						**1**
Atractocarpus sp. 1					1				**1**
Bungarimba papuana K.M.Wong		1	1						**2**
Coprosma papuensis W.R.B.Oliv. subsp. *discolor* (P.Royen) R.O.Gardner							1		**1**
Dolianthus ovatifolius A.P.Davis					1				**1**
Dolianthus subalpinus (P.Royen) A.P.Davis							1		**1**
Gardenia sp. 1	1			1					**2**
Hydnophytum dauloense Jebb & C.R.Huxley					1				**1**
Ixora amplexifolia K.Schum. & Lauterb.		1							**1**
Lasianthus chlorocarpus K.Schum.			1						**1**
Lasianthus clementis Merr.			1						**1**
Myrmecodia sp. 1					1				**1**
Neonauclea lanceolata Merr. subsp. *gracilis* (S.Vidal) Ridsdale			2						**2**
Nertera granadensis Druce					1				**1**
Ophiorrhiza debruynii Valeton					1				**1**
Ophiorrhiza sp. 1			1						**1**
Psychotria hollandiae Valeton	1								**1**
Psychotria leucococca K.Schum. & Lauterb.			1						**1**
Psychotria micrococca (Lauterb. & K.Schum.) Valeton		1							**1**
Psychotria sp. 1			1						**1**
Psychotria sp. 2					1				**1**
Psychotria sp. 3			1						**1**
Psychotria sp. 4							1		**1**
Psychotria sp. 5						1			**1**
Psychotria sp. 6			1						**1**
Psychotria sp. 7			1						**1**
Psychotria sp. 8	1						1		**2**
Randia schumanniana Merr. & L.M.Perry		1							**1**

	ELEVATION (m)								
TAXA	**200**	**700**	**1200**	**1700**	**2200**	**2700**	**3200**	**3700**	**TOTAL**
Randia sphaerocarpa K.Schum. & Lauterb.			1						**1**
Rothmannia sp. 1			1						**1**
Rubiaceae sp. 1		1							**1**
Rubiaceae sp. 3		1							**1**
Tarenna multinervia (Merr.) Bremek.		1							**1**
Timonius belensis Merr. & L.M.Perry							1		**1**
Timonius longitubus Merr. & L.M.Perry				1					**1**
Timonius meridionalis S.P.Darwin			1						**1**
Timonius sp. 1				1	1				**2**
Rutaceae	1			2	1	4	1	2	**11**
Acronychia emarginata Lauterb.								2	**2**
Acronychia ledermannii Lauterb.				1					**1**
Acronychia murina Ridl.						1			**1**
Acronychia pullei Lauterb.						1			**1**
Flindersia amboinensis Poir.						1			**1**
Melicope sp. 1					1				**1**
Melicope rubra (Lauterb. & K.Schum.) T.G.Hartley							1		**1**
Micromelum minutum Wight & Arn.	1								**1**
Tetractomia tetrandra (Roxb.) Merr.						1			**1**
Zanthoxylum sp. 1				1					**1**
Sabiaceae			2	1	1				**4**
Meliosma pinnata (Roxb.) Maxim. subsp. *humilis* (Merr. & L.M.Perry) Beusekom			2	1	1				**4**
Salicaceae		2	1						**3**
Ryparosa calotricha Mildbr.		1	1						**2**
Ryparosa sp. 1		1							**1**
Sapindaceae	6	3	4						**13**
Alectryon ferrugineum (Blume) Radlk.			1						**1**
Cupaniopsis sp. 1			1						**1**
Dictyoneura obtusa Blume	2								**2**
Guioa comesperma Radlk.	1								**1**
Guioa sp. 1			1						**1**
Harpullia longipetala Leenh.		2							**2**
Lepisanthes sp. 1	1								**1**
Mischocarpus sp. 1			1						**1**
Mischocarpus sundaicus Blume	1								**1**
Pometia pinnata J.R.Forst. & G.Forst.	1	1							**2**
Sapotaceae		7	3	1	4				**15**
Palaquium cf. *supfianum* Schltr.		3	1						**4**
Palaquium morobense P.Royen			1						**1**
Planchonella polyneura (K.Krause) Swenson		2							**2**
Planchonella thyrsoidea C.T.White		1							**1**
Pleioluma firma (Miq.) Swenson				1	3				**4**
Pleioluma macropoda (H.J.Lam) Swenson					1				**1**
Pleioluma sp. 1, n. sp.			1						**1**
Pouteria doonsaf P.Royen		1							**1**
Simaroubaceae		1							**1**
Picrasma javanica Blume		1							**1**
Smilacaceae				1					**1**
Smilax papuana Lauterb.				1					**1**
Solanaceae			1						**1**

	ELEVATION (m)								
TAXA	**200**	**700**	**1200**	**1700**	**2200**	**2700**	**3200**	**3700**	**TOTAL**
Lycianthes memecylonoides (Bitter & Schltr.) Bitter			1						**1**
Stemonaceae		1							**1**
Stemona javanica (Kunth) Engler		1							**1**
Stemonuraceae		1	2	1					**4**
Gomphandra montana (G.Schellenb.) Sleumer				1					**1**
Gomphandra papuana (Becc.) Sleumer			2						**2**
Medusanthera laxiflora (Miers) R.A.Howard		1							**1**
Symplocaceae				2	3	2	4	1	**12**
Symplocos cerasifolia Wall.							1		**1**
Symplocos cochinchinensis (Lour.) S.Moore subsp. *leptophylla* (Brand) Noot.				1	2	2	2		**7**
Symplocos cochinchinensis (Lour.) S.Moore var. *leptophylla* (Lour.) S.Moore							1		**1**
Symplocos cochinchinensis (Lour.) S.Moore var. *molobros* (Brand) Noot.					1				**1**
Symplocos cochinchinensis (Lour.) S.Moore var. *orbicularis* (Hemsl.) Noot.								1	**1**
Symplocos cochinchinensis (Lour.) S.Moore var. *reginae* (Brand) Noot.				1					**1**
Theaceae						1	1	2	**4**
Eurya pullenii Hoogland								1	**1**
Eurya sp. 2								1	**1**
Eurya tigang K.Schum. & Lauterb.						1	1		**2**
Thymelaeaceae	1		3						**4**
Phaleria capitata Jack			3						**3**
Phaleria macrocarpa (Scheff.) Boerl.	1								**1**
Trimeniaceae					1				**1**
Trimenia papuana Ridl.					1				**1**
Violaceae	1								**1**
Rinorea sp. 1	1								**1**
Vitaceae	1	1		2					**4**
Leea gonioptera Lauterb.	1								**1**
Leea heterodoxa K.Schum. & Lauterb.		1							**1**
Tetrastigma sp. 1				1					**1**
Tetrastigma sp. 2				1					**1**
Winteraceae		2	1		1	2	2	4	**12**
Tasmannia montis-wilhelmi (Hoogland) A.C. Sm.						2			**2**
Tasmannia dictyophlebia (Diels) A.C.Sm.								2	**2**
Tasmannia cf. *reticulata* (Diels) A.C.Sm.								1	**1**
Tasmannia piperita (Hook. f.) Miers s. lat.entity 2. 'subalpina'								1	**1**
Tasmannia rosea (Ridl.) A.C.Sm.							1		**1**
Tasmannia sp. 1					1				**1**
Tasmannia sp. 2			1						**1**
Zygogynum calothyrsum (Diels) Vink							1		**1**
Zygogynum montanum (Lauterb.) Vink		2							**2**
Xanthorrhoeaceae					1				**1**
Dianella ensifolia (L.) DC.					1				**1**
Zingiberaceae		1		1					**2**
Pleuranthodium cf. *macropycnanthum* (Valeton) R.M.Sm.		1							**1**
Riedelia sp. 1				1					**1**
TOTAL	**107**	**106**	**131**	**79**	**87**	**59**	**51**	**28**	**648**

POLYPODIIDAE
CYATHEACEAE

Alsophila hornei Baker

Munzinger *et al.* 6838, Alt. 2200 m, Dupl.:MPU [MPU380748, MPU380749, MPU380750], P [P02275649, P02275650, P02433740]
Identification: Pintaud 2012

Alsophila microphylloides (Rosenst.) R.M.Tryon

Pintaud *et al.* 667, Alt. 2200 m, Dupl.: MPU [MPU380747], P [P00580462, P00580463, P00580464, P00580465]
Identification: Pintaud 2012

Alsophila pruinosa (Rosenst.) R.M.Tryon

Pintaud *et al.* 666, Alt. 2200 m, Dupl.: MPU [MPU380746], P [P00580466]
Identification: Pintaud 2012

Pintaud *et al.* 676, Alt. 1700 m, Dupl.: P [P00580456, P00580457, P00580458]
Identification: Pintaud 2012

Alsophila rigens (Rosenst.) R.M.Tryon

Pintaud *et al.* 660, Alt. 3200 m, Dupl.: P [P00580476, P00580477]
Identification: Pintaud 2012

Alsophila semiamplectens (Holttum) R.M.Tryon

Pintaud *et al.* 663, Alt. 3200 m, Dupl.: P [P00580467, P00580468, P00580469]
Identification: Pintaud 2012

Sphaeropteris aeneifolia (vAvR.) R.M.Tryon

Pintaud *et al.* 662, Alt. 3200 m, Dupl.: P [P00580470, P00580471, P00580472, P00580473, P00580474]
Identification: Pintaud 2012

Sphaeropteris auriculifera (Copel.) R.M.Tryon

Pintaud *et al.* 674, Alt. 1700 m, Dupl.: P [P00580483, P00580484, P00580485]
Identification: Pintaud 2012

Sphaeropteris werneri (Rosenst.) R.M.Tryon

Pintaud *et al.* 700, Alt. 700 m, Dupl.: P [P00580497, P00580498, P00580499]
Identification: Pintaud 2012

Sphaeropteris sp. 1

Pintaud *et al.* 669, Alt. 2200 m, Dupl.: MPU [MPU380744, MPU380745], P [P00580459, P00580460, P00580461]
Identification: Rouhan 2018

Sphaeropteris sp. 2

Pintaud *et al.* 659, Alt. 3200 m, Dupl.: P [P00580478, P00580479, P00580480]
Identification: Munzinger 2019

Sphaeropteris sp. 3

Pintaud *et al.* 658, Alt. 2800 m, Dupl.: P [P00580481]
Identification: Munzinger 2019

Sphaeropteris sp. 4

Pintaud *et al.* 679, Alt. 1188 m, Dupl.: MPU [MPU380743], P [P02091739, P02091740, P02091741, P02091742]
Identification: Munzinger 2019

DICKSONIACEAE

Dicksonia hieronymi Brause

Pintaud *et al.* 672, Alt. 2200 m, Dupl.: MPU [MPU380740], P [P00580487, P00580488, P00580489, P00580490, P00580491]
Identification: Pintaud 2012

Dicksonia sciurus C.Chr.

Pintaud *et al.* 677, Alt. 1700 m, Dupl.: MPU [MPU380741, MPU380742], P [P02091747, P02091748, P02091749, P02091750]
Identification: Pintaud 2012

LOMARIOPSIDACEAE

Elaphoglossum sp. 1

Munzinger *et al.* 6861bis, Alt. 2200 m, Dupl.: P [P02433762]
Identification: Rouhan 2018

Elaphoglossum sp. 2

Munzinger *et al.* 6855, Alt. 2200 m, Dupl.: P [P02433755]
Identification: Rouhan 2018

POLYPODIACEAE

Selliguea albidosquamata (Blume) Parris

Munzinger *et al.* 6877, Alt. 1700 m, Dupl.: P [P02433776]
Identification: Rouhan 2018

PINIDAE
CUPRESSACEAE

Papuacedrus papuana (F.Muell.) H.L.Li

Pintaud *et al.* 661, Alt. 3200 m, Dupl.: P [P00580475]
Identification: Pintaud 2012

PODOCARPACEAE

Dacrycarpus compactus (Wasscher) de Laub.

Figure 82, page 81

Munzinger *et al.* 6754, Alt. 3700 m, Dupl.: MPU [MPU380572]
Identification: Pintaud 2012

Dacrycarpus imbricata Alderw

Pintaud *et al.* 668, Alt. 2200 m, Dupl.: P [P00580453]
Identification: Pintaud 2012

Podocarpus brassii Pilg. var. ***humilis*** de Laub.

Munzinger *et al.* 6755, Alt. 3700 m, Dupl.: KYO, P [P02433670]
Identification: Pintaud 2012

Podocarpus pilgeri Foxw.

Pintaud *et al.* 664, Alt. 3200 m, Dupl.: BRC, K, LAE
Identification: Pintaud 2012

Pintaud *et al.* 665, Alt. 2700 m, Dupl.: BRC, K, LAE
Identification: Pintaud 2012.

Note: the collection is considered as lost.

Podocarpus pseudobracteatus de Laub.

Pintaud *et al.* 698, Alt. 1223 m, Dupl.: BRC, LAE
Identification: Pintaud 2012

Note: the collection is considered as lost.

Podocarpus sp. 1

Pintaud *et al.* 685, Alt. 1200 m, Dupl.: KYO, MPU [MPU380624], P [P00580486]
Identification: Molino 2015

Sundacarpus amarus (Blume) C.N.Page

Pintaud *et al.* 684, Alt. 1200 m, Dupl.: KYO, P [P00580482]
Identification: Pintaud 2012

GNETIDAE
GNETACEAE

Gnetum gnemon L.

Molino *et al.* 3098, Alt. 700 m, Dupl.: B, G, K, L [L.3977110], MPU [MPU380577], P [P02433644]
Identification: Molino 2016

Munzinger *et al.* 7337, Alt. 200 m, Dupl.: MPU [MPU380579]
Identification: Molino 2016

Gnetum sp. 3

Molino *et al.* 3090, Alt. 700 m, Dupl.: BRC, LAE, MPU [MPU380578]
Identification: Munzinger 2018

Gnetum sp. 4

Munzinger *et al.* 7027, Alt. 200 m, Dupl.: MPU [MPU380580], P [P02433860]
Identification: Munzinger 2018

Gnetum sp. 5

Molino *et al.* 3127, Alt. 200 m, Dupl.: P [P02433650]
Identification: Munzinger 2018

MAGNOLIIDAE

Indet. sp. 2

Molino *et al.* 3084, Alt. 700 m, Dupl.: MPU [MPU380566]
Identification: Munzinger 2015

Indet. sp. 4

Munzinger *et al.* 7336, Alt. 1200 m, Dupl.: MPU [MPU380565]
Identification: Molino 2016

ACHARIACEAE

Erythrospermum candidum Becc.

Molino *et al.* 3150, Alt. 200 m, Dupl.: MPU [MPU380842]
Identification: Munzinger 2016

Munzinger *et al.* 7013, Alt. 200 m, Dupl.: MPU [MPU380841], P [P02433856]
Identification: Munzinger 2016

Note: the material Molino *et al.* 3150 matches with the type in L [L 0010826].

Pangium edule Reinw.

Munzinger *et al.* 7006, Alt. 700 m, Dupl.: MPU [MPU380739]
Identification: Munzinger 2016

ACTINIDIACEAE

Saurauia conferta Warb.

Munzinger *et al.* 6928, Alt. 1200 m, Dupl.: MPU [MPU380735]
Identification: Molino 2016

Saurauia ilicifolia P.Royen

Figure 2

Munzinger *et al.* 6767, Alt. 3200 m, Dupl.: CANB, L, MPU [MPU380734], NSW [NSW818299], P [P02433679]
Identification: Molino 2016

Note: matches with the type in K.

Saurauia poolei C.T.White & W.D.Francis

Munzinger *et al.* 7343, Alt. 1200 m, Dupl.: MPU [MPU380733]
Identification: Munzinger 2016

ANACARDIACEAE

Anacardiaceae sp. 1

Munzinger *et al.* 6978, Alt. 700 m, Dupl.: MPU [MPU380737]
Identification: Munzinger 2016

Note: possibly a *Dracontomelum*, but without domatia, so cannot be *Dracontomelum lenticulatum* H.P.Wilk. Meanwhile, the only species of the genus lacking domatia (*D. costatum* Bl.) is not known from Papua New Guinea (Hou 1974).

Buchanania macrocarpa Lauterb.

Munzinger *et al.* 6986, Alt. 700 m, Dupl.: MPU [MPU380755, MPU380756], NY, P [P02433843]
Identification: Munzinger 2016

Note: the material is almost sterile, but is identical to Hoogland 4729 [L.2263098] in L.

Dracontomelon dao (Blanco) Merr. & Rolfe

Munzinger *et al.* 6977, Alt. 700 m, Dupl.: MPU [MPU380738], NY, P [P02433839]
Identification: Mitchell 2015

Dracontomelon lenticulatum H.P.Wilk.

Molino *et al.* 3131, Alt. 200 m, Dupl.: MPU [MPU380736]
Identification: Munzinger 2016

ANNONACEAE

Goniothalamus aruensis Scheff.

Figure 3

Molino *et al.* 3040, Alt. 1200 m, Dupl.: L, P [P02433631]
Identification: Fazang & Molem 2012

Meiogyne sp. 1

Figures 4-5

Munzinger *et al.* 6945, Alt. 1200 m, Dupl.: P [P02275660, P02433813]
Identification: Liu 2019

Note: could be a new species fide Ming-Fai Liu, who is currently working on this genus for his PhD (com. pers.)

Polyalthia sp. 1

Molino *et al.* 3054, Alt. 1200 m, Dupl.: L, MPU [MPU380730], P [P02433634]
Identification: Munzinger 2014

Munzinger *et al.* 7315, Alt. 1200 m, Dupl.: MPU [MPU380729]
Identification: Munzinger 2014

Polyalthia sp. 2

Figure 6

Munzinger *et al.* 7053, Alt. 200 m, Dupl.: L, MPU [MPU380727], NSW [NSW818329], P [P02433871]
Identification: Molino 2015

Popowia pachypetala Diels

Molino *et al.* 3091, Alt. 700 m, Dupl.: L, MPU [MPU380723]
Identification: Molino 2016

Molino *et al.* 3103, Alt. 700 m, Dupl.: G, K, L, MPU [MPU380724], P [P02433647]
Identification: Molino 2016

Molino *et al.* 3187, Alt. 700 m, Dupl.: MPU [MPU310607]
Identification: Molino 2016

Munzinger *et al.* 6971, Alt. 700 m, Dupl.: MPU [MPU380725], P [P02433833]
Identification: Molino 2016

Munzinger *et al.* 7056, Alt. 200 m, Dupl.: LAE, MPU [MPU380726]
Identification: Molino 2016

Note: no specimen seen at L, but images of types held at P and B seen on Jstor.

Pseuduvaria sp. 1

Figure 7

Molino *et al.* 3056, Alt. 1200 m, Dupl.: L, MPU [MPU380722], P [P02433636]
Identification: Munzinger 2018

Note: close to *P. rhytidophylla / silvestris*, fruit smooth.

Pseuduvaria sp. 2

Figure 8

Molino *et al.* 3061, Alt. 1188 m, Dupl.: L, MPU [MPU380731, MPU380732], P [P02433640]
Identification: Munzinger 2018

Note: close to *P. rhytidophylla* or *P. silvestris*, fruit crested, seems different from Molino *et al.* 3056.

Pseuduvaria versteegii (Diels) Merr.

Munzinger *et al.* 6994, Alt. 700 m, Dupl.: MPU [MPU380728]
Identification: Molino 2016

APOCYNACEAE

Hoya magnifica P.I.Forst. & Liddle

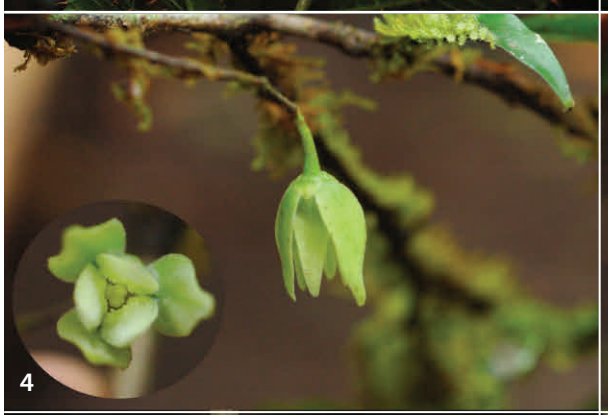
Molino *et al.* 3088, Alt. 700 m, Dupl.: MPU [MPU380721]
Identification: Munzinger 2018

FIGURES 2-9

2, Actinidiaceae, *Saurauia ilicifolia*, Munzinger *et al.* 6767, flower; **3**, Annonaceae, *Goniothalamus aruensis*, Molino *et al.* 3040; **4**, *Meiogyne* sp., Munzinger 6945, fruit; **5**, *Meiogyne* sp., Munzinger *et al.* 6945 flowers; **6**, *Polyalthia* sp. 2, Munzinger *et al.* 7053; **7**, *Pseuduvaria* sp. 1, Molino *et al.* 3056, fruit; **8**, *Pseuduvaria* sp. 2, Molino 3061, flower and fruit; **9**, Apocynaceae *Hoya* sp., Molino *et al.* 2978. 2, 4-6, 8 © J. Munzinger/IRD. 3, 7, 9 © J.-F. Molino/IRD.


2

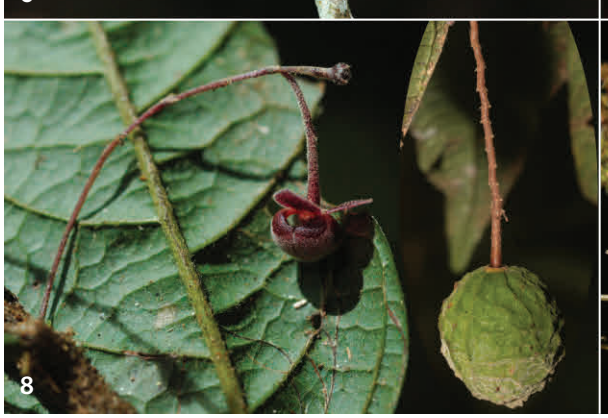

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Hoya sp. 1

Figure 9

Molino *et al.* 2978, Alt. 1700 m, Dupl.: P [P02433599]
Identification: Molino 2012

Marsdenia sp. 1

Figure 10

Munzinger *et al.* 6951, Alt. 1200 m, Dupl.: MPU [MPU380720], P [P02433819]
Identification: Munzinger 2018

Parsonsia sp. 1

Figure 11

Munzinger *et al.* 6799, Alt. 2700 m, Dupl.: MPU [MPU380719], P [P02433708]
Identification: Munzinger 2012

Tabernaemontana orientalis R.Br.

Munzinger *et al.* 7319, Alt. 700 m, Dupl.: MPU [MPU380718]
Identification: Munzinger 2016

AQUIFOLIACEAE

Ilex archboldiana Merr. & L.M.Perry

Figure 12

Molino *et al.* 2914, Alt. 3200 m, Dupl.: G, K, L, MPU [MPU380716], P [P02433576]
Identification: Molino 2016

Molino *et al.* 2928, Alt. 2700 m, Dupl.: MPU [MPU380919]
Identification: Munzinger 2016

Munzinger *et al.* 6777, Alt. 3200 m, Dupl.: MPU [MPU380717], P [P02433688]
Identification: Molino 2016

Note: the material Molino *et al.* 2928 is similar to Ridsdale 36810 [L.2281286] in L.

ARACEAE

Epipremnum amplissimum (Schott) Engl.

Munzinger *et al.* 6981, Alt. 700 m, Dupl.: P [P02089479, P02433841]
Identification: Bogner 2017

Rhaphidophora neoguineensis Engl.

Munzinger *et al.* 7029, Alt. 200 m, Dupl.: MPU [MPU380715], P [P02433861]
Identification: Bogner 2017

ARALIACEAE

Osmoxylon cf. ***micranthum*** (Harms) Philipson

Munzinger *et al.* 6871, Alt. 1700 m, Dupl.: P [P02433770]
Identification: Plunkett 2019

Note: identification based on picture (from the field).

Polyscias ledermannii Harms

Munzinger *et al.* 7322, Alt. 1700 m, Dupl.: MPU [MPU380702]
Identification: Fazang & Molem 2012

Schefflera schumanniana Harms

Figure 14

Molino *et al.* 2966, Alt. 2200 m, Dupl.: MPU [MPU380706]
Identification: Frodin 2016

Munzinger *et al.* 6886, Alt. 1700 m, Dupl.: P [P0160275]
Identification: Lowry 2018

Note: D. Frodin (pers. comm.) indicated "featuring rather small heads and fruits with a stylar column" for the material Molino *et al.* 2966.

Schefflera sp. 1 aff. ***hirsuta*** Philipson

Molino *et al.* 2977, Alt. 1188 m, Dupl.: MPU [MPU380712, MPU380713], P [P02275638, P02433598]
Identification: Frodin 2016

Note: "related to *S. hirsuta* Harms but here the heads are larger and the leaflets entire" (D. Frodin, pers. comm.).

Schefflera sp. 2 aff. ***lasiosphaera*** Harms

Munzinger *et al.* 6908, Alt. 1200 m, Dupl.: MPU [MPU380709], P [P02433831]
Identification: Frodin 2016

Note: "related to *S. eriocephala* Harms/*S. lasiosphaera* Harms (though the plants in the Central Highlands may be distinct from both of these)" (D. Frodin, pers. comm.).

Schefflera sp. 3 aff. ***forbesii*** Ridl.

Figure 13

Munzinger *et al.* 6938, Alt. 1200 m, Dupl.: MPU [MPU380710, MPU380711], P [P02275636, P02275637, P02433810]
Identification: Frodin 2016

Note: "aff. *forbesii*" but that is a difficult 'complex'. The main axis of the inflorescence is elongate (D. Frodin, pers. comm.).

Schefflera sp. 4 aff. ***schumanniana*** Harms

Munzinger *et al.* 6796, Alt. 2700 m, Dupl.: P [P02275639, P02433706]
Identification: Frodin 2016

Munzinger *et al.* 6796bis, Alt. 2700 m, Dupl.: MPU [MPU380714]
Identification: Frodin 2016

Note: "allied to Molino *et al.* 2966 but may be a distinct species, with the leaflets most resembling *S. dentata* but here a more robust plant than usual in that species. The *schumanniana* group seems to have some diversity on the Bismarck Range." (D. Frodin, pers. comm.).

Schefflera sp. 5

Munzinger *et al.* 6756, Alt. 3500 m, Dupl.: P [P02433671]
Identification: Munzinger 2018

ARECACEAE

Areca macrocalyx Zipp. ex Blume

Pintaud *et al.* 682, Alt. 1200 m, Dupl.: K [K001262304], P [P02091732, P02091733, P02091734]
Identification: Pintaud 2012

Calamus aruensis Becc.

Pintaud *et al.* 689, Alt. 1188 m, Dupl.: BRC, LAE
Identification: Pintaud 2012

Note: the collection is considered as lost.

Calamus sp. 1

Pintaud *et al.* 702, Alt. 700 m, Dupl.: K [K001193037]
Identification: Pintaud 2012

Pintaud *et al.* 704, Alt. 200 m, Dupl.: BRC, LAE
Identification: Pintaud 2012

Pintaud *et al.* 705, Alt. 200 m, Dupl.: K
Identification: Pintaud 2012

Pintaud *et al.* 706, Alt. 200 m, Dupl.: K, LAE
Identification: Pintaud 2012

Calamus pintaudii W.J.Baker & J.Dransf.

Pintaud *et al.* 671, Alt. 2200 m, Dupl.: K [K000606762], P [P00580492, P00580493, P00580494, P00580495, P00580496]
Identification: Baker 2017

Note: this is the type specimen (Baker & Dransfield, 2017).

Calyptrocalyx sp. 1

Pintaud *et al.* 683, Alt. 1200 m, Dupl.: K [K001262305]
Identification: Pintaud 2012

Heterospathe elegans (Becc.) Becc. subsp. ***humilis*** (Becc.) M.S.Trudgen & W.J.Baker

Pintaud *et al.* 678, Alt. 1700 m, Dupl.: K [K001287200], P [P02091743, P02091744, P02091745, P02091746]
Identification: Petoe 2018

Pintaud *et al.* 680, Alt. 1200 m, Dupl.: K [K001287198], P [P02091737, P02091738]
Identification: Petoe 2018

Pintaud *et al.* 681, Alt. 1200 m, Dupl.: K [K001287199], P [P02091735, P02091736]
Identification: Petoe 2018

Heterospathe muelleriana (Becc.) Becc.

Pintaud *et al.* 670, Alt. 2200 m, Dupl.: K [K001287194], P [P02091751, P02091752, P02091753, P02091754, P02091755]
Identification: Petoe 2018

Hydriastele costata F.M.Bailey

Pintaud *et al.* 707, Alt. 200 m, Dupl.: K
Identification: Pintaud 2012

Korthalsia zippelii Blume

Pintaud *et al.* 708, Alt. 200 m, Dupl.: LAE
Identification: Pintaud 2012

Licuala lauterbachii Dammer & K.Schum.

Pintaud *et al.* 703, Alt. 200 m, Dupl.: LAE
Identification: Pintaud 2012

Orania sp. 1

Pintaud *et al.* 699, Alt. 700 m, Dupl.: K [K001262306]
Identification: Pintaud 2012

Pintaud *et al.* 701, Alt. 700 m, Dupl.: K [K001262307], P [P00580454, P00580455]
Identification: Pintaud 2012

ASPARAGACEAE

Cordyline fruticosa (L.) A.Chev.

Molino *et al.* 3138, Alt. 200 m, Dupl.: P [P02433658]
Identification: Munzinger 2018

Note: similar to Hartley 98330 (L.1447877) in L.

Dracaena angustifolia (Medik.) Roxb.

Molino *et al.* 3136, Alt. 200 m, Dupl.: L [L.3977123], MPU [MPU380703], P [P02433656]
Identification: Munzinger 2018

ASTERACEAE

Olearia floccosa J.Kost.

Figure 15

Molino *et al.* 2903, Alt. 3700 m, Dupl.: K, L, MPU [MPU380704], P [P02433566]
Identification: Damas 2012

Munzinger *et al.* 6761, Alt. 3700 m, Dupl.: MPU [MPU380705], P [P02433674]
Identification: Damas 2012

Olearia leptocephala J.Kost.

Munzinger *et al.* 6776, Alt. 3200 m, Dupl.: P [P02433687]
Identification: Munzinger 2019

Note: similar to van Balgooy 976 (L.3673144) in L.

Olearia spectabilis J.Kost.

Molino *et al.* 2905, Alt. 3700 m, Dupl.: L, P [P02433568]
Identification: Molino 2016

Munzinger *et al.* 6762, Alt. 3700 m, Dupl.: MPU [MPU380708], NSW [NSW818284], P [P02433675]
Identification: Munzinger 2016

BEGONIACEAE

Begonia sp. 1

Molino *et al.* 3021, Alt. 1200 m, Dupl.: MPU [MPU380861], P [P02433623]
Identification: Molino 2012

Molino *et al.* 3023, Alt. 1200 m, Dupl.: P [P02433624]
Identification: Molino 2012

Begonia sp. 2

Figure 16

Munzinger *et al.* 6948, Alt. 1200 m, Dupl.: P [P02433816]
Identification: Munzinger 2018

BURSERACEAE

Burseraceae sp. 3

Munzinger *et al.* 6984, Alt. 700 m, Dupl.: MPU [MPU380856], NY, P [P02433842]
Identification: Molino 2016

Note: this is not *Haplolobus floribundus* (K.Schum.) H.J.Lam.

Canarium cf. ***macadamii*** Leenh.

Munzinger *et al.* 7325, Alt. 1200 m, Dupl.: MPU [MPU380857]
Identification: Molino 2016

Canarium oleosum (Lam.) Engl.

Molino *et al.* 3147, Alt. 200 m, Dupl.: MPU [MPU380860], NY
Identification: Molino 2016

FIGURES 10-17

10, Apocynaceae, *Marsdenia* sp., Munzinger *et al.* 6951, flower; **11**, *Parsonsia* sp., Munzinger *et al.* 6799, flower; **12**, Aquifoliaceae *Ilex archboldiana*, Molino *et al.* 2914, buds; **13**, Araliaceae, *Schefflera* aff. *forbesii*, Munzinger *et al.* 6938, flowers; **14**, *Schefflera schumanniana*, cf. Molino *et al.* 2966, fruits; **15**, Asteraceae *Olearia floccosa*, Munzinger *et al.* 6776, flowers; **16**, Begoniaceae, *Begonia* sp. 2, Munzinger *et al.* 6948, flower; **17**, Celastraceae, *Celastrus novoguineensis*, Munzinger *et al.* 6771, fruits. 10, 11, 13, 15-17 © J. Munzinger/IRD. 12 © J.-F. Molino/IRD. 14 © L. Pierron.


10


11

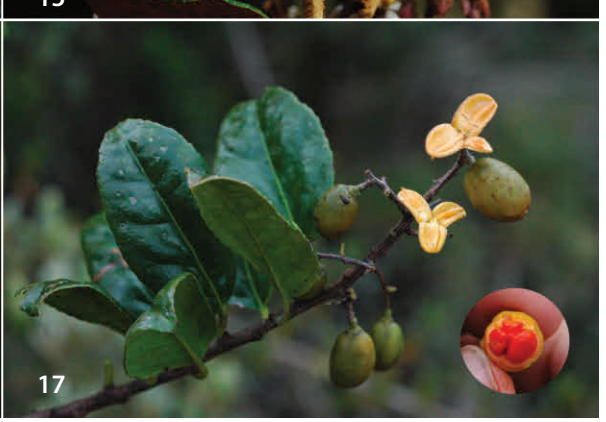

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Canarium cf. ***schlechteri*** Lauterb.

Munzinger *et al.* 7047, Alt. 200 m, Dupl.: MPU [MPU380858]
Identification: Fazang & Molem 2012

Canarium sp. 2

Munzinger *et al.* 6953, Alt. 1200 m, Dupl.: BRC, LAE, MPU [MPU380859], NY, P [P02275654, P02433821, P02433883]
Identification: Munzinger 2012

Note: differs from other *Canarium* collected in the plots.

Haplolobus floribundus (K.Schum.) H.J.Lam

Munzinger *et al.* 7326, Alt. 200 m, Dupl.: MPU [MPU380855]
Identification: Molino 2016

CANNABACEAE

Celtis latifolia Planch.

Munzinger *et al.* 7049, Alt. 200 m, Dupl.: MPU [MPU380969]
Identification: Molino 2016

Celtis philippensis Blanco

Munzinger *et al.* 7015, Alt. 200 m, Dupl.: MPU [MPU380968], P [P02433857]
Identification: Munzinger 2016

CARDIOPTERIDACEAE

Citronella suaveolens (Blume) R.A.Howard

Molino *et al.* 3106, Alt. 700 m, Dupl.: MPU [MPU380569]
Identification: Molino 2016

CELASTRACEAE

Celastrus novoguineensis Merr. & L.M.Perry

Figure 17

Munzinger *et al.* 6771, Alt. 3200 m, Dupl.: L [L.3977124], MO, MPU [MPU380837], NSW, P [P02433683]
Identification: Munzinger 2018

Perrottetia alpestris (Blume) Loes.

Molino *et al.* 2982, Alt. 1700 m, Dupl.: MPU [MPU380839], P [P02433603]
Identification: Munzinger 2016

Molino *et al.* 3053, Alt. 1200 m, Dupl.: MPU [MPU380840]
Identification: Munzinger 2016

Siphonodon celastrineus Griff.

Munzinger *et al.* 7031, Alt. 200 m, Dupl.: MPU [MPU380838], NSW [NSW818325], P [P02433862]
Identification: Munzinger 2016

Note: the species appears highly variable, and our specimen is similar to *Neth. Ind. For. Service 30559* [L.2288044] in L.

CHLORANTHACEAE

Ascarina philippinensis C.B.Rob.

Molino *et al.* 2953, Alt. 2200 m, Dupl.: MPU [MPU380854]
Identification: Molino 2016

Munzinger *et al.* 6768, Alt. 3200 m, Dupl.: MPU [MPU380853], NSW [NSW818298], P [P02433680]
Identification: Molino 2016

Ascarina subsessilis Verdc.

Molino *et al.* 2987, Alt. 1700 m, Dupl.: MPU [MPU380851]
Identification: Munzinger 2016

Munzinger *et al.* 6798, Alt. 2700 m, Dupl.: MPU [MPU380852]
Identification: Munzinger 2016

CHRYSOBALANACEAE

Parinari papuana C.T.White subsp. ***papuana***

Molino *et al.* 3085, Alt. 700 m, Dupl.: MPU [MPU380850]
Identification: Molino 2016

Note: identified in L, and isotype seen on JSTOR. Leaves usually smaller, but this species is a big tree, while our specimen comes from an understorey juvenile.

CLUSIACEAE

Garcinia engleriana A.C.Sm.

Munzinger *et al.* 6882, Alt. 1700 m, Dupl.: MPU [MPU380848], P [P02433781]
Identification: Munzinger 2016

Note: identified in L, matches with the type.

Garcinia cf. ***lauterbachiana*** A.C.Sm.

Figure 19

Munzinger *et al.* 6963, Alt. 1200 m, Dupl.: P [P02433885]
Identification: Munzinger 2019

Note: The species appears quite variable, but our specimen matches with Floyd NGF 7447 [L.2416368], identified by Hildebrand.

Garcinia ledermannii Lauterb.

Munzinger *et al.* 7032, Alt. 200 m, Dupl.: MPU [MPU380846], P [P02433863]
Identification: Munzinger 2016

Garcinia maluensis Lauterb.

Munzinger *et al.* 6960, Alt. 1200 m, Dupl.: MPU [MPU380844, MPU380845], P [P02433828]
Identification: Munzinger 2016

Garcinia* sp. 4** cf. ***schraderi Lauterb.

Molino *et al.* 2975, Alt. 2200 m, Dupl.: MPU [MPU380849]
Identification: Munzinger 2016

Note: identical to Sanders 1003 (L.2417739) identified *as G. schraderi* by Hildebrand in L, but this specimen looks different from all the remaining specimens of that species in L.

***Garcinia* sp. 6**

Figure 18

Molino *et al.* 3058, Alt. 1200 m, Dupl.: G, K, L, MPU [MPU380843], P [P02433638]
Identification: Munzinger 2014

Garcinia teysmanniana Scheff.

Figure 20

Munzinger *et al.* 6907, Alt. 1200 m, Dupl.: MPU [MPU380847], P [P02433799]
Identification: Munzinger 2016

Note: identified in L, matches with the type.

CUNONIACEAE

Opocunonia nymanii (K.Schum.) Schltr.

Munzinger *et al.* 6935, Alt. 1200 m, Dupl.: BRC, LAE
Identification: Fazang & Molem 2012

Munzinger *et al.* 7335, Alt. 700 m, Dupl.: MPU [MPU380988]
Identification: Munzinger 2018

Note: identification of the material Munzinger *et al.* 7335 made thanks to the help of H. Hopkins, the other specimen is lost, but was noted in the field as identical to to the tree *GBB1191*.

Pullea glabra Schltr. var. ***glabra***

Munzinger *et al.* 6906, Alt. 1200 m, Dupl.: K [K000618206], MPU [MPU380825], P [P02433798]
Identification: Hopkins 2014

Pullea mollis Schltr.

Munzinger *et al.* 6879, Alt. 1700 m, Dupl.: K [K000618204], MPU [MPU3808 23], NSW [NSW818314], P [P02433778]
Identification: Hopkins 2014

Munzinger *et al.* 6895, Alt. 1700 m, Dupl.: K [K000618203], L [L.3977118], MPU [MPU380824], NSW [NSW818317], P [P02433791]
Identification: Hopkins 2014

Schizomeria ilicina (Ridl.) Schltr.

Munzinger *et al.* 6797, Alt. 2700 m, Dupl.: K [K000618205], L [L.3977117], MPU [MPU380822], NSW, P [P02433707]
Identification: Hopkins 2014

Note: material cited in Hopkins (2018, p. 36).

Schizomeria serrata Hochr.

Molino *et al.* 2933, Alt. 2700 m, Dupl.: MPU [MPU380820]
Identification: Munzinger 2016

Note: identical to Stevens 58763 [L1874735] in L.

Spiraeopsis brassii L.M.Perry

Munzinger *et al.* 6892, Alt. 1700 m, Dupl.: K [K000618201], L [L.3977120], MPU [MPU380821], P [P02433789]
Identification: Hopkins 2014

Spiraeopsis clemensiae L.M.Perry

Molino *et al.* 2940, Alt. 2700 m, Dupl.: MPU [MPU380827]
Identification: Munzinger 2018

Munzinger 7309, Alt. 2700 m, Dupl.: MPU [MPU380826]
Identification: Munzinger 2018

Spiraeopsis fulva (Schltr.) L.M.Perry

Figure 21

Munzinger *et al.* 6825, Alt. 2200 m, Dupl.: K [K000618200], MPU [MPU380814, MPU380818], P [P02433728]
Identification: Hopkins 2014

Weinmannia urdanetensis Elmer

Munzinger *et al.* 6811, Alt. 2700 m, Dupl.: K [K000618202], MPU [MPU380819], P [P02433715]
Identification: Hopkins 2014

CYPERACEAE

Mapania baccifera C.B.Clarke

Figure 22

Munzinger *et al.* 6915, Alt. 1200 m, Dupl.: G, MPU [MPU380834], P [P02275652, P02275653, P02433805]
Identification: Munzinger 2016

DAPHNIPHYLLACEAE

Daphniphyllum gracile Gage

Molino *et al.* 2923, Alt. 3200 m, Dupl.: MPU [MPU380568]
Identification: Fazang & Molem 2012

DILLENIACEAE

Dillenia castaneifolia (Miq.) Martelli

Munzinger *et al.* 7321, Alt. 1200 m, Dupl.: MPU [MPU380833]
Identification: Munzinger 2018

Dillenia fagifolia Hoogland

Molino *et al.* 3052, Alt. 1200 m, Dupl.: L [L.3977119], MPU [MPU380832], P [P02433633]
Identification: Munzinger 2018

Note: according to the protologue (Hoogland 1952), leaves are 12.5-16 x 8-10 cm, with 17-19 nerves on each side, but the Isotype in L (L 281406) has one leaf 11.2 x 6.2 with 13 nerves, identical to our specimen.

Dillenia sp. 3, n. sp.?

Molino *et al.* 2991, Alt. 1700 m, Dupl.: MPU [MPU380831], P [P02433608]
Identification: Munzinger 2014

Munzinger *et al.* 6824, Alt. 2200 m, Dupl.: MPU [MPU380830], P [P02433727]
Identification: Molino 2016

Note: similar specimens in LAE are labelled "sp. nov."

Dillenia sp. 4

Munzinger *et al.* 7323, Alt. 2200 m, Dupl.: LAE, MPU [MPU380829]
Identification: Molino 2016

Note: nothing similar seen in L.

DIPTEROCARPACEAE

Vatica rassak (Korth.) Blume

Molino *et al.* 3017, Alt. 1200 m, Dupl.: MPU [MPU380563]
Identification: Munzinger 2016

Munzinger *et al.* 6920, Alt. 1200 m, Dupl.: MPU [MPU380564]
Identification: Munzinger 2016

EBENACEAE

Diospyros hebecarpa A.Cunn. ex Benth.

Molino *et al.* 3142, Alt. 200 m, Dupl.: BRC, MPU [MPU380559]
Identification: Munzinger 2016

Diospyros sogeriensis Bakh.

Molino *et al.* 3074, Alt. 700 m, Dupl.: MPU [MPU380560]
Identification: Munzinger 2016

Note: similar to Womersley & Millar NGF8533 LAE, [L.2664402] in L.

FIGURES 18-24

18, Clusiaceae, *Garcinia* sp. 6, Molino *et al.* 3058, fruit; **19**, *Garcinia* cf. *lauterbachiana*, Munzinger *et al.* 6963, fruit; **20**, *Garcinia teysmanniana*, fruit; **21**. Cunoniaceae, *Spiraeopsis fulva* Munzinger *et al.* 6825, flowers; **22**, Cyperaceae, *Mapania baccifera*, Munzinger *et al.* 6915, fruits; **23**, Elaeocarpaceae, *Elaeocarpus fuscoides*, Molino *et al.* 2946, flowers; **24**, Ericaceae, *Dimorphantera* cf. *nigropunctata*, Munzinger *et al.* 6828, flowers. 18-19, 21-22, 24 © J. Munzinger/IRD. 20 © M. Leponce. 23 © J.-F. Molino/IRD.


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Diospyros subsessilis Kosterm.

Molino *et al.* 3028, Alt. 1200 m, Dupl.: MPU [MPU380547], P [P02433628], W
Identification: Munzinger 2016

ELAEOCARPACEAE

Elaeocarpus amplifolius Schltr.

Molino *et al.* 3109, Alt. 700 m, Dupl.: P [P02433648]
Identification: Munzinger 2018

Elaeocarpus blepharoceras Schltr.

Munzinger *et al.* 6965, Alt. 1200 m, Dupl.: BRC, LAE, MPU [MPU380554], P [P02275468, P02433887]
Identification: Munzinger 2018

Note: *sensu lato.*

Elaeocarpus dolichodactylus Schltr.

Munzinger *et al.* 6883, Alt. 1700 m, Dupl.: MPU [MPU380552]
Identification: Munzinger 2018

Note: our collection matches *E. cephalodactylus* Schltr., recently synonymized by Coode (2019).

Elaeocarpus filiformi-dentatus R.Knuth

Molino 3157, Alt. 2700 m, Dupl.: MPU [MPU310602]
Identification: Munzinger 2018

Munzinger *et al.* 6806, Alt. 2700 m, Dupl.: MPU [MPU380550]
Identification: Munzinger 2018

Elaeocarpus fuscoides R.Knuth

Figure 23

Molino *et al.* 2946, Alt. 2200 m, Dupl.: B, G, K, L, MO, MPU [MPU380556], NY, P [P02433588]
Identification: Munzinger 2018

Note: *sensu lato.*

Elaeocarpus kaniensis Schltr.

Molino *et al.* 2998, Alt. 1700 m, Dupl.: K, L, MPU [MPU380549]
Identification: Munzinger 2018

Elaeocarpus miegei Weibel

Munzinger *et al.* 6930, Alt. 1200 m, Dupl.: BRC, LAE
Identification: Munzinger 2012

Note: the collection is considered as lost.

Elaeocarpus millariae Weibel

Molino *et al.* 2956, Alt. 2200 m, Dupl.: MPU [MPU380539]
Identification: Munzinger 2016

Notes: identical to Womersley NGF37081 LAE90836, [L.2346651] in L. Weibel (1971) named that plant after Andrée N. Millar, but he was unaware that she was a woman (M. Coode pers. comm.). The epithet *millarii* is thus corrected to *millariae* according to Art. 60.8, note 4 (Turland *et al.* 2018).

Elaeocarpus myrtoides A.C.Sm. subsp. ***vinkii*** Coode

Munzinger *et al.* 6783, Alt. 3200 m, Dupl.: MPU [MPU380555], P [P02433693]
Identification: Munzinger 2018

Note: identical to Brass 30188 [L.2339740], the type of the subspecies (Coode 2005).

Elaeocarpus poculiferus A.C.Sm.

Molino 3155, Alt. 2700 m, Dupl.: MPU [MPU312126]
Identification: Munzinger 2018

Elaeocarpus polydactylus Schltr.

Munzinger *et al.* 6780, Alt. 3200 m, Dupl.: MPU [MPU380548], NSW [NSW818292], P [P02433690]
Identification: Munzinger 2018

Munzinger *et al.* 6808, Alt. 2700 m, Dupl.: L [L.3977111], MPU [MPU380558], NSW [NSW818286], P [P02433712]
Identification: Munzinger 2018

Elaeocarpus ptilanthus Schltr.

Munzinger *et al.* 6801, Alt. 2700 m, Dupl.: MPU [MPU380557]
Identification: Munzinger 2018

Note: identical to Brass 30411 [L.2347556] in L.

Elaeocarpus cf. ***womersleyi*** Weibel

Molino *et al.* 2962, Alt. 2200 m, Dupl.: MPU [MPU380553]
Identification: Munzinger 2018

Note: identical to Ridsdale 2234 [L.2344438.] in L.

Sericolea micans Schltr.

Munzinger *et al.* 7344, Alt. 3200 m, Dupl.: MPU [MPU380546]
Identification: Munzinger & Molino 2012

Sloanea aberrans (Brandis) A.C.Sm.

Molino *et al.* 2958, Alt. 2200 m, Dupl.: MPU [MPU380561, MPU380562], P [P02433591]
Identification: Munzinger 2018

Molino *et al.* 2994, Alt. 1700 m, Dupl.: MPU [MPU380544], P [P02433611]
Identification: Munzinger 2018

Note: the best match for the sterile material Molino *et al.* 2958 is Flenley 2470 identified "probably" as this species in L [L.2351830] by Coode.

Sloanea forbesii F.Muell.

Munzinger *et al.* 7000, Alt. 700 m, Dupl.: MPU [MPU380551], P [P02433851]
Identification: Munzinger 2018

Note: identical to Womersley NGF37208 LAE, L [L.2352056].

Sloanea pulleniana Coode

Molino *et al.* 2944, Alt. 2700 m, Dupl.: MPU [MPU380506], P [P02433586]
Identification: Munzinger 2018

Munzinger *et al.* 6800, Alt. 2700 m, Dupl.: MPU [MPU380535], P [P02433709]
Identification: Munzinger 2018

Munzinger *et al.* 6819, Alt. 2700 m, Dupl.: MPU [MPU380505], NSW [NSW818304], P [P02288550, P02433723]
Identification: Munzinger 2018

Munzinger *et al.* 7028, Alt. 200 m, Dupl.: MPU [MPU380536]
Identification: Munzinger 2018

Note: neither the protologue (Coode 1978) nor Coode (1981) mention domatia, but they are conspicuous on all our samples.

ERICACEAE

Dimorphanthera microphylla Sleumer

Munzinger 7187, Alt. 3700 m, Dupl.: MPU [MPU028030]
Identification: Danet 2014

Dimorphanthera nigropunctata Sleumer

Figure 24

Munzinger *et al.* 6828, Alt. 2200 m, Dupl.: MPU [MPU028037], P [P02433730]
Identification: Danet 2014

Diplycosia morobeensis Sleumer var. ***morobeensis***

Figure 25

Munzinger *et al.* 6809, Alt. 2700 m, Dupl.: MPU [MPU028036], P [P02433713]
Identification: Danet 2014

Rhododendron anagalliflorum Wernham

Figure 26

Molino *et al.* 2976, Alt. 2200 m, Dupl.: P [P02433597]
Identification: Munzinger 2018

Munzinger *et al.* 6861, Alt. 2200 m, Dupl.: MPU [MPU028035], P [P02433761]
Identification: Danet 2014

Rhododendron gracilentum F.Muell.

Molino *et al.* 2971, Alt. 2200 m, Dupl.:MPU [MPU028034], P [P02433594]
Identification: Danet 2014

Munzinger *et al.* 6849, Alt. 2200 m, Dupl.: P [P02433751]
Identification: Munzinger 2018

Rhododendron cf. ***rubrobracteatum*** Sleumer

Figure 27

Molino *et al.* 3008, Alt. 1700 m, Dupl.: MPU [MPU028033], P [P02433613]
Identification: Danet 2014

Vaccinium acrobracteatum K.Schum.

Figure 28

Munzinger *et al.* 6921, Alt. 1200 m, Dupl.: MPU [MPU028031]
Identification: Danet 2014

Vaccinium crassistylum Sleumer

Figure 29

Molino *et al.* 2974, Alt. 2200 m, Dupl.: P [P02433596]
Identification: Munzinger 2018

Vaccinium cyclopense J.J.Sm.

Molino *et al.* 2972, Alt. 2200 m, Dupl.: P [P02433595]
Identification: Munzinger 2018

Vaccinium cf. ***obedii*** Veldkamp

Figure 30

Molino *et al.* 2902, Alt. 3700 m, Dupl.: MO, MPU [MPU028032], P [P02433565]
Identification: Danet 2014

Molino *et al.* 2908, Alt. 3700 m, Dupl.: MPU [MPU028038], P [P02433571]
Identification: Danet 2014

Munzinger 7313, Alt. 3700 m, Dupl.: MPU [MPU380614]
Identification: Danet 2014

Munzinger *et al.* 6753, Alt. 3700 m, Dupl.:P [P02433669]
Identification: Munzinger 2016

ERYTHROXYLACEAE

Erythroxylum ecarinatum Hochr.

Molino *et al.* 2990, Alt. 1700 m, Dupl.: K, L, MPU [MPU380504, MPU380545], P [P02433607]
Identification: Fazang & Molem 2012

ESCALLONIACEAE

Note: the genus *Polyosma* is currently under revision by O. Paul, M. Henwood and B. Conn.

Polyosma amygdaloides Reeder

Munzinger *et al.* 6937, Alt. 1200 m, Dupl.: MPU [MPU380611], NSW [NSW818320], P [P02275642, P02433809]
Identification: Munzinger 2016

Polyosma crassifolia Kaneh. & Hatus.

Munzinger *et al.* 6902, Alt. 1700 m, Dupl.: P [P02433795]
Identification: Munzinger 2016

Polyosma sp. 2

Munzinger *et al.* 7340, Alt. 1200 m, Dupl.: LAE, MPU [MPU380610]
Identification: Munzinger 2015

Note: identical to Stevens 54111 [L.1868156], probably new species.

Polyosma sp. 3 "***lateralis*** Schulze-Menz, ined."

Munzinger *et al.* 6816, Alt. 200 m, Dupl.: MPU [MPU380609], NSW [NSW818303], P [P02433720]
Identification: Munzinger 2015

Note: a specimen annotated as isotype in L [L 0035098) by G.K.W. Schulze-Menz in 1967, but not officially published (Potztal, 1979).

Polyosma sp. 5, nov.

Molino *et al.* 2919, Alt. 3200 m, Dupl.: MPU [MPU380613]
Identification: Munzinger 2016

Note: O. Paul (pers. comm.) identified our specimen as the undescribed *P. brassii* Schulze-Menz ined., but we believe this is a distinct additional new species, along with Clemens 7887 [L.1871108, L.1868103], Barker 67506 [L.1867489], and Veldkamp 6704 [L.1868205, L.1868206].

Polyosma sp. 6 "***scyphocalyx*** Schulze-Menz, ined."

Molino *et al.* 2922, Alt. 3200 m, Dupl.: G, K, L, MPU [MPU380612], P [P02433581]
Identification: Munzinger 2016

Note: a specimen annotated as isotype in L [L 0035112] by G.K.W. Schulze-Menz in 1967.

Polyosma subalpina Schulze-Menz ex P.Royen

Munzinger *et al.* 6758, Alt. 3500 m, Dupl.: BRC, LAE, MPU [MPU380608]
Identification: Munzinger 2016

EUPHORBIACEAE

Cleistanthus myrianthus (Hassk.) Kurz

Munzinger *et al.* 7314, Alt. 1200 m, Dupl.: LAE, MPU [MPU380606]
Identification: van Welzen 2016

Euphorbiaceae sp. 3

Molino *et al.* 3083, Alt. 700 m, Dupl.: MPU [MPU380590]
Identification: Munzinger 2014

Euphorbiaceae sp. 5

Molino *et al.* 3016, Alt. 1200 m, Dupl.: MPU [MPU380588]
Identification: Munzinger 2014

FIGURES 25-32

25, Ericaceae, *Diplycosia morobeensis* cf. Munzinger *et al.* 6809, flower; **26**, *Rhododendron anagalliflorum*, Molino *et al.* 2976, flowers; **27**, *Rhododendron rubrobracteatum*, Molino 3008, flower; **28**, *Vaccinium acrobracteatum*, Munzinger *et al.* 6921, flowers; **29**, *Vaccinium crassistylum*, Molino 2974, flowers; **30**, *Vaccinium* cf. *obedii*, Molino 2908, fruits; **31**, Euphorbiaceae, *Antidesma excavatum* Munzinger *et al.* 6954, fruits; **32**, Gesneriaceae, *Aeschynanthus* cf. *calanthus* Molino *et al.* 2979, flowers. 25, 28, 31 © J. Munzinger/IRD. 26-27, 29-30, 32 © J.-F. Molino/IRD.


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Euphorbiaceae sp. 6

Munzinger *et al.* 7003, Alt. 700 m, Dupl.: MPU [MPU380595]
Identification: Munzinger & Molino 2016

Euphorbiaceae sp. 7

Munzinger *et al.* 7307, Alt. 2700 m, Dupl.: MPU [MPU380596]
Identification: Molino & Munzinger 2016

Homalanthus arfakiensis Hutch.

Munzinger *et al.* 6769, Alt. 3200 m, Dupl.: L [L.3977121], MPU [MPU380601], NSW [NSW818297], P [P02433681]
Identification: van Welzen 2016

Macaranga barkeriana Whitmore

Munzinger *et al.* 6836, Alt. 2200 m, Dupl.: MPU [MPU380597], P [P02433738]
Identification: van Welzen 2016

Macaranga inermis Pax & K.Hoffm.

Munzinger *et al.* 6956, Alt. 1200 m, Dupl.: MPU [MPU380591], NSW [NSW1001671], P [P02433824]
Identification: van Welzen 2016

Macaranga melanosticta Airy Shaw

Munzinger 7191, Alt. 3200 m, Dupl.: MPU [MPU380599]
Identification: Munzinger 2016

Munzinger *et al.* 6785, Alt. 3200 m, Dupl.: MPU [MPU380600], P [P02433695]
Identification: van Welzen 2016

Macaranga cf. ***polyadenia*** Pax & K.Hoffm.

Munzinger *et al.* 6848, Alt. 2200 m, Dupl.: LAE, MPU [MPU380592], P [P02433750]
Identification: van Welzen 2016

Macaranga quadriglandulosa Warb.

Munzinger *et al.* 7308, Alt. 700 m, Dupl.: MPU [MPU380598]
Identification: van Welzen 2016

Pimelodendron amboinicum Hassk.

Molino *et al.* 3118, Alt. 200 m, Dupl.: MPU [MPU380594]
Identification: Munzinger 2016

Munzinger *et al.* 6988, Alt. 700 m, Dupl.: BRC, LAE, MPU [MPU380593]
Identification: van Welzen 2016

FAGACEAE

Castanopsis cf. ***acuminatissima*** (Blume) A.DC.

Molino *et al.* 3079, Alt. 700 m, Dupl.: BRC, LAE, MPU [MPU380587]
Identification: van Balgooy 2016

GESNERIACEAE

Aeschynanthus cf. ***calanthus*** Schltr.

Figure 32

Molino *et al.* 2979, Alt. 1700 m, Dupl.: L, P [P02433600]
Identification: Munzinger 2018

Note: very similar to Woods 2784 [L.2821203] in L.

Aeschynanthus sp. 1

Munzinger *et al.* 6814, Alt. 200 m, Dupl.: P [P02433718]
Identification: Munzinger 2018

Agalmyla sp. 1

Figure 33

Molino *et al.* 3002, Alt. 1700 m, Dupl.: P [P02433612]
Identification: Munzinger 2017

Note: could not be identified using Hilliard and Burtt (2002) revision of the genus, thus might be a new species.

Cyrtandra sp. 1

Munzinger *et al.* 6856, Alt. 2200 m, Dupl.: MPU [MPU380582], P [P02433756]
Identification: Munzinger 2018

Cyrtandra sp. 2

Molino *et al.* 2989, Alt. 1700 m, Dupl.: P [P02433606]
Identification: Munzinger 2018

Cyrtandra sp. 3

Munzinger *et al.* 6901, Alt. 1700 m, Dupl.: P [P02433794]
Identification: Munzinger 2018

Cyrtandra sp. 4

Molino *et al.* 3025, Alt. 1200 m, Dupl.: P [P02433625]
Identification: Munzinger 2018

Note: aff. Munzinger 6901 but pubescence of the calyx, and shape of bracteoles different.

Cyrtandra sp. 5

Figure 34

Molino *et al.* 3055, Alt. 1210 m, Dupl.: L, MPU [MPU380583], P [P02433635]
Identification: Munzinger 2018

Molino *et al.* 3057, Alt. 1210 m, Dupl.: K [K000938977], L, MPU [MPU380581], P [P02433637]
Identification: Munzinger 2018

Cyrtandra sp. 6

Figure 35

Molino *et al.* 3009, Alt. 1700 m, Dupl.: P [P02433614]
Identification: Munzinger 2018

Munzinger *et al.* 6887, Alt. 1700 m, Dupl.: P [P02433784]
Identification: Munzinger 2018

HIMANTANDRACEAE

Galbulimima belgraveana (F.Muell.) Sprague

Molino *et al.* 2985, Alt. 1700 m, Dupl.: MPU [MPU380575, MPU380576]
Identification: Munzinger 2016

ICACINACEAE

Platea excelsa Blume

Molino *et al.* 2961, Alt. 2200 m, Dupl.: MPU [MPU380574]
Identification: Molino 2016

Munzinger *et al.* 7332, Alt. 1700 m, Dupl.: MPU [MPU380573]
Identification: Molino 2016

JUGLANDACEAE

Engelhardia rigida Blume

Molino *et al.* 3090B, Alt. 700 m, Dupl.: BRC, LAE, MPU [MPU380892]
Identification: Munzinger 2019

Munzinger *et al.* 6900, Alt. 1700 m, Dupl.: MPU [MPU380567], P [P02433793]
Identification: Munzinger 2016

Note: the specimen Molino *et al.* 3090B looks different from Munzinger *et al.* 6900, but as it is sterile and only *E. rigida* is known from Papua New Guinea (Jacobs 1960), we used that name.

LAMIACEAE

Vitex cofassus Reinw. ex Blume

Munzinger *et al.* 7035, Alt. 200 m, Dupl.: MPU [MPU380571]
Identification: Fazang & Molem 2012

LAURACEAE

Actinodaphne cf. ***ledermannii*** Teschner

Molino *et al.* 3165, Alt. 1200 m, Dupl.: MPU [MPU380801]
Identification: Molino 2016

Actinodaphne nitida Teschner

Munzinger *et al.* 7018, Alt. 200 m, Dupl.: MPU [MPU380813]
Identification: Molino 2016

Actinodaphne sp. 1

Molino *et al.* 3034, Alt. 1200 m, Dupl.: MPU [MPU380786]
Identification: Molino 2016

Beilschmiedia acutifolia Teschner

Molino *et al.* 3164, Alt. 1200 m, Dupl.: LAE, MPU [MPU380783]
Identification: Molino 2016

Cinnamomum grandiflorum Kosterm.

Munzinger *et al.* 7021, Alt. 200 m, Dupl.: MPU [MPU380812]
Identification: Molino 2016

Cryptocarya albida Kosterm.

Munzinger *et al.* 6885, Alt. 1700 m, Dupl.: MPU [MPU380800]
Identification: Molino 2016

Note: the specimen was sequenced (C. Gemmill pers. comm.) and ITS confirm its placement in the genus *Cryptocarya*, close to *C. laevigata*.

Cryptocarya apamifolia Gamble

Molino *et al.* 3163, Alt. 1200 m, Dupl.: MPU [MPU380802]
Identification: Molino 2016

Cryptocarya aff. ***apamifolia*** Gamble

Molino *et al.* 3033, Alt. 1200 m, Dupl.: MPU [MPU380808]
Identification: Molino 2016

Note: similar to Piskaut UPNG20392 in P [P00848774], id as *C. apamifolia*, but seems different from the type (domatia, leaves shiny), ITS confirm its placement in the genus *Cryptocarya*, close to *Cryptocarya* sp. 12.

Cryptocarya densiflora Blume

Munzinger *et al.* 6975, Alt. 700 m, Dupl.: L [L.3977125], MPU [MPU380810], NSW [NSW818322], P [P02433837], WAIK
Identification: Molino 2014

Note: the specimen was sequenced (C. Gemmill pers. comm.) and ITS confirm its placement in the genus *Cryptocarya*, related to *C. chinensis* Hemsl.

Cryptocarya hartleyi Kosterm.

Molino *et al.* 3161, Alt. 1200 m, Dupl.: MPU [MPU380815]
Identification: Molino 2016

Cryptocarya indenburgensis C.K.Allen

Molino *et al.* 2997, Alt. 1700 m, Dupl.: MPU [MPU380803]
Identification: Molino 2016

Cryptocarya laevigata Blume

Molino *et al.* 2999, Alt. 1700 m, Dupl.: MPU [MPU114970]
Identification: Molino 2012

Cryptocarya ledermannii Teschner

Munzinger *et al.* 6821, Alt. 2700 m, Dupl.: MPU [MPU380809]
Identification: Munzinger 2019

Note: the sterile specimen was sequenced (C. Gemmill pers. comm.) and ITS confirm place it in sister position of a clade including *C. albida* and *Cryptocarya* sp. 3.

Cryptocarya minutifolia C.K.Allen

Munzinger *et al.* 6793, Alt. 2700 m, Dupl.: MPU [MPU380811], P [P02433703]
Identification: Munzinger 2019

Cryptocarya cf. ***nothofagetorum*** Kosterm.

Molino *et al.* 3006, Alt. 1700 m, Dupl.: MPU [MPU380804]
Identification: Molino 2016

Note: similar to Takeuchi 10652 [P01952924], identified as *C. nothofagetorum*, but seems slightly different from the type.

Cryptocarya sp. 3

Molino *et al.* 2948, Alt. 2200 m, Dupl.: MPU [MPU380805]
Identification: Molino 2016

Note: nothing similar seen in L, but the sterile specimen, with remarkable caudate apex, was sequenced (C. Gemmill pers. comm.) and ITS confirm its placement in the genus *Cryptocarya,* close to *C. albida*.

Cryptocarya sp. 12

Munzinger *et al.* 6842, Alt. 2200 m, Dupl.:L [L.3977122], MO, MPU [MPU380798], P [P02433744], WAIK
Identification: Munzinger 2018

Note: identical to Pullen 8305, the sterile specimen was sequenced (C. Gemmill pers. comm.) and ITS confirm its placement in the genus *Cryptocarya*, in sister position of *Cryptocarya* aff. *apamifolia* [Molino *et al.* 3033].

Endiandra carrii Kosterm.

Munzinger *et al.* 6943, Alt. 1200 m, Dupl.: MPU [MPU380806]
Identification: Munzinger 2018

Note: the sterile specimen was sequenced (C. Gemmill pers. comm.) and ITS confirm its placement in the genus *Endiandra*, close to *E. euadenia*.

Endiandra engleriana Teschner

Molino *et al.* 3030, Alt. 1200 m, Dupl.: MPU [MPU380784]
Identification: Molino 2016

Note: the sterile specimen was sequenced (C. Gemmill pers. comm.) and ITS placed it close to *E. impressicosta* C.K.Allen.

FIGURES 33-39

33, Gesneriaceae, *Agalmyla* sp., Molino *et al.* 3002, flower; **34**, *Cyrtandra* sp. 5, Molino *et al.* 3057, flowers; **35**, *Cyrtandra* sp. 6, Molino *et al.* 3009, flowers; **36**, Lauraceae, *Litsea exudens*, Munzinger *et al.* 6748, fruits; **37**, Lecythidaceae, *Barringtonia calyptrocalyx*, Munzinger *et al.* 7025, fruits; **38**, Leguminosae, *Mucuna novoguineensis*, Molino *et al.* 3135, flowers; **39**, Melastomataceae, *Medinilla brassii*, Molino *et al.* 3015, flowers. 33, 36-37 © J. Munzinger/IRD. 34-35, 38-39 © J.-F. Molino/IRD.


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Endiandra euadenia Kosterm.

Munzinger *et al.* 6985, Alt. 700 m, Dupl.: MPU [MPU380785]
Identification: Molino 2016

Note: the sterile specimen was sequenced (C. Gemmill pers. comm.) and ITS placed it close to *E. carrrii*.

Endiandra forbesii Gamble

Munzinger *et al.* 6914, Alt. 1200 m, Dupl.: L, MPU [MPU380807], P [P02433804], WAIK
Identification: Munzinger 2018

Note: identical to the types in L, K and P, and ITS sequences (C. Gemmill pers. comm.) placed it close to *E. glauca* R.Br. from Australia.

Endiandra sp. 2

Molino *et al.* 3162, Alt. 1200 m, Dupl.: MPU [MPU380799]
Identification: Molino 2016

Note: this is not *E. forbesii*.

Litsea exsudens Kosterm.

Figure 36

Molino *et al.* 2911, Alt. 3200 m, Dupl.: MPU [MPU380795]
Identification: Munzinger 2016

Molino *et al.* 2932, Alt. 2700 m, Dupl.: MPU [MPU380794]
Identification: Munzinger 2016

Munzinger *et al.* 6748, Alt. 2800 m, Dupl.: MPU [MPU380796], Pc
Identification: Molino 2014

Munzinger *et al.* 6890, Alt. 1700 m, Dupl.: L, MO, MPU [MPU380793], P [P02433787]
Identification: Munzinger 2016

Note: the material Munzinger *et al.* 6748 is a 4.5 m high sapling, unexpectedly fruiting.

Litsea kauloensis Teschner

Molino *et al.* 3124, Alt. 200 m, Dupl.: MPU [MPU380791]
Identification: Munzinger 2018

Molino *et al.* 3149, Alt. 200 m, Dupl.: L, MPU [MPU380792], P [P02433660]
Identification: Munzinger 2018

Munzinger *et al.* 6989, Alt. 700 m, Dupl.: MPU [MPU380817]
Identification: Munzinger 2018

Munzinger *et al.* 7020, Alt. 200 m, Dupl.: MPU [MPU380789]
Identification: Munzinger & Bau 2018

Munzinger *et al.* 7051, Alt. 200 m, Dupl.: MPU [MPU380790]
Identification: Munzinger 2018

Note: synonym of *L. timoriana* fide Kostermans in herb. L, but we believe this is a distinct species.

Litsea ledermannii Teschner

Munzinger *et al.* 7005, Alt. 700 m, Dupl.: MPU [MPU380787]
Identification: Molino 2016

Litsea sp. 4

Molino *et al.* 3076, Alt. 700 m, Dupl.: MPU [MPU380816]
Identification: Molino 2016

Note: nothing similar seen in L.

Litsea sp. 5

Munzinger *et al.* 6980, Alt. 700 m, Dupl.: P [P02433840]
Identification: Munzinger 2016

Note: very different from type of *L. collina*.

Litsea sp. 6

Munzinger *et al.* 6909, Alt. 1200 m, Dupl.: L, MPU [MPU380797], P [P02433800], WAIK
Identification: Munzinger 2018

Note: very different from type of *L. collina*.

Litsea tomentosa Blume

Munzinger *et al.* 6974, Alt. 700 m, Dupl.: L, MPU [MPU380788], P [P02433836]
Identification: Munzinger 2018

Note: our material is identical to the type of *L. grandifolia* Teschner (nom. illeg. hom., non Lecomte).

LECYTHIDACEAE

Barringtonia calyptrocalyx K.Schum

Figure 37

Molino *et al.* 3130, Alt. 200 m, Dupl.: MPU [MPU380781, MPU380782]
Identification: Fazang & Molem 2012

Munzinger *et al.* 7044, Alt. 200 m, Dupl.: MPU [MPU380780]
Identification: Munzinger 2018

Munzinger *et al.* 7025, Alt. 200 m, Dupl.: P [P02433858]
Identification: Munzinger 2019

Note: using the revision of the genus by Prance (2012).

LEGUMINOSAE

Archidendron sp. 1

Munzinger *et al.* 6957, Alt. 1200 m, Dupl.: P [P02433825]
Identification: Munzinger 2019

Note: the specimen was sequenced (S. Buerki, pers. comm.) and blasted as *Cojoba arborea* Britton & Rose, probably the closest relative in the database, as the genus *Archidendron* is missing in Genbank.

Intsia palembanica Miq.

Molino *et al.* 3119, Alt. 200 m, Dupl.: MPU [MPU380776]
Identification: Munzinger 2016

Mucuna novoguineensis Scheff.

Figure 38

Molino *et al.* 3135, Alt. 200 m, Dupl.: MPU [MPU380779], P [P02433655]
Identification: Damas 2019

Pterocarpus indicus Willd

Molino *et al.* 3113, Alt. 200 m, Dupl.: MPU [MPU380778]
Identification: Fazang & Molem 2012

Molino *et al.* 3139, Alt. 200 m, Dupl.: BRC, LAE, MPU [MPU380777]
Identification: Molino 2012

LOGANIACEAE

Geniostoma dasyneurum Gilg & Gilg-Ben.

Molino *et al.* 3020, Alt. 1200 m, Dupl.: P [P02433622]
Identification: Munzinger 2018

Note: synonym of *G. rupestre* J.R.Forst. & G.Forst. fide Conn (1980).

Neuburgia corynocarpa (A.Gray) Leenh.

Munzinger *et al.* 6932, Alt. 1200 m, Dupl.: MPU [MPU380775]
Identification: Munzinger 2016

MAGNOLIACEAE

Magnolia tsiampacca (L.) Figlar & Noot.

Munzinger *et al.* 7324, Alt. 700 m, Dupl.: MPU [MPU380772]
Identification: Munzinger 2016

Magnolia tsiampacca (L.) Figlar & Noot. var. ***tsiampacca***

Molino *et al.* 3099, Alt. 700 m, Dupl.: L, MPU [MPU380773], P [P02433645]
Identification: Munzinger 2016

MALVACEAE

Microcos bifida Burret

Molino *et al.* 3062, Alt. 1223 m, Dupl.: K, L, MPU [MPU380770], P [P02433641]
Identification: Munzinger 2018

Microcos tetrasperma Merr. & L.M.Perry

Molino *et al.* 3031, Alt. 1200 m, Dupl.: G, K [K001045854], L, LAE, MPU [MPU380771], P [P02433630]
Identification: Fazang & Molem 2012

Sterculia cf. ***schlechteri*** Mildbr.

Molino *et al.* 2984, Alt. 1700 m, Dupl.: MPU [MPU380765]
Identification: Munzinger 2018

Note: similar to Craven & Schodde 1388 [L.2374999] in L.

Sterculia tantraensis Morat

Molino *et al.* 3094, Alt. 700 m, Dupl.: MPU [MPU380767, MPU380768]
Identification: Munzinger 2018

Molino *et al.* 3112, Alt. 700 m, Dupl.: MPU [MPU380766]
Identification: Munzinger 2018

Molino *et al.* 3117, Alt. 200 m, Dupl.: MPU [MPU380764]
Identification: Munzinger 2018

Note: a new name given by Morat (1986) for *Pterocymbium schumannianum* Lauterb., non *Sterculia schumanniana* (Schltr.) Guillaumin.

MELASTOMATACEAE

Astronidium cuneatum J.F.Maxwell

Molino *et al.* 2954, Alt. 2200 m, Dupl.: MPU [MPU380757]
Identification: Munzinger 2016

Molino *et al.* 2968, Alt. 2200 m, Dupl.: MPU [MPU380763]
Identification: Munzinger 2016

Molino *et al.* 3000, Alt. 1700 m, Dupl.: LAE, MPU [MPU380758]
Identification: Munzinger 2016

Astronidium morobiense J.F.Maxwell

Munzinger *et al.* 7318, Alt. 1200 m, Dupl.: LAE, MPU [MPU380759]
Identification: Munzinger 2016

Medinilla brassii Markgr

Figure 39

Molino *et al.* 3015, Alt. 1200 m, Dupl.: MPU [MPU380760], P [P02433619]
Identification: Munzinger 2018

Medinilla cf. ***minutifolia*** Bodegom

Figure 40

Munzinger *et al.* 6844, Alt. 2200 m, Dupl.: MPU [MPU380761], P [P02433746]
Identification: Munzinger 2018

Medinilla setiflora Bodegom

Munzinger *et al.* 6847, Alt. 2200 m, Dupl.: P [P02433749]
Identification: Munzinger 2018

Medinilla cf. ***versteegii*** Mansf.

Molino *et al.* 2992, Alt. 1700 m, Dupl.: MPU [MPU380762], P [P02433609]
Identification: Munzinger 2018

Memecylon cf. ***hepaticum*** Blume

Munzinger *et al.* 6913, Alt. 1200 m, Dupl.: MPU [MPU380903], P [P02433803]
Identification: Damas 2019

Note: matches the material identified by Takeuchi (1999) as *Memecylon 'hepaticum'* sensu Mansf. but this name is considered as a synonym of *Memecylon lilacinum* Zoll. & Mor. a species distributed from Java to Thailand. A taxonomic revision is needed here.

Poikilogyne callantha (Mansf.) Nayar

Molino *et al.* 2983, Alt. 1700 m, Dupl.: P [P02433604]
Identification: Munzinger 2018

MELIACEAE

Aglaia cf. ***rimosa*** (Blanco) Merr.

Molino *et al.* 3140, Alt. 200 m, Dupl.: MPU [MPU380867]
Identification: Munzinger & Molino 2015

Molino *et al.* 3145, Alt. 200 m, Dupl.: MPU [MPU380865]
Identification: Munzinger & Molino 2015

Note: vel *A. costata* Merr. In *A. rimosa*, the fruit opens in 2 parts

Aglaia silvestris (M.Roem.) Merr.

Molino *et al.* 3148, Alt. 200 m, Dupl.: MPU [MPU380863]
Identification: Munzinger 2016

Note: similar to Vink 11362 in L.

Aglaia sp. 1

Molino *et al.* 2964, Alt. 2200 m, Dupl.: MPU [MPU380864]
Identification: Munzinger 2016

Note: cf. *A. eximia* (could match with the description of that species); *A. argentea* (but leaves acuminate); *A. squamulosa* (but does not seem rugose).

Aglaia sp. 3

Molino *et al.* 3105, Alt. 700 m, Dupl.: MPU [MPU380866]
Identification: Munzinger & Molino 2016

Note: nothing similar seen in L.

Aglaia sp. 4

Figure 41

Molino *et al.* 3137, Alt. 200 m, Dupl.: K, MPU [MPU380870, MPU380871], P [P02433657]
Identification: Molino 2015

Aglaia sp. 5

Munzinger *et al.* 7342, Alt. 1200 m, Dupl.: LAE, MPU [MPU202899, MPU380893]
Identification: Munzinger 2016

Note: «sp.nov. R» fide Pannell [Clemens 8550 in L]

Aglaia sp. 6

Munzinger *et al.* 7011, Alt. 700 m, Dupl.: P [P02275641, P02433854]
Identification: Munzinger 2016

Aglaia tomentosa Teijsm. & Binn.

Molino *et al.* 3100, Alt. 700 m, Dupl.: MPU [MPU380868, MPU380869], P [P02433646]
Identification: Munzinger 2016

Aphanamixis polystachya (Wall.) R.Parker

Molino *et al.* 3104, Alt. 700 m, Dupl.: MPU [MPU380874, MPU380876]
Identification: Munzinger 2016

Molino *et al.* 3146, Alt. 200 m, Dupl.: MPU [MPU380873, MPU380875]
Identification: Munzinger 2016

Chisocheton sp. 1

Figure 42

Molino *et al.* 3049, Alt. 1200 m.
Identification: Molino 2012

Note: the specimen is lost, only field photographs remain.

Chisocheton ceramicus Miq.

Molino *et al.* 3093, Alt. 700 m, Dupl.: MPU [MPU380877]
Identification: Munzinger 2016

Munzinger *et al.* 7057, Alt. 200 m, Dupl.: BRC, LAE, MPU [MPU380878, MPU380879]
Identification: Munzinger 2016

Chisocheton lasiocarpus (Miq.) Valeton

Munzinger *et al.* 7052, Alt. 200 m, Dupl.: LAE, MPU [MPU380894]
Identification: Munzinger 2016

Chisocheton lasiocarpus (Miq.) Valeton entity «pachyrhachis»

Munzinger *et al.* 7341, Alt. 700 m, Dupl.: MPU [MPU380872]
Identification: Munzinger 2019

Munzinger *et al.* 6973, Alt. 700 m, Dupl.: MPU [MPU114972], P [P02433835]
Identification: Munzinger 2019

Note: entity «pachyrhachis» of Mabberley *et al.* (1995), see [L.2147354] in L.

Chisocheton longistipitatus (F.M.Bailey) L.S.Sm.

Munzinger *et al.* 7338, Alt. 200 m, Dupl.: MPU [MPU380897]
Identification: Munzinger 2016

Note: similar to Mangold 2218 in L [L.2151678].

Chisocheton sp. 2

Munzinger *et al.* 7339, Alt. 1200 m, Dupl.: LAE, MPU [MPU380862]
Identification: Munzinger & Molino 2016

Note: nothing similar seen in L.

Chisocheton sp. 4

Munzinger *et al.* 7030, Alt. 200 m, Dupl.: MPU [MPU380880]
Identification: Munzinger & Molino 2015

Note: nothing similar seen in L.

Chisocheton sp. 5, n. sp.

Molino *et al.* 3141, Alt. 200 m, Dupl.: LAE, MPU [MPU380895]
Identification: Munzinger 2016

Note: probably a new species, the material is identical to Davis 618 [L0498205] & Streimann 51809 [L.2152989, det as *Chisocheton* by Mabberley 1993, in herb.].

Chisocheton sp. 6

Molino *et al.* 3037, Alt. 1223 m, Dupl.: P [P01044677]
Identification: Molino 2012

Note: using the key of Mabberley *et al.* (1995) shoud be *C. sayeri* (C.DC.) P.F. Stevens, but calyx is not reddish brown, nor obscurely lobed.

Chisocheton sp. 7

Figure 43

Munzinger *et al.* 6952, Alt. 1200 m, Dupl.: P [P02433820]
Identification: Munzinger 2016

Munzinger *et al.* 6955, Alt. 1200 m, Dupl.: P [P02433823]
Identification: Munzinger 2016

Note: Munzinger et al. 6952 and 6955 were sequenced (S. Buerki, pers. comm.) and both blasted as *Chisocheton macrophyllus* King, probably the closest species in Genebank.

Dysoxylum annae Mabb.

Molino *et al.* 3123, Alt. 200 m, Dupl.: MPU [MPU380890]
Identification: Munzinger 2016

Molino *et al.* 3132, Alt. 200 m, Dupl.: MPU [MPU380884]
Identification: Munzinger 2016

Note: both specimens similar to Iwanggin 5740 in L [L 0723326].

Dysoxylum brassii Merr. & L.M.Perry

Molino *et al.* 3073, Alt. 700 m, Dupl.: BRC, LAE, MPU [MPU380896]
Identification: Munzinger 2016

Molino *et al.* 3144, Alt. 200 m, Dupl.: P [P02433659]
Identification: Munzinger 2016

Munzinger *et al.* 7048, Alt. 200 m, Dupl.: MPU [MPU380898]
Identification: Munzinger 2016

Note: similar to Katik 46689 [L.2147829] in L.

FIGURES 40-47

40, Melastomataceae, *Medinilla* cf. *minutifolia*, Munzinger *et al.* 6844, flower; **41**, Meliaceae, *Aglaia* sp. 4, Molino *et al.* 3137, fruits; **42**, *Chisocheton* sp., Molino *et al.* 3049, fruit; **43**, *Chisocheton* sp. 7, Munzinger *et al.* 6952, fruit; **44**, Monimiaceae, *Dryadodaphne novoguineensis*, Molino *et al.* 3038, flower; **45**, *Kairoa* sp. 1, Munzinger *et al.* 6968, fruits; **46**, *Palmeria scandens*, Munzinger *et al.* 6835, fruits; **47**, *Steganthera ilicifolia*, Munzinger *et al.* 6772, fruit. 40, 42-43, 45-47 © J. Munzinger/IRD. 41, 44 © J-F. Molino/IRD.


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Dysoxylum brevipaniculum C.DC.

Molino *et al.* 3102, Alt. 700 m, Dupl.: MPU [MPU380883]
Identification: Munzinger 2016

Munzinger *et al.* 7042, Alt. 200 m, Dupl.: MPU [MPU380882], P [P02433870]
Identification: Munzinger 2016

Note: Munzinger *et al.* 7042 similar to Brass 32595 [L.2147822] in L, while Molino *et al.* 3102 is identical to Munzinger *et al.* 7042.

Dysoxylum excelsum Blume

Munzinger *et al.* 7050, Alt. 200 m, Dupl.: MPU [MPU380889]
Identification: Munzinger 2016

Dysoxylum longipetalum C.DC.

Molino *et al.* 3143, Alt. 200 m, Dupl.: MPU [MPU380887]
Identification: Munzinger 2016

Note: = *D. parasiticum* (Osbeck) Kosterm.

Dysoxylum papuanum Mabb.

Molino et al. 3115, Alt. 200 m, Dupl.: MPU [MPU380881]
Identification: Munzinger 2016

Dysoxylum sp. 4

Molino *et al.* 3018, Alt. 1200 m, Dupl.: K, MPU [MPU380888, MPU380891], P [P02433620]
Identification: Munzinger & Molino 2015

Note: nothing similar seen in L.

Dysoxylum sp. 6

Molino *et al.* 3095, Alt. 700 m, Dupl.: MPU [MPU380886]
Identification: Munzinger & Molino 2015

Note: nothing similar seen in L.

Dysoxylum sp. 7

Munzinger *et al.* 7045, Alt. 200 m, Dupl.: BRC, LAE, MPU [MPU380885]
Identification: Munzinger & Molino 2015

Note: nothing similar seen in L.

MENISPERMACEAE

Strychnos minor Dennst.

Molino *et al.* 3087, Alt. 700 m, Dupl.: P [P01066634]
Identification: Munzinger 2018

Molino *et al.* 3128, Alt. 200 m, Dupl.: K, L [L.3977127], MPU [MPU380774], P [P02433651]
Identification: van Balgooy 2014

Munzinger *et al.* 7041, Alt. 200 m, Dupl.: MPU [MPU380937], P [P02433869]
Identification: Munzinger 2018

Note: sensu Leenhouts in herb. L.

MONIMIACEAE

Dryadodaphne crassa Schodde ex Philipson

Munzinger *et al.* 6802, Alt. 2700 m, Dupl.: MPU [MPU380934]
Identification: Munzinger 2016

Dryadodaphne novoguineensis (Perkins) A.C.Sm.

Figure 44

Molino *et al.* 3038, Alt. 1223 m, Dupl.: MPU [MPU380836]
Identification: Utteridge 2019

Note: using the key of Philipson (1986).

Kairoa sp. 1

Figure 45

Munzinger *et al.* 6968, Alt. 1200 m, Dupl.: P [P02433889]
Identification: Munzinger 2018

Note: sequence identical to *K. endressiana* (S. Renner, pers. comm.), but indument is hirsute (not lanuginose), leaves are < 7 cm long (vs. 9.5–34.5 cm), and leaf base is attenuate (not cordate). It might thus be a distinct species, not treated in Renner & Takeushi (2009).

Kairoa aff. ***suberosa*** Philipson

Molino *et al.* 3001, Alt. 1700 m, Dupl.: MPU [MPU380929, MPU380930]
Identification: Munzinger 2018

Molino *et al.* 3026, Alt. 1200 m, Dupl.: K, L, MPU [MPU380932], P [P02433626]
Identification: Munzinger 2018

Note: sequences are 99% identical *to Kairoa endressiana* (S. Renner, pers. comm.), but that species has deeply impressed venation on leaf upper side, whereas that of our sample is prominulous, as it is the case for *K. suberosa* according to the key in Renner & Takeushi (2009). In addition, *K. suberosa* is described as a 0.5 to 5.0 m high shrub while our specimen comes from a 25.7 cm DBH tree. Therefore, these collections, as well as Henty NGF14319 in L [L.1774024], might represent a taxa not treated in Renner & Takeushi (2009).

Palmeria clemensae Philipson

Molino *et al.* 3063, Alt. 1223 m, Dupl.: L [L.4313266], MPU [MPU380935], P [P02433642]
Identification: Munzinger 2018

Note: has the close felt of minute stellate hairs on the undersurface of the leaves, combined with long soft bristly hairs along the veins described by Philipson (1982).

Palmeria scandens F.Muell.

Figure 46

Munzinger *et al.* 6835, Alt. 2200 m, Dupl.: P [P02433737]
Identification: Munzinger 2018

Note: sequence identical to *P. scandens* (S. Renner, pers. comm.).

Steganthera chimbuensis Philipson

Munzinger *et al.* 6810, Alt. 2700 m, Dupl.: MPU [MPU380933], P [P02433714]
Identification: Munzinger 2018

Note: using Philipson (1984) key, and identical to Brass 30459 [L.1786214]

Steganthera hirsuta Perkins

Molino *et al.* 2986, Alt. 1700 m, Dupl.: MPU [MPU380931]
Identification: Munzinger 2016

Note: identical to Streimann 8328 [L.1786170] in L.

Steganthera ilicifolia A.C.Sm.

Figure 47

Munzinger *et al.* 6772, Alt. 3200 m, Dupl.: MPU [MPU380936]
Identification: Munzinger 2018

Note: similar to Kairo 407 [L1786874] in L; sequences are 99% identical to *Steganthera hirsuta* (S. Renner, pers. comm.) but plant different from Molino 2986.

MORACEAE

Artocarpus camansi Blanco

Molino *et al.* 3108, Alt. 700 m, Dupl.: MPU [MPU028252]
Identification: Weiblen 2016

Artocarpus communis J.R.Forst. & G.Forst.

Munzinger *et al.* 7024, Alt. 200 m, Dupl.: BRC, LAE
Identification: Fazang & Molem 2012

Note: the collection is considered lost.

Artocarpus lacucha Buch.-Ham.

Molino *et al.* 3114, Alt. 200 m, Dupl.: MPU [MPU028253]
Identification: Weiblen 2016

Molino *et al.* 3175, Alt. 1700 m, Dupl.: MPU [MPU028259]
Identification: Weiblen 2016

Ficus arfakensis King

Molino *et al.* 3050, Alt. 1200 m, Dupl.: MPU [MPU028274]
Identification: Weiblen 2016

Ficus bernaysii King

Molino *et al.* 3177, Alt. 700 m, Dupl.: MPU [MPU028261]
Identification: Weiblen 2016

Ficus endochaete Summerh.

Munzinger *et al.* 6845, Alt. 2200 m, Dupl.: MPU [MPU028272], P [P02433747]
Identification: Weiblen 2016

Ficus hispidioides S.Moore

Figure 48

Molino *et al.* 3154, Alt. 200 m, Dupl.: LAE, MPU [MPU028268]
Identification: Weiblen 2016

Ficus hombroniana Corner

Molino *et al.* 3027, Alt. 1200 m, Dupl.: K, L, MPU [MPU028251], P [P02433627]
Identification: Weiblen 2016

Ficus microdictya Diels

Molino *et al.* 2967, Alt. 2200 m, Dupl.: MPU [MPU028256]
Identification: Weiblen 2016

Molino *et al.* 3174, Alt. 1700 m, Dupl.: MPU [MPU028258]
Identification: Weiblen 2016

Munzinger *et al.* 6826, Alt. 2200 m, Dupl.: MPU [MPU028266], NSW [NSW818306], P [P02433729]
Identification: Weiblen 2016

Munzinger *et al.* 6881, Alt. 1700 m, Dupl.: L, MO, MPU [MPU028257], NSW [NSW818316], P [P02433780]
Identification: Weiblen 2016

Ficus mollior F.Muell. ex Benth.

Molino *et al.* 3173, Alt. 1200 m, Dupl.: MPU [MPU028255]
Identification: Weiblen 2016

Ficus pachyrrhachis K.Schum. & Lauterb.

Molino *et al.* 3179, Alt. 1200 m, Dupl.: MPU [MPU028263]
Identification: Weiblen 2016

Ficus pilulifera Corner

Munzinger *et al.* 6967, Alt. 1200 m, Dupl.: MPU [MPU028265], P [P02433830]
Identification: Weiblen 2016

Ficus pungens Reinw. ex Bl.

Figure 49

Molino *et al.* 3152, Alt. 200 m, Dupl.: LAE, MPU [MPU028264]
Identification: Weiblen 2016

Ficus quercetorum Corner

Munzinger *et al.* 6891, Alt. 1700 m, Dupl.: MPU [MPU028275], P [P02433788]
Identification: Weiblen 2016

Ficus robusta Corner

Molino *et al.* 3070, Alt. 700 m, Dupl.: LAE, MPU [MPU028270]
Identification: Weiblen 2016

Ficus rubrivestimenta Weiblen & Whitfeld

Figure 50

Molino *et al.* 3075, Alt. 700 m, Dupl.: LAE, MIN, MPU [MPU028254], P [P01455313]
Identification: Weiblen 2016

Ficus sp. 5, n. sp.

Figure 51

Munzinger *et al.* 6897, Alt. 1700 m, Dupl.: LAE, MPU [MPU028267]
Identification: Weiblen 2016

Note: this species, remarkable by its green prickly fruit is undescribed (G. Weiblen in prep.)

Ficus trichocerasa Diels

Molino *et al.* 3176, Alt. 1700 m, Dupl.: MPU [MPU028260]
Identification: Weiblen 2016

Ficus wassa Roxb.

Molino *et al.* 2960, Alt. 2200 m, Dupl.: MPU [MPU028269]
Identification: Weiblen 2016

Molino *et al.* 3134, Alt. 200 m, Dupl.: K, L, MPU [MPU028273], P [P02433654]
Identification: Weiblen 2016

Molino *et al.* 3178, Alt. 200 m, Dupl.: MPU [MPU028262]
Identification: Weiblen 2016

Ficus xylosycia Diels

Figure 52

Molino *et al.* 3014, Alt. 1200 m, Dupl.: L [L.4329654], MPU [MPU028271], P [P02433618]
Identification: Weiblen 2016

Prainea papuana Becc.

Molino *et al.* 3120, Alt. 200 m, Dupl.: MPU [MPU028276]
Identification: Weiblen 2016

Streblus glaber (Merr.) Corner subsp. ***urophyllus*** (Diels) C.C.Berg

Figure 53

Molino *et al.* 2910, Alt. 3200 m, Dupl.: K, L [L.4329653], MPU [MPU028279], P [P02433573]
Identification: Weiblen 2016

Molino *et al.* 2945, Alt. 2700 m, Dupl.: B, CANB, L [L.4329651], LAE, MO, MPU [MPU026676], P [P02433587]
Identification: Weiblen 2016

Molino *et al.* 2965, Alt. 2200 m, Dupl.: L [L.4329652], MPU [MPU028278], P [P02433592]
Identification: Weiblen 2016

Munzinger 7312, Alt. 2700 m, Dupl.: MPU [MPU380928]
Identification: Munzinger 2018

Munzinger *et al.* 6773, Alt. 3200 m, Dupl.: MPU [MPU028277], NSW [NSW818295], P [P02433684]
Identification: Weiblen 2016

FIGURES 48-55

48, Moraceae, *Ficus hispidioides*, Molino *et al.* 3154, fruits; **49**, *Ficus pungens*, Molino *et al.* 3152, fruits; **50**, *Ficus rubrivestimenta*, Molino *et al.* 3075, fruits; **51**, *Ficus* n. sp., Munzinger *et al.* 6897, fruit; **52**, *Ficus xylosycia*, Molino *et al.* 3014, fruit; **53**, *Streblus glaber* subsp. *urophyllus*, Molino *et al.* 2910, flowers; **54**, Myristicaceae, *Myristica subalulata* var. *subalulata*, Molino *et al.* 3072, flowers; **55**, Myrtaceae, *Decaspermum alpinum*, Molino *et al.* 2918, flower. 48-50, 52-55 © J-F. Molino/IRD. 51 © J. Munzinger/IRD.


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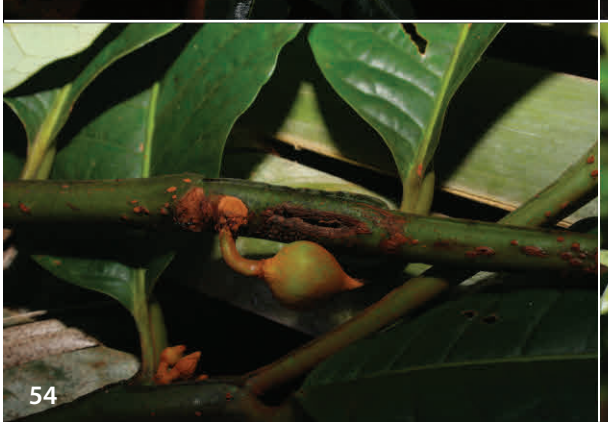

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MYRISTICACEAE

Gymnacranthera farquhariana (Wall. ex Hook.f. & Thomson) Warb. var. ***zippeliana*** (Miq.) R.T.A.Schouten

Munzinger *et al.* 6982, Alt. 700 m, Dupl.: MPU [MPU380542]
Identification: Munzinger 2016

Munzinger *et al.* 7017, Alt. 200 m, Dupl.: MPU [MPU380543]
Identification: Munzinger 2016

Munzinger *et al.* 7043, Alt. 200 m, Dupl.: BRC, LAE, MPU [MPU380541]
Identification: de Wilde & Duyfjes 2016

Horsfieldia basifissa W.J.de Wilde

Molino *et al.* 3082, Alt. 700 m, Dupl.: MPU [MPU310603]
Identification: Fazang & Molem 2012

Horsfieldia pulverulenta Warb.

Molino *et al.* 3125, Alt. 200 m, Dupl.: K, L [L.3978024], MPU [MPU380538, MPU380540], P [P02433649]
Identification: de Wilde & Duyfjes 2016

Horsfieldia sp. 1

Munzinger *et al.* 7014, Alt. 200 m, Dupl.: MPU [MPU380530]
Identification: Munzinger 2014

Munzinger *et al.* 7022, Alt. 200 m, Dupl.: MPU [MPU380531]
Identification: Munzinger 2014

Munzinger *et al.* 7026, Alt. 200 m, Dupl.: MPU [MPU380532, MPU380533], P [P02275640, P02433859]
Identification: Molino & Munzinger 2016

Munzinger *et al.* 7040, Alt. 200 m, Dupl.: MPU [MPU380534], P [P02433868]
Identification: Molino & Munzinger 2016

Horsfieldia sp. 2

Munzinger *et al.* 7327, Alt. 200 m, Dupl.: MPU [MPU380502]
Identification: Munzinger 2014

Horsfieldia sp. 3

Munzinger *et al.* 7058, Alt. 200 m, Dupl.: MPU [MPU380537]
Identification: Molino 2016

Myristica crassipes Warb.

Molino *et al.* 2996, Alt. 1700 m, Dupl.: MPU [MPU380524]
Identification: de Wilde & Duyfjes 2016

Munzinger *et al.* 6876, Alt. 1700 m, Dupl.: MPU [MPU380528], P [P02275634, P02433775]
Identification: de Wilde & Duyfjes 2016

Myristica fatua Houtt.

Molino *et al.* 3048, Alt. 1200 m, Dupl.: BRC, LAE
Identification: Fazang & Molem 2012

Note: the collection is considered lost.

Myristica pachyphylla A.C.Sm.

Munzinger *et al.* 6898, Alt. 1700 m, Dupl.: BRC, LAE, MPU [MPU380525]
Identification: de Wilde & Duyfjes 2016

Myristica sp. 1

Munzinger *et al.* 7328, Alt. 1200 m, Dupl.: MPU [MPU380507]
Identification: Munzinger 2014

Myristica sp. 2

Munzinger *et al.* 7306, Alt. 200 m, Dupl.: MPU [MPU380508]
Identification: Munzinger 2014

Myristica sp. 3

Molino *et al.* 3092, Alt. 700 m, Dupl.: MPU [MPU380512], P [P02433643]
Identification: Munzinger 2014

Myristica sp. 4

Molino *et al.* 3122, Alt. 200 m, Dupl.: MPU [MPU380529]
Identification: Munzinger 2014

Myristica sp. 6

Molino *et al.* 3077, Alt. 700 m, Dupl.: BRC, LAE, MPU [MPU380527]
Identification: Munzinger 2014

Myristica sp. 7

Munzinger *et al.* 7019, Alt. 200 m, Dupl.: LAE, MPU [MPU380526]
Identification: Munzinger 2015

Myristica sp. 9

Munzinger *et al.* 7023, Alt. 200 m, Dupl.: MPU [MPU380501]
Identification: Molino & Munzinger 2016

Myristica subalulata Miq. var. ***subalulata***

Figure 54

Molino *et al.* 3042, Alt. 1200 m, Dupl.: BRC, LAE
Identification: Molino 2015

Molino *et al.* 3072, Alt. 700 m, Dupl.: LAE, MPU [MPU380503]
Identification: de Wilde & Duyfjes 2016

Note: Molino et al. 3042, considered lost, is identified as this because noted in the field as identical to Molino *et al.* 3072.

MYRTACEAE

Decaspermum alpinum P.Royen

Figure 55

Molino *et al.* 2918, Alt. 3200 m, Dupl.: G, K, MPU [MPU380926], P [P02433580]
Identification: Munzinger 2016

Decaspermum forbesii Baker f.

Molino *et al.* 3166, Alt. 3200 m, Dupl.: MPU [MPU380927]
Identification: Molino 2016

Note: following A.J. Scott's (1985) key of *Decaspermum* in New Guinea.

Metrosideros cordata (C.T.White & W.D.Francis) J.W.Dawson

Munzinger *et al.* 6837, Alt. 2200 m, Dupl.: MPU [MPU380908], NSW [NSW818308], P [P02433739]
Identification: Munzinger 2016

Metrosideros sp. 1

Munzinger *et al.* 6843, Alt. 2200 m, Dupl.: CANB, MPU [MPU380907, MPU380909], NSW [NSW818310], P [P02433745]
Identification: Munzinger 2019

Note: dry fruit, cannot be a *Syzygium*.

Syzygium adelphicum Diels

Figure 56

Molino *et al.* 2930, Alt. 2700 m, Dupl.: MPU [MPU380925]
Identification: Byng 2016

Syzygium aqueum (Burm.f.) Alston

Molino *et al.* 3043, Alt. 1200 m, Dupl.: BRC, LAE
Identification: Fazang & Molem 2012

Note: the collection is considered lost.

Syzygium cf. ***hylochare*** (Diels) Merr. & L.M.Perry

Figure 59

Molino *et al.* 3059, Alt. 1200 m, Dupl.: K, MPU [MPU380905]
Identification: Munzinger & Morel 2019

Note: very similar to the type in P.

Syzygium homichlophilum Diels

Molino *et al.* 2963, Alt. 2200 m, Dupl.: MPU [MPU380924]
Identification: Fazang & Molem 2012

FIGURES 56-62

56, Myrtaceae, *Syzygium adelphicum*, Molino *et al.* 2930, fruits; **57**, *Syzygium longipes*, Molino *et al.* 3071, buds; **58**, *Syzygium* sp. 9, Molino *et al.* 3133, flowers; **59**, *Syzygium* cf. *hylochare*, Molino *et al.* 3059, fruits; **60-61**, Nepenthaceae, *Nepenthes maxima*, Molino *et al.* 3036, flowers; **62**, Ochnaceae, *Schuurmansia elegans*, Molino *et al.* 2916, fruits. 56-58, 60-62 © J-F. Molino/IRD. 59 © J. Munzinger/IRD.


56


57


58


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60


61


62

Syzygium longipes Merr. & L.M.Perry

Figure 57

Molino *et al.* 3071, Alt. 700 m, Dupl.: BRC, G, K, L, LAE, MO, MPU [MPU380900]
Identification: Byng 2016

Syzygium madangense T.G.Hartley & L.M.Perry

Molino *et al.* 3172, Alt. 700 m, Dupl.: BRC, MPU [MPU380913]
Identification: Byng 2016

Syzygium sogerense (Greves) Merr. & L.M.Perry

Molino *et al.* 3170, Alt. 1200 m, Dupl.: MPU [MPU380911]
Identification: Byng 2016

Syzygium sp. 1

Molino *et al.* 3167, Alt. 700 m, Dupl.: LAE, MPU [MPU380922]
Identification: Byng 2016

Note: *S. trachyanthum* (Diels) Merr. & L.M.Perry vel *S. subalatum* (Ridl.) Merr. & L.M.Perry.

Syzygium sp. 2

Munzinger *et al.* 6942, Alt. 1200 m, Dupl.: MPU [MPU380921]
Identification: Molino 2014

Syzygium sp. 3

Molino *et al.* 2942, Alt. 2700 m, Dupl.: MPU [MPU380923]
Identification: Molino 2016

Molino *et al.* 3168, Alt. 2700 m, Dupl.: MPU [MPU380920]
Identification: Molino 2014

Syzygium sp. 5

Molino *et al.* 3086, Alt. 700 m, Dupl.: MPU [MPU380899]
Identification: Molino 2016

Syzygium sp. 6

Molino *et al.* 2951, Alt. 2200 m, Dupl.: MPU [MPU380918]
Identification: Byng 2016

Note: *S. malaccense* (L.) Merr. & L.M.Perry vel *S. madangense* T.G.Hartley & L.M.Perry

Syzygium sp. 7

Molino *et al.* 3010, Alt. 1700 m, Dupl.: MPU [MPU380917]
Identification: Molino 2014

Munzinger *et al.* 6896, Alt. 1700 m, Dupl.: BRC, LAE, MPU [MPU380916]
Identification: Byng 2016

Note: *S.* cf. *decipiens* (Koord. & Valeton) Merr. & L.M.Perry vel *S. claviflorum* (Roxb.) Wall. ex Steud.

Syzygium sp. 8

Molino *et al.* 3116, Alt. 200 m, Dupl.: MPU [MPU380915]
Identification: Molino 2014

Syzygium sp. 9

Figure 58

Molino *et al.* 3133, Alt. 200 m, Dupl.: MPU [MPU380910], P [P02433653]
Identification: Molino 2014

Note: cf. *S. validinerve* T.G.Hartley & L.M.Perry vel *S. subalatum* (Ridl.) Merr. & L.M.Perry

Syzygium sp. 11

Molino *et al.* 3171, Alt. 1700 m, Dupl.: MPU [MPU380912]
Identification: Molino 2014

Syzygium sp. 13

Molino *et al.* 2959, Alt. 2200 m, Dupl.: MPU [MPU380914]
Identification: Molino 2014

Syzygium sp. 14

Molino *et al.* 3029, Alt. 1188 m, Dupl.: K, L, MPU [MPU380906], P [P02433629]
Identification: Molino 2012

Xanthomyrtus angustifolia A.J.Scott

Molino *et al.* 2924, Alt. 2700 m, Dupl.: G, K, L, MPU [MPU380902]
Identification: Byng 2016

Munzinger *et al.* 6792, Alt. 2700 m, Dupl.: MPU [MPU380904], NSW [NSW818289], P [P02433702]
Identification: Munzinger 2016

Xanthomyrtus bryophila Diels

Molino *et al.* 3169, Alt. 3200 m, Dupl.: MPU [MPU380901]
Identification: Molino 2014

NEPENTHACEAE

Nepenthes maxima Nees

Figures 60-61

Molino *et al.* 3036, Alt. 1223 m, Dupl.: MPU [MPU380642]
Identification: Munzinger 2019

Note: identified using Jebb's key (1991).

NOTHOFAGACEAE

Nothofagus grandis Steenis

Molino *et al.* 2955, Alt. 2200 m, Dupl.: B, G, K, L, MPU [MPU380585], P [P02433590]
Identification: Munzinger 2016

Nothofagus resinosa Steenis

Munzinger *et al.* 6791, Alt. 2700 m, Dupl.: MPU [MPU380584], P [P02433701], S [S14-1902]
Identification: Munzinger 2016

NYCTAGINACEAE

Pisonia umbellifera (J.R.Forst. & G.Forst.) Seem.

Molino *et al.* 3107, Alt. 700 m, Dupl.: MPU [MPU380648]
Identification: Molino 2016

OCHNACEAE

Schuurmansia elegans Blume

Figure 62

Molino *et al.* 2916, Alt. 3200 m, Dupl.: G, K, L, MPU [MPU380644], P [P02433578]
Identification: Molino 2016

Schuurmansia henningsii K.Schum.

Molino *et al.* 3004, Alt. 1700 m, Dupl.: MPU [MPU380645, MPU380646]
Identification: Molino 2016

Schuurmansia sp. 1

Molino *et al.* 3182, Alt. 2200 m, Dupl.: MPU [MPU310601]
Identification: Molino 2016

OLEACEAE

Chionanthus brassii (Kobuski) Kiew

Munzinger *et al.* 7333, Alt. 1700 m, Dupl.: MPU [MPU380637]
Identification: Molino 2016

Chionanthus gigas (Lingelsh.) Kiew

Munzinger *et al.* 7330, Alt. 700 m, Dupl.: MPU [MPU380643]
Identification: Molino 2016

Chionanthus sp. 3

Molino *et al.* 3078, Alt. 700 m, Dupl.: BRC, LAE, MPU [MPU380641]

Identification: Molino 2016

Molino *et al.* 3081, Alt. 700 m, Dupl.: MPU [MPU380640]
Identification: Molino 2016

Note: this is not *C. ramiflorus* (checked in L). Molino 3078 & 3081 were sequenced (G. Besnard unpublished data) and no difference was found in chloroplastic genome (155000 bp), and they are very similar in complete ribosomal sequence (more than 8000 bp), thus they certainly belong to the same species.

ORCHIDACEAE

Bulbophyllum desmotrichoides Schltr.

Munzinger *et al.* 7001, Alt. 700 m, Dupl.: MPU [MPU028516], P [P02433852]
Identification: Schuiteman 2016

Bulbophyllum cf. ***lepanthiflorum*** Schltr.

Figure 63

Molino *et al.* 3089, Alt. 700 m, Dupl.: MPU [MPU028517]
Identification: Schuiteman 2016

Bulbophyllum manobulbum Schltr.

Figure 64

Munzinger *et al.* 6803, Alt. 2700 m, Dupl.: LAE, P [P010073593]
Identification: Schuiteman 2016

Bulbophyllum rhodoleucum Schltr.

Munzinger *et al.* 6864, Alt. 2200 m, Dupl.: P [P02433764]
Identification: Schuiteman 2016

Ceratostylis sp. 1

Munzinger *et al.* 6868, Alt. 2200 m, Dupl.: MPU [MPU028518]
Identification: Schuiteman 2016

Dendrobium cuthbertsonii F.Muell.

Figure 65

Molino *et al.* 2949, Alt. 2200 m, Dupl.: P [P010073592]
Identification: Pignal 2019

Dendrobium nardoides Schltr.

Molino *et al.* 2970, Alt. 2200 m, Dupl.: L, MPU [MPU028521], P [P010073591]
Identification: Schuiteman 2016

Dendrobium masarangense Schltr.

Figure 66

Molino *et al.* 3005, Alt. 1700 m, Dupl.: P [P010073590]
Identification: Pignal 2019

Dendrobium sp. 1

Molino *et al.* 2941, Alt. 200 m, Dupl.: L, MPU [MPU028515]
Identification: Munzinger 2016

Dendrobium sp. 2

Figure 67

Molino *et al.* 2947, Alt. 200 m, Dupl.: MPU [MPU028520]
Identification: Schuiteman 2016

Epiblastus sp. 1

Munzinger *et al.* 6812, Alt. 200 m, Dupl.: P [P02433716]
Identification: Schuiteman 2016

Glomera cf. ***aurea*** Schltr

Munzinger *et al.* 6869, Alt. 2200 m, Dupl.: P [P02433768]
Identification: Schuiteman 2016

Glomera sp. 1

Munzinger *et al.* 6878, Alt. 1700 m, Dupl.: P [P02433777]
Identification: Schuiteman 2016

Munzinger *et al.* 6884, Alt. 1700 m, Dupl.: P [P02433782]
Identification: Schuiteman 2016

Mediocalcar bifolium J.J.Sm.

Figure 68

Molino *et al.* 2993, Alt. 1700 m, Dupl.: L, MPU [MPU028519], P [P02433610]
Identification: Schuiteman 2016

Orchidaceae sp. 1

Figure 69

Molino *et al.* 2937, Alt. 2700 m, Dupl.: L, LAE
Identification: Molino 2012

Molino *et al.* 2995, Alt. 1700 m, Dupl.: L
Identification: Molino 2012

Phreatia cf. ***ganggapensis*** P.Royen

Figure 70

Munzinger *et al.* 6787, Alt. 3200 m, Dupl.: P [P02433697]
Identification: Schuiteman 2016

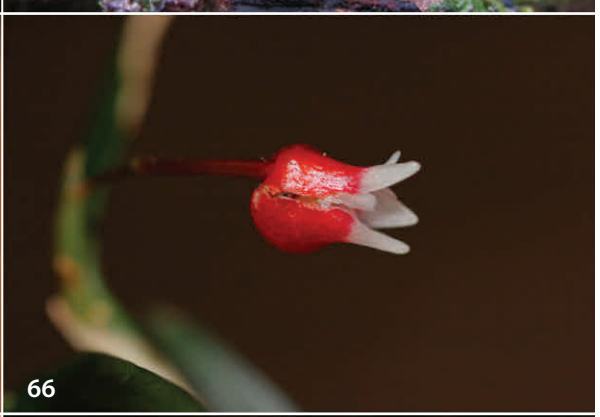
FIGURES 63-70

63, Orchidaceae, *Bulbophyllum* cf. *lepanthiflorum*, Molino *et al.* 3089, flowers; **64**, *Bulbophyllum manobulbum*, Munzinger *et al.* 6803, flowers; **65**, *Dendrobium*, sp. 2 Molino *et al.* 2947, flowers; **66**, *Mediocalcar bifolium*, Molino *et al.* 2993, flowers; **67**, *Dendrobium cuthbertsonii*, Molino *et al.* 2949, flower; **68**, Unidentified, Molino *et al.* 2995, flowers; **69**, *Dendrobium masarangense*, Molino *et al.* 3005, flowers; **70**, *Phreatia* cf. *ganggapensis*, Munzinger *et al.* 6787. 63, 65-69 © J.-F Molino/IRD. 64 © L. Pierron. 70 © J. Munzinger/IRD.

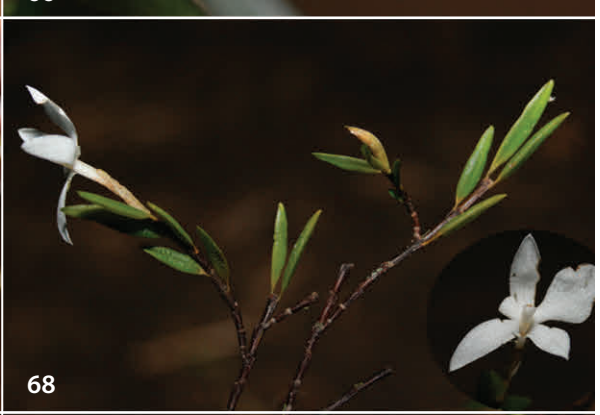

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PANDACEAE

Galearia celebica Koord.

Munzinger *et al.* 6997, Alt. 700 m, Dupl.: MPU [MPU380634], P [P02433848]
Identification: Munzinger 2015

PANDANACEAE

Freycinetia sp. 1

Munzinger *et al.* 6889, Alt. 1700 m, Dupl.: G, P [P02275472, P02275659, P02433786]
Identification: Munzinger 2012

Freycinetia sp. 2

Figure 71
Munzinger *et al.* 6964, Alt. 1200 m, Dupl.: P [P02433886]
Identification: Munzinger 2017

Freycinetia sp. 3

Figure 72
Munzinger *et al.* 6947, Alt. 1200 m, Dupl.: P [P02433815]
Identification: Munzinger 2012

Freycinetia sp. 4

Munzinger *et al.* 6863, Alt. 2200 m, Dupl.: P [P02433763]
Identification: Munzinger 2012

Pandanus antaresensis H.St.John

Munzinger *et al.* 6852, Alt. 2200 m, Dupl.: P [P02275473, P02275474, P02275643, P02275644, P02275645, P02433753]
Identification: Callmander 2012

Pandanus archiboldianus Merr. & L.M.Perry

Munzinger *et al.* 6888, Alt. 1700 m, Dupl.: G, P [P02275656, P02433785]
Identification: Callmander 2018

Pandanus conoideus Lam.

Figure 73
Munzinger *et al.* 7039, Alt. 200 m, Dupl.: G, P [P02275470, P02275655, P02433867]
Identification: Callmander 2012

Pandanus sp. 2

Molino 3184, Alt. 2200 m, Dupl.: LAE, MPU [MPU310604]
Identification: Fazang & Molem 2012

Pandanus sp. 3

Munzinger *et al.* 6795, Alt. 2700 m, Dupl.: P [P02275658, P02433705]
Identification: Fazang & Molem 2012

Pandanus sp. 4

Figure 74

Munzinger *et al.* 6833, Alt. 2200 m, Dupl.: P [P02433735]
Identification: Munzinger 2012

Pandanus sp. 5

Munzinger *et al.* 6950, Alt. 1200 m, Dupl.: P [P02275471, P02433818]
Identification: Munzinger 2012

PARACRYPHIACEAE

Quintinia altigena Schltr.

Figure 75

Molino *et al.* 2926, Alt. 2700 m, Dupl.: G, K, L, MO, MPU [MPU380628], P [P02433583]
Identification: Munzinger 2016

Quintinia montiswilhelmii P.Royen

Figure 76

Munzinger *et al.* 6760, Alt. 3600 m, Dupl.: MPU [MPU380629], P [P02433673]
Identification: Munzinger 2016

Quintinia nutantiflora Schltr.

Munzinger *et al.* 6778, Alt. 3200 m, Dupl.: MPU [MPU380633]
Identification: Munzinger 2016

Munzinger *et al.* 6815, Alt. 2700 m, Dupl.: MPU [MPU380632], NSW [NSW818285], P [P02433719]
Identification: Munzinger 2016

Sphenostemon papuanus (Lauterb.) Steenis & Erdtm.

Molino *et al.* 2938, Alt. 2700 m, Dupl.: MPU [MPU380989, MPU380990]
Identification: Munzinger 2016

Molino *et al.* 3003, Alt. 1700 m, Dupl.: MPU [MPU380991]
Identification: Molino 2012

PHYLLANTHACEAE

Antidesma excavatum Miq. var. ***excavatum***

Figure 31

Munzinger *et al.* 6954, Alt. 1200 m, Dupl.: MPU [MPU380769], P [P02433822]
Identification: van Welzen 2016

Munzinger *et al.* 6993, Alt. 700 m, Dupl.: MO, MPU [MPU380589], NSW [NSW818323], P [P02433845]
Identification: van Welzen 2016

Munzinger *et al.* 7316, Alt. 1200 m, Dupl.: MPU [MPU380607]
Identification: van Welzen 2016

Glochidion cf. ***acustylum*** Airy Shaw

Munzinger *et al.* 6794, Alt. 2700 m, Dupl.: L, MPU [MPU380603], NSW [NSW818288], P [P02433704]
Identification: van Welzen 2016

Munzinger *et al.* 6866, Alt. 2200 m, Dupl.: CANB, L, MO, MPU [MPU380604], NSW [NSW818312], P [P02433766]
Identification: Molino 2016

Glochidion cf. ***pachyconum*** Airy Shaw

Munzinger *et al.* 6941, Alt. 1200 m, Dupl.: MPU [MPU380605], NSW [NSW818321], P [P02433811]
Identification: van Welzen 2016.

Munzinger *et al.* 7317, Alt. 2700 m, Dupl.: LAE, MPU [MPU380602]
Identification: van Welzen 2016

PIPERACEAE

Piper macropiper Pennant

Munzinger *et al.* 6813, Alt. 200 m, Dupl.: P [P02433717]
Identification: Munzinger 2018

Note: sensu Gardner (2013).

Piper triangulare Chew

Munzinger *et al.* 6807, Alt. 2700 m, Dupl.: P [P02433711]
Identification: Munzinger 2018

Note: the label indicates a liana but this is probably a mistake.

PITTOSPORACEAE

Pittosporum sp. 1

Munzinger *et al.* 6940, Alt. 1200 m, Dupl.: MPU [MPU380619]
Identification: Munzinger 2012

Note: nothing similar seen in L (Munzinger 05/2016), but the specimen is sterile.

FIGURES 71-78

71, Pandanaceae, *Freycinetia* sp. 2, Munzinger *et al.* 6964, flowers; **72**, *Freycinetia* sp. 3, Munzinger *et al.* 6947, fruits; **73**, *Pandanus conoideus*, Munzinger *et al.* 7039, fruit; **74**, *Pandanus* sp. 4, Munzinger *et al.* 6833, habit; **75**, Paracryphiaceae, *Quintinia altigena*, Molino *et al.* 2926, flower; **76**, *Quintinia montiswilhelmii*, Munzinger *et al.* 6760, flower; **77**, Pittosporaceae, *Pittosporum berberidoides*, Munzinger *et al.* 6749, fruit; **78**, *Pittosporum pullifolium* var. *pullifolium*, Munzinger *et al.* 6750, fruit. 71-74, 76-78 © J. Munzinger/IRD. 75 © J-F. Molino/IRD.

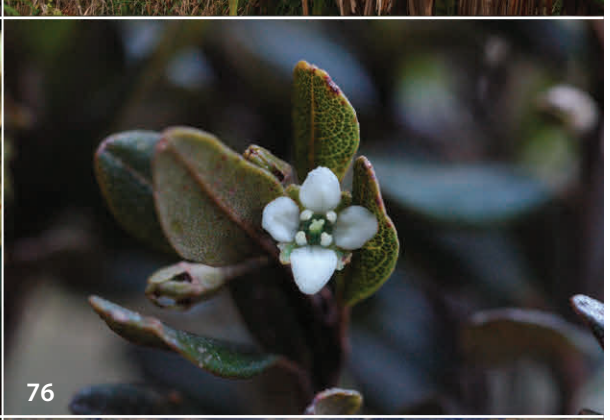

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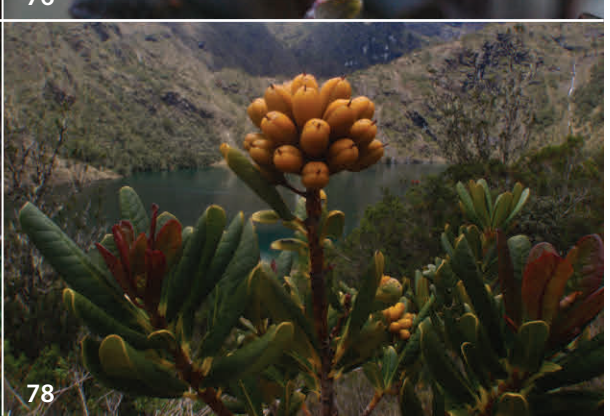

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Pittosporum berberidoides Burkill

Figure 77

Molino *et al.* 2917, Alt. 3200 m, Dupl.: MPU [MPU380630], P [P02433579], WAIK
Identification: Munzinger 2016

Munzinger 7186, Alt. 3200 m, Dupl.: MPU [MPU380631]
Identification: Munzinger 2016

Munzinger *et al.* 6749, Alt. 2800 m, Dupl.: NSW [NSW818283], P [P02433665]
Identification: Munzinger 2016

Pittosporum pullifolium Burkill subsp. ***ledermannii*** (E.Pritz.) Schodde

Munzinger *et al.* 6840, Alt. 2200 m, Dupl.: MPU [MPU380622], P [P02433742], WAIK
Identification: Munzinger 2016

Pittosporum pullifolium Burkill var. ***pullifolium***

Figure 78

Munzinger *et al.* 6750, Alt. 3700 m, Dupl.: MPU [MPU380627], P [P02433666], WAIK
Identification: Damas 2012

Pittosporum ramiflorum Zoll ex Miq.

Figure 79

Munzinger *et al.* 6775, Alt. 3200 m, Dupl.: L [L.3977116], MPU [MPU380626], NSW [NSW818293], P [P02433686], WAIK
Identification: Munzinger 2016

Munzinger *et al.* 6911, Alt. 1200 m, Dupl.: MPU [MPU380623], NSW [NSW818319], P [P02433802], WAIK
Identification: Munzinger 2016

Pittosporum sinuatum Blume

Figures 80-81

Munzinger *et al.* 6805, Alt. 2700 m, Dupl.: MPU [MPU380621], P [P02433710], WAIK
Identification: Munzinger 2016

Munzinger *et al.* 6853, Alt. 2200 m, Dupl.: P [P02433754]
Identification: Munzinger 2016

Munzinger *et al.* 6944, Alt. 1200 m, Dupl.: P [P02433812]
Identification: Munzinger 2016

Note: following the identification key provided by Bakker & van Steenis (1957) our three collections belong to *P. sinuatum*, but according to phylogenetics studies (C. Gemmill *et al.* unpublished) Munzinger 6944 is not conspecific with Munzinger 6805 & 6853. The collection Munzinger *et al.* 6805 is similar to van Royen 18166, in L.

POLYGALACEAE

Xanthophyllum papuanum Whitmore ex Meijden

Munzinger *et al.* 6991, Alt. 700 m, Dupl.: MPU [MPU380707]
Identification: Munzinger 2016

Xanthophyllum sp. 1

Molino *et al.* 3110, Alt. 700 m, Dupl.: MPU [MPU380625]
Identification: Munzinger 2017

Note: identification to genus by van Balgooy 05/2016 in L.

PRIMULACEAE

Ardisia forbesii S.Moore

Molino *et al.* 3126, Alt. 200 m, Dupl.: MPU [MPU380514]
Identification: Damas 2012

Molino *et al.* 3129, Alt. 200 m, Dupl.: L, MPU [MPU380515], P [P02433652]
Identification: Molino 2012

Discocalyx cf. ***latepetiolata*** (Mez) Sleumer

Molino *et al.* 3068, Alt. 700 m, Dupl.: BRC, LAE, MPU [MPU380517]
Identification: Munzinger 2016.

Embelia cotinoides (S.Moore) Merr.

Munzinger *et al.* 6851, Alt. 2200 m, Dupl.: K [K000606479], MPU [MPU380518], P [P02433752]
Identification: Utteridge 2015

Maesa haplobotrys F.Muell.

Munzinger *et al.* 6784, Alt. 3200 m, Dupl.: P [P02433694]
Identification: Munzinger 2012

Myrsine leucantha (K.Schum.) Pipoly

Munzinger *et al.* 6846, Alt. 2200 m, Dupl.: MPU [MPU380519], P [P02433748]
Identification: Munzinger 2016

Myrsine papuana Hemsl.

Munzinger 7190, Alt. 3700 m, Dupl.: MPU [MPU380513]
Identification: Fazang & Molem 2012

Myrsine sp. 2

Molino *et al.* 2925, Alt. 2700 m, Dupl.: K, L, MPU [MPU380510], P [P02433582]
Identification: Munzinger 2015

Myrsine sp. 3

Figure 83

Munzinger *et al.* 6823, Alt. 2200 m, Dupl.: L [L.3977126], MPU [MPU380516], NSW [NSW818305], P [P02433726]
Identification: Utteridge 2016

Myrsine velutina (Knoester, Wijn & Sleumer) Pipoly

Figure 84

Molino *et al.* 2907, Alt. 3700 m, Dupl.: L, MPU [MPU380521], P [P02433570]
Identification: Damas 2012

Munzinger 7189, Alt. 3700 m, Dupl.: MPU [MPU380522]
Identification: Fazang & Molem 2012

Munzinger 7311, Alt. 3700 m, Dupl.: MPU [MPU380509]
Identification: Fazang & Molem 2012

Munzinger *et al.* 6751, Alt. 3700 m, Dupl.: MPU [MPU380520], NSW [NSW818302], P [P02433667]
Identification: Damas 2012

Munzinger *et al.* 6782, Alt. 3200 m, Dupl.: MPU [MPU380523], P [P02433692]
Identification: Fazang & Molem 2012

PROTEACEAE

Helicia cf. ***coeruleopurpurea*** P.Royen

Molino *et al.* 2920, Alt. 3200 m, Dupl.: MPU [MPU380617]
Identification: Munzinger 2016

Munzinger *et al.* 6779, Alt. 3200 m, Dupl.: P [P02433689]
Identification: Munzinger 2016

Helicia hypoglauca Diels

Molino *et al.* 3180, Alt. 1200 m, Dupl.: MPU [MPU380620]
Identification: Munzinger 2016

Helicia odorata Diels

Molino *et al.* 3007, Alt. 1700 m, Dupl.: MPU [MPU310606]
Identification: Fazang & Molem 2012

Helicia sleumeri Foreman

Molino *et al.* 2931, Alt. 2700 m, Dupl.: MPU [MPU380618]
Identification: Fazang & Molem 2012

RHAMNACEAE

Ziziphus angustifolia (Miq.) Hatus. ex Steenis

Molino *et al.* 3151, Alt. 200 m, Dupl.: MPU [MPU380701]
Identification: Munzinger 2016

FIGURES 79-86

79, Pittosporaceae, *Pittosporum ramiflorum*, Munzinger *et al.* 6775, fruits; **80**, *Pittosporum sinuatum*, Munzinger *et al.* 6944, fruit; **81**, *Pittosporum sinuatum*, Munzinger *et al.* 6805, fruits; **82**, Podocarpaceae, *Dacrycarpus compactus*, Munzinger *et al.* 6754, cones; **83**, Primulaceae, *Myrsine* sp. 3, Munzinger *et al.* 6823, flowers; **84**, *Myrsine velutina*, Molino *et al.* 2907, fruits; **85**, Rubiaceae, *Atractocarpus macarthurii*, Munzinger *et al.* 6961, fruit; **86**, *Bungarimba papuana*, Munzinger *et al.* 6949, fruits. 79-80, 82-83, 85-86 © J. Munzinger/IRD. 81, 84 © J-F. Molino/IRD.


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Ziziphus djamuensis Lauterb.

Molino *et al.* 3097, Alt. 700 m, Dupl.: B, G, K, L, MPU [MPU380700], NSW [NSW 818282]
Identification: Munzinger 2018

Note: following Lauterbach's key (1922).

RHIZOPHORACEAE

Gynotroches axillaris Blume

Munzinger *et al.* 6880, Alt. 1700 m, Dupl.: MPU [MPU380699], NSW [NSW818315], P [P02433779]
Identification: Munzinger 2016

Molino *et al.* 3185, Alt. 1200 m, Dupl.: MPU [MPU310507]
Identification: Damas 2019

ROSACEAE

Prunus brassii Kalkman

Molino *et al.* 2929, Alt. 2700 m, Dupl.: MPU [MPU380695]
Identification: Munzinger 2016

Prunus grisea (Blume ex Müll.Berol.) Kalkman var. ***microphylla*** Kalkman

Molino *et al.* 2912, Alt. 3200 m, Dupl.: G, K, MPU [MPU380696], P [P02433574]
Identification: Munzinger 2016

Note: similar to Wade ANU 7705 in L

Prunus oligantha Kalkman

Molino *et al.* 2934, Alt. 2700 m, Dupl.: MPU [MPU380697]
Identification: Munzinger 2016

Molino *et al.* 2957, Alt. 2200 m, Dupl.: MPU [MPU380698]
Identification: Munzinger 2016

RUBIACEAE

Atractocarpus macarthurii (F.Muell.) Puttock

Figure 85

Munzinger *et al.* 6961, Alt. 1200 m, Dupl.: P [P02433829]
Identification: Mouly 2016

Atractocarpus sp. 1

Munzinger *et al.* 6839, Alt. 2200 m, Dupl.: P [P02433741]
Identification: Munzinger 2012

Bungarimba papuana K.M.Wong

Figure 86

Munzinger *et al.* 6949, Alt. 1200 m, Dupl.: MPU [MPU380691], P [P02433817]
Identification: Mouly 2016

Munzinger *et al.* 6987, Alt. 700 m, Dupl.: MPU [MPU380685], P [P02433844], S [S15-28103]
Identification: Mouly 2016

Coprosma papuensis W.R.B.Oliv. subsp. ***discolor*** (P.Royen) R.O.Gardner

Figure 87

Munzinger *et al.* 6774, Alt. 3200 m, Dupl.: MPU [MPU380670], NSW [NSW818294], P [P02433685], S [S14-1901]
Identification: Munzinger 2018

Note: identified using the key provided by Gardner (2002).

Dolianthus ovatifolius A.P.Davis

Munzinger *et al.* 6857, Alt. 2200 m, Dupl.: MPU [MPU380666], P [P00966803, P02433757]
Identification: Munzinger 2018

Note: leaves are rather small but otherwise conform to description in Davis (2001).

Dolianthus subalpinus (P.Royen) A.P.Davis

Figure 88

Munzinger *et al.* 6786, Alt. 3200 m, Dupl.: MPU [MPU380663], P [P02433696]
Identification: Munzinger 2018

Gardenia sp. 1

Figure 89

Munzinger *et al.* 6870, Alt. 1700 m, Dupl.: P [P02433769]
Identification: Munzinger 2018

Note: *sensu lato*.

Gardenia sp. 2

Munzinger *et al.* 7033, Alt. 200 m, Dupl.: MPU [MPU380686], NSW [NSW818326], P [P02433864], S [S14-1913]
Identification: Mouly 2016

Hydnophytum dauloense Jebb & C.R.Huxley

Munzinger *et al.* 6858, Alt. 2200 m, Dupl.: MPU [MPU380673], P [P02433758]
Identification: Munzinger 2018

Note: a species described during the reviewing process (Jebb & Huxley 2019).

Ixora amplexifolia K.Schum. & Lauterb.

Munzinger *et al.* 7012, Alt. 700 m, Dupl.: MPU [MPU380669], P [P02433855]
Identification: Munzinger 2018

Lasianthus chlorocarpus K.Schum

Munzinger *et al.* 6962, Alt. 1200 m, Dupl.: BRC, MPU [MPU380677], P [P02433884]
Identification: Munzinger 2018

Lasianthus clementis Merr.

Figure 90

Munzinger *et al.* 6958, Alt. 1200 m, Dupl.: MPU [MPU380680], P [P02433826]
Identification: Munzinger 2018

Note: matches *Lasianthus canephoroides* Wernham which is considered as a synonym of *L. clementis* Merr. by Zhu *et al.* (2012).

Myrmecodia sp. 1

Molino *et al.* 2969, Alt. 2200 m, Dupl.: P [P02433593]
Identification: Molino 2012

Neonauclea lanceolata Merr. subsp. ***gracilis*** (S.Vidal) Ridsdale

Molino *et al.* 3024, Alt. 1188 m, Dupl.: K, L, MPU [MPU380688]
Identification: Munzinger 2016

Molino *et al.* 3032, Alt. 1200 m, Dupl.: MPU [MPU380687]
Identification: Munzinger 2016

Note: the collection Molino *et al.* 3032 is sterile but identical to Molino *et al.* 3024.

Nertera granadensis Druce

Munzinger *et al.* 6834, Alt. 2200 m, Dupl.: MPU [MPU380672], P [P02433736]
Identification: Munzinger 2018

Ophiorrhiza debruynii Valeton

Munzinger *et al.* 6867, Alt. 2200 m, Dupl.: MPU [MPU380668], P [P02433767]
Identification: Munzinger 2018

Note: similar to Takeuchi 10382 (L.0218207) in L.

Ophiorrhiza sp. 1

Munzinger *et al.* 6919, Alt. 1200 m, Dupl.: MPU [MPU380667], P [P02433808]
Identification: Munzinger 2018

Psychotria hollandiae Valeton

Munzinger *et al.* 7037, Alt. 200 m, Dupl.: MPU [MPU380681]
Identification: Munzinger 2018

Note: matches *P. djamunensis* Valeton, considered as a synonym of *P. hollandiae* by Sohmer (1988).

Psychotria leucococca K.Schum. & Lauterb.

Munzinger *et al.* 6927, Alt. 1200 m, Dupl.: MPU [MPU380683]
Identification: Fazang & Molem 2012

FIGURES 87-94

87, Rubiaceae, *Coprosma papuensis* subsp *discolor*, Munzinger *et al.* 6774, fruits; **88**, *Dolianthus subalpinus*, Munzinger *et al.* 6786, fruit and flower; **89**, *Gardenia* sp. 1, Munzinger *et al.* 6870, fruit; **90**, *Lasianthus clementis*, Munzinger *et al.* 6958, fruit; **91**, *Psychotria* sp. 1, Munzinger *et al.* 6946, flowers; **92**, *Psychotria* sp. 3, Munzinger *et al.* 6917, flowers; **93**, *Timonius belensis*, Munzinger *et al.* 6765, flowers; **94**, *Timonius longitubus*, Molino *et al.* 2988, fruit and flower. 87-92 © J. Munzinger/IRD. 93-94 © J-F. Molino/IRD.


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Psychotria micrococca (Lauterb. & K.Schum.) Valeton

Munzinger *et al.* 7004, Alt. 700 m, Dupl.: MPU [MPU380674]
Identification: Fazang & Molem 2012

Psychotria sp. 1

Figure 91

Munzinger *et al.* 6946, Alt. 1200 m, Dupl.: MPU [MPU380675], P [P02433814], S [S14-1909]
Identification: Munzinger 2015

***Psychotria* sp. 2**

Munzinger *et al.* 6832, Alt. 2200 m, Dupl.: MPU [MPU380678], P [P02433734]
Identification: Munzinger 2012

Psychotria sp. 3

Figure 92

Munzinger *et al.* 6917, Alt. 1200 m, Dupl.: MPU [MPU380665], P [P00966804, P02433806]
Identification: Munzinger 2012

Psychotria sp. 4

Munzinger *et al.* 6766, Alt. 3200 m, Dupl.: MPU [MPU380676], P [P02433678], S [S14-1898]
Identification: Munzinger 2012

Psychotria sp. 5

Munzinger *et al.* 6804, Alt. 2700 m, Dupl.: MPU [MPU380682]
Identification: Munzinger 2012

Psychotria sp. 6

Molino *et al.* 3013, Alt. 1200 m, Dupl.: K, MPU [MPU380664], P [P02433617]
Identification: Molino 2012

Psychotria sp. 7

Munzinger *et al.* 6966, Alt. 1200 m, Dupl.: P [P02433888, P02433890]
Identification: Munzinger 2019

Psychotria sp. 8

Munzinger *et al.* 6788, Alt. 3200 m, Dupl.: P [P02433698]
Identification: Munzinger 2018

Munzinger *et al.* 6818, Alt. 200 m, Dupl.: P [P02433722]
Identification: Munzinger 2018

Randia schumanniana Merr. & L.M.Perry

Molino *et al.* 3080, Alt. 700 m, Dupl.: LAE, MPU [MPU380689, MPU380690]
Identification: Fazang & Molem 2012

Randia sphaerocarpa K.Schum. & Lauterb.

Munzinger *et al.* 7329, Alt. 1200 m, Dupl.: MPU [MPU380684]
Identification: Munzinger & Molino 2012

Rothmannia sp. 1

Molino *et al.* 3051, Alt. 1223 m, Dupl.: MPU [MPU380692], P [P02433632]
Identification: Mouly 2016

Rubiaceae sp. 1

Munzinger *et al.* 7009, Alt. 700 m, Dupl.: MPU [MPU380679]
Identification: Munzinger 2015

Rubiaceae sp. 3

Munzinger *et al.* 7002, Alt. 700 m, Dupl.: P [P02433853]
Identification: Munzinger 2019

Tarenna multinervia (Merr.) Bremek.

Munzinger *et al.* 6995, Alt. 700 m, Dupl.: MPU [MPU380671], P [P02433846]
Identification: Munzinger 2018

Timonius belensis Merr. & L.M.Perry

Figure 93

Munzinger *et al.* 6765, Alt. 3200 m, Dupl.: MPU [MPU380662], NSW [NSW818300], P [P02433677]
Identification: Munzinger 2016

Timonius longitubus Merr. & L.M.Perry

Figure 94

Molino *et al.* 2988, Alt. 1700 m, Dupl.: B, G, K, L, MPU [MPU380661], P [P02433605]
Identification: Fazang & Molem 2012

Timonius cf. ***meridionalis*** S.P.Darwin

Munzinger *et al.* 6929, Alt. 1200 m, Dupl.: MPU [MPU310679]
Identification: Munzinger 2018

Note: identified using the key in Darwin (1994).

Timonius sp. 1

Munzinger *et al.* 6829, Alt. 2200 m, Dupl.: MPU [MPU380660], P [P02433731]
Identification: Munzinger 2015

Munzinger *et al.* 6875, Alt. 1700 m, Dupl.: MPU [MPU380659], NSW [NSW818313], P [P02433774], S [S14-1905]
Identification: Munzinger 2015

RUTACEAE

Acronychia emarginata Lauterb.

Figure 95

Molino *et al.* 2904, Alt. 3700 m, Dupl.: CANB, MPU [MPU380656], P [P02433567]
Identification: Munzinger 2016

Molino *et al.* 2906, Alt. 3700 m, Dupl.: CANB, GOET, MPU [MPU380657], P [P02433569]
Identification: Molino 2016

Acronychia cf. ***ledermannii*** Lauterb.

Molino *et al.* 3011, Alt. 1700 m, Dupl.: B, CANB, GOET, K, L, MPU [MPU380658], P [P02275648, P02433615]
Identification: Appelhans 2013

Acronychia murina Ridl.

Molino *et al.* 2939, Alt. 2700 m, Dupl.: MPU [MPU380653]
Identification: Damas 2012

Acronychia pullei Lauterb.

Molino *et al.* 3181, Alt. 2700 m, Dupl.: MPU [MPU310538]
Identification: Munzinger & Molino 2012

Flindersia amboinensis Poir.

Molino *et al.* 2943, Alt. 2700 m, Dupl.: CANB, MPU [MPU380650]
Identification: Molino 2016

Melicope sp. 1

Molino *et al.* 2952, Alt. 2200 m, Dupl.: B, CANB, G, K, L, MO, MPU [MPU380638], NSW [NSW 818281], NY
Identification: Molino 2016

Note: nothing similar seen in L.

Melicope rubra (Lauterb. & K.Schum.) T.G.Hartley

Figure 96

Molino *et al.* 2909, Alt. 3200 m, Dupl.: CANB, GOET, K, L, MO, MPU [MPU380651], P [P02433572]
Identification: Appelhans 2013

Micromelum minutum Wight & Arn.

Molino *et al.* 3153, Alt. 200 m, Dupl.: MPU [MPU380652, MPU380654]
Identification: Molino 2016

Tetractomia tetrandra (Roxb.) Merr.

Molino *et al.* 2927, Alt. 2700 m, Dupl.: MPU [MPU380655]
Identification: Molino 2016

Zanthoxylum sp. 1

Munzinger *et al.* 6874, Alt. 1700 m, Dupl.: P [P02433773]
Identification: Munzinger 2012

SABIACEAE

Meliosma pinnata (Roxb.) Maxim. subsp. ***humilis*** (Merr. & L.M.Perry) Beusekom

Molino *et al.* 3012, Alt. 1200 m, Dupl.: P [P02433616]
Identification: Munzinger 2016

Molino *et al.* 3022, Alt. 1200 m, Dupl.: MPU [MPU380639, MPU380649]
Identification: Munzinger 2016

Munzinger *et al.* 6830, Alt. 2200 m, Dupl.: MPU [MPU380754], P [P02433732]
Identification: Munzinger 2016

Munzinger *et al.* 6872, Alt. 1700 m, Dupl.: P [P02433771]
Identification: Munzinger 2016

SALICACEAE

Ryparosa calotricha Mildbr.

Munzinger *et al.* 6905, Alt. 1200 m, Dupl.: P [P02433797]
Identification: Munzinger 2012

Munzinger *et al.* 7007, Alt. 700 m, Dupl.: MPU [MPU380647]
Identification: Molino 2016

Ryparosa sp. 1

Molino *et al.* 3183, Alt. 700 m, Dupl.: BRC, LAE, MPU [MPU310600]
Identification: Munzinger 2016

SAPINDACEAE

Alectryon ferrugineum (Blume) Radlk.

Munzinger *et al.* 7310, Alt. 1200 m, Dupl.: LAE, MPU [MPU380954]
Identification: Munzinger 2016

Cupaniopsis sp. 1

Munzinger *et al.* 6959, Alt. 1200 m, Dupl.: P [P02433827]
Identification: Munzinger 2017

Dictyoneura obtusa Blume

Molino *et al.* 3159, Alt. 200 m, Dupl.: MPU [MPU114971]
Identification: Munzinger 2016

Munzinger *et al.* 7034, Alt. 200 m, Dupl.: MPU [MPU028289], P [P02433865]
Identification: Callmander 2015

Guioa comesperma Radlk.

Munzinger *et al.* 7038, Alt. 200 m, Dupl.: L [L.3977112; L.3977113], MPU [MPU028290], NSW [NSW818327, NSW818328], P [P02433866]
Identification: Munzinger 2018

Guioa sp. 1

Figure 97

Munzinger *et al.* 6926, Alt. 1200 m, Dupl.: MPU [MPU028292]
Identification: Munzinger 2018

Note: the sterile specimen was sequenced (S. Buerki, pers. comm.) and confirmed to be a *Guioa*.

Harpullia longipetala Leenh.

Molino *et al.* 3101, Alt. 700 m, Dupl.: MPU [MPU028291]
Identification: Fazang & Molem 2012

Munzinger *et al.* 6972, Alt. 700 m, Dupl.: P [P02433834]
Identification: Fazang & Molem 2012

Lepisanthes sp. 1

Munzinger *et al.* 7054, Alt. 200 m, Dupl.: MPU [MPU028293]
Identification: Molino 2015

Mischocarpus sp. 1

Munzinger *et al.* 6923, Alt. 1200 m, Dupl.: MPU [MPU310605]
Identification: Fazang & Molem 2012

Mischocarpus cf. ***sundaicus*** Blume

Munzinger *et al.* 7055, Alt. 200 m, Dupl.: BRC, LAE, MPU [MPU028294]
Identification: Munzinger 2016

Pometia pinnata J.R.Forst. & G.Forst.

Molino *et al.* 3096, Alt. 700 m, Dupl.: MPU [MPU028295]
Identification: Fazang & Molem 2012

Munzinger *et al.* 7016, Alt. 200 m, Dupl.: MPU [MPU028296]
Identification: Fazang & Molem 2012

SAPOTACEAE

Palaquium morobense P.Royen

Munzinger *et al.* 6939, Alt. 1200 m, Dupl.: MPU [MPU380941, MPU380943], S [S14-5076]
Identification: Fazang & Molem 2012

Palaquium cf. ***supfianum*** Schltr.

Molino *et al.* 3186, Alt. 700 m, Dupl.: MPU [MPU310608]
Identification: Munzinger 2019

FIGURES 95-102

95, Rutaceae, *Acronychia emarginata*, Molino *et al.* 2904, habit and flower; **96**, *Melicope rubra*, Molino *et al.* 2909, flowers and fruit; **97**, Sapindaceae, *Guioa* sp. 1, Munzinger *et al.* 6926, fruit; **98**, Symplocaceae, *Symplocos cerasifolia*, Molino *et al.* 2915, habit and flowers; **99**, *Symplocos cochinchinensis* subsp. *leptophylla* Munzinger, *et al.* 6781, flowers; **100**, *Symplocos cochinchinensis* subsp. *leptophylla*, Molino *et al.* 2935, flowers; **101**, *Symplocos cochinchinensis* var. *molobros*, Munzinger *et al.* 6860, flowers; **102**, Theaceae, *Eurya pullenii*, Munzinger *et al.* 6752, flowers. 95-98, 100-102 © J.-F. Molino/IRD. 99, 102 © J. Munzinger/IRD.


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Munzinger *et al.* 6916, Alt. 1200 m, Dupl.: MPU [MPU380942], S [S14-5081]
Identification: Munzinger 2019

Munzinger *et al.* 6983, Alt. 700 m, Dupl.: MPU [MPU380944]
Identification: Munzinger 2019

Munzinger *et al.* 6999, Alt. 700 m, Dupl.: MPU [MPU380945], NSW [NSW818324], P [P02433850], S [S14-5085]
Identification: Munzinger 2019

Note: using van Royen's key (1960), the most probable species is *P. pseudocalophyllum* H.J.Lam, but it has narrow stipules (<1.5 mm), whereas *P. supfianum* Schltr. has stipules up to 3 mm wide like our specimens. However, this species remains poorly known. Our fertile collection Munzinger *et al.* 6999 seems quite similar to the type of *Palaquium inutile* Schltr. & K.Krause, considered as a synonym of *P. supfianum* by van Royen.

Planchonella polyneura (K.Krause) Swenson

Munzinger *et al.* 6992, Alt. 700 m, Dupl.: MPU [MPU380953], S [S14-5060]
Identification: Swenson 2017

Munzinger *et al.* 7010, Alt. 700 m, Dupl.: MPU [MPU380952], S [S14-5057]
Identification: Swenson 2017

Note: the species was known as *Krausella polyneura* (K. Krause) H.J. Lam, but the genus *Krausella* H.J. Lam was recently put in synonmy under *Planchonella* Pierre (Swenson *et al.* 2013).

Planchonella thyrsoidea C.T.White

Munzinger *et al.* 7008, Alt. 700 m, Dupl.: MPU [MPU380946, MPU380951], S [S14-5039]
Identification: Swenson 2014

Pleioluma firma (Miq.) Swenson

Munzinger *et al.* 6827, Alt. 2200 m, Dupl.: MPU [MPU380948], S [S14-5008]
Identification: Swenson 2014

Munzinger *et al.* 6850, Alt. 2200 m, Dupl.: MPU [MPU380949], S [S14-5016]
Identification: Swenson 2014

Munzinger *et al.* 6854, Alt. 2200 m, Dupl.: MPU [MPU380950], S [S14-5004]
Identification: Swenson 2014

Munzinger *et al.* 6893, Alt. 1700 m, Dupl.: MPU [MPU380938], S [S14-5000]
Identification: Swenson 2014

Pleioluma macropoda (H.J.Lam) Swenson

Munzinger *et al.* 6862, Alt. 2200 m, Dupl.: MPU [MPU380939], S [S14-5030]
Identification: Swenson 2014

Pleioluma sp. 1, n. sp.

Munzinger *et al.* 6912, Alt. 1200 m, Dupl.: MPU [MPU380947], S [S14-4991]
Identification: Swenson 2014

Note: signaled as new species in Swenson *et al.* (2018).

Pouteria doonsaf P.Royen

Munzinger *et al.* 6979, Alt. 700 m, Dupl.: MPU [MPU380940], S [S14-5051]
Identification: Swenson 2014

Note: *P. doonsaf* should be transferred to the genus *Planchonella* Pierre, but two accessions of that taxon revealed two distinct species (Swenson *et al.*, 2019).

SIMAROUBACEAE

Picrasma javanica Blume

Munzinger *et al.* 6969, Alt. 700 m, Dupl.: MPU [MPU380992]
Identification: Munzinger 2016

SMILACACEAE

Smilax papuana Lauterb.

Munzinger *et al.* 6894, Alt. 1700 m, Dupl.:P [P02433790]
Identification: Munzinger 2018

SOLANACEAE

Lycianthes memecylonoides (Bitter & Schltr.) Bitter

Molino *et al.* 3060, Alt. 1223 m, Dupl.: MPU [MPU380586], P [P02433639]
Identification: Munzinger 2019

STEMONACEAE

Stemona javanica (Kunth) Engler

Munzinger *et al.* 6976, Alt. 700 m, Dupl.: MPU [MPU380570], P [P02433838]
Identification: Munzinger 2019

Note: this species was only known from below 300 m (Duyfjes 1993).

STEMONURACEAE

Gomphandra montana (G.Schellenb.) Sleumer

Munzinger *et al.* 6899, Alt. 1700 m, Dupl.: MPU [MPU380986], NSW [NSW818318], P [P02433792]
Identification: Molino 2016

Gomphandra papuana (Becc.) Sleumer

Molino *et al.* 3035, Alt. 1200 m, Dupl.: MPU [MPU380985]
Identification: Molino 2016

Munzinger *et al.* 7320, Alt. 1200 m, Dupl.: MPU [MPU380835]
Identification: Munzinger 2018

Medusanthera laxiflora (Miers) R.A.Howard

Molino *et al.* 3069, Alt. 700 m, Dupl.: BRC, LAE, MPU [MPU380987]
Identification: Molino 2016

Note: using Utteridge's key (2011).

SYMPLOCACEAE

Symplocos cerasifolia Wall.

Figure 98

Molino *et al.* 2915, Alt. 3200 m, Dupl.: MO, MPU [MPU380980], NY, P [P02433577]
Identification: Munzinger 2018

Symplocos cochinchinensis (Lour.) S.Moore subsp. ***leptophylla*** (Brand) Noot.

Figures 99-100

Molino *et al.* 2921, Alt. 3200 m, Dupl.: L, MPU [MPU380978]
Identification: Munzinger 2018

Molino *et al.* 2935, Alt. 2700 m, Dupl.: B, G, K, L, MPU [MPU380984], NY, P [P02433584]
Identification: Fazang & Molem 2012

Munzinger *et al.* 6781, Alt. 3200 m, Dupl.: L [L.3977108], MPU [MPU380981], NSW [NSW818291], P [P02433691]
Identification: Munzinger 2018

Munzinger *et al.* 6817, Alt. 2700 m, Dupl.: L [L.3977107], MPU [MPU380982], P [P02433721]
Identification: Munzinger 2018

Munzinger *et al.* 6831, Alt. 2200 m, Dupl.: MPU [MPU380693], NSW [NSW818307], P [P02433733]
Identification: Munzinger 2018

Munzinger *et al.* 6865, Alt. 2200 m, Dupl.: P [P02433765]
Identification: Fazang & Molem 2012

Munzinger *et al.* 6903, Alt. 1700 m, Dupl.: MPU [MPU380983], P [P02433796]
Identification: Fazang & Molem 2012

Note: the material *Molino et al. 2921*, *Munzinger et al. 6781*, *6817* & *6831*, belong to that taxa sensu Nooteboom (1975).

Symplocos cochinchinensis (Lour.) S.Moore var. ***leptophylla*** (Lour.) S.Moore

Molino *et al.* 2913, Alt. 3200 m, Dupl.: K, L, MPU [MPU380979], P [P02433575]
Identification: Munzinger 2018

Note: sensu Nooteboom (1975) & similar to *Stone 53227* [L.2669447] in L.

Symplocos cochinchinensis (Lour.) S.Moore var. ***molobros*** (Brand) Noot.

Figure 101

Munzinger *et al.* 6860, Alt. 2200 m, Dupl.: L [L.3977109], MPU [MPU380694], NSW [NSW818311], P [P02275646, P02433760]
Identification: Munzinger 2018

Note: similar to L.2681071.

Symplocos cochinchinensis (Lour.) S.Moore var. ***orbicularis*** (Hemsl.) Noot.

Munzinger *et al.* 7334, Alt. 3700 m, Dupl.: MPU [MPU380973]
Identification: Munzinger 2016

Symplocos cochinchinensis (Lour.) S.Moore var. ***reginae*** (Brand) Noot.

Munzinger *et al.* 6873, Alt. 1700 m, Dupl.: MPU [MPU091690], P [P02433772]
Identification: Munzinger 2019

THEACEAE

Eurya pullenii Hoogland

Figure 102

Munzinger *et al.* 6752, Alt. 3700 m, Dupl.: MO, MPU [MPU380974], P [P02433668]
Identification: Munzinger 2016

Note: similar to the type from the same locality.

Eurya tigang K.Schum. & Lauterb.

Munzinger *et al.* 6789, Alt. 2700 m, Dupl.: L [L.3977114], MPU [MPU380976], NSW [NSW818290], P [P02433699]
Identification: Fazang & Molem 2012

Munzinger *et al.* 7331, Alt. 3200 m, Dupl.: MPU [MPU380975]
Identification: Fazang & Molem 2012

Eurya sp. 2

Molino *et al.* 2901, Alt. 3500 m, Dupl.: LAE, MPU [MPU380977]
Identification: Munzinger 2016

Note: close to *E. tigang* but different indumentum.

THYMELAEACEAE

Phaleria cf. ***capitata*** Jack

Figure 103

Molino *et al.* 3019, Alt. 1200 m, Dupl.: P [P02433621]
Identification: Munzinger 2016

Molino *et al.* 3039, Alt. 1200 m, Dupl.: P [P02434885]
Identification: Munzinger 2018

Munzinger *et al.* 6910, Alt. 1200 m, Dupl.: MPU [MPU380971], P [P02433801]
Identification: Munzinger 2016

Note: very similar to the type of *Drimyspermum cauliflorum* Thwaites

Phaleria macrocarpa (Scheff.) Boerl.

Molino *et al.* 3121, Alt. 200 m, Dupl.: MPU [MPU380972]
Identification: Fazang & Molem 2012

Note: the genus is correct, but identification to species is nearly impossible on sterile material (Molino 2016 in L).

TRIMENIACEAE

Trimenia papuana Ridl.

Figure 104

Munzinger *et al.* 6841, Alt. 2200 m, Dupl.: MPU [MPU380970], NSW [NSW818309], P [P02275647, P02433743]
Identification: Munzinger 2016

VIOLACEAE

Rinorea sp. 1

Munzinger *et al.* 7036, Alt. 200 m, Dupl.: MPU [MPU380753]
Identification: de Muria 2018

Note: belongs to a new species fide J. de Muria, who is currently working on that genus (pers. comm.).

VITACEAE

Leea gonioptera Lauterb.

Munzinger *et al.* 7046, Alt. 200 m, Dupl.: MPU [MPU380828]
Identification: Munzinger 2016

Leea heterodoxa K.Schum. & Lauterb.

Munzinger *et al.* 6970, Alt. 700 m, Dupl.: MPU [MPU380967], P [P02433832]
Identification: Munzinger 2016

Tetrastigma sp. 1

Figure 105

Molino *et al.* 2980, Alt. 1700 m, Dupl.: P [P02433601]
Identification: Lu 2017

Tetrastigma sp. 2

Munzinger *et al.* 6904, Alt. 1700 m, Dupl.: LAE, MPU [MPU380965]
Identification: Munzinger 2018

FIGURES 103-110

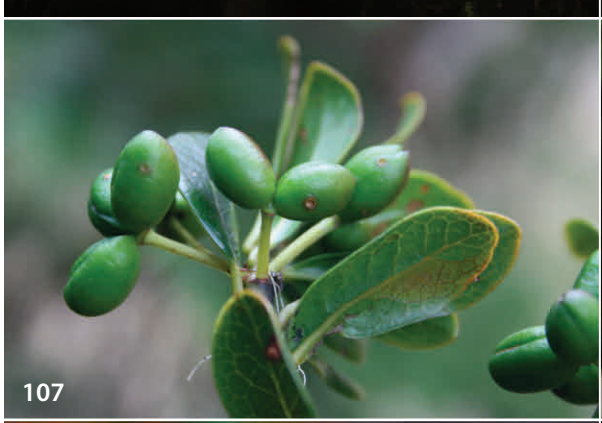
103, Thymelaeaceae, *Phaleria* cf. *capitata*, Molino *et al.* 3039, leaves and flowers; **104**, Trimeniaceae, *Trimenia papuana*, Munzinger *et al.* 6841, flowers; **105**, Vitaceae, *Tetrastigma* sp. 1, Molino *et al.* 2980, fruit; **106**, Winteraceae, *Tasmannia montiswilhelmi*, Molino *et al.* 2900, fruits; **107**, *Tasmannia rosea*, Munzinger *et al.* 6764, fruits and flowers; **108**, *Tasmannia* sp. 2, Munzinger *et al.* 6822, flowers; **109**, *Zygogynum montanum*, Munzinger *et al.* 6990, flower; **110**, Zingiberaceae, *Riedelia* sp., Molino *et al.* 2981, fruits. 102, 104, 107-109 © J. Munzinger/IRD. 103, 105-106, 110 © J.-F. Molino/IRD.


103


104


105


106


107


108


109


110

WINTERACEAE

Tasmannia dictyophlebia (Diels) A.C.Sm.

Molino *et al.* 2936, Alt. 2700 m, Dupl.: G, L, MPU [MPU380960], P [P02433585]
Identification: Molino 2016

Munzinger *et al.* 6790, Alt. 2700 m, Dupl.: MPU [MPU380955], P [P02433700]
Identification: Munzinger 2016

Note: = *D. piperita* Hook.f. "entity coriacea" fide Vink (1970). The status on *Drimys* versus *Tasmannia* was longly debated, and *Tasmannia* is now considered as a distinct genus (Doust & Drinnan 2004).

Tasmannia montiswilhelmi (Hoogland) A.C. Sm.

Figure 106

Molino *et al.* 2900, Alt. 3500 m, Dupl.: LAE, MPU [MPU380962, MPU380963]
Identification: Munzinger 2016

Munzinger 7188, Alt. 3700 m, Dupl.: LAE, MPU [MPU380961]
Identification: Munzinger 2016

Note: = *D. piperita* Hook.f. "entity montis-wilhelmi" fide Vink (1970).

Tasmannia piperita (Hook. f.) Miers s. lat. entity 2. 'subalpina'

Munzinger 6759, Alt. 3700 m, Dupl.: P [P02433672]
Identification: Munzinger 2019

Note: this "entity subalpina" of Vink (1970) does not correspond to a previously described species.

Tasmannia cf. ***reticulata*** (Diels) A.C.Sm.

Munzinger *et al.* 6757, Alt. 3500 m, Dupl.: BRC, LAE, MPU [MPU380956]
Identification: Munzinger 2016

Note: following Smith's key (1943), the size of the leaves matches better *T. reticulata* than *T. arkakensis* (Gibbs) A.C.Sm. *Tasmannia reticulata* (Diels) A.C.Sm. = *D. piperita* Hook.f. "entity reticulata" fide Vink (1970).

Tasmannia rosea (Ridl.) A.C.Sm.

Figure 107

Munzinger *et al.* 6764, Alt. 3200 m, Dupl.: NSW [NSW818301], P [P02433676]
Identification: Munzinger 2016

Note: = *D. piperita* Hook.f. "entity rosea" fide Vink (1970).

Tasmannia sp. 1

Munzinger *et al.* 6918, Alt. 1200 m, Dupl.: L [L.3977115], MPU [MPU380964], P [P02275635, P02433807], WAIK
Identification: Munzinger 2015

Note: Munzinger *et al.* 6918 was identified as *Drimys piperita* Hook.f. (=*Tasmannia piperita* (Hook. f.) Miers) by van Balgooy in L following the wide species conception of Vink (1970), but we do not believe all our material belongs to a single species and retained Smith's taxonomy (1943) that consider several species of *Drimys* (thus *Tasmannia*) in Papua New Guinea.

Tasmannia sp. 2

Figure 108

Munzinger *et al.* 6822, Alt. 2200 m, Dupl.: MPU [MPU380966], P [P02433725]
Identification: Munzinger 2015

Note: should be *D. piperita* Hook.f. "entity heteromera" using Vink's key (1970) in his wide species conception.

Zygogynum calothyrsum (Diels) Vink

Munzinger *et al.* 6770, Alt. 3200 m, Dupl.: MPU [MPU380957], P [P02433682]
Identification: Fazang & Molem 2012

Zygogynum montanum (Lauterb.) Vink

Figure 109

Munzinger *et al.* 6990, Alt. 700 m, Dupl.: MPU [MPU380958], P [P01382800]
Identification: Munzinger 2018

Munzinger *et al.* 6996, Alt. 700 m, Dupl.: MPU [MPU380959], P [P02433847], WAIK
Identification: Munzinger 2018

Note: identified using the key of Smith (1943). The specimen Munzinger *et al.* 6990 was sequenced (C. Gemmill, pers. comm.) and confirmed to be a *Zygogynum*.

XANTHORRHOEACEAE

Dianella ensifolia (L.) DC.

Munzinger *et al.* 6859, Alt. 2200 m, Dupl.: P [P02433759]
Identification: Munzinger 2018

Note: *sensu lato*.

ZINGIBERACEAE

Pleuranthodium cf. ***macropycnanthum*** (Valeton) R.M.Sm.

Munzinger *et al.* 6998, Alt. 700 m, Dupl.: P [P02089480, P02433849]
Identification: Munzinger 2018

Riedelia sp. 1

Figure 110

Molino *et al.* 2981, Alt. 1700 m, Dupl.: L, P [P02433602]
Identification: Munzinger 2018

Molino *et al.* 2973, Alt. 2200 m, Dupl.: LAE
Identification: Damas 2019

Note: Molino *et al.* 2973 is considered as lost, the identification is based on field picture.

CONCLUSIONS

At least fourteen potentially new species have been detected at various altitudes, in the following genera: *Meiogyne* (Annonaceae), *Polyosma* (Escalloniaceae), *Dillenia* (Dilleniaceae), *Agalmyla* (Gesneriaceae), *Aglaia* and *Chisocheton* (Meliaceae), *Ficus* (Moraceae), *Pleioluma* (Sapotaceae), *Rinorea* (Violaceae), *Hydnophytum* (Rubiaceae).

The tropical island of New Guinea has long been recognized as a center of biological diversification, ranking among the world's most botanically diverse countries, with 13,634 species, 68% of which being endemic (Cámara-Leret *et al*. 2020).

New Guinea is still one of the least explored regions in the world, with vast areas considered wilderness remaining (Mittermeier et al. 2003), but at the same time, there is probably no other country whose citizens are more familiar with tropical forests and more comfortable living in them (Novotny & Molem 2020).

Finally, all the recent botanical explorations have led to the discovery of several undescribed species (*e.g.* Takeuchi 1999, 2003; Utteridge &Edwards 2009). This was also the case for this work, which is thus another contribution to the inventory of this poorly known flora. A comprehensive sampling was carried out in all the plots, allowing a very high level of identification. Furthermore, several of these collections were fertile, which made it possible to assign valid names in most cases, and to point out several potentially new species. Interestingly, yet not surprisingly, since our expedition was the first to cover a full altitudinal range of forests, those discoveries were evenly distributed along the transect. This suggests that there are still many new species to be found on the slopes of Mt Wilhelm.

ACKNOWLEDGMENTS

We thank all the specialists who provided identifications of our specimens. MNHN and MPU give access to the collections in the framework of the RECOLNAT national Research Infrastructure (ANR-11-INBS-0004). We thank Sébastien Levionnois who nicely mounted most of specimens deposited in MPU, and Laurent Pierron and Maurice Leponce who kindly gave use authorization to use some of their field photographs. We are indebted to people in herbaria who welcome and helped us in various way, Caroline Loup (MPU), Germinal Rouhan, Grégoire Flament, and Marc Pignal (P), Peter van Welzen, Nicolien Sol and Roxali Bijmoer (L). Work in Leiden was funded by a Synthesis program grant (NL-TAF-5610 to JM), thanks to Ronald Sluys. We thank Papua New Guinean authorities for collect permit. This study was conducted in the framework of "Our Planet Reviewed – Papua New Guinea 2012-2013" set up by Pro-Natura International, the National Museum of Natural History (MNHN, France), the Institut de Recherche pour le Developpement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New Caledonia Government, the Reef Foundation, FNRS (Belgium) and the Belgian National Lottery.

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Polyrhachis sexspinosa (Latreille, 1802), a species nesting in silk nests under leaves.
(Photo © Xavier Desmier; identification: Petr Klimes).

New findings of the subfamily Euphorinae (Hymenoptera: Braconidae) from Papua New Guinea, with descriptions, illustrations and molecular data

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ABSTRACT

Here we describe 21 new species of Braconidae in the subfamily Euphorinae from five different tribes: Euphorini: *Leiophron agovauae* n. sp., *Leiophron anthoferi* n. sp., *Leiophron barbarae* n. sp., *Leiophron chevalieri* n. sp., *Leiophron diluae* n. sp., *Leiophron gewai* n. sp., *Leiophron keltimi* n. sp., *Leiophron kepai* n. sp., *Leiophron lilipi* n. sp., *Leiophron mellifacialis* n. sp., *Leiophron pascali* n. sp., *Leiophron tulai* n. sp., *Leiophron umai* n. sp., *Leiophron winckleriae* sp.n., *Peristenus montwilhelmi* n. sp., *Peristenus quadriplex* n. sp.; Syntretini: *Syntretus amber* n. sp.; Townesilitini: *Streblocera rugosa* n. sp., *Streblocera semirugosa* n. sp.; Perilitini: *Microctonus madang* n. sp.; and Meteorini: *Meteorus braeti* n. sp. The descriptions are based on distinct morphological characters supplemented with molecular data. We also present genetic sequences for three *Meteorus* species (*Meteorus achterbergi*, *Meteorus obscurus*, *Meteorus tarius*) previously described by Huddleston, 1983. Finally, an identification key to the Papua New Guinean species of the genus *Leiophron* is provided.

RÉSUMÉ

Nouvelles découvertes dans la sous-famille Euphorinae (Hymenoptères : Braconidae) de Papouasie-Nouvelle-Guinée, avec descriptions, illustrations et données moléculaires.

Nous décrivons ici 21 nouvelles espèces de Braconidae dans cinq tribus différentes de la sous-famille Euphorinae : Euphorini : *Leiophron agovauae* n. sp., *Leiophron anthoferi* n. sp., *Leiophron barbarae* n. sp., *Leiophron chevalieri* n. sp., *Leiophron diluae* n. sp., *Leiophron gewai* n. sp., *Leiophron keltimi* n. sp., *Leiophron kepai* n. sp., *Leiophron lilipi* n. sp., *Leiophron mellifacialis* n. sp., *Leiophron pascali* n. sp., *Leiophron tulai* n. sp., *Leiophron umai* n. sp., *Leiophron winckleriae* sp.n., *Peristenus montwilhelmi* n. sp., *Peristenus quadriplex* n. sp. ;

STIGENBERG J. & ZHANG Y. M. 2020 — New findings of the subfamily Euphorinae (Hymenoptera: Braconidae) from Papua New Guinea, with descriptions, illustrations and molecular data, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 143-190 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

Syntretini : *Syntretus amber* n. sp. ; Townesilitini : *Streblocera rugosa* n. sp., *Streblocera semirugosa* n. sp. ; Perilitini : *Microctonus madang* n. sp. ; et Meteorini : *Meteorus braeti* n. sp. Ces descriptions sont basées sur des caractères morphologiques distincts que complémentent des données moléculaires. Nous présentons également des séquences génétiques de trois espèces de *Meteorus* (*Meteorus achterbergi*, *Meteorus obscurus*, *Meteorus tarius*) précédemment décrites par Huddleston, 1983. Finalement, une clé d'identification des espèces du genre *Leiophron* de Papouasie-Nouvelle-Guinée est fournie.

INTRODUCTION

In 2012 the biotic inventory "Our Planet Reviewed" program was conducted on Mount Wilhelm, the highest peak of Papua New Guinea (PNG) (4509 m); and at Wanang, a lowland rainforest station near Madang (Braet 2016). Numerous new species and new records have been documented as a result of this program and are presented in the book *Insects of Mount Wilhelm, Papua New Guinea* Volume I (Robillard *et al.* 2016). In the same volume, 18 new species of Braconidae (Hymenoptera) from 6 different subfamilies were presented (Belokobylskij 2016, Braet 2016, Quicke & Butcher 2016). This study continues the study on the PNG Braconidae, with a focus on the subfamily Euphorinae.

The braconid subfamily Euphorinae is a large, cosmopolitan group of endoparasitoid wasps. The majority of euphorines attack adult hosts, but many species also attack nymphs and larval stages. Euphorines parasitize hosts from a variety of insect orders (Coleoptera, Hemiptera, Hymenoptera, Neuroptera, Psocodea, Orthoptera and Lepidoptera) although the ground plan for host preferences seems to be confined to Coleoptera (Stigenberg *et al.* 2015).

Prior to this study the knowledge of Euphorinae from Australasia was very limited. Huddleston (1983) documented 23 species of the *Meteorus* fauna from Australasia and van Achterberg & Quicke (2000) documented 22 species of the tribe Cosmophorini from the Palaeotropics. Chou (1990) and Papp (2004) revised the *Streblocera* and *Syntreus* of Taiwan, respectively. Finally, Gloag *et al.* (2009) described a new species of *Syntretus* from Australia. Regarding species of *Peristenus* and *Leiophron* there are no prior described species from PNG or Australasia. Zhang *et al.* (2018) also included sequences of six undescribed species of *Leiophron* in building the phylogeny of Euphorini, these species are herein formally described.

MATERIAL AND METHODS

All species described here were collected with Malaise traps during the "Our Planet Reviewed – Papua New Guinea" expedition, from October 25 to November 10 in 2012 at eight sites placed every 500 m along an altitudinal transect on the north-eastern face of Mount Wilhelm; and at Wanang (Swire) Research Station (175 m above sea level), a lowland forest 63 km north of Mount Wilhelm. At each sampling site, four Malaise traps were set up every 100 m following the same contour line. The samples were collected daily and stored in 90% EtOH in zip-lock bags. Samples were sorted to order, and then exported to Muséum national d'Histoire naturelle (MNHN) for further processing (Leponce *et al.* 2016).

Molecular protocol: Specimens were extracted, amplified at the Molecular Systematics Laboratory, Swedish Museum of Natural History. DNA was extracted from ethanol-preserved specimens following the Qiagen protocol from the DNeasy Tissue Kit using one or two legs (Qiagen, Valencia, CA, U.S.A.). Two markers were sequenced when possible, the mitochondrial gene cytochrome oxidase 1 (*COI*; 658 bp) and the D2 loop of the nuclear *28S* ribosomal sequence (*28S* D2; 632 bp). The *COI* primers used were LCO and HCO (Folmer *et al.* 1994), while *28S* D2 was sequenced using the fwd and rev primers used by Campbell *et al.* (1993). The PCR program for *COI* had an initial 5 min denaturation at 94°C, followed by 40 cycles of (94°C for 15 s, 46°C for 15 s and 72°C for 15 s), and ending with a 10 min extension period at 72°C. The PCR program for *28S* D2 had an initial 4 min denaturation at 95°C, followed by 40 cycles of (94°C for 30 s, 55°C for 30 s and 72°C for 30 s), and ending with a 10 min extension period at 72°C. These genes have been successfully used in previous studies of braconid phylogenetics at various levels (Belshaw *et al.* 2000; Belshaw & Quicke 2002; Dowton *et al.* 2002; Zaldivar-Riverón *et al.* 2006; Sharanowski *et al.* 2011; Stigenberg & Ronquist 2011). Product yield, specificity of amplification and contamination were investigated using agarose gel electrophoresis. DNA fragments were amplified using Ready-To-Go PCR beads (Amersham Pharmacia Biotech, Amersham, U.K.). PCR products were

purified using EXOFAP (EXO1 and FastAP). Gene regions were sequenced with the same primers, sequencing reactions were purified using the DyeEx 96 kit (Qiagen) and sequenced using Macrogen sequencing services. Gene regions were sequenced in both directions. Sequences were assembled and edited using Geneious Pro 9.1.8. The Voseq 1.7.3 database (Peña & Malm 2012) was used for storing voucher and DNA sequence data. Some sequences have been used for other publications (Stigenberg *et al.* 2015, Zhang *et al.* 2018) and thus uploaded at different times but they are formally described herein together with their voucher specimens (Table 1).We largely follow Zhang *et al*. (2018) in the downstream analyses of the Euphorini molecular data, using MAFFT server (Katoh *et al.* 2002) default settings for *COI* and Q-INS-I strategy for *28S* which takes secondary structure into account (Katoh & Toh 2008). We conducted phylogenetic analyses of the PNG Euphorini under the maximum likelihood criterion with IQ-TREE v.1.69 (Nguyen *et al.* 2015). Additional sequences from identified specimens of *Leiophron* and *Peristenus* were supplemented from previous published studies (Stigenberg *et al.* 2015, *Zhang et al.* 2017, 2018), as well as the *Microctonus* sp. that is used as the outgroup. The best models of nucleotide substitution for both genes, and partitioning schemes based on codon positions for *COI* were determined with ModelFinder (Kalyaanamoorthy *et al.* 2017) in IQ-TREE: *28S*, TVM+F+G4; *COI*_pos1, TPM3u+F+G4; *COI*_pos2, TPM2u+F+I+G4; and *COI*_pos3, TPM2+F+R2. To assess nodal support, we performed 1000 ultrafast bootstrap replicates (UFBoot2, Hoang *et al.* 2017) were conducted using "-bb", along with "-bnni" to reduce risk of overestimating branch supports. The resulting phylogenetic tree was modified using Adobe Illustrator. Terminology for species description follows Wharton *et al.* (1997) and Stigenberg *et al.* (2015). A character important for the genus *Meteorus* is the ocellar-ocular length, the length of lateral ocelli versus the distance to the eye, abbreviated as OOL. Specimens were photographed using a Canon D50 with a microscope objective (10X) mounted on a bellow or using a MP-E 65 mm lens, custom-made diffusers were used to reduce hot spots. Images were stacked using Zerene Stacker software. Images are that of the holotypes (n = 19), with the exception of *Meteorus achterbergi*, *M. tarius* and *M. obscurus*, where we used images from fresh specimens.

TABLE 1
Overview table of species names, voucher codes and GenBank ID numbers.

VOUCHER CODE	SPECIES NAME	*COI*	*28S*
01_Yves	*Streblocera semirugosa*	KJ591420	KJ591205
02_Yves	*Streblocera rugosa*	KJ591421	KJ591206
03_Yves	*Microctonus madang*	-	KJ591265
04_Yves	*Syntretus amber*	-	MH464440
05_Yves	*Peristenus montwilhelmi*	MH464428	-
07_Yves	*Leiophron anthoferi*	MG926854	MG913702
08_Yves	*Leiophron mellifacialis*	MG926855	MG913703
09_Yves	*Peristenus quadriplex*	MH464429	MH464441
10_Yves	*Leiophron umai*	MG926856	MG913704
11_Yves	*Leiophron tulai*	MH464430	MH464442
12_Yves	*Leiophron chevalieri*	MH464431	-
13_Yves	*Leiophron diluae*	MH464432	MH464443
14_Yves	*Leiophron kepai*	MH464433	MH464444
JS10_00532	*Meteorus achterbergi*	KJ591543	KJ591343
JS10_00567	*Meteorus braeti*	MH464434	MH464445
JS10_00568	*Meteorus obscurus*	-	MH464446
JS10_00571	*Meteorus tarius*	MH464435	MH464447
JS10_00572	*Meteorus braeti*	-	MH464448
PNG_1	*Leiophron agovauae*	MH464436	MH464449
PNG_2	*Leiophron gewai*	MH464437	MH464450
PNG_3	*Leiophron lilipi*	MH464438	MH464451
PNG_4	*Leiophron barbarae*	MH464439	MH464452
PNG_5	*Leiophron keltimi*	MG926872	MG913714
PNG_6	*Leiophron pascali*	MG926873	MG913715
PNG_7	*Leiophron winckleriae*	MG926874	MG913716

RESULTS AND DISCUSSION

A total of 21 news species of Euphorinae (Braconidae) were identified from the PNG material, but mostly as singletons with one specimen per species. The majority of the diversity is within the tribe Euphorini, with 14 new species of *Leiophron* and 2 new species of *Peristenus*. The PNG *Leiophron* is divided into two clades (Figure 1), with Clade 1 containing specimens with infuscate wings and basal cell of fore wing totally lacking or having only few setae (*L. anthoferi*, *L. barbarae*, *L. keltimi*, *L. pascali*, *L. winckleriae*). Specimens in this clade closely resembling the genus type *Leiophron apicalis*, and other western Palearctic species such as *Leiophron deficiens*. Clade 2 consists of specimens that are darker in general body colour (*L. agovauae*, *L. chevalieri*, *L. diluae*, *L. gewai*, *L. kepai*, *L. lilipi*, *L. mellifacialis*, *L. tulai*, *L. umai*), and most closely related to the western Palearctic species such as *Leiophron basalis* and *Leiophron oblitus*. However, the relationships shown within *Leiophron* in this study is not robust given the low ultrafast bootstrap support, likely resulting from the low-resolution power of *28S* at the species level. The two species of PNG *Peristenus* form a strongly supported monophyletic group, and is sister to the rest of Palearctic and Nearctic *Peristenus* species (Figure 1).

The molecular difference between the *Leiophron* species of PNG as a group was on average 10-20 nucleotides more in comparison to the nucleotide differences among the Western Palaearctic species. The least difference among the PNG species was found between *L. diluae* and *L. agovauae* (47 nucleotides). The first author has examined the paratype material at the BMNH and concludes that the identity of *Meteorus obscurus* and *M. achterbergi* are correct. Huddleston (1983) remarks on a species very close to *M. achterbergi* that differs on "numerous enough" characters and thus he does not include it in *M. achterbergi*. We have come to the judgement that the material we have identified as *M. achterbergi* from PNG are indeed *M. achterbergi* described by Huddleston in 1983.

Given the high level of diversity of Euphorinae as a result of this limited sampling in PNG, the actual number of species for this group and in the region is likely much higher. We recommend establishing long term collaboration with the Papua New Guinean and Indonesian government to continue the sampling efforts in order to better understand the tremendous parasitoid diversity of New Guinea and their surrounding islands.

KEY TO THE SPECIES OF GENUS *LEIOPHRON* FROM PAPUA NEW GUINEA

1. Fore wings with darker band centrally (Figures 15, 78), fore wing basal cell often lacking setae. Scutellum acutely pointed (Figures 8, 74). Petiole distinctly bent and fused all of its ventral length (Figures 7, 8), yellow to brownish colour **2**
– Fore wings without dark band, fore wing basal cells setate. Scutellum not acutely pointed, a more flattened appearance (Figures 2, 29). Petiole straight and only touching ventrally. Dark brown species **5**

2. Larger species > 2.0 mm. Basal cell with some setae, though setae short (Figure 15). Fore and middle coxae white. Body brownish (Figure 10) ..... *L. barbarae* n. sp.
– Smaller species, < 2.0 mm. Basal cells mostly without setae (Figures 56, 78). Fore and middle coxa yellow to yellowish brown (Figures 6, 56, 72). Yellow species **3**

3. Palpi brown (Figure 73). Scutellum and propodeum with acute points (Figure 74), lateral sides of mesosoma smooth, with some weak longitudinal striae but no deep structures ..... *L. winckleriae* n. sp.
– Palpi yellow. Only scutellum with an acute point (Figures 8, 56), lateral sides of mesosoma variable, either a rugose sternaulus (Figure 6) or completely smooth (Figure 56) **4**

4. Antennae apically square, lateral sides of mesosoma smooth (Figure 56). Yellow species .... *L. pascali* n. sp.
– Antennae apically longer than wide, lateral sides of mesosoma with a rugose sternaulus (Figure 6), yellow to brownish species ..... *L. anthoferi* n. sp.

5. Fore and middle legs whitish, basal antennae yellowish-white (Figures 2, 16, 20, 26, 42) **6**
– All legs yellowish to brown, basal antennae yellow to brown (Figures 31, 35, 47, 60, 66) **10**

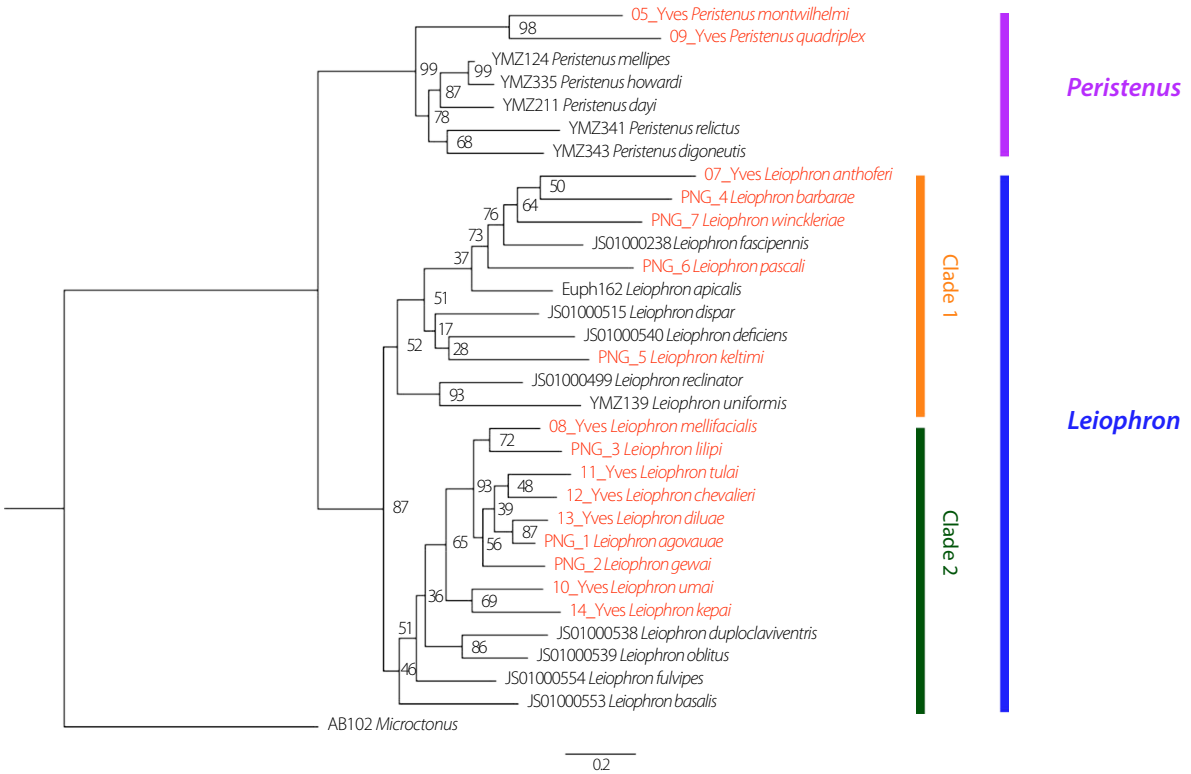


FIGURE 1

Concatenated *COI* and *28S* gene tree of Euphorini including *Peristenus* (purple) and *Leiophron* (blue) using IQ-Tree, with ultrafast bootstrap (UFBoot2) nodal support. *Leiophron* is further divided into two clades (orange, green). Newly described Papua New Guinea species are in red.

6. Mandibles brown/yellow with darker teeth, clypeus brown (Figures 27, 43), basal antennae pale yellow (Figures 26, 42) **7**
– Mandibles whitish with darker teeth, clypeus white or partly white (Figures 3, 17, 21) **8**

7. Hind legs whitish yellow, all coxae pale with base brown (Figure 26), notauli absent or very weakly impressed (Figure 30) ..... *L. gewai* n. sp.
– Hind legs yellowish brown, all coxae brown (Figure 42), notauli punctate (Figure 45) ..... *L. lilipi* n. sp.

8. Face and clypeus white (Figure 17) ..... *L. chevalieri* n. sp.
– Face brown, clypeus partly brown (Figures 3, 21) **9**

9. Specimen dark brown, mesosoma with weak sternaulus (Figure 2), slightly wider clypeus, 2.6X wider than high (Figure 3) ..... *L. agovauae* n. sp.
– Specimen light brown, without sternaulus (Figures 20, 22), clypeus 2.3X wider than high (Figure 21) .....
..... *L. diluae* n. sp.

10. Notauli absent (Figure 33) **11**
– Notauli present, sometimes weak (Figures 39, 70) **12**

11. Sternaulus deeply impressed (Figure 31), scape flattened, antennae 14 segmented ..... *L. keltimi* n. sp.
– Sternaulus absent or very weak (Figure 62), scape of normal shape, antennae 16 segmented .....
..... *L. tulaii* n. sp.

12. Notauli weakly impressed as a line (Figure 53), the male has a swollen fore femur with excavated structures (Figures 54, 55) and a peculiarly small clypeus (Figure 50), mesosoma without any traces of a sternaulus (Figure 48) ..... *L. mellifacialis* n. sp.
– Notauli visibly impressed and punctate (Figures 39, 70), clypeus normal and mesosoma with sternaulus (Figures 37, 68) **13**

13. Sternaulus wide and fairly deep (Figure 37), notauli ending bluntly towards the scutellar sulcus (Figure 39) ..... *L. kepai* n. sp.
– Sternaulus narrow and weak but present (Figure 68), notauli delicately impressed ending with a sharp point or narrow point (Figure 70) ..... *L. umai* n. sp.

TAXONOMIC PART

Subfamily EUPHORINAE Förster, 1862

Genus ***LEIOPHRON*** Nees, 1818

Leiophron Nees, 1818: 303

Type species. *Leiophron apicalis* Haliday, 1833.

Leiophron agovauae n. sp.

Figures 2-5

TYPE MATERIAL — Holotype, ♀♂, **Papua New Guinea**. Province Madang, Mount Wilhelm 1200 m (-5.720903, 145.2715) 1200 m, 06-07/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW1200C-13/16-d13, P1822-11346; Voucher ID: PNG_1 (MNHN). GenBank ID: MH464436 (*COI*), MH464449 (*28S*).

DIAGNOSIS — Grouped together with the other small, pale and brown *Leiophron* species from PNG, this species is characterised by a dark brown colour but having the mandibles and clypeus pale. The closely related species *L. diluae* has the same features of a pale clypeus and mandibles but the body colour is light brown and the clypeus slightly higher. *L. chevalieri* has the whole face and clypeus white.

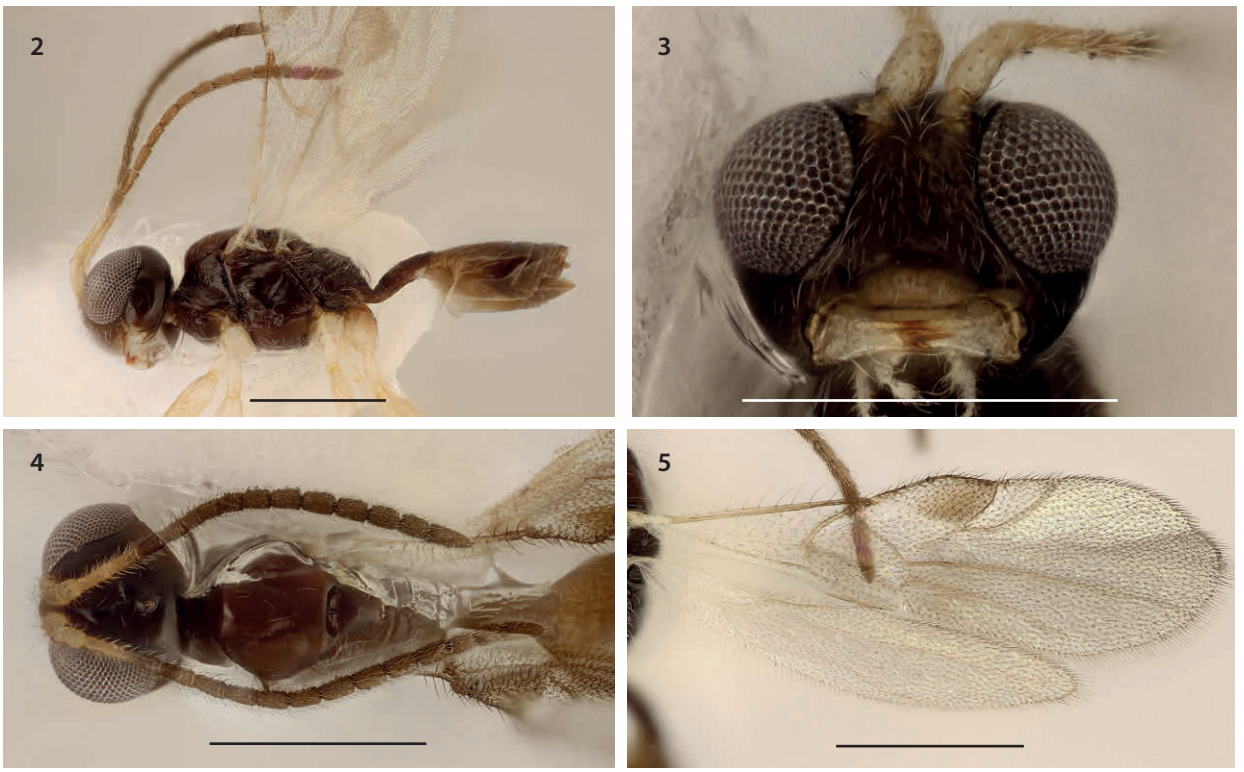
DESCRIPTION — *Colour.* Dark brown, head black, first four segments of antennae yellow, following segments browner. Clypeus yellow, mandibles and palpi light yellow to white, mandible teeth reddish brown. Mesosoma dark brown. Wing veins and pterostigma light brown to yellow. Legs pale yellow to white, only hind coxae brown. Metasoma dark brown.

Head. Antenna 16 segmented, first flagellomere 2.75X longer than wide, the following segments longer than wide. Face 1.6X wider than long. Face weakly punctate, setose with long setae. Clypeus slightly wider than face. Clypeus 2.60X wider than clypeus height. Occipital carina interrupted, vertex smooth.

Mesosoma. Notauli present as weak punctures, mesonotum, mesopleuron smooth except sternaulus present as small rugose dots. Propodeum with median carina and propodeal areola, in between the carinae smooth. Postpectal carina strong ventrally, laterally absent.

Metasoma. Petiole rugose and sparsely striate, with spiracle slightly apical to middle, petiole not fused ventrally. Gaster 1.6X the length of petiole.

Wings. Fore wing M-Cu spectral, basal and subbasal cell less setose. Pterostigma 2X wider than R1, fore wing vein r absent, 1st submarginal and 1st discal cell open.



FIGURES 2-5

Holotype *Leiophron agovauae* n. sp. **2**, lateral view of habitus; **3**, front view of head; **4**, dorsal view of head and mesosoma; **5**, wings. Scale bars: 0.5 mm.

Legs. Fore femur 3.4X as long as its maximum width. Hind femur 3.6X as long as its maximum width.

MEASUREMENTS — 1.6 mm in length, fore wing length 1.5 mm.

ETYMOLOGY — This species is named in honour of one of the notable Hymenoptera sorters within the project; Sharon Agovaua, from the National Agricultural Research Institute, Papua New Guinea.

Leiophron anthoferi n. sp.

Figures 6-9

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm 200 m (-5.739897, 145.3297) 200 m, 31/10-01/11/2012, leg Dilu, Ray, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW0200A-07/16-d07, P1004-11966; Voucher ID: 07_Yves (MNHN). GenBank ID: MG926854 (*COI*), MG913702 (*28S*).

DIAGNOSIS — Differs from the similar species *L. pascali* by its slightly darker colour, the white palpi and the shape of flagellomeres, which is longer than wide.

DESCRIPTION — *Colour.* Antennae, head, forelegs and apical part of thorax yellowish and body gradually darkening distally, abdomen dark brown. All tarsi white, in contrast with rest of leg. Wings brownish infuscate, pterostigma dark brown with basal translucent area.

Head. Antenna with 16 segments, slender basally, thickening apically. First flagellomere 2.6X longer than wide. Face wide and with very short setae, 1.9X as wide as high. Clypeus 0.6X face width, clypeus 2.4X as wide as high. Malar space 1.4X width of mandible base. Occipital carina incomplete, only present laterally. Vertex with few short setae.

Mesosoma. Notauli indicated apically with carina and with few shallow punctures, mesoscutum smooth and not setate, scutellum pointed but with a blunt point. Scutellar sulcus with median carinae. Epicnemial carina and postpectal carina present. Mesopleuron irregularly rugose. Propodeum finely areolet-reticulate, not sharply angulated but smooth.

Metasoma. Petiole with longitudinal striae dorsally and ventrally. Dorso-basally the petiole is softly rugose halfway, striate afterwards. Petiole fused ventrally except basally where the triangular area is elongate. Spiracles in basal ⅓. Length of petiole 4.2X its apical width. Gaster 1.3X the length of petiole.



FIGURES 6-9

Holotype of *Leiophron anthoferi* n. sp. **6**, lateral view of head and mesosoma; **7**, front view of head; **8**, lateral view of propodeum and abdomen; **9**, ventral view of mesosoma and petiole. Scale bars: 0.5 mm.

Wings. Fore wing M-Cu spectral. Most fore wing veins spectral or absent except vein 1-M which is wider than ordinary. Fore wing vein 3RSb nebulous. Pterostigma 4.6X wider than R1, dark brown and basally white. Wings infuscate with translucent band in the middle. Fore wing basal and subbasal cells glabrous.

Legs. Fore femur 3.0X as long as its maximum width. Hind femur 3.6X as long as its maximum width. All femurs and tibiae with 'scale like' microstructure.

MEASUREMENTS — 1.8 mm in length, fore wing length 1.3 mm.

ETYMOLOGY — This species is named in honour of Fariz Anthofer, a devoted student from the Université de Nouvelle-Calédonie who helped with sorting this material.

NOTE — This specimen was labelled as "07_Yves_Leiophron_PNG" in Zhang *et al.* (2018).

Leiophron barbarae n. sp.

Figures 10-15

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797) 175m, 24-25/11/2012, leg Basset, Plot 1, understorey; Malaise - MAL-WAN01-D07 P4906-935; Voucher ID: PNG_4 (MNHN). GenBank ID: MH464439 (*COI*), MH464452 (*28S*).

DIAGNOSIS — This beautiful and large species is distinct with its dark brown colour with contrasting white coxae. The similar species are smaller and lighter in colour.

DESCRIPTION — *Colour.* Head and clypeus brown; mandibles and three first antennal segments yellow; rest of body dark brown/black. Fore and middle coxae and trochanter white, hind coxa and femur brown but trochanter white, all tarsi yellow. Wings infuscate, pterostigma brown and basally translucent.

Head. Antenna broken after 6th segment, first flagellar segment 5X longer than wide, following two segments also slender. Face smooth, 1.3X as wide as high, sparsely setose with short setae, gena sparsely setose. Clypeus slightly wider than face, (1.05X) truncate. Vertex smooth. Malar space 0.7X width of mandible base. Occipital carina incomplete.

Mesosoma. Mesoscutum highly, roundly elevated above pronotum. Notauli absent, mesonotum largely smooth with a few umbilicate punctures. Scutellum distinctly raised to a projection past scutellar sulcus, seen as a triangle in lateral view. Epicnemial carina present. Mesopleuron with deep, rugose sternaulus that almost reaches ventrally, otherwise smooth. Postpectal carina ventrally distinct, laterally absent. Propodeum areolate-weakly rugulose.

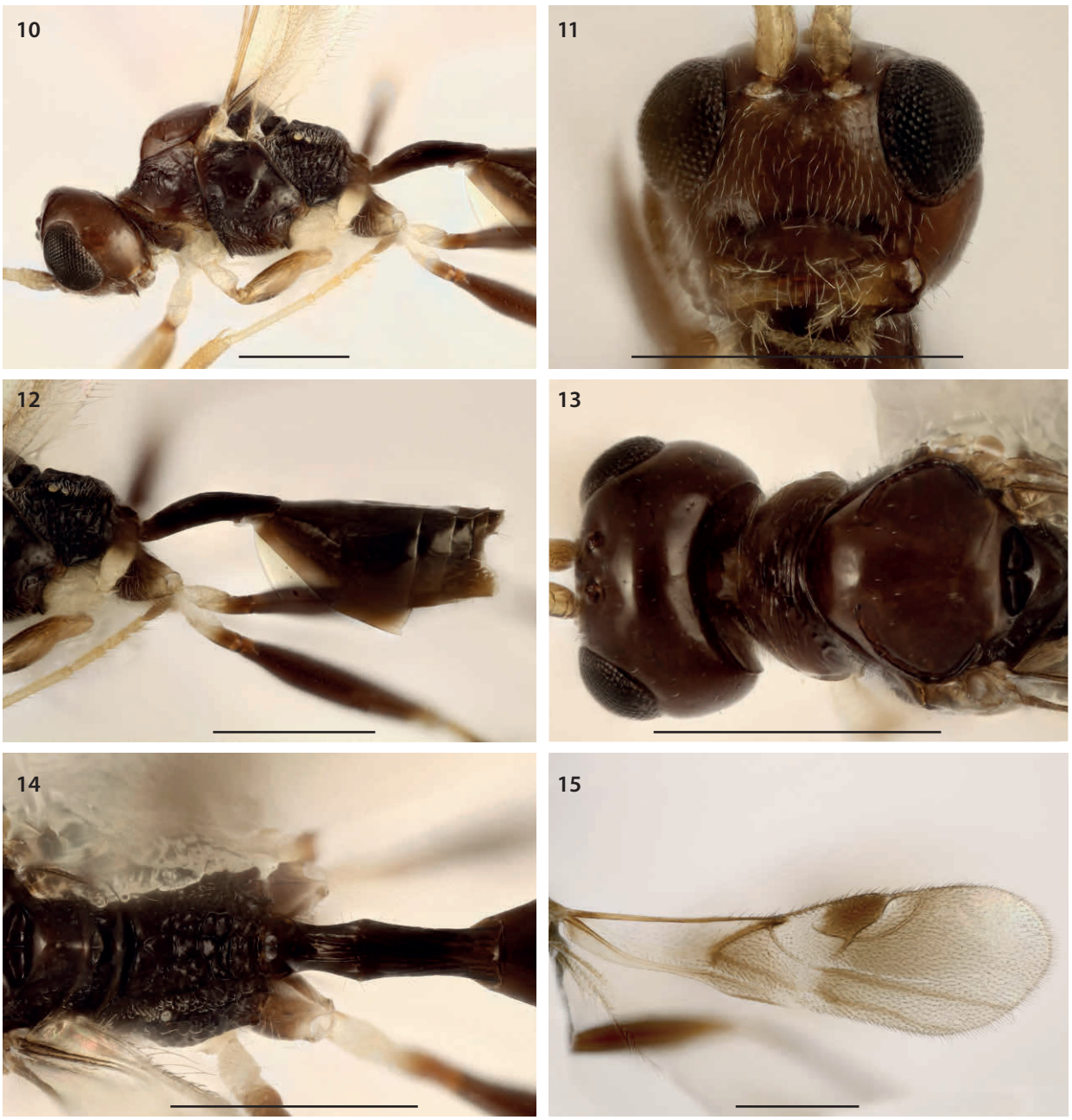
Metasoma. Petiole slender with long sparse striae, spiracles situated in basal ⅓. Length of petiole 3.5X its apical width, fused ventrally. Gaster 1.5X length of petiole.

Wings. Fore wing M-Cu spectral, basal and subbasal cell sparsely setose. Vein r absent, 1st submarginal and 1st discal cell open distally. Pterostigma 3.3X wider than R1.

Legs. Fore femur 4.4X as long as its maximum width. Hind femur 5X as long as its maximum width.

MEASUREMENTS — 2.4 mm in length, fore wing length 2.0 mm.

ETYMOLOGY — Named in honour of Dr Barbara Sharanowski, the PhD advisor of the second author, for her guidance and patience.



FIGURES 10-15

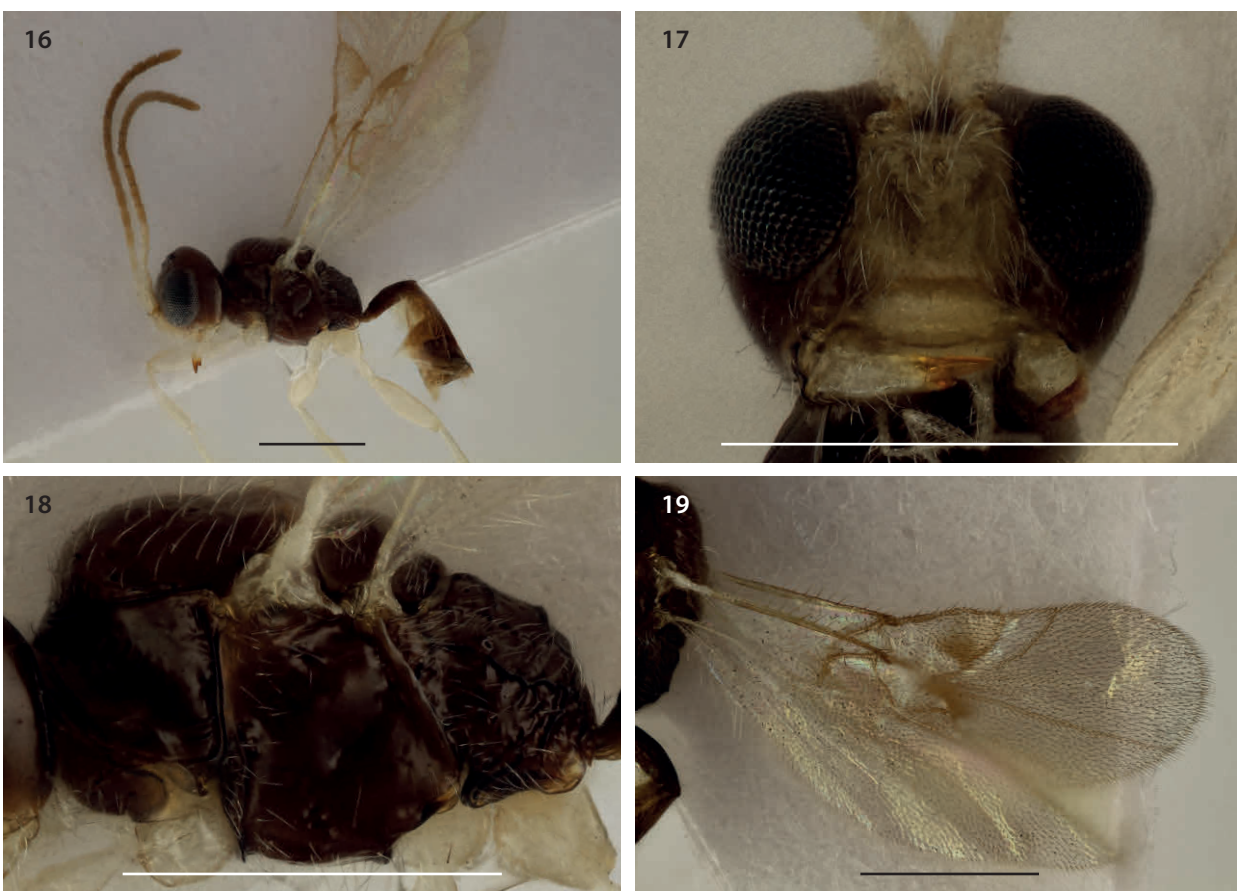
Holotype *Leiophron barbarae* n. sp. **10**, lateral view of mesosoma; **11**, front view of head; **12**, lateral view of metasoma; **13**, dorsal view of head and mesosoma; **14**, dorsal view of propodeum and petiole; **15**, fore wing. Scale bars: 0.5 mm.

Leiophron chevalieri n. sp.

Figures 16-19

TYPE MATERIAL — Holotype , ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm 1200 m (-5.721022, 145.2703) 1200 m, 03-04/11/2012, leg Philip, Alois, Novotny, Leponce Plot 2, understorey; Malaise - MAL-MW1200B-10/16-d10, P1803-11328; Voucher ID: 12_Yves (MNHN). GenBank ID: MH464431 (*COI*), N/A (*28S*).

DIAGNOSIS — Very peculiar species with a white face, a character not so common among the Braconidae.



FIGURES 16-19

Holotype *Leiophron chevalieri* n. sp. **16**, lateral view of habitus; **17**, front view of head; **18**, lateral view of mesosoma; **19**, fore wing. Scale bars: 0.5 mm.

DESCRIPTION — *Colour.* Specimen with brown head, mesosoma and abdomen. Face, mandibles (except teeth) and legs white, only last tarseromere slightly brownish. Antennal segments basally white, darkening gradually apically. Pterostigma light dark brown with basal translucent area.

Head. Antenna with 16 segments, stout. Face 1.1X as wide as high, flat, dense with long setae. Clypeus as wide as face, 2.5X wider than high. Malar space 0.75X width of mandible base. Occipital carina incomplete, only present laterally. Vertex with long setae. Upper mandible tooth long, 3X longer than lower tooth.

Mesosoma. Notauli punctate, mesoscutum smooth with long setae, scutellum flattened. Epicnemial carina present. Postpectal carina present and distinct. Mesopleuron smooth. Propodeum with median latitudinal carina, smooth in between, gently sloping towards petiole.

Metasoma. Petiole with dorsope, dorsally with few longitudinal striae. Petiole not fused ventrally. Length of petiole 2.0X its apical width. Gaster 1.8X the length of petiole.

Wings. Fore wing M-Cu spectral. Fore wing vein r absent, 1st submarginal and 1st discal cell open distally. Wings translucent. Pterostigma 1.8X wider than R1.

Legs. Fore femur 2.9X as long as its maximum width, hind femur 3.9X as long as its maximum width.

MEASUREMENTS — 1.8 mm in length, fore wing length 1.8 mm.

ETYMOLOGY — This species is named in honour of Dr. Cyril Chevalier who happily volunteers to any expedition.

Leiophron diluae n. sp.

Figures 20-25

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm 1200 m (-5.720874, 145.2695) 1200 m, 05-06/11/2012, leg Philip, Alois, Novotny, Leponce Plot 4, understorey; Malaise - MAL-MW1200D-12/16-d12, P1837-11340; Voucher ID: 13_Yves (MNHN). GenBank ID: MH464432 (*COI*), MH464443 (*28S*).

DIAGNOSIS — Belonging to the pale-legged *Leiophron* group, but also with a pale-brown clypeus, this species is similar to *L. agovauae* but lacks the deep brown colour and the sternaulus.

DESCRIPTION — *Colour.* Reddish-brown, antennae light yellow basally and darkening apically, wing veins and pterostigma yellow, legs white. Posterior half of metasoma brown. Mandible white with brown teeth.

Head. Antenna 16 segmented, first flagellomere 3.6X longer than wide, the following segments longer than wide. Head 1.4X as wide as long. Face 1.6X as wide as long, evenly setose with long hairs, not appressed. Clypeus flat, 2.25X wider than high. Clypeus just slightly wider than face (1.1X). Height of malar space 0.7X that of basal width of mandible. Vertex smooth. Occipital carina incomplete. Only occiput and stemmaticum with few setae, length of setae twice the diameter of ocelli.

Mesosoma. Notauli present apically, mesoscutum sparsely setose. Scutellar sulcus with distinct fovea, with one median longitudinal carina. Epicnemial carina present. Mesopleuron largely smooth, sternaulus very shallow. Postpectal carina strong. Propodeum areolate, smooth in between carinae.

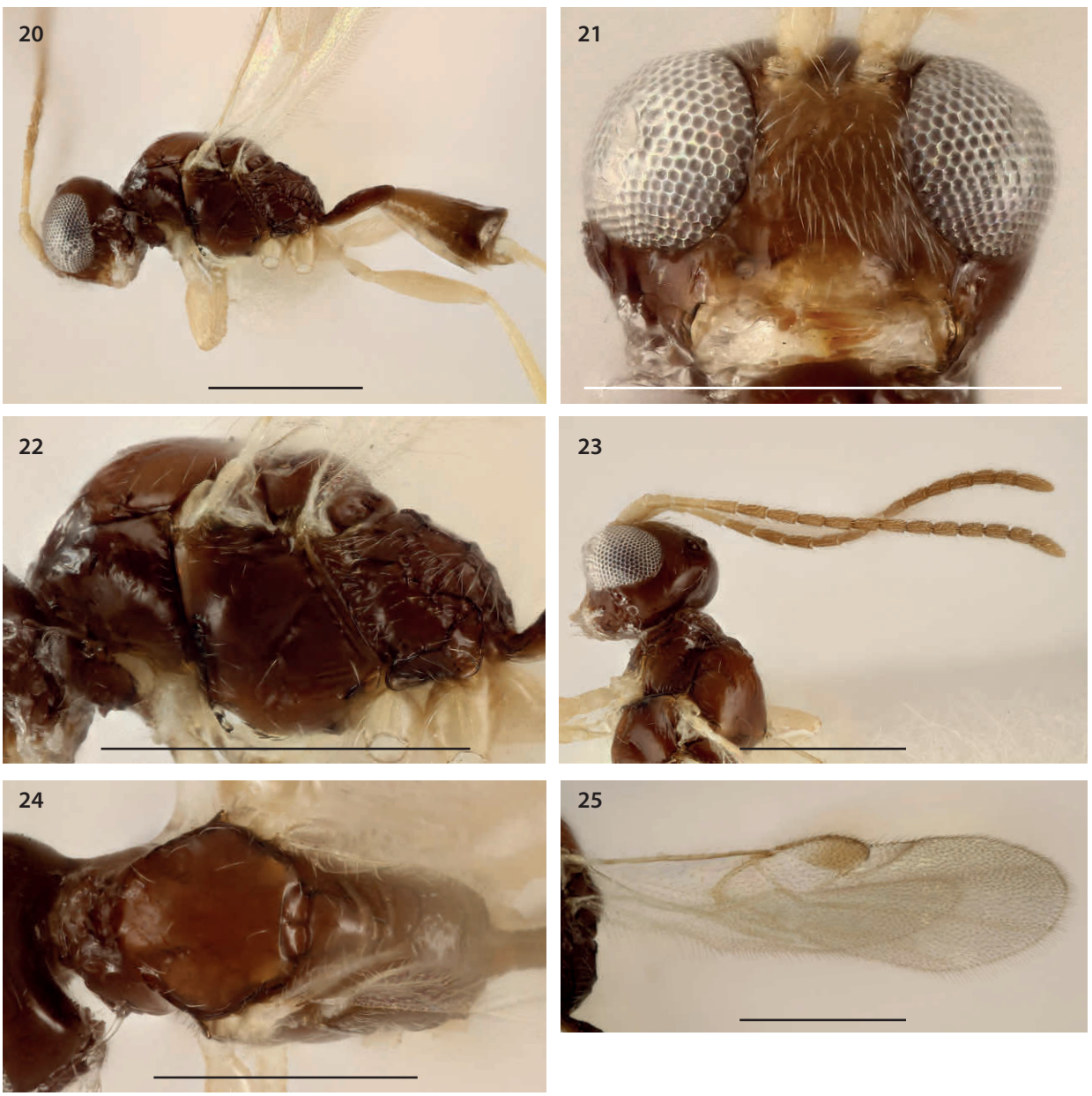
Metasoma. Petiole rugulose, dorsope present, with spiracular tubercle in basal 1/2. Sparsely setate (< 5 setae) surrounding the spiracle. Length of petiole 3.0X its apical width, not touching in ventral view. Gaster 1.5X the length of petiole.

Wings. Fore wing M-Cu weakly spectral, basal and subbasal cell sparsely setose. r, r-m, absent, 1st submarginal and 1st discals cell incomplete. Vein 2RS spectral. Hindwing basal cell complete, subbasal cell absent.

Legs. Fore femur 3.1X as long as its maximum width. Hind femur 4.0X as long as its maximum width.

MEASUREMENTS — 1.6 mm in length, fore wing length 1.6 mm.

ETYMOLOGY — This species is named after Mary Dilu, a member of the New Guinea Binatang Research Center who participated in this project and contributed with sorting material.



FIGURES 20-25

Holotype *Leiophron diluae* n. sp. **20**, lateral view of habitus; **21**, front view of head; **22**, lateral view of mesosoma; **23**, lateral view of head and antennae; **24**, dorsal view of mesosoma; **25**, fore wing. Scale bars: 0.5 mm.

Leiophron gewai n. sp.

Figures 26-30

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm 700 m (-5.732698, 145.2556) 700 m, 26-27/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0700B-02/16-d02, P1405-11987; Voucher ID: PNG_2 (MNHN). GenBank ID: MH464437 (*COI*), MH464450 (*28S*).











FIGURES 26-30

Holotype *Leiophron gewai* n. sp. **26**, lateral view of habitus; **27**, front view of head; **28**, lateral view of abdomen; **29**, lateral view of head and mesosoma; **30**, dorsal view of head and mesosoma. Scale bars: 0.5 mm.

DIAGNOSIS — This species is characterised by a dark brown colour with mandibles yellow with dark teeth and clypeus brown. The closely related species *L. gewai*, *L. agovauae* and *L. diluae* all have a paler clypeus.

DESCRIPTION — *Colour.* Generally, mesosoma black, clypeus dark brown, mandibles brownish yellow. Antennae yellow, first four segments pale yellow. Wing colour infuscate, venation and pterostigma brownish, pterostigma basally translucent. Legs pale yellow, hind coxae brown. Metasoma dark brown.

Head. Antenna 16 segmented, first flagellomere 4.3X longer than wide, the following segments longer than wide. Face as wide as long, sparsely setose with long setae, length of setae > clypeus height, setae shorter nearer the eyes. Clypeus slightly wider than face, 2.8X wider than high. Antennae basally long and slender. Occipital carina incomplete, vertex smooth.

Mesosoma. Notauli present with faint punctures and a few long setae, mesonotum smooth. Epicnemial carina present, laterally associated with rugosity.

Metasoma. Petiole dorsally with small dorsope and rugulose structure, length of petiole 3X its apical width, minute spiracles situated before middle. Gaster 1.8X the length of petiole.

Wings. Fore wing M-Cu spectral, basal and subbasal cell less setose. 1st submarginal and 1st discal cell open distally. Pterostigma 3X wider than R1, fore wing vein r absent.

Legs. Fore femur 3.2X as long as wide (1.6 long/0.5 wide). Hind femur 3.8X as long as wide.

MEASUREMENTS — 1.9 mm in length, fore wing length 1.9 mm.

ETYMOLOGY — This species is named in honour of one of the notable hymenoptera sortes within the project, Bradley Gewa from the Binatang Research Center, Papua New Guinea.

Leiophron keltimi n. sp.

Figures 31-34

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm 3200 m (-5.806944, 145.0721) 3200 m, 20-21/10/2012, leg Dahl, Kaupa, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW3200C-05/16-d05, P3374-8873; P3374; Voucher ID: PNG_5 (MNHN). GenBank ID: MG926872 (*COI*), MG913714 (*28S*).

DIAGNOSIS — *L. keltimi* has a unique appearance regarding shape of the head, the flattened shape of the scape and the colour of all the legs.

DESCRIPTION — *Colour.* Dark specimen with black body, antennae basally yellow and darkening apically. Femur and coxae brown otherwise legs pale yellowish to brown. Wings infuscate, pterostigma brown with small translucent basal spot.

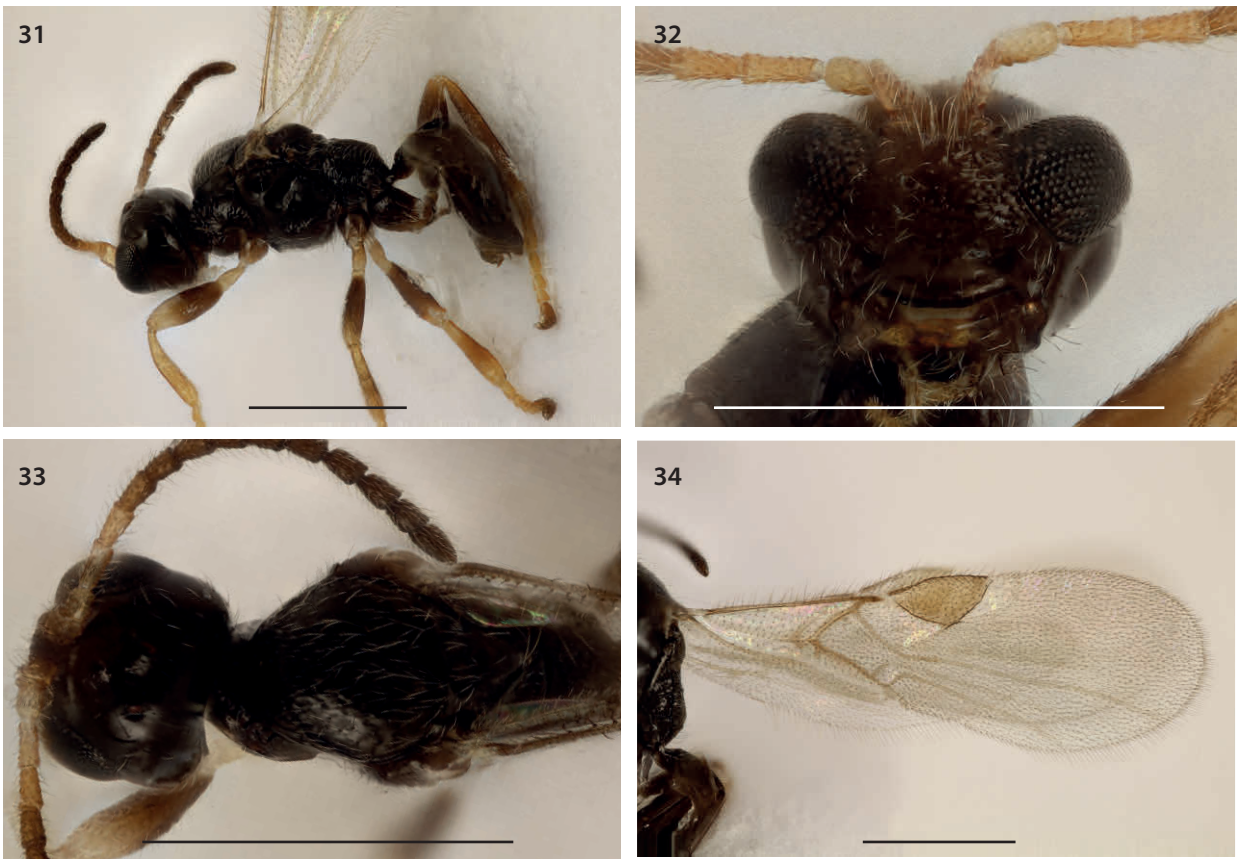
Head. Antenna with 14 segments, first segment (scape) flattened, spoon-like. Face with small punctures originating from the setae, 1.1X as wide as high. Clypeus as wide as face, clypeus with a protruding ventral rim and clypeus 2.5X as wide as high. Malar space 0.6X width of mandible base. Occipital carina incomplete. Vertex setate.

Mesosoma. Notauli absent, mesothorax punctate and setate. Epicnemial carina present. Postpectal carina absent. Mesopleuron with short, spot-like sternaulus, otherwise smooth. Propodeum reticulate rugose.

Metasoma. Petiole with dorsope and longitudinal striae mixed with rugose structure. Petiole not fused ventrally, 1.9X as long as apically wide.

Wings. Fore wing M-Cu spectral, basal and subbasal cell sparsely setose. Fore wing vein r absent, 1st submarginal and 1st discal cell open distally. Wings infuscate except marginal cell. Pterostigma 4.5X wider than R1.

Legs. Fore femur 3.0X as long as its maximum width. Fore tibia with a ridge running almost all its length. Hind femur 3.6X as long as its maximum width. Tarsi very shortened.



FIGURES 31-34

Holotype *Leiophron keltimi* n. sp. **31**, lateral view of habitus; **32**, front view of head; **33**, dorsal view of head and mesosoma; **34**, fore wing. Scale bars: 0.5 mm.

MEASUREMENTS — About 2.0 mm in length, fore wing length 2.5 mm.

ETYMOLOGY — This species is named in honour of one of the notable sorters within the project, Martin Keltim, at the Binatang Research Center, Papua New Guinea.

NOTE — This specimen was labelled as "PNG_5_Leiophron" in Zhang *et al.* (2018).

Leiophron kepai n. sp.

Figures 35-41

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm 3200 m (-5.807419, 145.0736) 3200 m, 28-29/10/2012, leg Dahl, Kaupa, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW3200B-13/16-d13; P3366-9155; Voucher ID: 14_Yves (MNHN). GenBank ID: MH464433 (*COI*), MH464444 (28*S*).

DIAGNOSIS — *L. kepai* has a wide sternaulus and deep notauli that ends in a U-shape.

DESCRIPTION — *Colour.* Dark brown, almost black. Mandibles, antennal segments and legs brown. Pterostigma light brown with pale base.

Head. Antenna with 16 segments, basally slender, first segment (scape) 2.5X longer than widest point, first flagellar segment 2.6X longer than wide, apical segments as wide as long. Face wide, 1.25X as wide as high, with scattered long setae. Clypeus as wide as face, and 1.3X wider than its median height. Malar space 1.15X width of mandible base. Occipital carina interrupted dorsally. Vertex with few setae. Face with a notch where from striae emerges horizontally towards the eyes.

Mesosoma. Notauli present, anterior part of mesonotal lobe with few scattered setae, otherwise mesoscutum smooth. Scutellum rather flattened. Mesopleuron smooth, with sternaulus. Epicnemial carina present. Postpectal carina present and the medioventral area reticulate-rugose. Propodeum reticulate areolate.

Metasoma. Petiole with longitudinal striae, with dorsope. Petiole not fused ventrally. Length of petiole 2.8X its apical width. Gaster 1.6X the length of petiole.

Wings. Fore wing M-Cu spectral. Fore wing vein r absent, 1st submarginal and 1st discal cell open distally, the veins 2SR and m-cu spectral, basal and subbasal cells with normal density of setae. Pterostigma 2.0X wider than R1.

Legs. Fore femur 3.8X as long as its maximum width. Hind femur 3.6X its maximum width.

MEASUREMENTS — 2.4 mm in length, fore wing length 2.4 mm.

ETYMOLOGY — This species is named after Jonathan Kepa, a member of the New Guinea Binatang Research Center who participated in this project and contributed by sorting material.

Leiophron lilipi n. sp.

Figures 42-46

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm 3200 m (-5.807419, 145.0736) 3200 m, 26-27/10/2012, leg Dahl, Kaupa, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW3200B-11/16-d11, P3364-9151; Voucher ID: PNG_3 (MNHN). GenBank ID: MH464438 (*COI*), MH464451 (*28S*).

DIAGNOSIS — The species is most similar to *L. gewai*, but is separated by the brown coxae and the presence of notauli.

DESCRIPTION — *Colour.* Dark brown, first three segments of antennae yellow, following segments brown. Clypeus brown as face, mandibles yellow-brown. Wing veins and pterostigma yellow. Legs yellow, hind leg dark yellow, all tarsi and coxae brown.

Head. Antenna with 16 segments, first flagellomere 4.3X longer than wide, the following segments longer than wide. Face as wide as long, punctate, densely setose. Clypeus 1.3X wider than face. Mandible with upper tooth 6 times longer than lower tooth. Occipital carina incomplete, vertex smooth.

Mesosoma. Notauli present as weak punctures, mesonotum smooth. Epicnemial carina present, postpectal carina strong medially, without any associated rugosity, laterally absent. Sternaulus wide.

Metasoma. Petiole dorsally with weakly rugose basal half, apically punctate. Dorsope shallow, spiracles situated just before middle. Length of petiole 2.5X its apical width, petiole not fused ventrally, gaster 1.53X the length of petiole.

Wings. Fore wing M-Cu spectral, basal and subbasal cell less setose. 1st submarginal and 1st discal cell open distally. Pterostigma 2.8X wider than R1, fore wing vein r absent.

Legs. Fore femur 3.6X as long as its maximum width. Hind femur 4.3X as long as its maximum width.



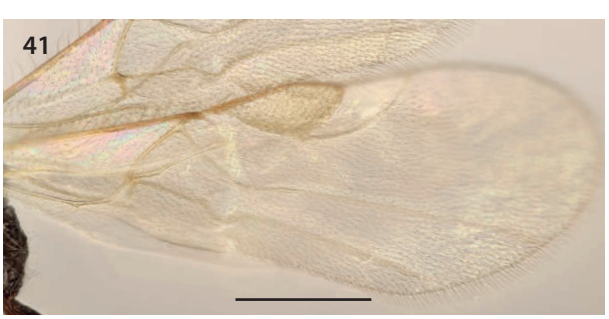












FIGURES 35-41

Holotype *Leiophron kepai* n. sp. **35**, lateral view of habitus; **36**, front view of head; **37**, lateral view of mesosoma; **38**, dorsal view of head; **39**, dorsal view of mesosoma; **40**, dorsal view of propodeum and petiole; **41**, fore wing. Scale bars: 0.5 mm.

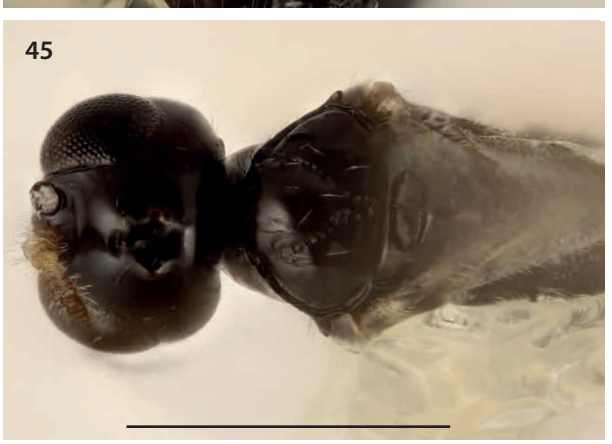
MEASUREMENTS — 1.6 mm in length, fore wing length 2.0 mm.

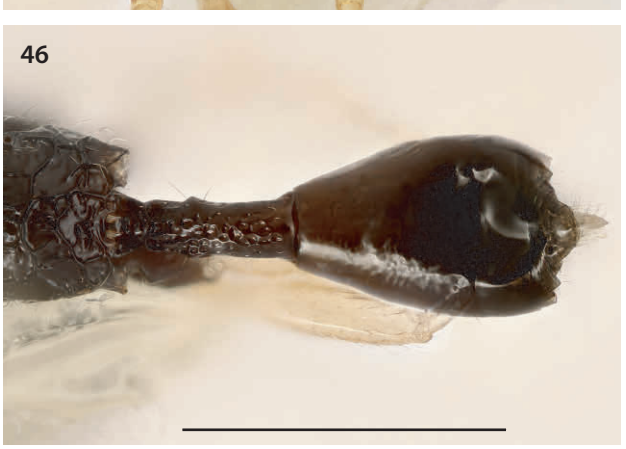
ETYMOLOGY — This species is named in honour of one of the notable sorters within the project, Roll Lilip, senior staff member at the Binatang Research Center, Papua New Guinea.











FIGURES 42-46

Holotype *Leiophron lilipi* n. sp. **42**, lateral view of habitus; **43**, front view of head; **44**, lateral view of mesosoma; **45**, dorsal view of head and mesosoma; **46**, dorsal view of propodeum and abdomen. Scale bars: 0.5 mm.

Leiophron mellifacialis n. sp.

Figures 47-55

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm 1700 m (-5.759269, 145.2356) 1700 m, 27-28/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1700A-03/16-d03, P2170-8755; Voucher ID: 08_Yves (MNHN). GenBank ID: MG926855 (*COI*), MG913703 (*28S*).

DIAGNOSIS — This species can be separated from all other Papua New Guinea species by the presence of swollen fore femur with excavated structures and the oral cavity which resembles a cyclostome.

DESCRIPTION — *Colour.* Body colour reddish-brown, antennae, legs, wing veins and pterostigma yellow. Tarsal claws and posterior half of metasoma brown. Mandible yellow.

Head. Antenna 16 segmented, the flagellomeres slender. First flagellomere 3.5X longer than wide. Face 1.3X as wide as long, evenly setose with long appressed hairs. Clypeus strongly deflexed, almost as wide as face, 6X wider than its median height. Malar space 1.2X width of mandible base. Occipital carina widely incomplete. Vertex smooth. A slight pit in front of fore ocelli.

Mesosoma. Mesoscutum highly, roundly, elevated above pronotum. Notauli present as a shallow impression, sparsely setose. Scutellar sulcus with distinct fovea, with incomplete median longitudinal carina. Mesopleuron largely smooth, sternaulus shallow and lineate. Epicnemial carina present and sharp, postpectal carina short (only ventrally) and thin. Propodeum thinly areolate-rugose, rather smooth in between the areola.

Metasoma. Petiole rugulose and sparsely striae, with dorsope and with fine spiracular tubercle in basal 1/2. Length of petiole 3.0X its apical width, not touching in ventral view. Gaster 1.7X the length of petiole.

Wings. Fore wing M-Cu spectral. Fore wing vein r absent, 1st submarginal and 1st discal cell incomplete, open distally, RS+M, 3RS spectral, the veins 2RS partially spectral, m-cu absent, basal and subbasal cells with normal density of setae. Pterostigma 2.7X wider than R1. Hindwing basal cell complete, subbasal cell absent.

Legs. Fore femur swollen medially with strange structure, ventrally concave, with lamella at the posterior surface. Fore femur 2.3X as long as its maximum width. Hind femur 3.9X as long as its maximum width.

MEASUREMENTS — 1.8 mm in length, fore wing length 1.8 mm.

ETYMOLOGY — *melli* -latin for sweet, *facialis* -face, this species has a sweet, cute face.

NOTE — This specimen was labelled as "08_Yves_Leiophron_PNG" in Zhang *et al.* (2018).

FIGURES 47-55

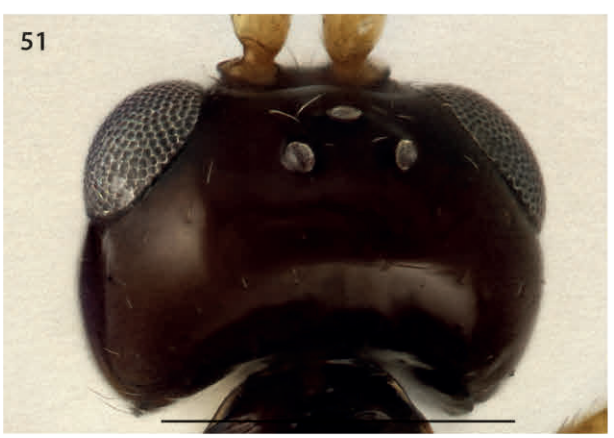
Holotype *Leiophron mellifacialis* n. sp. **47**, ventral view of habitus; **48**, ventral head and mesosoma; **49**, dorsal propodeum and abdomen; **50**, front view of head. **51**, dorsal view of head; **52**, Wings; **53**, dorsal view of mesosoma; **54**, Dorso-lateral view of fore leg; **55**, ventral view of fore leg. Scale bars: 0.5 mm.


47

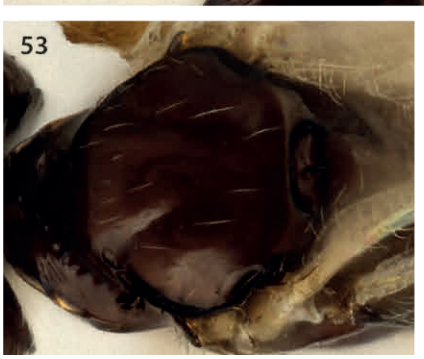

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Leiophron pascali n. sp.

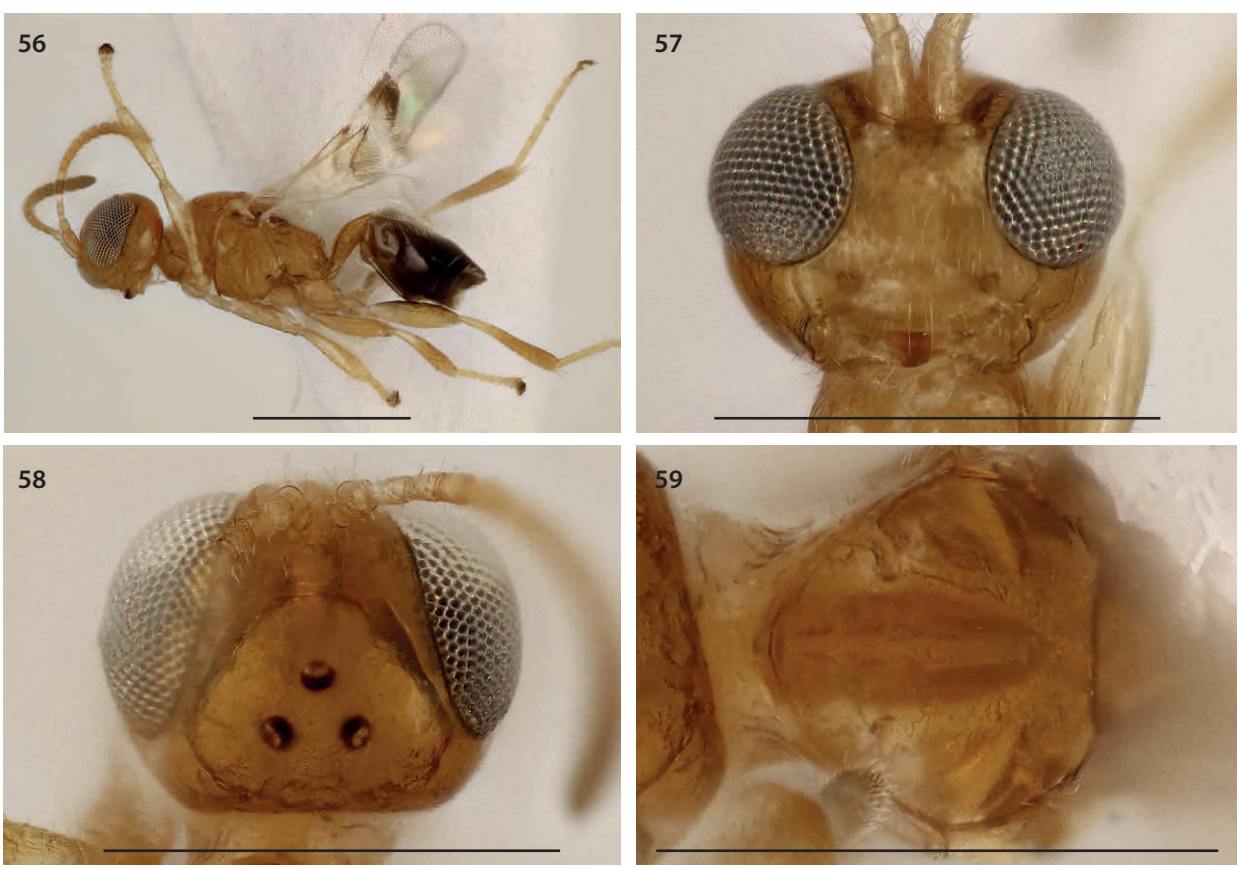
Figures 56-59

TYPE MATERIAL — Holotype, ♀ **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797) 175 m, 18-19/11/2012, leg Basset, Plot 3, understorey; Malaise - MAL-WAN03-D01 P4932, P4932-9227; Voucher ID: PNG_6 (MNHN). GenBank ID: MG926873 (*COI*), MG913715 (*28S*).

DIAGNOSIS — Differs from the very similar species *L. anthoferi* by having flagellomeres as high as wide and a much smoother mesosoma.

DESCRIPTION — *Colour.* Whole specimen generally yellow except abdomen which is brown. Antennal tip, hind legs with brownish-yellow. Wings brownish infuscate, pterostigma dark brown with basal ⅓ translucent.

Head. Antenna with 15 robust segments, pedicel equal in length as first flagellomere, first flagellomere 1.6X longer than wide. Face with very short setae, 1.2X as wide as high. Clypeus 1.2X wider than face, clypeus 2.3X as wide as high. Malar space 0.8X width of mandible base. Occipital carina incomplete only present laterally. Vertex sparsely setate with very short setae.



FIGURES 56-59

Holotype *Leiophron pascali* n. sp. **56**, lateral view of habitus; **57**, front view of head; **58**, dorsal view of head; **59**, dorsal view of meso-soma. Scale bars: 0.5 mm.

Mesosoma. Notauli absent, mesoscutum smooth and not setate, scutellum pointed. Epicnemial carina present. Postpectal carina thin and only present medially. Mesopleuron totally smooth. Propodeum weakly reticulate rugose.

Metasoma. Petiole with longitudinal striae dorsally and ventrally. Petiole fused ventrally. Length of petiole 3.7X its apical width. Gaster 1.5X the length of petiole.

Wings. Most fore wing veins spectral or absent except vein 1-M which is wider than ordinary. Pterostigma 5.2 times wider than R1, dark brown except translucent basal ⅓. Wings darkly infuscate with translucent band in the middle. Basal cell glabrous.

Legs. Fore femur 3.5X as long as its maximum width. Hind femur 3.3X as long as its maximum width.

MEASUREMENTS — 1.5 mm in length, fore wing length 1.1 mm.

ETYMOLOGY — This species is named in honour of Olivier Pascal who contributed with the organisation of all the Planète Revisitée expeditions.

NOTE — This specimen was labelled as "PNG_6_Leiophron" in Zhang *et al.* (2018).

Leiophron tulai n. sp.

Figures 60-65

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm 2700 m (-5.815272, 145.1565) 2700 m, 20-21/10/2012, leg Kua, Yalang, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW2700D-05/16-d05, P3000-8822; Voucher ID: 11_Yves (MNHN). GenBank ID: MH464430 (*COI*), MH464442 (*28S*).

DIAGNOSIS — A smooth species, similar to *L. kepai* and *L. umai* but lacking notauli.

DESCRIPTION — *Colour.* Brown. Mandibles, basal antennal segments yellowish, apically brown, legs brown. Pterostigma light brown with pale base.

Head. Antenna with 16 segments, first segment (scape) 2.6X longer than widest point, first flagellar segment 3.3X longer than wide. Face and clypeus in profile flat. Face 1.2X as wide as high, setate. Clypeus 1.3X wider than face, and 4X wider than its median height. Malar space equal to width of mandible base. Occipital carina widely interrupted dorsally. Frons with a long setae.

Mesosoma. Notauli not present, mesoscutum smooth and with long setae. Scutellum evenly, weakly convex. Mesopleuron smooth, with short sternaulus. Epicnemial carina present. Postpectal carina not present. Propodeum areolate-reticulate.

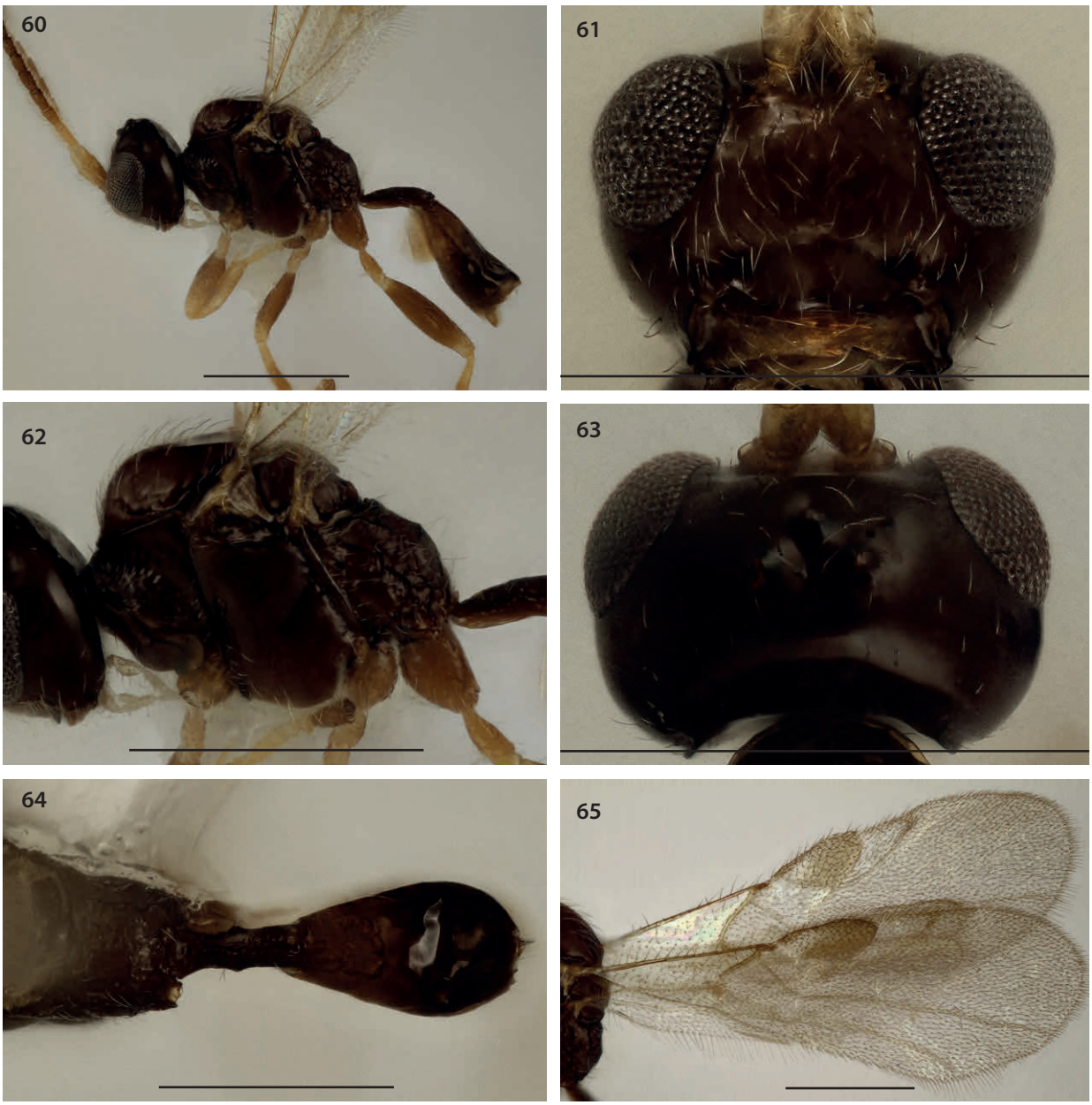
Metasoma. Petiole rugose and with deep dorsope, parallel sided, spiracles situated just before middle. Petiole not fused ventrally. Length of petiole 23.5X its apical width. Gaster 1.5X the length of petiole.

Wings. Fore wing M-Cu spectral. Fore wing vein r absent, 1st submarginal and 1st discal cell open distally. Wings translucent. Pterostigma 1.9X wider than R1.

Legs. Fore femur 3.5X as long as its maximum width. Hind femur 4.1X as long as its maximum width.

MEASUREMENTS — 1.5 mm in length, fore wing length 1.9 mm.

ETYMOLOGY — This species is named in honour of one of the notable sorters within the project, Salape Tulei, at the Binatang Research Center, Papua New Guinea.



FIGURES 60-65

Holotype *Leiophron tulai* n. sp. **60**, lateral view of habitus; **61**, front view of head; **62**, lateral view of mesosoma; **63**, dorsal view of head; **64**, dorsal view of abdomen; **65**, fore wings. Scale bars: 0.5 mm.

Leiophron umai n. sp.

Figures 66-71

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm 2700 m (-5.814968, 145.1580) 2700 m, 18-19/10/2012, leg Kua, Yalang, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW2700D-03/16-d03, P2998-8817; Voucher ID: 10_Yves (MNHN). GenBank ID: MG926856 (*COI*), MG913704 (*28S*).

DIAGNOSIS — A very "ordinary" looking *Leiophron* but with an apically elongated pronotum.

DESCRIPTION — *Colour.* Brown. Mandibles, basal antennal segments and coxae yellowish-brown, legs yellow. Pterostigma light brown with pale base. Fore wing vein SR1 white.

Head. Antenna with 16 segments, basally slender, first segment (scape) 2.8X longer than widest point, first flagellar segment 5X longer than wide. Face narrow, higher than wide, 0.8X as wide as high, with scattered long setae. Clypeus 1.2X wider than face, and 2.8X wider than its median height. Malar space 0.8X width of mandible base. Occipital carina interrupted dorsally. Vertex with a few setae.

Mesosoma. Notauli present, anterior part of mesonotal lobe with few scattered setae, otherwise mesoscutum smooth. Scutellum rather flattened. Mesopleuron smooth, with sternaulus and with very few but rather long setae. Epicnemial carina present. Postpectal carina not present but the medioventral area reticulate-rugose. Propodeum areolate, smooth in between.

Metasoma. Petiole basally smooth, apically with longitudinal striae. Petiole not fused ventrally. Length of petiole 2.3X its apical width. Gaster 1.6X the length of petiole.

Wings. Fore wing M-Cu spectral. Fore wing vein r absent, 1st submarginal and 1st discal cell open distally. Wings infuscate except marginal cell. Pterostigma 1.9X wider than R1.

Legs. Fore femur 3.4X as long as its maximum width.

ETYMOLOGY — This species is named in honour of one of the notable sorters within the project, Collin Uma, at the Binatang Research Center, Papua New Guinea.

MEASUREMENTS — 1.2 mm in length, fore wing length 2.3 mm.

NOTE — This specimen was labelled as "10_Yves_Leiophron_PNG" in Zhang *et al.* (2018).

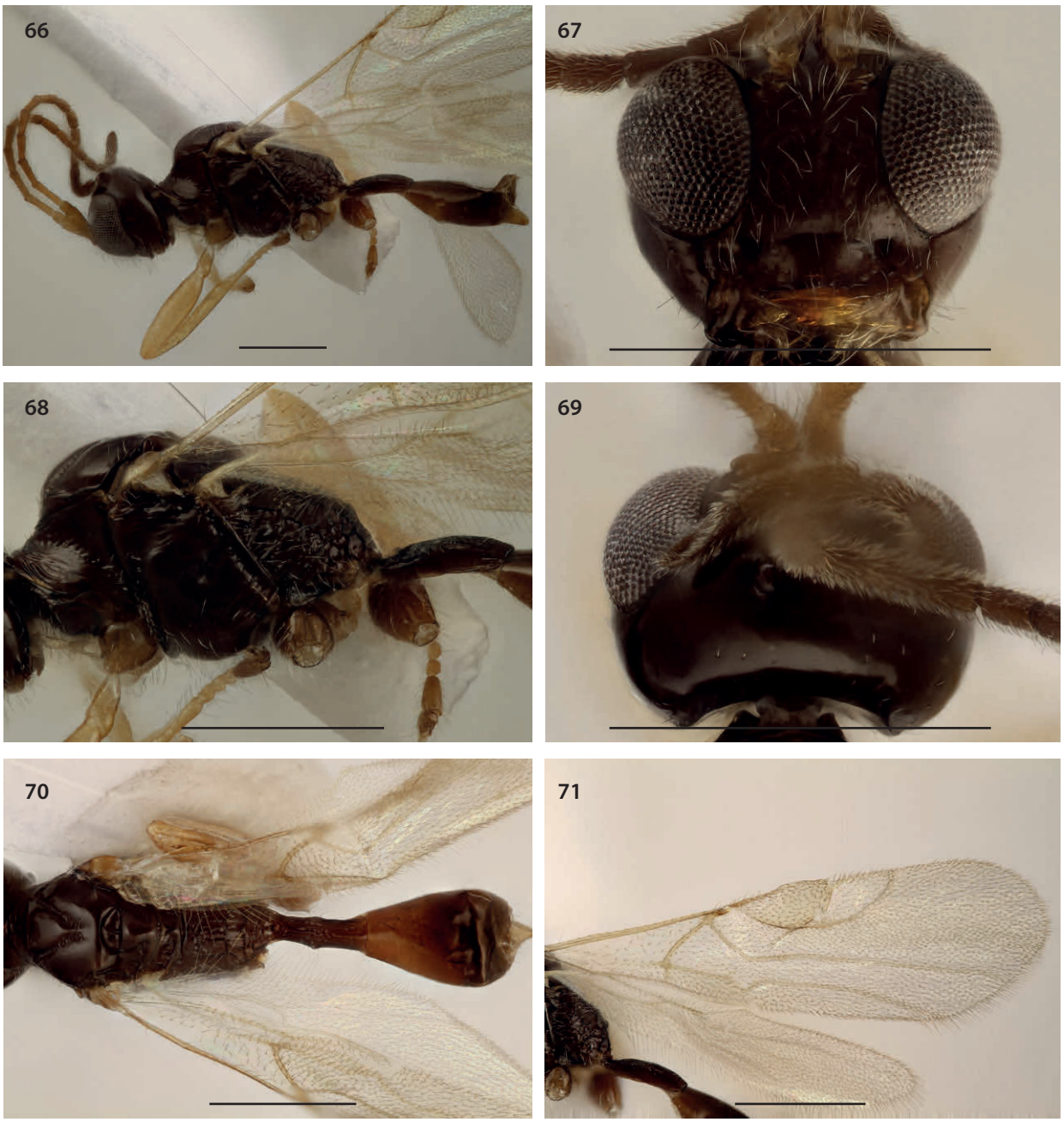
Leiophron wincklerae n. sp.

Figures 72-78

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797) 175m, 02-03/12/2012, leg Basset, Plot 1, understorey; Malaise - MAL-WAN01-D15 P4914, P4914-18147; Voucher ID: PNG_7 (MNHN). GenBank ID: MG926874 (*COI*), MG913716 (*28S*).

DIAGNOSIS — Differs from other similar species by having a pointy scutellum but also by a pointy angulated propodeum.

DESCRIPTION — *Colour.* Whole specimen generally reddish brown except abdomen (dark brown). Antennal tip, palpi, hind and middle legs dark brown. Wings brownish infuscate, pterostigma dark brown with basal translucent area.



FIGURES 66-71

Holotype *Leiophron umai* n. sp. **66**, lateral view of habitus; **67**, front view of head; **68**, lateral view of mesosoma; **69**, dorsal view of head; **70**, dorsal view of mesosoma and metasoma; **71**, fore wing. Scale bars: 0.5 mm.















FIGURES 72-78

Holotype *Leiophron wincklerae* n. sp. **72**, lateral view of habitus; **73**, front view of head; **74**, lateral view of mesosoma; **75**, dorsal view of head; **76**, dorsal view of meso- and metasoma; **77**, lateral view of metasoma; **78**, fore wing. Scale bars: 0.5 mm.

Head. Antenna with 15 segments, slender basally. Face wide and with very short setae, 1.4X as wide as high. Clypeus 1.1X wider than face, clypeus 2.5X as wide as high. Malar space 1.4X width of mandible base. Occipital carina incomplete, only present laterally. Vertex with no setae.

Mesosoma. Notauli absent, mesoscutum smooth and not setate, scutellum acutely pointed. Scutellar sulcus without any carina. Epicnemial carina and postpectal carina present. Mesopleuron smooth but with minute punctures and minute striae lateral-ventrally. Propodeum weakly areolate-reticulate, sharply angulated.

Metasoma. Petiole with longitudinal striate dorsally and ventrally. Petiole fused ventrally except basally. Length of petiole 3.9X its apical width. Gaster 1.3X the length of petiole.

Wings. Most fore wing veins spectral or absent except vein 1-M which is wider than ordinary. Pterostigma 4.8 times wider than R1, dark brown and basally white. Fore wing vein 3RSb tubular but vestigial towards R1. Wings darkly infuscate with translucent band in the middle. Basal cell glabrous.

Legs. Hind femur 3.7X as long as its maximum width. All femur and tibia with 'scale like' microstructure.

MEASUREMENTS — 1.8 mm in length, fore wing length 1.4 mm.

ETYMOLOGY — Named after Amandine Winckler, a devoted student that helped with sorting the material. During this sorting Amandine Winckler was a student at the Université de Nouvelle-Calédonie. The species name also has a Swedish etymology as "vinkel" means angle and the species has two sharp angles dorsally.

NOTE — This specimen was labelled as "PNG_7_Leiophron" in Zhang *et al.* (2018).

Genus ***PERISTENUS*** Förster, 1862

Peristenus Förster, 1862.

Type species. *Microctonus barbiger* Wesmael (=*Leiophron pallipes* Curtis). Original designation. Lectotype designation by Loan (1974).

Peristenus montwilhelmi n. sp.

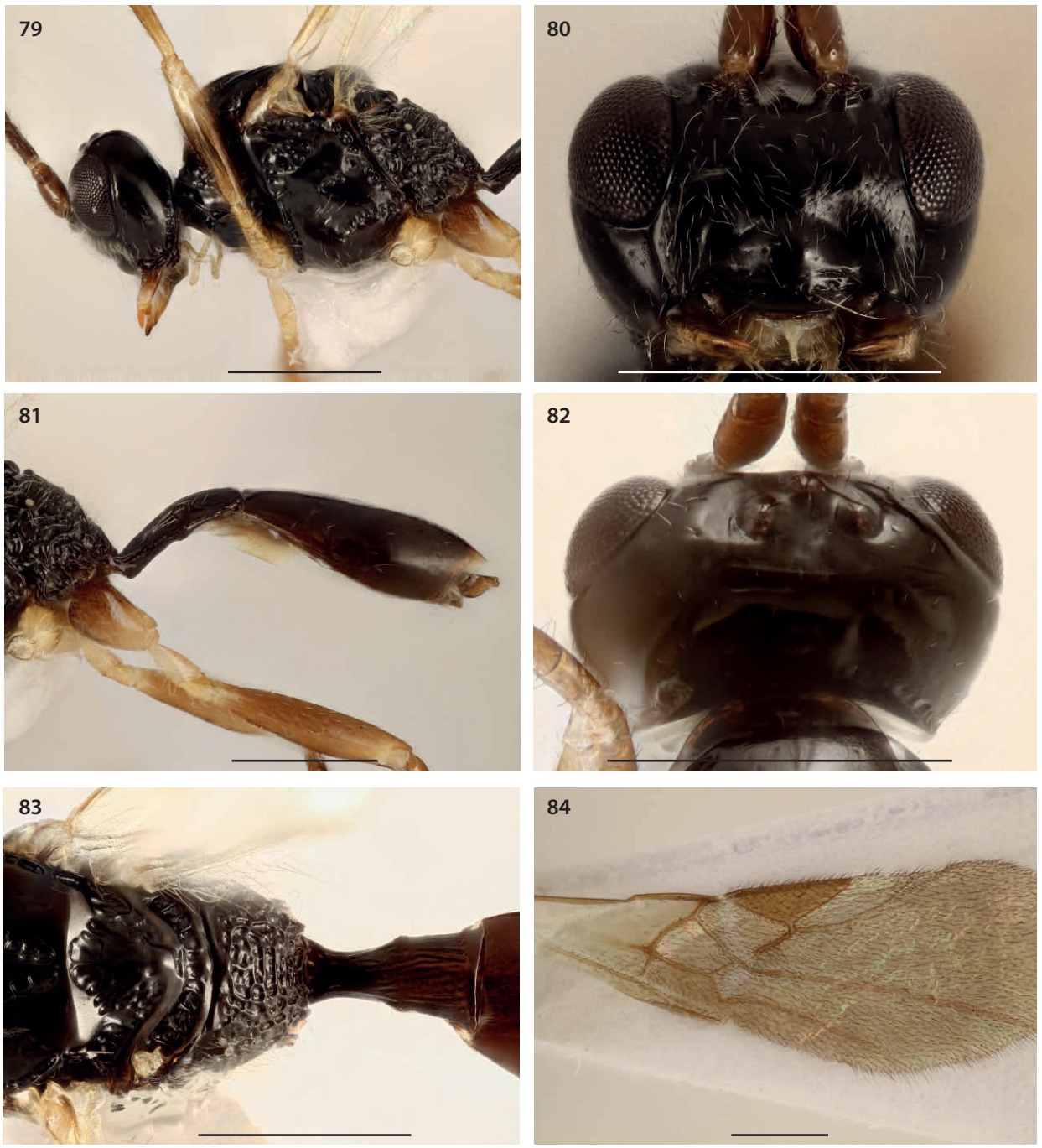
Figures 79-84

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm 2700 m (-5.814968, 145.1580) 2700 m, 23-24/10/2012, leg Kua, Yalang, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW2700B-08/16-d08, P2971-8833; Voucher ID: 05_Yves (MNHN). GenBank ID: MH464428 (*COI*), N/A (*28S*).

DIAGNOSIS — Fore wing basal cells basally glabrous, distally with few setae. Fore wing slightly infuscated.

DESCRIPTION — *Colour.* Black, a tinge of brown on dorsal corners of scutellum. Antennae brown, legs and mandibles yellowish brown, palpi light yellow. Wings infuscate with light brown tone, pterostigma light brown. Fore wing vein SR1 white.

Head. Antenna with 28 segments, slender, first flagellomere 3.3X longer than widest point. Face wide and with few setae, 1.9X as wide as high. Face 2.4X wider than clypeus, clypeus 1.75X as wide as high. Malar space 0.9X width of mandible base. Occipital carina interrupted dorsally. Vertex with a few setae.



FIGURES 79-84

Holotype *Peristenus montwilhelmi* n. sp. **79**, lateral view of mesosoma; **80**, front view of head; **81**, lateral view of abdomen; **82**, dorsal view of head; **83**, dorsal view of propodeum and petiole; **84**, fore wing. Scale bars: 0.5 mm.

Mesosoma. Notauli present and strongly impressed, mesoscutum smooth and not setate. Epicnemial carina present. Postpectal carina present. Mesopleuron smooth but with sternaulus and episternal scrobe. Propodeum weakly areolate-reticulate, no distinct carina, smoothly rounded.

Metasoma. Petiole with longitudinal striae dorsally. Petiole fused ventrally. Length of petiole 2.0X its apical width. Gaster 1.1X the length of petiole.

Wings. All wing veins distinct, pterostigma 2.3X wider than R1, pterostigma light brown, wings infuscate. Basal cells distally with a few setae, basally glabrous.

Legs. Fore femur 4.8X as long as its maximum width, hind femur 4.6X as long as its maximum width.

MEASUREMENTS — 2.8 mm in length, fore wing length 3.2 mm.

ETYMOLOGY — Named after the mountain where it was found.

Peristenus quadriplex n. sp.

Figures 85-90

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm 1700 m (-5.759269, 145.2356) 1700 m, 29-30/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1700A-05/16-d05, P2172-8760; Voucher ID: 09_Yves (MNHN). GenBank ID: MH464429 (*COI*), MH464441 (*28S*).

DIAGNOSIS — Can be separated from the *Peristenus montwilhelmi* by the smaller size, and the four teeth on the ventral border of the clypeus seen from a lateral aspect.

DESCRIPTION — *Colour.* Brown; mandible, antennae, legs straw coloured. Wings clear, veins and pterostigma light brown. Eyes iridescently silver. Posterior half of metasoma darker brown.

Head. Antenna 16 segmented, first flagellomere 4.5X longer than wide, the following segments longer than wide. Width of face 1.5X as wide as high, evenly setose with appressed hairs. Width of face 1.2X that of the clypeus width, and 3.8X its median height. Clypeus setose along the ventral margin. Vertex smooth. Gena with setae limited to the ventral edge. Height of malar space 1.2X that of basal width of mandible. Occipital carina incomplete.

Mesosoma. Mesoscutum highly, roundly elevated above pronotum. Notauli present, shallow but complete. Scutellar sulcus with 2 distinct fovea. Epicnemial carina present, postpectal carina present only medially, but disjunct. Mesopleuron largely smooth, with a few setae on mesosternum. Sternaulus present as short, shallow rugae. Propodeum areolate, smooth in between.

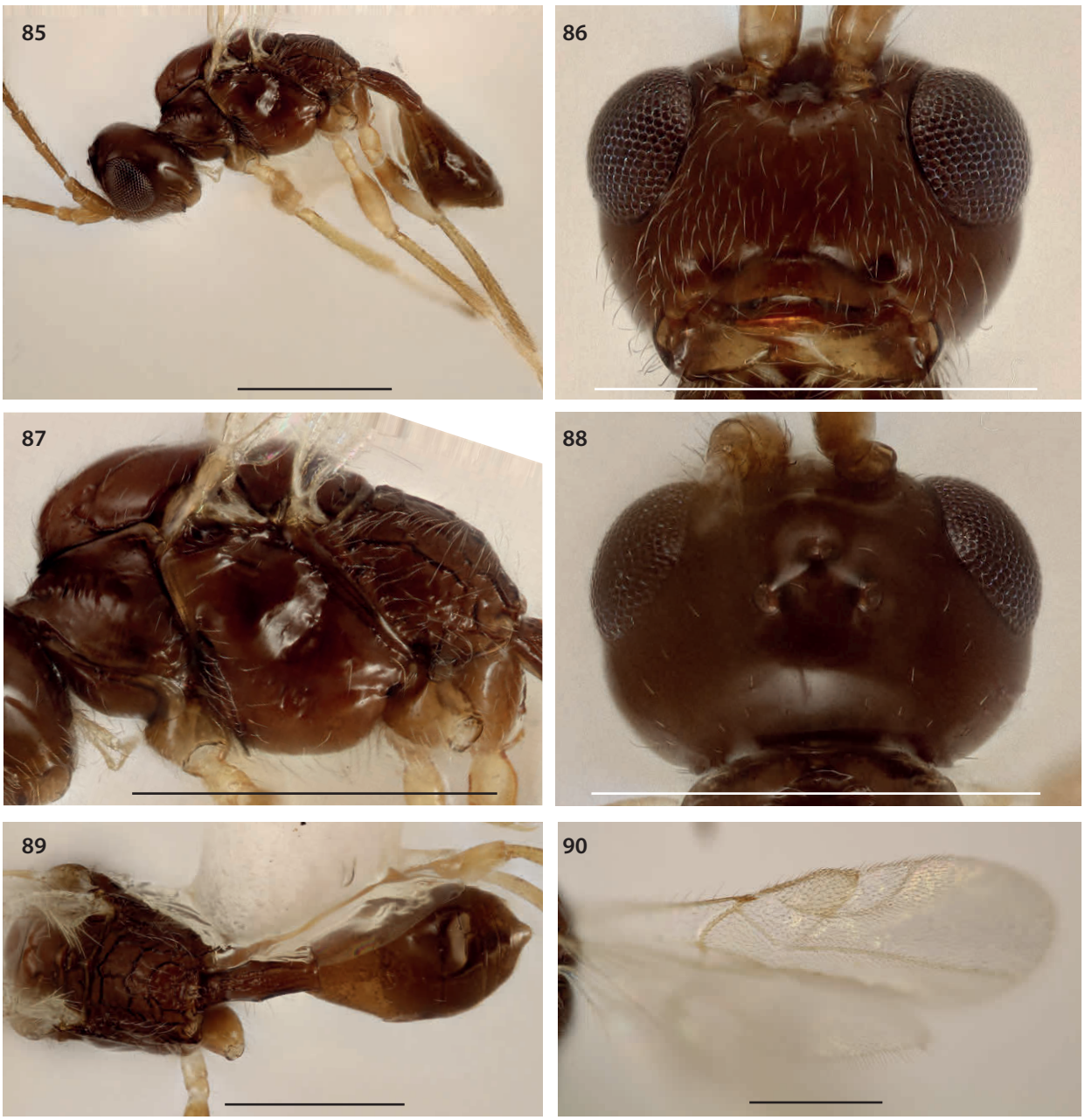
Metasoma. Petiole rugulose and sparsely striae, dorsope with fine spiracular tubercle in basal ⅓. Length of petiole 2.9X its apical width, basally touching anteriorly in ventral view. Gaster 1.8X length of petiole.

Wings. Fore wing M-Cu nebulous/spectral, basal and subbasal cell setose. Fore wing veins r and r-m absent, 1st submarginal and 1st discal cell incomplete, open distally. RS+M, 3RS tubular. 2RS tubular but very short. Hind wing basal cell complete, subbasal cell absent.

Legs. Fore femur 3.6X as long as its maximum width. Hind femur 4.6X as long as its maximum width.

MEASUREMENTS — 1.8 mm in length, fore wing length 1.9 mm.

ETYMOLOGY — Quadriplex - the clypeus has four small teeth when seen from a lateral aspect.



FIGURES 85-90

Holotype *Peristenus quadriplex* n. sp. **85**, lateral view of habitus; **86**, front view of head; **87**, lateral view of mesosoma; **88**, dorsal view of head; **89**, dorsal view of abdomen; **90**, fore wing. Scale bars: 0.5 mm.

Genus ***MICROCTONUS*** Wesmael, 1835

Microctonus Wesmael, 1835: 54.

Type species. *Perilitus aethiops* Nees, designated by Förster (1862). Neotype designation by Loan (1975).

Microctonus madang n. sp.

Figures 91-97

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm 1200 m (-5.720874, 145.2695) 1200 m, 08-09/11/2012, leg Philip, Alois, Novotny, Leponce Plot 2, understorey; Malaise - MAL-MW1200D-15/16-d15, P1840-11384; Voucher ID: 03_Yves (MNHN). GenBank ID: N/A (*COI*), KJ591265 (*28S*).

DIAGNOSIS — Very deep notauli, almost round pedicel and strongly angulated ovipositor.

DESCRIPTION — *Colour.* Dark brown, palpi, fore and middle legs yellow.

Head. Antenna with 33 segments, slender, first flagellomere 3.3X longer than widest point. Face 1.5X as wide as high and with short setae (setae about 0.25X clypeus height). Face 1.5X wider than clypeus, and clypeus 1.7X as wide as high. Malar space 1.1X width of mandible base. Occipital carina dorsally slightly incomplete.

Mesosoma. Notauli deeply impressed and rugose, mesopleuron with deep sternaulus. Epicnemial carina present. Propodeum strongly reticulate.

Metasoma. Petiole completely rugose dorsally with a median carina running along major central part of petiole. Petiole not fused ventrally. Length of petiole 2.1X its apical width. Spiracular tubercle positioned just basal to middle of petiole. Gaster 1.5X the length of petiole.

Wings. All wing veins distinct except fore wing RS+M and RS which are absent. Fore wing vein R1 about equal to pterostigma length. Both fore and hind wing normally setate. Wings slightly infuscate.

Legs. Fore femur slender, 5.2X as long as its maximum width, hind femur 4.8X as long as its maximum width. Hind femur with a little hump ventrally near tibial joint.

MEASUREMENTS — 4.9 mm in length, fore wing length 3.2 mm.

ETYMOLOGY — Named after the province where it was found.

Genus ***SYNTRETUS*** Förster, 1862

Syntretus Förster, 1862: 251.

Type species. *Microctonus vernalis* Wesmael, 1835.

Syntretus amber n. sp.

Figures 98-103

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm 1200 m (-5.720903, 145.2715) 1200 m, 05-06/11/2012, leg Philip, Alois, Novotny, Leponce Plot 2, understorey; Malaise - MAL-MW1200C-12/16-d12, P1821-11343; Voucher ID: 04_Yves (MNHN). GenBank ID: N/A (*COI*), MH464440 (*28S*).









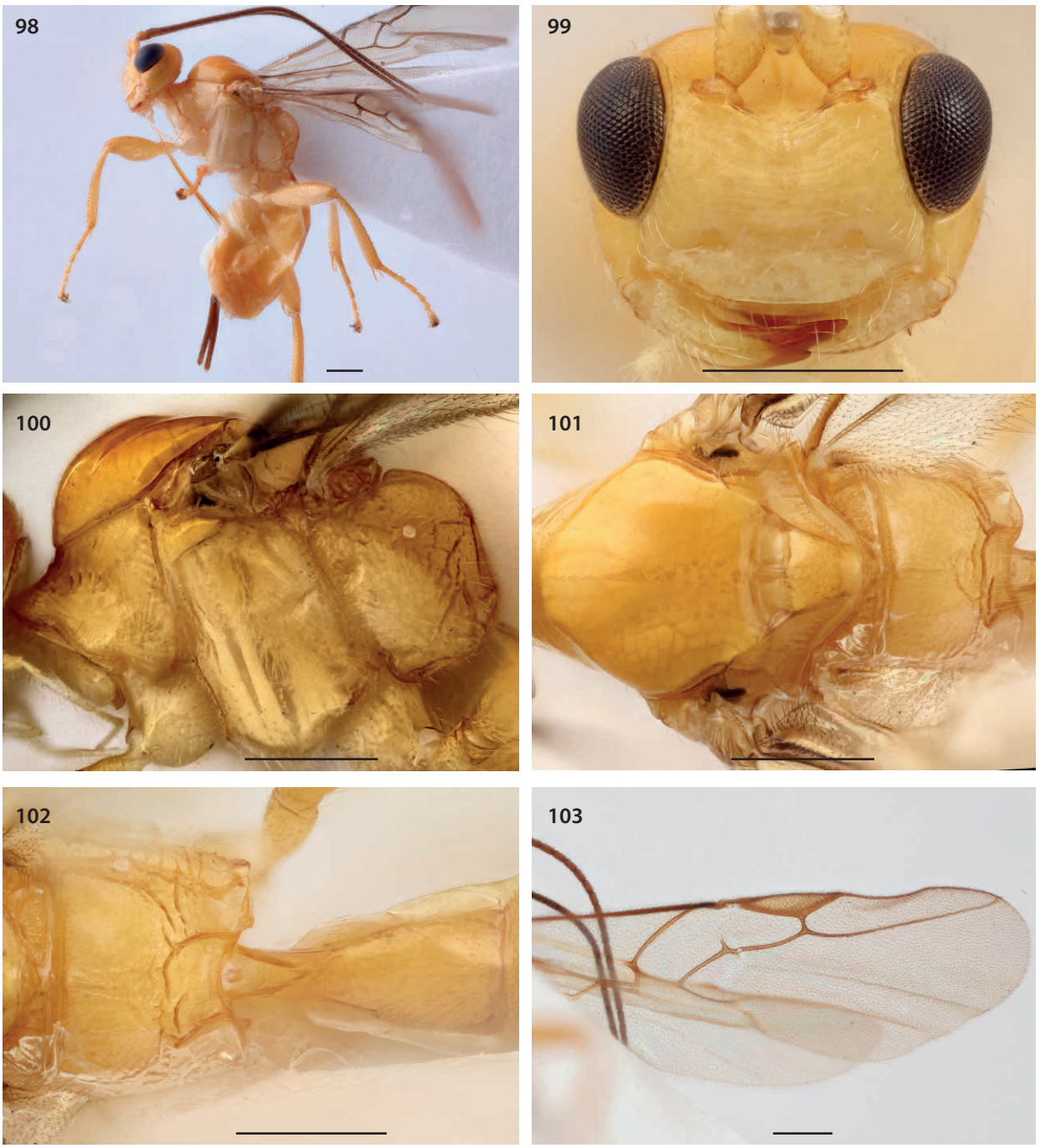






FIGURES 91-97

Holotype *Microctonus madang* n. sp. **91**, lateral view of habitus; **92**, front view of head; **93**, lateral view of mesosoma; **94**, dorsal view of head; **95**, dorsal view of mesosoma; **96**, dorsal view of propodeum and petiole; **97**, ventral view of petiole. Scale bars: 0.5 mm.



FIGURES 98-103

Holotype *Syntretus amber* n. sp. **98**, lateral view of mesosoma; **99**, front view of head; **100**, lateral view of abdomen; **101**, dorsal view of mesosoma; **102**, dorsal view of propodeum and petiole; **103**, fore wing. Scale bars: 0.5 mm.

DIAGNOSIS — The lack of notauli, the carinae of the propodeum and the length of the ovipsitor are some of the characters to distinguish this species from other *Syntretus* species that might be occurring in Australasia.

DESCRIPTION — *Colour.* Dorsally yellow, ventral colour, including meso- and metapleuron, light yellow to white. Antennae, ovipositor sheaths, mandible teeth, wing veins brown. Pterostigma yellow in the center, brown towards edges.

Head. Antenna with 40 segments, slender, first flagellomere 2.0X longer than widest point. Face wide and with few setae along inner border of eye, face 1.9X as wide as high. Clypeus 1.1X wider than face, and 3.2X as wide as high. Malar space 0.8X width of mandible base. Occipital carina complete.

Mesosoma. Notauli absent, mesoscutum and mesopleuron smooth. Epicnemial carina present, postpectal carina absent. Propodeum on dorsal surface with a short longitudinal carina surrounded with weak rugosity. Posterior part of propodeum with large areola.

Metasoma. Petiole completely smooth dorsally, laterally with deep and long laterope. Petiole fused ventrally. Length of petiole 2.1X its apical width. Gaster 1.9X the length of petiole.

Wings. All fore wing veins distinct except fore wing 3M and 3Cu which are nebulous, M+Cu spectral. Vein RS+M present but incomplete, only 1/4th of its intended length. Fore wing vein R1 1.3X longer than pterostigma. Both fore and hind wing normally setate.

Legs. Fore femur 3.2X as long as its maximum width, hind femur 3.2X as long as its maximum width.

MEASUREMENTS — 4.6 mm in length, fore wing length 4.4 mm.

ETYMOLOGY — Named after the amber colour of this species.

Genus ***STREBLOCERA*** Westwood, 1833

Streblocera Westwood, 1833, 342.

Type species. *Streblocera fulviceps* Westwood, 1833.

Streblocera semirugosa n. sp.

Figures 104-111

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm 1700 m (-5.760916, 145.2353) 1700 m, 07-08/11/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW1700C-14/16-d14, P2213-8794; Voucher ID: 01_Yves (MNHN). GenBank ID: KJ591420 (*COI*), KJ591205 (*28S*).

DIAGNOSIS — A punctate ventral rim of clypeus and a very long, slender and smooth petiole together with a punctate mesopleuron. Differs from *S. rugosa* by not being so rugose.

DESCRIPTION — *Colour.* Face, thorax, hind coxae and petiole dark brown, mandibles, pedicel, femur and tibia yellowish brown.

Head. Antenna with 28 segments, slender, first flagellomere 5.6X longer than widest point. Base of antennae prominent. Eyes with very few, hardly noticeable, tiny setae (<5). Face 1.4X as wide as high. Face 1.3X wider than clypeus, and clypeus 2.0X as wide as high. Malar space 1.2X width of mandible base. Gena punctate. Occipital carina dorsally slightly interrupted. Whole head setate, the setae slightly longer than longest ocellar diameter.

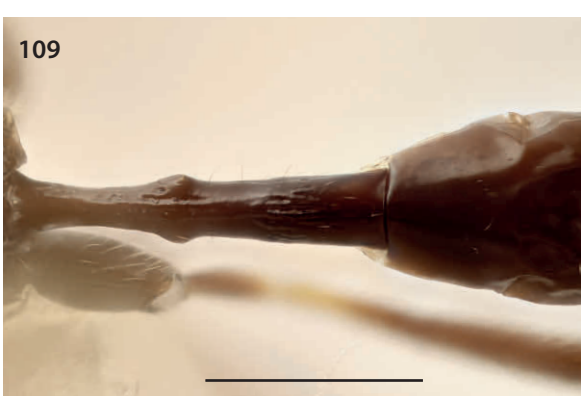

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Mesosoma. Notauli deeply impressed, punctate, mesopleuron with punctate sternaulus, apical part of mesoscutum towards pronotum with vaguely punctate surface. Sides of pronotum punctate. Scutellar sulcus wide and deep with a medial longitudinal carina and some reticulate structures, sides of scutellum wide and rugose. Epicnemial carina present. Postpectal carina absent. Propodeum reticulate-rugose and smoothly sloping.

Metasoma. Petiole smooth dorsally with a median incision with small punctures in a line, apically slightly widening with vague striae. Petiole solidly fused ventrally. Length of petiole 4.6X its apical width. Spiracular tubercle positioned at middle of petiole. Gaster 1.2X the length of petiole. Ovipositor 0.25X petiolar length.

Wings. All wing veins distinct except fore wing 3M that is not tubular and RS+M which is absent. Fore wing vein R1 equal to pterostigma length. Both fore and hind wing normally setate. Wings not infuscate.

Legs. Fore femur slender, 5.3X as long as its maximum width, hind femur 5.5X as long as its maximum width.

MEASUREMENTS — 3.4 mm in length, fore wing length 3.4 mm.

ETYMOLOGY — Named by the degree of sculpture on the specimen.

Streblocera rugosa n. sp.

Figures 112-118

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm 1200 m (-5.720903, 145.2715) 1200 m, 09-10/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW1200C-16/16-d16, P1825-11334; Voucher ID: 02_Yves (MNHN). GenBank ID: KJ591421 (*COI*), KJ591206 (28*S*).

DIAGNOSIS — A punctate ventral rim of clypeus and a very long, slender and rugose petiole together with a reticulate-rugose, strongly sculptured mesopleuron. Differs from *S. semirugosa* by being much more sculptured and rugose.

DESCRIPTION — *Colour.* Face, thorax, hind coxae and petiole dark brown, mandibles, pedicel, femur and tibia yellowish brown.

Head. Antenna with 28 segments, slender, first flagellomere 5.2X longer than widest point. Base of antennae prominent. Eyes with very few tiny setae (< 5). Face 1.9X wider than high. Face 1.8X wider than clypeus, and clypeus 2.0X as wide as high. Malar space equal to width of mandible base. Not only gena but whole head with small punctures at every setae. Occipital carina dorsally slightly interrupted. Whole head setate, the setae slightly longer than longest ocellar diameter.

Mesosoma. Notauli deeply impressed and rugose-punctate, apical part of mesoscutum towards pronotum not smooth but with rough surface and a vague median carina. Mesopleuron with strongly rugose sternaulus. Sides of pronotum with deep strong punctures. Scutellar sulcus smooth, very wide and deep with a strong medial longitudinal carina, sides of scutellum wide and rugose. Epicnemial carina, postpectal carina and medioventral suture all with very strong sculpture. Propodeum strongly reticulate-rugose and smoothly sloping.

FIGURES 104-111

Holotype *Streblocera semirugosa* n. sp. **104**, lateral view of habitus; **105**, front view of head; **106**, lateral view of abdomen; **107**, dorsal view of head; **108**, dorsal view of mesosoma; **109**, dorsal view of petiole; **110**, lateral view of ab-domen; **111**, ventral view of petiole. Scale bar represents 0.5 mm.















FIGURES 112-118

Holotype *Streblocera rugosa* n. sp. **112**, lateral view of habitus; **113**, front view of head; **114**, lateral view of abdomen; **115**, dorsal view of head; **116**, dorsal view of mesosoma; **117**, ventral view of mesosoma and petiole; **118**, lateral view of abdomen. Scale bars: 0.5 mm.

Metasoma. Petiole striate dorsally with small punctures in between, apically slightly widening with vague striae. Petiole solidly fused ventrally with the sternite separated with a strong carina. Length of petiole 3.9X its apical width. Spiracular tubercle prominent and positioned at middle of petiole. Gaster 1.1X the length of petiole. Ovipositor 0.6X petiolar length.

Wings. All wing veins distinct except fore wing 3M that is not tubular and RS+M which is absent. Fore wing vein R1 equal to pterostigma length. Both fore and hind wing normally setate. Wings not infuscate.

Legs. Fore femur slender, 5.6X as long as its maximum width, hind femur 6.0X as long as its maximum width.

MEASUREMENTS — 3.2 mm in length, fore wing length 3.2 mm.

ETYMOLOGY — Named by the degree of sculpture and rugosity on the specimen.

Genus ***METEORUS*** Haliday, 1832

Meteorus Haliday, 1832: 24.

Type species. *Ichneumon pendulator* Latreille, 1799.

Here we describe one new species of *Meteorus* and add barcodes and images of three already named species.

Meteorus achterbergi Huddleston, 1983

Figures 119-124

Meteorus achterbergi Huddleston, 1983: 396.

TYPE MATERIAL — 2 ♀ (paratypes) of *M. achterbergi* from BMNH examined.

MATERIAL EXAMINED — Papua New Guinea. 1 ♀, Province Madang, Mount Wilhelm 1700 m (-5.760916, 145.2353) 1700 m, 04-05/11/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW1700C-11/16-d11, P2210-8783; Voucher ID: JS10_00532. GenBank ID: KJ591543 (*COI*), KJ591343 (*28S*). 1 ♀, Province Madang, Mount Wilhelm 2200 m (-5.758987, 145.1861) 2200 m, 23-24/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW2200A-08/16-d08, P2565-11893; Voucher ID: JS10_00570 (MNHN). 1 ♀, Province Madang, Mount Wilhelm 2200 m (-5.760178, 145.1863) 2200 m, 17-18/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW2200B-02/16-d02, P2575-11905; Voucher ID: JS10_00569 (MNHN).

DISTRIBUTION — Papua New Guinea, Australia.

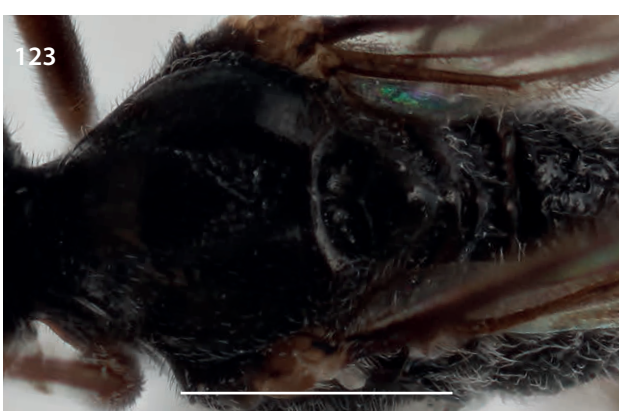
REMARKS — Huddleston (1983) mentions some characters that differ between the Australian and Papua New Guinean species, and we have studied two paratypes at BMNH. Our conclusion is that the PNG and Australian specimens (until molecular evidence is available) should be kept as the same species. The characters differing according to Huddleston (malar space, depth of notauli, sculpture of mesonotum), cannot be found to such degree in our PNG specimens to separate these as their own species. The colour, though, is darker on the PNG specimens than the Australian specimens, as Huddleston noted. We add an additional character that might be interesting if *M. achterbergi* gets split in the future: the propodeum is evenly reticulate in the Australian species whereas on the PNG specimens the propodeum is more carinate.













FIGURES 119-124

Meteorus achterbergi (Voucher ID: JS10_00532, fig 123 specimen JS10_00569). **119**, lateral view of habitus; **120**, front view of head; **121**, lateral view of mesosoma; **122**, dorsal view of head; **123**, dorsal view of mesosoma; **124**, dorso-lateral view of propodeum and petiole. Scale bars: 0.5 mm.

Meteorus braeti n. sp.

Figures 125-130

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797) 175 m, 25-26/11/2012, leg Basset, Plot 1, understorey; Malaise - MAL-WAN01-D08, P4907-9054; Voucher ID: JS10_00567 (MNHN). GenBank ID: MH464434 (*COI*), MH464445 (*28S*). Paratype ♀, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797) 175 m, 21-22/11/2012, leg Basset, Plot 1, understorey; Malaise - MAL-WAN01-D04, P4903-9047; Voucher ID: JS10_00572 (MNHN). GenBank ID: N/A (*COI*), MH464448 (*28S*).

DIAGNOSIS — The long ovipositor, the very long, slender and smooth petiole along with the large and converging eyes defines this species. It differs from JS10_00572 by the overall smoother appearance (petiole, mesopleuron, precoxal sulcus).

DESCRIPTION — *Colour.* Black, palpi white, fore and middle legs yellow, coxa, hind leg and antennae brown.

Head. Antenna with 28 segments, slender, first flagellomere 4.0X longer than widest point. Face 1.0X as wide as high. Face 1.1X wider than clypeus, and clypeus 1.4X as wide as median height. Malar space short, 0.6X width of mandible base. Occipital carina complete. OOL=0.4. Eyes large, protruding and strongly converging, with very few short setae. Head setate.

Mesosoma. Notauli deeply impressed, mesopleuron with deep and broad precoxal sulcus. Epicnemial carina present. Propodeum with distinct longitudinal and transverse carina, in-between smooth. The apical face of scutellum abruptly sloping, giving a "pointy" scutellar appearance.

Metasoma. Petiole long and slender, dorsally with a median carina running along major length of petiole. Length of petiole 3.0X its apical width. Spiracular tubercle positioned just basal to middle of petiole. Gaster of the same length as of the petiole. Ovipositor long and straight, when exerted 1.3 mm.

Wings. Fore wing vein r 0.6X length of 3-SR. Fore wing vein R1 about equal to pterostigma length (1.2X). Both fore and hind wing normally setate. Wings slightly infuscate.

Legs. Fore femur slender 6.3X as long as its maximum width, hind femur 5.9X as long as its maximum width. Hind coxa punctate. Claws simple without basal lobe.

VARIATION — Paratype with 29 antennal segments and scutellum flatter.

MEASUREMENTS — 2.9 mm in length, fore wing length 2.3 mm.

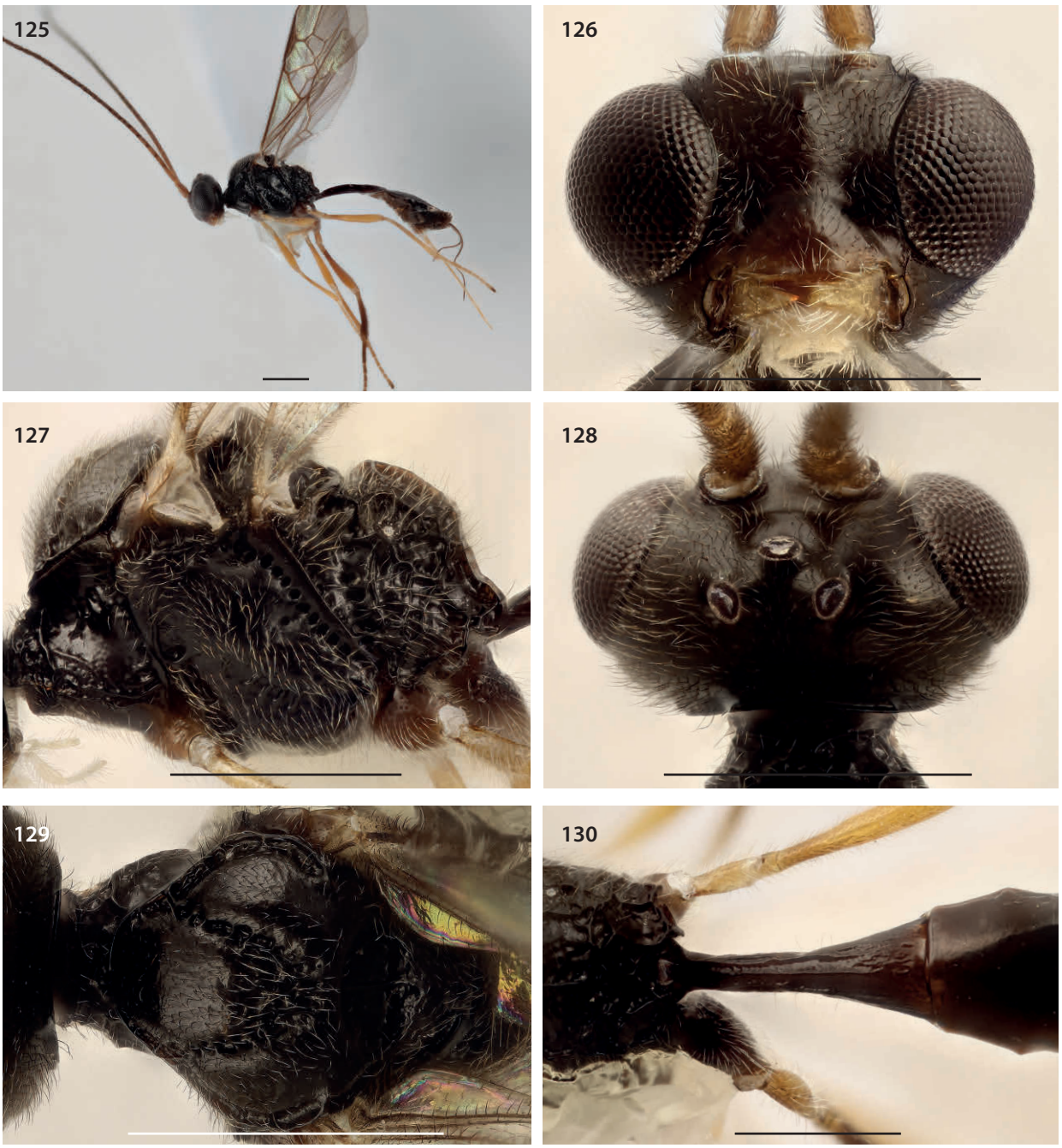
ETYMOLOGY — Named after Yves Braet, a Belgian fellow hymenopterist who introduced us to this fantastic PNG material (a very long time ago).

Meteorus obscurus Huddleston, 1983

Figures 131-137

Meteorus obscurus Huddleston, 1983: 411.

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Baiyer, R., 1100 m, 25.ii–9.iii.1979 (Sedlacek) (TC, Ann Arbor). [not examined]. Paratypes, 1 ♂, 1 ♀, **Papua New Guinea**. Baiyer, R., 1100 m, 27.ii–7.iii.1979 (BMNH). [♀ paratype examined]

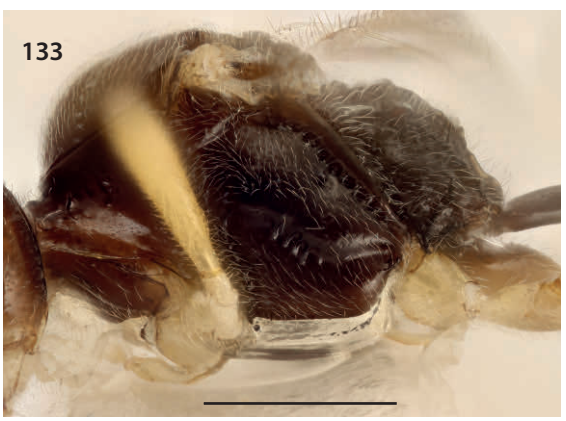


FIGURES 125-130

Holotype *Meteorus braeti* n. sp. **125**, lateral view of habitus; **126**, front view of head; **127**, lateral view of mesosoma; **128**, dorsal view of head; **129**, dorsal view of mesosoma; **130**, dorsal view of propodeum and petiole. Scale bars: 0.5 mm.











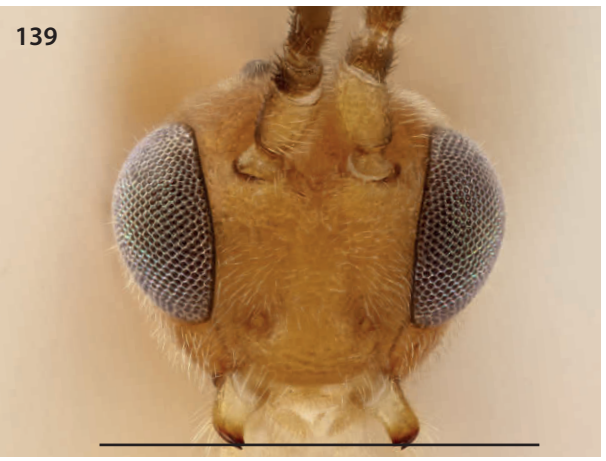




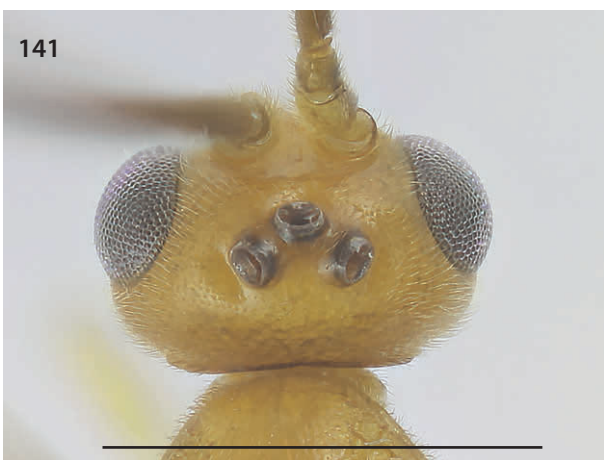
FIGURES 131-137

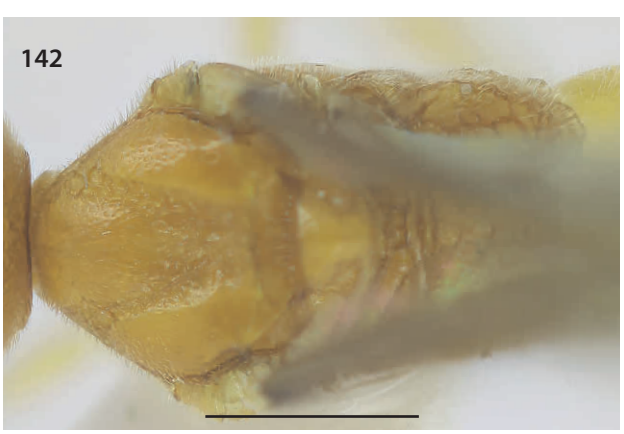
Meteorus obscurus (Voucher ID: JS10_00568). **131**, lateral view of habitus; **132**, front view of head; **133**, lateral view of mesosoma; **134**, dorsal view of head; **135**, dorsal view of mesosoma; **136**, lateral view of abdomen; **137**, fore wing. Scale bars: 0.5 mm.













FIGURES 138-143

Meteorus tarius. **138**, habitus; **139**, front view of head; **140**, lateral view of mesosoma; **141**, dorsal view of head; **142**, dorsal view of mesosoma; **143**, lateral view of propodeum and petiole. Scale bars: 0.5 mm.

MATERIAL EXAMINED — Papua New Guinea. 1 ♀, Province Madang, Mount Wilhelm 1200 m (-5.721022, 145.2703) 1200 m, 02-03/11/2012, leg Philip, Alois, Novotny, Leponce Plot 2, understorey; Malaise - MAL-MW1200B-09/16-d09, P1802-11323; Voucher ID: JS10_00568 (MNHN). GenBank ID: N/A (*COI*), MH464446 (*28S*).

DISTRIBUTION — Papua New Guinea.

Meteorus tarius Huddleston, 1983

Figures 138-143

Meteorus tarius Huddleston, 1983: 417.

TYPE MATERIAL — 1 ♀ of *M. tarius* at BMNH, not examined.

MATERIAL EXAMINED — Papua New Guinea. 1 ♀, Province Madang, Mount Wilhelm 200 m (-5.741031 145.3294) 200 m, 27-28/10/2012, leg Dilu, Ray, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0200B-03/16-d03, P1016-11952; Voucher ID: JS10_00571 (MNHN). GenBank ID: MH464435 (*COI*), MH464447 (*28S*).

DISTRIBUTION — Papua New Guinea.

ACKNOWLEDGEMENTS

Claire Villemant and Yves Braet for loan of the material and introducing us to the PNG project, Rasa Bukontaite for lab-assistance and Gavin Broad for loan of type material. Mathilde Gaudreau for translating the abstract into French. This study was conducted in the framework of "Our Planet Reviewed – Papua New Guinea 2012-2013" set up by Pro-Natura International, the Muséum national d'Histoire naturelle (MNHN, France), the Institut de Recherche pour le Développement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery. The IBISCA expert network, the patron for this project, Prof. R. L. Kitching AM, and all other participants in this collective effort are thanked for their contribution.

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The scientific expedition benefited from the help of the local communities who participated in setting up the camps and transporting equipment and food. (Photo © Xavier Desmier).

Species of the subgenus *Synaldis* Foerster, 1863 (Hymenoptera: Braconidae: Alysiinae: *Dinotrema* Foerster, 1863) in Papua New Guinea: descriptions of three new species and a key to the Australasian taxa

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ABSTRACT

A revision of all Australasian species of subgenus *Synaldis* Foerster, 1863 (from the genus *Dinotrema* Foerster, 1863) is provided and three new species from Papua New Guinea are described and illustrated: *Dinotrema (Synaldis) expeditionum* n. sp., *D. (S.) mamuchiae* n. sp., and *D. (S.) wilhelmense* n. sp. The new combination *Dinotrema (Synaldis) baloghi* (Fischer, 1993), n. comb. is suggested. A key for determination of the Australasian *Synaldis* species is provided.

RÉSUMÉ

Révision des espèces australasiennes du sous-genre *Synaldis*.

Une révision de toutes les espèces australiennes du sous-genre *Synaldis* Foerster, 1863 (genre *Dinotrema* Foerster, 1863) est présentée et trois nouvelles espèces de Papouasie-Nouvelle-Guinée sont décrites et illustrées: *Dinotrema (Synaldis) expeditionum* n. sp., *D. (S.) mamuchiae* n. sp., et *D. (S.) wilhelmense* n. sp. La nouvelle combinaison *Dinotrema (Synaldis) baloghi* (Fischer, 1993), n. comb. est suggérée. Une clé pour la détermination des espèces australasiennes du genre *Synaldis* est fournie.

PERIS-FELIPO F. J. & BELOKOBYLSKIJ S. A. 2020 — Species of the subgenus *Synaldis* Foerster, 1863 (Hymenoptera: Braconidae: Alysiinae: *Dinotrema* Foerster, 1863) in Papua New Guinea: descriptions of three new species and a key to the Australasian taxa, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 191-208 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

INTRODUCTION

Biodiversity study of braconids has a great importance because of their enormous ecological interest to their role in the control of the population of phytophagous insects, causing direct effects on the host species' population size and indirect ones in the diversity and survival of host plants (La Salle & Gauld 1992; Peris-Felipo *et al.* 2014a).

The subfamily Alysiinae, with 2,450 catalogued species worldwide (Yu *et al.* 2016), has potential use in biocontrol thanks to the interaction with a wide variety of Cyclorrhapha-Diptera as leaf or stem miners (Griffiths 1964; Wharton 2002).

The subgenus *Synaldis* comprises about a hundred species described worldwide (Fischer 1962, 1967a, 1967b, 1971, 1993a, 1993b, 2003, 2005; Belokobylskij 2002, 2004a, 2004b; Belokobylskij & Tobias 2007; Peris-Felipo *et al.* 2014a; Peris-Felipo & Belokobylskij 2017). Members of *Synaldis* are often reared from agaric mushrooms and recorded as parasitoids of the larvae and pupae of the dipterous families Phoridae (mainly) and Drosophilidae (doubtfully) (Hussey 1960; Fischer 2005; Yu *et al.* 2016).

Despite the studies carried out in the last years (Fischer 2014; Peris-Felipo *et al.* 2014a, 2014b; Peris-Felipo & Belokobylskij 2017) the knowledge of this subgenus is still insufficient. Therefore, expeditions such as "Our Planet Reviewed – Papua New Guinea" carried out by the Muséum national d'Histoire naturelle (Paris, France) in 2012 it is very important to increase our knowledge about the biology and distribution of its members.

In this paper, three species of the subgenus *Synaldis* are described and illustrated for Papua New Guinea, *Dinotrema (Synaldis) expeditionum* n. sp., *D. (S.) mamuchiae* n. sp., and *D. (S.) wilhelmense* n. sp., and the new combination *D. (S.) baloghi* (Fischer, 1993) n. comb. is suggested.

MATERIALS AND METHODS

Specimens were collected with Malaise traps during the expedition "Our Planet Reviewed –Papua New Guinea (PNG)" between 25 October and 10 November 2012, at eight sites located every 500 m along an altitudinal transect set up on the north-eastern face of Mt Wilhelm and at Wanang (Swire) Research Station (175 m asl) a lowland forest 63 km north of Mt Wilhelm. At each sampling site, four Malaise traps were set up every 100 m following the same contour line. The captures were preserved with 90% ethyl alcohol (Robillard *et al*. 2016).

For the terminology of morphological features, sculpture and measurements (including for mandibles) see Peris-Felipo *et al.* (2014); for wing venation nomenclature see van Achterberg (1993); for measurements of the marginal cell see Peris-Felipo & Belokobylskij (2017). Material was imaged using a Digital Microscope Keyence® VHX-2000 and Adobe Photoshop® imaging system. The types of described species are deposited in the collection the Muséum national d'Histoire naturelle (Paris, France; MNHN), Museum of Natural History of Vienna (Vienna, Austria; NHMW) the Zoological Institute of the Russian Academy of Sciences (St Petersburg, Russia; ZISP), and the F.J. Peris-Felipo Entomological Collectio, (Basel, Switzerland; PFEC).

TAXONOMIC PART

Order HYMENOPTERA Linnaeus, 1758
Family BRACONIDAE Nees, 1811
Subfamily ALYSIINAE Leach, 1815
Tribe ALYSIINI Leach, 1815

Genus ***DINOTREMA*** Foerster, 1863

Type species. *Dinotrema erythropa* Foerster, 1863.

Subgenus ***SYNALDIS*** Foerster, 1863

DIAGNOSIS — Mandibles tridentate, teeth of differing shape and length. Paraclypeal fovea short, far removed from inner edge of eyes. Mesoscutal pit present or absent. Precoxal sulcus always present, usually not reaching anterior and posterior margins of mesopleuron. Pterostigma very long and narrow. Vein 2-SR always absent; break between veins r and 3-SR absent and abscissae here only gently and rather widely curved. Veins m-cu and cu-a always postfurcal.

HOSTS — Diptera larvae, mainly of the family Phoridae and possibly Drosophilidae.

Dinotrema (Synaldis) baloghi (Fischer, 1993), n. comb.

Figures 1-11

Synaldis baloghi Fischer, 1993a: 458. — 2003: 21; 2014: 113; Yu *et al.* 2016.

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. [New-Guinea], Mt. Wilhelm, Keglsugl, 11.viii.1969 (Dr. J. Balogh leg.) [No. NGMt-U.8.] (NHMW) [examined]. Paratype, 1 ♂, **Papua New Guinea** [New-Guinea], NE, Wau, Bddy Creek, 2050 m, 30.viii.1968 (Dr. J. Balogh leg.) [No. NG-W.C.13] (NHMW).

DESCRIPTION — ***Female*** (holotype).

Head. In dorsal view 1.8 times as wide as long, 1.3 times as wide as mesoscutum, smooth, with temple rounded behind eyes. Eye in lateral view 1.5 times as high as wide and 1.8 times as wide as temple medially. POL 1.2 times OD; OOL 3.5 times OD. Face 1.6 times as wide as high; inner margins of eyes subparallel. Clypeus 3.1 times as wide as high, slightly concave ventrally. Paraclypeal fovea short, reaching half distance between clypeus and eye. Mandible not widened towards apex, 1.4 times as long as its maximum width. Upper tooth very small, shorter than middle tooth; middle tooth small, wide basally and pointed apically; lower tooth short, as long as upper tooth, rounded. Antenna 22-segmented, 1.2 times as long as body. Scape 1.8 times as long as pedicel. First flagellar segment 4.1 times as long as its apical width, 1.1 times as long as second segment. Second flagellar segment 3.8 times, third to 12th segments 3.6 times, 13th to 19th segments 2.8 times, and 20th (apical) segment 3.0 times as long as their maximum width, respectively.

Mesosoma. In lateral view 1.1 times as long as high. Mesoscutum (dorsal view) 0.9 times as long as its maximum width. Notauli mainly absent on horizontal surface of mesoscutum. Mesoscutal pit absent. Prescutellar depression smooth, without lateral carinae, 1.3 times as long as its maximum width. Precoxal sulcus present, crenulate, not reaching anterior and posterior margins of mesopleuron. Posterior mesopleural furrow smooth. Propodeum sculptured, with complete and distinct medio-longitudinal carina from its base to apex and with smooth fields. Propodeal spiracle small, its diameter 0.2 times as wide as distance from spiracle to anterior margin of propodeum.

Wings. Length of fore wing 2.4 times its maximum width. Marginal cell ending at apex of wing, 4.1 times as long as its maximum width. Vein SR1 2.6 times as long as vein 3-SR. Vein cu-a distinctly postfurcal. First subdiscal cell 4.0 times as long as its maximum width. Hind wing 5.3 times as long as its maximum width.

Legs. Hind femur 5.6 times as long as its maximum width. Hind tibia weakly widened to apex, 9.4 times as long as its maximum subapical width, 1.2 times as long as hind tarsus. First segment of hind tarsus 2.5 times as long as second segment.

Metasoma. First tergite weakly widened towards apex, 2.6 times as long as its apical width, weakly striate. Ovipositor sheath 1.6 times as long as first tergite, 0.4 times as long as metasoma and 0.9 times as long as hind femur.



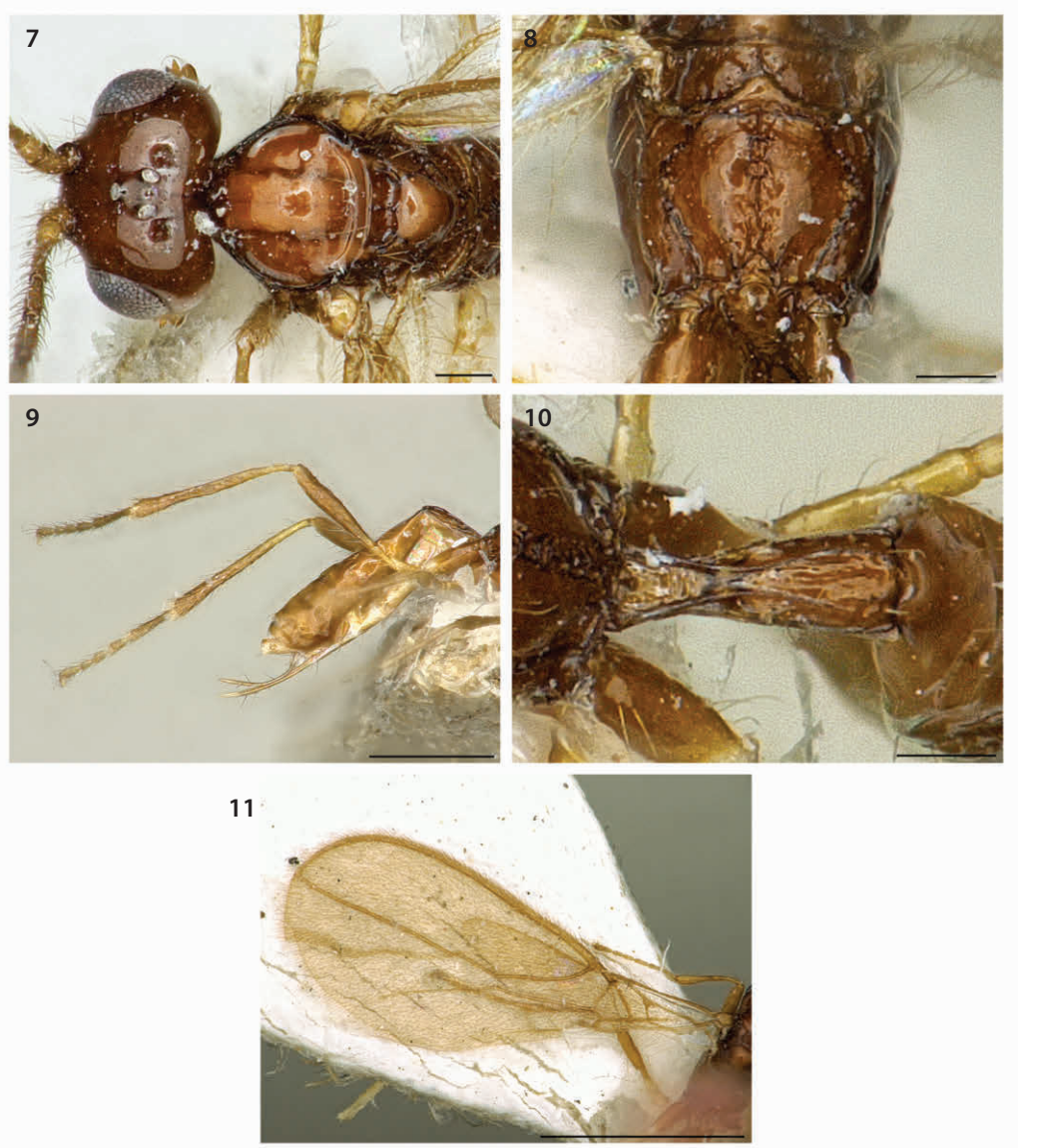
FIGURES 1-6

Dinotrema (Synaldis) baloghi. (**1**, **3-6** – female, holotype; **2** – male, paratype). **1**, **2**, Habitus, lateral view. **3**, Head and mesosoma, lateral view. **4**, Mandible. **5**, Antenna. **6**, Head, anterior view. Scale bars: 1 mm (1-2, 5); 0,5 mm (3); 0,1 mm (4, 6).

Colour. Body and antenna dark brown. Mandible and legs brown. First-third metasomal tergites similarly coloured. Wings hyaline.

Length. Body 1.7 mm, fore wing 2.0 mm, hind wing 1.3 mm.

Male. Body length 1.5 mm, fore wing length 1.8 mm, hind wing length 1.1 mm. Antenna with more than 16-segmented (apical segments missing). First flagellar segment 4.0 times as long as its maximum width. Hind femur 5.2 times as long as its maximum width. Otherwise similar to female.



FIGURES 7-11

Dinotrema (Synaldis) baloghi. (female, holotype). **7**, Head and mesoscutum, dorsal view. **8**, Propodeum, dorsal view. **9**, Hind legs, metasoma and ovipositor, lateral view. **10**, First metasomal tergite, dorsal view. **11**, Fore and hind wings. Scale bars: 0,1 mm (7-8, 10); 0,5 mm (9); 1 mm (11).

COMPARATIVE DIAGNOSIS — This species is similar to *Dinotrema (Synaldis) mamuchiae* n. sp. (Papua New Guinea) and to *D. (S.) wilhelmse* n. sp. (Papua New Guinea), but differs from both in having the mandible 1.4 times as long as its maximum width (2.2 times in *D. mamuchiae* and 2.3 times in *D. wilhelmense*) and first metasomal tergite 2.6 times as long as its apical width (2.2 times in *D. mamuchiae* and *D. wilhelmense*). In addition, clypeus 3.1 times as wide as high (2.1 times in *D. wilhelmense*) and hind femur 5.2-5.6 times as long as its maximum width (4.2 times in *D. wilhelmense*); first flagellar segment 4.1 times as long as its maximum width (5.0 times in *D. mamuchiae*) and mesoscutal pit absent (present in *D. mamuchiae*).

Dinotrema (Synaldis) expeditionum Peris-Felipo n. sp.

Figures 12-23

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mt. Wilhelm, UTM (-5.758978, 145.1861), 2200 m, 18-19.x.2012, Malaise trap, Plot 1, understorey (Mogia, Lilip, Novotny, Leponce leg.) [MAL-MW2200A-03/16-d03] (MNHN). Paratypes, 1 ♀, **Papua New Guinea**. Same locality as holotype but, 24-25.x.2012 [MAL-MW2200A-09/16-d09] (MHNM); 1 ♀, same locality as holotype but, 26-27.x.2012, Plot 4 [MAL-MW2200D-11/16-d11] (MHNM); 1 ♀, same locality as holotype but, 27-28.x.2012 [MAL-MW2200A-12/16-d12] (MHNM); 2 ♀, same locality as holotype but, 28-29.x.2012 , Plot 4 [MAL-MW2200D-13/16-d13] (ZISP); 1 ♀, same locality as holotype but, 8-9.xi.2012, UTM (-5.720874, 145.2695), 1200 m , Plot 4 (Philip, Alois, Novotny, Leponce leg.) [MAL-MW1200D-15/16-d15] (MHNM); 2 ♀, same locality as holotype but, 31.x-1.ix.2012, Plot 2 [MAL-MW2200B-16/16-d16] (PFEC); 1 ♀, same locality as holotype but, 18.v.2013, UTM (-5.71961, 145.2522), 700 m, Coll. by Sam *et al.* [site: MW0700-01, P4705, vial: 20833, MAL-MW0700'A-05/16-d05] (MNHN); 1 ♀, same locality as holotype but, 25-26.v.2013, UTM (-5.731961, 145.2522), 700 m, Coll. by Sam *et al.* [site: MW0700-03, P4745, vial: 20602, MAL-MW0700'C-13/16-d13] (MNHN); 1 ♂, same locality as holotype but, 25 - 26.x.2012, UTM (-5.720874, 145.2695), 1200 m (Philip, Alois, Novotny, Leponce leg.) [MAL-MW1200A-01/16-d01] (MHNM).

DESCRIPTION — ***Female*** (holotype).

Head. In dorsal view 1.8 times as wide as long, 1.3 times as wide as mesoscutum, smooth, with temple rounded behind eyes. Eye in lateral view 1.2 times as high as wide and 2.8 times as wide as temple medially. POL 0.8 times OD; OOL 2.3 times OD. Face 1.7 times as wide as high; inner margins of eyes subparallel. Clypeus 2.8 times as wide as high, weakly concave ventrally. Paraclypeal fovea short, not reaching half of distance between clypeus and eye. Mandible weakly widened towards apex, 1.5 times as long as its maximum width. Upper tooth small, slightly shorter than middle tooth; middle tooth short, wide basally and pointed apically; lower tooth short, wide, rounded. Antenna 22-segmented and 1.7 times as long as body. Scape 1.6 times as long as pedicel. First flagellar segment 4.0 times as long as its apical width, about as long as second segment. Second flagellar segment 3.4 times as long as its maximum width, third to 11th segments 3.6 times, 12th to 20th (apical) segments 4.0 times as long as their width, respectively.

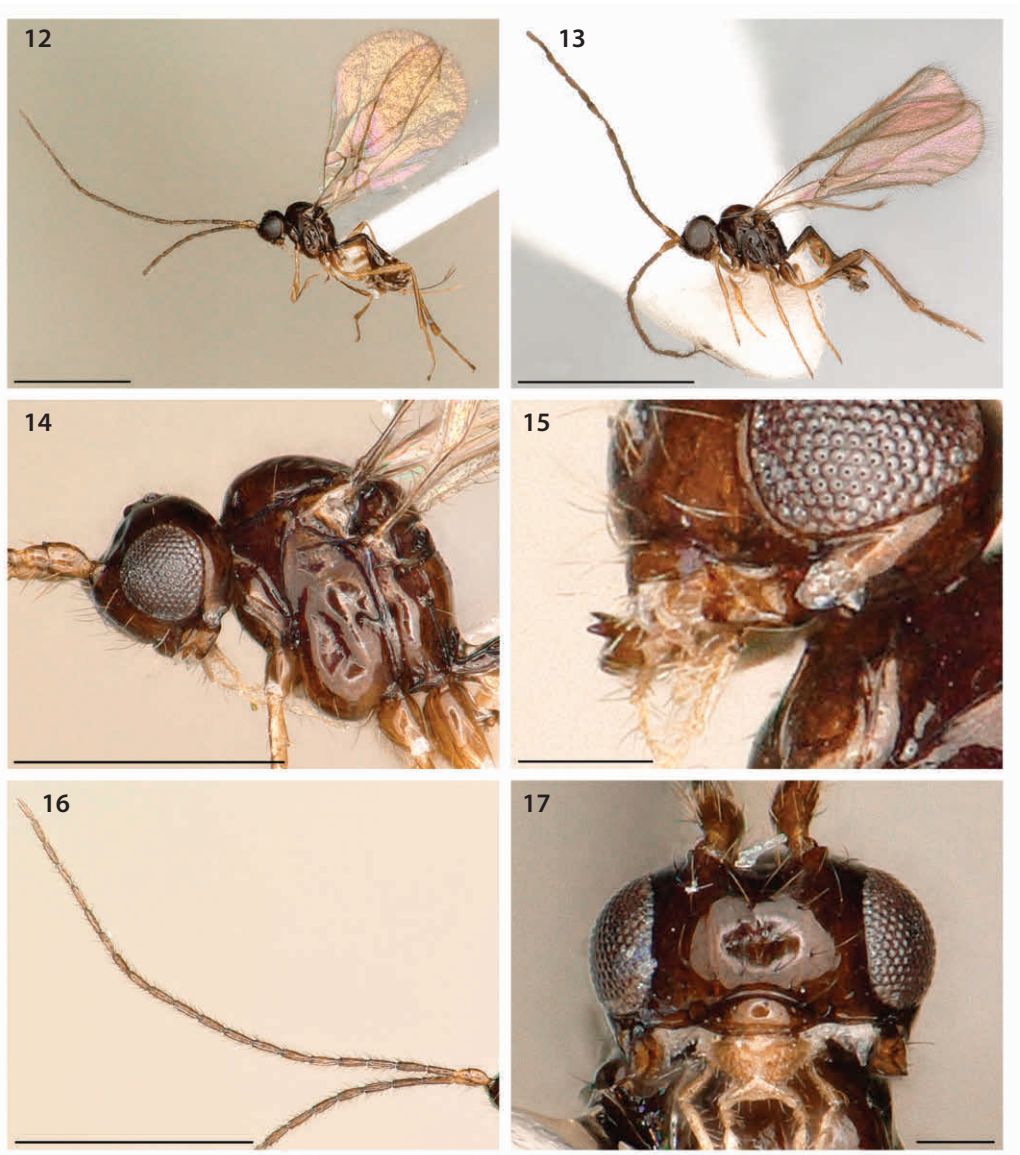
Mesosoma. In lateral view about as long as high. Mesoscutum (dorsal view) about as long as its maximum width, smooth. Notauli mainly absent on horizontal surface of mesoscutum. Mesoscutal pit absent. Prescutellar depression smooth, without median and lateral carinae. Precoxal sulcus present, weakly crenulate (mainly smooth), not reaching anterior and posterior margins of mesopleuron. Posterior mesopleural furrow smooth. Propodeum smooth, with short medio-longitudinal carina from its base to half distance of propodeum. Propodeal spiracle small, its diameter about 0.2 times as large as distance from spiracle to anterior margin of propodeum.

Wings. Length of fore wing 2.3 times its maximum width. Marginal cell ending at apex of wing, 4.2 times as long as its maximum width. Vein SR1 3.2 times as long as vein 3-SR. Vein cu-a distinctly postfurcal. First subdiscal cell 2.8 times as long as its maximum width. Hind wing 13.3 times as long as its maximum width.

Legs. Hind femur 4.8 times as long as its maximum width. Hind tibia weakly widened to apex, 8.4 times as long as its maximum subapical width and 1.2 times as long as hind tarsus. First segment of hind tarsus 2.7 times as long as second segment.

Metasoma. First tergite weakly widened towards apex, 2.1 times as long as its apical width, striate. Ovipositor sheath 2.2 times as long as first tergite, 0.8 times as long as metasoma, 1.5 times as long as hind femur.

Colour. Body, pterostigma and flagellar segments of antenna brown to dark brown; legs and remainder of antenna brown. First-third metasomal tergites similarly coloured. Wings hyaline.

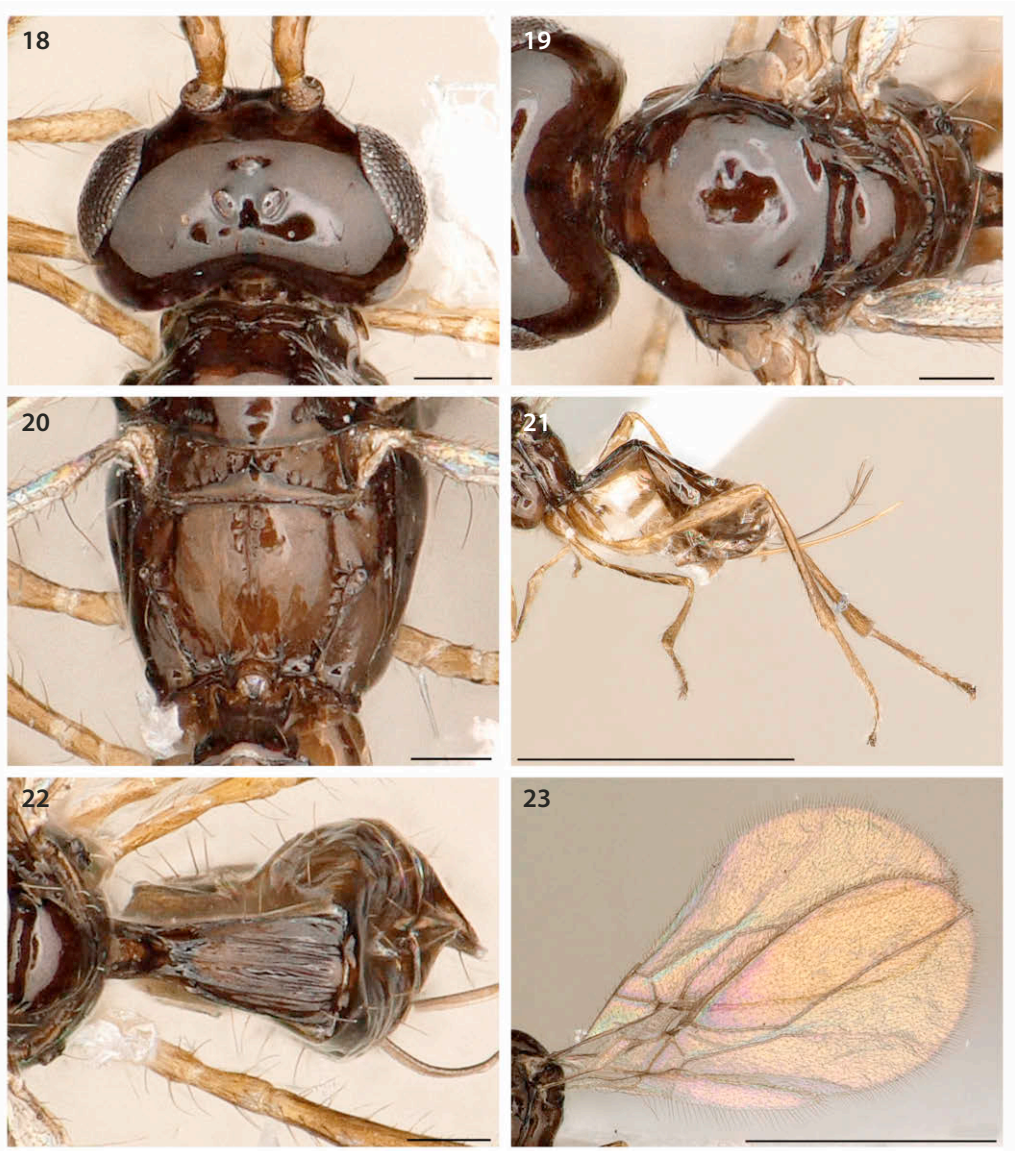


FIGURES 12-17

Dinotrema (Synaldis) expeditionum. (12, 14-17 – female, holotype; 13 – male, paratype). **12**, **13**, Habitus, lateral view. **14**, Head and mesosoma, lateral view. **15**, Mandible. **16**, Antenna. **17**, Head, front view. Scale bars: 1 mm (12-13, 16); 0,5 mm (14); 0,1 mm (15, 17).

Length. Body 1.4 mm, fore wing 1.8 mm, hind wing 1.1 mm.

Variation. Body length 1.1-1.4 mm; fore wing length 1.4-1.8 mm; hind wing length 0.9-1.1 mm. Antenna 21-24-segmented. Eye in lateral view 2.8-3.2 times as wide as temple medially. Face 1.4-1.7 times as wide as high. Clypeus 2.8-3.0 times as wide as high. Mandible 1.5-1.7 times as long as its maximum width. First flagellar segment 3.7-4.0 times as long as its apical width. Sixth flagellar segment 3.3-3.6 times as long as its maximum width. Hind femur 4.5-4.8 times as long as its maximum width. First metasomal tergite 2.1-2.3 times as long as its apical width. Ovipositor sheath 0.8-1.0 times as long as metasoma.



FIGURES 18-23

Dinotrema (Synaldis) expeditionum. (female, holotype). **18**, Head, dorsal view. **19**, Mesoscutum, dorsal view. **20**, Propodeum, dorsal view. **21**, Hind leg, metasoma and ovipositor, lateral view. **22**, First metasomal tergite, dorsal view. **23**, Fore and hind wings. Scale bars: 0,1 mm (18-20, 22); 1 mm (21-23).

Male. Body length 1.1 mm, fore wing 1.4 mm, hind wing 1.0 mm. Antenna more than 16-segmented (apical segments missing). First flagellar segment 3.8 times as long as its maximum width. Middle flagellar segments (fourth to 10th) 2.7-2.8 times as long as their maximum width. Hind femur 4.3 times as long as its maximum width. Otherwise similar to female.

ETYMOLOGY — The name is referring to the 2012 expedition because of the important role that expeditions play in the increasing knowledge of PGN biodiversity.

COMPARATIVE DIAGNOSIS — This new species is similar to *Dinotrema (Synaldis) baloghi* (Fischer, 1993) (Papua New Guinea) but differs from it by having the propodeum with a short median longitudinal carina from its base to half distance of propodeum (with complete medio- longitudinal carina in *D. (S.) baloghi*); eye in lateral view 2.8-3.2 times as wide as temple medially (1.8 times in *D. (S.) baloghi*); hind femur 4.3-4.8 times as long as its maximum width (5.2-5.6 times in *D. (S.) baloghi*); prescutellar depression smooth, without median and lateral carinae (with median carinae in *D. (S.) baloghi*) and ovipositor sheath 0.8-1.0 times as long as metasoma (0.4 times in *D. (S.) baloghi*).

Dinotrema (Synaldis) mamuchiae Peris-Felipo n. sp.

Figures 24-34

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mt. Wilhelm, UTM (-5.758978, 145.1861), 2200 m, 31.x-01.xi.2012, Malaise trap, Plot 1, understorey (Mogia, Lilip, Novotny, Leponce leg.) [MAL-MW2200A-16/16-d16] (MNHN). Paratypes, **Papua New Guinea**. 1 ♀ and 1 ♂, same data as holotype but, 16-17.x.2012 [MAL-MW2200A-01/16-d01] (♂ MNHN, ♀ ZISP); 1 ♀, same data as holotype but, 27-28.x.2012, 1700 m, Plot 4 (Valeba, Tulei, Novotny, Leponce leg.) [MAL-MW1700D-03/16-d03] (PFEC).

DESCRIPTION — ***Female*** (holotype).

Head. In dorsal view 1.6 times as wide as long, 1.4 times as wide as mesoscutum, smooth, with temple rounded behind eyes. Eye in lateral view 1.4 times as high as wide and 1.6 times as wide as temple medially. POL 1.2 times OD; OOL 4.0 times OD. Face 1.4 times as wide as high; inner margins of eyes subparallel. Clypeus 3.0 times as wide as high, slightly concave ventrally. Paraclypeal fovea reaching half way distance between clypeus and eye. Mandible very narrow, not widened towards apex, 2.2 times as long as its maximum width. Upper tooth very small, distinctly shorter than middle tooth; middle tooth small, pointed apically; lower tooth short, as long as upper tooth and rounded. Antenna 22-segmented, 1.3 times as long as body. Scape 2.0 times as long as pedicel. First flagellar segment 5.0 times as long as its apical width, 1.4 times as long as second segment. Second to 13th segments 3.4 times, 14th to 20th (apical) segments 3.0 times as long as their maximum width, respectively.

Mesosoma. In lateral view almost as long as high. Mesoscutum (dorsal view) almost as long as its maximum width, smooth. Notauli mainly absent on horizontal surface of mesoscutum. Mesoscutal pit present and round. Prescutellar depression smooth, without lateral carinae, 1.4 times as long as its maximum width. Precoxal sulcus present, crenulate, not reaching anterior and posterior margins of mesopleuron. Posterior mesopleural furrow smooth. Propodeum sculptured with a distinct medio-longitudinal carina from its base to apex and with smooth fields. Propodeal spiracle relatively small, its diameter 0.1 times as wide as the distance from spiracle to anterior margin of propodeum.

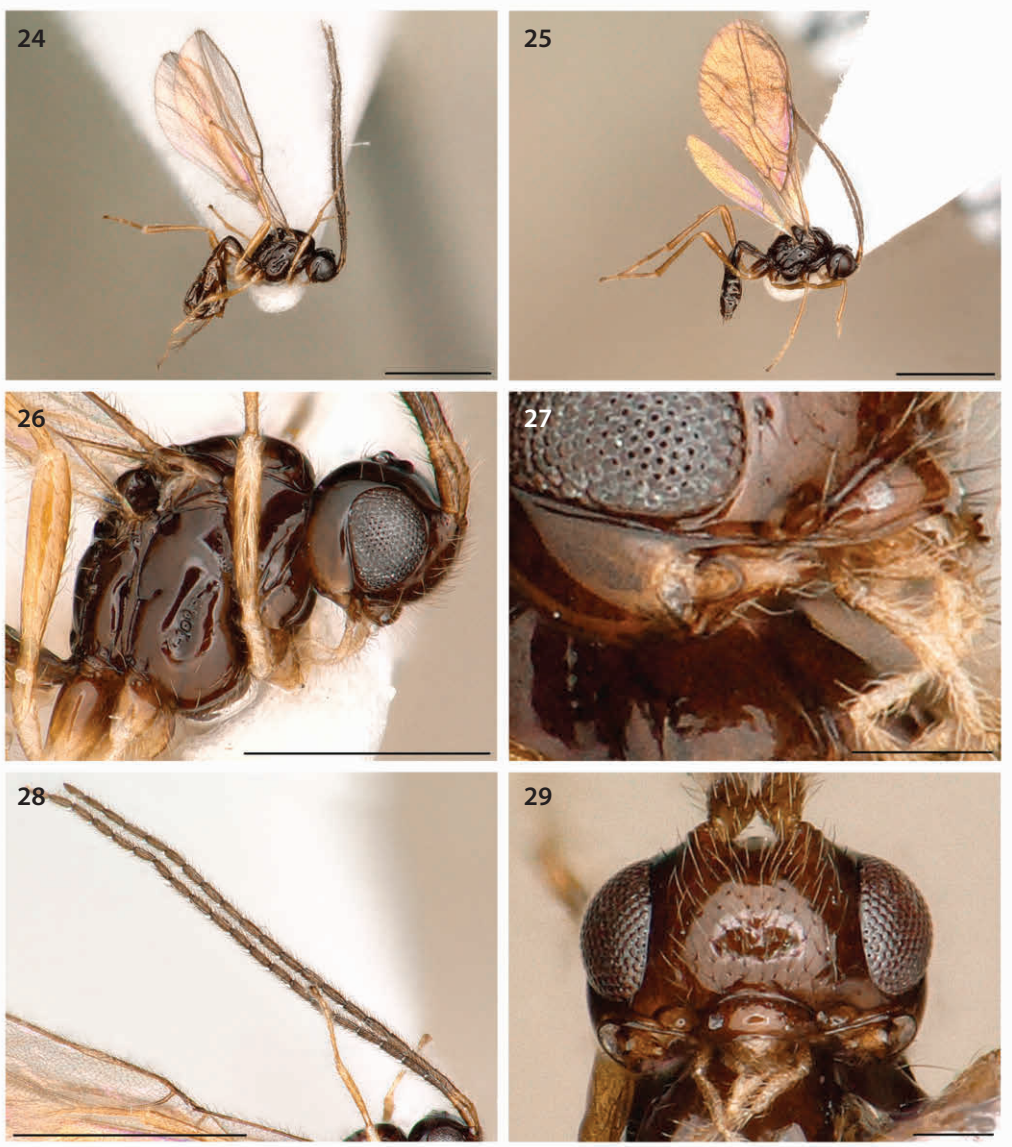
Wings. Length of fore wing 2.2 times its maximum width. Marginal cell ending at apex of wing, 4.3 times as long as its maximum width. Vein SR1 2.9 times as long as vein 3-SR. Vein cu-a distinctly postfurcal. First subdiscal cell 3.1 times as long as its maximum width. Hind wing 5.6 times as long as its maximum width.

Legs. Hind femur 5.4 times as long as its maximum width. Hind tibia weakly widened to apex, 8.6 times as long as its maximum subapical width and 1.2 times as long as hind tarsus. First segment of hind tarsus twice as long as second segment.

Metasoma. First tergite weakly widened towards apex, 2.2 times as long as its apical width, weakly striate in apical half. Ovipositor sheath 1.6 times as long as first tergite, 0.5 times as long as metasoma and almost as long as hind femur.

Colour. Body, pterostigma and flagellar segments of antenna brown to dark brown. Legs brownish yellow. First-third metasomal tergites similarly coloured. Wings hyaline.

Length. Body 1.7 mm, fore wing 2.1 mm, hind wing 1.4 mm.

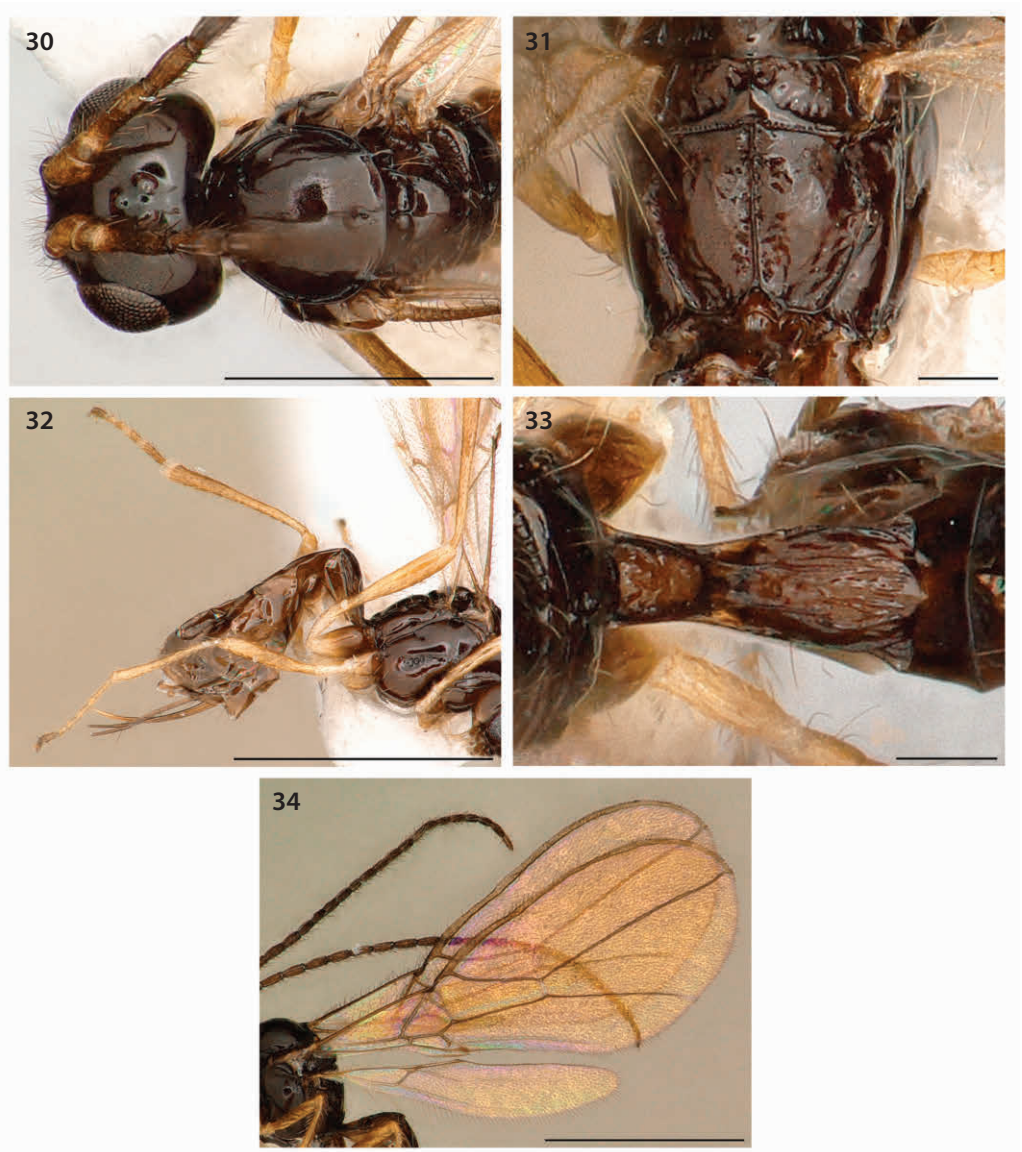


FIGURES 24-29

Dinotrema (Synaldis) mamuchiae (24, 26-29 – female, holotype; 25 – male, paratype). **24**, **25**, Habitus, lateral view. **26**, Head and mesosoma, lateral view. **27**, Mandible. **28**, Antenna. **29**, Head, anterior view. Scale bars: 1 mm (24-25, 28); 0,5 mm (26); 0,1 mm (27, 29).

Variation. Body 1.6-1.8 mm; fore wing 2.0-2.2 mm; hind wing 1.3-1.5 mm. Antenna 22-24-segmented. Hind femur 5.2-5.4 times as long as its maximum width. First metasomal segment 2.1-2.3 times as long as its apical width.

Male. Body length 1.8 mm, fore wing 2.2 mm, hind wing 1.4 mm. Antenna 25-segmented and 1.4 times as long as body. First flagellar segment 4.0 times as long as its maximum width. Hind femur 5.8 times as long as its maximum width. Otherwise similar to female.



FIGURES 30-34

Dinotrema (Synaldis) mamuchiae. (female, holotype). **30**, Head and mesoscutum, dorsal view. **31**, Propodeum, dorsal view. **32**, Hind leg, metasoma and ovipositor, lateral view. **33**, First metasomal tergite, dorsal view. **34**, Fore and hind wings. Scale bars: 0,5 mm (30); 0,1 mm (31, 33,); 1 mm (32, 34).

ETYMOLOGY — Named is derived from "mami", referring to the mother of the first author for her support and her encourage to continue working with insects.

COMPARATIVE DIAGNOSIS — This new species is similar to *Dinotrema (Synaldis) wilhelmense* n. sp. (Papua New Guinea), but differs from it in having the mesoscutal pit present (absent in *D. wilhelmense*); hind femur 5.4 times as long as its maximum width (4.2 times in *D. wilhelmense*); first flagellar segment 5.0 times as long as its maximum width (3.6 times in *D. wilhelmense*); second segment 3.4 times (2.7 times in *D. wilhelmense*); sixth segment 3.4 times (2.4 times in *D. wilhelmense*) and clypeus 3.0 times as wide as high (2.1 times in *D. wilhelmense*).

Dinotrema (Synaldis) wilhelmense Peris-Felipo n. sp.

Figures 35-44

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mt. Wilhelm, UTM (-5.759269, 145.2356), 1700 m, 25-26.x.2012, Malaise trap, Plot 4, understorey (Valeba, Tulei, Novotny, Leponce leg.) [MAL-MW1700D-01/16-d01] (MNHN). Paratype, **Papua New Guinea**. 1 ♀, same data as holotype (ZISP).

DESCRIPTION — ***Female*** (holotype).

Head. In dorsal view 1.6 times as wide as long, 1.4 times as wide as mesoscutum, smooth, with temple rounded behind eyes. Eye in lateral view 1.4 times as high as wide and 1.4 times as wide as temple medially. POL 1.1 times OD; OOL 3.8 times OD. Face 1.5 times as wide as high, completely covered by numerous setae; inner margins of eyes subparallel. Clypeus 2.1 times as wide as high, slightly concave ventrally. Paraclypeal fovea short, reaching half distance between clypeus and eye. Mandible weakly widened towards apex, 2.3 times as long as its maximum width. Upper tooth very small, shorter than lower and middle teeth; middle tooth short and pointed apically; lower tooth short, rounded. Antenna 10-segmented (incomplete, apical segments missing). Scape 1.5 times as long as pedicel. First flagellar segment 3.6 times as long as its apical width, 1.2 times as long as second segment. Second flagellar segment 2.7 times, third to eight flagellar segments 2.4 times as long as their maximum width, respectively.

Mesosoma. In lateral view 1.1 times as long as high. Mesoscutum (dorsal view) about as long as its maximum width. Notauli mainly absent on horizontal surface of mesoscutum. Mesoscutal pit absent. Prescutellar depression smooth, without carinae and 1.2 times as long as its maximum width. Precoxal sulcus present, crenulate, not reaching anterior and posterior margins of mesopleuron. Posterior mesopleural furrow smooth. Propodeum sculptured, with complete and distinct medio-longitudinal carina from its base to apex and with smooth fields. Propodeal spiracle small, its diameter 0.2 times as wide as the distance from spiracle to anterior margin of propodeum.

Wings. Length of fore wing 2.6 times its maximum width. Marginal cell ending at apex of wing, 4.1 times as long as its maximum width. Vein SR1 2.8 times as long as vein 3-SR. Vein cu-a distinctly postfurcal. First subdiscal cell 3.0 times as long as its maximum width. Hind wing 6.0 times as long as its maximum width.

Legs. Hind femur 4.2 times as long as its maximum width. Hind tibia weakly widened to apex, 9.6 times as long as its maximum subapical width and 1.1 times as long as hind tarsus. First segment of hind tarsus twice as long as second segment.

Metasoma. First tergite weakly widened towards apex, 2.2 times as long as its apical width, weakly striate. Ovipositor sheath 1.1 times as long as first tergite, 0.5 times as long as metasoma and 1.8 times as long as hind femur.

Colour. Body, flagellar segments of antenna and pterostigma brown. Legs brownish yellow. First-third metasomal tergites similarly coloured. Wings hyaline.

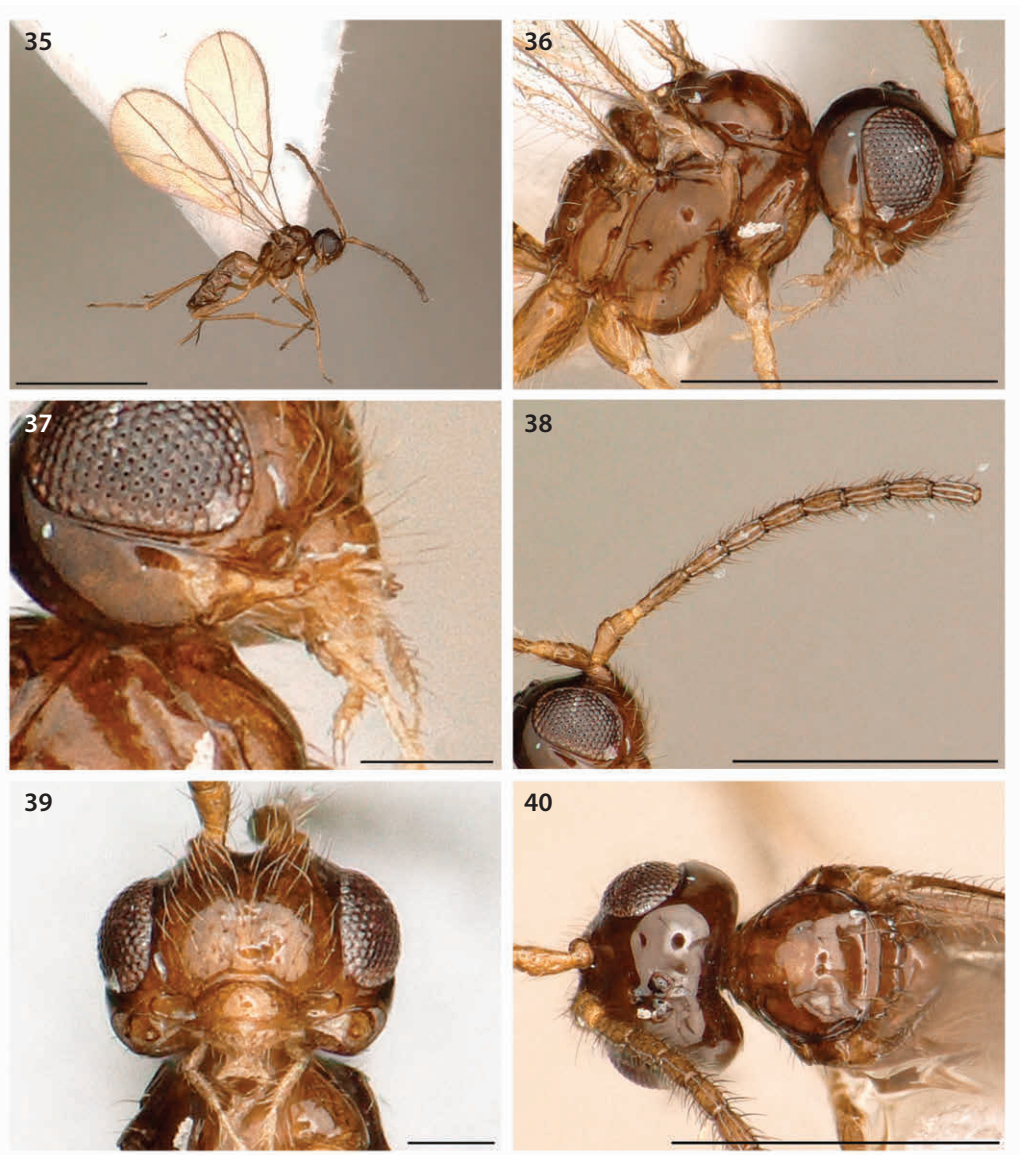
Length. Body 1.3 mm, fore wing 1.6 mm, hind wing 1.1 mm.

Variation. Body 1.3-1.4 mm, fore wing 1.6-1.8 mm, hind wing 1.1-1.2 mm.

Male. Unknown.

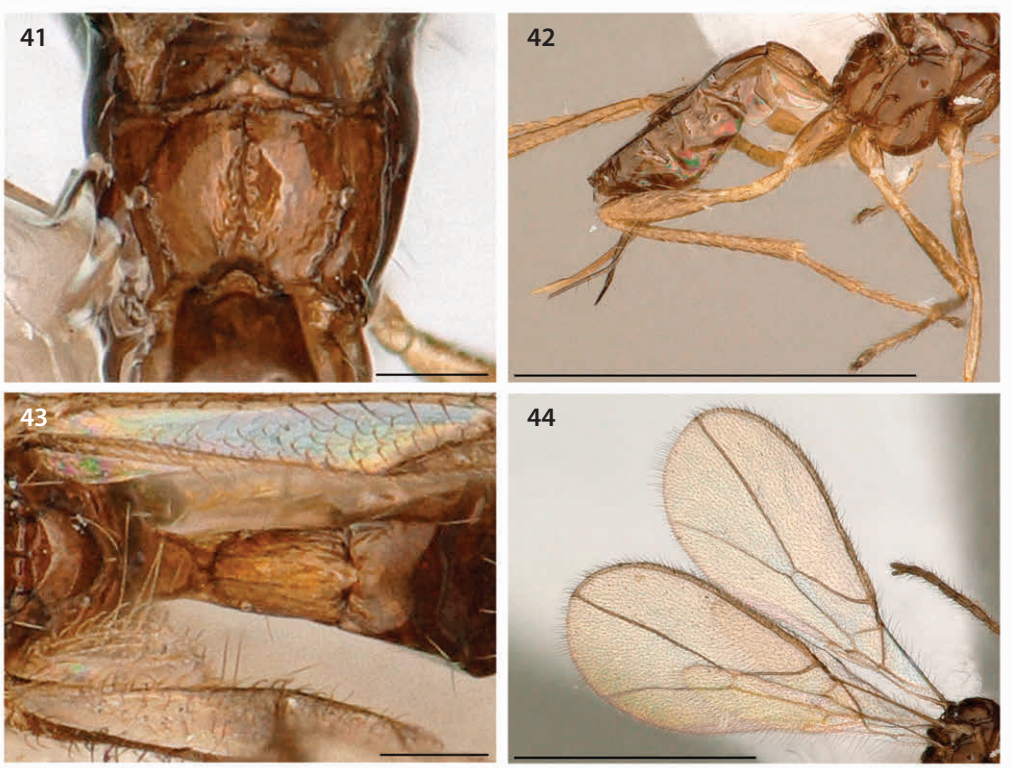
ETYMOLOGY — The name is referring to the type locality of the new species, Mount Wilhelm (Papua New Guinea).

COMPARATIVE DIAGNOSIS — This new species is similar to *Dinotrema (Synaldis) mamuchiae* n. sp. (Papua New Guinea); for the differences between both species see under the latter species.



FIGURES 35-40

Dinotrema (Synaldis) wilhelmense. (female, holotype). **35**, Habitus, lateral view. **36**, Head and mesosoma, lateral view. **37**, Mandible. **38**, Antenna. **39**, Head, anterior view. **40**, Head and mesoscutum, dorsal view. Scale bars: 1 mm (35); 0,5 mm (36, 38, 40); 0,1 mm (37, 39).



FIGURES 41-44

Dinotrema (Synaldis) wilhelmense (female, holotype). **41**. Propodeum, dorsal view. **42**. Hind leg, metasoma and ovipositor, lateral view. **43**. First metasomal tergite, dorsal view. **44**. Fore and hind wings. Scale bars: 0,1 mm (41, 43); 1 mm (42, 44).

KEY TO THE AUSTRALASIAN *DINOTREMA* SPECIES; SUBGENUS *SYNALDIS*

1. Propodeum smooth, with short medio-longitudinal carina in basal half of propodeum (Figure 20). Prescutellar depression without median carina (Figure 19). Eye in lateral view 2.8-3.2 times as wide as temple medially (Figure 14). Ovipositor sheath 0.8-1.0 times as long as metasoma (Figure 21). [Antennae 21-24-segmented. Body length 1.1-1.4 mm. Papua New Guinea]. ..... *Dinotrema* (*Synaldis*) *expeditionum* n. sp.
– Propodeum sculptured, with complete medio-longitudinal carina (Figures 8, 31, 41). Prescutellar depression with median carina (Figures 7, 30, 40). Eye in lateral view 1.4-1.8 times as wide as temple medially (Figures 3, 26, 36). Ovipositor sheath 0.4-0.5 times as long as metasoma (Figures 9, 32, 42). **2**

2. Mandible 1.4 times as long as its maximum width (Figure 4). First metasomal tergite 2.6 times as long as its apical width (Figure 10D). [Antenna 22-segmented. Body length 1.5-1.7 mm. Papua New Guinea]. .....
..... *Dinotrema* (*Synaldis*) *baloghi* (Fischer), n. comb.
– Mandible 2.2-2.3 times as long as its maximum width (Figures 27, 37). First metasomal tergite 2.2 times as long as its apical width (Figures 33, 42) **3**

3(2). Mesoscutal pit present (Figure 30). Hind femur 5.4 times as long as its maximum width (Figure 32). First flagellar segment 5.0 times as long as its maximum width; second segment 3.4 times; sixth segment 3.4 times (Figure 28). Clypeus 3.0 times as wide as high (Figure 29). [Antenna 22-24-segmented. Body length 1.6-1.8 mm. Papua New Guinea]. ..... *Dinotrema* (*Synaldis*) *mamuchiae* n. sp.
– Mesoscutal pit absent (Figure 40). Hind femur 4.2 times as long as its maximum width (Figure 42). First flagellar segment 3.6 times as long as its maximum width; second segment 2.7 times; sixth segment 2.4 times (Figure 38). Clypeus 2.1 times as wide as high (Figure 39). [Body length 1.3-1.4 mm. Papua New Guinea]. .... *Dinotrema* (*Synaldis*) *wilhelmense* n. sp.

ACKNOWLEDGEMENTS

We are very thankful to Claire Villemant (Muséum national d'Histoire naturelle, Paris, France) and Yves Braet (Institut Royal des Sciences naturelles de Belgique, Bruxelles, Belgium) for loan of material. Also, we want to thank Isabelle Zuecker, Mirjam Luzzi and Matthias Borer (Naturhistorisches Museum Basel, Switzerland) for their kindness and help during our work with the digital imaging system. This work was in part funded by grants given by of the Russian Foundation for Basic Research (project n° 19-04-00027 and the Russian State Research Project n° AAAA-A19-119020690101-6 to SAB. This study was conducted in the framework of "Our Planet Reviewed – Papua-New-Guinea 2012-2013" set up by Pro-Natura International, the Muséum national d'Histoire naturelle (MNHN, France), the Institut de Recherche pour le Développement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery. The IBISCA expert network, the patron for this project, Prof. R.L. Kitching AM, and all other participants in this collective effort are thanked for their contribution.

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Magnificent *Sphaeropteris atrox* (Cyatheacea) tree ferns in the Cambridge valley, around 3400 m a.s.l.
(Photo © Xavier Desmier; identification: Jérôme Munzinger).

Molecular and morphological species delimitation of Epyrinae (Hymenoptera: Bethylidae) from Papua New Guinea

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http://www.zoobank.org/urn:lsid:zoobank.org:pub:D3C6E9E9-5DA2-48B1-9DF7-9A886B7895C2

ABSTRACT

The fauna of Epyrinae from Papua New Guinea is revised by using molecular, the Cytochrome C Oxidase Subunit I (COI) mitochondrial gene and morphological data. This study is based on the observation of 115 specimens of Epyrinae from Mount Wilhelm and Wanang Conservation Area. Twenty-one species of *Chlorepyris*, six species of *Epyris* and nine species of *Holepyris* were recognized, all of them described and illustrated as new to Science: *Chlorepyris abelam* Colombo & Azevedo n. sp., *C. angu* Colombo & Azevedo n. sp., *C. baining* Colombo & Azevedo n. sp., *C. baruya* Colombo & Azevedo n. sp., *C. biangai* Colombo & Azevedo n. sp., *C. bilibil* Colombo & Azevedo n. sp., *C. chambri* Colombo & Azevedo n. sp., *C. duna* Colombo & Azevedo n. sp., *C. enga* Colombo & Azevedo n. sp., *C. etoro* Colombo & Azevedo n. sp., *C. fore* Colombo & Azevedo n. sp., *C. gadsup* Colombo & Azevedo n. sp., *C. gogodala* Colombo & Azevedo n sp., *C. haroli* Colombo & Azevedo n. sp., *C. hewa* Colombo & Azevedo n. sp., *C. huli* Colombo & Azevedo n. sp., *C. iatmul* Colombo & Azevedo n. sp., *C. kaluli* Colombo & Azevedo n. sp., *C. koteka* Colombo & Azevedo n. sp., *C. kwoma* Colombo & Azevedo n. sp., *C. maisin* Colombo & Azevedo n. sp., *Epyris melpa* Colombo & Azevedo n. sp., *E. mian* Colombo & Azevedo n. sp., *E. min* Colombo & Azevedo n. sp., *E. motu* Colombo & Azevedo n. sp., *E. mundugumor* Colombo & Azevedo n. sp., *E. ogea* Colombo & Azevedo n. sp., *Holepyris orokaiva* Colombo & Azevedo n. sp., *H. sambia* Colombo & Azevedo n. sp., *H. swagap* Colombo & Azevedo n. sp., *H. tairora* Colombo & Azevedo n. sp., *H. telefol* Colombo & Azevedo n. sp., *H. tsembaga* Colombo & Azevedo n. sp., *H. wiru* Colombo & Azevedo n. sp., *H. yaifo* Colombo & Azevedo n. sp., and *H. zia* Colombo & Azevedo n. sp. Three species already reported from Papua New Guinea are investigated: *Epyris erraticus* Smith, *E. interruptus* Kieffer and *Chlorepyris armatus* (Kieffer). *Holepyris* is recorded for the first time from Papua New Guinea, making Epyrinae now known from three genera. A key for all genera and species of Epyrinae in Papua New Guinea is provided.

COLOMBO W. D., WAICHERT C., & AZEVEDO C. O. 2020 — Molecular and morphological species delimitation of Epyrinae (Hymenoptera: Bethylidae) from Papua New Guinea, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 209-319 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

RÉSUMÉ

Délimitation moléculaire et morphologique des Epyrinae (Hyménoptères : Bethylidae) de Papouasie-Nouvelle-Guinée.

La faune des Epyrinae de Papouasie-Nouvelle-Guinée est révisée à l'aide de données moléculaires, avec le marqueur mitochondrial Cytochrome C Oxydase sous-unité 1 (COI), et morphologiques. Cette étude s'appuie sur l'observation de 115 spécimens d'Epyrinae provenant du Mont Wilhelm et de Wanang Conservation Area. Vingt et une espèces de *Chlorepyris*, six espèces d'*Epyris* et neuf espèces de *Holepyris* ont été reconnues, toutes décrites et illustrées comme nouvelles pour la science : *Chlorepyris abelam* Colombo & Azevedo n. sp., *C. angu* Colombo & Azevedo n. sp., *C. baining* Colombo & Azevedo n. sp., *C. baruya* Colombo & Azevedo n. sp, *C. biangai* Colombo & Azevedo n. sp., *C. bilibil* Colombo & Azevedo n. sp., *C. chambri* Colombo & Azevedo n. sp., *C. duna* Colombo & Azevedo n. sp., *C. enga* Colombo & Azevedo n. sp, *C. etoro* Colombo & Azevedo n. sp., *C. fore* Colombo & Azevedo n. sp., *C. gadsup* Colombo & Azevedo n. sp., *C. gogodala* Colombo & Azevedo n. sp., *C. haroli* Colombo & Azevedo n. sp, *C. hewa* Colombo & Azevedo n. sp., *C. huli* Colombo & Azevedo n. sp., *C. iatmul* Colombo & Azevedo n. sp., *C. kaluli* Colombo & Azevedo n. sp., *C. koteka* Colombo & Azevedo n. sp, *C. kwoma* Colombo & Azevedo n. sp., *C. maisin* Colombo & Azevedo n. sp., *Epyris melpa* Colombo & Azevedo n. sp., *E. mian* Colombo & Azevedo n. sp., *E. min* Colombo & Azevedo n. sp, *E. motu* Colombo & Azevedo n. sp., *E. mundugumor* Colombo & Azevedo n. sp., *E. ogea* Colombo & Azevedo n. sp., *Holepyris orokaiva* Colombo & Azevedo n. sp, *H. sambia* Colombo & Azevedo n. sp., *H. swagap* Colombo & Azevedo n. sp., *H. tairora* Colombo & Azevedo n. sp., *H. telefol* Colombo & Azevedo n. sp., *H. tsembaga* Colombo & Azevedo n. sp, *H. wiru* Colombo & Azevedo n. sp., *H. yaifo* Colombo & Azevedo n. sp. et *H. zia* Colombo & Azevedo n. sp. Trois espèces déjà signalées en Papouasie-Nouvelle-Guinée sont examinées : *Epyris erraticus* Smith, *E. interruptus* Kieffer et *Chlorepyris armatus* (Kieffer). *Holepyris* est signalé pour la première fois en Papouasie-Nouvelle-Guinée, amenant à trois le nombre de genres d'Epyrinae connus pour ce pays. Une clé pour tous les genres et espèces d'Epyrinae en Papouasie-Nouvelle-Guinée est fournie.

INTRODUCTION

Epyrinae are currently the second most speciose subfamily of Bethylidae and the most diverse group of Bethylidae in morphological terms (Alencar & Azevedo 2013). *Epyrinae* have approximately 930 species described and 13 genera (Azevedo *et al.* 2018). Although cosmopolitan, few species occur in the Oceanian region (*sense* Holt *et al.* 2013). Currently, there are 46 species of Epyrinae recorded for this region, being 39 from Philippines, two from Hawaii, two from Indonesia and three from Papua New Guinea (PNG).

Papua New Guinea (PNG) is the second largest island on Earth, harboring an impressive diversity of climates zones and land forms (Leponce *et al.* 2016). Three species of Epyrinae have been reported to PNG. Among the genera of Epyrinae, *Epyris* Westwood and *Chlorepyris* Kieffer are cosmopolitan and have three species recorded from New Guinea: *Epyris erraticus* Smith, *Epyris interruptus* Kieffer and *Chlorepyris armatus* (Kieffer). Herein, we record one more genus from this island, *Holepyris* Kieffer, summing the fauna of Epyrinae up to three genera and 39 species.

Once again, the material analyzed in this study and the uncovering of several species of Epyrinae reveals that the knowledge on this subfamily, and the three above-mentioned genera, is underestimated. Finally, we propose for the first time in Bethylidae genetic distance analyses based on the mitochondrial Cytochrome C Oxidase Subunit I (COI), aiming to improve delimitation of the species.

MATERIAL AND METHODS

COLLECTION AND TAXONOMIC METHODS

This study was based on 115 specimens of Epyrinae collected in PNG (Figure 1), in a rainforest transect (Mount Wilhelm and Wanang Conservation Area, Madang province) during the "Our Planet Reviewed – Papua New Guinea 2012-2013" expedition, which was launched by the Muséum national d'Histoire naturelle (MNHN, Paris, Philippe Bouchet) and Pro-Natura International (PNI, Paris, Olivier Pascal) in association with the Royal Belgian Institute of Natural Sciences (RBINS, Brussels, Maurice Leponce) and the New Guinea Binatang Research Center (NGBRC, Madang, Vojtech Novotny).

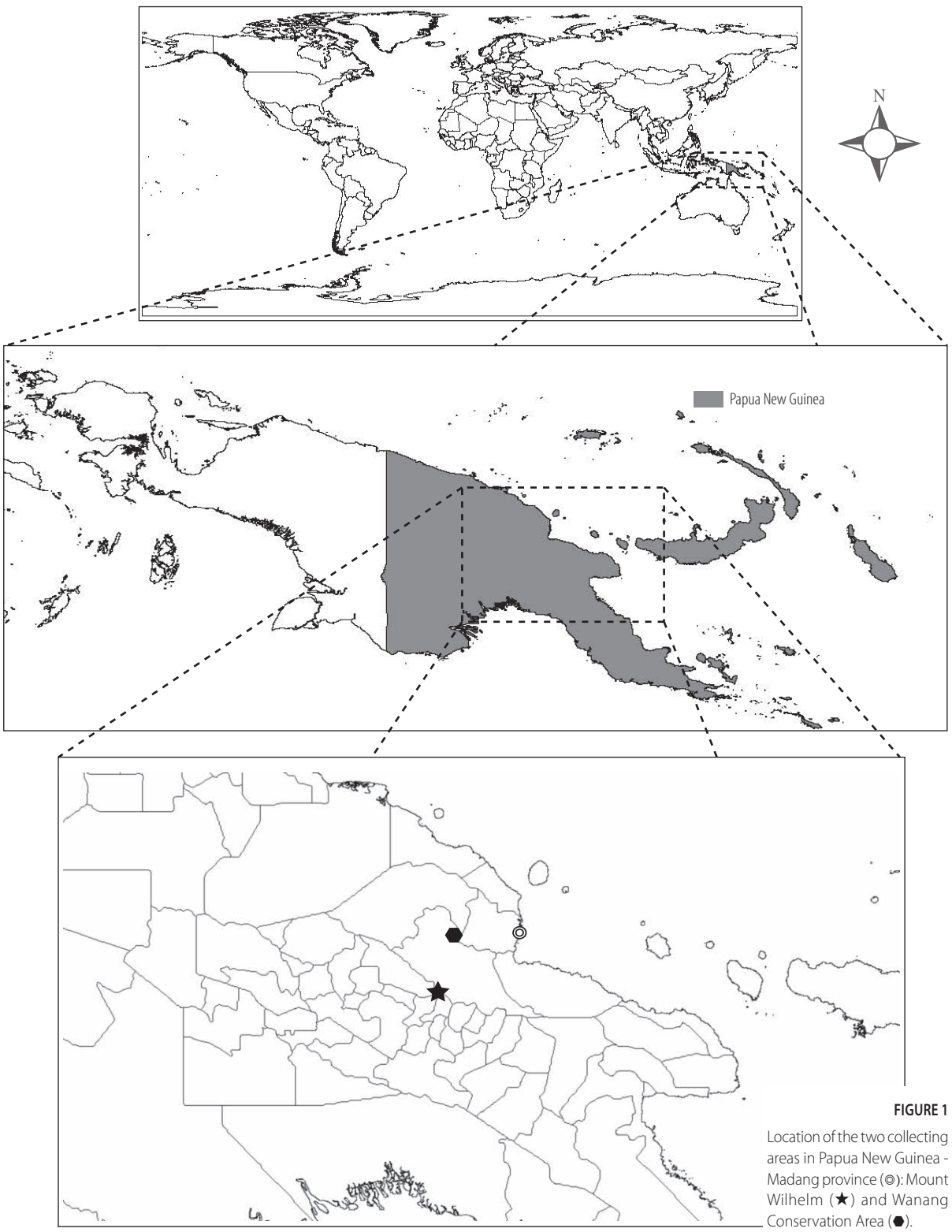


FIGURE 1

Location of the two collecting areas in Papua New Guinea - Madang province (◎): Mount Wilhelm (★) and Wanang Conservation Area (●).

The samples were collected with Malaise traps and flight interception traps in 2012, for more details, see Leponce *et al.* 2016. The material belongs to and it is deposited at Muséum national d'Histoire naturelle (MNHN, Paris, curator: Claire Villemant), with retentions in the Universidade Federal do Espírito Santo (UFES, Brazil, curator: Marcelo T. Tavares) as specified.

The holotypes of *Epyris interruptus* and *Chlorepyris armatus* are deposited in the Museo Civico di Storia Naturale (MCSN, Genova, curator: Maria Tavano) and were examined, photographed, illustrated and redescribed. The holotype of *Epyris erraticus* is supposed to be at the Natural History Museum in London (Gordh & Móczár 1990) but was not found, so that we have analyzed it through its original description.

The nomenclature of the integument generally follows Harris (1979) and the Hymenoptera Anatomy Ontology project (HAO) (Yoder *et al.* 2010). Terminology of external morphology follows Evans (1964), Azevedo (1999) and Kawada *et al.* (2015), and those of male genitalia follow Snodgrass (1941). Taxonomic characters related to genitalia and hypopygium were examined; such structures were previously dissected according to the Proteinase K protocol described by Martinelli *et al.* (2017).

We illustrated and highlighted the following morphological characters used for delimitation of species: clypeus (Figure 2A), mandibles (Figures 2B, 3A, 3J), eyes (Figures 2C, 3B, 3K), frontal line (Figure 2D), occipital carina (Figure 3C), pronotum (Figure 3L), anterior mesofurcal pit (Figure 3D), posterior mesofurcal pit (Figure 3E), metafurcal pit (Figure 3F), metasternum (Figure 3G), anterior mesopleural fovea (Figure 3M), mesopleural pit (Figure 3N), lower mesopleural fovea (Figure 3O), mesopleural suture (Figure 3P), notaulus (Figures 2E, 3Q), parapsidal signum (Figure 2F), forewing flexion lines (Figure 2G), forewing 2r-rs&Rs veins (Figure 2H), mesoscutellar foveae (Figures 2I, 3R), metascutellum (Figure 2J), metapostnotal anterior margin (Figure 2K), metapostnotal median carina (Figure 2L), first metapostnotal carina (Figures 2M, 3S), metapostnotal-propodeal suture (Figures 2N, 3T), metatibia (Figure 2O), petiole (Figures 2P, 3H, 3W), and metasoma (Figures 2Q, 3I, 3Y).

The specimens analyzed were compared with types, vouchers and original descriptions of the species reported from PNG, Indonesia, Philippines, Hawaii, and Australia.

The specific epithets of all new species refer to ethnic groups or languages from PNG.

The images were taken under a Leica Z16 APO stereomicroscope coupled to a Leica DFC 2 video camera by Leica Microsystems (Switzerland) under Modular Dome Illumination System by Kawada & Buffington (2016). To combine images, we used the Helicon Focus (HeliconSoft) and saved them in 300 DPI. The characters of the male genital structures were drawn in camera lucida adapted to a Leica DM 2500 microscope, then scanned into Photoshop and saved in 600 DPI.

For each specimen, illustrations were made as follows: head in dorsal view; mandible frontal view; mesosoma dorsal, ventral and lateral views; forewing in dorsal view and male genitalia in dorsal, ventral and lateral views. All photographs and drawings were based on holotypes or paratypes.

Molecular methods

For molecular protocols, we selected 37 specimens (11 ♀ and 26 ♂) of Epyrinae representing the morphospecies and the morphological variation previously recognized during morphospecies identification. All female representatives were included for potential conspecific male-female association. The DNA was extracted from the metasoma and mesosoma of the 37 adult specimens by using the NucleoSpin® Tissue Kit according to the manufacturer's protocol. The metasoma and head were disassembled to provide orifice to the reagents.

Standard PCR procedures and primers proposed by Folmer *et al.* (1994) were used to amplify the mitochondrial gene COI. Thermal setup of primers LCO1490/HCO2198 (Folmer *et al.* 1994) was: a 1-minute initial denaturation at 95 °C followed by 43 cycles of 45-second denaturation at 95 °C, 45 seconds of annealing at 47 °C, 45 seconds extension at 47 °C, and a 3-minute final extension at 72 °C.

The amplification products were detected in 1.5% agarose gel electrophoresis (AGE), and then successful products were purified using an enzymatic procedure with the ExoSAP-IT® kit (USB Corporation) incubated at 37 °C for 15 minutes to degrade remaining primers and nucleotides and finally, incubated at 80 °C for 15 minutes to inactivate ExoSAP-IT reagent. The eligible products were then sequenced in a T3500 Genetic Analyzer.

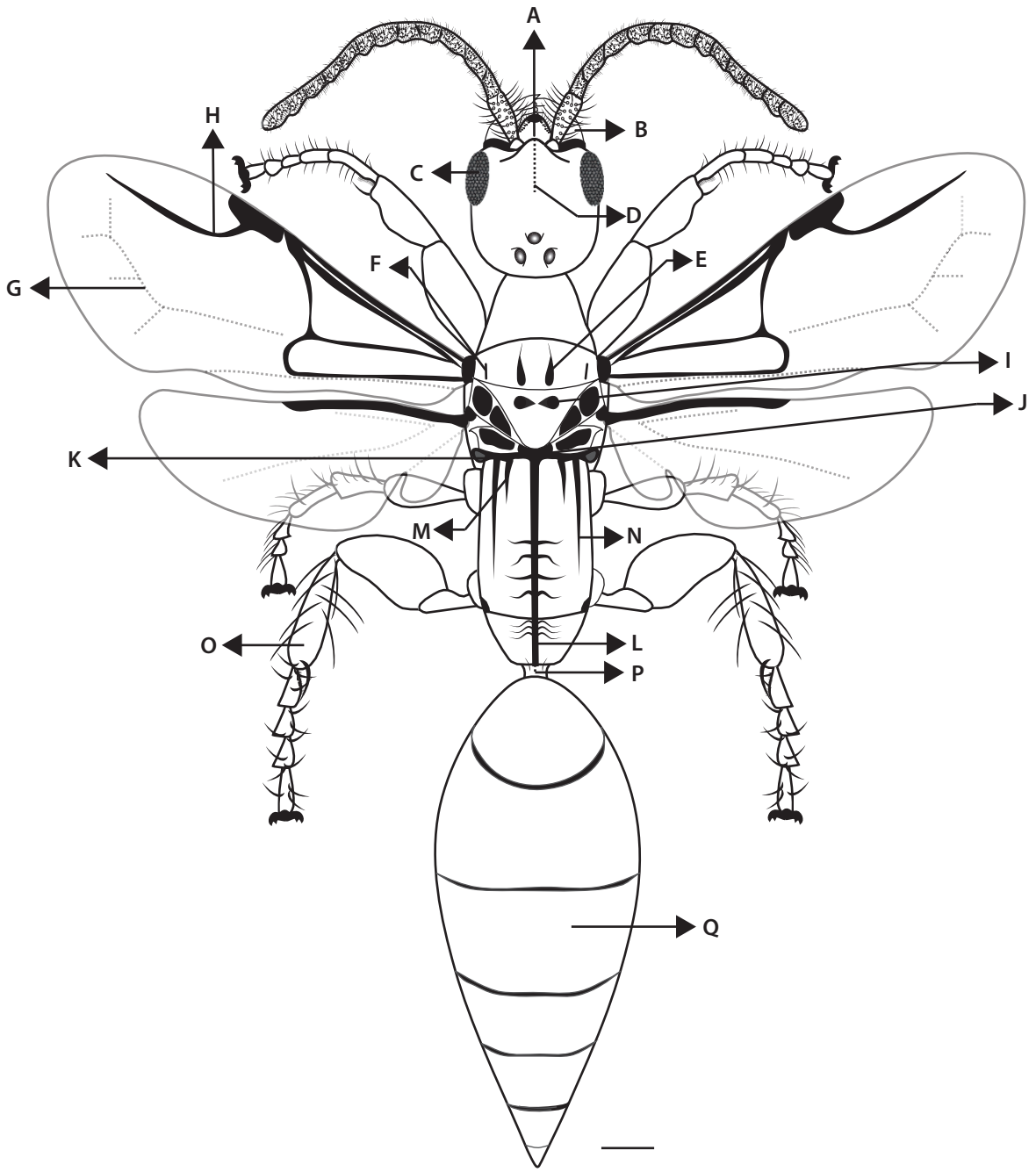


FIGURE 2

Bethylidae. Morphological characters in dorsal view. **A**, clypeus; **B**, mandible; **C**, eye; **D**, frontal line; **E**, notaulus; **F**, parapsidal signum; **G**, flexion lines of the forewing; **H**, forewing 2r-rs&Rs vein; **I**, mesoscutellar fovea; **J**, metascutellum; **K**, metapostnotal anterior margin; **L**, metapostnotal median carina; **M**, first metapostnotal carina; **N**, metapostnotal-propodeal suture; **O**, metatibia; **P**, petiole; **Q**, metasoma. Scale bar: 250 µm.

The returned forward and reverse chromatograms were examined and trimmed with MEGA 6 (Molecular Evolutionary Genetics Analysis version 6.0, Tamura *et al*. 2013). The alignments were made, adjusted, and edited manually in MEGA6.

SPECIES DELIMITATION METHODS

The nucleotide alignment was used to reconstruct a maximum likelihood phylogeny and to access genetic variability within the genera and species. The phylogenetic analysis was performed in RAxML (Stamatakis 2014) through CIPRES portal Science Gateway V. 3.0 (Miller *et al.* 2010) with GTRGAMMA model of nucleotide evolution; clades support were accessed by 1,000 bootstrap replications. We included three males of the genus *Apenesia* Westwood (Bethylidae, Pristocerinae) also collected in PNG, to root the tree (Figure 4).

The Kimura-2-parameter K2P model of base substitution was selected for pairwise distances calculation, which was made in MEGA6. The model was chosen to provide more accurate comparison between results as previous studies with Hymenoptera use K2P as model (Jiang *et al.* 2015; Waichert *et al.* 2015).

DNA barcoding based on a short fragment of mitochondrial DNA can provide an effective tool for species diagnosis (Zhu *et al.* 2017). Its effectiveness as a tool for rapid identification of species, and sex association, has been reported in some groups of insects, such as Hemiptera (Lee *et al.* 2011; Zhu *et al.* 2017), Hymenoptera (Smith *et al.* 2008), Coleoptera (Löbl & Leschen 2005), and Lepidoptera (Hajibabaei *et al.* 2006) for instance.

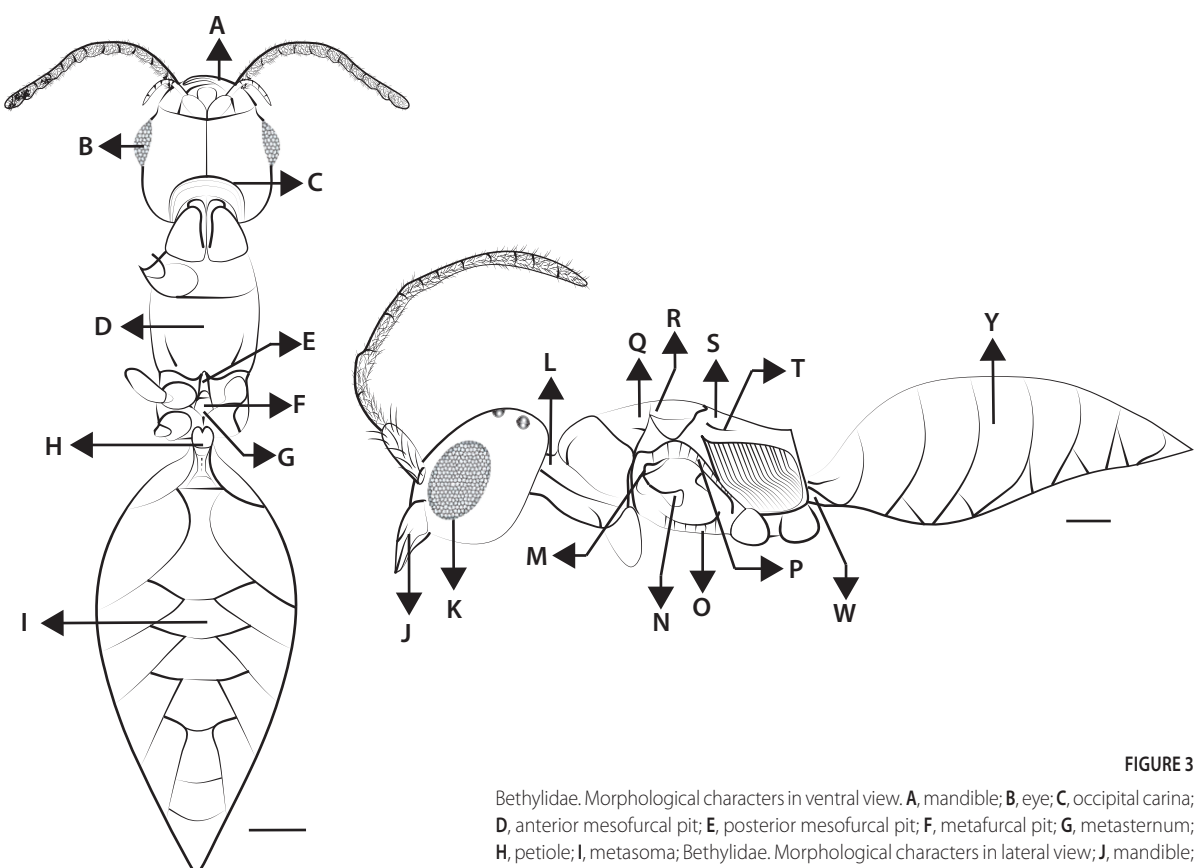


FIGURE 3

Bethylidae. Morphological characters in ventral view. **A**, mandible; **B**, eye; **C**, occipital carina; **D**, anterior mesofurcal pit; **E**, posterior mesofurcal pit; **F**, metafurcal pit; **G**, metasternum; **H**, petiole; **I**, metasoma; Bethylidae. Morphological characters in lateral view; **J**, mandible; **K**, eye; **L**, pronotum; **M**, anterior mesopleural fovea; **N**, mesopleural pit; **O**, lower mesopleural fovea; **P**, mesopleural suture; **Q**, notaulus; **R**, mesoscutellar fovea; **S**, first metapostnotal carina; **T**, metapostnotal-propodeal suture; **W**, petiole; **Y**, metasoma. Scale bar: 250 µm.

RESULTS

Molecular protocol and distance analyses

A COI sequence was amplified from 34 specimens out of 37 sampled (Table 1). The length of the nucleotide sequences varied from 633-709 bp. As expected for Hymenoptera (Crozier *et al.* 1989; Simon *et al.* 1994; Li *et al.* 2010), adenine (A) and thymine (T) had the highest frequency (A=37.0%, C=11.8%, G=11.5%, T=39.4%).

We recognized 21 species of *Chlorepyris*, nine species of *Holepyris* and six species of *Epyris*. Considering that the sampling effort was low, these results indicate that *Chlorepyris* is the most diverse genus of Epyrinae in this region, and the potential for more species in future expeditions is high.

Our results pointed to sex association. Conspecifics male and female specimens of *Chlorepyris* were associated based on identical nucleotide sequences. In the genus *Holepyris*, the lowest genetic distance observed between the species was 3%, but these taxa are morphologically distinct, especially in the male genitalia features. In *Chlorepyris*, besides the conspecific specimens that presented 0% of genetic distance, the minimum interspecific variation was 3%. *Epyris* presented lineages genetically distant, the shortest nucleotide distance among species was 10%. Overall, the mean genetic distance found among the lineages of Epyrinae in PNG was 24% variation (Figure 4).

When the nucleotide divergence was low, but the morphology presented differences, the morphological analysis prevailed. Different morphological data has been crucial to delimit and diagnose species (Waichert & Azevedo 2009; Alencar & Azevedo 2013).

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
1	*C. abelam*																																					
2	*C. angu*	0.13																																				
3	*C. baining*	0.15	0.18																																			
4	*C. baruya*	0.13	0.18	0.06																																		
5	*C. bilibil* (male)	0.14	0.17	0.08	0.06																																	
6	*C. bilibil* (female)	0.14	0.17	0.08	0.06	0.00																																
7	*C. chambri*	0.07	0.15	0.15	0.13	0.14	0.14																															
8	*C. enga*	0.12	0.15	0.15	0.15	0.13	0.13	0.13																														
9	*C. etoro*	0.13	0.16	0.16	0.16	0.14	0.14	0.12	0.14																													
10	*C. fore*	0.12	0.17	0.15	0.17	0.16	0.16	0.14	0.15	0.12																												
11	*C. gadsup*	0.08	0.13	0.15	0.13	0.12	0.12	0.10	0.12	0.14	0.14																											
12	*C. gogodala*	0.17	0.22	0.15	0.16	0.15	0.14	0.15	0.18	0.17	0.21	0.18																										
13	*C. haroli*	0.17	0.20	0.15	0.16	0.15	0.15	0.16	0.17	0.20	0.21	0.18	0.17																									
14	*C. hewa*	0.14	0.17	0.07	0.03	0.06	0.06	0.13	0.14	0.14	0.17	0.12	0.16	0.15																								
15	*C. huli*	0.06	0.13	0.15	0.13	0.13	0.12	0.05	0.12	0.12	0.13	0.08	0.14	0.17	0.13																							
16	*C. iatmul*	0.13	0.19	0.14	0.13	0.14	0.13	0.13	0.15	0.17	0.19	0.15	0.13	0.18	0.12	0.12																						
17	*C. kaluli*	0.15	0.20	0.14	0.15	0.14	0.14	0.14	0.16	0.16	0.18	0.17	0.09	0.16	0.14	0.14	0.11																					
18	*C. koteka*	0.13	0.16	0.12	0.11	0.11	0.11	0.11	0.16	0.16	0.18	0.14	0.13	0.14	0.10	0.12	0.13	0.14																				
19	*C. kwoma*	0.08	0.14	0.15	0.14	0.14	0.14	0.07	0.12	0.13	0.14	0.11	0.17	0.18	0.14	0.06	0.14	0.16	0.13																			
20	*C. maisin*	0.12	0.19	0.12	0.12	0.12	0.12	0.12	0.13	0.14	0.17	0.14	0.16	0.17	0.11	0.13	0.12	0.13	0.13	0.15																		
21	*E. melpa*	0.26	0.26	0.26	0.24	0.22	0.22	0.27	0.22	0.26	0.29	0.24	0.25	0.25	0.24	0.25	0.25	0.24	0.26	0.25	0.24																	
22	*E. mian*	0.18	0.23	0.19	0.18	0.19	0.19	0.19	0.19	0.21	0.24	0.18	0.21	0.20	0.18	0.20	0.19	0.20	0.19	0.22	0.18	0.25																
23	*E. min*	0.20	0.23	0.19	0.20	0.19	0.18	0.21	0.21	0.24	0.25	0.20	0.20	0.24	0.19	0.20	0.20	0.19	0.19	0.22	0.18	0.21	0.18															
24	*E. motu*	0.16	0.21	0.16	0.16	0.17	0.17	0.18	0.17	0.18	0.22	0.18	0.19	0.18	0.17	0.17	0.20	0.17	0.17	0.18	0.18	0.22	0.09	0.17														
25	*E. mundugumor*	0.22	0.28	0.20	0.19	0.20	0.20	0.22	0.22	0.23	0.26	0.20	0.22	0.25	0.19	0.22	0.23	0.18	0.21	0.24	0.19	0.23	0.18	0.13	0.16													
26	*E. ogea*	0.20	0.23	0.18	0.20	0.19	0.19	0.20	0.21	0.22	0.25	0.21	0.20	0.19	0.19	0.21	0.19	0.21	0.20	0.22	0.20	0.24	0.23	0.19	0.21	0.22												
27	*H. orokaiva*	0.14	0.20	0.17	0.15	0.14	0.14	0.14	0.13	0.16	0.18	0.15	0.19	0.18	0.15	0.14	0.17	0.16	0.15	0.16	0.14	0.22	0.19	0.19	0.18	0.20	0.18											
28	*H. telefol*	0.17	0.21	0.18	0.17	0.18	0.18	0.19	0.16	0.21	0.22	0.19	0.19	0.22	0.17	0.18	0.19	0.17	0.21	0.19	0.18	0.27	0.19	0.20	0.19	0.22	0.23	0.13										
29	*H. tsembaga*	0.17	0.21	0.17	0.16	0.17	0.16	0.16	0.16	0.19	0.19	0.17	0.20	0.23	0.15	0.15	0.17	0.17	0.16	0.18	0.17	0.25	0.19	0.18	0.18	0.21	0.24	0.08	0.14									
30	*H. sambia*	0.19	0.23	0.21	0.21	0.20	0.20	0.17	0.18	0.22	0.22	0.20	0.20	0.27	0.20	0.18	0.19	0.20	0.20	0.20	0.18	0.26	0.24	0.22	0.22	0.24	0.22	0.11	0.16	0.12								
31	*H. swagap*	0.18	0.22	0.19	0.18	0.17	0.17	0.18	0.20	0.21	0.23	0.18	0.20	0.24	0.18	0.16	0.17	0.18	0.18	0.19	0.20	0.28	0.21	0.22	0.18	0.23	0.23	0.15	0.15	0.16	0.16							
32	*H. tairora*	0.18	0.20	0.17	0.16	0.17	0.16	0.17	0.18	0.21	0.21	0.16	0.20	0.24	0.16	0.16	0.19	0.19	0.17	0.18	0.18	0.24	0.22	0.21	0.20	0.21	0.23	0.12	0.16	0.13	0.14	0.16						
33	*H. wiru*	0.15	0.19	0.17	0.16	0.15	0.15	0.15	0.14	0.16	0.19	0.16	0.19	0.20	0.16	0.15	0.18	0.18	0.17	0.17	0.15	0.23	0.20	0.20	0.19	0.21	0.18	0.03	0.13	0.09	0.11	0.15	0.13					
34	*H. zia*	0.17	0.20	0.17	0.17	0.17	0.17	0.15	0.17	0.18	0.19	0.17	0.21	0.21	0.15	0.15	0.17	0.19	0.19	0.18	0.16	0.25	0.18	0.21	0.18	0.22	0.21	0.08	0.14	0.08	0.14	0.17	0.15	0.09				
35	*A.* sp. 227	0.30	0.29	0.33	0.30	0.31	0.31	0.30	0.30	0.30	0.33	0.30	0.29	0.34	0.29	0.28	0.30	0.29	0.31	0.29	0.32	0.33	0.30	0.32	0.30	0.32	0.35	0.30	0.30	0.29	0.33	0.32	0.33	0.29	0.31			
36	*A.* sp. 228	0.29	0.35	0.31	0.29	0.29	0.29	0.32	0.33	0.32	0.38	0.29	0.32	0.34	0.29	0.32	0.33	0.32	0.30	0.32	0.31	0.34	0.31	0.30	0.30	0.31	0.36	0.30	0.33	0.33	0.36	0.37	0.34	0.32	0.35	0.22		
37	*A.* sp. 229	0.31	0.31	0.34	0.31	0.32	0.32	0.32	0.31	0.30	0.35	0.31	0.31	0.34	0.31	0.29	0.31	0.30	0.32	0.30	0.33	0.34	0.31	0.33	0.31	0.33	0.37	0.31	0.31	0.30	0.34	0.33	0.34	0.30	0.32	0.01	0.23	

FIGURE 4

Genetic distances between the species of tree of PNG Epyrinae from PNG.

PHYLOGENETICS ANALYSIS

The resulting analysis of PNG Epyrinae likelihood tree supported Epyrinae (Bootstrap=100), but the genera sampled here were not reconstructed with support (Figure 5). *Holepyris* was the only lineage of Epyrinae recovered with statistical support (Bootstrap=100); whereas *Epyris* had at least four lineages, considering Bootstrap values >70. Species of *Chlorepyris* nested together but the cluster is statically unsupported (Bootstrap=39), splitting into two clusters with bootstrap values=37 and 80. The supported clade of *Chlorepyris* included nine species.

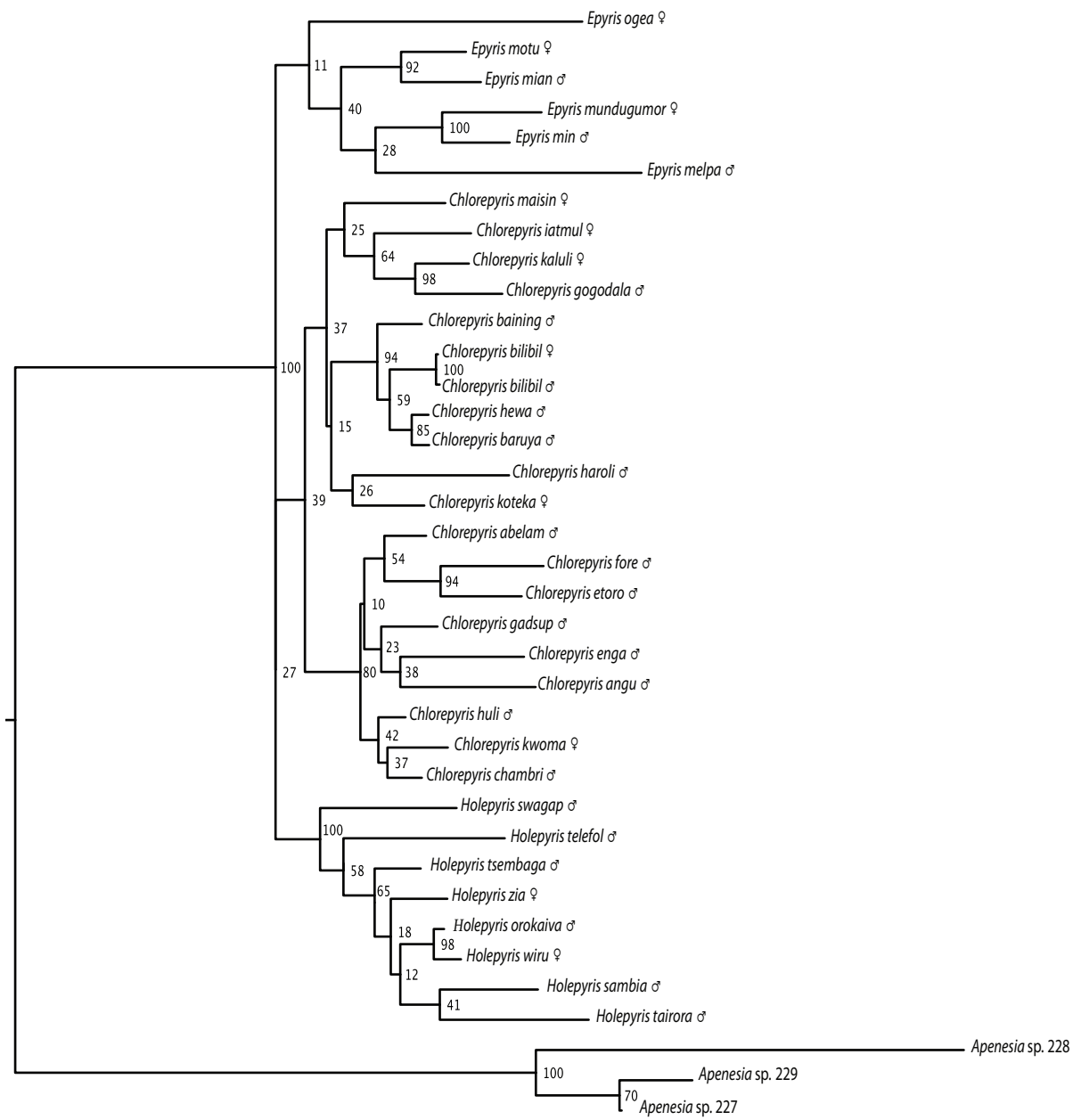


FIGURE 5

Phylogenetic maximum-likelihood tree based on the COI sequences.

TABLE 1

Terminal taxa of PNG Epyrinae molecular analysis with GenBank codes.

GENBANK CODE	SPECIMEN VOUCHER	SPECIES	SEX
MK051186	W10	*Chlorepyris abelam* Colombo & Azevedo n. sp.	♂
MK051187	W20	*Chlorepyris gogodala* Colombo & Azevedo n. sp.	♂
MK051188	W21	*Chlorepyris haroli* Colombo & Azevedo n. sp.	♂
MK051189	W22	*Chlorepyris hewa* Colombo & Azevedo n. sp.	♂
MK051190	W23	*Chlorepyris huli* Colombo & Azevedo n. sp.	♂
MK051191	W24	*Chlorepyris iatmul* Colombo & Azevedo n. sp.	♀
MK051192	W25	*Chlorepyris kaluli* Colombo & Azevedo n. sp.	♀
MK051193	W27	*Chlorepyris koteka* Colombo & Azevedo n. sp.	♀
MK051194	W28	*Chlorepyris bilibil* Colombo & Azevedo n. sp.	♀
MK051195	W12	*Chlorepyris baining* Colombo & Azevedo n. sp.	♂
MK051196	W31	*Chlorepyris maisin* Colombo & Azevedo n. sp.	♀
MK051197	W11	*Chlorepyris angu* Colombo & Azevedo n. sp.	♂
MK051198	W26	*Epyris ogea* Colombo & Azevedo n. sp.	♀
MK051199	W32	*Epyris melpa* Colombo & Azevedo n. sp.	♂
MK051200	W33	*Epyris mian* Colombo & Azevedo n. sp.	♂
MK051201	W34	*Epyris min* Colombo & Azevedo n. sp.	♂
MK051202	W35	*Epyris motu* Colombo & Azevedo n. sp.	♀
MK051203	W29	*Epyris mundugumor* Colombo & Azevedo n. sp.	♀
MK051204	W1	*Holepyris orokaiva* Colombo & Azevedo n. sp.	♂
MK051205	W6	*Holepyris telefol* Colombo & Azevedo n. sp.	♂
MK051206	W7	*Holepyris tsembaga* Colombo & Azevedo n. sp.	♂
MK051207	W2	*Holepyris sambia* Colombo & Azevedo n. sp.	♂
MK051208	W13	*Chlorepyris baruya* Colombo & Azevedo n. sp.	♂
MK051209	W3	*Holepyris swagap* Colombo & Azevedo n. sp.	♂
MK051210	W8	*Holepyris wiru* Colombo & Azevedo n. sp.	♀
MK051211	W9	*Holepyris zia* Colombo & Azevedo n. sp.	♀
MK051212	W5	*Holepyris tairora* Colombo & Azevedo n. sp.	♂
MK051213	W30	*Chlorepyris kwoma* Colombo & Azevedo n. sp.	♀
MK051214	W14	*Chlorepyris bilibil* Colombo & Azevedo n. sp.	♂
MK051215	W15	*Chlorepyris chambri* Colombo & Azevedo n. sp.	♂
MK051216	W16	*Chlorepyris enga* Colombo & Azevedo n. sp.	♂
MK051217	W17	*Chlorepyris etoro* Colombo & Azevedo n. sp.	♂
MK051218	W18	*Chlorepyris fore* Colombo & Azevedo n. sp.	♂
MK051219	W19	*Chlorepyris gadsup* Colombo & Azevedo n. sp.	♂

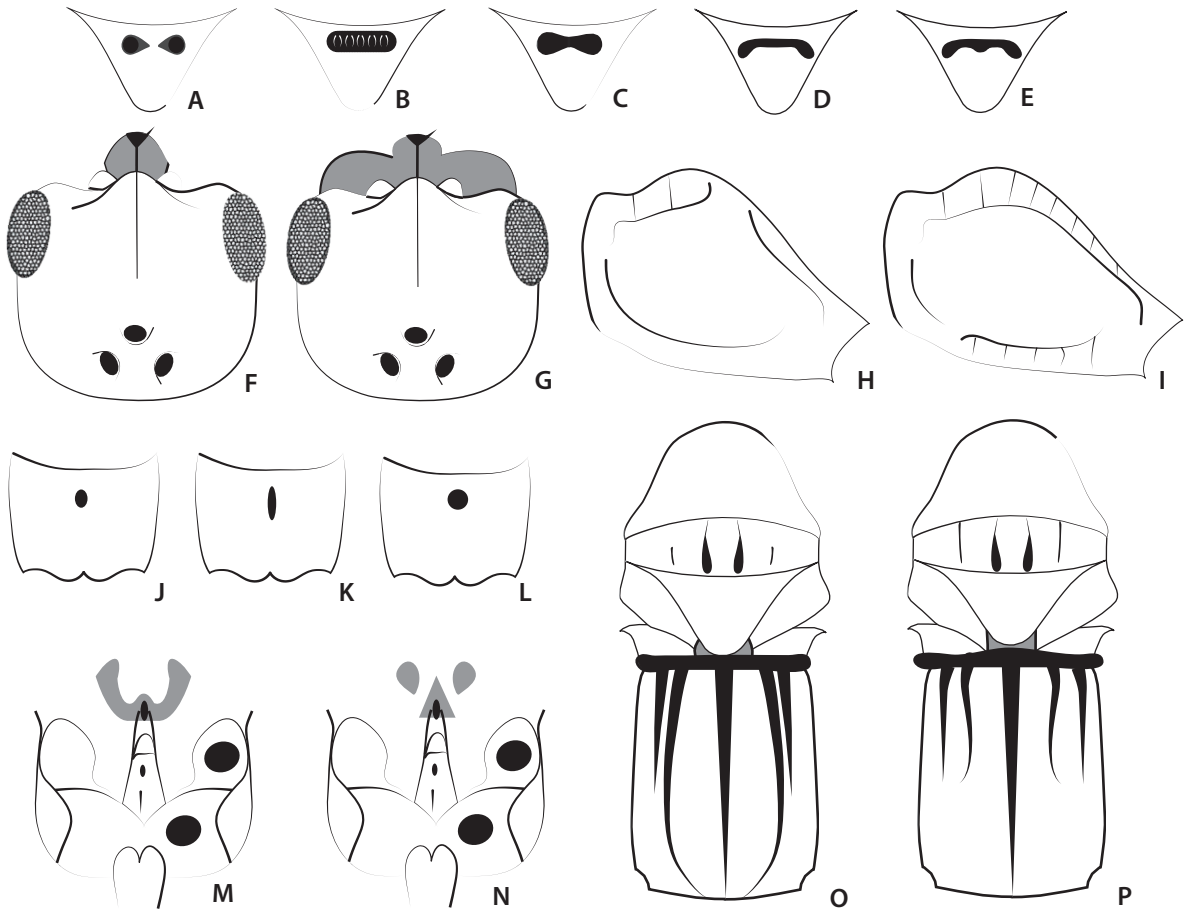


FIGURE 6

Figures of the key to Epyrinae from PNG. **A**, mesoscutellar fovea never connected by evident sulcus, large (*E. niger* pattern); **B**, mesoscutellar fovea connected by evident sulcus, non-projected sides, trabeculate; **C**, mesoscutellar fovea connected by evident sulcus, non-projected sides, not trabeculate, small elevation present; **D**, mesoscutellar foveae connected by evident sulcus, projected sides, ocuppying almost all mesoscutellum; **E**, mesoscutellar fovea connected by evident sulcus, M-shaped; **F**, clypeal lateral lobe never developed; **G**, clypeal lateral lobe well developed; **H**, mesopleuron with anterior mesopleural fovea connected with lower mesopleural fovea, lower mesopleural fovea not trabeculate, subalar impression not connected with mesopleural suture, and mesopleural suture not trabeculate; **I**, mesopleuron with anterior mesopleural fovea not connected with lower mesopleural fovea, lower mesopleural fovea trabeculate, subalar impression connected with mesopleural suture, and mesopleural suture trabeculate; **J**, posterior mesofurcal pit oval; **K**, posterior mesofurcal pit elongated; **L**, posterior mesofurcal pit circular; **M**, metafurcal pit inserted into crown-shaped depression; **N**, metafurcal pit inserted into triangle-shaped depression; **O**, parapsidal signum smaller than notaulus, mesoscutellum with posterior margin touching from metapostnotal anterior margin, first metapostnotal carina as long as metapostnotal median carina, convergent posteriorly, and metapostnotal-propodeal suture smaller than first metapostnotal carina; **P**, parapsidal signum as long as notaulus, mesoscutellum with posterior margin not touching from metapostnotal anterior margin, first metapostnotal carina smaller than metapostnotal median carina, divergent posteriorly, and metapostnotal-propodeal suture as long as first metapostnotal carina.

Key to genera of Epyrinae from Papua New Guinea

1. Mesoscutellar foveae never connected by evident sulcus ..... *Epyris* Westwood, 1832 (Figure 6A) **3**
– Mesoscutellar foveae connected by evident sulcus (Figure 6B-6E) **2**

2. Lateral clypeal lobe well projected forward ..... *Holepyris* Kieffer, 1904 (Figure 6G) **10**
– Lateral clypeal lobe very short ..... *Chlorepyris* Kieffer, 1913 (Figure 6F) **18**

3. Female **4**
– Male **7**

4. Metapostnotal median carina not visible posteriorly ..... *Epyris erraticus* Smith, 1860
– Metapostnotal median carina visible posteriorly **5**

5. Median clypeal lobe tridentate; mandible with four distal teeth; body strongly punctate .....
..... *Epyris ogea* Colombo & Azevedo n. sp.
– Median clypeal lobe rounded; mandible with five distal teeth; body weakly punctate **6**

6. Pedicel shorter than flagellomere I; eye setose; parapsidal signum as long as notaulus (Figure 6P) .....
..... *Epyris motu* Colombo & Azevedo n. sp.
– Pedicel as long as flagellomere I; eye glabrous; parapsidal signum shorter than notaulus (Figure 6O) .....
..... *Epyris mundugumor* Colombo & Azevedo n. sp.

7. Lower mesopleural fovea connected to upper mesopleural fovea ..... *Epyris interruptus* Kieffer, 1904
– Lower mesopleural fovea not connected to upper mesopleural fovea **8**

8. Median clypeal lobe straight; mesopleural suture not trabeculate (Figure 6H); parapsidal signum shorter than notaulus (Figure 6O) ..... *Epyris melpa* Colombo & Azevedo n. sp.
– Median clypeal lobe rounded; mesopleural suture trabeculate (Figure 6I); parapsidal signum as long as notaulus (Figure 6P) **9**

9. Anterior and lower mesopleural foveae not connected (Figure 6I); lower mesopleural fovea trabeculate (Figure 6I); first metapostnotal carina as long as metapostnotal median carina (Figure 6O) .....
..... *Epyris mian* Colombo & Azevedo n. sp.
– Anterior mesopleural fovea ill defined; lower mesopleural fovea not trabeculate (Figure 6H); first metapostnotal carina shorter than metapostnotal median carina (Figure 6P) .....
..... *Epyris min* Colombo & Azevedo n. sp.

10. Female **11**
– Male **13**

11. Mesoscutellar sulcus not trabeculate, small elevation present (Figure 6C) .....
..... *Holepyris wiru* Colombo & Azevedo n. sp.
– Mesoscutellar sulcus trabeculate, small elevation absent (Figure 6B) **12**

12. Mandible with one distal teeth; median clypeal lobe angulate .....
..... *Holepyris yaifo* Colombo & Azevedo n. sp.
– Mandible with two distal teeth; median clypeal lobe rounded ..... *Holepyris zia* Colombo & Azevedo n. sp.

13. Median clypeal lobe sharpened; posterior margin of mesoscutellum touching metapostnotal anterior margin (Figure 6O) ..... *Holepyris telefol* Colombo & Azevedo n. sp.
– Median clypeal lobe rounded; posterior margin of mesoscutellum not touching metapostnotal anterior margin (Figure 6P) **14**

14. Posterior margin of mesoscutellum foveolate; first metapostnotal carina straight (Figure 6O) .... *Holepyris tsembaga* Colombo & Azevedo n. sp.
– Posterior margin of mesoscutellum not foveolate; first metapostnotal carina outcurved or incurved (Figure 6P) **15**

15. Parapsidal signum shorter than notaulus (Figure 6O); lower mesopleural fovea ill defined **16**
– Parapsidal signum longer than notaulus (Figure 6P); lower mesopleural fovea without trabeculae (Figure 6H) **17**

16. Pedicel as long as flagellomere I; forewing with three distal flexion lines; mesoscutellar sulcus trabeculate (Figure 6B) ..... *Holepyris sambia* Colombo & Azevedo n. sp.
– Pedicel shorter flagellomere I; forewing with four distal flexion lines; mesoscutellar sulcus not trabeculate (Figure 6C) ..... *Holepyris orokaiva* Colombo & Azevedo n. sp.

17. Anterior and lower mesopleural foveae not connected (Figure 6I); notaulus present .... *Holepyris swagap* Colombo & Azevedo n. sp.
– Anterior and lower mesopleural foveae connected (Figure 6H); notaulus absent .... *Holepyris tairora* Colombo & Azevedo n. sp.

18. Female **19**
– Male **25**

19. Ventral margin of mandible with two teeth ..... *Chlorepyris armatus* (Kieffer, 1904)
– Ventral margin of mandible without teeth **20**

20. Anterior and lower mesopleural foveae not connected (Figure 6I) **21**
– Anterior and lower mesopleural foveae connected (Figure 6H) .... *Chlorepyris bilibil* Colombo & Azevedo n. sp.

21. Lower mesopleural fovea not trabeculate (Figure 6H) **22**
– Lower mesopleural fovea trabeculate (Figure 6I) **23**

22. Pedicel as long as flagellomere I; posterior mesofurcal pit oval (Figure 6J); metapostnotal anterior carina outcurved (Figure 6P) ..... *Chlorepyris iatmul* Colombo & Azevedo n. sp.
– Pedicel longer than flagellomere I; posterior mesofurcal pit elongated (Figure 6K); metapostnotal anterior carina straight (Figure 6O) ..... *Chlorepyris koteka* Colombo & Azevedo n. sp.

23. Pronotum coriaceous; posterior margin of mesoscutellum not touching metapostnotal anterior margin (Figure 6P) **24**
– Pronotum shiny; posterior margin of mesoscutellum touching metapostnotal anterior margin (Figure 6O) ..... *Chlorepyris maisin* Colombo & Azevedo n. sp.

24. Posterior mesofurcal pit circular (Figure 6L); first metapostnotal carina as long as metapostnotal median carina (Figure 6O) ..... *Chlorepyris kaluli* Colombo & Azevedo n. sp.
– Posterior mesofurcal pit elongated (Figure 6K); first metapostnotal carina shorter than metapostnotal median carina (Figure 6P) ..... *Chlorepyris kwoma* Colombo & Azevedo n. sp.

25. Posterior margin of mesoscutellar sulcus notched medially (Figure 6E) **26**
– Posterior margin of mesoscutellar sulcus straight medially (Figure 6D) **30**

26. Anterior and lower mesopleural foveae not connected (Figure 6I) **27**
– Anterior and lower mesopleural foveae connected (Figure 6H) **28**

27. Mandible with four distal teeth ..... *Chlorepyris fore* Colombo & Azevedo n. sp.
– Mandible with five distal teeth ..... *Chlorepyris abelam* Colombo & Azevedo n. sp.

28. Pedicel shorter than flagellomere I; frontal line absent; pronotum polished; metafurcal pit inserted into crown-shaped depression (Figure 6M) ..... *Chlorepyris etoro* Colombo & Azevedo n. sp.
– Pedicel as long as flagellomere I; frontal line present; pronotum punctate; metafurcal pit inserted into triangle-shaped depression (Figure 6N) **29**

29. Frons polished; posterior margin of mesoscutellum touching anterior margin of metapectal-propodeal complex (Figure 6O); first metapostnotal carina diverging posteriorly to metapostnotal median carina (Figure 6P) ..... *Chlorepyris chambri* Colombo & Azevedo n. sp.
– Frons coriaceous; posterior margin of mesoscutellum not touching anterior margin of metapectal-propodeal complex (Figure 6P); first metapostnotal carina converging posteriorly to metapostnotal median carina (Figure 6O) ..... *Chlorepyris enga* Colombo & Azevedo n. sp.

30. Pedicel shorter than flagellomere I **31**
– Pedicel as long as or longer than flagellomere I **34**

31. Anterior and lower mesopleural foveae not connected (Figure 6I) **32**
– Anterior and lower mesopleural foveae connected (Figure 6H) **33**

32. Anterior margin of mesoscutellar sulcus straight medially ... *Chlorepyris angu* Colombo & Azevedo n. sp.
– Anterior margin of mesoscutellar sulcus notched medially .....
..... *Chlorepyris biangai* Colombo & Azevedo n. sp.

33. Mesopleuron with subalar impression not connected with mesopleural suture (Figure 6H); parapsidal signum shorter than notaulus (Figure 6O) ..... *Chlorepyris baruya* Colombo & Azevedo n. sp.
– Mesopleuron with subalar impression connected with mesopleural suture (Figure 6I); parapsidal signum as long as notaulus (Figure 6P) ..... *Chlorepyris huli* Colombo & Azevedo n. sp.

34. Pedicel longer than flagellomere I **35**
– Pedicel as long as flagellomere I **36**

35. Mesopleuron with anterior and lower mesopleural foveae connected; mesopleural suture ill-defined .....
..... *Chlorepyris gadsup* Colombo & Azevedo n. sp.
– Mesopleuron with anterior and lower mesopleural foveae not connected; mesopleural suture defined .....
..... *Chlorepyris duna* Colombo & Azevedo n. sp.

36. First metapostnotal carina as long as metapostnotal median carina (Figure 6O) **37**
– First metapostnotal carina shorter than metapostnotal median carina (Figure 6P) **38**

37. First metapostnotal carina straight ..... *Chlorepyris bilibil* Colombo & Azevedo n. sp.
– First metapostnotal carina converging posteriorly to metapostnotal median carina (Figure 6O) .....
..... *Chlorepyris baining* Colombo & Azevedo n. sp.

38. Metatibia spinose; metapostnotal-propodeal suture as long as first metapostnotal carina (Figure 6P) .....
..... *Chlorepyris hewa* Colombo & Azevedo n. sp.
– Metatibia not spinose; metapostnotal-propodeal suture shorter than first metapostnotal carina (Figure 6O) **39**

39. Lower mesopleural fovea not trabeculate; mesopleuron suture not trabeculate .....
..... *Chlorepyris gogodala* Colombo & Azevedo n. sp.
– Lower mesopleural fovea ill defined; mesopleuron suture trabeculate .....
..... *Chlorepyris haroli* Colombo & Azevedo n. sp.

SYSTEMATIC PART

Genus ***CHLOREPYRIS*** Kieffer, 1913

Chlorepyris Kieffer, 1913.

Type species. *Chlorepyris semiviridis* Kieffer, 1913.

Chlorepyris armatus (Kieffer, 1904)

Figure 7

Rhabdepyris armatus Kieffer, 1904: 410-411.
Chlorepyris armatus – Azevedo *et al.*, 2018: 148.

TYPE MATERIAL — Holotype, ♀, N. Guinea S. E. [probably **Papua New Guinea**]. Hughibagu, Loria, V-IX/1991 (MCSN). [examined]

REDESCRIPTION — *Female*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma dark brown; wings hyaline. Mandible with three distal teeth, ventral margin with two twisted teeth. Clypeus with rounded median lobe, not visible dorsally, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel smaller than flagellomere I. Eye weakly setose. Frons weakly coriaceous and punctate. Frontal line present. Pronotum punctate and coriaceous. Posterior mesofurcal pit elongated. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum as long as notaulus. Forewing with ill defined distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, narrower medially, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, straight posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia with spines. Petiolar root with apex strongly incurved. Metasoma polished.

Male. Unknown.

REMARKS — Waichert & Azevedo (2009) redesigned *Rhabdepyris* Kieffer, 1904 under phylogenetic approach, making several new combinations. *Rhabdepyris armatus* was kept in *Rhabdepyris* because the authors were not able to locate its holotype, so that the species was not analyzed. Azevedo *et al.* (2018) transferred *R. armatus* to the genus *Chlorepyris* but did not provide details on this nomenclatural act. Here, analyzing the holotype, we concluded that this species belongs to *Chlorepyris* by having the pronotum punctate, coriaceous, and the mesoscutellar fovea connected by evident sulcus, not trabeculate. We did not find new specimens of *C. armatus* hindering molecular and phylogenetics analyses. This species is morphologically different from the other *Chlorepyris* species because it has the mandibles with five distal teeth, two are located in the ventral margin; the median clypeal lobe not visible dorsally; the posterior portion of the metapectal-propodeal complex polished. The teeth in the ventral margin of the mandibles have already been diagnosed for other Epyrinae, mainly in *Epyris afer* (Magretti, 1884) and related lineages (Stein *et al.* 2011).

DISTRIBUTION — Papua New Guinea.

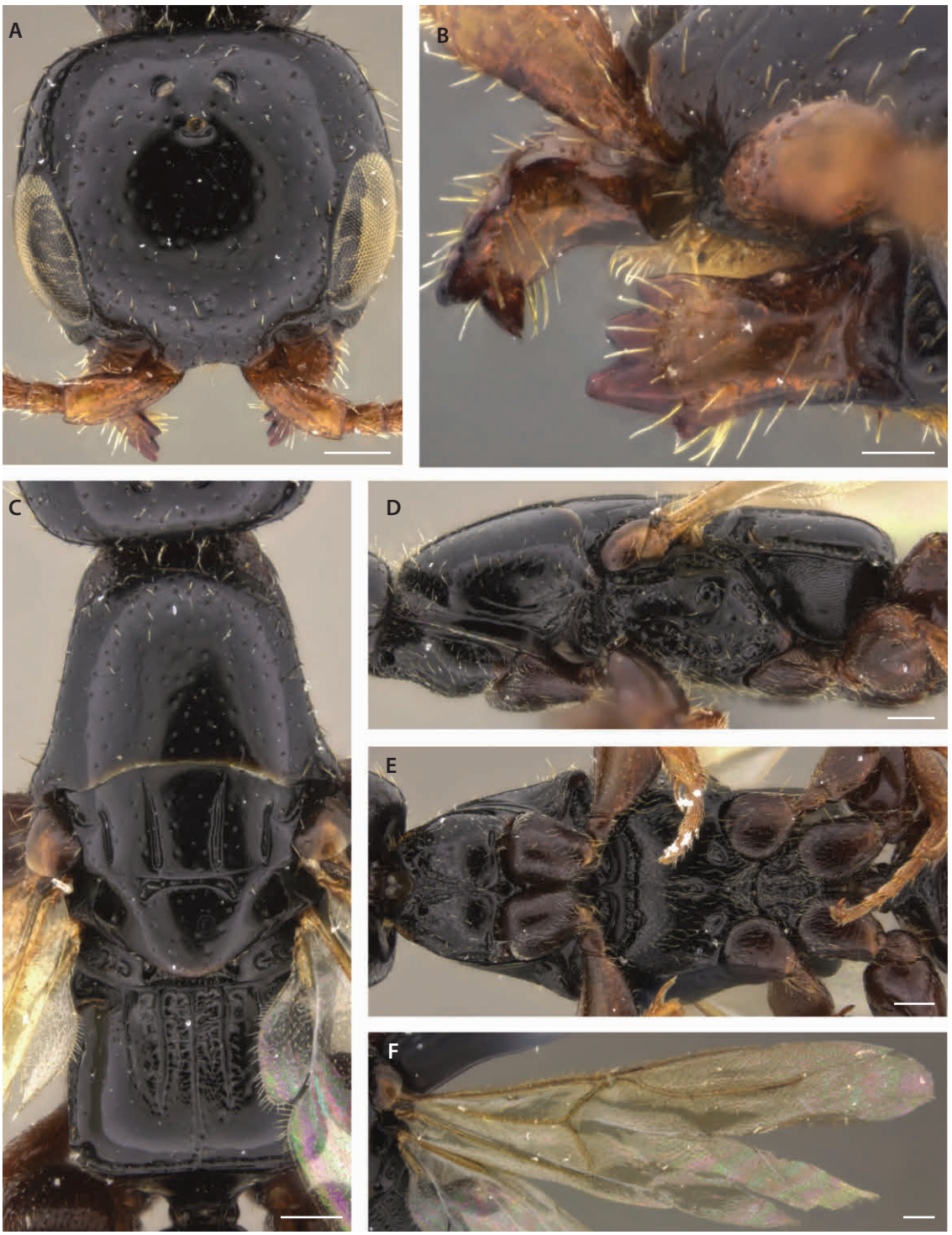


FIGURE 7

Chlorepyris armatus (Kieffer, 1904), holotype female. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

Chlorepyris abelam Colombo & Azevedo n. sp.

Figures 8-9

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 26-27/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 4, understorey, Malaise - MAL-MW1700D-02/16-d02, P2217-11357 (MNHN). Paratypes, **Papua New Guinea**. 1 ♂, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 29-30/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1700D-05/16-d05, P2220-8756 (MNHN); ♂, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 26-27/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1700A-02/16-d02, P2169-11358 (MNHN); ♂, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 29-30/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1700A-05/16-d05, P2172-8760 (MNHN); Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 30-31/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1700A-06/16-d06, P2173-8766 (MNHN); ♂, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 29-30/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1700D-05/16-d05, P2220-8756 (MNHN); ♂, Province Madang, Mount Wilhelm (-5.759910, 145.2347), 1700 m, 26-27/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW1700B-02/16-d02, P2185-11356 (MNHN); 2 ♂, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 25-26/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1700D-01/16-d01, P2216-11361 (MNHN); ♂, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 09-10/11/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1700D-16/16-d16, P2231-8804 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna dark brown; wings amber; metasoma reddish. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel shorter than flagellomere I. Eye glabrous. Frons polished and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, deep. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea trabeculate; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin notched medially, weakly inclined, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina sinuous; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina as long as metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia with few spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere as long as basiparamere in lateral view, apex straight, not arched inward, dorsal margin straight; basiparamere wide, covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex aligned to apex of cuspis, its posterior margin serrated; aedeagus bottle-shaped, its apex aligned to apex of digitus, ventral margin with translucent projection, base of apodeme dilated.

Female. Unknown.

VARIATIONS — Paramere with apex weakly rounded and arched inward.

REMARKS — This species is morphologically similar to *Chlorepyris etoro* n. sp. and *C. fore* n. sp. by having the median clypeal lobe rounded, the eye glabrous, the notauli complete, the mesoscutellar sulcus with the posterior margin notched medially and the mesopleuron with the lower fovea trabeculate. However, *Chlorepyris abelam* n. sp. has the paramere with the apex straight, not arched inward, the apex of the digitus is aligned to the apex of cuspis and the apex of aedeagus



FIGURE 8

Chlorepyris abelam Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in A and B.

aligned to the apex of digitus; whereas *C. etoro* n. sp. has the paramere with the apex sharpened, not arched inward, the digitus with apex anterior to the apex of cuspis and the apex of aedeagus anterior to the apex of digitus, and *C. fore* n. sp. has the paramere with rounded apex, weakly arched inward, the digitus with apex anterior to the apex of cuspis and the apex of aedeagus aligned to the apex of digitus. The genetic distance between *C. etoro* n. sp. and *C. fore* n. sp. was of 14% (Figure 4).

ETYMOLOGY — The epithet *abelam* refers to Abelam people who live in the East Sepik province of Papua New Guinea.

DISTRIBUTION — Papua New Guinea (Madang).

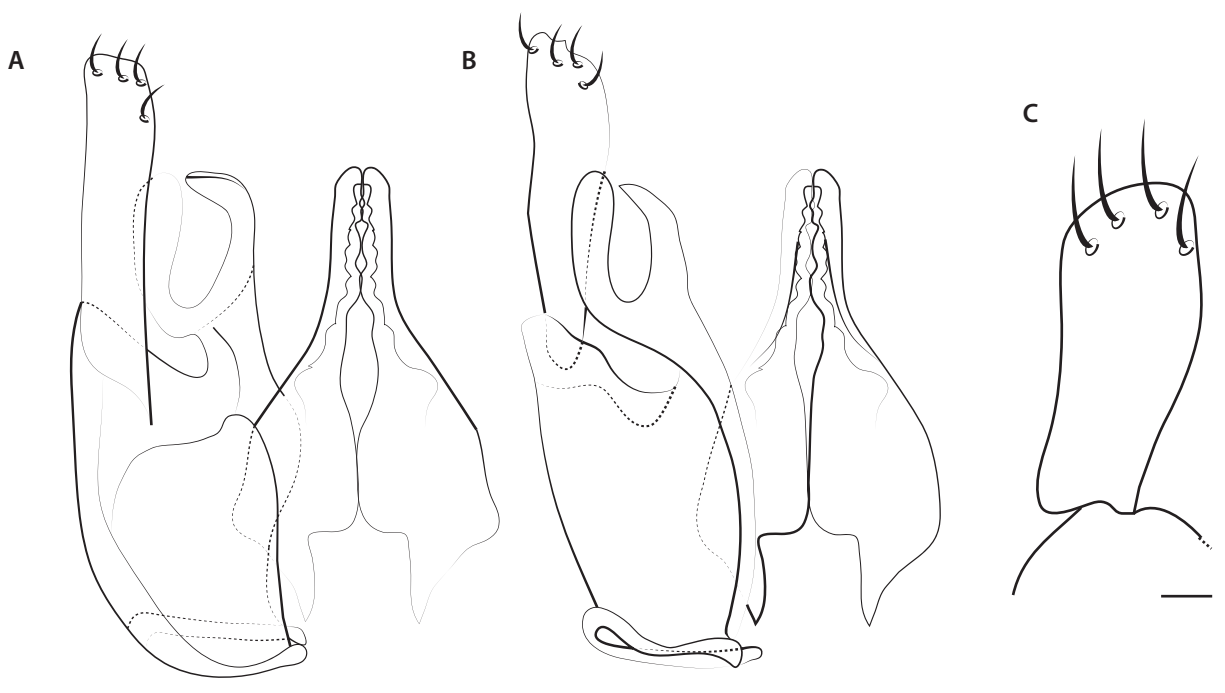


FIGURE 9

Chlorepyris abelam Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

Chlorepyris angu Colombo & Azevedo n. sp.

Figures 10-11

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.741031, 145.3294), 200 m, 30-31/10/2012, leg Dilu, Ray, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0200B-06/16-d06, P1019-11963 (MNHN). Paratypes, **Papua New Guinea**. ♂, Province Madang, Mount Wilhelm, (-5.739897, 145.3297), 200 m, 27-28/10/2012, leg Dilu, Ray, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW0200A-03/16-d03, P1000-11953 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna light brown; wings hyaline; metasoma reddish. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel shorter than flagellomere I. Eye glabrous. Frons coriaceous and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, deep. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea trabeculate; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, narrower medially, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina sinuous; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, divergent. Metatibia with few spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere longer than basiparamere in lateral view, apex sharpened, not arched inward, dorsal margin straight; basiparamere wide, not covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex aligned to apex of cuspis, its posterior margin crenulate; aedeagus bottle-shaped, its apex anterior to apex of digitus, ventral margin with opaque projection, base of apodeme dilated.

Female. Unknown.

REMARKS — This species is morphologically similar to *Chlorepyris enga* n. sp. by having the mandibles with five distal teeth, the clypeus with the median lobe rounded, the occipital carina absent, the paramere longer than the basiparamere in lateral view, and the apex of cuspis anterior to the apex of paramere. However, *C. angu* n. sp. has the mesoscutellar sulcus with the posterior margin straight medially, the metapostnotal-propodeal suture is divergent to the metapostnotal median carina and the apex of the aedeagus is anterior to the apex of digitus; whereas *C. enga* n. sp. has the mesoscutellar sulcus with the posterior margin notched medially, the metapostnotal-propodeal suture converging posteriorly to the metapostnotal median carina and the apex of aedeagus is aligned to the apex of digitus. The genetic distance between *Chlorepyris enga* n. sp. and *Chlorepyris angu* n. sp. was of 17% (Figure 4).

ETYMOLOGY — The epithet *angu* refers to Angu ethnic who live in the mountainous region of south-western Morobe, a province of Papua New Guinea.

DISTRIBUTION — Papua New Guinea (Madang).

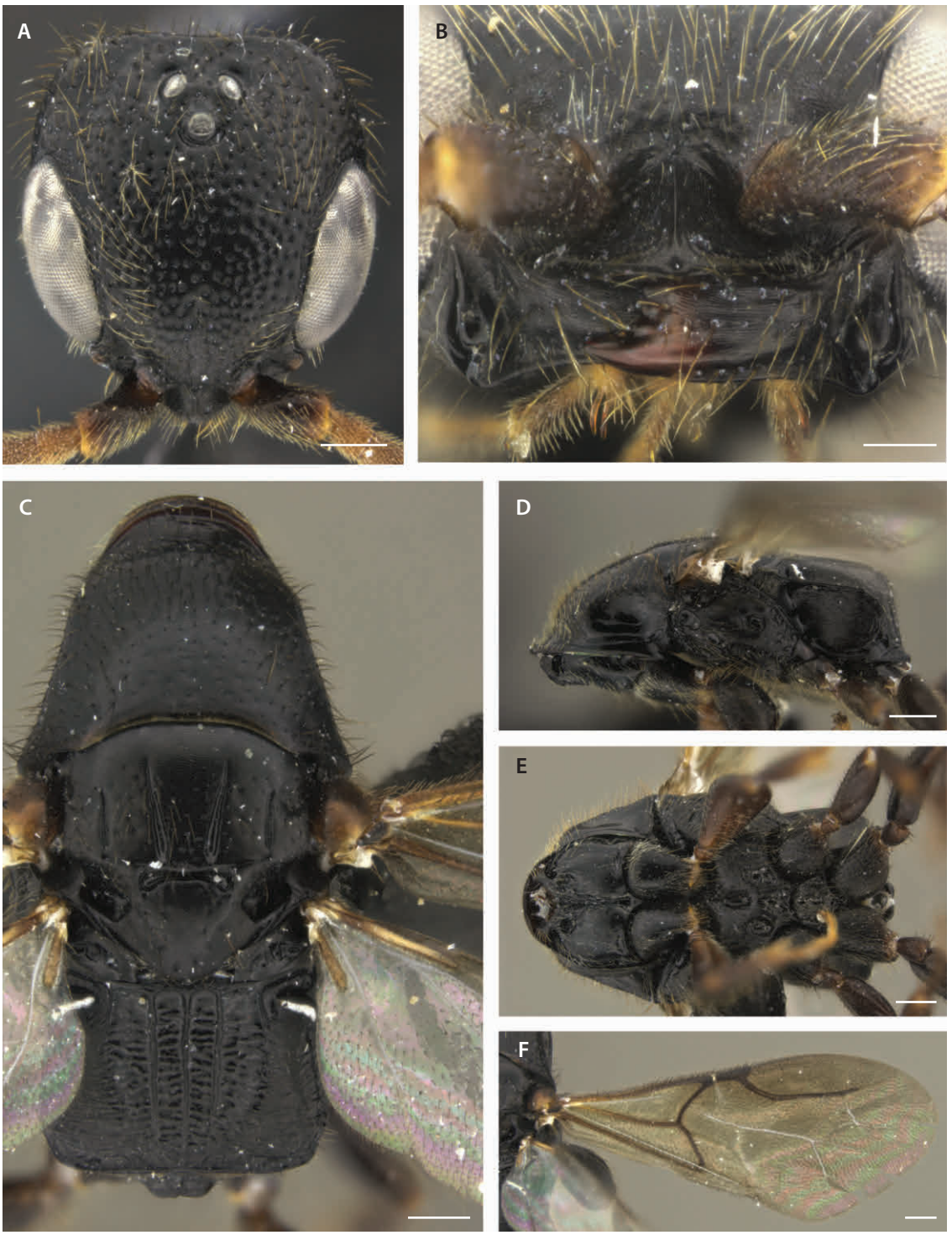


FIGURE 10

Chlorepyris angu Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

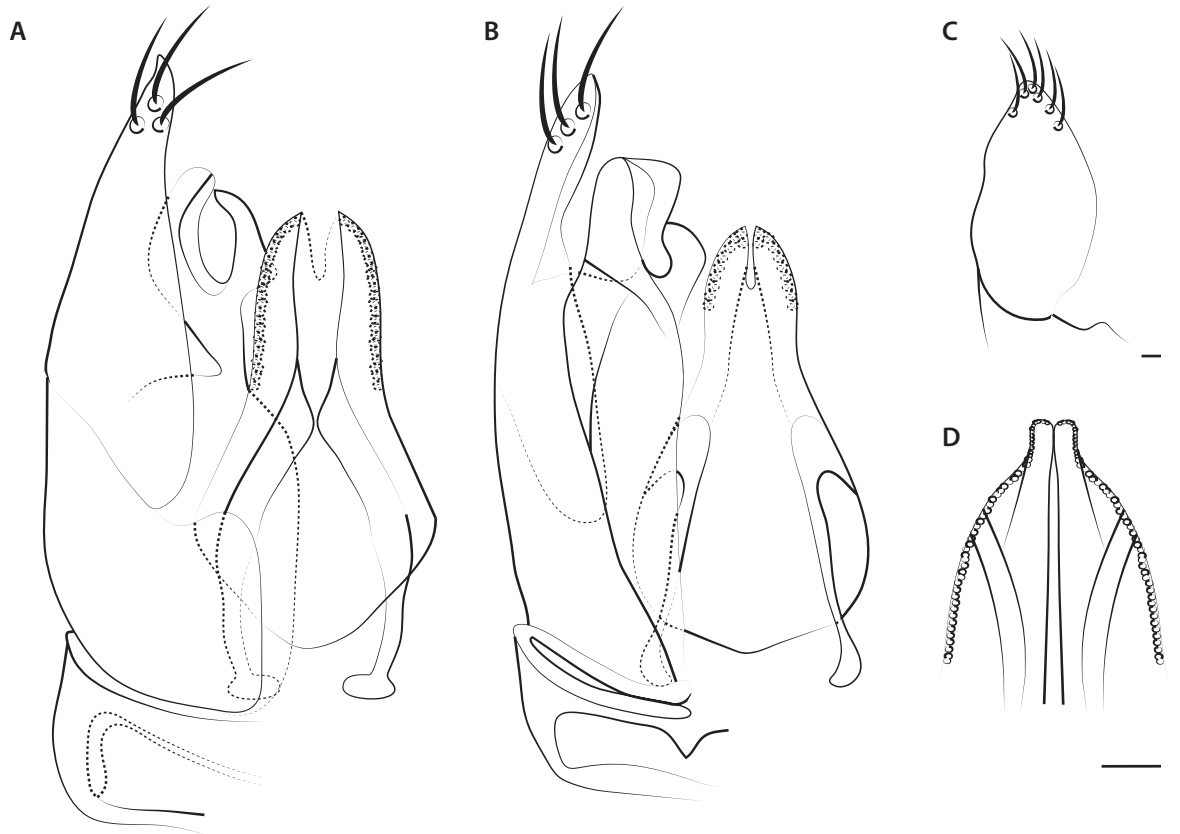


FIGURE 11

Chlorepyris angu Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view; **D**, Apex of aedeagus in dorsal view. Scale bar: 100 µm.

Chlorepyris baining Colombo & Azevedo n. sp.

Figures 12-13

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 28-29/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1200A-04/16-d04, P1781-11307 (MNHN). Paratypes, **Papua New Guinea**. ♂, Province Madang, Mount Wilhelm (-5.720903, 145.2715), 1200 m, 25-26/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW1200C-01/16-d01, P1810-11292 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.732698, 145.2556), 700 m, 08-09/11/2012, leg Keltim, Uma, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0700B-15/16-d15, P1418-11285 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.721022, 145.2703), 1200 m, 26-27/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW1200B-02/16-d02, P1795-11299 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.741031, 145.3294), 200 m, 07-08/11/2012, leg Dilu, Ray, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0200B-14/16-d14, P1027-11973 (MNHN).



FIGURE 12

Chlorepyris baining Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna dark brown; wings hyaline; metasoma yellowish. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel as long as flagellomere I. Eye weakly setose. Frons polished and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, deep. Metafurcal pit inserted into crown-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, incomplete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, narrower medially, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina outcurved; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina as long as metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture as long as first metapostnotal carina, converging posteriorly. Metatibia with few spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere shorter than basiparamere in lateral view, apex rounded, not arched inward, dorsal margin incurved; basiparamere wide, covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin smooth; aedeagus bottle-shaped, its apex posterior to apex of digitus, ventral margin with translucent projection, base of apodeme dilated.

Female. Unknown.



FIGURE 13

Chlorepyris baining Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

REMARKS — This species is morphologically and genetically similar to *Chlorepyris baruya* n. sp. by having the mandibles with five distal teeth, the median clypeal lobe rounded, the flagellar pubescence appressed, the eyes weakly setose, the mesoscutellar sulcus with the posterior margin straight medially, the lower fovea trabeculate and the paramere shorter than the basiparamere in lateral view. However, *C. baining* n. sp. has the pedicel as long as the flagellomere I and the anterior and lower mesopleural foveae are not connected; whereas *C. baruya* n. sp. has the pedicel shorter than the flagellomere I and the anterior and lower mesopleural foveae connected. The genetic distance between *C. baining* n. sp. and *C. baruya* n. sp. was of 6% (Figure 4) and reconstructed as sister taxa in the phylogenetic analyses.

ETYMOLOGY — The epithet *baining* refers to the Baining ethnic, the first inhabitants of the Gazelle Peninsula of East New Britain, Papua New Guinea.

DISTRIBUTION — Papua New Guinea (Madang).

Chlorepyris baruya Colombo & Azevedo n. sp.

Figures 14-15

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.720903, 145.2715), 1200 m, 25-26/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW1200C-01/16-d01, P1810-11292 (MNHN). Paratypes, **Papua New Guinea**. ♂, Province Madang, Mount Wilhelm (-5.732698, 145.2556), 700 m, 08-09/11/2012, leg Keltim, Uma, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0700B-15/16-d15, P1418-11285 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole dark brown; antenna brown; wings hyaline; metasoma light brown. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel shorter than flagellomere I. Eye weakly setose. Frons polished and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, deep. Metafurcal pit inserted into crown-shaped depression. Mesopleuron with anterior and lower mesopleural foveae connected; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially weakly inclined, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina as long as metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia with many spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere shorter than basiparamere in lateral view, apex rounded, weakly arched inward, dorsal margin incurved; basiparamere wide, not covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin crenulate; aedeagus bottle-shaped, its apex posterior to apex of digitus, ventral margin with opaque projection, base of apodeme dilated.

Female. Unknown.

REMARKS — This species is morphologically similar to *Chlorepyris hewa* n. sp. by having the median clypeal lobe rounded, the flagellar pubescence appressed, the notauli complete, the mesoscutellar sulcus with the posterior margin straight medially, the paramere shorter than the basiparamere in lateral view, and the apex of aedeagus posterior to the

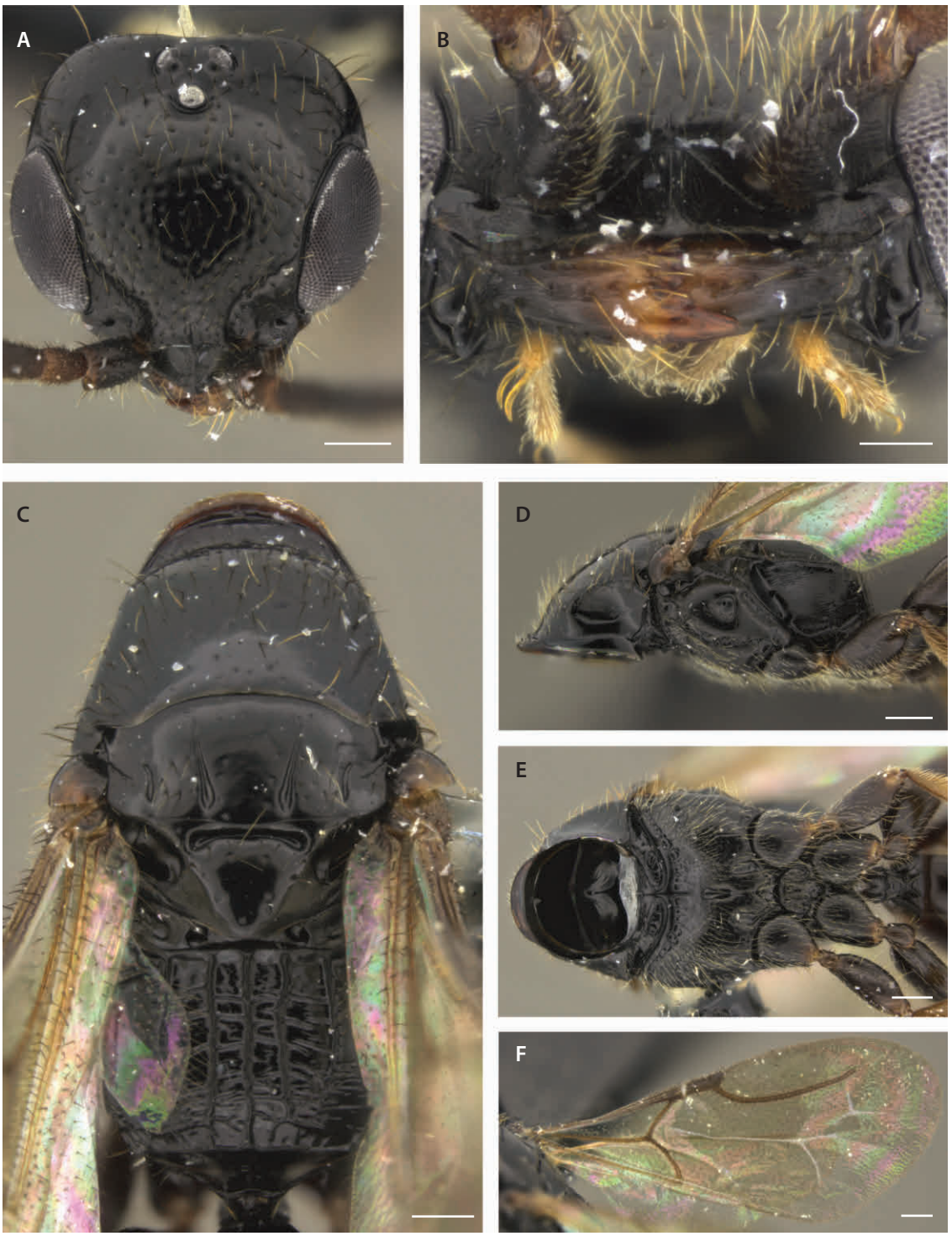


FIGURE 14

Chlorepyris baruya Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

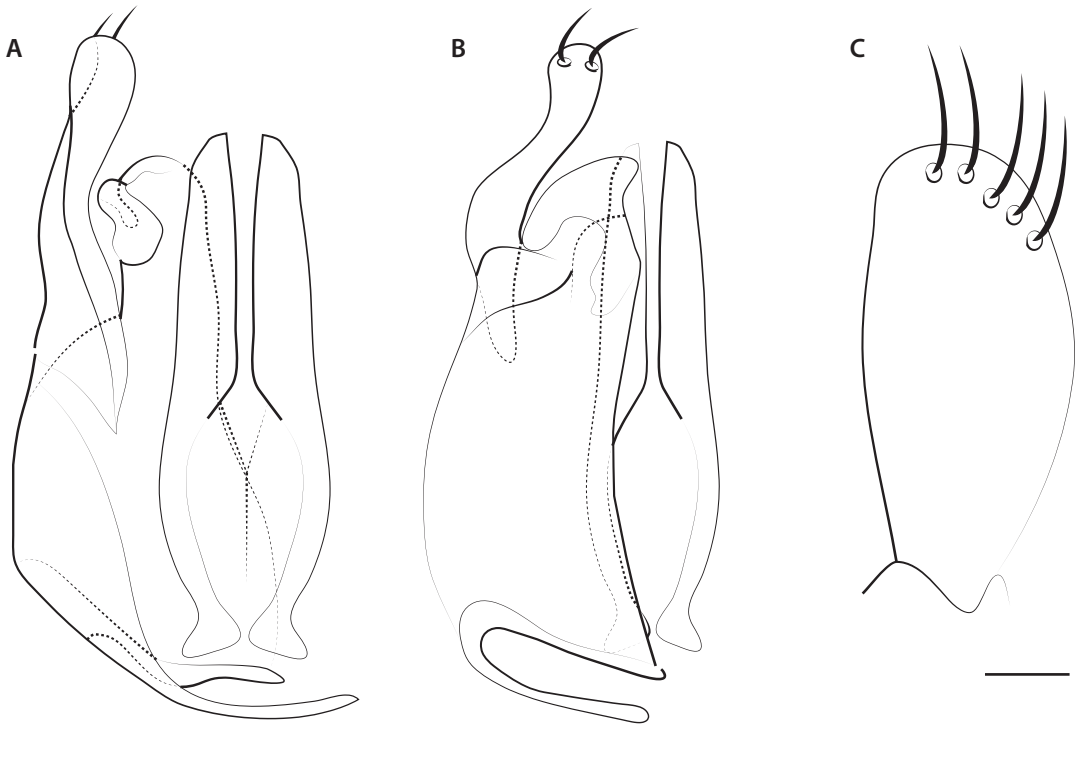


FIGURE 15

Chlorepyris baruya Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

apex of digitus. However, *Chlorepyris baruya* n. sp. has the pedicel shorter than the flagellomere I, the frons is polished, the frontal line is present and the lower mesopleural fovea is trabeculate; whereas *C. hewa* n. sp. has the pedicel as long as flagellomere I, the frons coriaceous, the frontal line is absent, and the lower mesopleural fovea is ill defined. The genetic distance between *C. baruya* n. sp. and *C.hewa* n. sp. was of 3% (Figure 4), the lowest nucleotide distance among all species of *Chlorepyris*.

ETYMOLOGY — The epithet *baruya* refers to Baruya ethnic, a tribe in the highlands of Papua New Guinea.

DISTRIBUTION — Papua New Guinea (Madang).

Chlorepyris biangai Colombo & Azevedo n. sp.

Figures 16-17

TYPE MATERIAL — Holotype, ♂, **Papua-New-Guinea**, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 09-10/11/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1700D-16/16-d16, P2231-8804 (MNHN).

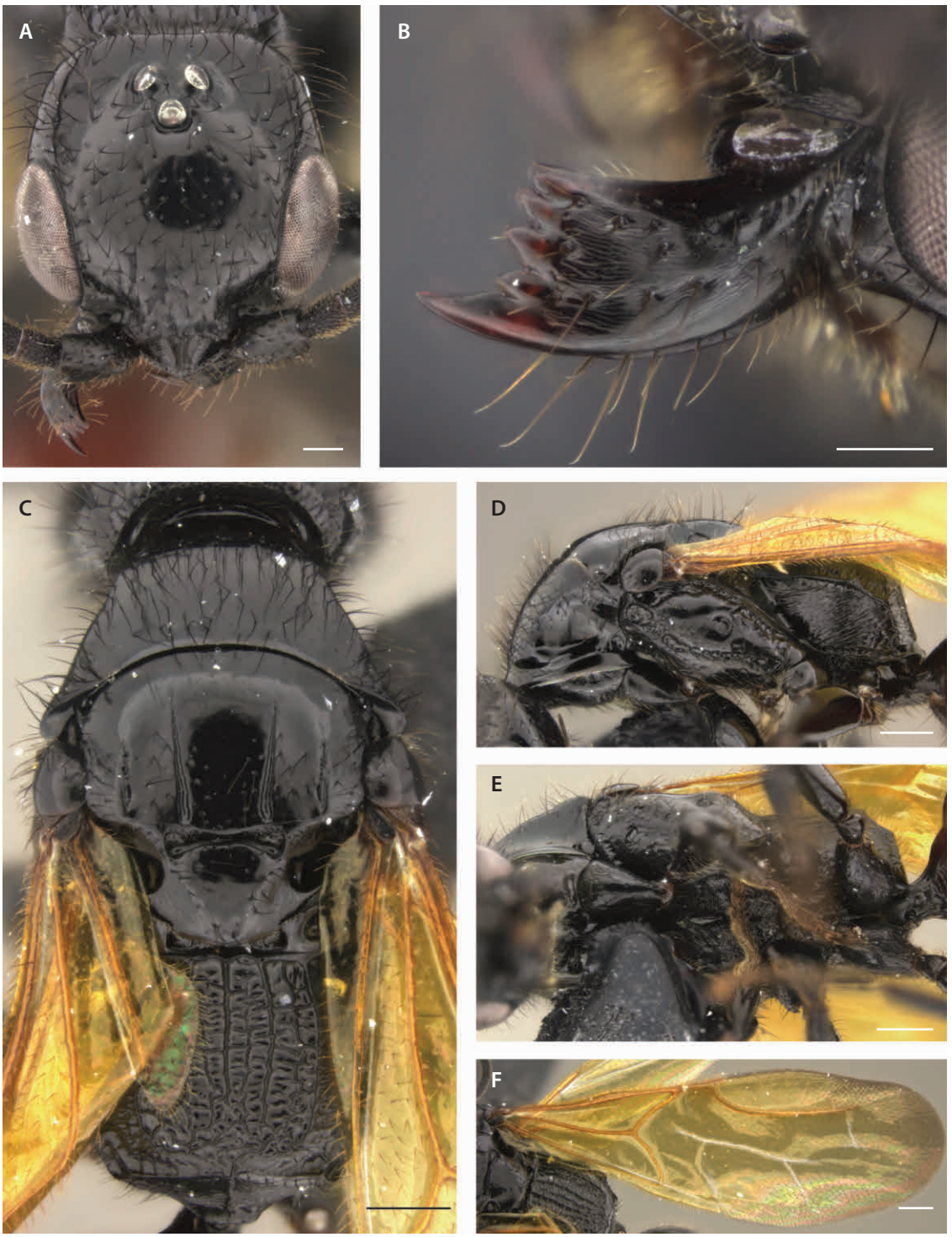


FIGURE 16

Chlorepyris biangai Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 400 µm, except 100 µm in B, 200 µm in A.

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna dark brown; wings amber; metasoma reddish. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel longer than flagellomere I. Eye glabrous. Frons polished and punctate. Frontal line absent. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, deep. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, anterior margin of mesoscutellar sulcus notched medially, weakly inclined, narrower medially, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina sinuous; metapostnotal median carina incomplete, visible posteriorly; first metapostnotal carina longer than metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture longer than first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere longer than basiparamere in lateral view, apex rounded, weakly arched inward, dorsal margin incurved, strongly setose; basiparamere wide, covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin smooth; aedeagus bottle-shaped, its apex posterior to apex of digitus, ventral margin with opaque projection, base of apodeme dilated.

Female. Unknown.

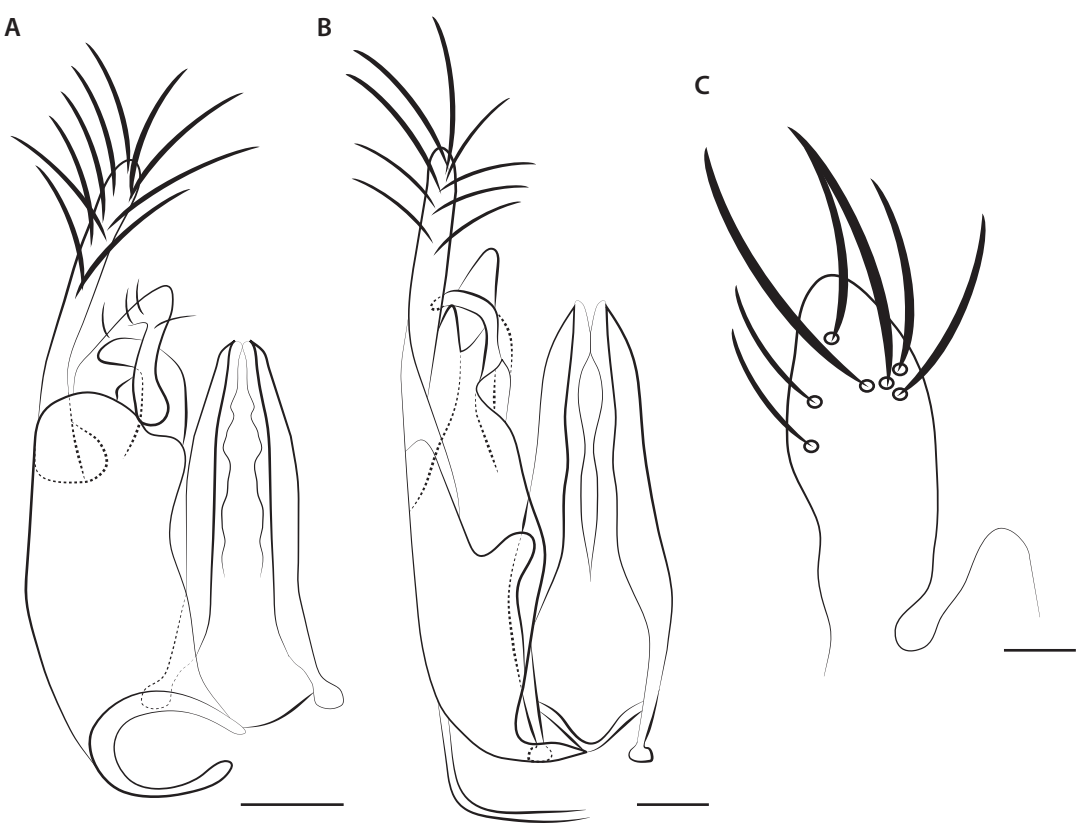


FIGURE 17

Chlorepyris biangai Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bars: 500 µm, except 25 µm in C.

REMARKS — This species is morphologically similar to *Chlorepyris angu* n. sp. by having the mandible with five distal teeth, median clypeal lobe rounded, the flagellar pubescence appressed, the metafurcal pit inserted into triangle-shaped depression, the mesoscutellar sulcus with the posterior margin straight medially, and the paramere longer than the basiparamere in lateral view. However, *C. biangai* n. sp. has the pedicel longer than the flagellomere I, the frontal line is absent, and the aedeagus is bottle-shaped with apex posterior to apex of digitus; whereas *C. angu* n. sp. has the pedicel shorter than the flagellomere I, the frontal line is present, and the aedeagus is bottle-shaped with apex anterior to apex of digitus.

ETYMOLOGY — The epithet *biangai* refers to Biangai ethnic, an ethnic group living on the slopes of the upper Bulolo valley, in Papua New Guinea.

DISTRIBUTION — Papua New Guinea (Madang).

Chlorepyris bilibil Colombo & Azevedo n. sp.

Figures 18-20

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 20-21/11/2012, leg Basset, Plot 1, understorey; Malaise - MAL-WAN01-D03, P4902-9231 (MNHN). Allotype, ♀, P**apua New Guinea**. Province Madang, Mount Wilhelm (-5.741031, 145.3294), 200 m, 07-08/11/2012, leg Dilu, Ray, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0200B-14/16-d14, P1027-11973 (MNHN). Paratypes, **Papua New Guinea**. ♀, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 29-30/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-05/16-d05, P1440-11993 (MNHN).

DESCRIPTION — *Male* (Figures 18-19). Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole dark brown; antenna brown; wings hyaline; metasoma dark brown to light brown. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel as long as flagellomere I. Eye weakly setose. Frons coriaceous and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina sinuous; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina as long as metapostnotal median carina, straight; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia with many spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere shorter than basiparamere in lateral view, apex rounded, arched inward, dorsal margin incurved; basiparamere wide, not covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin serrated, the aedeagus bottle-shaped, its apex posterior to apex of digitus, ventral margin with translucent projection, base of apodeme dilated.

Female (Figure 20). Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma dark brown; wings hyaline. Mandible with two distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel as long as flagellomere I. Eye weakly setose. Frons polished and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower

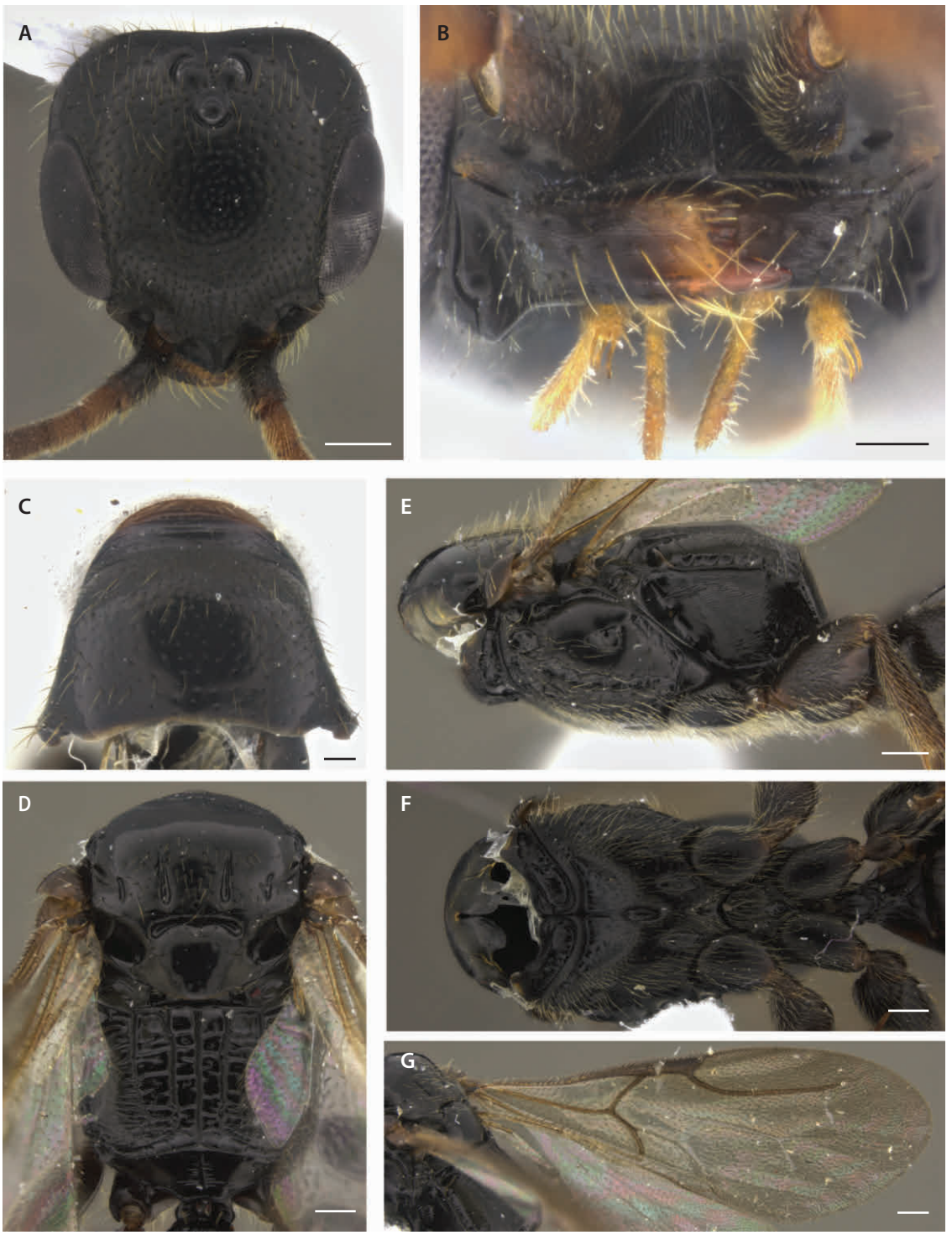


FIGURE 18

Chlorepyris bilibil Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, pronotum in dorsal view; **D**, mesosoma in dorsal view; **E**, mesosoma in lateral view; **F**, mesosoma in ventral view; **G**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in C, 400 µm in G.

mesopleural foveae connected; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina as long as metapostnotal median carina, straight; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia with few spines. Petiolar root with apex strongly incurved. Metasoma polished.

REMARKS — The male of this species is morphologically similar to *Chlorepyris hewa* n. sp. by having the median clypeal lobe rounded, the flagellar pubescence appressed, the notauli complete, the mesoscutellar sulcus with the posterior margin straight medially, the paramere shorter than the basiparamere in lateral view, the apex of cuspis anterior to the apex of paramere, the apex of aedeagus posterior to the apex of digitus. However, *Chlorepyris bilibil* n. sp. has the frontal line present, the anterior and lower mesopleural foveae not connected and the lower mesopleural fovea trabeculate; whereas *C. hewa* n. sp. has the frontal line absent, the anterior and lower mesopleural foveae connected, and the lower mesopleural fovea ill defined.

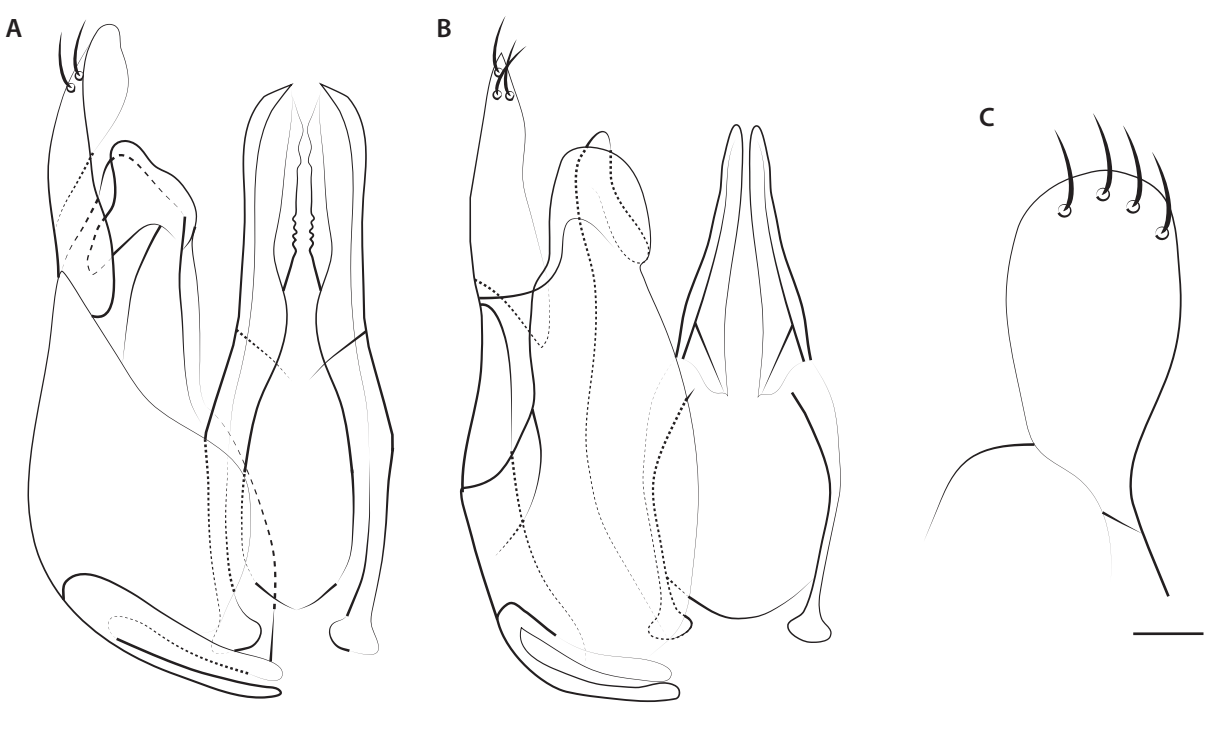


FIGURE 19

Chlorepyris bilibil Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

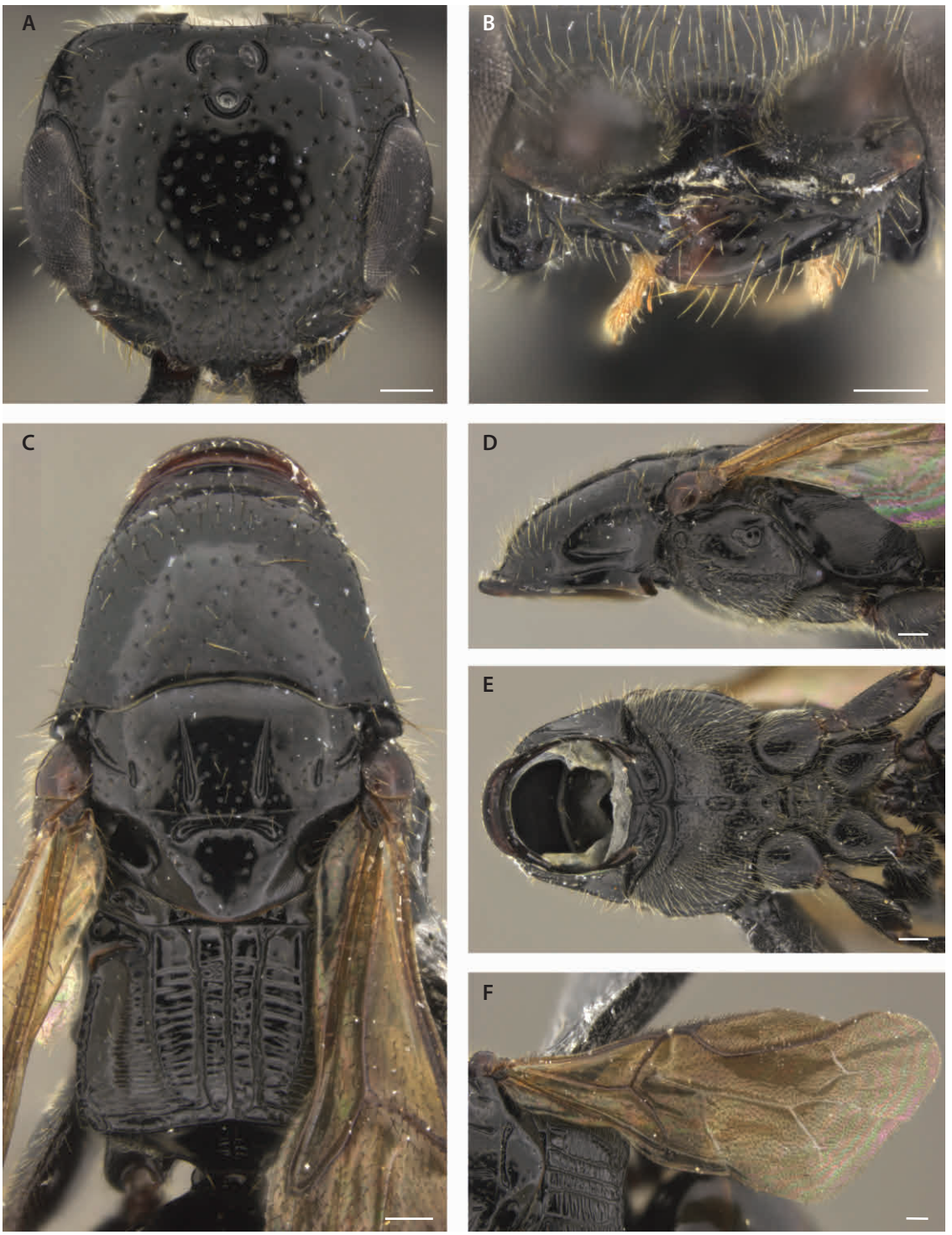


FIGURE 20

Chlorepyris bilibil Colombo & Azevedo n. sp., female. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bar: 200 µm.

The female is morphologically similar to *C. koteka* n. sp. by having the mandibles with two distal teeth, the mesoscutellar sulcus with the posterior margin straight medially and the metapostnotal-propodeal suture shorter than the first metapostnotal carina. However, *Chlorepyris bilibil* n. sp. has the pedicel as long as the flagellomere I, the frons is polished, the pronotum is shiny and the anterior and lower mesopleural fovea are connected; whereas *C. koteka* n. sp. has the pedicel longer than the flagellomere I, the frons is coriaceous, the pronotum is coriaceous and the anterior and lower mesopleural foveae are not connected.

The genetic distance between male and female of *Chlorepyris bilibil* n. sp. was of 0% (Figure 4) and they were associated based on molecular evidence.

ETYMOLOGY — The epithet *bilibil* refers to Bilibil ethnic who lived on the island offshore from Madang.

DISTRIBUTION — Papua New Guinea (Madang).

Chlorepyris chambri Colombo & Azevedo n. sp.

Figures 21-22

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.720903, 145.2715), 1200 m, 28-29/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW1200C-04/16-d04, P1813-11304 (MNHN). Paratypes, **Papua New Guinea**. ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 25-26/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-01/16-d01, P1436-11978 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna brown; wings hyaline; metasoma dark brown. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel as long as flagellomere I. Eye glabrous. Frons polished and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, deep. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae connected; lower mesopleural fovea trabeculate; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, narrower medially, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina outcurved; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, divergent; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere as long as basiparamere in lateral view, apex sharpened, not arched inward, dorsal margin straight; basiparamere wide, not covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin serrated; aedeagus bottle-shaped, its apex anterior to apex of digitus, ventral margin with translucent projection, base of apodeme dilated.

Female. Unknown.

REMARKS — This species is morphologically similar to *Chlorepyris huli* n. sp. by having the mandibles with five distal teeth, the median clypeal lobe rounded, the frontal line present, the mesoscutellar sulcus with the posterior margin straight medially and the apex of cuspis anterior to the apex of paramere. However, *C. chambri* n. sp. has the paramere shorter than the basiparamere in lateral view, the paramere has the apex rounded, arched inward and the apex of aedea-

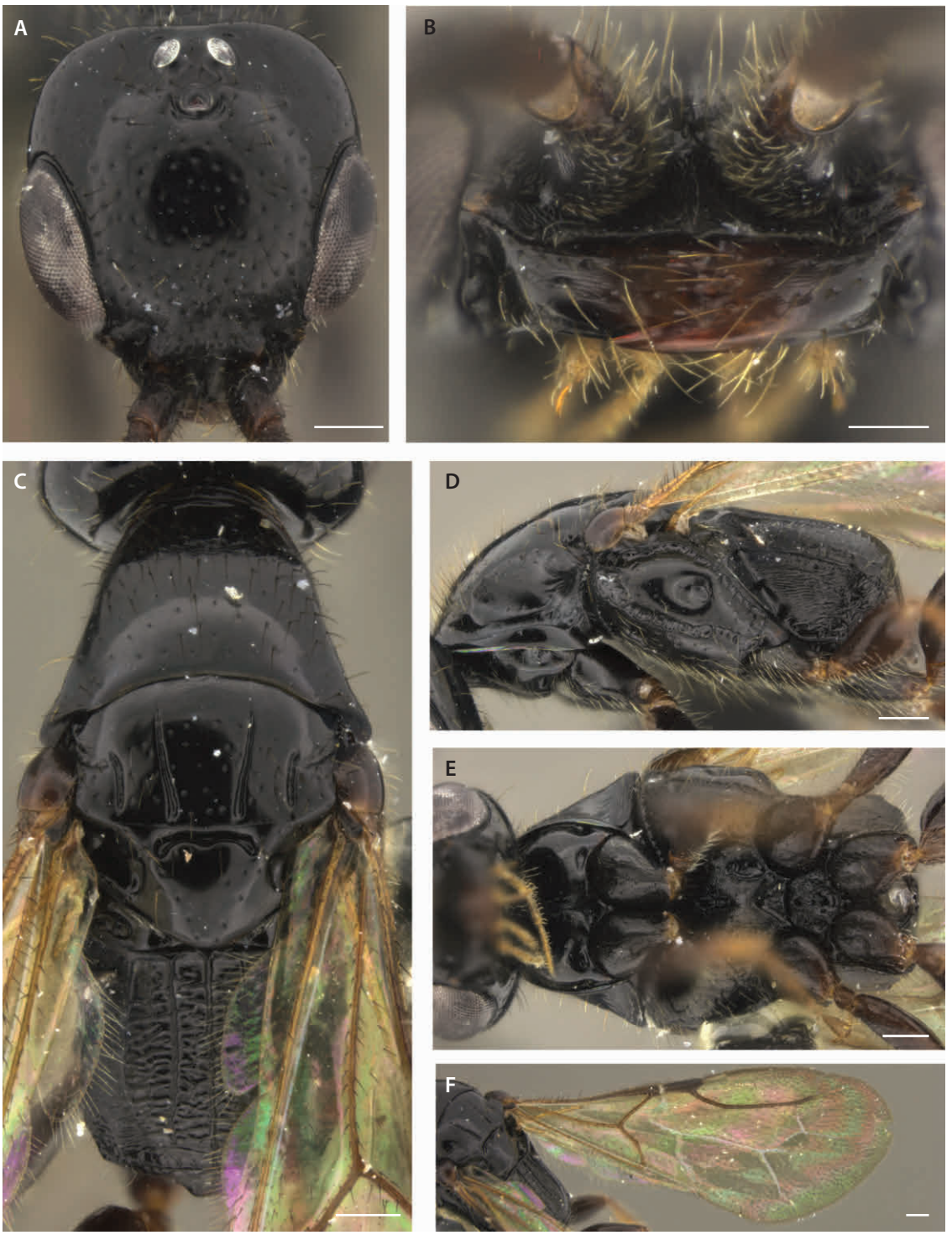


FIGURE 21

Chlorepyris chambri Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bar: 200 µm.

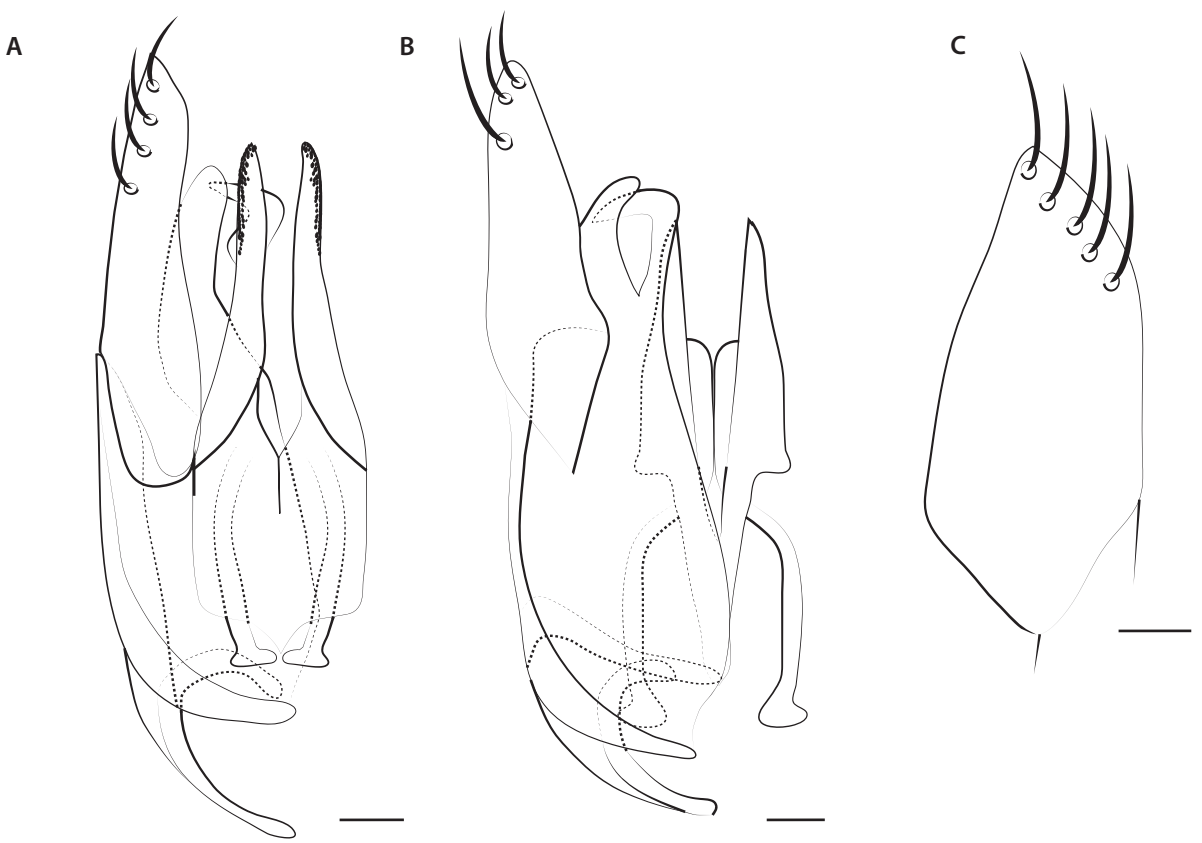


FIGURE 22

Chlorepyrischambri Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

gus is posterior to the apex of digitus; whereas *C. huli* n. sp. has the paramere with apex sharpened, weakly arched inward and apex of aedeagus is anterior to the apex of digitus. The genetic distance between *C. chambri* n. sp. and *C. huli* n. sp. was of 5% (Figure 4).

ETYMOLOGY — The epithet *chambri* refers to the Chambri ethnic, previously spelled Tchambuli, an ethnic group in the Chambri Lakes region in the East Sepik province of Papua New Guinea.

DISTRIBUTION — Papua New Guinea (Madang).

Chlorepyris duna Colombo & Azevedo n. sp.

Figures 23-24

TYPE MATERIAL — Holotype, ♂, **Papua-New-Guinea**. Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 29-30/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-05/16-d05, P1440-11993 (MNHN).

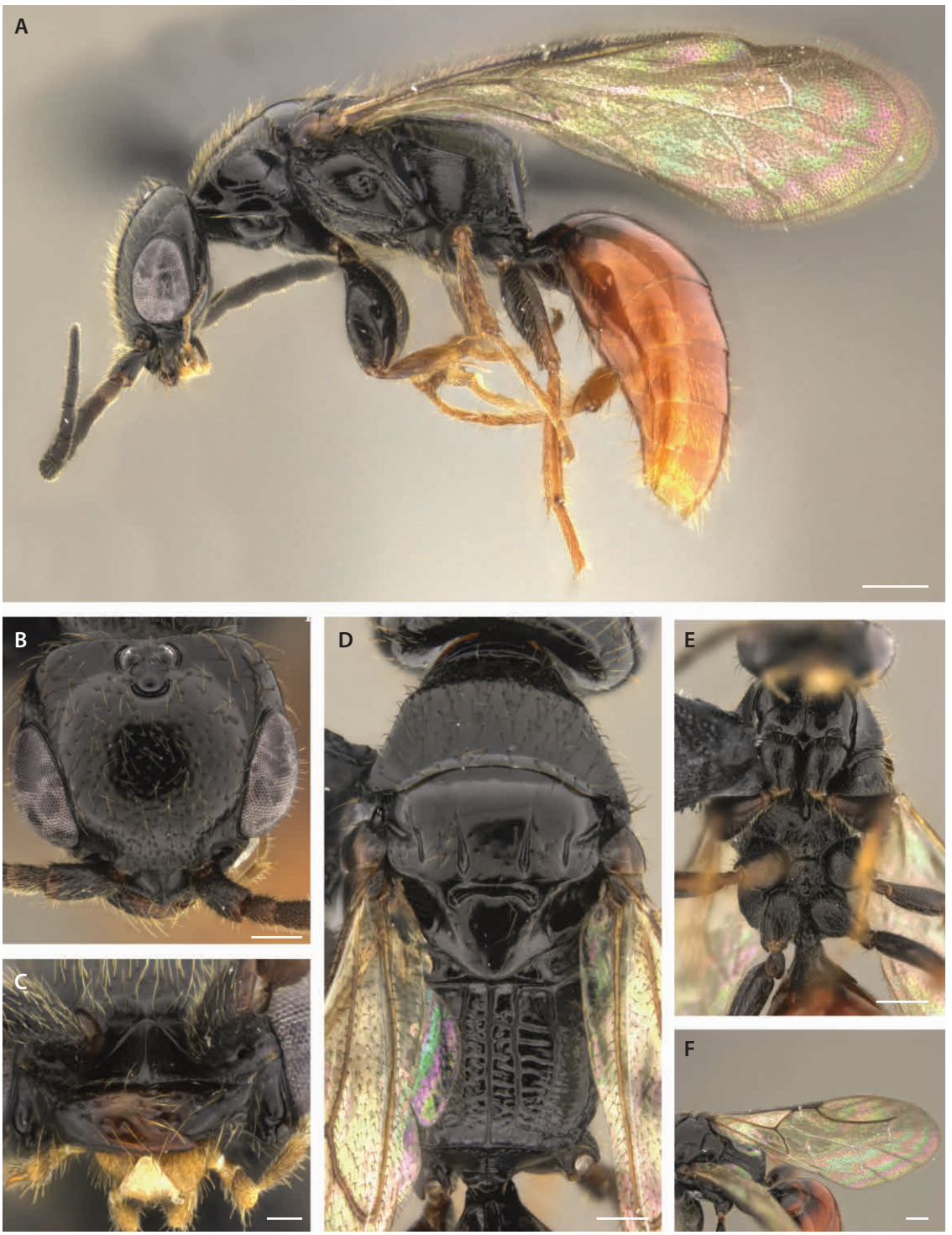


FIGURE 23

Chlorepyris duna Colombo & Azevedo n. sp., male. **A**, body in lateral view; **B**, head in dorsal view; **C**, mandible in frontal view; **D**, mesosoma in dorsal view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in C, 400 µm in A and F.

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna dark brown; wings hyaline; metasoma reddish. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel longer than flagellomere I. Eye glabrous. Frons polished and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, deep. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein weakly angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere as long as basiparamere in lateral view, apex rounded, weakly arched inward, dorsal margin incurved; basiparamere wide, not covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin crenulate; aedeagus bottle-shaped, its apex anterior to apex of digitus, ventral margin with opaque projection, base of apodeme dilated.

Female. Unknown.

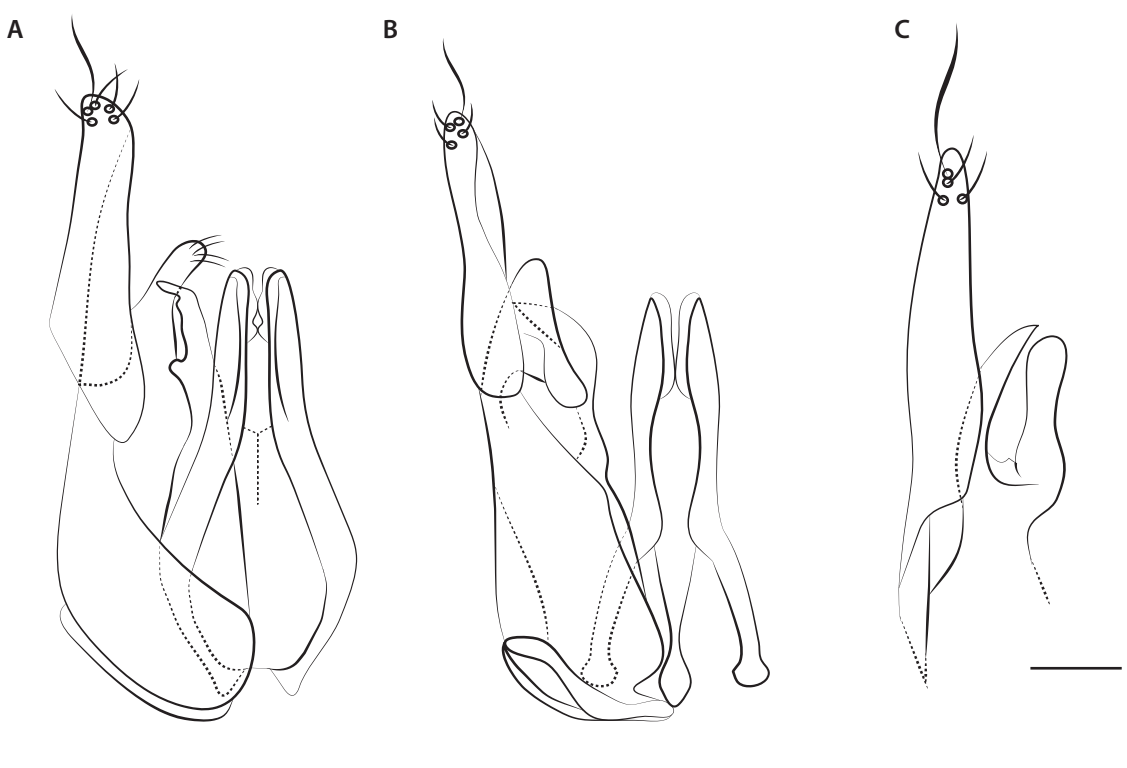


FIGURE 24

Chlorepyris duna Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 50 µm.

REMARKS — This species is morphologically similar to *Chlorepyris gadsup* n. sp. by having the mandible with five distal teeth, median clypeal lobe rounded, the flagellar pubescence appressed, the pedicel longer than the flagellomere I, the metafurcal pit inserted into triangle-shaped depression, and the mesoscutellar sulcus with the posterior margin straight medially. However, *C. duna* n. sp. has the eye glabrous, mesopleuron with anterior and lower mesopleural foveae not connected, and first metapostnotal carina shorter than metapostnotal median carina, whereas *C. gadsup* n. sp. has the eye weakly setose, mesopleuron with anterior and lower mesopleural foveae connected, and first metapostnotal carina longer than metapostnotal median carina.

ETYMOLOGY — The epithet *duna* refers to Duna ethnic, an indigenous people of Papua New Guinea (also known as Yuna) who live in the north-western area of the Southern Highlands Province.

DISTRIBUTION — Papua New Guinea (Madang).

Chlorepyris enga Colombo & Azevedo n. sp.

Figures 25-26

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 27-28/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1200D-03/16-d03, P1828-11300 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna brown; wings hyaline; metasoma dark brown. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel as long as flagellomere I. Eye weakly setose. Frons coriaceous and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae connected; lower mesopleural fovea trabeculate; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin notched medially, weakly inclined, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina outcurved; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere longer than basiparamere in lateral view, apex rounded, very arched and expanded inward, dorsal margin outcurved; basiparamere wide, covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin serrated; aedeagus bottle-shaped, its apex aligned to apex of digitus, ventral margin with translucent projection, base of apodeme dilated.

Female. Unknown.

REMARKS — This species is morphologically similar to *Chlorepyris angu* n. sp. by having the mandibles with five distal teeth, the clypeus with a rounded median lobe, the occipital carina absent, the paramere longer than the basiparamere in lateral view, and the volsella with the apex of cuspis anterior to the apex of paramere. However, *C. enga* n. sp. has the mesoscutellar sulcus with the posterior margin notched medially, the metapostnotal-propodeal suture converges



FIGURE 25

Chlorepyris enga Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.



FIGURE 26

Chlorepyris enga Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

posteriorly to metapostnotal median carina and the apex of the aedeagus is aligned to the apex of digitus; whereas *C. angu* n. sp. has the mesoscutellar sulcus with the posterior margin straight medially, the metapostnotal-propodeal suture diverges from the metapostnotal median carina and the aedeagus has its apex anterior to apex of digitus. The genetic distance between *Chlorepyris enga* n. sp. and *Chlorepyris angu* n. sp. was of 17% (Figure 4).

ETYMOLOGY — The epithet *enga* refers to Enga language of the East New Guinea Highlands spoken by a quarter-million people in Enga Province, Papua New Guinea.

DISTRIBUTION — Papua New Guinea (Madang).

Chlorepyris etoro Colombo & Azevedo n. sp.

Figures 27-28

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm, (-5.758978, 145.1861), 2200 m, 27-28/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW2200A-12/16-d12, P2569-11884 (MNHN).

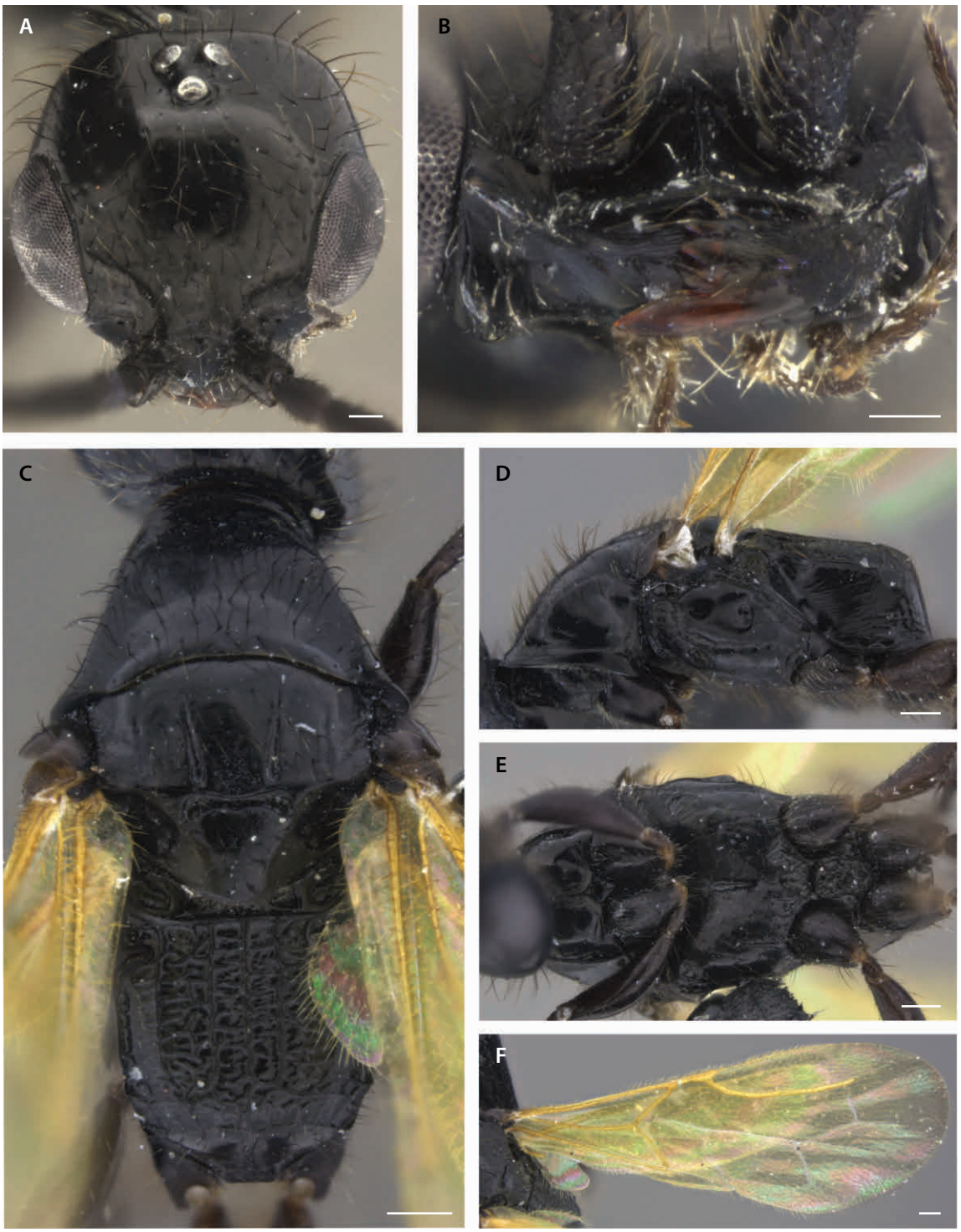


FIGURE 27

Chlorepyris etoro Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in A and B.

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma dark brown; wings amber. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence erect; pedicel shorter than flagellomere I. Eye glabrous. Frons polished and punctate. Frontal line present. Pronotum polished and shiny. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into crown-shaped depression. Mesopleuron with anterior and lower mesopleural foveae connected; lower mesopleural fovea not trabeculate; subalar impression connected with mesopleural suture; mesopleural suture not trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin notched medially, weakly inclined, evenly wide, touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, ill defined; metapostnotal-propodeal suture as long as first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere shorter than basiparamere in lateral view, apex sharpened, not arched inward, dorsal margin incurved; basiparamere wide, covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin serrated; aedeagus bottle-shaped, its apex anterior to apex of digitus, ventral margin with translucent projection, base of apodeme dilated.

Female. Unknown.

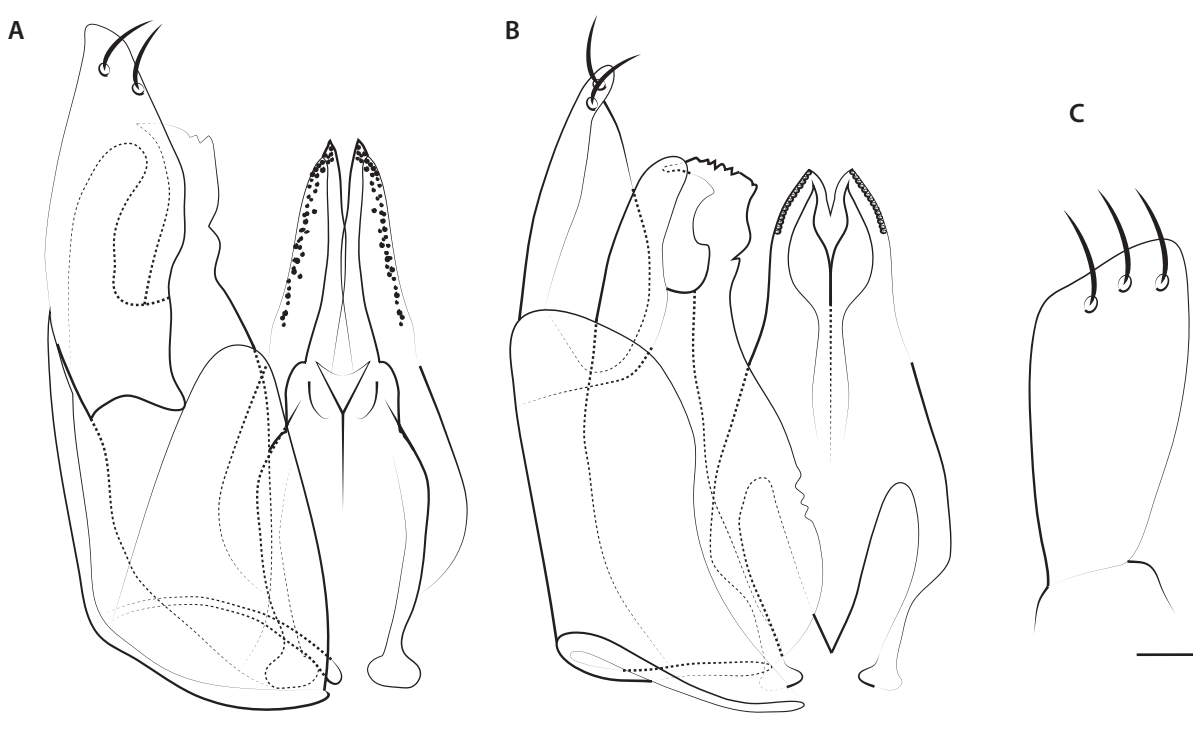


FIGURE 28

Chlorepyris etoro Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

REMARKS — This species is morphologically similar to *Chlorepyris fore* n. sp. by having the median clypeal lobe rounded, the eyes glabrous, the posterior mesofurcal pit elongated, the notauli complete and the mesoscutellar sulcus with the posterior margin notched medially. *Chlorepyris etoro* n. sp., however, has the mandibles with five distal teeth, the frons is polished, the frontal line is absent, the anterior and lower mesopleural foveae are connected, the male paramere is shorter than the basiparamere in lateral view and the apex of the aedeagus is anterior to the apex of digitus; whereas *C. fore* n. sp. has the mandibles with four distal teeth, the frons is coriaceous, the frontal line is present, the anterior and lower mesopleural foveae are not connected, the male paramere is as long as the basiparamere in lateral view and the apex of the aedeagus is aligned to the apex of digitus. The genetic distance between *C. fore* n. sp. and *C. etoro* n. sp. was of 14% (Figure 4).

ETYMOLOGY — The epithet *etoro* refers to the Etoro, or Edolo, a tribe and ethnic group of Papua New Guinea.

DISTRIBUTION — Papua New Guinea (Madang).

Chlorepyris fore Colombo & Azevedo n. sp.

Figures 29-30

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 04-05/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1200D-11/16-d11, P1836-11337 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole dark brown; antenna brown; wings hyaline; metasoma light brown. Mandible with four distal teeth. Clypeus with median lobe rounded, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel shorter than flagellomere I. Eye glabrous. Frons coriaceous and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea trabeculate; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin notched medially, weakly inclined, evenly wide, touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina sinuous; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, divergent; metapostnotal-propodeal suture as long as first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere as long as basiparamere in lateral view, apex rounded, weakly arched inward, dorsal margin incurved; basiparamere wide, covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin crenulate; aedeagus bottle-shaped, its apex aligned to apex of digitus, ventral margin with opaque projection, base of apodeme dilated.

Female. Unknown.

REMARKS — This species is morphologically similar to *Chlorepyris etoro* n. sp. by having the median clypeal lobe rounded, the eyes glabrous, the posterior mesofurcal pit elongated, the notauli complete and the mesoscutellar sulcus with the posterior margin notched medially. However, *C. fore* n. sp. has the mandibles with four distal teeth, the frons is coriaceous, the frontal line is present, the anterior and lower mesopleural foveae are not connected; whereas

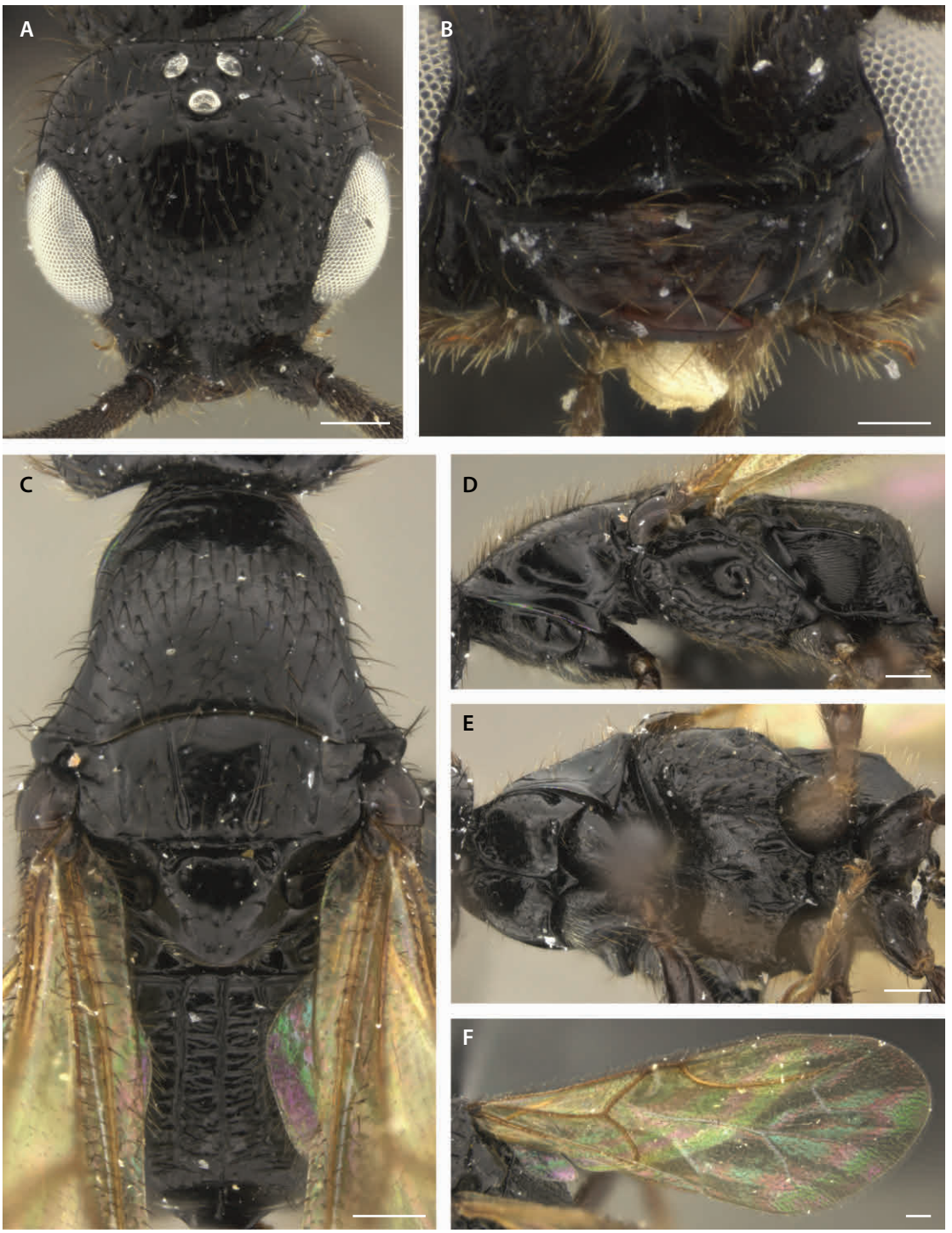


FIGURE 29

Chlorepyris fore Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

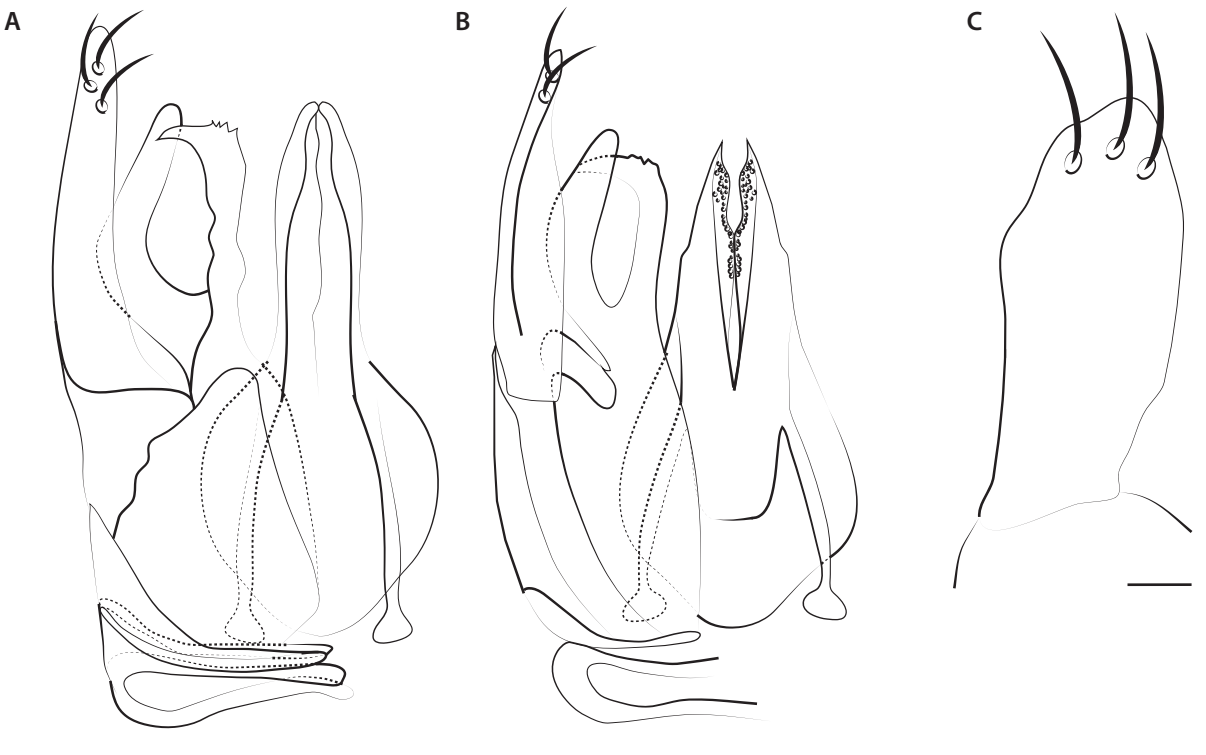


FIGURE 30

Chlorepyris fore Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

C. etoro n. sp. has the mandibles with five distal teeth, the frons is polished, the frontal line is absent, the anterior and lower mesopleural foveae are connected. The genetic distance between *C. fore* n. sp. and *C. etoro* n. sp. was of 14% (Figure 4).

ETYMOLOGY — The epithet fore refers to the *Fore* ethnic that lives in the Okapa District of the Eastern Highlands Province, Papua New Guinea.

DISTRIBUTION — Papua New Guinea (Madang).

Chlorepyris gadsup Colombo & Azevedo n. sp.

Figures 31-32

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 26-27/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1200D-02/16-d02, P1827-11296 (MNHN).

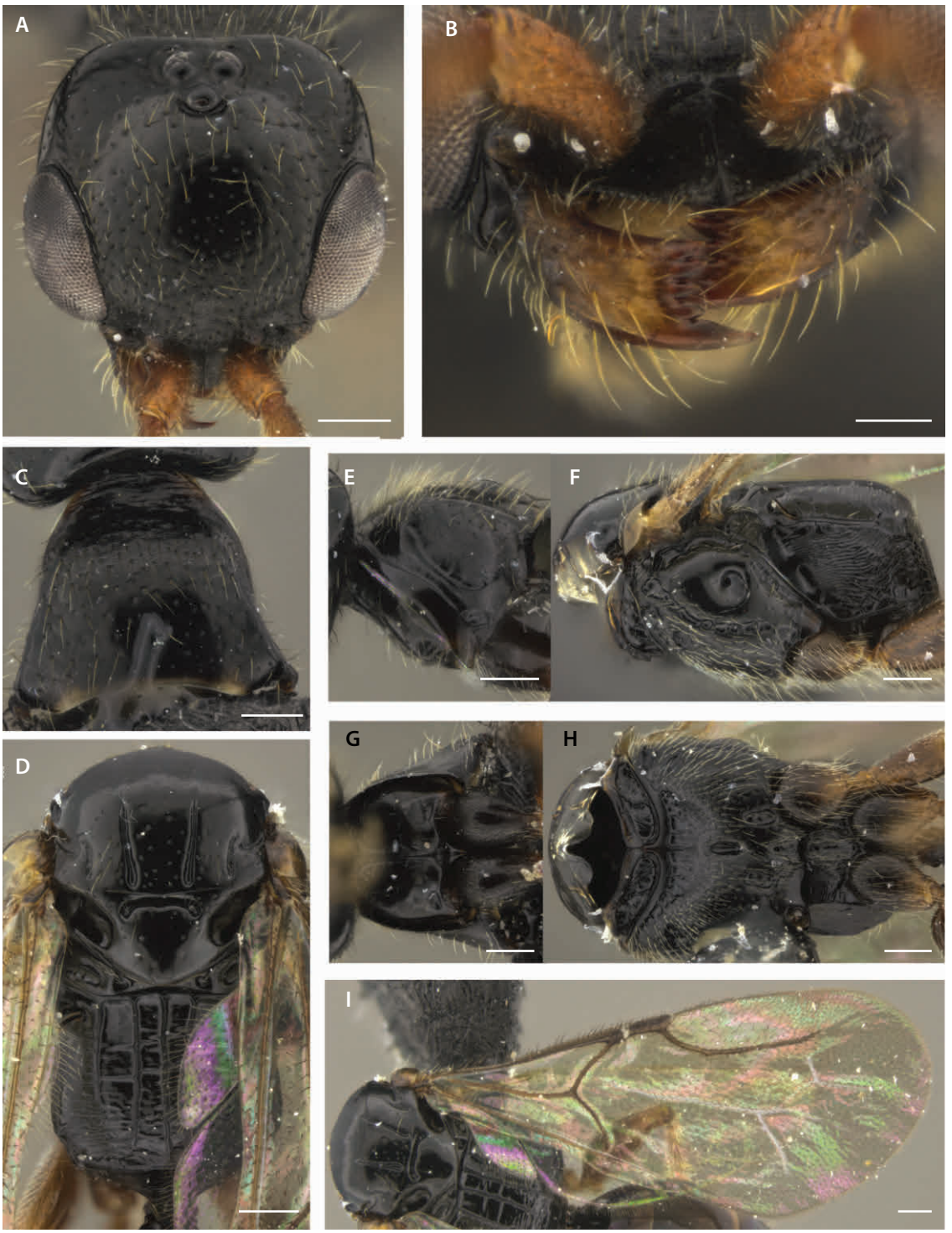


FIGURE 31

Chlorepyris gadsup Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, pronotum in dorsal view; **D**, mesosoma in dorsal view; **E**, pronotum in lateral view; **F**, mesosoma in lateral view; **G**, pronotum in ventral view; **H**, mesosoma in ventral view; **I**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna brown; wings hyaline; metasoma dark brown. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel longer than flagellomere I. Eye weakly setose. Frons coriaceous and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae connected; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture ill defined. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina outcurved; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina as long as metapostnotal median carina, divergent; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia with few spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere as long as basiparamere in lateral view, apex rounded, not arched inward, dorsal margin outcurved; basiparamere wide, not covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin smooth; aedeagus bottle-shaped, its apex aligned to apex of digitus, ventral margin with translucent projection, base of apodeme dilated.

Female. Unknown.

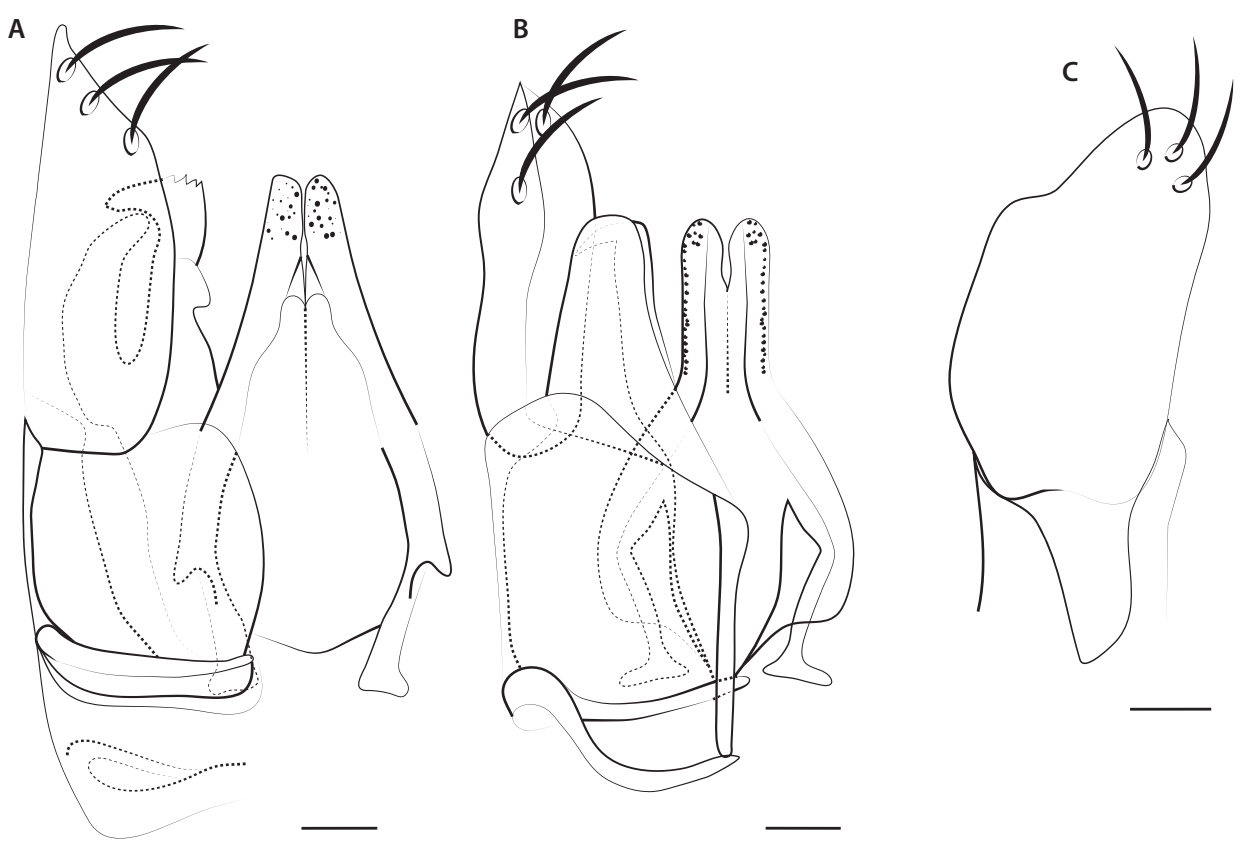


FIGURE 32

Chlorepyris gadsup Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

REMARKS — This species is morphologically similar to *Chlorepyris chambri* n. sp. by having the mandibles with five distal teeth, the median clypeal lobe rounded, the first metapostnotal carina divergent posteriorly to the metapostnotal median carina and the paramere as long as the basiparamere in lateral view. However, *C. gadsup* n. sp. has the pedicel longer than the flagellomere I and the mesoscutellar sulcus with the posterior margin straight medially; whereas *C. chambri* n. sp. has the pedicel as long as the flagellomere I and the mesoscutellar sulcus with the posterior margin notched medially. The genetic distance between *C. gadsup* n. sp. and *C. chambri* n. sp. was of 11% and between the *C. gadsup* n. sp. and *C. abelam* n. sp. was 8% (Figure 4). Thus, the lack of morphological and molecular evidences suggests that *C. chambri* and *C. gadsup* are two distinguished species.

ETYMOLOGY — The epithet *gadsup* refers to the Gadsup ethnic that lives in the Eastern Highlands of Papua New Guinea in or near the Aiyura Valley.

DISTRIBUTION — Papua New Guinea (Madang).

Chlorepyris gogodala Colombo & Azevedo n. sp.

Figures 33-34

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**, Province Madang, Mount Wilhelm (-5.732698, 145.2556), 700 m, 26-27/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0700B-02/16-d02, P1405-11987 (MNHN). Paratypes, **Papua New Guinea**. 2 ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 26-27/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-02/16-d02, P1437-11982 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 27-28/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-03/16-d03, P1438-11983 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 09-10/11/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-16/16-d16, P1451-11290 (MNHN); 1 ♂, Province Madang, Mount Wilhelm, (-5.720874,145.2695), 1200 m, 31-01/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1200D-07/16-d07, P1832-11316 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.732698, 145.2556), 700 m, 28-29/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0700B-04/16-d04, P1407-11997 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole dark brown; antenna brown; wings hyaline; metasoma light brown. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel as long as flagellomere I. Eye glabrous. Frons coriaceous and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea ill defined; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, touching mesoscutellar lateral margin. Mesoscutellum with posterior margin touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina sinuous; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere shorter than basiparamere in lateral view, apex rounded, weakly arched inward, dorsal margin straight; basiparamere wide, not covering aedeagal

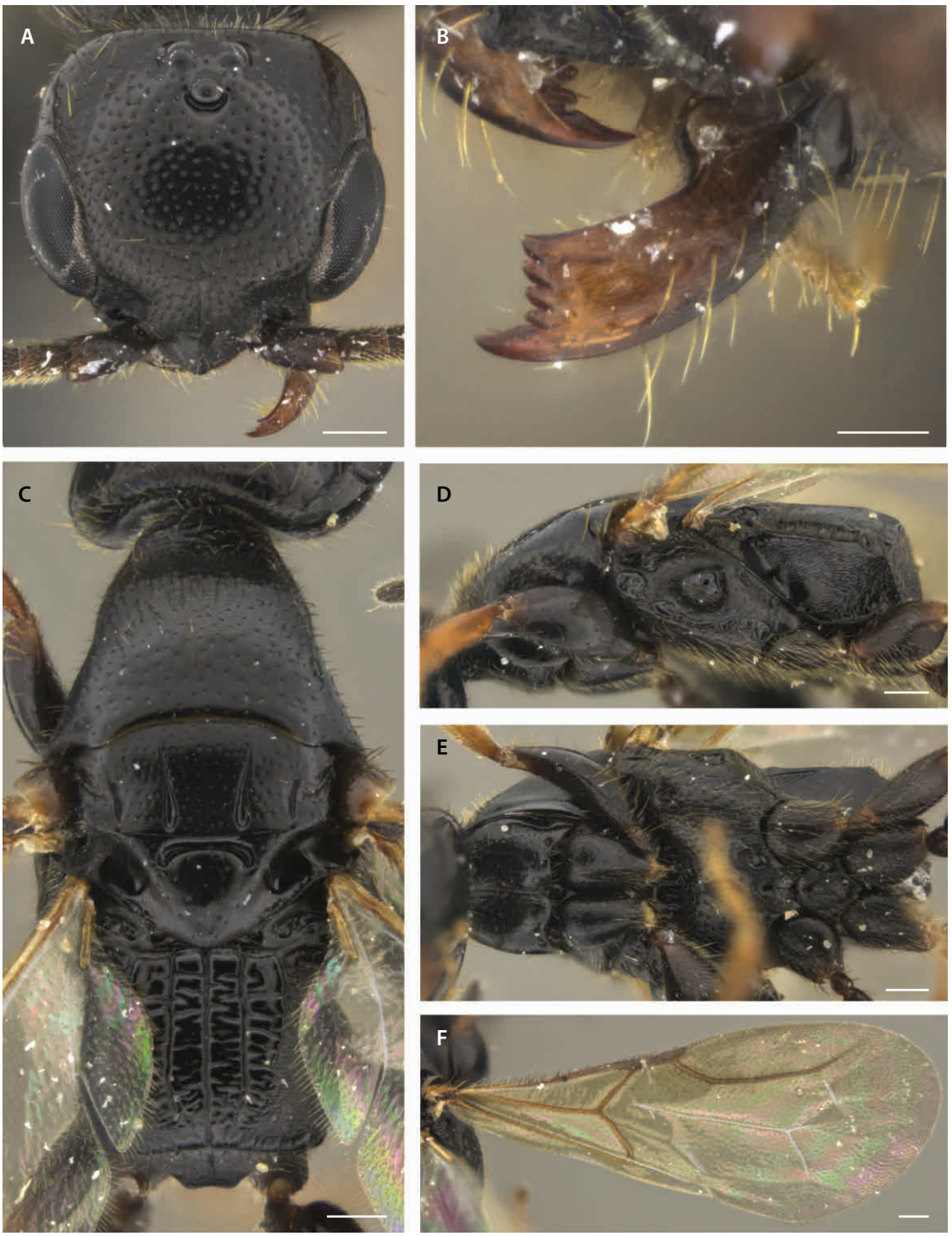


FIGURE 33

Chlorepyris gogodala Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, pronotum in dorsal view; **D**, mesosoma in dorsal view; **E**, pronotum in lateral view; **F**, mesosoma in lateral view; **G**, pronotum in ventral view; **H**, mesosoma in ventral view; **I**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin smooth; aedeagus bottle-shaped, its apex aligned to apex of digitus, ventral margin with translucent projection, base of apodeme dilated.

Female. Unknown.

VARIATIONS — Digitus with posterior margin crenulate.

REMARKS — This species is morphologically similar to *Chlorepyris angu* n. sp. by having the mandibles with five distal teeth, the median clypeal lobe is rounded, the eyes are glabrous and the mesoscutellar sulcus has the posterior margin straight medially. However, *C. gogodala* n. sp. has the pedicel as long as the flagellomere I, the lower mesopleural fovea is ill defined, the mesopleural subalar impression is disconnected with the mesopleural suture; whereas *C. angu* n. sp. has the pedicel shorter than the flagellomere I, the lower mesopleural fovea is trabeculate, and the mesopleural subalar impression is connected with the mesopleural suture. Although these species resemble morphologically, they are genetically distant with 25% of nucleotide sequence divergence (Figure 4).

ETYMOLOGY — The epithet *gogodala* refers to the Gogodala ethnic who lives in the Middle Fly District of the Western Province of Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

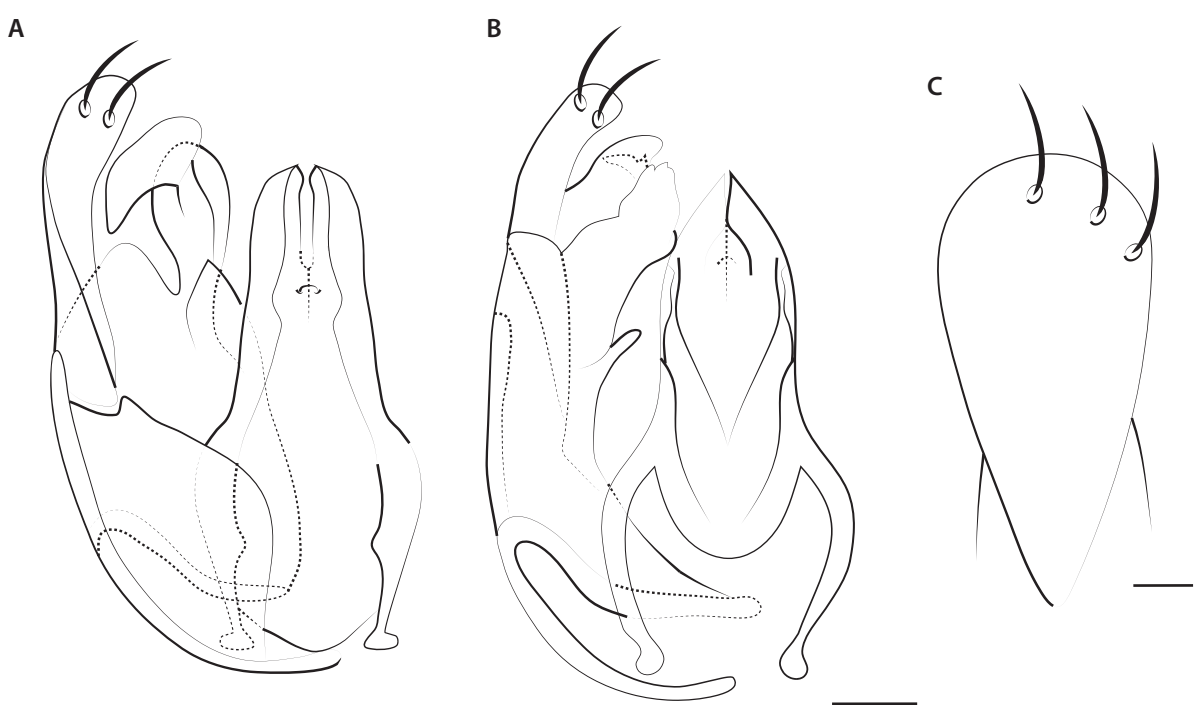


FIGURE 34

Chlorepyris gogodala Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

Chlorepyris haroli Colombo & Azevedo n. sp.

Figures 35-36

TYPE MATERIAL — Holotype, ♂, **Papua-New-Guinea**. Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 29-30/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1200A-05/16-d05, P1782-11308 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole dark brown; antenna brown; wings hyaline; metasoma light brown. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel as long as flagellomere I. Eye glabrous. Frons coriaceous and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea not trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture not trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere as long as basiparamere in lateral view, apex rounded, weakly arched inward, dorsal margin straight; basiparamere wide, not covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin serrated; aedeagus bottle-shaped, its apex posterior to apex of digitus, ventral margin without translucent projection, base of apodeme dilated.

Female. Unknown.

REMARKS — This species is morphologically similar to *Chlorepyris abelam* n. sp. by having the mandibles with five distal teeth, the mesoscutellum with posterior margin not touching the metapostnotal anterior margin, the first metapostnotal carina converging posteriorly to the metapostnotal median carina, the apex of cuspis anterior to the apex of paramere and the digitus with the posterior margin serrated. *C. haroli* n. sp., however, has the pedicel as long as flagellomere I, the frons is coriaceous, the mesopleural subalar impression is disconnected with the mesopleural suture and the mesoscutellar sulcus has the posterior margin straight medially; whereas *C. abelam* n. sp. has the pedicel shorter than the flagellomere I, the frons is polished, the mesopleural subalar impression is connected with the mesopleural suture and the mesoscutellar sulcus has the posterior margin notched medially. The genetic distance between *C. abelam* n. sp. and *C. haroli* n. sp. was of 19% (Figure 4).

ETYMOLOGY — The epithet *haroli* refers to the Haroli indigenous people who live in the Hela Province of Papua New Guinea.

DISTRIBUTION — Papua New Guinea (Madang).

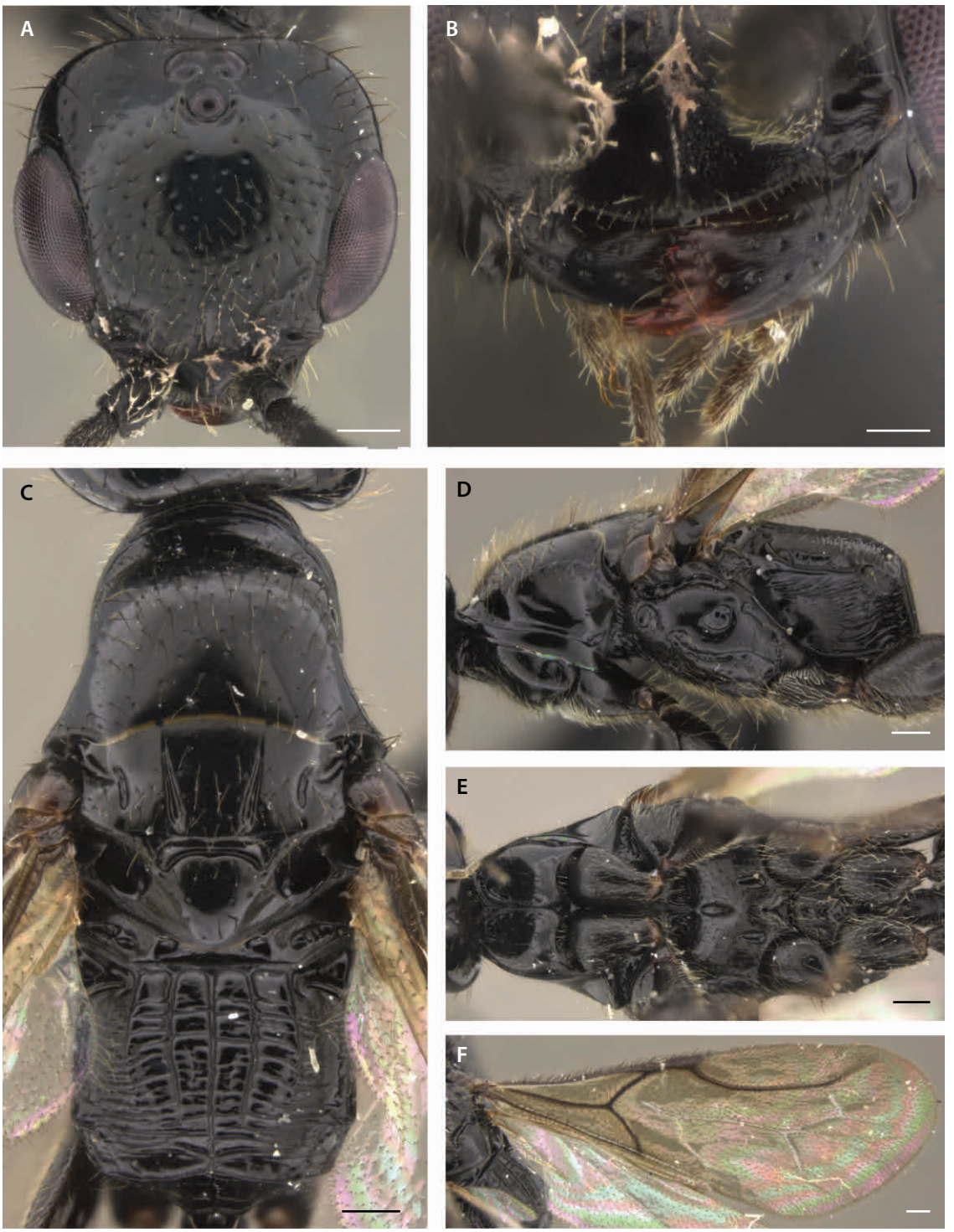


FIGURE 35

Chlorepyris haroli Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

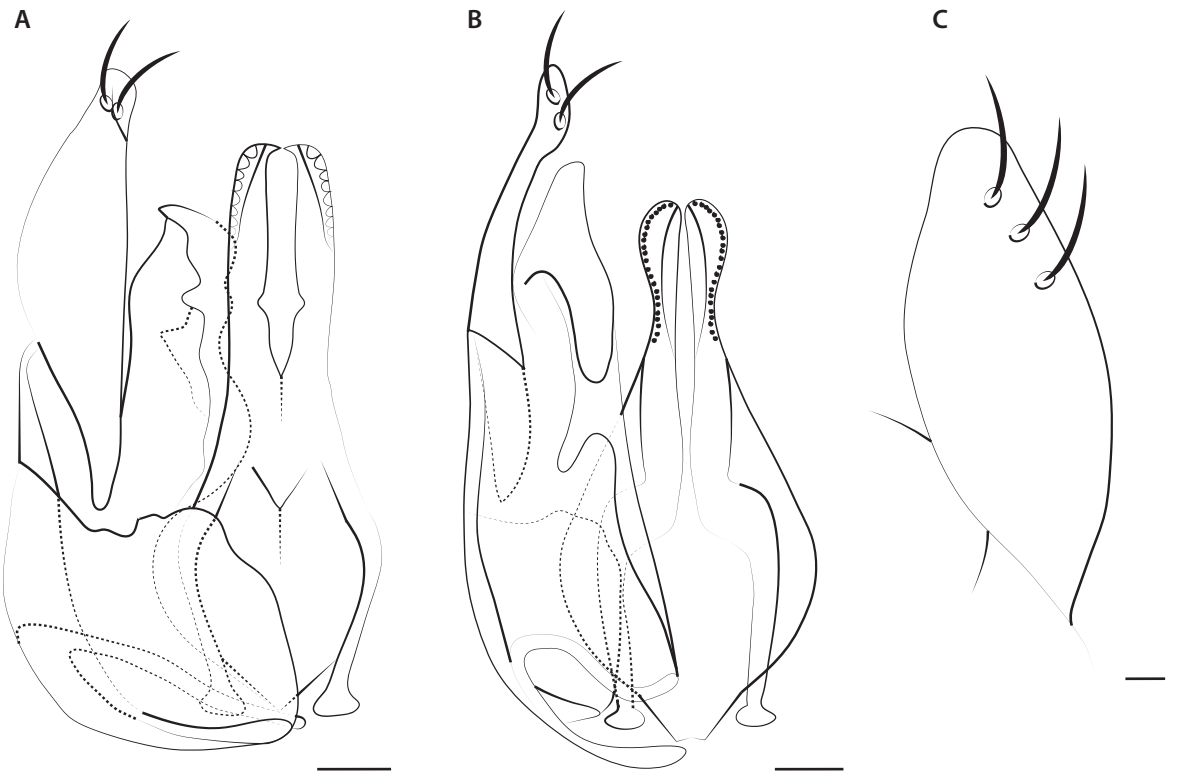


FIGURE 36

Chlorepyris haroli Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bars: 100 µm, except 50 µm in C.

Chlorepyris hewa Colombo & Azevedo n. sp.

Figures 37-38

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.739897, 145.3297), 200 m, 25-26/10/2012, leg Dilu, Ray, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0200D-01/16-d01, P1045-11941 (MNHN). Paratypes, **Papua New Guinea**. 1 ♂, Province Madang, Mount Wilhelm (-5.741031, 145.3294), 200 m, 25-26/10/2012, leg Dilu, Ray, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0200B-01/16-d01, P1014-11947 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 30-31/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1700A-06/16-d06, P2173-8766 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.732698, 145.2556), 700 m, 09-10/11/2012, leg Keltim, Uma, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0700B-16/16-d16, P1810-11292 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna light brown; wings hyaline; metasoma dark brown to light brown; metasoma light brown. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel as long as flagellomere I. Eye weakly setose. Frons coriaceous and punctate. Frontal



FIGURE 37

Chlorepyris hewa Colombo & Azevedo n. sp., male. **A**, body in lateral view; **B**, head in dorsal view; **C**, mandible in frontal view; **D**, mesosoma in dorsal view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in C and F, 400 µm in A and E.

line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae connected; lower mesopleural fovea ill defined; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, touching mesoscutellar lateral margin. Mesoscutellum with posterior margin touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, straight; metapostnotal-propodeal suture as long as first metapostnotal carina, converging posteriorly. Metatibia with many spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere shorter than basiparamere in lateral view, apex rounded, not arched inward, dorsal margin incurved; basiparamere wide, not covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex aligned to apex of cuspis, its posterior margin crenulate; aedeagus bottle-shaped, its apex posterior to apex of digitus, ventral margin with translucent projection, base of apodeme dilated.

Female. Unknown.

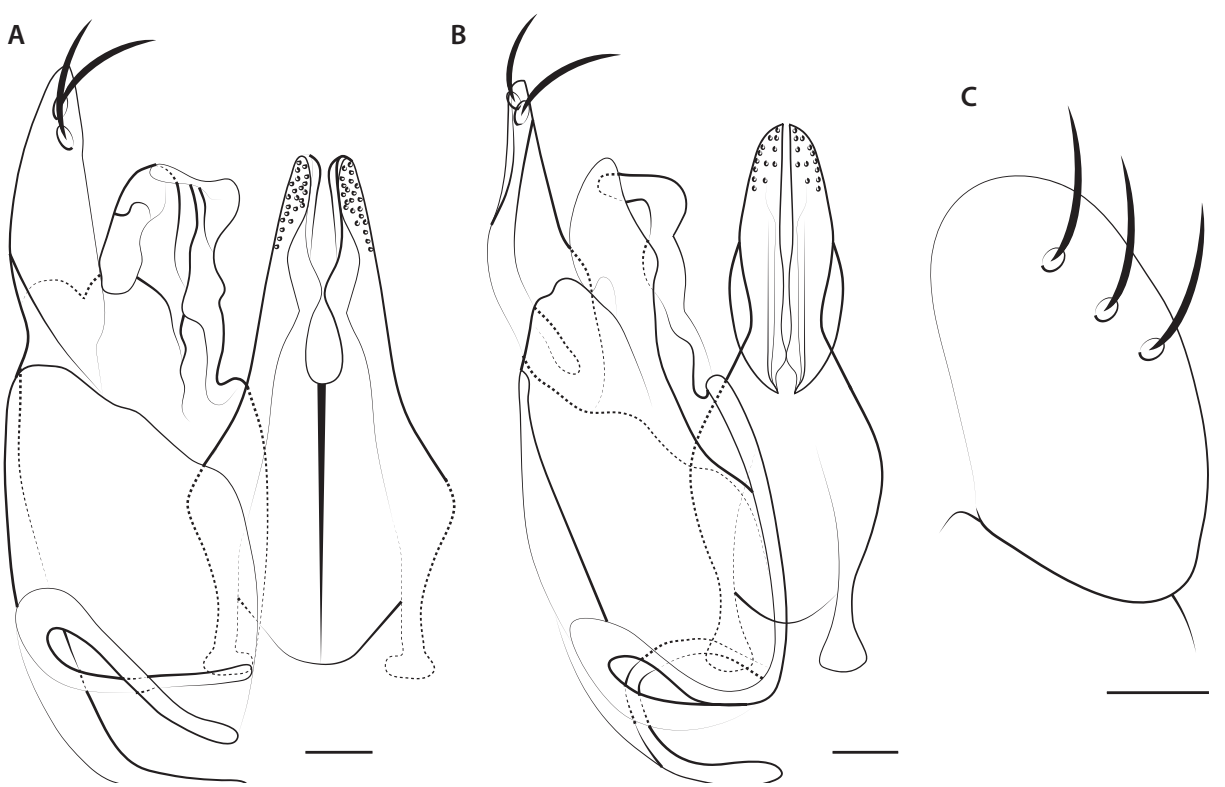


FIGURE 38

Chlorepyris hewa Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

REMARKS — This species is morphologically and genetically closely related to *Chlorepyris baruya* n. sp. by having the median clypeal lobe rounded, the flagellar pubescence appressed, the notauli complete, the mesoscutellar sulcus with the posterior margin straight medially, the paramere shorter than the basiparamere in lateral view, and the apex of aedeagus posterior to the apex of digitus. However, *C. hewa* n. sp. has the pedicel as long as flagellomere I, the frons is coriaceous, the frontal line is absent and the lower mesopleural fovea is ill defined; whereas *C. baruya* n. sp. has the pedicel shorter than the flagellomere I, the frons is polished, the frontal line is present and the lower mesopleural fovea diverge by 3%. This value was the lowest genetic distance found among the studied species of *Chlorepyris*.

ETYMOLOGY — The epithet *hewa* refers to the Hewa indigenous people who live in the Koroba Lake Kopiago Electorate of Hela Province of Papua New Guinea, near the junction of the Strickland River.

DISTRIBUTION — Papua New Guinea (Madang).

Chlorepyris huli Colombo & Azevedo n. sp.

Figures 39-40

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 04-05/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1200D-11/16-d11, P2225-11337 (MNHN). Paratypes, **Papua New Guinea**. 2 ♂, Province Madang, Mount Wilhelm (-5.759910, 145.2347), 1700 m, 26-27/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW1700B-02/16-d02, P2185-11356 (MNHN); ♂, Province Madang, Mount Wilhelm (-5.732514, 145.2568), 700 m, 28-29/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW0700C-04/16-d04, P1423-11996 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna dark brown; wings hyaline; metasoma dark brown to light brown. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence erect; pedicel shorter than flagellomere I. Eye glabrous. Frons polished and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae connected; lower mesopleural fovea trabeculate; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum as long as notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina sinuous; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, straight; metapostnotal-propodeal suture as long as first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin straight. Genitalia: paramere longer than basiparamere in lateral view, apex sharpened, weakly arched inward, dorsal margin incurved; basiparamere wide, not covering aedeagal base; apex of cuspis anterior to apex of paramere; digitus with apex anterior to apex of cuspis, its posterior margin serrated; aedeagus bottle-shaped, its apex anterior to apex of digitus, ventral margin with translucent projection, base of apodeme dilated.

Female. Unknown.

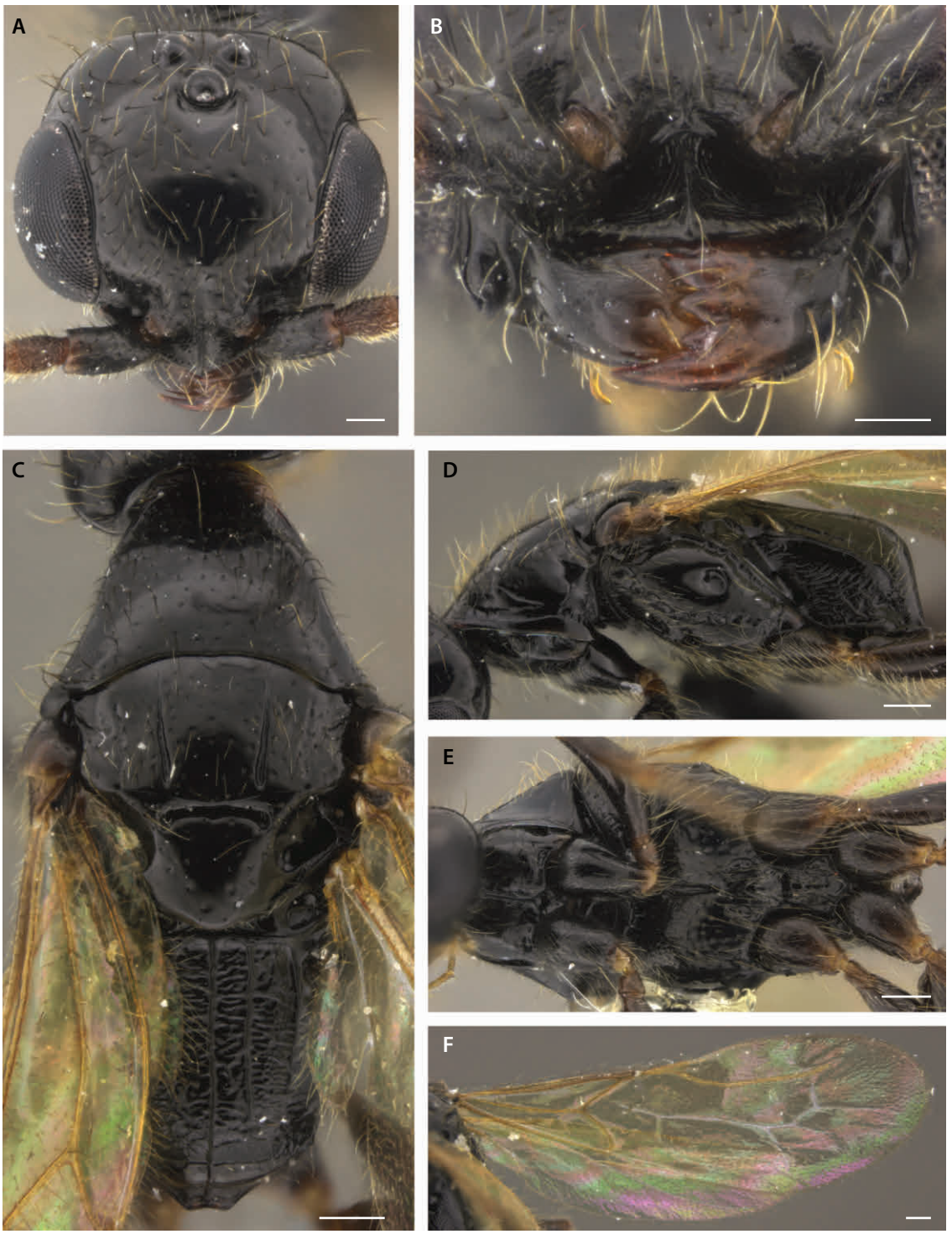


FIGURE 39

Chlorepyris huli Colombo & Azevedo n. sp., male **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; F, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in A.

REMARKS — This species is morphologically similar to *Chlorepyris chambri* n. sp. by having the mandibles with five distal teeth, the median clypeal lobe rounded, the frontal line present, the mesoscutellar sulcus with the posterior margin straight medially and the apex of cuspis anterior to the apex of paramere. However, *C. huli* n. sp. has the paramere longer than the basiparamere in lateral view, the paramere has the apex sharpened, weakly arched inward, and the apex of the aedeagus is anterior to the apex of digitus; whereas *C. chambri* n. sp. has the paramere shorter than the basiparamere in lateral view, the paramere has the apex rounded, arched inward and the apex of aedeagus is posterior to the apex of digitus; whereas. The genetic distance between *C. huli* n. sp. and *C. chambri* n. sp. was of 5% (Figure 4).

ETYMOLOGY — The epithet *huli* refers to the Huli indigenous ethnic who live in the Hela Province of Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

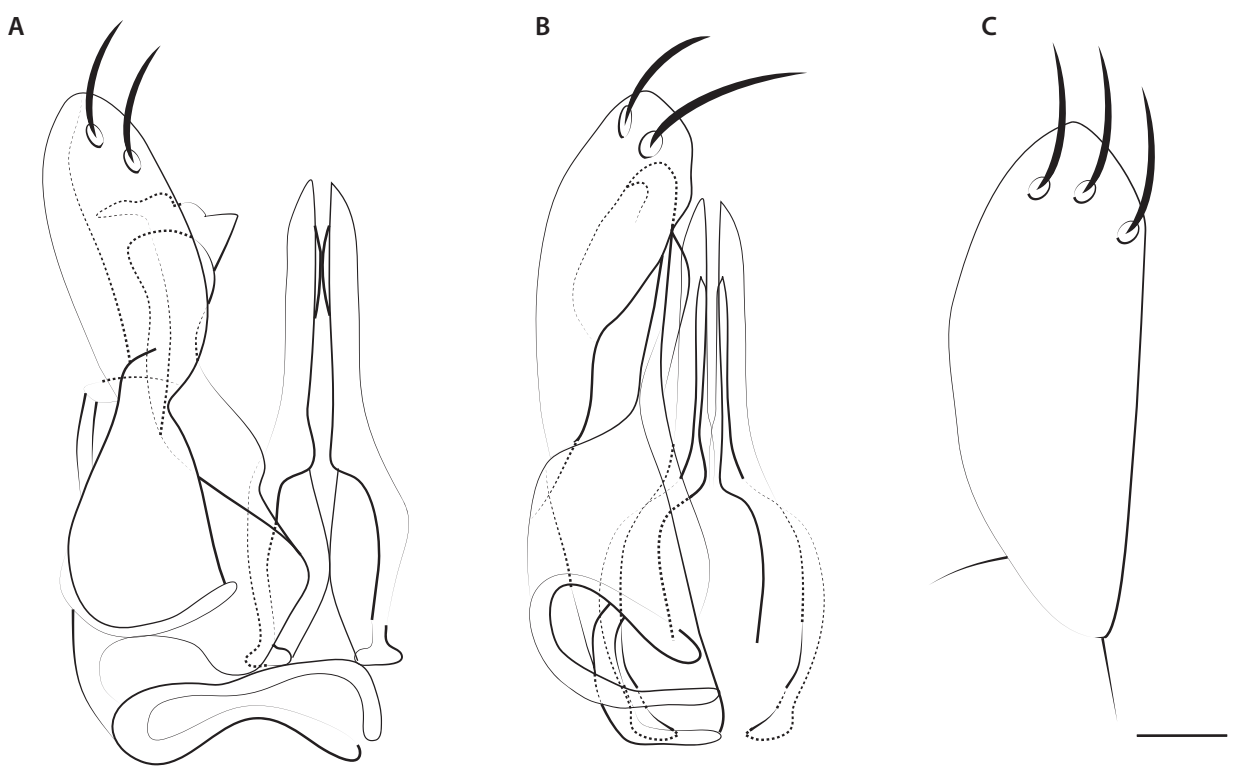


FIGURE 40

Chlorepyris huli Colombo & Azevedo n. sp., male **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

Chlorepyris iatmul Colombo & Azevedo n. sp.

Figure 41

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797), 175 m, 03-04/12/2012, leg Basset, Plot 1, understorey; Malaise - MAL-WAN01-D16, P4915-11066 (MNHN).

DESCRIPTION — *Female*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma dark brown; wings hyaline. Mandible with three distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel as long as flagellomere I. Eye weakly setose. Frons weakly coriaceous and punctate. Frontal line present. Pronotum punctate and coriaceous. Posterior mesofurcal pit oval. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea not trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina outcurved; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, straight. Metatibia with few spines. Petiolar root with apex strongly incurved. Metasoma polished.

Male. Unknown.

REMARKS — This species is morphologically similar to *Chlorepyris kaluli* n. sp. by having the median clypeal lobe rounded, the eyes weakly setose and the mesoscutellar sulcus with the posterior margin straight medially. *Chlorepyris iatmul* n. sp., however, has the mandibles with three distal teeth, the pedicel is as long as flagellomere I, the posterior mesofurcal pit is oval and the lower mesopleural fovea is not trabeculate; whereas *C. kaluli* n. sp. has the mandibles with two distal teeth, the pedicel is shorter than the flagellomere I, the posterior mesofurcal pit is circular and the lower mesopleural fovea is trabeculate. The genetic distance between *Chlorepyris iatmul* n. sp. and *Chlorepyris kaluli* n. sp. was of 12% (Figure 4).

ETYMOLOGY — The epithet *iatmul* refers to the Iatmul large ethnic group who inhabits around two-dozen politically autonomous villages along the middle Sepik River in Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

Chlorepyris kaluli Colombo & Azevedo n. sp.

Figure 42

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797), 175 m, 03-04/12/2012, leg Basset, Plot 1, understorey; Malaise - MAL-WAN01-D16, P4915-11066 (MNHN).

DESCRIPTION — *Female*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna light brown; wings hyaline; metasoma dark brown. Mandible with two distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence erect; pedicel shorter than flagellomere I. Eye weakly setose. Frons weakly coriaceous and punctate. Frontal line present. Pronotum punctate and coriaceous. Posterior mesofurcal pit circular. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron

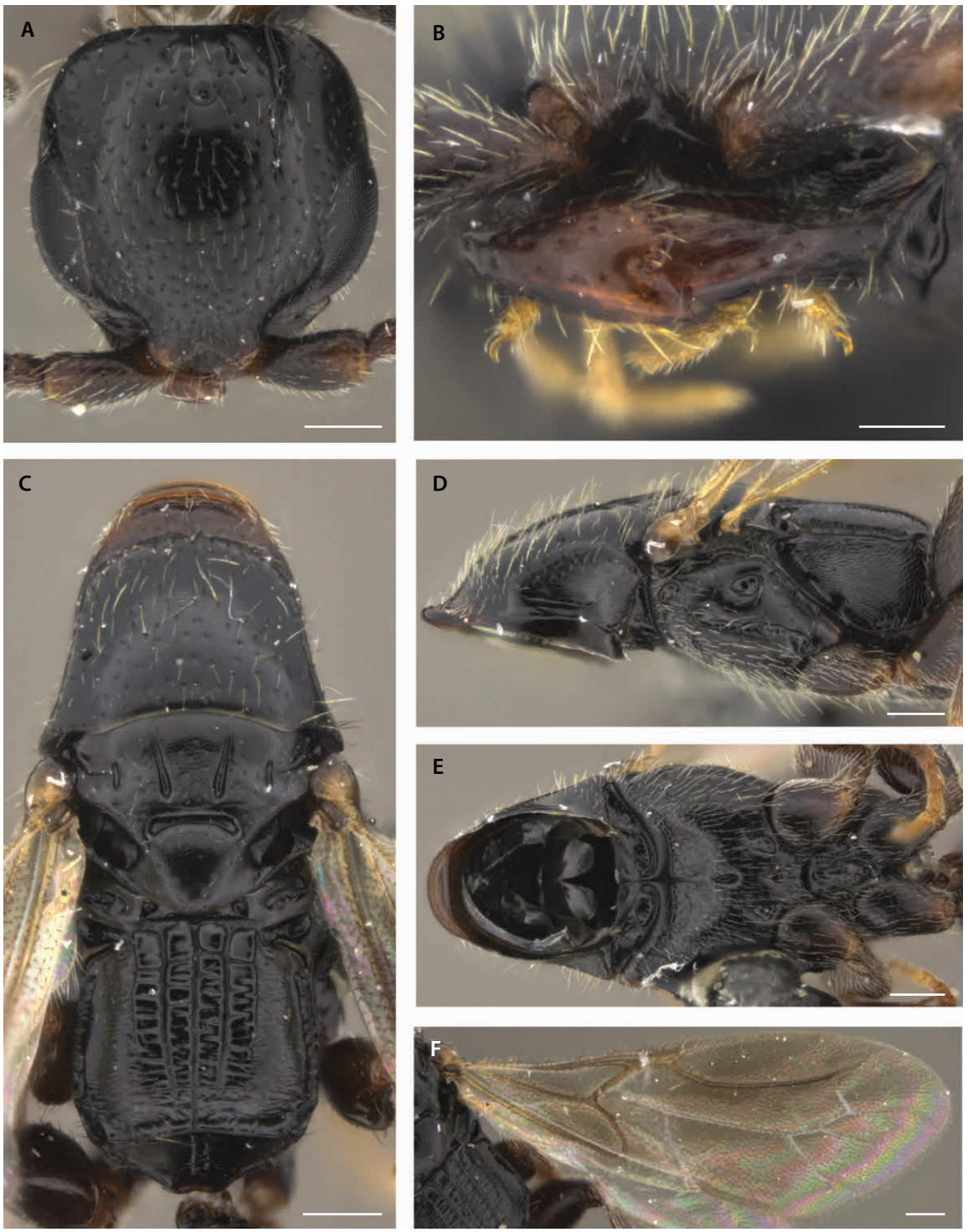


FIGURE 41

Chlorepyris iatmul Colombo & Azevedo n. sp., female. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

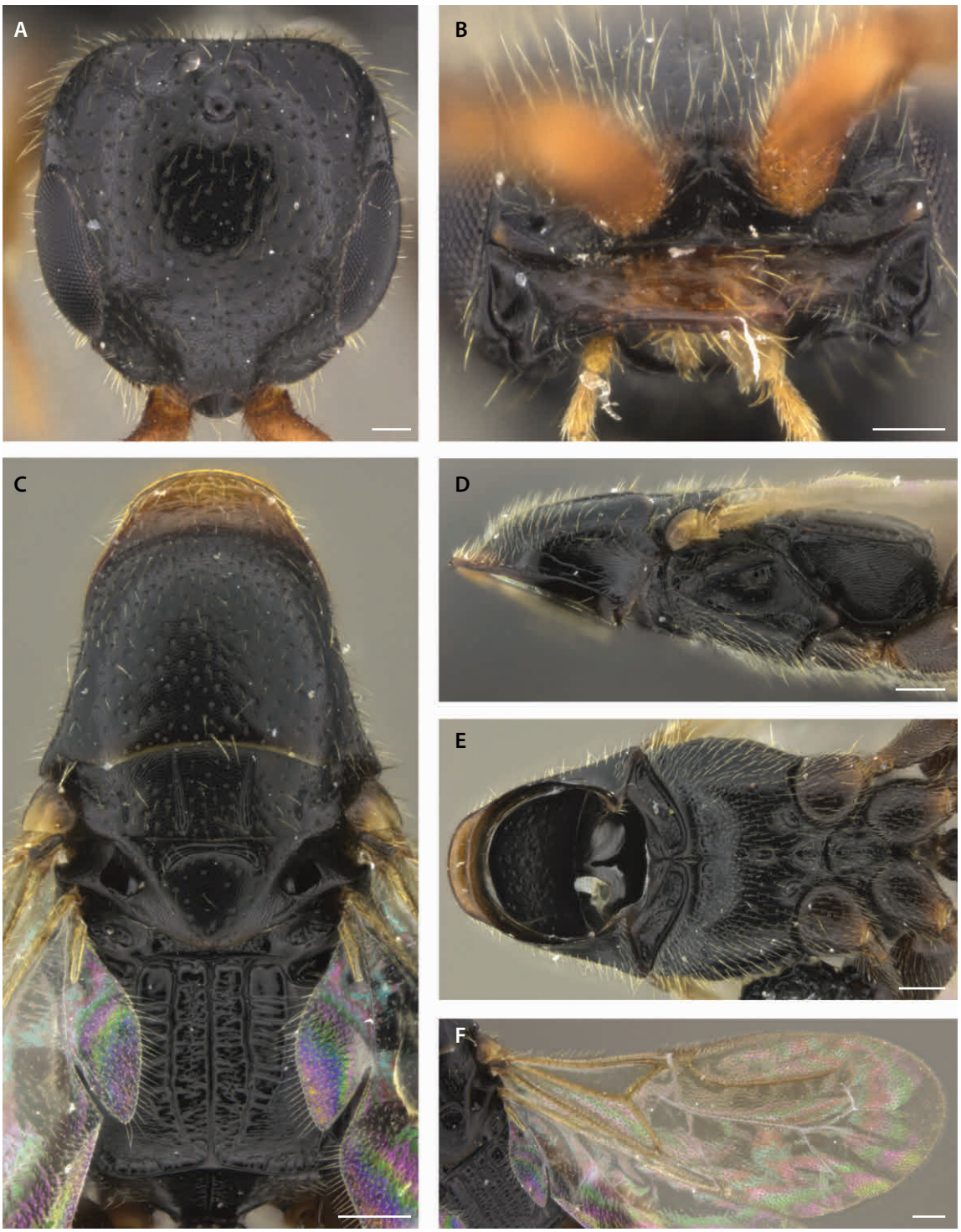


FIGURE 42

Chlorepyris kaluli Colombo & Azevedo n. sp., female. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in A and B.

with anterior and lower mesopleural foveae not connected; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina as long as metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished.

Male. Unknown.

REMARKS — This species is similar to *Chlorepyris iatmul* n. sp. by having the median clypeal lobe rounded, the eyes weakly setose and the mesoscutellar sulcus with the posterior margin straight medially. *Chlorepyris kaluli* n. sp., however, has the mandibles with two distal teeth, the pedicel is shorter than the flagellomere I, the posterior mesofurcal pit is circular and the lower mesopleural fovea is trabeculate; whereas *C. iatmul* n. sp. has the mandibles with three distal teeth, the pedicel is as long as the flagellomere I, the posterior mesofurcal pit is oval and the lower mesopleural fovea is not trabeculate. The genetic distance between *C. kaluli* n. sp. and *C. iatmul* n. sp. was of 12% (Figure 4).

ETYMOLOGY — The epithet *kaluli* refers to Kaluli, a large clan of non-literate indigenous people who live in the rain forests of Great Papuan Plateau in Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

Chlorepyris koteka Colombo & Azevedo n. sp.

Figure 43

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797), 175 m, 26-27/11/2012, leg Gewa, Damag, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-WAN-D-11/16-d11, P542-867 (MNHN).

DESCRIPTION — *Female*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna dark brown; wings hyaline; metasoma light brown. Mandible with two distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel longer than flagellomere I. Eye weakly setose. Frons coriaceous and punctate. Frontal line present. Pronotum punctate and coriaceous. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea not trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, not touching mesoscutellar lateral margin, very thin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, straight. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished.

Male. Unknown.

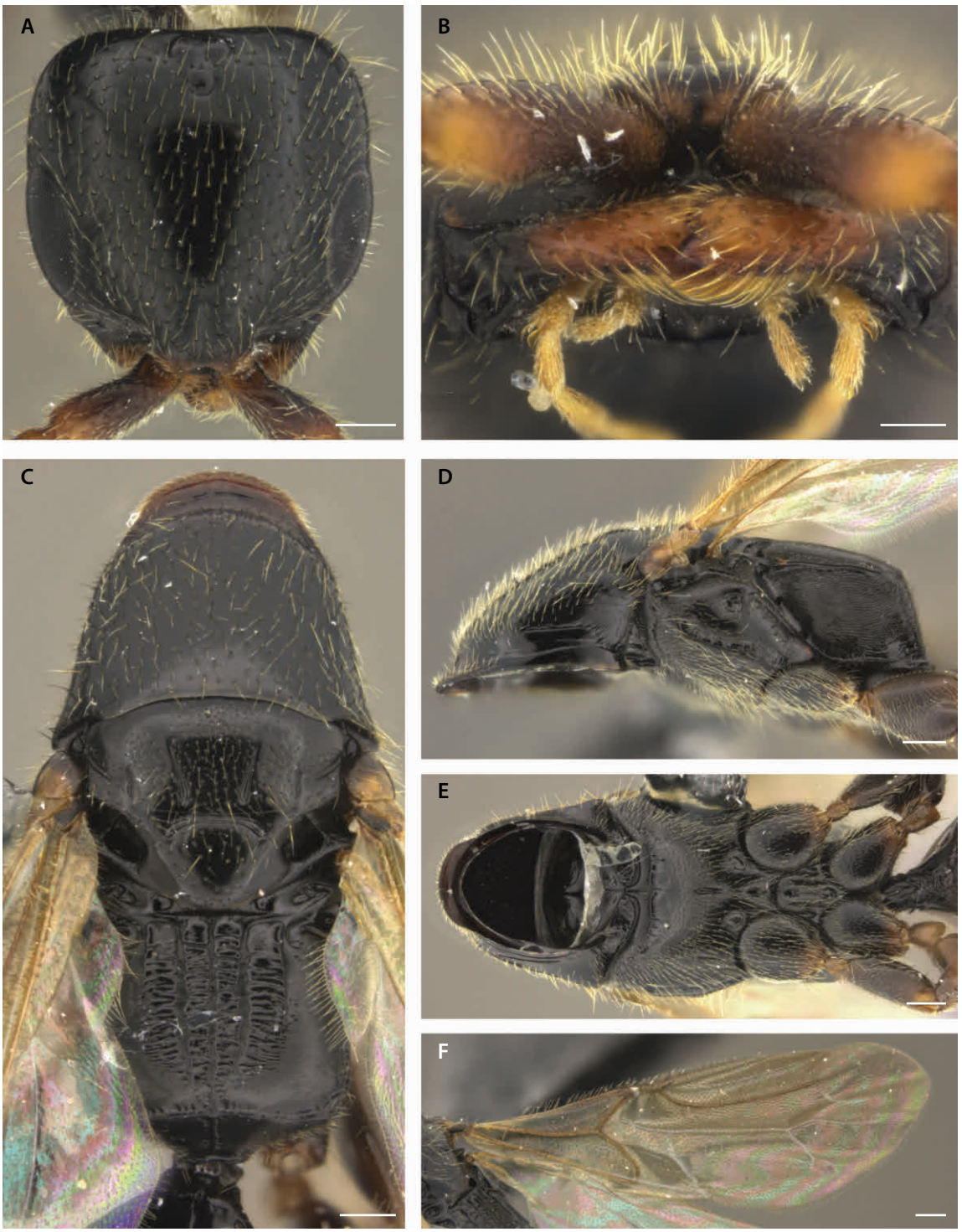


FIGURE 43

Chlorepyris koteka Colombo & Azevedo n. sp., female. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

REMARKS — Females of this species are morphologically similar to females of *Chlorepyris bilibil* n. sp. by having the mandibles with two distal teeth, the mesoscutellar sulcus with the posterior margin straight medially and the metapostnotal-propodeal suture shorter than the first metapostnotal carina. *Chlorepyris koteka* n. sp., however, has the pedicel longer than the flagellomere I, the frons is coriaceous, the pronotum is coriaceous and the anterior and lower mesopleural foveae are not connected; whereas *C. bilibil* n. sp. has the pedicel as long as the flagellomere I, the frons is polished, the pronotum is shiny, and the anterior and the lower mesopleural foveae are connected. The genetic divergence between *C. koteka* n. sp. and *C. bilibil* n. sp. was of 12%, lacking morphological and molecular evidences to associate them. Finally, our results showed a male of *C. hewa* n. sp. as the molecularly closest species to *C. koteka* n. sp. (11% divergence). This high nucleotide divergence, compared to the observed in this study (Figure 4), prevents us from sex associating them.

ETYMOLOGY — The epithet *koteka* refers to the Koteka ethnic who lives in West Papua.

DISTRIBUTION — Papua New Guinea.

Chlorepyris kwoma Colombo & Azevedo n. sp.

Figure 44

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm, (-5.741031, 145.3294), 200 m, 09-10/11/2012, leg Dilu, Ray, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0200B-16/16-d16, P1029-11974 (MNHN).

DESCRIPTION — *Female*. Pronotum, mesoscutum, metapectal-propodeal complex and petiole black; metasoma light brown; wings hyaline. Head lost. Pronotum punctate and coriaceous. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina sinuous; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished.

Male. Unknown.

REMARKS — This species is morphologically similar to *Chlorepyris kaluli* n. sp. by having the pronotum punctate and coriaceous, the anterior and lower mesopleural foveae not connected; the lower mesopleural fovea trabeculate, the notauli complete and the mesoscutellar sulcus with the posterior margin straight medially. *Chlorepyris kwoma* n. sp., however, has the posterior mesofurcal pit elongated and the first metapostnotal carina shorter than the metapostnotal median carina; whereas *C. kaluli* n. sp. has the posterior mesofurcal pit circular and the metapostnotal carina as long as the metapostnotal median carina. The nucleotide sequences of *C. kwoma* n. sp. and *C. kaluli* n. sp. diverged 18%. The lowest genetic distance observed between the female of *C. kwoma* n. sp. and the male of *C. huli* n. sp. or the male of *C. chambri* n. sp. was 7% (Figure 4).

ETYMOLOGY — The epithet *kwoma* refers to the Kwoma ethnic who lives in the northeastern New Guinea, in the Peilungupo mountains north of the Sepik River.

DISTRIBUTION — Papua New Guinea.

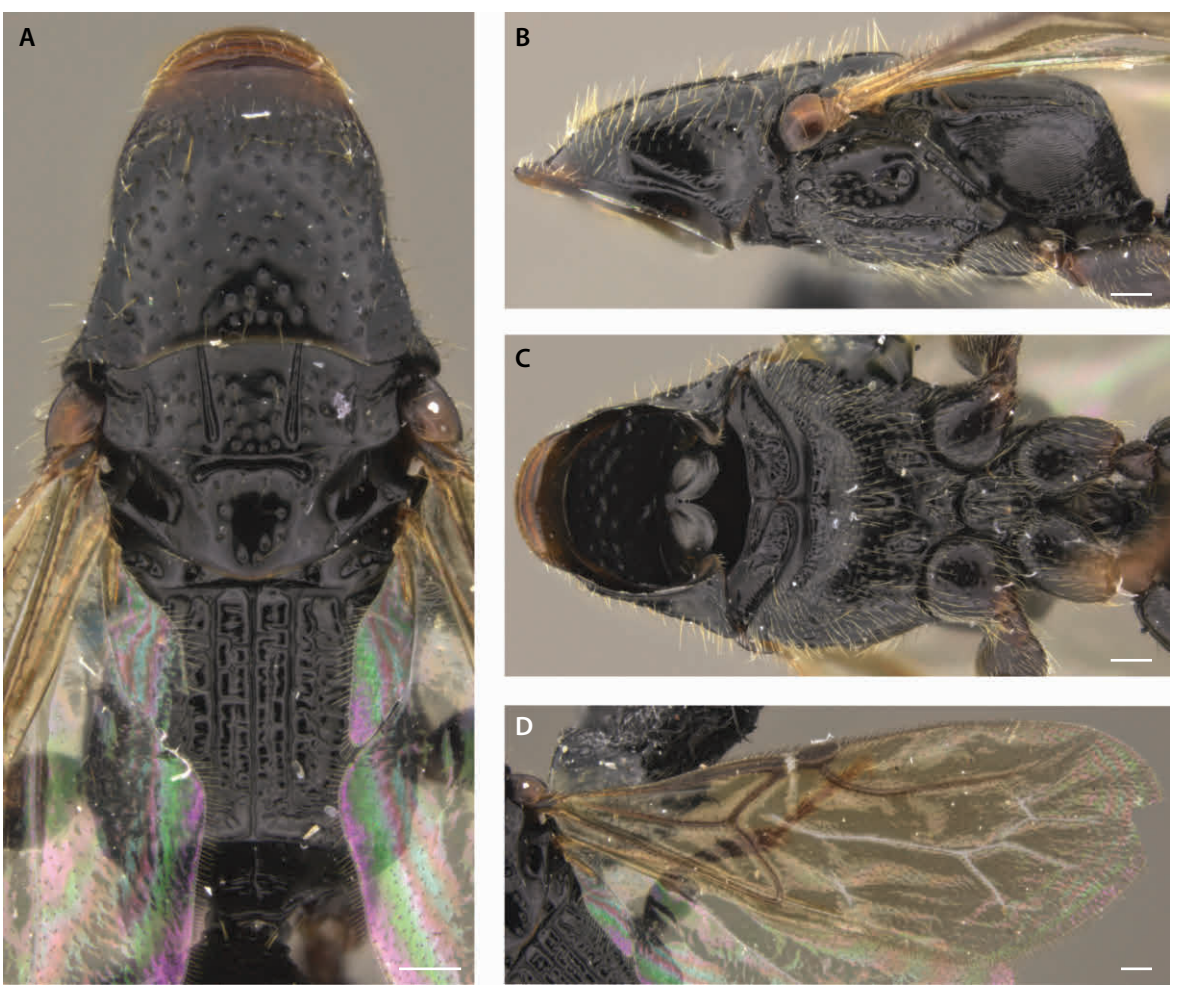


FIGURE 44

Chlorepyris kwoma Colombo & Azevedo n. sp., female. **A**, mesosoma in dorsal view; **B**, mesosoma in lateral view; **C**, mesosoma in ventral view; **D**, forewing in dorsal view. Scale bar: 200 µm.

Chlorepyris maisin Colombo & Azevedo n. sp.

Figure 45

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797), 175 m, 24-25/11/2012, leg Basset, Plot 1, understorey; Malaise - MAL-WAN01-D07, P4906-935 (MNHN). Paratypes, **Papua New Guinea**. 1 ♀, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 29-30/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-05/16-d05, P1440-11993 (MNHN); 1 ♀, Province Madang, Mount Wilhelm (-5.732514, 145.2568), 700 m, 27-28/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW0700C-03/16-d03, P1421-11988 (MNHN); 1 ♀, Province Madang, Mount Wilhelm (-5.741031, 145.3294), 200 m, 01-02/11/2012, leg Dilu, Ray, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0200B-08/16-d08, P1021-11967 (MNHN).

DESCRIPTION — *Female*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma light brown; wings hyaline. Mandible with five distal teeth. Clypeus with rounded median lobe, high in lateral view, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel longer than flagellomere I. Eye weakly setose. Frons polished and punctate. Frontal line present. Pronotum punctate and shiny. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar sulcus with posterior margin straight medially, weakly inclined, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina sinuous; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture shorter than first metapostnotal carina, converging posteriorly. Metatibia with few spines. Petiolar root with apex strongly incurved. Metasoma polished.

Male. Unknown.

REMARKS — This species is morphologically similar to *Chlorepyris kaluli* n. sp. by having the clypeus with the median lobe rounded, the eyes weakly setose, the frontal line present, the anterior and lower mesopleural foveae not connected, the mesopleural suture trabeculate, the notauli complete and the mesoscutellar sulcus with the posterior margin straight medially. *Chlorepyris maisin* n. sp., however, has the mandibles with five distal teeth, the pedicel is longer than flagellomere I, the frons is polished and the posterior mesofurcal pit is elongated; whereas *C. kaluli* n. sp. has the mandibles with two distal teeth, the pedicel is shorter than flagellomere I, the frons is weakly coriaceous and the posterior mesofurcal pit is circular. The genetic divergence between *C. maisin* n. sp. and *C. kaluli* n. sp. was of 14%., lacking morphological and molecular evidences to associate them. Finally, our results showed a male of *C. hewa* n. sp. as the molecularly closest species to *C. maisin* n. sp. (12% divergence). This high nucleotide divergence, compared to the observed in this study (Figure 4), prevents us from sex associating them.

ETYMOLOGY — The epithet *maisin* refers to the Maisin indigenous people who live in Oro Province in Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

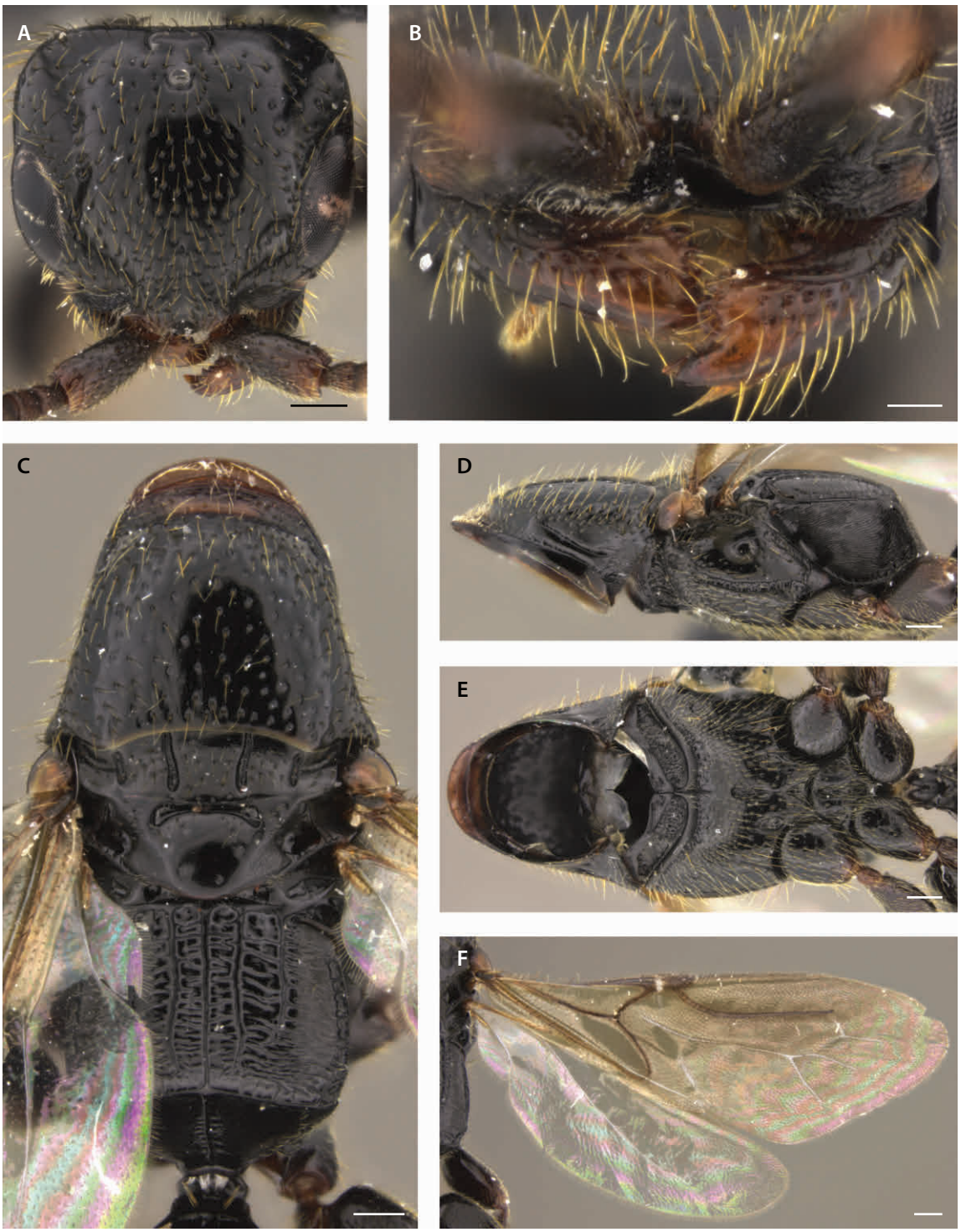


FIGURE 45

Chlorepyris maisin Colombo & Azevedo n. sp., female. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; F, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

Genus ***EPYRIS*** Westwood, 1832

Epyris Westwood 1832.

Type species. *Epyris niger* Westwood, 1832.

Epyris erraticus Smith, 1860

Epyris erraticus Smith, 1860: 136.

TYPE MATERIAL — Holotype, ♀, [probably **Papua New Guinea**]. Dory, [lost], [not examined].

DIAGNOSE — *Female*. Head black; wings fuscous; tibiae and tarsi obscure ferruginous; ovipositor rufo-testaceous. Head oblong, transverse behind, lateral angles rounded, scattered strong punctures. Eye large, oval, placed forwards. Antenna fulvous beneath, 13-jointed. Pronotum and mesonotum shining, strong punctate. Metapectal-propodeal complex quadrate, truncate, with three carinae not extending posteriorly, between carinae roughly striated transversely, beyond which striation is much finer. Metasoma polished and shining.

Male. Unknown.

REMARKS — We were not able to find the holotype of *E. erraticus*. According to Gordh & Móczar (1990), it is supposed to be deposited at the entomological collection of The Natural History Museum in London. However, the curator confirmed that this type is not there. We prepared a diagnose based on the original description of Smith (1860) to update nomenclatural terms currently used in taxonomic works of Epyrinae, such as the mesoscutellar fovea connected or not connected by evident sulcus, and mesopleuron. Based on the original description, this species can be distinguished from the other species of Epyrinae studied here, because the three carinae of the metapectal-propodeal complex (probably median carina and metapostnotal-propodeal carina) are not visible posteriorly while in all the other species of Epyrinae, the median carina is visible posteriorly.

DISTRIBUTION — Papua New Guinea.

Epyris interruptus Kieffer, 1904

Figures 46-47

Epyris interruptus Kieffer, 1904: 398.

TYPE MATERIAL — Holotype, ♂, N. Guinea S. E. [probably **Papua New Guinea**], Hatam, VI/1875, leg. Beccari (MCSN). [examined]

REDESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma dark brown; wings hyaline. Mandible with four distal teeth. Clypeus with straight median lobe, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel shorter than flagellomere I. Eye weakly setose. Frons coriaceous and punctate. Frontal line absent. Pronotum punctate and coriaceous. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior mesopleural fovea not connected with lower mesopleural fovea; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum as long as notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea not connected by evident sulcus, not



FIGURE 46

Epyris interruptus Kieffer, male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm A and F, 50 µm B, 400 µm F.

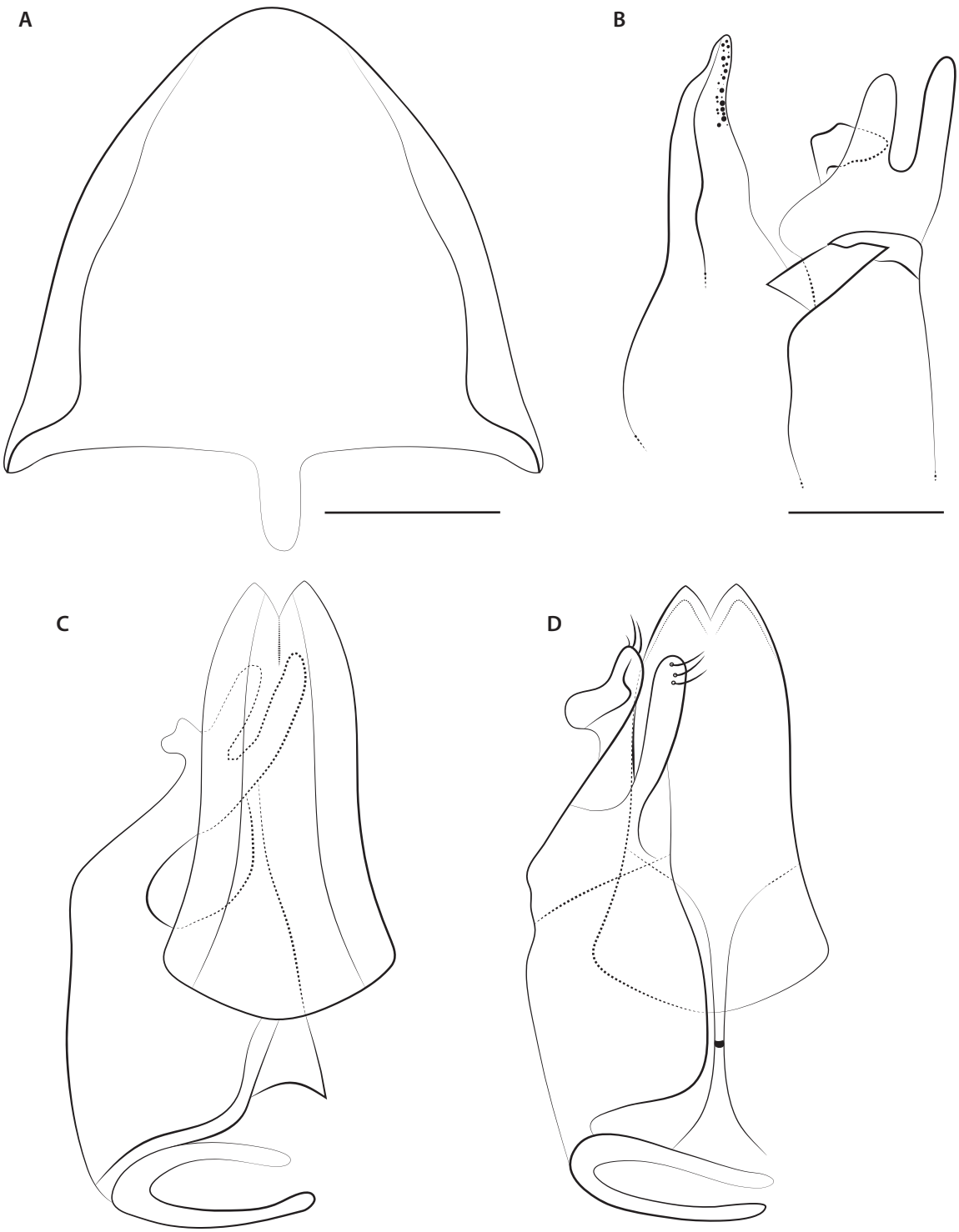


FIGURE 47

Epyris interruptus Kieffer, male. **A**, hypopygium in dorsal view; **B**, genitalia in lateral view; **C**, genitalia in dorsal view; **D**, genitalia in ventral view. Scale bar: 50 µm.

trabeculate, large, separated each other by thin septum, weakly inclined, bean-shaped, touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture as long as first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin outcurved. Genitalia: paramere smaller than basiparamere in lateral view, apex rounded, not arched inward, dorsal margin straight, strongly divided; basiparamere short; cuspis with apex anterior to apex of paramere, without small basal projection; digitus with apex not aligned to apex of cuspis, its posterior margin crenulate; aedeagus bottle-shaped, its apex posterior to apex of digitus, ventral margin ill defined, base of apodeme dilated.

Female. Unknown.

REMARKS — Kieffer (1904) described *Epyris interruptus*, and subsequently described *Parepyris* Kieffer, 1913 transferring *E. interruptus* to *Parepyris* (Kieffer 1914), and designated it as its type species. Evans (1964) synonymized *Parepyris* with *Epyris*, returning the combination of this species as *E. interruptus*. Here, we describe for the first time the characters of the male genitalia of this species, and we conclude that male genitalia do not follow the reported patterns for *Epyris*. We did not find in the new analyzed specimens, representatives of this species to delimit molecularly and phylogenetically this species in relation to the other *Epyris*. We have raised the question whether *Parepyris* can be considered a valid genus and have its reinstalled, but we do not have, at the moment, sufficient information to perform the nomenclatural act, keeping the species *E. interruptus* as valid for *Epyris*. Future molecular analyses with more genes and samples are required to better address such hypothesis. This species is different from the others of *Epyris* because it has the genitalia with very short paramere, much smaller than aedeagus and the well developed aedeagus.

DISTRIBUTION — Papua New Guinea.

Epyris melpa Colombo & Azevedo n. sp.

Figures 48-49

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.7599114%5.2347), 1700 m, 26-27/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW1700B-02/16-d02, P21851-11356 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna dark brown; wings amber; metasoma dark brown to yellowish. Mandible with five distal teeth. Clypeus with straight median lobe, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel shorter than flagellomere I. Eye glabrous. Frons coriaceous and punctate. Frontal line absent. Pronotum punctate and coriaceous. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior mesopleural fovea ill defined; lower mesopleural fovea not trabeculate; subalar impression connected with mesopleural suture; mesopleural suture not trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein angled. Mesoscutellar fovea not connected by evident sulcus, not trabeculate, large, separated each other by thin septum, weakly inclined, bean-shaped, touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina sinuous; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, ill defined; metapostnotal-propodeal suture as long as first metapostnotal carina, ill defined. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished. Hypopygeal posterior margin outcurved. Genitalia: paramere longer than basiparamere in lateral view, apex

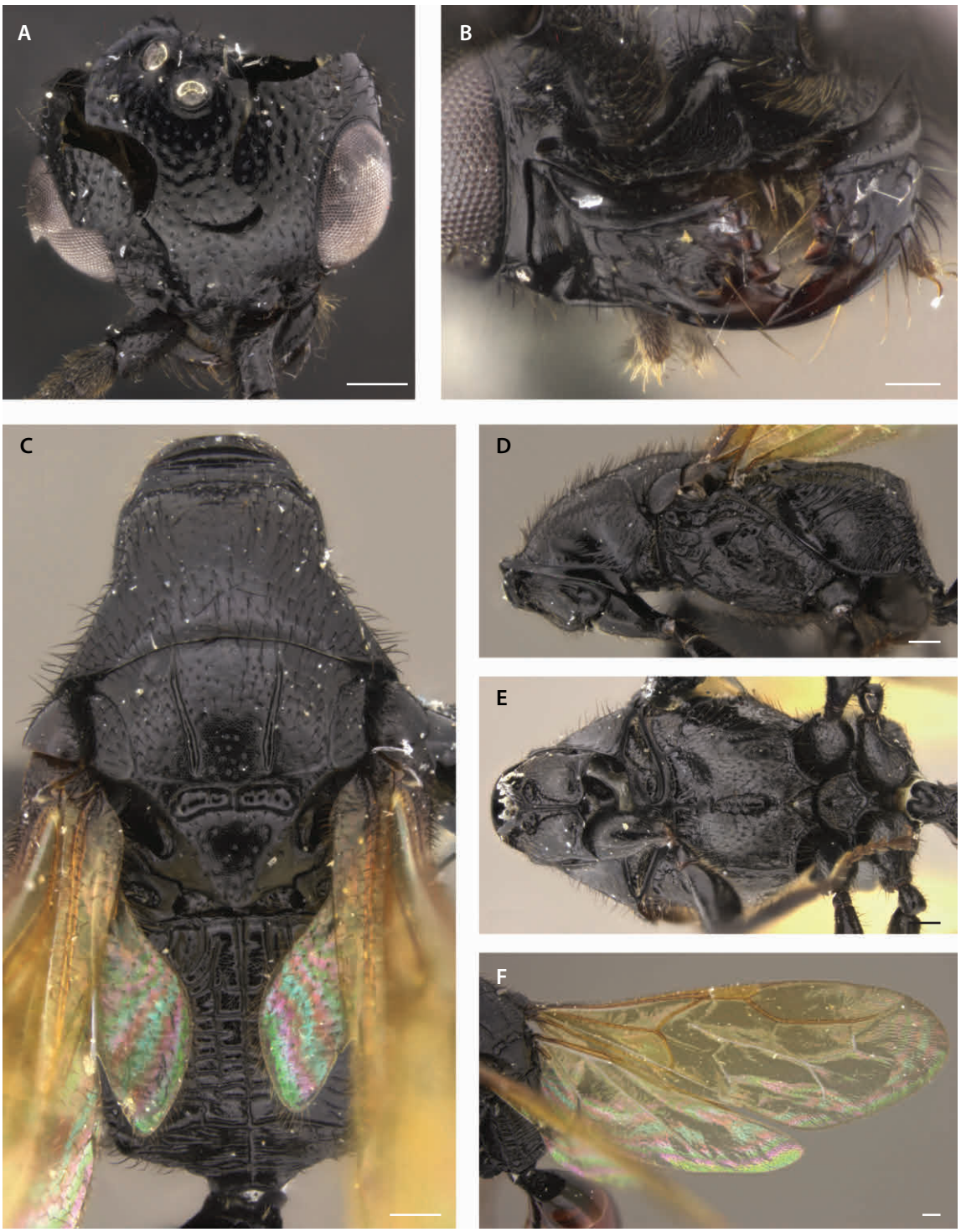


FIGURE 48

Epyris melpa Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

sharpened, not arched inward, dorsal margin straight; basiparamere short; cuspis with apex anterior to apex of paramere, without small basal projection; digitus with apex aligned to apex of cuspis, its posterior margin crenulate; aedeagus bottle-shaped, its apex aligned to apex of digitus, ventral margin ill defined, base of apodeme dilated.

Female. Unknown.

REMARKS — This species is morphologically unique among the Epyrinae from PNG because it has the paramere longer than the basiparamere in lateral view, the apex is sharpened, not arched inward, very thin and the digitus has the apex bifurcated. *Epyris melpa* n. sp. is distinguished molecularly as well, the lowest genetic distance observed between *Epyris melpa* n. sp. and the remaining species was between *E. min* n. sp. (25%) (Figure 4).

This species is unmistakably addressed to the former genus *Homoglenus* Kieffer 1904 and *Artiepyris* Kieffer 1913, mainly by having the paramere very slender. The genus *Artiepyris* was synonymized with *Epyris* by Evans (1964), which was considered as subgenus of *Epyris*, and the genus *Homoglenus* was synonymized with *Epyris* by Terayama (2003).

The females of both groups are very similar to each other, but the males are distinguished by the characters discussed above. The high molecular divergence of 25% from the other species of *Epyris* lead us to question whether such synonymy is correct, and perhaps *Artiepyris* and *Homoglenus* should be reinstalled. Future molecular analyses with more genes and samples are required to better address such hypotheses.

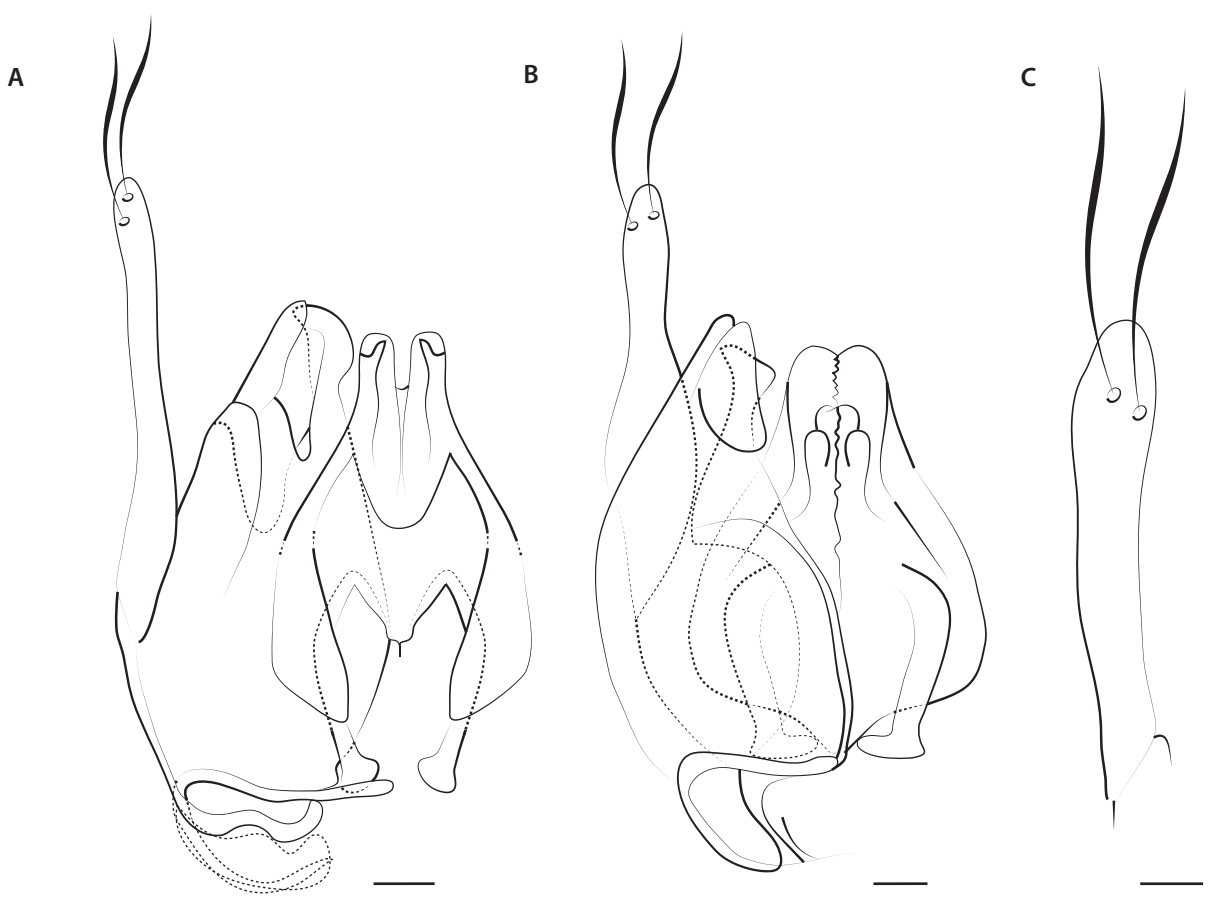


FIGURE 49

Epyris melpa Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

ETYMOLOGY — The epithet *melpa* refers to the Melpa language spoken by about 130,000 people predominantly in Mount Hagen and the surrounding district of Western Highlands Province, Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

Epyris mian Colombo & Azevedo n. sp.

Figures 50-51

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 28-29/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1200D-04/16-d04, P1829-11306 (MNHN). Paratypes, **Papua New Guinea**. 1 ♂, Province Madang, Mount Wilhelm (-5.721022, 145.2703), 1200 m, 26-27/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW1200B-02/16-d02, P1795-11299 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna dark brown; wings hyaline; metasoma light brown. Mandible with five distal teeth. Clypeus with rounded median lobe, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel shorter than flagellomere I. Eye glabrous. Frons polished and punctate. Frontal line present. Pronotum punctate and coriaceous. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum as long as than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea not connected by evident sulcus, not trabeculate, large, separated each other by thin septum, weakly inclined, bean-shaped, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina outcurved; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina as long as metapostnotal median carina, ill defined; metapostnotal-propodeal suture as long as first metapostnotal carina, straight. Metatibia without spines. Petiolar root with apex incurved. Metasoma polished. Hypopygeal posterior margin outcurved. Genitalia: paramere absent; basiparamere wide, not covering aedeagal base; volsella without small basal projection; digitus with apex posterior to apex of cuspis, its posterior margin denticulate; aedeagus bottle-shaped, its apex anterior to apex of digitus, ventral margin ill defined, base of apodeme dilated.

Female. Unknown.

REMARKS — This species is unique among the *Epyris* because it presents the frontal line, the anterior and lower mesopleural foveae are not connected, the lower mesopleural fovea is trabeculate, the mesopleural al subalar impression is not connected with the mesopleural suture and the metapectal-propodeal complex has the first metapostnotal carina as long as the metapostnotal median carina. The molecularly closest species observed in this study was *E. motu* n. sp., known from females only, with 10% divergence (Figure 4).

ETYMOLOGY — The epithet *mian* refers to the Mian ethnic who lives in the Telefomin district of the Sandaun province in Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

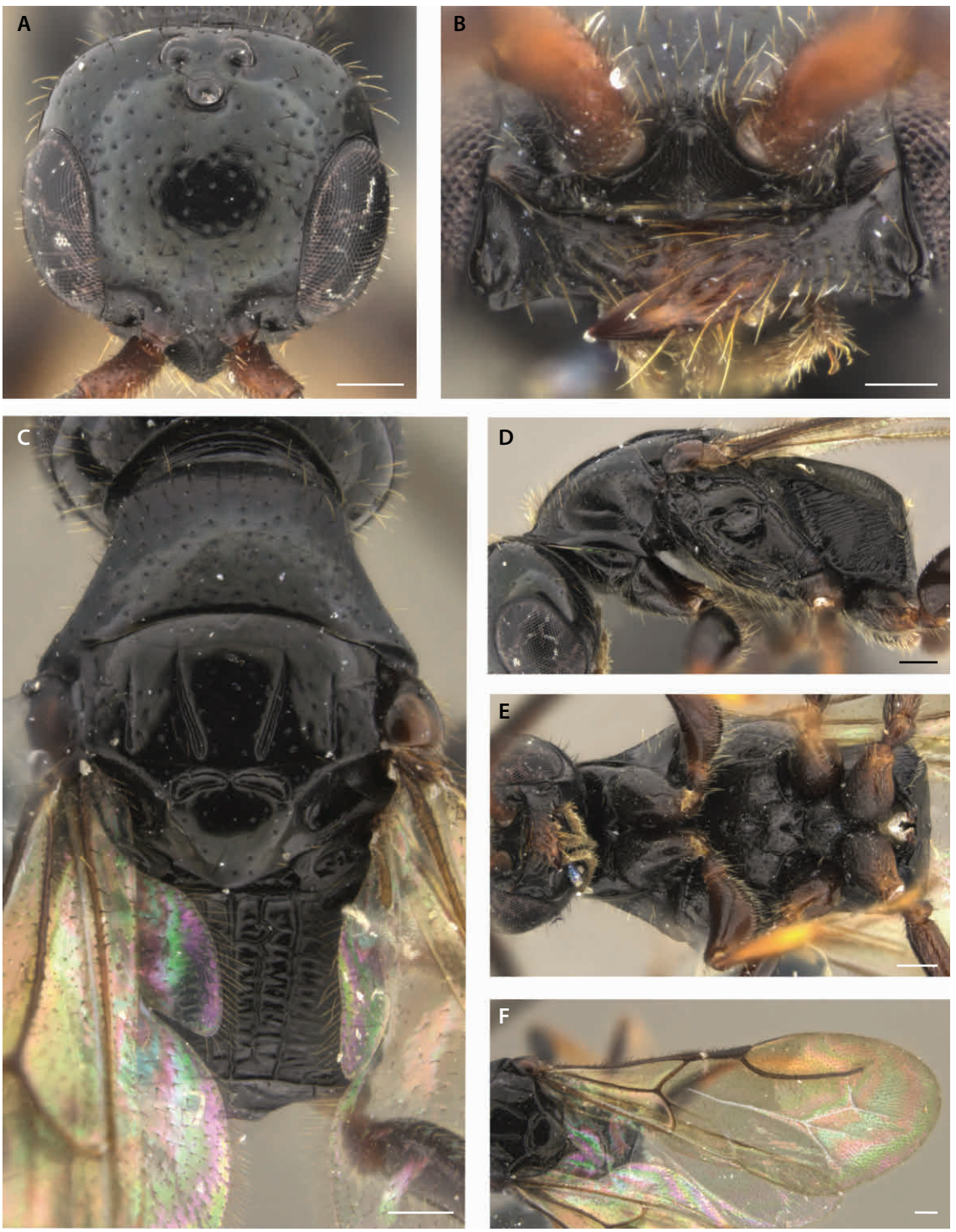


FIGURE 50

Epyris mian Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B and E.

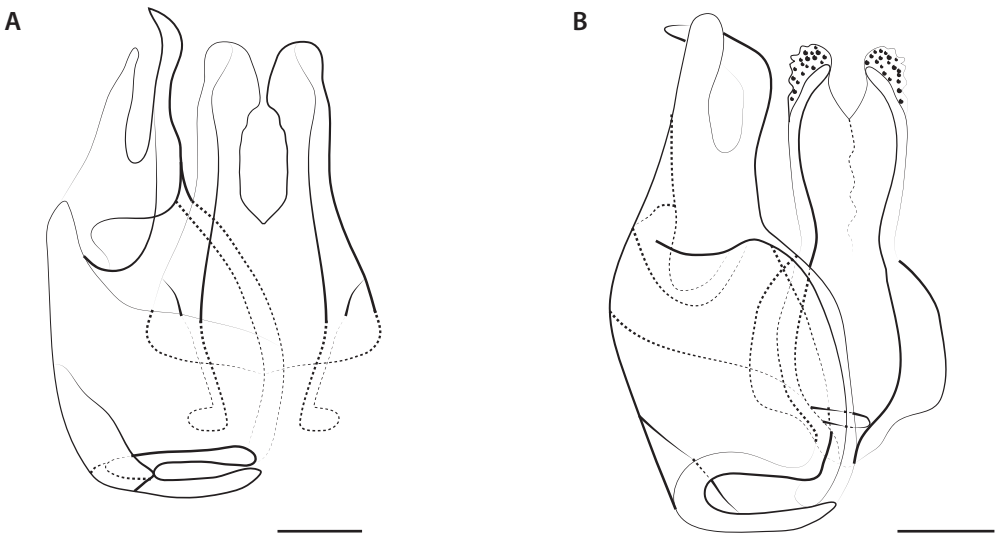


FIGURE 51

Epyris mian Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view. Scale bar: 100 µm.

Epyris min Colombo & Azevedo n. sp.

Figures 52-53

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 25-26/11/2012, leg Basset, Plot 2, understorey; Malaise - MAL-WAN02-D08, P4923-9045 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma dark brown; wings hyaline. Mandible with five distal teeth. Clypeus with rounded median lobe, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel shorter than flagellomere I. Eye glabrous. Frons coriaceous and punctate. Frontal line absent. Pronotum polished and coriaceous. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior mesopleural fovea ill defined; lower mesopleural fovea not trabeculate; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum as long as notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea not connected by evident sulcus, not trabeculate, large, separated each other by thin septum, weakly inclined, bean-shaped, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, ill defined; metapostnotal-propodeal suture longer than first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex incurved. Metasoma polished. Hypopygeal posterior margin outcurved. Genitalia: paramere as long as basiparamere in lateral view, apex rounded, not arched inward, dorsal margin straight; basiparamere short; cuspis with apex anterior to apex of paramere, without small basal projection; digitus with apex aligned to apex of cuspis, its posterior margin smooth; aedeagus bottle-shaped, its apex aligned to apex of digitus, ventral margin ill defined, base of apodeme dilated.

Female. Unknown.

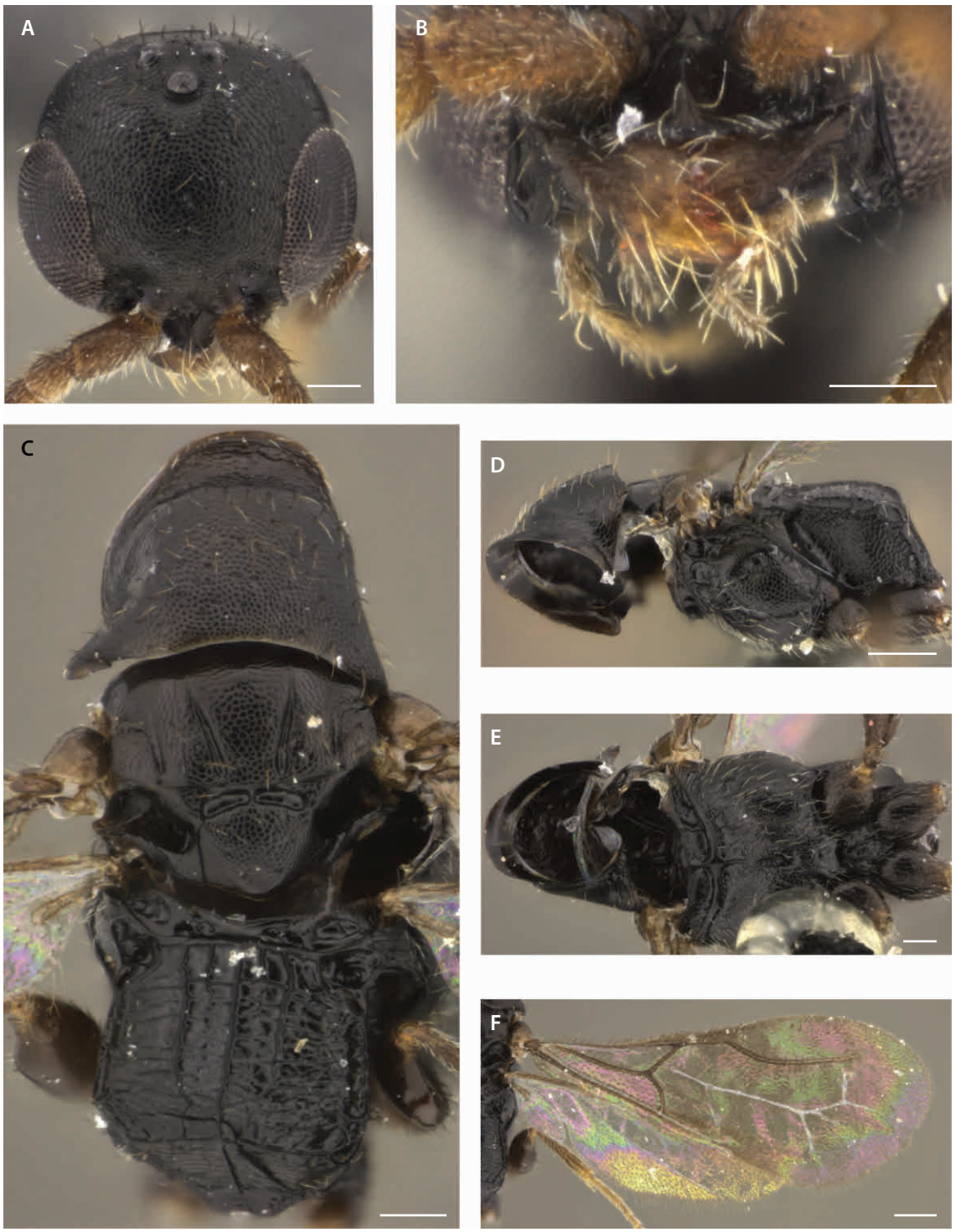


FIGURE 52

Epyris min Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in C and E.

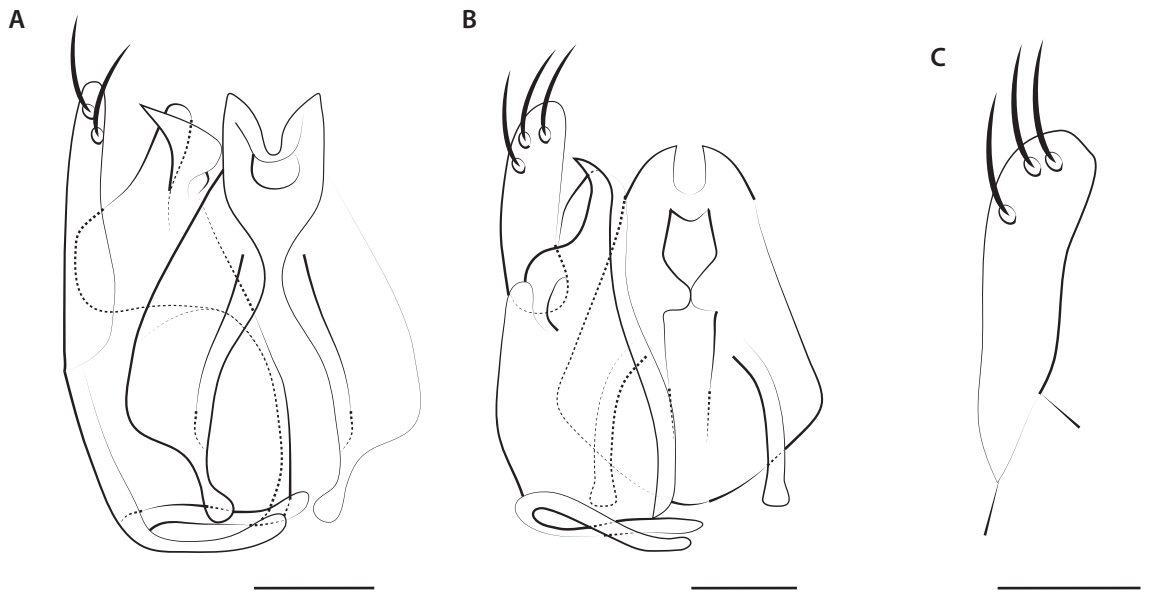


FIGURE 53

Epyris min Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view. Scale bar: 100 µm.

REMARKS — This species is distinguished from the other Papua New Guinean species of *Epyris* by having the metapostnotal anterior carina straight and the metapostnotal-propodeal suture longer than the first metapostnotal carina, converging posteriorly to the metapostnotal median carina. The lowest genetic distance observed was with a female representative of *E. mundugumor* n. sp., with 15% divergence (Figure 4).

ETYMOLOGY — The epithet *min* refers to the Min cultural group who lives in the West Sepik Province of Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

Epyris motu Colombo & Azevedo n. sp.

Figure 54

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 19-20/11/2012, leg Basset, Plot 2, understorey; Malaise - MAL-WAN02-D02, P4917-9225 (MNHN).

DESCRIPTION — *Female*. Head weakly metallic, the pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna dark brown; wings hyaline; metasoma dark brown to reddish. Mandible with five distal teeth. Clypeus with rounded median lobe, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel shorter than flagellomere I. Eye setose. Frons coriaceous and punctate. Frontal line present. Pronotum punctate and coriaceous. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression.

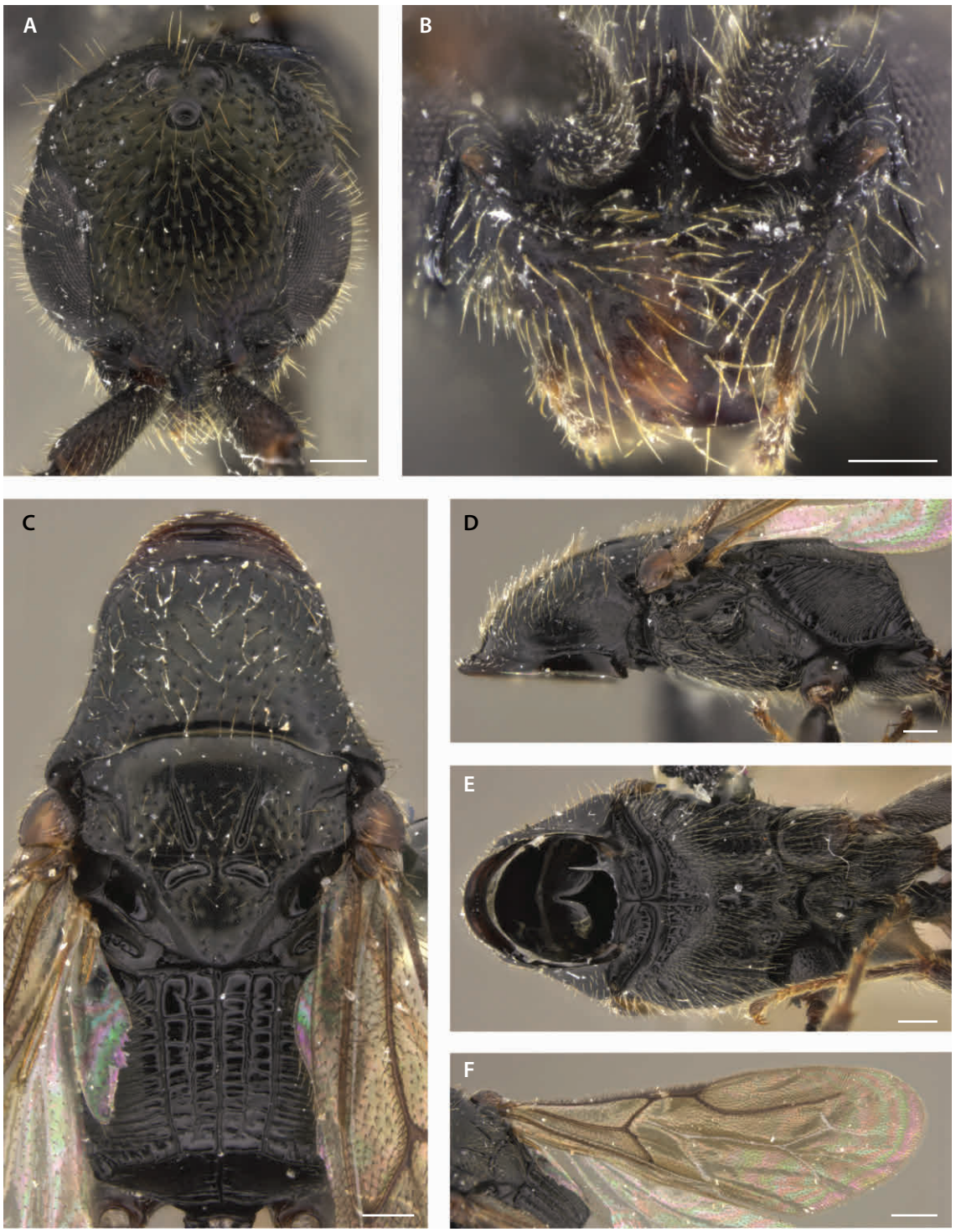


FIGURE 54

Epyris motu Colombo & Azevedo n. sp., female. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B, 400 µm in F.

Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea not trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum as long as notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea not connected by evident sulcus, not trabeculate, large, separated each other by large septum, weakly inclined, bean-shaped, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, straight; metapostnotal-propodeal suture longer than first metapostnotal carina, straight. Metatibia with many spines. Petiolar root with apex strongly incurved. Metasoma polished.

Male. Unknown.

REMARKS — This species is distinguished from the other Papua New Guinean species of *Epyris* by having the parapsidal signum as long as the notauli and the mesoscutellum with the posterior margin touching metapostnotal anterior margin. The molecularly closest species observed is *Epyris mian* n. sp., with COI sequences of the two species differing by 10% of their nucleotides (Figure 4).

ETYMOLOGY — The epithet *motu* refers to Motu native inhabitants who live along the southern coastal area of the Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

Epyris mundugumor Colombo & Azevedo n. sp.

Figure 55

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 26-27/11/2012, leg Basset, Plot 2, understorey; Malaise - MAL-WAN02-D09, P4924-8658 (MNHN).

DESCRIPTION — *Female*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma dark brown; wings hyaline. Mandible with five distal teeth. Clypeus with rounded median lobe, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence appressed; pedicel as long as flagellomere I. Eye glabrous. Frons weakly coriaceous and punctate. Frontal line present. Pronotum punctate and coriaceous. Posterior mesofurcal pit elongated, shallow. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea not trabeculate; subalar impression not connected with mesopleural suture; mesopleural suture trabeculate. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea not connected by evident sulcus, not trabeculate, large, separated each other by thin septum, weakly inclined, bean-shaped, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, straight; metapostnotal-propodeal suture longer than first metapostnotal carina, straight. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished.

Male. Unknown.

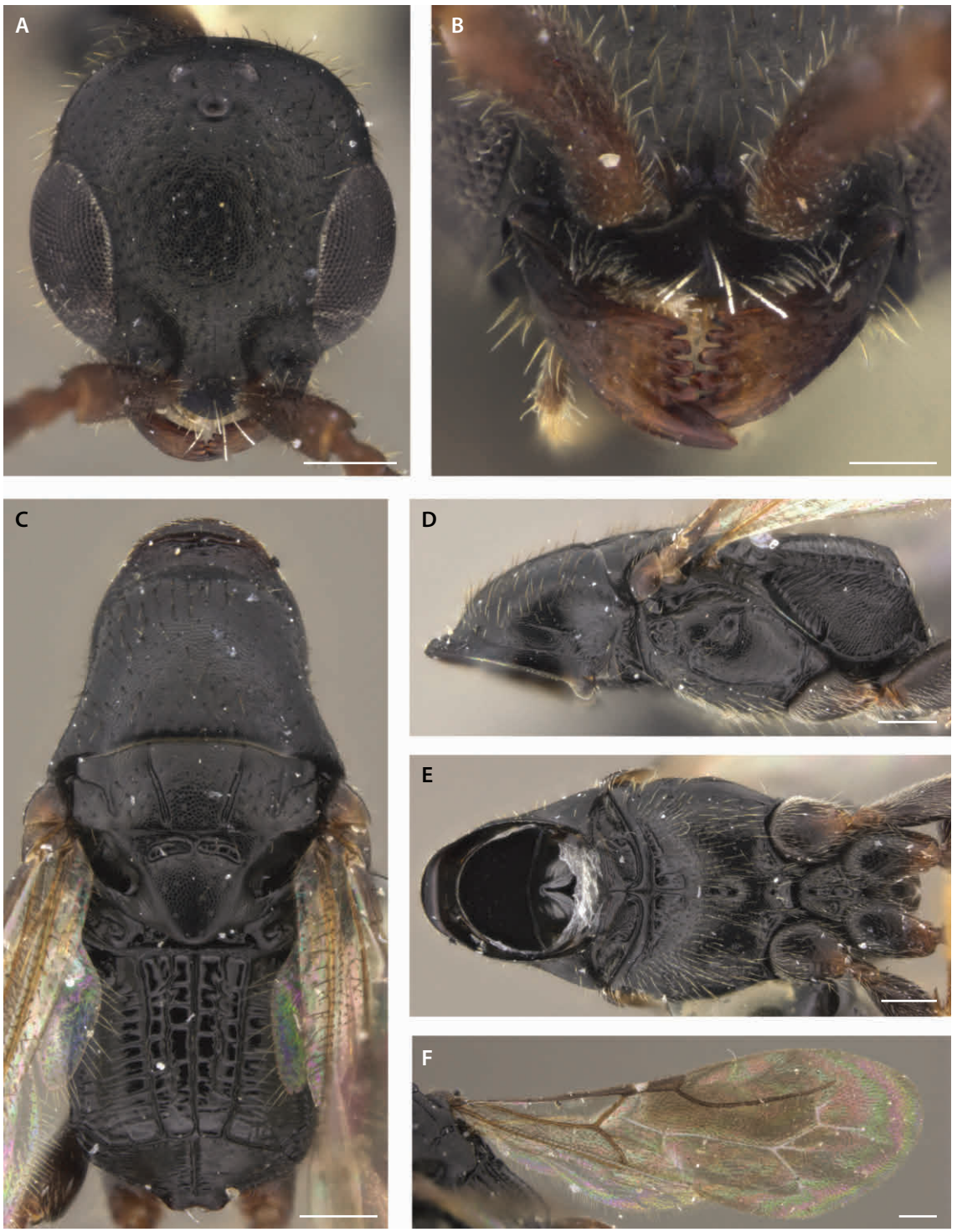


FIGURE 55

Epyris mundugumor Colombo & Azevedo n. sp., female. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

REMARKS — This species is distinguished from the other Papua New Guinean species of *Epyris* by having the pedicel as long as the flagellomere I and the eyes glabrous. The molecularly closest species observed is *Epyris mian* n. sp., known from males, with COI sequences of the two species differing by 15% of their nucleotides (Figure 4).

ETYMOLOGY — The epithet *mundugumor* refers to Mundugumor tribe who lives in the Sepik River region in Papua New Guinea's North West.

DISTRIBUTION — Papua New Guinea.

Epyris ogea Colombo & Azevedo n. sp.

Figure 56

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 28-29/11/2012, leg Gewa, Damag, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-WAN-D-13/16-d13, P0544-15389 (MNHN).

DESCRIPTION — *Female*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma dark brown; wings hyaline. Mandible with four distal teeth. Clypeus with tridentate median lobe, lateral lobe short, not visible dorsally. Antenna with flagellar pubescence erect; pedicel shorter than flagellomere I. Eye setose. Frons coriaceous and punctate. Frontal line absent. Pronotum punctate and coriaceous. Posterior mesofurcal pit oval. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea ill defined; subalar impression not connected with mesopleural suture; mesopleural suture ill defined. Notaulus drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea not connected by evident sulcus, not trabeculate, large, separated each other by thin septum, weakly inclined, bean-shaped, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, ill defined; metapostnotal-propodeal suture longer than first metapostnotal carina, converging posteriorly to metapostnotal median carina. Metatibia without spines. Petiolar root with apex strongly incurved. Metasoma polished.

Male. Unknown.

REMARKS — This species is distinguished from the other Papua New Guinean species of *Epyris* by having the median clypeal lobe tridentate and the body strongly punctate. The molecularly closest species observed is *Epyris min* n. sp., with COI sequences of the two species differing by 21% of their nucleotides (Figure 4).

ETYMOLOGY — The epithet *ogea* refers to Ogea ethnic who lives in the Madang Province of Papua New Guinea speaking the Ogea language.

DISTRIBUTION — Papua New Guinea.

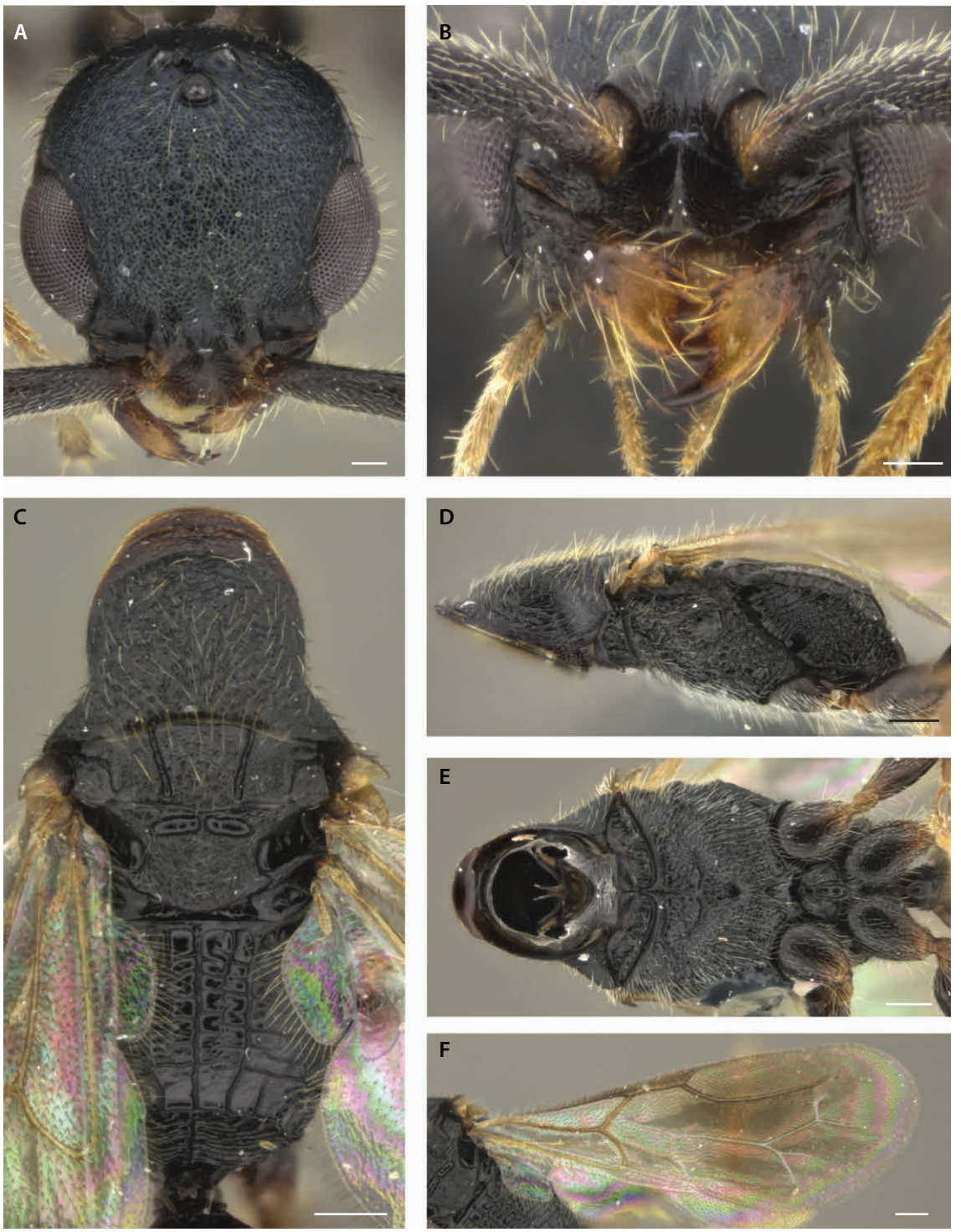


FIGURE 56

Epyris ogea Colombo & Azevedo n. sp., female. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 200 µm, except 100 µm in B.

Genus ***HOLEPYRIS*** Kieffer, 1904

Holepyris Kieffer 1905.

Type species. *Holepyris africanus* Kieffer, 1904.

Holepyris orokaiva Colombo & Azevedo n. sp.

Figures 57-58

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.721022, 145.2703). 1200 m, 25-26/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW1200B-01/16-d01, P1794-11295 (MNHN). Paratypes, **Papua New Guinea**. 1 ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 04-05/11/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-11/16-d11, P1446-11270 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.720903, 145.2715), 1200 m, 05-06/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW1200C-12/16-d12, P1821-11343 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 25-26/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1200A-01/16-d01, P1778-11294 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.720903, 145.2715), 1200 m, 26-27/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW1200C-02/16-d02, P1811-11303 (MNHN); 1 ♂, Papua-New-Guinea, Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 24-25/11/2012, leg Basset, Plot 3, understorey; Malaise - MAL-WAN03-D07, P4938-18131 (MNHN); 1 ♂, Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 23-24/11/2012, leg Basset, Plot 3, understorey; Malaise - MAL-WAN03-D06, P4937-9083 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma dark brown; wings hyaline. Mandible with one distal tooth. Clypeus with rounded median lobe, lateral lobe well developed, straight, visible dorsally. Antenna with flagellar pubescence erect; pedicel shorter than flagellomere I. Eye glabrous. Frons coriaceous and punctate. Frontal line absent. Pronotum punctate and coriaceous. Pronotal disc with anterior margin carinate, posterior margin with small foveae. Posterior mesofurcal pit thin. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior mesopleural fovea ill defined; lower mesopleural fovea ill defined; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Mesoscutellum without posterior margin foveolate. Notaulus not drop-shaped, incomplete. Parapsidal signum shorter than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea connected by evident sulcus, not trabeculate, small elevation present, transversally, narrower medially, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, ill defined; metapostnotal-propodeal suture longer than first metapostnotal carina, straight. Metatibia without spines. Petiolar root with apex incurved. Metasoma polished. Hypopygeal posterior margin outcurved. Genitalia: paramere shorter than basiparamere in lateral view, apex rounded, not arched inward, dorsal margin straight; basiparamere wide, covering aedeagal base, translucent, ill defined; cuspis with apex anterior to apex of paramere, without small basal projection; digitus with apex aligned to apex of cuspis, its posterior margin serrated; aedeagus bottle-shaped, its apex anterior to apex of digitus, ventral margin with apex with translucent projection, base of apodeme dilated.

Female. Unknown.

VARIATIONS — Clypeus with lateral lobe rounded.

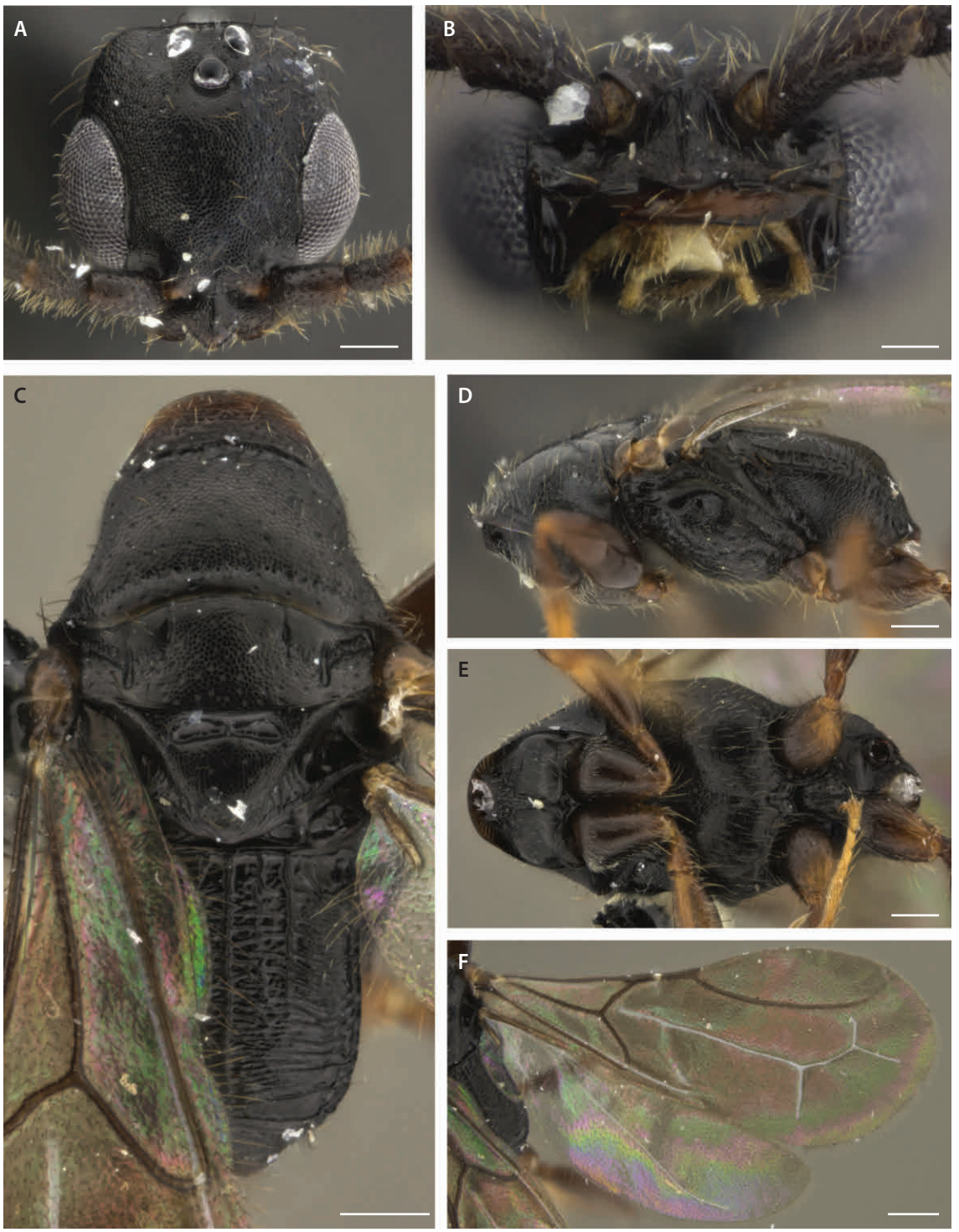


FIGURE 57

Holepyris orokaiva Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 100 µm, except 50 µm in B, 200 µm in F.

REMARKS — This species is similar to *Holepyris swagap* n. sp. by having the median clypeal lobe rounded, the eyes glabrous, the forewing with four distal flexion lines and the mesoscutellar fovea connected by an evident sulcus, which is not trabeculate and has a small elevation. However, *Holepyris orokaiva* n. sp. has the posterior mesofurcal pit thin, inserted into a triangle-shaped depression, the lower mesopleural fovea is ill defined, the paramere is shorter than the basiparamere in lateral view and the digitus is as long as the cuspis; whereas *H. swagap* n. sp. has the posterior mesofurcal pit foveolate, inserted into an ill defined depression, the lower mesopleural fovea is not trabeculate, the paramere is longer than the basiparamere in lateral view and the digitus has the apex anterior to apex of cuspis. The genetic distance between *H. orokaiva* n. sp. and *H. swagap* n. sp. was of 17%, but the molecularly closest species is *H. wiru* n. sp. with DNA sequences diverging 3% (Figure 4). *Holepyris orokaiva* n. sp. is known from males only; whereas *H. wiru* n. sp. is known from females; the genetic distance, however, is superior than expected from conspecifics. Besides sexual dimorphism, this species has the pedicel shorter than flagellomere I; eye glabrous; metafurcal pit inserted into triangle-shaped depression; notauli present and forewing with four distal flexion lines; whereas *H. wiru* n. sp. has the pedicel as long as flagellomere I; eye setose; metafurcal pit inserted into crown-shaped depression; notauli absent, and forewing with two distal flexion lines.

ETYMOLOGY — The epithet *orokaiva* refers to Orokaiva people indigenous to Papua New Guinea, who occupied what is now Oro Province and the periphery of the area they inhabited was marked by the Owen Stanley Range in the south, German New Guinea in the west and the Hydrographers Range in the south.

DISTRIBUTION — Papua New Guinea.

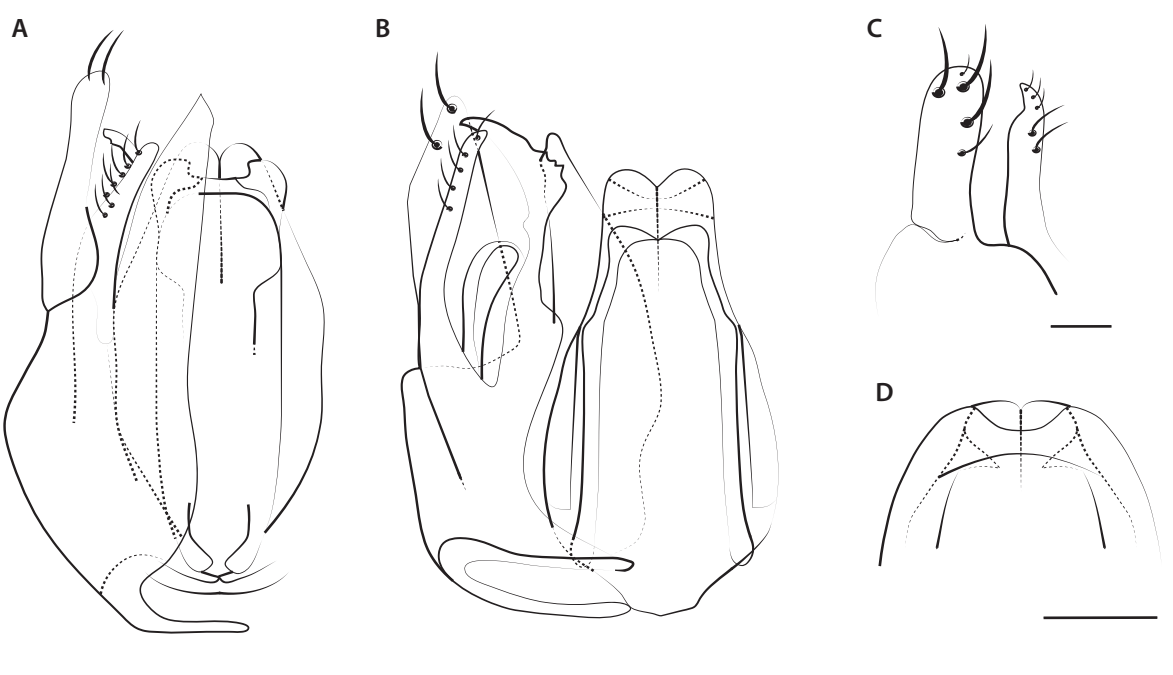


FIGURE 58

Holepyris orokaiva Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view; **D**, apex of aedeagus in dorsal view. Scale bar: 100 µm.

Holepyris sambia Colombo & Azevedo n. sp.

Figures 59-60

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 19-20/11/2012, leg Gewa, Damag, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-WAN-D-04/16-d04, P0535-9036 (MNHN). Paratypes, **Papua New Guinea**. 1 ♂, Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 23-24/11/2012, leg Gewa, Damag, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-WAN-D-08/16-d08, P0539-9071 (MNHN); 1 ♂, Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 20-21/11/2012, leg Basset, Plot 2, understorey; Malaise - MAL-WAN02-D03, P4918-9228 (MNHN); 1 ♂, Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 19-20/11/2012, leg Basset, Plot 3, understorey; Malaise - MAL-WAN03-D02, P4933-9222 (MNHN); 2 ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 26-27/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW0700A-02/16-d02, P1389-11985 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.732698, 145.2556), 700 m, 29-30/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0700B-05/16-d05, P1408-11994 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 02-03/11/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-09/16-d09, P1444-11262 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.741031, 145.3294), 200 m, 25-26/10/2012, leg Dilu, Ray, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0200B-01/16-d01, P1014-11947 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 04-05/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1200A-11/16-d11, P1788-11331 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.761029,145.1860), 2200 m, 29-30/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW2200C-14/16-d14, P1603-11900 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 25-26/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1200D-01/16-d01, P1826-11293 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 26-27/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-02/16-d02, P1437-11982 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 30-31/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-06/16-d06, P1441-11252 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 01-02/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1200D-08/16-d08, P1833-11320 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 02-03/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1200D-09/16-d09, P1834-11327 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma dark brown; wings hyaline. Mandible with one distal tooth. Clypeus with rounded median lobe, lateral lobe well developed, straight, visible dorsally. Antenna with flagellar pubescence erect; pedicel as long as flagellomere I. Eye glabrous. Frons coriaceous. Frontal line present. Pronotum punctate and coriaceous. Pronotal disc with anterior margin carinate, posterior margin with small foveae. Posterior mesofurcal pit thin. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior mesopleural fovea ill defined; lower mesopleural fovea ill defined; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Mesoscutellum without posterior margin foveolate. Notaulus not drop-shaped, incomplete. Parapsidal signum shorter than notaulus. Forewing with three distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea connected by evident sulcus, trabeculate, small elevation absent, transversally, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, ill defined; metapostnotal-propodeal suture longer than first metapostnotal carina, straight. Metatibia without spines. Petiolar root with apex incurved. Metasoma polished. Hypopygeal posterior margin outcurved. Genitalia: paramere as long as basiparamere in lateral view, apex sharpened, not arched inward, dorsal margin straight; basipara-



FIGURE 59

Holepyris sambia Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, pronotum in dorsal view; **D**, mesosoma in dorsal view; **E**, pronotum in lateral view; **F**, mesosoma in lateral view; **G**, mesosoma in ventral view; **H**, forewing in dorsal view. Scale bars: 100 µm, except 50 µm in B, C, E and H.

mere wide, not covering aedeagal base, translucent, ill defined; apex of cuspis aligned with apex of paramere, without small basal projection; digitus with apex anterior to apex of cuspis, its posterior margin crenulate; aedeagus bottle-shaped, its apex aligned to apex of digitus, ventral margin with apex ill defined, base of apodeme dilated.

Female. Unknown.

VARIATIONS — Aedeagus with apex sickle-shaped in ventral view.

REMARKS — This species is morphologically similar to *Holepyris tairora* n. sp. by having the median clypeal lobe rounded, the eyes glabrous, the posterior mesofurcal pit thin, the mesoscutellum with the posterior margin polished, the forewing with three distal flexion lines, the mesoscutellar fovea connected by an evident sulcus, trabeculate, without a small elevation and the apex of cuspis aligned to the apex of paramere. *Holepyris sambia* n. sp., however, has the pedicel as long as the flagellomere I; the metafurcal pit is inserted into a triangle-shaped depression, the notauli is present and the paramere is as long as the basiparamere in lateral view; whereas *H. tairora* n. sp. has the pedicel shorter than the flagellomere I; the metafurcal pit is inserted into an ill defined depression, the notauli is absent and the paramere is longer than the basiparamere in lateral view. The genetic distance between *H. sambia* n. sp. and *H. tairora* n. sp. was of 15% (Figure 4), thus, we do not have either morphological or molecular evidences to associate them into one single species.

ETYMOLOGY — The epithet *sambia* refers to the Sambia ethnic who lives the fringes of the Eastern Highlands Province of Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

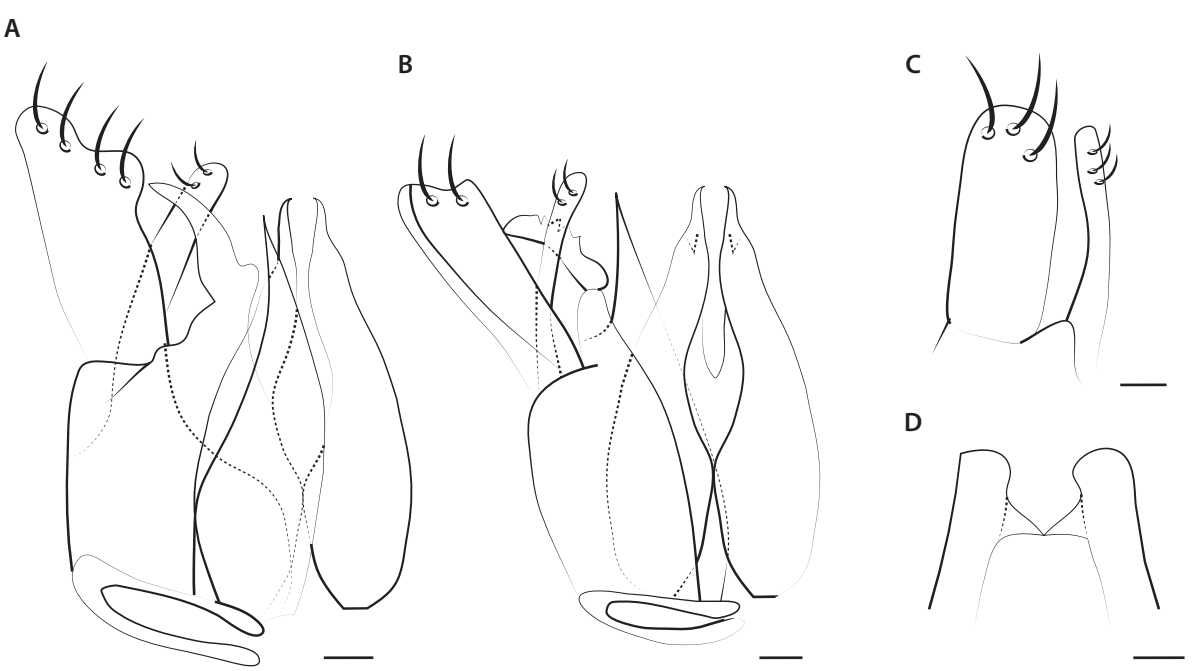


FIGURE 60

Holepyris sambia Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view; **D**, apex of aedeagus in dorsal view. Scale bars: 100 µm, except 50 µm in D.

Holepyris swagap Colombo & Azevedo n. sp.

Figures 61-62

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.758978, 145.1861), 2200 m, 17-18/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW2200A-02/16-d02, P2559-11906 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma dark brown; wings hyaline. Mandible with one distal tooth. Clypeus with rounded median lobe, lateral lobe well developed, rounded, visible dorsally. Antenna with flagellar pubescence erect; pedicel shorter than flagellomere I. Eye glabrous. Frons polished and punctate. Frontal line present. Pronotum punctate and coriaceous. Pronotal disc with anterior margin carinate, posterior margin with small foveae. Posterior mesofurcal pit foveolate. Metafurcal pit inserted into ill defined depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea not trabeculate; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Mesoscutellum without posterior margin foveolate. Notaulus not drop-shaped, incomplete. Parapsidal signum longer than notaulus. Forewing with four distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea connected by evident sulcus, not trabeculate, small elevation present, transversally, evenly wide, not touching mesoscutellar lateral margin, rectangular. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, ill defined; metapostnotal-propodeal suture longer than first metapostnotal carina, straight. Metatibia without spines. Petiolar root with apex incurved. Metasoma polished. Hypopygeal posterior margin outcurved. Genitalia: paramere longer than basiparamere in lateral view, apex rounded, not arched inward, dorsal margin straight; basiparamere wide, not covering aedeagal base, translucent, ill defined; apex of cuspis anterior to apex of paramere; with small basal projection; digitus with apex anterior to apex of cuspis, its posterior margin serrated; aedeagus bottle-shaped, its apex anterior to apex of digitus, ventral margin with apex with translucent projection, base of apodeme dilated.

Female. Unknown.

REMARKS — This species is morphologically similar to *Holepyris orokaiva* n. sp. by having the median clypeal lobe rounded, the eyes glabrous, the forewing with four distal flexion lines and the mesoscutellar fovea connected by an evident sulcus, not trabeculate, with a small elevation present. *Holepyris swagap* n. sp., however, has the posterior mesofurcal pit foveolate, inserted into an ill defined depression, the lower mesopleural fovea is not trabeculate, the paramere is longer than the basiparamere in lateral view and the digitus has the apex anterior to the apex of cuspis; whereas *H. orokaiva* n. sp. has the posterior mesofurcal pit thin, inserted into a triangle-shaped depression, the lower mesopleural fovea is ill defined, the paramere is shorter than the basiparamere in lateral view and the digitus is as long as the cuspis. The genetic distance between *H. swagap* n. sp. and *H. orokaiva* n. sp. was of 17% (Figure 4).

ETYMOLOGY — The epithet *swagap* refers to the Swagap indigenous tribes who live in a village that sits above the waters of the Sepik River, named Sawagap in Papua New Guinea. They are also known as the Insect Tribe.

DISTRIBUTION — Papua New Guinea.



FIGURE 61

Holepyris swagap Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 100 µm, except 50 µm in A and B.

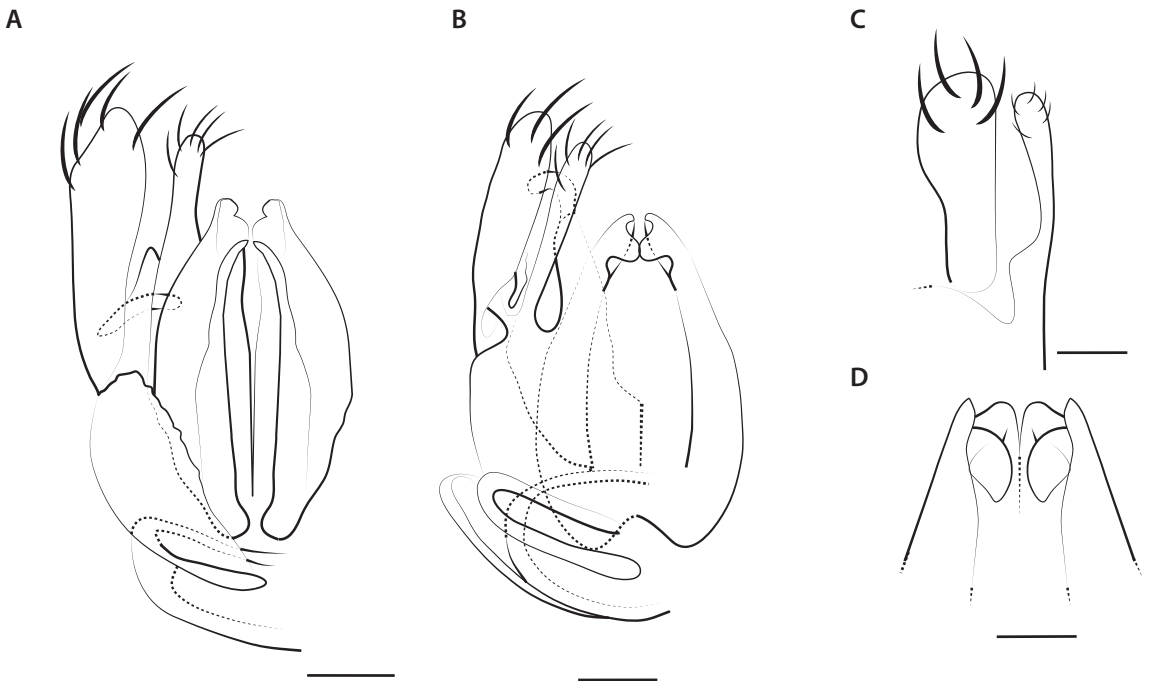


FIGURE 62

Holepyris swagap Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view; **D**, apex of aedeagus in dorsal view. Scale bars: 100 µm, except 50 µm in D.

Holepyris tairora Colombo & Azevedo n. sp.

Figures 63-64

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.759910, 145.2347), 1700 m, 26-27/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW1700B-02/16-d02, P2185-11356 (MNHN). Paratypes, **Papua New Guinea**. 1 ♂, Province Madang, Mount Wilhelm (-5.720903, 145.2715), 1200 m, 05-06/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW1200C-12/16-d12, P1821-11343 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.758978, 145.1861), 2200 m, 27-28/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW2200D-12/16-d12, P2617-11887 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.760178, 145.1863), 2200 m, 25-26/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW2200B-10/16-d10, P2583-11940 (MNHN); 2 ♂, Province Madang, Mount Wilhelm (-5.758978, 145.1861), 2200 m, 30-31/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW2200D-15/16-d15, P2620-11879 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.761029, 145.1860), 2200 m, 25-26/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW2200C-10/16-d10, P2599-11939 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.758978, 145.1861), 2200 m, 27-28/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW2200A-12/16-d12, P2569-11884 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 31-01/11/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-07/16-d07, P1442-11254 (MNHN).



FIGURE 63

Holepyris tairora Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 100 µm, except 50 µm in A, B and C.

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole dark brown; antenna and metasoma light brown; wings hyaline. Mandible with one distal tooth. Clypeus with rounded median lobe, lateral lobe well developed, straight, visible dorsally. Antenna with flagellar pubescence erect; pedicel shorter than flagellomere I. Eye glabrous. Frons coriaceous and punctate. Frontal line present. Pronotum punctate and coriaceous. Pronotal disc with anterior margin carinate, posterior margin with small foveae. Posterior mesofurcal pit thin. Metafurcal pit inserted into ill defined depression. Mesopleuron with anterior and lower mesopleural foveae connected; lower mesopleural fovea not trabeculate; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Mesoscutellum without posterior margin foveolate. Notaulus absent. Parapsidal signum longer than notaulus. Forewing with three distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea connected by evident sulcus, trabeculate, small elevation absent, transversally, corners as wide as, not touching mesoscutellar lateral margin, rectangular. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina outcurved; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, ill defined; metapostnotal-propodeal suture longer than first metapostnotal carina, straight. Metatibia without spines. Petiolar root with apex incurved. Metasoma polished. Hypopygeal posterior margin outcurved. Genitalia: paramere longer than basiparamere in lateral view, apex rounded, not arched inward, dorsal margin incurved; basiparamere wide, not covering aedeagal base, translucent, ill defined; apex of cuspis aligned with apex of paramere, without small basal projection; digitus with apex aligned to apex of cuspis, its posterior margin serrated; aedeagus bottle-shaped, its apex anterior to apex of digitus, ventral margin with apex ill defined, base of apodeme dilated.

Female. Unknown.

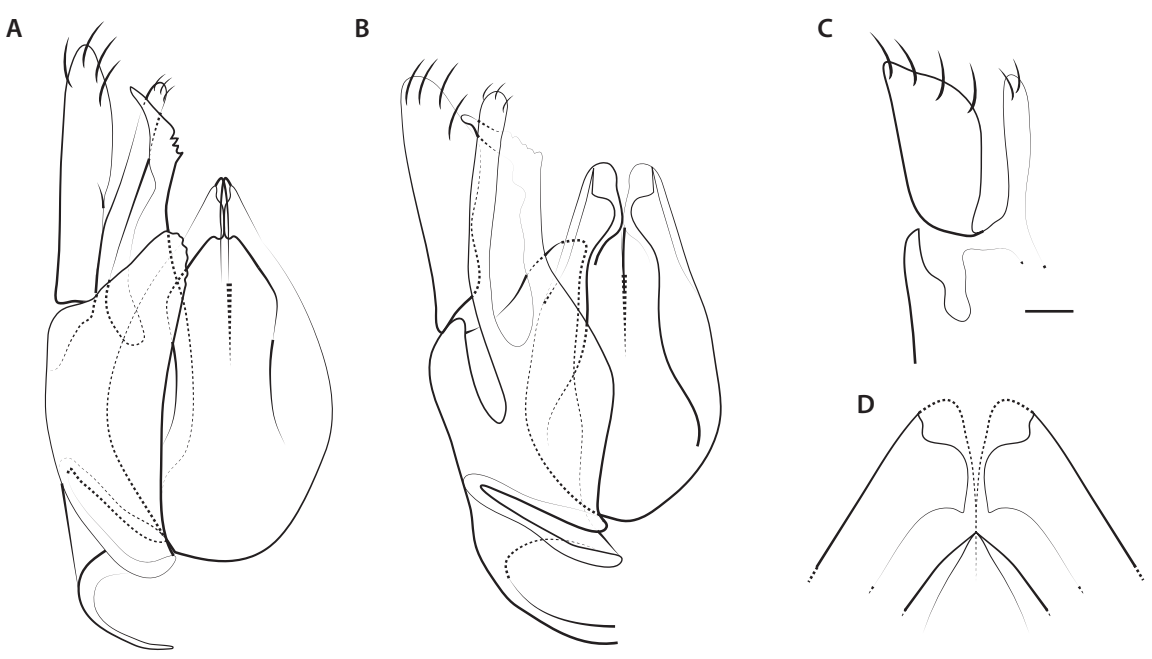


FIGURE 64

Holepyris tairora Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view; **D**, apex of aedeagus in dorsal view. Scale bars: 100 µm, except 50 µm in D.

REMARKS — This species is morphologically similar to *Holepyris sambia* n. sp. by having the median clypeal lobe rounded, the eyes glabrous, the posterior mesofurcal pit thin, the posterior margin of mesoscutellum not foveolate, the forewing with three distal flexion lines, the mesoscutellar fovea connected by an evident sulcus, trabeculate and without a small elevation and the apex of cuspis aligned to the apex of paramere. *Holepyris tairora* n. sp., however, has the pedicel shorter than the flagellomere I, the metafurcal pit is inserted into an ill defined depression, the notauli are absent and the paramere is longer than the basiparamere in lateral view; whereas *H. sambia* n. sp. has the pedicel as long as the flagellomere I, the metafurcal pit is inserted into a triangle-shaped depression, the notauli are present and the paramere is as long as the basiparamere in lateral view. The genetic sequences diverged 15% between *H. tairora* n. sp. and *H. sambia* n. sp. (Figure 4), supporting our decision to consider them two separate lineages.

ETYMOLOGY — The epithet *tairora* refers to the Tairora tribal group who live in Eastern Highlands of Papua New Guinea in or near the Aiyura Valley.

DISTRIBUTION — Papua New Guinea.

Holepyris telefol Colombo & Azevedo n. sp.

Figures 65-66

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 26-27/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-02/16-d02, P1437-11982 (MNHN). Paratypes, **Papua New Guinea**. 1 ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 28-29/10/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-04/16-d04, P1439-11998 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 01-02/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1200D-08/16-d08, P1833-11320 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 05-06/11/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-12/16-d12, P1447-11275 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.720903, 145.2715), 1200 m, 25-26/10/2012, leg Philip, Alois, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW1200C-01/16-d01, P1810-11292 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.731961, 145.2522), 700 m, 04-05/11/2012, leg Keltim, Uma, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW0700D-11/16-d11, P1446-11270 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 31-01/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1200D-07/16-d07, P1832-11316 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.758978, 145.1861), 2200 m, 18-19/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW2200A-03/16-d03, P2560-11913 (MNHN); 1 ♂, Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 24-25/11/2012, leg Basset, Plot 1, understorey; Malaise - MAL-WAN01-D07, P4906-0935 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.720874, 145.2695), 1200 m, 31-01/11/2012, leg Philip, Alois, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1200A-07/16-d07, P1784-11318 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna light brown; wings hyaline; metasoma dark brown. Mandible with one distal tooth. Clypeus with angulate median lobe, lateral lobe well developed, rounded, visible dorsally. Antenna with flagellar pubescence erect; pedicel shorter than flagellomere I. Eye glabrous. Frons coriaceous and punctate. Frontal line absent. Pronotum punctate and coriaceous. Pronotal disc with anterior margin carinate, posterior margin with small foveae. Posterior mesofurcal pit foveolate. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea foveolate; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Mesoscutellum with posterior margin foveolate. Notaulus not drop-shaped, incomplete. Parapsidal signum as long



FIGURE 65

Holepyris telefol Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bar: 100 µm.

as notaulus. Forewing with three distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea connected by evident sulcus, trabeculate, small elevation absent, weakly inclined, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina outcurved; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina as long as metapostnotal median carina, converging posteriorly; metapostnotal-propodeal suture as long as first metapostnotal carina, converging posteriorly to metapostnotal median carina. Metatibia without spines. Petiolar root with apex incurved. Metasoma polished. Hypopygeal posterior margin outcurved. Genitalia: paramere longer than basiparamere in lateral view, apex rounded, not arched inward, dorsal margin straight; basiparamere wide, not covering aedeagal base, translucent, ill defined; apex of cuspis aligned with apex of paramere, without small basal projection; digitus with apex aligned to apex of cuspis, its posterior margin serrated; aedeagus bottle-shaped, its apex anterior to apex of digitus, ventral margin with apex ill defined, base of apodeme dilated.

Female. Unknown.

REMARKS — This species is very different of all other Papuan species by having the median clypeal lobe sharpened. The lowest genetic distance observed between the male of *Holepyris orokaiva* n. sp. and the female of *H. wiru* n. sp. was 14% (Figure 4).

ETYMOLOGY — The epithet *telefol* refers to Telefol tribal group who live in Sandaun Province of Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

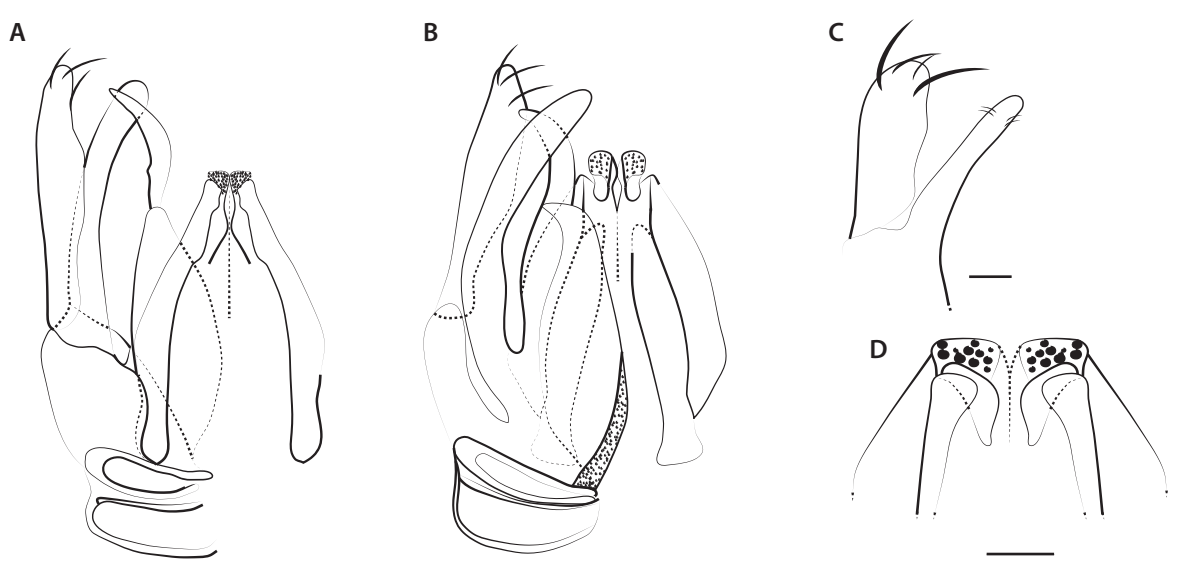


FIGURE 66

Holepyris telefol Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view; **D**, apex of aedeagus in dorsal view. Scale bars: 100 µm, except 50 µm in D.

Holepyris tsembaga Colombo & Azevedo n. sp.

Figures 67-68

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.761029, 145.1860), 2200 m, 18-19/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 3, understorey; Malaise - MAL-MW2200C-03/16-d03, P2592-11915 (MNHN). Paratypes, **Papua New Guinea**. 1 ♂, Province Madang, Mount Wilhelm (-5.758978, 145.1861), 2200 m, 20-21/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW2200A-05/16-d05, P2562-11894 (MNHN); 1 ♂, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 25-26/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1700A-01/16-d01, P2168-11360 (MNHN).

DESCRIPTION — *Male*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole dark brown; antenna brown; wings hyaline; metasoma dark brown to light brown. Mandible with one distal tooth. Clypeus with rounded median lobe, lateral lobe well developed, straight, visible dorsally. Antenna with flagellar pubescence erect; pedicel shorter than flagellomere I. Eye glabrous. Frons coriaceous. Frontal line absent. Pronotum polished and coriaceous. Pronotal disc with anterior margin carinate, posterior margin with small foveae. Posterior mesofurcal pit elongated, deep. Metafurcal pit inserted into crown-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea ill defined, transversally, evenly wide, not touching mesoscutellar lateral margin; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Mesoscutellum with posterior margin foveolate. Notaulus not drop-shaped, incomplete. Parapsidal signum as long as notaulus. Forewing with three distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea connected by evident sulcus, not trabeculate, small elevation present. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina shorter than metapostnotal median carina, straight; metapostnotal-propodeal suture shorter than first metapostnotal carina, straight. Metatibia without spines. Petiolar root with apex incurved. Metasoma polished. Hypopygeal posterior margin outcurved. Genitalia: paramere longer than basiparamere in lateral view, apex rounded, not arched inward, dorsal margin straight; basiparamere wide, covering aedeagal base, opaque, rabbit ear-shaped; cuspis with apex anterior to apex of paramere, without small basal projection; digitus with apex anterior to apex of cuspis, its posterior margin serrated; aedeagus bottle-shaped, its apex anterior to apex of digitus, ventral margin with apex ill defined, base of apodeme dilated.

Female. Unknown.

REMARKS — This species is distinguished from the other Papua New Guinean species of *Holepyris* by having the basiparamere wide with rabbit ear-shaped, opaque and as long as the paramere. The molecularly closest species observed is *H. orokaiva* n. sp., with COI sequences of the two species differing by 8% of their nucleotides (Figure 4).

ETYMOLOGY — The epithet *tsembaga* refers to the Tsembaga group of horticulturists who live in the highlands of New Guinea.

DISTRIBUTION — Papua New Guinea.



FIGURE 67

Holepyris tsembaga Colombo & Azevedo n. sp., male. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 100 µm, except 50 µm in A and B, 200 µm in F.

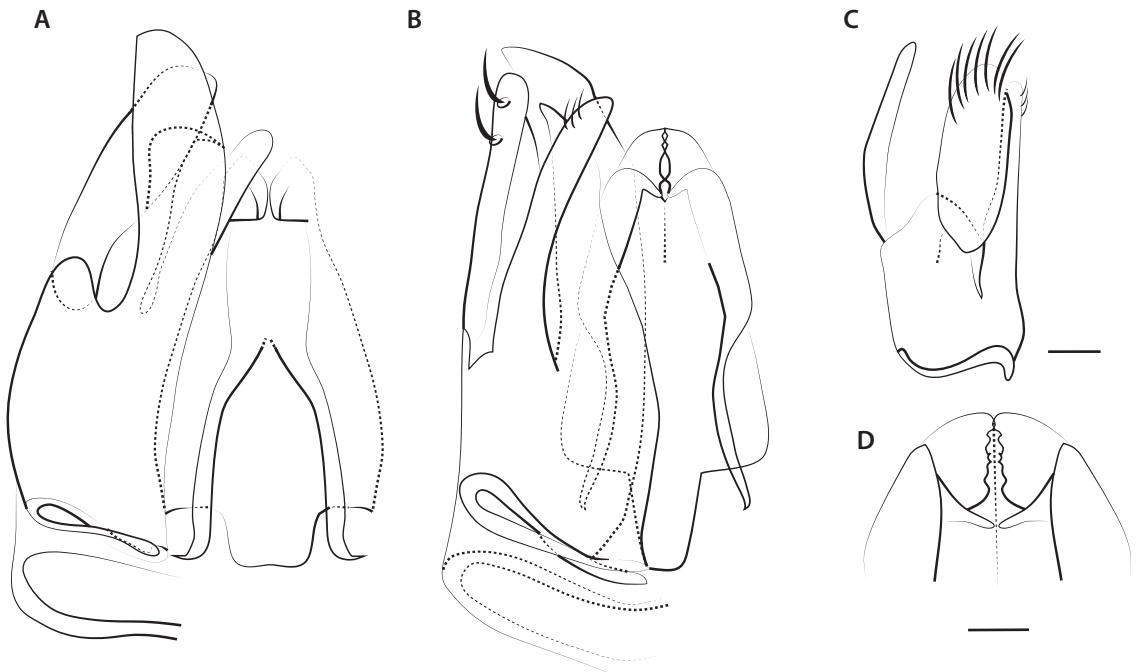


FIGURE 68

Holepyris tsembaga Colombo & Azevedo n. sp., male. **A**, genitalia in dorsal view; **B**, genitalia in ventral view; **C**, paramere in lateral view; **D**, apex of aedeagus in dorsal view. Scale bars: 100 µm, except 50 µm in D.

Holepyris wiru Colombo & Azevedo n. sp.

Figure 69

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Province Madang, Mount Wilhelm (-5.758978, 145.1861), 2200 m, 26-27/10/2012, leg Mogia, Lilip, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW2200A-11/16-d11, P2568-11931 (MNHN). Paratypes, **Papua New Guinea**. 1 ♀, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 09-10/11/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1700A-16/16-d16, P2183-8801 (MNHN); 1 ♀, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 07-08/11/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1700A-14/16-d14, P2181-8797 (MNHN); 1 ♀ Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 25-26/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1700A-01/16-d01, P2168-11360 (MNHN).

DESCRIPTION — *Female*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna dark brown; wings hyaline; metasoma light brown. Mandible with two distal teeth. Clypeus with rounded median lobe, lateral lobe well developed, rounded, visible dorsally. Antenna with flagellar pubescence appressed; pedicel as long as flagellomere I. Eye setose. Frons coriaceous and punctate. Frontal line present. Pronotum punctate and coriaceous. Posterior mesofurcal pit circular. Metafurcal pit inserted into crown-shaped depression. Mesopleuron with anterior mesopleural fovea ill defined; lower mesopleural fovea ill defined; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Notaulus absent. Parapsidal signum longer than notaulus. Forewing with two distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea connected by evident sulcus, not trabeculate, small elevation present,



FIGURE 69

Holepyris wiru Colombo & Azevedo n. sp., female. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 100 µm, except 50 µm in B, 200 µm in F.

transversally, narrower medially, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina as long as metapostnotal median carina, straight; metapostnotal-propodeal suture as long as first metapostnotal carina, straight. Metatibia without spines. Petiolar root with apex incurved. Metasoma polished.

Male. Unknown.

REMARKS — This species is morphologically similar to *Holepyris zia* n. sp. by having the median clypeal lobe rounded, the mandibles with two distal teeth and the forewing with two distal flexion lines. *Holepyris wiru* n. sp., however, has the metapostnotal-propodeal suture straight, the notauli are absent and the mesoscutellar fovea is connected by an evident sulcus, polished with a small elevation; whereas *H. zia* n. sp. has the metapostnotal-propodeal suture converging posteriorly to the metapostnotal median carina, the notauli are present and the mesoscutellar fovea is connected by an evident sulcus, trabeculate without a small elevation. The genetic distance between *H. wiru* n. sp. and *H. zia* n. sp. was of 10%, supporting our decision to consider two distinguished species. *Holepyris wiru* n. sp. is genetically close to *H. orokaiva* n. sp. (3%), which is known from males. Besides sexual dimorphism this species has the pedicel as long as flagellomere I; eye setose; metafurcal pit inserted into crown-shaped depression; notauli absent and forewing with two distal flexion lines; whereas *H. orokaiva* n. sp. has the pedicel shorter than flagellomere I; eye glabrous; metafurcal pit inserted into triangle-shaped depression; notauli present and forewing with four distal flexion lines.

ETYMOLOGY — The epithet *wiru* refers to the Wiru people who live in the Southern Highlands Province of Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

Holepyris yaifo Colombo & Azevedo n. sp.

Figure 70

TYPE MATERIAL — Holotype, ♀, **Papua-New-Guinea**. Province Madang, Mount Wilhelm (-5.741031, 145.3294), 200 m, 31-01/11/2012, leg Dilu, Ray, Novotny, Leponce, Plot 2, understorey; Malaise - MAL-MW0200B-07/16-d07, P1020-11968 (MNHN).

DESCRIPTION — *Female*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna light brown; wings hyaline; metasoma dark brown. Mandible with one distal teeth. Clypeus with angulate median lobe, lateral lobe well developed, rounded, visible dorsally. Antenna with flagellar pubescence erect; pedicel smaller than flagellomere I. Eye setose. Frons coriaceous and punctate. Frontal line absent. Pronotum punctate and coriaceous. Posterior mesofurcal pit circular. Metafurcal pit inserted into triangle-shaped depression. Mesopleuron with anterior mesopleural fovea ill defined; lower mesopleural fovea ill defined; subalar impression connected with mesopleural suture; mesopleural suture not trabeculate. Notaulus absent. Parapsidal signum longer than notaulus. Forewing with two distal flexion lines, 2r-rs&Rs vein not rounded. Mesoscutellar fovea connected by evident sulcus, trabeculate, small elevation absent, weakly inclined, narrower medially, touching mesoscutellar lateral margin. Mesoscutellum with posterior margin touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina as long as metapostnotal median carina, diverging posteriorly; metapostnotal-propodeal suture as long as first metapostnotal carina, converging posteriorly. Metatibia without spines. Petiolar root with apex incurved. Metasoma polished.

Male. Unknown.

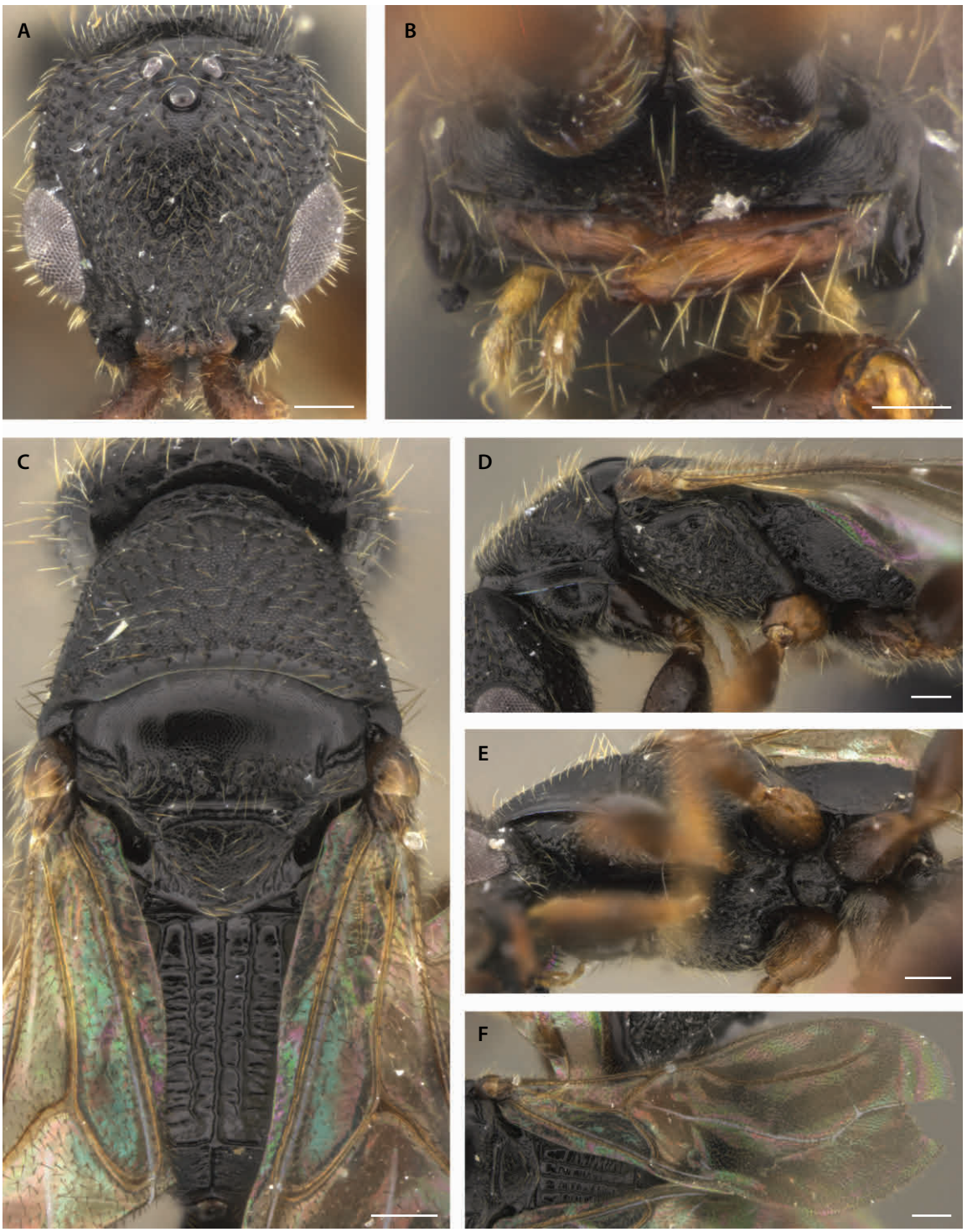


FIGURE 70

Holepyris yaifo Colombo & Azevedo n. sp., female. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 100 µm, except 50 µm in B, 200 µm in F.

REMARKS — This species is morphologically similar to *Holepyris zia* n. sp. by having the antenna and eye setose, posterior mesofurcal pit circular, forewing with two distal flexion lines, and first metapostnotal carina as long as metapostnotal median carina. However, *H. yaifo* n. sp., has the notauli absent, metafurcal pit inserted into triangle-shaped depression, and mesopleural suture not trabeculate; whereas *H. zia* n. sp. has the notauli present, metafurcal pit inserted into crown-shaped depression, and mesopleural suture trabeculate. The genetic distance was not performed because the specimen was found after molecular analysis.

ETYMOLOGY — The epithet *yaifo* refers to the Yaifo people who live in the remote tribe in the Chimbu Province of Papua New Guinea in the highlands.

DISTRIBUTION — Papua New Guinea.

Holepyris zia Colombo & Azevedo n. sp.

Figure 71

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Papua-New-Guinea, Province Madang, Wanang 3 station (-5.22767, 145.0797), 175m, 29-30/11/2012, leg Basset, Plot 3, understorey; Malaise - MAL-WAN03-D12, P4943-1176 (MNHN). Paratypes, **Papua New Guinea**. 1 ♀, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 26-27/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW1700A-02/16-d02, P2169-11358 (MNHN); 1 ♀, Province Madang, Mount Wilhelm (-5.739897, 145.3297), 200 m, 30-31/10/2012, leg Dilu, Ray, Novotny, Leponce, Plot 1, understorey; Malaise - MAL-MW0200A-06/16-d06, P1003-11961 (MNHN); 1 ♀, Province Madang, Mount Wilhelm (-5.759269, 145.2356), 1700 m, 25-26/10/2012, leg Valeba, Tulei, Novotny, Leponce, Plot 4, understorey; Malaise - MAL-MW1700D-01/16-d01, P2216-11361 (MNHN).

DESCRIPTION — *Female*. Head, pronotum, mesoscutum, metapectal-propodeal complex and petiole black; antenna and metasoma light brown; wings hyaline. Mandible with two distal teeth. Clypeus with rounded median lobe, lateral lobe well developed, rounded, visible dorsally. Antenna with flagellar pubescence appressed; pedicel as long as flagellomere I. Eye setose. Frons coriaceous and punctate. Frontal line present. Pronotum punctate and coriaceous. Posterior mesofurcal pit circular. Metafurcal pit inserted into crown-shaped depression. Mesopleuron with anterior and lower mesopleural foveae not connected; lower mesopleural fovea ill defined; subalar impression connected with mesopleural suture; mesopleural suture trabeculate. Notaulus not drop-shaped, complete. Parapsidal signum shorter than notaulus. Forewing with two distal flexion lines, 2r-rs&Rs vein not angled. Mesoscutellar fovea connected by evident sulcus, trabeculate, small elevation absent, weakly inclined, evenly wide, not touching mesoscutellar lateral margin. Mesoscutellum with posterior margin not touching metapostnotal anterior margin. Metapectal-propodeal complex with metapostnotal anterior carina straight; metapostnotal median carina complete, visible posteriorly; first metapostnotal carina as long as metapostnotal median carina, straight; metapostnotal-propodeal suture as long as first metapostnotal carina, converging posteriorly to metapostnotal median carina. Metatibia without spines. Petiolar root with apex incurved. Metasoma polished.

Male. Unknown.

REMARKS — This species is morphologically similar to *Holepyris wiru* n. sp. by having the median clypeal lobe rounded, the mandibles with two distal teeth and the forewing with two distal flexion lines. *Holepyris zia* n. sp., however, has the metapostnotal-propodeal suture converging posteriorly to the metapostnotal median carina, the notauli are present and the mesoscutellar fovea is connected by an evident sulcus, trabeculate without small elevation; whereas *H. wiru* n. sp. has the metapostnotal-propodeal straight suture, the notauli are absent and the mesoscutellar fovea is

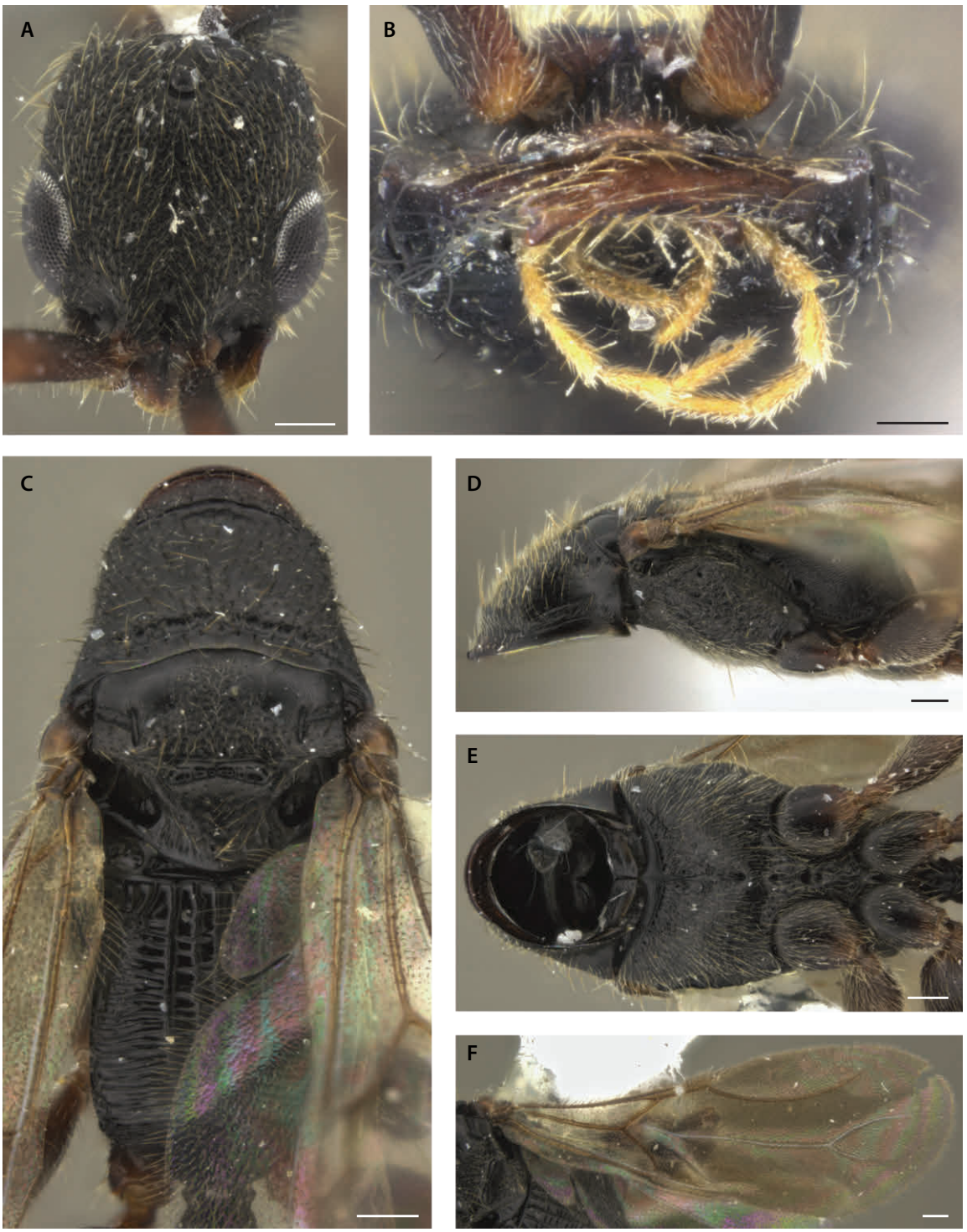


FIGURE 71

Holepyris zia Colombo & Azevedo n. sp., female. **A**, head in dorsal view; **B**, mandible in frontal view; **C**, mesosoma in dorsal view; **D**, mesosoma in lateral view; **E**, mesosoma in ventral view; **F**, forewing in dorsal view. Scale bars: 100 µm, except 50 µm in B.

connected by an evident sulcus, not trabeculate and with a small elevation. *Holepyris zia* n. sp. and *H. wiru* n. sp. diverged by 10% of their COI sequences; and the lowest genetic distance observed between the female of *H. zia* n. sp. and the male of *H. orokaiva* n. sp. or the male of *H. tsembaga* n. sp. was 8% (Figure 4).

ETYMOLOGY — The epithet *zia* refers to the Zia tribe who lives in the lower Waria Valley in Morobe Province, Papua New Guinea.

DISTRIBUTION — Papua New Guinea.

DISCUSSION

This is the first study of Epyrinae in which the species are hypothesized based on both morphological and molecular evidences. Here we report three genera to Papua New Guinea namely *Chlorepyris*, *Epyris* and *Holepyris* summing up to 36 species of Epyrinae.

Currently, it is difficult to establish the identity of the species of Epyrinae, mainly because most of the descriptions are outdated and some types are lost. In Bethylidae, identification at the species level is difficult because of the lack of unique diagnostic characters, and usually requires the detailed analyses of male genitalia, making them determinant in the taxonomy of the group. Some species have different morphological characteristics in male and female, in species of Pristocerinae for example, which show high sexual dimorphism (see Azevedo *et al.* 2016). We emphasize that in morphological terms, the subfamily Epyrinae is the most complex in Bethylidae (Alencar & Azevedo 2013). Moreover, taxonomic keys, representatives from both sexes and taxonomic revisions are scarce in Epyrinae.

We were able to distinguish morphological patterns among species of *Chlorepyris*, *Epyris* and *Holepyris*, showing generic and specific morphological boundaries. Some genera are easily delimited, for example *Holepyris* presented a more conserved morphology, whereas *Epyris* is a very complex genus and urges a taxonomic revision as suggested by previous works (Waichert & Azevedo 2009; Alencar & Azevedo 2013). Among the most conserved structures within the genera, we highlight the tarsal claw, the flexion lines and the posterior hypopygeal margins of the specimens. Peculiarities in the male genitalia are much generalized for each genus, for instance, the basiparameres are wide, covering the aedeagal base in *Chlorepyris*, and the volsella with cuspis is very long in *Holepyris*. We found some variations between males and females, mainly in the flexion lines of forewing, mesoscutellar foveae, and mandibles.

In Bethylidae, molecular studies are scarce (see Carr *et al.* 2010, Jiang *et al.* 2015, Alencar *et al.* 2018). The reconstructed phylogenetic tree based on the COI sequences (Figure 4) endorses those of Carr *et al.* (2010) and Alencar & Azevedo (2013), showing the subfamily Epyrinae monophyletic but with conflictic genera boundaries.

The phylogenetic tree, assisted with morphological examination, led to sex association. The identical genetic material indicates conspecificity in female and male representatives of *Chlorepyris bilibil* Colombo & Azevedo n. sp. In the genus *Holepyris*, the lowest genetic distance observed between species was 3% (*H. wiru* Colombo & Azevedo n. sp. and *H. orokaiva* Colombo & Azevedo n. sp.), but the species are morphologically distinct, especially for characteristics of the male genitalia. In *Chlorepyris*, besides specimens of *Chlorepyris bilibil* Colombo & Azevedo n. sp. that presented 0% of genetic distance, other species presented genetic distance superior to 5% divergence, but also were morphologically different. Finally, in *Epyris* the shortest distance was 10%, indicating that the diversity was probably poorly sampled and that the genus might be composed of several lineages and needs more sampling effort and taxonomic revision. Han *et al.* (2018), using COI barcodes in bumble bees (Hymenoptera: Apidae), detected distinct clades with large interspecific genetic distances (> 3%), and recent clades with low interspecific genetic distances (range: 1.2-2.7%), similar to what we found in PNG, supporting our results and taxonomic acts. Finally, all species were delimited based on morphological and genetic data.

The genera of Epyrinae vary by 3-30% of their COI genetic distances. We need to emphasize that high genetic distance, such as above 18% as in *Epyris melpa* n. sp., for example, may be considered intergeneric values. Therefore, we conclude that some lineage currently identified as *Epyris*, might be better placed as distinct genera. However, further morphological, and molecular analyzes must be achieved before nomenclatural acts are carried out. *Chlorepyris* also presented high genetic variation (~15%), but the morphology of the species is conserved and the phylogenetic analysis indicates common ancestry. Finally, *Holepyris* is less variable in both morphological characters, and molecular sequences.

The reduced number of specimens (35) and lack of duplicates used in the molecular analysis unabled us to discuss intraspecific genetic variation. However, since this is the first attempt to study Epyrinae based on molecular data, we strongly suggest new studies to support these findings.

Finally, this is our third contribution on the Bethylidae fauna of PNG. Mugrabi & Azevedo (2016) cited 91 species of *Dissomphalus* Ashmead, 1893, and Vargas & Azevedo (2016) reported one species of *Galodoxa* Nagy, 1974. Considering the present contribution, there are 131 known species of Bethylidae in PNG up to date.

ACKNOWLEDGEMENTS

We thank Claire Villemant (curator of MNHN) and Maria Tavano (curator of MCSN) for loaning specimens from Papua New Guinea; "Our Planet Reviewed – Niugini 2012-2013" program team, especially Tony Robillard and Claire Villemant for inviting to propose this manuscript to this volume; Juliana Justino from Núcleo de Genética Aplicada à Conservação da Biodiversidade (NGACB) at Universidade Federal do Espírito Santo (UFES) for support during molecular protocols and Felipe Bertholdi Fraga for photographing species. This paper was supported by *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq), grant #305746/2014-6 and grant #465562/2014-0. WDC has a Doctoral scholarship of *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (CAPES). CW thanks to *Fundação de Amparo à Pesquisa e Inovação do Espírito Santo* (FAPES)/CAPES for Postdoctoral fellowship, grant #71026436. COA of CNPQ grant #305746/2014-6. We thank two anonymous reviewers for the useful suggestions. This study was conducted in the framework of "Our Planet Reviewed – Papua-New-Guinea 2012-2013" set up by Pro-Natura International, the Muséum national d'Histoire naturelle (MNHN, France), the Institut de Recherche pour le Développement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery. The IBISCA expert network, the patron for this project, Prof. R.L. Kitching AM, and all other participants in this collective effort are thanked for their contribution.

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Traditional hut near the camp at 2200 m.
(Photo © Xavier Desmier).

Apsilocera Bouček (Hymenoptera: Pteromalidae) of Papua New Guinea

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ABSTRACT

The paper provides a key to the six species of *Apsilocera* Bouček known from Papua New Guinea, *A. maculata* Mitroiu & van Achterberg, 2013, and five new species: *A. acuta* n. sp., *A. carinata* n. sp., *A. compressa* n. sp., *A. edentula* n. sp., and *A. brunifemorata* n. sp. The new species are described and illustrated and a brief diagnosis is provided for *A. maculata*.

RÉSUMÉ

***Apsilocera* Bouček (Hyménoptères : Pteromalidae) de Papouasie-Nouvelle-Guinée.**

Le chapitre comprend une clé pour les six espèces d'*Apsilocera* Bouček connues en Papouasie-Nouvelle-Guinée, *A. maculata* Mitroiu & van Achterberg, 2013 et cinq espèces nouvelles: *A. acuta* n. sp., *A. carinata* n. sp., *A. compressa* n. sp., *A. edentula* n. sp. et *A. brunifemorata* n. sp. Les espèces nouvelles sont décrites et illustrées et une brève diagnose est donné pour *A. maculata*.

INTRODUCTION

Apsilocera Bouček, 1956 (Pteromalidae: Pteromalinae) is a genus of small-sized parasitoids mostly with unknown biology, the only host record available indicating gall-inducing Cecidomyidae (Diptera) associated with fungi (Ascomycetes) on broad leaved trees (Graham 1966).

According to Noyes (2018), nineteen species of *Apsilocera* have been described: thirteen from the Oriental region, three from the Australasian region – *A. australis* Bouček, 1988, *A. bidens* (Bouček, 1988), and *A. brevis* (Bouček, 1988) –, two from the Palaearctic region, and one from the Nearctic region. No species of *Apsilocera* have been previously

MITROIU M.-D. 2020 — *Apsilocera* Bouček (Hymenoptera: Pteromalidae) of Papua New Guinea, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 321-333 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

recorded or described from Papua New Guinea (PNG). The latest revision of the genus was published by Mitroiu & van Achterberg (2013). It included a redefined genus concept and diagnosis, a key to the Oriental species, and comments on their morphology.

In this paper I describe five new species of *Apsilocera* from PNG and provide a key to their respective females, together with *A. maculata* Mitroiu & van Achterberg, newly recorded from PNG. Males are known for only one of the newly described species, and no data on biology of the species is currently available. Of the five new species four are based on singletons because of the scarcity of available material. However, the characters that are useful in the separation of *Apsilocera* species, i.e. the shape and ornamentation of the head, the shape of the mandibles, the shape of the clypeus margin, and even the colour of the antennae and legs do not seem to be highly variable when series of specimens are studied.

MATERIALS AND METHODS

Material

All the material examined during this study was collected using Malaise traps (MAL) at various altitudes in Wanang and Mount Wilhelm area of PNG during 2012-2013. The collected specimens were kept in ethanol. Prior to air drying and mounting on rectangular cards, they were transferred in absolute ethanol and then in two baths of hexamethyldisilazane (HMDS) for 0.5 hour each time.

The specimens listed under examined material are deposited in the Muséum national d'Histoire naturelle, Paris, France (MNHN) and the Mitroiu collection, Faculty of Biology, the Alexandru Ioan Cuza University of Iași, Romania (MICO).

Descriptive methods

Observations were made using a Leica S8APO stereomicroscope. Images were taken using a Leica M205A automated research stereomicroscope with planapochromate objective connected to a Leica DFC500 high-resolution digital camera (Integrated Centre of Environmental Science Studies in the North East Region – CERNESIM, the Alexandru Ioan Cuza University of Iași). The acquired images were then processed using Zerene Stacker® and Adobe® Photoshop® 7.0.

Terminology follows Gibson (1997) and species description format Mitroiu & van Achterberg (2013). Abbreviations are as follows: F1-F6 = funicular segments 1-6; GT1 = first gastral tergite; M = marginal vein; OOL = oculo-ocellar line; P = postmarginal vein; POL = post-ocellar line; S = stigmal vein.

Measurements were taken with an ocular grid, at the same magnification for all measurements taken in one specimen. The scape is measured without the radicle. The pedicel is measured in lateral view. The distance between the clypeal margin and toruli is measured from the lower margins of the toruli. The propodeum and GT1 are measured along their median line. The tip of the hypopygium is considered the ventral, posteriormost point of the last gastral sternite. Descriptions are primarily for females; when males are known, only differential characters are mentioned.

SYSTEMATIC PART

Family PTEROMALIDAE Dalman, 1820
Subfamily PTEROMALINAE Dalman, 1820

Genus ***APSILOCERA*** Bouček, 1956

KEY TO PAPUA NEW GUINEA SPECIES (FEMALES)

1. Mandibles large, with apical tooth blunt (Figure 6); head in frontal view only slightly wider than high, triangular; frons with a small crest on either side of median ocellus (Figure 6: arrows); antennal flagellum brown and clava contrastingly pale yellow (Figure 5) ..... *A. carinata* n. sp.
– Mandibles small, with apical tooth sharp (Figures 2, 4, 8, 12); head in frontal view much wider than high, oval; frons without crests (Figures 2, 4, 8, 10, 12); antennal flagellum entirely brown (Figures 1, 3, 7, 9, 11) **2**

2. (1) Clypeal margin produced in middle but without teeth or tubercles, its lower margin very slightly emarginate (Figure 10); gaster subcircular, without yellowish spot on dorsal side of GT1 ..... *A. edentula* n. sp.
– Clypeal margin produced in middle as one (Figures 2, 12) or two (Figures 4, 8) sharp teeth or tubercles; gaster usually ovate, sometimes with distinct yellowish spot on GT1dorsally (Figures 1, 11) **3**

3. (2) Clypeal margin with one median tooth or tubercle (Figures 2, 12) **4**
– Clypeal margin with two median teeth (Figures 4, 8) **5**

4. (3) Clypeal margin with very small sharp median tooth (Figure 2); mesosoma with conspicuous blue reflections on mesoscutum and propodeum; GT1 with at most a transverse yellowish band dorsally (Figure 1) ..... *A. acuta* n. sp.
– Clypeal margin with median tubercle (Figure 12); mesosoma bronze-black, occasionally with very faint bluish reflections on mesoscutum; GT1 with large yellowish spot dorsally (Figure 11) ..... *A. maculata* Mitroiu & van Achterberg

5. (3) Head in frontal view with genae strongly converging towards mouth (Figure 8); mesoscutum dark blue and in lateral view virtually flat (Figure 7); gaster short-oval, hypopygium about in middle of gaster (Figure 7); femora with only apices dark (Figure 7) ..... *A. compressa* n. sp.
– Head in frontal view with genae less strongly converging towards mouth (Figure 4); mesoscutum black and in lateral view convex (Figure 3); gaster lanceolate, hypopygium well beyond middle of gaster (Figure 3); femora more extensively dark (Figure 3) ..... *A. brunifemorata* n. sp.

Apsilocera acuta n. sp.

Figures 1, 2

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Mount Wilhelm, 200 m, 5/11/2012-6/11/2012, PNG MAL-MW0200D-12/16-d12, P1057 (MNHN). Paratypes, **Papua New Guinea**. 1 ♀, Wanang, 20/11/2012-21/11/2012, PNG MAL-WAN01-D03, P4902, 9231 (MNHN); 1♀, Mount Wilhelm, -5.744789, 145.3272, 200 m, understorey, 13/05/2013-14/05/2013, MW0200-03, MAL-MW0200'C-01/16-d01, P4988, Malaise, leg. Sam et al. (MICO); 1♂, Wanang, 25/11/2012-26/11/2012, PNG MAL-WAN01-D08, P4907, 9054 (MNHN).

DIAGNOSIS — Clypeal margin with very small, sharp median tooth. Mesoscutum and propodeum with conspicuous blue reflections. GT1with at most a transverse yellowish band dorsally. Fore wing subhyaline.

DESCRIPTION — *Female holotype*. Body length: 2.0 mm. Colour. Head dark blue. Eyes reddish. Ocelli whitish. Scape whitish and becoming light brown distally; pedicel reddish-brown; flagellum uniformly brown. Mandibles light brown, teeth darker. Mesosoma with mesoscutum and propodeum blue, and pronotum and scutellum bronze-black. Wings subhyaline; tegula brown, venation brown. Fore coxa mainly dark brown, mid and hind coxae whitish, the latter with a dark spot basally, and all other leg parts whitish except apices of hind femora and tarsi brownish. Gaster laterally and dorsally brown except GT1 dorsally with a small lighter coloured depression basally and a transverse yellowish band, and ventrally gaster yellowish at base; ovipositor sheaths brown.

Head in anterior view much wider than high, without any ornamentation; clypeal margin with very small sharp median tooth; genae strongly converging towards mouth, hollowed at mouth corner; in dorsal view temple very short; occiput concave. Flagellum with each funicular segment having one row of dense sensilla and long decumbent setae. Mandibles normal, distal tooth sharp. Relative measurements - length: 40; width: 92; height: 63; POL: 19; OOL: 16; eye height: 38; eye length 30; malar space: 21; mouth width: 36; distance between clypeal margin and toruli: 42; scape length: 40; pedicel length: 8; pedicel width: 6; pedicel plus flagellum: 95; F1 length: 10; F1 width: 6; F6 length: 10; F6 width: 7; clava length: 25; clava width: 7.

Mesosoma in lateral view with dorsal surface slightly arched. Fore wing with basal cell bare, open below; basal vein pilose; ventral surface of costal cell with one row of setae in distal half; speculum reaching proximal end of M. Relative measurements - length: 85; width: 62; height: 50; mesoscutum length: 30; scutellum length: 29; scutellum width: 35; propodeum length: 11; fore wing length: 170; fore wing width: 80; M: 42; S: 15; P: 39.

Gaster ovate; in dorsal view ovipositor sheaths barely visible. Relative measurements - length: 100; width: 58; GT1 length: 38; distance from base of gaster to tip of hypopygium: 50.

Male. Body length: 1 mm. Similar to female, except for following: body colour darker; antenna longer and thinner, with each funicular having one verticil of long setae in basal third, which is also darker than the distal half; gaster shorter than mesosoma.

VARIATION — *Females*. Body length: 1.5-2.0 mm. Yellowish transverse band on dorsal surface of GT1 sometimes barely distinct.

REMARKS — Similar to *A. maculata* Mitroiu & van Achterberg (Figures 11, 12), from which it differs mainly in having the median tooth sharper and smaller, barely visible, proximal funiculars not wider than pedicel, the antennae inserted higher, and the transverse band on GT1 less distinct. Also similar to *Apsilocera australis* (Bouček, 1988: figs 748, 749), from which it differs mainly in having the median tooth sharper and smaller and higher toruli.

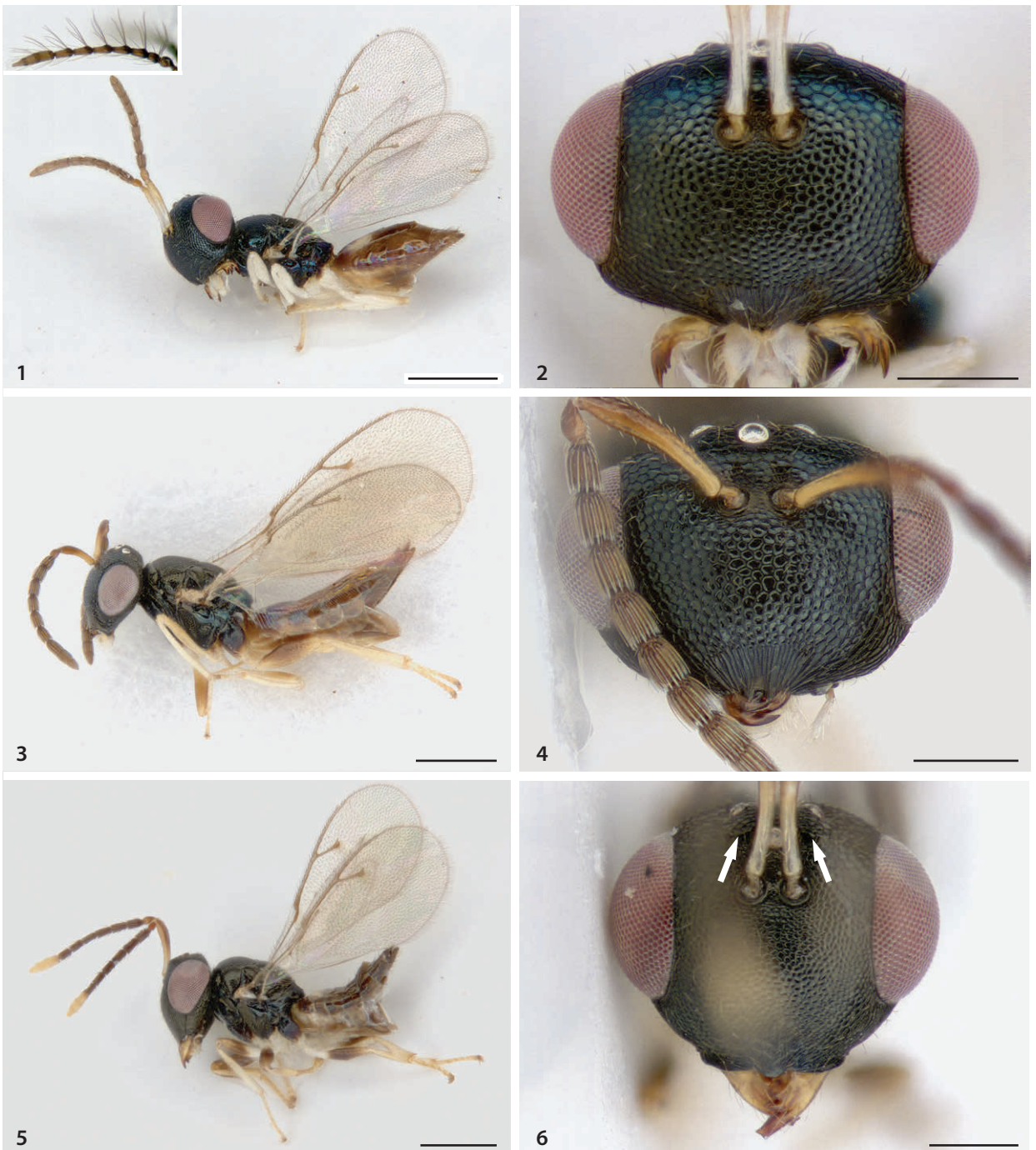
ETYMOLOGY — The name of the species refers to the sharp median tooth of the clypeus.

Apsilocera brunifemorata n. sp.

Figures 3, 4

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Mount Wilhelm, -5.741031,145.3294, 200 m, understorey, 31/10/2012-01/11/2012, MAL-MW0200A-07/16-d07, P1004, 18152, leg. Dilu, Ray, Novotny, Leponce (MNHN).

DIAGNOSIS — Head in frontal view much wider than high, with genae moderately converging towards mouth; frons without crests; clypeal margin with two median teeth. Mesoscutum black and in lateral view convex. Femora extensively dark. Gaster lanceolate, without yellowish spot dorsally on GT1; hypopygium well beyond middle of gaster.



FIGURES 1-6

1, **2**. *Apsilocera acuta*: **1**, Female holotype, habitus, lateral view (insert: detail of male antenna); **2**, Female holotype, head, frontal view. **3**, **4**, *Apsilocera brunifemorata*, female holotype: **3**, Habitus, lateral view; **4**, Head, frontal view. **5**, **6**, *Apsilocera carinata*, female holotype: **5**, Habitus, lateral view; **6**, Head, frontal view. Scale bars: Figures 1, 3, 5 = 500 micrometers; Figures 2, 4, 6 = 200 micrometers.

DESCRIPTION — *Female holotype*. Body length: 2.25 mm. Colour. Head black, with faint dark blue reflections. Eyes pale reddish. Ocelli whitish. Scape yellow except becoming brown distally; pedicel brown; flagellum uniformly dark brown. Mandibles brown, teeth darker. Mesosoma bronze-black except propodeum blue-green. Wings slightly yellowish; tegula brown; venation brown. Fore and hind coxae bluish-black, mid coxa brown; trochanters and tibiae light yellow; femora brown, with lighter apices; tarsi pale yellow except becoming light brown distally and apices dark brown. Gaster mainly brown but GT1 blue with a small light brown depression basally, and ventral surface of gaster pale; ovipositor sheaths brown.

Head in anterior view much wider than high, without any ornamentation; clypeal margin with two median teeth; genae moderately converging towards mouth, flat at mouth corner; in dorsal view temple very short; occiput concave. Flagellum with each funicular segment having one row of dense sensilla and long decumbent setae. Mandibles normal, distal tooth sharp. Relative measurements - length: 36; width: 98; height: 69; POL: 20; OOL: 19; eye height: 40; eye length 31; malar space: 20; mouth width: 40; distance between clypeal margin and toruli: 45; scape length: 42; pedicel length: 10; pedicel width: 7; pedicel plus flagellum: 120; F1 length: 10; F1 width: 8; F6 length: 12; F6 width: 8; clava length: 32; clava width: 9.

Mesosoma in lateral view with dorsal surface moderately arched. Fore wing with basal cell bare, open below; basal vein pilose; ventral surface of costal cell with one row of setae in distal half and a few additional setae towards distal end; speculum reaching proximal end of M. Relative measurements - length: 90; width: 77; height: 55; mesoscutum length: 34; scutellum length: 35; scutellum width: 40; propodeum length: 15; fore wing length: 235; fore wing width: 110; M: 52; S: 22; P: 60.

Gaster lanceolate; in dorsal view ovipositor sheaths conspicuous. Relative measurements - length: 145; width: 58; GT1 length: 32; distance from base of gaster to tip of hypopygium: 105.

REMARKS — Somewhat similar to *A. compressa*, n. sp. (Figures 7, 8), but from which it clearly differs in having the genae less strongly converging towards the mouth, the mesoscutum black and in lateral view convex, the gaster lanceolate with the hypopygium well beyond its middle, and all femora extensively dark.

ETYMOLOGY — The name of the species refers to the brown colour of the femora.

Apsilocera carinata n. sp.

Figures 5, 6

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Wanang, 23/11/2012-24/11/2012, PNG MAL-WAN02-D06, P4921, 9057 (MNHN).

DIAGNOSIS — Head in frontal view only slightly wider than high; frons with a small crest on either side of median ocellus. Mandibles large, with apical tooth blunt. Antennal clava pale yellow, contrasting with rest of flagellum.

DESCRIPTION — *Female holotype*. Body length: 2.0 mm. Colour. Head black. Eyes reddish. Ocelli whitish. Scape whitish except becoming light brown distally and darker dorsally; pedicel reddish-brown; flagellum dark brown, except clava yellowish. Mandibles yellow, teeth reddish-brown. Mesosoma black. Wings hyaline, the fore wings lightly infumate just under stigma; tegula light brown; venation brown. Fore coxa black, mid coxa whitish, hind coxa black except distal tip whitish; trochanters whitish; femora brown except proximal apices whitish; tibiae and tarsi yellowish except distal apices of tarsi brown. Gaster laterally and dorsally mainly dark brown but GT1 with a small lighter coloured depression at base, and gaster ventrally lighter basally; ovipositor sheaths dark brown.

Head in anterior view slightly wider than high, with a small crest on either side of median ocellus; clypeal margin medially produced and evenly rounded; genae moderately converging towards mouth, not hollowed at mouth corner;

in dorsal view temple virtually absent; occiput concave. Flagellum with each funicular segment having one row of dense sensilla and long decumbent setae. Mandibles large, distal tooth blunt. Relative measurements - length: 41; width: 95; height: 78; POL: 16; OOL: 16; eye height: 48; eye length 36; malar space: 19; mouth width: 42; distance between clypeal margin and toruli: 53; scape length: 48; pedicel length: 10; pedicel width: 6; pedicel plus flagellum: 115; F1 length: 12; F1 width: 7; F6 length: 10; F6 width: 7; clava length: 28; clava width: 9.

Mesosoma in lateral view with dorsal surface moderately arched. Fore wing with basal cell bare, open below; basal vein pilose; ventral surface of costal cell with one row of setae in distal half and a few additional setae towards distal end; speculum reaching proximal end of M. Relative measurements - length: 85; width: 71; height: 60; mesoscutum length: 34; scutellum length: 30; scutellum width: 37; propodeum length: 15; fore wing length: 195; fore wing width: 85; M: 47; S: 22; P: 50.

Gaster ovate; in dorsal view ovipositor sheaths barely visible. Relative measurements - length: 105; width: 65; GT1 length: 24; distance from base of gaster to tip of hypopygium: 80.

REMARKS — Similar to *A. bicristata* Mitroiu & van Achterberg from Indonesia (Mitroiu & van Achterberg, 2013: figs 2, 20), from which it differs mainly in having smaller crests on the frons, darker femora, and the clava entirely yellowish; also similar to *A. fulvipennis* Mitroiu & van Achterberg from Malaysia (Mitroiu & van Achterberg, 2013: figs 7, 25), from which it differs mainly in having smaller crests on the frons and hyaline fore wings, and to *Apsilocera brevis* (Bouček, 1988: figs 756-758), from which it differs mainly in having two crests on the frons and higher toruli.

ETYMOLOGY — The name of the species refers to the transverse crests on the frons.

Apsilocera compressa n. sp.

Figures 7, 8

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Mount Wilhelm, -5.731961,145.2522, 700 m, understorey, 24/05/2013-25/05/2013, MAL-MW0700'D-12/16-d12, P4760, leg. Sam et al. (MNHN).

DIAGNOSIS — Head in frontal view much wider than high, with genae strongly converging towards mouth; frons without crests; clypeal margin with two median teeth. Mesoscutum dark blue and in lateral view virtually flat. Only distal apices of femora dark. Gaster short-oval, without yellowish spot dorsally on GT1; hypopygium about in middle of gaster.

DESCRIPTION — *Female holotype*. Body length: 1.6 mm. Colour. Head dark blue. Eyes reddish. Ocelli whitish. Scape whitish except becoming light brown distally; pedicel light brown; flagellum uniformly brown. Mandibles reddish-brown, teeth darker. Mesosoma with mesoscutum and propodeum dark blue and pronotum and scutellum bronze-black. Wings hyaline; tegula light brown; venation brown. Fore coxa mainly bluish-black, mid and hind coxae whitish, the latter with a dark spot baso-laterally, and all other leg parts whitish or pale yellow except apices of femora and tarsi brownish. Gaster brown except GT1 with a small lighter coloured depression basally and ventral surface of gaster paler basally; ovipositor sheaths brown.

Head in anterior view much wider than high, without any ornamentation; clypeal margin with two median teeth; genae strongly converging towards mouth, flat at mouth corner; in dorsal view temple virtually absent; occiput almost straight. Flagellum with each funicular segment having one row of sensilla and long decumbent setae. Mandibles normal, distal tooth sharp. Relative measurements - length: 32; width: 75; height: 50; POL: 20; OOL: 13; eye height: 32; eye length 25; malar space: 13; mouth width: 30; distance between clypeal margin and toruli: 35; scape length: 35; pedicel length: 9; pedicel width: 5; pedicel plus flagellum: 87; F1 length: 9; F1 width: 6; F6 length: 8; F6 width: 6; clava length: 22; clava width: 7.

Mesosoma in lateral view with dorsal surface slightly arched. Fore wing with basal cell bare, open below; basal vein pilose; ventral surface of costal cell with one row of setae in distal half; speculum reaching proximal end of M. Relative measurements - length: 73; width: 50; height: 40; mesoscutum length: 29; scutellum length: 24; scutellum width: 27; propodeum length: 12; fore wing length: 160; fore wing width: 71; M: 39; S: 14; P: 35.

Gaster short-oval; in dorsal view ovipositor sheaths not visible. Relative measurements - length: 77; width: 60; GT1 length: 20; distance from base of gaster to tip of hypopygium: 35.

REMARKS — Similar to *A. dupla* Mitroiu & van Achterberg from Indonesia and Vietnam (Mitroiu & van Achterberg, 2013: figs 5, 23), from which it differs mainly in having the antennae inserted higher, more convergent genae, and the gaster short-oval with ovipositor sheaths not visible in dorsal view; also similar to *A. brunifemorata*, n. sp. (see below).

ETYMOLOGY — The name of the species refers to the flattened mesosoma.

Apsilocera edentula n. sp.

Figures 9, 10

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Wanang, 18/11/2012-19/11/2012, PNG MAL-WAN03-D01, P4932, 9227 (MNHN).

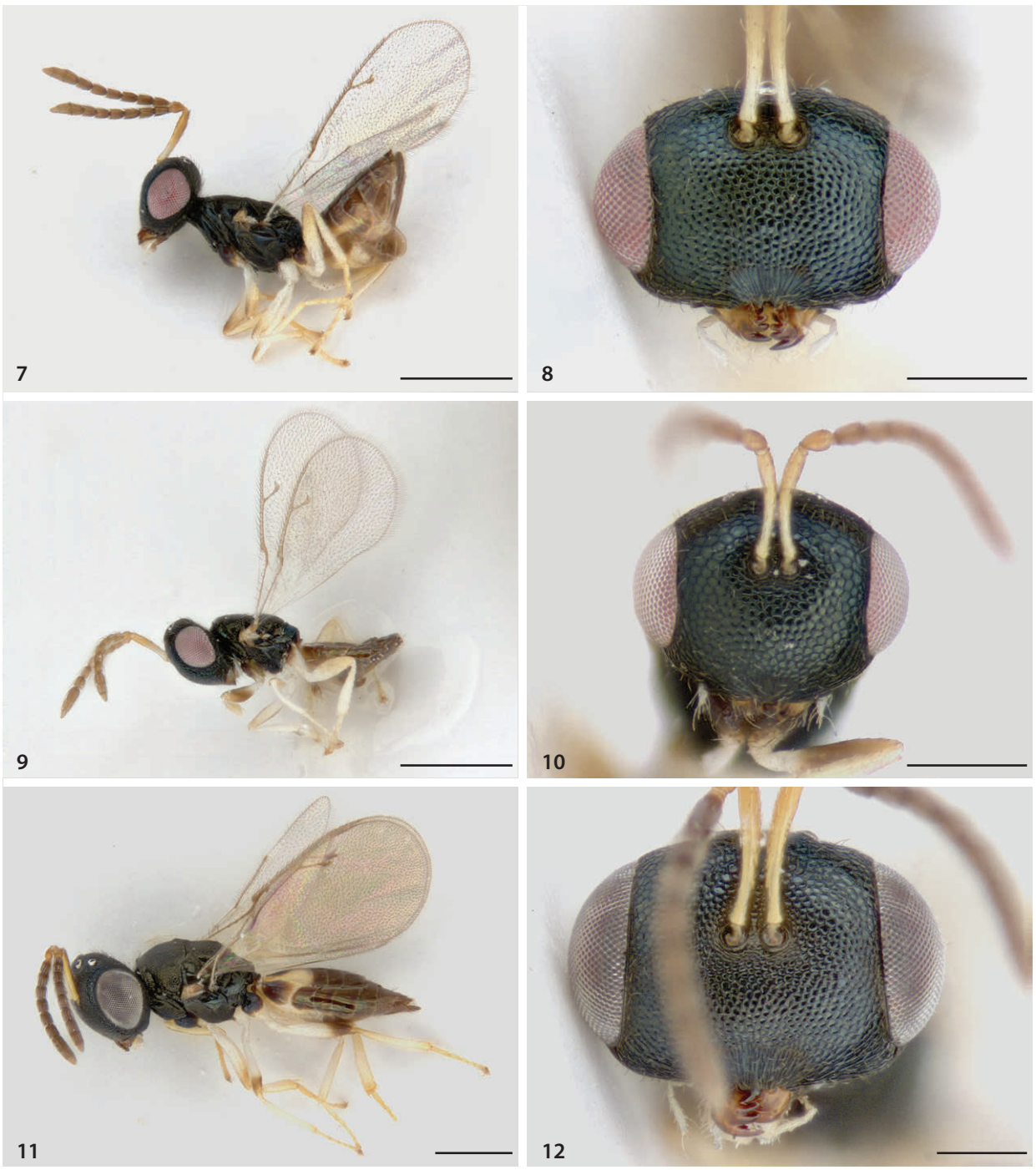
DIAGNOSIS — Head in frontal view much wider than high; frons without crests; clypeal margin produced in middle but without teeth or tubercles, its lower margin very slightly emarginated. Gaster subcircular, without yellowish spot dorsobasally.

DESCRIPTION — *Female holotype*. Body length: 1.25 mm. Colour. Head bluish-black. Eyes pale reddish. Ocelli whitish. Scape whitish except becoming light brown distally; pedicel light brown; flagellum uniformly brown. Mandibles light brown, teeth darker. Mesosoma blackish, with slight dark blue reflections on mesoscutum and propodeum. Wings hyaline; tegula brown; venation brown. Fore coxa mainly dark brown, mid and hind coxae whitish, the latter with a dark spot basally, fore femur mainly brown, mid and hind femora whitish except becoming pale brown in distal half; tibiae and tarsi whitish, the latter with brown apices. Gaster laterally and dorsally brown except GT1 with a small lighter coloured depression basally, but without any yellowish spots, and ventral surface of gaster slightly lighter basally; ovipositor sheaths brown.

Head in anterior view wider than high, without any ornamentation; clypeal margin produced in middle but without any teeth or tubercles, its lower margin very slightly emarginate; genae moderately converging towards mouth, not hollowed at mouth corner; in dorsal view temple very short; occiput concave. Flagellum with each funicular segment having one row of sparse sensilla and long decumbent setae. Mandibles normal, distal tooth sharp. Relative measurements - length: 30; width: 57; height: 43; POL: 16; OOL: 12; eye height: 27; eye length: 21; malar space: 12; mouth width: 27; distance between clypeal margin and toruli: 31; scape length: 25; pedicel length: 6; pedicel width: 4.5; pedicel plus flagellum: 69; F1 length: 6.5; F1 width: 5; F6 length: 6.5; F6 width: 5.5; clava length: 20; clava width: 5.5.

Mesosoma in lateral view with dorsal surface very slightly arched. Fore wing with basal cell bare, open below; basal vein pilose; ventral surface of costal cell with one row of setae in distal half; speculum barely reaching proximal end of M. Relative measurements - length: 54; width: 45; height: 35; mesoscutum length: 22; scutellum length: 18; scutellum width: 25; propodeum length: 8; fore wing length: 125; fore wing width: 60; M: 28; S: 11; P: 25.

Gaster subcircular; in dorsal view ovipositor sheaths not visible. Relative measurements - length: 60; width: 55; GT1 length: 20; distance from base of gaster to tip of hypopygium: 30.



FIGURES 7-12

7, **8**, *Apsilocera compressa*, female holotype: **7**, Habitus, lateral view; **8**, Head, frontal view. **9**, **10**, *Apsilocera edentula*, female holotype: **9**, Habitus, lateral view; **10**, Head, frontal view. **11**, **12**, *Apsilocera maculata*, female: **11**, Habitus, dorso-lateral view; **12**, Head, frontal view. Scale bar: Figures 7, 9, 11 = 500 micrometers; Figures 8, 10, 12 = 200 micrometers.

REMARKS — Somewhat similar to other species with head much wider than high, but distinct from all of them due to the shape of the clypeus, produced but without any teeth or tubercles.

ETYMOLOGY — The name of the species refers to the shape of the clypeus, without any teeth or tubercles.

Apsilocera maculata Mitroiu & van Achterberg, 2013

Figures 11, 12

Apsilocera maculata Mitroiu & van Achterberg, 2013: 464.

TYPE MATERIAL — Holotype, ♀, **Indonesia**. Sw Sulawesi, Gn. Bulusaraung, nr Camba, Mallawa, Mal. trap 3, c 800 m, 21.ii–25.iii.1997, C. v. Achterberg & R. de Vries, RMNH'97. Paratypes, **Indonesia**. 3 ♀, 3 ♂ same in formation as holotype (RMNH). [examined]

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. 1 ♀, Mount Wilhelm, 700 m, 26/10/2012-27/10/2012, PNG MAL-MW0700D-02/16-d02, P1437, 11982 (MNHN).

DIAGNOSIS — Head in frontal view much wider than high; frons without crests; clypeal margin with median tubercle. Mesosoma bronze-black, with very faint bluish reflections on mesoscutum. GT1 with large yellowish spot dorsally.

DISTRIBUTION — Indonesia (Maluku, Sulawesi, Sumatra), Vietnam (Mitroiu & van Achterberg 2013); Papua New Guinea (new record).

REMARKS — The female from PNG differs from the Oriental specimens (Mitroiu & van Achterberg 2013) mainly in having the flagellum darker than the scape, the fore wing yellowish, and a larger body size. *Apsilocera maculata* is similar to *A. acuta* n. sp. (see above) and *A. australis* (Bouček, 1988: figs 748, 749); from the latter *A. maculata* differs mainly in having a less blunt clypeal tubercle and more strongly convergent genae.

ACKNOWLEDGEMENTS

This study was conducted in the framework of "Our Planet Reviewed Papua-New-Guinea 2012-2013" set up by Pro-Natura International, the National Museum of Natural History (MNHN, France), the Institut de Recherche pour le Développement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Price Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery. The IBISCA expert network, the patron for this project, Prof. R.L. Kitching AM, Dr. Claire Villemant, in charge for the Hymenoptera material, and all other participants in this collective effort are thanked for their contribution. Many thanks to Dr. Gary Gibson and Dr. Ovidiu Popovici for providing useful comments on the manuscript.

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Huts bordering Piunde lake near the 3200 m site.
(Photo © Xavier Desmier).

Tersilochinae (Hymenoptera: Ichneumonidae) of Papua New Guinea: nine new species of the genus *Diaparsis* Förster

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ABSTRACT

Among the almost forty Tersilochinae species collected on the slopes of Mt Wilhelm in Papua New Guinea in the course of the "Our Planet Reviewed – Papua New Guinea" expedition, thirty belong to the genus *Diaparsis* Förster. In this first paper we reviewed eight of these species characterized by the lack of notauli, and one other having nearly impunctate head and mesosoma. Nine species, *D. alba* n. sp., *D. claviger* n. sp., *D. daphnoides* n. sp., *D. falcator* n. sp., *D. fragilis* n. sp., *D. granulator* n. sp., *D. levigata* n. sp., *D. macilenta* n. sp. and *D. nugatoria* n. sp., are described as new, and a provisional key to the species of *Diaparsis* occurring in Papua New Guinea is provided.

RÉSUMÉ

Tersilochinae (Hymenoptères : Ichneumonidae) de Papouasie-Nouvelle-Guinée : neuf espèces nouvelles du genre *Diaparsis* Förster.

Parmi la quarantaine d'espèces de Tersilochinae collectées sur les flancs du Mont Wilhelm en Papouasie-Nouvelle-Guinée lors de l'expédition "La Planète revisitée – Papouasie-Nouvelle-Guinée", une trentaine appartiennent au genre *Diaparsis* Förster. Parmi ces dernières, huit se caractérisent par l'absence de notauli et une neuvième par sa tête et son mesosoma presque dépourvus de ponctuation. Ces neuf espèces nouvelles : *D. alba* n. sp., *D. claviger* n. sp., *D. daphnoides* n. sp., *D. falcator* n. sp., *D. fragilis* n. sp., *D. granulator* n. sp., *D. levigata* n. sp., *D. macilenta* n. sp. and *D. nugatoria* n. sp. sont décrites et une clé préliminaire des espèces de *Diaparsis* présentes en Papouasie-Nouvelle-Guinée est fournie.

KHALAIM A. I. & VILLEMANT C. 2020 — Tersilochinae (Hymenoptera: Ichneumonidae) of Papua New Guinea: nine new species of the genus *Diaparsis* Förster, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 335-362 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

INTRODUCTION

A study of the subfamily Tersilochinae (Ichneumonidae) of Papua New Guinea started with our previous work (Khalaim & Villemant 2019), where we recognized three tersilochine genera, *Allophrys* Förster, *Probles* Förster and *Diaparsis* Förster, and reviewed the former two. The present paper concerns the third genus, *Diaparsis* Förster.

Diaparsis is the largest genus of Tersilochinae being distributed almost worldwide (unknown only from the Neotropical region) and includes over 90 described species (Yu *et al.* 2016). In the Oriental region, the genus is exceptionally species rich, comprising almost half of total Tersilochinae species of this region (Khalaim 2011). In the Australasian region, the genus is known from Australia (Gauld 1984; Khalaim 2008, 2015) and New Zealand (Khalaim & Ward 2018, 2019), and about thirty undescribed species were mentioned from Papua New Guinea (Khalaim & Villemant 2019).

The aim of this work is to describe nine species of *Diaparsis* from Papua New Guinea and provide a provisional identification key of this genus that allows the recognition of these new species.

MATERIAL AND METHODS

A large amount of material of Ichneumonidae was collected in Madang province in the north coast of Papua New Guinea (further PNG) in the course of the "Our Planet Reviewed – Papua New Guinea" expedition. All specimens were obtained from Malaise traps (MAL) or flight interception traps (FIT). Collections were made at eight sites every 500 m along an altitudinal transect ranging from 200 to 3700 m on Mt Wilhelm and in a conservation area at Wanang (Swire) Research Station (175 m) a lowland forest 63 km north of Mt Wilhelm (Leponce *et al.* 2016).

From this material, eight species of the genus *Diaparsis* lacking notauli, and one species with the head and mesosoma impunctate, were recognized – all are described here as new to science. All holotypes and most paratypes of the new species are deposited at the Muséum national d'Histoire naturelle, Paris, France (MNHN), with several paratypes preserved in the Zoological Institute of the Russian Academy of Sciences (further ZISP).

Morphological terminology follows that of Townes (1969) with changes according to Khalaim (2011). Photographs were taken with a Canon EOS 70D digital camera attached to an Olympus SZX10 stereomicroscope; partially focused images were combined using Helicon Focus Pro software; all photographs were taken in ZISP.

RESULTS

About 30 species of the genus *Diaparsis* are recognized in PNG, all belong to the subgenus *Diaparsis* s. str. and are apparently undescribed. This diversity is much more than those previously discovered in the genera *Allophrys* (7 species) and *Probles* (1 species), and indicates that *Diaparsis* is a dominant genus in PNG representing about 80% of the species of Tersilochinae currently known from this country.

Only limited material from a single restricted region of PNG was included, therefore this review does not reflect actual biodiversity of the genus, as well as the subfamily, in this country, and further investigation of Tersilochinae of PNG and nearby islands remain necessary.

In this work we review a group of eight *Diaparsis* species without notauli (Figures 2, 12, 17, 21, 33, 38, 42), one species with an impunctate head and mesosoma, and provide a provisional key of the genus in PNG allowing the identification of these taxa. Eight described species (all except *D. nugatoria* n. sp.) are represented only by females in our material. In spite of this, we suppose that the key can be used for identification of both females and males, with caution.

SYSTEMATIC PART

Family ICHNEUMONIDAE Latreille, 1802
Subfamily TERSILOCHINAE Schmiedeknecht, 1910

Genus *DIAPARSIS* Förster, 1869

KEY TO SPECIES OF *DIAPARSIS* OCCURRING IN PAPUA NEW GUINEA

1. Mesoscutum without notaulus, i.e. with neither impression nor wrinkle (or wrinkles) on its anterolateral side (Figures 1, 2, 12, 21, 33, 38, 43) **2**
– Mesoscutum with notaulus which is represented by impression (furrow) and/or distinct wrinkle (or wrinkles) on its anterolateral side (Figure 50) **9**

2. Antenna with subapical finger-shaped structures on outer surface of flagellomeres 1 and 2 (Figure 9, arrow). Clypeus narrow, 2.2-2.4 times as broad as long (Figures 3, 11). Head, in dorsal view, with gena 0.35-0.6 times as long as eye width (Figures 2, 10). Flagellum with 15-16 flagellomeres **3**
– Antenna with subapical finger-shaped structures on outer surface of flagellomeres 4 to 6 or 7 (Figure 14, arrow). Clypeus 2.2-2.8 times as broad as long. Head, in dorsal view, with gena 0.4-1.0 times as long as eye width. Flagellum with 15-22 flagellomeres **5**

3. Flagellum with conspicuous subapical pale band (Figure 1). Head, in dorsal view, with gena 0.35 times as long as eye width (Figure 2) ..... *D. alba* n. sp.
– Flagellum without subapical pale band. Head, in dorsal view, with gena 0.4-0.6 times as long as eye width..
..... **4**

4. Flagellum strongly clavate apically; subapical flagellomere as long as broad or transverse (Figure 9) .....
..... *D. claviger* n. sp.
– Flagellum filiform or slightly clavate apically; subapical flagellomere distinctly elongate ... *D. fragilis* n. sp.

5. First metasomal tergite, in dorsal view, with petiole more or less parallel-sided, postpetiole distinctly widened anteriorly and clearly separated from petiole (Figure 26) **6**
– First tergite, in dorsal view, weakly and evenly widened, with postpetiole not separated from petiole (as in Figure 49) **7**

6. Occipital carina dorsally completely absent. Flagellum with 15-16 flagellomeres; subbasal flagellomeres about 1.5 times as long as broad (Figure 20). Face, frons, mesoscutum, mesopleuron and dorsolateral area of propodeum with strong and dense punctures; distance between punctures mostly subequal to diameter of puncture (Figures 21-24). Propodeum with apical longitudinal carinae obliterated (Figure 24). Apex of ovipositor with two small notches dorsally (Figure 27); sheath 1.5 times as long as first tergite. Body length about 3.5 mm ..... *D. falcator* n. sp.
– Occipital carina dorsally complete. Flagellum with 20 flagellomeres; subbasal flagellomeres more than twice as long as broad (Figure 15). Face, frons, mesoscutum, mesopleuron and dorsolateral area of propodeum with fine and sparse punctures; distance between punctures much longer than diameter of puncture (Figures 16, 17). Propodeum with apical longitudinal carinae distinct. Apex of ovipositor with dorsal subapical depression and small rounded tooth before this depression (Figure 18); sheath over 3.0 times as long as first tergite (Figure 14). Body length 4.5 mm ..... *D. daphnoides* n. sp.

7. Head, in dorsal view, with gena 0.65 times as long as eye width. First metasomal tergite very slender, 6.5 times as long as apically broad ..... *D. levigata* n. sp.
– Head, in dorsal view, with gena 0.4-0.45 times as long as eye width (Figures 36, 42). First metasomal tergite shorter, 5.4-5.8 times as long as apically broad **8**

8. Clypeus 2.4-2.5 times as broad as long (Figure 37), weakly separated from face (Figure 35), with sparse punctures in upper part. Antennal flagellum basally slender, with subbasal flagellomeres 1.4-1.7 times as long as broad (Figure 35). Ovipositor with dorsal subapical depression, without distinct teeth (Figure 41) .... *D. macilenta* n. sp.
– Clypeus 3.0-3.2 times as broad as long, distinctly separated from face, densely punctate in upper part (Figure 44). Antennal flagellum with subbasal flagellomeres about 1.2 times as long as broad (Figure 45). Ovipositor with two distinct dorsal subapical teeth (Figure 47) ..... *D. nugatoria* n. sp.

9. Face, frons, mesopleuron and dorsolateral area of propodeum granulate but impunctate or with sparse indistinct punctures (Figures 29-31). Ovipositor robust, with dorsal subapical depression (Figure 32) and sheath about 1.2 times as long as first tergite (Figure 28) ..... *D. granulator* n. sp.
– Face, frons, mesopleuron and dorsolateral area of propodeum distinctly punctate. Ovipositor usually not as above, short to very long ..... 11 (other species of *Diaparsis*)

Diaparsis (Diaparsis) alba n. sp.

Figures 1-7

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Madang Prov. Mt Wilhelm (-5.720874, 145.2695), 1200 m, 13-14.V.2013, leg. Sam *et al.*, understorey, MAL-MW1200'D-01/16-d01, P4813-20997 (MNHN). Paratype. **Papua New Guinea**. Madang Prov., 1 ♀, Mt Wilhelm (-5.720874, 145.2695), 1200 m, 4-5.XI.2012, leg. Philip *et al.*, understorey, Plot 4, MAL-MW1200D-11/16-d11, P1836-11337 (MNHN).

COMPARISON — *Diaparsis alba* may easily be distinguished from all Oriental and Oceanic congeners by its slender antennal flagellum with 15 flagellomeres, of which 4 to 6 subapical ones are white (Figure 1).

DESCRIPTION — *Female*. Body length 4.0 mm. Fore wing length almost 2.8 mm.

Head strongly and roundly tapered behind eyes in dorsal view; gena very short, 0.35 times as long as eye width (Figure 2). Clypeus narrow, about 2.4 times as broad as long, lenticular (Figure 3), separated from face by shallow groove, smooth in lower part, with sparse punctures on very shallowly granulate background in upper 0.5-0.6, convex in lateral view. Mandible robust, distinctly tapered in basal half and with upper and lower margins subparallel in apical half; upper tooth almost twice as long as lower tooth (Figure 3). Malar space 0.6-0.7 times as long as basal mandibular width. Antennal flagellum slender, filiform, with 15 flagellomeres; subbasal and mid flagellomeres 2.2-2.5 times as long as broad; subapical flagellomere 1.2-1.4 times as long as broad; apical flagellomere in lateral view curved, with distal end rounded and conspicuously compressed; flagellomeres 1 and 2 bearing subapical finger-shaped structures on outer surface (Figure 14, arrow). Face weakly convex, without distinct median prominence. Face distinctly granulate, dull, punctate (punctures mostly indistinct because of granulation). Frons with fine but distinct, moderately dense punctures on finely granulate dull background. Vertex and gena very shallowly granulate, weakly shining, with very sparse punctures. Occipital carina complete, somewhat pointed mediodorsally in dorsal view. Hypostomal carina present in upper 0.6, not reaching occipital carina.

Mesoscutum with distinct and moderately dense punctures on nearly smooth shining background (Figure 2). Scutellum with lateral longitudinal carinae present on anterior 0.2 (Figure 2). Notaulus completely absent (Figure 2). Foveate groove extending over anterior half of mesopleuron, strongly oblique, broad, moderately deep, with distinct transverse wrinkles (Figure 4). Mesopleuron densely punctate, almost smooth between punctures centrally, finely granulate and dull peripherally and ventrally. Propodeum with distinct basal keel which is about 0.4 times as long as apical area (Figure 5); dorsolateral area punctate on shallowly granulate background, weakly shining. Propodeal spiracle separated from pleural carina by about 3.0 times diameter of spiracle (Figure 6). Apical area flat, narrowly rounded anteriorly (Figure 5); apical longitudinal carinae distinct, reaching transverse carina anteriorly.



FIGURES 1-7

Diaparsis alba n. sp., female, holotype (1, 2, 4-6) and paratype (3, 7): **1**, Head with antennae, lateral view; **2**, Head and mesoscutum, dorsal view; **3**, Head, front view; **4**, Head and mesosoma, lateral view; **5**, Propodeum, dorsal view; **6**, Propodeum and base of metasoma, lateral view; **7**, Apex of ovipositor, lateral view.

Fore wing with second recurrent vein (2m-cu) postfurcal, weakly pigmented in anterior 0.6, distinct posteriorly. First abscissa of radius (Rs+2r) straight, somewhat longer than width of pterostigma. First and second sections of radius (Rs+2r and Rs) meeting at slightly acute angle (about 85°). Intercubitus (2rs-m) very short and thick; abscissa of cubitus between intercubitus and second recurrent vein (abscissa of M between 2rs-m and 2m-cu) short. Metacarpus (R1) almost reaching tip of the wing. Second abscissa of postnervulus present. Hind wing with nervellus (cu1&cu-a) reclivous, slanted about 70° from horizontal. Legs slender; tarsal claws very thin.

First tergite slender, 5.8 times as long as posteriorly broad, round in cross-section centrally, polished, with shallow elongate oblique glymma at its mid-length (Figure 6); tergite weakly and evenly widened from anterior to posterior in dorsal view, with petiole not separated from postpetiole (as in Figure 49); upper margin of tergite, in lateral view, almost straight in anterior 0.7 and weakly arcuate in posterior 0.3 (Figure 6). Second tergite 2.2 times as long as anteriorly broad. Thyridial depression about 1.5 times as long as broad, separated from anterior margin of second tergite, with posterior end rounded. Ovipositor slender, weakly upcurved, with shallow dorsal subapical depression and weak rounded tooth before this depression (Figure 7); sheath (missing in both females) about 2.3 times as long as first tergite.

Head and mesosoma black. Palpi brownish yellow; lower 0.4 of clypeus and mandible (except reddish black teeth) yellow-brown. Scape and pedicel of antenna brown, distal end of pedicel yellowish; flagellum brown or dark brown with 4 (in paratype) or 6 (in holotype) subapical flagellomeres white (Figure 1). Tegula and pterostigma brown or dark brown. Wings almost hyaline. Legs predominantly brown; fore partly yellowish. First metasomal tergite brownish black, following tergites dark brown.

Male. Unknown.

VARIATION — The paratype is paler than the holotype, with head and mesosoma partly dark reddish brown rather than black, metasoma entirely brown and legs mostly brown to pale brown.

ETYMOLOGY — The species is named from the Latin "albus" (white), after its white-banded antennal flagellum.

DISTRIBUTION — **Papua New Guinea**.

Diaparsis (Diaparsis) claviger n. sp.

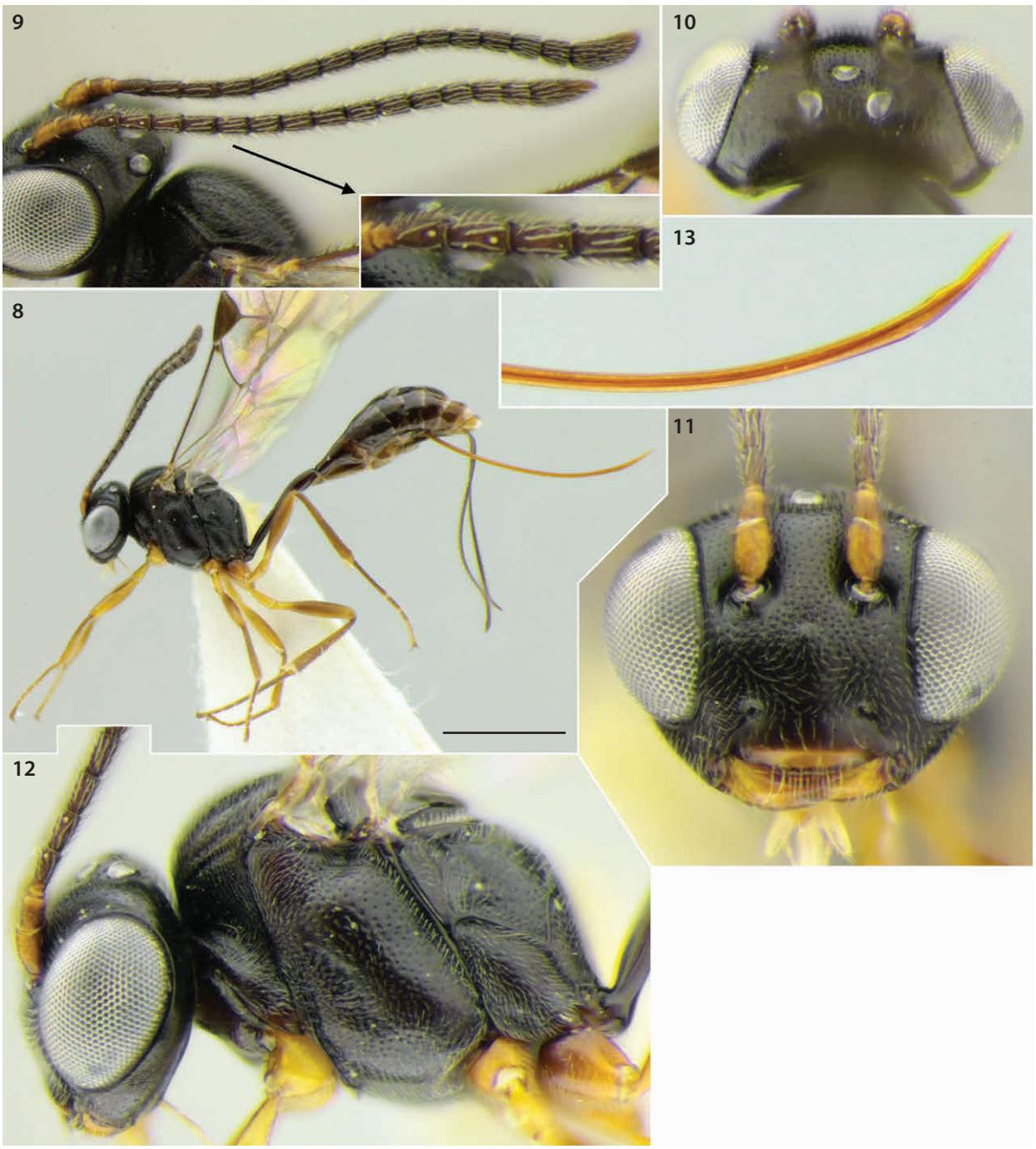
Figures 8-13

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Madang Prov. Mt Wilhelm (-5.720874, 145.2695), 1200 m, 13-14.V.2013, leg. Sam *et al.*, understorey, MAL-MW1200'C-01/16-d01, P4797-20882 (MNHN). Paratype. **Papua New Guinea**. Madang Prov., 1 ♀, Mt Wilhelm (-5.759269, 145.2356), 1700 m, 8-10.XI.2012, leg. Valeba *et al.*, understorey, FIT-MW1700-J-1/8-d01, P1950-18140 (MNHN).

COMPARISON — *Diaparsis claviger* is very similar to *D. alba* n. sp. and *D. fragilis* n. sp. but differs from both in having less slender and clavate antennal flagellum (Figure 9). It also differs from *D. alba* by its somewhat longer malar space and gena (Figure 10), more slender mandible, occipital carina evenly arcuate in dorsal view, and weaker foveate groove of the mesopleuron.

DESCRIPTION — *Female*. Body length 3.7 mm. Fore wing length 2.7 mm.

Head strongly and roundly tapered behind eyes in dorsal view; gena very short, 0.4 times as long as eye width (Figure 10). Clypeus narrow, about 2.4 times as broad as long, lenticular (Figure 11), separated from face by shallow impression, smooth (slightly scabrous near upper margin), with fine but distinct punctures in upper 0.7, convex in lateral view. Mandible distinctly tapered in basal half and with upper and lower margins subparallel in apical half; upper tooth



FIGURES 8-13

Diaparsis claviger n. sp., female, holotype: **8**, Habitus (without apices of wings), lateral view; **9**, Antennae, lateral view; **10**, Head, dorsal view; **11**, Head, front view; **12**, Head and mesosoma, lateral view; **13**, Apex of ovipositor, lateral view. Scale bar = 1 mm.

almost twice as long as lower tooth. Malar space 0.7-0.8 times as long as basal mandibular width. Antennal flagellum with 15 flagellomeres, basally slender, apically distinctly clavate; subbasal flagellomeres about 1.8 times as long as broad; subapical flagellomere as long as broad or slightly transverse; apical flagellomere in lateral view curved, with distal end rounded and compressed; flagellomeres 1 and 2 bearing distinct subapical finger-shaped structures on outer surface (Figures 9, 12). Face weakly convex, without distinct median prominence. Face and frons with fine moderately dense punctures on granulate and dull background (Figure 11). Vertex and gena very shallowly granulate to almost smooth, shining, with very sparse fine punctures. Occipital carina complete (mediodorsally very weak), evenly arcuate in dorsal view. Hypostomal carina absent (or not reaching occipital carina).

Mesoscutum with distinct and moderately dense punctures on nearly smooth shining background. Scutellum with lateral longitudinal carinae present on anterior 0.2. Notaulus completely absent (Figure 12). Foveate groove extending over anterior half of mesopleuron, strongly oblique, broad but very shallow, with short transverse wrinkles (Figure 12). Mesopleuron densely punctate, almost smooth between punctures centrally, finely granulate and dull peripherally and ventrally. Propodeum with distinct basal keel which is about 0.35 times as long as apical area; dorsolateral and apical areas punctate on almost smooth background, shining. Propodeal spiracle separated from pleural carina by about 3.0 times diameter of spiracle (Figure 12). Apical area flat, pointed or narrowly rounded anteriorly; apical longitudinal carinae distinct, reaching transverse carina anteriorly.

Fore wing with second recurrent vein (2m-cu) postfurcal, weakly pigmented in anterior 0.6, distinct posteriorly. First abscissa of radius (Rs+2r) straight, somewhat longer than width of pterostigma. First and second sections of radius (Rs+2r and Rs) meeting at slightly acute angle (about 85°). Intercubitus (2rs-m) short, slightly thickened, about as long as abscissa of cubitus between intercubitus and second recurrent vein (abscissa of M between 2rs-m and 2m-cu). Metacarpus (R1) almost reaching tip of the wing. Second abscissa of postnervulus present. Hind wing with nervellus (cu1&cu-a) reclivous, slanted about 70° from horizontal. Legs slender; tarsal claws very thin.

First tergite slender, 5.5 times as long as posteriorly broad, round in cross-section centrally, polished, without glymma; tergite weakly and evenly widened from anterior to posterior in dorsal view, with petiole not separated from postpetiole (as in Figure 49); upper margin of tergite, in lateral view, almost straight in anterior 0.7-0.8 and weakly arcuate in posterior 0.2-0.3. Second tergite 1.9-2.1 times as long as anteriorly broad. Thyridial depression 1.5-2.0 times as long as broad, with posterior end rounded. Ovipositor slender, weakly and evenly upcurved (Figure 8), with shallow dorsal subapical depression and weak rounded tooth before this depression (Figure 13); sheath about twice as long as first tergite.

Head and mesosoma black. Palpi yellow; lower 0.4 of clypeus and mandible (except dark red teeth) brownish yellow. Scape and pedicel of antenna yellow-brown, flagellum brownish black (Figure 9). Tegula and pterostigma brown. Wings almost hyaline, very weakly infumate with brown. Fore and mid legs predominantly brownish yellow; mid femur and tibia and both tarsi more or less darkened with brown; in paratype fore femur and both coxae brown. Hind leg predominantly brown, with yellow trochanters and base and apex of femur (Figure 8). First metasomal tergite dark brown, following tergites uniformly brown to dark brown.

Male. Unknown.

ETYMOLOGY — The species is named from the Latin "claviger" (clavate), after its club-shaped antennal flagellum.

DISTRIBUTION — Papua New Guinea.

Diaparsis (Diaparsis) daphnoides n. sp.

Figures 14-18

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Madang Prov. Mt Wilhelm (-5.785644, 145.0580), 3700 m, 24-25.X.2012, leg. Gewa *et al.*, understorey, Plot 3, MAL-MW3700C-09/16-d09, P3768-9196 (MNHN).

COMPARISON — *Diaparsis daphnoides* may easily be distinguished from other species of *Diaparsis* occurring in PNG by the combination of long gena, lack of notaulus, and long malar space and ovipositor.

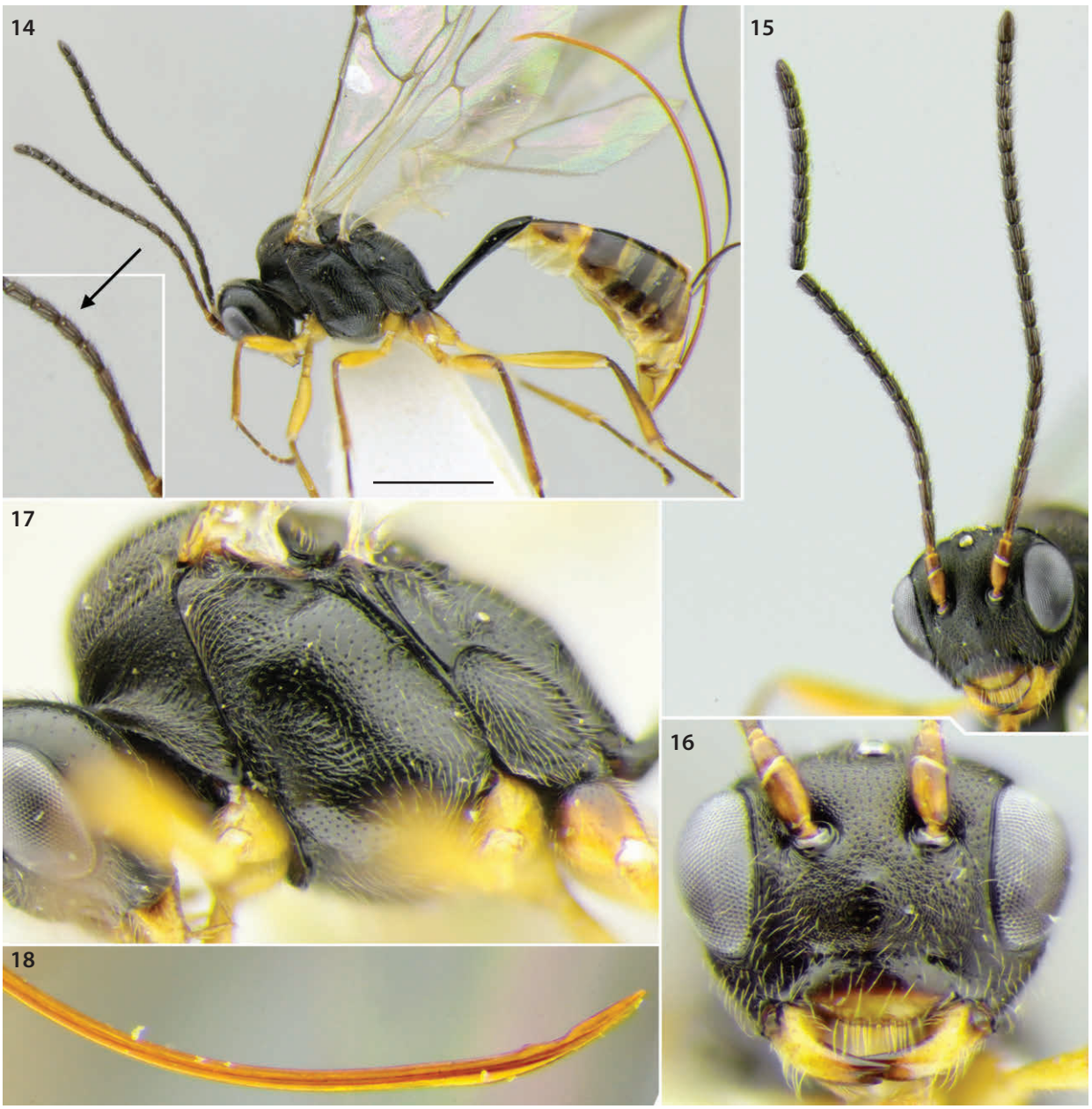
DESCRIPTION — *Female*. Body length 3.5 mm. Fore wing length 4.2 mm.

Head uniformly rounded behind eyes in dorsal view; gena as long as eye width. Clypeus 2.6 times as broad as long (Figure 16), lenticular, separated from face by distinct furrow, smooth, with distinct sparse punctures in upper half, straight in lateral view. Mandible distinctly tapered in basal half and with upper and lower margins subparallel in apical half; upper tooth almost twice as long as lower tooth. Malar space 1.1 times as long as basal mandibular width. Antennal flagellum with 20 flagellomeres, filiform (Figure 15); subbasal flagellomeres 2.2-2.4 times as long as broad; subapical flagellomeres 1.2-1.3 times as long as broad; flagellomeres 4 to 7 bearing distinct subapical finger-shaped structures on outer surface. Face weakly convex, with small tubercle centrally (Figure 16). Face and frons finely punctate on granulate and dull background (punctures partly indistinct because of granulation). Vertex shallowly granulate, dull, with fine but distinct sparse punctures. Gena shallowly granulate, nearly smooth, weakly shining, with very sparse fine punctures. Occipital carina complete, evenly arcuate in dorsal view. Hypostomal carina absent at least in lower part (upper part hidden).

Mesoscutum densely punctate on granulate background; punctures sparser and granulation weaker on lateral lobes. Scutellum with lateral longitudinal carinae present on anterior 0.3. Notaulus completely absent. Foveate groove extending over anterior half of mesopleuron, not reaching epicnemial carina anteriorly, strongly oblique, broad and shallow, with weak transverse wrinkles (Figure 17). Mesopleuron centrally with distinct punctures, shallowly granulate and weakly shining between punctures, peripherally granulate, dull and with punctures mostly indistinct. Propodeum with all carinae fine but complete; basal keel half as long as apical area; dorsolateral area finely but distinctly punctate on finely granulate and dull background. Propodeal spiracle separated from pleural carina by 2.0 times diameter of spiracle. Apical area flat, somewhat pointed anteriorly (with lateral carinae arcuate), distinctly granulate, impunctate, with very fine wrinkles in posterior half; apical longitudinal carinae distinct, reaching transverse carina anteriorly.

Fore wing with second recurrent vein (2m-cu) postfurcal, weakly pigmented in anterior half, distinct posteriorly. First abscissa of radius (Rs+2r) straight, distinctly longer than width of pterostigma. First and second sections of radius (Rs+2r and Rs) meeting at slightly acute angle (about 85°). Intercubitus (2rs-m) moderately long, slightly thickened, longer than abscissa of cubitus between intercubitus and second recurrent vein (abscissa of M between 2rs-m and 2m-cu). Metacarpus (R1) almost reaching tip of the wing. Second abscissa of postnervulus present. Hind wing with nervellus (cu1&cu-a) slightly reclivous, slanted about 80° from horizontal. Legs slender; tarsal claws very thin.

First tergite 4.2 times as long as posteriorly broad, round in cross-section centrally, polished, without glymma; first tergite in dorsal view, with petiole more or less parallel-sided, postpetiole distinctly widened anteriorly and clearly separated from petiole (as in Figure 26); upper margin of tergite, in lateral view, almost straight in anterior 0.7 and arcuate in posterior 0.3 (Figure 14). Second tergite 1.75 times as long as anteriorly broad. Thyridial depression about 1.5 times as long as broad, with posterior end rounded. Ovipositor long and slender, upcurved (Figure 14), with dorsal subapical depression and small rounded tooth before this depression (Figure 18); sheath over 3.0 times longer than first tergite.



FIGURES 14-18

Diaparsis daphnoides n. sp., female, holotype: **14**. Habitus (without apices of wings and legs), lateral view; **15**. Head with antennae, anterolateral view; **16**. Head, front view; **17**. Head and mesosoma, ventrolateral view; **18**. Apex of ovipositor, lateral view. Scale bar = 1 mm.

Head, mesosoma and first metasomal tergite black. Palpi, lower 0.4 of clypeus and mandible (except reddish black teeth) brownish yellow. Scape and pedicel of antenna brown, flagellum brownish black. Tegula brownish yellow. Pterostigma dark brown. Wings almost hyaline, very weakly infumate with brown. Legs yellow-brown with hind coxa dark brown in basal half, all tibiae brownish and all tarsi blackish. Metasoma behind first tergite predominantly dark brown, with brownish yellow markings on posterior margins of tergites and ventrally.

Male. Unknown.

ETYMOLOGY — The species is named after Daphne, a naiad (female nymph) in Greek mythology.

DISTRIBUTION — Papua New Guinea.

Diaparsis (Diaparsis) falcator n. sp.

Figures 19-27

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Madang Prov. Mt Wilhelm (-5.761029, 145.1860), 2200 m, 22-23.X.2012, leg. Mogia *et al.*, understorey, Plot 3, MAL-MW2200C-07/16-d07, P2596-9621 (MNHN). Paratypes, **Papua New Guinea**. Madang Prov., 1 ♀, same data as holotype, but 21-22.X.2012; MAL-MW2200C-06/16-d06, P2595-11936 (ZISP); 1 ♀, same data, but 29-30.X.2012; MAL-MW2200C-14/16-d14, P2603-11900 (MNHN).

COMPARISON — *Diaparsis falcator* is most easily recognized by its occipital carina widely absent dorsally. The species also possesses a notable first metasomal segment with the postpetiole unusually short and distinctly separated from the petiole (Figures 25, 26), similar to that of the genus *Probles* Förster, and the ovipositor apex has two dorsal subapical notches (Figure 27).

DESCRIPTION — *Female*. Body length 3.4 mm. Fore wing length 2.8 mm.

Head strongly and roundly tapered behind eyes in dorsal view; gena 0.5-0.6 times as long as eye width (Figure 21). Clypeus broad, about 2.6 times as broad as long, lenticular, separated from face by shallow impression (Figure 22), almost straight in lateral view, with distinct and dense punctures in upper 0.8, smooth between punctures. Mandible very slender, long, slightly tapered at base and with upper and lower margins subparallel in apical half; both teeth very long, and upper tooth twice as long as lower tooth. Malar space about 0.8 times as long as basal mandibular width. Antennal flagellum with 15-16 flagellomeres, filiform; subbasal and mid flagellomeres 1.2-1.4 times as long as broad; subapical flagellomeres slightly elongate; apical flagellomere in lateral view not curved (Figure 20); flagellomeres 4 to 6 bearing distinct subapical finger-shaped structures on outer surface. Face weakly convex. Face and frons with dense punctures on granulate and dull background. Vertex and gena with very fine and sparse (partly indistinct) punctures on very shallowly granulate background. Occipital carina dorsally widely absent, laterally distinct. Hypostomal carina absent.

Mesoscutum uniformly distinctly and densely punctate on shallowly granulate background; distance between punctures subequal to diameter of puncture (Figure 21). Scutellum with lateral longitudinal carinae present on anterior 0.3. Notaulus completely absent. Foveate groove extending over anterior half of mesopleuron, not reaching epicnemial carina anteriorly, strongly oblique, broad and shallow, with coarse transverse wrinkles. Mesopleuron densely punctate, smooth between punctures centrally and finely granulate peripherally (Figure 23). Propodeum with fine basal keel which is about half as long as apical area; dorsolateral and apical areas densely punctate on finely granulate or almost smooth background. Propodeal spiracle separated from pleural carina by 1.5-2.0 times diameter of spiracle. Apical area flat, rounded anteriorly; apical longitudinal carinae obliterated, completely absent or vestigial (Figure 24).

Fore wing with second recurrent vein (2m-cu) postfurcal, weakly pigmented in anterior half and distinct posteriorly. First abscissa of radius (Rs+2r) straight, somewhat longer than width of pterostigma. First and second sections of radius



FIGURES 19-24

Diaparsis falcator n. sp., female, holotype (19, 21, 24) and paratype (20, 22, 23): **19**, Habitus (without ovipositor sheath), lateral view; **20**, Antenna, lateral view; **21**, Head and mesoscutum, dorsal view; **22**, Head, front view; **23**, Mesosoma, ventrolateral view; **24**, Propodeum, dorsal view. Scale bar = 1 mm.

(Rs+2r and Rs) meeting at slightly acute angle (about 85°). Intercubitus (2rs-m) moderately long, somewhat thickened, longer than abscissa of cubitus between intercubitus and second recurrent vein (abscissa of M between 2rs-m and 2m-cu). Metacarpus (R1) almost reaching tip of the wing. Second abscissa of postnervulus present. Hind wing with nervellus (cu1&cu-a) slightly reclivous, slanted about 80° from horizontal. Legs slender.

First tergite very slender, almost 6.0 times as long as posteriorly broad, round in cross-section centrally, polished, without glymma but with fine oblique groove at apical end of petiole laterally (Figure 25); first tergite, in dorsal view, with petiole more or less parallel-sided, postpetiole distinctly widened anteriorly and approximately twice as wide as petiole (Figure 26); upper margin of tergite, in lateral view, arcuate in anterior 3/4 and apical 1/4, with distinct concavity in posterior 0.7 (Figure 25). Second tergite about twice as long as anteriorly broad. Thyridial depression 2.5 times as long as broad, with posterior end rounded or pointed. Ovipositor slender, distinctly upcurved, with two fine dorsal subapical notches (Figure 27); sheath about 1.5 times as long as first tergite.

Head and mesosoma black. Palpi and mandible (except red teeth) yellow or brownish yellow. Lower 0.3-0.4 of clypeus yellow-brown to brown. Scape and pedicel of antenna yellow-brown, flagellum brownish black. Tegula and pterostigma brown. Wings almost hyaline, very weakly infumate with brown. Legs predominantly brownish yellow, coxae brownish (hind coxa sometimes dark brown), fore and mid tibiae and tarsi more or less infuscate, hind femur (except base), tibia and tarsus brown to dark brown. First metasomal tergite dark brown, following tergites brown to dark brown; tergite 2 posteriorly pale (Figure 26).

Male. Unknown.

ETYMOLOGY — The species is named from the Latin "falcatus" (armed with scythes, sickle-shaped).

VARIATION — The three examined females are very similar to each other, with minor variation in structure and colour.

DISTRIBUTION — Papua New Guinea.

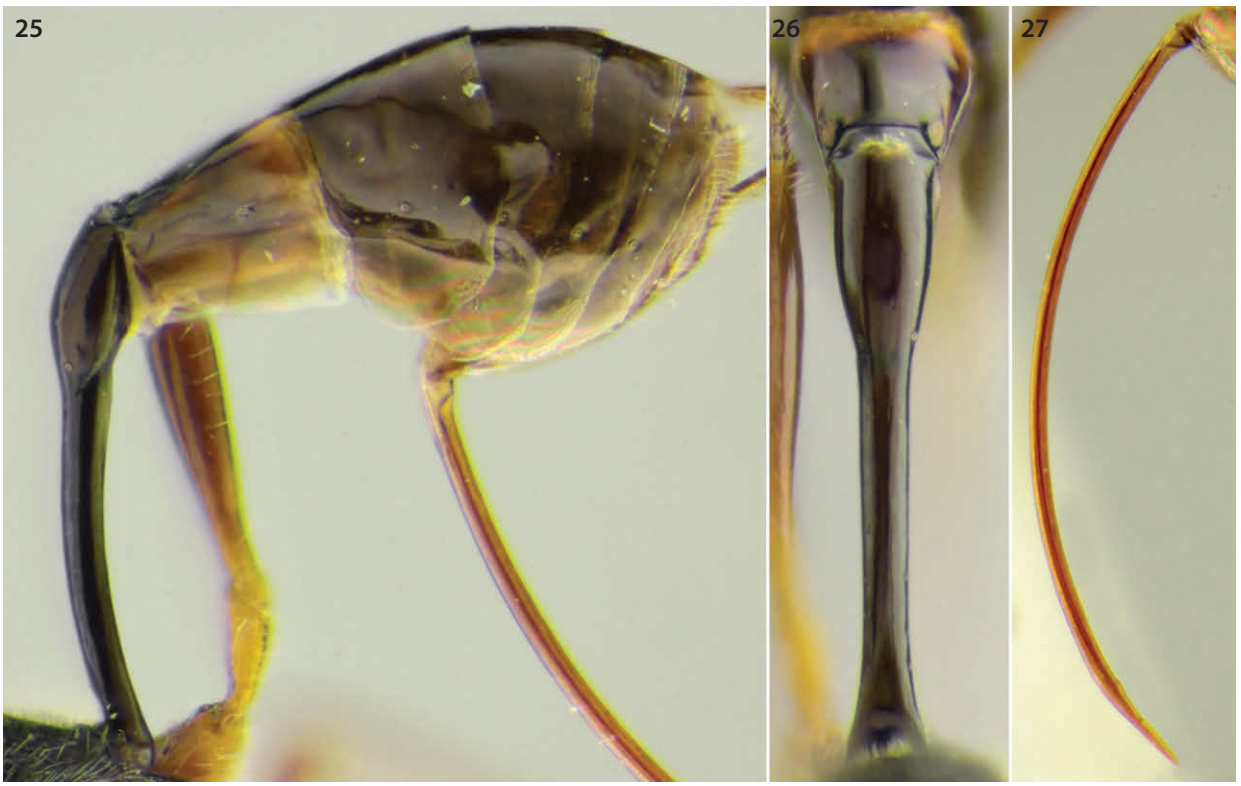
Diaparsis (Diaparsis) fragilis n. sp.

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Madang Prov. Mt Wilhelm (-5.815272, 145.1565), 2700 m, 27-28.X.2012, leg. Kua *et al.*, understorey, Plot 4, MAL-MW2700D-12/16-d12, P3007-8848 (MNHN). Paratypes, **Papua New Guinea**. Madang Prov., 1 ♀, Mt Wilhelm (-5.720874, 145.2695), 1200 m, 24-25.V.2013, leg. Sam *et al.*, understorey, MAL-MW1200'C-12/16-d12, P4808-20956 (ZISP); 1 ♀, Mt Wilhelm (-5.720874, 145.2695), 1200 m, 14-15.V.2013, leg. Sam *et al.*, understorey, MAL-MW1200'A-02/16-d02, P4766-20999 (MNHN).

COMPARISON — *Diaparsis fragilis* is very similar to *D. claviger* n. sp. but differs from this species by its antennal flagellum slender, filiform, with the subapical flagellomere distinctly elongate, while in *D. claviger* the flagellum is clavate, with the subapical flagellomere as long as broad or slightly transverse. It also differs from *D. alba* and *D. claviger* by longer genae and the shape of the apical flagellomere, which is straight in lateral view in *D. fragilis* and curved in *D. alba* and *D. claviger*.

DESCRIPTION — *Female*. Body length 3.2 mm. Fore wing length 2.7 mm.

Head strongly and roundly tapered behind eyes in dorsal view; gena 0.6 times as long as eye width. Clypeus narrow, about 2.2 times as broad as long, lenticular, separated from face by shallow impression, smooth in lower part and in upper part, with fine punctures in upper 0.7, convex in lateral view. Mandible distinctly tapered in basal half and with upper and lower margins subparallel in apical half; upper tooth almost twice as long as lower tooth. Malar space 0.7-0.9 times as long as basal mandibular width (0.9 times in holotype). Antennal flagellum with 15-16 flagellomeres, filiform, slender; subbasal



FIGURES 25-27

Diaparsis falcator n. sp., female, holotype: **25**, Metasoma, lateral view; **26**, First metasomal segment, dorsal view; **27**, Ovipositor, lateral view.

flagellomeres 2.0-2.3 times as long as broad; subapical flagellomere 1.2-1.3 times as long as broad; apical flagellomere in lateral view not curved, with distal end rounded and compressed; flagellomeres 1 and 2 bearing distinct subapical finger-shaped structures on outer surface. Face weakly convex, without distinct median prominence. Face and frons with very fine, partly indistinct punctures on granulate and dull background. Vertex with very shallow granulation, almost smooth, impunctate. Gena smooth, shining, impunctate. Occipital carina complete (mediodorsally very weak), somewhat pointed mediodorsally in dorsal view. Hypostomal carina present in upper about 2/3, not reaching occipital carina.

Mesoscutum with fine punctures on nearly smooth shining background. Scutellum with lateral longitudinal carinae present on anterior 0.2. Notaulus completely absent. Foveate groove extending over anterior half of mesopleuron, not reaching epicnemial carina anteriorly, strongly oblique, broad and very shallow, with very weak (sometimes indistinct) transverse wrinkles. Mesopleuron finely punctate, smooth between punctures centrally, finely granulate and dull peripherally. Propodeum with distinct basal keel which is about half as long as apical area; dorsolateral and apical areas shallowly granulate and weakly shining, without distinct punctures. Propodeal spiracle separated from pleural carina by 3.0-4.0 times diameter of spiracle. Apical area flat, pointed or very narrowly rounded anteriorly; apical longitudinal carinae distinct, reaching transverse carina anteriorly.

Fore wing with second recurrent vein (2m-cu) postfurcal, weakly pigmented in anterior 0.6, distinct posteriorly. First abscissa of radius (Rs+2r) straight, longer than width of pterostigma. First and second sections of radius (Rs+2r and Rs) meeting at slightly acute angle (about 85°). Intercubitus (2rs-m) short, slightly thickened, about as long as abscissa of

cubitus between intercubitus and second recurrent vein (abscissa of M between 2rs-m and 2m-cu). Metacarpus (R1) almost reaching tip of the wing. Second abscissa of postnervulus present. Hind wing with nervellus (cu1&cu-a) reclivous, slanted about 70° from horizontal. Legs slender; tarsal claws very thin.

First tergite slender, 5.5 times as long as posteriorly broad, round in cross-section centrally, polished, without glymma; tergite weakly and evenly widened from anterior to posterior in dorsal view, with petiole not separated from postpetiole (as in Figure 49); upper margin of tergite, in lateral view, almost straight in anterior 0.8 and weakly arcuate in posterior 0.2. Second tergite about twice as long as anteriorly broad. Thyridial depression almost twice as long as broad, separated from anterior margin of second tergite, with posterior end rounded. Ovipositor slender, weakly and evenly upcurved, with shallow dorsal subapical depression and weak rounded tooth before this depression (as in Figure 13); sheath about 2.1 times as long as first tergite.

Head and mesosoma black with reddish brown tinge. Palpi yellow; lower 0.4 of clypeus and mandible (except dark red teeth) yellow or brownish yellow. Scape and pedicel of antenna yellow-brown, flagellum uniformly brownish black. Tegula and pterostigma brown. Wings almost hyaline, very weakly infumate with brown. All coxae, hind femur, tibia and tarsus brown; remaining legs brownish yellow to brown. First metasomal tergite brown or dark brown, following tergites brown.

Male. Unknown.

ETYMOLOGY — The species is named from the Latin "fragilis" (fragile, brittle).

VARIATION — The two paratypes have genae longer than the holotype, 0.4-0.5 times as long as eye width; malar space shorter, about 0.7 times as long as basal mandibular width; head and mesosoma mostly granulate, dull and with stronger punctures than the holotype.

DISTRIBUTION — Papua New Guinea.

Diaparsis (Diaparsis) granulator n. sp.

Figures 28-32

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Madang Prov. Mt Wilhelm (-5.731961, 145.2522), 700 m, 22-23.V.2013, leg. Sam *et al.*, understorey, MAL-MW0700'B-10/16-d10, P4726-20875 (MNHN). Paratypes, **Papua New Guinea**. Madang Prov., 1 ♀, Mt Wilhelm (-5.720874, 145.2695), 1200 m, 31.X-1.XI.2012, leg. Philip *et al.*, understorey, Plot 1, MAL-MW1200A-07/16-d07, P1784-11318 (ZISP); 1 ♀, same data but 8-9.XI.2012, Plot 3; MAL-MW1200C-15/16-d15, P1824-11352 (MNHN); 1 ♀, Mt Wilhelm (-5.759269, 145.2356), 1700 m, 3-4.XI.2012, leg. Valeba *et al.*, understorey, Plot 4, MAL-MW1700D-10/16-d10, P2225-8778 (MNHN); 1 ♀, same data but 8-10.XI.2012, FIT-MW1700-J-1/8-d01, P1950-18140 (MNHN); 1 ♀, Mt Wilhelm (-5.731961, 145.2522), 700 m, 28-29.V.2013, leg. Sam *et al.*, understorey, MW0700'B-10/16-d16, P4732-20594 (MNHN).

COMPARISON — *Diaparsis granulator* is readily distinguished from other PNG species having notauli by its head and mesosoma impunctate or with sparse indistinct punctures on a granulate background (Figures 29-31). It also has a notable robust ovipositor with a shallow dorsal subapical depression (Figure 32) and the ovipositor sheath 1.2 times as long as the first tergite (Figure 28).

DESCRIPTION — *Female*. Body length 3.8 mm. Fore wing length 2.8 mm.

Head rounded and strongly tapered behind eyes in dorsal view; gena 0.45 times as long as eye width. Clypeus 2.6 times as broad as long, lenticular, separated from face by distinct impression, slightly convex in lateral view, smooth in lower half, with fine and sparse punctures on smooth or scabrous background in upper part. Mandible slender, weakly


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tapered in basal half and with upper and lower margins subparallel in apical half; upper tooth 2.5 times as long as lower tooth. Malar space 0.8-0.9 times as long as basal mandibular width. Antennal flagellum with 17-18 flagellomeres, filiform (Figure 29); subbasal flagellomeres 1.6-1.9 times as long as broad; subapical flagellomeres about 1.2 times as long as broad; apical flagellomere in lateral view not curved; flagellomeres 4 to 6 bearing distinct subapical finger-shaped structures on outer surface. Face weakly convex. Face, frons, vertex and gena granulate, dull, without distinct punctures; granulation of gena sometimes shallow; face and frons sometimes with indistinct punctures centrally. Occipital carina, in dorsal view, weakly convex.

Mesosoma granulate, dull, without distinct punctures; mesoscutum and mesopleuron sometimes with indistinct punctures. Scutellum with lateral longitudinal carinae present on anterior 0.3. Notaulus weakly impressed, with short but distinct wrinkle on anterolateral side of mesoscutum. Foveate groove over anterior half of mesopleuron, not reaching epicnemial carina anteriorly, strongly oblique, broad, with distinct transverse wrinkles (Figure 30). Propodeum with basal keel (partly obliterated in holotype) which is 0.4-0.5 times as long as apical area; transverse carina strong. Propodeal spiracle separated from pleural carina by 2.0-3.5 times diameter of spiracle (Figure 30). Apical area flat, rounded or somewhat pointed anteriorly (Figure 31); apical longitudinal carinae complete, usually strong, reaching transverse carina anteriorly (Figure 31).

Fore wing with second recurrent vein (2m-cu) postfurcal, weakly pigmented in anterior 0.4-0.5 and distinct posteriorly. First abscissa of radius (Rs+2r) straight, longer than width of pterostigma. First and second sections of radius (Rs+2r and Rs) meeting at right or slightly acute angle. Intercubitus (2rs-m) short, thick, distinctly shorter than abscissa of cubitus between intercubitus and second recurrent vein (abscissa of M between 2rs-m and 2m-cu). Metacarpus (R1) reaching tip of the wing. Second abscissa of postnervulus present. Hind wing with nervellus (cu1&cu-a) distinctly reclivous, slanted 65-70° from horizontal. Legs slender.

First tergite slender, about 4.6 times as long as posteriorly broad, round in cross-section centrally, polished, without glymma; first tergite, in dorsal view, weakly and evenly widened in posterior half, with petiole not separated from postpetiole; upper margin of tergite, in lateral view, straight or slightly arcuate in anterior 0.5-0.7, distinctly arcuate in posterior 0.3-0.5. Second tergite 1.6 times as long as anteriorly broad. Thyridial depression 1.5-1.8 times as long as broad, with posterior end rounded. Ovipositor robust, weakly upcurved, with shallow dorsal subapical depression (Figure 32); sheath about 1.2 times as long as first tergite (Figure 28).

Head and mesosoma black. Palpi, mandible (teeth red or dark red) and lower 0.4 of clypeus brownish yellow. Scape and pedicel of antenna yellow, dorsally brownish; flagellum dark brown, sometimes pale brown basally. Tegula brownish yellow or brown. Pterostigma brown. Wings almost hyaline, very weakly infumate with brown. Legs brownish yellow; coxae basally and hind femur centrally sometimes darkened with brown. First metasomal tergite brownish black; following tergites dark brown, distal end of metasoma sometimes pale (Figure 28).

Male. Unknown.

ETYMOLOGY — The species is named after its granulate, almost impunctate head and mesosoma.

VARIATION — All examined specimens are very similar, with minor variation in structure and colouration.

DISTRIBUTION — Papua New Guinea.

FIGURES 28-32

Diaparsis granulator n. sp., female, holotype: **28**, Habitus, lateral view; **29**, Head with antennae, front view; **30**, Head and mesosoma, lateral view; **31**, Propodeum, dorsal view; **32**, Ovipositor, lateral view. Scale bar = 1 mm.

Diaparsis (Diaparsis) levigata n. sp.

Figure 33

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Madang Prov. Mt Wilhelm (-5.758978, 145.1861), 2200 m, 30-31.X.2012, leg. Mogia *et al.*, understorey, Plot 1, MAL-MW2200A-15/16-d15, P2572-9380 (MNHN).

COMPARISON — *Diaparsis levigata* is very similar to *D. macilenta* n. sp. but differs in having longer genae and a more slender first metasomal segment.

DESCRIPTION — *Female*. Body length 5.4 mm. Fore wing length almost 4.0 mm.

Head strongly rounded and tapered behind eyes in dorsal view; gena 0.65 times as long as eye width. Clypeus 2.2 times as broad as long, lenticular, separated from face by shallow impression, almost straight in lateral view, smooth, with distinct and sparse punctures in upper 0.6. Mandible robust, weakly tapered basally, with upper tooth somewhat longer than lower tooth. Malar space half as long as basal mandibular width. Antennal flagellum with 20 flagellomeres, filiform; subbasal flagellomere about 1.8 times as long as broad; subapical flagellomere slightly elongate; apical flagellomere in lateral view not curved; flagellomeres 4 to 6 bearing distinct subapical finger-shaped structures on outer surface. Face weakly convex. Face and frons with very dense distinct punctures on shallowly granulate, nearly smooth background; distance between punctures mostly equal to diameter of puncture. Vertex and gena with fine and sparse punctures on polished background. Occipital carina, in dorsal view, evenly convex.

Mesoscutum distinctly and densely punctate on nearly smooth, shining background; distance between punctures mostly subequal to diameter of puncture. Scutellum with lateral longitudinal carinae present on anterior 0.3. Notaulus completely absent. Foveate groove in anterior half of mesopleuron, not reaching epicnemial carina anteriorly, strongly oblique, broad and shallow, with transverse wrinkles. Mesopleuron distinctly and densely punctate, smooth between punctures centrally and finely granulate peripherally, with impunctate area above foveate groove. Propodeum with fine basal keel which is half as long as apical area; dorsolateral area punctate on nearly smooth background. Propodeal spiracle separated from pleural carina by 2.5 times diameter of spiracle. Apical area flat, somewhat pointed anteriorly, finely granulate, dull, with indistinct punctures; apical longitudinal carinae almost completely obliterated, more or less discernible only posteriorly.

Fore wing with second recurrent vein (2m-cu) postfurcal, with short weakly pigmented bulla anteriorly. First abscissa of radius (Rs+2r) straight, longer than width of pterostigma. First and second sections of radius (Rs+2r and Rs) meeting at slightly acute angle (about 85°). Intercubitus (2rs-m) thickened, about as long as abscissa of cubitus between intercubitus and second recurrent vein (abscissa of M between 2rs-m and 2m-cu). Metacarpus (R1) almost reaching tip of the wing. Second abscissa of postnervulus present. Hind wing with nervellus (cu1&cu-a) slightly reclivous, slanted about 80° from horizontal. Legs slender.

First tergite very slender, 6.5 times as long as posteriorly broad, round in cross-section centrally, polished, without glymma; first tergite weakly and evenly widened from anterior to posterior in dorsal view, with petiole not separated from postpetiole (as in Figure 49); upper margin of tergite, in lateral view, almost straight in anterior 0.8, distinctly arcuate in posterior 0.2. Second tergite 2.5 times as long as anteriorly broad. Thyridial depression shallow, long, extending over anterior 0.4 of second tergite, with posterior end pointed. Ovipositor slender, upcurved, with weak dorsal subapical depression (as in Figure 41); sheath about 2.8 times as long as first tergite.

Head and mesosoma black. Palpi yellow. Mandible (except reddish black teeth) yellow-brown. Lower 0.3 of clypeus reddish brown. Scape and pedicel of antenna dark brown dorsally and pale brown ventrally, flagellum brownish black. Tegula dark brown. Pterostigma brown. Wings almost hyaline, very weakly infumate with brown. All coxae, trochanters and bases of femora yellow (hind coxa slightly brownish basally); fore and mid leg with femora, tibiae and tarsi brownish yellow, tibiae and tarsi infuscate; hind leg with femur dark brown (except base), tibia and tarsus brownish black. First metasomal tergite black with brownish tinge; following tergites brown to dark brown, posterior margins of tergites pale.

Male. Unknown.



FIGURE 33

Diaparsis levigata n. sp., female, holotype, habitus (without apices of wings and ovipositor), lateral view. Scale bar = 1 mm.

ETYMOLOGY — The species is named from the Latin "levigatus" (smooth), after its polished genae.

DISTRIBUTION — Papua New Guinea.

Diaparsis (Diaparsis) macilenta n. sp.

Figures 34-41

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Madang Prov. Mt Wilhelm (-5.731961, 145.2522), 700 m, 20-21.V.2013, leg. Sam *et al.*, understorey, MAL-MW0700'C-08/16-d08, P4740-20857 (MNHN). Paratypes, **Papua New Guinea**. Madang Prov., 1 ♀, Mt Wilhelm (-5.720874, 145.2695), 1200 m, 26-28.XI.2012, leg. Philip *et al.*, FIT-MW1200-M-1/8-d02, P1584-1178 (MNHN); 1 ♀, Mt Wilhelm (-5.720903, 145.2715), 1200 m, 4-5.XI.2012, leg. Philip *et al.*, understorey, Plot 3, MAL-MW1200C-11/16-d11, P1820-11338 (ZISP); 1 ♀, Mt Wilhelm (-5.721022, 145.2703), 1200 m, 2-3.XI.2012, leg. Philip *et al.*, understorey, Plot 2, MAL-MW1200B-09/16-d09, P1802-11323 (MNHN).

COMPARISON — *Diaparsis macilenta* is very similar to *D. levigata* n. sp. and *D. nugatoria* n. sp. but differs from the former by its shorter genae (Figure 36) and less slender first metasomal segment, and from the latter by the sparsely punctate clypeus, only weakly separated from the face (Figures 35, 37), basally slender antennal flagellum (Figure 35), and the ovipositor apex without dorsal subapical teeth (Figure 41).

DESCRIPTION — *Female*. Body length 5.4 mm. Fore wing length almost 3.7 mm.

Head strongly rounded and tapered behind eyes in dorsal view; gena about 0.4 times as long as eye width (Figure 36). Clypeus 2.4-2.5 times as broad as long, lenticular, separated from face by very shallow impression (Figure 35), almost straight in lateral view, smooth, with sparse or moderately dense punctures in upper 0.6-0.7; distance between punctures longer than diameter of puncture (Figure 37). Mandible robust, weakly tapered basally, with upper tooth somewhat longer than lower tooth. Malar space about half as long as basal mandibular width. Antennal flagellum with 19-22 flagellomeres (22 in holotype), filiform or weakly tapered towards apex; subbasal flagellomeres 1.4-1.7 times as long as broad; subapical flagellomere 1.0-1.2 times as long as broad; apical flagellomere in lateral view not curved; flagellomeres 4 to 6 bearing distinct subapical finger-shaped structures on outer surface. Face weakly convex. Face and frons very densely punctate on finely granulate and dull background; distance between punctures mostly equal to diameter of puncture (Figure 37). Vertex with fine and sparse punctures on shallowly granulate, laterally nearly smooth background. Gena polished, with fine and sparse punctures. Occipital carina, in dorsal view, rather strongly curved, narrowly rounded anteriorly. Hypostomal carina absent in lower part.

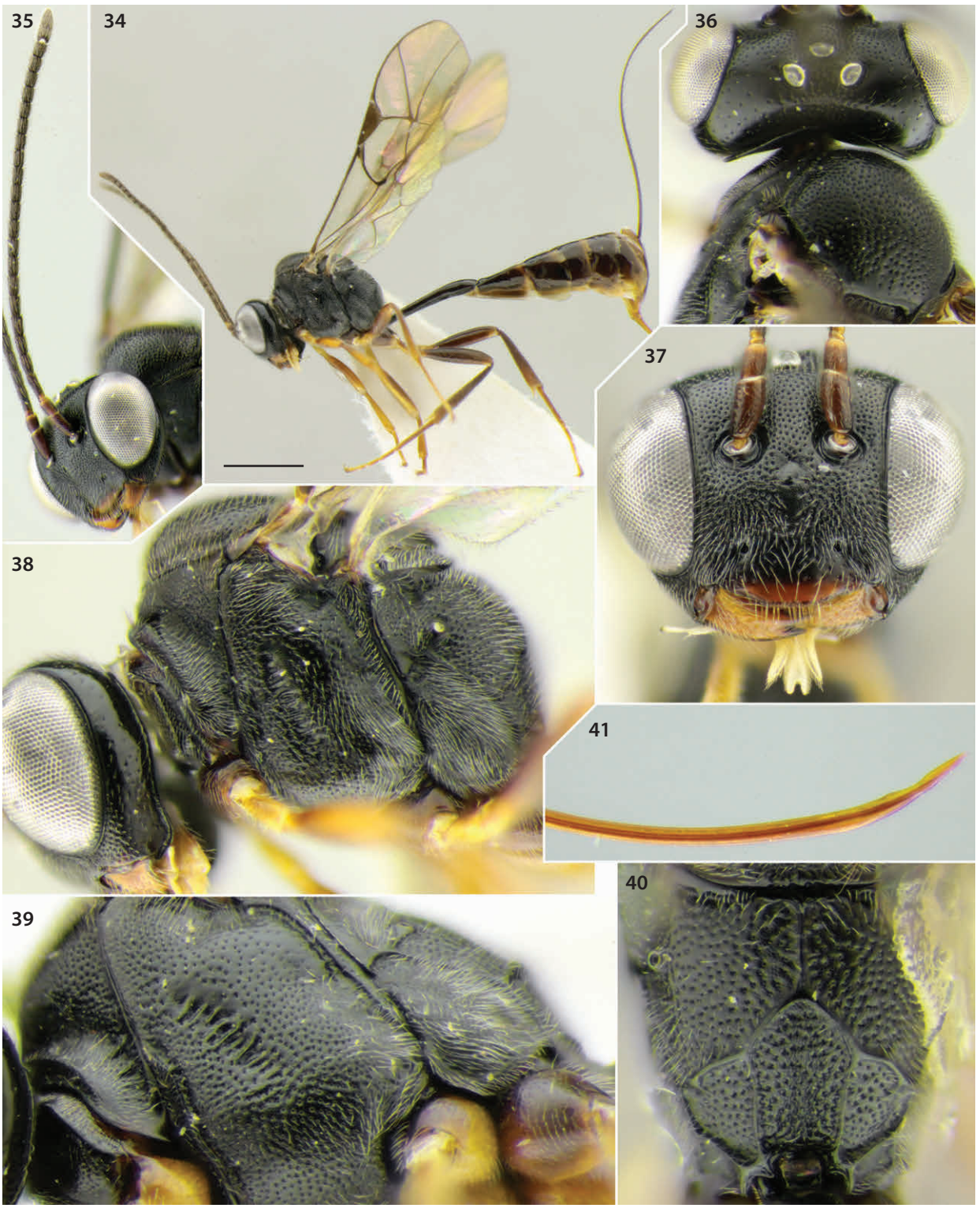
Mesoscutum densely punctate on shallowly granulate background. Scutellum with lateral longitudinal carinae present on anterior 0.2-0.3. Notaulus completely absent. Foveate groove over anterior half of mesopleuron, not reaching epicnemial carina anteriorly, strongly oblique, broad and shallow, with distinct transverse wrinkles. Mesopleuron distinctly and densely punctate, nearly smooth between punctures centrally and finely granulate peripherally, with impunctate area above foveate groove (Figures 38, 39). Propodeum with basal keel which is 0.5-0.6 times as long as apical area (Figure 40); dorsolateral area densely punctate on finely granulate background. Propodeal spiracle separated from pleural carina by 2.0-2.5 times diameter of spiracle (Figure 38). Apical area flat, narrowly rounded or somewhat pointed anteriorly (Figure 40), granulate, dull, densely punctate (punctures sometimes indistinct); apical longitudinal carinae usually complete, anteriorly sometimes weak or evanescent.

Fore wing with second recurrent vein (2m-cu) postfurcal, with short weakly pigmented bulla anteriorly. First abscissa of radius (Rs+2r) straight, longer than width of pterostigma. First and second sections of radius (Rs+2r and Rs) meeting at slightly acute angle (about 85°). Intercubitus (2rs-m) thickened, about as long as abscissa of cubitus between intercubitus and second recurrent vein (abscissa of M between 2rs-m and 2m-cu). Metacarpus (R1) almost reaching tip of the wing. Second abscissa of postnervulus present. Hind wing with nervellus (cu1&cu-a) slightly reclivous, slanted about 80° from horizontal. Legs slender, tarsal claws strongly curved.

First tergite slender, about 5.5 times as long as posteriorly broad, round in cross-section centrally, polished, without glymma; first tergite weakly and evenly widened from anterior to posterior in dorsal view, with petiole not separated from postpetiole (as in Figure 49); upper margin of tergite, in lateral view, almost straight in basal 0.75, arcuate in apical 0.25.

FIGURES 34-41

Diaparsis macilenta n. sp., female, holotype (34, 37, 38) and paratype (35, 36, 39-41): **34**, Habitus (without ovipositor), lateral view; **35**, Head with antennae, antero-lateral view; **36**, Head and mesoscutum, dorsal view; **37**, Head, front view; **38**, Head and mesosoma, lateral view; **39**, Mesosoma, ventro-lateral view; 40. Propodeum, dorsal view; 41. Apex of ovipositor, lateral view. Scale bar = 1 mm.


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Second tergite about 2.1 times as long as anteriorly broad. Thyridial depression distinct, long, extending over anterior 0.4-0.5 of second tergite, with posterior end pointed. Ovipositor slender, upcurved, with weak dorsal subapical depression (Figure 41); sheath about 2.8 times as long as first tergite.

Head and mesosoma black. Palpi yellow. Mandible yellow-brown with teeth reddish black. Lower 0.3 of clypeus brownish yellow. Scape and pedicel of antenna dark brown (pedicel apically pale), flagellum brownish black. Tegula brownish black. Pterostigma brown. Wings almost hyaline, very weakly infumate with brown. Legs brownish yellow; all coxae and hind femur brown to dark brown; hind tibia and tarsus weakly to strongly darkened with brown; fore and mid femora and tibiae slightly brownish to extensively brown-marked. First metasomal tergite black with slight brownish tinge; following tergites dark brown, posterior margins of tergites pale (Figure 34).

Male. Unknown.

ETYMOLOGY — The species is named from the Latin "macilentus" (thin, lean).

VARIATION — Leg colour varies from predominantly brownish yellow with brown markings to extensively dark brown. One paratype (collected 2-3.XI.2012) also has a flagellum which is short and tapered towards the apex, with 19 flagellomeres (21-22 in other specimens), and with subbasal flagellomeres about 1.4 times as long as broad. Otherwise the four examined females are rather similar, with minor variation in structure and colour.

DISTRIBUTION — Papua New Guinea.

Diaparsis (Diaparsis) nugatoria n. sp.

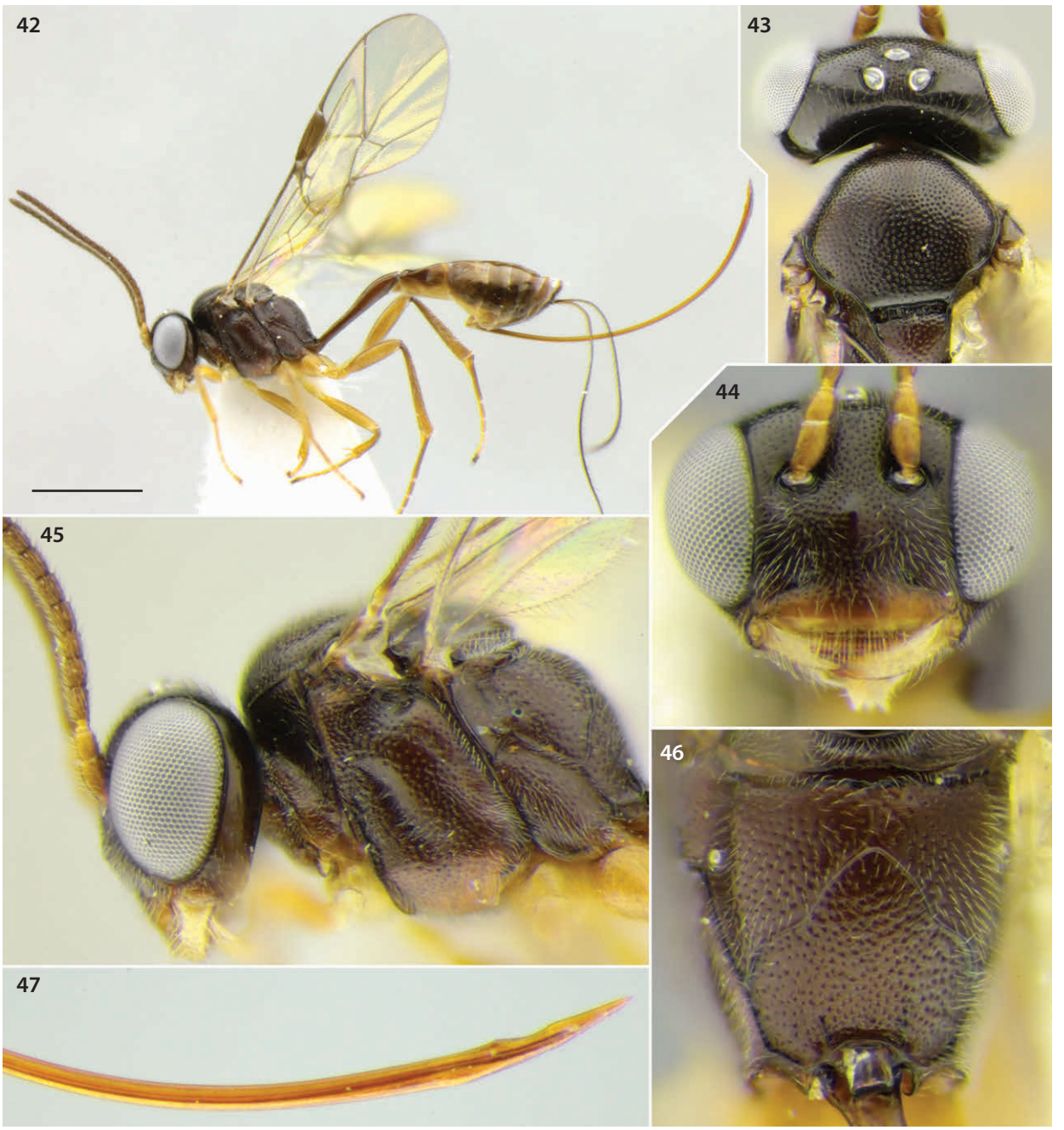
Figures 42-47

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Madang Prov. Mt Wilhelm (-5.720874, 145.2695), 1200 m, 17-18.V.2013, leg. Sam *et al.*, understorey, MAL-MW1200'C-05/16-d05, P4801-20903 (MNHN). Paratypes, **Papua New Guinea**. Madang Prov., 1 ♀, Mt Wilhelm (-5.721022, 145.2703), 1200 m, 3-4.XI.2012, leg. Philip *et al.*, understorey, Plot 2, MAL-MW1200B-10/16-d10, P1803-11328 (MNHN); 1 ♀, Mt Wilhelm (-5.720874, 145.2695), 1200 m, 31.X-1.XI.2012, leg. Philip *et al.*, understorey, Plot 1, MAL-MW1200A-07/16-d07, P1784-11318 (MNHN); 1 ♀, Mt Wilhelm (-5.720874, 145.2695), 1200 m, 26-27.V.2013, leg. Sam *et al.*, understorey, MAL-MW1200'C-14/16-d14, P4810-20981 (MNHN); 1 ♀, (without head), same data but 15-16.V.2013, MAL-MW1200'D-03/16-d03, P4815-20892 (MNHN); 1 ♀, same data but MAL-MW1200'B-12/16-d12, 24-25.V.2013, P4792-20957 (ZISP); 1 ♀, Mt Wilhelm (-5.731961, 145.2522), 700 m, 17-18.V.2013, leg. Sam *et al.*, understorey, MAL-MW0700'B-05/16-d05, P4721-20841 (MNHN); 1 ♀, same data but 28-29.V.2013, MAL-MW0700'B-16/16-d16, P47632-20594 (ZISP); 1 ♂, same data but 15-16.V.2013, MAL-MW0700'D-03/16-d03, P4751-20819 (MNHN); 1 ♂, same data but 23-24.V.2013, MAL-MW0700'D-11/16-d11, P4759-20620 (ZISP).

COMPARISON — *Diaparsis nugatoria* is very similar to *D. macilenta* n. sp. but differs from this species by the broad, densely punctate clypeus which is clearly separated from the face (Figure 44), basally less slender antennal flagellum (Figure 45), and the ovipositor apex with two distinct dorsal subapical teeth (Figure 47).

DESCRIPTION — *Female*. Body length 5.4 mm. Fore wing length almost 3.7 mm.

Head roundly tapered behind eyes in dorsal view; gena about 0.4-0.45 times as long as eye width (Figure 43). Clypeus about 3.0-3.2 times as broad as long, lenticular, separated from face by distinct impression (Figure 44), almost straight in lateral view, smooth, with dense punctures in upper 0.6-0.7 (Figure 44), with weak transverse ridge in lower 0.6-0.7. Mandible slender, weakly tapered in basal 0.3, with upper and lower margins subparallel in apical 0.7; upper tooth 2.0-2.5



FIGURES 42-47

Diaparsis nugatoria n. sp., female, holotype (42, 44, 45, 47) and paratype (43, 46): **42**, Habitus, lateral view; **43**, Head and mesoscutum, dorsal view; **44**, Head, front view; **45**, Head and mesosoma, lateral view; **46**, Propodeum, dorsal view; **47**, Apex of ovipositor, lateral view. Scale bar = 1 mm.

times as long as lower tooth. Malar space 0.3-0.4 times as long as basal mandibular width. Antennal flagellum with 20-22 flagellomeres (20 in holotype), weakly tapered towards apex; subbasal flagellomeres 1.1-1.3 times as long as broad (Figure 45); subapical flagellomeres 1.0-1.2 times as long as broad; apical flagellomere in lateral view not curved; flagellomeres 4 to 6-7 bearing distinct subapical finger-shaped structures on outer surface (Figure 45). Face weakly convex, with small tubercle centrally. Face and frons very densely punctate on finely granulate and dull background (Figure 44). Vertex with fine and sparse punctures on shallowly granulate, sometimes almost smooth background. Gena polished, with very fine and sparse punctures. Occipital carina, in dorsal view, rather strongly curved rounded (Figure 43). Hypostomal carina absent in lower part.



FIGURES 48-50

48, *Diaparsis nugatoria* n. sp., male, paratype, habitus, lateral view. **49**, **50**, *Diaparsis* sp., female: **49**, Base of metasoma, dorsal view; **50**, Upper part of head and mesoscutum, antero-lateral view. Scale bar = 1 mm.

Mesoscutum densely punctate on shallowly granulate, sometimes almost smooth background (Figure 43). Scutellum with lateral longitudinal carinae present on anterior 0.3 (Figure 43). Notaulus completely absent (Figure 43). Foveate groove over anterior half of mesopleuron, not reaching epicnemial carina anteriorly, strongly oblique, broad and shallow, with distinct transverse wrinkles. Mesopleuron distinctly and densely punctate, nearly smooth between punctures centrally and finely granulate peripherally, with impunctate area above foveate groove (Figure 45). Propodeum with basal keel which is 0.35-0.45 times as long as apical area (Figure 46); dorsolateral area punctate on finely granulate background. Propodeal spiracle separated from pleural carina by 1.5-2.5 times diameter of spiracle (Figure 45). Apical area flat, narrowly rounded or somewhat pointed anteriorly (Figure 46), granulate, dull, more or less punctate (punctures sometimes indistinct); apical longitudinal carinae usually complete in large specimens to completely obliterated in small specimens.

Fore wing with second recurrent vein (2m-cu) weakly to distinctly postfurcal, with weakly pigmented bulla anteriorly. First abscissa of radius (Rs+2r) straight, longer than width of pterostigma. First and second sections of radius (Rs+2r and Rs) meeting at right or slightly acute angle (85-90°). Intercubitus (2rs-m) thickened, 1.0-2.0 times as long as abscissa of cubitus between intercubitus and second recurrent vein (abscissa of M between 2rs-m and 2m-cu). Metacarpus (R1) almost reaching tip of the wing. Second abscissa of postnervulus present. Hind wing with nervellus (cu1&cu-a) slightly reclivous, slanted about 85° from horizontal. Legs slender, tarsal claws strongly curved.

First tergite slender, about 5.4-5.8 times as long as posteriorly broad, round in cross-section centrally, polished, without glymma; first tergite weakly and evenly widened from anterior to posterior in dorsal view, with petiole not separated from postpetiole (as in Figure 49); upper margin of tergite, in lateral view, almost straight in anterior 0.75, arcuate in posterior 0.25. Second tergite about 2.2 times as long as anteriorly broad. Thyridial depression shallow, 1.5-2.0 times as long as broad and rounded posteriorly in small specimens, extending over anterior 0.4-0.5 of second tergite and with more or less pointed posterior end in large specimens. Ovipositor slender, upcurved, with two dorsal subapical teeth (Figure 47); sheath about 2.8 times as long as first tergite.

Head and mesosoma dark reddish brown to black. Palpi and mandible (teeth dark red) yellow. Lower 0.3-0.4 of clypeus brownish yellow. Scape and pedicel of antenna brown to dark brown, sometimes yellow ventrally; flagellum dark brown to brownish black. Tegula dark brown. Pterostigma brown. Wings almost hyaline, very weakly infumate with brown. Legs predominantly brownish yellow; all coxae and hind femur weakly to strongly darkened with brown or dark brown; hind tibia and tarsus usually infuscate; fore and mid femora and tibiae sometimes partly darkened with brown. Metasoma brown to dark brown; tergites 2 to 7 usually pale brown or yellowish posteriorly (Figure 42).

Male (Figure 48). Gena 0.45 times as long as eye width. Flagellum with 20-21 flagellomeres. Malar space 0.15 times as long as basal mandibular width. Otherwise similar to female.

ETYMOLOGY — The species is named from the Latin "nugatorius" (trifling, worthless).

VARIATION — The species is rather variable in size and colour. Body length 5.4 to 7.8 mm, fore wing length 3.7 to 5.0 mm. In pale specimens the head and mesosoma are mostly brown and dark brown, metasoma brown, and legs brownish yellow with sparse brownish markings (as in Figure 42), while in dark specimens the head and mesosoma are mostly black, metasoma dark brown (first tergite brownish black to black), and legs extensively dark brown. In large specimens the apical longitudinal carinae of propodeum are usually complete and reach the transverse carina anteriorly, the thyridial depression is long (extending over the anterior 0.4-0.5 of the second tergite) and pointed posteriorly.

DISTRIBUTION — Papua New Guinea.

ACKNOWLEDGEMENTS

The project "Our Planet Reviewed – Papua New Guinea 2012-2013, Terrestrial component" was led by Pro-Natura International, the Muséum National d'Histoire Naturelle (MNHN), the Institut de Recherche pour le Développement (IRD, France) in partnership with the Institut Royal des Sciences Naturelles de Belgique (IRSNB, Belgium), the New Guinea Binatang Research Center (BRC, Madang), the University of Papua New Guinea, and the Divine Word University of Madang (PNG). Insect material was exported from Papua New Guinea under permit number 012297 granted by the Department of Environment and Conservation of Papua New Guinea. We warmly thank all the villagers from Wanang and Mt Wilhelm villages for their contribution to insect trapping and collection, and to the staff of the BRC and the scientists attending to the mission for the weeks spent at the Wanang Station to sort the insect material. We are particularly grateful to Sharon Agovaua (National Agriculture Research Institute, Port Moresby), Bradley Gewa (BRC) and Gilhem Duvot (MNHN) for sorting Hymenoptera families. We extend our thanks to Gavin R. Broad (Natural History Museum, London, UK) and Darren F. Ward (Landcare Research, Auckland, New Zealand) for reviewing the manuscript. The work of the senior author was supported by the Russian Foundation for Basic Research (grant no. 19-04-00027) and the State Research Project no. AAAA-A19-119020690101-6.

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Mixed lower montane forest dominated by Nothofagus trees at 2200 m asl.
(Photo © Xavier Desmier).

Binatangia (Diptera: Dolichopodidae) a new genus from Papua New Guinea

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ABSTRACT

A new genus, *Binatangia* (Diptera: Dolichopodidae) is described and comprises three new species: *Binatangia kokomo* n. sp., *B. maceveyi* n. sp. and *B. tabubil* n. sp. The three species were collected from forested sites under 1000 m elevation in Papua New Guinea. The genus is regarded *incertae sedis* within the Dolichopodidae.

RÉSUMÉ

***Binatangia* (Diptères : Dolichopodidae) un nouveau genre de Papouasie-Nouvelle-Guinée.**

Un nouveau genre, *Binatangia* (Diptères : Dolichopodidae) est décrit et comprend trois nouvelles espèces : *Binatangia kokomo* n. sp., *B. maceveyi* n. sp. et *B. tabubil* n. sp. Les trois espèces ont été collectées dans des sites forestiers à moins de 1000 m d'altitude en Papouasie-Nouvelle-Guinée. Ce genre est considéré *incertae sedis* au sein des Dolichopodidae.

INTRODUCTION

During October 2013, one of us (DJB) visited one of the "Our Planet Reviewed – Papua New Guinea" sites, Oromungu at 760 m in the Bismarck Range, Madang Province. While collecting with yellow water traps along a rainforest creek (Figure 14), he captured a pair of a striking new genus of Dolichopodidae that is described here. Also included are two additional species in the same genus collected at 950 m near Tabubil in the Western Province. This new genus is not assigned to any current dolichopodid subfamily and is regarded as genus *incertae sedis*.

BICKEL D.J. & MARTIN J. 2020 — *Binatangia* (Diptera: Dolichopodidae) a new genus from Papua New Guinea, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 363-375 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

MATERIALS AND METHODS

Material used in this study is housed at the Australian Museum, Sydney (AMS) and the B. P. Bishop Museum, Honolulu (BPBM).

Species are defined primarily based on male genitalia and male secondary sexual characters (MSSC). Photographs were made by JM with a Leica M205A photomontage system. The left lateral view of the hypopygium or male genital capsule is shown for each species. In describing the hypopygium, 'dorsal' and 'ventral' refer to morphological position prior to genitalic rotation and flexion. Thus, in figures showing a lateral view of the hypopygium, the top of the page is morphologically ventral, while the bottom is dorsal. Morphological terminology follows McAlpine (1981), except for the male hypopygium where Cumming *et al.* (1995) is used. Measurements were made on representative dry specimens (often the holotype). Body length of males is measured from the base of the antennae to the tip of the seventh abdominal segment. The CuAx ratio is the length of the m-cu crossvein/ distal section CuA. The position of features on elongate structures such as leg segments is given as a fraction of the total length, starting from the base. The relative lengths of the podomeres are representative ratios and not measurements, and are given for each leg in the following formula and punctuation: trochanter + femur; tibia; tarsomere 1/ 2/ 3/ 4/ 5. The following abbreviations and terms are used: MSSC - Male secondary sexual character(s); non-genitalic characters found only on male body; I, II, III: pro-, meso-, metathoracic legs; C, coxa; T, tibia; F, femur; ac, acrostichal setae; ad, anterodorsal; av, anteroventral; dc, dorsocentral setae; dv, dorsoventral; hm, postpronotal setae; np, notopleural setae; pa, postalar setae; pd, posterodorsal; pm, presutural supra-alar setae; ppl, proepisternal setae; pv, posteroventral; sa, postsutural supra-alar setae; sr, presutural intra-alar setae; t, tarsus; t_{1-5}, tarsomeres 1 to 5.

SYSTEMATIC PART

BINATANGIA Bickel n. gen.

Type species. *Binatangia kokomo* Bickel n. sp., here designated.

ETYMOLOGY — The name *Binatangia* honors the staff of the New Guinea Binatang Research Center in Madang. This organization conducts large-scale biodiversity and ecological studies in Papua New Guinea. In 2012 it was the in-country agency for the Our Planet Reviewed – Papua New Guinea terrestrial survey (Leponce *et al*. 2016). The gender is feminine.

DIAGNOSIS — Subfamily uncertain, *incertae sedis*.

Generic characters of *Binatangia*: body length: 2.5 - 2.8 mm (Figures 1, 7, 10).

Head. Wider than high in anterior view; ventral postcranium without field of setae; vertex not excavated, and with pair of strong vertical and pair of diverging ocellar setae present; pair of short postvertical setae on dorsal postcranium; lower face and clypeus narrow, and eyes almost contiguous anteriorly; male palp narrow basally and distally expanded with dense silvery pruinosity and fine hairs (Figure 2) (MSSC), female palp short and black; scape bare; both sexes with pedicel protruding into socket-like postpedicel, evident in both median and lateral views; postpedicel lobate and dorsally excised, with arista arising from excision.

Thorax. Mostly black with metallic green reflections, with little pruinosity; mesonotum short and rounded; ac biseriate; 6 dc present, with anteriormost dc shorter than others; median scutellar seta strong, lateral scutellar seta as short weak hair; proepisternum with strong seta dorsad of CI.

Legs. Coxa and remainder of legs black; CI with vertical row of 6-8 long white anterior setae (MSSC) and with subapical row of black curved anterior setae; CII with some short black anterolateral setae; FII with strong anterior preapical seta in both sexes (unless obscure in male by MSSC), FIII bare of anterior preapical seta; legs I and II sometimes with strong

male modifications (MSSC), podomeres variously with setal fields, swollen podomeres, cuticular projections, etc.; TII with strong offset ad-pd setal pairs.

Wing. Hyaline, vein M with flexion or *bosse alaire* midway between join of dm-cu and wing apex; R_{4+5} and M slightly diverging beyond crossvein dm-cu, but becoming subparallel beyond *bosse alaire*, and vein M joining margin slightly behind wing apex; anal angle absent.

Abdomen. segment 7 short, almost entirely retracted under segment 6, and tergite 7 with some short setae distally, but sternite 7 bare; segment 7 not forming peduncle for external hypopygium; sternite 8 ovate, covered with setae, and forming cap over hypopygial foramen; hypopygium (Figures 1, 4); epandrium ovate; basal epandrial seta not evident; hypandrium forming flat elongate cover over phallus, and with two pairs of modified socketed setae on ventral (external) surface of hypandrium; surstylus elongate, sometimes cleft cercus elongate, and sometimes flagelliform with elongate apical setae; female oviscapt broad, divided into two acanthophorites, each bearing 5 strong flat setae or dornen (Figure 5).

REMARKS — The genus *Binatangia* comprises three newly described species from New Guinea: *B. kokomo*, *B. tabubil*, and *B. maceveyi.* The species were collected in habitats ranging from near sea level to 950 m elevation in Papua New Guinea, mostly in rainforest (Figures 14, 15).

The genus displays several distinctive synapomorphies. These include both sexes with antennal pedicel protruding into socket-like postpedicel, males with enlarged silvery palps, male legs I and II sometimes with strong setal and cuticular modifications, hypopygium exserted but without pedunculate segment 7, males with an elongate cercus, and with one to two pairs of setae on the distal third of the ventral (outer) surface of the hypandrium.

Although males are readily recognized by their elongate exserted hypopygia, females have conservative facies and might not be distinctive enough to recognize while scanning large holdings of unsorted Dolichopodidae (for females, the pedicel enclosed by the postpedicel, visible in both median and lateral views, and the presence of a strong anterior preapical seta on femur II only are diagnostic characters).

Binatangia does not clearly fit into any of the major dolichopodid subfamilies. However, it appears to be closest to the *Urodolichous* Lamb, a paleotropical genus also found in New Guinea (see Grichanov *et al*. 2016, and key in this paper). Both *Binatangia* and *Urodolichous* are regarded as genera *incertae sedis.*

MORPHOLOGY — Important morphological characters that help define *Binatangia* are noted below:

1. Encapsulated pedicel. Both sexes of *Binatangia* have the pedicel protruding thumb-like into a socket-like postpedicel, evident in both median and lateral views (Figure 8). This encapsulation of the pedicel by the postpedicel is also characteristic of the genus *Syntormon* Loew (Sympycninae), but here the encapsulation is visible only in median view, the lateral view showing the pedicel truncate with the postpedicel.
2. Femoral preapical setae. Preapical femoral setae are important diagnostic characters in the Dolichopodidae, and the presence of a strong anterior preapical seta on femora II and III are important in defining such subfamilies as the Dolichopodinae and Sympycninae. In both sexes of *Binatangia*, the anterior preapical seta is found only on leg II, but absent on leg III.
3. Male postabdomen. The male postabdominal segment 7 in *Binatangia* is short, and almost entirely retracted under segment 6, with tergite 7 with only setose distally and sternite 7 bare. In the Dolichopodidae segment 7 is sometimes modified as a peduncle for a large exserted hypopygium, with the tergite and sternite prolonged or narrowed with respect to each other. In *Binatangia* segment 7 is plesiomorphic and rather unmodified.
4. Hypandrium. *Binatangia* is unusual in that males have socketed setae (usually two pairs) on the ventral (external) surface of the hypandrium (Figures 4, 13). Socketed hypandrial setae are rarely found in the Dolichopodidae.

KEY TO MALES OF THE GENUS *BINATANGIA* (DOLICHOPODIDAE) IN THE CONTEXT OF THE PAPUAN FAUNA

1. Vertex not excavated laterad of ocellar tubercle; vein M unbranched; scape dorsally bare of setae; posterior mesonotum not flattened; postvertical setae, short and near vertex, not on surface of dorsal postcranium; abdomen ovate, not flattened..... **2**
– Without the above combination of characters ..... other Dolichopodidae

2. Hypopygium rather small and encapsulated, with epandrium partially enclosed by abdominal segment 7, and cercus short, not much longer than genitalic capsule; other features various **3**
– Hypopygium large, with epandrium mostly free from segment 7; cercus often much longer than epandrium; ac biseriate; 6 dc present; lateral scutellar setae reduced to weak hairs **4**

3. Femora II and III with distinct anterior preapical seta; antenna usually high on head, about 1/4 distance from vertex; head usually ovate in anterior view; wing with anal angle often reduced or lost; tibia I often with ad row of short setae (serration) along distal half ..... Sympycninae
– Femora II and III without anterior preapical seta, or such apparent preapicals indistinct from background setal field; antenna usually near middle of head, 2/5 to 1/2 distance from vertex; head almost circular in anterior view, about as wide as high; anal angle well-developed (both sexes); male tarsomere 5 sometimes with enlarged pulvilli; tibia I without ad setal serration ..... Diaphorinae

4. Male palp spatulate with dense silvery pruinosity (Figures 2, 11); pedicel protruding into socket-like postpedicel, both sexes (Figures 6, 8); postpedicel lobate; hypandrium with setae on ventral (outer) surface (Figures 4, 13); femur II only with distinct anterior preapical seta; abdominal segment 7 short, mostly retracted under segment 6 ..... *Binatangia* n. gen. **5**
– Male palp unmodified; pedicel truncate on postpedicel; postpedicel short, subrectangular; hypandrium without setae on ventral surface; neither femur II or III with distinct anterior preapical seta; abdominal segment 7 pedunculate, exserted and setose ..... *Urodolichous* Lamb

5. Tibia I swollen, with very long ventral seta arising near base and extending to apex of TI (Figure 3); tibia II various; hypandrial setae narrow and tapering, not lanceolate (Figure 4); surstylus various; cercus elongate, with long apical setae **6**
– Tibia I and tarsus I unmodified; distal half of tibia II with row 6-7 ventral hairs, longer than general vestiture, and with two distally projecting pd setae near 9/10; pair of lanceolate hypandrial setae on ventral surface; surstylus with subtriangular projection and upcurved apex; cercus tapering, not much longer than surstylus, and without long apical setae (Figures 10-13) ..... *B. tabubil* n. sp.

6. It_4 ventrally excavated; It_5 subrectangular with pointed basoventral projection (Figures 1-4); cercus with subapical group of long whitish setae, subparallel in large open curve (Figure 4); surstylus lobate .....
..... *B. kokomo* n. sp.
– It_4 with strong distal seta; It_5 enlarged, subrectangular with pair of expanded spatulate pulvilli; FII with anterior row of 12-14 black setae, TII with long av and pv setae along distal half (Figures 7-9); cercus with apical group of 10-12 elongate flagellate setae and not subparallel; surstylus clavate and deeply cleft; .....
..... *B. maceveyi* n. sp.

Binatangia kokomo Bickel n. sp.

Figures 1-6

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Madang Province: Bismarck Range, Oromungu; 760 m, -5.727754 145.257943, yellow pans along creek, 16-18. X.2013, D. J. Bickel (AMS). Paratype. **Papua New Guinea**. ♀, same information as holotype (AMS).

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. Morobe Province: 1 ♂, Lae, Didyman's Ck, 15 m, 30.IV.1963, J. & N. Sedlacek (BPBM).

ETYMOLOGY — The specific epithet *kokomo* is the Melanesian pidgin word for the Papuan hornbill. "Kokomo" is also the name of the hornbill mascot at the Binatang Research Center where it has a commanding presence (https://www.prirodovedci.cz/storage/images/800x600/4808.jpg).

DESCRIPTION — ***Male***. Body length: 2.8 mm; wing: 2.6 x 0.7 mm.

Head. Wider than high in anterior view; setae black; postorbitals forming single row, and ventral postcranium without field of setae; vertex, frons and face black with dark metallic green reflections, and with some brownish pruinosity; pairs of strong vertical and diverging ocellar setae present; pair of short postvertical setae on dorsal postcranium; upper face narrowed under antennae; lower face and clypeus very narrow, but eyes not joined anteriorly; eye facets enlarged anteroventrally; palp narrow basally and gradually expanding, spatulate and covered with dense silvery pruinosity on both sides, and with two pale setae on external surface, and apparently held out from head (Figure 2) (MSSC); proboscis dark brown and rather prolonged; antenna black; scape bare, and subequal in length to pedicel; pedicel with short dorsal seta, and protruding into socket-like postpedicel, evident in both median and lateral views; postpedicel lobate and dorsally excised, with arista arising from excision; arista rather thick, and shorter than head height.

Thorax. Mesonotum, scutellum, and pleura black with some dark metallic green reflections, and weakly shining with little pruinosity; mesonotum rather short and rounded; all setae black; ac biseriate, with some 6 short pairs; 6 dc present, with anteriormost dc shorter than others; 1 strong pa, only 1 sa, 1 sr, 1 strong hm, 1 pm, 2 npl; median scutellar seta strong, lateral scutellar seta weak, about one-quarter length of median seta; proepisternum with single strong seta dorsad of CI.

Legs. Coxa and remainder of legs black; CI with vertical row of 6-8 long white anterior setae (MSSC) and with subapical row of black curved anterior setae; CII with some short black anterolateral setae; CIII with black lateral seta at 1/3; I: 3.5; 2.9; 1.0/ 0.3/ 0.3/ 0.2/ 0.4; FI with 5-6 long black av and pv setae along basal third (MSSC), and anterior surface with field of short erect black setae along length (MSSC); TI somewhat swollen (MSSC), with very long strong black ventral seta arising near base and extending almost to apex of TI (MSSC); and with abundant black ventral setae along tibial length, with some outstanding dorsal setae along distal third, and with strong subapical pd seta (MSSC); It_1 with short strong ventral setae (MSSC); It_2 with short apicoventral projection (MSSC); It_4 ventrally excavated (MSSC); It_5 expanded, subrectangular with pointed basoventral projection(MSSC), and pulvilli small, unmodified; II: 4.1; 4.3; 1.6/ 1.1/ 0.5/ 0.4/ 0.4; FII with anterior row of short curved black setae (MSSC), with row of short pv setae along distal half, and with strong anterior preapical seta; TII with strong dorsal seta at 1/5, and strong ad seta at 1/3 and 2/3, distal fifth with ventral field of curved hairs longer than general vestiture (MSSC), with two very long distally projecting pd setae near 9/10 (MSSC), and with circlet of preapical dorsal, ad, pv, and av setae; IIt_1 slightly excavated and curved ventrally, with ventral field of curved hairs along basal three-quarters (MSSC); III: 4.2; 5.0; 0.8/ 1.6/ 1.0/ 0.6/ 0.4; FIII with row of black av to ventral short setae along length and with short black anterior setae, without distinct anterior preapical seta; TIII with ad seta at ¼ and ¾, 4-5 short dorsal setae along length, and subapical circlet of strong dorsal, ad, av, and pv setae.

Wing. Membrane hyaline, vein R_{2+3} ending in costa near 4/5; vein M with flexion or *bosse alaire* midway between join of dm-cu and apex; R_{4+5} and M slightly diverging beyond crossvein dm-cu, but becoming subparallel beyond *bosse alaire*,



FIGURES 1-6

Binatangia kokomo n. sp. **1**, male habitus, left lateral; **2**, male head and thorax, anterior; **3**, male right leg I, lateral and left leg II, posterior; **4**, male hypopygium, left lateral; **5**, female habitus, dorsal; **6**, female head and thorax, left anterior. Scale bars: 1 = 1.0 mm; 2, 4, = 0.5 mm; 3, 5-6 = 0.2 mm.

and with vein M joining margin slightly behind wing apex; CuAx ratio: 0.7; anal angle absent; lower calypter brown with fan of black setae; halter pale yellow.

Abdomen. Tergites 1-6 black, covered with short black vestiture, with some longer setae near tergal margins; sternite 1-6 also black, unmodified; segment 7 short, almost entirely retracted under segment 6, with tergite 7 with some short setae distally, but sternite 7 bare; sternite 8 ovate, covered with setae, and forming cap over hypopygial foramen; hypopygium (Figures 1, 4) mostly dark brown; epandrium ovate; basal epandrial seta not evident; hypandrium forming flat elongate cover over phallus, and with two pairs of modified setae on ventral (external) surface of hypandrium: short blade-like subapical pair, and narrow longer pair basad; surstylus elongate, rod-like, with short setae; cercus elongate, more than twice length of epandrium, with lateral field of long black slightly curved setae, and with subapical group of long whitish setae, all subparallel in large open curve.

Female (Figures 5-6). Body length: 2.4 mm; wing: 2.3 x 0.8 mm; similar to male except as noted: lower face and clypeus wider, approximated width of antennal bases, and eyes distinctly separated; eye facets uniform; palp flat, ovate and black and covered with short black setae; leg coloration similar; I: 3.1; 3.3; 1.1/ 0.4/ 0.3/ 0.2/ 0.3; legs without MSSC, but with black vestiture and as noted; TI short dorsal setae at ¼, 2/3 and subapically; tarsus I unmodified; II: 3.6; 3.2; 1.4; 0.9/ 0.6/ 0.4/ 0.3; FII with strong anterior preapical seta; TII with strong offset ad-pd setal pairs at 1/6, and 3/5, short ventral near ¾, and with preapical circlet of dorsal, ad, pv, and av setae; III: 4.0; 4.0; 1.2/ 0.8/ 0.6/ 0.4/ 0.4; FIII without distinct anterior preapical seta; TIII with strong ad-pd setal pair at ¼, ad seta at 2/3 , 3 short dorsal setae along length; wing similar but not as broad; CuAx ratio: 0.8; abdomen dark brown, covered with short black vestiture, oviscapt broad, divided into two acanthophorites, each bearing 5 strong flat setae or dornen, and decreasing in size laterally (Figure 5).

REMARKS — *Binatangia kokomo* n. sp. is known from two Papua New Guinea localities, a rainforest creek near Oro-mungu at 760 m in the Bismarck Range, Madang Province (Figure 14), and near Lae at 15 m in Morobe Province. This species is readily identified by the complex MSSC on leg I (see key), and the distinctive cercus with its subapical group of long curved white setae.

Binatangia maceveyi Bickel n. sp.

Figures 7-9

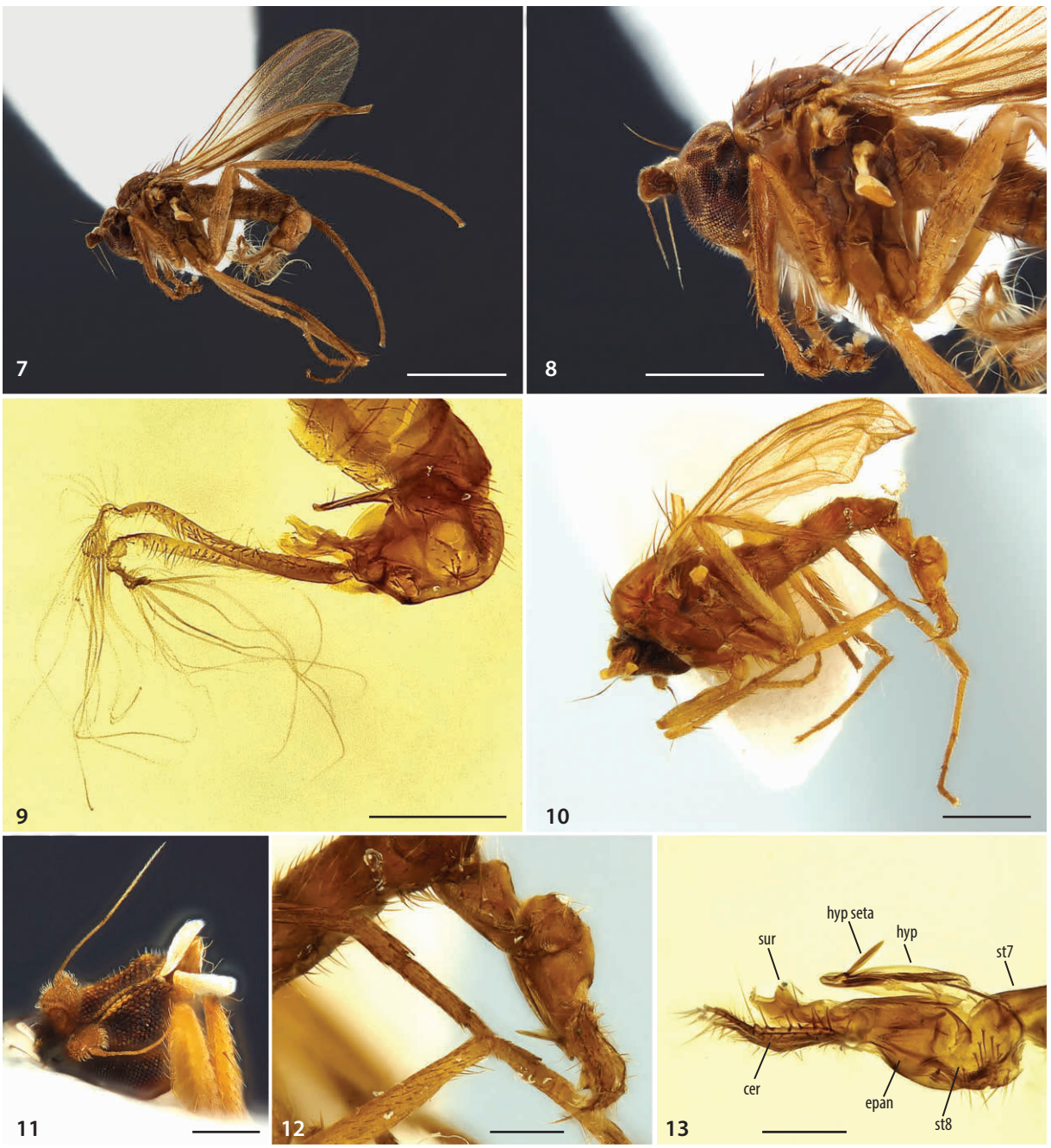
TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Western Province: Tabubil, 950 m, 5.214°S 141.236°E, sweeping, 29.I.2009, S. McEvey (AMS). Paratype. **Papua New Guinea**. Western Province: ♂, same information as holotype (AMS).

ETYMOLOGY — This species is named in honor of the dipterist Shane McEvey, who collected the two sympatric species of *Binatangia* near Tabubil.

DESCRIPTION — ***Male***. Body length: 2.7 mm; wing: 2.4 x 0.7 mm; both specimens somewhat cleared, and overall light brown cuticle is undoubtedly dark brown; similar to *B. kokomo* except as noted:

Head. Palp elongate spatulate, covered with dense silvery pruinosity, and with two yellowish hairs on external surface (MSSC).

Legs. Coxa and remainder of legs dark brown; CI with vertical row of 6-8 long white anterior setae (MSSC) and with subapical row of black curved anterior setae; CII with some short black anterolateral setae; CIII with black lateral seta at 1/3; I: 3.4; 3.0; 1.2/ 0.3/ 0.2/ 0.2/ 0.4; FI with 5-6 black av and pv setae along basal third (MSSC), and anterior surface with field of short black setae along length (MSSC); TI somewhat swollen (MSSC), also with elongate strong black ventral seta arising near base and extending almost to apex of TI (MSSC); and with abundant black ventral setae along tibial length, with some outstanding dorsal setae along distal third, and with strong subapical pd seta (MSSC); It_1 with 3 strong ventral setae (MSSC); It_4 with strong distal seta; It_5 enlarged, subrectangular with pair of expanded spatulate pulvilli (MSSC); II:



FIGURES 7-13

Binatangia maceveyi n. sp., male: **7**, habitus, left lateral; **8**, thorax and head, left lateral; **9**, postabdomen and hypopygium, left lateral. *Binatangia tabubil* n. sp., male: **10**, habitus, left lateral; **11**, head, anterior; **12**, postabdomen, left lateral; **13**, hypopygium, left lateral. Legend: cer, cercus; epan, epandrium; hyp, hypandrium; hyp seta, hypandrial seta; st7, sternite 7; st8, sternite 8; sur, surstylus. Scale bars: 7 = 1.0 mm; 8-10 = 0.5 mm; 11-13 = 0.2 mm.

4.1; 4.4; 1.6; 0.7/ 0.5/ 0.4/ 0.4; FII with anterior row of 12-14 black setae, which apparently includes the anterior preapical seta (MSSC); TII with ad-pd setal pair at 1/5, and offset pair near 2/3, with very strong anterior at ¼, with long av and pv setae along distal half (MSSC), and with circlet of preapical dorsal, ad, pv, and av setae; IIt_1 unmodified, with normal short vestiture; III: 4.4; 5.0; 1.0/ 1.8/ 1.2/ 0.6/ 0.4; FIII with row of black av to ventral setae along length and with short black anterior setae, but without distinct anterior preapical seta; TIII without any distinct ad seta, but possibly included within irregular row of long ad to av setae along length (MSSC?), with row of dorsal setae along length with 6-7 of these distinctly stronger, and subapical circlet of strong dorsal, ad, av, and pv setae.

Abdomen. Hypopygium (Figure 9) mostly dark brown; epandrium ovate; hypandrium forming flat elongate cover over phallus, and with two pairs of setae on ventral (external) surface of hypandrium: shorter but narrower subapical pair, and longer pair basad; surstylus elongate, distally expanded and cleft midway, with lobate dorsal and ventral arms; cercus elongate, more than twice length of epandrium, and with lateral field of long black slightly curved setae, and apical group of 10-12 elongate flagellate setae, subequal to length of cercus and not ordered or subparallel.

Female. Unknown.

REMARKS — *Binatangia maceveyi* is known only from the Tabubil type locality near the Ok Tedi Mine, Western Province, Papua New Guinea (Figure 15), where it is sympatric with *B. tabubil*.

B. maceveyi is close to *B. kokomo* as both species share a similar modified male foreleg, especially noting the elongate ventral seta arising near the base of tibia I and the setation of tarsus I, and a long digitiform cercus with curved elongate apical setae. Also, the anterior preapical seta is not distinct from the row of anterior setae (MSSC) on male femur II.

Binatangia tabubil Bickel n. sp.

Figures 10-13

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea.** Western Province: Tabubil, 950 m, 5.214°S 141.236°E, sweeping, 29.I.2009, S. McEvey (AMS).

ETYMOLOGY — The specific epithet *tabubil* is a place name of indigenous origin and a noun in apposition.

DESCRIPTION — ***Male***. Body length: 2.5 mm; wing: 2.2 x 0.6 mm; specimen somewhat cleared, and overall light brown cuticle is undoubtedly dark brown; similar to *B. kokomo* except as noted:

Head. Palp elongate and only slightly spatulate and covered with dense silvery pruinosity and with two weak white hairs (MSSC) (Figure 11).

Legs. Coxa and remainder of legs brown (probably black); CI with vertical row of 6-8 long white anterior setae (MSSC); CII with some short black anterolateral setae; CIII with black lateral seta at ½; I: 2.2; 2.5; 1.1/ 0.3/ 0.3/ 0.2/ 0.2; TI with strong dorsal at ¼, and pv seta near ½, and without MSSC; tarsus I unmodified. II: 3.2; 3.8; 1.5; 0.9/ 0.7/ 0.4/ 0.4; FII unmodified, and with strong anterior preapical seta; TII with strong dorsal seta at 1/5, and strong ad seta at 1/3 and 2/3, distal half with row 6-7 ventral hairs, distinctly longer than general vestiture (MSSC), with two long distally projecting pd setae near 9/10 (MSSC), and with circlet of preapical dorsal, ad, pv, and av setae; IIt_1 unmodified. III: 3.6; 3.7; 0.7/ 1.2/ 0.8/ 0.5/ 0.4; FIII with row av to ventral setae along length and with short black anterior setae; TIII with ad seta at ¼ and ¾, 4-5 short dorsal setae along length, with stronger dorsal setae at setae at 1/5 and ½., and subapical circlet of setae.

Abdomen. Hypopygium (Figures 12, 13) mostly dark brown but with yellowish hypandrium and surstylus; epandrium ovate; hypandrium forming flat elongate cover over phallus, and with pair of lanceolate subapical hypandrial setae on the ventral (external) surface; surstylus with prominent subtriangular projection (with single strong seta near base), and upcurved apex; cercus not extending much beyond surstylus; tapering with 6-7 strong lateral setae along basal two-thirds, and generally covered with shorter setae.

Female. Unknown.

REMARKS — *Binatangia tabubil* n. sp. is known only from the type locality near Ok Tedi Mine, Western Province, Papua New Guinea (Figure 15), where it is sympatric with *B. maceveyi*. This species has a rather unmodified male leg I and lacks the elongate long apical setae found on the cercus of its two congeners.





FIGURES 14-15

Papua New Guinea collecting locales for *Binatangia* species. **14**, Creek near village of Oromungu, 760 m, with yellow pans (photo D. Bickel); **15**, Rainforest at Tabubil, 900 m (photo S. McEvey).

ACKNOWLEDGEMENTS

We would like to thank the respective curators of these institutions for information and the loan of specimens. (AMS) – Russell Cox; (BPBM) – Neal Evenhuis & Keith Arakaki. Melissa Graf and Natalie Tees constructed the plates in Photoshop. DJB would like to thank the organizers of the expedition for the invitation to participate, Vojtech Novotny for hospitality at the Binatang Institute, and numerous expedition associates, parataxonomists This study was conducted in the framework of "Our Planet Reviewed – Papua New Guinea 2012-2013" set up by Pro-Natura International, the Muséum national d'Histoire naturelle (MNHN, France), the Institut de Recherche pour le Développement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery. The IBISCA expert network, the patron for this project, Prof. R.L. Kitching AM, and all other participants in this collective effort are thanked for their contribution.

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Flightless southern cassowary bird *Casuarius casuarius*. These cassowaries lay beautiful green eggs and their chicks are often used as pets in villages. (Photo © Xavier Desmier; identification: Katerina Sam).

The genera *Plagiozopelma* and *Krakatauia* (Diptera: Dolichopodidae: Sciapodinae) in New Guinea and surrounding areas

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ABSTRACT

A key is provided to the genera of Sciapodinae (Diptera: Dolichopodidae) of New Guinea and adjacent regions. The genera *Plagiozopelma* Enderlein and *Krakatauia* Enderlein (Diptera: Dolichopodidae: Sciapodinae) are reviewed. The *Plagiozopelma angustifacies* group comprises *P. angustifacies* (Becker) from the Bismarck Archipelago and Solomon Islands, *P. mouldsorum* Bickel from New Guinea and Australia, and the following six new species from New Guinea: *P. eilogo* n. sp., *P. ismayi* n. sp., *P. kikori* n. sp., *P. maspainae* n. sp., *P. millerorum* n. sp., and *P. oromungu* n. sp. The *Plagiozopelma terminiferum* group, with highly elongated male genitalia, includes *P. terminiferum* (Walker) from New Guinea and Australia and two new species from New Guinea: *P. kokoda* n. sp. and *P. arabuka* n. sp. The *Krakatauia waudoma* group has striking modifications to the male antenna, with the scape inflated and globular and the postpedicel fused to the arista, is confined to New Guinea and comprises the following species: *K digitula* (Becker), *K. purpurascens* (de Meijere), and four new species from New Guinea: *K distortipennis*, *K. finisterrensis*, *K. mankiensis*, and *K. waudoma.* The *Krakatauia funeralis* group includes the following species in the New Guinea region: *K. claudiensis* Bickel (also in northern Australia), *K. compressipes* (Parent), *K. obscuripennis* (de Meijere) (new status), and three new species from New Guinea: *K. morobensis* n. sp., *K. sepikensis* n. sp., and *K. stellaris* n. sp. *Chrysosoma arctifacies* Parent is regarded as a junior synonym of *Plagiozopelma angustifacies* (Becker). The following species are regarded as *nomina dubia*: *Chrysosoma anthracinum* Becker, *Chrysosoma atropurpureum* Parent, *Condylostylus inflatus* Becker, *Chrysosoma latemaculatum* Parent, *Psilopus marginalis* Walker, *Psilopus nigrolimbatus* de Meijere, and *Chrysosoma sigma* Parent.

BICKEL D. J. & MARTIN J. 2020 — The genera *Plagiozopelma* and *Krakatauia* (Diptera: Dolichopodidae: Sciapodinae) in New Guinea and surrounding areas, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 377-420 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

RÉSUMÉ

Les genres *Plagiozopelma* et *Krakatauia* (Diptères : Dolichopodidae : Sciapodinae) en Nouvelle-Guinée et dans ses environs.

Une clé est fournie pour les genres de Sciapodinae (Diptères : Dolichopodidae) de Nouvelle-Guinée et des régions voisines. Les genres *Plagiozopelma* Enderlein et *Krakatauia* Enderlein (Diptères : Dolichopodidae : Sciapodinae) sont révisés. Le groupe *Plagiozopelma angustifacies* comprend *P. angustifacies* (Becker) de l'archipel de Bismarck et des îles Salomon, *P. moldsorum* Bickel de Nouvelle-Guinée et d'Australie, et les six nouvelles espèces suivantes de Nouvelle-Guinée : *P. eilogo* n. sp, *P. ismayi* n. sp, *P. kikori* n. sp, *P. maspainae* n. sp, *P. millerorum* et *P. oromungu* n. sp. Le groupe *Plagiozopelma terminiferum*, avec des genitalia mâles très allongés, comprend *P. terminiferum* (Walker) de Nouvelle-Guinée et d'Australie et deux nouvelles espèces de Nouvelle-Guinée : *P. kokoda* n. sp et *P. arabuka* n. sp. Le groupe *Krakatauia waudoma* présente des modifications remarquables de l'antenne mâle, avec le scape gonflé et globulaire et le post-pédicelle fusionné à l'arista. Ce groupe est confiné à la Nouvelle-Guinée et comprend les espèces suivantes : *K. digitula* (Becker), *K. purpurascens* (de Meijere), et quatre nouvelles espèces de Nouvelle-Guinée : *K distortipennis*, *K. finisterrensis*, *K. mankiensis*, et *K. waudoma*. Le groupe *Krakatauia funeralis* comprend les espèces suivantes dans la région de la Nouvelle-Guinée : *K. claudiensis* Bickel (également dans le nord de l'Australie), *K. compressipes* (Parent), *K. obscuripennis* (de Meijere) (nouveau statut), et trois nouvelles espèces de Nouvelle-Guinée : *K. morobensis* n. sp, *K. sepikensis* n. sp, et *K. stellaris* n. sp. *Chrysosoma arctifacies* Parent est considéré comme un synonyme junior de *Plagiozopelma angustifacies* (Becker). Les espèces suivantes sont considérées comme *nomina dubia* : *Chrysosoma anthracinum* Becker, *Chrysosoma atropurpureum* Parent, *Condylostylus inflatus* Becker, *Chrysosoma latemaculatum* Parent, *Psilopus marginalis* Walker, *Psilopus nigrolimbatus* de Meijere, et *Chrysosoma sigma* Parent.

INTRODUCTION

The Sciapodinae (Dolichopodidae) are one of the more cohesive dolichopodid subfamilies, often readily identified by the excavated vertex and usually by the branched vein M. These small, metallic green flies with "sweptback" wings are frequently seen running on foliage in moist habitats, making them familiar by sight even to casual observers (review in Bickel 1994). The subfamily is often abundant in samples collected from tropical forests, and the fauna of the topographically complex New Guinea region is particularly rich, with many undescribed species.

This paper treats the New Guinea fauna in species groups of two genera, *Plagiozopelma* Enderlein (the *angustifacies* and *terminiferum* groups) and *Krakatauia* Enderlein (the *waudoma* and *funeralis* groups), based on material collected during the 2012 Our Planet Reviewed – Papua New Guinea expedition (Leponce *et al.* 2016) and borrowed from various museum holdings. The region of focus is New Guinea, but also including the islands of Indonesian Maluku, the Bismarck Archipelago, the Solomon Islands, and the Cape York Peninsula of northern Australia.

MATERIALS AND METHODS

The repositories of material studied or cited in this revision use the following acronyms: (AMS) - Australian Museum, Sydney; (ANIC) - Australian National Insect Collection, CSIRO, Canberra; (BMNH) - The Natural History Museum, London; (BPBM) - Bishop Museum, Honolulu; (CNC) - Biosystematics Research Institute, Agriculture Canada, Ottawa; (MNHN) - Museum national d'Histoire naturelle, Paris; (NHMV) - Naturhistorisches Museum, Vienna; (QDPI) - Queensland Department of Primary Industries, Brisbane; (RMNH) - Naturalis Biodiversity Center, Leiden; (SAM) - South Australian Museum, Adelaide; (SDEI) - Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany; (TMB) - Termeszettudomanyi Muzeum (Hungarian Natural History Museum), Budapest; (USNM) - National Museum of Natural History, Smithsonian Institution, Washington, D.C.; (ZMHB) - Zoologisches Museum, Humboldt Universitat, Berlin.

Species are defined based on the male genitalia and male secondary sexual characters (MSSC). Keys are based on nongenitalic characters where possible, although accurate identification often requires male postabdominal characters. Since the male genitalic are external in Sciapodinae, clearing the hypopygium usually is not necessary. Species descriptions are condensed to avoid unnecessary repetition. Photographs were made with a Leica M205A photomontage system. The left lateral view of the hypopygium or male genital capsule is shown for most species. In describing the hypopygium, 'dorsal' and 'ventral' refer to morphological position prior to genitalic rotation and flexion. Thus, in figures showing a lateral view

of the hypopygium, the top of the page is morphologically ventral, while the bottom is dorsal. Morphological terminology follows McAlpine (1981), except for the male hypopygium where terms of Cumming *et al.* (1995) are used. Measurements were made on representative dry specimens (usually the holotype). Body length of males is measured from the base of the antennae to the tip of the seventh abdominal segment. The CuAx ratio is the length of the dm-cu crossvein/ distal section CuA. The position of features on elongate structures such as leg segments is given as a fraction of the total length, starting from the base. The relative lengths of the podomeres are representative ratios and not measurements, and they are given for each leg in the following formula and punctuation: trochanter + femur; tibia; tarsomere 1/ 2/ 3/ 4/ 5. The following abbreviations and terms are used: FSSC - Female secondary sexual character(s), non-genitalic characters found only on female body; MSSC - Male secondary sexual character(s), non-genitalic characters found only on male body; I, II, III: pro-, meso-, metathoracic legs; C, coxa; T, tibia; F, femur; ac, acrostichal setae; ad, anterodorsal; av, anteroventral; dc, dorsocentral setae; dv, dorsoventral; hm, postpronotal setae; npl, notopleural setae; pa, postalar setae; pd, posterodorsal; pm, presutural supra-alar setae; ppl, proepisternitesl setae; pv, posteroventral; sa, postsutural supra-alar setae; sr, presutural intra-alar setae; t, tarsus; t_{1-5}, tarsomeres 1 to 5.

SYSTEMATIC PART

KEY TO THE GENERA OF SCIAPODINAE (DIPTERA: DOLICHOPODIDAE) OF NEW GUINEA AND ADJACENT REGIONS, WITH A FOCUS ON THE GENERA *KRAKATAUIA* AND *PLAGIOZOPELMA*.

1. Vertex usually strongly excavated on either side of ocellar tubercle, or if weakly excavated, vein M distinctly branched, with M_2 present at least as a fold on membrane; mesonotum short, about as wide as long; hypopygium exerted and distinctly pedunculate; posterior mesonotum never flattened, subfamily Sciapodinae **2**
– Vertex not excavated, vein M_2 usually absent; other features various .....other Dolichopodidae

2. Vein M unbranched but with gentle anterior bend beyond crossvein dm-cu (vein M_2 totally absent, without fold or indication on membrane); all dc setae and vertical seta present and strong in both sexes .....
.....*Mesorhaga* Schiner
– Vein M branched and vein M_2 present, even if as fold on membrane; if unbranched, then males with anterior dc setae as weak hairs; other features various **3**

3. Arista usually apical on triangular postpedicel (if female sometimes with distinctly dorsal arista, then TI with strong dorsal and ventral setae, and lateral scutellar setae strong), usually long, more than half body length in females; male arista sometimes with apical flag dm-cu often sinuous; TI often with long setae **4**
– Arista usually distinctly dorsal on subrectangular postpedicel and rarely longer than head width; tibial chaetotaxy often weak, especially on males; dm-cu usually straight; TI rarely with long setae **7**

4. Crossvein dm-cu straight; 2 long ac present; pleura usually yellow; legs elongate, with few major setae; TI with strong curved posterior subapical seta ..... *Amblypsilopus pallidicornis* group
– Crossvein dm-cu sinuous; tibiae often with major setae; other features various **5**

5. Lateral scutellar setae strong, about 2/3 length of medians; male frons with dense abundant hairs; halter black in both sexes; wing smoky colored ..... *Krakatauia* Enderlein (part; treated below)
– Lateral scutellar setae usually less than 1/3 length of medians; male frons usually without abundant hairs; halter usually yellow; wing usually hyaline or with distinct brown maculations **6**

6. Frons polished metallic bluegreen; male frons bare or with single weak vertical seta only; male scape often swollen and vaselike; FI and TI in both sexes usually without major setae; CI with either 3-7 strong lateral spinelike setae (stronger in females than males), *or* CI with 3 strong black distolateral setae; FI and TI in both sexes usually without major setae ..... *Plagiozopelma* Enderlein (treated below)

– Vertex and frons usually with pruinosity; male frons often with hairs on lateral slope; male scape rarely swollen and vaselike; pedicel often with long ventral and dorsal setae; FI and TI usually with long setae; CI without strong lateral spinelike setae ..... *Chrysosoma* Guérin Méneville

7. Vein M_2 arcuate and forming a broad Ushape with vein M_1; femora often with long av and pv setae; male sometimes with crocheted cilia on costa and male TIII sometimes with callus or irregularity; male $IIIt_{3-5}$ often flattened and padlike ventrally; lateral scutellar usually strong, more than 1/2 length of medians; ac usually strong; posterior two dc strong, anterior dc reduced to weak hairs ..... *Parentia* Hardy
– Vein M_2 usually straight and not curved; femora usually with hairlike ventral setae TIII rarely with callus or irregularity; male $IIIt_{3-5}$ sometimes flattened and padlike; thoracic chaetotaxy various **8**

8. Strong vertical setae present on both sexes; both sexes with all dc setae strong; female only femur I usually with stout basiventral setae; female only lower postcranium with strong projecting spine like setae ..... *Plagiozopelma angustifacies* group (treated below)
– Vertical setae in males usually strongly reduced, or lateral frons with dense hairs; males with some anterior dc setae weak and hairlike; female femur I rarely with strong basiventral setae **9**

9. Male frons strongly flattened, with abundant pale or black hairs; arista dorsal to dorsoapical; It_{2-5} each very short; dm-cu slightly sinuous ..... *Krakatauia* Enderlein (treated below)
– Male frons not flattened in most species; It_{25} with It_2 distinctly longer than any of distal tarsomere; arista usually dorsal; dm-cu straight **10**

10. Male clypeus narrowed and free from eye margin; male vertical seta reduced in size or absent; lateral scutellar setae reduced and hair like; wing usually hyaline; short setae; body often appearing delicate, with elongate legs ..... *Amblypsilopus* Bigot
– Male clypeus adjacent to eye margin; vertical seta usually strong in both sexes; body more robust ..... *Austrosciapus* Bickel

Genus ***PLAGIOZOPELMA*** Enderlein, 1912

Plagiozopelma Enderlein, 1912: 367.

Type species. *Plagiozopelma spengeli* Enderlein, 1912 [= *Psilopus appendiculatus* Bigot, 1890], orig. des.

DIAGNOSIS — *Head.* Frons usually shining metallic green although sometimes with dusting of pruinosity; strong postvertical setae present as continuation of postocular series; vertical seta strongly developed in female, but absent or as weak hair in males; face usually bulging in males (MSSC), but conforming with curvature of eyes in females; male clypeus usually narrowed and separated from margins of eyes; male scape sometimes often swollen and vaselike (MSSC); pedicel with only weak dorsal and ventral setae; male postpedicel conical with apical arista; female postpedicel subrectangular with arista dorsoapical to dorsal; male postpedicel sometimes elongate more than three times as long as wide (MSSC); male arista sometimes modified with apical flag, or thickening (MSSC).

Thorax. Usually 2-4 pairs of strong ac present; male usually with 2 strong posterior dc, and 3-4 weak anterior hairs (MSSC), OR male with 5 strong dc; female with 5 strong dc; lateral scutellar setae reduced to weak hairs or absent.

Legs. CI usually with 3-7 strong lateral spinelike setae, more strongly developed in females than males; CI sometimes with 3 strong black distolateral setae; FI and TI in both sexes usually without major setae.

Wings. Crossvein dm-cu straight to slightly sinuous.

Abdomen. Without strong setae; hypopygial peduncle (segment 7) with tergum and sternum both well-developed; phallus with dorsal angle; cercus usually deeply forked.

REMARKS — *Plagiozopelma* centers around the diverse *flavipodex* group, and most species in the genus have at least some of the following characters: frons usually shining, highly polished; male with vertical seta as weak hair or absent; male postpedicel conical with apical arista; tibiae and femora without strong setae (unlike most *Chrysosoma*); crossvein dm-cu slightly sinuous to straight; abdomen without strong setae.

Of interest in *Plagiozopelma* is the development of distinctive female secondary sexual chaetotaxy (FSSC), not found on the male. In most sciapodines, males develop the more distinctive chaetotaxy (modified leg setae, anterior dc reduced to hairs, supernumerary setae, etc.) while females carry a conservative and more predictable chaetotaxy. However, in *Plagiozopelma*, especially the *flavipodex* and *angustifacies* groups, females have strongly developed lateral CI spines and sometimes anteromedian setal fields, which are only weakly developed in males. In addition, females of the *angustifacies* group have strong projecting spines on the ventral postcranium.

Plagiozopelma is primarily tropical and occurs across the Australasian, Oriental, and Afrotropical regions. For detailed discussion, see Bickel (1994, 2005).

KEY TO AUSTRALASIAN SPECIES GROUPS OF *PLAGIOZOPELMA*, AND MALES IN THE TERMINIFERUM AND *ANGUSTIFACIES* GROUPS

1. Male usually with 2 strong posterior dc and 3-4 weak hairlike dc anteriad; head wider than high; vertex and frons polished metallic greenblue; other features various **2**
– Five strong dc present in both sexes; head circular in anterior view, and face and clypeus elongate (Figure 11); pleura with silvery pruinosity; CI with 3-5 strong black distolateral spinelike setae; female ventral postcranium with strong projecting setae on ventral postcranium in addition to field of pale hairs; $IIIt_{3-5}$ each slightly flattened (MSSC); dm-cu straight; epandrium with flat dorsal surface; cercus lobate (Australia, New Guinea, Solomon Is) ..... *angustifacies* **5**

2. Male scape swollen and vaselike; male arista as long as or longer than body, and often with apical flag; male $IIIt_{3-5}$ unmodified; male It_1 rarely with long posterior hairs; epandrium not as prolonged; cercus as two subequal arms, outer dorsal arm and inner basoventral arm (Orient, Australasia) .....
..... *flavipodex* group (not treated here)
– Male scape not strongly swollen; arista distinctly shorter than body and simple; male $IIIt_{3-5}$ dorsoventrally flattened, padlike; male It_1 distally with four short posterior crocheted hairs; epandrium elongate subtriangular; cercus with elongate bladelike arm subtended basally by shorter inner arm (Australia, New Guinea) .....
..... *terminiferum* **3**

3. Wing with distinctive dark brown apical spot; hypopygium with surstylus dark brown, lobate with distinctive tapering lateral projection with strong curved white apical seta (Figures 26-28) (New Guinea, Australia)
..... *P. terminiferum* (Walker)
– Wing hyaline; other characters various **4**

4. Face bulging; antennal scape swollen; $IIIt_5$ only slightly flattened; surstylus pale yellow, broad and apically subrectangular with elongate dorsoapical digitiform projection (Figures 24-25) (New Guinea) .....
..... *P. kokoda* n. sp.
– Face bulging; antennal scape not swollen; $IIIt_{3-5}$ distinctly flattened.(Figures 29-31) (New Guinea) .....
..... *P. arabuka* n. sp.

5. Tibiae I and II dark brown in basal quarter, and distally yellow; cercus divided into three arms: basoventral arm lying continuing elongate and tapering beyond apex of surstylus, and with apical bean-shaped projection; middle cercal arm flexed and tapering to narrow point, with group of white hairs midway along ventral surface; dorsal cercal arm subtriangular, short and with single strong black apical seta. (Figures 4-6) (New Guinea) ..... *P. maspainae* n. sp.
– Tibiae I and II entirely yellow; other characters various **6**

6. Tarsomeres It_{2-4} unmodified; antenna entirely dark brown; cercus basally short and subtriangular, and bearing ventral Y-shaped projection divided into two arms, the proximal arm shorter and thicker, and distal arm elongate with apical enlarged black spatulate seta. (Figures 17-18) (New Guinea) ..... *P. oromungu* n. sp.
– Each tarsomere It_{2-4} with short comb-like row of ventral setae and with whitish pile; antenna mostly brown but yellow basoventrally; other features various **7**
7. Middle cercal and dorsal cercal arms both short and subequal in length (Figures 14, 21-22) **8**
– At least middle cercal arm elongate (Figures 3, 8, 9, 12) **9**

8. Cercus with basoventral arm subapically expanded and clavate, with lateral field of short spinelike setae; FII with comb of 7-8 curved black hook-like setae along basal fifth (Figures 13-16) (Australia, New Guinea) .... *P. mouldsorum* Bickel
– Cercus with basoventral arm not apically clubbed but with distinctive apical dentate seta, subtended by bladelike seta; FII with (Figure 19) or without comb of curved short black ventral setae along basal fifth (Figures 19-23) (Bismarck Arch., Solomon Is) ..... *P. angustifacies* (Becker)

9. Middle cercal arm elongate and distally spatulate, with white hairs on the ventral spatular surface; dorsal cercal arm short, and with strong curved white subapical setae (Figure 9); FII basally with black comb of 5 curved black hook-like setae (similar to Figure 16) (New Guinea) ..... *P. kikori* n. sp.
– Middle cercal arm not spatulate, and dorsal cercal arm without strong white subapical setae; FII with only white ventral hairs **10**

10. Ventral cercal arm massive, hammer-shaped and apically truncate, with external curved seta near bend at 2/3; middle and dorsal cercal arms elongate and tapering to point, subequal in length (Figures 10-12) (New Guinea) ..... *P. eilogo* n. sp.
– Ventral cercal arm not greatly expanded; middle cercal arm distinctly longer than dorsal cercal arm **11**

11. Ventral cercal arm apically clubbed, and with distinctive curved ventral seta at midlength; middle cercal arm digitiform, with abundant white hairs along ventral surface; dorsal cercal arm short, tapering subtriangular, with long white apical setae (Figures 1-3) (New Guinea) ..... *P. millerorum* n. sp.
– Ventral cercal arm alongside epandrium curved and not clubbed, and with subapical spatulate setae; middle cercal arm elongate with white hairs along ventral surface and slightly expanded apically with long curved subapical seta; dorsal cercal arm short subtriangular, with long white apical setae (Figures 7-8) (New Guinea) ..... *P. ismayi* n. sp.

Plagiozopelma flavipodex species group

REMARKS — The *flavipodex* group comprises some 70 described species, found across most of the Oriental and Australasian tropics, and as far east as Fiji and the Northern Marianas (see Bickel 1994, 1995, 2005). Most species are associated with rainforest and are frequently collected in yellow pans or Malaise traps near creeks.

This group is based around *Plagiozopelma flavipodex,* a widespread and common Oriental-Australasian species. Most group members have a delicate appearance with long pale-yellow legs and often a very long male arista. Males of most species have an arista that is longer than the body, and often with an apical flattening aristal flag (MSSC). This group has undergone a radiation in eastern Melanesia, where in addition to the widespread *P. flavipodex,* there are an additional four species from Fiji, four from Vanuatu, and one from the Solomon Islands (Bickel 2005). Two species are known from the Papuan region, *Plagiozopelma flavipodex* (Becker) and *P. subrectum* (Walker), although additional undescribed species are known from collections. The *flavipodex* group will not be considered further here.

Plagiozopelma angustifacies species group

DIAGNOSIS — *Head*. Almost circular in anterior view (Figure 11), making the head appear high in comparison with other sciapodines; vertex shining metallic blueviolet; face and clypeus parallel sided and narrow, especially in males; male clypeus adjacent to lateral margin of eyes; male face not bulging but conforming with eye contour; pedicel with short dorsal and ventral setae; postpedicel tapering triangular; arista apical, about equal in length to head height; postcranium, face, and clypeus with silvery pruinosity; female ventral postcranium often with 3-4 black projecting spinelike setae (FSSC) in addition to the usual field of pale setae (Figure5).

Thorax. Generally dark metallic blue-green, often with silvery pruinosity on pleura; three pairs of long ac present; 5 strong dc present in both sexes, decreasing in size anteriorly, without sexual dimorphism; lateral scutellar setae absent.

Legs. CI with 3-5 strong black distolateral spinelike setae, more strongly developed in females; female CI also with anteromedian field of short setae (FSSC); TI with dorsal seta at 1/5; male It_1 with various strong black ventral setae (MSSC); each male tarsomere It_{2-4} often with short comb-like row of ventral seta, and with white pile (MSSC); $IIIt_3$ on distal half and $IIIt_{45}$ slightly flattened and ventrally padlike in male (MSSC).

Wings. Hyaline; crossvein dm-cu straight (Figures 10, 17); halter yellow.

Abdomen. Epandrium tapering subtriangular, with straight dorsal surface (like that of the *terminiferum* group); cercus large, usually with three arms, a large ventral cercal arm lying along surstylus, a usually short middle cercal arm, and a dorsal cercal arm, all with various diagnostic setae, projections, and modifications.

REMARKS — The *angustifacies* group often has distinctive dark blue-violet metallic body coloration with silvery pruinosity, almost circular head, male clypeus adjacent to lateral margin of eyes, male $IIIt_{4-5}$ slightly flattened and ventrally padlike in male (MSSC), and lateral scutellar setae absent. Females have strongly developed distolateral setae with additional setal fields on CI (FSSC), and strong ventral postcranial setae (Figure 5) (FSSC), both absent on males. The group is unusual in showing no sexual dimorphism in dorsocentral setal (dc) chaetotaxy, with five strong setae in both sexes.

All species in the *angustifacies* group have a similar basic hypopygial structure. Some intraspecific variation in position and development of cercal setae is evident among species. The *angustifacies* group occurs in rainforest from New Guinea to the Solomon Islands, and northernmost Cape York Peninsula, Australia.

Plagiozopelma millerorum Bickel n. sp.

Figures 1-3

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Province: Wau, Wau Ecology Institute, 1200 m, Malaise trap, 1-10.VIII.1983, S. E. & P. M. Miller (BPBM).

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. Madang Province:♂ Bismarck Range, Oromungu, -5.727 145.257943, 760 m, sticky trap on tree trunk, 16-18.X.2013, D. J. Bickel (AMS). Morobe Province: ♂, Bulolo, 750 m, Malaise trap, 5.X.1965, J. Sedlacek (BPBM); ♂, Zenag - Lae Road, 200 m, Malaise trap, 17.I.1965, J. Sedlacek (BPBM); ♂, Upper Manki logging area, nr Bulolo, 1600 m, sticky trap, 9.III.1973, F.R. Wylie & P. Shanahan (AMS). West Sepik Province: ♂, Green River & Sepik River jct., 200 m, 27-28.VI.1963, X.1965, light trap, R. Straatman (BPBM).

DESCRIPTION — ***Male***. Body length: 5.7-6.0 mm; wing: 5.7 x 1.8 mm (Figure 1).

Head. Subcircular in anterior view; frons shining metallic dark blueviolet; single strong postvertical present, continuation of postocular series; distinct vertical seta not evident, but two white hairs present on slope of frons; face and clypeus with dense silvery pruinosity and extending below level of eyes; face and clypeus parallel-sided and narrow, adjacent to lateral margin of eyes; face not bulging but conforming with eye contour; palp brown; proboscis yellowish; antenna brownish,

but postpedicel yellow basoventrally; scape and pedicel subequal, pedicel with short dorsal and ventral setae; postpedicel tapering, subtriangular, arista apical, equal in length to head height; ventral postcranium with abundant pale setae.

Thorax. Mesonotum and scutellum shining metallic greenblue; pleura with silvery pruinosity; three pairs of long ac present; 5 strong dc present, decreasing in size anteriorly, anterior dc not hairlike; 1 pa, 2 sa, 2sr, 2npl, 1 pm, 1 weak hm present; median scutellar setae strong, lateral scutellar setae absent.

Legs. Coxae, trochanters, femora and the remainder of leg III dark brown; tibiae I and II and all tarsus I and basitarsus II yellow; distal tarsomeres II brown; CI with pale hairs and 4-5 strong black distolateral setae; CII with short black anterior setae and stronger anterolateral seta in distal quarter; CIII with strong black lateral seta at 1/3 and some white hairs; I: 6.8; 6.5; 4.2/ 1.4/ 1.4/ 1.2/ 0.7; FI with some fine white ventral hairs and subapical pv seta; TI with dorsal at 1/5, and pv surface from 1/5 to apex covered with fine whitish pile, not usual rows of black setulae, and with short subapical pd seta; It_1 (Figure 2) with black ventral setae at 1/6 (short), 2/3 (long), and 3/4 (shorter) (MSSC); each tarsomere It_{2-4} with short comb-like row of ventral seta, and with white pile (MSSC); II: 7.0; 10.0; 6.0/ 2.7/ 1.7/ 1.0; 0.5; FII with white ventral hairs; TII with ad at 1/6, anterior at 1/2, and dorsal at 1/4, with 4 spaced ventral setae along length, and with subapical corona of dorsal, ad, av, and pv setae; IIt_1 with 5 short ventral setae along length; III: 8.8; 12.4; 5.0/ 3.0/ 1.8/ 1.3/ 0.8; FIII with fine white hairs; TIII with strong ad seta at 1/5, and with 5 strong dorsal setae along length, and with strong subapical dorsal, av, pv, and ad setae; $IIIt_3$ on distal quarter, and all $IIIt_{45}$ slightly flattened and ventrally padlike (MSSC).

Wings. Hyaline; R_{2+3} joining costa near 9/10; M_1 branching sharply and converging towards $R_{4+5,}$ but both veins almost joining near end of costa before wing apex; M_2 slightly curved; dm-cu straight; CuAx ratio: 1.3; lower calypter brown with fan of white setae; halter yellow.

Abdomen. Tergites 1-3 matt brown on anterior half of each tergite and metallic green with bronze reflections posteriorly; tergites 4-8 metallic violet with blue reflections; tergites 1-2 each with subapical row of 8 strong black setae, and with whitish hairs on tergal surface; hypopygium including cercus dark brown (Figures 2-3); epandrium tapering, elongate subtriangular, with flat dorsal surface; hypandrial arm arising at midlength and almost reaching aedeagal apex; 2 short white epandrial setae present, near epandrial lobe; epandrial lobe with strong apical and subapical setae; surstylus lobate with strong distal setae; cercus divided into three arms: basoventral arm lying alongside epandrium broad and apically clubbed, and with distinctive curved ventral seta at midlength, and with group of short white dorsal setae; middle cercal arm elongate and digitiform, with white hairs along ventral surface; dorsal cercal arm short and tapering subtriangular, with long white apical setae reaching beyond apex of middle arm.

Female. Unknown.

REMARKS — *Plagiozopelma millerorum* is known from low to mid-elevation forested habitats (to 1700 m) in northern Papua New Guinea.

ETYMOLOGY — This species is named in honor of Scott & Pamela Miller, who collected this species near the Wau Ecology Institute.

Plagiozopelma maspainae Bickel n. sp.

Figures 4-6

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Madang Province: Wanang 3, -5.2277 145.0797, 175 m, sticky trap on tree trunk, 25-30.XI.2012, D. J. Bickel (MNHN). Paratypes. Papua New Guinea. Madang Province: 2 ♂, 1 ♀, same information as holotype (♂, ♀, MNHN; paratype ♂, AMS).

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. Madang Province: 2 ♂ Bismarck Range, Oromungu, -5.72754 145.257943, 760 m, sticky trap on tree trunk, 16-18.X.2013, D. J. Bickel (AMS).

DESCRIPTION — ***Male***. Body length: 5.2 mm; wing: 4.5 x 1.4 mm (Figure 4); similar to *P. millerorum* except as noted:

Head. Postpedicel dark brown, but yellow basoventrally.

Legs. Coxae, trochanters, femora, basal quarter of TI and TII and all of leg III dark brown; distal tibiae I and II and basal half of basitarsus II yellow; all tarsus I and distal tarsus II dark brown; CI without pale hairs, but with 5 strong anterior directed black distolateral setae along length; CII with short black anterior setae and stronger anterolateral seta in distal



FIGURES 1-9

Plagiozopelma millerorum n. sp.: **1**, male habitus, left lateral; **2**, male legs and postabdomen, left lateral; **3**, male postabdomen, left lateral. *P. maspainae* n. sp.: **4**, male habitus, left lateral; **5**, female head, right lateral; **6**, male postabdomen, left lateral. *Plagiozopelma ismayi* n. sp.: **7**, male habitus, left lateral; **8**, male postabdomen, left lateral. *P. kikori* n. sp.: **9**, male postabdomen, right lateral. Scale bars, 1, 4: 2.0 mm; 7, 1.0 mm; 2-3, 5: 0.5 mm; 6, 8-9: 0.2 mm.

quarter; CIII with strong black lateral seta at 1/3 and some white hairs; I: 6.0; 5.7; 3.7/ 0.8/ 0.7/ 0.6/ 0.5; FI with some black ventral hairs and subapical pv seta; TI with dorsal at 1/5; It_1 with short black ventral setae at 1/3, 2/3, and 5/6 (MSSC); each tarsomere It_{2-4} with short comb-like row of ventral seta and with grey pile (MSSC); II: 7.2; 8.1; 5.0/ 2.5/ 1.4/ 0.8; 0.6; FII with black ventral setae; TII with ad seta at 1/6, anterior at 2/5, dorsal seta near 1/3, and 2-3 short spaced ventral setae, and with subapical corona of dorsal, ad, av, and pv setae; IIt_1 with 4-5 short ventral setae along length; III: 8.8; 10.8; 5.0/ 2.9/ 1.7/ 1.1/ 0.7; FIII with black vestiture, but with some white ventral hairs near base; TIII with strong ad seta at 1/5, and with 5 strong dorsal setae along length, and with strong subapical dorsal, av, pv, and ad setae; $IIIt_{45}$ weakly flattened.

Wings. CuAx ratio: 1.5.

Abdomen. Hypopygium including cercus entirely dark brown (Figure 6); epandrium tapering, elongate subtriangular, with flat dorsal surface; hypandrial arm arising at midlength and almost reaching aedeagal apex; 2 short white epandrial setae present, near epandrial lobe; epandrial lobe with strong apical and subapical setae; surstylus curved and slightly expanded distally, with strong distal setae; cercus divided into three arms: basoventral arm lying alongside epandrium basally flexed and continuing elongate and tapering beyond apex of surstylus, and with apical bean-shaped projection and strong dorsal seta arising one third distance from base; middle cercal arm flexed and tapering to narrow point, with group of white hairs midway along ventral surface; dorsal cercal arm subtriangular, short and with single strong black apical seta.

Female. Similar to male except as noted: strong vertical seta present (Figure 5); face and clypeus wider; ventral postcranium, in addition to pale hairs, with row of 5 strong black ventral setae (FSSC); legs mostly dark brown; coxa I with additional field of short black setae medially, black distolateral setae stronger (FSSC); tarsus unmodified; $IIIt_{45}$ not flattened.

REMARKS — *Plagiozopelma maspainae* is known from forested sites at 175 m and 750 m, in Madang Province, Papua New Guinea, sites where Malaise traps were ran as part of the Mt Wilhelm transect. All specimens were collected with tree trunk sticky traps.

ETYMOLOGY — This species is named in honor of Dolly Maspaine who prepared delicious and satisfying meals at the remote Wanang 3 camp during the Our Planet Reviewed – Papua New Guinea expedition.

Plagiozopelma ismayi Bickel n. sp.

Figures 7-8

TYPE MATERIAL EXAMINED — Holotype, ♂, **Papua New Guinea**. Central Province: nr Eilogo, 500 m, 12.IX.1984, forest, J. Ismay (AMS; Holotype # K328180). Paratype: Papua New Guinea. Central Province: 1♂, same as HT but 23.VII.1984, J. Ismay & N. Sui (AMS).

DESCRIPTION — ***Male***. Body length: 5.5 mm; wing: 4.6 x 1.3 mm (Figure 7); similar to *P. millerorum* except as noted:

Head. Antennae missing from specimens.

Legs. Coxae, trochanters, femora and remainder of leg III dark brown; tibiae I and II and all tarsus I and basitarsus II yellow; distal tarsomeres II brown; CI with pale hairs and 4-5 strong black distolateral setae; CII with short black anterior setae and stronger anterolateral seta in distal quarter; CIII with strong black lateral seta at 1/3 and some white hairs; I: 6.2/ 6.4; 4.0/ 1.4/ 1.2/ 1.2/ 0.7; FI with some fine white ventral hairs and subapical pv seta; TI with dorsal at 1/5; It_1 with black ventral setae at 1/4 (short), 3/4 (longer), and 7/8 (longest) (MSSC); each tarsomere It_2 distally and It_3 along length with comb-like row of short ventral setae and with white pile (MSSC); II: 6.9; 9.2; 6.0/ 2.3/ 1.3/ 1.1; 0.5; FII with white ventral hairs; TII with ad at 1/6, anterior at1/2, and dorsal at 1/4, and 3 spaced short ventral setae, and with subapical corona of dorsal, ad, av, and pv setae; IIt_1 with some short ventral setae along length; III: 8.8; 11.9; 4.9/ 2.8/ 1.7/ 1.2/ 0.8; FIII with fine white hairs; TIII with strong ad seta at 1/5, and with 5 strong dorsal setae along length, and with strong subapical dorsal, av, pv, and ad setae; $IIIt_3$ on distal quarter, and all $IIIt_{4-5}$ slightly flattened and ventrally padlike (MSSC).

Wings. CuAx ratio: 1.8.

Abdomen. Hypopygium including cercus dark brown (Figure 8); epandrium tapering, elongate subtriangular, with flat dorsal surface; hypandrial arm arising at midlength and almost reaching aedeagal apex; 2 short white setae present, near epandrial lobe; epandrial lobe with strong apical and subapical setae; surstylus lobate with strong distal setae; cercus divided into three arms: basoventral arm lying alongside epandrium slightly clubbed apically, and with some distinctive curved dorsal subapical setae, and with subapical spatulate setae; middle cercal arm elongate with white hairs along ventral surface and slightly expanded apical club bearing long curved subapical seta; dorsal cercal arm short and tapering subtriangular, with 3 long white apical setae reaching beyond apex of middle arm.

Female — Unknown.

REMARKS — *Plagiozopelma ismayi* is known only from low elevation forested habitat (500 m) in Central Province, Papua New Guinea. This species is close to *P. millerorum*, with similar leg coloration and setation, but with distinctly different cerci.

ETYMOLOGY — This species is named in honor of John Ismay, who collected many fine Diptera specimens in Papua New Guinea.

Plagiozopelma kikori Bickel n. sp.

Figure 9

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Gulf Province: Kikori, Doibu Village, "swamp country", 1956, P. Dawson (AMS). Paratype. Papua New Guinea. Gulf Province: ♀, same information as holotype (AMS).

DESCRIPTION — ***Male***. Body length: 5.6 mm; wing: 5.5 x 1.6. mm; similar to *P. millerorum* except as noted:

Legs. Coloration and coxae similar; CI with pale hairs and 4-5 strong black distolateral setae; I: 7.5; 7.5; 3.8/ 1.4/ 1.3/ 1.7/ 0.7; It_1 with black ventral seta at 1/5 (short), and two longer ventral setae at 3/4 and 4/5 (MSSC); each tarsomere It_{2-4} with short comb-like row of ventral seta, and with white pile (MSSC); II: 7.8; 11.6; 7.3/ 3.1/ 1.7/ 1.0; 0.6; FII with black comb of 5 curved black hook-like setae on basal fifth (MSSC) with adjacent ventral field of white hairs on basal third; TII with ad-pd setal pair at 1/6, 1/2, and pd at 1/4, with row of five spaced setae along length, and with subapical corona of dorsal, ad, av, and pv setae; IIt_1 with 5 short ventral setae along length; III: 9.5; 14.1; 6.5/ 3.7/ 2.0/ 1.5/ 0.9; FIII with fine white hairs; TIII with strong ad seta at 1/5, and with 5 strong dorsal setae along length, and with strong subapical dorsal, av, pv, and ad setae; $IIIt_3$ on distal quarter and all $IIIt_{4-5}$ slightly flattened and ventrally padlike (MSSC).

Abdomen. Hypopygium mostly dark brown, cercus brown (Figure 9); epandrium elongate subtriangular, with flat dorsal surface; surstylus lobate with strong distal setae; cercus divided into three arms: basoventral arm lying alongside epandrium thick apically clubbed, bent and outwardly curved, and with apical curved bean-like projection; middle cercal arm elongate and distally spatulate, bearing abundant white hairs on the ventral spatular surface; dorsal cercal arm short and with strong curved white subapical setae.

Female. Similar to male except where noted: face and clypeus wider; ventral postcranium with two strong black setae (FSSC); thorax similar; coxa I with additional field of short black setae medially, pale hairs anterolaterally, and black distolateral setae much stronger (FSSC); It_1 with only two short ventral setae; tarsomeres It_{2-4} unmodified; FII without basoventral setal comb; $IIIt_{4-5}$ not flattened.

REMARKS — *Plagiozopelma kikori* is known from a lowland swampy site in Gulf Province, Papua New Guinea. It has five black curved hook-like setae near the base of femur II, and a distinctive spatulate cercal arm.

ETYMOLOGY — The specific epithet *kikori* is an indigenous place name and a noun in apposition.

Plagiozopelma eilogo Bickel n. sp.

Figures 10-12

TYPE MATERIAL — Holotype, ♂**, Papua New Guinea**. Central Province: Eilogo Creek, 500 m, 2.IX.1984, J. W. Ismay (AMS).

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. Gulf Province: ♂, Wabo, Purari River, Malaise trap at edge of secondary rainforest, 18-22 VII.1978, E. N. Marks (QDPI). Morobe Province: 2 ♂, Upper Manki logging area, nr Bulolo, 1600 m, sticky trap, 9 & 23.III.1973, F.R. Wylie & P. Shanahan (AMS); ♂, Wau Ecology Institute, 1200 m, Malaise trap, secondary forest, 2-24.VII.1983, S. E. & P. M. Miller; ♂, Wau, Hospital Ck., 1250 m, IV.1963, Malaise trap, J. Sedlacek (BPBM).

DESCRIPTION — ***Male***. Body length: 5.9 mm; wing: 4.7 x 1.4 mm (Figure10); similar to *P. millerorum* except as noted:

Head (Figure 11). Postpedicel mostly brown but yellow basoventrally.

Legs. Coxae, trochanters, femora and remainder of leg III dark brown; tibiae I and II, and all tarsus I and basitarsus II yellow; distal tarsomeres II brown; CI with pale hairs and 4-5 strong black distolateral setae; CII with short black anterior setae and stronger anterolateral seta in distal quarter; CIII with strong black lateral seta at 1/3 and some white hairs; I: 6.3/ 6.4; 3.8/ 1.3/ 1.1/ 1.0/ 0.6; FI with some fine white ventral hairs and subapical pv seta; TI with dorsal at 1/5; It_1 with black ventral setae at 1/4 (short), 1/2 (short), 3/4 (long), and 7/8 (long) (MSSC); It_2 only with some weakly developed white pile (MSSC); II: 7.3; 9.6; 5.9/ 2.5/ 1.5/ 0.8; 0.5; FII with white ventral hairs; TII with ad at 1/6, anterior at 1/2, and dorsal at 1/3 and 2/3, and 3 spaced short ventral setae, and with subapical corona of dorsal, ad, av, and pv setae; IIt_1 with some short ventral setae along length; III: 9.2; 12.1; 4.7/ 2.7/ 1.4/ 1.0/ 0.9; FIII with fine white hairs; TIII with strong ad seta at 1/5, and with 5 strong dorsal setae along length, and with strong subapical dorsal, av, pv, and ad setae; $IIIt_3$ on distal quarter, and all $IIIt_{4\text{-}5}$ slightly flattened and ventrally padlike (MSSC).

Wings. CuAx ratio: 1.8.

Abdomen. Tergites 1-3 matt brown on anterior half of each tergite and metallic blue green with bronze reflections posteriorly; tergites 4-8 metallic violet with blue reflections; hypopygium including cercus dark brown (Figure 12); surstylus lobate with strong distal setae; cercus divided into three arms: massive hammer-shaped basoventral arm lying alongside epandrium, thick and slightly expanded distally and apically truncate, with distinctive curved external setae near bend at 2/3; middle and dorsal cercal arms elongate and tapering to point, subequal in length, and with middle arm only bearing small white apical seta.

Female. Unknown

REMARKS — *Plagiozopelma eilogo* is known from the Gulf, Central and Morobe Provinces, of Papua New Guinea, at elevations ranging from 500 m to 1600 m.

ETYMOLOGY — The specific epithet *eilogo* is an indigenous place name and a noun in apposition.

Plagiozopelma mouldsorum Bickel, 1994

Figures 13-16

Plagiozopelma mouldsorum Bickel, 1994: 225.

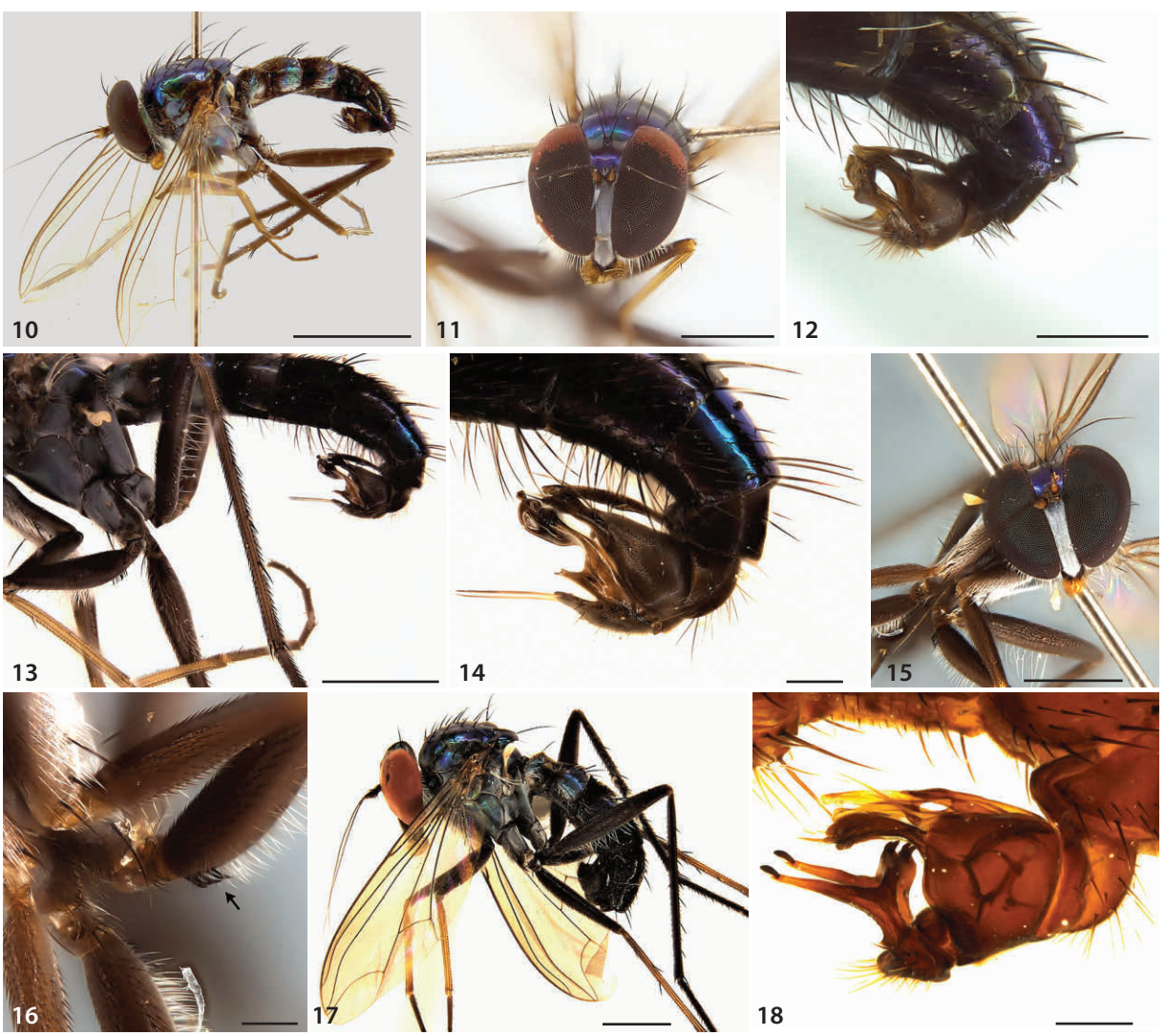
TYPE MATERIAL — This species was described from northern Cape York Peninsula, Queensland (AMS, examined).

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. Central Province: 2 ♂, ♀, Laloki, 2.VIII.1984, J. W. Ismay (AMS).

DIAGNOSIS — ***Male***. Body length: 5.5 mm; wing: 4.6 x 1.3 mm; similar to *P. millerorum* except as noted:

Head. Subcircular in anterior view (Figure 15); antenna yellowish.

Legs. Coxae dark brown with silvery pruinosity; trochanters and femora dark brown; tibia and basitarsus I and II yellow; tibia III yellowish; distal tarsomere I and II and all tarsus III dark brown; CI with pale hairs and 4 strong black distolateral setae; CII with short black anterior setae and stronger anterolateral seta in distal quarter; CIII with strong black lateral seta at 1/3 and some white hairs; I: 5.5; 5.2; 3.0/ 1.0/ 1.1/ 1.0/ 0.7; FI with white ventral hairs; TI with dorsal seta at 1/5, and pv surface from 1/5 to apex covered with fine whitish pile, not usual rows of black setulae, and with short subapical



FIGURES 10-18

Plagiozopelma eilogo n. sp.: **10**, male habitus, left lateral; **11**, male head, anterior; **12**, male postabdomen, left lateral. *P. mouldsorum* Bickel: **13**, male thorax and abdomen, left lateral; **14**, male postabdomen, left lateral; **15**, male head and thorax, anterior; 16, male coxa and femora, anterior. *P. oromungu* n. sp.: **17**, male habitus, left lateral; **18**, male hypopygium, left lateral. Scale bars, 10: 2.0 mm; 11, 13, 15, 17: 1.0 mm; 12: 0.5 mm; 14-15, 18: = 0.2 mm.

pd seta; It_1 with black ventral setae at 1/6, (short) and 2/3 (long); each tarsomere It_{2-4} with short comb-like row of ventral setae, and with white pile (MSSC); II: 6.5; 8.0; 5.0/ 2.0/ 1.5/ 0.8/ 0.6; FII with comb of 7-8 curved black hook-like setae on basal fifth (Figure16) (MSSC) with abundant white ventral hairs distally; TII with ad seta at 1/8, anterior seta at 1/4 and 1/2, dorsal at 1/3, and 3 ventral seta spaced along length, and with subapical corona of dorsal, ad, av, and pv setae; IIt_1 with 6-8 short ventral setae along length; III: 7.3; 11.4; 4.0/ 3.7/ 1.4/ 1.0/ 0.7; FIII with long white ventral hairs; TIII with strong ad seta at 1/5, anterior seta at 4/5 and with 4 strong dorsal setae along length, and with strong subapical dorsal, av, pv, and ad setae; $IIIt_{4-5}$ slightly flattened and ventrally padlike (MSSC).

Wings. CuAx ratio: 1.7.

Abdomen. Hypopygium including cercus dark brown (Figures 13-14); epandrium tapering, elongate subtriangular, with flat dorsal surface; hypandrial arm arising at midlength and almost reaching aedeagal apex; epandrial lobe with strong apical and subapical setae; surstylus lobate with strong distal setae; cercus massive, and divided into three arms: basoventral arm lying alongside epandrium, subapically expanded with lateral field of short spinelike setae, and subapical spatulate setae; middle cercal arm as short subrectangular projection with sharp dorsoapical point; dorsal cercal arm short and tapering subtriangular, with long curved apical setae reaching beyond apex of basoventral arm.

Female. Similar to male except lacking MSSC, and as noted: head; face wider; strong black vertical present; ventral postcranium behind eye with 3-4 black projecting spinelike setae in addition to usual pale setae; CI with black distolateral spinelike setae strongly developed and anteromedian setal field; It_1 without pv setae; FII without comb of thick setae near base; FIII without long ventral setae; $IIIt_{3-5}$ not flattened.

REMARKS — *Plagiozopelma mouldsorum* is known from northern Cape York Peninsula, and low elevation (~500 m) forested habitat in Central Province, Papua New Guinea. In hypopygial structure, it is close to *P. angustifacies.*

Plagiozopelma oromungu Bickel n. sp.

Figures 17-18

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Madang Province: Bismarck Range, Oromungu, -5.72754 145.257943, 760 m, yellow pans along creek, 16-18.X.2013, D. J. Bickel (AMS).

DESCRIPTION — ***Male***. Body length: 5.1 mm; wing: 4.5 x 1.5 mm (Figure17); similar to *P. millerorum* except as noted:

Head. Antenna dark brown.

Legs. Coxae, trochanters, femora and remainder of leg III dark brown; tibiae I and II and all tarsus I and basitarsus II yellow; distal tarsomeres II brown; CI with pale hairs and 3 strong black distolateral setae; CII with short black anterior setae and stronger anterolateral seta in distal quarter; CIII with strong black lateral seta at 1/3 and some white hairs; I: 6.1; 6.0; 3.8/ 1.0/ 1.3/ 0.9/ 0.7; FI with some fine white ventral hairs and subapical pv seta; TI with dorsal seta at 1/5, and pv surface from 1/5 to apex covered with fine whitish pile, not usual rows of black setulae, and with short subapical pd seta; It_1 with black ventral setae at 1/5 (short), 1/3 (short), and 3/4 (long) (MSSC); tarsomeres It_{2-4} unmodified; II: 6.9; 8.8; 5.2/ 2.0/1.3/ 0.7/ 0.4; FII with white ventral hairs; TII with ad seta at 1/6, anterior seta at 1/2, and dorsal seta at 1/3, with 4 spaced ventral setae along length, and with subapical corona of dorsal, ad, av, and pv setae; III: 8.5; 12.0; 4.4/ 2.4/ 1.2/ 1.0/ 0.6; FIII with fine white hairs; TIII with strong ad seta at 1/5, and with 5 strong dorsal setae along length, and with strong subapical dorsal, av, pv, and ad setae; $IIIt_3$ on distal quarter, and all $IIIt_{4-5}$ slightly flattened and ventrally padlike (MSSC).

Wings. CuAx ratio: 1.7.

Abdomen. Hypopygium including cercus dark brown (Figure 18); epandrium tapering, elongate subtriangular, hypandrial arm arising at midlength and almost reaching aedeagal apex; 2 short white epandrial setae present, near epandrial lobe; epandrial lobe with strong apical and subapical setae; surstylus expanded distally, lobate and with strong distal setae; cercus short and subtriangular, with abundant white setae, and bearing ventral Y-shaped projection divided into two arms,

proximal arm shorter and thicker, and apically with two short curved lobes, and distal arm elongate, reaching beyond surstylus, and apically with short point and enlarged black spatulate seta.

Female. Unknown.

REMARKS — *Plagiozopelma oromungu* is known from a single male taken in yellow pans along a forested creek at 760 m near Oromungu village, Bismarck Range, Madang Province (an Our Planet Reviewed – Papua New Guinea Mt Wilhelm transect site). The cercus of this species has only two major branches rather than the usual three.

ETYMOLOGY — The specific epithet *oromungu* is an indigenous place name and a noun in apposition.

Plagiozopelma angustifacies (Becker, 1922)

Figures 19-23

Chrysosoma angustifacies Becker, 1922: 186.
Chrysosoma arctifacies Parent, 1935: 65. N. SYN.

TYPE MATERIAL — Becker based *Chrysosoma angustifacies* on a mixed syntype series, a male and two females from the "Key Inseln" (= Kai Islands, Maluku, Indonesia; deposited SDEI, but apparently lost), three females from Simbang (= Finschhafen, PNG; TMB, destroyed) and two males from Ralum, New Britain, Bismarck Archipelago (ZMHB, examined; lectotype designated in Bickel 1994, male with label "BismarckArch, Ralum, 29 May 1896, Dahl S 189697"). Parent described *Chrysosoma arctifacies* from a single male collected in the Solomon Islands, Three Sisters Group, Malaupaina I. (BMNH examined, and Figures 19, 20, 22). Parent noted his species was very close to Becker's description of *C. angustifacies*, and I regard the two species as synonyms (new synonymy).

ADDITIONAL MATERIAL EXAMINED — Solomon Islands. Makira (=San Cristobal): ♂, Kira, 0-100 m, XI.1970, N. L. H. Krauss (BPBM). Guadalcanal: ♂, Honiara, 0-200 m, XII.1975, N. L. H. Krauss (BPBM); ♂, no locale, 30.X.1944, D.G. Hall (USNM).

DIAGNOSIS — ***Male***. Body length: 5.7 mm; wing: 5.2 x 1.5 mm; similar to *P. millerorum* except as noted:

Legs. Coxae, trochanters, femora and the remainder of leg III dark brown; tibiae I and II and all tarsus I and basitarsus II yellow; distal tarsomeres I and II brown; CI with pale hairs and 4-5 strong black distolateral setae; CII with short black anterior setae and stronger anterolateral seta in distal quarter; CIII with strong black lateral seta at 1/3 and some white hairs; I: 7.0; 6.1; 3.8/ 1.3/ 1.0/ 1.2/ 0.7; FI with some fine white ventral hairs and subapical pv seta; TI with dorsal seta at 1/5, and ventral row of setulae from 1/3 to apex white, not usual black setulae; and with short subapical pd seta; It_1 with black ventral setae at 1/6 (short), 1/3 (short), 3/4 (long) and 1/8 (short) (MSSC); each tarsomere It_{2-4} with short comb-like row of ventral seta, and with white pile (MSSC); II: 8.2; 10.8; 7.5/ 2.8/ 1.7/ 1.0; 0.6; FII with comb of 3-6 curved short black ventral setae on basal fifth (Figure 19) (MSSC) or absent, with ventral field of white hairs along basal two-thirds; TII with ad seta at 1/10, dorsal seta at 1/3 and 2/3, pv at 2/5, and ventral setae at 1/3, 1/2 and 2/3, and with subapical corona of dorsal, ad, av, and pv setae; IIt_1 with 5-6 short ventral setae along length; III: 9.2; 13.0; 5.7/ 3.2/ 1.6/ 1.3/ 0.8; FIII with fine white ventral hairs; TIII with strong ad seta at 1/5, and with 5 strong dorsal setae along length, and with strong subapical dorsal, av, pv, and ad setae; $IIIt_3$ on distal quarter, and all $IIIt_{4-5}$ slightly flattened and ventrally padlike (MSSC).

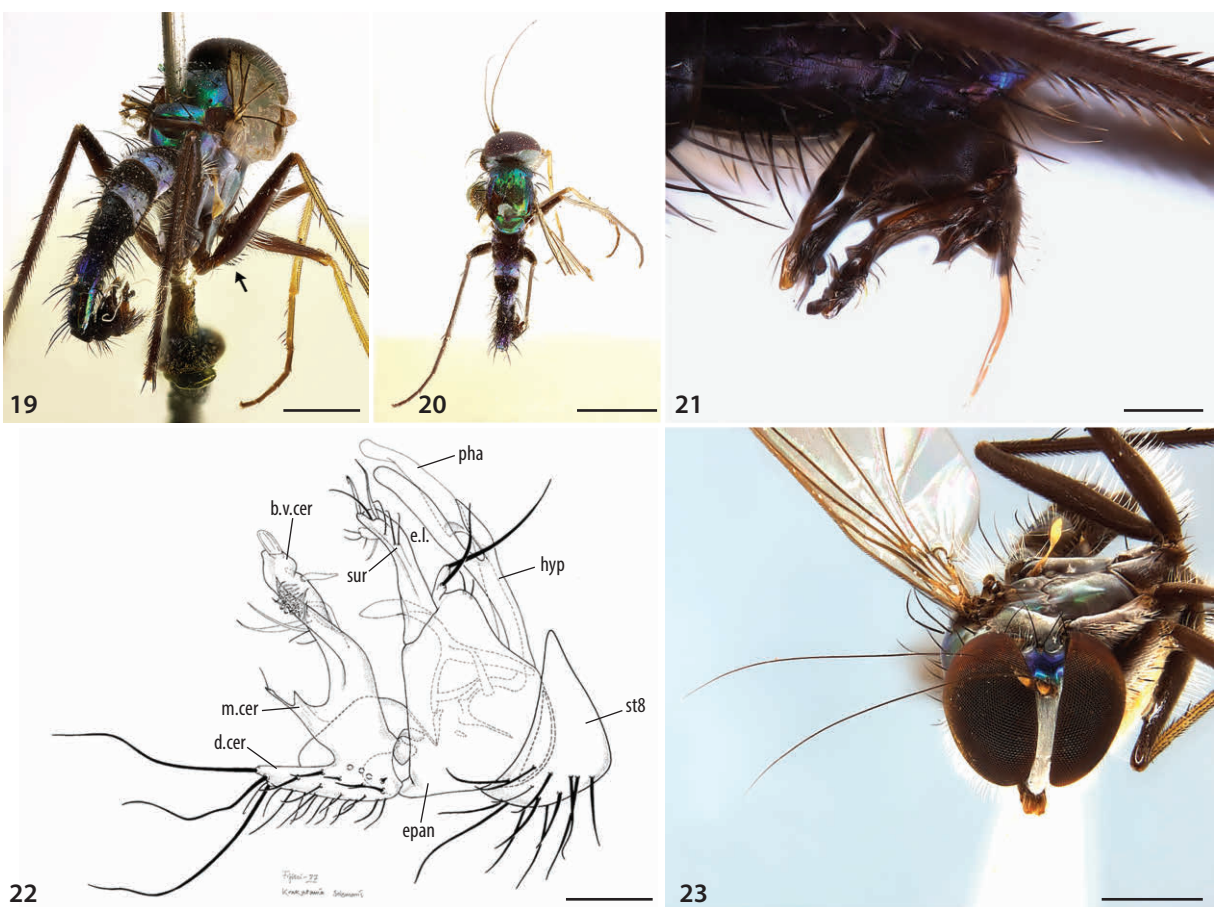
Wings. CuAx ratio: 1.7.

Abdomen. Hypopygium including cercus dark brown (Figures 21-22); epandrium tapering, elongate subtriangular, with flat dorsal surface; hypandrial arm arising at midlength and almost reaching aedeagal apex; 2 short white epandrial setae present, near epandrial lobe; epandrial lobe with strong apical and subapical setae; surstylus lobate with strong distal setae; cercus massive, and divided into three arms: basoventral arm lying alongside epandrium broad and with distinctive

apical dentate seta, subtended by bladelike seta, and with distinctive curved ventral dorsal and overlapping arm with field of short subapical setae; middle cercal arm with sharp basal projection, and sometimes with elongate digitiform apical projection bearing fine hair (Figure 22); dorsal cercal arm short and tapering subtriangular, with some lateral white setae, and group of 3-4 strong white apical setae.

Female. Unknown.

REMARKS — *Plagiozopelma angustifacies* is known from lowland habitats in New Britain and the Solomon Islands (Makira, its offshore Three Kings island group, and Guadalcanal). Becker (1922) used specimens from the Kai Islands, Indonesia and Finschhafen, Papua New Guinea as part of his syntype series, but since these specimens are destroyed and cannot be verified, it is best not to include these records in the species distribution range. The closely related *P. mouldsorum* has a large club-shaped basoventral cercal arm, whereas in *P. angustifacies* the basoventral cercal arm is not expanded.



FIGURES 19-23

Plagiozopelma angustifacies (Becker): **19**, male habitus, right lateral (holotype, jun. syn. *Chrysosoma arctifacies* (Parent) BMNH); **20**, male habitus, dorsal (holotype, jun. syn. *C. arctifacies*, BMNH); **21**, hypopygium, left lateral; **22**, hypopygium, left lateral; **23**, head and thorax, anterior. Legend: b.v.cer, basoventral cercal arm; d.cer, distal cercal arm; e.l., epandrial lobe; epan, epandrium; hyp, hypandrium; pha, phallus; st8, sternite 8; sur, surstylus. Scale bars, 20, 2.0 mm; 19, 23: 1.0 mm; 21, 22: 0.2 mm.

The four male specimens examined show variation that I regard as intraspecific. On the basal fifth of femur II is a comb of short curved black ventral setae, comprising four setae on the New Britain lectotype, six setae on the Three Kings specimen (holotype of *P. arctifacies*, Figure 19, arrow), three on the Makira specimen, but none on the two Guadalcanal specimens. As well, there is variation on the middle cercal arm, the Makira specimen with an elongate projection (Figure 22), and the other specimens without (Figure 21). I regard this as intraspecific variation, as one might find resulting from isolation within an island archipelago. In all other respects the specimens are similar, and I regard them as conspecific.

Plagiozopelma terminiferum species group

DIAGNOSIS — *Plagiozopelma terminiferum* group:

Head. Frons polished metallic green; male scape weakly swollen

Thorax. Lateral scutellar setae present as weak hairs.

Legs. Female coxa I with strong lateral setae; FI with strong whitish basoventral setae; male It_1 with 4 long slightly crocheted posterior hairs on distal half (MSSC).

Abdomen. Epandrium elongate subtriangular; surstylus with tapering digitiform lateral projection; cercus with elongate bladelike arms and with shorter basomedial arms with apical seta.

REMARKS — The *Plagiozopelma terminiferum* group has hypopygial similarities with the *Krakatauia alanae* group, as both have elongated bladelike cerci, triangular epandrium, and surstylar structure. However, these hypopygial similarities are regarded as convergence and not evidence for a close relationship with *Krakatauia* (see Bickel 1994).

The *terminiferum* group occurs in the Aru Islands, New Guinea and northern Queensland and includes three species, the widespread *Plagiozopelma terminiferum* (Walker), and the newly described *P. kokoda* and *K. arabuka*, both from New Guinea only.

Plagiozopelma kokoda Bickel n. sp.

Figures 24-25

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Oro Province: Kokoda, 1200 ft (~ 360 m), VIII.1933, L. E. Cheesman (BMNH, B.M. 1933-427). Paratype. Papua New Guinea. Oro Province: ♂, Kokoda, 400 m, 20.XI.1965, J. Sedlacek (BPBM).

DESCRIPTION — ***Male***. Body length: 5.2 mm; wing: 5.1 x 1.6 mm (Figure 24).

Head. Vertex and frons highly polished and deep metallic blue; vertex deeply excavated; lateral sides of vertex with pale hairs; lower face and clypeus covered in grey pruinosity such that in anterior view appears frosted green; ocellar setae black, postverticals pale yellow; face bulging, with distinct frontoclypeal suture; clypeus free from margin of eyes; palp and proboscis yellow; antenna bright redyellow; scape slightly swollen; postpedicel short and conical; arista apical and about two-thirds of body length.

Thorax. Mesonotum and scutellum shining metallic greenblue; pleura with silvery pruinosity; three pairs of long ac present; with 2 strong posterior dc and 3-4 weak hairlike dc anteriad; 1 pa, 2 sa, 2sr, 2npl, 1 pm, 1 weak hm present; median scutellar setae strong, lateral scutellar seta as weak whitish seta.

Legs. CI yellow; CII and CIII dark brown; trochanters and legs yellow, except $IIIt_{35}$ dark brown; CI with white hairs and 4 strong with distolateral setae; CII with short white anterior setae and stronger white anterolateral seta in distal quarter; CIII with 2 strong white lateral setae and some white hairs; legs mostly bare of major setae; I: 6.5; 6.2; 3.3/ 1.5/ 0.8/ 0.6/ 0.5/0.4; FI slightly swollen in basal third subtended ventrally by 4 long white setae; male It_1 with 4 long slightly

crocheted posterior hairs on distal half (MSSC). II: 6.5; 7.0; 6.7/ 2.2/ 1.2/ 0.7/ 0.4; FII with subapical pv seta; TII with 45 short anterior setae and with subapical corona of dorsal, ad, av, and pv; IIt_1 very long, longer than FII; III: 8.5; 12.0; 6.0/ 2.0/ 1.4/ 0.8/ 0.6; FIII with black subapical pv seta; TIII with short dorsal setae along length, and with strong subapical ad and av seta; $IIIt_5$ slightly flattened.



FIGURES 24-31

Plagiozopelma kokoda n. sp.: **24**, male habitus, anterior; **25**, hypopygium, left lateral. *P. terminiferum* (Walker): **26**, male habitus, left anterior; **27**, male postabdomen, left lateral; **28**, hypopygium, right ventral. *P. arabuka*. sp.: **29**, male habitus, left lateral; **30**, hypopygium, left lateral; **31**, hypopygium, dorsal. Scale bars, 24, 26, 29: 2.0 mm; 25, 27-28, 30-31: 0.2 mm.

Wings. Elongate, relatively narrow, hyaline; dm-cu slightly sinuate; CuAx ration 2.0; lower calypter pale yellow with dark brown rim and fan of pale setae; halter yellow.

Abdomen. Tergites 13 metallic green with some grey pruinosity; tergites 45 matt brown in basal 2/3 and white pruinose in distal 1/3, and tergite 6 shining metallic green-bronze; tergites 2-6 each with 4 posterior marginal setae, otherwise tergites with short vestiture; segment 7 with well-developed tergite and sternite, dark brown; hypopygium basally dark brown with pale yellow distal epandrium and surstylus, and yellow cerci (Figure 25); 2 epandrial setae present; epandrial lobe with 2 long setae; surstylus pale yellow, broad and apically subrectangular with elongate dorsoapical digitiform projection, and with pale yellow marginal and apical setae; cercus with bare elongate lateral arms that reach to apex of surstylar projection, and with apical pair of flattened setae, and with median arm about two-fifths length of lateral arm, infuscated distally and with spikelike apical seta, and subtended along median line by pedunculate seta on cuticular projection.

Female. Unknown.

REMARKS — *Plagiozopelma kokoda* is known only from two specimens taken independently between 360-400 m near Kokoda, Oro Province, Papua New Guinea. This species is close to the widespread *P. terminiferum,* with similar coloration and setation, but its wing is totally hyaline, without any apical infuscation.

ETYMOLOGY — The specific epithet *kokoda* is an indigenous place name and a noun in apposition.

Plagiozopelma terminiferum (Walker, 1858)

Figures 26-28

Psilopus terminifer Walker, 1858: 92.
Plagiozoplema [sic] *terminiferum* (Walker) – Bickel & Dyte 1989: 400.

TYPE MATERIAL — Holotype, ♂, **Indonesia**. Aru Island, A. R. Wallace (BMNH). [examined].

ADDITIONAL MATERIAL EXAMINED — **Indonesia**. Papua Province: ♂, Nabire, Geelvink Bay, 3 m, 2.VII.1962, J. L. Gressitt (BPBM). Papua New Guinea: Central Province: ♂, Cape Rodney, 4.XI.1960, L.& M. Gressitt (BPBM); ♂, Laloki, 10.VII.1985, J. W. Ismay (AMS); ♂, Koitaki, 5.12.1921, E. O. Pockley (AMS).

DIAGNOSIS — ***Male***. length 5.7; wing: 4.6 x 1.3 mm; similar to *P. kokoda* except as noted:

Wings. Elongate, relatively narrow, and with distinctive dark brown apical spot (MSSC) (Figure 26); club of halter slightly infuscated.

Abdomen. Hypopygium with dark brown epandrium and surstylus, and yellow cercus (Figures 27-28); surstylus lobate with distinctive tapering blade-like lateral projection which bears strong curved white apical seta; cercus distinctive with bare elongate lateral arms and pair of apical flattened fanlike setae, and basally with short median arm about one-quarter length of lateral arm, and with spikelike apical seta.

REMARKS — *Plagiozopelma terminiferum* is a widespread lowland species known from New Guinea (Indonesia and Papua New Guinea), the Torres Strait islands and the northern Cape York Peninsula, Queensland. (additional records in Bickel 1994).

Plagiozopelma arabuka Bickel n. sp.

Figures 29-31

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Province: Arabuka, 1500-2000 m, 7.I.1968, no collector (BPBM).

DESCRIPTION — ***Male***. Body length: 5.2 mm; wing: 4.7 x 1.4 mm (Figure 29); similar to *P. kokoda* except as noted:

Head. Vertex and frons metallic blue-green and with grey pruinosity; lateral slope of vertex with single white hair; postvertical seta black; face not strongly bulging; clypeus adjacent to eyes margin; palp, proboscis yellow; antenna bright redyellow; scape not swollen; postpedicel short, subtriangular, with arista dorsoapical and about one-third body length.

Legs. CI yellow; CII and CIII dark brown; trochanters and legs yellow, except $IIIt_{35}$ dark brown; CI with white hairs and 4 strong distolateral setae; CII with short white anterior setae and stronger white anterolateral seta in distal quarter; CIII with 2 strong white lateral setae and some white hairs; legs mostly bare of major setae; I: 6.2; 6.4; 5.5/ 0.4/ 0.4/ 0.3/ 0.3; FI slightly swollen in basal third, with only tiny white ventral hairs; TI bare; It_1 greatly elongates and distal tarsomeres greatly reduced in size, and It_2 slightly enlarged with ventral setal field (MSSC); II: 7.0; 9.5; 6.8/ 2.2/ 1.2/ 0.7/ 0.4; FII with subapical pv seta; TII with short anterior setae at 1/6, 1/2 and ¾, with subapical corona of dorsal, ad, av, and pv; IIt_1 almost about as long as FII; III: 8.0; 12.5; 5.0/ 2.0/ 1.0/ 0.8/ 0.6; FIII with black subapical pv seta; TIII with short dorsal setae along length, and with strong subapical ad and av setae; $IIIt_{3-5}$ distinctly flattened and ventrally pad-like (MSSC).

Abdomen. Tergite1 metallic green; tergites 2-6 dark matt brown in basal half and metallic green distally, with some grey pruinosity laterally; tergites 2-6 each with 4 posterior marginal setae, otherwise tergites with short vestiture; hypopygium mostly brown with brown cercus (Figures 30-31); surstylus broad and subrectangular with apical subtriangular projection, and with yellow marginal and apical setae; cercus with bare elongate lateral arms reaching apex of surstylus projection, and with median arm about three-fifths length of lateral arm.

Female. Unknown.

REMARKS — *Plagiozopelma arabuka* is known only from a male taken between 1500-2000 m in Morobe Province, Papua New Guinea. This species has a hypopygium similar to that of *P. kokoda* and the widespread *P. terminiferum,* but the male scape is not strongly swollen, and the face is not bulging. As well, leg III tarsomeres 3-5 are strongly flattened on *P. arabuka.*

ETYMOLOGY — The specific epithet *arabuka* is an indigenous place name and a noun in apposition.

Genus ***KRAKATAUIA*** Enderlein, 1912

Krakatauia Enderlein, 1912: 408.

Type species. *Psilopus rectus* Wiedemann, 1830, orig. des.

DIAGNOSIS —*General*. Body relatively compact, with stout thorax; legs and abdomen not greatly prolonged.

Head. Male frons with abundant pale or black hairs (MSSC), without isolated vertical seta; female frons lacking hairs, but with strong vertical seta; male frons sometimes strongly flattened (MSSC); male upper face usually bulging (MSSC); clypeus usually distinctly free from margin of eyes in male, adjacent to or near eyes in female; eyes often with pale hairs between facets, longer in males than in females; pedicel usually with only short dorsal and ventral setae; male scape, and/ or postpedicel sometimes strongly modified (MSSC); arista varies from dorsal to apical among species; male arista sometimes with ovate apical flag (MSSC).

Thorax. Ac setae present as 2-3 long pairs; male with 2 strong posterior dc, and anterior dc represented by 4-5 weak hairs (MSSC); 5 strong dc present in female; lateral scutellar setae vary from about 2/3 length of medians to short and hairlike.

Legs. TI usually bare of major setae; TII with ad-pd setal pairs, especially in female; leg MSSC developed in some species include: a) male It_1 with pale ventral pile; b) $IIIt_{3-5}$ flattened and padlike.

Wings. often infuscated or with brown maculations; venation often modified, especially M_1 sometimes strongly curved towards R_{4+5}; crossvein dm-cu straight to sinuous with external bulge in center; halter sometimes black in both sexes.

Abdomen. Cercus usually branched with large lobate ventral projection and short distal digitiform projection; large subtriangular projection present between cercal bases.

REMARKS — *Krakatauia*, like many genera in the Sciapodinae, is not defined by strong synapomorphies (see discussion in Bickel 1994). Rather it comprises species that share the following features in a mosaic of combinations: abundant setae on the male frons (MSSC), male face bulging (MSSC), eyes often with pale hairs between facets, pedicel usually with rather short dorsal and ventral setae, male aristal flags sometimes present (MSSC), tibia I often bare of major setae, wing often infuscated, halter sometimes black in both sexes, cercus with large ventral clavate arm and short distal digitiform projection, large subtriangular projection present between cercal bases.

Krakatauia comprises 62 species (including five newly described here) from the tropical Orient and Australasia. In the southwest Pacific there has been a large radiation in Fiji and Vanuatu, and species extend eastward as far as Tonga and Niue (Bickel, 2008). The major species groups include: the *evulgata* group with eleven species in the western Pacific, Australasia, and eastern Orient and including some widespread tramp species; the *abaca* and *malakula* groups with some 25 species endemic to Fiji and Vanuatu; the *nupta* group with three species from Fiji, Tonga and Niue; the *anthracoides* group from southeastern Asia; and the *alanae* group with five species forming an unusual Australia-Fiji disjunct distribution. The *funeralis* group and newly established *waudoma* group from eastern Australia and the Papuan region are treated here in detail (for overview, see Bickel 1994, 2008).

KEY TO PAPUAN *KRAKATAUIA* SPECIES GROUPS AND MALES IN THE *WAUDOMA* AND *FUNERALIS* GROUPS

1. Frons strongly flattened, appearing almost flat in anterior view, with abundant whitish or black hairs; male arista dorsal to dorsoapical, and simple, without apical flag; wing usually hyaline; halter either yellow or black; It_2 often shorter than It_3; thorax and abdomen often green (Figures 63-65) (Australasia, Pacific, and Orient) ..... *evulgata* group (see summary)

– Male frons not flattened but sloping laterally, usually with abundant black hairs; arista dorsoapical to apical, and sometimes with apical flag; wing with smoky infuscation; halter black in both sexes; stout mostly dark metallic blue-green colored (Australian and Papuan region) **2**

2. Epandrium prolonged and tapering, with straight dorsal margin; cercus flattened, bladelike and elongate, not divided, and with pair of beanshaped apical setae (Australia, Fiji) ..... *alanae* group (see summary)

– Epandrium subtriangular with surstylus lobate; cercus various (*e.g.*, Figures 35, 41, 48, 51) **3**

3. Male scape swollen and vase-like (Figures 37, 42, 43); male postpedicel forming tapering base for arista, and closely fused to arista; frons always with distinct laterally bent white seta among black hairs (Figures 40, 43); femur I with only short whitish setae; arista often thickened and enlarged; basitarsus I shorter than TI; It_{2-5} unmodified; $IIIt_{4-5}$ dorsally flattened and ventrally padlike; lateral scutellar setae short, less than one-third length of the median scutellar. (New Guinea), *waudoma* group **4**

– Male scape unmodified (Figure 50); male postpedicel subtriangular and distinct from arista; femur I usually with row of strong pv setae; frons without bent white seta but with black hairs; basitarsus I long, almost as long as TI; It_{2-5} laterally flattened; tarsus III unmodified; lateral scutellar setae at least half length of median scutellar setae .. (Australia, Papuan region), *funeralis* group **9**

4. Male arista strap-like, not distally expanded (*e.g.* Figures 33, 40, 47) **5**
– Male arista distally expanded, with enlarged apical flag (*e.g.*, Figures 36, 43) **7**

5. Abdominal segment 7 greatly prolonged, one and a half times length of segment 6; arista as elongate narrow strap with flexion near 2/3; cercus deeply forked into two subequal arms, basal arm with white apical spatulate seta (Figures 32-35) (New Guinea) ..... *K. waudoma* n. sp.
– Abdominal segment 7 subequal in length to segment 6; arista straight, without flexion; cercus various **6**

6. Frons with abundant black setae and laterally bent white seta; basal third of FI, and very base of FII and FIII black and all distally yellow; cercus deeply forked at base into two arms, shorter basal arm with white setae along length, some distal setae bladelike, and apically with white truncated spatulate seta, and distal arm elongate and almost flagelliform (Figures 39-41) (New Guinea) ..... *K. finisterrensis* n. sp.
– Frons bare of black hairs, but with bent white seta only; femora I and II mostly yellow and FIII mostly yellow and distal fifth only black; cercus simple and digitiform, with short whitish seta and white elongate apical setae; surstylus distally deflexed, bearing 5-6 strong white apical (Figures 47-48) (New Guinea) .....
..... *K. purpurascens* (de Meijere)

7. Arista expanded near 3/4 and tapering gradually to apex; cercus elongate and forked into shorter basoventral arm with strong apical bladelike seta and longer distal arm (Figures 36-38) (New Guinea) .....
..... *K. mankiensis* n. sp.
– Arista expanded apically into large subtriangular flag (*e.g.*, Figure 43); cercus with both arms subequal (Figure 45) **8**

8. Aristal flag with distinct right-angled margin basad of apex (see fig. 162, Becker, 1922) (New Guinea) .....
..... *K. digitula* (Becker)
- Aristal flag gradually tapering to apex (Figures 43, 44); crossvein dm-cu arising far distally on wing, close to M_2 origin, and distinctly sinuous and subparallel to posterior margin of wing (Figures 42-46) (New Guinea)
..... *K. distortipennis* (Becker)

9. Cercus elongate, and flagelliform, distinctly longer than length of epandrium **10**
– Cercus short, rather stout and about length of epandrium **12**

10. Femur I with only short pv setae; cercus more than three times the epandrial length, with lobate basoventral projection with narrow digitiform arms (Figures 49-51) (New Guinea) ..... *K. stellaris* n. sp.
– Femur I with strong pv setae; other features various **11**

11. Cercus with relatively mostly white short setae along distal arm; wing almost entirely smoky brown color (Figures 52-54) (Australia, New Guinea) ..... *K. claudiensis* Bickel
– Cercus with long curved black and white setae along distal three-quarters; wing slightly infuscated with brownish clouding along major veins (Figures 55-56) (New Guinea) ..... *K. obscuripennis* (de Meijere)

12. Basitarsus I with strong pv seta at 1/3 (Figure 57); tibia III with posterior longitudinal groove along basal third; cercus with group of strong external setae near midlength (Figures 57-58) (New Guinea) .....
..... *K. morobensis* n. sp.
– Basitarsus I with short setae or whitish pile; tibia III unmodified; cercus with short uniform external setae along length **13**

13. Femur I with row of black pv setae; legs entirely bark brown to black; TI with ventral row of fine hairs along length; basitarsus I with whitish ventral pile along basal half, and with distal quarter laterally flattened (in addition to distal tarsomeres on leg I); FIII with row of long black av setae along length; (Figures 59-61) (New Guinea) ..... *K. sepikensis* n. sp.
– Femur I without row of black pv setae; all tibiae and basitarsi mostly yellowish; TI ventrally bare; basitarsus I with 5 short black spaced ventral setae, and unmodified; FIII with only short ventral setae (Figure 62) (New Guinea) ..... *K. compressipes* (Parent)

Krakatauia evulgata species group

DIAGNOSIS — *General*. Thorax and abdomen often bright metallic green (Figure 63).

Head. Male vertex and frons shallowly excavated, almost flat, and with abundant pale or black hairs on flattened lateral surface (Figure 64) (MSSC); male without distinct vertical seta; female vertex slightly flattened and without hairs, but with strong vertical seta; male frons flattened, and sometimes projecting to form protruding antennal base (MSSC); face bulging (MSSC); eyes often with pale setae between facets, longer in males than in females.

Thorax. lateral scutellar setae usually more than one third length of medians.

Legs. It_1 relatively long, and with pale ventral pile, with tarsomere It_{2-5} each short (MSSC); male It_2 often shorter than It3 (MSSC).

Wings. M_1 strongly approaching R_{4+5}; sometimes M_1 approaches R_{4+5} in a broad arc, making cell R_5 hatchet-shaped, in some species M_1 joins R_{4+5} before wing apex, closing cell R_5; cross vein dm-cu straight to slightly sinuous.

Abdomen. Cercus often with enlarged clavate basoventral arm and short digitiform dorsal arm (Figure 65).

REMARKS — The *Krakatauia evulgata* group is characterized by the male frons strongly flattened with abundant hairs on lateral flattened surface (Figure 64), male frons below antennal base often bulging; It_1 relatively long, and with pale ventral pile, and vein M_1 strongly approaching R_{4+5}. Many species have a bright metallic green body coloration.

The *evulgata* group is diverse in the Melanesian archipelago, where additional species await description. The lowland and coastal species *Krakatauia evulgata* (Becker) (Figures 63-65) itself is particularly widespread in the western Pacific and is often the only sciapodine present on Micronesian atolls.

The following described *evulgata* group species are found in the Papuan region: *K. abbreviata* (Becker), *K. barbescens* (Parent), *K. evulgata* (Becker), *K. nitidifacies* (Parent), *K. sericea* (de Meijere), and *K. tabulina* (Becker). For listings of species outside the Papuan region and additional information, see Bickel (1994, 1995, 2008).

Krakatauia alanae species group

REMARKS — The *Krakatauia alanae* group is known from five species, two from eastern Australia and three from Fiji and nearby archipelagoes. This group has not been found elsewhere in the Melanesian archipelago. It is close to the *funeralis* group but is distinguished in having the epandrium prolonged and tapering, with a flattened and bladelike cercus bearing apical flattened beanshaped setae. This distinctive epandrium and cercus is convergent to that of *Plagiozopelma terminiferum* group (see this paper), but the two taxa are not considered to be closely related (see Bickel 1994, 2008).

Krakatauia waudoma species group

DIAGNOSIS — *Head*. Vertex strongly excavated, not flattened; male lateral frons usually with field of 7-8 black setae, but always with single white seta bent laterally at right angle, and without distinct vertical seta (Figures 40, 43) (MSSC); female frons with single black vertical seta; male face and base of antenna bulging in male (Figures 33, 36) (MSSC); scape swollen, vase like (Figures 37, 47) (MSSC); pedicel short with dorsal seta; postpedicel forming triangular tapering base, with faint join to apical arista (MSSC): arista thickened and sometimes into flattened apical flag (MSSC); female postpedicel subrectangular and arista dorsal to dorsoapical, and unmodified, without thickening or apical flags.

Thorax. Lateral scutellar setae short, less than one third length of medians.

Legs. CI with some black distolateral setae; FI with white ventral hairs along length; tarsus I unmodified; $IIIt_{4-5}$ dorsoventrally flattened and ventrally padlike (MSSC).

Wings. Broad and usually with smoky brown membrane in males, but with brown clouding around veins in females; male wing sometimes with modified venation (*e.g.*, Figure 46) (MSSC); crossvein dm-cu usually sinuous; halter black in both sexes.

Abdomen. Epandrium subtriangular with lobate surstylus; cercus usually forked, with setose distal arm and short basoventral arm.

REMARKS — The species of the *Krakatauia waudoma* group were included within the *funeralis* group in Bickel (1994), and both groups share the following characteristic habitus: stout dark metallic green sciapodines, often with broad smoky wings, black halters, black setae on the male frons, pedicel with short dorsal and ventral setae, and M_1 and R_{4+5} converging at wing apex. However, *waudoma* group males all share the following characters: swollen antennal vase-like scape (group autapomorphy); short pedicel, and postpedicel modified as a thickened base for an apical thickened strap-like arista (group autapomorphy); arista sometimes flattened into an apical flag (MSSC); frons usually with field of 7-8 black setae, but always with single white seta bent laterally at right angle (group autapomorphy); tarsus I is unmodified (*i.e.*, without the leg I basitarsus elongated, and tarsomeres not laterally flattened); male $IIIt_{3-5}$ dorsally flattened and ventrally padlike (MSSC), and lateral scutellar setae short, less than one-third length of the median scutellar setae (also see "Remarks" under the *funeralis* group).

The *waudoma* group is restricted to the main island of New Guinea and has been collected mostly from mid-elevational forests (600-1400 m), although some species are known from lowland sites. The group includes six species: *Krakatauia digitula* (Becker), *K distortipennis* n. sp., *K. finisterrensis* n. sp., *K. mankiensis* n. sp., *K. purpurascens* (de Meijere), and *K. waudoma* n. sp.

Krakatauia waudoma Bickel n. sp.

Figures 32-35

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Province: Wau, Wau Ecology Institute, 1200 m, Malaise trap, second growth montane forest, 25-31.VII.1983, S. E. & P. M. Miller (BPBM). Paratypes. Papua New Guinea. Morobe Province: 4 ♂, ♀, Wau, 1200 m, 1.VI.1968, 5.X.1969, 8.X.1969, I.1965, II.1970, J. Sedlacek; 4 ♂, 3 ♀, Wau, Hospital Ck., 1250 m, 17-22.V.1965, J. Sedlacek; 2 ♂, Wau, 7.24°S 146.44°E, 1150-2300 m, 8.III.1993, ex Piper sp., canopy fog, Y. Basset (BMBM); 4 ♂, Wau, Malaise trap 2, VI-X.1972, B. S. Cheary (AMS); 1 ♂, Wau, Nakata Ridge, 4700 ft (~ 1420 m), 9.VI.1968, J. W. Boyes (CNC).

ADDITIONAL MATERIAL EXAMINED — Indonesia. Papua: 4 ♂, Cyclops Mtns, Mt. Lina, 3,500 ft (=~ 1060 m), moss forest, III.1936, L. E. Cheesman (BMNH, B.M. 1936-271). Papua New Guinea. Milne Bay Province: Agaun, 4400 ft (= 1, 330 m), VIII.1969, R. Pullen (ANIC). Morobe Province: 3 ♂, Ulap, 800-1100 m, IX.1968, N. L. H. Krauss (BBM); 1 ♂, Etep, 600-700 m, IX.1968, N. L. H. Krauss (BBM); ♂, Wantoat, Finisterre Mtns, 1800 m, 4.IX.1957, Munroe & Holland (CNC). Oro Province: 1 ♂, 1 ♀, Popondetta District, Buri, nr Sasambata, 30.X.1963, D. K. McAlpine (AMS); 2 ♂, 1 ♀, Laloki, 35 m, 2.VIII.1984, J. Ismay (AMS); 2 ♂, "Kokoda," 1200 ft (~ 360 m), VIII.1933, L. E. Cheesman (BMNH, B.M. 1933-427). Sandaun Province: 3 ♂, Torricelli Mtns, 200-1000 ft (60-300 m) I.1939, L. E. Cheesman (SAM). Western Province: ♂, Star Mtns, Camp 1, 5° 13'S, 141° 14'E, 950-1200 m, II-III.2013, yellow pans, C. Muller (AMS); 3 ♂, Tabubil, 5.15°S, 141.13°E, 650 m, 3.X.1993, 23-24.XI.1996, M.S. Moulds (AMS); 2 ♂, ♀, Kionga, Fly River, 6.VIII.1969, J. L. Gressitt & J. Sedlacek (BPBM).

DESCRIPTION — ***Male***. Body length:7.6-8.2 mm; wing: 6.3 x 2.2 mm (Figure 32).

Head. Vertex strongly excavated; vertex, frons violet; lateral frons with field of 7-8 black setae, and single white seta bent laterally at right angle, but without distinct vertical seta (MSSC); strong diverging ocellar setae present on prominent ocellar tubercle; upper face shining metallic green; lower face and clypeus with silvery pruinosity; clypeus free from eye margin; distal frons and upper face bulging, forming mound like base for antenna (MSSC); eye facets uniform and without microtrichia between facets; palp dark brown with two long black setae; proboscis yellowbrown; antenna black (Figure 33);

scape globular (MSSC); pedicel short with dorsal seta; postpedicel tapering and forming base for arista and with close join to arista (MSSC), arista forming elongate narrow strap about twice head height in length with distinct flexion at midlength and with dorsal row of white microtrichia pile along distal half (Figure 34) (MSSC); ventral postcranium with abundant pale setae.

Thorax. Mostly green with bronze reflections; scutellum metallic blue; matt chocolate colored stripes present dorsad of notopleuron; setae black; pleura with only dusting of grey pruinosity; 3 pairs long ac present; dc row with 2 strong posterior setae and 3 weak hairlike setae anteriad; 1 pa, 2 sa, 2sr, 2npl, 1 pm, 1 weak hm present; median scutellar setae strong with lateral setae weak, about one-third length of medians.

Legs. Coxae, trochanters and femora black with dusting of grey pruinosity, except "knee" of FI and FII yellow; tibiae and basitarsi I and II mostly yellow, with distal tarsomeres brown; TIII yellowish and tarsus III brown; CI with white anterior hairs and 2-3 stronger white distolateral setae; CII with white anterior setae; CIII with group of 4-5 long white lateral setae on basal half; all femora with white ventral hairs; I: 7.0; 7.5; 6.2; / 1.8/ 1.0/ 0.7/ 0.5; FI with white ventral hairs along length; TI with short dorsal at 1/6, and sometimes dorsal seta at 1/3, and longer pv setae at 1/3 and 1/2; tarsus I unmodified. II: 8.0; 11.2; 7.5/ 2.2/ 1.2/ 0.5/ 0.5; TII with ad setae at 1/10 and 1/5, pd at 1/3, anterior at 2/3, short ventral setae near 1/4, 1/2, and 4/5, and subapical circlet of ad, av, pv and pd setae; III: 10.5; 15.5; 6.5/ 2.5/ 1.3/ 1.0/ 0.7; TIII with short ad at 1/8, stronger ad at 1/4, irregular dorsal row of setae, and subapical circlet of dorsal, ad, and av setae; $IIIt_1$ near very base with strong ventral seta; $IIIt_{4-5}$ dorsally flattened and ventrally padlike (MSSC).

Wings. Broad with smoky brown wash except hyaline along posterior membrane, and in cell bm + db; vein R_{2+3} joining costa beyond 9/10; veins M and R_{4+5} strongly diverging from wing base, with M_1 separating from M_2 near 3/4 and curving strongly, almost meeting R_{4+5} before joining costa anteriad of wing apex; crossvein dm-cu distinctly sinuous, elongate, CuA_1 not reaching posterior wing margin; lower calypter dark brown with fan of black setae; halter mostly dark brown.

Abdomen. Tergites 1 and 2 metallic blueviolet with wide matt brown bands across near middle and along distal edge; tergites 3 and 4 metallic green with bronze reflections, and tergal overlap, *i.e.*, basal half and distal fifth of each tergite, covered by matt brown band, tergites 5 to 8 dark metallic black; sternites mostly black; tergite 1 with group of long white lateral setae and 4 strong black marginal setae; tergites 2-6 with erect black setae and row of 4 longer setae along posterior margin, and with some white lateral hairs; segment 7 greatly prolonged, one and a half times length of segment 6 (MSSC), with setae only distally near join with sternite 8, and partially enclosed by segment 6 at rest; hypopygium (Figure 35) dark brown with brown cerci; hypandrial hood short; phallus extending beyond apex of surstylus; epandrial lobe with long apical and shorter subapical setae; surstylus with faint line marking join with epandrium; surstylus lobate with short digitiform projection which bears apical seta; cercus elongate and deeply forked into two subequal arms near 1/3, basal arm with long white hairs and white apical spatulate seta, and distal arm narrow with short pale setae.

Female. Similar to male except lack MSSC and as noted: smaller, length 6.8 mm, wing 4.5 x 2.0 mm; face not bulging; lateral slope of vertex bare of black hairs and bent white seta, but with single strong black vertical seta; scape only slightly swollen; postpedicel apically rounded subrectangular with distinct dorsoapical arista, arista unmodified; 5 strong dc present; leg coloration similar; femora with only short pale hairs; FI without row pv setae; leg coloration similar; TI with dorsal setae at 1/5 and 3/5, posterior setae at 2/5 and ¾, and strong ventral setae at 3/10 and 1/2; TII with ad setae at 1/10, 1/5, and ¾, pd at 1/10 (weak), and 2/5 and strong ventral setae at 1/4 and 2/5; TIII setation similar; $IIIt_1$ near base also with strong ventral seta; $IIIt_{4-5}$ unmodified; crossvein dm-cu weakly sinuous; CuA_1 reaching posterior wing margin; CuAx ratio: 3.0; halter also dark brown; tergites 1-5 metallic green with bronze reflections, but at tergal overlap, *i.e.*, basal half and distal fifth of each tergite covered by matt brown band.

REMARKS — *Krakatauia waudoma* is a widespread species in New Guinea, and has been collected at many locales, from the Cyclops Mountains in Indonesian Papua to Milne Bay Province in eastern Papua New Guinea. The species has been taken from elevations ranging from 200 m to near 1400 m.

ETYMOLOGY — This species is readily recognized by male characters, the globular scape, and the arista as an elongate narrow strap with flexion near 2/3, and abdominal segment 7 greatly prolonged, one and a half times length of segment 6, and the cercus deeply forked into two subequal arms, the basal arm with a white apical spatulate seta. Some intraspecific variation is evident in this widespread species, especially in the relative length and setation of the cercal arms, but the pedunculate postabdomen and the elongate strap-like and distally flexed arista is constant among specimens. The specific epithet "*waudoma*" is a combination of "Wau", an indigenous place name and "*domus*", from Latin meaning "home", and refers to the Wau Research Institute, once the major center for New Guinea biodiversity research and entomological collecting activity.

Krakatauia mankiensis Bickel n. sp.

Figures 36-38

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Western Province: Tabubil, 5.15°S, 141.13°E, 650 m, 3.X.1993, 23-24.XI.1996, M.S. Moulds (AMS). Paratypes. Papua New Guinea. Western Province: ♂, same information as HT (AMS); ♂, Finalbin, 940 m, 5.222°S 141.194°E, 940 m, sweeping, 2.II.2009, S. McEvey (AMS).

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. Morobe Province: 1 ♂, Upper Manki logging area, nr Bulolo, 1600 m, sticky trap, 9 & 23.III.1973, F.R. Wylie & P. Shanahan (AMS).

DESCRIPTION — ***Male***. Body length: 5.2 mm; wing: 5.1 x 1.8 mm (Figure 36); similar to *K. waudoma* except as noted:

Head. Vertex strongly excavated, but not flattened; vertex, frons violet; lateral frons with field of 5-6 long black setae, and with single white seta bent laterally at right angle (MSSC); antenna black (Figure 37); scape globular (MSSC); pedicel short with dorsal seta; postpedicel tapering and forming base for arista, and with close join to arista (MSSC), arista thick and expanded near three-quarters and tapering distally to pointed apex, with dorsal crest of finely hooked microtrichia (MSSC).

Thorax. Mesonotum and scutellum dark metallic blue with green reflections.

Legs. Coxae, trochanters and femora black with dusting of grey pruinosity, except "knee" of FI yellow; TI and tarsus I yellow, although distal tarsomeres infuscated; tibiae and tarsi II and III brownish; I: 7.0; 6.0; 4.5/ 1.3/ 0.9/ 0.8/ 0.4; TI with short dorsal at 1/6, and longer ventral setae at 1/3 and 1/2; tarsus I unmodified. II: 7.0; 9.2; 6.7/ 1.7/ 1.0/ 0.4/ 0.3; TII with ad setae at 1/10 and 1/5, pd at 1/3, anterior at 2/3, short ventral setae near 1/4, 1/2, and 4/5, and subapical circlet of ad, av, pv and pd setae. III: 8.3; 12.3; 5.8/ 2.1/ 1.0/ 0.9/ 0.6; TIII with short ad at 1/8, stronger ad at 1/4, irregular row of dorsal setae, and subapical circlet of dorsal, ad, and av setae; $IIIt_1$ near very base with strong ventral seta; $IIIt_{3-5}$ dorsally flattened and ventrally padlike (MSSC).

Wings. Broad with smoky brown wash except hyaline along posterior membrane and in cell bm + db; crossvein dm-cu distinctly sinuous, elongate, CuA_1 not reaching posterior wing margin.

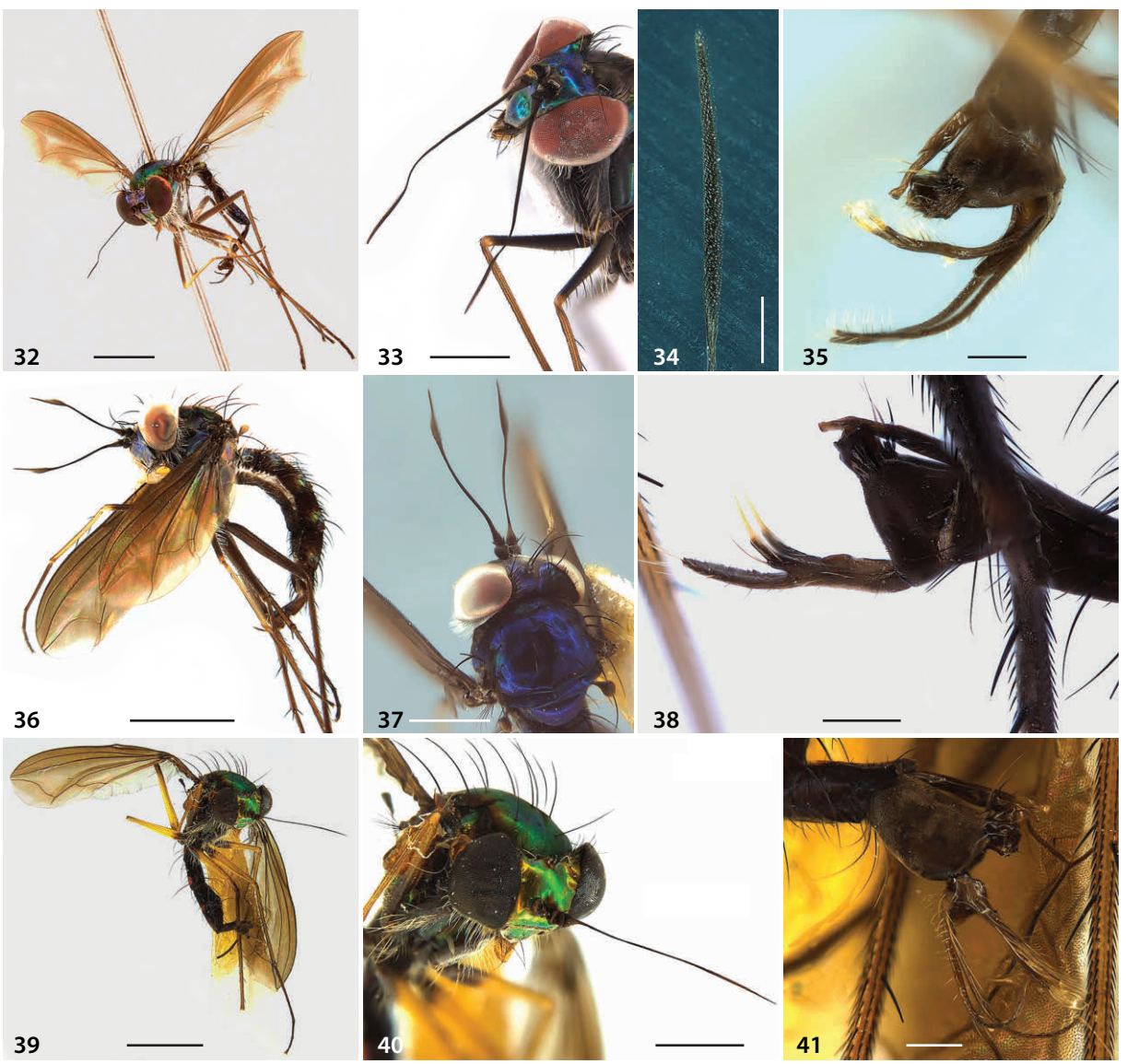
Abdomen. Tergites 1-5 mostly metallic green with bronze reflections, but basal half and distal fifth of each tergite covered by matt brown band; tergites 6 to 8 dark metallic black with violet reflections; tergite 1 with group of long white lateral setae and 4 strong black marginal setae; tergites 2-6 with erect black setae and row of 4 longer setae along posterior margin; segment 7 slightly shorter than segment 6; hypopygium (Figure 38) dark brown with brown cerci; surstylus truncate with some short white seta and short digitiform dorsal projection; cercus elongate and forked halfway into shorter basoventral arm bearing white subapical setae and strong apical bladelike seta, and longer distal arm with white setae along length and stronger distal setae.

Female. Unknown.

REMARKS — *Krakatauia mankiensis* is known from Morobe and Western Provinces at elevations from 650 to 1600 m. This species is readily recognized by male characters: the thickened arista slightly expanded near at three-quarters length

and tapers gradually to apex (Figures 36-37), and the elongate cercus forked halfway into short basoventral arm and longer distal arm (Figure 38).

ETYMOLOGY —The specific epithet *mankiensis* is derived from the place name "Manki".



FIGURES 32-41

Krakatauia waudoma n. sp.: **32**, male habitus, anterior; **33**, male head and thorax, anterior; **34**, male arista, apex; **35**, male postabdomen, left lateral. *K. mankiensis* n. sp.: **36**, male habitus, left lateral; **37**, male head, dorsal; **38**, male postabdomen, left lateral. *K. finisterrensis* n. sp.: **39**, male habitus, right anterior; **40**, male head and thorax, right anterior; **41**, male postabdomen, right lateral. Scale bars, 32, 36, 39: 2.0 mm; 33, 37, 40: 1.0 mm; 34-35, 38, 41: 0.2 mm.

Krakatauia finisterrensis Bickel n. sp.

Figures 39-41

TYPE MATERIAL —Holotype, ♂, **Papua New Guinea**. Madang Province: Moro, Finisterre Mtns, 5550 ft (~1600 m), 30.X-15.XI.1964, M. E. Bachuus, Stn. No. 30 (BMNH). Paratypes: Papua New Guinea. Madang Province: 1♂, same information as HT; 1 ♂, Budemu, Finisterre Mtns, 4000 ft (~1510 m), 15-24.X.1964, M. E. Bachuus, Stn. No. 30 (BMNH).

DESCRIPTION — ***Male***. Body length: 5.9 mm; wing: 5.7 x 2.0 mm (Figure 39); similar to *K. waudoma* except as noted:

Head. Vertex strongly excavated and flattened; frons metallic green bronze; lateral frons with field of 7-8 black setae, and single white seta bent laterally at right angle, and without distinct vertical seta (MSSC); scape globular (MSSC); pedicel short with dorsal seta; postpedicel forming short base and fused to arista; arista as elongate narrow strap about twice head height in length, and with dorsal row of white pile along distal half (Figure 40).

Legs. Coxae, trochanters, basal third of FI, and very base of FII and FIII femora black; distal two-thirds of FI, most of FII, tibiae and basitarsi I and II mostly yellow, with distal tarsomeres brown; FIII mostly yellow but apical tenth ("knee") brown; TIII yellowish, tarsus III missing; I: 6.2; 6.8; 4.5/ 1.2/ 0.8/ 0.5/ 0.4; TI with short dorsal setae at 1/8 and 1/4, and longer pv setae at 1/6 and 1/3; tarsus I unmodified. II: 7.5; 9.5; 6.4/ 1.6/ 0.9/ 0.4/ 0.4; FII with pv row of 9 black setae from 1/5 to apex; TII with ad setae at 1/10 and 1/4 and 1/2, anterior seta, ventral setae near 1/3 and 1/2, and 4/5; III: 9.4; 13.6; 6.5/ tarsus missing; TIII with short ad at 1/8, anterior setae 1/2, 3/4, and 9/10.

Wings. Similar, also with CuA_1 not reaching posterior wing margin.

Abdomen. Tergites 1-5 basically metallic green with bronze reflections, but at tergal overlap, *i.e.*, basal half and distal fifth of each tergite, covered by matt brown band; tergites 6 to 8 dark metallic black with violet reflections; tergite 1 with group of long white lateral setae and 4 strong black marginal setae; tergites 2-6 with erect black setae and row of 4 longer setae along posterior margin; segment 7 slightly shorter than segment 6; hypopygium (Figure 41) dark brown with brown cerci; hypandrial hood short; surstylus short and apically truncated; with some short white setae; cercus deeply forked at base into two arms, shorter basal arm with white setae along length, some distal setae bladelike, and apically with white truncated spatulate seta, and distal arm elongate and almost flagelliform, with pale setae along distal two-thirds.

Female. Unknown.

REMARKS — *Krakatauia finisterrensis* is known only from elevations between 1500-1600 m in the Finisterre Range, Madang Province, Papua New Guinea.

This species is readily recognized by male characters: arista forming elongate narrow strap, and with dorsal row of white pile along distal half, and the distal two-thirds of FI, most of FII, tibiae and basitarsi I and II is mostly yellow. The cercus deeply forked at base into two arms, with the shorter basal arm with white setae along length and apically with white truncated spatulate seta, and the distal arm is elongate and almost flagelliform.

ETYMOLOGY — The specific epithet *finisterrensis* refers to this species' distribution in the Finisterre Range, Papua New Guinea.

Krakatauia distortipennis Bickel n. sp.

Figures 42-46

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Province: Wau, Edie Creek Rd, 1280 m, Malaise trap, second growth montane forest, 19.VI.1984, permethrin fog of Lithocarpus canopy, sample 10, tree 3310, W. C. Gagné (BPBM). Paratypes. Papua New Guinea. Morobe Province: ♂, Wau, Mt. Kaindi, 1200 m, 7.24°S 146.44°E, 1150-2300 m, 9-19.XI.1992, ex Cinnamomum canopy, fog, Y. Basset (BMBM); 2 ♂, Wau, Malaise trap 2, 23.IX.1972, 28.VII.1972, B. S. Cheary (AMS).

DESCRIPTION — ***Male***. Body length: 6.1 mm; wing: 6.3 x 2.2 mm (Figure 42); similar to *K. waudoma* except as noted:

Head. Lateral frons with field of 5-6 black setae, and single white seta bent laterally at right angle, without distinct vertical seta (MSSC); antenna black; scape globular (MSSC); postpedicel tapering and forming base for arista and with close join to arista (MSSC), arista highly modified, with thick basal stalk and expanded subtriangular hatchet-shaped apex (with reflective silvery surface, Figure 44) and tapering apically.

Legs. Coloration similar; I: 6.5; 7.0; 5.8/ 1.5/ 1.0/ 0.7/ 0.5; FI without row of black pv setae; TI with short dorsal at 1/6, and sometimes longer pv setae at 1/3 and 3/5; II: 6.9; 9.8; 6.9/ 1.8/ 1.2/ 0.4/ 0.4; setation similar; III: 8.5; 13.0; 5.2/1.9/ 0.9/ 0.7/ 0.5; TIII setation similar; $IIIt_1$ near base also with strong ventral seta; $IIIt_{3-5}$ dorsally flattened and ventrally padlike (MSSC).

Wings. Broad with smoky brown wash along anterior half of wing ending halfway across cell r_{4+5}, with basal half of that cell hyaline, and smoky brown wash around cell m, with posterior margin of wing hyaline (Figure 46); veins R_{2+3} and R_{4+5} closely parallel, with flexion before and joining costa beyond 9/10; veins M and R_{4+5} strongly diverging from wing base, with M_1 separating from M_2 near ¾ and gently curving anteriorly, almost meeting R_{4+5} before joining costa anteriad of wing apex; crossvein dm-cu arising far distally on wing, very close to M_2 origin, and distinctly sinuous and subparallel to posterior margin of wing (MSSC); CuA not reaching posterior wing margin, but marked by flexion in membrane; lower calypter dark brown with fan of whitish setae; halter dark brown.

Abdomen. Segment 7 subequal to length of segment 6, with setae only distally near join with sternite 8, and partially enclosed by segment 6 at rest; hypopygium (Figure 45) dark brown with brown cerci; hypandrial hood short; phallus extending beyond apex of surstylus; epandrial lobe with long apical and shorter subapical setae; surstylus with faint line marking join with epandrium; surstylus lobate with short digitiform projection which bears apical seta; cercus elongate and deeply forked into two subequal arms near base, basal arm with long white hairs and distal arm narrow with short setae.

Female. Unknown.

REMARKS — *Krakatauia distortipennis* is only known from sites between 1150-2300 m near the Wau Institute, Papua New Guinea. It is sympatric with *K. waudoma,* at least in the Wau district. However, *K. distortipennis* seems to be closest to *K. digitula* (Becker), and both appear to have a distinctive male venation wing where vein M_2 originates near the join of crossvein dm-cu and vein M, but each species has a distinctive hatchet-shaped aristal flag.

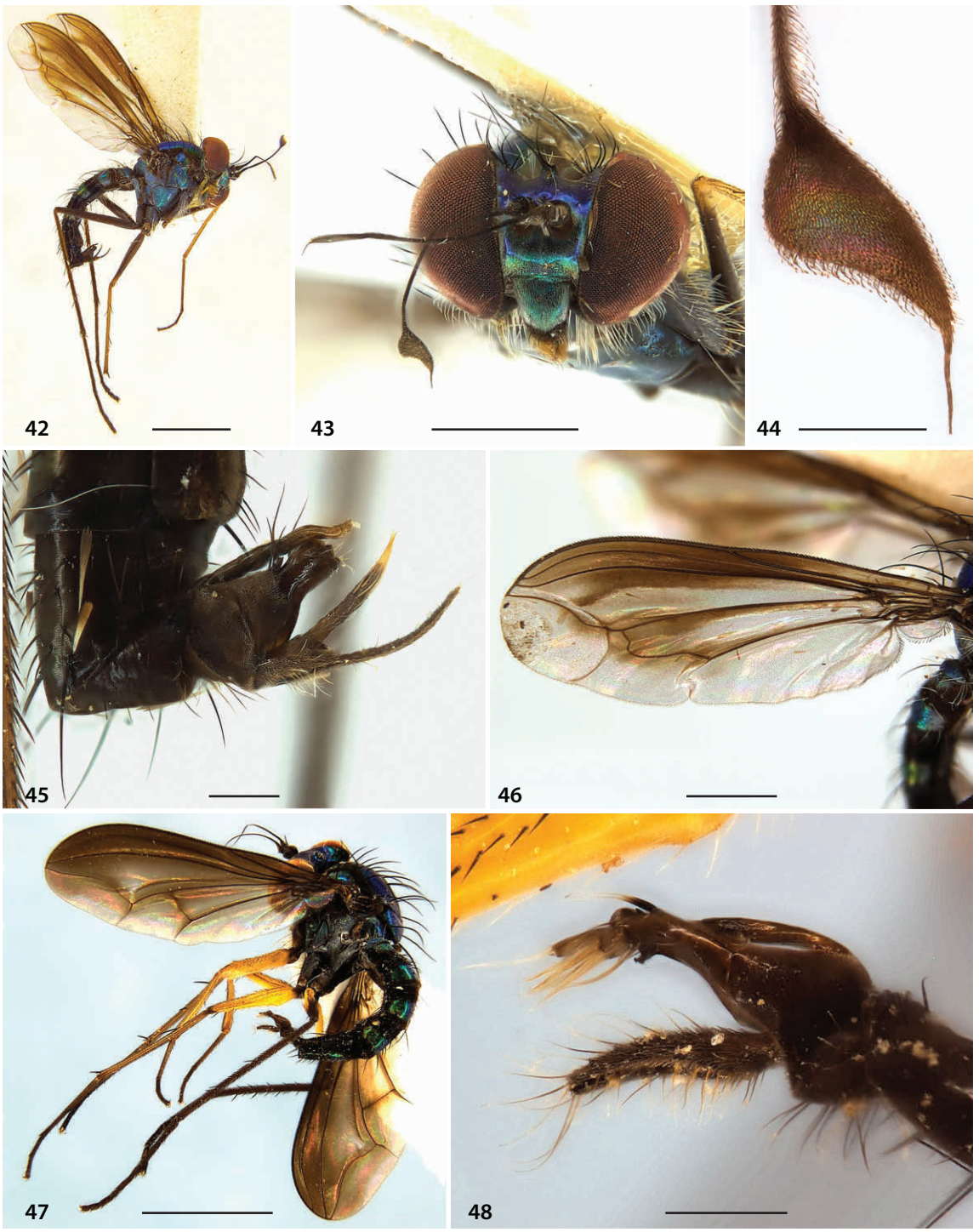
ETYMOLOGY — The specific epithet "*distortipennis*" is from Latin meaning "distorted wing" and refers to the unusual male venation where vein M_2 originates near the join of crossvein dm-cu and vein M.

Krakatauia digitula (Becker, 1922)

Chrysosoma digitulum Becker, 1922: 190, fig. 162.
Krakatauia digitula (Becker) [combination *in* Bickel 1994: 148].

TYPE MATERIAL — Holotype, ♂, **Indonesia**. West Papua, "Hatam, New Guinea" [Hatam = Arfak Mountains, Vogelkop], June 1875, O. Beccaricari. (TMB) [destroyed, see Mayr 1941].

REMARKS — I have not seen additional material of this species, and since it is known only from the Vogelkop Peninsula, West Papua, it possibly is confined to western New Guinea. Becker's rather complete species description and figure of the male blade-like apical aristal flag with distinct subapical right-angled margin should enable accurate identification of this species. The male aristal flag of *Krakatauia distortipennis* appears to be a more tapering version of that found on *K. digitula.* As well, the wing as described by Becker could be close to that of *K. distortipennis.*



FIGURES 42-48

Krakatauia distortipennis n. sp.: **42**, male habitus, right lateral; **43**, male head, anterior, left lateral; **44**, apex of male arista, dorsal; **45**, male postabdomen, right lateral; **46**, male right wing, ventral. *K. purpurascens* (de Meijere): **47**, male habitus, left lateral; **48**, male postabdomen, left lateral. Scale bars, 42, 47: 2.0 mm; 43, 46: 1.0 mm; 44-45, 48: 0.2 mm.

Krakatauia purpurascens (De Meijere, 1906)

Figures 47-48

Agonosoma purpuratum de Meijere, 1906: 84 [preocc. Aldrich 1901].
Psilopus purpurascens – de Meijere 1915: 117. (n. name for *purpuratum* de Meijere).
Krakatauia purpurascens – Bickel 1994: 149, n. comb.

TYPE MATERIAL — Holotype, ♀, **Indonesia**. Papua: Manikion (RMNH). [examined].

ADDITIONAL MATERIAL EXAMINED — Indonesia. Papua: ♂, ♀, Jayapura (as "Hollandia"), 22-28 XI.1944, D. G. Hall (USNM). Papua New Guinea. East Sepik Province: 2 ♂, Opangai, nr Maprik, 15.XII.1963, D. K. McAlpine (AMS); ♂, Kuminibus, nr Maprik, 17.XII.1963, D. K. McAlpine (AMS). Madang Province: ♂, Wanang 3, -5.2277 145.0797, 175 m, yellow pans, 18-30.XI.2012, D. J. Bickel (MNHN). Morobe Province: ♂, Bulolo, 700 m, 6.XI.1969, J. Sedlacek (BPBM).

REDESCRIPTION — ***Male***. Body length: 5.0 mm; wing: 4.9 x 1.7 mm (Figure 47); similar to *K. waudoma* except as noted:

Head. Lateral frons without black hairs, but with single white laterally bent seta (MSSC); frons and upper face shining metallic green; antenna black; scape globular (MSSC); postpedicel tapering and tightly joining arista (MSSC); arista rather thick elongate and flagelliform, about twice head height in length.

Thorax. Lateral scutellar setae short and weak.

Legs. Coxae and trochanters black; legs I and II mostly yellow but distal tarsomeres infuscated; FIII mostly yellow with variously with distal fifth to "knee" only black; TIII brownish, and tarsus III brown; CI with white anterior hairs and 2-3 stronger white distolateral setae; CII with white anterior hairs setae; CIII with strong white lateral and adjacent white hears near 1/2; femora with white ventral hairs; I: 5.0; 5.2; 3.2/ 0.9/ 0.5/ 0.3/ 0.3; TI slightly swollen distally, and with short dorsal at 1/6; tarsus I unmodified. II: 6.0; 8.1; 5.5/ 1.7/ 1.0/ 0.5/ 0.5; FII bare of major setae; TII with short ad setae at 1/8, very strong ad at 1/4, and shorter ad at 3/5, short pv setae at 1/4 and 1/2, and subapical circlet of ad, av, pv and pd setae. III: 7.3; 11.2; 4.3/ 2.0/ 1.0/ 0.8/ 0.5; FIII bare of major setae; TIII with short ad at 1/5, stronger anterior setae at 2/5, 2/3, and 4/5; irregular dorsal row of 5 spaced setae, and subapical circlet of dorsal, ad, and av setae; IIIt1 near very base with strong ventral seta; $IIIt_{3-5}$ dorsally flattened and ventrally pad-like (MSSC).

Wings. Broad with smoky brown wash except hyaline along posterior membrane; R_{2+3} joining costa beyond 9/10; veins M and R_{4+5} strongly diverging from wing base, and after vein M bifurcation M_1 with gentle curve, almost meeting R_{4+5} before joining costa anteriad of wing apex; crossvein dm-cu almost straight; CuAx ratio 1.5.

Abdomen. Segment 7 about same length as segment 6; hypopygium (Figure 48) including cercus dark brown; hypandrial hood short; epandrium elongate; surstylus elongate and distally deflexed, bearing 5-6 strong white apical and subapical setae; cercus simple and digitiform, with short whitish seta and white elongate apical setae.

REMARKS — De Meijere described *Agonosoma purpuratum* based on a female collected at Manikion, in Indonesian Papua. He later (1915) described the male from Zontbron also in Papua and replaced the preoccupied specific epithet. *Krakatauia purpurascens* is known from localities in both Indonesian Papua and Papua New Guinea and is probably widespread in New Guinea. It differs distinctly from other members of the *waudoma* group in the absence of black hairs on the lateral frons (the bent white seta is present, however), the lateral scutellar seta is a short weak hair, femora are mostly yellow; crossvein dm-cu is straight without a median bulge, and the cercus simple and digitiform (not forked).

Krakatauia funeralis species group

DIAGNOSIS — *Head*. vertex strongly excavated, but not flattened; male lateral frons with dense black hairs but no distinct vertical seta (MSSC); female frons with strong vertical seta, otherwise bare; face and base of antenna sometimes bulging in male (MSSC); postpedicel triangular with dorsoapical to apical arista in both sexes (Figures 45, 47); arista sometimes with lanceolate or spatulate apical flag (MSSC).

Thorax. lateral scutellar setae about two-thirds length of medians.

Legs. CI with some black distolateral setae; male FI with row of strong pv setae (MSSC); It_1 long, almost as long as TI, and sometimes dorsoventrally flattened with ventral pile (MSSC); It_{2-5} laterally flattened and padlike in some species (MSSC); tarsus III unmodified.

Wings. Broad and usually with smoky brown membrane; M_1 and R_{4+5} strongly converging at wing apex; R_{2+3} and R_{4+5} in both sexes with distinctive subapical bend; crossvein dm-cu distinctly sinuous; halter black in both sexes.

Abdomen. epandrium subtriangular with lobate surstylus; cercus with setose distal arm and short basoventral arm.

REMARKS — Members of the *Krakatauia funeralis* group have a characteristic habitus: stout dark metallic green sciapodines, usually with broad smoky wings, black halters, black setae on the male frons, FI with strong pv setae (group autapomorphy), pedicel without long dorsal and ventral setae, It_{3+5} often laterally flattened, and M_1 and R_{4+5} converging at wing apex.

The *funeralis* group might be regarded as the paraphyletic residue from which the *waudoma* group, defined by many distinctive male characters (group autapomorphies), was derived. However, if I subsume the *waudoma* group into the *funeralis* group, the "*waudoma* group species" would still come out as a distinctive monophyletic assemblage defined by autapomorphies. Many complex taxa are paraphyletic to some degree and comprise "residues" that are not readily defined by strong autapomorphies, and that is the case with the *funeralis* group.

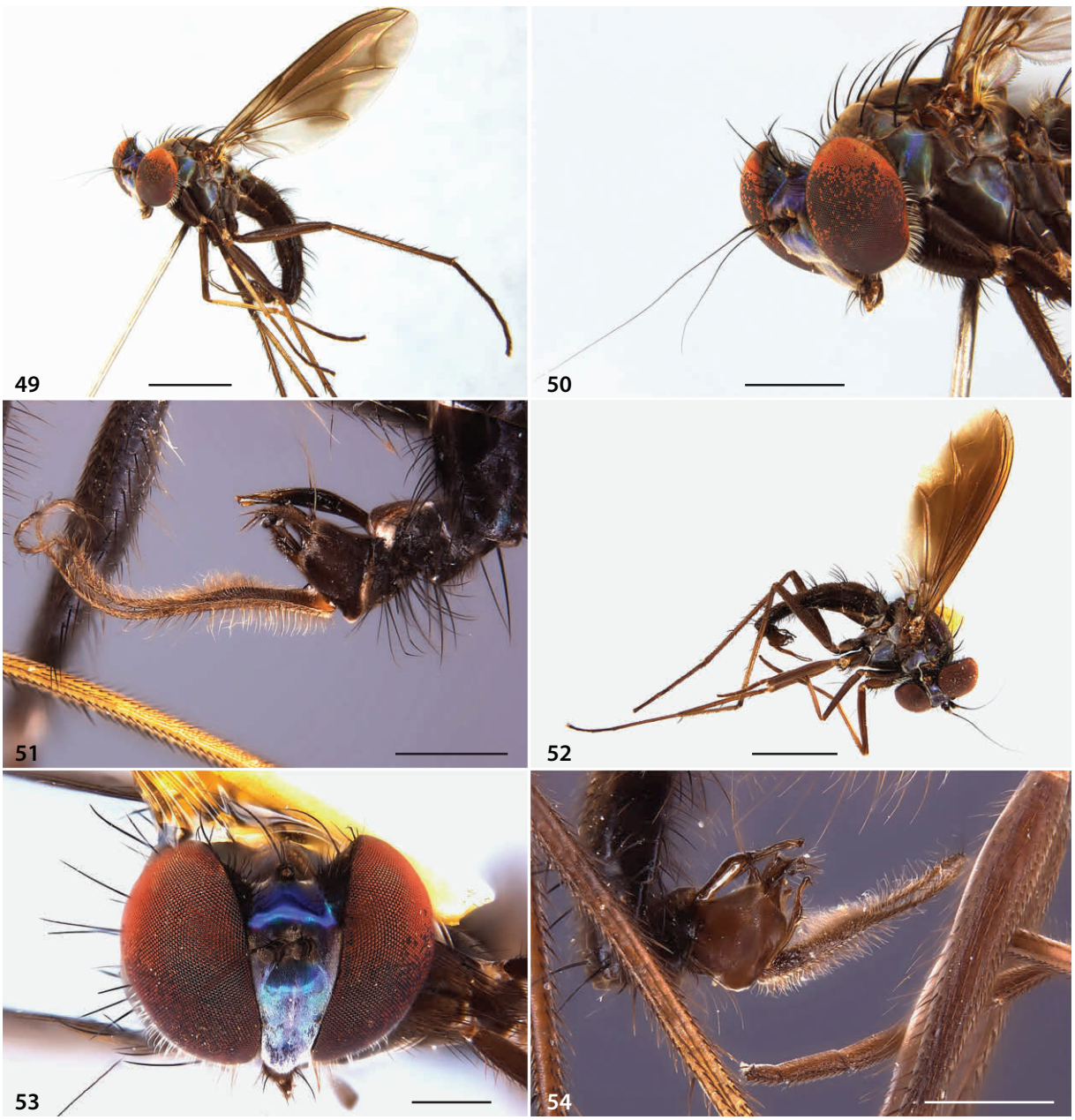
The *funeralis* group occurs in the New Guinea and eastern Australia (Bickel, 1994). There are three Australian species, *K. funeralis* (Parent) (northeastern New South Wales to Cape York Peninsula), *K. pseudofuneralis* Bickel (northern Queensland), and *K. claudiensis* Bickel (Cape York Peninsula, also eastern Papua New Guinea). The following species occurring in New Guinea are treated here: *Krakatauia claudiensis* Bickel, *K. compressipes* (Parent), *K. obscuripennis* (de Meijere), *K. sepikensis* n. sp., and *K. stellaris* n. sp.

Krakatauia stellaris Bickel n. sp.

Figures 49-51

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Western Province: Star Mtns, Camp 1, 5°13'S, 141°14'E, 950-1200 m, II-III.2013, yellow pans, C. Muller. Paratypes. Papua New Guinea. Western Province: ♂, ♀, Star Mtns, Camp 2, 5°10'S, 141°15'E, 700-850 m, II-III.2013, yellow pans, C. Muller (AMS).

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. Gulf Province: ♂, Orokolo, X.1923, G. H. Murray (AMS). Morobe Province: ♂, Geraina, 800 m, 10.I.1948, J. E. Sedlacek (BPBM); ♂, Wau, Mt Missim, 95-300 m, J. & M. Sedlacek (BMBM). Oro Province: ♂, Mt Lamington, 1300-1500 ft., no date, C. T. McNamara (SAM); ♂, Kokoda, 1200 ft, VIII.1933, L. E. Cheesman (BMNH). Western Province: ♂, Tabubil, 5.15°S, 141.13°E, 650 m, 23-24.XI.1996, M.S. Moulds (AMS); ♂, SE slope of Mt Arik (=Ian), NW of Tabubil, 5.10°S, 141.09°E, 1625 m, 21-22.XI.1996, M.S. Moulds (AMS); ♂, Tabubil, 5.307°S 141.251°E, 365 m, 4.II.2009, S. McEvey, #27403 (AMS).



FIGURES 49-54

Krakatauia stellaris n. sp.: **49**, male habitus, left lateral; **50**, male head and thorax, left anterior; **51**, male postabdomen, left lateral. *K. claudiensis* Bickel: **52**, male habitus, right lateral; **53**, Male head, anterior; **54**, male postabdomen, right lateral. Scale bars, 49, 52: 2.0 mm; 50: 1.0 mm; 51, 53-54: 0.5 mm;

DESCRIPTION — ***Male***. Body length: 6.5 mm; wing: 7.0 x 2.3 mm. (Figures 49-50)

Head. Vertex, frons violet with dense black hairs on lateral slope; face and clypeus metallic green; lower face and clypeus covered with some pruinosity; face not bulging; palp dark brown; proboscis yellowbrown; antenna black (Figure 50); scape somewhat globular; postpedicel tapering; dorsoapical arista simple, and slightly longer than half body length; ventral postcranium with abundant white setae.

Thorax. Metallic blueviolet with green reflections; setae black; pleura with only dusting of grey pruinosity; 3 pairs long ac present; dc row with 2 strong posterior setae and 3 weak hair-like setae anteriad; 1 pa, 2 sa, 2sr, 2npl, 1 pm, 1 weak hm present; median scutellar setae strong with lateral scutellar setae about 2/3 length of medians.

Legs. Coxae and femora black; tibiae and basitarsi I and II yellowish, with their distal tarsomeres dark brown; TIII brown, and tarsus III black; CI with black anterior hairs and 4-5 strong black distolateral setae; CII with black anterior black setae; CIII with single black lateral seta near 1/2 and some longer whitish hairs; I: 7.2; 6.9; 5.0/ 1.5/ 1.2/ 1.0/ 0.6; FI with row of erect ventral hairs, white near base but black distally, and black pv hairs; TI with 1-2 short dorsal seta along basal quarter; It_{2-5} slightly flattened laterally (MSSC); II: 8.3; .9.7; 7.9/ 2.5/ 1.5/ 1.0/ 0.5; FII with mixed white and black ventral hairs along the basal third, black along the distal two-thirds; TII with anterior seta at 1/3 and 3/5, pd seta at 1/3, and subapical corona of pd, ad, av, and pv setae; III: 9.5; 13.4; 6.8/ 3.0/ 2.0/ 0.9/ 0.7; FIII with white ventral hairs along the basal third, black along the distal two-thirds; FIII with row of long black av setae along length; TIII with 5 short dorsal setae spaced along length and with row of short ventral setae with 56 longer setae along length, and subapical circlet of dorsal, ad, and av setae; $IIIt_1$ near very base with strong ventral seta.

Wings. Relatively broad and with smoky brown membrane and only posterior margin of membrane hyaline; veins R_{4+5} and M strongly diverging, with M_1 making right angle bend to almost join R_{4+5} before the margin, anteriad of wing apex; crossvein dm-cu distinctly sinuous, bulging externally in center; CuAx ratio: 1.7; lower calypter brown with fan of white and black setae.

Abdomen. Metallic blueviolet with wide matt brown bands around areas of tergal overlap; tergites with strong black marginal setae and shorter black; hypopygium dark brown with brown cerci (Figure 51); hypandrial hood short; phallus extending beyond apex of surstylus; epandrial lobe with long apical and shorter subapical setae; surstylus lobate with short digitiform projection which bears apical seta; cercus with lobate basoventral projection with narrow digitiform arms, and with long flagellate setose distal cercus, almost three times length of epandrium, and with ventral patch of dense pile near base.

Female. Similar to male except lacks MSSC and as noted: lateral slope of vertex bare except for strong vertical seta; 5 strong dc present; femora with only fine short white hairs; tarsus I unmodified; TII with adpd pair at 1/5; TIII with strong anterior setae at 1/5, 1/2, and 2/3.

REMARKS — *Krakatauia stellaris* appears to be widespread in the Papua New Guinea and is known from lowland areas to elevations near 1600 m. *K. stellaris* is close to *K. claudiensis* and the two species are readily separated by key characters.

ETYMOLOGY — The specific epithet *stellaris* is from Latin, meaning "of the stars," in reference to the Star Mountains type locality.

Krakatauia claudiensis Bickel, 1994

Figures 52-54

Krakatauia claudiensis Bickel, 1994: 151.

TYPE MATERIAL — Holotype, ♂, **Australia**. Queensland: Iron Range, northern Cape York Peninsula (AMS). [examined]

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. Central Province: ♂, near Eilago, 17 May 1981, J. Ismay. Milne Bay Province: ♂, Normanby I., Wamula, 29.XII.1988-3.I.1989, R. deKeyser (AMS).

DIAGNOSIS — ***Male***. Body length: 5.4-6.5 mm; wing: 4.0-5.0 mm (Figure 52).

Head. Face and clypeus blue-green and covered with grey pruinosity; eyes with short pale setae between facets; arista dorsoapical (but almost dorsal) and about twice head height, and simple (Figure 53).

Thorax. Metallic bluegreen with violet reflections and brownish pruinosity.

Legs. Coxae and legs dark red brown- black; CI with black anterior hairs and 3 strong black distolateral setae; CII with black anterior hairs; CIII with single black lateral seta and other black hairs; femora with black ventral setae; FI with pv row of 6-7 long black setae which slightly decrease in size distally (MSSC); It_{3-5} flattened laterally (MSSC); TIII with 5 dorsal setae and strong anterior seta at 2/3.

Wings. Solid smoky brown color with only posterior margin of membrane hyaline; R_{4+5} distinctly downcurved towards M_1; M_1 arches up towards R_{4+5}; dm-cu strongly sinuous; CuAx ratio: 2.5; lower calypter brown with black setae.

Abdomen. Hypopygium (Figure 54); surstylus lobate with 2 strong projecting blade-like apical setae and other setae as figured; cercus long, setose, and with long black apical setae; cercus elongate, about twice length of epandrium, and with long basoventral projection with curved hooklike apical setae.

Female. Similar to male except lacks MSSC and as noted: face not bulging; lateral slope of vertex bare; vertical seta present; 5 strong dc present; femora with only black ventral hairs and FI without strong pv setae; It_1 not flattened.

REMARKS — *Krakatauia claudiensis* is known from northern Cape York Peninsula, Australia and the Milne Bay and Central provinces in Papua New Guinea. It is close to the New Guinea *K. stellaris.* However, in *K. claudiensis*, the cercus is less than twice the length of the epandrium and male femur I has a row of strong pv setae, whereas in *K. stellaris*, the cercus is more than three times the epandrial length, and femur I has only short pv hairs.

Krakatauia obscuripennis (de Meijere, 1913)

Figures 55-56

Psilopus obscuripennis de Meijere, 1913a: 54.
Krakatauia obscuripennis – this study, n. status.

TYPE MATERIAL — Holotype, ♂, **Indonesia**. West Papua: "Waigeu" (=Waigeo), January (RMNH). [examined]

DIAGNOSIS (based on original description, and holotype photographs, Figures 55-56) — ***Male***. Body length: 4.5 mm; wing: 4.5 x 1.4 mm.

Head. Vertex, frons metallic blue with dense black hairs on lateral slope; face not bulging; palp dark brown; proboscis yellowbrown; antenna black; postpedicel subtrianguar; arista dorsoapical.

Thorax. Metallic blueviolet with green reflections; setae black; pleura with only dusting of grey pruinosity; 3 pairs long ac present; dc row with 2 strong posterior setae and 3 weak hair-like setae anteriad; median scutellar setae strong with lateral scutellar setae about 2/3 length of medians.

Legs. Coxae and legs black; FI with 3 strong black pv setae on basal third; TI with 1-2 short dorsal seta; along basal quarter; It_1 with some whitish ventral pile along basal third; It_{2-5} slightly flattened laterally (MSSC). FII and FIII with short black ventral hairs.

Wings. Slightly infuscated with brownish clouding along veins; veins R_{4+5} and M strongly diverging, with M_1 making right angle bend to almost join R_{4+5} near margin anteriad of wing apex; crossvein dm-cu slightly bulging in center; lower calypter brown.

Abdomen. Metallic blueviolet with wide matt brown bands around areas of tergal overlap; tergites with strong black marginal setae and shorter black; hypopygium dark brown with brown cerci (Figure 56); hypandrial hood short; epandrial lobe with long apical and shorter subapical setae; surstylus lobate with short digitiform projection which bears strong apical setae; cercus basally with narrow outer arms and larger median arms produced into long apical recurved claw, and with elongate setose distal cercus, almost three times length of epandrium, and with very long black and white setae along distal three-quarters.

Female. Unknown.

REMARKS — *Krakatauia obscuripennis* is known only from Waigeo Island, near the Vogelkop Peninsula, West Papua. The long, curved claw like projection at the base of the male cercus (Figure 56) is diagnostic. The species was previously regarded it as a junior synonym of *Psilopus marginalis* Walker, but is now considered as a valid species.

Krakatauia morobensis Bickel n. sp.

Figures 57-58

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Province: Wau, 1220 m, 30.I.1965, Malaise trap, J. & M. Sedlacek. Paratype. Papua New Guinea, Morobe Province: ♂, Wau, Hospital Ck, 1230 m, 26.VI.1965, Malaise trap, J. Sedlacek (BPBM).

DESCRIPTION — ***Male***. Body length: 5.9 mm; wing: 5.8 x 1.8 mm (Figure 57).

Head. Vertex, frons shining blue-violet with dense black hairs on lateral slope; face and clypeus covered by dense grey pruinosity; face not bulging; palp dark brown; proboscis yellowbrown; antenna black; scape somewhat globular; pedicel with strong dorsal and ventral setae; postpedicel rounded, subtriangular; dorsoapical arista simple, and slightly longer than half body length; ventral postcranium with abundant white setae.

Thorax. Metallic blueviolet with green reflections; setae black; pleura with only dusting of grey pruinosity; 3 pairs long ac present; dc row with 2 strong posterior setae and 3 weak hair-like setae anteriad; 1 pa, 2 sa, 2sr, 2npl, 1 pm, 1 weak hm present; median scutellar setae strong with lateral scutellar setae about 1/2 length of medians.

Legs. Coxae and remainder of legs dark brown/ black; CI with black anterior hairs and 45 strong black distolateral setae; CII with black anterior black setae; CIII with black lateral seta near 1/3 and some whitish hairs; I: 6.5; 6.0; 3.5/ 1.2/ 1.9/ 1.0/ 0.5; FI with some black ventral setae near in basal third, and with mixed long black and white hairs along entire posterior surface; TI with short dorsal seta at 1/4 and 2/3, and with pv seta at 1/2 and 2/3; It_1 with strong pv seta at 1/3 (MSSC?); It_3 longer than It_2 (MSSC?); II: 7.1; 8.6; 6.9/ 2.2/ 1.7/ 0.9/ 0.5; FII with some white ventral hairs and short black av setae along distal quarter; TII with ad seta at 1/5, dorsal seta at 2/5, some short ventral setae and subapical corona of pd, ad, av, and pv setae. III: 9.5; 11.2; 5.8/ 2.9/ 1.8/ 0.9/ 0.6; FIII with some white ventral hairs; TIII with slight swelling from 1/8 to 2/5 with longitudinal along posterior surface (MSSC), some short dorsal setae spaced along length and subapical circlet of short dorsal, ad, and av setae; $IIIt_1$ with ventral seta near base.

Wings. Relatively broad and with smoky brown membrane and only posterior margin of membrane hyaline; veins R_{4+5} and M strongly diverging, with M_1 making right angle trace to almost joint R_{4+5} before the margin, anteriad of wing apex; crossvein dm-cu distinctly sinuous, bulging externally in center; CuAx ratio: 1.8; lower calypter brown with fan of white setae.

Abdomen. Metallic blue-violet with wide matt brown bands around areas of tergal overlap; tergites with strong black marginal setae and shorter black; hypopygium dark brown with brown cerci (Figure 58); hypandrial hood short; phallus extending beyond apex of surstylus; epandrial lobe with long apical and shorter subapical setae; surstylus subrectangular, distally truncate with some strong distal setae; cercus with expanded basally, but distally narrowed and curved towards surstylus, with group of strong external setae near midlength.

Female. Unknown.

REMARKS — *Krakatauia morobensis* is known only from the Wau district, Morobe Province, Papua New Guinea. The curved cercus with a group of strong external setae near midlength is diagnostic for this species.

Of interest in this species is the posterior longitudinal groove along the basal third of male tibia III (MSSC). This character is found on males in several sciapodine genera, including some *Krakatauia.* It is either a widespread sciapodine synapomorphy that is not always expressed, or possibly arose independently a number of times (see Bickel, 1994 for discussion).The specific epithet *morobensis* refers to the provenance of this species in Morobe Province, PNG.



FIGURES 55-58

Krakatauia obscuripennis (de Meijere): **55**, male habitus, left anterior; **56**, male postabdomen, right lateral. *K. morobensis* n. sp.: **57**, male habitus, left lateral; **58**, male postabdomen, left lateral. Scale bars, 55, 57: 1.0 mm; 56: 0.2 mm; 58: 0.5 mm.

Krakatauia sepikensis Bickel n. sp.

Figures 59-61

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. East Sepik Province: Pagwi, Sepik River, 5.III.1964, D. H. Colless (ANIC).

DESCRIPTION — ***Male***. Body length: 5.3 mm; wing: 5.2 x 1.8 mm (Figure 59).

Head. Vertex, frons metallic blue-violet with dense black hairs on lateral slope; face and clypeus metallic blue-green, and with silvery pruinosity; clypeus free from eye margin; palp dark brown; proboscis yellowbrown; antenna black; scape somewhat globular; postpedicel tapering; dorsoapical arista shorter than body length and simple.

Thorax. Metallic bluegreen; setae black; pleura with only dusting of grey pruinosity; 3 pairs long ac present; 2 strong posterior dc and anterior dc represented by 4-5 weak hairs (MSSC); 1 pa, 2 sa, 2sr, 2npl, 1 pm, 1 weak hm present; lateral scutellar setae about 1/2 length of median scutellar setae.

Legs. Coxae and legs dark brown to black; CI with white and black anterior setae, and with 4 stronger black distolateral setae; CII with black setae; CIII with strong black lateral seta near 1/2; I: 6.0; 5.2; 3.5/ 1.1/ 0.8/ 0.8/ 0.5 (Figure 60); FI with av and pv row of fine black setae from base to ¾, with pv row longer than av row; TI with short dorsal seta at 1/8, and with ventral row of fine hairs along length (MSSC); It_1 basally with whitish ventral pile (MSSC) with distal quarter laterally flattened; It_{2-5} with each tarsomere flattened laterally (MSSC). II: 6.5; 8.1; 5.7/ 1.6/ 1.2/ 0.4/ 0.4; FII with black ventral hairs along length; TII with anterior seta at 1/5, 3/8, and 2/3, pd seta at 3/5, and subapical corona of pd, ad, av, and pv setae. III: 8.0; 11.2; 4.6/ 2.0/ 1.5/ 1.0/ 0.5; FIII with row of long black av setae along length; TIII with 5 short dorsal setae spaced along length, and subapical circlet of dorsal, ad, and av setae; $IIIt_1$ near very base with strong ventral seta.

Wings. Broad and with smoky brown membrane, with only posterior margin of membrane hyaline; veins R_{4+5} and M strongly diverging, with M_1 making right angle trace to almost joint R_{4+5} before the margin, anteriad of wing apex; crossvein dm-cu bulging externally in center; CuAx ratio: 1.7; lower calypter brown with fan of black setae.

Abdomen. Mostly dark metallic green-bronze with wide matt brown on anterior areas of tergites 2-5, near tergal overlap; tergites 2-6 with strong black marginal setae, shorter black setae, and with pale lateral hairs; hypopygium (Figure 61) dark brown with brown cerci; epandrial lobe with long apical and shorter subapical setae; surstylus subrectangular with apical indentation and with two strong dorsoapical setae; cercus with stout basoventral projection with two strong apical setae, and distal cercus curved digitiform and with black lateral and apical setae.

Female. Unknown.

REMARKS — *Krakatauia sepikensis* is known only from East Sepik Province, Papua New Guinea. The male has mostly dark brown wings. Tibia I has a ventral row of fine hairs along length (MSSC), and the distal quarter of the basitarsus and all the distal tarsomeres of leg I are laterally flattened. This species is named for the Sepik River, near the collecting locality of the holotype.

Krakatauia compressipes (Parent, 1939)

Figure 62

Chrysosoma compressipes Parent, 1939: 157 – Bickel 1994: 157.

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Vanimo (ANIC). [examined]

REDESCRIPTION — ***Male***. Body length: 5.3 mm; wing: 5.2 x 1.8 mm.

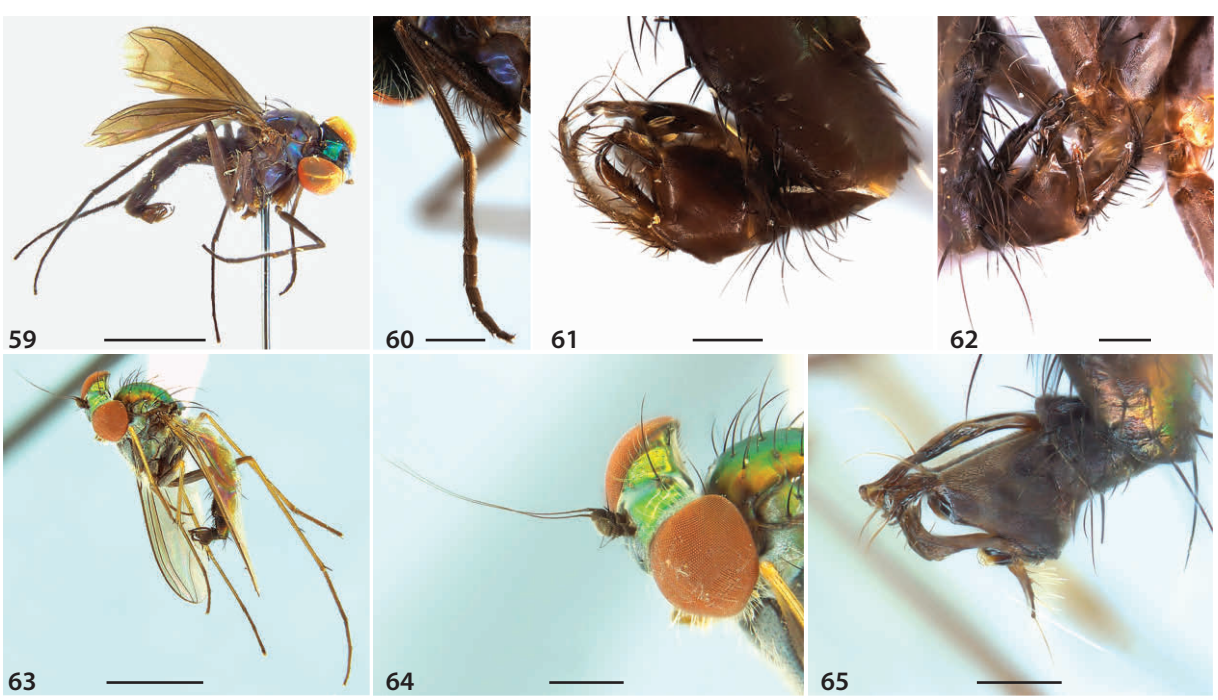
Head. vertex, frons metallic blue-violet with dense black hairs on lateral slope; face and clypeus metallic blue-green, and with silvery pruinosity; clypeus free from eye margin; palp dark brown; proboscis yellowbrown; antenna black; scape somewhat globular; postpedicel tapering; dorsoapical; arista shorter than body length and simple.

Thorax. Metallic blueviolet with green reflections; bronze stripe present dorsad of notopleuron; setae black; pleura with only dusting of grey pruinosity; 3 pairs long ac present; 2 strong posterior dc and anterior dc represented by 4-5 weak hairs (MSSC); 1 pa, 2 sa, 2sr, 2npl, 1 pm, 1 weak hm present; lateral scutellar setae about 2/3 length of median scutellar setae.

Legs. Coxae and femora mostly dark brown, but all tibiae and basitarsi yellowish and distal tarsomeres brown; CI with pale anterior hairs and 4 strong black distolateral setae; CII with black setae; CIII with single black lateral seta and tuft of long pale hairs; all femora with ventral white hairs; I: 6.5; 5.7; 4.0/ 1.0/ 0.8/ 0.8/ 0.5; FI some short black subapical pv setae; TI with short dorsal seta at 1/8; It_1 with 5 short black spaced ventral setae; It_{2-5} with each tarsomere flattened laterally (MSSC); II: 7.5; 9.5; 6.0/ 2.0/ 1.3/ 0.6/ 0.4; FII with some black av setae along distal third; TII with anterior seta at 3/10, pd seta at 2/5, and subapical corona of pd, ad, av, and pv setae. III: 7.7; 11.4; 5.0/ 3.6/ 1.0/ 1.0/ 0.5; TIII with 5 short dorsal setae spaced along length, and subapical circlet of dorsal, ad, and av setae; $IIIt_1$ near very base with strong ventral seta.

Wings. Relatively broad and with smoky brown membrane along anterior margin and along main veins, with posterior margin of membrane hyaline; veins R_{4+5} and M strongly diverging, with M_1 making right angle trace to almost joint R_{4+5} before the margin, anteriad of wing apex; crossvein dm-cu distinctly sinuous, bulging externally in center; CuAx ratio: 1.7; lower calypter brown with fan of white and black setae.

Abdomen. Mostly metallic blueviolet with wide matt brown on anterior areas of tergites 2-5, near tergal overlap; tergites 2-6 with strong black marginal setae, shorter black setae, and with pale lateral hairs; hypopygium dark brown with



FIGURES 59-65

Krakatauia sepikensis n. sp.: **59**, male habitus, right lateral; **60**, male right leg I, posterior; **61**, male postabdomen, left lateral. *K. compressipes* (Parent): **62**, male postabdomen, right lateral. *K. evulgata* (Becker): **63**, male habitus, left lateral; **64**, male head, right dorsal; **65**, male postabdomen, left lateral. Scale bars, 59, 63: 2.0 mm; 60, 64: 0.5 mm; 61-62, 65: 0.2 mm.

brown cerci (Figure 62); epandrial lobe with long apical and shorter subapical setae; surstylus lobate with short digitiform projection, shorter than distal cercus, which bears strong apical setae; cercus with long basoventral projection with some external setae; distal cercus curved digitiform and with strong black outer and lateral setae.

Female. Unknown.

REMARKS — *Krakatauia compressipes* is known only from Vanimo, Sandaun Province, Papua New Guinea. The single male specimen has mostly hyaline wings with brownish clouding around the veins, and possibly it is somewhat teneral and a darker wing clouding is more characteristic of the species. Each tarsomere $It_{2\text{-}5}$ is laterally flattened, and the specific epithet from Latin, expresses this character.

NOMINA DUBIA

anthracinum Becker, 1922: 191. (*Chrysosoma*). Nomen dubium.

Chrysosoma anthracinum was based on three females, one from Friedrich-Wilhelmshafen (=Madang; TMB, destroyed), and two from "Minjamfluss", Kaiser-Wilhelmsland (= New Guinea, PNG; SDEI examined). The two extant specimens are unrecognizable. Bickel (1994) regarded this species as a junior synonym of *Psilopus marginalis* Walker, described on a female from Maluku, a species that here is also considered *nomen dubium* (see below). It is best to regard *Chrysosoma anthracinum* as *nomen dubium*.

atropurpureum Parent, 1939: 156 (*Chrysosoma)*. Nomen dubium.

This species was described from two females, collected in Wewak and New Britain, Papua New Guinea (holotype and paratype, ANIC, examined). This species is clearly a member of the *Plagiozopelma angustifacies* species group, but there are no diagnostic male characters to define the species. It is regarded as unrecognizable.

inflatus Becker, 1922: 221 (*Condylostylus).* Nomen dubium.

This species was based on a male and two females collected at Astrolabe Bay, Papua New Guinea (TMB, destroyed). The description and wing figure suggest it belongs in the genus *Krakatauia*, but without diagnostic MSSC and genitalic characters, it is unrecognizable.

latemaculatum Parent, 1939: 160 (*Chrysosoma*). Nomen dubium.

This species was described from a single female from Vanimo, Papua New Guinea. The female holotype is missing its head (ANIC, examined), and although it belongs in the genus *Krakatauia*, it lacks diagnostic characters and is unrecognizable.

marginalis Walker, 1861: 283 (*Psilopus*). Nomen dubium.

Walker described *Psilopus marginalis* Walker from a single female collected on the island of Batchian in Maluku province, Indonesia. I previously (Bickel 1994) regarded *marginalis* as a widespread Papuan species, and a senior synonym of both *Psilopus obscuripennis* de Meijere and *Chrysosoma anthracinum* Becker. I now regard *P. obscuripennis* (from West Papua) as a valid species defined by distinctive male characters, and *C. anthracinum* as *nomen dubium* (see above). Without diagnostic male characters, it is best to regard *Psilopus marginalis* as *nomen dubium*.

nigrolimbatus de Meijere, 1913b: 340 (*Psilopus*). Nomen dubium.

De Meijere described this species from a female collected at Alkmar, Indonesia: Papua (RMNH, female only, examined). He later (1915: 188) described a male for this species from Zoutbron, Papua, and provided a small sketch of the postabdomen. It has an elongate cercus and is probably close to *Krakatauia marginalis, K. stellaris,* and *K. claudiensis*. However, this male specimen could not be located and is presumed lost (RMNH, P. Ciliberti, *pers. comm*.). I regard this species as unrecognizable. Records of this species from Fiji and the Philippines are unsubstantiated (see Bickel 1994).

sigma Parent, 1935: 73 (*Chrysosoma)*. Nomen dubium.

This species was described from a single teneral specimen of unknown sex (the abdomen is missing) from the "British Solomons" (holotype BMNH, examined). Although Parent thought that it might be close to *Plagiozopelma angustifacies* (Becker), the overall habitus and tibial setation suggests it is a female *Chrysosoma* s.s. This species is unrecognizable.

ACKNOWLEDGEMENTS

We would like to thank the respective curators of these institutions for information and the loan of specimens. (AMS) - Derek Smith & Russell Cox; (ANIC) - Alan Landford; (BMNH) - John Chainey & Duncan Sivell; (BPBM) - Neal Evenhuis & Keith Arakaki; (CNC) - Jeff Cumming; (MNHN) - Christophe Daugeron; (QDPI) - Brian Cantrell; (RMNH) - Pasquale Ciliberti; (SAM) - L. Queale; (USNM) - Chris Thompson; (ZMHB) - Sven Marotzke. The following curators provided photographs of specimens in their care: Duncan Sivell (BMNH), *Chrysosoma arctifacies* Parent (Figures 19-20); Pasquale Ciliberti (RMNH), *Psilopus obscuripennis* de Meijere (Figures 55-56); Sven Marotzke (ZMHB) *Chrysosoma angustifacies* Becker (not used here). Hannah Finlay drew Figure 23 and Natalie Tees constructed the plates in Photoshop. DJB thanks the organizers of the Our Planet Reviewed – "Papua New Guinea" expedition for the invitation to participate, Vojtech Novotny for hospitality at the Binatang Institute, and numerous "Our Planet Reviewed – Papua New Guinea" expedition associates, parataxonomists and Binatang staff for a memorable experience. This study was conducted in the framework of "Our Planet Reviewed – Papua New Guinea 2012-2013" set up by Pro-Natura International, the Muséum national d'Histoire naturelle (MNHN, France), the Institut de Recherche pour le Développement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery. The IBISCA expert network, the patron for this project, Prof. R.L. Kitching AM, and all other participants in this collective effort are thanked for their contribution.

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Numba camp at 700 m a.s.l. under heavy rain.
(Photo © Xavier Desmier).

The *Chaetogonopteron appendiculatum* group (Diptera: Dolichopodidae: Sympycninae) in New Guinea, the Solomon Islands and Australia, with notes on the Oriental fauna

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ABSTRACT

The *Chaetogonopteron appendiculatum* group (Diptera: Dolichopodidae: Sympycninae) is known from southeastern Asia, the Philippines, Indonesia, New Guinea, the Solomon Islands, and northern Australia. This work treats the fauna of New Guinea, the Solomon Islands and Australia in detail with notes on the eastern Oriental fauna, and includes 17 newly described species. The *appendiculatum* group is defined and divided into putative monophyletic assemblages. Many species of the group have unusual male wing modifications. The *gloriosum* assemblage is confined to tropical Asia, and two species, *C. appendiculatum* (de Meijere) from southeastern Asia and *C. gloriosum* (Frey) from the Philippines, are briefly discussed and figured. The *dilatum* assemblage includes *C. wauense* n. sp., *C. oreibatum* Bickel, *C. kaindi* n. sp., and *C. dilatum* n. sp., all from New Guinea. The *missim* assemblage includes *C. missim* n. sp., *C. ialibu* n. sp., *C. purari* n. sp., *C. collessi* n. sp., *C. kamulai* n. sp., all from New Guinea. The *tribulosum* assemblage includes *C. tribulosum* n. sp. from Australia, *C. parnabyi* n. sp. from the Solomon Islands, and *C. anacrostichum* (Meuffels & Grootaert), *C. maneau* n. sp., *C. astrorum* n. sp., *C. agovauae* n. sp., all from New Guinea, and *C. misamis* n. sp. from the Philippines. The presence of the Philippine *C. misamis* in an otherwise Australasian grouping suggests this assemblage might be more widespread in Wallacea, the zoogeographic transition zone between Wallace's Line and Weber's Line. The *acricauda* assemblage includes *C. acricauda* n. sp. from Australia and *C. hutuna* n. sp. from the Solomon Islands. The *tricornigerum* assemblage includes *C. tricornigerum* (Meuffels & Grootaert) and *C. oomsis* n. sp., both from New Guinea. *C. cheesmanae* Hollis from New Guinea is unplaced in the *appendiculatum* group.

BICKEL D. J. & MARTIN J. 2020 — The *Chaetogonopteron appendiculatum* group (Diptera: Dolichopodidae: Sympycninae) in New Guinea, the Solomon Islands and Australia,with notes on the Oriental fauna, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 421-458 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

RÉSUMÉ

Le groupe *Chaetogonopteron appendiculatum* (Diptères : Dolichopodidae : Sympycninae) en Nouvelle-Guinée, dans les Îles Salomon et en Australie, avec des notes sur la faune orientale.

Le groupe *Chaetogonopteron appendiculatum* (Diptères : Dolichopodidae : Sympycninae) est connu en Asie du sud-est, aux Philippines, en Indonésie, en Nouvelle-Guinée, aux Îles Salomon et dans le nord de l'Australie. Ce travail traite en détail de la faune de la Nouvelle-Guinée, des Îles Salomon et de l'Australie avec des notes sur la faune orientale et comprend 17 espèces nouvellement décrites. Le groupe des *appendiculatum* est défini et divisé en assemblages monophylétiques présumés. De nombreuses espèces du groupe présentent des modifications inhabituelles des ailes des mâles. L'assemblage de *gloriosum* est confiné à l'Asie tropicale, et deux espèces, *C. appendiculatum* (de Meijere) d'Asie du sud-est et *C. gloriosum* (Frey) des Philippines, sont brièvement présentées et illustrées. L'assemblage de *dilatum* comprend *C. wauense* n. sp., *C. oreibatum* Bickel, *C. kaindi* n. sp. et *C. dilatum* n. sp., tous de Nouvelle-Guinée. L'assemblage *missim* comprend *C. missim* n. sp., *C. ialibu* n. sp., *C. purari* n. sp., *C. collessi* n. sp., *C. kamulai* n. sp., tous originaires de Nouvelle-Guinée. L'assemblage de *tribulosum* comprend *C. tribulosum* n. sp. d'Australie, *C. parnabyi* n. sp. des îles Salomon, et *C. anacrostichum* (Meuffels & Grootaert), *C. maneau* n. sp., *C. astrorum* n. sp., *C. agovauae* n. sp., tous de Nouvelle-Guinée, et *C. misamis* n. sp. des Philippines. La présence du *C. misamis* philippin dans un groupe par ailleurs australasien suggère que cet assemblage pourrait être plus répandu en Wallacea, la zone de transition zoogéographique entre la ligne de Wallace et la ligne de Weber. L'assemblage *acricauda* comprend *C. acricauda* n. sp. d'Australie et *C. hutuna* n. sp. des Îles Salomon. L'assemblage *tricornigerum* comprend *C. tricornigerum* (Meuffels & Grootaert) et *C. oomsis* n. sp., tous deux de Nouvelle-Guinée. *C. cheesmanae* Hollis de Nouvelle-Guinée n'est pas placé dans le groupe *appendiculatum*.

INTRODUCTION

Chaetogonopteron is a rich and diverse Old World genus, and although most species occur in the moist tropics, some are known from higher latitudes and more arid regions, such as central Algeria and southern Australia. Currently 106 species have been referred to *Chaetogonopteron* (Wikipedia Contributors, 2019), but the genus is considerably larger. Samples from montane rainforest in New Guinea, the Philippines and Borneo indicate very rich faunas from which only a handful of species have been described. For example, in the BPBM collections, one of us (DJB) isolated some 45 species of the genus collected over thirty years within a 1700 m elevational range near the old Wau Institute, Morobe Province, PNG. These include five previously described species and four newly treated in this study. Many of the species are represented by only few specimens, suggesting that additional species await collection, and the Wau district is only a small portion of the topographically complex island of New Guinea.

This work treats the fauna of New Guinea, the Solomon Islands and Australia, along with some discussion of the Oriental fauna, and 17 species are newly described. The Oriental and Australian zoogeographic regions are separated by island archipelagos of varying faunal composition, making it difficult demarcate the two regions (*e.g.*, the *Chaetogonopteron appendiculatum* group occurs across this entire area). Traditionally Wallace's Line has been used as a boundary, but another line further east, Weber's Line, was proposed to more accurately divide the fauna of the two regions. Geologically, Wallace's Line marks the eastern limit of Sundaland, an extension of the Southeast Asian continental shelf and joined during glacial periods, and Weber's Line roughly marks the western limit of the Sahul Shelf, of which Australia and New Guinea are a part. The archipelagos intermediate between Wallace's and Weber's lines comprise Wallacea and are often transitional in faunal composition (Wikipedia Contributors, 2020).

MATERIALS AND METHODS

The repositories of material studied or cited in this revision use the following acronyms: (AMS) Australian Museum, Sydney; (ANIC) Australian National Insect Collection, CSIRO, Canberra; (BMNH) The Natural History Museum, London; (BPBM) Bishop Museum, Honolulu; (MNHN) Museum national d'Histoire naturelle, Paris; (MZH) Finnish Museum of Natural History, Helsinki; (QDPI) Queensland Department of Primary Industries, Brisbane; (QMB) Queensland Museum, Brisbane; (RMNH) Naturalis Biodiversity Center, Leiden; (USNM) National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Species are defined primarily on the basis of male genitalia and male secondary sexual characters (MSSC). Keys are based on nongenitalic characters when possible, although accurate identification sometimes requires clearing the male postabdomen. Species descriptions are condensed to avoid unnecessary repetition. Photographs were made with a Leica M205A photomontage system. The left lateral view of the hypopygium or male genital capsule is shown for most species. In describing the hypopygium, 'dorsal' and 'ventral' refer to morphological position prior to genitalic rotation and flexion. Thus, in figures showing a lateral view of the hypopygium, the top of the page is morphologically ventral, while the bottom is dorsal. Morphological terminology follows McAlpine (1981), except for the male hypopygium where terms of Cumming *et al.* (1995) are used.

Measurements were made on representative dry specimens. Body length of males is measured from the base of the antennae to the tip of the seventh abdominal segment. The CuAx ratio is the length of the m-cu crossvein/ distal section CuA.

The position of features on elongate structures such as leg segments is given as a fraction of the total length, starting from the base. The relative lengths of the podomeres are representative ratios and not measurements, and they are given for each leg in the following formula and punctuation: trochanter + femur; tibia; tarsomere 1/ 2/ 3/ 4/ 5.

The following abbreviations and terms are used: FSSC — Female secondary sexual character(s), non-genitalic characters found only on female body; MSSC — Male secondary sexual character(s), non-genitalic characters found only on male body; I, II, III: pro-, meso-, metathoracic legs; C, coxa; T, tibia; F, femur; ac, acrostichal setae; ad, anterodorsal; av, anteroventral; dc, dorsocentral setae (a numbering system using subscripts indicates specific dc starting from the posterior end, thus dc_3 is the third seta anteriad of the posteriormost seta); dv, dorsoventral; hm, postpronotal setae; np, notopleural setae; pa, postalar setae; pd, posterodorsal; pm, presutural supra-alar setae; ppl, proepisternal setae; pv, posteroventral; sa, postsutural supra-alar setae; sr, presutural intra-alar setae; t, tarsus; t_{1-5}, tarsomeres 1 to 5.

SYSTEMATIC PART

Subfamily SYMPYCNINAE

Genus ***CHAETOGONOPTERON*** de Meijere, 1914

Type species. *Chaetogonopteron appendiculatum* de Meijere, 1914.

REMARKS — *Chaetogonopteron* is a diverse Old World genus in the subfamily Sympycninae. Although most species occur in the moist tropics, some species are known from higher latitudes, such as central Algeria and southern Australia. The genus includes 106 described species (Wikipedia Contributors 2019), but it is considerably larger, with most species undescribed or uncollected. De Meijere (1914, 1915) defined the genus based on the strongly modified male wings of the type species (as in Figure 2), but Becker (1922), Hollis (1963), and Meuffels & Grootaert (1997) further refined the generic concept, and based the genus primarily on the modified male tarsomeres on leg III, as noted below.

Chaetogonopteron is readily separated from other members of the subfamily Sympycninae by two synapomorphies found on the leg III tarsus:

a) Leg III tarsomere 1 is shorter than tarsomere 2 in both sexes; in other genera of the Sympycninae, leg III tarsomere 1 is usually longer than tarsomere 2.

b) Male leg III tarsomere 2 has an elongate projection, known as a *clidium* or vermiform appendage. The clidium is a male secondary sexual character (MSSC) and often has diagnostic characters in length, shape (if bent, branched, etc.) and setation (modified setulae are often present).

The Melanesian and Australian faunas include many species originally described as the genus *Sympycnus* Meigen (*e.g.*, Becker 1922; Meuffels & Grootaert 1987), but these have since been referred to *Chaetogonopteron* (see list in Wikipedia Contributors 2019).

This works focuses on members of the *appendiculatum* group as defined below, many of which have strongly modified male venation. There are other monophyletic groups in the genus needing delineation, numerous unassociated species, and many awaiting both description and / or collection from various Paleotropical habitats.

Chaetogonopteron appendiculatum group

DIAGNOSIS — *Head.* Vertex and frons metallic blue-green with some grey pruinosity; strong vertical and strong diverging ocellar setae present; postverticals represented by 4-5 short black setae, continuation of postoculars; male face silvery and narrow, distinctly separating eyes; male anterior eye facets slightly enlarged; palp and proboscis mostly yellow; postpedicel usually rounded, subtriangular; arista dorsal.

Thorax. Mostly yellow with shining metallic blue-green mesonotum and dorsal scutellum; ac almost always absent (except *C. cheesmanae*), with only minute setae on anterior mesonotal slope; 5 strong dc present; 1 pa, 2 sa, 1 sr, 2 npl, 1 hm, 1 pm present; median scutellar seta strong, lateral scutellar seta present as fine short hair or absent.

Legs. Predominately yellow; CI with short anterior hairs and 4-5 distolateral setae; CII with short anterior setae; CIII with lateral seta at 1/3, usually subtended by weak hair; TI almost always with distinct ad setal serration on distal half; male legs I and II usually unmodified, although some species with TI and/or It with whitish coloration or ventral hairs (MSSC), and/ or TII with ventral hairs (MSSC); TII of both sexes often with strong ad seta positioned from 1/4 to 1/3, distad of more basal offset ad-pd setae; male $IIIt_1$ with strong curved seta arching over clidium; clidium often long and curved.

Wings. Male venation often with diagnostic modifications, such as distorted venation, projections, microtrichial fields, or maculation (all MSSC); species with unmodified male wings and all females with M and R_{4+5} subparallel beyond dm-cu crossvein; anal angle strongly reduced in males, but present in females.

Abdomen. Male postabdomen with sessile or partially encapsulated hypopygium (not pedunculate); female oviscapt with long ventral cercus, and with tergites 9+10 divided into two acanthophorites, each bearing 4 pointed spines (Figure 49).

REMARKS — The *Chaetogonopteron appendiculatum* group of species includes the type species of genus as defined by de Meijere (1914, 1915). Species have predominately yellow legs and thorax, the latter with shining metallic blue-green mesonotum, ac absent or with only minute uniseriate setae on anterior slope of mesonotum, 5 strong dc, tibia I with distinct distal ad setal comb or "serration" of short setae, and male legs with only weakly developed MSSC (apart from the modified tarsomeres 1-2 of leg III, characteristic of the genus *Chaetogonopteron* as a whole). Although many species in the *appendiculatum* group have distorted male venation, their suite of shared characters listed above suggests that species with unmodified male wings should also be included. [Another large group of species centered around *Chaetogonopteron apicale* de Meijere appear similar to the *appendiculatum* group in general coloration (predominately yellow legs and thorax) and also lacking ac, but those have 6 dc, tibia I without an ad setal serration, and usually with strongly modified setae on male leg II and often male leg I.]

The *appendiculatum* group is known from southeastern Asia, the Philippines, Indonesia, New Guinea, Solomon Islands, and the Cape York Peninsula, Australia. I have subdivided the *Chaetogonopteron appendiculatum* group into six informal monophyletic assemblages, which will be treated in order: *gloriosum* assemblage, *dilatum* assemblage, *missim* assemblage, *tribulosum* assemblage, *acricauda* assemblage, and *tricornigerum* assemblage. *C. cheesmanae* is regarded as unplaced in the *appendiculatum* group.

This work primarily treats the fauna of New Guinea, Australia and the Solomon Islands. However, the presence of the Philippine *Chaetogonopteron misamis* in the otherwise Australasian *tribulosum* assemblage suggests this grouping might be more widespread, possibly in the Wallacea zoogeographic zone demarcated by Wallace's Line and Weber's Line, the transition between the Oriental and Australasian zoogeographic regions.

KEY TO MALES OF THE *CHAETOGONOPTERON APPENDICULATUM* GROUP IN AUSTRALASIA

This key excludes Dolichopodidae that have: the vertex excavated either side of ocellar tubercle; scape dorsally setose; pair of distinct postvertical setae on dorsal postcranium, not in line with postocular series; posterior mesonotum distinctly flattened immediately anteriad of scutellum; vein M branched; a strongly pedunculate hypopygium.

1. Femora II and III each with distinct strong anterior preapical seta; antenna usually high on head, about 1/4 distance from vertex; head usually ovate in anterior view; wing with anal angle often reduced or lost Sympycninae **2**
– Femora II and III without strong anterior preapical seta, or apparent preapicals indistinct from background setal field; antenna usually near middle of head, 2/5 to 1/2 distance from vertex; head almost circular in anterior view, about as wide as high; anal angle often well developed (both sexes) ..... Diaphorinae (not treated here).

2. Leg III tarsomere 1 longer than tarsomere 2, and tarsomere 2 bearing digitiform projection (clidium) with diagnostic shape and setation ..... *Chaetogonopteron* de Meijere **3**
– Leg III tarsomere 1 usually shorter than tarsomere 2, and tarsomere 2 without digitiform projection ..... other Sympycninae (not treated here)

3. Acrostichal setae (ac) absent, with few short setulae on anterior mesonotal slope, or if ac uniseriate, wing with strongly distorted venation (Figure 9); tibia I with distinct ad setal serration along distal half; 5 strong dorsocentral setae present; thoracic pleura and legs mostly yellow ..... *appendiculatum* group **4**
– Without the above combination of characters ..... other *Chaetogonopteron*

4. Ac uniseriate, with row of 8-9 setae; posterior wing margin from 1/2 to 3/4 with subrectangular excavation and short black curved dorsal cuticular projection; hypopygium dark brown (Figures 6-9) (New Guinea) ..... *C. cheesmanae* Hollis
– Ac absent; other features various **5**

5. Tarsomere 5, leg I with strong pulvilli (Figures 1, 5); male wing modified (Oriental) ..... *gloriosum* assemblage (see text discussion)
– Tarsomere 5, leg I with small unmodified pulvilli; male wing various **6**

6. Crossvein dm-cu distinctly convex and / sinuate or greatly prolonged (all New Guinea) ..... *missim* assemblage **7**
– Crossvein dm-cu straight or at most slightly curved **11**

7. Crossvein dm-cu distinctly convex (Figures 28, 31, and 33) (all New Guinea) **8**
– Crossvein dm-cu prolonged anterodistally (Figures 39 and 41) **9**

8. Distal vein CuA more than half length of CuA basad of join with dm-cu crossvein; posterior margin of membrane gently curved (Figures 30-32) ..... *C. missim* n. sp.
– Distal vein CuA lest than one-third length of CuA basad of join with dm-cu crossvein; posterior margin distal posterior wing margin slightly indented, making wing appear almost falcate (Figures 33-35) ..... *C. purari* n. sp.

9. Wing with distinct brown apical spot covering anterodistal sixth; crossvein dm-cu prolonged distally with right angle bend joining vein M (Figures 40-42) ..... *C. kamulai* n. sp.
– Wing entirely hyaline **10**

10. Crossvein dm-cu greatly prolonged, more than half wing length, distal CuA very short, CuAx ratio of 7.0; scutellum dorsally metallic blue with broad yellow margin (Figures 36-39) ..... *C. collessi* n. sp.
– Crossvein dm-cu prolonged, but less than one-third wing length; distal CuA distinctly longer, CuAx ratio 1.7; scutellum dorsally metallic blue with only lateral margins yellow (Figures 28-29) ..... *C. ialibu* n. sp.

11. Wing membrane modified with dense microtrichial fields (which often appeared infuscated), and sometimes in shape (Figures 12, 15, 21, 22) (all New Guinea) ..... *dilatum* assemblage **12**
– Wing membrane without with dense microtrichial fields, or if present, distal vein M flexed **15**

12. Posterior wing margin expanded into lobe distad of join of CuA, bearing long marginal hairs and dense microtrichial field MSSC); scutellum with 8-10 short setulae along margin between median scutellar setae (Figures 22-27) ..... *C. dilatum* n. sp.
– Posterior wing margin not lobate; scutellar margin bare between median scutellar setae **13**

13. Distal section of vein CuA unmodified; posterior subapical membrane with dense field of microtrichia (Figures 17-21) ..... *C. kaindi* n. sp.
– Distal section of CuA is thickened and curved, and with field of elongate microtrichia along the posterodistal wing margin **14**

14. Vein M arched anteriorly distal of crossvein dm-cu to become closely parallel with R_{4+5} and joining margin anteriad of wing apex; scutellum metallic blue basally with broad yellow margin; hypopygium mostly yellow (Figures 14-16) ..... *C. oreibatum* Bickel
– Vein M more widely separated from R_{4+5} and joining margin at wing apex; scutellum metallic with only lateral margins yellow; hypopygium mostly dark brown (Figures 10-13) ..... *C. wauense* n. sp.

15. Clidium on leg III tarsomere 2 short and apically U-shaped with three projections including long lobate outer arm (Figure 77) (New Guinea) ..... *tricornigerum* assemblage **16**
– Clidium on leg III tarsomere 2 digitiform and usually distally flexed (Figures 62, 68, 72) **17**

16. Vein CuA terminates in membrane before reaching the wing margin; vein M slightly arched anteriorly just distad of dm-cu crossvein; (Figures 73-74) ..... *C. tricornigerum* (Meuffels & Grootaert)
– Vein CuA terminates on posterior wing margin; vein M in in gentle curve just distad of dm-cu crossvein (Figures 75-77) ..... *C. oomsis* n. sp.

17. Surstylus modified into strong beak-like projection, pointing dorsally or ventrally (Figures 66, 71); veins R_{4+5} and M closely parallel with each other beyond crosvein dm-cu (Figures 67, 69) .... *acricauda* assemblage .. **18**
- Surstylus distally tapering, not modified into strong beak-like projections; veins R_{4+5} and M subparallel or with vein M distinctly flexed .. *tribulosum* assemblage **19**

18. Surstylar arms elongated, appressed and tapering to point, and deflexed into dark brown "beak"; scutellum metallic blue but with only lateral margins yellow; $IIIt_3$ without strong seta at base (Figures 65-68) (Australia) ..... *C. acricauda* n. sp.
– Surstylar arms bent at right angle and tapering into sharp point; scutellum metallic blue with entire margin yellow; $IIIt_3$ with strong ad seta at base (Figures 69-72) (Solomon Islands) ..... *C. hutuna* n. sp.

19. Veins R_{4+5} and M subparallel distad of crossvein with R_{4+5} bending posteriorly just before joining costa anteriad of apex, vein M straight to join margin at apex; hypopygium pyriform and almost entirely yellow, except tips of surstylus dark brown (Figures 62-64) (New Guinea) ..... *C. agovauae* n. sp.
– Vein R_{4+5} joining costa near 5/6, and M gently sinuate, basally subparallel with R4+5, and then curved posteriad to join margin just anterad of apex (Figures 45, 50, 55, 60) **20**

20. Wing elongate, > 3.4 mm **21**
- Wing shorter, < 2.8 mm **22**

21. Wing with smoky infuscation anterodistally; vein M with gentle curve to become subparallel with R_{4+5} subapically; wing length > 4.0 mm (Figures 52-54) (New Guinea) ..... *C. maneau* n. sp.
– Wing hyaline; vein M strongly sinuate, approaching R_{4+5}, then curved to join margin anteriad of apex; wing length about 3.5 mm (Figures 57-61) (New Guinea) ..... *C. astrorum* n. sp.

22. Distal surstylus capitate, dome-shaped apical projection (Figures 44, 46) **23**
– Distal surstylus with dorsal and ventral arms inward pointing, almost like pincers (Figures 51, 56) **24**

23. Sternite 8 dark brown with violet reflections; tibia II bare of av setae along distal two-thirds (Figures 46-49) (Australia, New Guinea, Bougainville) ..... *C. tribulosum* n. sp.
– Sternite 8 yellow; tibia II has a row of short av setae along distal two-thirds (Figures 43-45) (Solomon Islands) ..... *C. parnabyi* n. sp.

24. Sternite 8 dark brown with violet reflections; surstylus with lateral yellow lobe, with exposed median black curved claw-like dorsal and ventral projections (Figures 50-51) (New Guinea) .....
..... *C. anacrostichum* (Meuffels & Grootaert)
– Sternite 8 and hypopygium almost entirely yellow; ventral surstylar arm broad (Figures 55-56) (Philippines) ..... *C. misamis* n. sp.

THE *GLORIOSUM* ASSEMBLAGE

REMARKS — The *gloriosum a*ssemblage of species includes the type species of *Chaetogonopteron* as defined by de Meijere (1914, 1915) and (Hollis 1963). The tropical Oriental fauna is not the focus of this revision, but we have seen undescribed Oriental species that would belong here. The presence of enlarged pulvilli (Figures 1, 5) on the male tarsus I (MSSC) and the modified male venation will help to roughly define this assemblage until further studies can be commenced. Three described species are included.

Chaetogonopteron appendiculatum de Meijere, 1914

Figures 1-3

Chaetogonopteron appendiculatum de Meijere, 1914: 96.

REMARKS — De Meijere described *Chaetogonopteron appendiculatum* (RMNH, examined) as the type species of his new genus, and the male wing is so modified (Figures 2, 3) that he initially listed the genus under the subfamily Sciapodinae (as Chrysosomatine) without comment. Becker (1922) discussed the genus and transferred it to the Sympycninae (as Campsicneminae). The types are from Java but the species is more widespread in southeastern Asia.

MATERIAL EXAMINED — (all based on males) **Thailand**. Chiang Mai: Chiang Dao, 450 m, IV.1958 (USNM). **Malaysia**. Sabah: Sandakan, Gomantong Caves (BPBM); Selangor: Templar Park, nr. Kuala Lumpur, D. K. McAlpine (AMS). **Vietnam**. M'Drak, east of Ban Me Thuot, XII.1969, 400-500 m (BPBM).

Chaetogonopteron fimbritibia Hollis, 1963

Chaetogonopteron fimbritibia Hollis, 1963: 732.

REMARKS — *Chaetogonopteron fimbritibia* (BMNH, examined), described from a single male from Malaysia: Sarawak, has distinctive emarginate wings with modified hairs (MSSC) and enlarged pulvilli. Hollis' description and figures should enable identification.

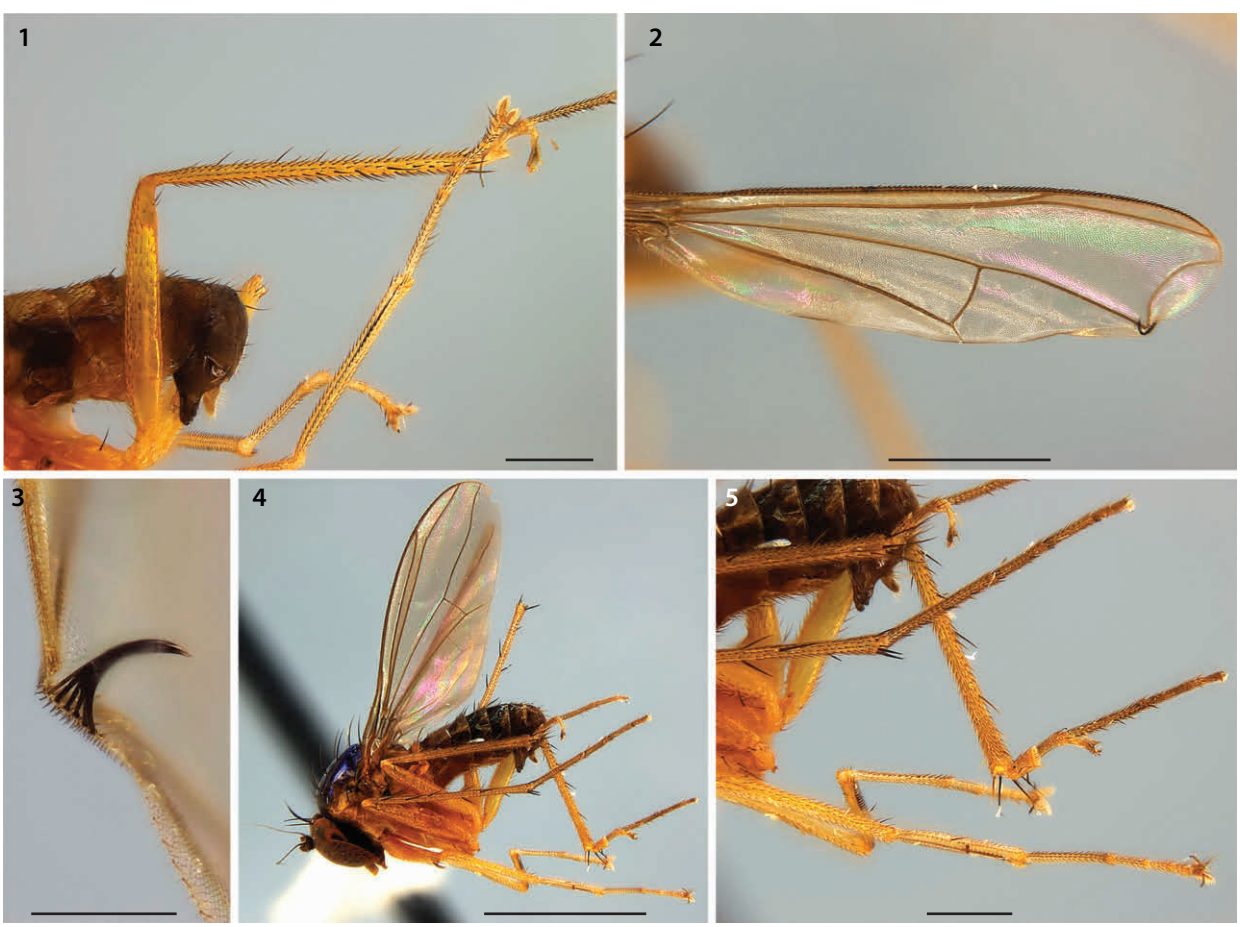
Chaetogonopteron gloriosum (Frey, 1925)

Figures 4-5

Pycsymnus gloriosum Frey, 1925: 21.
Sympycnus gloriosus – Dyte 1975: 255.
Chaetogonopteron gloriosum – Grichanov 217: 129.

TYPE MATERIAL — Lectotype, ♂, **Philippines**. "Philipp.", S. Theodoro, I.1916, new designation (MZH). Syntypes, **Philippines**. ♂, 3 ♀, (MZH). [examined]

ADDITIONAL MATERIAL EXAMINED — **Philippines**. Camarines Sur: Mt. Isarog, 500 m, 4.IV.1967, & Mt. Iriga, 500-600 m, 6.IV.1962. Negros Orientale: L. Balinsasayao, 1-7.X.1959, H. Torreville. Misamis Orientale: Balason, 4-5.IV.1960, H. Torreville. Luzon: Guiron, Pilar, Sorsogoa, 27.IV.1968; Mt. Makling, Laguna, 400 m, 30.III.1968, M. D. Delfinado; Dalton Pass, Nueva Vizcaya, 915 m, malaise trap, 9-10.IV.1968, M. D. Delfinado (all BPBM).



FIGURES 1-5

Chaetogonopteron appendiculatum (de Meijere): **1**, male tibia, tarsus I and III, and postabdomen, left lateral; **2**, male wing, dorsal; **3**, detail of male wing, dorsal. *C. gloriosum* (Frey): **4**, male habitus, left lateral; **5**, male tibia and tarsus, I and III, and postabdomen, left lateral. Scale bars, 1, 5: 0.5 mm; 2: 1.0 mm; 3: 0.2 mm; 4: 2.0 mm.

REMARKS — *Chaetogonopteron gloriosum* has male wing veins M and R_{4+5} bowed with respect to each other (MSSC) (Figure 4). Acrostichal setae are absent on both sexes, although Frey (1928) mistakenly claimed that females have two rows of ac. The pulvilli of male tarsus I are enlarged (MSSC). This species appears to be widespread in the Philippines.

THE *DILATUM* ASSEMBLAGE

REMARKS — The male wing membrane in *dilatum* assemblage species is modified with dense microtrichial fields (which often appear infuscated) and distorted in shape (Figures 12, 15, 21, 22). This assemblage includes four species, *C. wauense* n. sp., *C. oreibatum* Bickel, *C. kaindi* n. sp., and *C. dilatum* n. sp., all from New Guinea. *C. cheesmanae* is also included here, although it has uniserrate acrostichal setae.

Chaetogonopteron cheesmanae Hollis, 1963

Figures 6-9

Chaetogonopteron cheesmanae Hollis, 1963: 732.

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Oro Province, Kokoda, 1200 ft (~ 360 m) (BMNH). Paratypes, **Indonesia**. Papua Province, ♂, ♀, Cyclops Mtns, Mt. Lina, 3,500 ft (~ 1060 m) (BMNH). [examined]

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. Central Province: ♂, 2 ♀, Musgrave River, nr Port Moresby, 950 ft, 17.V.1981, D. K. McAlpine (AMS). East Sepik Province: ♂, Maprik, 22.III.1964, D. H. Colless (ANIC). Morobe Province: 8 ♂, 29 ♀, Lae, Oomsis, 6° 40'S 146° 48'E, yellow pans, 22-30.VII.2000, R. Kitching; ♂, Markham River Bridge, Bubia, 17.XI.1972, G.A. Holloway (AMS); ♂, Wau, 1200-1600 m, 9.II.1967, J. Sedlacek (BPBM). Oro Province: 1 ♂, 1 ♀, Popondetta District, Buri, nr Sasambata, 30.X.1963, D. K. McAlpine (AMS); ♂, Wanigela, 9° 16'S, 149° 08'E, 10-50 m, S. McEvey (AMS). Western Province: ♂, SE slope of Mt Arik (=Ian), NW of Tabubil, 5.10°S, 141.09°E, 1625 m, 21-22.XI.1996, M.S. Moulds (AMS).

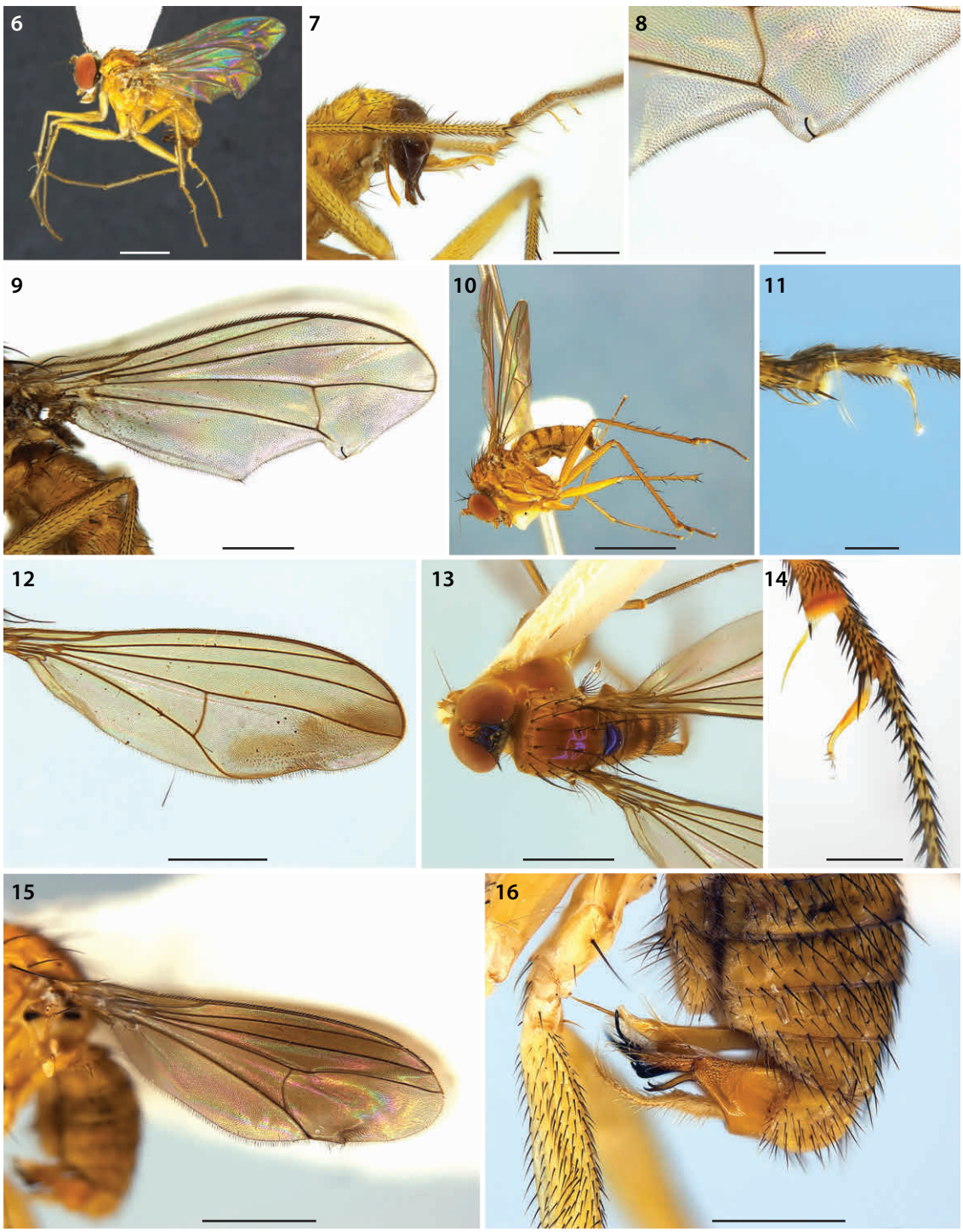
DESCRIPTION — ***Male***. Body length: 2.8-3.2 mm; wing: 3.2-3.4 x 1.2 mm.

Head. Scape, pedicel and basal postpedicel yellow, with distal postpedicel brownish, pedicel with short dorsal seta; postpedicel subtriangular, as long as wide; arista dorsal.

Thorax. Dorsum and pleura entirely yellow except for shining metallic blue area on mesonotum, extending caudally from level of second anteriormost dc and extending almost to lateral margin; scutellum metallic blue anterobasally but with broad yellow margin; ac uniseriate, as row of 8-9 short setae extending almost to posterior mesonotal slope.

Legs. All coxa and remainder of legs mostly yellow except where noted and with black posterobasal spot on CII; I: 4.7; 4.3; 3.0/ 1.2/ 0.8/ 0.2/ 0.3; TI and IIt1 whitish; TI with dorsal seta at 1/2, with shorter subapical pd seta, and with ad setal serration from 2/3 to 7/8; II: 5.8; 7.0; 3.2/ 1.5/ 1.1/ 0.5/ 0.4; FII with strong anterior and weaker posterior subapical setae; TII and IIt_1 white; TII with ad-pd pair at 1/8, ad setae at 1/4 (strong) and 3/4 (weaker), pd seta at 1/2, av at 1/4, 3/5, and 4/5, short ventral at 1/2, and with apical circlet of ad, anterior, av, pv and pd seta; III: 5.8; 7.1; 0.4/ 1.2/ 1.9/ 0.9/ 0.3; FIII with strong anterior and weaker posterior subapical setae; TII with strong ad setae at 1/3, 4 spaced dorsal setae along length, 2 weak ventral setae, and strong apical ad seta; $IIIt_1$ with strong curved white ventral seta (MSSC); $IIIt_2$ with simple straight clidium, pale white and with external seta on stalk (Figure 7).

Wings. (Figures 8, 9) Hyaline; R_{4+5} and M diverging from base to level of dm-cu crossvein at 3/4, with R_{4+5} joining costa near 7/8, and M gently sinuate to join margin just posteriad of apex; crossvein dm-cu positioned distally on wing at ¾ (MSSC), CuAx ratio: 3.0, with crossvein dm-cu slightly undulating; posterior wing margin from 1/2 to ¾ with subrectangular excavation (MSSC) and distal marginal edge of excavation with short black curved dorsal cuticular projection (MSSC); lower calypter yellow with fan of brown setae; halter yellow.



FIGURES 6-16

Chaetogonopteron cheesmanae Hollis: **6**, male habitus, left lateral; **7**, male postabdomen, and leg III; **8**, male posterior wing margin, dorsal; **9**, male wing, dorsal. *C. wauense* n. sp.: **10**, male habitus, left lateral; **11**, male tarsomeres 1 and 2, leg III, anterior; **12**, male wing, dorsal; **13**, male head and thorax, dorsal. *C. oreibatum* n. sp.: **14**, male tarsomeres 1 and 2, leg III, anterior; **15**, male wing, dorsal; **16**, male postabdomen, left lateral. Scale bars, 6, 12, 13, 15: 1.0 mm; 7, 9, 16: 0.5 mm; 8, 11, 14: 0.2 mm; 6, 8, 9: 0.2 mm; 10: 2.0 mm.

Abdomen. Mostly yellow with short brownish vestiture; sternite 8 dark brown; hypopygium pyriform and almost entirely dark brown except for brown hypandrium, and yellow phallus and cercus; (Figure 7); epandrial setae arising from ventral margin; surstylus digitiform with overlapping dorsal and ventral arms; phallus elongate with upcurved rounded apex; cercus short elongate with projection, and with pale yellow vestiture.

Female. Similar to male except lacking MSSC and as noted: face wider; female TII with 3 spaced ventral setae; IIIt unmodified; wing unmodified, with veins R_{4+5} and M subparallel, crossvein dm-cu positioned near 3/5; CuAx ratio: 1.0; posterior membrane entire, and lacking cuticular projection.

REMARKS — *Chaetogonopteron cheesmanae* is widely distributed in New Guinea, and occurs from lowland areas up to elevations of 1600 m. The male wing has the posterior membrane strongly emarginated (Figure 9), making it appear torn or damaged, and just beyond this emargination is a black curved spinelike cuticular projection. *C. cheesmanae* is unusual among the *appendiculatum* group in having a uniseriate acrostichal row while all other members of the group lack acrostichals. However, its total suite of characters suggests it does belong in the group, especially noting the modified male wing, which has cuticular projections on the membrane (Figures 8-9) , not unlike that of the Oriental *C. appendiculatum* (Figures 2-3).

Chaetogonopteron wauense Bickel n. sp.

Figures 10-13

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Province: Wau, 7° 20'S, 146° 42'E, 600 m, 2-3.XI.1996, M. Moulds (AMS).

ETYMOLOGY — The specific epithet, *wauense,* relates to the type locality.

DESCRIPTION — ***Male***. Body length: 3.6 mm; wing: 4.7 x 1.4 mm.

Head. Antenna yellow, with postpedicel distally brownish.

Thorax (Figure 13). Dorsum and pleura entirely yellow, except mesonotum shining with metallic blue reflections; scutellum mostly metallic blue dorsally except lateral margins yellow.

Legs. All coxa and remainder of legs yellow, with distal tarsomeres slightly infuscated; leg setae and vestiture black; I: 5.1; 5.0; 4.2/ 1.0/ 0.9/ 0.6/ 0.4; FI mostly bare except for short subapical pv seta; TI with dorsal setae at ½ (short) and 9/10 (longer), and short ad setal serration along distal third; II: 7.7/ 9.6; tarsus II missing; FII with strong anterior subapical seta, weak posterior subapical seta, and ventrally bare; TII with strong ad seta at 1/6, 1/3 and 2/3, weaker pd seta at 1/6 and 1/2, with ventral setae at 2/3 and 5/6, and apical circlet of ad, anterior, av, pv and pd setae; III: 7.4; 9.7; 0.6/ 1.0/ 2.5/ 1.4/ 0.7; FIII with strong anterior and posterior subapical setae; TIII strong ad at 1/8, 2/5, and 2/3, strong dorsal setae at 1/8, 1/4 1/2 and 3/4, and subapically with strong ad seta and weaker anterior seta; male $IIIt_1$ (Figure 11) with curved yellow ventral seta (MSSC); $IIIt_2$ with clidium digitiform, slightly curved and yellow (MSSC).

Wings. (Figure 12) Membrane with posteroapical band of short dense microtrichia, giving infuscated appearance (MSSC); R_{4+5} and M subparallel in distal half, with M ending at wing apex; CuAx ratio: 0.9; distad vein CuA thickened and curved, merging into posterior wing margin (MSSC), and with elongate microtrichia along posterodistal wing margin (MSSC); lower calypter brown with fan of brown setae; halter yellow.

Abdomen. Tergites and sternites mostly yellow; but tergites 2-6 with brown anterior and posterior bands, and with narrow brown mid-dorsal band along tergites; tergites 1-6 each with short black vestiture and posterior row of setae; sternite 8 dark brown; hypopygium elongate subtriangular, tapering distally; epandrium mostly dark brown, with hypandrium, phallus and cerci yellow; hypandrium forming inverted trough-like hood; epandrial lobe with two strong apical setae; surstylus comprising adjacent large ventral arm and narrower dorsal arm; cercus broad, subtriangular, with fine yellow hairs.

Female. Unknown.

REMARKS — *Chaetogonopteron wauense* is known only from 600 m in the Wau district, Morobe Province. This species has sternite 8 and the epandrium dark brown, and the scutellum is dorsally mostly metallic blue with only the lateral margins yellow. The distal section of CuA is thickened and curved, and merges into posterior wing margin (MSSC), with elongate microtrichia along the posterodistal wing margin (MSSC).

Chaetogonopteron oreibatum Bickel, 2016

Figures 14-16

Chaetogonopteron oreibatum Bickel, 2016: 104, *in* Bickel & Martin, 1916.

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Madang Province: Mt Wilhelm, -5.7320, 145.2522, 700 m, Malaise trap 4, 31.X-1.XI.2012, P1442, Keltic, Uma, Novotny & Leponce (MNHN). Paratypes, **Papua New Guinea**. ♂, same information as holotype; ♂, same but 30-31.X.2012, P1441 (BPBM); ♂, Bismarck Range, Oromungu, -5.2277, 145.0797, 760 m, yellow pans along forested creek, 16-18.X.2013, D.J. Bickel (AMS). [examined]

DIAGNOSIS — ***Male***. Body length: 3.4 mm; wing: 3.3 x 1.1 mm.

Head. Antenna yellow.

Thorax. Dorsum and pleura entirely yellow except for shining metallic blue area on mesonotum; scutellum metallic blue anterobasally but with broad yellow margin.

Legs. All coxa and remainder of legs yellow; TI dorsal seta at 2/5, and with ad setal serration of short setae from 2/5 to apex; male $IIIt_1$ (Figure 14) with strong curved yellow ventral seta (MSSC); $IIIt_2$ with slightly curved, deflexed clidium (MSSC).

Wings. (Figure 15) Membrane with smoky infuscation; R_{4+5} and M diverging from base to level of dm-cu crossvein, then very slightly converging to wing margin, with M ending slightly anteriad of wing apex; membrane distad of CuA_1 join at margin with slightly depressed field of elongate microtrichia also on adjacent posterior margin (MSSC); crossvein dm-cu concave; CuAx ratio: 1.0.

Abdomen. Hypopygium elongate subtriangular, tapering (Figure 16); epandrium mostly yellow with surstylus dark brown distally; hypandrium, phallus and cercus pale yellow; surstylus comprising two sections: ventral surstylar lobe basally yellow and tapering into narrow black curved stylus and with long pale yellow lateral setae, and subtended basally by shorter black curved hook, and dorsal surstylar lobe narrow and apically forked; cercus basally thick but tapering into digitiform projection with yellow hairs.

REMARKS — *Chaetogonopteron oreibatum* has a striking elevational range in Papua New Guinea, and it is known from 200 m and 700 m in the Bismarck Range, and at 3200 m on Mt Wilhelm. This species has the hypopygium almost entirely yellow, an elongate digitiform cercus and the male wing membrane has a distinctive field of elongate microtrichia distad of the join of CuA_1 with the posterior margin.

Chaetogonopteron kaindi Bickel n. sp.

Figures 17-21

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Province: Wau, Mt. Kaindi, 7° 24'S, 146° 44'E, 1150-2300 m, 12-29.I.1993, ex Caldcluvia, intercept trap, Y. Basset (BPBM).

ETYMOLOGY — The specific epithet, *kaindi,* is a place name and a noun in apposition.

DESCRIPTION — ***Male***. Body length: 2.7 mm; wing: 3.5 x 1.3 mm.

Head. (Figure 17) Antenna mostly yellow, but postpedicel brown; postpedicel rounded, subtriangular.

Thorax. Dorsum and pleura mostly yellow; dorsal scutellum metallic blue but with broad yellow margin.

Legs. All coxa and remainder of legs pale yellow, with distal tarsomeres slightly infuscated; I: 5.0; 4.4; 3.4/ 1.4/ 1.0/ 0.4/ 0.5; FI mostly bare except for short subapical pv seta; TI bare except for short ad setal serration from 3/5 to apex; II: 6.5; 8.5; 3.0/ 2.0/ 1.3/ 0.7/ 0.4; FII with strong anterior subapical seta, strong posterior subapical seta, and ventrally bare; TII with strong ad seta at 1/6 , 1/3 and 1/2 and 3/4,. weaker pd seta at 1/6 and strong pd at 1/2, and apical circlet of ad, anterior, av, pv and pd seta; III: 6.3; 8.8; 0.6/ 1.0/ 2.4/ 1.7/ 0.4; FIII with strong anterior subapical seta only; TIII strong ad at 1/8, 1/3, and 2/3, strong dorsal seta at 1/8, 1/4 1/2 and 3/4; without apical circlet of setae; male $IIIt_1$ (Figure 19) with strong curved yellow ventral seta (MSSC); $IIIt_2$ with erect but distally bend clidium (MSSC).

Wings. (Figure 20) Membrane hyaline; R_{4+5} and M diverging from base to level of dm-cu crossvein, then very slightly converging to wing margin, with M slightly deflexed subapically to end in margin anteriad of wing apex; membrane of posterior wing apex with dense field of microtrichia (Figure 21) (MSSC); crossvein dm-cu straight; CuAx ratio: 0.8; lower calypter brown with fan of black setae; halter yellow.

Abdomen. Tergites and sternites mostly yellow, except anterior third of tergites 3, 4 and 5 dark brown; tergite 1 with black posterior setae; tergites 1-6 each with short black vestiture and posterior row of longer setae; sternite 8 dark brown; hypopygium elongate subtriangular, tapering distally (Figure 18); epandrium mostly yellow with surstylus becoming dark brown distally; hypandrium, phallus and cercus pale yellow; hypandrium forming inverted trough-like hood; surstylus comprising two adjacent digitiform arms; cercus yellow, basally thick but tapering into digitiform projection with fine yellow hairs.

Female. Unknown.

REMARKS — *Chaetogonopteron kaindi* is known from a male collected on Mt Kaindi in the Wau district, Morobe Province, Papua New Guinea. The wing is elongate, distinctly longer than the body, and R_{4+5} and M slightly converge subapically. As well, the posterior region near the wing apex is covered by a dense field of microtrichia (Figure 21).

Chaetogonopteron dilatum Bickel n. sp.

Figures 22-27

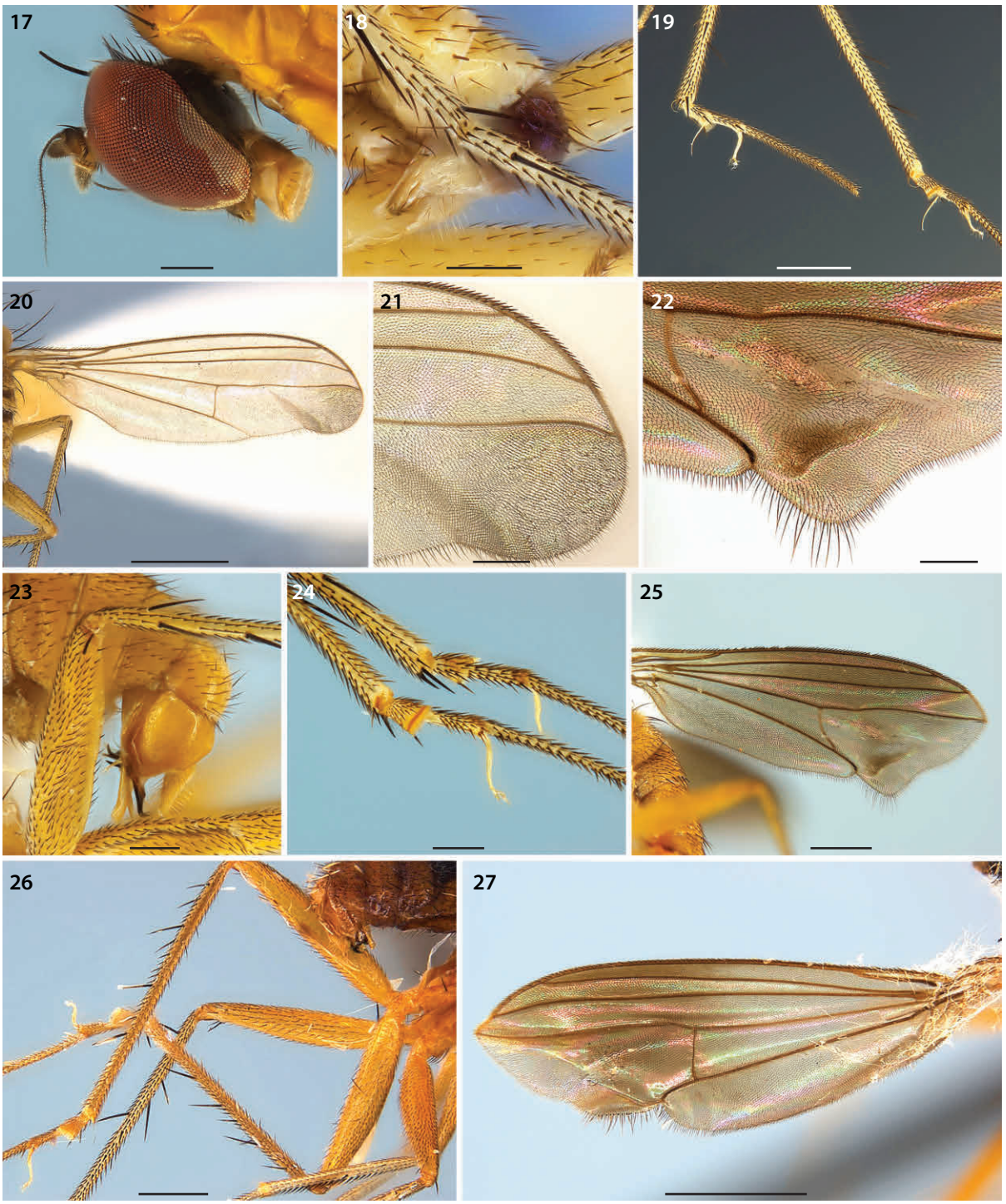
TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Madang Province, Mt Wilhelm, -5.7209° 145.2695°, 1200 m, Malaise trap, 29-30.X.2012, P1782, Keltic, Uma, Novotny & Leponce (MNHN). Paratypes, **Papua New Guinea**. Madang Province: 2 ♂, same information as holotype; 2 ♂, same but 2-3. XI.2012, P1818 (AMS).

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. Sandaun (West Sepik) Province: ♂, Feramin, [-5.208, 141.6988], 1450 m, 28.VIII.1963, light trap, R. Straatmann (BMBM). Western Province: ♂, Star Mtns, Camp 1, 5°13'S, 141° 14'E, 950-1200 m, II-III.2013, yellow pans, C. Muller (AMS).

ETYMOLOGY — The specific epithet, *dilatum,* is from Latin meaning "dilated" or "expanded", in reference to the expanded distal posterior margin of the male wing.

DESCRIPTION — ***Male***. Body length: 3.4 mm; wing: 3.7 x 1.3 mm.

Head. Scape and pedicel yellow with brownish postpedicel, pedicel with short dorsal seta; postpedicel subtriangular, slightly longer than wide.



FIGURES 17-27

Chaetogonopteron kaindi n. sp.: **17**, male head, left lateral; **18**, male postabdomen, left lateral; **19**, male leg III, distal tibial and tarsus; **20**, male wing, dorsal; **21**, male wing apex, dorsal. *C. dilatum* n. sp.; **22**, male wing, dorsal, detail (Mt Wilhelm); **23**, male postabdomen, left lateral; **24**, male leg III, basal tarsomeres, lateral (Mt Wilhelm); **25**, male wing, dorsal (Mt Wilhelm); **26**, male postabdomen and posterior legs, right lateral (Feramin); **27**, male wing, dorsal (Feramin). Scale bars, 20, 27: 1.0 mm; 19, 25, 26: 0.5 mm; 17, 18, 21, 22, 23, 24: 0.2 mm.

Thorax. Median scutellar seta strong, lateral seta reduced to weak hair, and with 8-10 short setulae along scutellar margin between median scutellar setae (MSSC?).

Legs. All coxa and remainder of legs mostly yellow except where noted and with black posterobasal spot on CII; I: 4.9; 4.7; 3.7/ 1.8/ 1.0/ 0.6/ 0.5; FI bare except for short pv seta; TI with short dorsal seta at 1/2, and with ad serration of strong short setae from 1/3 to apex; II: 6.0; 8.2; 4.6/ 2.2/ 1.4/ 0.7/ 0.3; FII with strong anterior and weaker posterior subapical setae; TII with offset ad-pd pair at 1/8, strong ad setae at 1/3 and 3/5, strong pd at 1/2, with some short ventral setae on distal half, and subapical circlet of ad, anterior, av, pv and pd seta; III: 6.5; 8.7; 0.7/ 1.2/ 2.8/ 1.0/ 0.3; FIII with strong anterior and weaker posterior subapical setae; TIII with strong ad setae at 1/5, and 1/3, strong dorsal setae at 1/8, 1/3, 3/5, and 3/4, $IIIt_1$ with short strong black ventral seta (MSSC); $IIIt_2$ ventrally flattened with simple apical clidium, white and slightly sinuate, with short external seta near bend (Figure 24) (MSSC).

Wing (Figures 22, 25, 27). Hyaline but infuscated anteriorly; R_{4+5} and M diverging from base to level of dm-cu crossvein, but becoming subparallel with R_{4+5} joining costa near 7/8, and M joining margin anteriad of apex (MSSC); posterior wing margin expanded into lobe distad of join of CuA, with lobe bearing long marginal hairs and dense microtrichial field MSSC); crossvein dm-cu curved and either gradually joining CuA at acute angle (Figures 22, 25) or almost perpendicular to CuA (Figure 27); lower calypter yellow with fan of black setae; halter yellow.

Abdomen. Mostly yellow with short brownish vestiture; sternite 8 yellow; hypopygium pyriform and almost entirely yellow, surstylus dark brown (Figure 23); hypandrium and phallus pale yellow; epandrial setae arising from ventral margin; surstylus rounded capitate, subtended by strong curved dark brown claw-like projection along ventral margin; cercus pale yellow, subtriangular but narrowed distally into digitiform projection, and with pale yellow vestiture.

Female. Unknown.

REMARKS — *Chaetogonopteron dilatum* is known from 1200 m in the Bismarck Range, Madang Province 950-1200 m in the Star Mountains, Western Province and 1450 m, Sandaun Province, all in Papua New Guinea. The dilated hind margin of the male wing is diagnostic. Also of interest is the row of 8-10 short setulae along scutellar margin between median scutellar setae.

The specimen from Feramin, Sandaun Province (Figure 27) has crossvein dm-cu almost perpendicular to vein CuA, whereas in other specimens, crossvein dm-cu joins CuA at an acute angle (Figures 22, 25). I regard this as intraspecific variation.

THE *MISSIM* ASSEMBLAGE

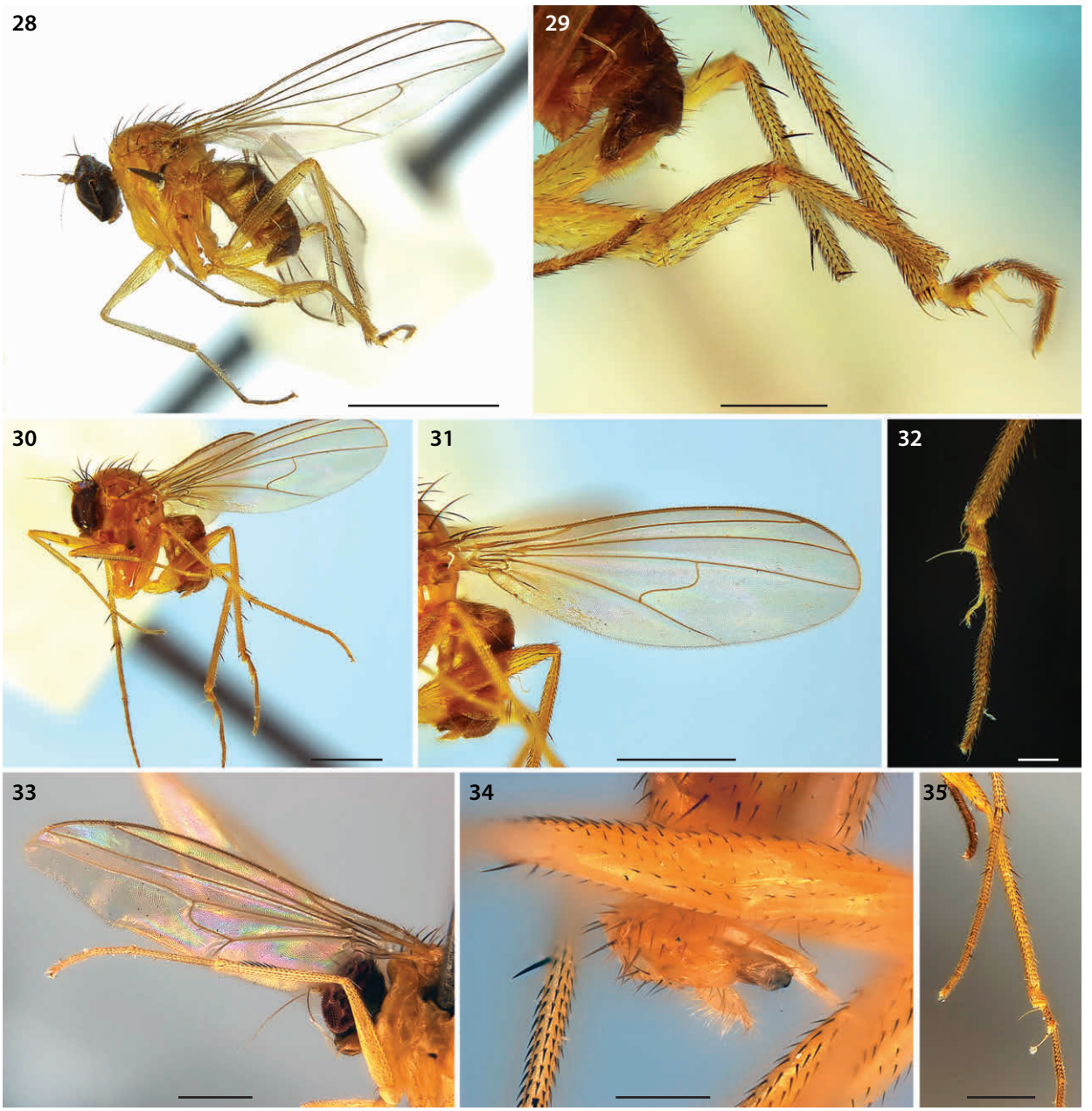
REMARKS — Species in the *missim* assemblage have crossvein dm-cu on the male wing modified as bowed, sinuate or greatly prolonged (Figures 28, 31, 33, 39, and 41) and tibia I has only the distal ad setal serration, with no other setae. All have rather simple hypopygia, not strongly modified. The *missim* assemblage includes five species, *C. missim* n. sp., *C. ialibu* n. sp., *C. purari* n. sp., *C. collessi* n. sp., *C. kamulai* n. sp., all from New Guinea.

Chaetogonopteron ialibu Bickel n. sp.

Figures 28-29

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Southern Highlands Province: Ialibu, 2600 m, 8-14. IV.1968, J. L. Gressitt & T. Maa (BPBM). Paratypes, **Papua New Guinea**. 3 ♀, same information as holotype (BPBM).

ETYMOLOGY — The specific epithet, *ialibu,* is a place name and a noun in apposition.



FIGURES 28-35

Chaetogonopteron ialibu n. sp.; **28**, male habitus, left lateral; **29**, male postabdomen and leg III, left lateral. *C. missim* n. sp.; **30**, male habitus, left lateral; **31**, male wing, dorsal; **32**, male tarsus III, left lateral. *C. purari* n. sp.; **33**, male wing and leg I, left lateral; **34**, male postabdomen, right lateral; **35**, male tibia and tarsus III, left lateral. Scale bars, 28: 2.0 mm; 30, 31: 1.0 mm; 29, 33, 35: 0.5 mm; 32, 34: 0.2 mm.

DESCRIPTION — ***Male***. Body length: 3.7 mm; wing: 4.7 x 1.3 mm; similar to *C. missim* except as noted.

Head. Scape, pedicel and postpedicel yellow with apex of postpedicel brown.

Thorax. Scutellum metallic blue dorsally with only lateral margins yellow.

Legs. All coxa and remainder of legs mostly yellow with black posterobasal spot on CII; I: 5.6; 5.5; 5.0/ 1.3/ 1.0/ 0.4/ 0.4; TI very short ad setal serration from 2/5 to 7/8, ventral at 2/5, posterior seta at 1/2, and subapically; distal It_1 with 4 ventral erect hairs on distal half (MSSC); II: 6.8; distal podomeres missing; FII with strong anterior and weaker posterior subapical setae; III: 7.5; 10.9; 0.7/ 0.9/ 2.9/ 1.3/ 0.4; FIII with strong anterior but lacking posterior subapical setae; TIII with ad seta at 1/8, 1/3, and 2/5, short dorsal seta at 1/3 and 2/3, and subapical ad seta; $IIIt_1$ with strong curved white ventral seta (MSSC); $IIIt_2$ with simple decumbent clidium, white and decumbent, short setae (Figure 29).

Wing. (Figure 28) Hyaline; R_{4+5} and M gradually diverging from base to join of dm-cu, and subparallel distally, with M joining margin slightly posteriad of apex; crossvein dm-cu crossvein greatly extended distally and bending anteriorly to join vein M at a right angle (MSSC); distal CuA short; ratio of straight line connecting ends of dm-cu/ distal CuA: 1.7; lower calypter yellow with fan of black setae; halter yellow.

Abdomen. Tergites and sternites mostly yellow; but tergites 2-6 with brown anterior and posterior bands, and with narrow brown mid-dorsal band along tergites; tergites 1-6 each with short black vestiture and posterior row of setae; sternite 8 brown; hypopygium subtriangular, tapering distally; epandrium mostly dark brown; hypandrium yellow; surstylus rounded subrectangular; cercus yellow subtriangular but narrowed distally, with pale yellow vestiture.

Female. Similar to male except lacking MSSC and as noted: face wider; tarsus I and III unmodified; wing with veins R_{4+5} and M subparallel, crossvein dm-cu straight unmodified.

REMARKS — *Chaetogonopteron ialibu* is known only from the Southern Highlands Province, Papua New Guinea, at an elevation of 2600 m. The male wing is distinctly longer than the body, and the dm-cu crossvein is greatly extended distally and bending anterodistally to join vein M at a right angle.

Chaetogonopteron missim Bickel n. sp.

Figures 30-32

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Province: Mt Missim, Wau, 7° 15'S, 146° 48'E, 1500 - 1600 m, 7.I.1970, M. Sedlacek (BPBM). Paratypes, **Papua New Guinea**. ♂, 2 ♀, same information as holotype but 1900 m, 10-15.V.1967, G. A. Samuelson; ♂, 2 ♀, 950 - 1300 m, 9.V.1967, J. L. Gressitt; 3 ♀, 2400-2800 m, 22-30.IV.1968, J. L. Gressitt & R. C. A. Rice; 4 ♀, 2300-2370 m, 10.V.1967, J. L. Gressitt (all BPBM).

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. Central Province: ♂, Woitape, Wharton Range, 10.X.1963, D. K. McAlpine (AMS). Morobe Province: ♂, ♀, Mt Chapman, 7° 19'S, 146° 48'E, 2000 m, 5.V.1966, J. L. Gressitt (BPBM); 2 ♂, Upper Watut, 1800 - 2200 m, 2.V.1968, J. L. Gressitt (BPBM); ♂, Kuper Range, 7° 31'S, 146° 49'E, 2200 m, 31.X.1996, M. Moulds (AMS). Oro (Northern) Province: 2 ♂, Myola II, 2200 m, 3.VI.1984, C. Young & J. Ismay (AMS).

ETYMOLOGY — The specific epithet, *missim,* is a place name and a noun in apposition.

DESCRIPTION — ***Male***. Body length: 2.7-2.8 mm; wing: 3.3 x 1.1 mm.

Head. Scape and pedicel yellow with brownish postpedicel, pedicel with short dorsal seta; postpedicel subtriangular, about as long as wide.

Thorax. Dorsum and pleura entirely yellow except with shining metallic blue reflections across mesonotum, scutellum dorsally metallic blue with broad yellow margin.

Legs. All coxa and remainder of legs mostly yellow with black posterobasal spot on CII; leg vestiture mostly black; I: 4.2; 4.0; 3.0/ 1.6/ 1.2/ 0.6/ 0.3; FI bare except for short subapical pv seta; TI short ad setal serration from 2/5 to 7/8; distal It_1 and all It_2 with ventral row of short erect setae (MSSC); II: 5.3; 6.7; 3.2/ 1.6/ 1.0/ 0.6/ 0.3; FII with strong anterior and weaker posterior subapical setae; TII with strong ad at 3/10 and 2/3, pd at 1/8, ventral at 3/5, and apical circlet of ad, anterior, av, pv and pd seta; III: 5.4; 6.9; 0.5/ 0.8/ 1.7/ 1.0/ 0.2; FIII with strong anterior and with but lacking posterior subapical setae; TIII rather bare of major setae, with only short dorsal seta and 1/3 and 2/3, and with short ventral seta at 1/2; $IIIt_1$ with strong curved white ventral seta (MSSC); $IIIt_2$ with simple white decumbent clidium, with short setae (Figure 32).

Wing (Figure 31). Hyaline; R_{4+5} and M gradually diverging from base to wing apex, with R_{4+5} joining costa near 7/8, and M joining margin posteriad of apex (MSSC); crossvein dm-cu strongly sinuate with anterior crossvein bulging distally (MSSC); ratio of straight line connecting ends of dm-cu/ distal CuA: 0.9; lower calypter yellow with fan of black setae; halter yellow.

Abdomen. Tergites and sternites mostly yellow; but tergites 2-6 with brown anterior and posterior bands, and with narrow brown mid-dorsal band along tergites; tergites 1-6 each with short black vestiture and posterior row of setae; sternite 8 dark brown; hypopygium subtriangular, tapering distally; epandrium mostly dark brown; hypandrium yellow; surstylus rounded subrectangular; cercus subtriangular but narrowed distally, with pale yellow vestiture.

Female. Similar to male except lacking MSSC and as noted: face wider; tarsus I and III unmodified; wing with veins R_{4+5} and M subparallel; crossvein dm-cu straight.

REMARKS — *Chaetogonopteron missim* is common between 950 and 2800 m on Mt Missim, Wau district, and from elevations around 2000 m, at Mt Chapman, Upper Watut, and the Kuper Range, all in Morobe Province. It is also known from near Myola at 2200 m in Oro Province, Papua New Guinea. The male wing has a strongly sinuate crossvein dm-cu, as well as an elongate distal vein CuA.

Chaetogonopteron purari Bickel n. sp.

Figures 33-35

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Gulf Province: Wabo, Purari River, 18- 22.VIII.1978, Malaise trap, edge of secondary rainforest; E. N. Marks (QDPI, deposited QMB).

ADDITIONAL MATERIAL EXAMINED —Indonesia. West Papua Province: ♂, Fak Fak, Bomberi, 6.VI.1969, Gressitt & Mag (BPBM). Papua New Guinea: Western Province: ♂, Star Mtns, Camp 1, 5° 13′S, 141° 14′E, 950-1200 m, II-III.2013, yellow pans, C. Muller (AMS).

ETYMOLOGY — The specific epithet, *purari,* is a place name and a noun in apposition.

DESCRIPTION — ***Male***. Body length: 2.8 mm; wing: 3.0 x 0.9 mm; similar to *C. missim* except as noted.

Legs. All coxa and remainder of legs mostly yellow with black posterobasal spot on CII; I: 4.0; 3.8; 2.1/ 1.0/ 0.6/ 0.4/ 0.3; TI short ad setal serration from 1/2 to 5/6; tarsus I unmodified; II: 4.7; 5.7; 3.0/ 1.3/ 0.8/ 0.4/ 0.3; FII with strong anterior and weaker posterior subapical setae; TII with strong ad at 1/6, 3/8, and 2/3, weaker pd at 1/8, short ventrals at 1/2 and 3/4, and apical circlet of ad, anterior, av, pv and pd setae; III: 5.0; 6.5; 0.5/ 0.8/ 1.7/ 1.0/ 0.3; FIII with strong anterior subapical set and weaker pv subapical seta; TIII with ad seta at 1/8, 1/4, and ½, short dorsal seta at 1/3 and 2/3, and subapical ad seta; $IIIt_1$ with strong curved white ventral seta (MSSC); $IIIt_2$ with simple elongate clidium, white and truncate (Figure 35).

Wing (Figure 33). Hyaline and narrowed, with posterior margin of distal third slightly indented and apex almost falcate, with longer hairs along margin (MSSC); R_{4+5} and M gradually diverging from base to join of dm-cu, and subparallel distally, with M joining margin distinctly anteriad of apex (MSSC); crossvein dm-cu strongly sinuate with anterior crossvein bulging distally (MSSC); distal CuA short; ratio of straight line connecting ends of dm-cu/ distal CuA: 1.8; lower calypter yellow with fan of black setae; halter yellow.

Abdomen. Tergites and sternites mostly yellow; but tergites 2-6 with brown anterior and posterior bands, and with narrow brown mid-dorsal band along tergites; tergites 1-6 each with short black vestiture and posterior row of setae; sternite 8 yellow; hypopygium (Figure 34) subtriangular, tapering distally; epandrium mostly yellow, surstylus brown; hypandrium yellow; surstylus rounded subrectangular; cercus subtriangular but narrowed distally, with pale yellow vestiture.

Female. Unknown.

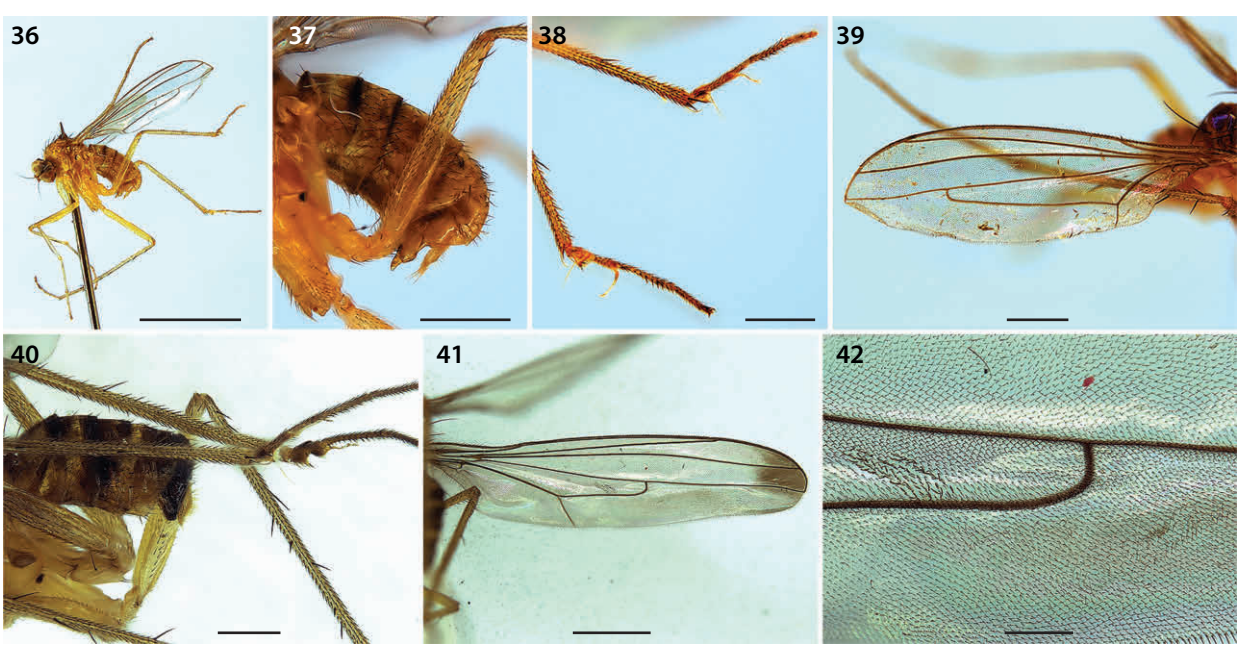
REMARKS — *Chaetogonopteron purari* is known from three distant localities in New Guinea, nr Fak Fak in West Papua and Wabo in Gulf Province, Papua New Guinea (both lowland) and the Star Mountains (950-1200 m) in Western Province. The male wing is elongate and relatively narrow, and it has a distinctly sinuate crossvein dm-cu, not unlike that of *C. missim,* but the distal posterior wing margin is indented, making the wing appear almost falcate.

Chaetogonopteron collessi Bickel n. sp.

Figures 36-39

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. East Sepik Province: Maprik, 21.III.1964, D. H. Colless (ANIC). Paratype, **Papua New Guinea**. ♂, same information as holotype (ANIC).

ETYMOLOGY — This species is named after the Australian dipterist Don Colless, who collected the known material of this species.



FIGURES 36-42

Chaetogonopteron collessi n. sp.: **36**, male habitus, left lateral; **37**, male postabdomen, left lateral; **38**, male leg III, left lateral; **39**, male wing, dorsal. *C. kamulai* n. sp.: **40**, male postabdomen and legs III, left lateral; **41**, male wing dorsal; **42**, male wing, detail. Scale bars, 36: 2.0 mm; 41: 1.0 mm; 37, 38, 39, 40: 0.5 mm; 42: 0.2 mm.

DESCRIPTION — ***Male***. Body length: 2.8 mm; wing: 3.3 x 0.8 mm; similar to *C. missim* except as noted.

Thorax. Scutellum dorsally metallic blue with broad yellow margin.

Legs. All coxa and remainder of legs mostly yellow with black posterobasal spot on CII;

I: 4.5; 4.0; 3.4/ 1.6/ 1.0/ 0.6/ 0.3; FI with short subapical pv seta; TI with ad setal serration from 2/3 to 7/8, otherwise bare; It_1 with short ventral seta at ¾ (MSSC); II: 5.3; 7.6; 3.2/ 1.8/ 1.1/ 0.6/ 0.3; FII with strong anterior and weaker posterior subapical setae; TII with strong ad-pd setal pair at 1/8, ad at 3/10 and 2/3, weak pd seta at 3/5, l pd at pd at 1/8, ventral at 3/5, and apical circlet of ad, anterior, av, pv and pd seta; III: 5.4; 7.0; 0.6/ 0.8/ 1.7/ 1.0/ 0.2; FIII with strong anterior and with weaker posterior subapical setae; TIII rather bare of major setae, with short ad setae at 1/5, anterior seta at ½, and apically, and some short dorsal setae; $IIIt_1$ with strong curved white ventral seta (MSSC); $IIIt_2$ with simple decumbent clidium, white and decumbent, short setae (Figure 38).

Wing. (Figure 39) Elongate, hyaline; R_{4+5} and M gradually diverging from base to wing apex, and subparallel in distal half of wing; with M joining in margin just anteriad apex (MSSC); crossvein dm-cu crossvein greatly prolonged distally of more than half wing length (MSSC), and bending anteriorly to join vein M at a right angle (MSSC); distal CuA very short, joining wing margin directly from posterior join with dm-cu; ratio of straight line connecting ends of dm-cu/ distal CuA: 7.0; lower calypter yellow with fan of brown setae; halter yellow.

Abdomen. Tergites and sternites mostly yellow; tergites 1-6 each with short dark brown vestiture and posterior row of setae; sternite 8 and hypopygium yellow; hypopygium (Figure 37) subtriangular, tapering distally; surstylus rounded subrectangular with short yellow distal setae; cercus subtriangular but narrowed distally, with pale yellow vestiture.

Female. Unknown.

REMARKS — *Chaetogonopteron collessi* is known only from Maprik (possibly near 200 m elevation), East Sepik Province, Papua New Guinea. The male wing has a greatly prolonged crossvein dm-cu of more than half wing length, and the distal CuA is very short, meeting the wing margin directly from the posterior join with dm-cu, and with a CuAx ratio of 7.0, the highest I have seen in the Dolichopodidae.

Chaetogonopteron kamulai Bickel n. sp.

Figures 40-42

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Central Province: nr Kamulai, 2000 m, 2.IV.1983, J. W. Ismay (AMS).

ETYMOLOGY — The specific epithet, *kamulai,* is a place name and a noun in apposition.

DESCRIPTION — ***Male***. Body length: 3.4 mm; wing: 5.0 x 1.2 mm; similar to *C. missim* except as noted.

Thorax. Scutellum dorsally metallic blue with only lateral margins yellow.

Legs. All coxa and remainder of legs mostly yellow; I: 6.1; 6.0; 5.5/ 1.3/ 0.9/ 0.4/ 0.3; TI with posterior seta at 1/3, dorsal seta at 2/5 and with short ad setal serration from ½ to 4/5;

II: 8.0; 11.7; 5.2/ 2.3/ 1.5/ 0.8/ 0.5; FII with strong anterior and weaker posterior subapical setae; TII with strong ad setae at 1/6, 1/3, and 2/3, pd setae at 1/10, ¼, and 2/3, shorter ventral and 2/5 and 5/6, and apical circlet of ad, anterior, av, pv and pd seta; III: 8.5; 11.5; 0.6/ 0.7/ 2.7/ 1.1/ 0.8; FIII with strong anterior but lacking posterior subapical setae; TIII with strong ad at ¼ and 3/5, some short dorsal setae, and short subapical anterior seta; $IIIt_1$ with strong curved white ventral seta (MSSC); $IIIt_2$ with simple white decumbent clidium, with some short setae (Figure40).

Wings. (Figure 41) Distinctly prolonged, mostly hyaline but with distinct brown apical spot covering anterodistal sixth (MSSC); R_{4+5} and M gradually diverging from base, and subparallel beyond dm-cu crossvein to wing apex, with R_{4+5} joining costa anteriad of wing apex, and M joining costa posteriad of apex (MSSC); distal cell M with modified

microtrichia (Figure 42) (MSSC); crossvein dm-cu prolonged distally with right angle bend joining vein M; ratio of straight line connecting ends of dm-cu/ distal CuA: 2.2; lower calypter yellow with fan of brown; halter yellow.

Abdomen. Tergites and sternites mostly yellow; but tergites 2-6 with brown anterior and posterior bands, and with narrow brown mid-dorsal band along tergites; tergites 1-6 each with short black vestiture and posterior row of setae; sternite 8 dark brown; hypopygium subtriangular (Figure 37), tapering distally; epandrium mostly dark brown; hypandrium yellow; surstylus rounded subrectangular; cercus yellow, elongate subrectangular, with external short brush of pale yellow setae.

Female. Unknown.

REMARKS — *Chaetogonopteron kamulai* is known only from 2000 m in Central Province, Papua New Guinea. The male wing is elongate with a distinctive brown spot on the distal sixth, and with a distally prolonged crossvein dm-cu.

THE *TRIBULOSUM* ASSEMBLAGE

REMARKS — Species in the *tribulosum* assemblage have male vein R_{4+5} joining costa near 5/6, and M gently sinuate, basally subparallel with R_{4+5}, and then curved posteriad to join margin just anteriad of apex (Figures 45, 50, 55) (MSSC). This venation varies from strongly slightly curved and sinuate (*C. astrorum*, Figure 60) to only weakly curved (*C. maneau*, Figure 52) to unmodified (*C. agovauae*, Figure 63). The clidium on $IIIt_2$ is simple digitiform and distally deflexed. The *tribulosum* assemblage includes seven species, *C. tribulosum* n. sp. from Australia, *C. parnabyi* n. sp. from the Solomon Islands, and *C. anacrostichum* (Meuffels & Grootaert), *C. maneau* n. sp., *C. astrorum* n. sp., *C. agovauae* n. sp., all from New Guinea, and *C. misamis* n. sp. from the Philippines.

Chaetogonopteron parnabyi Bickel n. sp.

Figures 43-45

TYPE MATERIAL — Holotype, ♂, **Solomon Islands**. New Georgia: Camp 1, 5 km NW of Patutiva, 8° 31' S, 157° 52'E, 50-100 m, 22-25.VI.1990, mixed primary and secondary rainforest, yellow pans, H. Parnaby (AMS). Paratypes. Solomon Islands. 14 ♂, 3 ♀, same information as holotype (AMS).

ADDITIONAL MATERIAL EXAMINED — Solomon Islands. Guadalcanal: ♂, Tambalia 30 km W of Honiara, 21.V.1964, Malaise trap, R. Straatmann. San Cristobal: ♂, Kira-Kira, 0-50 m, 5.XI.1964, light trap, R. Straatmann (BPBM).

ETYMOLOGY — This species is named for the mammologist Harry Parnaby who collected type series under difficult conditions.

DESCRIPTION — ***Male***. Body length: 2.6 mm; wing: 2.4 x 1.0 mm; similar to *C. tribulosum* except as noted.

Head. Scape and pedicel yellow with brownish postpedicel, pedicel with short dorsal seta; postpedicel subtriangular; arista dorsal.

Legs. All coxa and remainder of legs yellow except black posterobasal spot on CII; leg vestiture mostly black; I: 4.0; 3.8; 2.7/ 1.5/ 1.0/ 0.4/ 0.3; TI whitish (MSSC) and with short ad setal serration along distal half; II: 5.1; 5.5; 3.2/ 1.8/ 1.1/ 0.5/ 0.3; FII with strong anterior and weaker posterior subapical setae; TII and IIt_1 white (MSSC); TII with ad-pd pair at 1/8, ad setae at 1/4 (strong) and 3/5 (weaker), with row of short av setae along distal two-thirds (MSSC), and apical circlet of ad, anterior, av, pv and pd seta; III: 5.4; 6.0; 0.4/ 0.8/ 2.3/ 1.2/ 0.4; III with strong anterior and weaker subapical setae; TIII with ad setae at 1/5, 1/3 and ¾, some strong spaced dorsal setae; $IIIt_1$ with strong curved white ventral seta (MSSC); $IIIt_2$ with clidium simple, white and deflexed, with external seta near bend (Figure 44).



FIGURES 43-49

Chaetogonopteron parnabyi n. sp.: **43**, male habitus, left lateral; **44**, male postabdomen, and tarsus III, left lateral; **45**, male wing, dorsal. *C. tribulosum* n. sp.: **46**, male postabdomen and legs III, left lateral; **47**, male wing dorsal; **48**, female, left lateral; **49**, female oviscapt, left lateral. Scale bars, 48: 1.0 mm; 43, 45, 46, 47: 0.5 mm; 49: 0.2 mm.

Wing (Figure 45). Hyaline but with smoky infuscation on distal third; R_{4+5} and M diverging from base to level of dm-cu crossvein, R_{4+5} joining costa near 5/6, and M gently sinuate, subparallel basally with R_{4+5}, and then curved to join margin anteriad of apex (MSSC); CuAx ratio: 0.7; lower calypter yellow with fan of black setae; halter yellow.

Abdomen. Mostly yellow with short brownish vestiture; sternite 8 yellow; hypopygium pyriform and almost entirely yellow (Figure 44); epandrial setae arising from ventral margin; surstylus rounded capitate, with strong curved dark brown claw-like projection; cercus subtriangular but narrowed distally into digitiform projection, and with pale yellow vestiture.

Female. Similar to male except MSSC and as noted: face wider; TI, TII and IIt_1 whitish; TII without av row of setae, and TII with strong ventral setae at ¼ and 2/3; IIIt unmodified; wing with veins R_{4+5} and M subparallel.

REMARKS — *Chaetogonopteron parnabyi* is known from the islands of New Georgia, San Cristobal and Guadalcanal, Solomon Islands. This species is very close to *C. tribulosum* with similar venation, but it has an entirely yellow sternite 8, and the male wing is slightly infuscated on the distad third and tibia II has a row of short av setae along the distal two-thirds.

Chaetogonopteron tribulosum Bickel n. sp.

Figures 46-49

TYPE MATERIAL — Holotype, ♂, **Australia**. Queensland: Cape Tribulation, 16°07'S,145°26'E, 11-27. III 2000, yellow pans & ground and canopy Malaise traps, R. Kitching (AMS). Paratypes, **Australia**. 29 ♂, 49 ♀, same information as holotype (AMS).

ADDITIONAL MATERIAL EXAMINED — Australia. Queensland: 3 ♂, 7 ♀, Mt Webb Nat. Park, 15°03'145°09'E, 28-29.IX.1980, 29.IV.1981, Malaise trap, D.H. Colless (ANIC); 14km ENE of Heathlands, 11°41'S 142'42°E" 21.I-19.II.1994, Malaise trap, P. Zborowski (ANIC); ♂, Mission Beach, S1, 17°52'S 146°04'E, 40 m, 4.XII.1995- 2.I.1996, Malaise, M. Cermak (ANIC); 1 km WNW of Cape Tribulation 16°04'S,145°28'E, 28.II-27.III.1996, Malaise, P. Zborowski (ANIC); ♂, Cedar Bay Nat. Park, Gap Creek, 5km ESE of Mt. Finnigan, 15°50'S 145°20'E", 150 m, rainforest along rocky stream,14-15. IV.1994, yellow pans, D. Bickel (AMS); 7 ♂, 3 ♀, Tully Gorge SF, Tully River, 17°46'S 145°36'E, 175 m, rainforest, 10.IV.1994, yellow pans, D. Bickel (AMS). Papua New Guinea. Bougainville Province: ♂, Bougainville Is., Kokuro, 690 m, 16.VI.1956 (BPBM). Central Province: ♂, Don Estate, 50 miles W of Port Moresby, 8.VII.1986, R. Hornabrook (ANIC); ♂, 30km SE of Port Moresby, 26.I.1985, J.W. Ismay (AMS). Eastern Highlands Province: 9 ♂, 7 ♀, Okapo, Okasa, pine [= Agathis sp.?] forest, 1360 m, 14-15.XII.1954, R Hornabrook (ANIC). Madang Province: ♂, Mis, 5°15'30"S, 145°4'00"E, 29.VI-2.VII.1999, yellow pans, R. Kitching (AMS). Morobe Province: ♂, Lae, Oomsis, 6° 40'S, 146° 48'E, yellow pans, 22.VII.2000, R. Kitching (AMS). Western Province: ♂, Rouna, 300-500 m, XI.1968, N. H. L. Krauss (BPBM).

ETYMOLOGY — The specific epithet, *tribulosum,* is from Latin meaning "of trouble." The Cape Tribulation type locality is where Captain Cook's ship *Endeavour* ran onto a coral reef, and he named the nearby land Cape Tribulation because "here begun all our troubles".

DESCRIPTION — ***Male***. Body length: 2.5-2.6 mm; wing: 2.6-2.7 x 1.1 mm.

Head. Vertex and frons metallic blue with some grey pruinosity; scape and pedicel yellow with postpedicel brownish, postpedicel subtriangular, about as long as wide.

Thorax. Dorsum and pleura entirely yellow except for shining metallic blue area on mesonotum, extending caudally from level of second anteriormost dc and extending almost to lateral mesonotal margin; scutellum metallic blue anterobasally but with broad yellow margin.

Legs. All coxa and remainder of legs mostly yellow except where noted and with black posterobasal spot on CII; I: 3.7; 3.8; 2.5/ 1.2/ 1.0/ 0.2/ 0.2; TI and IIt_1 white; TI short ad setal serration along distal half; II: 4.5; 5.0; 3.4/ 1.8/ 1.2/ 0.7/ 0.3; FII with strong anterior and weaker posterior subapical setae; TII and IIt_1 white; TII with ad-pd pair at 1/8, ad setae at 1/4 (strong) and 3/5 (weaker), and without av row of short setae, and apical circlet of ad, anterior, av, pv and pd seta; IIt_1

with some short ventral setulae; III: 5.0; 5.9; 0.5/ 1.0/ 2.0/ 1.1/ 0.2; FIII with strong anterior and weaker posterior subapical setae; TIII with ad setae at 1/4, and ¾, some strong spaced dorsal setae; $IIIt_1$ with strong curved white ventral seta (MSSC); $IIIt_2$ with simple clidium, white and deflexed, with external seta on stalk and seta near bend (Figure 46).

Wings. (Figure 42) Hyaline but only faintly infuscated distally; R_{4+5} and M diverging from base to level of dm-cu crossvein, R_{4+5} joining costa near 5/6, and M gently sinuate, subparallel basally with R_{4+5}, and then curved to join margin anteriad of apex (MSSC); CuAx ratio: 0.7; lower calypter yellow with fan of black setae; halter yellow.

Abdomen. Mostly yellow with short brownish vestiture; sternite 8 dark brown with violet reflections; hypopygium pyriform and almost entirely yellow (Figure 46); epandrial setae arising from ventral margin; surstylus rounded capitate, subtended by strong curved dark brown claw-like projection along ventral margin ; cercus subtriangular but narrowed distally into digitiform projection, and with pale yellow vestiture.

Female (Figure 48). Similar to male except lacking MSSC and as noted: face wider; TI and TII entirely yellow; female TII with strong ventral setae at ¼ and 2/3, and with strong ad at 2/3; IIIt unmodified; wing with veins R_{4+5} and M subparallel.

REMARKS — *Chaetogonopteron tribulosum* occurs in northern Queensland, from the Cairns district to the Torres Strait Islands, Papua New Guinea, and Bougainville Island, all from lowland elevations less than 1400 m. In some locales it appears to be common.

The male wing has veins M and R_{4+5} are distinctively curved and tibiae I and II are white in both sexes (MSSC). The New Guinea specimens (wing length 2.6) are slightly larger than those from Queensland (wing length 2.4). Male sternite 8 of the male (covering the hypopygial foramen) is dark brown with metallic violet reflections while in *C. parnabyi* sternite 8 is yellow. Unlike in *C. parnabyi*, ventral setae are absent on tibia II.

Chaetogonopteron anacrostichum (Meuffels & Grootaert), 1987

Figures 50-51

Sympycnus anacrostichus Meuffels & Grootaert, 1987: 341.
Chaetogonopteron anacrostichum – Meuffels & Grootaert 1997: 253.

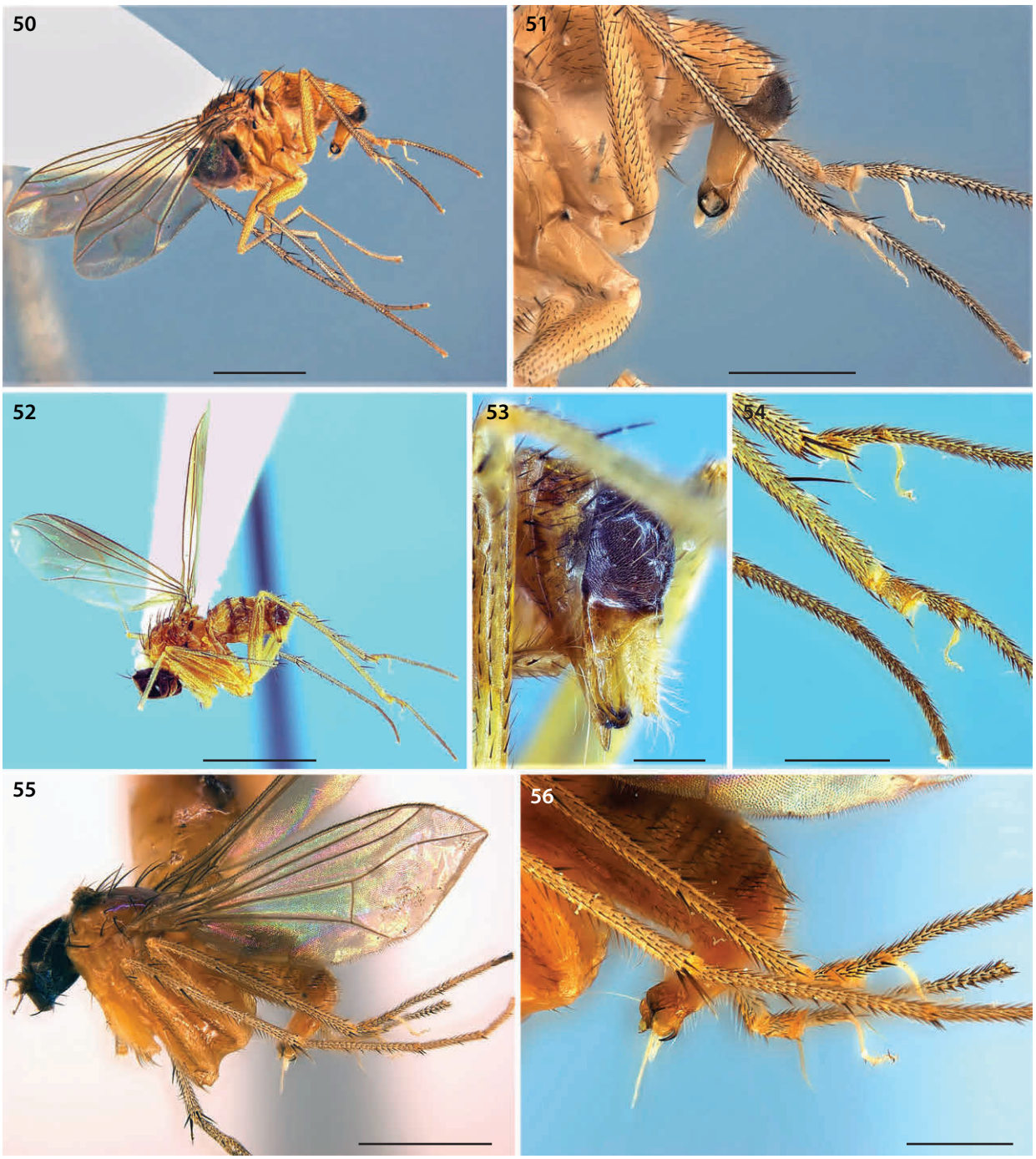
TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Madang Province (IRSN). Paratype, **Papua New Guinea**. ♂, same information as holotype (IRSN). [not examined]

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea: Madang Province: ♂, ♀, Ohu, 5°12'30"S, 145°4'00"E, 150-200 m, 30.VI-4.VII.1999, yellow pans, R. Kitching (AMS).

DIAGNOSIS — ***Male***. Body length: 2.4 mm; wing: 2.6 x 1.0 mm; similar to *C. tribulosum* except as noted.

Legs. All coxa and remainder of legs mostly yellow except where noted; I: 3.7; 3.8; 3.0/ 1.2/ 1.0/ 0.3/ 0.2; TI and IIt_1 white; TI with short ad setal serration from 1/3 to 7/8; II: 4.9; 6.0; 3.3/ 1.8/ 1.2/ 0.7/ 0.3; FII with strong anterior and weaker posterior subapical setae; TII and IIt_1 white; TII with ad-pd pair at 1/8, ad setae at 1/4 (strong) and 3/5 (weaker), and without av row of short setae, and apical circlet of ad, anterior, av, pv and pd seta; IIt_1 with some short ventral setulae; III: 5.0; 6.0; 0.6/ 1.0/ 2.2/ 1.3/ 0.3; FIII with strong anterior and weaker posterior subapical setae; TIII with ad setae at 1/4, and ¾, some strong spaced dorsal setae; anterior surface of $IIIt_1$ and $IIIt_2$ concave with smooth white surface; $IIIt_1$ with strong curved brown ventral seta (MSSC); $IIIt_2$ with clidium simple, white and deflexed, with external seta externally on stalk and seta near bend and complex apical seta (Figure 51).

Wing (Figure 50). Hyaline; R_{4+5} and M diverging from base to level of dm-cu crossvein, R_{4+5} joining costa near 5/6, and M sinuate, subparallel basally with R_{4+5}, and then with gentle curve to join margin anteriad of apex (MSSC); CuAx ratio: 1.0.



FIGURES 50-56

Chaetogonopteron anacrostichum (Meuffels & Grootaert): **50**, male habitus, left lateral; **51**, male postabdomen, and leg III, left lateral. *C. maneau* n. sp.: **52**, male habitus, left lateral; **53**, male hypopygium, left lateral; **54**, basal tarsal segments, male leg III. *C. misamis* n. sp.: **55**, male habitus, left lateral; **56**, male hypopygium and leg III basal tarsal segments, left lateral. Scale bars, 50, 55: 1.0 mm; 52: 2.0 mm; 51, 54, 56: 0.5 mm; 53: 0.2 mm.

Abdomen. Mostly yellow with short brownish vestiture; sternite 8 dark brown with violet reflections; hypopygium subrectangular and mostly yellow (Figure51); epandrial setae arising from ventral margin; surstylus with lateral yellow lobe, with exposed median black curved claw-like dorsal and ventral projections joined almost pincer-like apically; cercus elongate subtriangular but narrowed distally into digitiform projection, and with pale yellow vestiture.

Female. Similar to male except MSSC and as noted: face wider; TII with strong ventral setae at ¼ and 2/3, and with strong ad at 2/3; IIIt unmodified; wing with veins R_{4+5} and M subparallel.

REMARKS — *Chaetogonopteron anacrostichum* is known only from lowland Madang Province, Papua New Guinea. It is close to *C. tribulosum* except it has a very gentle bend in the distal part of vein M, and the distal area of the surstylus is not well developed, leaving the two curved spinelike surstylar projections exposed.

Chaetogonopteron maneau Bickel n. sp.

Figures 52-54

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Milne Bay Province, Mt. Dayman, Maneau Range, North Slope No.5, 1550 m, 30.VI-13.VII.1953, G. M. Tate (AMNH). Paratype, **Papua New Guinea**. ♀, same information as holotype (AMNH).

ETYMOLOGY — The specific epithet, *maneau,* is a place name and a noun in apposition.

DESCRIPTION — ***Male***. Body length: 3.2 mm; wing: 4.2 x 1.1 mm; similar to *C. tribulosum e*xcept as noted.

Head. Similar but antennae missing from specimens.

Legs. I: 5.0; 7.0; 3.8/ 1.8/ 1.2/ 0.6/ 0.5; TI whitish (MSSC), with strong pd seta near 1/2, strong subapical posterior seta, and with short ad setal serration along distal half; II: 6.0; 8.0; 4.5/ 2.5/ 1.6/ 0.7/ 0.4; FII with strong anterior and weaker posterior subapical setae; TII and IIt_1 white (MSSC); TII with strong offset ad-pd pair at 1/6, ad setae at 1/4 (strong) and 2/3 (weaker), strong ad at 3/5, and apical circlet of ad, anterior, av, pv and pd setae; III: 6.5; 9.1; 0.8/ 1.2/ 3.0/ 1.8/ 0.7; FIII with strong anterior and weaker posterior subapical setae; TIII with ad setae at 1/5, 1/3 and ¾, and 4 strong spaced dorsal setae; $IIIt_1$ with strong curved white ventral seta (MSSC); clidium simple, white and deflexed, without external setulae (Figure 54).

Wings. Hyaline with distinct smoky infuscation along anterodistal half of the wing (Figure 52) R_{4+5} and M diverging from base to level of dm-cu crossvein, R_{4+5} joining costa near 5/6, and M with very gradual approach to R_{4+5}, and with gentle curve to become subparallel with R_{4+5} in the distal tenth of wing (MSSC); CuAx ratio: 0.7; lower calypter yellow with fan of yellow setae; halter yellow.

Abdomen. Tergites mostly yellow but with dark brown posterior margins near tergal overlap; tergite 1 with some dark brown lateral setae, otherwise tergites with short brown vestiture; sternite 8 also dark brown; hypopygium pyriform, with epandrium brown basally but otherwise mostly yellow, and surstylus with dark brown apex (Figure53); epandrial setae arising from ventral margin; surstylus rounded digitiform, without strong curved claw-like projection; cercus yellow, elongate subtriangular, and with pale yellow vestiture.

Female. Similar to male except MSSC and as noted: face wider; legs all yellow; major leg setation similar but IIIt unmodified; wing hyaline with veins R_{4+5} and M subparallel.

REMARKS — *Chaetogonopteron maneau* is known only from the Maneau range at 1500 m, Milne Bay Province, Papua New Guinea. This species, with its wing length wing length of 4.2 mm is distinctly larger than other members of the *tribulosum* assemblage. The male wing is infuscated along the anterodistal half, and distal vein M has a rather gentle curve as compared with other members of the *tribulosum* assemblage.

Chaetogonopteron misamis Bickel n. sp.

Figures 55-56

TYPE MATERIAL — Holotype, ♂, **Philippines**. Mindanao: Misamis Oriental, Mt Balatukan, 15 km SW of Gingoog, 1000-2000 m, 27-30.IV.1960, at light, H. Torreville (BPBM).

ETYMOLOGY — The specific epithet, *misamis,* is a place name and a noun in apposition.

DESCRIPTION — ***Male***. Body length: 2.6 mm; wing: 2.4 x 1.0 mm; similar to *C. tribulosum* except as noted.

Legs. All coxa and remainder of legs yellow except where noted; I: 4.0; 4.2; distal leg I missing; TI whitish (MSSC) and with short ad setal serration along distal two-thirds; II: 5.8; 7.5; 4.0/ 1.5/ 2.0/ 1.2/ 0.8; FII with anterior and weaker posterior subapical setae; TII and IIt_1 white (MSSC); TII with ad-pd pair at 1/8, ad setae at 1/4 (strong) and 3/5 (weaker), weak pd seta at 3/5, with ventral row of short setae along distal three-quarters (MSSC), and apical circlet of ad, anterior, av (strong), pv and pd (strong) seta; IIt_1 with 5 short black spaced ventral setae along length; III: 6.0; 7.3; 0.6/ 0.8/ 2.2/ 1.0/ 0.6; FIII with strong anterior and weaker subapical setae; TIII with ad setae at 1/5, 1/3 and ¾, some strong spaced dorsal setae; $IIIt_1$ with strong curved white ventral seta (MSSC); clidium (Figure 56) simple, white and distally deflexed, with short setae.

Wings. (Figure 55) Hyaline; R_{4+5} and M diverging from base to level of dm-cu crossvein, R_{4+5} joining costa near 5/6, and M gently sinuate, subparallel basally with R_{4+5}, and then curved to join margin anteriad of apex (MSSC); CuAx ratio: 0.8; lower calypter yellow with fan of black setae; halter yellow.

Abdomen. Mostly yellow with short brownish vestiture; sternite 8 yellow; hypopygium subrectangular and slightly tapering, and almost entirely yellow (Figure56); epandrial setae arising from ventral margin; surstylus rounded capitate, almost encircled by both dorsal and ventral strong curved dark brown claw-like projections ; cercus pale yellow, subtriangular but narrowed distally into digitiform projection, and with pale yellow vestiture.

Female. Unknown.

REMARKS — *Chaetogonopteron misamis* is known from a single male collected in northern Mindanao, Philippines. It clearly belongs in the *tribulosum* assemblage, with its distinctive curved male vein M, the dorsal and ventral spine-like projections of the surstylus and the simple deflexed clidium, and it extends the range of the *tribulosum* assemblage to include both the Australasian and eastern Oriental zoogeographic regions.

Chaetogonopteron astrorum Bickel n. sp.

Figures 57-61

TYPE MATERIAL — Holotype, ♂, Papua New Guinea. Western Province: Star Mtns, Camp 1, 5° 13'S, 141° 14'E, 950-1200 m, II-III.2013, yellow pans, C. Muller (AMS). Paratype, **Papua New Guinea**. ♂, same information as holotype (AMS).

ETYMOLOGY — The specific epithet *astrorum* is from Latin meaning "of the stars," in reference to the Star Mountains type locality.

DESCRIPTION — ***Male***. Body length: 3.5 mm; wing: 3.2 x 1.3 mm; similar to *C. tribulosum* except as noted.

Head (Figure 58). Scape and pedicel yellowish; postpedicel triangular, about twice as long as wide.

Thorax. Dorsum and pleura mostly yellow with shining metallic blue area on mesonotum extending posteriorly from level of third anteriormost dc and mostly within area bordered by dc row, so lateral mesonotal margin yellow; scutellum metallic blue anterobasally but with broad yellow margin (Figure 58).



FIGURES 57-64

Chaetogonopteron astrorum n. sp.: **57**, male habitus, left lateral; **58**, male head and thorax, left anterior; **59**, clidium on male tarsus III, left lateral; **60**, male wing, dorsal; **61**, male hypopygium, left lateral. *C. agovauae* n. sp.: **62**, basal segments on male tarsus III, left lateral; **63**, male habitus, left lateral; **64**, male postabdomen, left lateral. Scale bars, 63: 1.0 mm; 57: 2.0 mm; 58, 60: 0.5 mm; 59, 61, 62, 64: 0.2 mm.

Legs. I: 3.8; 4.0; 2.7/ 1.3/ 1.0/ 0.3/ 0.2; TI white; TI short ad setal serration from 1/3 to almost to apex; II: 5.0; 6.2; 3.5/ 1.8/ 1.0/ 0.7/ 0.3; FII with strong anterior and weaker posterior subapical setae; TII and IIt_1 white; TII with ad-pd pair at 1/8, ad setae at 1/4 (strong) and 3/5 (weaker), strong dorsal at 3/4, strong pd near 2/3, short ventral near 2/3, without av row of short setae, and apical circlet of strong ad, anterior, av, pv and pd seta; III: 5.3; 6.5; 0.5/ 1.1/ 2.2/ 1.4/ 0.2; FIII with strong anterior and weaker posterior subapical setae; TIII with ad setae at 1/4, and 3/4, some strong spaced dorsal setae; $IIIt_1$ with strong curved white ventral seta (MSSC); $IIIt_2$ with simple clidium, white and only weakly deflexed with short white spatulate seta near base, with external setulae on stalk and subapically (Figure 59).

Wings. (Figure 60) Hyaline; R_{4+5} and M diverging from base to level of dm-cu crossvein, R_{4+5} joining costa near 9/10, and M strongly sinuate, approaching R_{4+5}, and then curved to join margin anteriad of apex (MSSC); CuAx ratio: 0.7; lower calypter yellow with fan of black setae; halter mostly yellow.

Abdomen. Almost entirely yellow with short brownish vestiture; sternite 8 yellow with short brown vestiture; hypopygium subrectangular and almost entirely yellow (Figure 61); epandrial setae arising from ventral margin; surstylus rounded, comprising yellow external capitate structure with dorsal triangular "beak", subtended medially with wider brown plate-like structure, with narrow curved spinzelike projection along outer margin of capitate head, and with strong brown claw-like projection along dorsal margin; cercus elongate digitiform, tapering distally, and with pale yellow vestiture.

Female. Unknown.

REMARKS — *Chaetogonopteron astrorum* is known from elevations of 850-1200 m in the Star Mountains, Western Province, Papua New Guinea. This species has the characteristic venation of the *tribulosum* assemblage, but is distinguished by the decidedly longer subtriangular postpedicel, limited extent of the metallic blue coloration on the mesonotum, and the distinctive surstylus as shown (Figure 61).

Chaetogonopteron agovauae Bickel n. sp.

Figures 62-64

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Madang Province: Mt Wilhelm, -5.7320° 145.2522°, 700 m, Malaise trap, 30-31.X.2012, P1441, Keltic, Uma, Novotny & Leponce (MNHN). Paratypes, **Papua New Guinea**. 2 ♂, ♀, same information as holotype; 9 ♂, same, but various dates between 15-25.V.2013, P735, P741, P744, P4754 (MNHN, AMS, BPBM).

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea: Morobe Province: ♂, Kamiali, 7° 10′ 33″S, 147° 08′ 03″E, 30 m, 3-4.XII.2015, yellow pans on forest creek, D. J. Bickel (AMS).

ETYMOLOGY — This species is named in honor of Sharon Agovaua, Papua New Guinea National Agricultural Research Institute, a member of the Our Planet Reviewed – Papua New Guinea expedition.

DESCRIPTION — ***Male***. Body length: 2.7 mm; wing: 3.6 x 1.3 mm; similar to *C. tribulosum* except as noted.

Legs. I: 4.7; 4.6; 3.3/ 1.8/ 1.2/ 0.6/ 0.5; TI and IIt_1 white (MSSC); TI short ad setal serration along distal half; II: 5.6; 7.1; 4.8/ 2.1/ 1.5/ 0.7/ 0.3; FII with strong anterior and weaker posterior subapical setae; TII and IIt_1 white (MSSC); TII with ad-pd setal pair at 1/8, ad setae at 1/4 (strong) and 3/5 (weaker), strong pd seta at 3/5 and much shorter ventral seta also at 3/5, without av row of short setae, and apical circlet of ad, anterior, av, pv and pd seta; IIt_1 with some short ventral setulae; III: 6.1; 8.1; 0.8/ 1.0/ 3.0/ 1.5/ 0.3; FIII with strong anterior and weaker subapical setae; TIII with ad setae at 1/4, and 3/4, four strong spaced dorsal setae, and strong av apical seta and weaker ventral apical seta; $IIIt_1$ with strong curved white ventral seta (MSSC); $IIIt_2$ with simple clidium simple, white and deflexed, with external seta on stalk and seta distad of bend (Figure 62).

Wing (Figure 63). Hyaline but only faintly infuscated distally; R_{4+5} and M diverging from base to level of dm-cu crossvein, and subparallel distad of crossvein with R_{4+5} bending posteriorly slightly just before joining costa anteriad of apex, with vein M straight to join margin at apex; CuAx ratio: 1.0; lower calypter yellow with fan of black setae; halter yellow.

Abdomen. Mostly yellow with short brownish vestiture; sternite 8 dark brown with violet reflections; hypopygium pyriform (Figure 64) and almost entirely yellow, except tips of surstylus dark brown; hypandrium extending beyond surstyli; pair of epandrial lobe setae present on ventral margin; surstylus narrow and divided into two subequal parallel arms, apically dark brown and deflexed; cercus subtriangular but narrowed distally into digitiform projection, and with pale yellow vestiture.

Female. Similar to male except lacking MSSC and as noted: face wider; legs entirely yellow; female TII with strong ventral setae at ¼ and 2/3, and with strong ad at 2/3; IIIt unmodified; wing similar.

REMARKS — *Chaetogonopteron agovauae* is known from Malaise trap samples collected near 700 m in the Bismarck Range, and from coastal Morobe Province, Papua New Guinea. Males of this species do not have the modified wing venation characteristic of other *tribulosum* assemblage species, but it is included in the assemblage based on overall similarity of the male clidium, head, thorax and leg characters (both setation, and white color of tibia I and II). This species could be a putative ancestral taxon that is sister to all other members of the *tribulosum* assemblage as defined by the modified male venation.

THE *ACRICAUDA* ASSEMBLAGE

REMARKS — Species in the *acricauda* assemblage have the distal surstyli heavily sclerotized and modified into strong beak-like projections, pointing dorsally or ventrally (Figures 66, 71). Wing veins R_{4+5} and M are closely parallel with each other beyond crossvein dm-cu. The *acricauda* assemblage includes two species, *C. acricauda* n. sp. from Australia and *C. hutuna* n. sp. from the Solomon Islands.

Chaetogonopteron acricauda Bickel n. sp.

Figures 65-68

TYPE MATERIAL — Holotype, ♂, **Australia**. Queensland: Shipton's Flat, 15°47'S 145°14'E, 17-18.X.1980, D. H. Colless (ANIC). Paratype, **Australia**. ♀, same information as holotype (ANIC).

ADDITIONAL MATERIAL EXAMINED — Australia. Queensland: 2 ♂, ♀, 3 km NE of Mt Webb, 15°03'145°09'E, 1-4.X.1980, yellow pan traps & Malaise trap, J. Cardale & D.H. Colless; ♂, ♀, same but 29.IV.1981, Malaise trap, D.H. Colless (ANIC); ♂, 14km ENE of Heathlands, 11°41'S 142'42°E", 9.IX-21.X.1993, Malaise trap, P. Zborowski (ANIC); 2 ♂, Spear Ck, 5.8 km N of Mt Molloy, 16° 37' 52" S 145° 19' 32" E, 405 m, 24-26.III.2007, rainforest creek, yellow pans, D. Bickel; ♂, 12 km SSE of Heathlands, 11° 51' S 142'38° E, 22.III-25.IV.1992, Malaise trap, T. McLeod; ♂, Mulgrave River, 6.6 km W of Gordonvale, 21.V.1966, D. K. McAlpine (AMS).

ETYMOLOGY — The specific epithet, *acricauda,* is from Latin meaning "pointed tail" and refers to the curved beaklike male hypopygium.

DESCRIPTION — ***Male***. Body length: 3.0 mm; wing: 3.6 x 1.3 mm.

Head. Vertex and frons shining metallic blue-green; antenna yellow with postpedicel infuscated; pedicel with short dorsal seta; postpedicel rounded, about as long as wide.



FIGURES 65-72

Chaetogonopteron acricauda n. sp.: **65**, male habitus, left lateral; **66**, male postabdomen, right lateral; **67**, male wing dorsal; **68**, male tarsus III, basal segments. *C. hutuna* n. sp.: **69**, male habitus, anterodorsal; **70**, male habitus, left lateral; **71**, male postabdomen, left lateral; **72**, male tarsus III, basal segments, left lateral. Scale bars, 67, 70: 1.0 mm; 65, 69: 2.0 mm; 71, 72: 0.5 mm; 66, 68: 0.2 mm.

Thorax. Dorsum and pleura entirely yellow except for shining metallic blue area on mesonotum, extending caudally from level of second anteriormost dc and extending almost to lateral mesonotal margin; scutellum metallic blue anterobasally but with yellow lateral margin.

Legs. All coxa and remainder of legs mostly yellow; I: 4.9; 4.7; 3.7/ 1.5/ 1.1/ 0.4/ 0.3; TI and IIt_1 white; TI short ad setal serration along distal two thirds; II: 6.0; 7.6; 4.0/ 2.0/ 1.3/ 0.6/ 0.4; FII with strong anterior and weaker posterior subapical setae; TII with strong ad seta at 1/6, 1/3, 2/3, pd at 1/8, and 1/2, ventral at 3/5, and subapical circlet of pd, ad and av (stronger) setae. III: 6.2; 8.2; 0.8/ 1.2/ 2.2/ 1.1/ 0.4; FIII with strong anterior and weaker posterior subapical setae; TIII with strong ad setae at 1/6, and 3/8, and 4-5 strong spaced dorsal setae, and subapical anterior, av and pv setae; $IIIt_1$ with strong curved white ventral seta (MSSC); $IIIt_2$ with simple clidium (Figure 68), white and distally deflexed, with some short curved setulae on distal deflexed area.

Wing (Figure 67). Hyaline; R_{4+5} and M diverging from base to level of dm-cu crossvein, but closely subparallel distally, with R_{4+5} joining costa near 5/6, and M joining margin anteriad of apex; CuAx ratio: 0.7; lower calypter yellow with fan of brown setae; halter yellow.

Abdomen. Mostly yellow with dark brown vestiture; tergite 1 with long setae along posterior margin; tergites 2-6 which short vestiture and each with row of longer posterior setae along margin; sternite 8 and hypopygium mostly yellow except where noted; hypopygium pyriform (Figure 66); epandrial setae arising from ventral margin; surstylar arms elongated, appressed and tapering to apical points, and deflexed into sharp dark brown "beak"; projecting phallus white; cercus pale yellow, elongate tapering, with whitish vestiture and slightly flexed.

Female. Similar to male except MSSC and as noted: face wider; legs entirely yellow; female TII with strong ventral setae at 1/4 and 2/3, and with strong ad at 2/3; IIIt unmodified.

REMARKS — *Chaetogonopteron acricauda* occurs on the Cape York Peninsula, Queensland, from the Cairns district northwards. The male wings are unmodified, and the tapering beak-like surstyli (Figure 66) is diagnostic.

Chaetogonopteron hutuna Bickel n. sp.

Figures 69-72

TYPE MATERIAL — Holotype, ♂, **Solomon Islands**. Rennell Island: Kagaba, 5 .IV.1965, Malaise trap, T. Wolff (ZMUC). Paratypes, **Solomon Islands**. ♂, ♀, same information as holotype; ♂, 2 ♀, same but Hutuna, 24.III.1965, 26.III.1965, 2.IV.1965; ♂, same but Niupani, 25.VIII.1962, Noona Dan Exp., 61-62 (ZMUC).

ETYMOLOGY — The specific epithet, *hutuna,* is a place name and a noun in apposition.

DESCRIPTION — ***Male***. Body length: 2.5 mm; wing: 3.0 x 1.1 mm.; similar to *C. acricauda* except as noted.

Thorax. Scutellum metallic blue anterobasally and with entire margin yellow.

Legs. I: 4.3; 4.1; 3.1/ 1.2/ 1.0/ 0.3/ 0.2; TI and IIt_1 white; TI with very weak ad setal serration along distal half; II: 5.7; 6.3; 3.8/ 2.0/ 1.2/ 0.5/ 0.4; FII with strong anterior and weaker posterior subapical setae; TII with strong ad seta at 1/5, 3/8 (very strong), and 3/4, pd at 1/8, and 3/5, and subapical circlet of pd, ad and av (stronger) setae. III: 5.2; 6.9; 0.8/ 1.2/ 2.2/ 1.0/ 0.3; FIII with strong anterior and weaker posterior subapical setae; TIII with strong ad setae at 1/6, and 3/8, and 4-5 strong spaced dorsal setae, and subapical anterior, av and pv setae; TIII also with closely spaced row of long even dorsal, anterior and av seta along length (MSSC); tarsus III (Figure 72): $IIIt_1$ with strong curved white ventral seta (MSSC), $IIIt_2$ with simple clidium, white and distally deflexed, with some short setulae on distal deflexed area, and $IIIt_3$ with strong ad seta at base.

Abdomen. Sternite 8 dark brown; hypopygium mostly yellow except where noted; hypopygium subrectangular (Figure 71); epandrial setae arising from ventral margin; ventral surstylar arm curved and wide, tapering to black apex,

and bent at right angle, with weaker dorsal arm also bent in opposite direction and tapering into black apex; projecting phallus white; cercus pale yellow, elongate tapering, with whitish vestiture and slightly flexed.

Female. Similar to male except lacking MSSC and as noted: face wider; female TII with strong ad setae at 1/5 and 3/8; TIII without long dorsal, anterior and av setae along length; IIIt unmodified.

REMARKS — *Chaetogonopteron hutuna* is known only from Rennell Island in the Solomon Islands. The male wings are unmodified, and the hypopygium with its sharp upturned surstyli (Figure 71) is diagnostic.

THE *TRICORNIGERUM* ASSEMBLAGE

REMARKS — Species in the *tricornigerum* assemblage have the tarsus III clidium short and apically U-shaped with three projections, one of these being a lobate outer arm (Figure 77). As well wing veins R_{4+5} and M are closely parallel beyond crossvein dm-cu. The *tricornigerum* assemblage includes two species, *Chaetogonopteron tricornigerum* (Meuffels & Grootaert) and *C. oomsis* n. sp., both from New Guinea.

Chaetogonopteron tricornigerum (Meuffels & Grootaert, 1987)

Figures 73-74

Sympycnus tricorniger Meuffels & Grootaert, 1987b: 344.
Chaetogonopteron tricornigerum – Meuffels & Grootaert 1997: 254.

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Madang Province: Bunapas, 3.VI.1982 (IRSN). Paratypes, **Papua New Guinea**. 5 ♀, same information as holotype (IRSN). [not examined]

ADDITIONAL MATERIAL EXAMINED — Indonesia. Papua: Ifar, W. Sentani, Cyclops Mtns., 200-1000 m, VII.1962, J. L. Gressitt (BPBM). Papua New Guinea: East Sepik Province: ♂, Maprik, 22.III.1964, D. H. Colless; ♂, ♀, Pagel, Sepik River, III.1964, D. H. Colless (ANIC). Madang Province: 3 ♂, 2 ♀, Wanang 3, -5.2277 145.0797, 175 m, yellow pans, 18-30.XI.2012, D. J. Bickel (MNHN); 6 ♂, 5 ♀, Mis, 5°15′30″S, 145°4′00″E, 29.VI-2.VII.1999, yellow pans, R. Kitching; 19 ♂, 13 ♀, Baitabag, 5° 07′30″S, 145°4′00″E, 25.VI-2.VII.1999, yellow pans, R. Kitching; 4 ♂, 7 ♀, Ohu, 5°15′30″S, 145°4′00″E, 4.VII.1999, yellow pans, R. Kitching. Sandaun (West Sepik) Province: ♂, May River, Patrol Stn, 100 m, J. L. Gressitt (BPBM).

DIAGNOSIS — ***Male***. Body length: 2.3 mm; wing: 2.6 x 0.8 mm.

Head. Frons metallic blue-green; palp and proboscis yellowish; scape and pedicel yellow, 1st flagellomere brown; subtriangular.

Thorax. Yellow except for cuticle with metallic green reflections occupying most of mesoscutum and scutellum; ac absent; 5 strong dc present; lateral scutellars present as tiny weak setae.

Legs. All coxae and femora mostly pale yellow, with all tibiae and basal tarsomeres white; TI with strong ad setal serration from 2/3 –7/8, otherwise leg I bare of major setae; TII with ad-pd pair at 1/8, ad setae at 1/4 (strong) and 3/5 (weaker), with weak pd seta at 3/5, and apical circlet of ad, anterior, av, pv and pd seta; FIII with strong anterior and weaker subapical setae; TIII with some short dorsal setae and curved apical ventral seta; $IIIt_1$ with curved white ventral seta; $IIIt_2$ clidium short and apically U-shaped with three projections, with outer arm longer.

Wing (Figure 73). Hyaline; vein M arching anteriorly just distad of crossvein dm-cu (MSSC) and joins costa near apex; vein CuA ending in membrane before reaching margin (MSSC); lower calypter yellow with fan of brown setae; halter yellow.

Abdomen. Mostly yellow but tergites 2 and 3 infuscated near midline; sternite 8 and epandrium dark brown, with pale yellow hypandrium and cercus; hypopygium (Figure 74); epandrial lobe bearing two long setae; surstylus lobate and simple, without curved claw-like projections; cercus short subtriangular.

Female. similar to male except lacking MSSC and as noted: face wider; tibiae and tarsi yellow; flattened; tibiae and tarsi also white; IIIt unmodified; wing with vein M not arched, and vein CuA reaching margin.

REMARKS — *Chaetogonopteron tricornigerum* occurs mostly in lowland sites across northern New Guinea, from Madang Province to Indonesian Papua. It is rather small-sized (wing length 2.6 mm). The male wing venation is diagnostic, with vein M arching anteriorly distad of crossvein dm-cu (MSSC) and vein CuA ending in the membrane before reaching the wing margin (MSSC).



FIGURES 73-77

Chaetogonopteron tricornigerum (Meuffels & Grootaert): **50**, male habitus, left lateral; **51**, male postabdomen, and legs III, left lateral. *C. oomsis* n. sp.: **75**, male habitus, left lateral; **76**, male postabdomen, and legs III, left lateral; **77**, basal tarsal segments, male leg III. Scale bars, 73, 75: 1.0 mm; 74, 76: 0.5 mm; 77: 0.2 mm.

Chaetogonopteron oomsis Bickel n. sp.

Figures 75-77

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Province: Lae, Oomsis, 6° 40'S, 146° 48'E, yellow pans, 22.VII.2000, R. Kitching (AMS). Paratype, **Papua New Guinea**. 97 ♂, 31 ♀, same information as holotype (ANIC, BPBM, MNHN).

ADDITIONAL MATERIAL EXAMINED — Papua New Guinea. Oro Province: ♂, Popondetta District, Buri, nr Sasambata, 30.X.1963, D. K. McAlpine (AMS).

ETYMOLOGY — The specific epithet, *oomsis,* is a place name and a noun in apposition.

DIAGNOSIS — ***Male***. length: 2.3 mm; wing: 2.6 x 0.8 mm.

Head. Frons metallic blue-green; palp and proboscis yellowish; scape and pedicel yellow, 1st flagellomere brown.

Thorax. Yellow except most of mesoscutum and scutellum with metallic green reflections; ac absent; 5 strong dc present; lateral scutellars present as tiny weak setae.

Legs. All coxae and femora mostly pale yellow, with all tibiae and basal tarsomeres white; CI and CII with black distolateral setae, CIII with black lateral seta subtended by weaker ventral seta; I: 3.3; 3.2; 2.5/ 1.0/ 0.8/ 0.5/ 0.4; TI with strong ad setal serration from 2/3 –7/8, otherwise leg I bare of major setae; II: 3.6; 4.3; 2.0/ 1.0/ 0.8/ 0.5/ 0.2; FII with anterior and weaker posterior subapical setae; TII with ad-pd pair at 1/8, ad setae at 1/4 (strong) and 3/5 (weaker), with weak pd seta at 3/5, and apical circlet of ad, anterior, av, pv and pd seta; III: 4.5; 6.0; 0.4/ 0.6/ 1.8/ 1.0/ 0.3; FIII with strong anterior and weaker subapical setae; TIII with some short dorsal setae and curved apical ventral seta; $IIIt_1$ with curved white ventral seta; $IIIt_2$ clidium (Figure 77) short and apically U-shaped with three projections, with outer arm longer.

Wings. Hyaline; R_{4+5} and M subparallel and slightly curved beyond dm-cu crossvein, with M joining costa near apex; CuAx ratio: 0.4; lower calypter yellow with fan of brown setae; halter yellow.

Abdomen. Mostly yellow but tergites 2 and 3 infuscated near midline; sternite 8 and epandrium dark brown, with pale yellow hypandrium and cercus; hypopygium (Figure 76); epandrial lobe bearing two long setae; surstylus lobate and simple, without curved claw-like projections; cercus short subtriangular.

Female. similar to male except lacking MSSC and as noted: face wider; tibiae and tarsi yellow; flattened; tibiae and tarsi also white; IIIt unmodified.

REMARKS — *Chaetogonopteron oomsis* is known from lowland sites in Morobe and Oro Provinces. It is very close to *C. tricornigerum*, and the two species are probable sister taxa. The primary difference between the two species are male wing characters. In *C. oomsis* the male venation is unmodified, so vein M does not arch distad of crossvein dm-cu, and vein CuA reaches the wing margin. By contrast, in male *C. tricornigerum,* the vein M arches anteriorly distad of crossvein dm-cu (MSSC) and vein CuA terminates in the membrane before reaching the wing margin (MSSC). I do not think these differences are intraspecific variation, as the two forms seem quite distinct, and all 97 males from the *C. oomsis* type locality showed the same fixed venation.

ACKNOWLEDGEMENTS

We thank the respective curators of these institutions for information and the loan of specimens. (AMS) - Derek Smith & Russell Cox; (ANIC) - Alan Landford; (BMNH) - John Chainey & Duncan Sivell; (BPBM) - Neal Evenhuis & Keith Arakaki; (MNHN) - Christophe Daugeron; (QDPI) - Brian Cantrell; (USNM) - Chris Thompson. Chris Muller contributed many fine specimens of Dolichopodidae collected in remote parts of Papua New Guinea. Natalie Tees constructed the plates in Photoshop. Stefan Naglis provided useful comments on a manuscript version of this paper. DJB thanks the organizers of the Our Planet Reviewed – Papua New Guinea expedition for the invitation to participate, especially Maurice Leponce via Patrick Grootaert, Vojtech Novotny for hospitality at the Binatang Institute, and numerous Our Planet Reviewed – Papua New Guinea expedition associates, parataxonomists and Binatang staff for a memorable experience. This study was conducted in the framework of "Our Planet Reviewed – Papua New Guinea 2012-2013" set up by Pro-Natura International, the Muséum national d'Histoire naturelle (MNHN, France), the Institut de Recherche pour le Développement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery. The IBISCA expert network, the patron for this project, Prof. R.L. Kitching AM, and all other participants in this collective effort are thanked for their contribution.

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Juvenile of *Aphroptera biroi* Bolívar, 1902 (Tettigonoiidae, Phaneropterinae) dwelling on low plants in lowland forest. While the adults are green, the juveniles of this species are very colourful and possess a remarkable defense behavior: when disturbed, the insects inflate his body, forming yellow membranous bubbles between the head and the pronotum and along the dorsal segments of the abdomen.
(Photo © Xavier Desmier; identification: Ming Kai Tan).

A new species of *Microsalomona* Karny (Orthoptera: Tettigoniidae: Conocephalinae: Agraeciini) from Mount Wilhelm, Papua New Guinea, and a key to species

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ABSTRACT

The island of New Guinea is a biodiversity hotspot and is extremely rich in its orthopteran fauna, which includes as many as 380 katydid species. However, owing to the large area and fragmentary sampling, many more species are still awaiting discovery. A new species of *Microsalomona* Karny, 1912 is described here from Mount Wilhelm, Papua New Guinea: *Microsalomona pulchra* n. sp. This new species differs from all known congeners by the head black and black colour patterns of the pronotum, shape of male cerci and slender titillators. It is the fourth species known from this genus endemic to New Guinea. A key to species is also provided.

RÉSUMÉ

Une nouvelle espèce de *Microsalomona* Karny (Orthoptères : Tettigoniidae : Conocephalinae : Agraeciini) du Mont Wilhelm, Papouasie-Nouvelle-Guinée, et clé d'identification des espèces.

L'île de Nouvelle-Guinée est un point chaud de la biodiversité qui possède une faune d'Orthoptères extrêmement riche, qui comprend jusqu'à 380 espèces de sauterelles. Toutefois, en raison de l'étendue de la région et de l'échantillonnage fragmentaire, de nombreuses espèces attendent encore d'être découvertes. Une nouvelle espèce de *Microsalomona* Karny, 1912 est décrite du Mont Wilhelm, Papouasie-Nouvelle-Guinée : *Microsalomona pulchra* n. sp. Cette nouvelle espèce diffère de tous les congénères connus par la couleur noire de la tête et de la partie dorsale du pronotum, la forme des cerques mâles et les titillateurs fins. C'est la quatrième espèce connue de ce genre endémique de Nouvelle-Guinée. Une clé d'identification des espèces est également fournie.

TAN M. K. & ROBILLARD T. 2020 — A new species of *Microsalomona* Karny (Orthoptera: Tettigoniidae: Conocephalinae: Agraeciini) from Mount Wilhelm, Papua New Guinea, and a key to species, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 459-471 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

INTRODUCTION

The island of New Guinea is a hyper-diverse biodiversity hotspot and has drawn many biologists to explore its fauna and flora, including the Orthopteran insects. At least 980 orthopteran species have been recorded in New Guinea from 15 families across the phylogeny (Cigliano *et al.* 2019). At least 380 species from ca. 80 genera of the family Tettigoniidae are also known from the island, although these numbers are probably underestimated. These include the Agraeciini katydids, which are commonly known as the spine-headed katydids. These katydids are extremely diverse in form and shapes and are generally predatory. The taxonomy of Asian Agraeciini has been revised thoroughly by a few major works, including Ingrisch (1998)'s monograph on Oriental Agraeciini and Willemse (1959)'s revision of the genus *Salomona* (Blanchard, 1853). Since then, a few studies on the Agraeciini from New Guinea were published (Naskrecki & Rentz 2010; Ingrisch 2008, 2009, 2015). Nonetheless, owing to the vast area and fragmentary sampling in New Guinea, many previously unknown species are still awaiting discovery.

Microsalomona Karny, 1912 was proposed based on one species from New Guinea: *M. brachyptera* Karny, 1912. The genus is similar to *Salomona* but differs by the following characters: habitus more slender and cylindrical; fastigium verticis longer, frons weakly rugose, pronotum usually smooth, femora with numerous spines, male phallus with paired titillators, female ovipositor slightly curved and shorter than hind femora. It remained monotypic for 98 years until Naskrecki & Rentz (2010) described two more species, also from New Guinea: *M. cornuta* Naskrecki & Rentz, 2010 and *M. sawetau* Naskrecki & Rentz, 2010. These two species were based on material collected during two biological surveys of Papua New Guinea (PNG) conducted in 2009 by the Rapid Assessment Program (RAP) of Conservation International in the Nakanai Mountains of New Britain (East New Britain province) and Muller Range, a part of the Central Cordillera on the border of Western and Southern Highlands provinces (Naskrecki & Rentz 2010).

More recently, another study was conducted in Mount Wilhelm within the framework of "Our Planet Reviewed – Papua New Guinea 2012-2013" set up by the Muséum national d'Histoire naturelle and Pro-Natura International (Robillard *et al.* 2016). A new species of *Microsalomona* was found and is described here: *Microsalomona pulchra* n. sp. Although describing a new species without a proper taxonomic revision is not ideal, the biodiversity crisis in New Guinea where many species under threats are also still undescribed prompted us to describe this new species as a record of its existence.

MATERIALS AND METHODS

The specimens studied herein were collected during the expedition in Papua New Guinea in Oct-Dec 2012. They were collected by sight at night and are deposited in the collections of the Muséum national d'Histoire naturelle, Paris, France (MNHN).

Male genitalia were dissected from softened specimens, and genitalia were removed by squeezing the cerci against one another laterally. As the male was dry-pinned, the specimen was first softened using a mixture of absolute ethanol and diluted KOH solution. The male genitalia were then cleaned using aqueous KOH and subsequently preserved in glycerine. Habitus images were made with a Canon EOS 500D digital SLR camera with a compact-macro lens EF 100 mm f/2.8 Macro USM. Close-up images of morphological features (including male genitalia) were done using a Canon EOS 50D digital SLR camera with a macro photo lens MP-E 65mm f/2.8 USM (1-5×). Canon Macro Twin Lite MT-24EX and Canon Macro Ring Lite MR-14EX were used for lighting and flash. The female allotype was photographed with a Canon EOS 6D Digital SLR camera. Image editing was accomplished using Adobe Photoshop CC 2014.

Measurements of dry-pinned specimens were made using a 0.05 mm vernier caliper. Detailed measurements of the stridulatory apparatus were done by taking close-up images using a macro photo lens MP-E 65mm f/2.8 USM (1-5×) and measuring in ImageJ 1.51j8 (Wayne Rasband, Research Services Branch, National Institute of Mental Health, Bethesda, MD, USA).

The following terms are used in the measurements (following that in Tan *et al.* 2018): BL = body length; PL = pronotum length; PW = pronotum width; TL = tegmen length; HFL = hind femur length; HTL = hind tibia length; OL = ovipositor length. For BL, it refers to the length from the apex of the fastigium to the apex of the epiproct (female) or subgenital plate (male) (Naskrecki & Rentz 2010). Additionally, we also measured the tooth length from the anterior to the posterior ends of the cusp of each tooth as an indication of tooth size.

SYSTEMATIC PART

ORTHOPTERA: TETTIGONIIDAE
Subfamily CONOCEPHALINAE Burmeister, 1838
Tribe AGRAECIINI Redtenbacher, 1891

Genus ***MICROSALOMONA*** Karny, 1912

urn:lsid:Orthoptera.speciesfile.org:TaxonName:18057

Microsalomona Karny, 1912: 6 – Karny 1926: 225; Naskrecki & Rentz 2009: 170; 2010: 17.

Type species. *Microsalomona cornuta* Karny, by original monotypy.

DIFFERENTIAL DIAGNOSIS — The genus is characterised by slender and cylindrical habitus, long and straight fastigium verticis, frons weakly rugose, pronotum usually smooth, femora with numerous spines, male phallus with paired titillators, female ovipositor slightly curved and shorter than hind femora.

COMPOSITION — Three species are currently known from this genus (Cigliano *et al.* 2019), all of which are endemic to Papua New Guinea (Figure 1).

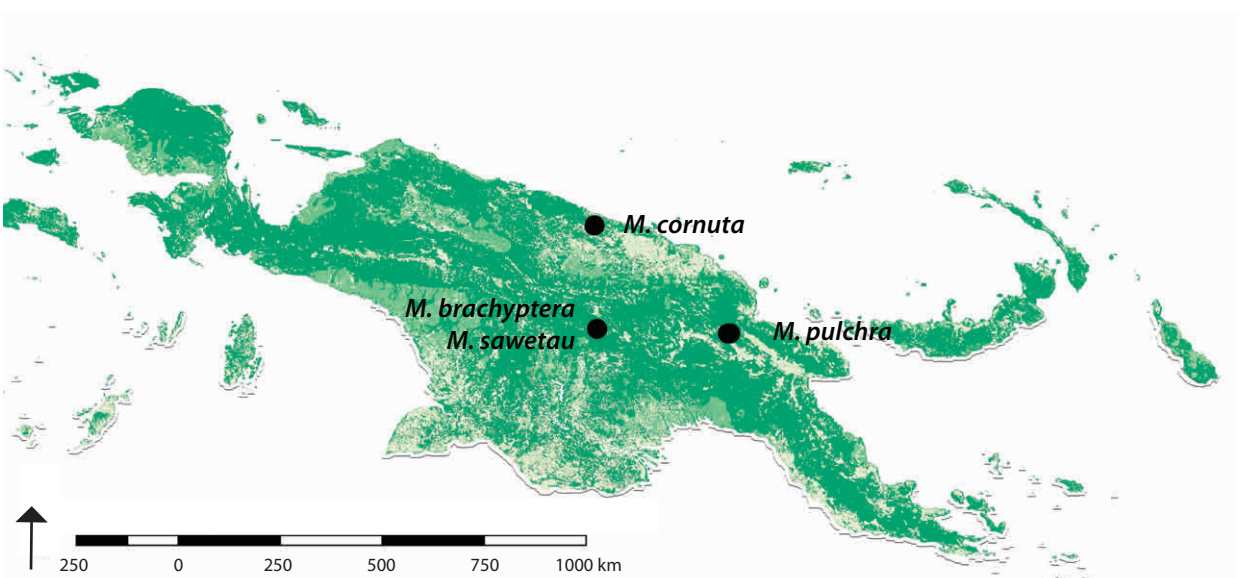
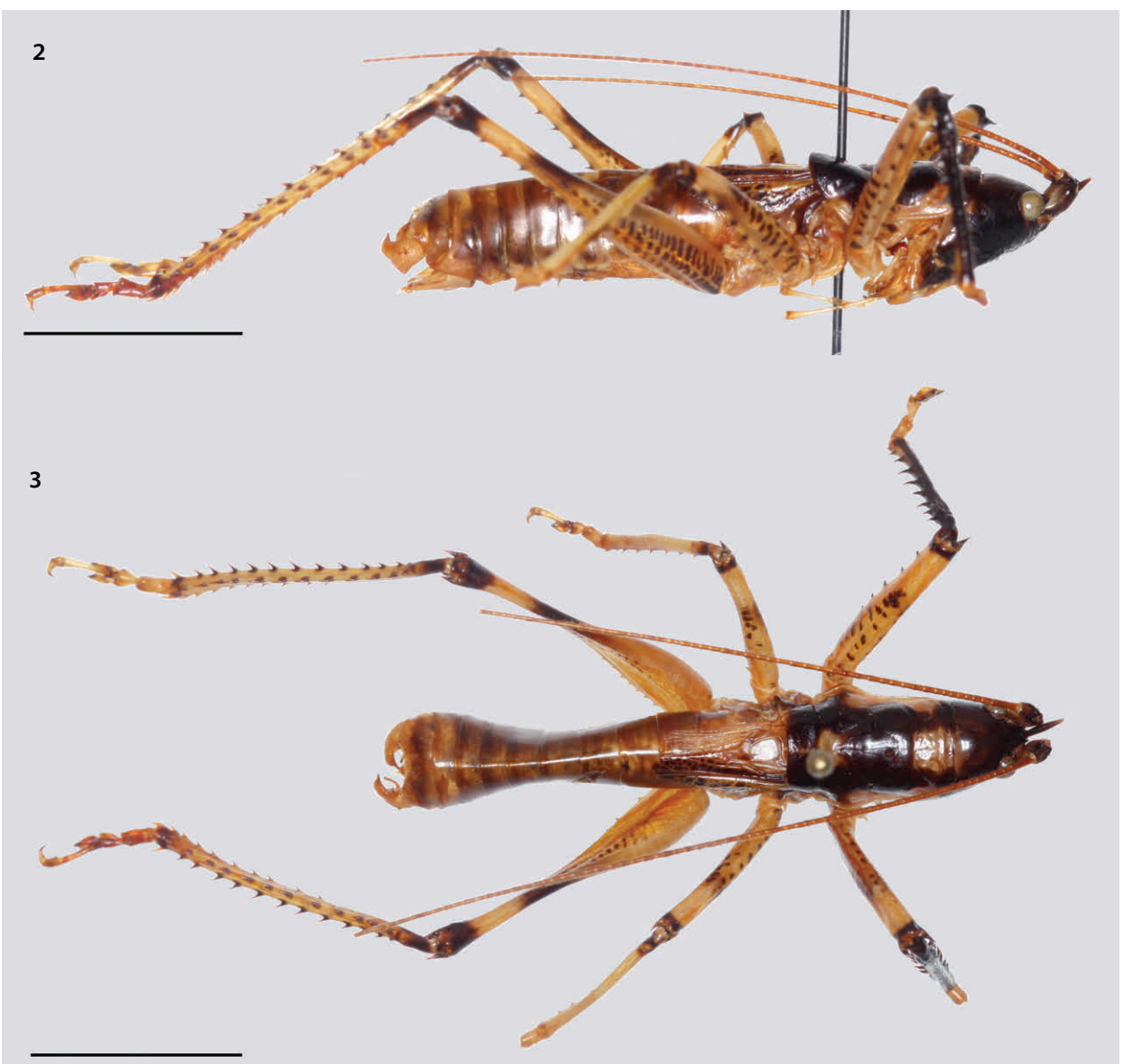


FIGURE 1
Map of New Guinea Island showing the localities of *Microsalomona* species. Layers from DIVA-GIS.

Microsalomona pulchra n. sp.

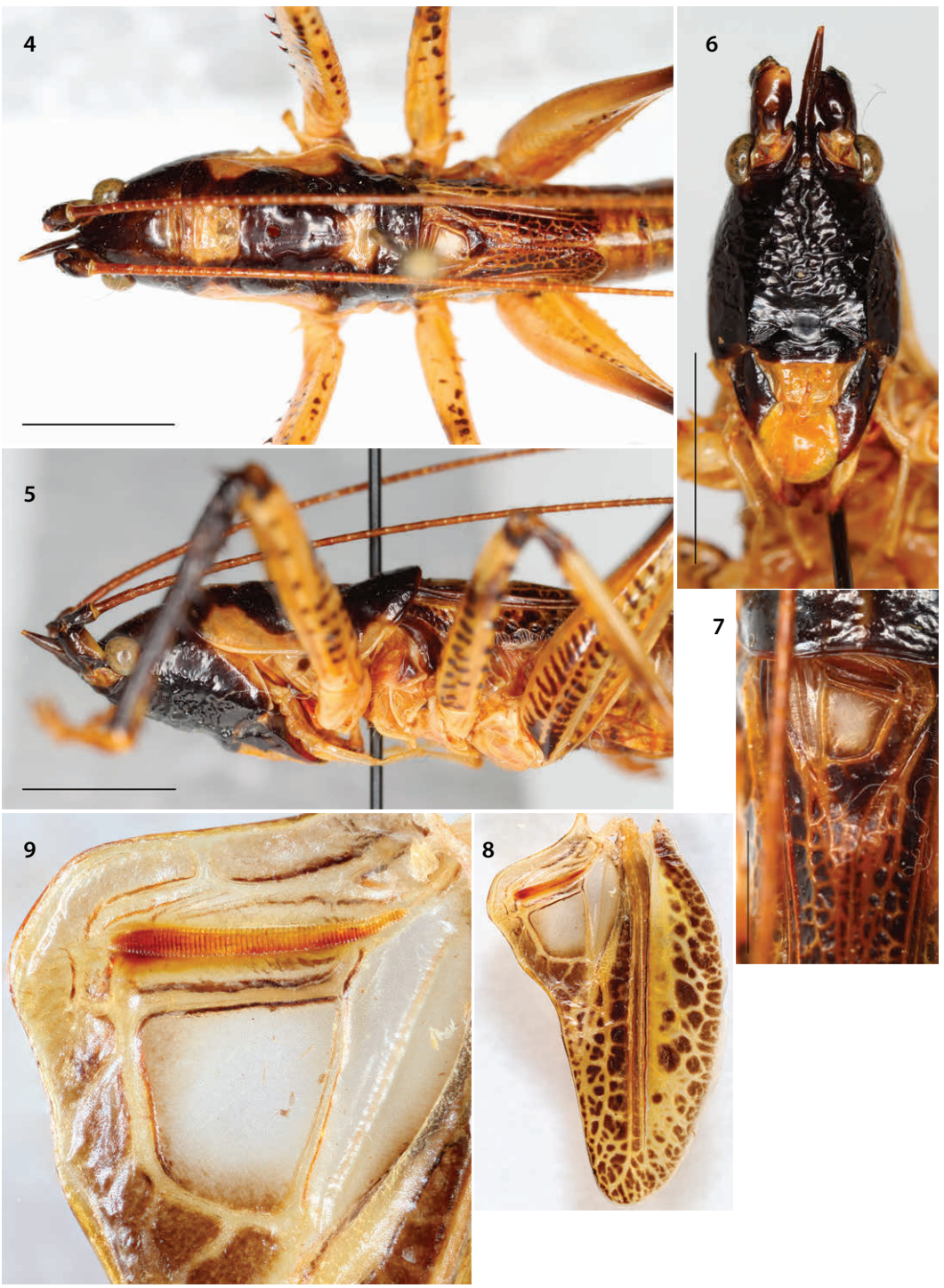
Figures 2-20

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Nouvelle-Guinée, Mt. Wilhelm, 2200 m, PlotB, 5°45'36,6"S, 145°11'10,1E (2017 m), 23-25.x.2012, nuit, sur plante, TR-392, F. Legendre & T. Robillard rec (MNHN-EO-ENSIF10713). Allotype, ♀, **Papua New Guinea**. Nouvelle-Guinée, Mt. Wilhelm, Bondy, 1700 m, Hors Plot 5°45'18,9"S 145°14'10,7"E (1669 m), 26-28.x.2012, FL56, P4255, nuit, sur plante, F. Legendre & T. Robillard rec (MNHN-EO-ENSIF10714).



FIGURES 2-3

Microsalomona pulchra n. sp. male holotype: lateral (**2**) and dorsal (**3**) habitus. Scale bars: 10 mm.



FIGURES 4-9

Microsalomona pulchra n. sp. male holotype. **4**, **5**, head to tegmen in dorsal (**4**) and lateral (**5**) views; **6**, face in anterior view; **7**, **8**, left tegmen in dorsal (**7**) and ventral (**8**) views; **9**, stridulatory area in ventral view. Scale bars: 5 mm (4-6), 2 mm (7).

TYPE LOCALITY — Papua New Guinea. New Guinea, Mount Wilhelm, 5°45'36,6"S, 145°11'10,1E, 2017 m.

DISTRIBUTION — The new species is only known from Mount Wilhelm, between 1700-2200 m asl.

ETYMOLOGY — This species name refers to handsome stature of the species; in Latin, pulcher = handsome.

DIAGNOSIS — This new species differs from all known congeners by the head black and back colour patterns of the pronotum, shape of male cerci with inner basal spine elongated and cylindrical, not inflated, and distinctly smaller than the apical process, and by shape of phallus (titillator slender and elongated). The new species is micropterous as *M. brachyptera*, from which it differs by male cercus with ventral subapical process (absent in *M. brachyptera*) and titillators slender and elongated (rather than stout). The new species also differs from other macropterous congeners *M. cornuta* and *M. sawetau* by inner basal spine not inflated and distinctly smaller than the apical process.

DESCRIPTION — Habitus typical of the genus, as shown in Figures 2, 3, 17, 18. Fastigium of vertex nearly hook-like, sharp apically, very narrow (Figure 6). Frons flat, oblique, weakly rugose (punctate); without lateral carinae (Figure 6). Maxillary palps elongated and slender; apical segment longest, much longer than subapical and third segments; third segment slightly longer than subapical segment. Eyes circular, weakly protruding (Figures 4, 5); median ocellus reduced, indicated only by lighter spot (Figure 6); lateral ocelli absent.

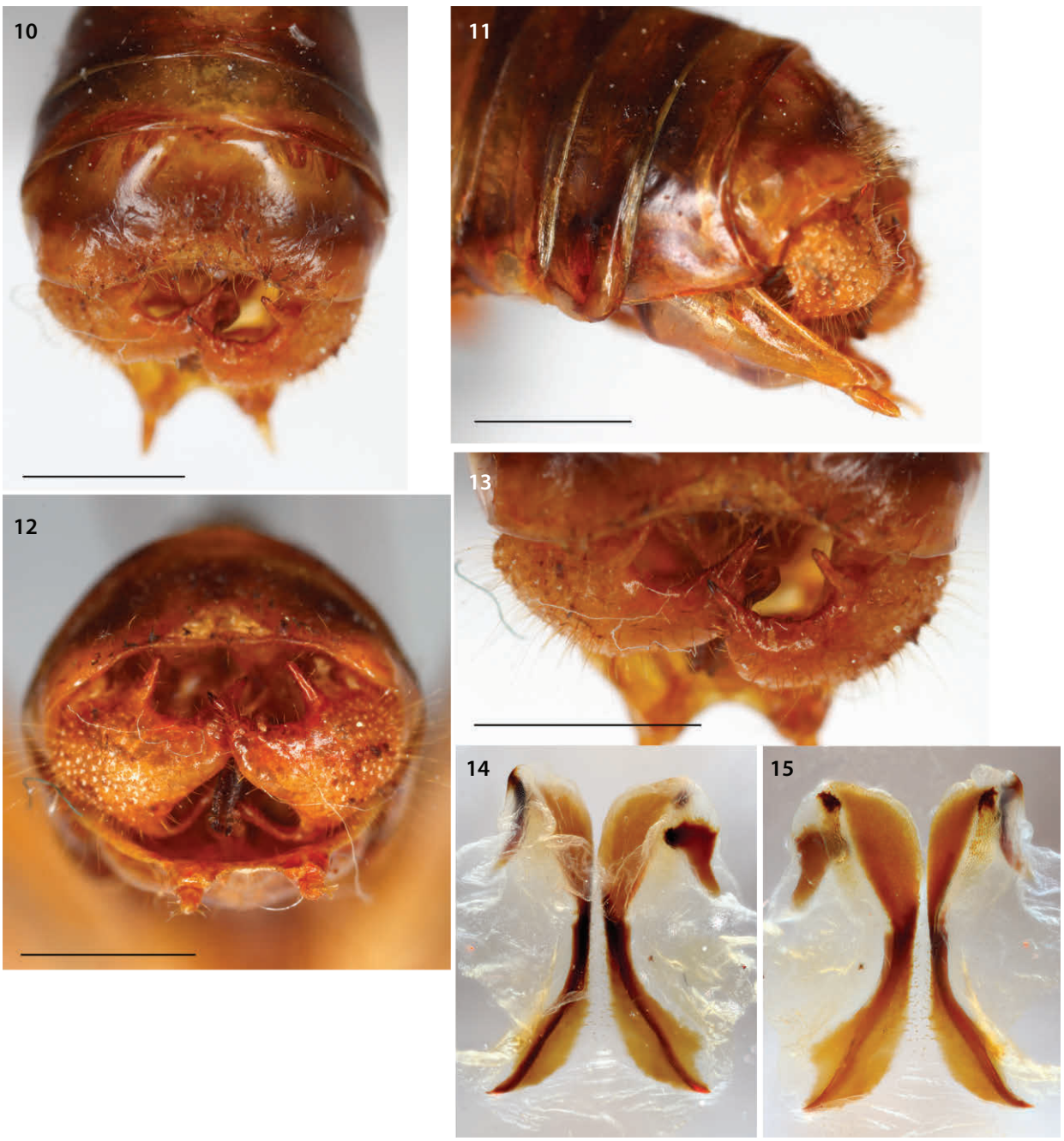
Pronotum smooth; disc longer than wide, broadly rounded into paranota, apical area slightly raised and shouldered (Figure 4); anterior margin slightly concave in middle; posterior margin truncated (Figure 4). Metazona of pronotum slightly raised. Lateral lobe about 3.2 times as long as high; lower margin sinuate; marginal fold of pronotum very narrow, smooth (Figure 5). Thoracic auditory spiracle slender-elongated, taller than long, completely covered by paranota (Figure 5). Prosternum with two acute spines. Mesosternal and metasternal lobes conical with blunt apices.

Anterior coxa with a long dorsal spine pointing anteriorly, apex acute. Anterior tibia with both tympana slit-shaped and small, barely swollen. Femora with the following number of robust spines on ventral margins: anterior femur 7 external (slightly smaller than internal ones), 7 internal of increasing size distally; middle femur 7 external of increasing size distally, 2 small internal at base; posterior femur 9 external of increasing size distally, 9 barely visible small internal (all anterior of the most basal external spines). All knee lobes long spinose externally and internally. Tibiae with the following number of spines on ventral margins: anterior tibia 9 external, 9 internal; middle tibia 8 external, 6 internal.

Male. Tegmen micropterous, slightly surpassing third abdominal tergite, apex rounded (Figures 4, 7, 8). Stridulatory file on underside of left tegmen straight; about 2.99 mm long; with teeth evenly distributed; with circa 72 teeth (Figures 9, 16). Mirror fully developed, rectangular, 1.1 times longer than wide, anterior margin wider than posterior margin (Figure 9). Hind wings concealed under tegmina.

Tenth abdominal tergite simple, with apical half setose in the middle; with posterior margin widely emarginated (Figure 10). Epiproct triangular. Cercus broad, robust, slightly curved inwards; dorso-inner margin with a slender elongated basal spine pointing dorsad, apex of spine subacute; slightly flattened apically before producing into a conical slender spine; apical spine with apex acute; ventral margin with a process in the middle, this process slender, elongated and strongly curved, apex slightly dilated (Figures 10-13). Subgenital plate rectangular, longer than broad, posterior margin roundly excised in the middle, lateral lobes stout; styli short and conical, apex obtuse. Phallus with pair of narrow, apically dilated titillators (Figures 14, 15). Each titillator slender, elongated and slightly curved; posterior end with apex acute; anterior end with granular apex (Figures 14, 15).

Female. Tegmen reaching middle of third tergite, with numerous longitudinal veins and cross-veins. Tenth abdominal tergite broadly emarginated in the middle. Epiproct triangular. Cerci cylindrical before tapering into a subacute apex. Ovipositor shorter than hind femora, gently curved dorsad; ventral valves surpassing dorsal valves, with margins smooth. Subgenital plate with median portion weakly sclerotized, flanked by large lateral sclerites, each with a short-pointed expansion near base of ovipositor.



FIGURES 10-15

Microsalomona pulchra n. sp. male holotype: **10**, **11**, **12**, abdominal apex in dorsal (**10**), lateral (**11**) and posterior (**12**) views; **13**, **14**, **15**, male cercus in dorsal view (**13**); titillators in dorsal (**14**) and ventral (**15**) views. Scale bars: 2 mm (10-13).

Colouration. Male and female do not show sexual dimorphism. Pale yellow with black patterns (Figures 2, 3). Face, including fastigium verticis, frons and genae, black; fastigium verticis with apex pale yellow. Scapus black ventrally, pale yellow dorsally; pedicel black; antennae brown. Dorsal of pale brown with a ventral black spot, antennae yellow brown. Clypeus black in dorsal half, pale yellow on ventral half; maxillary palpus and labrum pale yellow; mandible black (Figure 6). Dorsum of head mostly black (Figure 4). Pronotum generally black; dorsal disc with rectangular pale-yellow patch at anterior half and a transverse pale-yellow patch at posterior third (just anterior of metazona) (Figure 4). Lateral lobe of pronotum pale yellow ventrally, black dorsally (Figure 5). Tegmen generally with cells black; veins pale yellow (Figures 7, 8). Coxae pale yellow. Femora pale yellow with multiple transverse black stripes on external surface, fewer black patterns on internal surface (Figures 2, 3); knee black; base of spines on ventral surface of femora black; apical third of posterior femur with a black patch (with faint margins) along dorsal surface. Anterior tibia black, middle tibia black near knee, otherwise pale yellow; posterior tibia black at the base, subsequently pale yellow with dorsal spines black. Abdominal tergites, sternites and apex pale yellow.

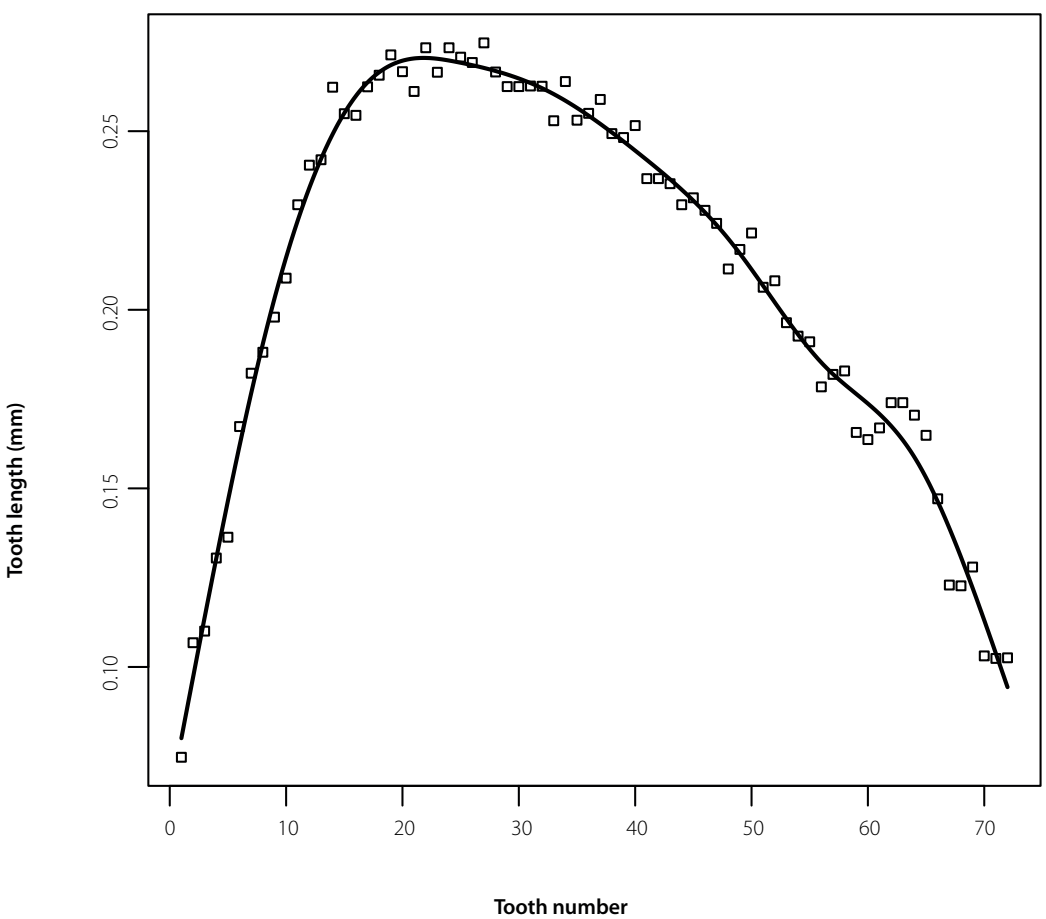
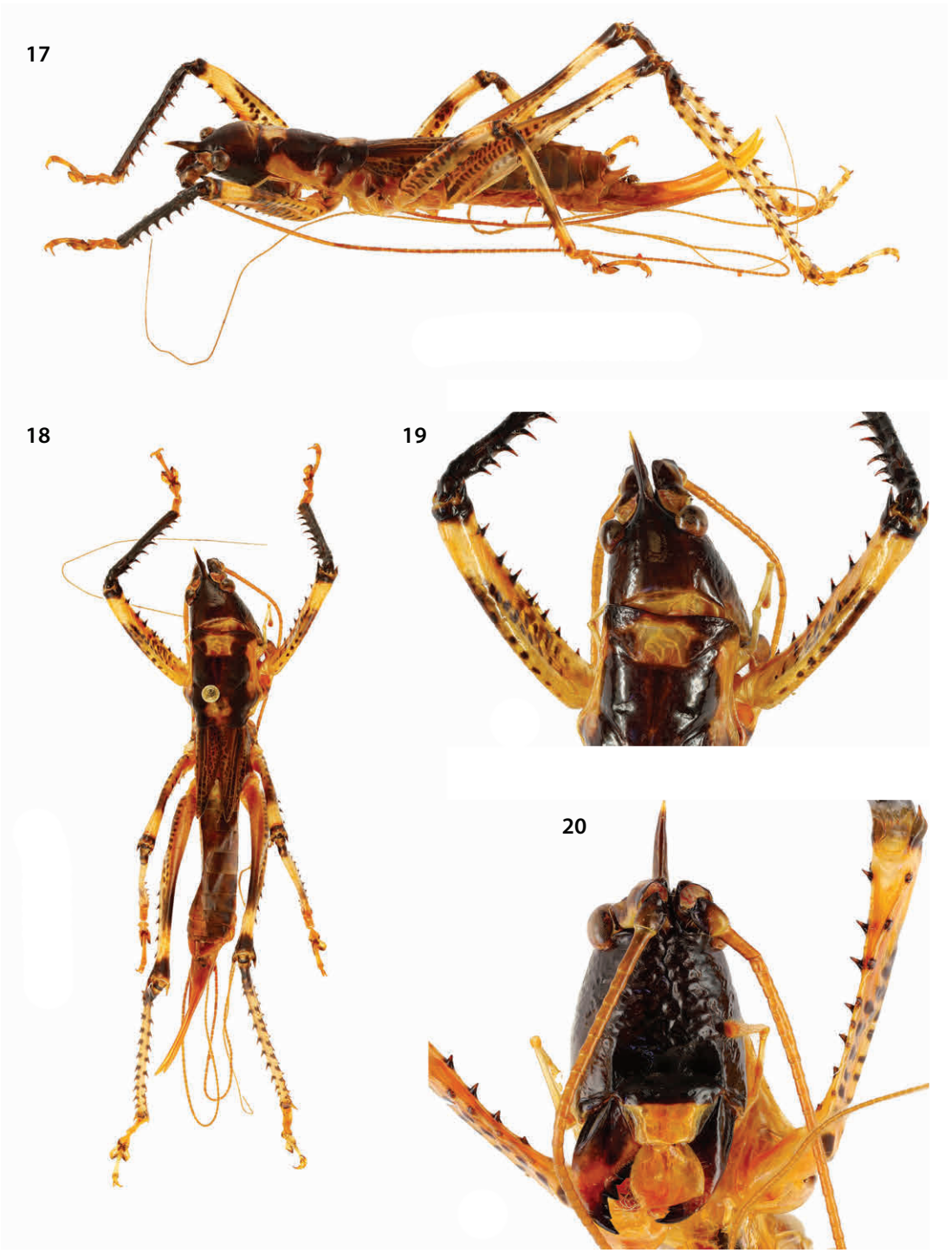


FIGURE 16

Tooth distribution on the stridulatory file of *Microsalomona pulchra* n. sp. male holotype based on tooth length variation. Trend line is generalised additive model fit, r2 = 0.99.



FIGURES 17-20

Microsalomona pulchra n. sp. female allotype: **17**, **18**, lateral (**17**) and dorsal (**18**) habitus; **19**, head in dorsal view; **20**, face in anterior view. Scale bars: 10 mm (17-18), 2 mm (19-20).

MEASUREMENTS — ***Male*** HT: BL 32.2; PL 7.8; PW 5.6; TL 6.6; HFL 16.4; HTL 16.6 mm.
Female AT: BL 29.7; PL 7.6; PW 6.5; TL 7.7; HFL 19; HTL 20; OL 13.3.

NATURAL HISTORY — The new species was found at night on low vegetation in forested area at mid-elevation on Mount Wilhelm.

KEY TO SPECIES OF MICROSALOMONA

1. Head, including frons, black. Pronotum disc with black colouration ..... *M. pulchra* n. sp.
– Head not black. Pronotum disc without black colouration **2**

2. Macropterous, tegmen reaching abdominal apex. Male cercus with ventral subapical process **3**
– Tegmen reduced, not reaching abdominal apex. Male cercus without ventral subapical process .....
..... *M. brachyptera* Karny, 1912

3. Male cercus with inner basal spine robust and distinctly inflated, slightly curved towards apex. Female subgenital plate with pair of deep invaginations at base, strongly sclerotized, posterior margin somewhat heart-shaped ..... *M. sawetau* Naskrecki & Rentz, 2010

4. Male cercus with inner basal spine more slender and tapering equally. Female subgenital plate posterior margin with small, median incision ..... *M. cornuta* Naskrecki & Rentz, 2010

DISCUSSION

Little is known about *Microsalomona* beyond their original descriptions. This is probably related to these katydids being elusive in nature and rarely encountered as well as inadequate sampling effort. We do know that these katydids are probably highly specialised in their ecological niche, occupying humid forests, having restricted distribution, and are predatory (Naskrecki & Rentz 2010). However, we are not sure how this genus is related to other genera from the subtribe Salomonina since none of the *Microsalomona* species have been placed yet in a molecular phylogeny.

Furthermore, the reduced tegmina suggest that the wings are more adapted for stridulation than for flight. Yet, nothing is known about the calling songs of any of the known *Microsalomona* species. Agraeciini katydids usually produce songs with vastly different frequencies, some at low frequencies audible to human and others at ultrasonic frequencies. That the stridulatory file in *Microsalomona* comprises of systematically distributed teeth suggests that resonant sound production is facilitated by constant tooth rate strike as observed in other Conocephalinae katydids (*e.g.*, Montealegre-Z & Mason 2005; Montealegre-Z & Postles 2010).

We speculate that the *Microsalomona* should survive well in captivity and may feed readily on artificial diet (*e.g.*, dog food pellet) as in the case of many *Salomona* and Agraeciini (MKT pers. obs.). As such, we recommend that these unique and interesting katydids can be kept under laboratory conditions for behavioral observations (including acoustic recording) in future collection to enhance our knowledge on these little-known katydids, particularly important in this era of mass extinction.

ACKNOWLEDGEMENTS

This study was conducted in the framework of "Our Planet Reviewed – Papua-New-Guinea 2012-2013" set up by Pro-Natura International, the Muséum national d'Histoire naturelle (MNHN, France), the Institut de Recherche pour le Développement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the

Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery. The IBISCA expert network, the patron for this project, Prof. R.L. Kitching AM, and all other participants in this collective effort are thanked for their contribution. We thank Simon Poulain for preparing the specimens and for taking photos of the female allotype.

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Male of *Anchiale* sp. (Phasmatidae) posing on plant.
(Photo © Xavier Desmier; identification: Emmanuel Delfosse).

Revision of *Thaumatobactron* Günther, 1929 (Phasmatodea: Lonchodidae) from New Guinea, with the description of four new species

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ABSTRACT

The author proposes a revision of the stick insect species of the genus *Thaumatobactron* Günther, 1929. Four new species, *T. bretoni* n. sp., *T. pulchracaelatura* n. sp., *T. pygminerme* n. sp. and *T. robillardi* n. sp., are described. Egg of *T. guentheri* Hennemann & Conle, 1997, and female and egg of *T. mayri* Günther, 1930 are described for the first time. New data are provided and identification keys proposed for males, females and eggs.

RÉSUME

Révision de *Thaumatobactron* Günther, 1929 (Phasmatodea : Lonchodidae) de Nouvelle-Guinée et description de quatre espèces nouvelles.

L'auteur propose une révision des espèces de Phasmes du genre *Thaumatobactron* Günther, 1929. Quatre nouvelles espèces, *T. bretoni* n. sp., *T. pulchracaelatura* n. sp., *T. pygminerme* n. sp. et *T. robillardi* n. sp., sont décrites. L'œuf de *T. guentheri* Hennemann & Conle, 1997, et la femelle et l'oeuf de *T. mayri* Günther, 1930 sont décrits pour la première fois. De nouvelles données sont apportées et des clés de détermination sont présentées pour la reconnaissance des mâles, des femelles et des œufs.

DELFOSSE E. 2020 — Revision of *Thaumatobactron* Günther, 1929 (Phasmatodea: Lonchodidae) from New Guinea, with the description of four new species, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 473-508 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

INTRODUCTION

The stick-insect genus *Thaumatobactron* Günther, 1929 is endemic to New Guinea and is characterized by a small stocky body and large legs more or less spinose. Males present larger hind legs armed with larger spines than in female (Günther, 1929, 1930; Hennemann & Conle 1997, 1998; Zompro 2001).

In 2001, Zompro reviewed the Eurycanthinae Brunner von Wattenwyl, 1893 at a generic level, and listed all genera in a single tribe, the Eurycanthini Brunner von Wattenwyl, 1893. Eurycanthinae were kept in the family Phasmatidae Gray, 1835.

Since that time, the taxonomy of the Eurycanthinae has evolved in various directions until 2009 (Bradler 2001; Buckley *et al.* 2009; Bradler 2009; Buckley *et al.* 2010), when molecular data overturned the traditional classification, and the genus *Thaumatobactron* was finally transferred to Lonchodinae Brunner von Wattenwyl, 1893 and Lonchodidae Brunner von Wattenwyl, 1893 and remains grouped among the Eurycanthini (Bradler *et al.* 2014; Robertson *et al.* 2018; Simon 2019).

In this work, I review all the species of *Thaumatobactron* currently described, which were previously only known from the eastern half of New Guinea.

Of the seven species of *Thaumatobactron* previously known, only two of them were known from both males and females. Similarly, the eggs of the genus have never been described. In this paper I describe the male of *T. bretoni* n. sp., female of *T. pulchracaelatura* n. sp., the male of *T. robillardi* n. sp., both sexes of *T. pygminerme* n. sp., the egg of *Thaumatobactron guentheri* Hennemann & Conle, 1997, and the female and egg of *T. mayri* Günther, 1930.

MATERIAL AND METHODS

The material studied here comes from various museums or private collections (NHMUK, MNHN, MNHU, CED, CFH, CPB). Part of the specimens studied herein were collected during the expedition "Our Planet Reviewed – Papua New Guinea" in Oct-Dec 2012.

Abbreviations. **Institutions and private collections**:

NHMUK	The Natural History Museum, London
MNHG	Muséum d'Histoire naturelle de la ville de Genève, Suisse
MNHN	Muséum national d'Histoire naturelle, Paris
MNHU	Museum für Naturkunde der Humboldt-Universität, Berlin
CED	Emmanuel Delfosse private collection
CFH	Frank Hennemann private collection
CPB	Paul Brock private collection

OBSERVATIONS AND MORPHOLOGICAL ANALYSIS

Terminology used for the adult descriptions is based on papers of Beier (1957, 1968), Lelong (1995, 1996a, 1996b), Bragg (2001) and Bradler (2009). The terminology used for the description of external egg structures follows that of Clark Sellick (1997). HT: holotype; PT: paratype.

Eggs. One female *Thaumatobactron guentheri* (CPB) and two females *T. mayri* (MNHN & CED) were dissected to recover some eggs. Only dried specimens were studied, hence the colours described must be taken with caution, as they may have been altered due to preservation.

Measurements. Specimens were measured using a calliper with a precision down to 0.01 mm for the insects and 1 micrometer for the eggs. Photographs of specimens were taken with two digital cameras: a Nikon D80 with a 105 mm AF-S Micro Nikkor lense and a Canon EOS 6D equipped with a 65 mm MP-E. Insects and eggs were examined using a binocular microscope Nikon SMZ 1000.

SYSTEMATIC PART

Family LONCHODIDAE Brunner von Wattenwyl, 1893
Subfamily LONCHODINAE Brunner von Wattenwyl, 1893
Tribe EURYCANTHINI Brunner von Wattenwyl, 1893

Genus ***THAUMATOBACTRON*** Günther, 1929

Thaumatobactron Günther, 1929: 663.

Type species. *Thaumatobactron poecilosoma* Günther, 1929.

DIAGNOSIS — The genus *Thaumatobactron* is characterized by a stocky body; operculum of female short; strong metafemora in male thickened and ventrally armed with large spines (Hennemann & Conle 1997).

REDESCRIPTION — Round head; antennae longer than mesonotum with 26 segments or more; small (male and female: 68.2-70 mm) stocky body, matt or shiny, more or less rough, sometimes spinose with some small or large spines; mesonotum about two and half times longer than wide on posterior margin; metanotum about as long as wide (with metapleural); body often cylindrical for female, with abdomen strongly widened, while male abdomen thinner than thorax; abdomen not armed laterally; rudiments of tegmina absent; anal segment, poculum of male, operculum of female short and not extended; metafemora and often tibiae sharply carinate; femora almost cylindrical in cross-section and strong, metafemora in male thickened and ventrally heavily armed with large spines and in female less armed with small spines; metatibiae round in cross-section (Günther 1929, 1930; Hennemann & Conle 1997 & 1998; Herwaarden 1998; Zompro 2001).

KNOWN SPECIES — Currently, seven species are known in the genus all from New Guinea (Brock *et al.* 2019), including: *T. granulosum* Hennemann & Conle, 1997; *T. guentheri* Hennemann & Conle, 1997; *T. harmani* Hennemann & Conle, 1998; *T. mayri* Günther, 1930; *T. poecilosoma* Günther, 1929; *T. spinosissimum* Hennemann & Conle, 1998; *T. unicolor* Hennemann & Conle, 1998. Four additional species are described here: *T. bretoni* n. sp., *T. pulchracaelatura* n. sp., *T. pygminerme* n. sp. and *T. robillardi* n. sp.

DISTRIBUTION — Endemic to New Guinea Island.

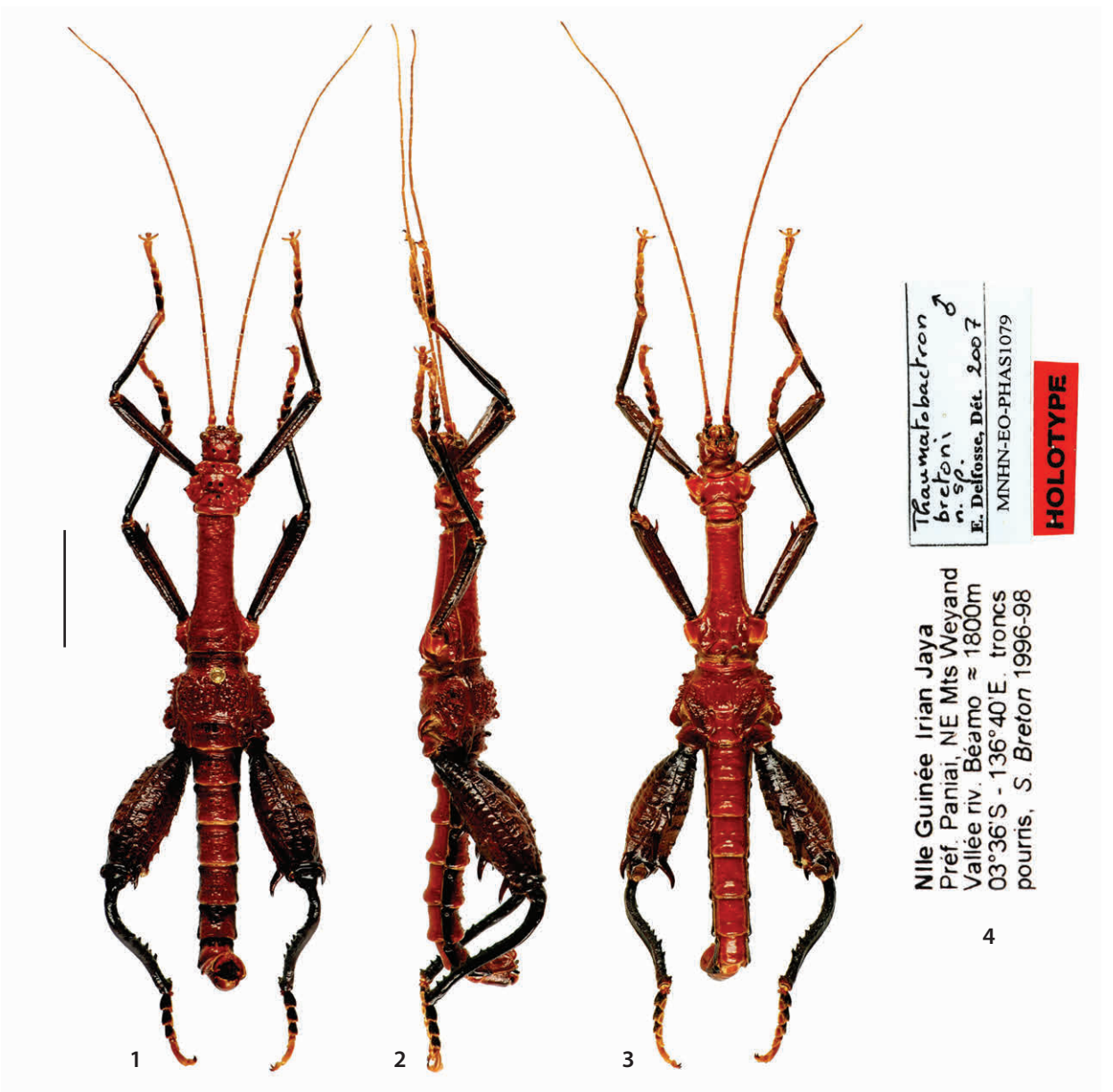
Thaumatobactron bretoni n. sp.

Figures 1-4

TYPE MATERIAL — Holotype, ♂, **Indonesia**. Nlle Guinée, Irian Jaya, Préf. Paniai, NE Mts Weyand, Vallée riv. Beamo, ~1800 m, 03°36'S - 136°40'E, troncs pourris, S. Breton leg, 1996-1998 (MNHN-EO-PHAS1079).

ETYMOLOGY — Named after Stéphane Breton, who collected this species in Indonesia (Western New Guinea). Stéphane Breton is a French ethnologist and director of documentary. As a specialist for New Guinean societies, he is senior lecturer in "Ecole des Hautes Etudes en Sciences Sociales", where he teaches anthropology and documentary.

DIAGNOSIS — **Male**. Small (53.21 mm), shiny and stocky, more or less spinose, wingless reddish-brown species with strong legs; legs are blackish brown.



FIGURES 1-4

Thaumatobactron bretoni n. sp., male holotype. **1-3**, dorsal, lateral and ventral views, scale bar = 1 cm; **4**, detail of the specimen label (not to scale).

DESCRIPTION — ***Male***. *Head.* Reddish brown. Slightly longer than wide, about 3/4 length of pronotum, as wide as mesonotum. Six small black spines: one on vertex behind each eye, the last four on posterior part of head, two lateral and two on top. Small shallow depression between eyes. Eyes convex, medium, greyish brown, looking rather coppery. Antennae long, light brown: with 39 segments, five of last seven paler. Each segment longer than wide and of varying length. Scapus and pedicel cylindrical; scapus longer than wide and about same length as pedicel and first antennal segments. End of labial palps black.

Thorax. Dorsally with same color as head; slightly lighter ventrally. Pronotum slightly longer and 1.5x wider than head; armed with some small humps and six small black dorsal spines: two in basal, median and apical areas. Pronotum enlarged in each lateral side and armed with four small spines, one in apical area and three in median area. Mesonotum cylindrical, about 3x length of pronotum. Mesonotum wrinkled and granulose with a small medio-apical spine tooth shaped. Mesonotum basally enlarged, but slightly less wide than pronotum. A large medianbasal blunt spine present. Metanotum about 3.5x wider than mesonotum in its narrowest section. Metanotum with a large hump, more granulose than mesonotum, mainly dorsally, from apex to 2/3 of length. Metanotum with some lateral metapleural flat outgrowth and small blunt spines. A large median basical blunt spine present. Pro- and mesosternum smooth; metasternum with a smaller hump less granulose than metanotum.

Legs. Femora dark brown, tibiae darker. Apex of pro- and median tibiae and the last two tarsal segment light brown. Legs robust. Pro- and median legs thiner, femora being twice as thick as tibiae. Pro- and median tibiae cylindrical. Pro- and median femora strongly keeled and wrinkled, legs slightly quadrate in cross-section. Forelegs unarmed, but median femora with a distinct thin and small apical sharp spine curved backward and tibiae with some very small minute spines. Hind femora c. 4x larger in median area than fore and mid femora; hind tibiae c. twice larger than fore and mid tibiae. Hind femora with a thinner base, strongly carinate, strongly wrinkled and quadrate in cross-section. In each dorsal and lateral carinae, some minute spines are present. Ventrally with six thin, long acute spines curved backwards: four about the same size, being 3x larger than the medio-apical two others; four apical spines in a row, mid-spines smaller than those on edges; behind the row of spines, with two large central spines, one behind the other one. Hind tibiae distinctly curved forward basally and slightly curved backward apically. Hind femora have towards the base a ventral carina with c. 10-minute spines in median to apical areas. Two last tarsal segments orange. Metatarsus slightly flattened and slightly larger than the other tarsal segments, except the last.

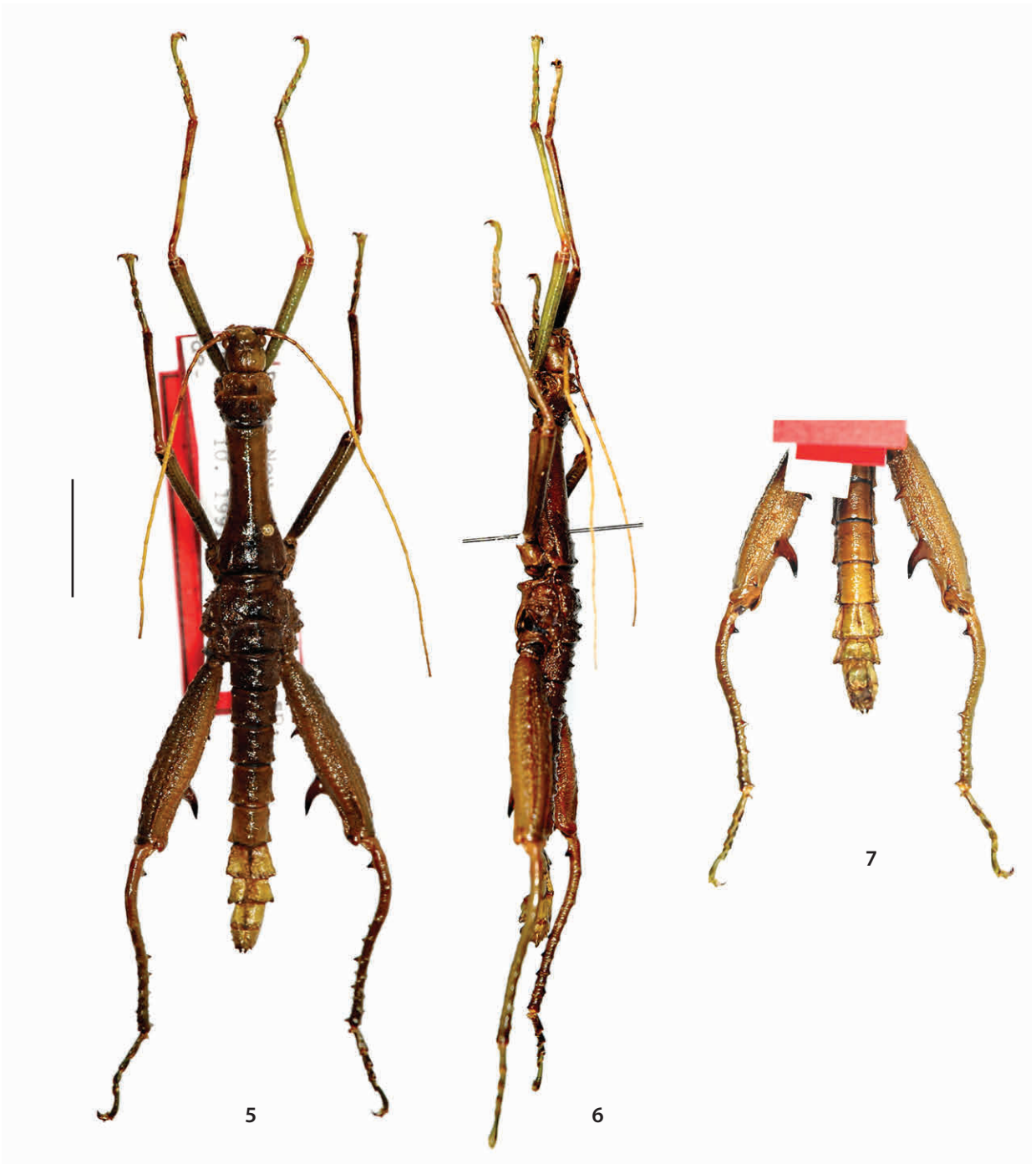
Abdomen. Same color as head and thorax but with a lateral black line on terga, just above the articulation membrane. Median segment twice as wide as long; about half length of each of segments II-VI. Abdominal terga segments II-VI a similar size. Terga VII-IX have a similar size but are slightly smaller in length than segments II-VI. Abdominal terga are wrinkled with some small humps or spines. Two spines slightly larger and black on median segment and on abdominal terga II-V. The last terga are less wrinkled. Anal segment small; 3x smaller than terga II-VI; conical with a lateral black finger-like lobe on each edge. Sterna are slightly lighter than terga except last three, which are darker closest in color to femora. Sterna with a long hump on each apical area, following the ventral articulation. Cerci small, black and cylindrical, with small bristles.

Female. Unknown.

MEASUREMENTS — See Table 1.

Body	53.21	Profemora	11.10
Head	3.37	Protibiae	10.40
Antennae	38.93	Mesofemora	10.07
Pronotum	4.48	Mesotibiae	10.22
Mesonotum	11.76	Metafemora	14.21
Metanotum	5.87	Metatibiae	14.60
Median segment	3.16	-	-

TABLE 1
Measurements of male holotype *Thaumatobactron bretoni* n. sp. (mm).



FIGURES 5-7

Thaumatobactron granulosum HT ♂. **5-6**, dorsal, lateral views; **7**, ventral view of abdomen (photo by F. Hennemann). Scale bar = 1 cm.

REMARKS — The male holotype *Thaumatobactron bretoni* n. sp. is in perfect condition except for the right large apical spine of the left femora broken off.

Thaumatobactron granulosum Hennemann & Conle, 1997

Figures 5-7

Thaumatobactron granulosa Hennemann & Conle, 1997: 176.
Thaumatobactron granulosum – According to the neutral status of the genus, the specific epithet must be granulosum.

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Papua Neuguinea, Morobe Provinz, Watut, Leg. Clark 3, 1991 (MNHU). [examined]

DIAGNOSIS — ***Male***. Size medium (60.5 mm), strongly granulose, anal segment with six finger-lobes; a very large back-curving spine ventro-medially on metafemora, with some other smaller spines; metatibae only with minute, blunt spinules ventrally and some low humps dorsally; basal spine blunt. Brown body with fore- and median legs more or less green (Hennemann & Conle 1997).

Female. Unknown.

Egg. Unknown.

Thaumatobactron guentheri Hennemann & Conle, 1997

Figures 8-16

Thaumatobactron guentheri Hennemann & Conle, 1997: 178.

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Prov., Aseki, leg. Clark 8, 1993 (MNHU). Paratypes (1 ♂, 1 ♀), Papua New Guinea. 1 ♂ PT, Morobe Prov., Asuh, leg. Clark 5, 1993 (CFH); 1 ♀ (noted as allotype), Morobe Prov., Aseki, leg. Clark 10, 1992 (MNHU). [examined]

OTHER MATERIAL EXAMINED — Papua New Guinea. 1 ♂, Morobe Province, Aseki, X.1992 (CPB); ♂, Morobe Province, Aseki, VIII.1992; 1 ♀, Morobe Province, Aseki, VI.1991 (CPB); 1 ♀, 9 eggs, Morobe Province, Aseki, X.1992 (CPB); 2 ♀, Morobe Province, Aseki, M. P., VIII.1993, P. R. (CPB); 1 ♂, Nouvelle-Guinée, Aseki M. P., PNG, 8/[19]92, coll. A. Deschandol (MNHN); 1 ♀, Morobe Provinz, Menyamya, leg. Clark, via IFTA, X.2000, Nr. FH 0149-2 (CFH).

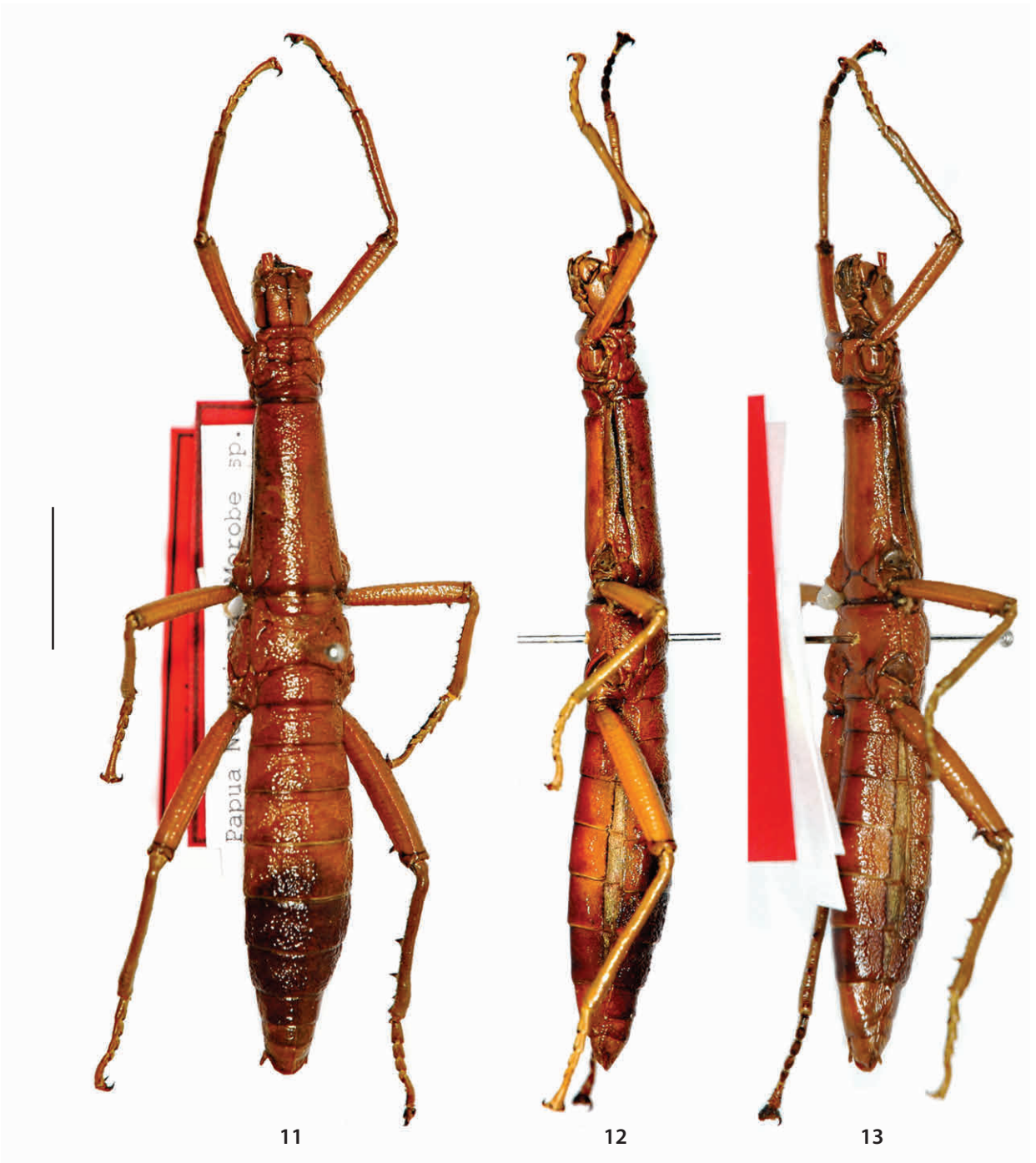
DIAGNOSIS — ***Male***. (Figures 8-10). Medium-size (61-64.25 mm), granulose body without spine, pale ochre body, head with three dark brown longitudinal stripes. Metafemora with four large curved spines; metatibiae with two large distal spines (Hennemann & Conle 1997 & 1998).

Female. (Figures 11-13). Medium-size (58-66 mm), same color and head with the same features. Minute ventral spines on pro- and mesotibiae; two distinct ventral spines on metatibiae (Hennemann & Conle 1997 & 1998).

ADDITIONAL DESCRIPTION — ***Egg***. (Figures 14-16). Six of the nine eggs represented in CPB material are sufficiently developed to allow a description: large, oval, almost round-shaped, 1.2x slightly longer than wide. Capsule brown, the micropylar plate slightly light. Operculum oval, almost round, edge of collar developed, mid brown. Micropylar plate large and in the centre of egg capsule; almost oval in shape, but the posterior area slightly truncated. Capsule with large net-like structure, slightly granulose on the operculum. Measurements (mm): length 3.31-3.39, width 2.65-2.72, height 2.85-2.98, length of micropylar plate: 1.41-1.67.



8 9 10



FIGURES 8-13

Thaumatobactron guentheri, male holotype and 1 ♀ PT. **8-10**, dorsal, lateral and ventral views of male holotype (photo by F. Hennemann); **11-13**, dorsal, lateral and ventral view ♀ PT (photo by F. Hennemann). Scale bar = 1 cm.



FIGURES 14-16

Thaumatobactron guentheri, egg. **14-15**, dorsal and lateral views; **16**, operculum in dorsal views. Scale bar = 1 mm.

Thaumatobactron harmani Hennemann & Conle, 1998

Figures 17-20

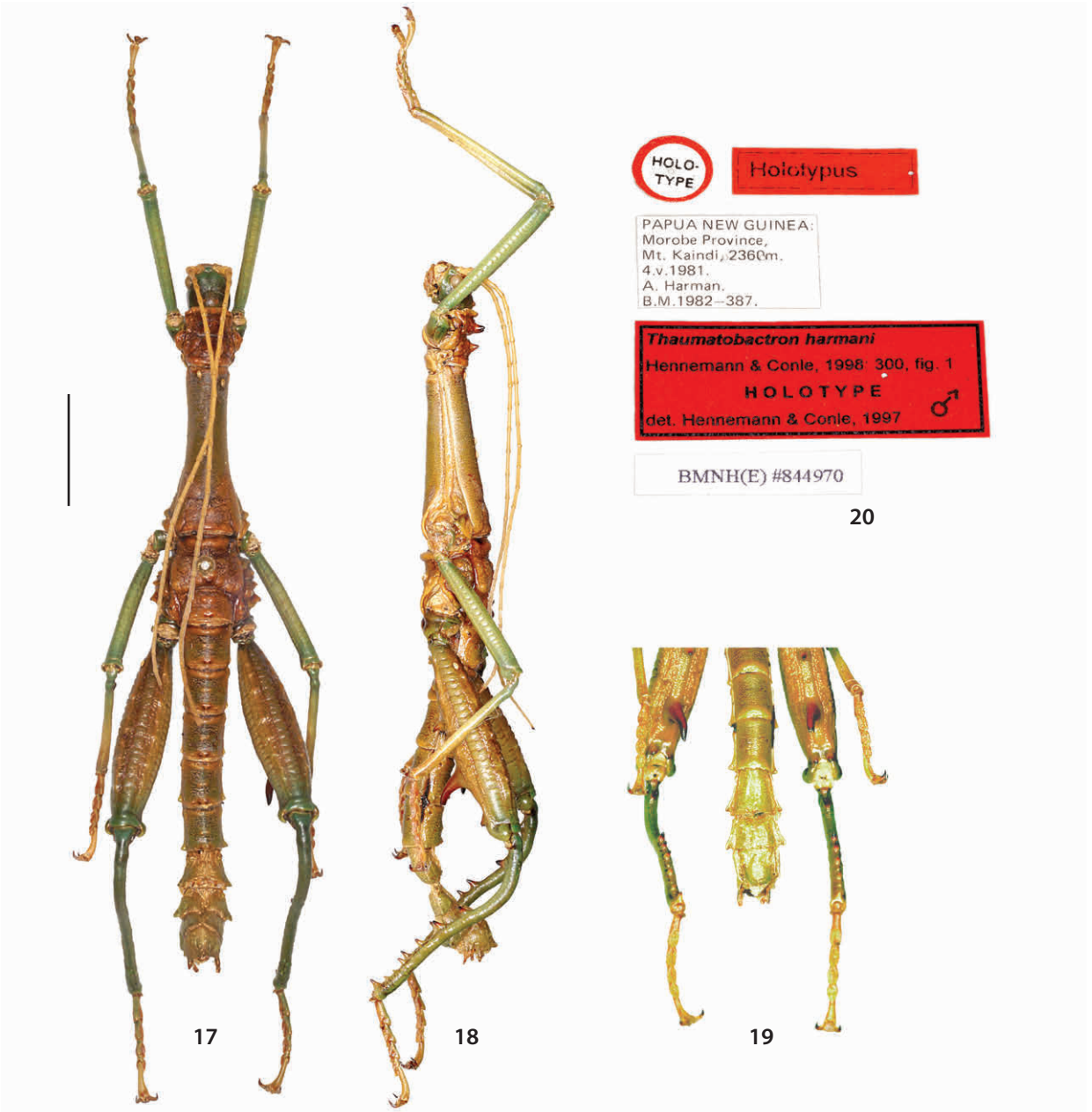
Thaumatobactron harmani Hennemann & Conle, 1998: 303.

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Prov., Mt. Kaindi, 2360 m, 4.V.1981, A. Harman leg., B. M. 1982-387 (BMNH). [examined]

DIAGNOSIS — ***Male***. Medium-size (66.5 mm), a pronotum with large blunt thorns; a very large back-curving spine ventro-medially on metafemora; metatibiae with a basal spine and the apical half with five equally sized spines extero-ventrally; the apical half with five equally sized spines extero-ventrally; brown body and green legs.

Female. Unknown.

Egg. Unknown.



FIGURES 17-20

Thaumatobactron harmani, male holotype. **17-19**, Dorsal, lateral body (photos by f P. Brock); **20**, ventral view of the abdominal apex (photos by P. Brock). scale bar = 1 cm.

Thaumatobactron mayri Günther, 1930

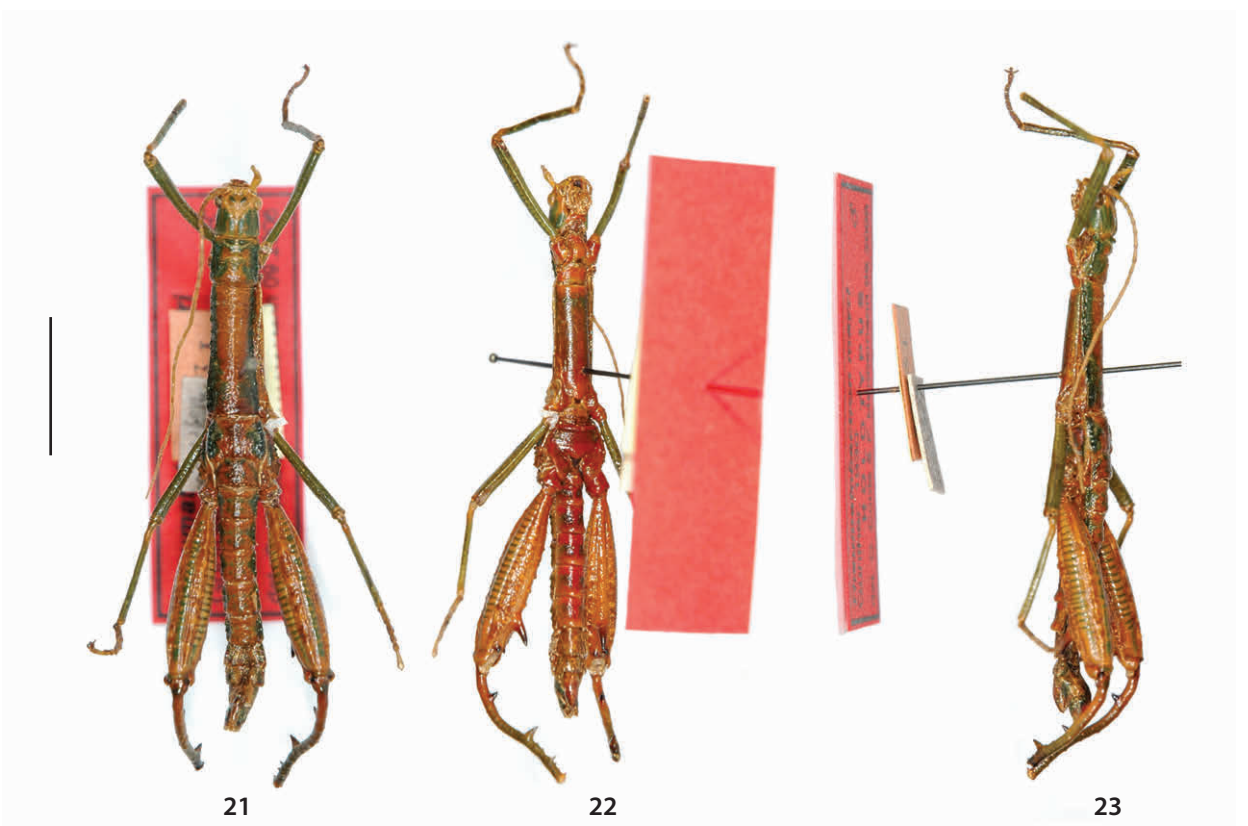
Figures 21-34

Thaumatobactron mayri Günther, 1930: 732.

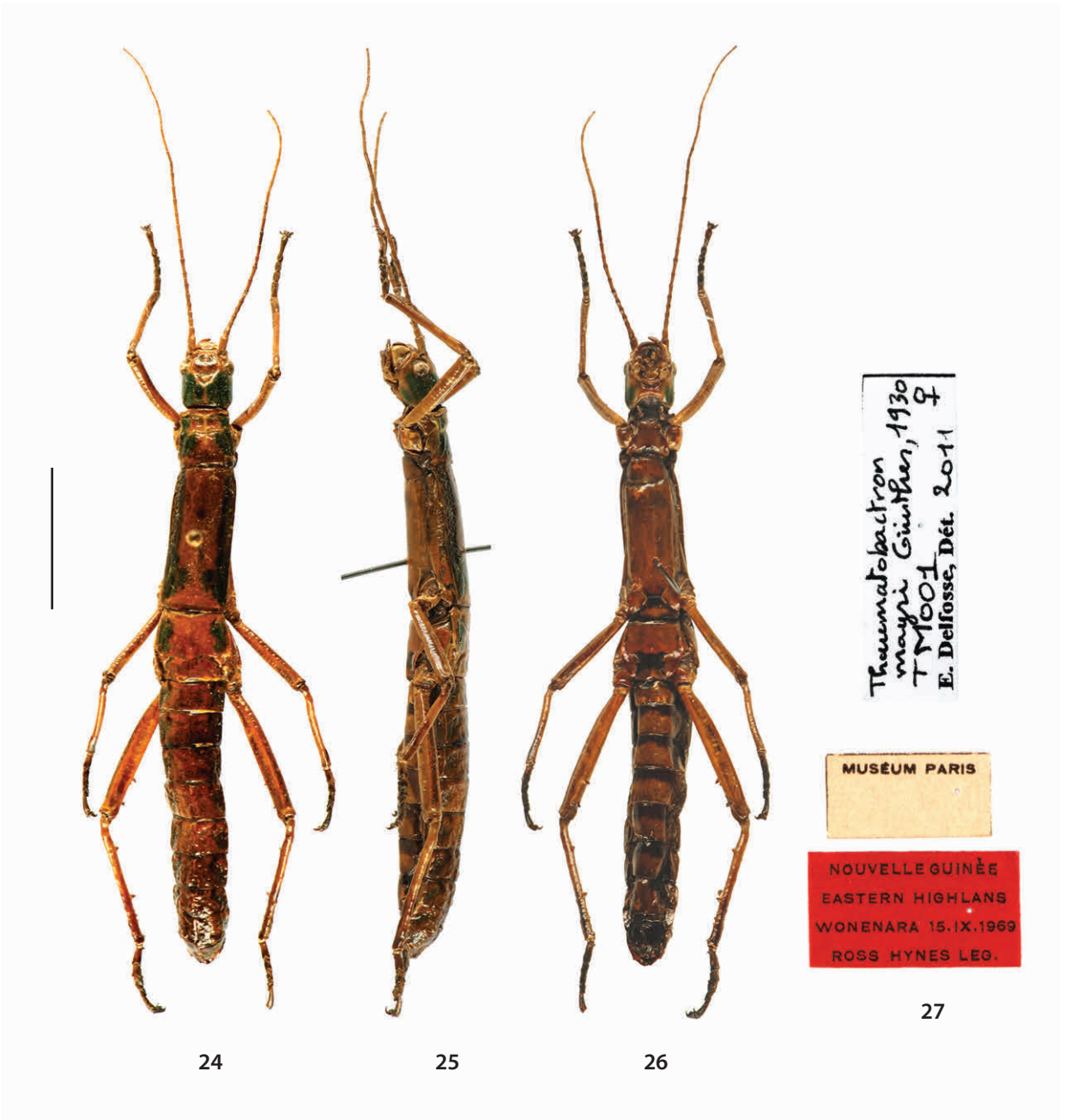
TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Neuguinea, Ogeramnang, Kaiser Wilhelmsland, Ostabhang des Saruwaged-Gebirges, im Quellgebiet des Bulung-Flußes, leg. Mayr, 1928 (MNHU). [examined].

OTHER MATERIAL EXAMINED — **Papua New Guinea**. 1 ♀, 4 eggs, Nouvelle Guinèe, Wonenara, Eastern Highlands, 15.IX.1989, Ross Hynes leg. (MNHN); 1 ♀, P. N. G., Aseki, 18.III.1997 and 1 egg (CED); 1 ♀, Eastern Highland Prov., Oicapa, via IFTA, 5.2001 (CFH); 1 ♀, New Guinea, 6.m. N. of Nondugl. Arl River. 31.I.1960, M. Tyler: B.M. 1961-305 (NHMUK); 1 ♀, Papua N. Guinea, Madang Dist. Kaironk area, Dec. 1971 – Jan 1972 Coll. J. Menzies, Coll. Agr. Dept Port Moresby Papua No. 16468, Pres by Comm Inst Ent B M 1975-I, C.I.E., Coll. A. 5. 5. 54 (NHMUK).

DIAGNOSIS — Male and female shiny, wingless, with no rudiments of wings, small (41-45.93 mm) and stocky, body almost smooth with few small tubercles, legs smooth except for hind legs armed with some spines. Green head, mid brown body, longitudinal lateral green stripe on the body, fore- and median legs more or less green. Female similar in appearance to male, but with smaller metafemora, first of all smaller spines on metafemora and a larger abdomen. Dorsally, general color of body more yellowish brown than reddish brown and green color more or less olive green. Ventrally, general color reddish brown with black or darker greenish rings or patches.



21 22 23



FIGURES 21-27

Thaumatobactron mayri, male holotype. **21-23**, Dorsal, lateral and ventral views (photos by F. Hennemann). Female. **24-26**, dorsal, lateral and ventral views; **27**, specimen labels. Scale bars = 1 cm.



FIGURES 28-31

Thaumatobactron mayri, female. **28-30**, dorsal, lateral and ventral views; **31**, specimen labels. Scale bar = 1 cm.



FIGURES 32-34

Thaumatobactron mayri, egg. **32-34**, dorsal and lateral views, operculum in dorsal view. Scale bar = 1 mm.

REDESCRIPTION — ***Male***. (Figures 21-23). *Head*. Vertex rounded, smooth and shiny. Frons and mouth yellowish-brown; two small green spots between eyes. On top of head a large rhombic mid brown spot; posteriorly and laterally green on head. Eyes brown and convex. Antennae brown, all segment longer than wide, clearly defined, up to 35 antennomeres reaching almost the second abdominal segment. Almost same length as pronotum. Scapus and pedicel cylindrical; scapus longer than wide.

Thorax. Same color as head: brown with green patches and green bands. The thorax is dorsally almost smooth, with some few small tubercles, and ventrally smooth. Pronotum anterior with a bead and a cross furrow slightly before the middle. Anteriorly and lateral edges mostly green, and with a small triangular patch green behind the second smaller transverse furrow. Whole mesonotum margin with few small tubercles, and with green lateral band on each lateral edge. The mesonotum is more or less cylindrical, and at least 2.3x longer than wide. Almost 2.3x longer than the pronotum and almost 3x longer than the metanotum. Metanotum slightly arched, clearly separated from median segment. Each lateral edge green. Median segment slightly shorter and narrower than mesonotum. Mesopleuron brown, smooth. Metapleuron margin quite strong, green, with some coarse tubercles. Metanotum is slightly wider than the base of the mesonotum. Prosternum brown and dark greenish, a small black patch behind middle. Mesosternum and metasternum darker than prosternum, with a small black patch posteriorly, between legs; black patch larger on metasternum. Median segment about twice as wide as long and close in length to each tergum.

Legs. Legs large and robust. Legs almost entirely green, mid brown around knee joint. Coxae and trochanters brown, smooth. Femora and tibiae more or less quadrate in cross-section. Hind femora strongly larger than other femora. Hind leg with some distinct spines, fore- and midlegs are smooth. All other femora smooth. Hind femora with a thinner base, strongly carinate, strongly wrinkled and quadrate in cross-section. Hind leg general colour mid brown, femora with a green centre stripe dorsally and laterally, tibiae more or less mid brown greenish. Tibiae strongly curved backwards apically, in the first 2/3. In each dorsal and lateral hind femoral carinae, some minute spines are present. On hind femora, in ventral carinae, two large spines on the 2/3 base margin, two smaller near apical area. Hind tibiae are more or less finely bumpy,

with some spines more or less distinct. Hind tibiae with some ventral minute spines in the 2/3 apical and four more distinct spines surrounded. Two spines very large, the last two smaller. The first large spine is near basal area, the next one, slightly larger, is just behind the middle of the tibiae. Some minute spines follow and are surrounded by two other larger spines, the last one on apice. All tarsi stocky, mid brown. Basitarsus almost as long as the following two others. Metatarsus slightly flattened and slightly larger than other tarsi except for the last one.

Abdomen. Terga and sterna wider than long. Terga mid brown, with a green ring in the middle and lateral margin green. Abdominal sterna mid brown, with a large dark ring in middle of each one. Abdominal terga and sterna are almost smooth, some very small tubercles on terga edges. Terga II-VI similar size in length and width. Terga VII and VIII slightly widened. Last two terga tapering progressively in width. Anal segment slightly beyond end of operculum, margin curved down. Anal segment split posteriorly, very small epiproct. Operculum very glossy, distinctly compressed laterally, distinctly curved up. Cerci small, uniformly thick, rounded back and not protruding beyond anal segment.

Female. (Figures 24-31). *Head*. As in male, brown with some little parts green. Smooth and shiny. Frons and mouth yellowish-brown. Not narrowed posteriorly and almost 1.3x longer than wide. Almost same length than pronotum. Between the eyes a small shallow depression and two small green humps like two spots. Posteriorly and laterally, head green. Eyes mid brown and convex. Long antennae mid brown. More than 30 segments (antennae of the two studied specimens are broken). Each segment of various length, longer than wide, the first shorter than the last. Scapus and pedicel cylindrical; scapus longer than wide and almost 2.3x length of pedicel, and about twice length of other antennal segments.

Thorax. Similar to the male. Same color as head: mid brown with mid green lateral band on each side and basically. The thorax is dorsally almost smooth, with few and very small tubercles laterally. Thorax ventrally smooth. Pronotum is slightly longer than head and with a transverse groove in the almost 1/3 anterior part. Not only green laterally but on articulation border too. Mesonotum more or less cylindrical, and at least 2.3x longer than wide. Almost 2.5x longer than pronotum and almost 4x longer than metanotum. Mesonotum slightly enlarged basally. Few small indistinct tubercles at irregular intervals along entire length, mainly on each lateral edge, which has dark olive band. Metanotum is slightly wider than base of mesonotum. Median segment distinct but more slender than thorax. Prosternum mid brown, other ventral parts of body darker, notably mesosternum. Some darker or black patches posteriorly on mesosternum.

Legs. Similar to male, except for hind legs. Large, robust. Fore- and median legs mainly green; hind legs mid brown with a little green especially on tibiae. Legs with apice and base of femora and tibiae mid brown. Femora and tibiae more or less quadrate in cross-section. Tibiae twice more slender than femora in lateral view in fore- and median legs, slightly more for hind legs. Hind femora slightly larger than other femora and metafemora with two small spines. Hind tibiae more or less finely bumpy, with four distinct small spines. Fore- and midlegs are smooth. Metatarsus slightly flattened and slightly larger than other tarsi except for the last one. Basitarsus almost as long as the following two others. Basitarsus slightly longer in male than in female.

Abdomen. Close to male except anal segment and subgenital plate. Like head and thorax, terga mid brown, with lateral margin green. Abdominal terga and sterna are almost smooth, some small tubercles notably on the posteriorly margin of the last four terga. Terga and sterna wider than long. Terga II-VII similar size in length and width. Last three terga tapering slightly in width. Median segment about twice as wide as long and close in length of each tergum. Anal segment rounded posteriorly but with 5-7 blunt spines extending around its margin, the largest median. Anal segment slightly beyond end of operculum. Abdominal sterna darker than terga and with black rings apically on 1/3 to 1/4 of each abdominal segment. Cerci are small, cylindrical with small bristles. Operculum very short, slightly convex and smooth.

Egg. (Figures 32-34). Large, oval, barrel-shaped, 1,5x longer than wide. Capsule mid brown yellowish, the micropylar plate blackish brown. Operculum small, slightly oval, almost round, and conical, blackish brown on the collar edge, with some net-like structures like those of an orbital web spider. Micropylar plate small and slightly displaced towards the posterior of egg capsule; almost circular in shape, but the posterior area slightly truncated, blackish brown on the edge. Capsule, with slight net-like structure, more prominent and radially arranged on the operculum. Measurements (mm): length 3.35-3.46, width 2.22-2.27, height 2.49-2.68, length of micropylar plate: 0.9-1.5.

MEASUREMENTS — See Table 2.

TABLE 2
Measurements of *Thaumatobactron mayri* (mm).

Males, according to Günther (1930)			
Body	41	Metanotum & median segment	5.5
Pronotum	4	Profemora	9
Mesonotum	9	Mesofemora	8.5
Metanotum	3.5	Metafemora	13.5
Females			
Body	45.12-63.0	Profemora	7.98-10.0
Head	5.15-6.7	Protibiae	7.50-10.1
Antennae	> 23.71	Mesofemora	7.62-10.0
Pronotum	4.32-5.5	Mesotibiae	7.53-9.5
Mesonotum	11.05-13.9	Metafemora	10.67-13.9
Metanotum	2.28-4.00	Metatibiae	10.20-13.2
Median segment	1.97-2.3	-	-

REMARKS — Distribution, colour, size, smoothness, shiny body, and legs acanthotaxy place the four females studied here in the species *T. mayri*. In this species, the female and the egg were unknown and we described them for the first time. The four studied specimens are in poor condition. The female in MNHN lacks the subgenital plate, apical tergum X is somewhat damaged and the antennae are incomplete. Furthermore, the specimen is slightly discoloured. The specimen in CED lacks the extremity of the antennae and all tarsi, except for those of the forelegs, are damaged. There are some holes in the body, around the trochanter. Part of the colour has been lost too but one can also see the colour when the specimen was alive. A large part of antennae and anterior leg tarsae lack for both specimens of NHMUK; posterior left leg lacks for one of them. Both specimens of NHMUK are distinctly larger than the other.

Thaumatobactron poecilosoma Günther, 1929

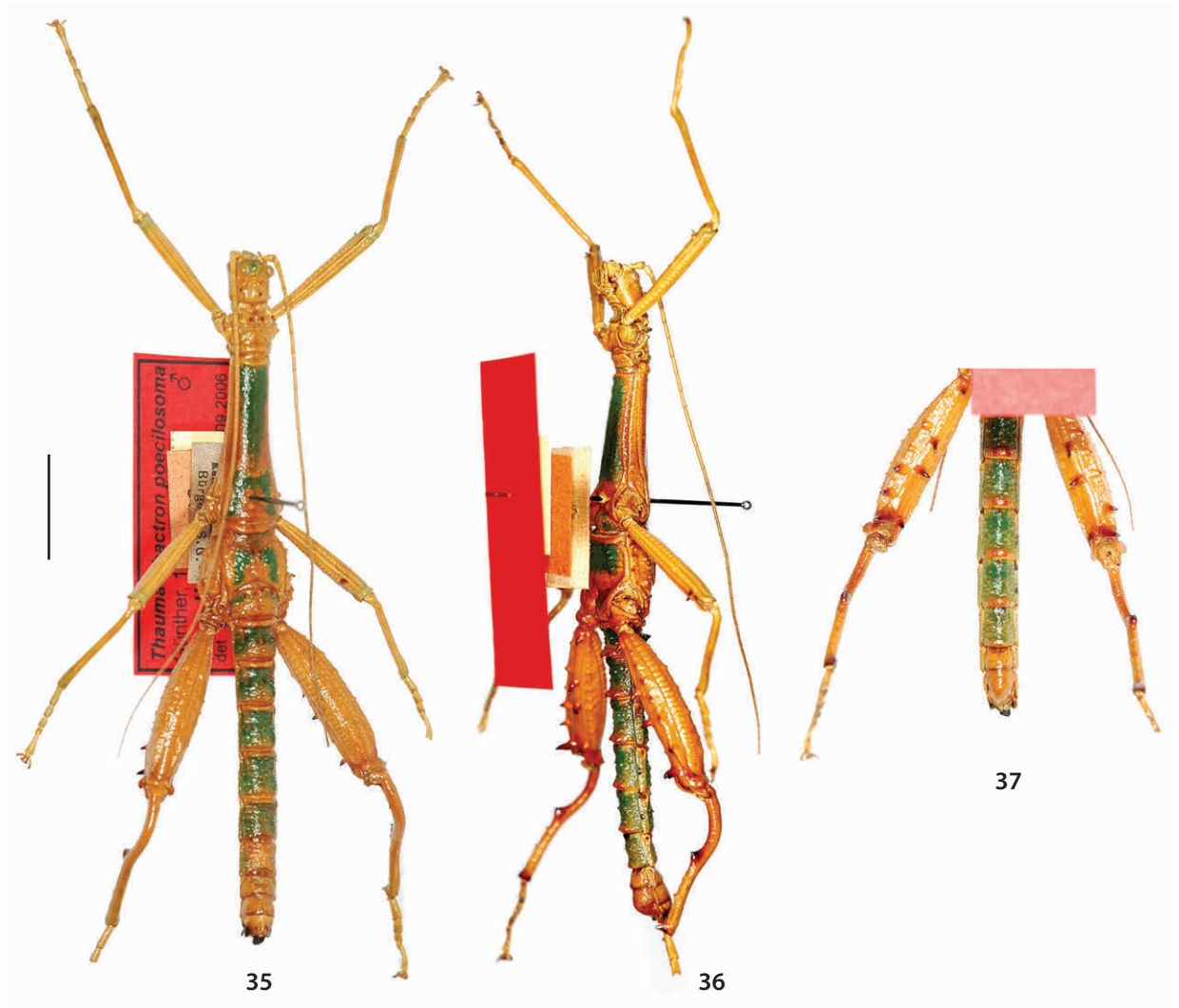
Figures 35-40

Thaumatobactron poecilosoma Günther, 1929: 664.

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. W-Neuguinea, Hunsteingebirge, Quellenlager, 990 m, leg. Bürgers, 13-16.VIII.1912 (MNHU). Paratypes (1 ♂, 2 ♀), Papua New Guinea. 1 ♂, Neuguinea, Etappenberg, 891 m, leg. Bürgers, 13-18.VIII.1912 (MNHU); 1 ♀ (noted as allotype), Neuguinea, Hunsteingebirge, Quellenlager, 990 m, leg. Bürgers, 13-16. VIII.1912 (MNHU); 1 ♀, Neuguinea, Schraderberg, 2000 m, 1-4.VI.1913 (MNHU). [examined]

OTHER MATERIAL EXAMINED— Papua New Guinea. 1 ♂, 1 ♀, Kais Wilhelmsland, Toricelli Gebirge, Dr. Schlag inhaufen, 1910, 1, *Thaumatobactron poecilosoma* Gthr, female, var. *immaculata* (MNHG).

DIAGNOSIS — ***Male***. (Figures 35-37). Large-size (70 mm), body surface densely granulose and rugulose; body pale ochre pale with green parts dorsally and ventrally, ventromedian spine of metatibiae about equal in size to apical spine, two apical spines on the other femora (Günther 1929; Hennemann & Conle 1997 & 1998).

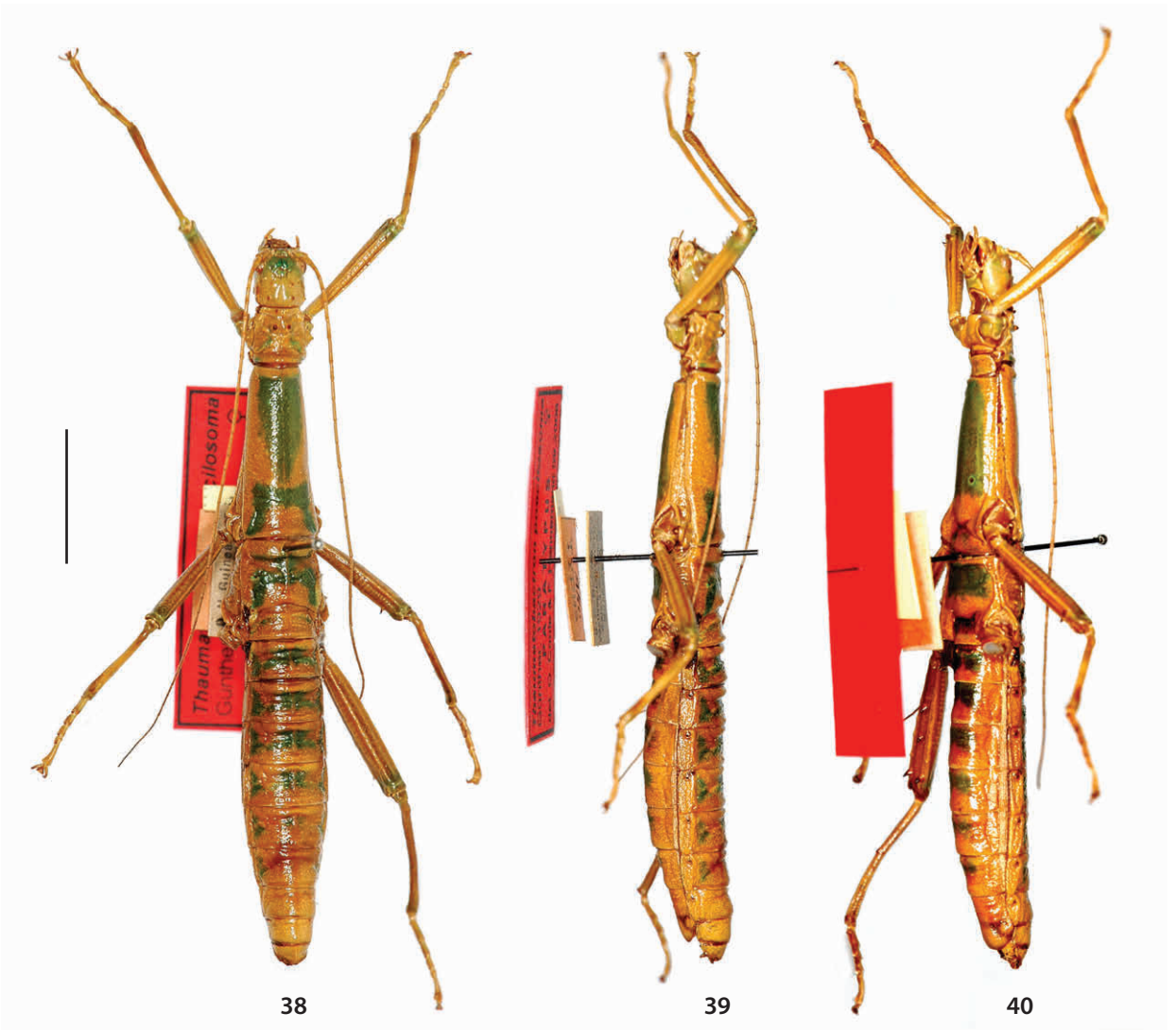


FIGURES 35-40

Thaumatobactron poecilosoma, male holotype & female paratype. **35-37**, dorsal, lateral and ventral views of male holotype (photos by F. Hennemann); **38-40**, dorsal, lateral and ventral views of female paratype (photos by F. Hennemann). Scale bar = 1 cm

Female. (Figures 38-40). Large-size (68,2 mm), body finely granulose and rugulose with some distinct spines on pronotum; same color and head with the same features as male; four distinct small ventral spine on metatibiae; two apical spines on each femora (Günther 1929; Hennemann & Conle 1997 & 1998).

Egg. Unknown.



Thaumatobactron pulchracaelatura n. sp.

Figures 41-44

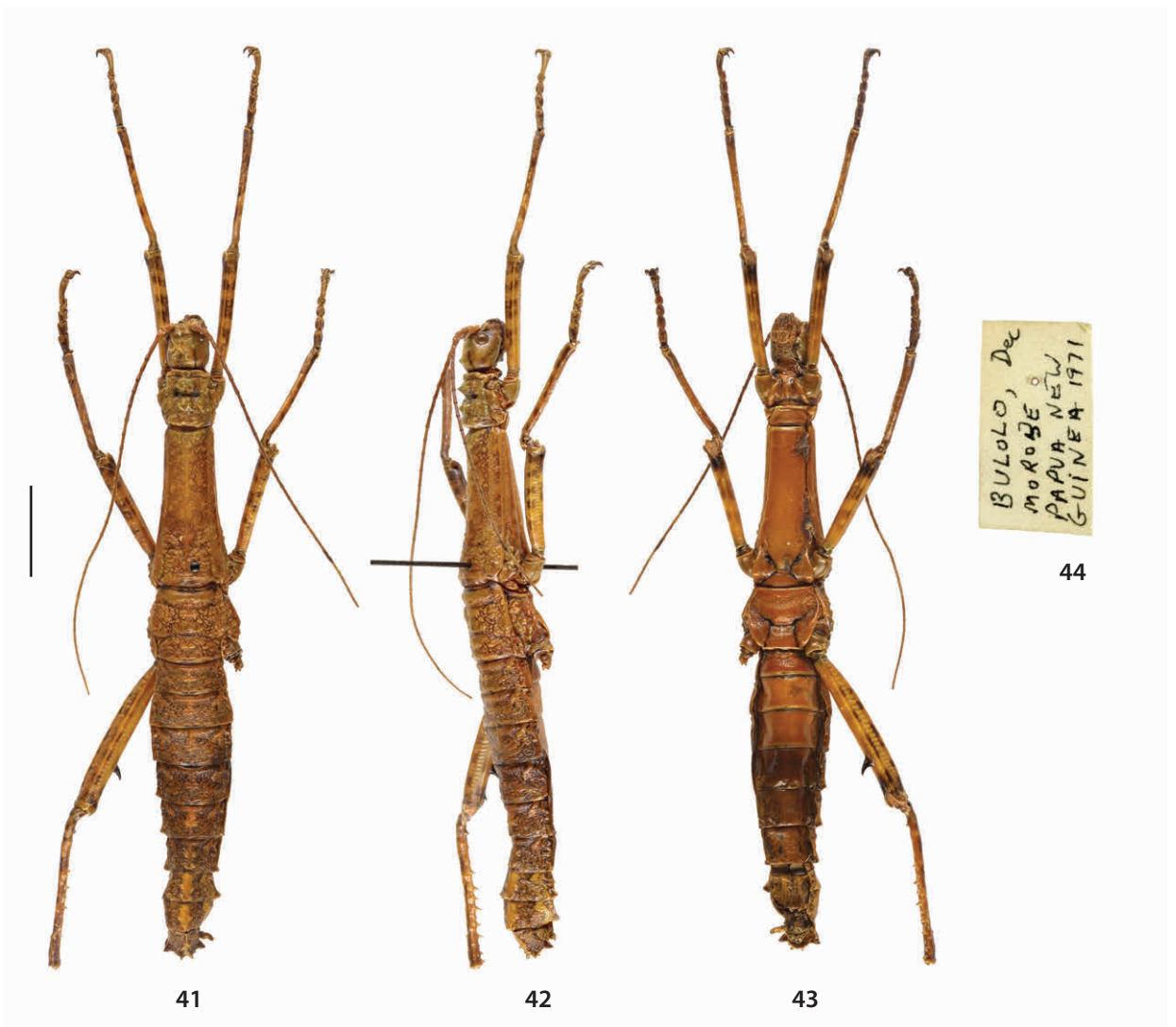
TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Bulolo, Morobe, Dec 1971 (NHMUK).

ETYMOLOGY — From *pulchra* (beautiful) and *caelaturum* (sculpture), named after its abdomen, which looks beautifully carved.

DIAGNOSIS — Female. Size medium (71 mm), very rough body, without spines; ventral sides of abdomen shiny and smooth; metafemora ventrally with one large black back-curved spine in apical third and a smaller near ape; metatibiae with a series of small spines ventrally; body and legs yellowish brown, slightly lighter ventrally.

DESCRIPTION — ***Female***. *Head*. Light brown. ca. twice longer than wide, same length as pronotum, slightly less wide than mesonotum. Between eyes two small bumps; two small blunt thorns on the occiput. Eyes convex, small, brown and darker than head color. Antennae long, light brown: with at less 34 segments. Each segment longer than wide and of varying length, basal segment shorter than others. Scapus slightly flattened basally and pedicel cylindrical; scapus longer than wide and longer than pedicel. Some parts of head slightly greenish brown.

Thorax. Dorsally, same color as head with always some parts slightly greenish brown. Pronotum about as long as head; dorsally two small apical bumps and two others basal, with other bumps and other rough structures. Mesonotum cylindrical, about 3x length of pronotum; basally enlarged, slightly wider than pronotum. Mesonotum slightly rough apical



FIGURES 41-44

Thaumatobactron pulchracaelatura n. sp., male. **41-43**, dorsal, lateral and ventral view; **44**, specimen labels. Scale bar = 1 cm.

2/3 and strongly rough basally with a lot of small bumps, asymmetrically placed. Small apical part slightly greenish brown. Metanotum about twice wider than mesonotum in its narrowest section and more than 1/4 of its length. Metanotum strongly rough with a lot of small bumps, asymmetrically placed. Some bumps slightly greenish brown. Pro-, meso- and metasternum shiny and smooth. Pro-, meso- and metasternum slightly lighter than pro-, meso- and metanotum, more reddish brown.

Legs. Robust, slightly yellowish as body, dark brown ringed. Pro- and median legs thiner, femora being less than twice as thick as tibiae. Pro- median tibiae cylindrical. Pro- and median femora strongly keeled and wrinkled, legs slightly quadrate in cross-section. Pro- and median femora and tibiae without spine. Pro- and median tibiae smooth. Hind femora slightly quadrate in cross-section, slightly larger and thicker than pro- and medianfemora. Metafemora ventrally with one large black back-curved spine in apical third and a smaller near apex, and metatibiae with a serie of a dozen of small spines ventrally. Metatibia also with a small sort of carinae in apical quarter ornated with rare small spines dorsally.

Abdomen. Median segment ca 2.5 as wide as long; slightly smaller than segments II-X. Abdominal terga segments II-IX a similar size. Tergum X slightly smaller in length than segments II-IX. Abdominal terga wrinkled with small asymetrical humps, and some distinct rafters on tergum II-VIII. Tergum widens further to each segment on apical edge, making a kind of outwardly directed tip, from segment IV to tergum VIII. Tergum IX slightly narrowed apically. Anal segment small, slightly smaller than other terga, with a distinct longitudinal carinae, two small blunt spines near apex and eight more or less blunt spines of different size around apex. Sterna smooth and slightly lighter than terga. Cerci small, cylindrical and finger-like, slightly curved, slightly tapering from half, rounded tip.

Male. Unknown.

Egg. Unknown

MEASUREMENTS — See Table 3.

TABLE 3
Measurements of female holotype of *Thaumatobactron pulchracaelatura* n. sp. (mm).

Body	71	Profemora	13.5
Head	6.5	Protibiae	13.5
Antennae	42,5	Mesofemora	12.5
Pronotum	6	Mesotibiae	12.5
Mesonotum	17.5	Metafemora	18.5
Metanotum	5	Metatibiae	18.5
Median segment	3	-	-

REMARKS — The holotype is missing the following parts: right antenna apical segments (27 segments), left antenna (34 segments), right leg (start of limb regeneration), left tarsus. Alive, the specimen may have been a little greener.

Thaumatobactron pygminerme n. sp.

Figures 45-54

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Nouvelle-Guinée, Mt Wilhelm, 3700 m, forêt de mousse hors parcelle, 5°47'23.2"S 145°03'33.1"E, 3574 m, 15.X.2012, nuit, FL18, sur plante, Muséum de Paris, Papouasie-Nouvelle-Guinée, F. Legendre & T. Robillard rec. (MNHN-EO-PHAS1084). Paratypes (2 ♂, 3 ♀), Papua New Guinea. 1 ♂ Nouvelle-Guinée, Mt Wilhelm, 3700 m, forêt de mousse hors parcelle, 5°47'23.2"S 145°03'33.1"E, 3574 m, 15.X.2012, jour, mousse, bois mort, FL5, Muséum de Paris, Papouasie-Nouvelle-Guinée, F. Legendre & T. Robillard rec. (MNHN-EO-PHAS1086); 1 ♂ Nouvelle-Guinée, Mt Wilhelm, 3700 m, forêt de mousse hors parcelle, 5°47'23.2"S 145°03'33.1"E, 3574 m, 15.X.2012, FL17, nuit, sur plante, Muséum de Paris, Papouasie-Nouvelle-Guinée, F. Legendre & T. Robillard rec. (MNHN-EO-

PHAS1085); 1 ♀, Mt Wilhelm, 3700 m, forêt de mousse hors parcelle, 5°47'23.2"S 145°03'33.1"E, 3574 m, 15.X.2012, jour, mousse, FL6, Muséum de Paris, Papouasie-Nouvelle-Guinée, F. Legendre & T. Robillard rec. (MNHN-EO-PHAS1087); 1 ♀, Mt Wilhelm, 3700 m, forêt de mousse hors parcelle, 5°47'23.2"S 145°03'33.1"E, 3574 m, 15.X.2012, nuit, FL15, sur plante, Muséum de Paris, Papouasie-Nouvelle-Guinée, F. Legendre & T. Robillard rec. (MNHN-EO-PHAS1088); 1 ♀, Nouvelle-Guinée, Mt Wilhelm, 3700 m, forêt en bord du lac, GPS HP2, 5°47'28.6"S 145°03'18.8"E, 3541 m, 16.X.2012, nuit, TR47, sur plante, arbuste, Muséum de Paris, Papouasie-Nouvelle-Guinée, F. Legendre & T. Robillard rec. (MNHN-EO-PHAS1090).

OTHER MATERIAL EXAMINED — Papua New Guinea. 1 ♀ subadult, Mt Wilhelm, 3700 m, forêt de mousse hors parcelle, 5°47'23.2"S 145°03'33.1"E, 3574 m, 15.X.2012, jour, FL7, bois mort, Muséum de Paris, Papouasie-Nouvelle-Guinée, F. Legendre & T. Robillard rec. (MNHN-EO-PHAS1089).

ETYMOLOGY — From *pygmaei* (means "very small") and *inermis* (smooth), named after its small size and shiny coloration.



FIGURES 45-48

Thaumatobactron pygminerme n. sp., male holotype. **45-47**, dorsal, lateral and ventral views; **48**, specimen labels. Scale bar = 1 cm.

DIAGNOSIS — Very small (21-27 mm), shiny and stocky, body almost smooth. Male. Colorful, dorsally and ventrally with a blue green body. Legs more or less yellowish green color on the most part of femora, and red on the end of femora, on tibiae and tarsi. Female. With a dark brown body, almost black. Legs brown and ringed with a lighter brown.

DESCRIPTION — ***Male***. (Figures 45-49). *Head*. Blue green, slightly brownish basally. Smooth and shiny, not narrowed posteriorly. About 1.5x longer than wide. Almost same length as pronotum. Eyes black and convex. Long red antennae with 26 segments. Each segment of various length, longer than wide, the first shorter than the last. Scapus and pedicel cylindrical; scapus longer than wide and almost slightly longer than pedicel, and sometimes longer or smaller than the other antennal segments.

Thorax. Dorsally and ventrally smooth and same color as head, blue green slightly brownish around each joint segment and on lateral edges of the body. Pronotum slightly longer than head and almost as long as wide. Mesonotum is more or less cylindrical, and about 1.4x longer than wide. Almost twice longer than pronotum and almost 4.2x longer than the metanotum. A distinct thin darker line along mesonotum. Metanotum slightly wider than base of mesonotum. Median segment distinct but slenderer than thorax.



FIGURE 49

Thaumatobactron pygminerme n. sp., male holotype. Living male in its natural habitat during the day (photo by F. Legendre).

Legs. Robust; fore- and median legs, femora yellowish with brown rings basally to middle part, and red since centre to apical part; tibiae red; tarsae red and reddish brown. Hind femora mostly yellowish green and red apically; tibiae red; tarsae like other legs. Femora and tibiae more or less quadrate in cross-section. Tibiae 1.5x slenderer than femora in lateral view in fore- and median legs, about 5x for hind legs. Fore- and midlegs smooth. Hindfemora larger and longer than other. Hind femora ventrally armed with a large and sharp spine around the middle and two small other acute and close to apex. Hind tibiae ventrally rugose with three of four large and blunt spines and two or three others smaller. Metatarsus slightly flattened and slightly larger than each other tarsi except for last one. Basitarsus slightly longer than other tarsomeres, except pretarsus.

Abdomen. Dorsally and ventrally last four abdominal terga and sterna brownish red, thers blue green with each joint segments and lateral edges brownish; a distinct brownish spot on centre of joint segments. Abdominal terga and sterna smooth. Terga and sterna wider than long. Terga II-VII as long as wide. Last three terga tapering distinctly in width. Median segment more or less same size as each tergum. Anal segment slightly shorter than previous abdominal segment. Cerci small, cylindrical, slightly tapering in width, apex rounded, covered with small bristles.

Female. (Figures 50-54). *Head*. Dark brown, almost black, with. Smooth and shiny and not narrowed posteriorly. About 1.5x longer longer than wide. Almost same length than pronotum. Eyes black and convex. Long antennae dark brown with 28 segments. Each segment of various length, longer than wide, first one shorter than last. Scapus and pedicel cylindrical; scapus longer than wide and almost slightly longer than pedicel, and sometimes longer or smaller than other antennal segments.



FIGURES 50-54

Thaumatobactron pygminerme n. sp., female paratype. **50-52**, dorsal, lateral and ventral views; **53**, specimen labels. Scale bar = 1 cm.

Thorax. Dorsally, same color as head but slightly lighter in middle, with dark reddish-brown color; ventrally, dark reddish brown. Thorax dorsally and ventrally smooth. Pronotum slightly longer than head and almost as long as wide. Mesonotum more or less cylindrical, about 1.4x longer than wide. Almost twice longer than pronotum and almost 4.5x longer than metanotum. Metanotum slightly wider than base of mesonotum. Median segment distinct but slenderer than thorax.

Legs. Robust brown, with light brown yellowish rings. Femora and tibiae more or less quadrate in cross-section. Tibiae 1.5x slenderer than femora in lateral view in fore- and median legs, about twice for hind legs. Fore- and midlegs are smooth. Hind femora slightly larger and longer than other. Hind femora ventrally armed with a sharp spine in middle and two other acute and close to apex. Metatarsus slightly flattened and slightly larger than each other tarsi except for the last one. Basitarsus slightly longer than the other tarsomeres, except the pretarsus.

Abdomen. Coloration like thorax, but with a larger and distinct dark reddish-brown spot in middle, particularly on terga II to VII. Abdominal terga and sterna smooth. Terga and sterna wider than long. Enlarged abdomen in mature female. Terga II-VI similar size in length and width. The last four terga tapering distinctly in width. Median segment more or less same size as each tergum. Anal segment slightly cut shaped posteriorly. Anal segment distinctly beyond end of operculum. Small rounded epiproct distinct. Cerci are small, cylindrical, slightly tapering in width, apex rounded, covered with small bristles. Operculum very short, slightly convex and smooth.

Egg. Unknown.

MEASUREMENTS — See Table 4.



FIGURES 54

Thaumatobactron pygminerme n. sp., female paratype. Living specimen in its natural habitat during the night (photo by T. Robillard).

TABLE 4
Measurements of *Thaumatobactron pygminerme* n. sp. (mm).

Male holotype. Note: three tarsomeres are missing on the median right leg			
Body	22.75	Profemora	5.17
Head	2.94	Protibiae	5.50
Antennae	16.84	Mesofemora	5.08
Pronotum	2.36	Mesotibiae	4.92
Mesonotum	5.16	Metafemora	9.95
Metanotum	1.31	Metatibiae	6.50
Median segment	1.38	-	-
Male paratypes			
Body	20.84-23.66	Profemora	4.98-5.20
Head	2.32-2.78	Protibiae	5.16-5.40
Antennae	15.79	Mesofemora	4.85-4.92
Pronotum	2.30-2.45	Mesotibiae	4.85-4.99
Mesonotum	4.58-4.99	Metafemora	7.13-8.17
Metanotum	0,82-1.37	Metatibiae	5.79-6.97
Median segment	1.23-1.70	-	-
Female paratypes			
Body	25.38-27.03	Profemora	5.63-6.03
Head	2,95-3.27	Protibiae	5.63-6.58
Antennae	16.42-18.57	Mesofemora	4.85-5.67
Pronotum	2.65-3.13	Mesotibiae	5.40-6.13
Mesonotum	4.70-6.65	Metafemora	7.37-8.63
Metanotum	1.22-1.50	Metatibiae	7.50-8.71
Median segment	1.07-1.35	-	-

Thaumatobactron robillardi n. sp.

Figures 55-59

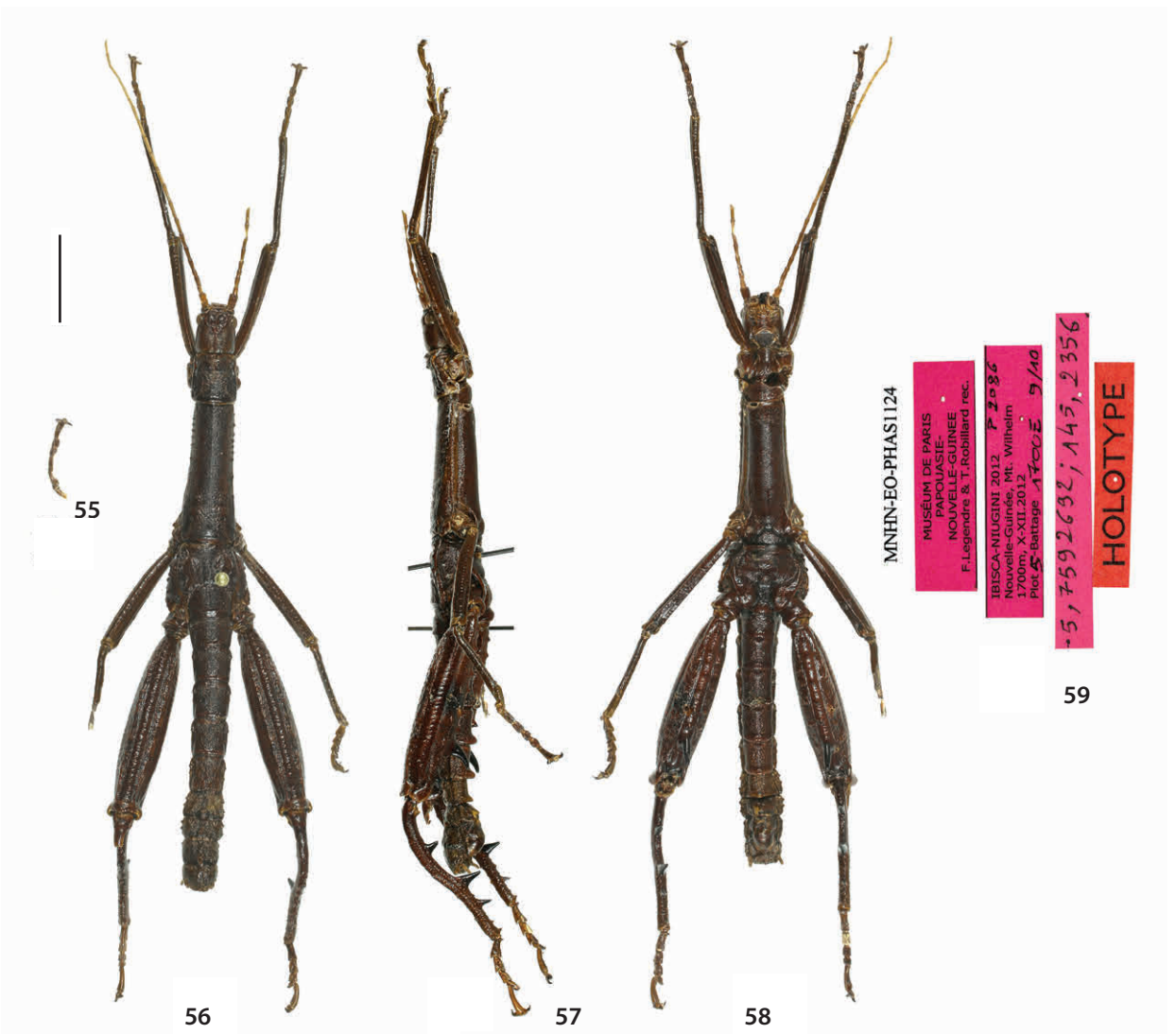
TYPE MATERIAL —Holotype, ♂, **Papua New Guinea**. Papouasie-Nouvelle-Guinée, Our Planet Reviewed – Papua New Guinea Mt Wilhelm, -5,7592692 145,2356, 1700 m, Plot 5 Battage, P2086, 1700 m, 9/10, X-XII.2012, F. Legendre & T. Robillard (MNHN-EO-PHAS1124).

ETYMOLOGY — Named after Tony Robillard, who collected this species in New Guinea. Tony Robillard is a French entomologist working in the MNHN. He is a specialist on Orthoptera Ensifera, especially Eneopterinae crickets.

DIAGNOSIS — Male. Size medium (63.36 mm), rather smooth body, with occasional roughness and minutes spines; ventral sides of abdomen with some bumps; two-minute spines on profemora, same on protibiae; metafemora with one large spine and metatibiae with three large spines; body and legs entirely brown.

DESCRIPTION — ***Male***. *Head*. Brown. More than 3/4 longer than wide, slightly longer than pronotum, more or less as wide as mesonotum. Between eyes two small bumps. Eyes convex, small, greyish brown, paler than head color. Antennae long, light brown: with more than 21 segments. Each segment longer than wide, basal segment shorter than others. Scapus slightly flattened, pedicel cylindrical; scapus longer than wide, about same length as pedicel and first antennal segments.

Thorax. Dorsally, with same color than head. Pronotum is about 90 % of the longer of the head; two small bumps on the apical part. Mesonotum cylindrical, about 3x length of pronotum; basally enlarged, but slightly wider than pronotum. Mesonotum rather smooth with just a serie of blunt minute blunt thorns on each border sides especially in the apical part. Metanotum more than twice wider than mesonotum in its narrowest section and 1/3 of its length. Metanotum with one flat hump, some rare granules on the border. Pro- and mesosternum smooth; metasternum with a smaller hump. Pro-, meso- and metasternum same colour as pro-, meso- and metanotum.



FIGURES 55-59

Thaumatobactron robillardi n. sp., male. **55**, left apical tibiae and tarsi; **56-58**, dorsal, lateral and ventral views; **59**, specimen labels. Scale bar = 1 cm.

Legs. Robust and entirely brown. Pro- and median legs thiner, femora twice as thick as tibiae. Pro- and median tibiae cylindrical. Pro- and median femora strongly keeled and wrinkled, legs slightly quadrate in cross-section. Forelegs with two minutes spines on tibiae, one in first 1/3, second in 2/3 part; pro- and median femora with two small apical spines. Median tibiae smooth. Hind femora c. 3x larger in median area than fore and mid femora; hind tibiae ca. 1.5x larger than fore and mid tibiae. Hind femora strongly carinate, strongly wrinkled and quadrate in cross-section. In each dorsal and lateral carinae, some rare small blunt spines present. Ventrally, a central serie of 5-7 blunt minute spines until a large and long acute spine curved backwards, close to apex, and two last small apical spines. Last spines slightly larger than others. Tibiae slightly curved forward basally; ventrally with eight spines, three larger than the other, especially the central spine almost as long as large spine of femora; dorsally, more or less two series of a dozen of blunt spines. Metatarsus slightly flattened and slightly larger than other tarsal segments, except the last.

Abdomen. Median segment ca. twice wide as long; slightly smaller than segments II-VI. Abdominal tergum segments II-VI with similar size. Terga VII-IX of similar size but slightly smaller in length than segments II-VI. Abdominal terga wrinkled with some small humps. Terga II-VII with two spines on each border of the tergum but more marked on two last ones, VI and VII. Terga VI-VII slightly flatter and slightly wider than others. Anal segment small, slightly smaller than other terga; rounded shape with a longitudinal hull. Sterna with same color as terga. Sterna with a long hump on each apical area, following ventral articulation. Cerci small, cylindrical, slightly tapering, rounded tip.

Female. Unknown.

Egg. Unknown.

MEASUREMENTS — See Table 5.

TABLE 5
Measurements of male holotype of *Thaumatobactron robillardi* n. sp. (mm).

Body	63.36	Profemora	13.37
Head	5.60	Protibiae	13.11
Antennae	33	Mesofemora	13
Pronotum	5.11	Mesotibiae	11.31
Mesonotum	15.45	Metafemora	20.97
Metanotum	4.43	Metatibiae	17.30
Median segment	3.60	-	-

REMARKS — Male holotype with right antenna in very poor condition (9 segments), left antenna incomplete (21 segments), left median leg broken at the tibia with 1/3 missing, the knee of the left rear leg damaged, a large hole on the right side of the prosternum.

Thaumatobactron spinosissimum Hennemann & Conle, 1998

Figures 60-63

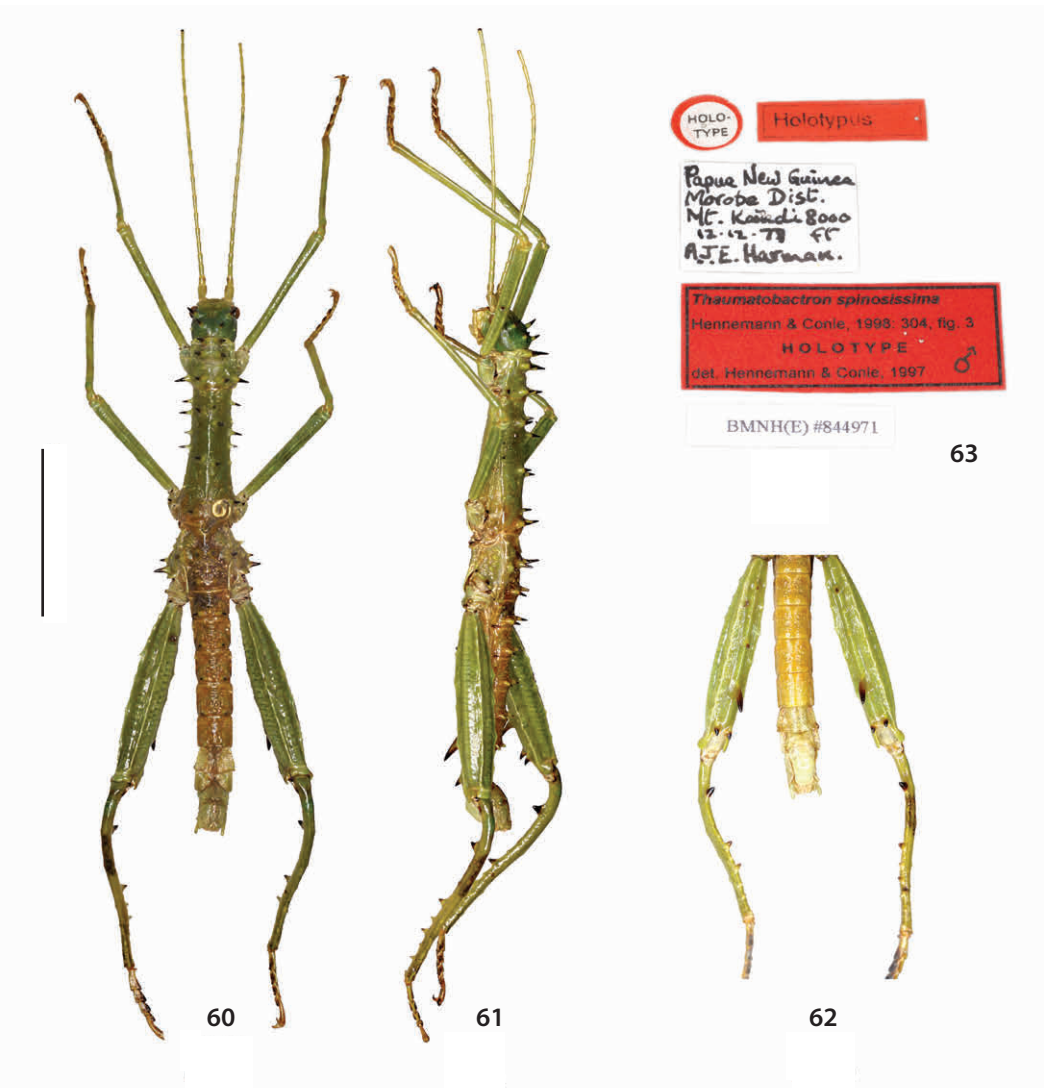
Thaumatobactron spinosissima Hennemann & Conle, 1998: 304.

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Prov., Mt. Kaindi, 8 000 ft., 12.XII.1979, A. Harman leg. (NHMUK). Paratypes (2 ♂), **Papua New Guinea**. 1 ♂, Morobe Prov., Mt. Kaindi, 2360 m, 4.V.1981, A. Harman leg. (NHMUK); 1 ♂, Morobe Province Mount Kaindi ca 8,000 feet 12 XII 1977 AJE Harman, *Thaumatobactron spinosissima* ♂, det. Hennemann & Conle, 1998 (NHMUK). [examined]

DIAGNOSIS — ***Male***. Size medium (38-39 mm), body slender more or less green; head and body acutely spinose with long thin sharp spines; a very large back-curving spine ventro-medially on metafemora, with some other small spines notably the two larger at the apex; more or less seven spines ventrally on metatibiae (Hennemann & Conle 1998).

Female. Unknown.

Egg. Unknown.



FIGURES 60-63

Thaumatobactron spinosissima, male. **60-62**, dorsal, lateral and ventral views (pictures of P. Brock); **63**, specimen labels (pictures of P. Brock). Scale bar = 1 cm.

Thaumatobactron unicolor Hennemann & Conle, 1998

Figures 64-66

Thaumatobactron unicolor Hennemann & Conle, 1998: 302.

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Morobe Prov., Shore of L. Trist 6000 ft., 2.XI.1979, I. Redmond leg., B.M. 1983-63 (NHMUK). [examined]

DIAGNOSIS — ***Male***. Size medium (37 mm), body shiny and smooth, colour plain dark reddish brown. Four larges back-curved spines and three smaller on metafemora; ventromedian spine of metatibiae very large, flattened and noticeably larger than apical spine; a serie of more or less six dorsomedian small spines (Hennemann & Conle 1998).

Female. Unknown.

Egg. Unknown.



FIGURES 64-66

Thaumatobactron unicolor, male. **64-65**, dorsal and lateral view (pictures of P. Brock); **66**, specimen labels (pictures of P. Brock). Scale bar = 1 cm.

DISCUSSION

Until now, *Thaumatobactron* was only known from the eastern part of New Guinea, and we are still lacking information even with new data of previously described species (Hennemann & Conle 1997, 1998). Its distribution thus remains little known due to expeditions carried out in the same location. Discovering of *T. bretoni* n. sp. shows that this genus has a much larger distribution than the one we knew before and that we need more investigations for a better knowledge of this group.

Thaumatobactron pygminerme n. sp. is a remarkable species in this genus for various reasons. Females in *Thaumatobactron* genus are always poorly known. In previously described species *T. mayri*, *T. guentheri* and *T. poecilosoma*, the females are very similar to the males, apart from more and larger spines and larger hind legs. But in *T. pygminerme* n. sp. there are significant differences of coloration between male and female. The male is very colourful, a nuanced bright color, with a mixture of blue, green yellow, red and brown, while the female is darker, and dark brown.

The genus *Thaumatobactron* includes some relatively small species, but *T. pyginermis* n. sp. is particularly small, being the smallest species of the group. Indeed, while other species have a body length length ranging between 35 and 70 mm (Günther 1929, 1930; Hennemann & Conle 1997, 1998), *T. pygminerme* n. sp. has a body length between 21 mm and 27 mm.

Eggs of two species of *Thaumatobactron* are described here for the first time and allow to further confirm the relationship to Lonchodidae, the family where the genus is currently placed (Robertson *et al.* 2018). Species of this family are characterized by a rather flattened operculum on top, they are large, oval, barrel-shaped, with a small, slightly oval operculum, which necessarily brings them closer to the Eurycanthini, with more pronounced net-like structures on the capsule and less elongated than in the genus *Eurycantha* Boisduval, 1835, also endemic to New Guinea (Clark-Sellick 1997; Delfosse 2002).

IDENTIFICATION KEYS FOR *THAUMATOBACTRON* GÜNTHER, 1929

Males

1. Body length < 30 mm. Metafemora with three ventral spines, metatibiae with more or less seven blunt ventral spines; shiny and smooth body, blue green body with some brown on joint parts and on three last abdominal segments; yellowish green femora, with brown rings for fore- and median femora, and red tibiae ..... *T. pygminerme* n. sp.

– Body length > 30 mm **2**

2. Metafemora with a very prominent, blunt and back-curving spine ventro-medially **3**

– Metafemora with several ventral spines of variable sizes, no enlarged ventro-medial spine **6**

3. Head and body acutely spinose; more or less green, slender ..... *T. spinosissima*

– Head and body granulose, rugulose or covered with enlarged humps, few spines notably on the pronotum **4**

4. Posterior margin of anal segment with six finger-like lobes; metatibiae only with minute, blunt spinules ventrally and some low humps dorsally; basal spine blunt; brown body, fore- and median legs more or less green ..... *T. granulosum*

– Posterior margin of anal segment without finger-like lobes **5**

5. Metatibiae with a basal spine; the apical half with five equally sized spines extero-ventrally; brown body and green legs ..... *T. harmani*

– Metatibiae with two enlarged spines ventrally; no basal spine; anal segment without lobes; green head, mid brown body, longitudinal lateral green stripe on the body, fore- and median legs green ..... *T. mayri*

6. Metatibiae with two or more spines ventrally **7**
– Metatibiae only with a single large spine ventro-medially **9**

7. Metatibiae with two long, forward directed spines ventrally; pale ochre, body surface shiny; head with three dark brown longitudinal stripes ..... *T. guentheri*
– Metatibiae with more than two spines **8**

8. Metatibiae with three large spines, the median spine significantly longer than the both other and almost as large as that of the metafemora; body and legs entirely brown ..... *T. robillardi* n. sp.
– Metatibiae with minute spines ventrally; a large hump on the metanotum; posterior margin of anal segment with one finger-like lobe on each side; shiny, red brown body and black brown legs ..... *T. bretoni* n. sp.

9. Ventromedian spine of metatibiae very large and noticeably larger than apical spine; body surface smooth and shiny; colour plain dark reddish brown ..... *T. unicolor*
– Ventromedian spine of metatibiae about equal in size to apical spine; body surface densely granulose and rugulose; body pale ochre pale ochre with green parts dorsally and ventrally ..... *T. poecilosoma*

Females

1. Body length < 30 mm. Metatibiae smooth, metafemora with three small ventral spines; dark brown shiny body, brown legs ringed with light brown ..... *T. pygminerme* n. sp.

– Body length > 30 mm **2**

2. Minute ventral spines on pro- and mesotibiae; two distinct ventral spines on metatibiae; granulose body but no distinct spines; pale ochre body and with three dark brown longitudinal stripes on the head .....
..... *T. guentheri*
– Pro- and mesotibiae smooth **3**

3. Shiny and smooth body **4**
– Granular and matt body **5**

4. Metatibiae with four distinct small spines; metafemora with two small spines ; anal segment with six spines around its margin; green head, mid brown body, longitudinal lateral green stripe on the body, fore- and median legs more or less green; body length 45-46 mm ..... *T. mayri*
5. Finely granular body; two apical spines on each femora; four distinct small ventral spine on metatibiae; granulose body; granulose body with some distinct spines on pronotum; pale ochre body with green parts dorsally and ventrally ..... *T. poecilosoma*
– Very rough body; metafemora ventrally with one large black back-curved spine in the apical 1/3 and a smaller near the apex; metatibiae with a serie of small spines ventrally; eight blunt spines on the anal segment; yellowish body and brown dark ringed legs ..... *T. pulchracaelatura* n. sp.

Eggs

1. Capsule oval, almost round-shaped, capsule with large net-like structure, slightly granulose on the operculum; large collar; micropylar plate large and in the centre of the capsule; capsule mid brown yellowish .....
..... *T. guentheri*
– Capsule oval, barred-shaped, capsule with slight net-like structure, more prominent and radially arranged on the operculum, small collar; micropylar plate small and toward the posterior part of the capsule; capsule brown ..... *T. mayri*

ACKNOWLEDGEMENTS

First of all we want to thank Tony Robillard (MNHN) for the access to the stick-insects collection, for his pictures and informations about material he collected, and for the corrections and comments on our manuscript. Many thanks to Paul Brock (NHMUK), Nicolas Cliquennois (Madagascar), Frédéric Legendre (MNHN), Adrian Plant (Department of Biology, Faculty of Science, Mahasarakham University, Thailand), to Frank Hennemann and Oskar Conle (Germany) for their help, for additional material, pictures, corrections and comments on our work. We are also greatly indebted to George Beccaloni (Wallace correspondence Project), Judith Marshall (NHMUK) and for the access of the collection and for the loan form, corrections and comments on our work, for their help in various degree, and to Simon Poulain (MNHN) for his help, hospitality and for preparing some specimens. Finally we are greateful to Stéphane Boucher (MNHN), John Hollier (MNHG), Tony Jourdan (ASPER) and Christophe Hervé (MNHN) for the provided informations. MNHN gives access to the collections in the framework of the RECOLNAT national Research Infrastructure (ANR-11-INBS-0004)." This study was conducted in the framework of "Our Planet Reviewed – Papua New Guinea 2012-2013" set up by Pro-Natura International, the Muséum national d'Histoire naturelle (MNHN, France), the Institut de Recherche pour le Développement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation and the Belgian National Lottery. The IBISCA expert network, the patron for this project, Prof. R.L. Kitching AM, and all other participants in this collective effort are thanked for their contribution.

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Adult female of a praying mantis of the genus *Hierodula* (Mantidae).
(Photo © Xavier Desmier; identification: Nicolas Moulin).

Termites among wood decomposers along an elevational gradient in Papua New Guinea

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ABSTRACT

To evaluate the place of termites among wood decomposers along an elevational rainforest gradient, dead wood was sampled for xylophageous insects at 500 m elevation intervals (200-3700 m) on the slopes of Mount Wilhelm, Papua New Guinea. Termites, represented by 14 species, were dominant at low elevations (200-700 m) but were not found above 1200 m. Passalid beetles were present from 200 to 2700 m, with maximum frequency at middle elevations (1200 m), whereas Panesthiinae cockroaches were most common in montane forest (1700-2200 m). These observations suggest that the three major wood-feeding taxa may compete for resources, but with energetic constraints on social life limiting the distribution of termites to leave higher elevations to passalids and panesthiines.

RÉSUMÉ

Les termites parmi les décomposeurs de bois mort le long d'un gradient d'altitude en Papouasie-Nouvelle-Guinée.

Afin d'évaluer la place des termites parmi les décomposeurs de bois le long d'un gradient d'altitude, les insectes xylophages ont été échantillonnés à des intervalles d'altitude de 500 m (200-3700 m) dans le bois mort des forêts pluvieuses sur les pentes du Mont Wilhelm, Papouasie-Nouvelle-Guinée. Les termites, représentés par 14 espèces, étaient dominants aux basses altitudes (200-700 m) mais absents au-dessus de 1200 m. Les coléoptères Passalidae étaient présents de 200 à 2700 m, avec une fréquence maximale aux altitudes moyennes (1200 m), tandis que les blattes Panesthiinae étaient les plus communes en forêt de montagne (1700-2200 m). Ces observations suggèrent que les trois taxa xylophages majeurs peuvent être en compétition pour les ressources, mais que les contraintes énergétiques sur la vie en société limitent la distribution des termites pour laisser les hautes altitudes aux passalides et panesthiines.

ROISIN Y. 2020 — Termites among wood decomposers along an elevational gradient in Papua New Guinea, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds), Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 509-520 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

INTRODUCTION

Insects and fungi play a major role in the decomposition of wood in tropical rainforests. In lowland forests, termites occupy a dominant place among wood feeders (Martius 1994, Berge *et al.* 2008). However, although the effect of elevation on termite assemblages has seldom been quantified, termite abundance and diversity clearly decline from lowland to montane forests (Collins 1980; Thomas & Proctor 1997; Gathorne-Hardy *et al*. 2001; Palin *et al.* 2011). Likewise, in the Brazilian cerrado, observed termite species richness dropped from 32 at 835 m to 14 at 1386 m (Nunes *et al.* 2017). In our own records from New Guinea, totalling 60 species of Termitidae and Rhinotermitidae, only one (*Schedorhinotermes translucens*) was found above 2000 m (Bourguignon & Roisin 2011).

The reason for the rapid decrease in termite diversity and abundance above 1000 m in south America, southeast Asia and New Guinea may be related to their social nature and the poor digestibility of their main food source: high temperatures may be required to obtain a positive energy balance in spite of foraging costs (Eggleton & Tayasu 2001). Species with a distinct nest and a complex foraging behaviour are likely to be more sensitive to elevation than species residing permanently within wood. The most cold-resistant termites are small-colony wood-confined species, among which some species even withstand frost (Lacey et al. 2010).

Termites (clade *Isoptera*) have long been known to be social cockroaches (Lameere 1910). Their phylogenetic position within the Blattodea was confirmed by recent molecular studies (Lo *et al.* 2000, Inward *et al.* 2007), but unlike termites, non-eusocial Blattodea (hereafter simply called "cockroaches") as well as some Coleoptera retain a substantial diversity above 1000 m elevation (Collins 1980; Atkin & Proctor 1988; Thomas & Proctor 1997). Cockroaches and Coleoptera both comprise several wood-feeding taxa. Panesthiinae cockroaches (Blaberidae) are widespread from southeast Asia to Australia (Maekawa *et al.* 2003). The genera *Panesthia*, *Ancaudellia* and *Salganea* are represented in New Guinea by a total of 31 species, 14 of which occur above 1500 m (Roth 1979a, b, 1982). Among beetles, Cerambycidae and Passalidae are two important families comprising wood-feeding species, distributed worldwide. In the Caribbean region of Colombia, abundance and species richness of passalids is highest around 1500 m (Jiménez-Ferbans *et al.* 2010). In the Dumoga-Bone National Park, Sulawesi, 65% and 27% of the recorded Passalidae and Cerambycidae species, respectively, occur above 950 m (Hammond 1990).

There is thus evidence that xylophagous cockroaches and beetles may remain common, or even attain their peak of diversity and abundance, at elevations where xylophagous termites become scarce. In this project, we will focus on possible interactions among xylophagous insects in an elevational forest gradient along the slopes of Mount Wilhelm, Papua New Guinea. A compilation of previous records suggests that at least 39 termite species might occur in this area (Table 1). Our hypothesis is that the elevational distribution of termites is limited by energetic constraints, species with high foraging costs (central-place foragers) being likely to disappear first with elevation. Xylophagous cockroaches and beetles, by contrast, would be limited downhill by competition with termites, and uphill by energetical constraints, but at much higher elevations than termites. The shift in abundance from termites to cockroaches and beetles is expected to be most obvious in the 1000-1500 m range.

METHODS

Sampling in dead wood was conducted on the slopes of Mount Wilhelm, Papua New Guinea, along the elevational transect (200-3700 m elevation) previously decribed by Leponce *et al.* (2016). At 3700 m, dead wood was scarce and often very damp, and therefore unsuitable for insects or insect larvae. Only casual samples were collected at this elevation. Systematic sampling was carried out from 3200 m downwards. At each elevation, logs were searched for in and around the botanical plots. State of decay was estimated according to the scale of Berge *et al.* (2008). Only logs at the decay stages 2 (wood with loose or lost bark, but wood still sound) and 3 (wood with perceptible decay by loss of strength, but not friable) were sampled. Log diameter or circumference was first recorded, then the logs were chopped with axes along a length of one metre and the following insects or larvae present in the wood were collected and preserved in alcohol: Coleoptera (adults, pupae or larvae); Lepidoptera (larvae); cockroaches, Orthoptera and Dermaptera (all stages);

TABLE 1

Termite species reported from northeastern New Guinea (provinces of Madang, Morobe, Eastern Highlands, Chimbu, Western Highlands), and potentially occurring along slopes of Mount Wilhelm. [NCD: National Capital District].

FAMILY, GENUS AND SPECIES	DISRIBUTION IN NEW GUINEA	MAXIMUM ELEVATION (M A.S.L.)	REFERENCES
Kalotermitidae			
Neotermes ferrugineus (Holmgren, 1911)	NE New Guinea	lowlands	Holmgren (1911)
Neotermes papua (Desneux, 1905)	NE New Guinea, NCD	lowlands	Desneux (1905); Héraoui (1997)
Glyptotermes xantholabrum (Hill, 1926)	E Highlands	1370	Barrett (1965)
Glyptotermes sp. A	NE New Guinea	lowlands	Héraoui (1997)
Glyptotermes sp. B	NE New Guinea, NCD	lowlands	Héraoui (1997)
Glyptotermes sp. C	NE New Guinea, S Highlands	1600	Héraoui (1997)
Glyptotermes sp. D	N and S New Guinea	lowlands	Héraoui (1997)
Glyptotermes sp. F	N and S New Guinea	lowlands	Héraoui (1997)
Glyptotermes sp. G	NE New Guinea	lowlands	Héraoui (1997)
Glyptotermes sp. H	NE New Guinea	lowlands	Héraoui (1997)
Calcaritermes krishnai (Maiti & Chakraborty, 1981)	NE New Guinea	lowlands	Héraoui (1997) (as *Calcaritermes* sp. A)[1]
Incisitermes sp. A	NE New Guinea	lowlands	Héraoui (1997)
Cryptotermes albipes (Holmgren & Holmgren, 1915)	NE New Guinea	lowlands	Héraoui (1997) (as Genus A)[1]
Cryptotermes domesticus (Haviland, 1898)	NE New Guinea	lowlands	Gay & Watson (1982); Héraoui (1997) (as *Cryptotermes* sp. B)[1]
Cryptotermes secundus (Hill, 1925)	N and S New Guinea	lowlands	Héraoui (1997) (as *Cryptotermes sp.* E)[1]
Cryptotermes sp. A	N and S New Guinea	1000	Héraoui (1997)
Rhinotermitidae			
Prorhinotermes inopinatus Silvestri, 1909	N and S New Guinea	750	Bourguignon & Roisin (2011)
Coptotermes elisae (Desneux, 1905)	N and S New Guinea	800	Bourguignon & Roisin (2011)
Coptotermes gambrinus Bourguignon & Roisin, 2011	NE New Guinea, NCD	950	Bourguignon & Roisin (2011)
Coptotermes remotus Hill, 1927	N and S New Guinea	750	Bourguignon & Roisin (2011)
Parrhinotermes browni (Harris, 1958)	N New Guinea, NCD	850	Bourguignon & Roisin (2011)
Schedorhinotermes longirostris (Brauer, 1866)	N and S New Guinea[2]	1700	Bourguignon & Roisin (2011)
Schedorhinotermes translucens (Haviland, 1898)	N and S New Guinea	2100	Bourguignon & Roisin (2011)
Termitidae			
Protocapritermes odontomachus (Desneux, 1905)	N and S New Guinea	1600	Bourguignon *et al.* (2008)
Pericapritermes cfr. schultzei (Holmgren, 1911)	N and S New Guinea	1650	Bourguignon *et al.* (2008)
Pericapritermes parvus Bourguignon & Roisin, 2008	N New Guinea	1200	Bourguignon *et al.* (2008)
Microcerotermes biroi (Desneux, 1905)	N and S New Guinea	880	Roisin & Pasteels (2000)
Microcerotermes brevior (Desneux, 1905)	NE New Guinea	800	Roisin & Pasteels (2000)
Microcerotermes papuanus Holmgren, 1911	N and S New Guinea	700	Roisin & Pasteels (2000)
Microcerotermes piliceps Snyder, 1925	NE New Guinea	lowlands	Roisin & Pasteels (2000)
Nasutitermes princeps (Desneux, 1905)	N New Guinea, Fly	650	Roisin & Pasteels (1996)
Nasutitermes novarumhebridarum (N. Holmgren & K. Holmgren, 1915)	N and S New Guinea	800	Roisin & Pasteels (1996)
Nasutitermes corniger (Motschulsky, 1855)	N and S New Guinea	lowlands	Roisin & Pasteels (1985, 1996) (as *N. polygynus)*[3]
Nasutitermes bikpelanus Roisin & Pasteels, 1996	N and S New Guinea[2]	1300	Roisin & Pasteels (1996)
Nasutitermes gracilirostris (Desneux, 1905)	N New Guinea[2]	1000	Roisin & Pasteels (1996)
Nasutitermes seghersi Roisin & Pasteels, 1996	NE New Guinea	lowlands	Roisin & Pasteels (1996)
Diwaitermes kanehirae (Oshima, 1914)	N and S New Guinea	600	Roisin & Pasteels (1996)
Diwaitermes castanopsis Roisin & Pasteels, 1996	NE New Guinea	1550	Roisin & Pasteels (1996)
Grallatotermes grallator (Desneux, 1905)	NE New Guinea	800	Roisin & Pasteels (1996)

[1] Identification revised in this work.

[2] Recorded from Bundi, on E slope of Mt Wilhelm.

[3] Synonymy established by Scheffrahn *et al.* (2005).

Isoptera (colony sample including soldiers, workers, and if present, alates and immatures). Termites were identified according to the keys of Roisin & Pasteels (1996, 2000), Bourguignon *et al.* (2008) and Bourguignon & Roisin (2011). Other taxa are still to be identified.

RESULTS

In the range 200-2200 m, a high proportion of the logs (74-85 %) were occupied by wood-feeding insects (Table 2). Rates of occupancy dropped to 22 % at 2700 m, and were very low at 3200 m. The three major taxa observed in logs were Blattodea, including termites (Isoptera) and non-eusocial cockroaches, and Passalidae (Coleoptera). Their elevational distribution, based on presence/absence in individual logs, is shown in Table 2 and Figure 1.

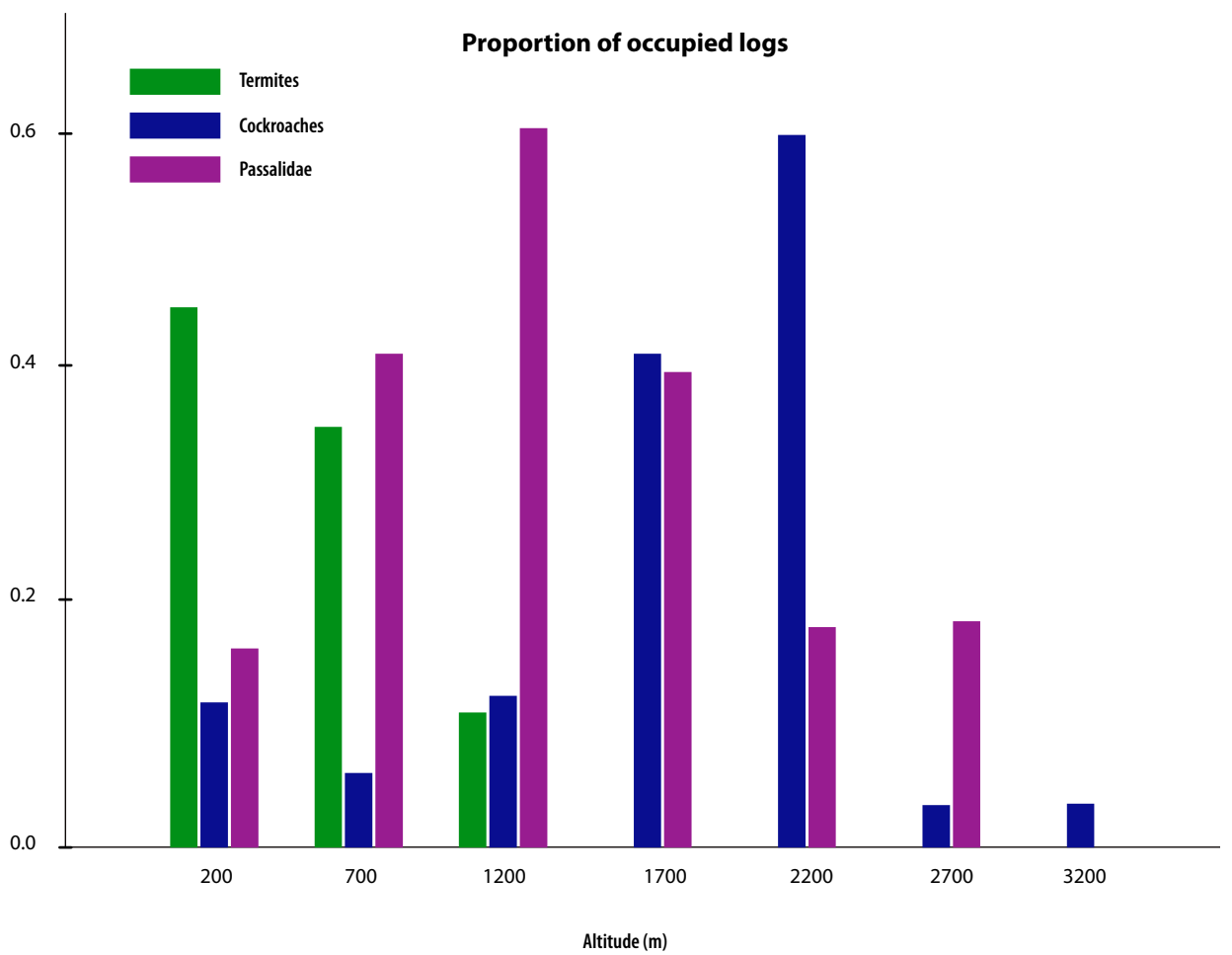


FIGURE 1

Proportion of sampled logs occupied by termites, cockroaches or Passalidae as a function of elevation.

TABLE 2

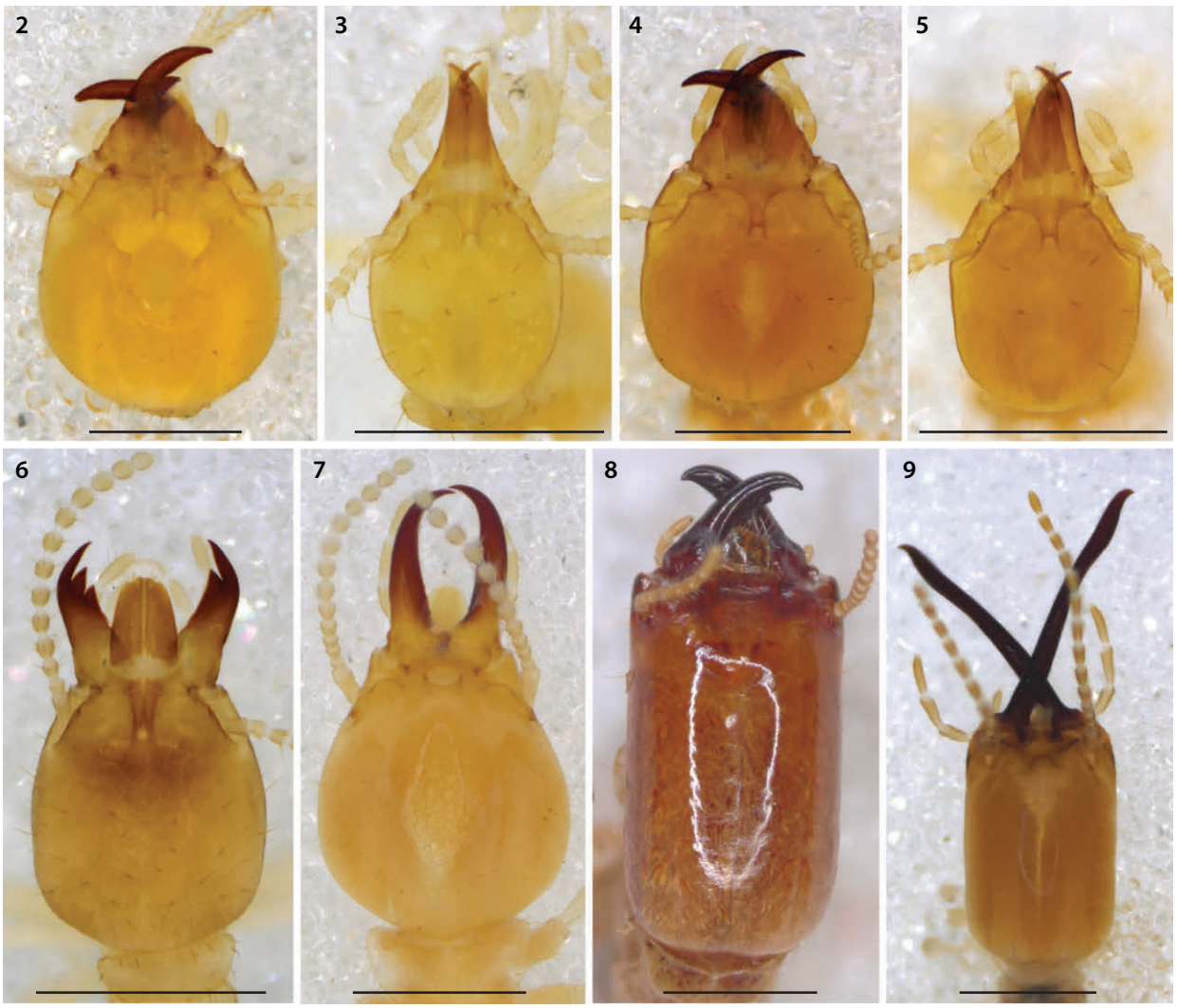
Distribution of logs occupied by termites, cockroaches or passalids as a function of elevation (from presence/absence data).

ELEVATION (m)	LOGS SEARCHED	WITH TERMITES	WITH COCKROACHES	WITH PASSALIDS	PERCENT OCCUPIED
3200	28	-	1	-	3.6
2700	58	-	2	11	22.4
2200	65	-	39	12	78.5
1700	65	-	27	26	81.5
1200	71	8	9	43	84.6
700	65	23	4	27	83.1
200	66	30	8	11	74.3

TABLE 3

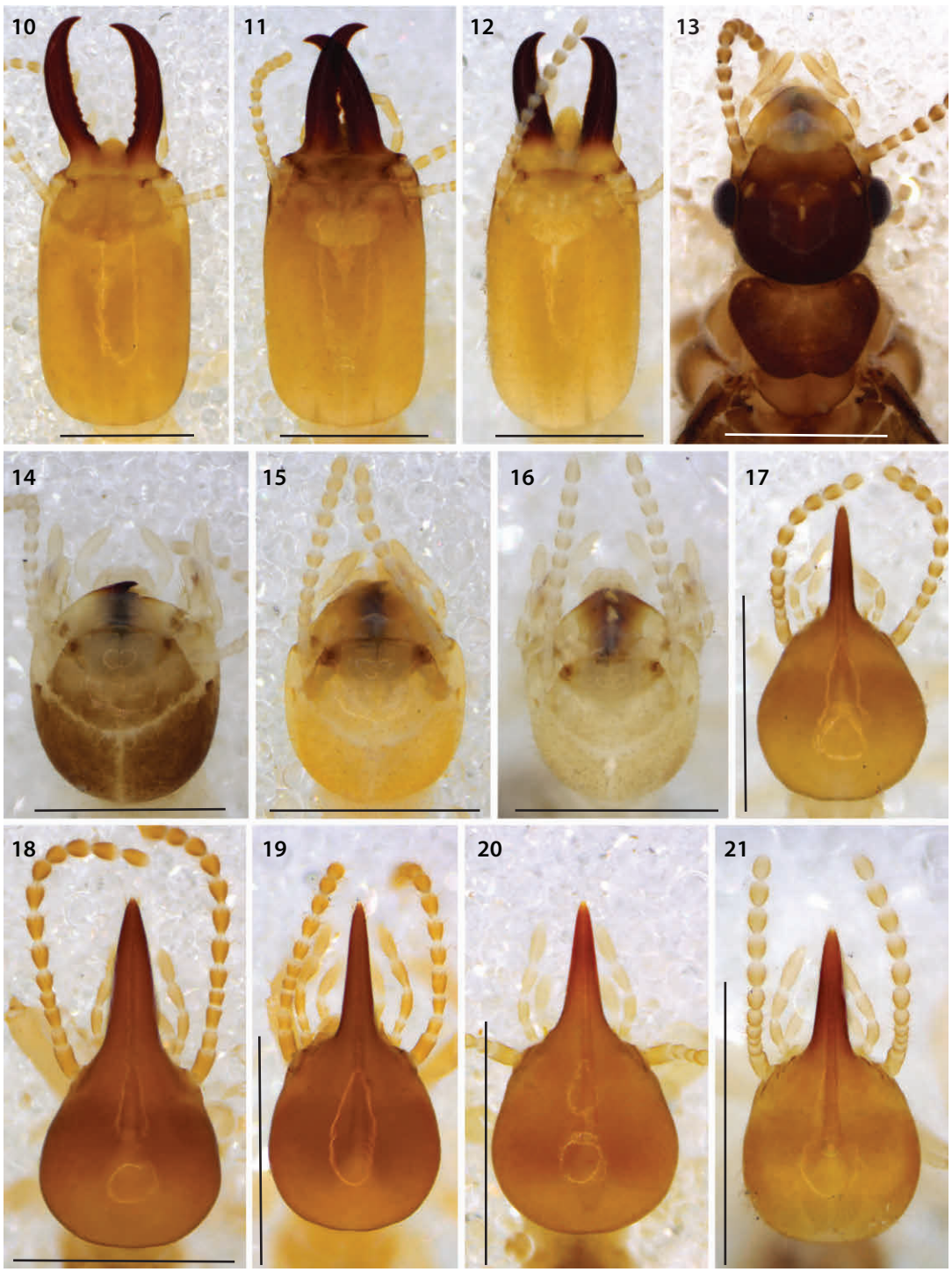
Elevational distribution of termite species: number of logs in which each species was found.

FAMILY, GENUS AND SPECIES	200 m	700 m	1200 m	TOTAL
Kalotermitidae				
Glyptotermes sp.	-	1	-	1
Rhinotermitidae				
Coptotermes elisae	1	-	-	1
Parrhinotermes browni	1	-	2	3
Schedorhinotermes translucens	8	11	1	20
Schedorhinotermes longirostris	8	4	2	14
Schedorhinotermes sp.	-	1	-	1
Termitidae				
Protocapritermes odontomachus	1	-	-	1
Microcerotermes papuanus	6	4	-	10
Microcerotermes brevior	1	-	-	1
Microcerotermes biroi	2	-	-	2
Microcerotermes sp.	-	1	-	1
Nasutitermes bikpelanus	-	3	2	5
Nasutitermes gracilirostris	-	3	-	3
Nasutitermes seghersi	-	1	-	1
Diwaitermes kanehirae	3	-	-	3
Diwaitermes foi	-	-	1	1
Total records	**31**	**29**	**8**	**68**
Total species	**9**	**7**	**5**	**14**
Logs sampled	66	65	71	202



FIGURES 2-9

Termite species collected from the slopes of Mt Wilhelm: head in dorsal view. Rhinotermitidae: **2**, *Schedorhinotermes longirostris*, major soldier; **3**, *S. longirostris*, minor soldier; **4**, *S. translucens*, major soldier; **5**, *S. translucens*, minor soldier; **6**, *Parrhinotermes browni*, soldier; **7**, *Coptotermes elisae*, soldier. Kalotermitidae: **8**, *Glyptotermes* sp., soldier. Termitidae: **9**, *Protocapritermes odontomachus*, soldier. All scale bars = 1 mm.



FIGURES 10-21

Termite species collected from the slopes of Mt Wilhelm: head in dorsal view. Termitidae: **10**, *Microcerotermes biroi*, soldier; **11**, *M. brevior*, soldier; **12**, *M. papuanus*, soldier; **13**, *Diwaitermes foi*, alate; **14**, *M. biroi*, worker; **15**, *M. brevior*, worker; **16**, *M. papuanus*, worker; **17**, *D. foi*, soldier; **18**, *Nasutitermes bikpelanus*, soldier; **19**, *N. gracilirostris*, soldier; **20**, *N. seghersi*, soldier; **21**, *D. kanehirae*, soldier. All scale bars = 1 mm.

Passalidae were common up to 2700 m, but were especially abundant in the 700-1700 m elevation range. Cockroaches were found at all elevations, but were particularly common in the moss forest at 1700 and 2200 m. Termites were found with increasing frequency from 1200 m downwards (Table 3). Two *Schedorhinotermes* species (Rhinotermitidae) were especially abundant, and found from 200 to 1200 m. The termite species collected during this survey are depicted in Figures 2-21.

DISCUSSION

The elevational distribution of termites recorded along the slopes of Mount Wilhelm is consistent with previous data from other mountain ranges in southeast Asia (Collins 1980; Gathorne-Hardy *et al.* 2001). For instance, termite species density rapidly drops between 1000 and 1400 m elevation along the slopes of Mt Leuser in Sumatra (Gathorne-Hardy *et al.* 2001). On Mt Giting-Giting, Philippines, termites completely disappear between 860 and 1240 m (Thomas & Proctor 1997). Four of the five species recorded at 1200 m during the present survey were previously known from similar elevations: *P. browni*, *S. translucens* and *N. bikpelanus* from mountain forests above Bulolo, and *S. longirostris* from Bundi, on this same slope of Mt Wilhelm (Roisin & Pasteels 1996, Bourguignon & Roisin 2011). The only previously known location of *D. foi* was at 800-900 m elevation in the Pimaga-Lake Kutubu area, Southern Highlands (Roisin & Pasteels 1996). Consistent with the energetic constraints hypothesis introduced above, the five species are wood dwellers, not known to build nest structures separated from their food sources. Yet, energetic constraints associated with sociality itself —the cost of the production and turnover of sterile castes— might limit their distribution further uphill.

An elevational pattern in the distribution of three major wood-feeding taxa (Isoptera, Passalidae and Blattodea) was expected from literature data on elevational occurrence of various species. This study now demonstrates, from systematic sampling, that these three taxa are dominant at different elevations along a single transect: presence in more than 30% of the logs was achieved at 200 and 700 m for termites, from 700 to 1700 m for Passalidae, and at 1700 and 2200 m for cockroaches. Occurrence frequencies even reached over 60% for Passalidae at 1200 m and cockroaches at 2200 m. Passalidae are broadly co-dominant with termites at 700 m and with cockroaches at 1700 m. These occurrence data, revealing very high rates of log occupancy at elevations up to 2200 m, suggest that the three major wood-feeding taxa may compete for this resource. Surprisingly, although encounters within wood between termites and other xylophagous insects are likely to occur frequently, and casual observations suggest a negative relationship between termite activity and abundance of other saproxylic insects (Ulyshen & Šobotník 2018), literature about such interactions is practically non-existent (Brin & Bouget 2018). Future studies should be aimed at a better characterization of the feeding niche and physiology of these xylophagous taxa, and include an experimental approach such as selective exclusion or confrontation experiments.

ACKNOWLEDGMENTS

I am grateful to the Department of Environment and Conservation (DEC, Port Moresby) for issuing the permit # 012297 allowing to export the material collected during this project. This study was conducted in the framework of "Our Planet Reviewed – Papua New Guinea 2012-2013" set up by Pro-Natura International, the National Museum of Natural History (MNHN, France), the Institut de Recherche pour le Développement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation, and the Belgian National Lottery. I also thank the FNRS (Belgium) for providing a travel grant.

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Female daddy long-leg spider (*Micromerys*, Pholcidae) carrying her egg sac in her mouthparts and found at 2200 m a.s.l. These spiders are typical leaf-dwellers. During the day, they spend most of the time tightly pressed against the underside of a leaf. At night, they are more active, repairing their simple domed sheet-web and catching preys.
(Photo © Maurice Leponce; identification: Bernhard Huber).

Jumping Spiders (Araneae: Salticidae) of the Papua New Guinean Mount Wilhelm and surrounding mountains

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ABSTRACT

The jumping spider fauna of Mount Wilhelm is reviewed and representatives of Cocalodini Simon, 1901; Viciriini Simon, 1901 and Euophryini Simon, 1901 are described and illustrated. Two new genera, the cocalodine *Waymadda* n. gen. and the euophryine *Vallvonas* n. gen. are erected for *Waymadda enduwa* n. sp., *W. rufa* (Maddison, 2009) n. comb. and *Vallvonas zarandi* n. sp., respectively, and *Yamangalea frewana* Maddison, 2009 and the second known male of *Tabuina varirata* Maddison, 2009 are also illustrated. The genus *Capeyorkia* Richardson, 2016 is recorded from Papua New Guinea by the new species *Capeyorkia richardsoni* n. sp. and the female morphology described for the first time. The female holotype of *Porius decempunctatus* (Szombathy, 1915) and the matching male are illustrated and described, resulting in the first description of any *Porius* male morphology. In addition, the following new species are described: *Omoedus danyii* n. sp., *Omoedus koehalmii* n. sp. and *Omoedus baloghi* n. sp. (based on males only), and *Omoedus bunbi* n. sp. and *Euryattus zilleae* (represented by both sexes). In addition the genus *Viribestus* Zhang & Maddison, 2012, known previously from a single male specimen, is recorded from three new localities: Mt Wilhelm, Mt Kaindi and Paniai Lakes which its first record from West Papua, Indonesia.

TAMÁS SZŰTS, JUNXIA ZHANG, NIKOLETT SZPISJAK & DOMIR DEBAKKER 2020 — Jumping Spiders (Araneae: Salticidae) of the Papua New Guinean Mount Wilhelm and surrounding mountains, *in* ROBILLARD T., LEGENDRE F., VILLEMANT C. & LEPONCE M. (eds),Insects of Mount Wilhelm, Papua New Guinea - volume 2. Muséum national d'Histoire naturelle, Paris : 521-555 (Mémoires du Muséum national d'Histoire naturelle ; 214). ISBN : 978-2-85653-836-4.

RÉSUMÉ

Les araignées sauteuses (Araneae : Salticidae) du Mont Wilhelm et des montagnes avoisinantes de Papouasie-Nouvelle-Guinée.

La faune des araignées salticides du Mont Wilhelm (Papouasie-Nouvelle-Guinée) est révisée. Des représentants de Cocalodini Simon, 1901; Viciriini Simon, 1901 et Euophryini Simon, 1901 sont décrits et illustrés. Deux nouveaux genres, respectivement le cocalodine *Waymadda* n. gen. et l'euophryine *Vallvonas* n. gen. sont établis pour *Waymadda enduwa* n. sp., *Waymadda rufa* (Maddison, 2009) n. comb., et *Vallvonas zarandi* n. sp. *Yamangalea frewana* Maddison, 2009 et le second mâle connu de *Tabuina varirata* Maddison, 2009 sont illustrés. Le genre *Capeyorkia* Richardson, 2016 est signalé pour la Papouasie-Nouvelle-Guinée pour la première fois la description d'une femelle à partir de l'espèce nouvelle, *Capeyorkia richardsoni* n. sp. L'holotype femelle de *Porius decempunctatus* (Szombathy, 1915) et le mâle correspondant sont illustrés et décrits, constituant la première description de la morphologie d'un mâle de *Porius*. Les espèces suivantes sont décrites: *Omoedus danyii* n. sp., *Omoedus koehalmii* n. sp. et *Omoedus baloghi* n. sp. sur base des mâles, tandis qu'*Omoedus bunbi* n. sp. et *Euryattus zilleae* n. sp. sont représentés pour les deux sexes. Concernant le genre *Viribestus* Zhang & Maddison, 2012, connu auparavant sur base d'un seul mâle, trois nouvelles données géographiques sont communiquées: les Monts Wilhelm et Kaindi ainsi que les lacs Paniai constituent ainsi les premières observations pour la Papouasie occidentale, Indonésie.

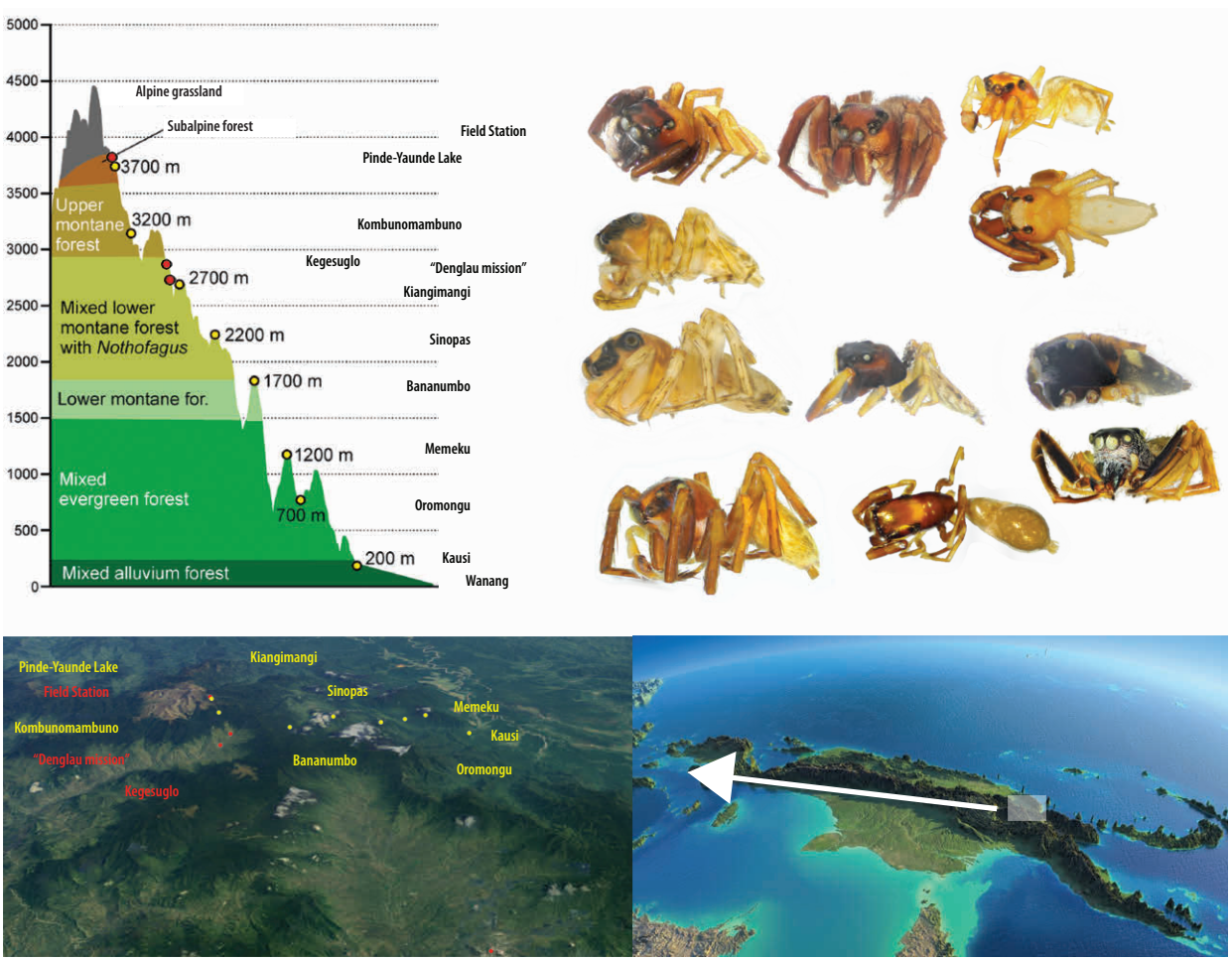


FIGURE 1

Elevational presentation of the taxa and localities of the "transect sites" (Leponce *et al* 2016 - yellow) or Balogh's expeditions (red).

INTRODUCTION

The jumping spiders (Araneae: Salticidae) comprise the most speciose spider family with over 6100 described species worldwide, corresponding to more than one eighth of the total spider diversity (WSC 2019). Currently, the provision for a phylogenetic classification system (Maddison 2015), a well curated database of images and literature and distributional data (Metzner 2019) and easy access to taxonomic literature (WSC 2019) are helping jumping spider discovery. In alpha taxonomy there are often three huge obstacles: 1 not being able to place taxa; 2 not knowing which taxa occur in a certain area or what those taxa look like; and 3 not having access to all the relevant literature. These obstacles have been removed from the taxonomic study of salticids and recent treatments on major clades, such as Euophryini (Zhang & Maddison 2012, 2013, 2015), Amycoida (Ruiz & Maddison 2015) and Spartaeinae (Maddison 2009, 2012), have greatly advanced the taxonomic knowledge of jumping spiders.

Papua New Guinea remains one of the last frontiers for spider taxonomy. It is not only the second largest island on the planet located in the South-West Pacific, but also occupies a "*phytogeographically strategic position between Asia and Australia and the Pacific*" (van Balgooy 1977). Additionally, it has a very complex geotectonic history, further complicated by "*ice and fire*": frequent volcanic activity and glaciations (Hall & Holloway 1998; Hall 2002; Hill & Hall 2003; Baldwin *et al.* 2012, Soldati *et al.* 2016), so it is not surprising that is accommodates an unmatched diversity of biota of spiders. Salticidae are perhaps among the most abundant in samples from this region and are clearly the most diverse regarding the body forms (Szűts 2003, Maddison 2009, Zhang & Maddison 2012).

MATERIALS AND METHODS

This study is primarily based on material collected during the "Our Planet Reviewed – Papua New Guinea" Mt Wilhelm (Figure 1) expedition (Leponce *et al.* 2016, map 1) and housed at the Museum national d'Histoire naturelle, Paris (MNHN), Smithsonian Institute (SI) and Royal Belgian Institute of Natural Sciences (RBINS). Additional material from Mt Wilhelm were retrieved from the Hungarian Soil Zoology Expeditions (1968, 1969 see Balogh, 1971, Map 1) housed at the Hungarian Natural History Museum, Budapest (HNHM). Faunistic information was retrieved from Metzner (2019).

Photographs were taken using a NIKON D300S DSLR attached to a NIKON S800 stereo and a NIKON Eclipse E200 compound microscope. Different focal images were captured and combined to create a multifocal image using Helicon Remote™ and Helicon Focus Software™. All measurements are given in millimeters.

Morphological terminology is standard for salticids (Maddison 2009, Zhang & Maddison 2012). Systematics follows Maddison (2015). Female genitalia were digested with NeoPanPurr™, a commercial pancreatic enzyme cocktail pill. Cleared epigynes and palps (Figures 12-16, 90, 127) were placed in methyl-salicylate to make sclerotized part more transparent.

SYSTEMATIC PART

Subfamily SPARTAENINAE Wanless, 1984
Tribe COCALODINI Simon, 1901

WAYMADDA n. gen.

Figures 2, 6, 9, 15-17, 20-34

Type species. *Waymadda enduwa* n. sp. here designated.

DIAGNOSIS — Identified by the short embolus of the male palp, which originates on the top of the tegulum (Figures 20, 21), covered by the conductor (Figures 15, 22). Female epigynum with short copulatory ducts and large spermathecae (Figures 32, 34).

ETYMOLOGY — The genus is dedicated to Dr. Wayne Maddison, a well know salticid specialist, who described several Cocalodini genera. The generic name is built by concatenating of the first few letters of his name. The genus name's gender is feminine.

COMPOSITION — *Waymadda enduwa* n. sp., *Waymadda rufa* (Maddison, 2009) n. comb.

DESCRIPTION — *Male*. Small bodied (c.ca 3.0 in total body length), light colored cocalodini spiders (Figure 2). Carapace without a thoracic dome Figure 6 (with a high dome in *Yamangalea* see Figure 7). Carapace with a darker pattern, and with a pale margin (Figures 2, 23). Abdomen with two darker spots, and an indistinct line in the middle, and the posterior lateral spinnerets dark and elongated (Figures 2, 6, 23-24).

Male palpal tibia about twice as long, as wide (Figures 14, 21), with three apophyses (Figures 15-17): two retrolateral, and one prolateral (contra to *Tabuina,* which has four apophyses - Maddison 2009: 37-38, Figures 12-14). Male palp with embolus base situated at 12 o'clock position of the tegulum (Figures 15, 22), hidden (contra to *Tabuina*, where the embolus situated in the median or lower half and clearly visible - Figures 12, 18). Median apophysis (Figures 20-22) is rod like (contra to *Tabuina* which has a hook at the end - Figures 10-14), slightly bent (Figures 20-22).

Female. Carapace with a dark pattern, similar to the male (Figures 26-28). Abdomen with a lighter median stripe (Figure 26) Female spinnerets light colored. Female epigynum with an inverted "U" shaped indention on the posterior margin (Figure 32), between the copulatory openings, situated below the huge spermathecae (Figures 31-34).

DISTRIBUTION —Papua New Guinea: Paiam Forest, Mt Wilhelm.

REMARK — The differences between *Tabuina* Maddison, 2009 and *Waymadda rufa* (Maddison, 2009) have already been noted by Maddison (2009), who wrote: "I have chosen to place *T. rufa* there even though it is distinctive. As more species are discovered it may deserve its own genus". *Waymadda rufa* (Maddison, 2009) differs from *Tabuina varirata* Maddison, 2009 and *T. baiteta* Maddison, 2009 due to the smaller size, the characteristics of the palp and the habitat where it was collected from. The separation of the latter two species from *Waymadda rufa* received more support by the molecular phylogeny that was published by Maddison *et al.* (2014: fig. 15), where representatives of *Tabuina* and *Waymadda rufa* were placed well apart, and *Tabuina baiteta* and *T. varirata* were grouped together with *Allococalodes*, *Yamangalea* and *Cocalodes*. *Waymadda enduwa* n. sp. is very similar to *W. rufa* and describing a new genus for these two species would resolve the paraphyly of *Tabuina*. The morphology differences of these species from Mt Wilhelm (Figures 2-7) are justifying the erection of *Waymadda* as a new genus.

Waymadda enduwa n. sp.

Figures 2, 6, 9, 15-17, 21-32, 34

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Mt Wilhelm, Bananumbo, 1700 m, 5°45'33"S 145°13'48"E, 26.I.2014, Beating. MNHN. Paratypes, 3 ♂ and 2 ♀, same data as the holotype.

FIGURES 2-11

2, *Waymadda enduwa* gen. et sp. n., male, dorsal view; **3**, *Yamangalea frewana* Maddison, 2009, male, dorsal view; **4**, *Tabuina varirata* Maddison, 2009, male, dorsal view; **5**, ditto, lateral view; **6**, *Waymadda enduwa* sp. n., male, lateral view; **7**, *Yamangalea frewana*, male, lateral view. Scale bars 1 mm. **8**, *Yamangalea frewana*, male palp, ventral view; **9**, *Waymadda enduwa*, dorsal view; **10**, *Tabuina varirata*, male, ventral view; **11**, *Tabuina baiteta* Maddison, 2009, ventrolateral view. Scale bars 0.25 mm.


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DIAGNOSIS — Can be readily identified by the upward pointing of the short embolus in males (Figure 22) and the slightly bent copulatory ducts in females (Figure 32).

Waymadda enduwa n. sp. is very similar to *W. rufa*. However, it could be distinguished, by the upward twisted shorter embolus' end (Figures 14, 22) - *W. rufa* has a filiform part of the embolus pointing away from the bulbus' plane (Figure 20), the triangle shaped embolar sclerite (Figure 22) and the shorter copulatory ducts which directed outwards (Figure 34) contra to *W. rufa* where those are starting towards the inner axis of the body (Figure 33; Maddison 2009: fig. 61) as seen from the dorsal side. Hence the ducts directly connect the spermathecae with to the copulatory openings. The ventrolateral secondary palpal apophysis is large and situated at the proximal end (Figure 17), rather than in the middle of the segments (as in *W. rufa* Figure 20).

ETYMOLOGY — The species name is derived from Enduwa Kombuglu, the local Kuman name of Mt Wilhelm's peak.

DESCRIPTION — *Male.* relatively small bodied, light colored cocalodini spiders (Figure 2). Carapace 1.8 long, abdomen 1.45 long. PLE is on the highest point of the carapace, thoracic slope without dome (Figures 6, 24) - contra to *Yamangalea* (Figure 7). Carapace with a darker pattern, and with a pale margin (Figures 6, 24). Abdomen with some darker spots, posterior lateral spinnerets dark, elongated and ornament like (Figures 2, 6, 23-25).

Male palp about twice as long, as wide, with two retrolateral apophyses (Figures 15, 17). Male palp with embolus base situated at a 12 o'clock position to the tegulum (Figure 15), hidden, with an upward turn at the end (Figure 21). Median apophysis is rod-shaped, slightly bent (Figure 22).

Female. carapace 1.9 long, abdomen 2.3 long. Carapace with a dark brown pattern, with a pale median stripe, and margins (Figure 26). Abdomen with a median pale stripe (Figure 26). Female epigynum with an inverted "U" shaped indention on the posterior margin (Figure 32), between the copulatory openings, which situated below the huge spermathecae (Figures 34).

DISTRIBUTION —Papua New Guinea: Mt Wilhelm (Figure 35).

Tabuina Maddison, 2009

Figures 4-5, 10-14, 18

Type species. *Tabuina varirata* Maddison, 2009.

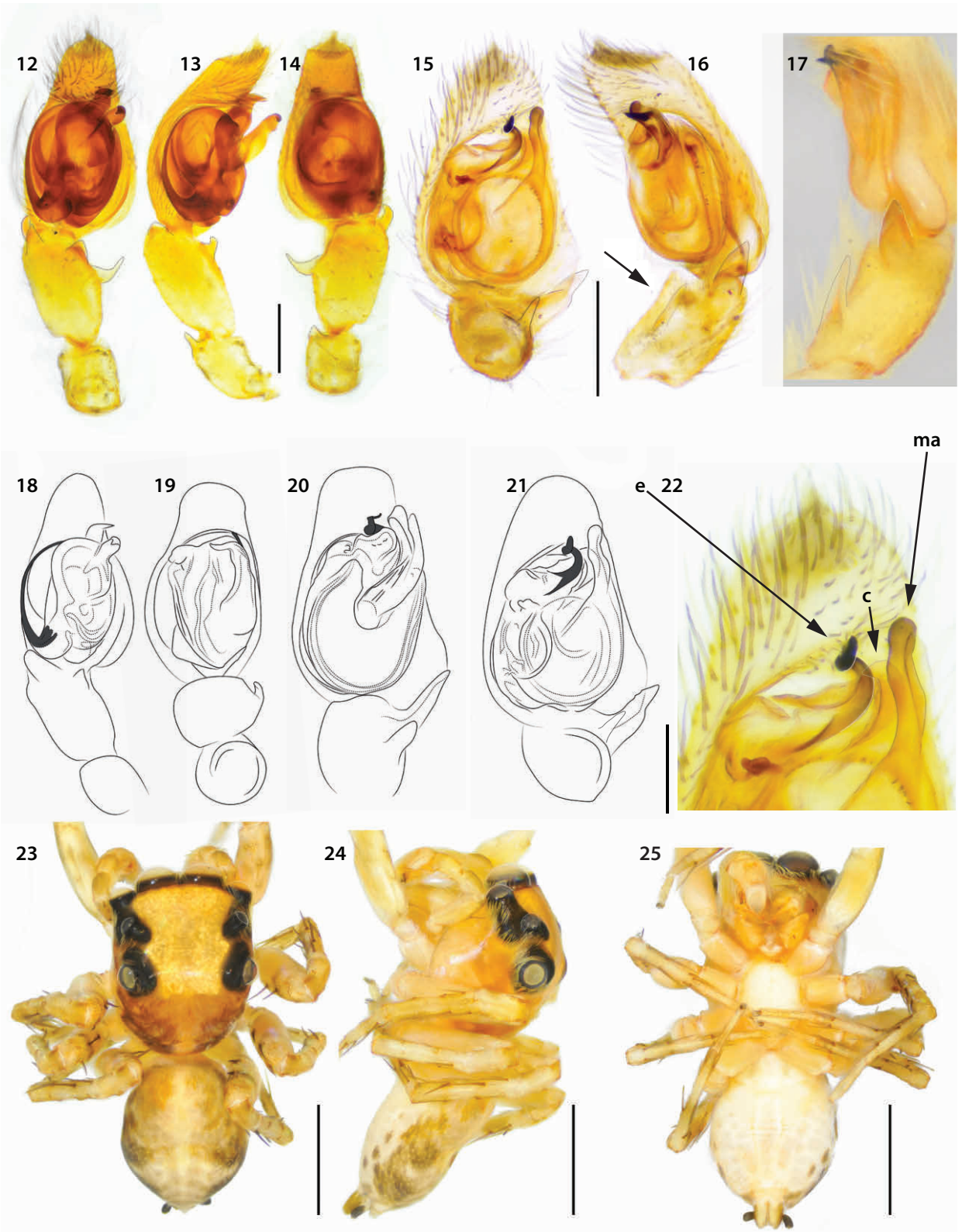
DIAGNOSIS — Large-bodied cocalodine salticid (Figure 4), with large, complex palpi, equipped with large median apophysis with a hook at the end (Figures 10-11).

DESCRIPTION — See Maddison (2009).

DISTRIBUTION — Papua New Guinea: Varirata National Park; Baiteta Forest, Mt Wilhelm and Mt Kaindi (Figure 35).

FIGURES 12-25

Cocalodini genera. **12**, *Tabuina varirata* Maddison, 2009 male palp, ventral view; **13**, ditto, prolateral view; **14**, ditto, dorsal view; **15**, *Waymadda enduwa* cleared palp, ventral view; **16**, ditto, retrolateral view; **17**, ditto, closeup on the tibial apophyses, retrolateral view. Scale bars 0.25 mm. **18** *Tabuina varirata* Maddison, 2009 male palp, line drawing; **19**, *Yamangalea frewana*, male palp, line drawing; **20**, *Waymadda rufa* (Maddison, 2009), male palp, line drawing; **21**, *Waymadda enduwa*, male palp, line drawing; **22**, closeup of the bulb, ventral view. Abbreviations: e: embolus, c: conductor, ma: median apophysis **23**, male holotype, dorsal view; **24**, ditto, lateral view. **25**, ditto, ventral view. Scale bars 1.0 mm.


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Tabuina varirata Maddison, 2009

Figures 4-5, 10-14, 18

Tabuina varirata Maddison, 2009: 10.

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Central Province: Varirata National Park, S 9.436 E 147.364, elev. 740 m a.s.l. 4 August 2008, W. Maddison, A. Kore & J. Kore, WPM#08-029, UBC-SEM AR00028. Paratypes, 1 ♀, 5 juveniles, same data as holotype (UBC-SEM). [not examined]

MATERIAL EXAMINED — Wau, Mt Kaindi, Field Station of the Bishop Museum, 25.IV.1965, 1 ♂, leg: Balogh & Szent-Iványi (HNHM 9324).

DIAGNOSIS — Carapace's lower border with a thick white band around (Figures 4-5). Palps covered with thick white setae (Figure 10). Fovea long, well visible, chelicerae sclerotized and slightly elongated (Figure 4). Embolus origin is at a 7 o'clock position to the tegulum (Figure 18). Median apophysis and conductor are similar in size, diverging from each other, on the bulb at a 1 o'clock position on the bulb (Figures 12, 18).

DESCRIPTION — See Maddison (2009).

DISTRIBUTION —Papua New Guinea: Varirata National Park and Wau (Figure 35).

Tabuina baiteta Maddison, 2009

Figure 11

Tabuina baiteta Maddison, 2009: 11.

TYPE MATERIAL — Holotype, ♂ **Papua New Guinea**. Madang Province, Baiteta Forest, S 5°01' E 145°45', Canopy fogging, especially *Celtis latifolia* (Ulmaceae), 21 June 1995, Olivier Missa, (RBINS). Paratypes, 11 ♂, 8 ♀, same data. [not examined]

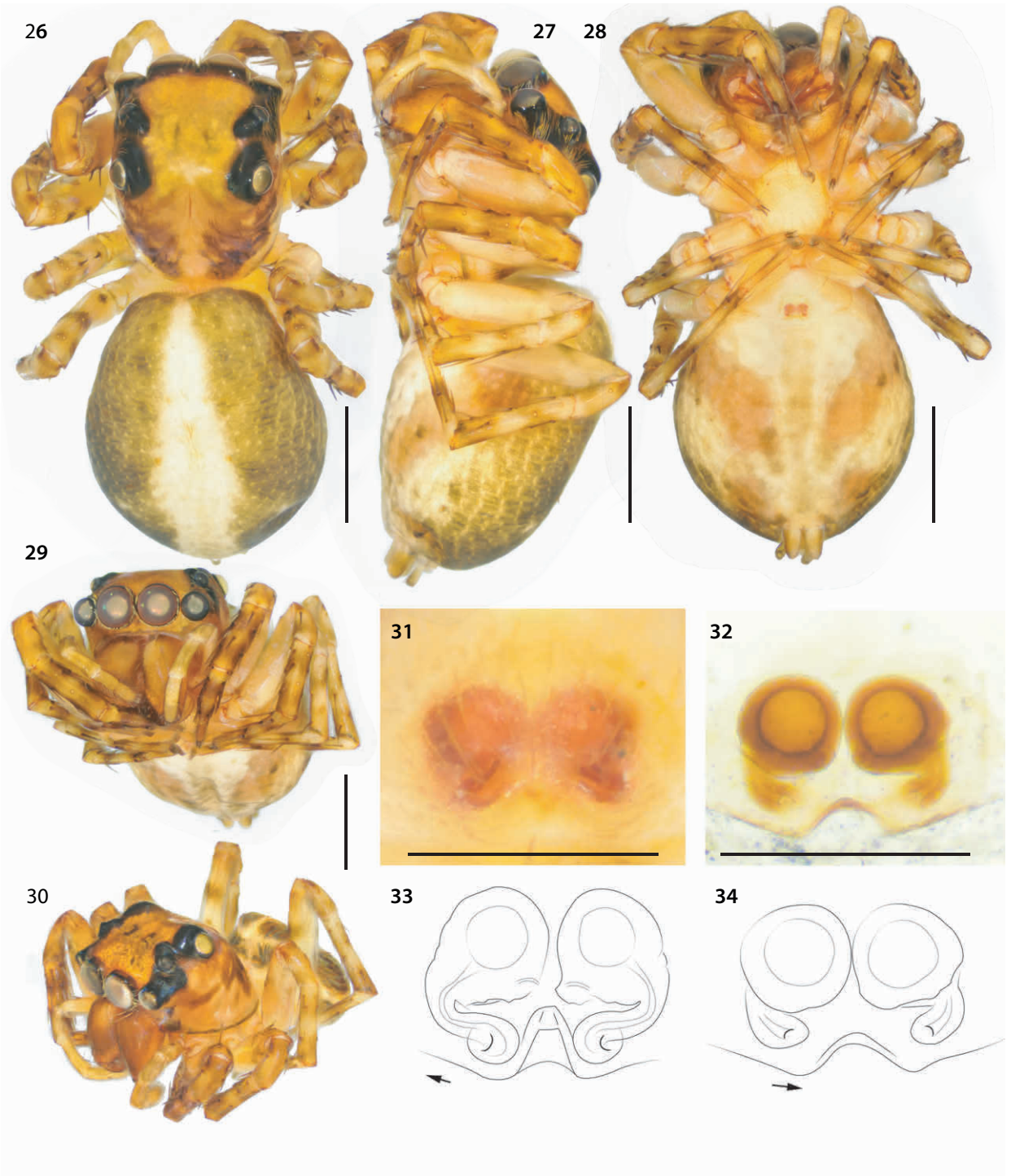
MATERIAL EXAMINED — One ♂ from Papua New Guinea, Mt Wilhelm, Kausi 5° 44' 23.6292"S 145° 19' 47.0712"E 200 m, mixed lowland forest and alluvium forest of plains and fans, understorey. 26.I.2014, beating (RBINS).

DIAGNOSIS — Males can be identified by the complex palp, bulbus with a hooked median apophysis and a hooked conductor (Figure 11). RTA is also characteristic with a smaller anterior and larger posterior connected at a right angle. Median apophysis and conductor are similar in size, diverging from each other, on the bulb at a 2 o'clock position on the bulb.

DESCRIPTION — See Maddison (2009).

DISTRIBUTION —Papua New Guinea: Baiteta Forest and Mt Wilhelm (Figure 35).

REMARK — A single male has been captured with only one partially expanded palp (Figure 11).



FIGURES 26-34

Waymadda enduwa gen. et n. sp. female. **26**, female paratype, dorsal view; **27**, ditto, lateral view; **28**, ditto, ventral view; **29** ditto frontal view; **30**, ditto, fronto-lateral view. Scale bars 1.0 mm. **31**, female epigyne, ventral view; **32**, vulva, dorsal view. Scale bars 0.25 mm. **33**, *Waymadda rufa* (Maddison, 2009), female vulva, dorsal view, line drawing; **34**, *W. enduwa*, female vulva, dorsal view, line drawing. Arrows indicate the orientation of copulatory openings.

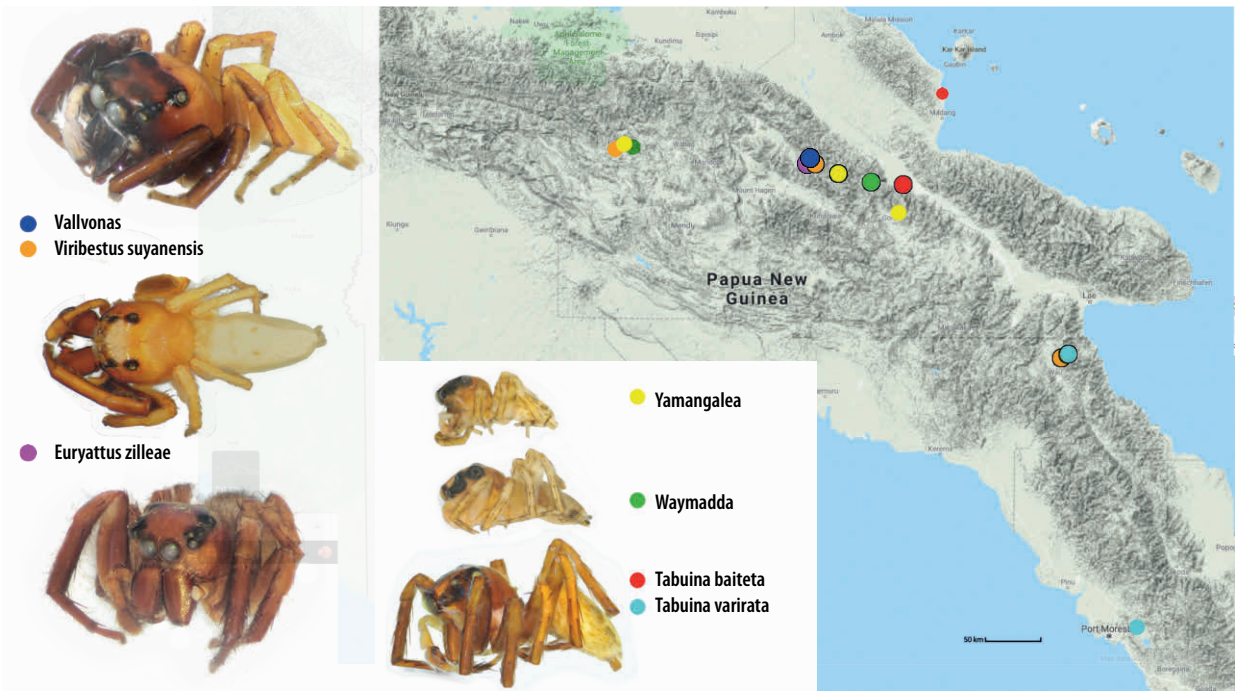


FIGURE 35

Perspective of the new data on known taxa. Dots with black outline are data published in this paper, without black outline are literature data.

Genus *YAMANGALEA* Maddison, 2009

Figures 3, 7, 8, 19

Type species. *Yamangalea frewana* Maddison, 2009.

DIAGNOSIS — Small bodied cocalodini salticid (Figure 3), similar to those of *Waymadda*, but the thoracic slope is very much domed (Figure 7). Conductor, median apophysis bent, equipped with a hook at the end. Embolus makes a turn behind the bulb and is visible through the cymbium.

COMPOSITION — *Yamangalea frewana* Maddison, 2009 and *Yamangalea lubinae* Żabka, 2012.

DESCRIPTION — See Maddison (2009).

DISTRIBUTION — Australia and Papua New Guinea: known from Paiam Forest, Mt Gahavisuka Provincial Park, Mt Wilhelm.

Yamangalea frewana Maddison, 2009

Figures 3, 7, 8, 19

Yamangalea frewana Maddison, 2009: 8.

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Enga Province: Paiam Forest, near Suyan Village, S 5.495 E 143.144, elev. 2400 m a.s.l., 10 July 2008, W. Maddison, Pingisa Saiké, Yainé Ribson, S. Soté, N. Soté, WPM#08-007 UBC-SEM AR00016. Paratypes, 3 ♂, 7 ♀, 3 juveniles, same data. [not examined]

MATERIAL EXAMINED — Papua New Guinea, Mt Wilhelm, Sinopas, -5.758978 145.186067 5.5, 2200 m, mid montane forest Mixed lower montane forest, understorey. 2013.10.04, 2 ♂, leg: Mogia, Lilip, Novotny, Leponce, understorey, beating (RBINS).

DIAGNOSIS — Males can be recognized by the embolus that makes a curve behind the bulb (Figure 19), and is visible through the cymbium.

DESCRIPTION — See Maddison (2009).

DISTRIBUTION — Papua New Guinea: Paiam Forest, Mt Gahavisuka Provincial Park and Mt Wilhelm (Figure 35).

Subfamily SALTICINAE Blackwall, 1841
Clade SALTICOIDA: ASTIOIDA Maddison, Bodner & Needham, 2008
Tribe VICIRIINI Simon, 1901

Genus *CAPEYORKIA* Richardson, 2016

Figures 36-46

Type species. *Capeyorkia vulpecula* (Thorell, 1881).

DIAGNOSIS — Richardson's diagnosis (Richardson 2016) remains valid, with the addition of female characters. Unidentate, large bodied salticids with narrow abdomen and carapace with a characteristic thoracic hump. (Figures 44-45). Males can be identified by a circular bulbus with the embolus wrapped around it (Figure 40). Tibia has a distinct ventral distal median lip overlapping the tegulum (Richardson 2016). Females can be recognized by the sheep-horn shaped sclerotized anterior flaps (Figure 41).

COMPOSITION — *Capeyorkia vulpecula* (Thorell, 1881) and *Capeyorkia richardsoni* n. sp.

DESCRIPTION — For details see Richardson (2016). *Male.* Large jumping spiders, with narrow and long abdomen. Carapace thoracic slope with a hump (Figures 44, 45), steep. Clypeus low, chelicerae robust, dentation unident (Figure 42). Gnathocoxae long, curved outwards. Leg I long and slightly wider than the others (Figures 43, 46). Palp with a circular bulbus (Figure 36), embolus long and thin wrapped around the bulb (Figure 40). RTA is robust and pointed (Figure 37).

Female. Similar as males but larger (Figures 45, 45). Thoracic slope with a hump (Figure 45), leg I more robust, than the others (Figure 46).

DISTRIBUTION — Australia (Cape York) and Papua New Guinea.

Capeyorkia richardsoni n. sp.

Figures 36-46

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Mt Wilhelm, Bananumbo, 1700 m, 5°45'33" S 145°13'48" E, 4th October 2013, Beating, leg: Valeba, Tulei, Novotny, Leponce (from collection event #P2070 (RBINS). Paratypes, 1 ♂, (from collection event #P1302), same data as the holotype. 4 ♂ (from collection events #P0148, #P0179, #P0184, #P0190), 1 ♀ (from collection event #P0186), from Wanang (Swire) Research Station 5°13' 31.5"S 45'33"S 145°4' 51"E 11th September 2012, Beating. Leg: Basset, Y. (RBINS).

DIAGNOSIS — Males of *C. richardsoni* n. sp. could be identified by the embolus' origin at the top of the tegulum, which is in a 12 o'clock position to the circular bulb) (Figure 40) versus the three o'clock position in *C. vulpecula* (Thorell, 1881). Females can be identified by the pear shaped spermathecae, horn shaped epigynal flaps, and the copulatory ducts course which are shaped like the letters "Я R" (Figure 41). Both females and males have reddish scales around AME.

DESCRIPTION — *Male.* Medium sized spiders, carapace 2.54 long, abdomen 2.7 long. Carapace dark brown, with a light band around the ocular area (Figures 42-44). Reddish scales around the eyes. Chelicerae with robust paturon and gnathocoxae elongated. Abdomen light colored with an ill-defined pattern on the dorsum. Legs are light yellow except the dark brown femorae I-III. Chelicerae robust (Figure 42).

Female. Slightly larger than males, carapace 3.21 long, abdomen 4.3 long. Carapace dark brown, with a light band around ocular area (Figures 45, 46), with light colored setae in the thoracic area. Reddish hairs around the first eye row and a poorly defined light colored pattern on the abdomen. Leg I. robust and dark brown whereas tarsus I and legs II-IV light yellow (Figure 45).

DISTRIBUTION —Papua New Guinea: Mt Wilhelm and Wanang.

Genus ***PORIUS*** Thorell, 1892

Figures 47-60

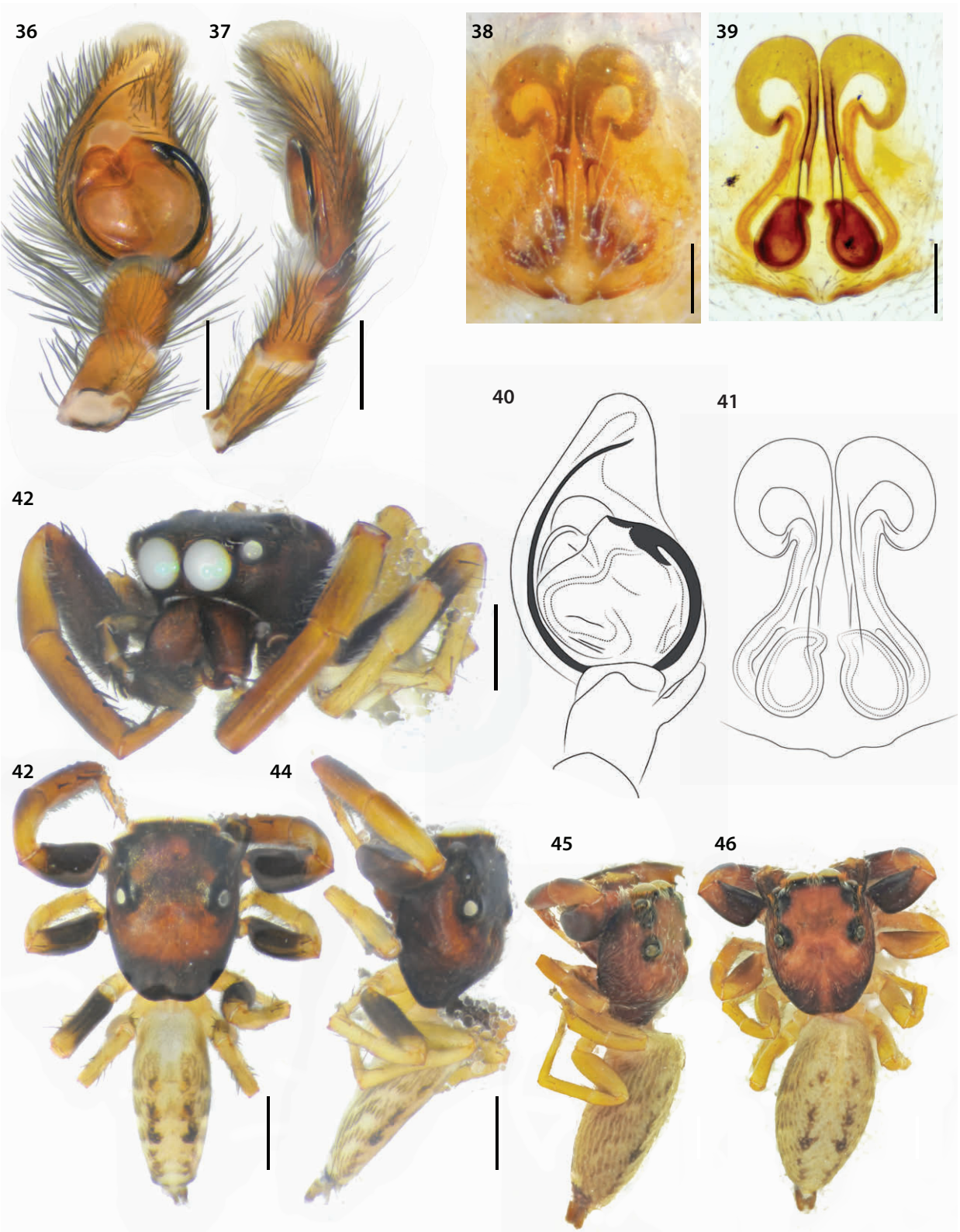
Type species. *Porius papuanus* (Thorell, 1881).

DIAGNOSIS — Thoracic slope has a characteristic bilobed hump, that does not overhang the rest of the thoracic slope (Figure 55). Males has a huge mesal promarginal teeth on the paturon (Figure 56). Thorell's original diagnosis, carapace widest after PLE [*quod cephalothorax ejus latitudinem suam maximarn non parum pone oculos posticos habet*] still applies.

COMPOSITION — *Porius papuanus* (Thorell, 1881) and *Porius decempunctatus* (Szombathy, 1915).

FIGURES 36-46

Capeyorkia richardsoni n. sp. **36**, male palp, ventral view; **37**, ditto, retrolateral view; **38**, female epigyne, ventral view; **39** vulva, dorsal view. Scale bars 0.25 mm. **40**, male palp, line drawing; **41**, female vulva, dorsal view, line drawing. **42**, male habitus, frontal-lateral view; **43**, ditto, dorsal view; **44**, ditto, lateral view; **45**, female habitus lateral view; **46**, ditto, dorsal view. Scale bars 1.0 mm.


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DESCRIPTION — Small sized but wide and probably a beetle mimic salticid. The carapace shape is diagnostic (Figures 47, 51, 54-56), with a rugose tegument, covered with fine white, light reflecting setae. Leg I (coxae too) robust in both sexes (Figures 47, 51, 54), tibia with three pairs and metatarsus with two pairs of strong ventral spines with elevated bases (Figure 56).

DISTRIBUTION — West Papua, Papua New Guinea.

REMARK — *Porius papuanus* (Thorell, 1881) has been described from South Papua, Hatan, Arfak Mts (not Watan - see Thorell 1881: p. 665 contra Prószyński 1984: p. 113), whereas *Porius decempunctatus* (Szombathy, 1913) from Papua New Guinea, Stephansort (close to Madang). Both species have been reillustrated by Prószyński (1983, 1984) by the epigynes only, and based on the drawings alone the only difference between the species is how far the central, anterior ridge bulge in between the openings: reaches well above the level of openings in *P. decempunctatus* (Figures 48, 52 white arrow) remain the level of the openings in *P. papuanus* (Prószyński 1984: p 133).

The type specimen of *Ballus decempunctatus* Szombathy, 1913 has a weakly sclerotized epigyne and the structures are difficult to interpret (Figure 52). Fortunately, we were allowed to examine the vulva of the holotype in detail (Figures 52-53), and the characters are similar enough to put the illustrated female to the same species (Figures 48-49, 52-53).

The hitherto unknown males have been assigned to this genus based (besides on the characteristic shape of the carapace, the concave margin of the thoracic slope and its with two distinct lobes, as seen from above) with *P. decempunctatus* female holotype due the close proximity the two localities where the specimens collected.

Porius decempunctatus (Szombathy, 1915)

Figures 47-60

Ballus decempunctatus Szombathy, 1915: 472.
Coccorchestes decempunctatus Prószyński, 1983b: 292, f. 21, 24-8 (Tf from *Ballus*).
Porius decempunctatus Prószyński, 1983b: Errata, p. 297 (Tf from *Coccorchestes*).

TYPE MATERIAL — Holotype, ♀, **Papua New Guinea**. Stephansort (Astrolabe bay), leg: L. BÍRÓ (HNHM Araneae-5131). [examined]

MATERIAL — Morobe Prov. Oomsis, 1.9 km E, 0.6 km N Wau Aerodrome 510 m, canopy fogging of TREE 30 *Pometia tomentosa*, 08.Sept.1988, 1 ♂. Morobe Prov., Mt Missim, 6 km E, 7 km W Wau Aerodrome, 1350 m, canopy fogging of TREE 13 *Castanopsis acuminatissima*, 19.Aug.1988, 1 ♂, leg: Allison. Morobe Prov., Biaru Rd. 24 km S, 11km E Wau Aerodrome, canopy fogging of TREE 49 *Lithocarpus rufovillosus* 1960 01.Oct.1988, 1 ♂, leg: Allison. Mt Missim, 1350 m, canopy fogging of TREE 19 Prunus sp., 23.Aug.1988, 1 ♂, leg: Allison; Morobe Prov., Biaru Rd. 21 km S, 10 km E Wau Aerodrome 2070, canopy fogging of TREE 44 *Cryptocarya* cf. *ledermanii*, 28. Sept.1988, 1 ♀, leg: Allison. Mt Missim, 1350 m, canopy fogging of TREE 17 Calophyllum sp., 22.Aug.88 12, 3 ♀, leg: Allison (SI). Mt Wilhelm, NG-M-U.26, Beating during descent, between Kambugomanbuno and Kamamemane, mainly in moss forest, along the river. ~2800-3000 m a.s.l. 1968 Sept. 24th, 2 ♀, leg.: J. Balogh (HNHM 9232).

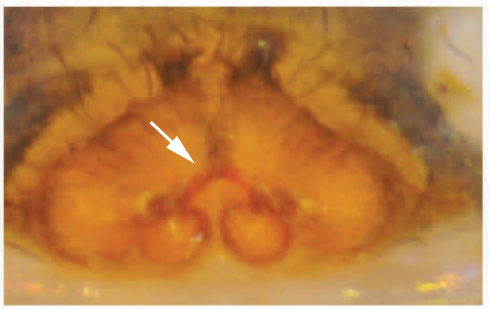
FIGURES 47-53

Porius decempunctatus (Szombathy, 1915) female. **47**, female from Mt Wilhelm, habitus, dorsal view. Scale bar 1.0 mm **48**, ditto, epigyne ventral view; **49**, vulva, dorsal view; **50**, vulva, line drawing. Scale bars 0.1 mm. **51**, female holotype, habitus, dorsal view; **52**, ditto, epigyne, ventral view; **53** vulva, dorsal view. Scale bars 0.1 mm.

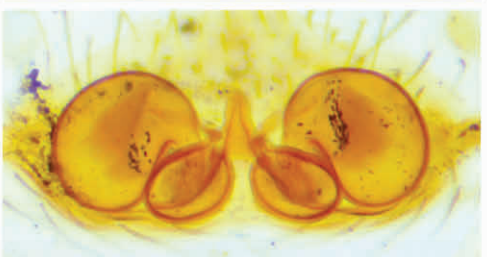
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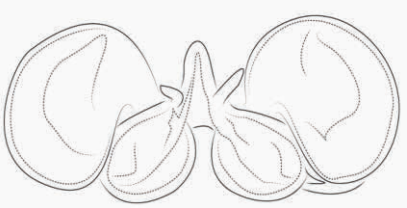
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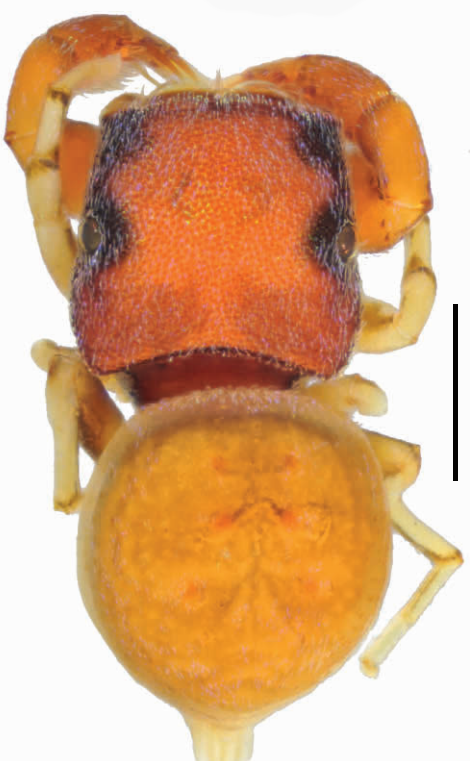
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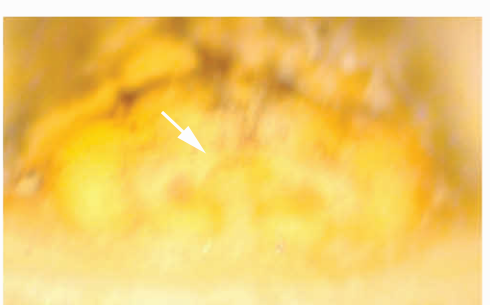
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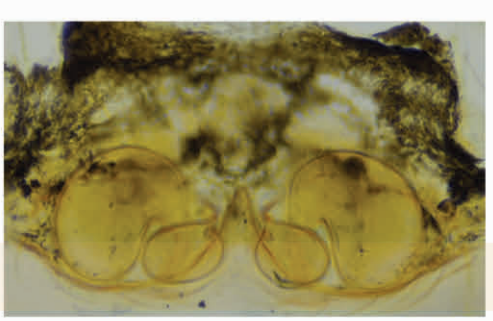
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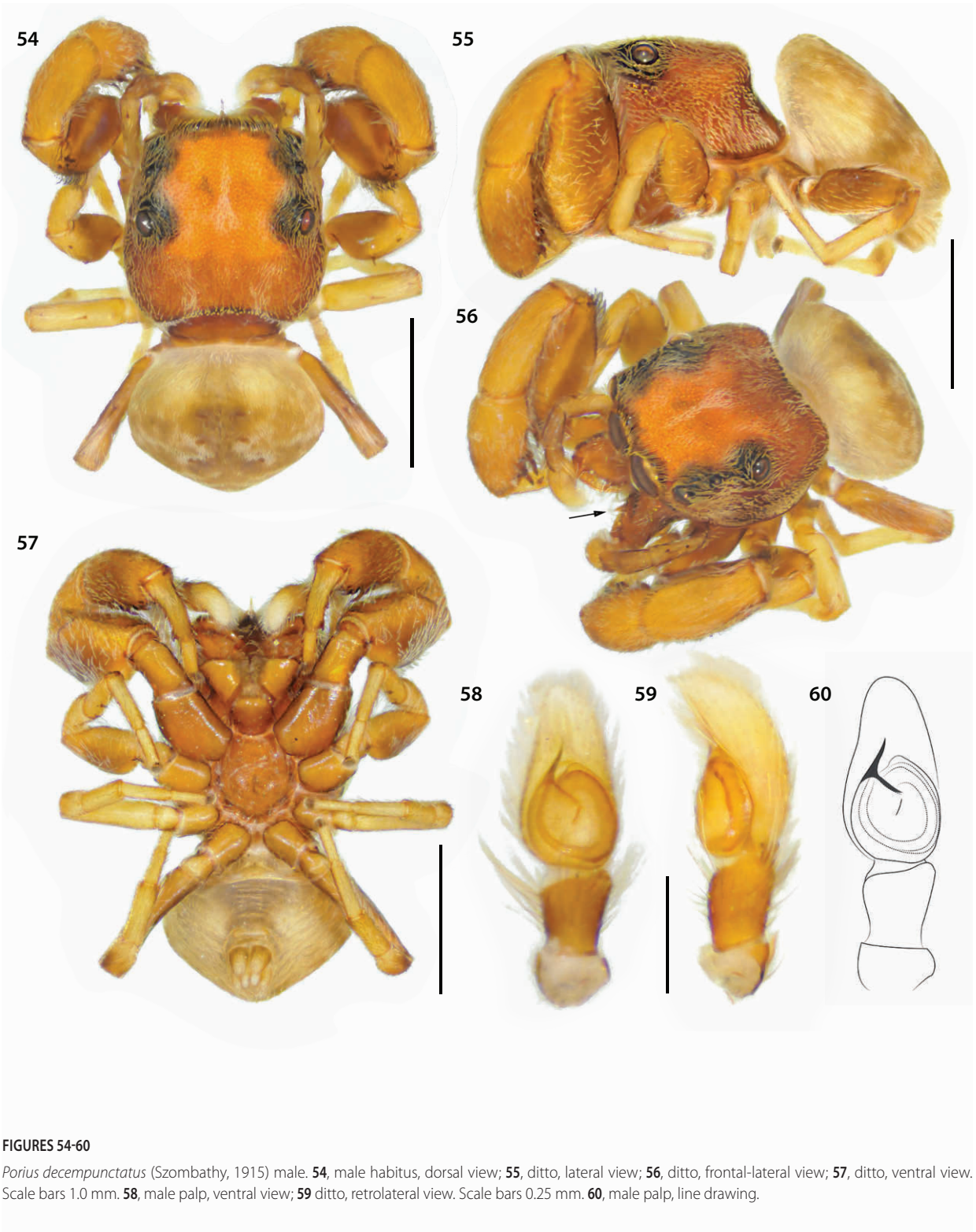


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FIGURES 54-60

Porius decempunctatus (Szombathy, 1915) male. **54**, male habitus, dorsal view; **55**, ditto, lateral view; **56**, ditto, frontal-lateral view; **57**, ditto, ventral view. Scale bars 1.0 mm. **58**, male palp, ventral view; **59** ditto, retrolateral view. Scale bars 0.25 mm. **60**, male palp, line drawing.

DIAGNOSIS — Females can be identified by the light yellow median part of the epigyne that has an anterior sclerotized rim which reaches well between the copulatory openings level as seen from the ventral side (Figures 48, 52). Males can be recognized by the embolus originating at a 10 o'clock position, and the small RTA (Figures 58-60).

DESCRIPTION — *Male.* Small sized carapace 1.48 long, abdomen 1.61 long, relatively wide and flat salticids (Figures 54-57). The light brown carapace covered with white iridescent setae. Leg I. robust, but other legs slender. Chelicerae with a robust paturon, and with two mesal promarginal large teeth (Figure 56. arrowed) one is close to the base of the fang. Male palp simple, round bulb, spermophore simple circular, without any twists or opposite turns (Figures 58, 59). Embolar part marked with a well emphasized margin and a short, needle-like embolus (Figure 60).

Female. Slightly larger than males, carapace 1.87 long, abdomen 1.67 long. Carapace dark, with rugose tegument, covered with white iridescent setae (Figures 47, 51). Leg I robust. Epigyne with a lighter triangular median area (Figures 48, 52), wide sperm ducts, about twice as large as the spermathecae (Figures 49-50, 53). Spermathecae close to each other (less than half a diameter apart).

DISTRIBUTION — Papua New Guinea: Stephansort, Mt Wilhelm, Mt Missim, Wau.

Subfamily SALTICINAE Blackwall, 1841
Clade SALTICOIDA: SALTAFRESIA: SIMONIDA Maddison, 2015
Tribe EUOPHRYINI Simon, 1901

Genus ***OMOEDUS*** Thorell, 1881

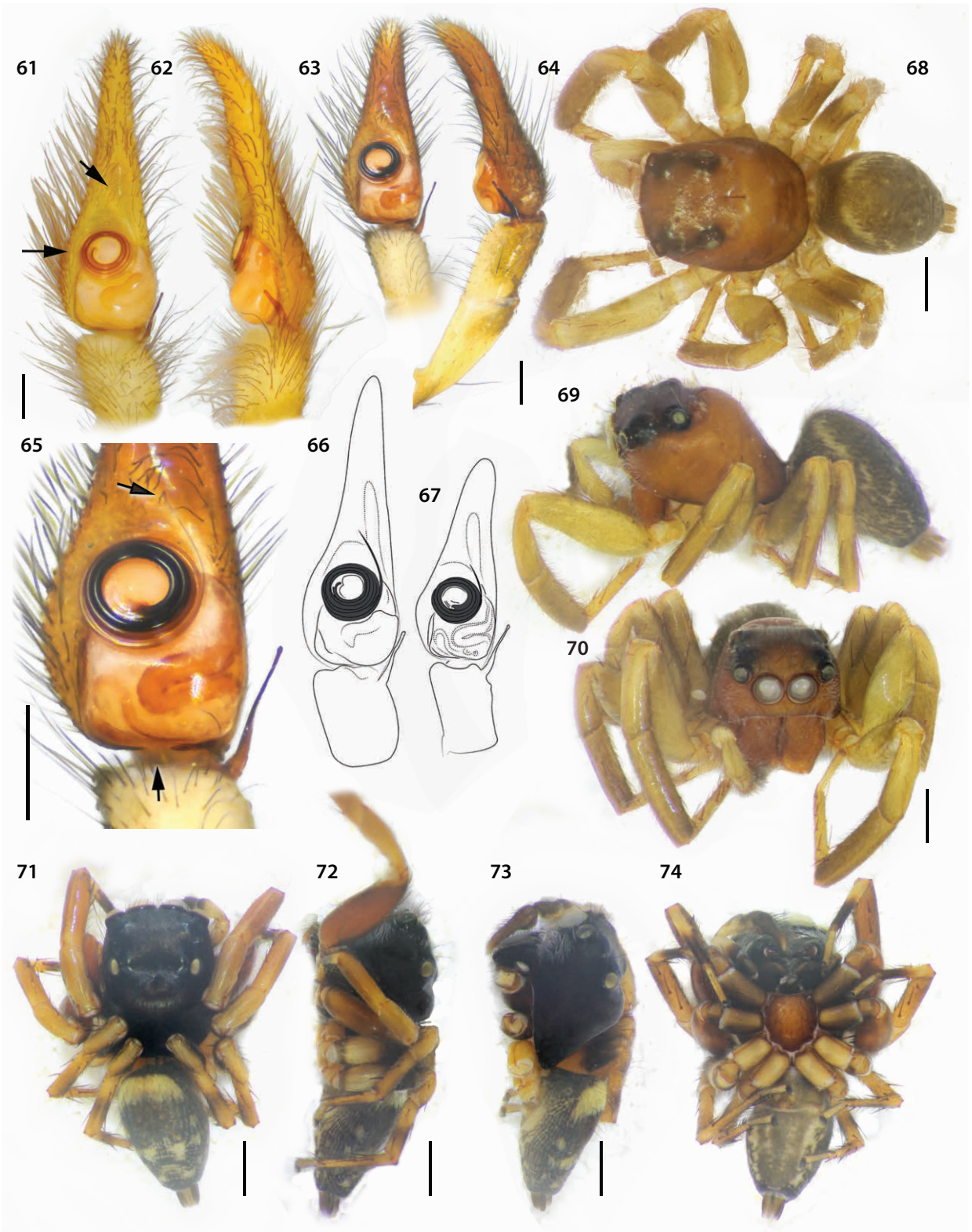
Figures 61-95

Type species. *Omoedus niger* Thorell, 1881

DIAGNOSIS — The diagnosis of Zhang and Maddison (2012 and 2015) still applies with a small correction: the embolus coils less than one and a half time for *Omoedus* cf. *piceus* (Zhang and Maddison 2015: figs 343-349) and *Omoedus baloghi* n. sp. (Figures 87, 90).

REMARK — There is a strong disagreement among specialists regarding the precise limits and composition of the genus *Omoedus* Thorell, 1881. When defined by Zhang and Maddison (2012) it was based on the monophyly of three genera, *Zenodorus* Peckham & Peckham, 1886 (30 spp.); *Pystira* Simon, 1901 (5 spp.) and *Omoedus* Thorell, 1881 (7 spp.). *Omoedus* sensu Zhang & Maddison was diagnosed by the "*absence of proximal tegular lobe and the highly coiled embolus of the male palp, the long and convoluted copulatory duct and the small and tubular spermatheca of the vulva*". This larger genus concept has since been rejected by Prószyński (2017), but without providing diagnoses of the genera mentioned above, as noted by Kropf *et al.* (2019). Besides the lack of explicit diagnoses, we were unable to find and describe differences between the female genitalia of *Zenodorus* Peckham & Peckham, 1886 and *Pystira* Simon, 1901 or between the male palp of *Pystira* Simon, 1901 and *Omoedus* Thorell, 1881. Moreover, *Omoedus bunbi* n. sp. does not fit into any of the three genera as presented by Prószyński (2017).

Clearly the species described here differ in a certain level and it is therefore encouraged and recommended that future division takes place (but is well beyond the scope of this paper). However, as we are unable to see their boundaries or test the diagnoses of those genera, and since there is an available name for a monophyletic taxon, we have chosen to put the species we describe here as *Omoedus* sensu Zhang and Maddison (2012) to minimize confusion.


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COMPOSITION — Species listed in WSC as *Zenodorus* Peckham & Peckham, 1886 (30 spp.), *Pystira* Simon, 1901 (5 spp.) and *Omoedus* Thorell, 1881 (7 spp.) with the additional four species described here as new.

DESCRIPTION — Diverse salticid clade with individuals of small to large sizes, diverse salticid clade. Species that belong here have relatively high carapaces, males either with a steep slope (*Omoedus bunbi* n. sp. Figure 80), a clear bump (*O. koehalmii* n. sp. Figure 73 and *O. danyii* n. sp. Figure 69) or a lobe like protusion (*O. piceus* Simon, 1902, *O. baloghi* n. sp. Figure 93). Color pattern varies significantly, from a brownish dull through bright to shiny black, in some cases with secondary (reflective or physical) colors. The male palp with a tibial apophysis which takes many forms, such as robust (*O. baloghi* n. sp. Figure 90), very thin (*O. koehalmii* n. sp. Figure 65, *Omoedus darleyorum* Zhang & Maddison 2012), embolus tightly coiled once (*O. baloghi* n. sp. Figure 87) or many times (*O. danyii* n. sp. Figure 61) vertically (*O. koehalimii* n. sp. Figure 67, *O danyii* n. sp. Figure 66) or horizontally (*O. bunbi* n. sp. Figure 78). Females may have a triangular epigynal plate (*Omoedus darleyorum* Zhang & Maddison 2012, *O. niger* Thorell, 1881) or do not have a triangular epigynal plate (*O. bunbi* n. sp. Figure 84).

DISTRIBUTION — Australia, Indonesia, Papua New Guinea and Oceania.

Omoedus danyii n. sp.

Figures 61-62, 66, 68-70

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Mt Wilhelm, NG-M-R.3 Field Station 3200 m. a.s.l. 1968 Sept. 14th, Moss forest, sifted from epiphyton mosses. leg: Balogh, J. (HNHM 9214).

DIAGNOSIS — The males of this species can be recognized by the cymbium, that is elongated over 3 times more than the tegulum (3.3x times on the holotype, Figure 61). RTA thin, bent forward in the middle (Figure 62). The embolus tightly coiled 4x times, originating from a 9 o'clock position of the coil and is filiform at the end (Figure 66).

ETYMOLOGY — The species is dedicated to László Dányi PhD, the curator of the spider collection of Hungarian Natural History Museum, making Papua New Guinean material available for this study.

DESCRIPTION — Medium sized salticids, carapace 3.2 log, abdomen 2.3 long. Carapace light brown, with darker ocular area (Figure 68). Legs brown (bleached out), but tibiae seemingly darker. Chelicerae as slightly bent (Figure 70) as in *e.g. O. darleyorum* Zhang & Maddison, 2012. The thin RTA, bent towards the ventral side (Figure 62). Cymbium extremely long and slightly bent at the apex. Embolus tightly coiled (Figures 61, 66).

DISTRIBUTION — Papua New Guinea, Mt Wilhelm.

FIGURES 61-74

Omoedus spp. **61**, *Omoedus danyii* n. sp., holotype, male palp, ventral view; **62**, ditto, retrolateral view. **63**, *Omoedus koehalmii* n. sp., holotype, male palp, ventral view; **64**, ditto, retrolateral view; **65**, ditto, closeup of the male palp and RTA. Scale bars 0.25 mm. Arrows indicating the embolar groove, and the origin of the embolus. **66**, *Omoedus danyii* n. sp., male palp line drawing; **67**, *Omoedus koehalmii* n. sp., male palp line drawing. **68**, *Omoedus danyii* holotype male habitus, dorsal view; **69**, ditto, dorsolateral view; **70**, ditto, frontal view; **71**, *Omoedus koehalmii*, holotype male, dorsal view; **72**, ditto, lateral view with legs; **73**, ditto, lateral view, without legs; **74**, ditto, ventral view. Scale bars 1.0 mm.

Omoedus koehalmii n. sp.

Figures 63-65, 67, 71-74

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Mt Wilhelm, Bananumbo, 1700 m, 5°45'33"S 145°13'48"E, 4th October 2013, Beating, leg: Valeba, Tulei, Novotny, Leponce, from collection event #P2077 (RBINS). Paratypes, 2 ♂, Papua New Guinea. Mt Wilhelm, Sinopas -5.758978 145.186067 5.5, 2200 m, mid montane forest Mixed lower montane forest, understorey, 2013.10.04, leg: Mogia, Lilip, Novotny, Leponce, understorey, beating, from collection events #P2461, #P2454 (RBINS and MNHN).

DIAGNOSIS — The elongated cymbium of male palp of this species is similar to that of *Omoedus danyii* n. sp., but this species can be distinguished by the cymbium that is slightly less than 3 times as long as the tegulum (Figure 66). The embolus tightly coiled 3.5x times and originate from the 6 o'clock position (Figure 65).

ETYMOLOGY — The species is dedicated to Zoltán Kőhalmi, Hungarian stand-up comedian and scriptwriter.

DESCRIPTION — Carapace 2.77 long, abdomen 2.1 long. Carapace black, abdomen dark, with a whitish anterior band, and two pairs whitish dots distally (Figure 71). Legs yellowish, apical half of tibiae and femora black (Figure 72). Chelicarae unmodified and clypeus with a white moustache (Figures 73, 74).

DISTRIBUTION — Papua New Guinea, Mt Wilhelm.

Omoedus bunbi n. sp.

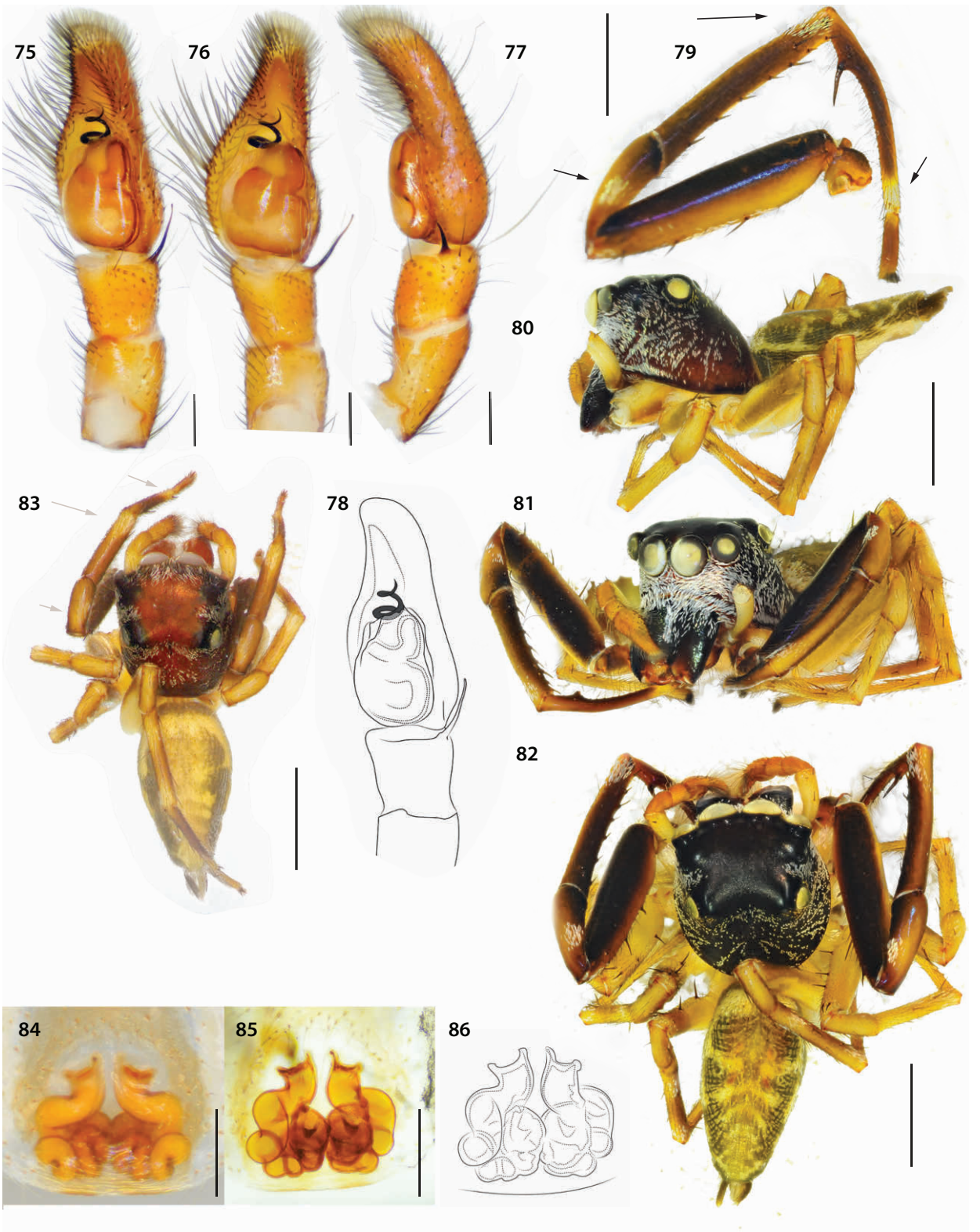
Figures 75-86

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Madang Province, Oromongu, 5.73° S 142.53° E 700 m a.s.l., 26 January 2014, Mixed lowland forest Mixed evergreen forest of foothills and mountains, Maurice Leponce #P5099. Beating (RBINS). Paratypes. **Papua New Guinea**. Same locality as the holotype, 11 September 2012, 2 ♂, Basset, #P0180, Beating (MNHN); 9 September 2012, 1 ♂, Basset, #P0148, Beating (RBINS). Mt Wilhelm, NG-M-C.26 Beating during descent, between Kambugomanbuno and Kamamemane, mainly in moss forest, along the river, ~2800-3000 m a.s.l., 1968. Sept. 24th, 1 ♀, leg.: J. Balogh (HNHM 9217).

DIAGNOSIS — Males of *O. bunbi* n. sp. can be easily recognized by the huge proximal macroseta of the first metatarsus (Figure 79). The loosely, horizontally coiled embolus (Figures 75-76, 78) is similar to that of *Omoedus torquatus* (Simon, 1902) (Prószyński 1984), but it can be distinguished by the longer and more coiled embolus (Figure 75). Females can be identified by the lack of a triangular epigynal plate, and the upward directed copulatory openings (Figures 84-86). The male and female specimens have been matched based on the first leg's color pattern of the metatarsus and tibia I with distal patella I having a median pale-yellow stripe (Figures 79, 83 arrowed).

FIGURES 75-86

Omoedus bunbi n. sp. **75**, male palp, ventrolateral view; **76**, male palp, ventral view; **77**, ditto, retrolateral view. Scale bars 0.25 mm. **78**, ditto, line drawing. **79**, male holotype, first leg, prolateral view; **80**, male holotype, habitus, lateral view; **81**, ditto, frontolateral view; **82**, ditto, dorsal view; **83**, female paratype dorsal view. Arrows indicating the lighter bands in the first legs in both sexes. Scale bars 2.0 mm. **84**, female epigyne, ventral view; **85** vulva, dorsal view. Scale bars 0.25 mm. **86**, female vulva, dorsal view, line drawing.


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ETYMOLOGY — The species is dedicated to Bernadett Solymosi (Bunbi), the wife of Tamás Szűts.

DESCRIPTION — *Male.* relatively large bodied euophryine spiders, with white scales on the carapace and clypeus (Figures 80-81). Carapace 3.4 long, abdomen 4.0 long. Ocular area with a slight hump, with a steep thoracic slope (Figure 80) - contra to *Omoedus koehalmii, O. baloghi* or *O. danyii* (Figures 72, 93, 69 respectively). Carapace with darker integument, and with white scales patterned radially in the thoracic area but absent in the ocular area except between PLE and ALE (Figure 82). Clypeus and the robust chelicerae densely covered with white reflective scales (Figure 81). Legs long and slender and dark yellow, except for leg I that is dark, blackish brown, with iridescent scales on the dorsal side of the femur, in the middle part of patella, and the apical end of the tibia and metatarsus (Figure 79). The metatarsus modified (Figure 79): elongated, as long as tibia, slightly bent and with a large proximal macroseta. Metatarsal apical macroseta pair tiny and barely visible (Figure 79). Abdomen with an anterior white band and a folium like pattern comprised by white setae, which can come off easily. Posterior lateral spinnerets dark and elongated (Figures 80-82).

Male palp dark yellow, with a thin typical *Omoedus*-like RTA with a blunt tip (Figure 76), that slightly bent towards the ventral and the retrolateral side. (Figure 77). Embolus base hidden behind the tegulum and loosely coiled in around on the vertical axis (hence the coils horizontal, Figure 76).

Female. carapace 2.6 long, abdomen 3.3 long. Carapace with a brown integument with white iridescent scales situated in similar pattern than those on the males (Figure 83). Abdomen with an anterior pale band (Figure 83) and an ill-defined pattern. Legs unmodified and leg I color pattern matching with that on the male's leg I pattern (Figure 83). Metatarsus I unmodified, with 2 pairs of macrosetae and the apex pair slightly smaller. Female epigynum without the scletorized triangular epigynal plate (Figure 84) and copulatory opening directed upwards (Figure 85), similar to those of *O. metallescens* (L. Koch, 1879) (Prószyński 1984), but the first coil is much tighter (Figures 84-86).

DISTRIBUTION — Papua New Guinea, Mt Wilhelm.

REMARK — The male palp of this species is very similar to that illustrated by Prószyński (1984) under the nomen nudum *Margaromma kochi* Simon, 1901. However, there is no description available of specimens the images are made from, meaning it is impossible to review it adequately. In addition, the copulatory ducts of the female epigynum of this species are longer and more convoluted with the starting portion closer to each other than in *Margaromma kochi* Simon, 1901 resulting in the decision to describe this species as new. Male and female specimens have been matched by the similar habitus and the markings on the first leg (Figures 79, 83).

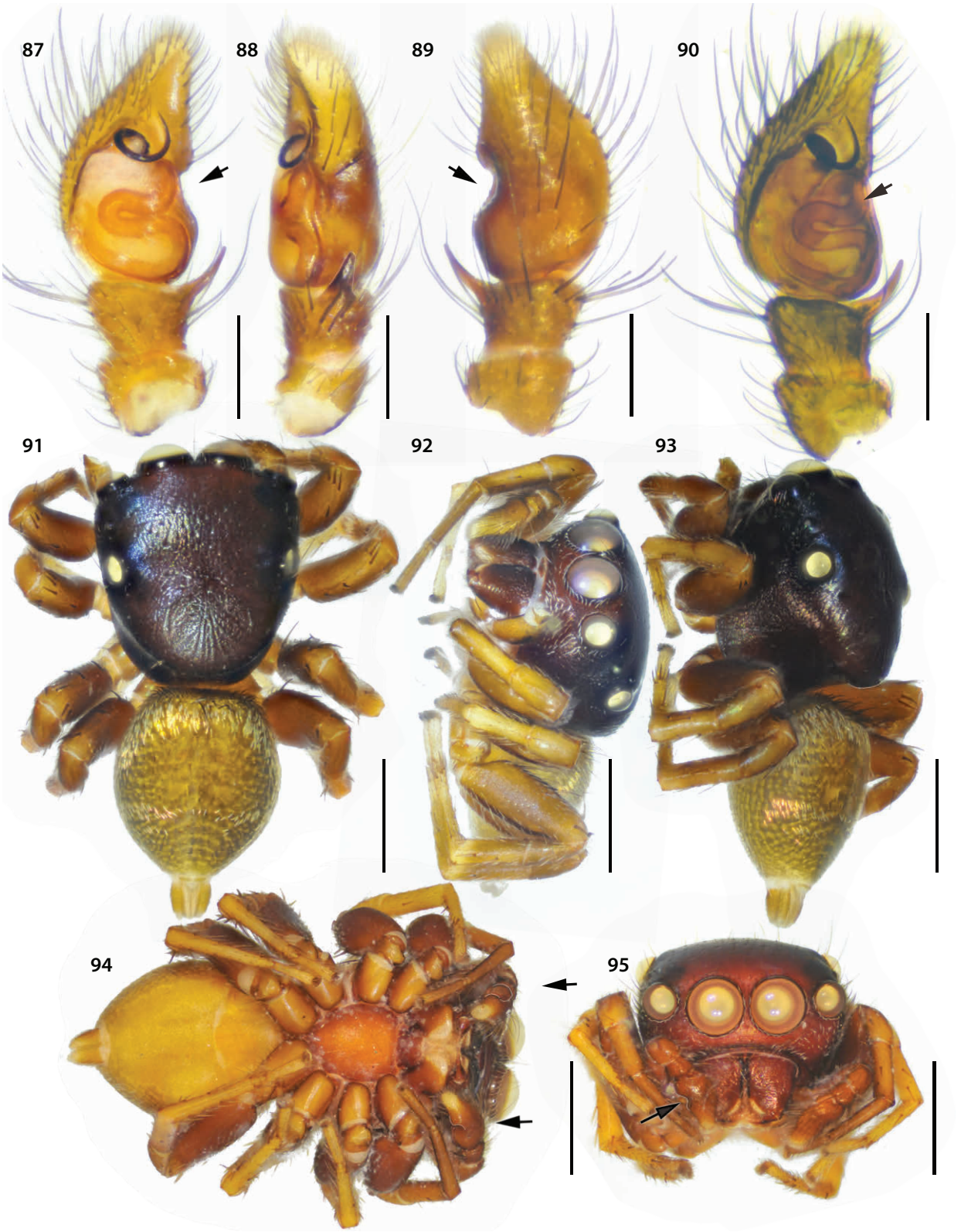
Omoedus baloghi n. sp.

Figures 87-95

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Mt Wilhelm, NG-M-C.26 Beating during descent, between Kambugomanbuno and Kamamemane, mainly in moss forest, along the river, ~2800-3000 m a.s.l. 1968. Sept. 24th, (HNHM 9220). Paratypes, **Papua New Guinea**. Same data as holotype, 1 ♂ (HNHM 9249). Madang Province, Kausi, 5.73° S 145.33° E, 200 m a.s.l., 4th October 2013, Mixed lowland forest Mixed alluvium forest of plains and fans, 2 ♂ leg: Dilu, Ray, Novotny, Leponce #P0916, #P0888, Beating (RBINS).

FIGURES 87-95

Omoedus baloghi n. sp. **87**, male palp, ventral view; **88**, male palp, lateral view; **89**, ditto, dorsal view; **90**, cleared palp, ventrolateral view. Arrows indicating the cymbial depression. Scale bars 0.25 mm. **91**, male holotype, dorsal view; **92**, ditto, frontolateral view; **93**, ditto, lateral view; **94**, paratype, ventral view; **95**, ditto, frontal view. Arrows indicating the cymbial depression. Scale bars 1.0 mm.


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DIAGNOSIS — The males of this species can be recognized by the retrolateral depression of the cymbium (Figures 87, 89, 90, 94, 95). The palp otherwise is very similar to that of *O. piceus* Simon, 1902. The embolus has a 1.2 turn of coil and the coil's plane is at 45 degrees.

ETYMOLOGY — The species is dedicated to the late professor János Balogh, the collector of the Papua New Guinean material which was borrowed for this study from the HNHM.

DESCRIPTION — Small salticids, carapace 2.0 long, abdomen 1.65 long. Carapace black with a thoracic slope with a large hump, overhanging the rest of the thoracic area, with a radial pattern (Figures 91, 93). Carapace with iridescent setae, around the sides of the clypeus (Figure 92). Chelicerae conical (Figures 92, 95). Abdomen dark, with a proximal band and a median side dot of iridescent setae (Figure 91). RTA of the palp strong, slightly bent as seen from the venter. Cymbium with a characteristic retrolateral depression (Figures 87-90).

DISTRIBUTION — Papua New Guinea, Mt Wilhelm.

Genus ***EURYATTUS*** Thorell, 1881

Figures 35, 96-108

Type species. *Euryattus porcellus* Thorell, 1881.

DIAGNOSIS — Robust, medium sized salticids, with a characteristic embolar base. The embolus often has lobes at the apical area (Figure 98). RTA often has an apical hook (Figure 99). The female vulva has secondary spermathecae (Figure 107).

COMPOSITION — Species listed in WSC as *Euryattus* Thorell, 1881 and *Euryattus zilleae* n. sp.

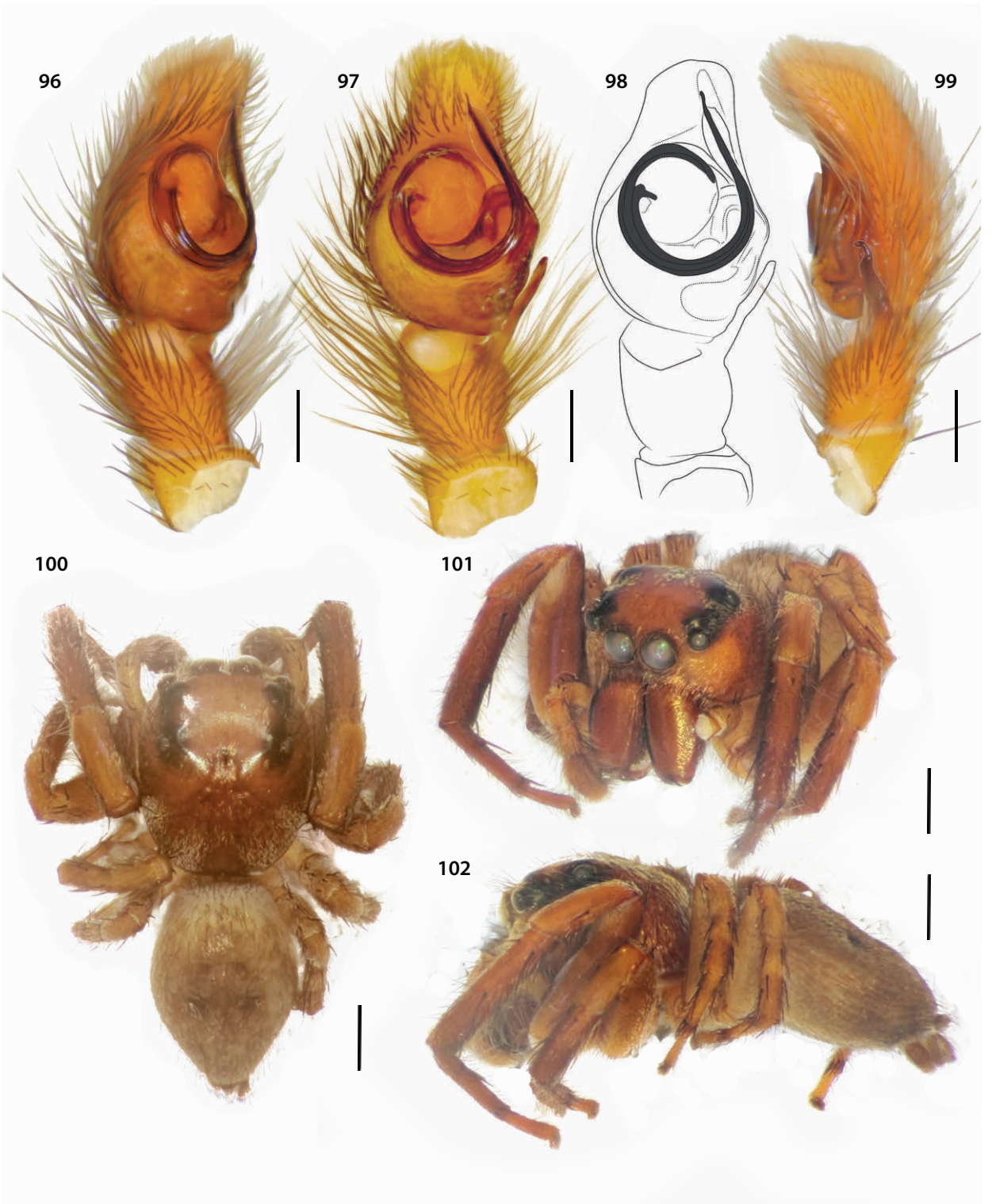
DESCRIPTION — Medium sized fissidentate salticids, with a robust carapace and an abrupt steep thoracic slope. (Figure 102). Chelicerae sexually dimorphic; males' chelicerae "*flat-fronted, smooth*" (Figure 101, Davies & Żabka 1989), females with robust, frontally domed chelicerae (Figures 103, 104). RTA of the palp strong, varies from slightly bent to a hook when seen from the side (Figure 99). Embolus with lobes or appendages ("*bifurcate*" — Davies & Żabka 1989) at the apical end (Figure 97), epigyne with a median septum (Figure 106), secondary spermathecae and with "*chitinous intucking*" (Davies & Żabka 1989 pl. 32) (Figure 107).

DISTRIBUTION — Australasian, from Sri Lanka to Australia. So far six species have been reported from Papua New Guinea.

Euryattus zilleae n. sp.

Figures 96-108

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Mt Wilhelm, NG-M-C.26 Beating during descent, between Kambugomanbuno and Kamamemane, mainly in moss forest, along the river, ~2800-3000 m a.s.l. 1968, Sept. 24th, leg: J. Balogh (HNHM 9317). Paratypes, **Papua New Guinea**. Same data as holotype, 5 ♂, 5 ♀ (HNHM).

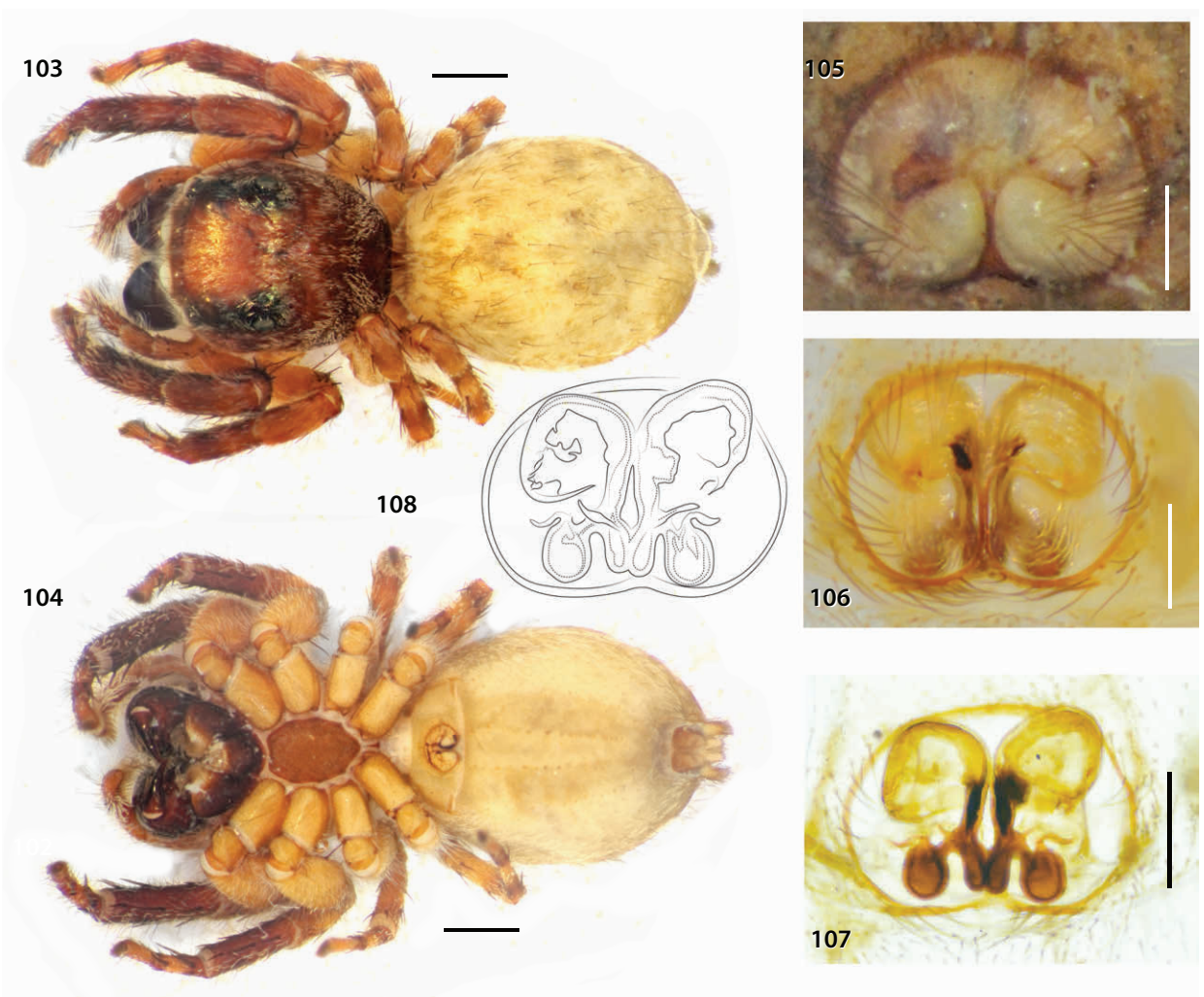


FIGURES 96-102

Euryattus zilleae n. sp., male. **96**, male palp, ventrolateral view; **97**, ditto, ventral view; **98**, ditto, line drawing; **99**, ditto, retro lateral view. Scale bars 0.25 mm. **100**, male holotype, dorsal view; **101**, ditto, frontolateral view; **102**, ditto, lateral view. Scale bars 1.0 mm.

DIAGNOSIS — Males can be recognized by the loose embolar coil (not covering the retrolater side of the embolar base Figure 98) and the "shoulder of the tegulum" at the same level as the embolus origin (Figures 97, 98). RTA long and reaching the level of the lower coil of the embolus (Figures 97, 98). Apical third of embolus with wide membranous extensions on both sides (like *pars pendula*) Figures 96-98. Female vulva with spermathecae far apart (about twice the spermatheca's diameter - Figure 108), compared to those of *E. myopotami* (Thorell, 1881), but spermduct situated within the sclerotized ring around epigyne (Figures 105-108).

ETYMOLOGY — The species is dedicated to Zille Dóra Szűts, the daughter of the first author.



FIGURES 103-108

Euryattus zilleae n. sp., female. **103**, female paratype, dorsal view; **104**, ditto, ventral view. Scale bars 1.0 mm. **105**, epigyne, ventral view; **106**, enzyme cleared epigyne, ventral view; **107**, vulva, dorsal view. Scale bars 0.25 mm. 108, female vulva, dorsal view, line drawing.

DESCRIPTION — *Male.* Relatively large bodied, dark with shiny greenish metallic carapace and four wide radial stripes in the thoracic area (Figures 100-102). Carapace 3.3 long, abdomen 3.2 long. Ocular area with a slight hump and steep thoracic slope (Figure 102) Carapace with brown integument and covered with green metallic setae as the clypeus (Figure 101). Chelicerae robust, with a flat anterior surface (Figure 101). Legs dark brown, with iridescent setae, but legs I-II somewhat stronger than leg III-IV. Abdomen without a clear pattern (Figure 100).

Male palp dark yellow, with dense thick setae on the lateral sides (Figures 96-97). RTA strong with a hook at the tip (Figure 99). Embolus originates at a 9 o'clock position to the base, loosely coiled, about 1.5 times the bulb height (Figures 97-98). Apical third with wide, membraneous extensions on both sides (Figure 97). Shoulder of the tegulum at the same level as base of embolus (Figures 96-98) and the base is somewhat larger than other *Euryattus* species occupies about half of the bulb.

Female. Carapace 2.9 long, abdomen 3.8 long. Carapace with a brown integument with greenish metallic shine and two wide radial stripes in the thoracic area, which covered with whitish setae (Figure 103). Abdomen without a clear pattern (Figure 103). Chelicerae robust, but with domed anterior surface (Figures 103, 104). Legs unmodified. Female epigynum typical to those of *Euryattus* (Figures 105-108), with a very thin median septum, spermathecae longer than wide. The spermathecae are far apart (about twice the spermatheca's diameter) and the sperm ducts remain within the sclerotized ring around epigyne (Figure 108) and the "*chitinous intucking*" (sensu Davies & Żabka 1989 pl. 32) also remains within the sclerotized ring (Figure 107). The secondary spermathecae similar in size, but only about half of the primary's width.

DISTRIBUTION — Papua New Guinea, Mt Wilhelm (Figure 35).

VALLVONAS n. gen.

Figures 117-118, 120-127

Type species. *Vallvonas zarandi* n. sp. by monotypy.

DIAGNOSIS — Males of the genus can be recognized by the blunt teeth on the RTA and the blunt, clockwise coiled embolar end.

ETYMOLOGY — The genus name is a random combination of letters.

COMPOSITION — Monotypic.

DESCRIPTION — Medium sized spiders, with a wide carapace. Habitus in general (Fig 121-123) is similar to *Viribestus* Zhang & Maddison, 2012 (Figures 109-111), but can be readily distinguished by the white hairs on the clypeus (Figures 117, 123) and the structure of the male palp: "gear-shaped" blunt teeth on the RTA (Figure 127), clockwise coiled embolus (Figure 120). Chelicerae dark brown with a flattened surface (Figure 117), but the paturon's retrolateral side and cheliceral teeth unmodified (Figure 118).

DISTRIBUTION — Papua New Guinea, Mt Wilhelm (Figure 35).

Vallvonas zarandi n. sp.

Figures 117-118, 120-127

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Mt Wilhelm, NG-M-C.27 Beating during descent, between Kambugomanbuno and Kamamemane, mainly in moss forest, along the river. ~2800-3000 m a.s.l. 1968. Sept. 24th. HNHM 9234.

DIAGNOSIS — The species can be identified based on the blunt, "gear shaped" angular teeth on the RTA (Figures 120, 126, 127) and the clockwise coiled, blunt embolar end (Figures 120, 127).

ETYMOLOGY — The species is dedicated to the first author's son, Zaránd Bence Szűts.

DESCRIPTION — Medium sized euophryine, with a stout carapace of 1.7 long and elongated abdomen 1.8 long, with a dark ventral side (Figures 120-123). The carapace (in alcohol) bright yellowish with a darker ocular area, chelicerae with a flattened, shiny dark brown surface. Gnathocoxae without any lobes (Figure 117 indicated with an arrow). Clypeus and distal segments (cymbium, tibia and patella) of the palp is covered by white, fine setae (Figures 117, 124-126). Legs are unmodified, first legs dark brown, hind legs are dark yellowish (Figures 121-123). First leg somewhat enlarged, with stronger setae on the ventral side of tibia and patella.

Palp with a unique shaped strong RTA: inner side with 6 blunt, angular teeth (look like gears - Figures 120, 124, 127). Proportions of the palp are not typical euophryne; the tegulum narrow, situated on the lower third of the bulb (Figure 127), embolus coil is large, embolus wide, similar to *Xenocytea albomaculata* Zhang & Maddison, 2012, but coiled clockwise (Figure 124).

DISTRIBUTION — Papua New Guinea, Mt Wilhelm (Figure 35).

Genus ***VIRIBESTUS*** Zhang & Maddison, 2012

Figures 109-116, 119

Type species. *Viribestus suyanensis* Zhang & Maddison, 2012 by monotypy.

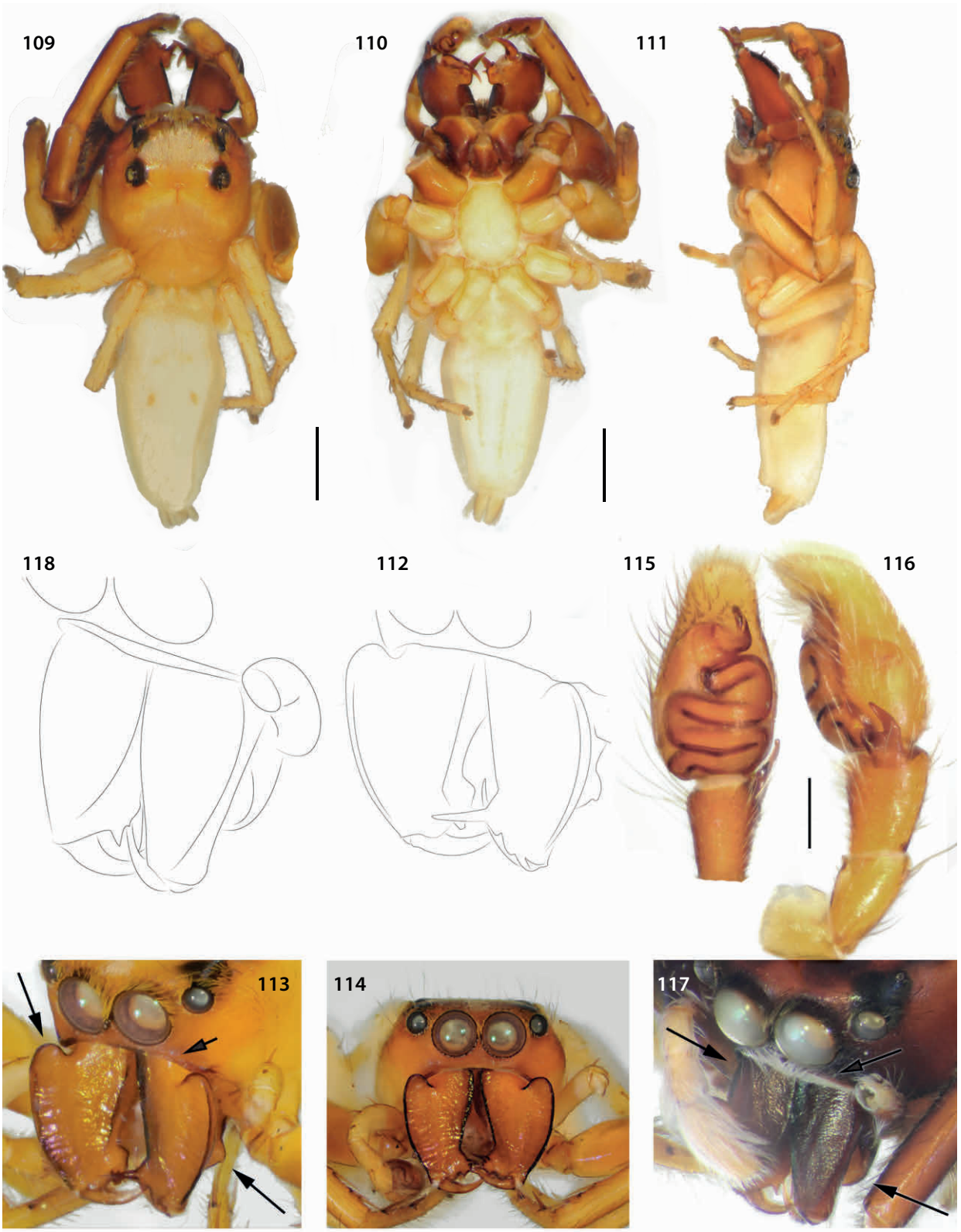
DIAGNOSIS — The males of the genus can be recognized by the proximal, retrolateral lobe of the flat paturon (Figures 112-114), the protuding cheliceral promarginal tooth (Figure 110), the stout slightly coiled embolus, and the bifid RTA (Figures 115, 116).

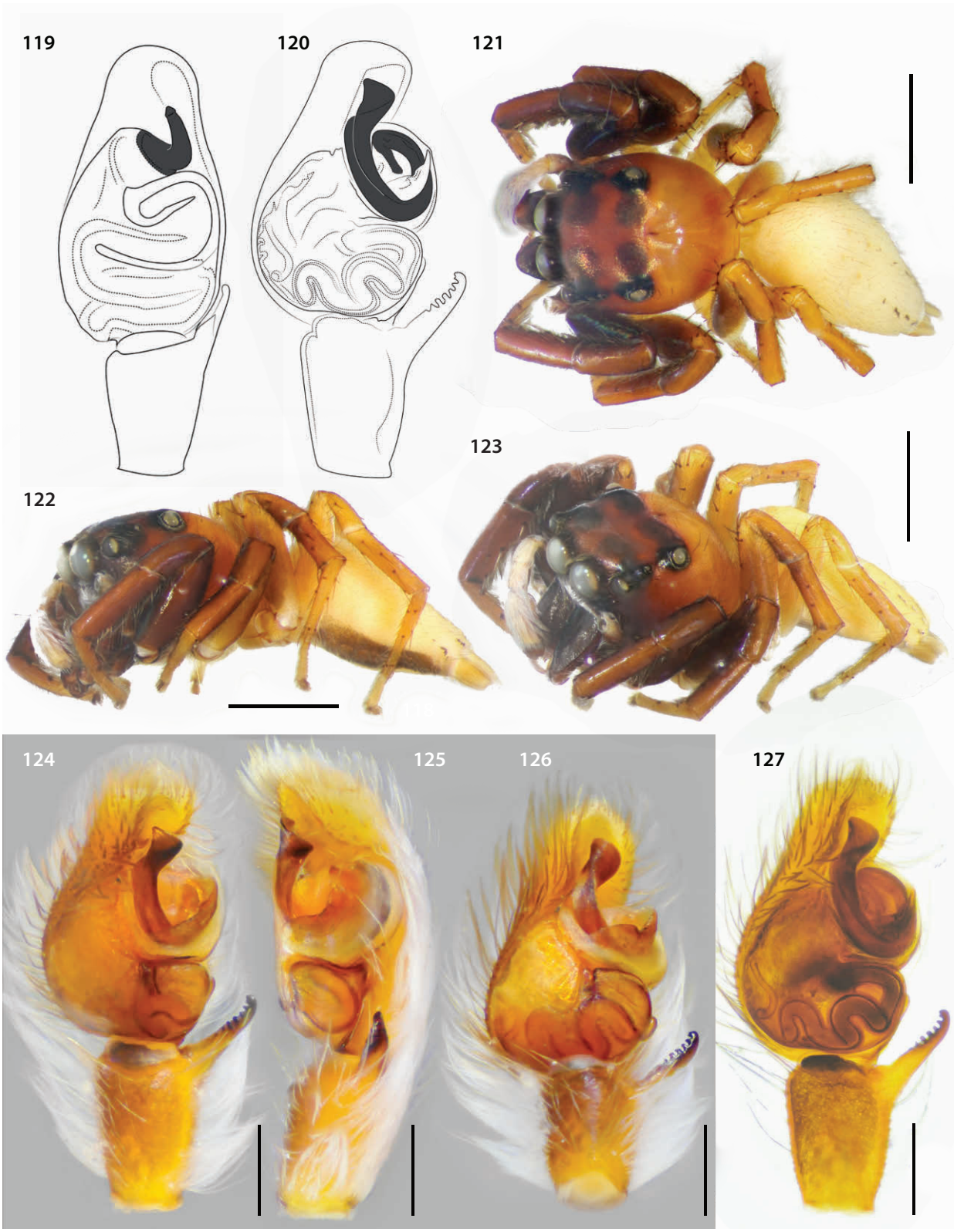
COMPOSITION — *Viribestus suyanensis* Zhang & Maddison, 2012

DESCRIPTION — Gnathocoxae with a retrolateral lobe (Figure 113 indicated with an arrow). For other details see Zhang & Maddison, 2012.

FIGURES 109-118

Viribestus Zhang & Maddison, 2012. **109**, male, dorsal view; **110**, ditto, ventral view; **111**, ditto, lateral view; Scale bars 1.0 mm. **112**, cheliceral dentation, line drawing, frontolateral view. **113**, ditto, retrolateral extension of the paturon, gnathocoxal extension, setaless clypeus marked with arrow; **114**, ditto, frontal view. **115**, Male palp, ventral view; **116**, ditto retrolateral view; Scale bars 0.25 mm. **117**, *Vallvonas zarandi* n. gen et n. sp., male holotype, chelicerae and frontal part of carapace, frontolateral view; **118** ditto, line drawing.


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DISTRIBUTION — Papua New Guinea (Figure 35), Indonesia.

Viribestus suyanensis Zhang & Maddison, 2012

Figures 109-116, 119

TYPE MATERIAL — Holotype, ♂, **Papua New Guinea**. Enga Province: Suyan Camp, Porgera, 5.4833° S, 143.1337° E, 2300 m a.s.l., 28-29 July 2008, coll. W. Maddison, WPM#08-022 (UBC-SEM AR00110). [not examined]

MATERIAL EXAMINED — Papua New Guinea. Mt Wilhelm, NG-M-C.23, 1968.09.17, Beaten in moss forest at the meteorological station of Kambugomanbuno, ~2800-3000 m a.s.l., 1 ♂, leg: J. Balogh (HNHM 9245). Mt Kaindi, moss forest, 2400 m, 1968 VIII.28, 1 ♂ (HNHM 9216). Indonesia: Paniai Lakes [Wisselmeeren VIII. 11. 1962. leg: Sedlacek], 1 male (HNHM 9235).

DESCRIPTION — Carapace 2.4 long, abdomen 2.5 long. For other details see Zhang & Maddison, 2012.

DISTRIBUTION — Papua New Guinea, Indonesia.

DISCUSSION

A decade has been passed since the last review on the Papua New Guinean salticid fauna (Maddison & Zhang 2009). At that time, 180 species have been reported from Papua New Guinea (based on the WSC), and Maddison and Zhang collected at least 128 most of which were new to the science. Today Metzner's (2019) list consist of 290 species, 60 of which have been described in the past ten years.

As mentioned above, 180 salticid species has been reported from the island which called as a small continent by Beron (2018 p. 746.), having the highest number of endemic genera. Among the twenty-one endemic genera listed by Beron (2018) and Maddison & Szűts (2019), thirteen is endemic to Papua New Guinea. Seemingly (as already mentioned by Maddison & Zhang 2009), the Cocalodini (90% of the taxa endemic to the island) and the Euophryini give the majority of the taxa (with Euophryini having more than 50% of the species), which was observed in this sampling as well, although small fraction of the new taxa illustrated. On Figure 1. yellow dots illustrate the "transect collecting sites" described in Leponce *et al.* (2016) were supplemented with additional sites by Balogh (1971) - red dots. Most of the species were characteristic to one-three sites / elevations (Figure 1). One of the most striking pattern was observed the distribution of the Levieina subtribe of Myrmarachnini. Most of the *Papuamyr* species were collected around 200 m and 700 m, *Agorioides* 500 m and 1000 m, whereas *Leviea* always above 2500m in several mountains. Besides the relatively strict elevational zonation of the subtribe, *Leviea* is currently the only non-antlike Myrmarachnini genus. The decreasing number of ant-morphs in high elevation (or the larger proportion of those in lowlands forest as observed in Baiteta forest foggings as well (De Bakker & Szűts unpublished data).

The Cocalodini genera also show a similar elevational zonation, *Tabuina* from 200 m to 700 m; *Waymadda* 1200-1700 m and *Yamangalea* 2200 m, together with a negative body size gradient, the smallest occurring at highest elevation. Regarding the Euophryini genera the data are either too scarce like *Viribestus*, *Vallvonas* (See Figure 35) or the species are too numerous like *Omoedus* / *Zenodorus* where the precise limits need to be refined (see comment in *Omoedus*) and matched with morphology.

FIGURES 119-127

Vallvonas n. gen. **119**, *Viribestus suyanensis* male palp line drawing; **120**, *Vallvonas zarandi* n. sp., male palp line drawing; **121**, male habitus, dorsal view; **122**, ditto, lateral view; **123**, ditto, antero-lateral view; **124**, male palp, ventral view; **125**, ditto, retrolateral view; **126**, ditto, ventral view, different angle. **127**, cleared palp, ventral view. Scale bars 0.25 mm.

ACKNOWLEDGEMENTS

This study has been kindly supported my many collectors and colleagues. László Dányi (HNHM, Budapest) has provided easy access to János Balogh's Mt Wilhelm and an extensive Papua New Guinean Collection, and Edit Horváth has helped with the localities of that collection. Wayne Maddison has provided powerful insight on the taxonomic decisions.

This study was conducted in the framework of "Our Planet Reviewed – Papua New Guinea 2012-2013" set up by Pro-Natura International, the National Museum of Natural History (MNHN, France), the Institut de Recherche pour le Dévelopement (IRD, France) in partnership with the Royal Belgian Institute of Natural Sciences, the New Guinea Binatang Research Center, the University of Papua New Guinea, and the Divine Word University of Madang and with core funding of Prince Albert II of Monaco Foundation, the Stavros Niarchos Foundation, the Total Foundation, the Fondation d'entreprise EDF, the Fonds Pacifique, Spiecapag, Entrepose Contracting, the New-Caledonia Government, the Reef Foundation, FNRS (Belgium) and the Belgian National Lottery. All participants to this collective project, part of the IBISCA experts network patronned here by Prof. R.K. Kitching, are thanked for their contribution. Tony Robillard's patience is highly praised, and he has helped with the French resumé as well. The Department of Ecology in the Veterinary University Budapest has provided facilities for the study. Helicon Focus has been obtained via the financial support of the California Academy of Sciences. Tamás Szűts was supported by the framework of TÁMOP-4.2.4.A/ 2-11/1-2012-0001 'National Excellence Program'. This work was also supported by the Hebei University High-level Talents Startup grant to Junxia Zhang (No.521000981324). The manuscript has been much improved by the comments, constructive critics of four reviewers whom we wish to thank their efforts and time. Emma Shaw has read the manuscript for linguistic errors which is highly appreciated. Wojciech T. Szczepański and Martin Fikáček allowed us to use their transect image on Figure 1. from their paper (Szczepański *et al.* 2018: fig. 54), for which we are grateful.

Tamás Szűts is also thanking for his family (Bernadett Solymosi, Zaránd and Zille Szűts) who showed so much patience toward working extra office hours during the study period.

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Swire Research Station in the lowlands. Maurice Leponce calling Vojtech Novotny on the phone to get a reinforcement from the team of the parataxonomist team to accelerate the pre-sorting of the very large quantity of specimens collected at Mount Wilhelm. The buildings of the research station were inspired by the traditional style, on stilts. A narrow location on the terrace allowed for a telephone signal.
(photo © Xavier Desmier).

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PORTFOLIO

A rainy Friday afternoon at the 3200 m camp. Participants try to warm up with a meal and an impromptu aperitif.
From left to right: Rob Colwell, Jérôme Orivel, Tony Robillard, doctor Cyril Chevalier, Maurice Leponce, Olivier Pascal and Fred Legendre.
(Photo © Xavier Desmier).


GORDON'S

Rainy afternoon at 3700 m with from left to right Fred Legendre, Tony Robillard, Olivier Pascal and his inseparable cigarette and the doctor Cyril Chevalier. (Photo © Xavier Desmier).


deuter

Grasshopper of the genus *Oxya* (Orthoptera, Caelifera, Acrididae) on plant.
(Photo © Xavier Desmier; identification: Ming Kai Tan).



The camp at 2700 m maintained by the local community who authorized the expedition to carry out research on their territory. (Photo © Xavier Desmier).



Silky owl *Taenaris catops* (Nymphalidae).
(Photo © Xavier Desmier; identification: Legi Sam).



Field camp at 1200 m a.s.l. Transcription of the data collected during the day.
From left to right: Jérôme Orivel, Olivier Pascal and Maurice Leponce.
(Photo © Xavier Desmier).



The botanist Jérôme Munzinger puts his samples in an herbarium, assisted by Cyril Chevalier, doctor of the expedition. (Photo © Xavier Desmier).


Nikon
North & Beaches

Caterpillar of a species of the family Eupterotidae (Bombycoidea).
(Photo © Xavier Desmier; identification: Joël Minet).



Botanists Kenneth Molem and Jérôme Munzinger at 1700 m.
(Photo © Maurice Leponce).



Male katydid of the genus *Caedicia* sp. (Tettigononiidae: Phaneropterinae). When copulation is not possible, for example when a mating couple is interrupted, the male removes his spermatophylax (nuptial gift) and eats it.
(Photo © Xavier Desmier; identification: Ming Kai Tan).



Frédéric Legendre collecting Epilamprinae cockroaches below rocks in a forest stream.
(Photo © Xavier Desmier).



Hemiptera of the Flatidae family. Often the adults gather on the branches and the whole thing looks like an inflorescence. This is a good camouflage strategy. Juveniles often do this as well, but because they are covered with wax, they look like a patch of lichens.
(Photo © Xavier Desmier; identification: Adeline Soulier-Perkins).



Day flying moth *Alcides agathyrsus* (Uraniidae).
(Photo © Xavier Desmier; identification: Legi Sam).



A villager from Wanang dressed in traditional costume on the occasion of a Sing Sing (celebration) to welcome the project participants to their conservation area. (Photo © Xavier Desmier).



End of the drivable part of the road. Unloading of the equipment and the botanical patrol which must continue on foot to reach the 2700 m site. (Photo © Xavier Desmier).



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EN OCTOBRE 2020
SUR LES PRESSES
DE
L'IMPRIMERIE F. PAILLART
À ABBEVILLE

Date de distribution : 19 novembre 2020
Dépôt légal : novembre 2020
N° d'impression : 16610