Systematics of jumping plant-lice (Hemiptera: Psylloidea): examples from the West Palaearctic and Neotropical Regions including a revision of the genus *Russelliana*

Inauguraldissertation

zur
Erlangung der Würde eines Doktors der Philosophie
vorgelegt der
Philosophisch-Naturwissenschaftlichen Fakultät
der Universität Basel

von

Liliya Serbina
aus der Ukraine

Basel, 2016

Genehmigt von der Philosophisch-Naturwissenschaftlichen Fakultät
auf Antrag von

Prof. Dr. Bruno Baur
Prof. Dr. Andreas Erhardt

Basel, den 22. März 2016

Prof. Dr. Jörg Schibler
Dekan

Namensnennung-Keine kommerzielle Nutzung-Keine Bearbeitung 3.0 Schweiz
(CC BY-NC-ND 3.0 CH)

Sie dürfen: Teilen — den Inhalt kopieren, verbreiten und zugänglich machen

Unter den folgenden Bedingungen:

Namensnennung — Sie müssen den Namen des Autors/Rechteinhabers in der von ihm festgelegten Weise nennen.

Keine kommerzielle Nutzung — Sie dürfen diesen Inhalt nicht für kommerzielle Zwecke nutzen.

Keine Bearbeitung erlaubt — Sie dürfen diesen Inhalt nicht bearbeiten, abwandeln oder in anderer Weise verändern.

Wobei gilt:

- **Verzichtserklärung —** Jede der vorgenannten Bedingungen kann **aufgehoben** werden, sofern Sie die ausdrückliche Einwilligung des Rechteinhabers dazu erhalten.

- **Public Domain (gemeinfreie oder nicht-schützbare Inhalte) —** Soweit das Werk, der Inhalt oder irgendein Teil davon zur Public Domain der jeweiligen Rechtsordnung gehört, wird dieser Status von der Lizenz in keiner Weise berührt.

- **Sonstige Rechte —** Die Lizenz hat keinerlei Einfluss auf die folgenden Rechte:

    - Die Rechte, die jedermann wegen der Schranken des Urheberrechts oder aufgrund gesetzlicher Erlaubnisse zustehen (in einigen Ländern als grundsätzliche Doktrin des **fair use** bekannt);

    - Die **Persönlichkeitsrechte** des Urhebers;

    - Rechte anderer Personen, entweder am Lizenzgegenstand selber oder bezüglich seiner Verwendung, zum Beispiel für **Werbung** oder Privatsphärenschutz.

- **Hinweis —** Bei jeder Nutzung oder Verbreitung müssen Sie anderen alle Lizenzbedingungen mitteilen, die für diesen Inhalt gelten. Am einfachsten ist es, an entsprechender Stelle einen Link auf diese Seite einzubinden.

Quelle: http://creativecommons.org/licenses/by-nc-nd/3.0/ch/ Datum: 12.11.2013

ACKNOWLEDGEMENTS

First of all, I would like to express my sincere gratitude to PD Dr. Daniel Burckhardt for giving me the opportunity to do my Ph.D. studies on the most wonderful group of insects – the psyllids. His enormous knowledge in psyllid taxonomy and supportive, always thoughtful guidance provided me with priceless knowledge in psyllid systematics and taxonomy. I am also grateful to him for letting me work on the unique and precious *Russelliana* material which he collected over the years in South Amercia. Without these collections many of the new species could not have been described.

I express my deep gratitude to my parents and grandparents for their constant, invaluable support in every step that I take and their unconditional love.

My special thanks are extended to the examiners and co-referents Prof. Dr. Bruno Baur and Prof. Dr. Andreas Erhardt, who kindly agreed to be members of the examination board.

I would like to thank my friends and colleagues from the Naturhistorisches Museum Basel and the University of Basel: Dr. Tatyana Vakhlamova, Isabelle Zurcher-Pfander, Dr. Matthias Borer, Anna Pevzner, Ruben Janssen, Dr. Eliane Riedener, Ramona Melliger, Dr. Bastien Mennecart, Dr. Loïc Costeur, Tandra Fairbanks-Freund, Christophe Bonetti, Dr. Brigitte Braschler. Their friendship and support in any life situation is a priceless gift. I thank my teachers and friends from the Belarusian State University, Department of Zoology for their help during my master and doctoral studies: Dr. Oxana L. Nesterova, Ivan Orlov, Fedor Sautkin, Prof. Dr. Sergei V. Buga and Dr. Oleg I. Borodin.

This study was funded by a grant of the Swiss Confederation (Federal Commission) and the Freiwillige Akademische Gesellschaft (FAG), Basel.

CONTENTS

SUMMARY

Coevolution or cospeciation of phytophagous insects and plants is assumed to be a major driver of evolution leading to the present enormous insect diversity. However, an increasing number of insect–plant studies suggest that speciation is driven by geographical vicariance, and host switching to related plant taxa also occurs frequently in insects. Despite a number of studies on global patterns of insect–plant associations, there are notable gaps in the interpretation of evolutionary processes leading to insect speciation. This thesis consists of four studies in five papers (three published papers and two are to be submitted) conducted to investigate the biodiversity of a poorly known group of insects, the psyllids or jumping plant-lice, and their associations with host-plants. The studies were focused on areas from which few information were available: western Palaearctic (Belarus) and south temperate Neotropical regions.

Most psyllids are mono- or oligophagous on a restricted number of plant taxa. The first study examined the plausibility of polyphagy of the Neotropical potato pest *Russelliana solanicola* Tuthill by means of multivariate analyses of morphological characters. The results showed an unexpectedly high polyphagy of the species on a number of economically important crops and its very likely introduction from the native Andean region into eastern South America. Considering its high potential of a successful invasion into non-native regions, it is extremely important to prevent spread and invasion of *R. solanicola* in the incipient stages. The second project assessed and predicted the potential occurrence of *R. solanicola* worldwide using species distribution models (SDMs), based on environmental variables derived from its natural range of distribution. We also investigated the similarities between geographical, environmental and morphological characteristics of *R. solanicola* and its related Solanaceae-feeders, and their tolerance to a range of environmental conditions by contrast to non-Solanaceae feeding species from the same genus.

The third study investigated and described the diversity of *Russelliana* species in order to understand patterns of psyllid speciation and explain the evolutionary processes leading to the species diversity in the genus. The Neotropical genus *Russelliana* is an excellent and interesting model group for host-plant and biogeographical studies, considering its high species-richness and wide host associations with species from a number of plant families. The revision of *Russelliana* included the descriptions of 24 new psyllid species and the redescriptions of 19 previously described ones. A phylogenetic analysis suggested that the psyllid speciation in *Russelliana* is better explained by geographical vicariance rather than by cospeciation with plants, and host switching has occurred relatively frequently in the genus.

The fourth study is reflected in two publications on the fauna of Belarusian psyllids. The psyllid fauna of the west Palaearctic region is relatively well known, with Belarus being a notable exception. Based on the literature records and recently collected material, an updated checklist of psyllids of Belarus is provided. The checklist is supplemented with an illustrated identification key for the psyllid species confirmed from and likely to occur in Belarus.

To my knowledge, the results of this thesis provide important taxonomic information on the biodiversity and host-plant associations of a poorly studied group of insects from the western Palaearctic (Belarus) and south temperate Neotropical regions. These findings may contribute to studies on global patterns of insect–plant associations helping to interpret the evolutionary processes leading to insect speciation and its current huge diversity on the planet. Moreover, the studies on the polyphagy and potential distribution of pest species in new regions can predict the establishment of invasive populations and provide the pest management with all necessary information before the species is recognised as a serious threat. In addition, the developed illustrated identification keys for the psyllid species will be of help to applied entomologists dealing with agricultural, forestry and ornamental pests.

GENERAL INTRODUCTION

Phytophagous insects represent one of the most species-rich groups of animals on the planet (Southwood 1978), and the majority of them develop on a restricted number of host taxa. Studies of insect–plant associations are very helpful and interesting for discovering and understanding evolutionary processes, which lead to the speciation in insects and their current enormous diversity (Futuyma & Mitter 1996; Becerra & Venable 1999; Burckhardt & Basset 2000; Percy 2002, 2003; Percy *et al.* 2004; Burckhardt & Ouvrard 2007; Ouvrard *et al.* 2015). Despite a number of entomological studies globally, many groups of insects still remain poorly known and require a detailed systematic revision. One of these groups, the psyllids or jumping plant-lice, remains poorly studied in terms of taxonomy with around 4000 described species and at least as many undescribed ones (Li 2011). The host specificity and narrow geographical ranges make psyllids a perfect model group for studies on insect–plant interactions and biogeography. Psyllids are probably most species-rich in the tropics and south temperate regions, but the west Palaearctic fauna remains the best studied with around 400 species reported from Europe (Burckhardt 2004) or 1000 species from China (Li 2011). Despite this, little was known on the psyllid fauna from Belarus as the existing information is outdated or incomplete with only 12 recorded species of which one is doubtful (Loginova 1961, 1962; Palyakova 1969; Byazdzenka *et al.* 1973; Gorlenko *et al.* 1988; Sidlyarevich & Bolotnikova 1992; Petrov 2004; Petrov *et al.* 2011; Petrov & Sautkin 2013). Also the south temperate Neotropics are poorly studied in terms of psyllid taxonomy, faunistics and host-plant associations, where only relatively few studies on the psyllid fauna were conducted so far (Tuthill 1959, 1964; Burckhardt 1987a, b, 1988).

The jumping plant-lice or psyllids (Hemiptera, Psylloidea) form a small group of phytophagous, phloem-feeding insects, associated mostly with woody angiosperms. Adult psyllids are always winged, while immatures are unable to fly and, therefore, are tied to their host-plants (Burckhardt *et al.* 2014). Most psyllid species are mono- or oligophagous, and related psyllids tend to develop on related hosts. Among psyllids there are a number of economically important pests, some of which are invasive and transmit plant pathogens, causing serious diseases in crop plants, such as citrus fruits (Rutaceae) or potatoes (Solanaceae) (Hodkinson 1981; Halbert & Manjunath 2004; Liefting *et al.* 2009; Hall *et al.* 2012; Ouvrard & Burckhardt 2012). The world psylloid fauna associated with Solanaceae is relatively modest and comprises only 25 described (and at least 12 undescribed) species. Some of them are economically important pests of crop plants and vectors of plant pathogens (Hodkinson 1981; Burckhardt & Lauterer 1997b; Hansen *et al.* 2008; Burckhardt *et al.* 2012;

Taylor & Kent 2013). The Neotropical genus *Russelliana* (Aphalaroidinae) comprises a highest number of psyllid species, which are confirmed or likely to be associated with Solanaceae (Burckhardt 1987a; Burckhardt *et al.* 2012).

At present, *Russelliana* is the most species-rich genus of the subfamily Aphalaroidinae with 19 described (Tuthill 1959, 1964; Burckhardt 1986, 1987a, 2008) and many undescribed species. A detailed taxonomic revision showed that *Russelliana* representatives are associated with a surprisingly wide range of hosts from a number of plant families and, as far as information is available, all species are mono- or oligophagous on related species of the same host genus, with the exception of the polyphagous *Russelliana solanicola* Tuthill. To investigate host-plant patterns in *Russelliana*, a cladistic analysis using morphological characters was performed. One question which was addressed was whether species associated with a particular host taxon, e.g. Solanaceae, form a monophyletic group, another aspect was the detection of cospeciation, i.e. the search for shared components in the psyllid and host phylogenies. Biogeographical patterns were also investigated using the phylogenetic relationships of species in the genus.

This thesis includes studies of the diversity of a poorly known taxon of insects, the psyllids, from the western Palaearctic and south temperate Neotropical regions. The study of the psyllid fauna of Belarus aims at providing an updated checklist and estimating species potentially occurring in Belarus. The study of psyllids from the Neotropics includes descriptions and analysis of the biodiversity of *Russelliana* species, along with the analysis of its phylogeny. A taxonomic part of the study covers the formal descriptions of new taxa, revision and redescriptions of previously described species. The phylogenetic results are used for the analysis of the host-plant and biogeographical patterns, aiming to explain the current species diversity in *Russelliana*, along with the patterns of psyllid speciation.

The aim of **Chapter I** was to examine the polyphagy of *R. solanicola*, a potential economically important potato pest and a probable vector of plant pathogens (Chávez *et al.* 2003; Tenorio *et al.* 2003; Jeffries 2006; Salazar 2006). The populations morphologically similar to *R. solanicola* were collected on a large variety of plant taxa of at least ten different families from a very wide range of distribution in western and eastern South America. Burckhardt & Queiroz (2012) hypothesized that *R. solanicola* may be polyphagous but no studies have been conducted to confirm this. Often psyllid 'species' with a wide host and distributional range turn out to be a complex of monophagous, morphologically similar species (Ossiannilsson 1951; Burckhardt & Lauterer 1997a), suggesting that a complex of cryptic species might be involved in case of *R. solanicola*. In this study, by means of the multivariate analyses of morphometric characters I investigated whether *R. solanicola* is a complex of monophagous, morphologically similar species (host races/cryptic species) or a single polyphagous species with a very wide distributional range.

In **Chapter II**, we assessed the likelihood of spread and invasion of *R. solanicola* worldwide. Species distribution models (SDMs) are useful tools for predicting invasion ecology by modelling climatic niches within native ranges and projecting the niche across a continental or global scale to identify regions with a higher likelihood of the species establishing. We modelled global emergence potential of *R. solanicola* using SDMs, based on environmental variables derived from its natural range of distribution, and used concepts from the study of plant crop wild relatives (CWR) for the investigation and prevention of a pest invasion to non-native regions. In addition, we tested the importance of the studies of non-pest relatives for the investigation of a pest emergence within an evolutionary context and the plausibility of host switching within closely related species. We explored the relevance of shared geographical, ecological and morphological characteristics for better understanding of the elements that differentiate pests from related non-pest taxa.

In **Chapter III**, I revised the taxonomy of *Russelliana* with descriptions and illustrations of 24 new and 19 previously described species (Tuthill 1959, 1964; Burckhardt 1986, 1987a, 2008). An illustrated identification key for the adults was developed for all 43 species. Based on the results of the phylogenetic analysis, the host-plant and biogeographical patterns within the genus were investigated. I examined the pattern of geographical vicariance, and estimated to which degree this explains species diversity in *Russelliana*. The study also showed that Solanaceae are confirmed or likely hosts of a high number of *Russelliana* species. This underlines the importance of further research on the group and applying the SDMs for predicting the invasive ecology of all Solanaceae-feeders in the genus as it was done for *R. solanicola* (**Chapter II**).

In **Chapter IV**, I presented the results of a faunistic study of the Belarusian psyllid fauna. The study of Eastern European psyllids was initiated by Flor (1861) with a survey on the fauna of Livonia followed by a large number of publications dealing with the European part of the former Soviet Union (Gegechkori & Loginova 1990). Based on the entomological collections in the last 15 years in all administrative regions of Belarus, I analysed and confirmed the previous psyllid identifications, and added new confirmed species to the faunal list. Based on the information of the psyllid faunas from surrounding countries and data on the occurrence of respective host-plants in Belarus, I estimated which additional psyllid species are likely to occur in the country. I also constructed an identification key with illustrations for

127 species of psyllids, whose occurrence in the country was documented or is likely.

The final section of this thesis, the **General Discussion**, comprises the most important findings of the four chapters and their implications for Science and pest management.

References

Becerra, J.X. & Venable, D.L. (1999) Macroevolution of insect-plant associations: The relevance of host biogeography to host affiliation. *PNAS*, 96 (22), 12626–12631. Burckhardt, D. (1986) A new *Russelliana* species (Homoptera: Psyllidae) on *Adesmia* (Leguminosae). *Revista Chilena de Entomologia*, 14, 95–97.

Burckhardt, D. (1987a) Jumping plant-lice (Homoptera: Psylloidea) of the temperate Neotropical region. Part 1: Psyllidae (subfamilies Aphalarinae, Rhinocolinae and Aphalaroidinae). *Zoological Journal of the Linnean Society*, 89 (4), 299–392.

Burckhardt, D. (1987b) Jumping plant-lice (Homoptera: Psylloidea) of the temperate Neotropical region. Part 2: Psyllidae (subfamilies Diaphorininae, Acizziinae, Ciriacreminae and Psyllinae). *Zoological Journal of the Linnean Society*, 90 (2), 145–205.

Burckhardt, D. (1988) Jumping plant lice (Homoptera: Psylloidea) of the temperate neotropical region. Part 3: Calophyidae and Triozidae. *Zoological Journal of the Linnean Society*, 92, 115–191.

Burckhardt, D. (2008) Jumping plant-lice (Hemiptera, Psylloidea) associated with *Diostea* (Verbenaceae). *Deutsche Entomologische Zeitschrift*, 55 (1), 79–89.

Burckhardt, D. (2004) Fauna Europaea: Psylloidea. Fauna Europaea version 2.4. Available from: http://www.faunaeur.org (accessed 5 June 2012).

Burckhardt, D. & Basset, Y. (2000) The jumping plant-lice (Hemiptera, Psylloidea) associated with *Schinus* (Anacardiaceae): systematics, biogeography and host-plant relationships. *Journal of Natural History*, 34 (1), 57–155.

Burckhardt, D. & Lauterer, P. (1997a) Systematics and biology of the *Aphalara exilis* (Weber & Mohr) species assemblage (Hemiptera: Psyllidae). *Entomologica Scandinavica*, 28 (3), 271–305.

Burckhardt, D. & Lauterer, P. (1997b) A taxonomic reassessment of the triozid genus *Bactericera* (Hemiptera: Psylloidea). *Journal of Natural History*, 31 (1), 99–153.

Burckhardt, D. & Ouvrard, D. (2007) The taxonomy, biogeography and host plant relationships of jumping plant-lice (Hemiptera: Psyllidae) associated with creosote bushes (*Larrea* spp., Zygophyllaceae). *Systematic Entomology*, 32 (1), 136–155.

Burckhardt, D., Ouvrard, D., Queiroz, D. & Percy, D. (2014) Psyllid host-plants (Hemiptera: Psylloidea): resolving a semantic problem. *Florida Entomologist*, 97 (1), 242–246.

Burckhardt, D. & Queiroz, D.L. (2012) Checklist and comments on the jumping plant-lice (Hemiptera: Psylloidea) from Brazil. *Zootaxa*, 3571, 26–48.

Burckhardt, D., Queiroz, D.L., Rezende, M.Q., Queiroz, E.C. & Bouvet, J.P.R. (2012) The capsicum psyllid, *Russelliana capsici* (Hemiptera, Psylloidea), a pest on *Capsicum annuum* (Solanaceae) in Argentina and Brazil. *Mitteilungen der schweizerischen entomologischen Gesellschaft*, 85 (1–2), 71–78.

Byazdzenka, T.T., Palyakova, T.J. & Osipaŭ, U.G. (1973) Yablynevaya veratsennitsa (*Psylla mali* Schmdbg.) u Belarusi. *Vestsi AN BSSR. Seriya sel'skagaspadarchykh navuk*, 3, 62–64.

Chávez, R., Salazar, L., Upadhya, M., Chujoy, E., Cabello, R., Garcia, A. & Linares, J. (2003) The occurrence of genetic resistance and susceptibility to the new potato virus SB–29 among tetraploide potato populations (*Solanum tuberosum* L., 2n = 4x = 48 AAAA) in an arid agroecosystem. *IDESIA*, 21 (1), 9–22.

Flor, G. (1861) *Die Rhynchoten Livlands in systematischer Folge beschrieben*. Archiv für die Naturkunde Liv-, Ehst- und Kurlands. Dorpat, 637 pp.

Futuyma, D.J. & Mitter, C. (1996) Insect-plant interactions: the evolution of component communities. *Philosophical Transactions of the Royal Society of London Series B-Biological Sciences*, 351, 1361–1366.

Gegechkori, A.M. & Loginova, M.M. (1990) *Psillidy (Homoptera, Psylloidea) SSSR: annotirovannyi spisok*. Metsniereba, Tbilisi, Georgia, 161 pp.

Gorlenko, S.V., Blintsov, A.I. & Pan'ko, N.A. (1988) *Ustoychivost' drevesnykh introdutsentov k bioticheskim faktoram*. Nauka i tekhnika, Minsk, 189 pp.

Halbert, S.E. & Manjunath, K.L. (2004) Asian citrus psyllids (Sternorrhyncha: Psyllidae) and greening disease of citrus: a literature review and assessment of risk in Florida. *The Florida Entomologist*, 87 (3), 330–353.

Hall, D.G., Richardson, M.L., Ammar, E.-D. & Halbert, S.E. (2012) Asian citrus psyllid, *Diaphorina citri*, vector of citrus huanglongbing disease. *Entomologia Experimentalis et Applicata*, 146, 207–223.

Hansen, A.K., Trumble, J.T., Stouthamer, R. & Paine, T.D. (2008) New Huanglongbing (HLB) *Candidatus* species,"*C*. Liberibacter psyllaurous", found to infect tomato and potato is vectored by the psyllid *Bactericerca cockerelli* (Sulc). *Applied and Environmental Microbiology*, 74 (18), 5862–5865.

Hodkinson, I.D. (1981) Status and taxonomy of the *Trioza* (*Bactericera*) *nigricornis* Forster complex (Hemiptera: Triozidae). *Bulletin of Entomological Research*, 71 (4), 671–679.

Jeffries, C. (2006) Potato. FAO/lPGRI Technical guidelines for the safe movement of germplasm. Available from: http:// pdf.usaid.gov/pdf_docs/PNACJ008.pdf (accessed 15 January 2015).

Li, F. (2011) *Psyllidomorpha of China (Insecta: Hemiptera).* Psyllidomorpha of China. Science Press, Beijing, China, 1976 pp.

Liefting, L.W., Weir, B.S., Pennycook, S.R. & Clover, G.R.G. (2009) '*Candidatus* Liberibacter solanacearum', associated with plants in the family Solanaceae. *International Journal of Systematic and Evolutionary Microbiology*, 59, 2274–2276.

Loginova, M.M. (1961) A revision of the species of the genera *Aphalara* Frst. and *Craspedolepta* Enderl. (Homoptera, Psylloidea) in the fauna of the USSR. I. *Entomologicheskoe Obozrenie*, 40 (3), 602–623.

Loginova, M.M. (1962) Psyllid fauna (Homoptera, Psylloidea) of Leningrad region. *Trudy Zoologicheskogo Instituta*, 31, 33–45.

Ossiannilsson, F. (1951) *On the Psyllid of the marsh marigold, Aphalara calthae (Linn.).* Akademiska bokhandeln, Helsingfors, 8 pp.

Ouvrard, D. & Burckhardt, D. (2012) First record of the onion psyllid *Bactericera tremblayi* (Wagner, 1961) in France (Insecta: Hemiptera: Sternorrhyncha: Psylloidea), new symptoms on leek crops and reassessment of the *B. nigricornis*-group distribution. *EPPO Bulletin*, 42 (3), 585–590.

Ouvrard, D., Chalise, P. & Percy, D. (2015) Host-plant leaps versus host-plant shuffle: a global survey reveals contrasting patterns in an oligophagous insect group (Hemiptera, Psylloidea). *Systematics and Biodiversity*, 1–21.

Palyakova, T.J. (1969) Da biyalogii grushavykh veratsennits u Belarusi. *Vestsi AN BSSR. Seriya sel'skagaspadarchykh navuk*, 5, 87–89.

Percy, D.M. (2002) Distribution patterns and taxonomy of some legume-feeding psyllids (Hemiptera: Psylloidea) and their hosts from the Iberian Peninsula, Morocco and Macaronesia. *Insect Systematics & Evolution*, 33 (3), 291–310.

Percy, D.M. (2003) Radiation, diversity, and host-plant interactions among island and continental legume-feeding psyllids. *Evolution*, 57 (11), 2540–2556.

Percy, D.M., Page, R.D.M. & Cronk, Q.C.B. (2004) Plant-insect interactions: double-dating associated insect and plant lineages reveals asynchronous radiations. *Systematic Biology*, 53 (1), 120–127.

Petrov, D.L. (2004) Fonovyye vidy teratformiruyushchikh nasekomykh Belarusi. *BGU Byulleten'*, 2 (2), 63–71.

Petrov, D.L. & Sautkin, F.V. (2013) Nasekomyye-galloobrazovateli – vrediteli kustarnikovykh rasteniy zelenykh nasazhdeniy Belarusi. *Vestnik BGU*, 2 (1), 65–71.

Petrov, D.L., Sautkin, F.V. & Ivanov, V.V. (2011) *Fitofagi – vrediteli kustarnikovykh rasteniy*. BGU, Minsk, 36 pp.

Salazar, L.F. (2006) Emerging and re-emerging potato diseases in the Andes. *Potato Research*, 49, 43–47.

Sidlyarevich, V.I. & Bolotnikova, V.I. (1992) *Entomofagi vrediteley ovoshchnykh kul'tur*. Urozhay, Minsk, 126 pp.

Southwood, T.R.E. (1978) The components of diversity. *Symposium of the Royal Entomological Society, London*, 9, 19–40.

Taylor, G.S. & Kent, D.S. (2013) Potential economic pests of solanaceous crops: a new species of *Solanum*-feeding psyllid from Australia and first record from New Zealand of *Acizzia solanicola* (Hemiptera: Psyllidae). *Zootaxa*, 3613 (3), 257–273.

Tenorio, J., Chuquillanqui, C., Garcia, A., Guillén, M., Chavez, R. & Salazar, L.F. (2003) Sintomatología y efecto en el rendimiento de papa de un nuevo virus transmitido por el psílido *Russelliana solanicola*. *Fitopatología*, 38, 32–36.

Tuthill, L.D. (1959) Los Psyllidae del Perú Central (Insecta: Homoptera). *Revista Peruana de Entomologia Agricola*, 2 (2), 1–27.

Tuthill, L.D. (1964) Conocimientos Adicionales sobre los Psyllidae (Homoptera) del Perú. *Revista Peruana de Entomologia*, 7 (1), 25–32.

Chapter I

The potato pest *Russelliana solanicola* Tuthill (Hemiptera: Psylloidea): taxonomy and host-plant patterns

Serbina, L., Burckhardt, D., Birkhofer, K., Syfert, M.M. & Halbert, S.E.

Zootaxa, 2015, 4021 (1): 33–62

Zootaxa 4021 (1): 033–062
www.mapress.com/zootaxa/

Article

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

http://dx.doi.org/10.11646/zootaxa.4021.1.2
http://zoobank.org/urn:lsid:zoobank.org:pub:D55CC448-A873-4D17-92CD-33B9A3CE4D24

The potato pest *Russelliana solanicola* Tuthill (Hemiptera: Psylloidea): taxonomy and host-plant patterns

LILIYA SERBINA[1], DANIEL BURCKHARDT[2], KLAUS BIRKHOFER[3],
MINDY M. SYFERT[4] & SUSAN E. HALBERT[5]

[1] *Naturhistorisches Museum, Augustinergasse 2, CH–4001 Basel, Switzerland. Institut für Natur-, Landschafts- und Umweltschutz an der Universität Basel, St. Johanns-Vorstadt 10, CH–4056 Basel, Switzerland. E-mail: liliya_serbina@mail.ru*

[2] *Naturhistorisches Museum, Augustinergasse 2, CH–4001 Basel, Switzerland. E-mail: daniel.burckhardt@bs.ch*

[3] *Lund University, Sölvegatan 37, SE–223 62 Lund, Sweden. E-mail: klaus.birkhofer@biol.lu.se*

[4] *The Natural History Museum, Department of Life Sciences, Cromwell Road, London, SW7 5BD, UK. E-mail: m.syfert@nhm.ac.uk*

[5] *Florida Department of Agriculture and Consumer Services, Division of Plant Industry, P.O. Box 147100, Gainesville, FL 32614–7100, USA. E-mail: susan.halbert@freshfromflorida.com*

Abstract

The Neotropical jumping plant-louse *Russelliana solanicola* Tuthill is a potato pest and a probable vector of plant pathogens. Populations morphologically similar to those found on potatoes have been collected on plants of at least ten different families, four of which have been confirmed as hosts by the presence of immatures. This suggests that *R. solanicola* is either a single polyphagous species or a complex of closely related, monophagous species (host races/cryptic species). Results of our analyses of multiple morphometric characters show for both sexes a grouping of the populations of *R. solanicola* and a clear separation of the latter from other *Russelliana* species. On the other hand, within *R. solanicola*, there is an overlap of populations from different host-plants as well as from different geographical regions. The results of the present study strongly suggest that *R. solanicola* is a single, polyphagous species and the known distribution indicates that it is native to the Andes. It is likely that *R. solanicola* has been introduced into eastern Argentina, Brazil and Uruguay. The polyphagy together with the ability to disperse and transmit plant pathogens potentially make this species an economically important pest of potato and other crop species.

Key words: psyllids, polyphagy, host races, cryptic species, Solanaceae, vector of plant pathogens, multivariate analysis, CAP

Introduction

The South American psyllid *Russelliana solanicola* Tuthill (Figs. 1A, B) was described from specimens collected in Peru on potato plants (*Solanum tuberosum*, Solanaceae) where they occurred in epidemic numbers and caused serious damage. Potato plants damaged by *R. solanicola* have also been reported from Chile (Artigas 1994). Other specimens collected in Peru, including the holotype, were found on *Datura* sp. (Solanaceae) (Tuthill 1959). Artigas (1994) listed *Datura* sp., sunflower, barley and wheat as additional host-plants, however, a source for these records was not provided. Chávez *et al.* (2003) listed 12 psyllid associated plant species, including *S. tuberosum*, from the families of Asteraceae and Solanaceae as well as reported *R. solanicola* as a serious pest on potatoes in Peru since 1996. The geographic distribution of *R. solanicola* is Andean (central and western Argentina, Bolivia, Chile and Peru) (Burckhardt 1987a) but there are also records from eastern Argentina, Brazil and Uruguay (Burckhardt 1987a; Burckhardt & Queiroz 2012). *R. solanicola* has been reported as a vector of the not yet fully identified virus SB26/29 causing 'Potato Yellows' (Chávez *et al.* 2003; Tenorio *et al.* 2003; Salazar 2006). The potato yellows virus causes severe damage to potatoes in Peru and a previous study has suggested a strong correlation between virus infected psyllids and potato yield reduction (Chávez *et al.* 2003). Future studies are needed to confirm *R. solanicola* as a potato yellows vector with a molecular methodology so that fastidious prokaryotes such as

Accepted by D. Ouvrard: 29 Jun. 2015; published: 24 Sept. 2015

Candidatus Phytoplasma spp. and especially *Candidatus* Liberibacter spp. can also be detected. *R. solanicola* has been cited as a potential vector of Potato Witches' Broom Phytoplasma (PWB) (Jeffries 2006), but the host range for the disease (mostly legumes) is not consistent with the host range of *R. solanicola*. Jeffries (2006) suggests that the vectors of PWB probably are unable to acquire the pathogen from potato.

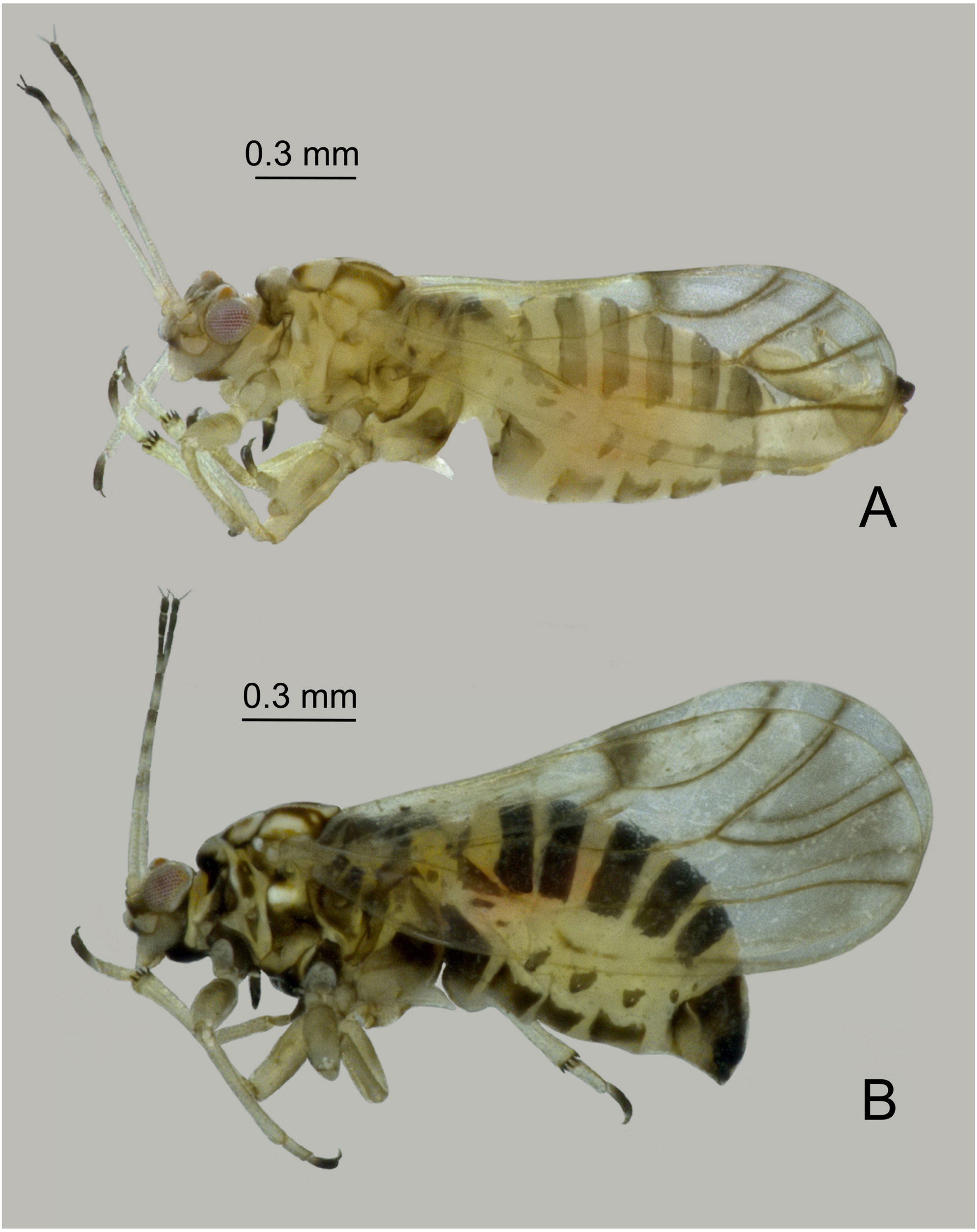


FIGURE 1. Habitus of adult *Russelliana solanicola.* A, ♂. B, ♀.

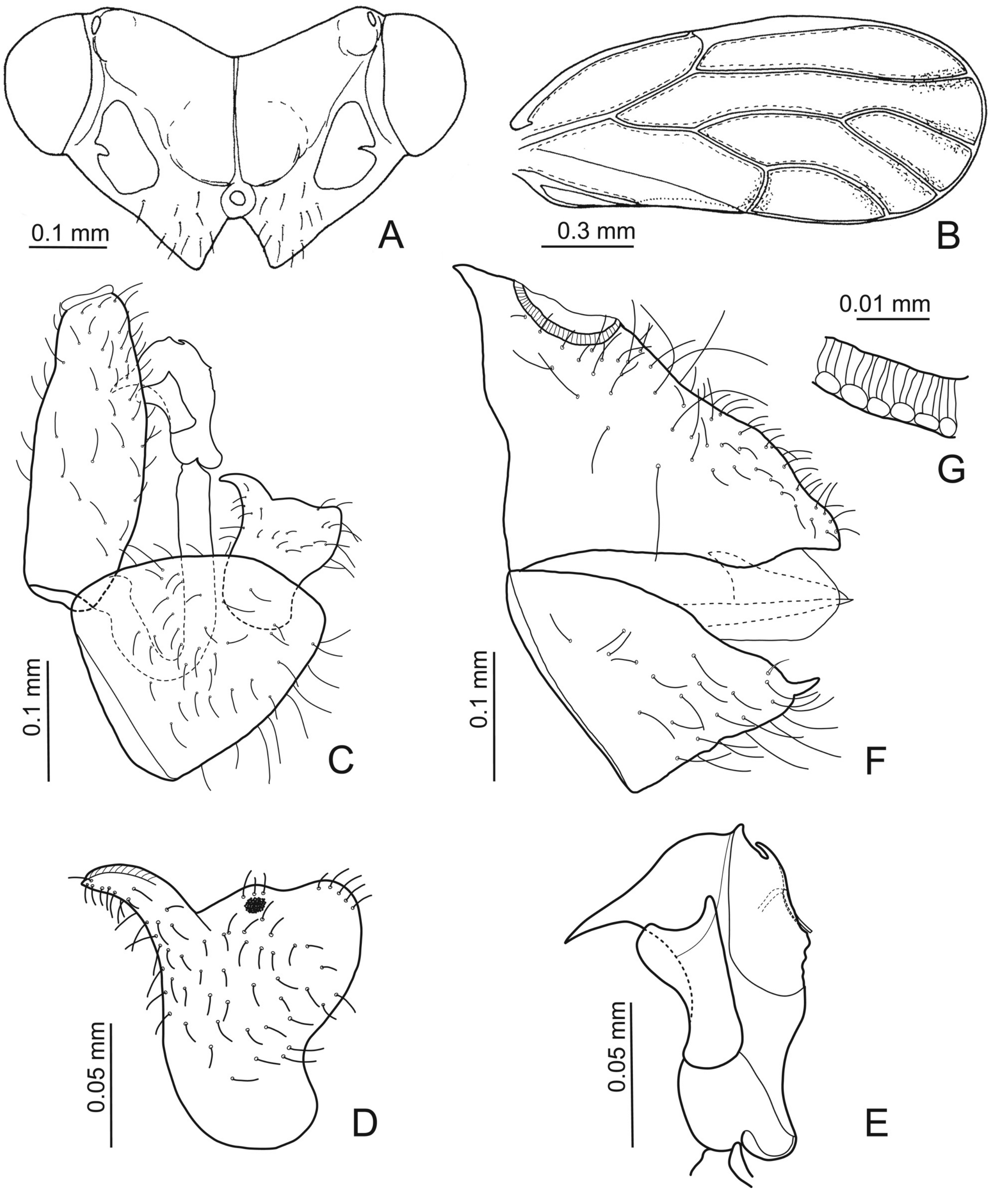


FIGURE 2. Diagnostic morphological important characters of adult *R. solanicola*. A, Head, dorsal view. B, Forewing. C, Male terminalia, in profile. D, Paramere, inner surface. E, Distal portion of the aedeagus. F, Female terminalia, in profile. G, Section of female circumanal ring.

Potato is the world's fourth largest food crop after maize, wheat and rice (FAO 2009). It is a member of the Solanaceae family which contains other important agricultural crops such as tomato, capsicum and eggplant, as well as many species with horticultural and medicinal use (Hawkes 1999). In addition to *R. solanicola* there are 25 described species and at least 10 undescribed species of Psylloidea associated with Solanaceae (Burckhardt & Lauterer 1997b; Taylor & Kent 2013). They belong to the genera *Lanthanaphalara* (1 sp.) (Aphalaridae), *Diaphorina* (3 spp.) (Liviidae), *Acizzia* (3 spp.) and *Russelliana* (6 spp.) (Psyllidae) as well as *Bactericera* (9 spp.), *Leuronota* (1 sp.), *Schedoneolithus* (1 sp.) and *Trioza* (1 sp.) (Triozidae). These genera also comprise of species associated with host families other than Solanaceae, apart from the monotypic *Lanthanaphalara* and *Schedoneolithus*.

Among the Solanaceae-feeders, *Bactericera cockerelli* (Šulc 1909), the vector of the causal agent of the Zebra Chip Disease (Hansen *et al.* 2008; Liefting *et al.* 2009), *B. nigricornis* (Foerster 1848), *B. tremblayi* (Wagner 1961) and maybe a few other *Bactericera* species are remarkable for their polyphagy (as defined in Burckhardt *et al.* 2014). This is highly unusual for psyllids which are generally monophagous or oligophagous (Hodkinson 2009; Burckhardt *et al.* 2014). A genuinely polyphagous species could also be confused with a complex of host races or cryptic species where little morphological variation is observed (Funk 2011). Host races are interesting from an evolutionary perspective as they may represent the first steps of speciation (Blair *et al.* 2005; Cook *et al.* 2011). The detection of cryptic species is very important for management and conservation (Bickford *et al.* 2007).

Russelliana comprises 19 described and at least 27 undescribed species restricted to the Neotropical region (Tuthill 1959, 1964; Burckhardt 1986, 1987a, 2008; CASC, MHNG, NHMB, unpublished data). The host-plants of *Russelliana* are within seven families: Amaranthaceae, Asteraceae, Fabaceae, Polygonaceae, Rosaceae, Solanaceae and Verbenaceae. Usually *Russelliana* species develop on a single host-species or genus, and are well defined by the structure of the head (Fig. 2A), the forewing (Fig. 2B) and, in particular, the male (Figs. 2C–E) and female terminalia (Figs. 2F–G) (Burckhardt 1987a). *R. solanicola*, however, does not fit this pattern. Apart from the alleged wide host range mentioned in the literature (Tuthill 1959; Artigas 1994; Chávez *et al.* 2003), we have specimens at hand which are morphologically similar to the holotype of *R. solanicola* and which were collected on a large variety of plant taxa (Table 1). Here we investigate by means of multivariate analyses of morphometric characters whether *R. solanicola* s. l. is a complex of morphologically similar, monophagous species (host races/ cryptic species) or a single polyphagous species, as hypothesized by Burckhardt & Queiroz (2012).

TABLE 1. Plant species on which specimens of *R. solanicola* s. l. were collected based on literature records and museum collections. Plant taxa are confirmed as hosts when the samples contain immatures (Burckhardt *et al.* 2014). *Citrus* is an unlikely host despite the discovery of a single immature (see discussion).

Plant name	Host status	Reference
Amaranthaceae		
Alternanthera ficoidea (L.) Sm.	confirmed	NHMB
Beta vulgaris L.	likely	MHNG
gen. sp.	likely	MHNG
Asteraceae		
Baccharis lycioides J.Rémy	confirmed	NHMB
Baccharis neaei DC.	likely	MHNG
Baccharis zoellneri F.H.Hellw. ssp. *minor* F.H.Hellw.	confirmed	MHNG
Baccharis sp.	likely	MHNG
Flaveria bidentis (L.) Kuntze	likely	Chávez *et al.* (2003)
Helenium aromaticum (Hook.) L.H.Bailey	confirmed	MHNG
Helianthus annuus L.	likely	Artigas (1994)
Parthenium hysterophorus L.	confirmed	BMNH, NHMB
Tagetes erecta L.	likely	Chávez *et al.* (2003)
Tagetes minuta L.	likely	Chávez *et al.* (2003)
Tagetes sp.	likely	NHMB
Xanthium spinosum L.	confirmed	BMNH
Escalloniaceae		
Escallonia rosea Griseb.	confirmed	MHNG, NHMB

......*continued on the next page*

TABLE 1. (Continued)

Plant name	Host status	Reference
Fabaceae		
Adesmia hystrix Phil.	unlikely	MHNG
Prosopis tamarugo Phil.	unlikely	NHMB
Prosopis sp.	unlikely	NHMB
Nothofagaceae		
Nothofagus alpina (Poepp. & Endl.) Oerst.	unlikely	MHNG
Nothofagus antarctica (G. Forst.) Oerst.	unlikely	MHNG
Nothofagus pumilio (Poepp. & Endl.) Krasser	unlikely	MHNG
Poaceae		
Hordeum vulgare L.	unlikely	Artigas (1994)
Triticum sp.	unlikely	Artigas (1994)
Rhamnaceae		
Discaria serratifolia Benth. & Hook.f. ex Mast.	unlikely	MHNG
Rutaceae		
Citrus sp.	accidental	FSCA
Solanaceae		
Acnistus arborescens (L.) Schltdl.	likely	BMNH
Brugmansia arborea (L.) Steud.	confirmed	BMNH
Capsicum annuum L.	likely	Chávez *et al.* (2003)
Capsicum baccatum L.	likely	Chávez *et al.* (2003)
Cestrum auriculatum L'Hér.	likely	Chávez *et al.* (2003)
Datura stramonium L.	likely	Chávez *et al.* (2003)
Datura sp.	confirmed	Tuthill (1959)
Fabiana imbricata Ruiz & Pav.	likely	MHNG
Lycium chilense Bertero	likely	NHMB
Lycium sp.	confirmed	MHNG
Lycopersicon esculentum Mill.	likely	Chávez *et al.* (2003)
Nicotiana glutinosa L.	likely	BMNH
Nolana cf. *sedifolia* Poepp.	likely	MHNG
Solanum americanum Mill.	likely	Chávez *et al.* (2003)
Solanum chilense Dunal	likely	Chávez *et al.* (2003)
Solanum corymbosum Jacq.	likely	BMNH
Solanum peruvianum L.	likely	Chávez *et al.* (2003)
Solanum pinnatum Cav.	likely	MHNG
Solanum tuberosum L.	confirmed	Tuthill (1959), Artigas (1994), Chávez *et al.* (2003), Burckhardt (1987a), MHNG, NHMB
Solanum valdiviense Dunal	likely	MHNG
Solanum sp.	likely	MHNG
gen. sp.	likely	MHNG
Zygophyllaceae		
gen. sp.	unlikely	MHNG

Material and methods

A total of 183 specimens were analysed in this study. The measured specimens were: 103 specimens (48 ♂, 55 ♀) of *Russelliana solanicola* s. l. and 80 specimens (42 ♂, 38 ♀) of the following 17 other *Russelliana* species (Table 2): *R. adesmiae* Burckhardt 1986, *R. adunca* Burckhardt 1987, *R. bulbosa* Burckhardt, 1987, *R. chilensis* Burckhardt 1987, *R. diosteae* Burckhardt 2008, *R. disparilis* Tuthill 1964, *R. fabianae* Burckhardt 1987, *R. intermedia* Burckhardt 1987, *R. maculata* Burckhardt 1987, *R. marionae* Burckhardt 2008, *R. nigra* Burckhardt 1987, *R. punctulata* Burckhardt 1987, *R. sebastiani* Burckhardt 2008, *R. similis* Burckhardt 1987, *R. theresae* Burckhardt 2008, *R. vinculipennis* Burckhardt 1987 and an undescribed species *R.* cf. *adunca*. Table 3 lists collection information of *R. solanicola* s. l. from all examined material (including the measured specimens) and of those published records that provide more information than just the country. The specimens are deposited in the following institutions: California Academy of Sciences, San Francisco, California, United States of America (CASC), Florida State Collection of Arthropods, Gainesville, Florida, United States of America (FSCA), Muséum d'histoire naturelle, Geneva, Switzerland (MHNG), Natural History Museum, London, United Kingdom (BMNH) and Naturhistorisches Museum, Basel, Switzerland (NHMB). The measurements were taken from specimens permanently mounted on slides in Canada balsam. Morphological characters used in the multivariate analyses are (24 for ♂, 23 for ♀): GL = genal process length; HW = head width; VL = vertex length; VW = vertex width; AL = antennal length; 3AL, 4AL, 5AL, 6AL, 7AL, 8AL, 9AL, 10AL = length of antennal segments 3, 4, 5, 6, 7, 8, 9, 10; PFL = profemur length; PTL = protibia length; MFL = mesofemur length; MTL = mesotibia length; MtFL = metafemur length; MtTL = metatibia length; FL = forewing length; FW = forewing width. – Male terminalia: MP = male proctiger length; PL = paramere length; DL = length of distal segment of aedeagus. – Female terminalia: FP = female proctiger length; SP = female subgenital plate length. Morphological terminology follows mostly Hollis (2004). Measurements are listed in Appendices 1 and 2.

A total of 26 morphometric characters were compared between *R. solanicola* and all other *Russelliana* species. Differences between morphometric characters were analysed using a set of multivariate techniques in the statistical software Primer-E v6 (Clarke & Gorley 2006) with the PERMANOVA+ add-on (Anderson *et al.* 2008). All morphometric variables were standardised prior to analyses by setting the maximum measurement in each variable to 100 and adjusting the other values. The resulting table of relative values for morphometric measurements in all individuals was then transformed into a resemblance matrix that documents the dissimilarity between individuals based on Euclidean distances. Two types of analyses were performed on the dissimilarity matrices to identify whether *R. solanicola* s. l. is a complex of morphologically similar, monophagous species or a single polyphagous species.

Non-metric multidimensional scaling (NMDS) was used to illustrate resemblance between individuals of *Russelliana* species, including *R. solanicola* s. l. No a-priori classifications for individuals were assigned in an unconstrained ordination procedure. This ordination provides a representation of the similarity between individuals and the stress value reflects how good the two-dimensional ordination captures the multivariate resemblance between individuals. Stress values around 0.1 or lower is a good representation of the multivariate pattern that can be visually interpreted without the risk of drawing false inferences (Clarke 1993). In a constrained ordination procedure the points were assigned a-priori to species and a Canonical Analysis of Principal Coordinates (CAP) (Anderson & Willis 2003) then fitted axes through the multivariate point cloud that are best to discriminate among the pre-defined groups. We followed a leave-one-out procedure (Seber 1984) to evaluate the axes representation of classifying individuals into pre-defined classes. This approach leaves out one individual from the CAP and then places this point into the canonical space produced by the CAP based on all other points. The point that was left out is then allocated to the class with the closest centroid from any of the pre-defined classes. The percentage of wrongly allocated points is the misclassification error. Each analysis was performed separately for males and females.

The nomenclature of plant names follows The Plant List (2014).

Results

The morphometric analyses for both male and female specimens revealed *R. solanicola* to be distinct from other *Russelliana* species. The NMDS plot for males (Fig. 3) shows the separation of *Russelliana solanicola* s. l.

individuals from all other (16) species (Fig. 3B) mainly due to a lower relative size in four head characters: genal process length (GL), vertex length (VL), antennal length (AL) and length of antennal segment 7 (7AL), and also due to two characters of the terminalia: length of distal portion of the aedeagus (DL) and paramere length (PL) (Fig. 3A). The results for females are similar (Fig. 5) as individuals of *R. solanicola* s. l. primarily are separated from individuals of other species due to lower relative sizes in four head characters: genal process length (GL), vertex length (VL), antennal length (AL) and length of antennal segment 5 (5AL), as well as one character of the terminalia: female proctiger length (FP) (Fig. 5A). These characters separate *R. solanicola* s. l. from most (14) species except for *R.* cf. *adunca* and *R. nigra* (Fig. 5B). Within *R. solanicola* s. l., on the other hand, populations from both different plant species (Figs. 4A, 6A) and different geographical regions (Figs. 4B, 6B), respectively, overlap in both sexes.

In the CAP plot for males (Fig. 7) *R. solanicola* s. l. individuals are separated from all other (16) species (Fig. 7B) mainly due to a lower relative genal process length (GL), length of distal portion of the aedeagus (DL) and paramere length (PL) (Fig. 7C). Head width (HW) is an additional character that contributed to this separation but which was not significant in the separation in NMDS plots. The misclassification error was 6.7% documenting that 84 out of 90 male individuals were correctly assigned to the pre-defined species based on the generated axes. Misclassifications occurred for three individuals of *R. solanicola* s. l. which were classified as *R.* cf. *adunca* (n=2) or *R. vinculipennis* (n=1). Other misclassifications included one individual of *R. adunca* (classified as *R. punctulata*), one individual of *R. chilensis* (classified as *R. maculata*) and one individual of *R. vinculipennis* (classified as *R. maculata*). The CAP results for females (Fig. 8) were similar to those for males, but the separation of *R. solanicola* s. l. from *R.* cf. *adunca* was not as good. Females of *R. solanicola* s. l. mostly were separated from individuals of other species (Fig. 8B) by lower values of head characters: genal process length (GL), vertex length (VL) and length of antennal segment 6 (6AL) (Fig. 8C). The misclassification error was 6.4%, in that 87 out of 93 female individuals were assigned correctly to the pre-defined species based on the generated axes. Misclassifications occurred for one individual of *R. solanicola* s. l., which was classified as *R.* cf. *adunca*, one individual of *R. diosteae* (classified as *R. sebastiani*), one individual of *R. maculata* (classified as *R. vinculipennis*), one individual of *R. intermedia* (classified as *R.* cf. *adunca*) and one individual of *R. vinculipennis* (classified as *R. maculata*). As in the NMDS the individuals of *R. solanicola* s. l. from different plant species as well as from different geographical regions overlap with each other to a large extent in both the male and female analyses. There is no population which is clearly clustered and isolated from other populations.

Discussion

Morphometric analyses. In both, the unconstrained and constrained ordinations for both sexes the populations of *R. solanicola* s. l. group together and clearly are separated from the majority of the other species. This suggests that *R. solanicola* s. l. is a well-defined species. It can be differentiated from other species by a number of characters, which vary, however, between sexes and types of ordination. On the other hand, within *R. solanicola* s. l. there are no detectable groups corresponding to the populations from either different plant species or geographical regions.

The unconstrained ordination analysis largely supports species defined through the morphology of terminalia (Burckhardt 1986, 1987a, 2008). For the males, many of the characters that are diagnostically important in the unconstrained ordination analysis (i.e. genal process length, vertex length, antennal length, paramere length and length of distal segment of the aedeagus) (Fig. 3A) have been used previously to diagnose *Russelliana* species (Burckhardt 1986, 1987a, 2008). However, the length of antennal segment 7 is a morphological character that had not been previously used to describe species and we suggest this character would be helpful in future species descriptions. The results for the females are similar (Fig. 5A) with the most important diagnostic characters being genal process length, vertex length, antennal length and female proctiger length. These characters have also been used previously to diagnose *Russelliana* species. Only the length of antennal segment 5 represents a new and potentially important diagnostic character.

For both sexes, the constrained ordination (Figs. 7B, 8B) better separated species clusters than the unconstrained ordination. However, species clusters differed slightly between the males and females. While the separation of *R. solanicola* s. l. (Fig. 7B) from the other species is complete in males, there is a partial overlap *R. solanicola* with *R.* cf. *adunca* in females (Fig. 8B). The better resolution of species in the male analysis possibly

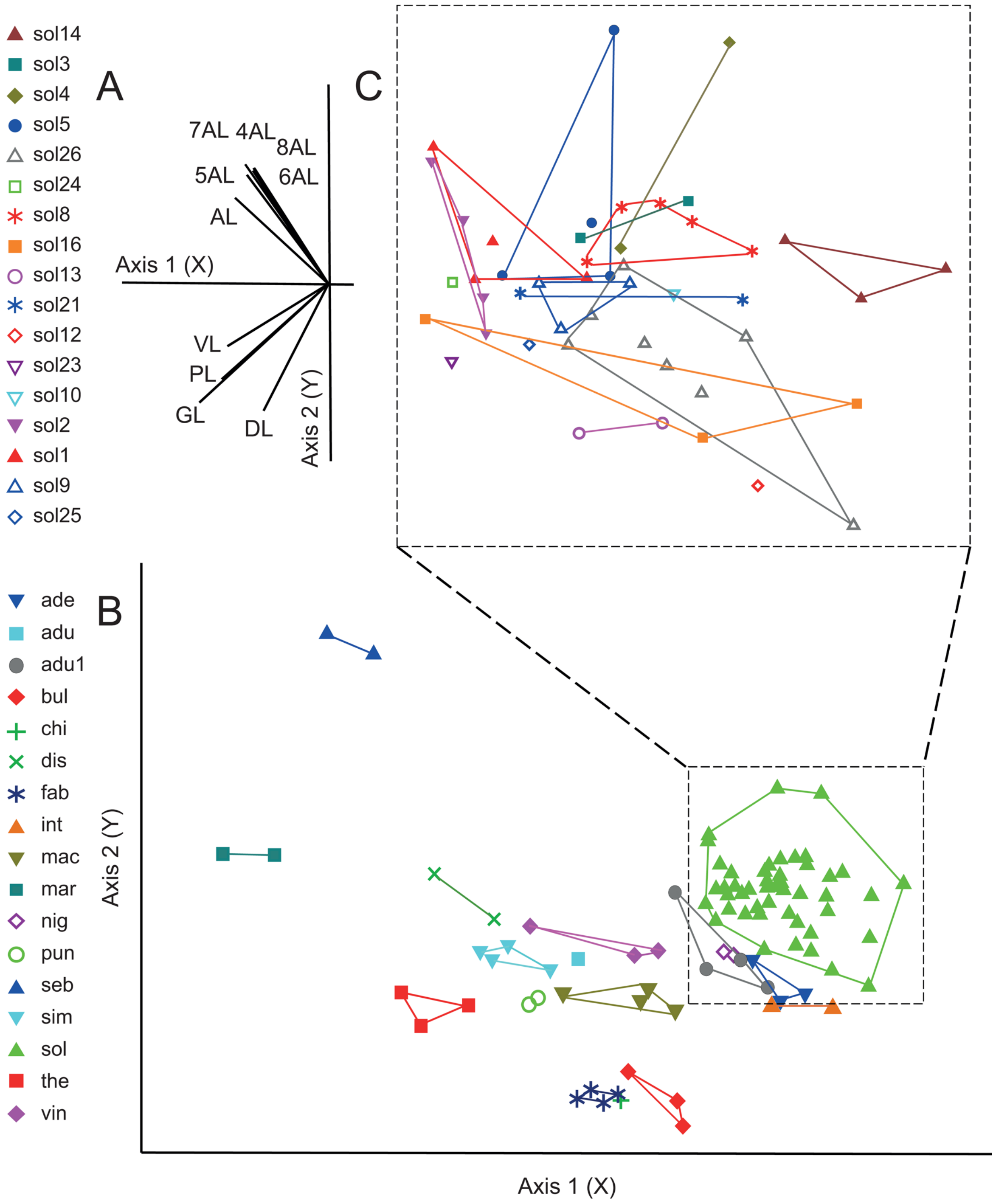


FIGURE 3. Non-metric multidimensional scaling (NMDS) based on body measurements of *Russelliana* species for males (final 2-d stress = 0.08). A, Morphometric variables that contributed to group separation (multiple correlation coefficient > 0.3, for abbreviations see material and methods). B, NMDS plot of 17 species projected onto axes 1/2. C, NMDS plot of 17 populations of *R. solanicola* s. l.

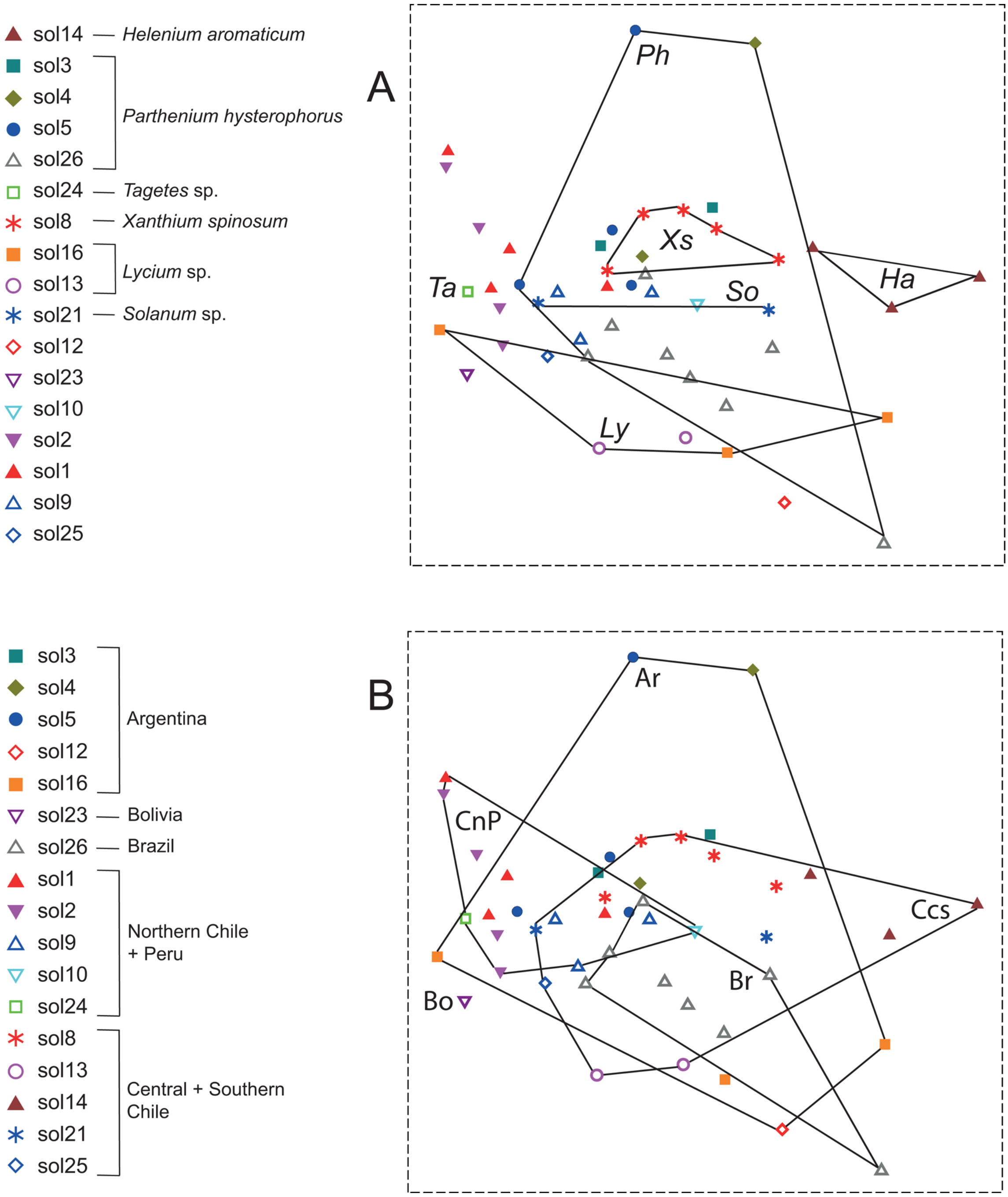


FIGURE 4. Non-metric multidimensional scaling (NMDS) plot of 17 populations of *R. solanicola* s. l. for males (see also Fig. 3). A, Clusters of 6 host-plant species, unclustered individuals lack host-plant information. Plant codes: *Helenium aromaticum* = *Ha*, *Parthenium hysterophorus* = *Ph*, *Tagetes* sp. = *Ta*, *Xanthium spinosum* = *Xs*, *Lycium* sp. = *Ly*, *Solanum* sp. = *So*. B, Clusters of 5 geographical regions. Geographical codes: Ar = Argentina, Bo = Bolivia, Br = Brazil, CnP = Northern Chile (III, IV Regions) and Peru, Ccs = Central and Southern Chile (V, VIII, IX Regions).

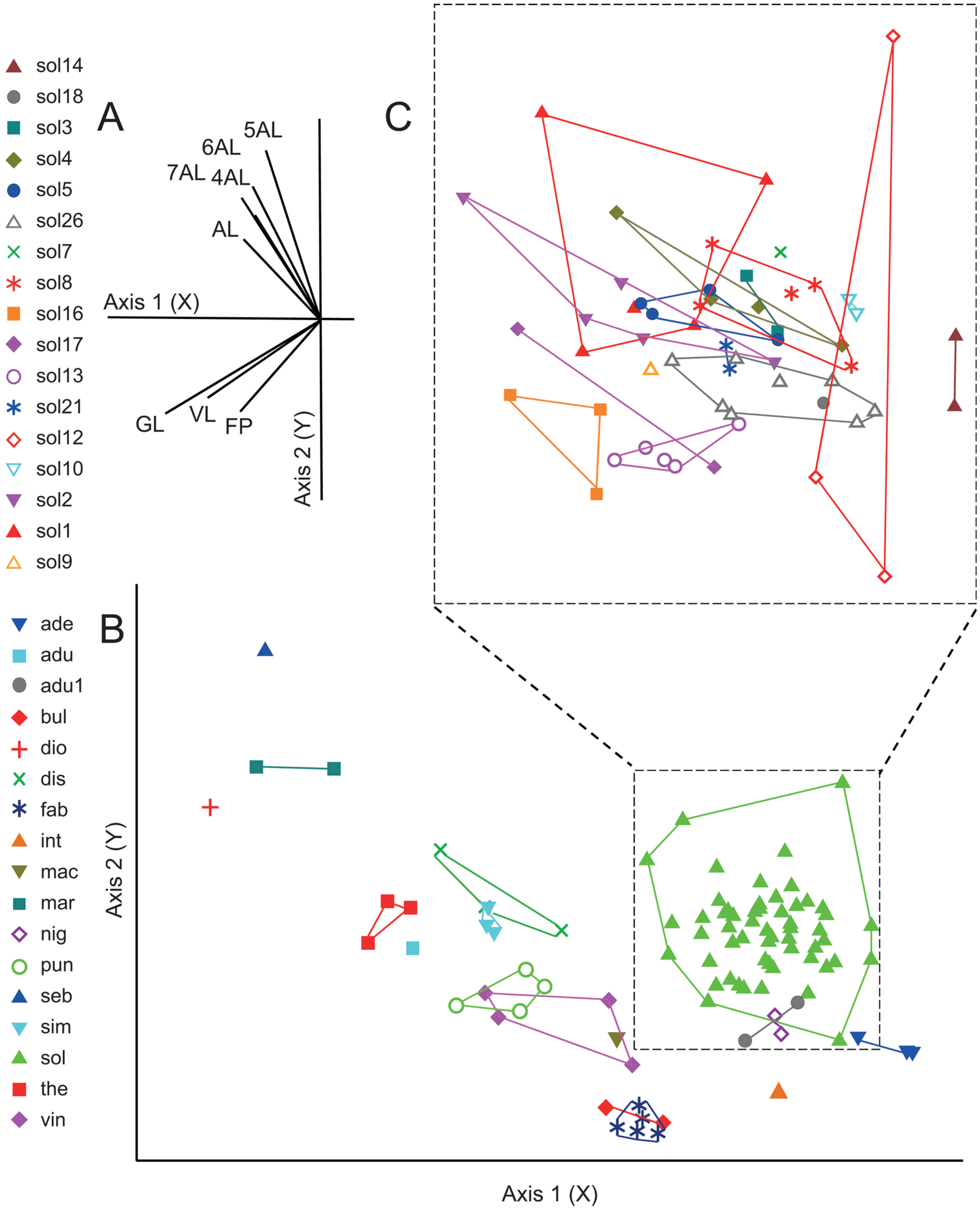


FIGURE 5. Non-metric multidimensional scaling (NMDS) based on body measurements of *Russelliana* species for females (final 2-d stress = 0.10). A, Morphometric variables that contributed to group separation (multiple correlation coefficient > 0.3, for abbreviations see material and methods). B, NMDS plot of 17 species projected onto axes 1/2. C, NMDS plot of 17 populations of *R. solanicola* s. l.

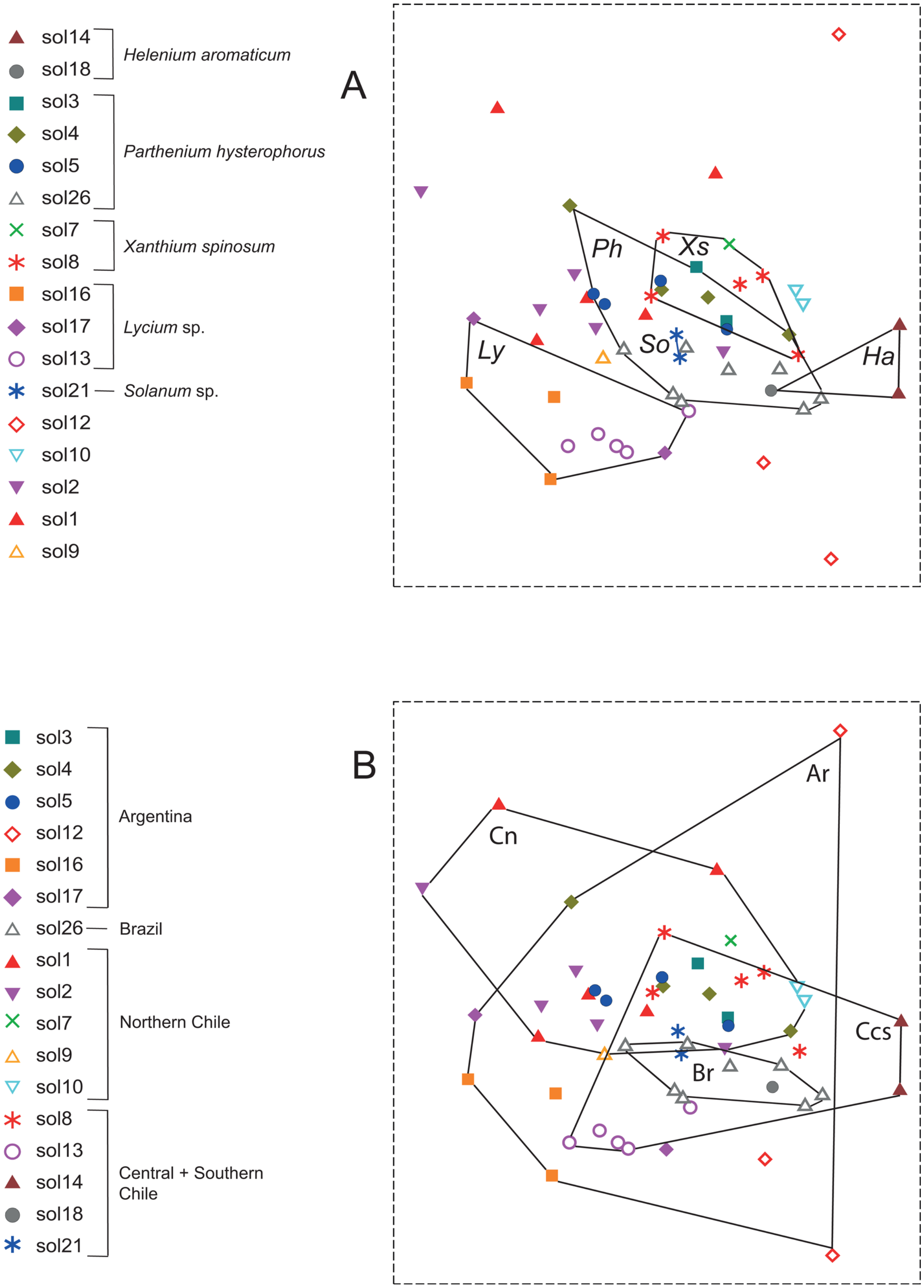


FIGURE 6. Non-metric multidimensional scaling (NMDS) plot of 17 populations of *R. solanicola* s. l. for females (see also Fig. 5). A, Clusters of 5 host-plant species, unclustered individuals lack host-plant information. Plant codes: *Helenium aromaticum* = *Ha*, *Parthenium hysterophorus* = *Ph*, *Xanthium spinosum* = *Xs*, *Lycium* sp. = *Ly*, *Solanum* sp. = *So*. B, Clusters of 4 geographical regions. Geographical codes: Ar = Argentina, Br = Brazil, Cn = Northern Chile (III, IV Regions), Ccs = Central and Southern Chile (V, VIII Regions).

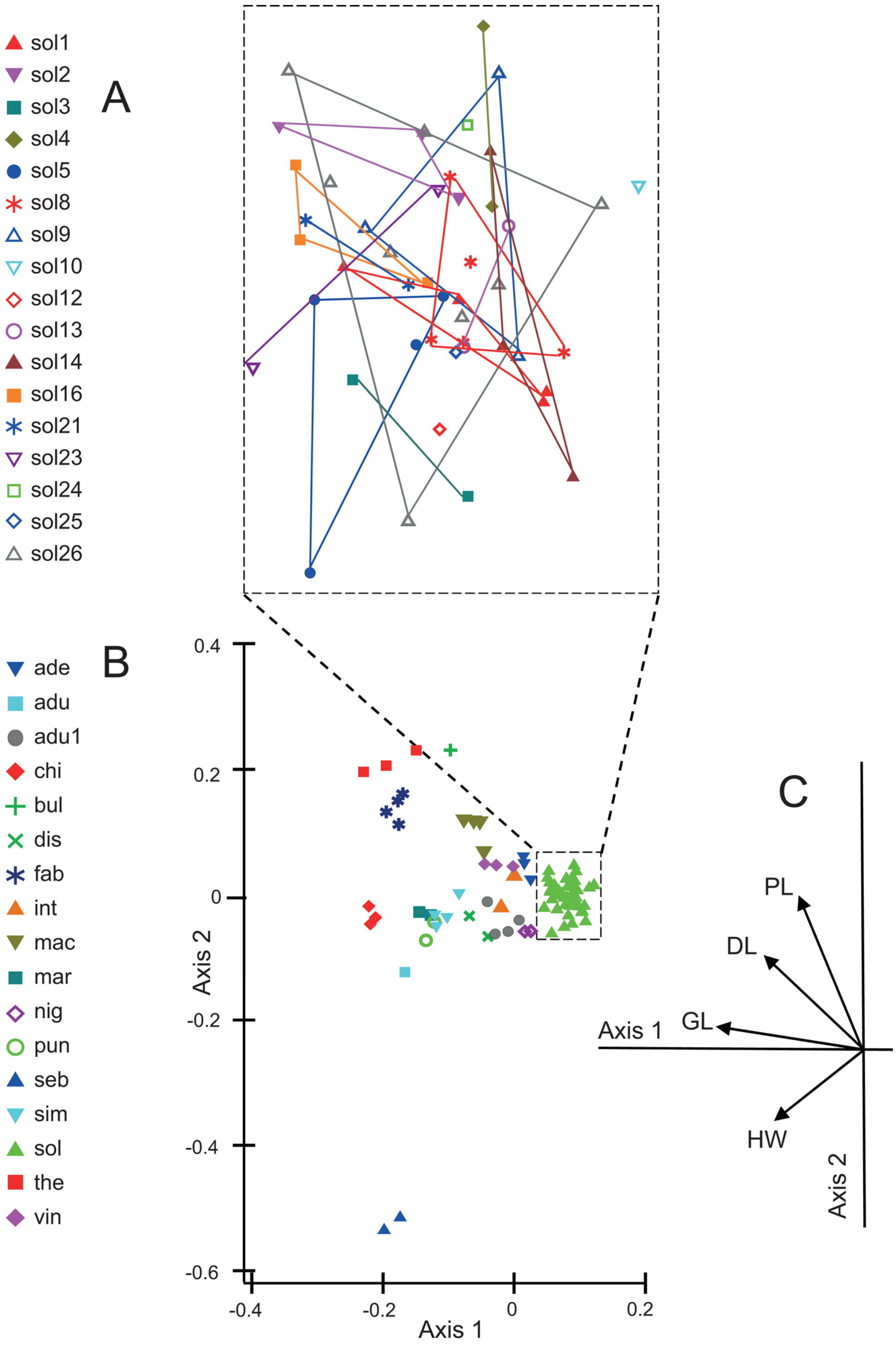


FIGURE 7. Canonical analysis of principle coordinates (CAP) based on body measurements of *Russelliana* species for males. A, CAP plot of 17 populations of *R. solanicola* s. l. B, CAP plot of 17 species projected onto axes 1/2. C, Morphometric variables that contributed to group separation (multiple correlation coefficient > 0.3, for abbreviations see material and methods).

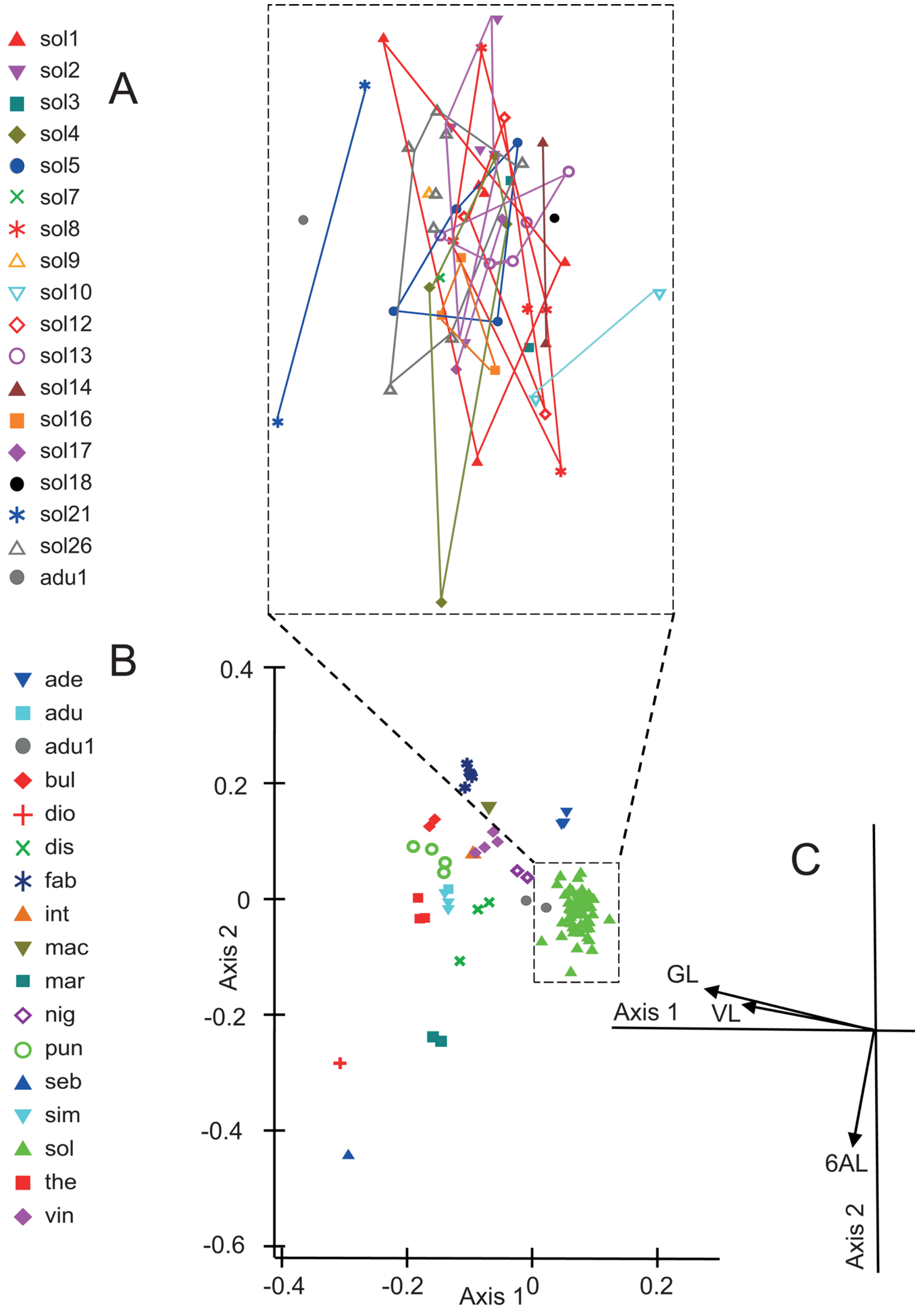


FIGURE 8. Canonical analysis of principle coordinates (CAP) based on body measurements of *Russelliana* species for females. A, CAP plot of 17 populations of *R. solanicola* s. l. B, CAP plot of 17 species projected onto axes 1/2. C, Morphometric variables that contributed to group separation (multiple correlation coefficient > 0.3, for abbreviations see material and methods).

is due to the contribution of terminalia characters lacking in the female analysis. All diagnostically significant characters in the male analysis (i.e. genal process length, head width, paramere length and length of distal segment of the aedeagus) (Fig. 7C) have been used previously to diagnose *Russelliana* species (Burckhardt 1986, 1987a, 2008). In the female analysis some of the characters contributing to clustering are different from those in the male analysis (i.e. vertex length and length of antennal segment 6) (Fig. 8C). Only the length of antennal segment 6 has not been used previously to diagnose species and should be considered in future species descriptions.

Host-plants. Host-plants for *R. solanicola* were identified through a literature search and available specimen material at BMNH, MHNG and NHMB. Through a literature search, we found 16 plant species from three families were recorded as host-plants of *R. solanicola* (Tuthill 1959; Artigas 1994; Chávez *et al.* 2003). Of those records found in literature, two (*Datura* sp. and *Solanum tuberosum*) can be confirmed as host-plants by the presence of immature psyllids, twelve (4 spp. of Asteraceae, 8 spp. of Solanaceae) are probable and two (2 spp. of Poaceae) are unlikely hosts. Much additional plant information is available in the material at hand, which increases the number of plants *R. solanicola* have been collected on to 49 species from 10 families (Table 1).

Among these records, 11 species from the four families Amaranthaceae (*Alternanthera ficoidea*), Asteraceae (*Baccharis lycioides*, *Baccharis zoellneri minor*, *Helenium aromaticum*, *Parthenium hysterophorus*, *Xanthium spinosum*), Escalloniaceae (*Escallonia rosea*) and Solanaceae (*Brugmansia arborea*, *Datura* sp., *Lycium* sp., *Solanum tuberosum*) are confirmed as hosts by the presence of immature psyllids. Although only adult *R. solanicola* were collected on several species from the families mentioned above (Amaranthaceae 2 spp., Asteraceae 7 spp. and Solanaceae 18 spp.), it is likely they are hosts as well. Many of the Asteraceae and Solanaceae in Table 1 that we define as likely host-plants have patchy distributions which makes a systematic collecting effort difficult (D. Burckhardt, pers. obs.). However, we expect immatures can be found on species in these families on future field expeditions.

A single immature and numerous adults were found on *Citrus* (Rutaceae) in Brazil. This association appears accidental. If *R. solanicola* has been recently introduced into Brazil, it could have an artificially inflated temporary host range due to invasion biology. For this reason we consider *Citrus* as an unlikely host.

Only adults but no immatures of *R. solanicola* s. l. were collected on plants from the Fabaceae, Nothofagaceae, Poaceae, Rhamnaceae and Zygophyllaceae suggesting they are not hosts. In the case of *Nothofagus* spp. (Nothofagaceae), targeted and very intensive field work was conducted to study the host patterns of *Notophorina* spp. (Liviidae, Euphyllurinae) (8 described, 11 undescribed spp.) that are monophagous or oligophagous on 9 of the 10 South American *Nothofagus* spp. (Burckhardt 1987b; unpublished MHNG, NHMB data). Even though adult *R. solanicola* s. l. were collected on *Nothofagus*, sometimes in larger numbers, no single immature of this species was found, suggesting that these are stray specimens that probably were blown from their host-plants (D. Burckhardt, pers. obs.). The situation is similar for *Prosopis* (Fabaceae) and *Discaria* (Rhamnaceae).

The families of confirmed host-plants of *R. solanicola* s. l. all belong to the same clade of eudicots (Caryophyllales and asterids) (Stevens 2001 onwards). There is no confirmed record from taxa outside this clade and we consider that the plants belonging to the monocots (Poaceae) and rosids (Fabaceae, Nothofagaceae, Rhamnaceae, Rutaceae and Zygophyllaceae) are improbable hosts of *R. solanicola* s. l.

Distribution. *Russelliana solanicola* s. l. is distributed widely along the Andes in central and western Argentina, Bolivia, Chile and Peru (Table 3, Fig. 9). It can be found from 80–3800 m a.s.l. in a large variety of habitats ranging from semi-desert, alpine and mediterranean scrub to edges and clearings of *Nothofagus* forests. A large number of specimens from these countries have been collected in natural or semi-natural habitats, usually on native plants. *R. solanicola* s. l. is also known from a few localities in eastern Argentina, Brazil and Uruguay. In Brazil, from where information is available, the psyllid species has only been collected on introduced or cultivated plants in man-made habitats. This pattern of occurrence in natural versus man-made habitats and native versus introduced plants suggests that *R. solanicola* s. l. is native to the Andes and has been introduced into eastern South America (eastern Argentina, Brazil, Uruguay).

Conclusions

Psyllids are known for their narrow host ranges, and there are only a few examples of genuine polyphagy (Hodkinson 1981; Burckhardt *et al.* 2014). Often, 'species' with a putatively wide host-range turn out to be a complex of narrowly oligophagous or monophagous species when examined more closely. For instance, Ossiannilsson (1951) showed that *Aphalara calthae* (Linnaeus 1758) as identified by previous authors was actually a complex of species associated with *Caltha palustris* (Ranunculaceae), *Polygonum* or *Rumex* spp. (Polygonaceae) (Burckhardt & Lauterer 1997a). The discovery of adult and immature *R. solanicola* s. l. on many plant species belonging to several families was unexpected, which suggested that a complex of cryptic species may be involved. However, there were no consistent morphological differences between the various populations collected on different plants. To uncover the possible presence of cryptic species, NMDS and CAP were performed in this study and the results strongly suggest that *R. solanicola* is a single, polyphagous species. We suggest future research should focus on host-transplant experiments to detect the potential presence of host-plant preferences of particular populations, as well as DNA studies that may reveal the presence of host races.

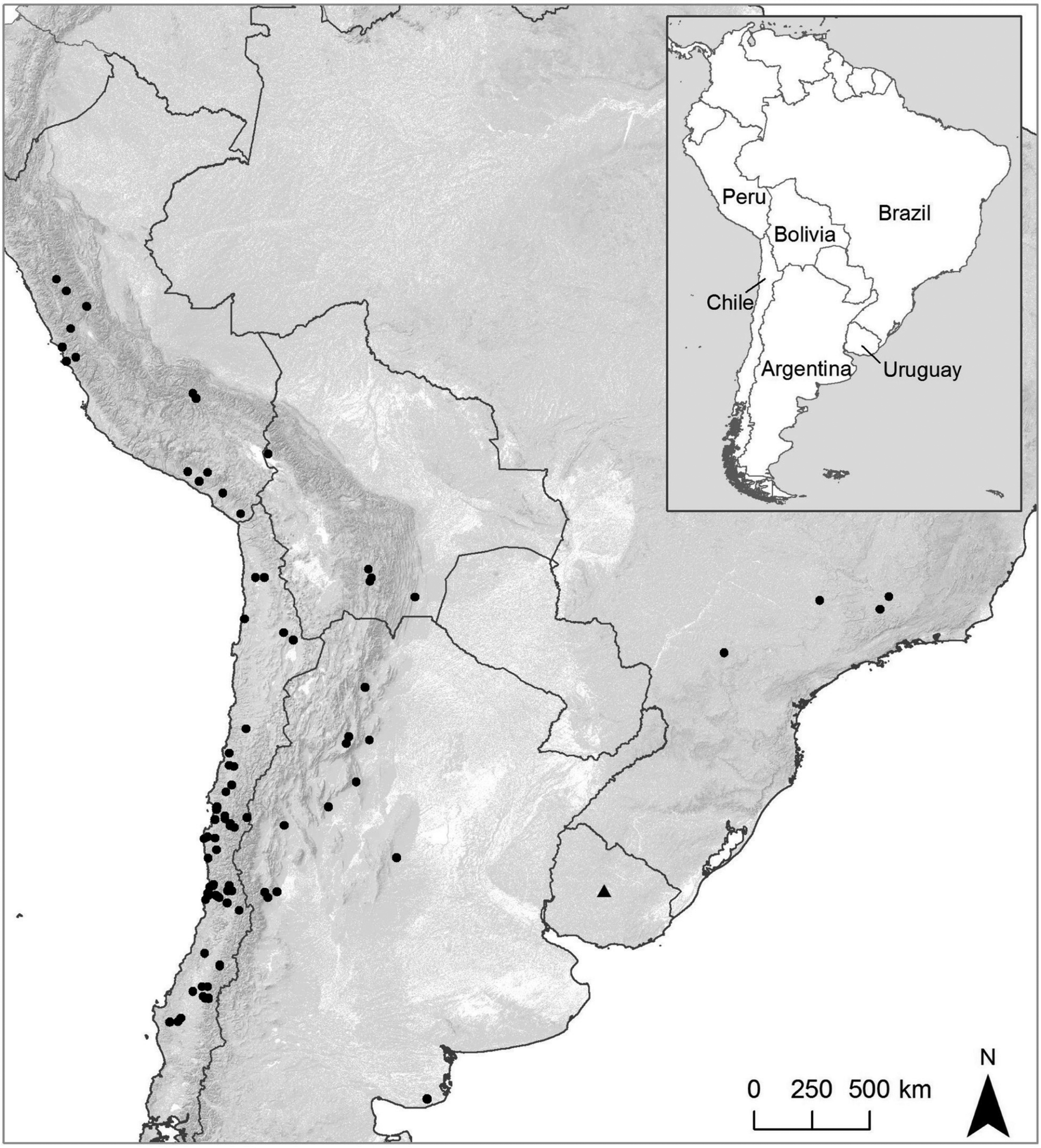


FIGURE 9. Known geographic distribution of *R. solanicola* from Argentina, Bolivia, Brazil, Chile and Peru. For Uruguay the exact location of the sample is unknown (marked with ▲).

TABLE 2. Label information of *Russelliana* specimens included in the multivariate analyses. Samples (code) containing also immatures are marked with an asterisk (*).

species	number of measured specimens	country	locality	altitude above sea level in m	plant family: species	date	collector	depository	code
solanicola	3 ♂, 2 ♀	Chile	V Region, San Felipe de Aconcagua, El Asiento, 10 km NW San Felipe	900	Asteraceae: *Helenium aromaticum* (Hook.) L.H.Bailey	13–20.i.1997	D. Burckhardt	MHNG	sol14*
solanicola	1 ♀	Chile	V Region, San Felipe de Aconcagua, Putaendo, El Tártaro, 20 km N San Felipe	1100	Asteraceae: *Helenium aromaticum* (Hook.) L.H.Bailey	24.xii.1995	D. Burckhardt	MHNG	sol18*
solanicola	2 ♂, 2 ♀	Argentina	Córdoba		Asteraceae: *Parthenium hysterophorus* L.	6.ii.1976		BMNH	sol3
solanicola	2 ♂, 4 ♀	Argentina	La Rioja		Asteraceae: *Parthenium hysterophorus* L.	xi.1986	C. Garcia	BMNH	sol4
solanicola	4 ♂, 4 ♀	Argentina	Tucumán		Asteraceae: *Parthenium hysterophorus* L.	1986	C. Garcia	BMNH	sol5
solanicola	8 ♂, 8 ♀	Brazil	São Paulo, Gavião Peixoto, Fazenda Citrícola	650	Asteraceae: *Parthenium hysterophorus* L.	2.ix.2014	D. Burckhardt & D.L. Queiroz	NHMB	sol26*
solanicola	1 ♂	Peru	Lima, Huaral		Asteraceae: *Tagetes* sp.	12.ii.1995	C. Vergara	NHMB	sol24
solanicola	1 ♀	Chile	IV Region, Limarí, 31 km W of Ovalle		Asteraceae: *Xanthium spinosum* L.	19.ii.1985	D. Hollis	BMNH	sol7
solanicola	5 ♂, 5 ♀	Chile	V Region, Quillota, La Campana National Park	1300	Asteraceae: *Xanthium spinosum* L.	11.i.1985	D. Hollis	BMNH	sol8*
solanicola	3 ♂, 3 ♀	Argentina	Mendoza, km 18 Mendoza to Villa Vicencia	700	Solanaceae: *Lycium* sp.	18.i.1997	D. Burckhardt	MHNG	sol16
solanicola	2 ♀	Argentina	Mendoza, Mendoza Valley, Uspallata to Potrerillos	1700	Solanaceae: *Lycium* sp.	30–31.xii.1995	D. Burckhardt	MHNG	sol17
solanicola	2 ♂, 5 ♀	Chile	V Region, San Felipe de Aconcagua, Putaendo, 10 km N San Felipe	700	Solanaceae: *Lycium* sp.	15.xii.1995	D. Burckhardt	MHNG	sol13*
solanicola	2 ♂, 2 ♀	Chile	VIII Region, Ñuble, Chillán		Solanaceae: *Solanum* sp.	4.i.1956	J.N. Artigas	MHNG	sol21
solanicola	1 ♂, 3 ♀	Argentina	San Juan, La Cienaga			6.iii.1992	L.E. Peña	NHMB	sol12
solanicola	2 ♂	Bolivia	Chuquisaca, Nor Cinti, Padcoya to Camargo	2800–3200		26–28.xii.1984	L.E. Peña	MHNG	sol23
solanicola	1 ♂, 2 ♀	Chile	III Region, Chañaral, Diego de Almagro			21.i.1992	L.E. Peña	NHMB	sol10
solanicola	4 ♂, 5 ♀	Chile	III Region, Copiapó, 65 km SE Copiapó			25.x.1991	L.E. Peña	NHMB	sol2*
solanicola	4 ♂, 5 ♀	Chile	III Region, Huasco, 30 km S Vallenar			16.i.1992	L.E. Peña	NHMB	sol1*
solanicola	3 ♂, 1 ♀	Chile	IV Region, Elqui, La Higuera			17.xi.1991	L.E. Peña	NHMB	sol9
solanicola	1 ♂	Chile	IX Region, Malleco, Angol			21.xii.1924	D.S. Bullock	MHNG	sol25
adesmiae	1 ♂	Chile	IV Region, Choapa, Agua Dulce		Asteraceae: *Bahia ambrosioides* Lag.	20.viii.1985	J. Solervicens	MHNG	ade
adesmiae	1 ♂, 1 ♀	Chile	IV Region Choapa, km 272, Panamericana Norte		Fabaceae: *Adesmia* sp.	20.viii.1985	M. Elgueta	MHNG	ade

......*continued on the next page*

species	number of measured specimens	country	locality	altitude above sea level in m	plant family: species	date	collector	depository	code
adesmiae	1 ♂, 2 ♀	Chile	IV Region, Choapa, Agua Dulce		Fabaceae: *Adesmia* sp.	22.v.1986	J. Solervicens	MHNG	ade
adunca	1 ♂, 1 ♀	Bolivia	Chuquisaca, Nor Cinti, Lecori, S Potosi	3200		26–27.xii.1984	L.E. Peña	MHNG	adu
bulbosa	1 ♂	Chile	VII Region, Talca, Parque Gil de Vilches, sector Majadilla	1350–1550	Verbenaceae: *Dipyrena juncea* (Gillies & Hook.) Ravenna	13.i.1996	D. Burckhardt	NHMB	bul*
bulbosa	2 ♂, 2 ♀	Argentina	Río Negro, El Bolsón			1.iv.1961	G. Topal	MHNG	bul
chilensis	1 ♂	Chile	VIII Region, Ñuble, Las Trancas	1550		12–13.xii.1983	L.E. Peña	MHNG	chi
diosteae	1 ♀	Chile	VII Region, Talca, Parque Gil de Vilches, El Enladrillado, Valle El Venado	1350–1700	Verbenaceae: *Dipyrena juncea* (Gillies & Hook.) Ravenna	14.i.1996	D. Burckhardt	NHMB	dio
disparilis	1 ♂, 1 ♀	Bolivia	Chuquisaca, Nor Cinti, Lecori, S Potosi	3200		26–27.xii.1984	L.E. Peña	MHNG	dis
disparilis	1 ♂, 2 ♀	Bolivia	Chuquisaca, Nor Cinti, Padcoya to Camargo	2800–3200		26–28.xii.1984	L.E. Peña	MHNG	dis*
fabianae	4 ♂, 5 ♀	Argentina	Río Negro, El Bolsón			4.xi.1961	G. Topal	MHNG	fab
intermedia	2 ♂, 1 ♀	Bolivia	Chuquisaca, Nor Cinti, Padcoya to Camargo	2800–3200		26–28.xii.1984	L.E. Peña	MHNG	int
maculata	1 ♂	Argentina	Jujuy, Iturbe			31.xii.1984	L.E. Peña	MHNG	mac
maculata	3 ♂, 1 ♀	Bolivia	Chuquisaca, Nor Cinti, Lecori, S Potosi	3200		26–27.xii.1984	L.E. Peña	MHNG	mac
marionae	2 ♂, 2 ♀	Argentina	Mendoza, above Villa Vicencia, 50 km NW Mendoza	1800–2200		18.i.1997	D. Burckhardt	NHMB	mar*
nigra	2 ♂, 2 ♀	Bolivia	Chuquisaca, Nor Cinti, Padcoya to Camargo	2800–3200		26–28.xii.1984	L.E. Peña	MHNG	nig
punctulata	2 ♂, 4 ♀	Argentina	Jujuy, Iturbe			31.xii.1984	L.E. Peña	MHNG	pun
sebastiani	2 ♂, 1 ♀	Chile	VII Region, Talca, Parque Gil de Vilches, sector Majadilla	1350–1550	Verbenaceae: *Dipyrena juncea* (Gillies & Hook.) Ravenna	13.i.1996	D. Burckhardt	NHMB	seb*
similis	4 ♂, 3 ♀	Bolivia	Chuquisaca, Nor Cinti, Lecori, S Potosi	3200		26–27.xii.1984	L.E. Peña	MHNG	sim
theresae	1 ♂, 1 ♀	Chile	V Region, Los Andes, Juncal	2200	Verbenaceae: *Dipyrena juncea* (Gillies & Hook.) Ravenna	24.xii.1998	D. Burckhardt	NHMB	the*
theresae	2 ♂, 2 ♀	Chile	V Region, Los Andes, Portillo to Río Blanco	1900	Verbenaceae: *Dipyrena juncea* (Gillies & Hook.) Ravenna	24.xii.1999	D. Burckhardt	NHMB	the
vinculipennis	1 ♂, 1 ♀	Argentina	Jujuy, Iturbe			31.xii.1984	L.E. Peña	MHNG	vin
vinculipennis	2 ♂, 3 ♀	Bolivia	Chuquisaca, Nor Cinti, Lecori, S Potosi	3200		26–27.xii.1984	L.E. Peña	MHNG	vin
sp. cf. *adunca*	4 ♂, 2 ♀	Argentina	Chubut, Los Altares			3–5.xi.1990	L.E. Peña	NHMG	adu1

TABLE 3. Collection information on populations of *R. solanicola* s. l. from examined museum samples (including material used in the multivariate analyses) as well as literature records that provide more information than just mention the country. Samples containing immatures are marked with an asterisk (*).

locality	habitat: natural / man-made	altitude above sea level in m	samples containing immatures	plant family: species	native / introduced / cultivated	date	collector	depository / literature reference
Argentina: Catamarca, Punta Balasto		2200				26–28.xi.1983	L.E. Peña	Burckhardt (1987a)
Argentina: Catamarca, San Fernando, NE Tinogasta				Fabaceae: *Prosopis* sp.		4.xi.1991	L.E. Peña	NHMB
Argentina: Catamarca, *c.* 2 km N of Santa María		1800				21.iii.1974	C.R. Vardy	BMNH
Argentina: Córdoba				Asteraceae: *Parthenium hysterophorus* L.	native	6.ii.1976		BMNH
Argentina: La Rioja				Asteraceae: *Parthenium hysterophorus* L.	native	xi.1986	C. Garcia	BMNH
Argentina: Mendoza, km 18 Mendoza to Villa Vicencia	natural	700		Solanaceae: *Lycium* sp.		18.i.1997	D. Burckhardt	MHNG
Argentina: Mendoza, Mendoza Valley, Potrerillos	natural	1300		Solanaceae: *Lycium* sp.		17.i.1997	D. Burckhardt	MHNG
Argentina: Mendoza, Mendoza Valley, Uspallata to Potrerillos	natural	1700		Solanaceae: *Lycium* sp.		30–31.xii.1995	D. Burckhardt	MHNG
Argentina: Rio Negro, Viedma						23.x.1926	F. & M. Edwards	BMNH
Argentina: Salta		1200				2–9.ii.1905	J. Steinbach S.J.	Burckhardt (1987a)
Argentina: San Juan, La Cienaga						6.iii.1992	L.E. Peña	NHMB
Argentina: Tucumán				Asteraceae: *Parthenium hysterophorus* L.	native	1986	C. Garcia	BMNH
Argentina: Tucumán							Vezenyi	Burckhardt (1987a)
Bolivia: Chuquisaca, Nor Cinti, Lecori, S Potosi		3200				26–27.xii.1984	L.E. Peña	MNHG
Bolivia: Chuquisaca, Nor Cinti, Padcoya to Camargo		2800–3200				26–28.xii.1984	L.E. Peña	MHNG
Bolivia: Taipina, nr Lag. Titicaca		3800				11.xi.1984	L.E. Peña	MHNG
Bolivia: Tarija, Gran Chaco,Villa Montes						xi.1930	Eisentraut	Burckhardt (1987a)
Brazil: Minas Gerais, Lavras, UFLA	man-made	900	*	Amaranthaceae: *Alternanthera ficoidea* (L.) Sm.	introduced	1–6.vi.2010	D. Burckhardt	NHMB
Brazil: Paraná, Arapongas			*	Solanaceae: *Brugmansia arborea* (L.) Steud.	introduced	30.vii.1996	C. Wilcken	BMNH
Brazil: São Paulo, Gavião Peixoto, Fazenda Citrícola	man-made	650	*	Asteraceae: *Parthenium hysterophorus* L.	introduced	2.ix.2014	D. Burckhardt & D.L. Queiroz	NHMB
Brazil: São Paulo, near Ribierão Preto, Facenda Santo Antõnio of Cutrale	man-made		*	Rutaceae: *Citrus* sp.	cultivated	20.vii.2006	M. Rogers	FSCA
Chile: I Region, Iquique, Pampa del Tamarugal				Fabaceae: *Prosopis tamarugo* Phil.	native	24.i.1992	L.E. Peña	NHMB
Chile: I Region, Tamarugal, Pica						23.ix–20.xi.1966	M.E. Irwin & E. Medina	CASC
Chile: II Region, 40 km Calama to San Pedro de Atacama	natural	850		Amaranthaceae: gen. sp.		23.iv.1993	D. Burckhardt	MHNG
Chile: II Region, 40 km Calama to San Pedro de Atacama	natural	850		Solanaceae: gen. sp.		23.iv.1993	D. Burckhardt	MHNG
Chile: II Region, San Pedro de Atacama	natural	2400				24.iv.1993	D. Burckhardt	MHNG
Chile: II Region, 110–130 km Tocopilla, Pampa del Tamarugal	natural	500–800		Solanaceae: gen. sp.		23.iv.1993	D. Burckhardt	MHNG
Chile: II Region, 110–130 km Tocopilla, Pampa del	natural	500–800		Zygophyllaceae: gen. sp.		23.iv.1993	D. Burckhardt	MHNG

locality	habitat: natural / man-made	altitude above sea level in m	samples containing immatures	plant family: species	native / introduced / cultivated	date	collector	depository / literature reference
Tamarugal								
Chile: III Region, Chañaral, Diego de Almagro						21.i.1992	L.E. Peña	NHMB
Chile: III Region, Copiapó, 65 km SE Copiapó			*			25.x.1991	L.E. Peña	NHMB
Chile: III Region, Copiapó, 30 km SE Caldera						26.x.1983	L.E. Peña	MHNG
Chile: III Region, Copiapó, 50–60 km S Copiapó		500–600				24.viii.1966	M.E. Irwin & E.I. Schlinger	CASC
Chile: III Region, Huasco, 30 km S Vallenar			*			16.i.1992	L.E. Peña	NHMB
Chile: IV Region, Elqui, Baños del Toro, 170 km E La Serena	natural	3000		Fabaceae: *Adesmia hystrix* Phil.	native	3.xii.1993	D. Burckhardt	MHNG
Chile: IV Region, Elqui, El Pangue, Vicuña		1800				17.xi.1987	L.E. Peña	MHNG
Chile: IV Region, Elqui, La Higuera						17.xi.1991	L.E. Peña	NHMB
Chile: IV Region, Elqui, La Serena				Solanaceae: *Solanum pinnatum* Cav.	native	ii.1996	R. Muniz	MHNG
Chile: IV Region, Elqui, ca 45 km ENE La Serena, Viñita Baja to Condoriaco	natural	800–1000	*	Solanaceae: *Lycium* sp.		19.xii.1995	D. Burckhardt	MHNG
Chile: IV Region, Elqui, ca 40 km E La Serena, 5 km SW Vinita Baja	natural	450		Solanaceae: *Lycium* sp.		19.xii.1995	D. Burckhardt	MHNG
Chile: IV Region, Elqui, Panamericana km 550, 85 km N La Serena	natural	200		Solanaceae: *Nolana* cf. *sedifolia* Poepp.	native	6.xii.1993	D. Burckhardt	MHNG
Chile: IV Region, Elqui, Panamericana km 550, 85 km N La Serena	natural	200		Solanaceae: *Solanum pinnatum* Cav.	native	6.xii.1993	D. Burckhardt	MHNG
Chile: IV Region, Elqui, Valle del Río Claro, Alcohuaz	natural	1700				20.xii.1995	D. Burckhardt	MHNG
Chile: IV Region, Elqui, 5–10 km S Vicuña	natural	750–950		Solanaceae: ?*Lycium* sp.		5.xii.1993	D. Burckhardt	MHNG
Chile: IV Region, Elqui, 16 km S Vicuña						23.x.1992	J.G. Rozen, A. Sharkov, A.J. Snyder	NHMB
Chile: IV Region, Limarí, 5 miles SW of Ovalle						12.xii.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: IV Region, Limarí, 35 miles S of Ovalle		850				01.xii.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: IV Region, Limarí, 70 miles S of Ovalle						13.xii.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: IV Region, Limarí, 31 km W of Ovalle				Asteraceae: *Xanthium spinosum* L.	native	19.ii.1985	D. Hollis	BMNH
Chile: IV Region, Limarí, Parque Nacional Fray Jorge, Quebrada de La Vaca	natural	100–200		Solanaceae: *Lycium chilense* Bertero	native	15–17.xii.1992	D. Burckhardt	NHMB
Chile: V Region, Petorca, 5 miles W of La Ligua						14.xii.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: V Region, Petorca, 10 km E of Papudo						27.xi.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: V Region, Petorca, Zapallar						15.xii.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: V Region, Quillota, S slope Bell Mountain		3000				17.xii.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: V Region, Quillota, La Campana National Park	natural	1300	*	Asteraceae: *Xanthium spinosum* L.	native	11.i.1985	D. Hollis	BMNH
Chile: V Region, Quillota, Quillota	natural	200				1.i.1994	D. Burckhardt	MHNG

locality	habitat: natural / man-made	altitude above sea level in m	samples containing immatures	plant family: species	native / introduced / cultivated	date	collector	depository / literature reference
Chile: V Region, San Felipe, 5 km N El Tártaro, 30 km N San Felipe	natural	1100				26.xii.1993	D. Burckhardt	MHNG
Chile: V Region, San Felipe de Aconcagua, El Asiento, 10 km NW San Felipe	natural	900	*	Asteraceae: *Helenium aromaticum* (Hook.) L.H.Bailey	native	13–20.i.1997	D. Burckhardt	MHNG
Chile: V Region, San Felipe de Aconcagua, Putaendo, El Tártaro, 20 km N San Felipe	natural	1100	*	Asteraceae: *Helenium aromaticum* (Hook.) L.H.Bailey	native	24.xii.1995	D. Burckhardt	MHNG
Chile: V Region, San Felipe de Aconcagua, Putaendo, 10 km N San Felipe	natural	700	*	Solanaceae: *Lycium* sp.		15.xii.1995	D. Burckhardt	MHNG
Chile: V Region, San Felipe de Aconcagua, Termas de Jahuel	natural	1000–1100				27.xii.1998	D. Burckhardt	NHMB
Chile: V Region, Valparaíso							M. Just sg.	Burckhardt (1987a)
Chile: V Region, Valparaíso, 5 miles N of Concón						16.xii.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: V Region, Valparaíso, 10 miles N of Concón		80				16.xii.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: V Region, Valparaíso, between Concón and Quintero						14.xii.1964	S. Mahunka	Burckhardt (1987a)
Chile: V Region, Valparaíso, Quintero						27.x.1966	L. Manne M.	Burckhardt (1987a)
Chile: Region Metropolitana, 10 km E Polpaico, along Panamericana	natural	150				15.xi.1992	D. Burckhardt	NHMB
Chile: Region Metropolitana, 34 km W of Santiago						19.xii.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: VI Region, Cachapoal, Rancagua						15.v.1901		MHNG
Chile: VII Region, Cauquenes						25.i.1900		MHNG
Chile: VII Region, Talca, Parque Gil de Vilches, Monumento Natural	natural	1100		Asteraceae: *Baccharis* sp.		4–5.i.1994	D. Burckhardt	MHNG
Chile: VII Region, Talca, Parque Gil de Vilches, sector Piedras blancas	natural	1350–1600		Asteraceae: *Baccharis* sp.		12.i.1996	D. Burckhardt	MHNG
Chile: VII Region, Talca, 22 miles N of Talca						22.xii.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: VIII Region, Ñuble, Chillán	man-made			Solanaceae: *Solanum tuberosum* L.	cultivated	4.i.1956	J.N. Artigas	MHNG, NHMB
Chile: VIII Region, Ñuble, Chillán				Solanaceae: *Solanum* sp.		4.i.1956	J.N. Artigas	MHNG
Chile: VIII Region, Ñuble, Las Trancas		1550				12–13.xii.1983	L.E. Peña	MHNG
Chile: VIII Region, Ñuble, nr Recinto, ca 60 km E Chillán	natural + man-made	400–600		Nothofagaceae: *Nothofagus alpina* (Poepp. & Endl.) Oerst.	native	12.xii.1990	D. Agosti & D. Burckhardt	MHNG
Chile: VIII Region, Ñuble, 18 km E of San Carlos						24.xii.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: VIII Region, Ñuble, 40 km E of San Carlos						24.xii.1950	E.S. Ross & A.E. Michelbacher	CASC
Chile: VIII Region, Ñuble, 10 km W Termas de Chillán	natural	1250		Asteraceae: *Baccharis neaei* DC.	native	12–13.xii.1990	D. Agosti & D. Burckhardt	MHNG
Chile: VIII Region, Ñuble, 10 km W Termas de Chillán	natural	1250		Escalloniaceae: *Escallonia rosea* Griseb.	native	12–13.xii.1990	D. Agosti & D. Burckhardt	MHNG
Chile: VIII Region, Ñuble, 20 km W Termas de Chillán	man-made	1000		Solanaceae: *Fabiana imbricata* Ruiz & Pav.	native	12.xii.1990	D. Agosti & D. Burckhardt	MHNG
Chile: VIII Region, Ñuble, Termas de Chillán	natural	1900–2000	*	Escalloniaceae: *Escallonia rosea* Griseb.	native	13.xii.1990	D. Agosti & D. Burckhardt	NHMB

locality	habitat: natural / man-made	altitude above sea level in m	samples containing immatures	plant family: species	native / introduced / cultivated	date	collector	depository / literature reference
Chile: VIII Region, Ñuble, Termas de Chillán	natural	1900–2000	*	Escalloniaceae: *Escallonia rosea* Griseb.	native	13.xii.1990	D. Agosti & D. Burckhardt	NHMB
Chile: VIII Region, Ñuble, Termas de Chillán	natural	1900–2000		Nothofagaceae: *Nothofagus pumilio* (Poepp. & Endl.) Krasser	native	13.xii.1990	D. Agosti & D. Burckhardt	MHNG
Chile: VIII Region, Ñuble, Termas de Chillán	natural	1900–2000		Rhamnaceae: *Discaria serratifolia* Benth. & Hook.f. ex Mast.	native	13.xii.1990	D. Agosti & D. Burckhardt	MHNG
Chile: IX Region, Malleco, Angol	man-made			Amaranthaceae: *Beta vulgaris* L.	cultivated	7.ii.1941	P.A. Berry	MHNG
Chile: IX Region, Malleco, Angol						21.xii.1924	D.S. Bullock	MHNG
Chile: IX Region, Malleco, W of Angol, Crest of Sierra Nahuelbuta Elev.		1200				3.i.1951	E.S. Ross & A.E. Michelbacher	CASC
Chile: IX Region, Malleco, Nahuelbuta National Park	natural	1100	*	Asteraceae: *Baccharis lycioides* J.Rémy	native	23.xii.1992	D. Burckhardt	NHMB
Chile: IX Region, Malleco, Nahuelbuta National Park	natural	1100	*	Asteraceae: *Baccharis zoellneri* F.H.Hellw. ssp. *minor* F.H.Hellw.	native	14–17.xii.1990	D. Agosti & D. Burckhardt	MHNG
Chile: IX Region, Malleco, Nahuelbuta National Park	natural	1300	*	Asteraceae: *Baccharis zoellneri* F.H.Hellw. ssp. *minor* F.H.Hellw.	native	16–17.xii.1990	D. Agosti & D. Burckhardt	MHNG
Chile: IX Region, Malleco, Nahuelbuta National Park	natural	1300		Solanaceae: *Solanum valdiviense* Dunal	native	16–17.xii.1990	D. Agosti & D. Burckhardt	MHNG
Chile: IX Region, Malleco, Nahuelbuta National Park, Piedra del Águila	natural	1450		Nothofagaceae: *Nothofagus antarctica* (G. Forst.) Oerst.	native	15.xii.1990	D. Agosti & D. Burckhardt	MHNG
Chile: IX Region, Malleco, Renaico						1.iv.1932	D.S. Bullock	Burckhardt (1987a)
Peru: Ancash		2853		Solanaceae: *Acnistus arborescens* (L.) Schltdl.	native	22.v.2013	D. Percy	BMNH
Peru: Ancash, Huari		2670		Solanaceae: *Nicotiana glutinosa* L.	native	26.v.2013	E. McAlister	BMNH
Peru: Arequipa				Solanaceae: *Solanum tuberosum* L.		19.xii.1957	J.L. Sánchez	Tuthill (1959)
Peru: Arequipa				Solanaceae: *Solanum tuberosum* L.		ii.1959	J.L. Sánchez	Tuthill (1959)
Peru: Arequipa, La Joya	man-made	1800–2000		Solanaceae: *Solanum tuberosum* L.	cultivated			Chávez *et al.* (2003)
Peru: Caylloma, Majes	man-made	1400–1500		Solanaceae: *Solanum tuberosum* L.	cultivated			Chávez *et al.* (2003)
Peru: Cusco, Urubamba		2900				9.vii.1971	C. & M. Vardy	BMNH
Peru: Huánuco		1850				19–20.viii.1971	C. & M. Vardy	BMNH
Peru: Lima	man-made		*	Solanaceae: *Solanum tuberosum* L.	cultivated	xii.1957	J.E. Willie	Burckhardt (1987a)
Peru: Lima, Huaral				Asteraceae: *Tagetes* sp.		12.ii.1995	C. Vergara	NHMB
Peru: Lima, Oyón, Cochamarca, 4 km N of Churín		2412		Solanaceae: *Solanum corymbosum* Jacq.	native	5.iii.2014	D. Whitmore	BMNH
Peru: Lima, Santa Eulalia			*	Solanaceae: *Datura* sp.		28.x.1958	T.D. Tuthill	BMNH / Tuthill (1959)
Peru: Mariscal de Nieto, Valle de Moquegua	man-made	1400–1600		Solanaceae: *Solanum tuberosum* L.	cultivated			Chávez *et al.* (2003)
Peru: Tacna, Valle de Tacna	man-made	500–1000		Solanaceae: *Solanum tuberosum* L.	cultivated			Chávez *et al.* (2003)
Uruguay: Brisa de la Pinta (the exact provenience of the sample is unknown)						6.xii.1943	H.L. Parker	Burckhardt (1987a)

Polyphagy in psyllids is exceptional and has been previously documented only for species from the genus *Bactericera*. Specifically, it has been documented that *Bactericera cockerelli*, *B. nigricornis* and *B. tremblayi* (Triozidae) are polyphagous (Hodkinson 1981; Liefting *et al.* 2009; Ouvrard & Burckhardt, 2012). In addition *B. antennata* (Crawford 1910), *B. bucegica* (Dobreanu & Manolache 1962) and *B. trigonica* Hodkinson 1981 are also likely polyphagous (Burckhardt & Lauterer 1997b). It is interesting to note that *Bactericera* is predominantly Holarctic (i.e. mostly Northern Hemisphere) while *Russelliana* is Neotropical (i.e. South American). Therefore, *R. solanicola* is currently the only known polyphagous species from the Southern Hemisphere and the only polyphagous species known from outside the Triozidae.

Russelliana species generally display a fairly restricted geographical distribution and often are confined to a particular type of habitat (Burckhardt 1986, 1987a, 2008; unpublished MHNG, NHMB data). In contrast, *R. solanicola*, has been collected across a large geographic region (Fig. 9) with wide latitudinal (40°0'S to 8°0'S) and altitudinal ranges (80–3800 m a. s. l.) as well as differing vegetation communities (e.g. semi-deserts, *Nothofagus* forests, pastures, citrus groves, waste places) (Table 3). The fact that most of the material from central and western Argentina, Bolivia, Chile and Peru was collected on native plants in natural habitats and that from Brazil comes exclusively from introduced or cultivated plants in man-made habitats (Table 3) strongly suggests that the species is native to the Andean region, from where most *Russelliana* spp. are known, and has been introduced into eastern Argentina, Brazil and Uruguay.

There is some evidence that *R. solanicola* is a vector of plant pathogens. Currently the species is not a major pest on potatoes but given its polyphagy and invasive nature, combined with its probable capacity to transmit plant pathogens, this species could become a serious threat to agriculture.

Acknowledgements

We thank Paul H. Arnaud (CASC) for the loan of material. We are grateful to Luis M. Bernardello and Armando T. Hunziker (Instituto Multidisciplinario de Biología Vegetal, Córdoba), Rosy M. dos Santos Isaias (Departamento de Botânica, Universidade Federal de Minas Gerais Belo Horizonte), Osmar dos Santos Ribas (Museu Botânico Municipal, Curitiba), Emilio A. Ulibarri (Instituto de Botánica Darwinion, Buenos Aires) and Eduardo Van den Berg (Universidade Federal de Lavras, Lavras) for the identification of plant specimens. Cordial thanks go to Dalva L. Queiroz, Malkie Spodek, Diana Percy and David Ouvrard for useful comments on the manuscript and stimulating discussions. DB gratefully acknowledges collecting permits of CONAF for Chile and CnPQ for Brazil. This study was partially funded by a grant of the Swiss Confederation (Federal Commission) to LS. MMS is funded by the Natural History Museum, London (BMNH) Pest Wild Relatives project within the Natural Resources Initiative.

References

Anderson, M.J., Gorley, R.N. & Clarke, K.R. (2008) PERMANOVA+ for PRIMER: guide to software and statistical methods. PRIMER-E Ltd. [Software]

Anderson, M.J. & Willis, T.J. (2003) Canonical analysis of principal coordinates: a useful method of constrained ordination for ecology. *Ecology*, 84 (2), 511–525. http://dx.doi.org/10.1890/0012-9658(2003)084[0511:CAOPCA]2.0.CO;2

Artigas, J.N. (1994) *Entomología Económica, Insectos de interés agrícola, forestal, médico y veterinario*. Ediciones Universidad de Concepción, Concepción. Chile, 1126 pp.

Bickford, D., Lohman, D.J., Sodhie, N.S., Ng, P.K.L., Meier, R., Winker, K., Ingram, K.K. & Das, I. (2007) Cryptic species as a window on diversity and conservation. *Trends in Ecology & Evolution*, 22 (3), 148–155. http://dx.doi.org/10.1016/j.tree.2006.11.004

Blair, C.P., Abrahamson, W.G., Jackman, J.A. & Tyrrell, L. (2005) Cryptic speciation and host-race formation in a purportedly generalist tumbling flower beetle. *Evolution*, 59 (2), 304–316.

Burckhardt, D. (1986) A new *Russelliana* species (Homoptera: Psyllidae) on *Adesmia* (Leguminosae). *Revista Chilena de Entomologia*, 14, 95–97.

Burckhardt, D. (1987a) Jumping plant-lice (Homoptera: Psylloidea) of the temperate Neotropical region. Part 1: Psyllidae (subfamilies Aphalarinae, Rhinocolinae and Aphalaroidinae). *Zoological Journal of the Linnean Society*, 89 (4), 299–392.

Burckhardt, D. (1987b) Jumping plant-lice (Homoptera: Psylloidea) of the temperate Neotropical region. Part 2: Psyllidae (subfamilies Diaphorininae, Acizziinae, Ciriacreminae and Psyllinae). *Zoological Journal of the Linnean Society*, 90 (2), 145–205.

Burckhardt, D. (2008) Jumping plant-lice (Hemiptera, Psylloidea) associated with *Diostea* (Verbenaceae). *Deutsche Entomologische Zeitschrift*, 55 (1), 79–89.
http://dx.doi.org/10.1002/mmnd.200800005

Burckhardt, D. & Lauterer, P. (1997a) Systematics and biology of the *Aphalara exilis* (Weber & Mohr) species assemblage (Hemiptera: Psyllidae). *Entomologica Scandinavica*, 28 (3), 271–305.

Burckhardt, D. & Lauterer, P. (1997b) A taxonomic reassessment of the triozid genus *Bactericera* (Hemiptera: Psylloidea). *Journal of Natural History*, 31 (1), 99–153.

Burckhardt, D., Ouvrard, D., Queiroz, D. & Percy, D. (2014) Psyllid host-plants (Hemiptera: Psylloidea): resolving a semantic problem. *Florida Entomologist*, 97 (1), 242–246.
http://dx.doi.org/10.1653/024.097.0132

Burckhardt, D. & Queiroz, D.L. (2012) Checklist and comments on the jumping plant-lice (Hemiptera: Psylloidea) from Brazil. *Zootaxa*, 3571, 26–48.

Chávez, R., Salazar, L., Upadhya, M., Chujoy, E., Cabello, R., Garcia, A. & Linares, J. (2003) The occurrence of genetic resistance and susceptibility to the new potato virus SB–29 among tetraploide potato populations (*Solanum tuberosum* L., 2n = 4x = 48 AAAA) in an arid agroecosystem. *IDESIA*, 21 (1), 9–22.

Clarke, K.R. (1993) Non-parametric multivariate analyses of changes in community structure. *Australian Journal of Ecology*, 18, 117–143.
http://dx.doi.org/10.1111/j.1442-9993.1993.tb00438.x

Clarke, K.R. & Gorley, R.N. (2006) PRIMER v6: User Manual/Tutorial. PRIMER-E.

Cook, M.A., Ozeroff, S.N., Fitzpatrick, S.M. & Roitberg, B.D. (2011) Host-associated differentiation in reproductive behaviour of cecidomyiid midges on cranberry and blueberry. *Entomologia Experimentalis et Applicata*, 141 (1), 8–14.
http://dx.doi.org/10.1111/j.1570-7458.2011.01166.x

Crawford, D.L. (1910) American Psyllidae I (Triozinae). *Pomona College Journal of Entomology*, 2 (4), 228–237.

Dobreanu, E. & Manolache, C. (1962) *Insecta. Homoptera Psylloidea.* Fauna Republicii Populare Romîne. Academiei Republicii Populare Romîne, Bucarest, 377 pp.

FAO (2009) *International Year of the Potato 2008*. The potato. United Nations Food and Agricultural Organisation. Available from: ftp://ftp.fao.org/docrep/fao/011/i0500e/i0500e02.pdf (accessed 30 June 2015)

Foerster, A. (1848) Uebersicht der Gattungen und Arten in der Familie der Psylloden. *Verhandlungen des naturhistorischen Vereins der preussischen Rheinlande*, 5, 65–98.

Funk, D.J. (2011) Of "host forms" and host races: terminological issues in ecological speciation. *International Journal of Ecology*, 2012, 1–8.
http://dx.doi.org/10.1155/2012/506957

Hansen, A.K., Trumble, J.T., Stouthamer, R. & Paine, T.D. (2008) New Huanglongbing (HLB) *Candidatus* species, "*C.* Liberibacter psyllaurous", found to infect tomato and potato is vectored by the psyllid *Bactericerca cockerelli* (Sulc). *Applied and Environmental Microbiology*, 74 (18), 5862–5865.

Hawkes, J.G. (1999) The economic importance of the family Solanaceae. *In:* Nee, M., Symon, D.E., Lester, R.N. & Jessop, J.P. (Eds.), *Advances in Biology and Utilization*. Publications Royal Botanic Gardens, Kew, pp. 1–8.

Hodkinson, I.D. (1981) Status and taxonomy of the *Trioza* (*Bactericera*) *nigricornis* Forster complex (Hemiptera: Triozidae). *Bulletin of Entomological Research*, 71 (4), 671–679.
http://dx.doi.org/10.1017/S0007485300010208

Hodkinson, I.D. (2009) Life cycle variation and adaptation in jumping plant lice (Insecta: Hemiptera: Psylloidea): a global synthesis. *Journal of Natural History*, 43 (1), 65–179.
http://dx.doi.org/10.1080/00222930802354167

Hollis, D. (2004) *Australian Psylloidea: jumping plant-lice and lerp insects*. Australian Biological Resources Study, Canberra, 216 pp.

Jeffries, C.J. (2006) Potato. FAO/IPGRI Technical guidelines for the safe movement of germplasm. Available from: http://pdf.usaid.gov/pdf_docs/PNACJ008.pdf (accessed 15 January 2015)

Liefting, L.W., Weir, B.S., Pennycook, S.R. & Clover, G.R.G. (2009) '*Candidatus* Liberibacter solanacearum', associated with plants in the family Solanaceae. *International Journal of Systematic and Evolutionary Microbiology*, 59, 2274–2276.
http://dx.doi.org/10.1099/ijs.0.007377-0

Linnaeus, C. (1758) *Systema naturae*. Impensis Direct. Laurentii Salvii, Stockholm, 824 pp.

Ossiannilsson, F. (1951) *On the Psyllid of the marsh marigold, Aphalara calthae (Linn.)*. Akademiska bokhandeln, Helsingfors, 8 pp.

Ouvrard, D. & Burckhardt, D. (2012). First record of the onion psyllid *Bactericera tremblayi* (Wagner, 1961) in France (Insecta: Hemiptera: Sternorrhyncha: Psylloidea), new symptoms on leek crops and reassessment of the *B. nigricornis*-group distribution. *EPPO Bulletin*, 42 (3), 585–590.
http://dx.doi.org/10.1111/epp.12005

Salazar, L.F. (2006) Emerging and re-emerging potato diseases in the Andes. *Potato Research*, 49, 43–47.
http://dx.doi.org/10.1007/s11540-006-9005-2

Seber, G.A.F. (1984) *Multivariate Observations*. J. Wiley & Sons, New York, 686 pp.

Stevens, P.F. (2001 onwards) Angiosperm Phylogeny Website. Available from: http://www.mobot.org/MOBOT/research/APweb/ (accessed 15 January 2015)

Šulc, K. (1909) *Trioza cockerelli* n. sp., novinka ze Severní Ameriky, mající i hospodářský význam. *Acta Societatis Entomologicae Bohemiae*, 1909, 102–108.

Taylor, G.S. & Kent, D.S. (2013) Potential economic pests of solanaceous crops: a new species of *Solanum*-feeding psyllid from Australia and first record from New Zealand of *Acizzia solanicola* (Hemiptera: Psyllidae). *Zootaxa*, 3613 (3), 257–273.
http://dx.doi.org/10.11646/zootaxa.3613.3.4

Tenorio, J., Chuquillanqui, C., Garcia, A., Guillén, M., Chavez, R. & Salazar, L.F. (2003) Sintomatología y efecto en el rendimiento de papa de un nuevo virus transmitido por el psílido *Russelliana solanicola*. *Fitopatología*, 38, 32–36.

The Plant List (2014) Available from: http://www.theplantlist.org/ (accessed 15 December 2014)

Tuthill, L.D. (1959) Los Psyllidae del Perú Central (Insecta: Homoptera). *Revista Peruana de Entomologia Agricola*, 2 (2), 1–27.

Tuthill, L.D. (1964) Conocimientos Adicionales sobre los Psyllidae (Homoptera) del Perú. *Revista Peruana de Entomologia*, 7 (1), 25–32.

Wagner, W. (1961) *Trioza tremblayi* eine neue Blattfloh-Art aus Italien (Homoptera-Psyllina). *Bollettino del laboratorio di entomologia agraria "Filippo Silvestri" Portici*, 19, 263–269.

APPENDIX 1. Variables (measurements in mm) used in the multivariate analysis of males.

species	GL	HW	VL	VW	AL	3AL	4AL	5AL	6AL	7AL	8AL	9AL	10AL	PFL	PTL	MFL	MTL	FL	FW	MtFL	MtTL	MP	PL	DL
sol1	0.06	0.59	0.14	0.39	0.86	0.19	0.10	0.09	0.09	0.09	0.10	0.06	0.05	0.29	0.41	0.26	0.37	1.66	0.66	0.34	0.45	0.25	0.11	0.10
sol1	0.07	0.59	0.14	0.37	1.02	0.22	0.13	0.10	0.10	0.10	0.10	0.06	0.05	0.30	0.45	0.25	0.38	1.60	0.70	0.35	0.49	0.26	0.11	0.11
sol1	0.06	0.62	0.14	0.43	0.97	0.20	0.13	0.10	0.10	0.10	0.11	0.07	0.06	0.29	0.44	0.27	0.40	1.70	0.68	0.35	0.46	0.26	0.12	0.12
sol1	0.08	0.58	0.14	0.37	0.92	0.20	0.11	0.10	0.10	0.10	0.11	0.06	0.05	0.30	0.43	0.28	0.40	1.70	0.68	0.35	0.48	0.28	0.11	0.12
sol2	0.08	0.60	0.13	0.38	0.95	0.20	0.11	0.10	0.11	0.10	0.11	0.07	0.06	0.29	0.42	0.28	0.38	1.80	0.70	0.36	0.47	0.27	0.12	0.11
sol2	0.07	0.60	0.15	0.40	0.87	0.19	0.11	0.10	0.09	0.10	0.08	0.05	0.05	0.30	0.44	0.27	0.40	1.76	0.74	0.35	0.49	0.28	0.12	0.11
sol2	0.08	0.60	0.14	0.39	0.92	0.20	0.11	0.09	0.10	0.10	0.11	0.06	0.06	0.30	0.42	0.27	0.40	1.64	0.70	0.33	0.46	0.27	0.12	0.12
sol2	0.08	0.57	0.14	0.38	0.91	0.20	0.11	0.10	0.10	0.10	0.10	0.06	0.05	0.30	0.42	0.26	0.40	1.78	0.72	0.35	0.45	0.25	0.12	0.12
sol3	0.05	0.57	0.15	0.36	0.91	0.19	0.10	0.09	0.10	0.10	0.11	0.06	0.05	0.26	0.36	0.24	0.33	1.48	0.56	0.30	0.40	0.25	0.11	0.11
sol3	0.07	0.58	0.13	0.37	0.95	0.20	0.11	0.09	0.11	0.10	0.10	0.06	0.05	0.30	0.41	0.25	0.37	1.56	0.60	0.32	0.42	0.26	0.11	0.11
sol4	0.06	0.56	0.04	0.37	0.93	0.20	0.12	0.10	0.12	0.10	0.10	0.06	0.04	0.28	0.38	0.25	0.32	1.62	0.70	0.32	0.43	0.24	0.12	0.11
sol4	0.07	0.55	0.13	0.35	0.91	0.21	0.11	0.09	0.10	0.09	0.10	0.06	0.05	0.28	0.38	0.25	0.35	1.50	0.62	0.32	0.43	0.23	0.12	0.12
sol5	0.07	0.60	0.13	0.40	0.94	0.20	0.11	0.10	0.10	0.10	0.10	0.06	0.05	0.29	0.40	0.27	0.36	1.70	0.72	0.35	0.44	0.27	0.13	0.11
sol5	0.07	0.58	0.12	0.38	0.91	0.17	0.10	0.08	0.10	0.11	0.11	0.06	0.05	0.25	0.40	0.26	0.38	1.64	0.70	0.33	0.44	0.25	0.11	0.11
sol5	0.06	0.59	0.13	0.37	0.94	0.20	0.11	0.10	0.11	0.10	0.11	0.05	0.04	0.30	0.40	0.25	0.39	1.56	0.62	0.34	0.42	0.25	0.11	0.11
sol5	0.05	0.56	0.13	0.36	0.90	0.20	0.20	0.09	0.10	0.09	0.10	0.06	0.05	0.29	0.37	0.25	0.35	1.52	0.56	0.33	0.40	0.24	0.12	0.12
sol8	0.07	0.56	0.15	0.35	0.92	0.17	0.12	0.10	0.11	0.10	0.10	0.06	0.05	0.29	0.40	0.24	0.35	1.50	0.56	0.31	0.40	0.25	0.11	0.11
sol8	0.06	0.55	0.13	0.37	0.82	0.16	0.10	0.08	0.09	0.08	0.09	0.06	0.05	0.25	0.35	0.24	0.32	1.48	0.58	0.31	0.40	0.25	0.11	0.11
sol8	0.06	0.57	0.14	0.35	0.93	0.20	0.11	0.10	0.10	0.10	0.10	0.06	0.05	0.28	0.37	0.25	0.35	1.44	0.56	0.30	0.40	0.23	0.11	0.11
sol8	0.07	0.58	0.14	0.39	0.89	0.18	0.11	0.10	0.10	0.09	0.10	0.06	0.05	0.28	0.40	0.26	0.36	1.50	0.62	0.34	0.43	0.25	0.11	0.11
sol8	0.06	0.55	0.13	0.35	0.87	0.20	0.10	0.08	0.10	0.10	0.10	0.06	0.05	0.26	0.35	0.25	0.36	1.48	0.56	0.32	0.40	0.24	0.11	0.11
sol9	0.06	0.57	0.15	0.36	0.87	0.21	0.12	0.09	0.10	0.10	0.10	0.05	0.04	0.33	0.42	0.27	0.38	1.48	0.66	0.33	0.45	0.26	0.13	0.11
sol9	0.05	0.55	0.13	0.35	0.91	0.21	0.12	0.09	0.10	0.10	0.10	0.05	0.04	0.30	0.43	0.26	0.39	1.62	0.60	0.35	0.45	0.25	0.11	0.11
sol9	0.06	0.56	0.15	0.34	0.90	0.20	0.11	0.09	0.10	0.09	0.10	0.05	0.05	0.30	0.45	0.28	0.39	1.60	0.66	0.36	0.48	0.27	0.12	0.11
sol10	0.05	0.53	0.13	0.33	0.86	0.20	0.12	0.09	0.10	0.09	0.09	0.05	0.04	0.29	0.42	0.25	0.40	1.56	0.64	0.31	0.44	0.25	0.11	0.11
sol12	0.08	0.57	0.13	0.35	0.72	0.15	0.10	0.08	0.10	0.10	0.09	0.04	0.03	0.30	0.36	0.27	0.38	1.72	0.78	0.35	0.49	0.25	0.10	0.10
sol13	0.07	0.63	0.14	0.37	0.85	0.18	0.10	0.08	0.10	0.10	0.10	0.06	0.03	0.31	0.48	0.29	0.43	1.56	0.66	0.35	0.50	0.25	0.12	0.10
sol13	0.07	0.63	0.14	0.39	0.84	0.18	0.10	0.08	0.10	0.10	0.09	0.05	0.03	0.29	0.43	0.27	0.42	1.50	0.60	0.35	0.50	0.25	0.12	0.09
sol14	0.06	0.51	0.13	0.30	0.78	0.19	0.10	0.07	0.08	0.08	0.08	0.05	0.04	0.25	0.33	0.22	0.30	1.22	0.48	0.28	0.37	0.22	0.10	0.11

......continued on the next page

species	GL	HW	VL	VW	AL	3AL	4AL	5AL	6AL	7AL	8AL	9AL	10AL	PFL	PTL	MFL	MTL	FL	FW	MtFL	MtTL	MP	PL	DL
sol14	0.05	0.52	0.13	0.35	0.76	0.16	0.09	0.08	0.08	0.07	0.09	0.05	0.04	0.25	0.35	0.24	0.32	1.36	0.58	0.29	0.39	0.25	0.10	0.10
sol14	0.06	0.53	0.12	0.36	0.80	0.19	0.12	0.10	0.10	0.09	0.09	0.05	0.04	0.25	0.36	0.25	0.33	1.32	0.56	0.31	0.40	0.23	0.10	0.10
sol16	0.08	0.65	0.14	0.41	0.96	0.21	0.12	0.11	0.10	0.11	0.10	0.05	0.04	0.27	0.43	0.27	0.44	1.56	0.70	0.35	0.52	0.27	0.13	0.12
sol16	0.06	0.61	0.14	0.37	0.81	0.20	0.10	0.09	0.09	0.09	0.09	0.04	0.03	0.30	0.45	0.26	0.40	1.44	0.62	0.32	0.47	0.25	0.12	0.12
sol16	0.07	0.57	0.13	0.36	0.75	0.15	0.09	0.08	0.08	0.09	0.09	0.04	0.03	0.25	0.36	0.23	0.34	1.48	0.64	0.30	0.44	0.24	0.12	0.09
sol21	0.08	0.59	0.16	0.35	0.96	0.21	0.11	0.10	0.10	0.10	0.10	0.05	0.05	0.27	0.42	0.25	0.39	1.63	0.68	0.35	0.47	0.25	0.11	0.12
sol21	0.08	0.54	0.15	0.34	0.85	0.17	0.10	0.08	0.10	0.09	0.10	0.06	0.04	0.26	0.37	0.23	0.32	1.38	0.55	0.30	0.38	0.23	0.11	0.12
sol23	0.08	0.59	0.18	0.36	0.93	0.20	0.12	0.10	0.10	0.10	0.10	0.06	0.04	0.30	0.42	0.27	0.40	1.70	0.70	0.36	0.46	0.24	0.13	0.12
sol24	0.08	0.56	0.15	0.36	0.94	0.19	0.12	0.10	0.11	0.10	0.11	0.06	0.05	0.30	0.43	0.27	0.40	1.78	0.73	0.36	0.48	0.26	0.12	0.12
sol25	0.08	0.60	0.18	0.38	0.86	0.20	0.10	0.09	0.09	0.09	0.09	0.06	0.05	0.28	0.42	0.25	0.37	1.65	0.68	0.35	0.46	0.25	0.11	0.11
sol26	0.07	0.55	0.16	0.36	0.93	0.20	0.11	0.09	0.10	0.10	0.10	0.06	0.04	0.28	0.39	0.26	0.37	1.52	0.60	0.34	0.44	0.24	0.12	0.11
sol26	0.08	0.58	0.17	0.35	0.94	0.18	0.12	0.08	0.10	0.11	0.10	0.06	0.04	0.28	0.39	0.26	0.36	1.60	0.70	0.34	0.43	0.24	0.11	0.11
sol26	0.07	0.54	0.15	0.36	0.77	0.17	0.10	0.08	0.07	0.07	0.07	0.05	0.02	0.26	0.36	0.25	0.36	1.44	0.64	0.33	0.43	0.26	0.12	0.11
sol26	0.07	0.53	0.16	0.35	0.82	0.18	0.10	0.08	0.09	0.08	0.10	0.05	0.04	0.21	0.37	0.24	0.36	1.46	0.58	0.31	0.42	0.24	0.12	0.11
sol26	0.07	0.55	0.15	0.39	0.83	0.19	0.10	0.08	0.09	0.08	0.08	0.05	0.04	0.28	0.39	0.25	0.37	1.52	0.62	0.32	0.44	0.25	0.11	0.11
sol26	0.07	0.56	0.16	0.39	0.79	0.15	0.10	0.08	0.08	0.08	0.08	0.05	0.04	0.27	0.37	0.26	0.34	1.48	0.62	0.32	0.42	0.25	0.12	0.12
sol26	0.06	0.56	0.15	0.37	0.87	0.18	0.10	0.08	0.10	0.09	0.09	0.05	0.04	0.29	0.40	0.26	0.36	1.52	0.66	0.34	0.44	0.24	0.11	0.11
sol26	0.07	0.54	0.15	0.36	0.87	0.17	0.10	0.09	0.10	0.09	0.10	0.06	0.05	0.29	0.40	0.26	0.37	1.48	0.62	0.32	0.44	0.25	0.11	0.10
ade	0.09	0.60	0.17	0.37	0.79	0.19	0.09	0.06	0.07	0.06	0.07	0.05	0.04	0.29	0.38	0.24	0.37	1.63	0.75	0.32	0.41	0.24	0.12	0.11
ade	0.09	0.62	0.16	0.38	0.85	0.20	0.10	0.07	0.08	0.07	0.09	0.06	0.05	0.28	0.41	0.25	0.38	1.65	0.75	0.34	0.40	0.25	0.14	0.11
ade	0.09	0.62	0.16	0.38	0.80	0.18	0.10	0.06	0.07	0.05	0.08	0.06	0.04	0.29	0.41	0.26	0.36	1.70	0.75	0.34	0.42	0.24	0.13	0.12
adu	0.14	0.74	0.19	0.45	0.97	0.22	0.13	0.10	0.11	0.11	0.11	0.05	0.04	0.35	0.46	0.29	0.40	1.93	0.80	0.35	0.50	0.38	0.14	0.12
bul	0.16	0.75	0.20	0.45	0.88	0.18	0.10	0.07	0.09	0.09	0.11	0.06	0.04	0.34	0.45	0.29	0.42	1.80	0.75	0.40	0.43	0.30	0.11	0.17
bul	0.16	0.74	0.20	0.44	0.84	0.18	0.09	0.08	0.08	0.08	0.09	0.05	0.04	0.32	0.42	0.26	0.39	1.85	0.80	0.38	0.42	0.30	0.11	0.17
bul	0.15	0.73	0.20	0.43	0.84	0.16	0.10	0.06	0.08	0.08	0.09	0.06	0.03	0.33	0.42	0.29	0.40	1.70	0.75	0.40	0.42	0.31	0.11	0.18
chi	0.12	0.72	0.20	0.45	0.88	0.18	0.07	0.07	0.07	0.08	0.08	0.07	0.05	0.32	0.48	0.31	0.43	1.90	0.78	0.38	0.47	0.31	0.20	0.15
dis	0.14	0.73	0.20	0.50	1.19	0.26	0.15	0.13	0.14	0.14	0.14	0.06	0.05	0.40	0.50	0.32	0.48	2.13	0.88	0.41	0.60	0.26	0.14	0.15
dis	0.14	0.75	0.20	0.46	1.15	0.25	0.15	0.12	0.11	0.11	0.11	0.05	0.04	0.40	0.51	0.34	0.47	2.03	0.85	0.41	0.55	0.25	0.14	0.15
fab	0.10	0.79	0.21	0.48	0.90	0.22	0.10	0.07	0.08	0.07	0.09	0.06	0.04	0.36	0.48	0.30	0.44	1.88	0.83	0.41	0.49	0.32	0.18	0.18
fab	0.10	0.79	0.20	0.47	0.88	0.22	0.09	0.07	0.07	0.08	0.09	0.05	0.04	0.35	0.47	0.30	0.43	1.88	0.83	0.41	0.50	0.31	0.19	0.18
fab	0.11	0.79	0.21	0.49	0.90	0.20	0.09	0.07	0.08	0.08	0.08	0.06	0.05	0.36	0.50	0.30	0.45	1.90	0.83	0.41	0.50	0.34	0.19	0.17

......*continued on the next page*

species	GL	HW	VL	VW	AL	3AL	4AL	5AL	6AL	7AL	8AL	9AL	10AL	PFL	PTL	MFL	MTL	FL	FW	MtFL	MtTL	MP	PL	DL
fab	0.11	0.76	0.20	0.47	0.84	0.21	0.09	0.07	0.08	0.07	0.08	0.06	0.04	0.35	0.45	0.29	0.41	1.80	0.80	0.41	0.46	0.33	0.18	0.18
int	0.13	0.60	0.17	0.37	0.85	0.21	0.11	0.08	0.09	0.06	0.09	0.05	0.04	0.29	0.39	0.24	0.35	1.70	0.75	0.31	0.40	0.22	0.11	0.12
int	0.12	0.57	0.17	0.34	0.76	0.17	0.09	0.07	0.08	0.06	0.07	0.06	0.04	0.28	0.35	0.23	0.32	1.58	0.68	0.30	0.35	0.23	0.11	0.12
mac	0.13	0.71	0.19	0.44	1.02	0.23	0.12	0.09	0.10	0.09	0.10	0.07	0.05	0.35	0.47	0.29	0.44	2.00	0.80	0.40	0.51	0.32	0.20	0.12
mac	0.10	0.67	0.20	0.45	0.95	0.21	0.12	0.09	0.10	0.08	0.08	0.06	0.04	0.31	0.41	0.27	0.39	1.75	0.78	0.36	0.47	0.30	0.20	0.13
mac	0.10	0.65	0.20	0.45	0.95	0.23	0.12	0.09	0.09	0.08	0.08	0.05	0.04	0.32	0.43	0.29	0.41	1.73	0.75	0.39	0.49	0.30	0.18	0.12
mac	0.09	0.65	0.20	0.43	0.89	0.19	0.11	0.08	0.08	0.08	0.09	0.05	0.04	0.30	0.42	0.28	0.40	1.73	0.75	0.38	0.46	0.30	0.19	0.13
mar	0.15	0.72	0.19	0.42	1.43	0.33	0.22	0.16	0.15	0.15	0.15	0.06	0.04	0.43	0.56	0.37	0.55	2.20	0.75	0.47	0.56	0.33	0.19	0.15
mar	0.15	0.72	0.21	0.42	1.52	0.36	0.23	0.18	0.16	0.15	0.14	0.06	0.04	0.42	0.57	0.35	0.53	2.20	0.78	0.46	0.56	0.35	0.20	0.17
nig	0.10	0.66	0.18	0.41	0.89	0.20	0.11	0.08	0.09	0.08	0.10	0.06	0.04	0.31	0.40	0.27	0.37	1.75	0.73	0.35	0.46	0.23	0.11	0.12
nig	0.09	0.66	0.18	0.42	0.88	0.20	0.10	0.07	0.08	0.09	0.10	0.06	0.04	0.30	0.40	0.27	0.38	1.75	0.73	0.35	0.45	0.22	0.11	0.12
pun	0.15	0.78	0.20	0.50	1.02	0.21	0.12	0.10	0.11	0.10	0.10	0.06	0.04	0.35	0.47	0.31	0.44	2.05	0.85	0.40	0.50	0.34	0.17	0.10
pun	0.14	0.75	0.20	0.46	1.04	0.23	0.13	0.10	0.11	0.09	0.10	0.06	0.04	0.36	0.47	0.33	0.42	2.10	0.88	0.41	0.52	0.36	0.18	0.10
seb	0.13	0.89	0.25	0.54	1.48	0.30	0.20	0.16	0.18	0.18	0.19	0.06	0.03	0.41	0.49	0.35	0.48	1.70	0.63	0.46	0.38	0.27	0.12	0.10
seb	0.12	0.86	0.24	0.52	1.44	0.30	0.20	0.15	0.17	0.18	0.18	0.06	0.03	0.40	0.46	0.34	0.46	1.73	0.65	0.43	0.37	0.27	0.12	0.10
sim	0.12	0.71	0.23	0.47	1.07	0.25	0.12	0.10	0.10	0.10	0.12	0.06	0.04	0.37	0.48	0.34	0.45	1.95	0.78	0.39	0.46	0.30	0.16	0.14
sim	0.15	0.76	0.22	0.50	1.13	0.23	0.14	0.11	0.13	0.12	0.11	0.07	0.04	0.38	0.50	0.34	0.48	1.98	0.80	0.39	0.49	0.29	0.16	0.15
sim	0.13	0.71	0.22	0.50	1.10	0.23	0.15	0.10	0.11	0.11	0.12	0.07	0.05	0.38	0.50	0.33	0.47	1.98	0.83	0.40	0.50	0.28	0.16	0.15
sim	0.14	0.73	0.22	0.48	1.09	0.23	0.12	0.10	0.11	0.11	0.13	0.07	0.04	0.40	0.52	0.36	0.51	2.05	0.78	0.40	0.50	0.29	0.15	0.14
the	0.17	0.64	0.20	0.40	1.05	0.20	0.13	0.11	0.13	0.11	0.12	0.06	0.04	0.40	0.51	0.32	0.50	1.78	0.70	0.41	0.48	0.30	0.21	0.16
the	0.20	0.66	0.20	0.40	1.08	0.22	0.15	0.11	0.13	0.11	0.11	0.06	0.04	0.40	0.53	0.34	0.51	1.85	0.68	0.41	0.45	0.33	0.20	0.17
the	0.19	0.66	0.18	0.40	1.10	0.22	0.14	0.12	0.13	0.13	0.13	0.06	0.04	0.40	0.55	0.35	0.52	1.85	0.68	0.45	0.50	0.32	0.20	0.17
vin	0.12	0.74	0.20	0.46	1.10	0.25	0.13	0.11	0.11	0.11	0.11	0.06	0.05	0.38	0.48	0.33	0.45	1.88	0.83	0.42	0.55	0.28	0.19	0.11
vin	0.09	0.67	0.20	0.43	0.94	0.22	0.11	0.08	0.10	0.10	0.10	0.07	0.04	0.33	0.43	0.29	0.40	1.58	0.70	0.38	0.48	0.26	0.16	0.13
vin	0.11	0.69	0.20	0.44	0.96	0.22	0.12	0.08	0.10	0.10	0.11	0.07	0.04	0.33	0.44	0.30	0.40	1.60	0.70	0.37	0.47	0.26	0.17	0.13
adu1	0.09	0.67	0.15	0.41	0.95	0.20	0.13	0.11	0.11	0.11	0.10	0.06	0.05	0.34	0.45	0.30	0.40	1.78	0.70	0.35	0.42	0.30	0.13	0.11
adu1	0.09	0.68	0.15	0.44	0.83	0.19	0.09	0.09	0.09	0.09	0.08	0.05	0.04	0.34	0.42	0.30	0.40	1.80	0.74	0.37	0.44	0.30	0.14	0.11
adu1	0.08	0.66	0.15	0.41	0.85	0.19	0.11	0.10	0.10	0.10	0.09	0.05	0.03	0.33	0.40	0.27	0.37	1.66	0.70	0.34	0.41	0.28	0.13	0.12
adu1	0.10	0.61	0.14	0.39	0.81	0.18	0.11	0.10	0.10	0.10	0.08	0.04	0.03	0.30	0.40	0.25	0.39	1.80	0.78	0.33	0.44	0.27	0.12	0.11

APPENDIX 2. Variables (measurements in mm) used in the multivariate analysis of females.

species	GL	HW	VL	VW	AL	3AL	4AL	5AL	6AL	7AL	8AL	9AL	10AL	PFL	PTL	MFL	MTL	FL	FW	MtFL	MtTL	FP	SP
sol1	0.08	0.65	0.16	0.42	0.96	0.22	0.12	0.08	0.10	0.10	0.10	0.06	0.05	0.31	0.43	0.27	0.38	1.96	0.82	0.37	0.49	0.39	0.23
sol1	0.06	0.60	0.13	0.39	0.96	0.18	0.11	0.09	0.11	0.10	0.11	0.07	0.06	0.30	0.39	0.28	0.35	1.68	0.74	0.36	0.44	0.34	0.20
sol1	0.08	0.61	0.14	0.38	0.97	0.20	0.11	0.10	0.10	0.10	0.11	0.06	0.05	0.30	0.43	0.30	0.40	1.80	0.74	0.38	0.49	0.35	0.21
sol1	0.07	0.65	0.14	0.43	0.91	0.20	0.11	0.09	0.10	0.10	0.10	0.06	0.05	0.29	0.42	0.26	0.39	1.76	0.76	0.35	0.45	0.35	0.20
sol1	0.07	0.63	0.14	0.42	1.03	0.20	0.14	0.10	0.13	0.12	0.12	0.07	0.06	0.34	0.46	0.30	0.40	1.86	0.80	0.39	0.48	0.39	0.18
sol2	0.08	0.60	0.14	0.38	0.85	0.17	0.10	0.08	0.10	0.09	0.08	0.06	0.05	0.29	0.39	0.26	0.38	1.84	0.72	0.35	0.43	0.35	0.19
sol2	0.07	0.68	0.13	0.48	1.03	0.19	0.14	0.10	0.10	0.12	0.12	0.06	0.05	0.33	0.50	0.28	0.45	2.14	0.92	0.40	0.48	0.38	0.25
sol2	0.08	0.63	0.14	0.40	1.00	0.20	0.12	0.11	0.11	0.11	0.11	0.06	0.05	0.30	0.41	0.29	0.39	1.90	0.80	0.36	0.47	0.35	0.19
sol2	0.08	0.63	0.14	0.41	0.93	0.20	0.11	0.09	0.10	0.10	0.10	0.06	0.05	0.30	0.42	0.30	0.40	1.84	0.78	0.37	0.46	0.37	0.20
sol2	0.08	0.65	0.13	0.44	0.98	0.21	0.13	0.09	0.10	0.10	0.10	0.06	0.05	0.32	0.45	0.30	0.41	1.90	0.80	0.38	0.48	0.38	0.20
sol3	0.06	0.61	0.14	0.39	0.93	0.19	0.11	0.10	0.10	0.11	0.11	0.06	0.05	0.28	0.40	0.25	0.36	1.76	0.76	0.35	0.42	0.33	0.20
sol3	0.06	0.64	0.15	0.45	0.89	0.20	0.11	0.08	0.10	0.09	0.09	0.06	0.05	0.26	0.40	0.25	0.35	1.70	0.76	0.35	0.45	0.34	0.18
sol4	0.07	0.61	0.14	0.40	0.93	0.20	0.10	0.08	0.10	0.10	0.11	0.06	0.05	0.30	0.37	0.29	0.34	1.84	0.82	0.34	0.39	0.35	0.16
sol4	0.07	0.58	0.14	0.37	0.95	0.18	0.10	0.08	0.09	0.08	0.10	0.06	0.05	0.27	0.36	0.25	0.35	1.66	0.70	0.33	0.41	0.35	0.18
sol4	0.07	0.62	0.14	0.40	1.08	0.21	0.12	0.10	0.12	0.12	0.13	0.06	0.05	0.31	0.42	0.28	0.39	1.88	0.78	0.38	0.46	0.37	0.15
sol4	0.07	0.59	0.14	0.39	0.91	0.19	0.12	0.10	0.10	0.10	0.10	0.06	0.05	0.30	0.39	0.28	0.35	1.84	0.84	0.35	0.41	0.34	0.20
sol5	0.09	0.64	0.14	0.40	0.97	0.20	0.12	0.10	0.10	0.11	0.11	0.06	0.05	0.30	0.42	0.28	0.37	1.84	0.80	0.37	0.45	0.33	0.18
sol5	0.08	0.63	0.14	0.40	0.96	0.21	0.13	0.10	0.10	0.09	0.10	0.06	0.05	0.30	0.40	0.28	0.38	1.90	0.82	0.37	0.44	0.33	0.20
sol5	0.07	0.60	0.14	0.40	0.87	0.17	0.11	0.08	0.10	0.09	0.10	0.06	0.05	0.28	0.38	0.25	0.35	1.80	0.82	0.35	0.43	0.36	0.17
sol5	0.07	0.60	0.14	0.40	0.92	0.19	0.12	0.10	0.10	0.10	0.10	0.06	0.05	0.30	0.40	0.28	0.39	1.72	0.62	0.36	0.45	0.37	0.18
sol7	0.08	0.62	0.13	0.40	0.91	0.17	0.10	0.08	0.11	0.10	0.11	0.07	0.05	0.29	0.40	0.23	0.38	1.80	0.70	0.34	0.44	0.32	0.17
sol8	0.07	0.60	0.14	0.40	0.83	0.18	0.10	0.07	0.09	0.08	0.09	0.06	0.05	0.27	0.36	0.27	0.34	1.66	0.68	0.34	0.41	0.35	0.19
sol8	0.05	0.59	0.15	0.40	0.91	0.20	0.12	0.08	0.10	0.10	0.10	0.06	0.05	0.28	0.38	0.26	0.35	1.66	0.72	0.35	0.41	0.34	0.20
sol8	0.07	0.56	0.13	0.38	0.96	0.20	0.13	0.10	0.11	0.11	0.11	0.06	0.05	0.28	0.41	0.28	0.38	1.74	0.70	0.36	0.45	0.31	0.18
sol8	0.06	0.58	0.14	0.38	0.89	0.17	0.11	0.09	0.10	0.10	0.10	0.06	0.05	0.27	0.38	0.31	0.34	1.60	0.66	0.32	0.41	0.35	0.18
sol8	0.08	0.61	0.14	0.40	0.91	0.19	0.10	0.10	0.11	0.10	0.10	0.06	0.05	0.30	0.40	0.28	0.38	1.72	0.72	0.36	0.45	0.32	0.20
sol9	0.07	0.62	0.15	0.45	0.95	0.22	0.12	0.10	0.10	0.09	0.09	0.06	0.04	0.30	0.42	0.25	0.37	1.90	0.80	0.35	0.45	0.38	0.20
sol10	0.06	0.54	0.15	0.35	0.85	0.20	0.11	0.09	0.10	0.10	0.10	0.06	0.05	0.26	0.37	0.25	0.35	1.64	0.70	0.33	0.39	0.32	0.16
sol10	0.06	0.53	0.14	0.33	0.86	0.17	0.11	0.08	0.10	0.10	0.10	0.05	0.05	0.28	0.40	0.25	0.38	1.68	0.68	0.32	0.43	0.32	0.17
sol12	0.08	0.61	0.14	0.41	0.83	0.16	0.10	0.08	0.09	0.10	0.10	0.05	0.03	0.28	0.38	0.27	0.40	1.82	0.84	0.33	0.45	0.28	0.15

......continued on the next page

species	GL	HW	VL	VW	AL	3AL	4AL	5AL	6AL	7AL	8AL	9AL	10AL	PFL	PTL	MFL	MTL	FL	FW	MtFL	MtTL	FP	SP
sol12	0.08	0.60	0.13	0.45	0.80	0.16	0.10	0.17	0.10	0.09	0.09	0.05	0.03	0.30	0.37	0.24	0.34	1.86	0.86	0.35	0.45	0.25	0.15
sol12	0.08	0.64	0.14	0.46	0.79	0.15	0.09	0.08	0.08	0.09	0.10	0.05	0.03	0.30	0.41	0.27	0.40	1.90	0.90	0.25	0.47	0.26	0.12
sol13	0.07	0.67	0.14	0.41	0.92	0.20	0.13	0.07	0.10	0.10	0.10	0.05	0.03	0.30	0.50	0.30	0.46	1.82	0.80	0.35	0.52	0.36	0.17
sol13	0.07	0.66	0.15	0.42	0.82	0.19	0.12	0.10	0.10	0.10	0.09	0.05	0.03	0.31	0.42	0.30	0.45	1.90	0.80	0.36	0.49	0.37	0.15
sol13	0.08	0.63	0.16	0.40	0.85	0.20	0.12	0.09	0.10	0.09	0.09	0.05	0.03	0.30	0.43	0.27	0.44	1.86	0.80	0.35	0.50	0.36	0.14
sol13	0.08	0.57	0.14	0.35	0.88	0.20	0.11	0.09	0.09	0.09	0.09	0.05	0.04	0.30	0.43	0.28	0.40	1.72	0.72	0.35	0.50	0.36	0.15
sol13	0.07	0.64	0.14	0.41	0.81	0.20	0.12	0.09	0.10	0.09	0.10	0.05	0.03	0.31	0.46	0.31	0.44	1.64	0.72	0.36	0.51	0.38	0.16
sol14	0.07	0.55	0.15	0.34	0.76	0.19	0.10	0.09	0.08	0.08	0.07	0.05	0.04	0.26	0.35	0.22	0.32	1.60	0.66	0.31	0.39	0.31	0.17
sol14	0.06	0.54	0.13	0.34	0.82	0.18	0.09	0.08	0.10	0.09	0.10	0.06	0.04	0.25	0.35	0.23	0.31	1.50	0.64	0.30	0.38	0.33	0.17
sol16	0.08	0.66	0.14	0.36	0.90	0.22	0.12	0.11	0.10	0.10	0.10	0.05	0.03	0.31	0.45	0.30	0.45	1.72	0.76	0.37	0.52	0.37	0.15
sol16	0.09	0.64	0.15	0.40	0.93	0.22	0.15	0.10	0.11	0.10	0.08	0.04	0.03	0.34	0.45	0.30	0.42	1.76	0.76	0.38	0.52	0.40	0.17
sol16	0.08	0.65	0.15	0.40	0.98	0.24	0.12	0.10	0.10	0.09	0.09	0.04	0.03	0.30	0.45	0.29	0.40	1.76	0.78	0.40	0.53	0.40	0.17
sol17	0.08	0.67	0.15	0.39	0.94	0.21	0.13	0.10	0.11	0.10	0.10	0.05	0.03	0.33	0.49	0.28	0.47	1.70	0.72	0.40	0.56	0.40	0.15
sol17	0.08	0.62	0.14	0.37	0.87	0.21	0.12	0.09	0.09	0.09	0.09	0.05	0.03	0.30	0.42	0.28	0.41	1.62	0.70	0.36	0.52	0.38	0.16
sol18	0.05	0.59	0.14	0.40	0.90	0.20	0.10	0.08	0.09	0.09	0.09	0.05	0.04	0.30	0.38	0.25	0.35	1.66	0.70	0.37	0.42	0.38	0.18
sol21	0.09	0.59	0.16	0.39	0.93	0.18	0.12	0.09	0.11	0.10	0.11	0.06	0.04	0.27	0.39	0.26	0.36	1.63	0.68	0.34	0.42	0.35	0.17
sol21	0.09	0.59	0.16	0.36	0.88	0.18	0.10	0.08	0.09	0.10	0.10	0.06	0.05	0.28	0.40	0.27	0.38	1.75	0.75	0.35	0.43	0.37	0.18
sol26	0.07	0.56	0.16	0.37	0.82	0.19	0.10	0.08	0.08	0.08	0.08	0.06	0.04	0.26	0.37	0.26	0.35	1.56	0.66	0.34	0.41	0.31	0.18
sol26	0.08	0.58	0.16	0.39	0.95	0.19	0.12	0.10	0.11	0.10	0.11	0.05	0.04	0.29	0.42	0.27	0.39	1.82	0.74	0.35	0.44	0.35	0.18
sol26	0.08	0.58	0.16	0.37	0.88	0.19	0.11	0.09	0.10	0.09	0.08	0.05	0.04	0.28	0.41	0.28	0.38	1.66	0.76	0.36	0.44	0.35	0.19
sol26	0.07	0.56	0.18	0.36	0.84	0.17	0.10	0.10	0.08	0.09	0.08	0.06	0.04	0.26	0.36	0.25	0.34	1.70	0.78	0.33	0.40	0.34	0.16
sol26	0.07	0.57	0.16	0.37	0.90	0.17	0.10	0.10	0.10	0.10	0.10	0.06	0.04	0.30	0.40	0.27	0.36	1.80	0.76	0.36	0.44	0.31	0.20
sol26	0.07	0.56	0.15	0.41	0.87	0.19	0.11	0.09	0.11	0.09	0.10	0.05	0.04	0.27	0.37	0.26	0.35	1.68	0.74	0.36	0.42	0.35	0.17
sol26	0.08	0.59	0.16	0.38	0.85	0.18	0.11	0.09	0.10	0.10	0.09	0.05	0.04	0.29	0.41	0.26	0.37	1.86	0.78	0.35	0.44	0.36	0.17
sol26	0.06	0.56	0.15	0.37	0.81	0.16	0.10	0.08	0.09	0.09	0.10	0.06	0.04	0.27	0.38	0.26	0.37	1.68	0.72	0.34	0.43	0.33	0.18
ade	0.09	0.59	0.16	0.37	0.70	0.16	0.08	0.05	0.06	0.05	0.06	0.05	0.04	0.25	0.33	0.23	0.34	1.73	0.78	0.31	0.39	0.34	0.15
ade	0.09	0.61	0.16	0.38	0.72	0.18	0.08	0.06	0.07	0.05	0.07	0.05	0.04	0.27	0.37	0.25	0.34	1.78	0.83	0.34	0.42	0.34	0.15
ade	0.09	0.60	0.16	0.39	0.69	0.16	0.08	0.05	0.06	0.05	0.06	0.05	0.04	0.26	0.34	0.23	0.33	1.68	0.75	0.32	0.38	0.32	0.13
adu	0.14	0.74	0.23	0.49	1.17	0.27	0.14	0.11	0.12	0.13	0.13	0.06	0.05	0.40	0.54	0.35	0.49	2.25	0.95	0.44	0.55	0.51	0.26
bul	0.16	0.78	0.21	0.48	0.86	0.18	0.08	0.07	0.08	0.09	0.11	0.05	0.03	0.35	0.45	0.29	0.43	2.08	0.88	0.43	0.45	0.38	0.21
bul	0.16	0.77	0.21	0.46	0.85	0.18	0.09	0.07	0.08	0.08	0.09	0.05	0.03	0.33	0.42	0.29	0.39	2.08	0.90	0.40	0.41	0.40	0.20

......continued on the next page

species	GL	HW	VL	VW	AL	3AL	4AL	5AL	6AL	7AL	8AL	9AL	10AL	PFL	PTL	MFL	MTL	FL	FW	MtFL	MtTL	FP	SP
dio	0.16	1.00	0.26	0.58	1.48	0.33	0.18	0.15	0.17	0.15	0.18	0.06	0.04	0.42	0.51	0.31	0.45	2.35	1.03	0.52	0.45	0.45	0.20
dis	0.14	0.76	0.20	0.46	1.06	0.21	0.13	0.12	0.11	0.11	0.10	0.05	0.04	0.35	0.48	0.33	0.44	2.20	0.90	0.41	0.55	0.39	0.16
dis	0.16	0.77	0.20	0.50	1.19	0.24	0.15	0.14	0.14	0.13	0.13	0.05	0.04	0.38	0.49	0.32	0.49	2.35	0.98	0.42	0.56	0.39	0.16
dis	0.15	0.77	0.20	0.46	1.11	0.25	0.15	0.10	0.12	0.12	0.12	0.05	0.04	0.38	0.51	0.32	0.49	2.35	0.98	0.41	0.59	0.39	0.18
fab	0.12	0.81	0.22	0.49	0.83	0.21	0.08	0.07	0.07	0.06	0.09	0.05	0.04	0.33	0.45	0.30	0.40	2.03	0.93	0.44	0.48	0.47	0.25
fab	0.12	0.80	0.23	0.49	0.84	0.19	0.08	0.07	0.07	0.07	0.08	0.06	0.05	0.34	0.46	0.31	0.43	2.00	0.88	0.45	0.47	0.47	0.25
fab	0.11	0.80	0.22	0.50	0.84	0.19	0.08	0.06	0.07	0.07	0.09	0.06	0.04	0.34	0.45	0.30	0.42	1.95	0.90	0.43	0.48	0.48	0.24
fab	0.11	0.80	0.23	0.49	0.82	0.19	0.08	0.07	0.08	0.07	0.09	0.06	0.04	0.34	0.44	0.30	0.42	1.90	0.88	0.43	0.47	0.45	0.26
fab	0.11	0.80	0.22	0.49	0.81	0.21	0.07	0.06	0.07	0.06	0.09	0.06	0.04	0.34	0.44	0.29	0.41	1.98	0.88	0.43	0.48	0.46	0.24
int	0.15	0.65	0.19	0.43	0.82	0.18	0.09	0.07	0.07	0.08	0.09	0.05	0.04	0.30	0.38	0.26	0.34	1.88	0.83	0.33	0.37	0.33	0.14
mac	0.12	0.70	0.20	0.47	0.92	0.21	0.12	0.08	0.09	0.08	0.08	0.06	0.04	0.35	0.42	0.30	0.40	1.98	0.83	0.41	0.50	0.45	0.29
mar	0.15	0.75	0.21	0.45	1.39	0.31	0.20	0.17	0.16	0.14	0.14	0.06	0.04	0.41	0.52	0.34	0.50	2.38	0.88	0.44	0.50	0.42	0.19
mar	0.17	0.76	0.21	0.46	1.45	0.32	0.20	0.16	0.16	0.16	0.15	0.06	0.04	0.42	0.57	0.37	0.55	2.50	0.90	0.48	0.60	0.40	0.18
nig	0.10	0.66	0.18	0.43	0.86	0.18	0.10	0.07	0.08	0.08	0.09	0.05	0.04	0.30	0.39	0.26	0.36	1.90	0.78	0.36	0.43	0.35	0.13
nig	0.10	0.70	0.18	0.47	0.83	0.19	0.09	0.07	0.07	0.08	0.09	0.05	0.04	0.31	0.39	0.26	0.36	1.90	0.78	0.35	0.41	0.35	0.13
pun	0.16	0.80	0.22	0.52	1.02	0.22	0.14	0.09	0.09	0.10	0.11	0.07	0.04	0.34	0.45	0.32	0.43	2.28	0.95	0.40	0.52	0.37	0.23
pun	0.16	0.79	0.21	0.51	1.01	0.22	0.14	0.10	0.10	0.10	0.10	0.06	0.04	0.34	0.45	0.31	0.42	2.28	0.90	0.40	0.51	0.39	0.22
pun	0.18	0.82	0.22	0.51	1.07	0.23	0.14	0.10	0.11	0.10	0.10	0.07	0.04	0.36	0.49	0.33	0.45	2.38	0.93	0.44	0.53	0.42	0.24
pun	0.16	0.78	0.21	0.49	1.05	0.21	0.13	0.10	0.11	0.11	0.11	0.07	0.04	0.35	0.48	0.30	0.45	2.18	0.93	0.41	0.54	0.37	0.22
seb	0.14	0.97	0.25	0.59	1.47	0.31	0.20	0.17	0.17	0.17	0.19	0.06	0.03	0.41	0.50	0.35	0.49	1.98	0.75	0.48	0.40	0.34	0.18
sim	0.14	0.79	0.22	0.55	1.10	0.22	0.14	0.11	0.12	0.11	0.12	0.07	0.05	0.38	0.50	0.35	0.48	2.28	0.90	0.42	0.52	0.41	0.17
sim	0.14	0.76	0.22	0.54	1.10	0.23	0.12	0.10	0.12	0.11	0.12	0.07	0.05	0.39	0.51	0.36	0.50	2.25	0.90	0.42	0.52	0.40	0.16
sim	0.15	0.75	0.22	0.47	1.10	0.23	0.13	0.10	0.11	0.11	0.11	0.07	0.05	0.40	0.51	0.37	0.49	2.13	0.85	0.42	0.50	0.42	0.17
the	0.19	0.72	0.20	0.48	1.16	0.25	0.15	0.12	0.12	0.13	0.12	0.06	0.04	0.41	0.56	0.37	0.54	2.15	0.85	0.49	0.53	0.52	0.22
the	0.19	0.69	0.20	0.44	1.15	0.23	0.15	0.13	0.13	0.13	0.13	0.06	0.05	0.41	0.55	0.36	0.53	2.10	0.83	0.47	0.49	0.45	0.23
the	0.19	0.69	0.21	0.44	1.11	0.22	0.15	0.12	0.13	0.13	0.13	0.06	0.05	0.40	0.53	0.33	0.51	1.98	0.78	0.45	0.50	0.50	0.21
vin	0.12	0.78	0.20	0.48	1.09	0.24	0.13	0.11	0.11	0.11	0.12	0.07	0.05	0.37	0.47	0.33	0.43	2.10	1.00	0.44	0.52	0.50	0.30
vin	0.10	0.68	0.20	0.44	0.90	0.21	0.11	0.08	0.10	0.09	0.10	0.06	0.04	0.32	0.41	0.30	0.38	1.68	0.75	0.39	0.46	0.49	0.33
vin	0.12	0.74	0.20	0.47	1.04	0.23	0.13	0.10	0.12	0.11	0.11	0.06	0.04	0.36	0.50	0.32	0.45	2.05	0.95	0.45	0.55	0.54	0.30
vin	0.11	0.68	0.20	0.50	0.92	0.22	0.12	0.09	0.10	0.09	0.10	0.06	0.04	0.33	0.46	0.31	0.42	2.00	0.83	0.41	0.52	0.35	0.30
adu1	0.11	0.72	0.15	0.46	0.83	0.20	0.10	0.08	0.09	0.10	0.08	0.05	0.03	0.34	0.42	0.30	0.40	1.94	0.82	0.37	0.43	0.30	0.12
adu1	0.11	0.65	0.14	0.40	0.83	0.18	0.09	0.09	0.09	0.09	0.10	0.05	0.04	0.29	0.39	0.29	0.39	1.92	0.80	0.32	0.40	0.30	0.11

Chapter II

Assessing the emergence of new crop pests: ecological modelling and analysis of the potato psyllid *Russelliana solanicola* (Hemiptera: Psylloidea) and its wild relatives

Syfert, M.M., Serbina, L., Burckhardt, D., Knapp, S. & Percy, D.

Journal of Pest Science, submitted

Assessing the emergence of new crop pests: ecological modelling and analysis of the potato psyllid *Russelliana solanicola* (Hemiptera: Psylloidea) and its wild relatives

Mindy M. Syfert[1], Liliya Serbina[2, 3], Daniel Burckhardt[2], Sandra Knapp[1], Diana Percy[1]

[1]*The Natural History Museum, Department of Life Sciences, Cromwell Road, London, SW7 5BD, UK.*
[2]*Naturhistorisches Museum, Augustinergasse 2, CH–4001 Basel, Switzerland.*
[3]*Institut für Natur-, Landschafts- und Umweltschutz der Universität Basel, St. Johanns-Vorstadt 10, CH–4056 Basel, Switzerland.*

ABSTRACT

Crop pests are a growing threat to food security through increased spread and invasion due to human activities. The Neotropical jumping plant louse *Russelliana solanicola* Tuthill is a potato pest and probable vector of plant pathogens. It is an unusually polyphagous species that is widely distributed in and along the Andes and has been introduced into eastern Argentina, Brazil and Uruguay. Species distribution models (SDM) are built here to estimate the potential spread of *R. solanicola* worldwide, based on environmental variables derived from its natural distribution. We extend analyses of distribution to all described species of *Russelliana* in order to assess the utility of looking beyond pest species in prediction of pest spread. We investigate the extent to which data on geographical range and environmental niche can be effectively extracted from museum collections for comparative analyses of pest and non-pest species in *Russelliana*. Our results show that *R. solanicola* has potential for invasion in many parts of the world where it does not now occur but that have suitable environmental conditions as well as potato cultivation. Large geographic ranges are concentrated in a morphological group within *Russelliana* of which *R. solanicola* is a member; the same morphological group also has a larger environmental breadth than other groups in the genus. Ecological modelling provides a useful tool for identifying emerging pests and developing integrated pest management programs.

Keywords: *Russelliana solanicola,* South American potato pest, jumping plant-lice, Psyllidae, polyphagous species, invasion, species distribution models (SDM), potatoes, Solanaceae, *Solanum*, museum collections

INTRODUCTION

Movement and distributional change in crop pests and pathogens poses a threat to both native and agricultural systems. Although much disease spread is human-mediated, latitudinal shifts in pest and pathogen distributions have been documented for a wide variety of groups (Bebber et al. 2013; Bebber 2015). These broad scale patterns suggest that climate change, coupled with other environmental factors is having a significant impact on pest and pathogen distribution. Within these large datasets, however, considerable variation has been observed for individual pest species (Bebber et al. 2013), suggesting that detailed studies will reveal patterns that can be of importance for the prediction of outbreaks and control of disease in the future. Ecological modelling has been applied to investigate a threat of invasive species to non-native, agricultural and forestry systems (Peterson 2003; Chytrý et al. 2009; Catford et al. 2011; Queiroz et al. 2013). Results from these studies on individual species can predict distributional change and inform management subsequent to change, thereby mitigating or eliminating the negative impacts from invasions (Guisan et al. 2013). The Global Invasive Species Programme (McNeely et al. 2001) advocates prevention measures and management plans be developed before invasive populations become established; this approach necessitates the study of species with invasive or pest potential. Agricultural and forestry pests are a particularly important focus for predictive analysis in order to assess areas of potential invasion, the possibility of outbreaks or distributional change mediated by human dispersal. Assessing climatic similarities between native and target regions have been used to predict species spread (Thuiller et al. 2005; Richardson & Thuiller 2007; Venette et al. 2010; Guisan, et al. 2013; Fernández & Hamilton 2015). Species distribution models (SDMs) are a valuable approach for predicting invasion ecology by modelling climatic niches within native ranges and projecting the niche across a continental or global scale to identify regions with a higher likelihood of the species establishing. Biotic factors are also an important consideration (Thuiller et al. 2006; Fernández & Hamilton 2015), but such information is rarely available for taxa not yet on the threat radar.

Psyllids (Hemiptera: Sternorrhyncha: Psylloidea), also commonly called jumping plant-lice, comprise species that are important pests of a wide variety of crop plants. Psyllids damage plants due to both their negative effects on plant growth by feeding in both immature and adult stages and to their potential to act as vectors for a variety of plant pathogens (Salazar 2006; Weintraub & Beanland 2006; Grafton-Cardwell et al. 2013; Martini et al. 2015). Psyllids are highly host specific, with immatures typically developing on a single or a few closely related plant species (Ouvrard et al. 2015; Burckhardt et al. 2014). Due to the highly conserved nature of host-plant switching in psyllids (Percy et al. 2004; Ouvrard et al. 2015) congeners often develop on closely related plants. Nevertheless, psyllids from a large family, Psyllidae, are known from a wide range of angiosperm families, suggesting host switching has occurred multiple times to unrelated plants (Ouvrard et al. 2015). The challenging nature of early identification and prediction of emerging psyllid pests is highlighted by the scattered occurrence of known pests on a variety of plant taxa (Ouvrard et al. 2015).

Potato (*Solanum tuberosum* L.; Solanaceae) is the third most important food crop worldwide (Spooner et al. 2014) and provides calories and food security for populations in both the developed and developing countries. Potato is a member of the highly diverse genus *Solanum* that, with approximately 1500 species, is one of the handful of plant genera with more than 1000 species (Frodin 2004). Solanaceae and *Solanum* are most diverse in South America (Olmstead 2013; Särkinen et al. 2013) but wild species occur on all continents except Antarctica. Other important food crops in Solanaceae include tomato (*Solanum lycopersicum* L.), tamarillo (*Solanum betaceum* Cav.), eggplant (*Solanum melongena* L.) and pepper (*Capsicum* spp.). Many pests and plant pathogens are specific to Solanaceae (e.g., the Colorado potato beetle, *Leptinotarsa decemlineata* Say [Chrysomelidae]) and host switching amongst crops and wild species appears to be common (e.g., Harrison 1987). Cultivar improvement in both potato and tomato for resistance to pests and pathogens has relied on knowledge of wild relatives, including their distribution and ecological characteristics.

Psyllids from eight genera are known to develop on species from Solanaceae (Taylor & Kent 2013; Burckhardt & Lauterer 1997). The North American potato psyllid, *Bactericera cockerelli* Šulc (Triozidae) is one of the most destructive potato pests in the western hemisphere (Munyaneza 2015), and also occurs on several wild relatives of potato (Swisher et al. 2013). The potato disease "psyllid yellows", first identified in the southwestern United States (summarized in Butler & Trumble 2012) is vectored by *B. cockerelli,* and now it seems to affect other solanaceous crops such as tomatoes, pepper, eggplant and tamarillo in many parts of the world, causing severe economic losses (Hansen et al. 2008; Brown et al. 2010; Crosslin et al. 2010; Munyaneza 2015). The species has also recently been shown to be the vector of the emerging bacterial disease of potato called "zebra chip" (Hansen et al. 2008; Brown et al. 2010). *B. cockerelli* is now distributed and considered invasive (EPPO 2014) in some areas of the Americas and in New Zealand, where it was introduced by humans (Thomas et al. 2011). A recently described species of *Acizzia* (*A. solanicola* Kent & Taylor: Psyllidae) has been identified as a potentially serious commercial pest of eggplant in Australia (Kent & Taylor 2010, Taylor et al. 2013). It is one of several species of *Acizzia* associated with Solanaceae and has been recorded on both wild and cultivated species of *Solanum* (Kent & Taylor 2010), but currently there are no records of its associations with potatoes or tomatoes.

Russelliana (Psyllidae) is the only genus within the subfamily Aphalaroidinae associated with plants from eight families, suggesting more frequent host switching to unrelated plants (Burckhardt 1986, 1987, 2008; Tuthill 1959, 1964; Serbina & Burckhardt, in preparation). *Russelliana solanicola* was described from the solanaceous host plant *Datura* sp. in Peru, and from cultivated potatoes (*S. tuberosum*) where it caused feeding damage (Tuthill 1959). *R. solanicola* has now been reported as a pest on potato crops throughout Peru (Chávez et al. 2003) and in Chile (Artigas 1994), and is considered a potentially serious threat (Tenorio et al. 2003; Jeffries 2006; Salazar 2006; Serbina et al. 2015). It has also been identified as a possible future pest of tomato and pepper (Munyaneza et al. 2012). As with many recognized pests, *R. solanicola* exhibits a larger host range than fellow congeners, a pattern often differentiating non-pests from pests that have undergone a host range expansion (Bebber 2015; Alyokhin et al. 2012).

R. solanicola is one such newly emerging pest whose control may be better effected with sufficiently early warning of identification of key areas likely to be invaded. We model the global emergence potential of *R. solanicola*, and extend parts of the analysis to a comparison across the genus *Russelliana*. In order to better understand elements that differentiate pests from their non-pest relatives and investigate the emergence of pests within an evolutionary context, we explore the relevance of shared geographical, ecological and morphological characteristics of all *Russelliana* species. This approach has been useful in plant breeding where the characteristics of crop wild relatives (CWR) have been of importance for introducing new tolerances to both biotic and abiotic stresses (e.g., Hajjar & Hodgkin 2007; Ortíz 2015) as well as crop and wild species response to climate change (see papers in Redden et al. 2015). Unlike studies of CWR and their relation to the crop itself, studies of insect pests are often limited to the single, target pest species with little or no background information from related taxa, and therefore little comparative data to inform our understanding of the evolutionary origins of pests.

Our objective is to harness specimen information from museum collections of *Russelliana*, combined with systematic and biogeographic knowledge, to provide insights and predictions for an emerging pest. We test assumptions of pest-like ecology in *R. solanicola* and 18 related *Russelliana* species that are currently described with the aim of evaluating their potential for range expansion and invasion. We also investigate whether, given the patchiness of historical museum records, data on geographic range and environmental niche can be effectively extracted from museum collections for use in comparative analyses (e.g., between Solanaceae feeders and non-Solanaceae feeders as well as amongst morphological species groups of *Russelliana*). We evaluate species-environment relationships for *R.*

solanicola and relatives using an ordination exploration of co-occurrence and environmental variables.

DATA and METHODS

Species and host background

The world psylloid fauna associated with Solanaceae is relatively species poor, with only 25 described species (from eight genera in four families) and at least 12 undescribed species (Burckhardt pers. comm.), but a relatively high number of these are economically important pests and vectors of plant pathogens of crop plants, including potato (*S. tuberosum*), tomato (*S. lycopersicum*) and pepper (*Capsicum* spp.) (Hodkinson 1981; Burckhardt & Lauterer 1997; Burckhardt et al. 2012; Taylor & Kent 2013). *Russelliana* has the largest number of Solanaceae feeding species; in addition to *R. solanicola*, four species (*R. capsici*, *R. disparilis*, *R. fabianae* and *R. lycii*), have Solanaceae hosts confirmed with immature material, and three species (*R. adunca*, *R. nigra* and *R. similis*) have no immature records or host data, but probably also develop on Solanaceae (Burckhardt 1986; Burckhardt 1987; Burckhardt 2008; Tuthill 1959; Tuthill 1964) + (Serbina & Burckhardt, in preparation). A further eight undescribed *Russelliana* species are most probably also associated with Solanaceae (Serbina & Burckhardt, in preparation). We have used only the 19 described species of *Russelliana* of which eight are or are likely to be Solanaceae feeding (see Table 1; Burckhardt et al. 2012) in our analyses here.

Preliminary phylogenetic analyses using morphology (Serbina & Burkhardt, in preparation) indicate there are two primary groups in *Russelliana*, one with two species on *Fabiana* (Solanaceae) ("group 1"), and another containing the rest of the genus. This larger group comprises two sister clades: 1) a group of 11 species within which is nested a group of six species (five confirmed) probably associated with Solanaceae ("group 5"), and 2) a sister group composed of five clades. *Russelliana solanicola* is a member of one of these five clades ("group 4"), along with seven species on Solanaceae and two species on other hosts (see Table 1 for group membership of all described *Russelliana* species used in our analyses).

Occurrence data

We databased all specimen label data for *Russelliana* from the Natural History Museum, London, United Kingdom (BMNH), the Muséum d'histoire naturelle, Geneva, Switzerland (MHNG), the Naturhistorisches Museum, Basel, Switzerland (NHMB), and the California Academy of Sciences (CASC); 24 records with geographic coordinates were added from literature reports. Where geographic coordinates were not given on labels, records were georeferenced based on locality descriptions. The accuracy of georeferencing varied from within 500 m to over 100 km with a median error of less than 8 km. Our dataset includes a total of 208 records (i.e. unique localities per species) of *Russelliana* representing 2564 specimens for all 19 currently described species (Table 1); of the 76 host-plants listed in these records, 53 are unconfirmed due to the absence of immature records or host data (probable hosts for these taxa listed in Table 1 are based on Serbina & Burckhardt, in preparation). All records represent native ranges for *Russelliana* species, with the exception of seven localities where *R. solanicola* has been found from eastern South America and these localities have been identified as non-native (see Serbina et al. 2015). However, the exact provenience of the sample from one non-native locality, in Uruguay, is unknown and for this reason we exclude it from further analysis.

Environmental data

We selected environmental variables likely to affect psyllid biology (following recommendations of Hodkinson 2009) in order to build SDMs, investigate the environmental space of *Russelliana* species, and explore the relationship between *Russelliana* species co-occurrence and environmental variables. To build the SDMs for *R. solanicola*, we used: mean annual precipitation, mean annual temperature, precipitation seasonality, and temperature seasonality from the WorldClim database version 1.4 (http://www.worldclim.org; Hijmans et al. 2005); mean monthly Enhanced Vegetation Index (EVI) derived from Moderate Resolution Imaging Spectrometer (MODIS) satellite data and geological ages based on the surface geology from WorldGrids (http://www.worldgrids.org; accessed October 1, 2015). For the additional environmental space and species-environment relationships analyses, we obtained mean annual potential evapotranspiration (PET) and actual evapotranspiration (AET) from CGIAR consortium for spatial information (http://www.cgiar-csi.org/; Trabucco & Zomer 2010) as well as calculated annual water deficit (PET-AET; Stephenson 1998). All of the above variables had a 30 arc second (~1 km at the Equator) spatial resolution.

Species distribution modelling

A species distribution model (SDM) was built for the pest species *R. solanicola* with georeferenced specimen records as occurrence data. A sampling bias correction was applied to the occurrence data by using a method advocated by Fourcade et al., (2014) in which the occurrence data is systematically selected across a regularly distributed geographical space to reduce the spatial aggregation of records. We systematically subsampled the records using a distance of 15 km for a total of 57 *R. solanicola* occurrences. MaxEnt (Version 3.3.3k; Phillips et al. 2006) was selected to build the SDM as it is an effective modelling approach when utilizing presence-only data from museum collections (Elith et al. 2011). Our models were trained with *R. solanicola* occurrences within its native range and 15,000 background points constrained to the geographic extent of the native points (i.e. western South America).

We adopted the default regularisation parameters but restricted MaxEnt to using only linear and quadratic functional forms, which constrains models to produce relatively simple models that do not over-fit to the training data (Merow et al. 2013; Syfert et al. 2013). The SDM was built using a 5-fold cross–validation approach to assess model predictive accuracy. This approach uses 80% of the data to train the model and reserves 20% for model evaluation; this process was repeated until each reserved set was used to evaluate the models (Franklin 2009). SDM performance was evaluated by using the area under the curve (AUC) in a receiver operating characteristic (ROC) plot; an AUC value of 1.0 indicates perfect discrimination ability and a value of 0.5 or less indicates a prediction no better than random. Binary maps of predicted presence–absence were created for each replicate model using a maximum sensitivity and specificity threshold (Liu et al. 2005; Liu et al. 2013). The final SDM output was an ensemble of the cross–validation models; a grid cell was considered a presence when 3 or more models predicted a presence. We also evaluated the predictive performance of the SDM with six introduced localities of *R. solanicola*. A jack-knife procedure (leave one out) was used to evaluate variable importance in the models. We compared a model of suitable climates for the cultivated potato adapted from previous studies (Schafleitner et al. 2011; Jarvis et al. 2012) to our *R. solanicola* SDM.

Measuring geographical range and data analyses

Geographical range was estimated by applying a minimum convex polygon (MCP) around known species locations. This aspect of the geographical range is the area that lies within the outermost limits of the known locations. We have reasonable confidence that most of the species are well sampled and the known locations of the species represent its true geographical spread. Eight species (*R. diosteae, R. intermedia, R. lycii, R. maculata R. marionae, R. nigra, R. punctulata,* and *R. similis*) have fewer than three known localities and a MCP could not be calculated (see Table 1); for these taxa we created 5 km buffers around each locality. A Principal Component Analysis (PCA) was performed to distinguish possible environmental gaps or clusters between all taxa considered Solanaceae feeding (eight) and non-Solanaceae feeding species (eleven) of *Russelliana*. In addition, the PCA was performed to identify environmental patterns amongst the morphological groups within the genus (defined based on a preliminary phylogenetic study of *Russelliana*; Serbina & Burckhardt, in preparation).

We investigated *Russelliana* species co-occurring assemblages at the sampling sites and whether the assemblages were associated with environmental variables. A Non-metric multidimensional scaling (NMDS) is considered a robust unconstrained ordination method in community ecology (Minchin 1987) and iteratively ranks datasets according to their pairwise dissimilarity and is well suited to non-normal data (McCune & Grace 2002). The NMDS analyses use a matrix of dissimilarities between pairs of sampling sites based on compositional data. The compositional data in these analyses are typically plot-based, here we analysed *Russelliana* species co-occurrence by standardizing presence-only data, grouping the data into sampling units of 25 km grid cells and creating a presence–absence matrix from all locations that had a least one species of *Russelliana* present. For the NMDS ordination, the binomial distance measure was used to generate the dissimilarity matrix (Anderson & Millar 2004). Optimal NMDS configurations were determined using 150 random starts, and ordinations with the lowest stress values were used. Environmental variables selected for this study were incorporated into the analysis through the use of bi-plot ordinations in which variables were plotted as vector fits against co-occurrence assemblage ordinations. Permutation tests (999) were used to determine the significance of vector fits with ordination axes, and significant ($P < 0.001$) variables were included in the resulting bi-plots. The sample positions were evaluated within the ordination by including convex hulls to investigate whether distinct spatially or environmentally determined Solanaceae feeding and non-Solanaceae feeding assemblages exist.

Morphological characters and data analysis

In order to investigate the significance of morphological characters thought to be ecologically relevant for psyllid biology between Solanaceae feeders and non-Solanaceae feeders we extracted trait data from Serbina et al. (2015) as well measured traits from newly acquired specimens for *R. capsici* and *R. lycii* . We investigated the relationship between each species' range size and median morphological characters of the 19 *Russelliana* species. We focused on six potentially ecologically relevant morphological traits: genal processes length, head width, antennal length, forewing length and forewing width (potential indicators of active or passive dispersal modes), and forewing length/head width ratio (an indicator of body mass).

All data analyses were performed using R 3.0.2 (R Development Core Team 2010). We implemented the NMDS ordination using vegan package for R (Oksanen et al. 2014). Vector fitting of variables within ordinations were performed using the envfit function in the vegan package.

RESULTS

SDM

Predictive performance of the *R. solanicola* SDMs was good with all five replicate models having an AUC of 0.77 and above (test AUC range: 0.77-0.88). The jack–knife procedure suggests mean EVI (i.e. sensitivity in high biomass) is the most important variable in the SDMs followed by geological age and mean annual temperature (Table S1). EVI values range from 0 (i.e. bare rocks) to 100000 (i.e. dense forest canopy) and *R. solanicola* occurrences had a quadratic relationship with EVI and optimal values range from 800-2500; dominate geological age was the Jurassic/Triassic class (~250-200/ 200-0.6 million years ago) and optimal mean annual temperature was 15-22°C. The final SDM based on an ensemble of the presence–absence models represents well the known distribution of the species, including the region in Brazil where the species is considered to be introduced (Figure 1A); of the six introduced sites, five (83%) are correctly predicted as a presence. Globally, regions that grow potatoes as a crop and are climatically suitable for *R. solanicola*, include western South America, Mexico, southern and eastern Africa, central and south-eastern Asia, and southern Australia (Figure 1).

Geographical Ranges

Russelliana species occur throughout South America. The geographical ranges (as measured by the minimum convex polygon) of the described *Russelliana* species are concentrated across southern South America with many ranges that follow the Andean mountain range along the border between Chile and Argentina (Figure 2). The range of *R. capsici* is exclusively in eastern South America, occurring primarily in Brazil with one occurrence in eastern Argentina. The potato pest, *R. solanicola*, has the largest native geographical range (Table 1); but its range is four times larger with inclusion of introduced localities from Brazil and eastern Argentina. The native range alone is more than double the size of the next largest range (*R. disparilis*). The largest four native ranges of the 19 *Russelliana* species are from three morphologically defined groups (Table 1), and three (*R. capsici*, *R. disparilis* and *R. solanicola*) of these four species are associated with Solanaceae. Further work is needed to confirm phylogenetic independence of shared geographic ranges, dispersal ability, and host plants in *Russelliana*, but our preliminary data emphasize the value of looking at pest biology in the broader context of related taxa. The present morphological groups suggest there are as many as three independent colonizations of Solanaceae: *R. capsici* and *lycii* (“group 5”), *R. fabianae* (“group 1”) and other Solanaceae feeding species (“group 4”) (Serbina & Burckhardt, in preparation).

Environmental data analysis

The PCA reveals a pattern of Solanaceae feeding species distributed across a somewhat larger environmental space than non-Solanaceae feeding species (Figure 3A). Morphological groups identified within *Russelliana* tend to cluster more within environmental space, except group 4, which includes *R. solanicola* (Figure 3B). It is possible, however, that the larger number of *R. solanicola* records to some extent influences this lack of clustering.

Co-occurrence assemblages

Most points on the NMDS ordination are dispersed and indicate that co-occurrence assemblages appear to vary considerably among sites (Figure 4; $k = 2$, stress = 0.05), however, psyllid co-occurrence assemblages overlap in ordination space when we investigated discrete groupings (i.e. sites with only Solanaceae feeding species, sites with only non-Solanaceae feeding species, and sites that includes Solanaceae feeding species and non-Solanaceae feeding species). Two environmental variables were significantly correlated with *Russelliana* co-occurrence assemblages: mean annual precipitation and water deficit (Figure 4). Although these relationships are statistically significant, they were weak with low R^2 (annual water deficit $R^2 = 0.19$, *p-value* < 0.001; mean annual precipitation $R^2 = 0.17$, *p-value* < 0.001*).* This indicates that water deficit and annual precipitation contribute to explaining a small amount of variation in *Russelliana* co-occurrence assemblages but not enough to generate predictions.

Morphological character analysis

Evaluations of character measurements across species indicate that *R. solanicola* tends to have characters with median values that are distinct from those of other *Russelliana* species, although there is also considerable overlap (Figure S1). Taylor & Kent (2013) found morphological differences (presence/absence of genal processes, antennal length) between Solanaceae feeding versus non-Solanaceae feeding species in the psyllid genus *Acizzia*; we did not find support for similar differences in *Russelliana* in either these two characters or in head width, forewing length, forewing width and forewing length/head width ratio. The relationships between all morphological characters and geographical range size are relatively weak (Figure S2). Antennal length has the strongest relationship with range size ($R^2 = 0.242$, *p-value* 0.026) closely followed by forewing length ($R^2 = 0.206$, *p-value*: 0.039). Our data do not support morphological characters as indicators of geographical or environmental patterns in *Russelliana*; however the scale of our character measurements may be too coarse to be informative (i.e. psyllids are extremely small, ~2-3 mm) or the characters selected are not optimally informative for the variables analysed.

DISCUSSION

Our model for climatic suitability of the potentially invasive South American potato psyllid at a global scale identified several regions suitable for *R. solanicola* colonization that are outside of its native range, implying a greater risk of successful invasion (Figure 1). The best predictors for *R. solanicola* occurrence are mean EVI, geology and mean annual temperature (Table S1). *R. solanicola* occurrences were best predicted when the vegetation index (i.e.

EVI) ranged between sparse vegetation to open canopy vegetation as well as moderate temperatures with relatively young surficial geology (< 300 million years ago).

R. solanicola is already introduced in eastern Argentina, Brazil and Uruguay, and is thought to be in the incipient stages of invasion, which stresses the importance of its early detection and eradication. Established understanding of human-mediated spread resulting in invasiveness of the North American potato psyllid, *B. cockerelli* (Munyaneza et al. 2012), suggests that, given time, *R. solanicola* could have similar detrimental effect on potato cultivation in many new areas, such as those recently recognized as highly suitable for potato cultivation (Schafleitner et al. 2011, Figure 1). For instance, recent developments to invest in potato cultivation in southern China may need to consider the risks and prevention of *R. solanicola* invasion, as our models indicate these regions to climatically suitable for *R. solanicola*. Understanding the threat level for this emerging potato pest is particularly important given its role as a potential vector of plant pathogens (Salazar 2006; Chávez et al. 2003; Jeffries 2006; Tenorio et al. 2003).

Our model of “climate matching” between native and non-native areas is an initial step in evaluating the risk of invasion (Ficetola et al. 2007). Our SDMs, built with empirical data, model the realized niche (Guisan et al. 2013). The realized niche is shaped by both abiotic factors and biotic interactions that modulate species distributions; due to the nature of our dataset we only included abiotic variables in the SDM. Potentially important biotic interactions, such as competition with local species in the new areas, the presence of natural enemies (predators, diseases and parasitoids), population recruitment and establishment, were not considered due to the current lack of knowledge of these parameters for most species of psyllids. Psyllids are small insects that are often overlooked in general collecting, and we need focused efforts to close the knowledge gap between native/non-native biologies in specific cases, as well as between target/pest species and non-target/wild relative species, to ensure more background biological information is available for important taxa/groups. Our model is thus only a coarse approximation of the niche projected outside of the native range and it is possible that areas with low predicted suitability could sustain *R. solanicola* populations, especially if those areas were currently unsuited or uninvaded by other Solanaceae-feeders or potential competitors.

Our comparison of *R. solanicola* and other *Russelliana* species indicates some shared similarities in geographical and environmental characteristics, and among morphological groups. Although we did not find morphological traits specifically associated with Solanaceae feeding species (contrary to Taylor & Kent 2013), we did find support for sites with Solanaceae feeding species to have larger environmental breadth than sites with non-Solanaceae feeding species. These findings demonstrate the relevance of environmental conditions for species distribution in these taxa and suggest fairly subtle differences in environmental tolerances may determine the establishment and survival of different psyllid groups. In addition, there is a general overlap of wild potato species with *R. solanicola* and its relatives (Figure S3) in southern South America. Further assessment of range comparisons with combined data resources for *Russelliana* and other psyllid species and potato CWR could be useful in future exploration of potato feeding insects and their propensity to switch from wild to cultivated hosts.

It has long been recognized that natural history museum collections provide important historical records (Parmesan et al. 1999; Law & Salick 2005; Brooks et al. 2014; Suarez & Tsutsui 2004; Hart et al. 2014; Lees et al. 2011; Everill et al. 2014; Davis et al. 2015) for understanding distributions of species in relation to a variety of environmental factors. Accurate locality data coupled with broad geographic coverage in space can provide powerful baseline data for modelling approaches (Graham et al. 2004). Our study utilizes a combination of natural history museum collections and expert taxon knowledge to assess potentially important ecological characteristics of putative pests. We have considered the biogeographical and environmental components but these are only a piece of what is a complex puzzle. In order to provide more accurate predictions, we would need more detailed, site specific biological information, such as plant chemical analysis, physiological tolerance experiments, and more detailed ecological information about *Russelliana* species. Unfortunately, these systemic details are usually only investigated once a species is already recognized as a serious pest. Predictions of future pest invasion or outbreak in new areas thus necessarily rely on patchy information. Museum specimens, even if few, can provide baseline information allowing early detection and development of management plans for potential emerging pests on crops, analogous to their use for emerging infectious diseases (Di Euliis 2015). As our food supply becomes more homogenous (Khoury et al. 2014) and major crops such as potato are grown in areas whose suitability changes as climate shifts (Hijmans 2003; Schafleitner et al. 2011), identification and detection of potential and emerging pests becomes ever more important for food security worldwide. The digitisation and open availability of museum collections (e.g., papers in Smith & Blagoderov 2012) will be an important part of the solution to this societal problem.

ACKNOWLEDGEMENTS

We thank the curators of collections mentioned in the text for allowing us to use collections in their care; members of the iCollections digitization team at NHM for imaging and transcription of NHM collection labels; Caitlin McLaughlin for geo-referencing support; Julian Ramirez Villegas (CIAT) kindly provided the data for current potato cultivation potential; data collection and geo-referencing of potato wild relatives was done as part of "PBI Solanum: a worldwide treatment" funded by the National Science Foundation (DEB-0316614 to SK); LS was funded by grants from the Swiss Confederation (Federal Commission) and the Freiwillige Akademische Gesellschaft (FAG), Basel; MMS was funded by the Natural History Museum's Natural Resources Initiative.

LITERATURE CITED

Alyokhin, A., Chen, Y.H., Udalov, M., Benkovskaya, G. & Lindstrom, L., 2012. Evolutionary Considerations in Potato Pest Management. In A. Alyokhin, C. Vincent, & P. Giordanengo, eds. *Insect pests of potato: global perspectives on biology and management.* San Diego, CA: Academic Press, pp. 543–571.

Anderson, M.J. & Millar, R.B., 2004. Spatial variation and effects of habitat on temperate reef fish assemblages in northeastern New Zealand. *Journal of Experimental Marine Biology and Ecology*, 305(2), pp.191–221.

Artigas, J.N., 1994. Entomología Económica, Insectos de interés agrícola, forestal, médico y veterinario. , p.1126 pp.

Bebber, D.P., 2015. Range-Expanding Pests and Pathogens in a Warming World. *Annual Review of Phytopathology*, 53(1), pp.335–356.

Bebber, D.P., Ramotowski, M. a. T. & Gurr, S.J., 2013. Crop pests and pathogens move polewards in a warming world. *Nature Climate Change*, 3(11), pp.985–988.

Brooks, S.J., Self, A., Toloni, F. & Sparks, T., 2014. Natural history museum collections provide information on phenological change in British butterflies since the late-nineteenth century. *International journal of biometeorology*, 58(8), pp.1749–58.

Brown, J.K., Rehman, M., Rogan, D., Martin, R.R. & Idris, A.M., 2010. First Report of 'Candidatus Liberibacter psyllaurous' (synonym 'Ca. L. solanacearum') Associated with 'Tomato Vein-Greening' and 'Tomato Psyllid Yellows' Diseases in Commercial Greenhouses in Arizona. *Plant Disease*, 94(3), p.376.

Burckhardt, D., 1986. A new Russelliana species (Homoptera: Psyllidae) on Adesmia (Leguminosae). *Revista Chilena de Entomología*, 14, pp.95–97.

Burckhardt, D., 1987. Jumping plant lice (Hornoptera : Psylloidea) of the temperate neotropical region . Part 1 : Psyllidae (subfamilies Aphalarinae, Rhinocolinae and Aphalaroidinae). *Zoological Journal of the Linnean Society*, 89(1), pp.299–392.

Burckhardt, D., 2008. Jumping plant-lice (Hemiptera, Psylloidea) associated with Diostea (Verbenaceae). *Mitteilungen aus dem Museum fur Naturkunde in Berlin - Deutsche Entomologische Zeitschrift*, 55(1), pp.79–89.

Burckhardt, D. & Lauterer, P., 1997. A taxonomic reassessment of the triozid genus Bactericera (Hemiptera: Psylloidea). *J Natural History*, 31(1), pp.99–153.

Burckhardt, D., Ouvrard, D., Queiroz, D. & Percy, D., 2014. Psyllid Host-Plants (Hemiptera: Psylloidea): Resolving a Semantic Problem. *Florida Entomologist*, 97(1), pp.242–246.

Burckhardt, D., Queiroz, D.L., Rezende, M.Q., Castro de Queiroz, E. & Bouvet, J.P., 2012. The capsicum psyllid, Russelliana capsici (Hemiptera , Psylloidea), a pest on Capsicum annuum (Solanaceae) in Argentina and Brazil. *Mitteilungen der Schweizerischen Entomologischen Gessellschaft Bulletin D e La Société Entomologique*, 85, pp.71–78.

Butler, C.D. & Trumble, J.T., 2012. The potato psyllid, Bactericera cockerelli (Sulc) (Hemiptera: Triozidae): life history, relationship to plant diseases, and management strategies. *Terrestrial Arthropod Reviews*, 5(2), pp.87–111.

Catford, J. a., Vesk, P. a., White, M.D. & Wintle, B. a., 2011. Hotspots of plant invasion predicted by propagule pressure and ecosystem characteristics. *Diversity and Distributions*, 17(6), pp.1099–1110.

Chávez, R., Salazar, L., Upadhya, M., Chujoy, E., Cabello, R., Garcia, A. & Linares, J., 2003. The occurrence of genetic resistance and susceptibility to the new potato virus SB–29 among tetraploide potato populations (Solanum tuberosum L., 2n = 4x = 48 AAAA) in an arid agroecosystem. *IDESIA*, 12(1), pp.9–22.

Chytrý, M., Pyšek, P., Wild, J., Pino, J., Maskell, L.C. & Vilà, M., 2009. European map of alien plant invasions based on the quantitative assessment across habitats. *Diversity and Distributions*, 15(1), pp.98–107.

Crosslin, J., Munyaneza, J., Brown, J. & Liefting, L., 2010. A History in the Making: Potato Zebra Chip Disease Associated with a New Psyllid-borne Bacterium. A Tale of Striped Potatoes. *APSnet Feature Articles*, p.Online.

Davis, C.D., Willis, C.G., Connolly, B., C., K. & Ellison, A.M., 2015. Herbarium records are reliable sources of phenological change driven by climte and provide novel insights into species' phenological cueing mechanisms. *American Journal of Botany*, 102, pp.1599–1609.

Elith, J., Phillips, S.J., Hastie, T., Dudík, M., Chee, Y.E. & Yates, C.J., 2011. A statistical explanation of MaxEnt for ecologists. *Diversity and Distributions*, 17(1), pp.43–57.

EPPO, 2014. PQR - EPPO Plant quarantine retrieval system.

Di Euliis D., 2015. The role of scientific collections in scientific preparedness. *Emerging Infectious Diseases*, 21(8), p.e150423.

Everill, P.H., Primack, R.B., Ellwood, E.R. & Melaas, E.K., 2014. Determining past leaf-out times of New England's deciduous forests from herbarium specimens. *American Journal of Botany*, 101, pp.1–8.

Fernández, M. & Hamilton, H., 2015. Ecological niche transferability using invasive species as a case study. *PloS one*, 10(3), p.e0119891.

Ficetola, G.F., Thuiller, W. & Miaud, C., 2007. Prediction and validation of the potential global distribution of a problematic alien invasive species - The American bullfrog. *Diversity and Distributions*, 13(4), pp.476–485.

Fourcade, Y., Engler, J.O., Rodder, D. & Secondi, J., 2014. Mapping species distributions with MAXENT using a geographically biased sample of presence data: A performance assessment of methods for correcting sampling bias. *PLoS ONE*, 9(5), p.e97122.

Franklin, J., 2009. *Mapping Species Distributions: Spatial Inference and Prediction*, Cambridge, UK: Cambridge University Press.

Frodin, D.G., 2004. History and concepts of big plant genera. *Taxon*, 53(3), pp.753–776.

Grafton-Cardwell, E.E., Stelinski, L.L. & Stansly, P. a, 2013. Biology and management of Asian citrus psyllid, vector of the huanglongbing pathogens. *Annual review of entomology*, 58, pp.413–32.

Graham, C.H., Ferrier, S., Huettman, F., Moritz, C. & Peterson, A.T., 2004. New developments in museum-based informatics and applications in biodiversity analysis. *Trends in Ecology & Evolution*, 19(9), pp.497–503.

Guisan, A. et al., 2013. Predicting species distributions for conservation decisions. *Ecology Letters*, 16(12), pp.1424–1435.

Hail D, Dowd SE, Bextine B, 2012. Identification and location of symbionts associated with potato psyllid (Bactericera cockerelli) lifestages. Environmental Entomology, 41(1):98-107.

Hajjar, R. & Hodgkin, T., 2007. The use of wild relatives in crop improvement: A survey of developments over the last 20 years. *Euphytica*, 156(1-2), pp.1–13.

Hansen, K., Trumble, J.T., Stouthamer, R. & Paine, T.D., 2008. A new huanglongbing species, 'Candidatus liberibacter psyllaurous,' found to infect tomato and potato, is vectored by the psyllid Bactericera cockerelli (Sulc). *Applied and Environmental Microbiology*, 74(18), pp.5862–5865.

Harrison, G.D., 1987. Host-plant discrimination and evolution of feeding preference in the Colorado potato beetle Leptinotarsa decemlineata. *Physiological Entomology*, 12(4), pp.407–415.

Hart, R., Salick, J., Ranjitkar, S. & Xu, J., 2014. Herbarium specimens show contrasting phenological responses to Himalayan climate. *Proceedings of the National Academy of Sciences of the United States of America*, 111(29), pp.10615–9.

Hijmans, R.J., 2003. The effect of climate change on global potato production. *American Journal of Potato Research*, 80(4), pp.271–279.

Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G. & Jarvis, A., 2005. Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology*, 25(15), pp.1965–1978.

Hodkinson, I.D. 1981. Status and taxonomy of the *Trioza* (*Bactericera*) *nigricornis* Forster complex (Hemiptera: Triozidae). *Bulletin of Entomological Research*, 71, pp. 671–679.

Hodkinson, I.D., 2009. Life cycle variation and adaptation in jumping plant lice (Insecta: Hemiptera: Psylloidea): a global synthesis. *Journal of Natural History*, 43(1-2), pp.65–179.

Jarvis, A., Ramirez-Villegas, J., Campo, B.V.H. & Navarro-Racines, C., 2012. Is Cassava the Answer to African Climate Change Adaptation? *Tropical Plant Biology*, 5(1), pp.9–29.

Jeffries, C., 2006. Potato. FAO/lPGRI Technical guidelines for the safe movement of germplasm. , p.19: 1–117.

Kent, D. & Taylor, G., 2010. Two new species of Acizzia Crawford (Hemiptera: Psyllidae) from the Solanaceae with a potential new economic pest of eggplant, Solanum melongena. *Australian Journal of Entomology*, 49, pp.73–81.

Khoury, C.K., Bjorkman, A.D., Dempewolf, H., Ramirez-Villegas, J., Guarino, L., Jarvis, A., Rieseberg, L.H. & Struik, P.C., 2014. Increasing homogeneity in global food supplies and the implications for food security. *Proceedings of the National Academy of Sciences of the United States of America*, 111(11), pp.4001–6.

Law, W. & Salick, J., 2005. Human-induced dwarfing of Himalayan snow lotus, Saussurea laniceps (Asteraceae). *Proceedings of the National Academy of Sciences of the United States of America*, 102(29), pp.10218–10220.

Lees, D.C., Lack, H.W., Rougerie, R., Hernandez-Lopez, A., Raus, T., Avtzis, N.D., Augustin, S. & Lopez-Vaamonde, C., 2011. Tracking origins of invasive herbivores through herbaria and archival DNA: the case of the horse-chestnut leaf miner. *Frontiers in Ecology and the Environment*, 9(6), pp.322–328.

Liu, C., Berry, P.M., Dawson, T.P. & Pearson, R.G., 2005. Selecting thresholds of occurrence in the prediction of species distributions. *Ecography*, 28(3), pp.385–393.

Liu, C., White, M. & Newell, G., 2013. Selecting thresholds for the prediction of species occurrence with presence-only data. *Journal of Biogeography*, 40(4), pp.778–789.

Martini, X., Hoffmann, M., Coy, M.R., Stelinski, L.L. & Pelz-Stelinski, K.S., 2015. Infection of an Insect Vector with a Bacterial Plant Pathogen Increases Its Propensity for Dispersal. *PloS one*, 10(6), p.e0129373.

McCune, B. & Grace, J.B., 2002. Analysis of Ecological Communities.

McNeely, J.A., Mooney, H.A., Neville, L.E., Schei, P.J. & Waage, J.K., 2001. Global Strategy on Invasive Alien Species. *Strategy*, pp.3–62.

Merow, C., Smith, M.J. & Silander, J. a., 2013. A practical guide to MaxEnt for modeling species' distributions: what it does, and why inputs and settings matter. *Ecography*, 36(10), pp.1058–1069.

Minchin, P.R., 1987. An evaluation of the relative robustness of techniques for ecological ordination. *Vegetatio*, 69(1-3), pp.89–107.

Munyaneza, J.E., 2015. Zebra chip disease, Candidatus liberibacter, and potato psyllid: a global threat to the potato industry. *American Journal of Potato Research*, 92(2), pp.230–235.

Munyaneza, J.E., Henne, D.C., Giordanengo, P., Vincent, C. & Alyokhin, A., 2012. Leafhopper and psyllid pests of potato. In *Insect pests of potato: global perspectives on biology and management. Academic Press, San Diego, CA*. pp. 65–102.

Oksanen, A.J., Blanchet, F.G., Kindt, R., Legen-, P., Minchin, P.R., Hara, R.B.O., Simpson, G.L., Solymos, P. & Stevens, M.H.H., 2014. Package ‘ vegan ’.

Olmstead, R.G., 2013. Phylogeny and biogeography in Solanaceae, Verbenaceae and Bignoniaceae: a comparison of continental and intercontinental diversification patterns. *Botanical Journal of the Linnean Society*, 171(1), pp.80–102.

Ortíz, R., 2015. The Importance of Crop Wild Relatives, Diversity, and Genetic Potential for Adaptation to Abiotic Stress-Prone Environments. *Crop Wild Relatives and Climate Change*, pp.80–87.

Ouvrard, D., Chalise, P. & Percy, D.M., 2015. Host-plant leaps versus host-plant shuffle: a global survey reveals contrasting patterns in an oligophagous insect group (Hemiptera, Psylloidea). *Systematics and Biodiversity*, 13(5), pp.434–454.

Parmesan, C., Ryrholm, N., Stefanescu, C., Hill, J.K., Thomas, C.D., Descimon, H., Huntley, B., Kaila, L., Kullberg, J., Tammaru, T., Tennent, W.J., Thomas, J. a & Warren, M., 1999. Poleward shifts in geographical ranges of butterfly species associated with regional warming. *Nature*, 399, pp.579–583.

Percy, D.M., Page, R.D.M. & Cronk, Q.C.B., 2004. Plant-insect interactions: double-dating associated insect and plant lineages reveals asynchronous radiations. *Systematic Biology*, 53(1), pp.120–127.

Peterson, A.T., 2003. Predicting the geography of species’ invasions via ecological niche modeling. *The Quarterly review of biology*, 78(4), pp.419–33.

Phillips, S., Anderson, R. & Schapire, R., 2006. Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, 190(3-4), pp.231–259.

Queiroz, D.L., Majer, J., Burckhardt, D., Zanetti, R., Fernandez, J.I.R., de Queiroz, E.C., Garrastazu, M., Fernandes, B.V. & dos Anjos, N., 2013. Predicting the geographical distribution of Glycaspis brimblecombei (Hemiptera: Psylloidea) in Brazil. *Australian Journal of Entomology*, 52(1), pp.20–30.

R Development Core Team, 2010. R: a Language and Environment for Statistical Computing.

Redden, R., Yadav, S.S., Maxted, N., Dulloo, M.E., Guarino, L. & Smith, P., 2015. *Crop Wild Relatives and Climate Change*, London: Wiley and Sons.

Richardson, D.M. & Thuiller, W., 2007. Home away from home - Objective mapping of high-risk source areas for plant introductions. *Diversity and Distributions*, 13(3), pp.299–312.

Salazar, L.F., 2006. Emerging and re-emerging potato diseases in the Andes. *Potato Research*, 49(1), pp.43–47.

Särkinen, T., Bohs, L., Olmstead, R.G. & Knapp, S., 2013. A phylogenetic framework for evolutionary study of the nightshades (Solanaceae): a dated 1000-tip tree. *BMC evolutionary biology*, 13, p.214.

Schafleitner, R., Ramirez, J., Jarvis, A., Evers, D., Gutierrez, R. & Scurrah, M., 2011. Adaptation of the Potato Crop to Changing Climates. In S. . Yadav, R. Redden, J. Hatfield, L.-C. H, & H. AH, eds. *Crop Adaptation to Climate Change*. Wiley-Blackwell, pp. 287–297.

Serbina, L., Burckhardt, D., Birkhofer, K., Syfert, M.M. & Halbert, S.E., 2015. The potato pest Russelliana solanicola Tuthill (Hemiptera: Psylloidea): taxonomy and host-plant patterns. *Zootaxa*.

Smith, V.S. & Blagoderov, V., 2012. Bringing collections out of the dark. *ZooKeys*, 209, pp.1–6.

Spooner, D.M., Ghislain, M., Simon, R., Jansky, S.H. & Gavrilenko, T., 2014. Systematics, Diversity, Genetics, and Evolution of Wild and Cultivated Potatoes. *The Botanical Review*, 80(4), pp.283–383.

Stephenson, N.L., 1998. Actual evapotranspiration and deficit: biologically meaningful correlates of vegetation distribution across spatial scales. *Journal of Biogeography*, 25, pp.855–870.

Suarez, A. V. & Tsutsui, N.D., 2004. The Value of Museum Collections for Research and Society. *BioScience*, 54(1), p.66.

Swisher, K.D., Sengoda, V.G., Dixon, J., Echegaray, E., Murphy, A.F., Rondon, S.I., Munyaneza, J.E. & Crosslin, J.M., 2013. Haplotypes of the potato psyllid, Bactericera cockerelli, on the wild host plant, Solanum dulcamara, in the pacific Northwestern United States. *American Journal of Potato Research*, 90, pp.570–577.

Syfert, M.M., Smith, M.J. & Coomes, D.A., 2013. The Effects of Sampling Bias and Model Complexity on the Predictive Performance of MaxEnt Species Distribution Models. *PLoS ONE*, 8(2), p.e55158.

Taylor, G.S. & Kent, D.S., 2013. Potential economic pests of solanaceous crops: a new species of Solanum-feeding psyllid from Australia and first record from New Zealand of Acizzia solanicola (Hemiptera: Psyllidae). *Zootaxa*, 3613, pp.257–73.

Taylor, G.S., Kent, D.S., Tuthill, L. & Kent, A., 2013. psyllid from Australia and first record from New Zealand of Acizzia solanicola. , 3613(3), pp.257–273.

Tenorio, J., Chuquillanqui, C., Garcia, A., Guillén, M., Chavez, R. & Salazar, L., 2003. Sintomatología y efecto en el rendimiento de papa de un nuevo virus transmitido por el psílido Russelliana solanicola. *Fitopatología*, 38, pp.32–36.

Thomas, K.L., Jones, D.C., Kumarasinghe, L.B., Richmond, J.E., Gill, G.S.C. & Bullians, M.S., 2011. Investigation into the entry pathway for tomato potato psyllid Bactericera cockerelli. *New Zealand Plant Protection*, 64, pp.259–268.

Thuiller, W., Richardson, D.M., Pyšek, P., Midgley, G.F., Hughes, G.O. & Rouget, M., 2005. Niche-based modelling as a tool for predicting the risk of alien plant invasions at a global scale. *Global Change Biology*, 11(April), pp.2234–2250.

Thuiller, W., Richardson, D.M., Rouget, M., Procheş, Ş. & Wilson, J.R.U., 2006. Interactions between environment, species traits, and human uses describe patterns of plant invasions. *Ecology*, 87(7), pp.1755–1769.

Trabucco, A. & Zomer, R.J., 2010. Global soil water balance geospatial database. *CGIAR Consortium for Spatial Information*.

Tuthill, L., 1964. Conocimientos Adicionales sobre los Psyllidae (Homoptera) del Perú. *Revista Peruana de Entomologia Agricola*, 7(1), pp.25–32.

Tuthill, L., 1959. Los Psyllidae del Perú Central (Insecta : Homoptera). *Revista Peruana de Entomologia Agricola*, (2), pp.1–27.

Venette, R.C., Kriticos, D.J., Magarey, R.D., Koch, F.H., Baker, R.H., Worner, S.P., Gómez

Raboteaux, N.N., McKenney, D.W., Dobesberger, E.J., Yemshanov, D., De Barro, P.J., Hutchison, W.D., Fowler, G., Kalaris, T.M. & Pedlar, J., 2010. Pest Risk Maps for Invasive Alien Species: A Roadmap for Improvement. *BioScience*, 60(5), pp.349–362.

Weintraub, P.G. & Beanland, L., 2006. Insect vectors of phytoplasmas. *Annual review of entomology*, 51(46), pp.91–111.

Table 1. Currently described *Russelliana* species with host-plant information and geographical range size. Morphological groups correspond to the preliminary clades identified by Serbina & Burckhardt (in preparation): potential host taxa of eight species without host/immature data are evaluated from the phylogenetic analysis and marked with a question mark (?). The range area of *R. solanicola* that includes localities where it is likely introduced is marked with an asterisk (*).

Species	**Number of localities**	**Host species**	**Morphological groups**	**Range area (km²)**	**Reference**
Russelliana adesmiae Burckhardt	29	*Adesmia* spp. (Fabaceae)	3	34253	Burckhardt (1986)
Russelliana adunca Burckhardt	3	?*Lycium* sp. (Solanaceae)	4	21475	Burckhardt (1987)
Russelliana bulbosa Burckhardt	15	*Diostea juncea* (Gillies & Hook.) Miers (Verbenaceae)	clade A	607020	Burckhardt (1987, 2008)
Russelliana capsici Burckhardt	6	*Capsicum annuum* L. (Solanaceae)	5	185448	Burckhardt (1987), Burckhardt et al. 2012
Russelliana chilensis Burckhardt	3	?*Adesmia* sp. (Fabaceae)	3	1695	Burckhardt (1987)
Russelliana diosteae Burckhardt	1	*Diostea juncea* (Gillies & Hook.) Miers (Verbenaceae)	clade A	78	Burckhardt (2008)
Russelliana disparilis Tuthill	6	*Dunalia* sp. (Solanaceae)	4	754591	Tuthill (1964), Burckhardt (1987)
Russelliana fabianae Burckhardt	26	*Fabiana imbricata* Ruiz & Pav. (Solanaceae)	1	129980	Burckhardt (1987)
Russelliana intermedia Burckhardt	2	?Asteraceae	6	157	Burckhardt (1987)
Russelliana lycii Tuthill	2	*Lycium salsum* Ruiz & Pav. (Solanaceae)	5	157	Tuthill (1959) as *Arepuna lycii*, Burckhardt (1987)
Russelliana maculata Burckhardt	2	?*Adesmia* sp. (Fabaceae)	3	157	Burckhardt (1987)
Russelliana marionae Burckhardt	1	*Mulguraea scoparia* (Gillies & Hook.) N.O'Leary & P.Peralta (Verbenaceae)	clade A	78	Burckhardt (2008)
Russelliana nigra Burckhardt	2	?Solanaceae	4	157	Burckhardt (1987)
Russelliana punctulata Burckhardt	1	?*Adesmia* sp. (Fabaceae)	3	78	Burckhardt (1987)
Russelliana sebastiani Burckhardt	5	*Diostea juncea* (Gillies & Hook.) Miers (Verbenaceae)	clade A	1333	Burckhardt (2008)
Russelliana similis Burckhardt	2	?Solanaceae	4	157	Burckhardt (1987)

Russelliana solanicola Tuthill	91	*Alternanthera ficoidea* (L.) Sm. (Amaranthaceae), *Baccharis* spp. (Asteraceae), *Helenium aromaticum* (Hook.) L.H.Bailey (Asteraceae), *Parthenium hysterophorus* L. (Asteraceae), *Xanthium spinosum* L. (Asteraceae), *Escallonia rosea* Griseb. (Escalloniaceae), *Brugmansia arborea* (L.) Steud. (Solanaceae), *Datura* sp. (Solanaceae), *Solanum tuberosum* L. (Solanaceae)	4	2496773 6277176*	Tuthill (1959), Burckhardt (1987), Serbina et al. (2015)
Russelliana theresae Burckhardt	6	*Mulguraea scoparia* (Gillies & Hook.) N.O'Leary & P.Peralta (Verbenaceae)	clade A	52	Burckhardt (2008)
Russelliana vinculipennis Burckhardt	5	?*Adesmia* sp. (Fabaceae)	3	140553	Burckhardt (1987)

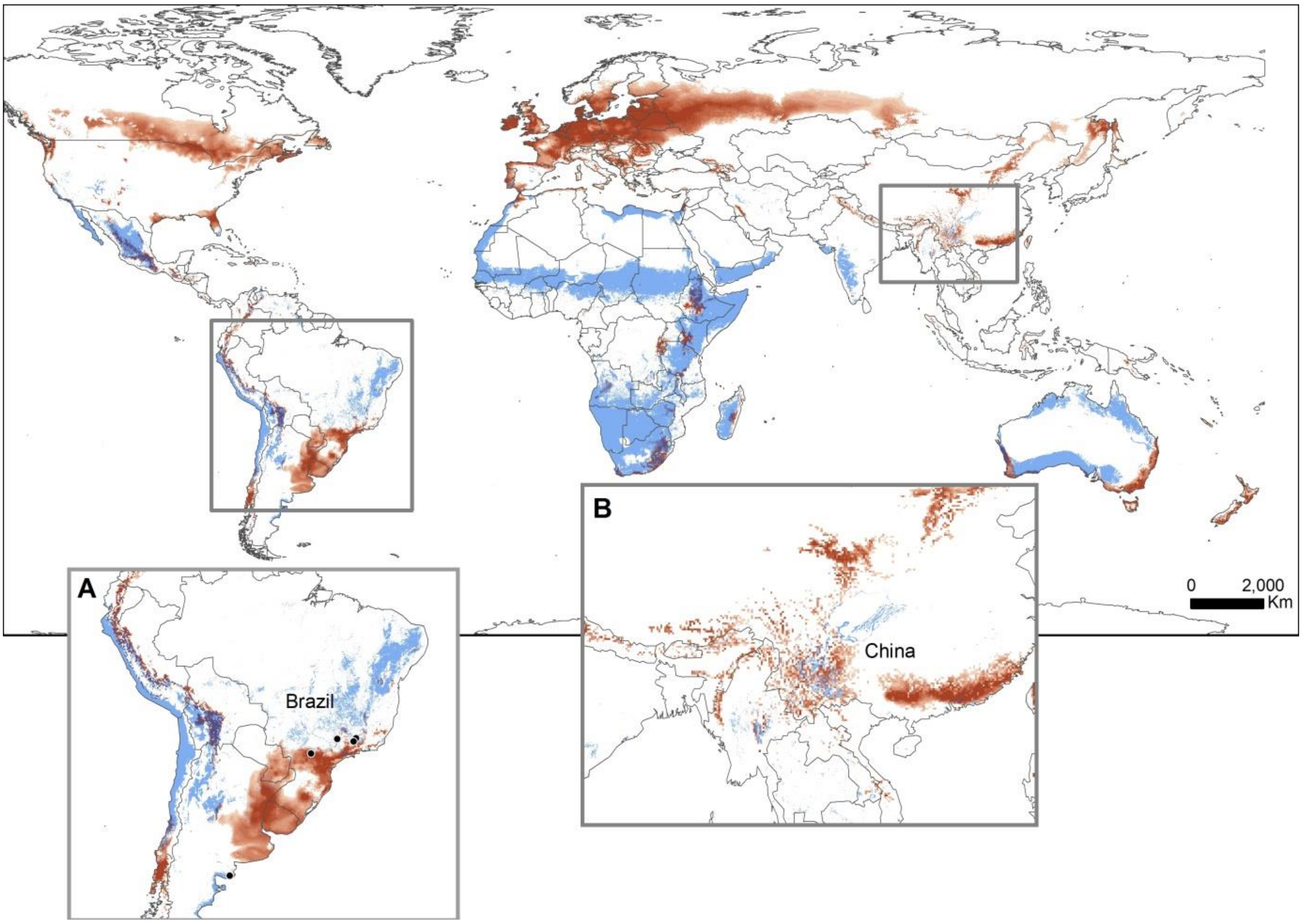


Figure 1. Predicted suitable habitat for *R. solanicola* (blue), using the MaxEnt species distribution modelling (SDM) approach overlayed with predicted suitable habitat for the cultivated potato (*Solanum tuberosum*; (red)), using data from (Schafleitner et al. 2011); areas of overlap are shown in dark grey; A) *R. solanicola* and potato geographical overlap in the Andes and parts of eastern South America, black points represent recent confirmed introductions of *R. solanicola*; B) *R. solanicola* and potato geographical overlap in southern China.

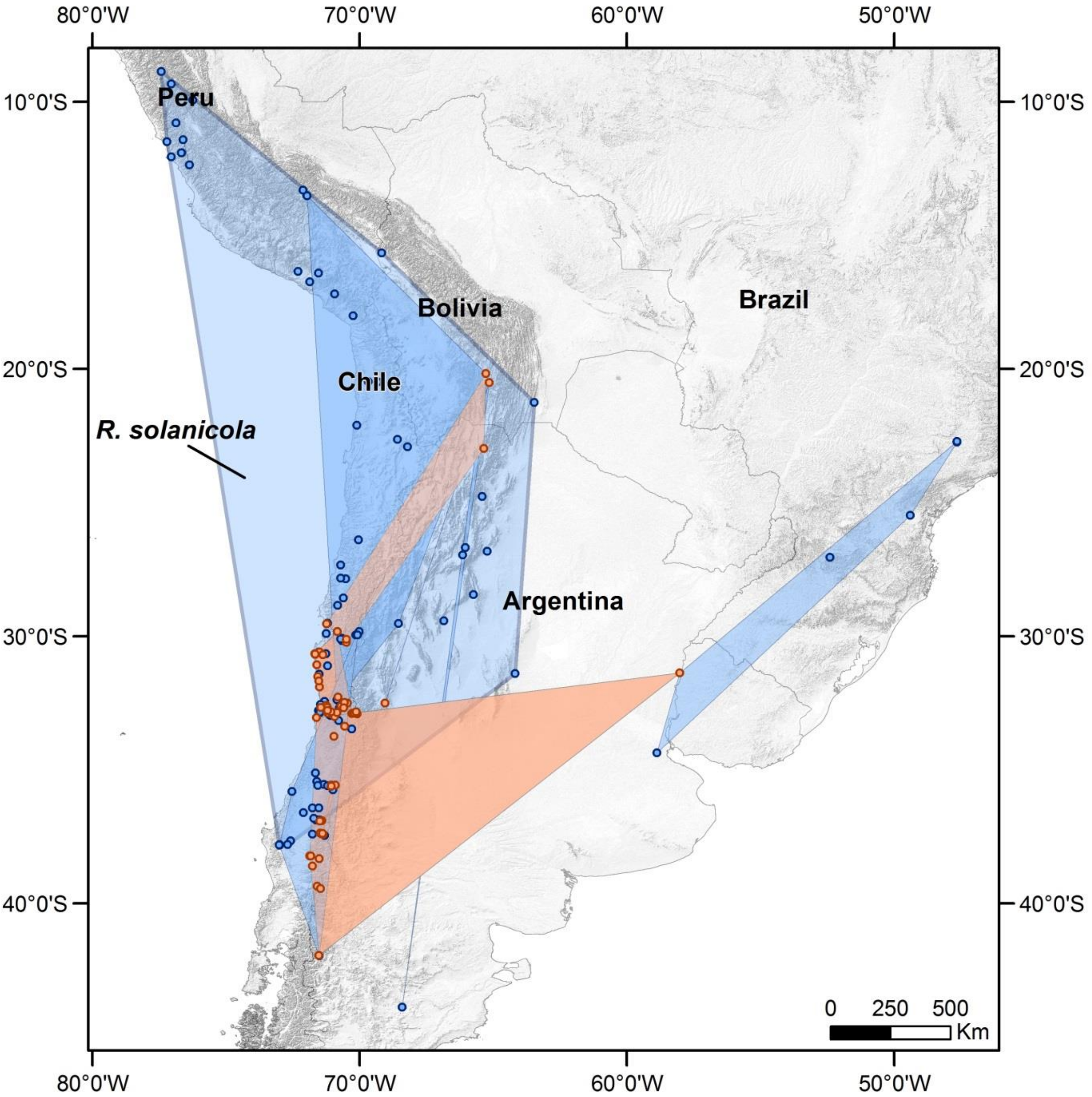


Figure 2. Overlapping native ranges with the distribution of eight Solanaceae feeding species (blue points and polygons) and eleven non-Solanaceae feeding species (orange points and polygons) of *Russelliana* in western and eastern South America as derived from minimum convex polygon (MCP). The native range for the pest species *R. solanicola* is labeled.

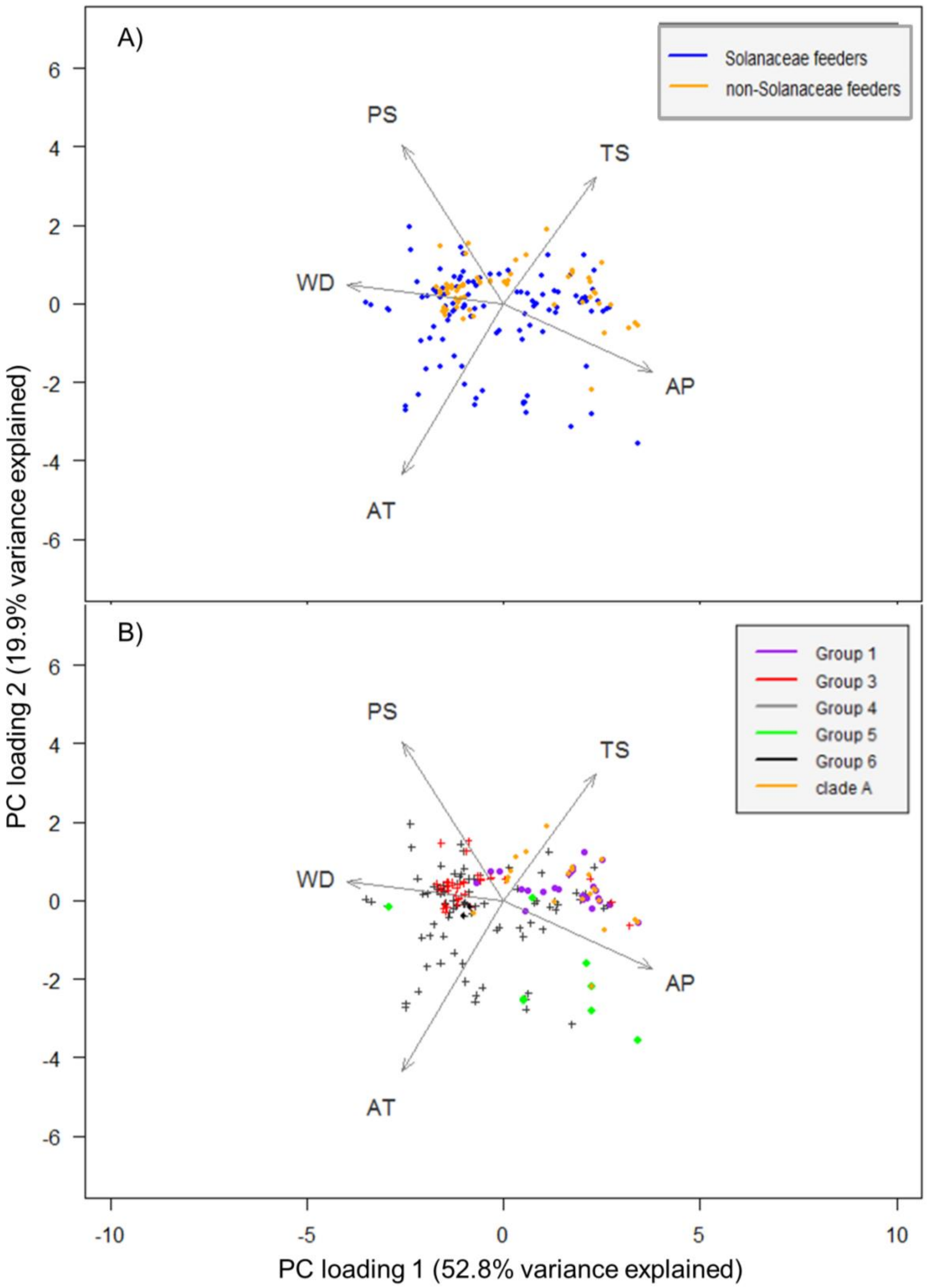


Figure 3. Principal component analysis (PCA) of Solanaceae feeding species and non-Solanaceae feeding species: (A) on axes 1 and 2; (B) PCA of morphological groups (see Table 1 for *Russelliana* group membership) on axes 1 and 2. Environmental variables codes: AP = annual precipitation, AT = annual temperature, WD = annual water deficit, PS = precipitation seasonality, TS = temperature seasonality.

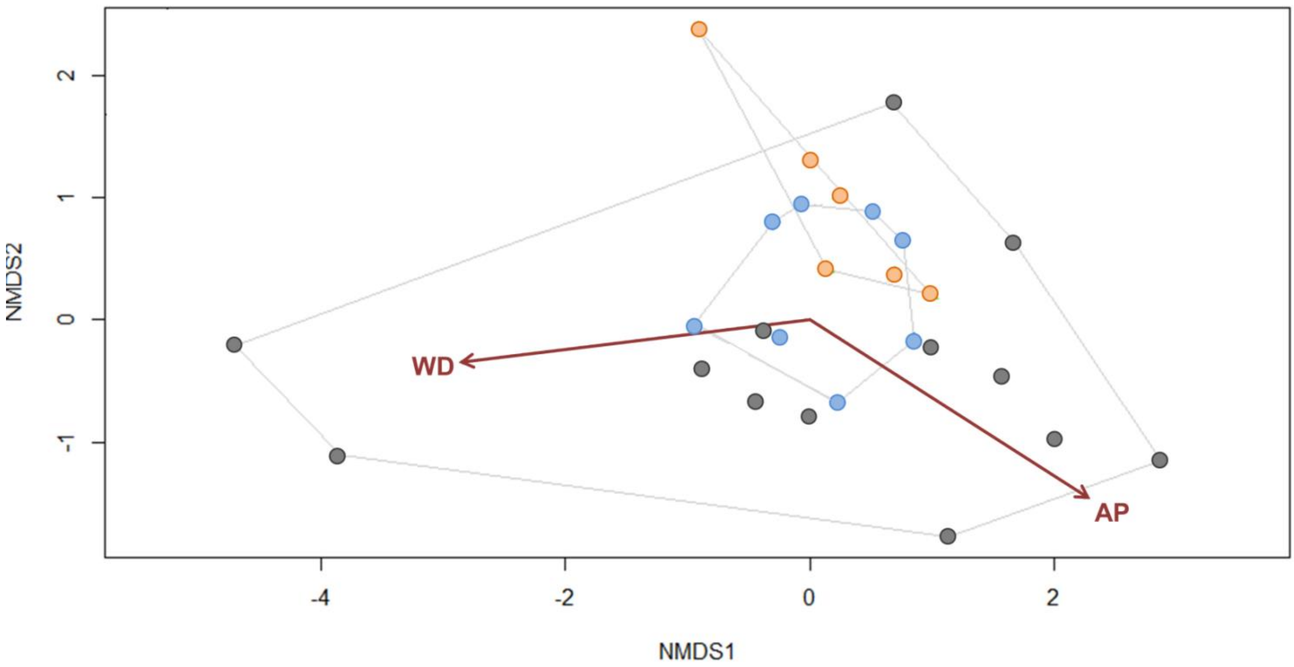


Figure 4. Non-metric Multidimensional Scaling (NMDS) plot illustrating co-occurrence dissimilarity of 19 *Russelliana* species between sample sites (derived from 25 km grid). Group boundaries for three Russelliana co-occurrence assemblages: Solanaceae feeding (blue points), non-Solanaceae feeding (orange points), and an assemblage with Solanaceae feeding species as well as non-Solanaceae feeding species (dark grey points) were drawn using ordihull function in the R package vegan (Oksanen et al. 2014). Environmental variables significantly correlated with NMDS ordination are shown: water deficit (WD) and mean annual precipitation (AP).

Chapter III

Systematics, biogeography and host-plant relationships of the Neotropical jumping plant-louse genus *Russelliana* (Hemiptera: Psylloidea)

Serbina, L. & Burckhardt, D.

Zoological Journal of the Linnean Society, to be submitted

Please replace everywhere m$ by male and f£ by female symbols

Systematics, biogeography and host-plant relationships of the Neotropical jumping plant-louse genus *Russelliana* (Hemiptera: Psylloidea)

LILIYA SERBINA[1,2*] and DANIEL BURCKHARDT[1]

[1]*Naturhistorisches Museum, Augustinergasse 2, CH–4001 Basel, Switzerland*

[2]*Institut für Natur-, Landschafts- und Umweltschutz der Universität Basel, St. Johanns-Vorstadt 10, CH–4056 Basel, Switzerland*

*Corresponding author. E-mail: liliya_serbina@mail.ru

The Neotropical genus *Russelliana* (Psyllidae: Aphalaroidinae) is revised and its internal phylogenetic, host-plant and biogeographical relationships are analysed. Twenty-four species are described as new, bringing the number of totally known species to 43. An identification key for the adult stage is provided for all species. A phylogenetic analysis of 28 morphological characters resulted in 324 most parsimonious trees. The consensus tree is fully resolved at the base and most of these clades are well supported. The resolution at the tip of the tree is, however, weak. Most *Russelliana* species are monophagous or oligophagous with the exception of *R. solanicola* which is polyphagous. The host range of *Russelliana* is surprisingly broad compared to other aphalaroidine genera and includes species of eight plant families. The psyllids associated with Fabaceae (13 spp.), Asteraceae (4 spp.) and Polygonaceae (1 sp.) form each a monophyletic group and those with Solanaceae constitute three monophyletic groups (6 spp., 4 spp. and 2 spp.). The species associated with Verbenaceae (5 spp.) are paraphyletic and those with Rosaceae (2 spp.) polyphyletic. These patterns suggest repeated host shifts. Whether there is cospeciation in some groups cannot be judged as neither the psyllid nor the host phylogeny is sufficiently resolved. The world psylloid fauna comprises relatively few species associated with Solanaceae. The number of 16 *Russelliana* species with confirmed or likely solanaceous hosts is therefore surprising and important in view of potential pest status of some *Russelliana* spp. The representatives of the genus are restricted to temperate and subtropical South America (Argentina, Bolivia, Southern Brazil, Chile, Peru and Uruguay). Most species are known from within or adjacent to the Andes. Only three species are currently known from Eastern South America. The cladogram suggests that geographical vicariance may account for at least part of the observed species richness, as five vicariant events were detected for *Russelliana*. A better resolution of the cladogram may reveal more cases of geographical vicariance.

ADDITIONAL KEYWORDS: psyllids – *Russelliana* – Asteraceae – Fabaceae – Solanaceae – cospeciation – host shifts – geographical vicariance – phylogeny.

INTRODUCTION

Phytophagous insects represent one of the most species-rich groups of animals on the planet (Southwood, 1978). The majority of them belong to three orders of insects: Coleoptera, Hemiptera and Lepidoptera (Chapman, 2007). A number of phytophagous insects are serious agricultural pests, such as the well-known Colorado potato beetle, *Leptinotarsa decemlineata* Say (Chrysomelidae), and the green peach-potato aphid, *Myzus persicae* Sulzer (Aphididae) (Hare, 1990; Louis & Shah, 2013). The latter is associated with plants from nearly 50 families including a number of important crops and, in addition, is a vector of more than 100 viral plant diseases (Louis & Shah, 2013). However, the majority of phytophagous insects are restricted to a limited number of host taxa (Bernays & Chapman, 1994). Often it is assumed that this enormous species-richness in phytophagous insects is driven mainly by cospeciation with host-plants. Some studies have addressed this issue in matching the phylogenies of insects and that of their hosts (Becerra & Venable, 1999; Burckhardt & Basset, 2000; Bush & Butlin, 2004; Futuyma & Mitter, 1996; Ouvrard, Chalise & Percy, 2015; Percy, 2002; Percy, 2003; Percy & Cronk, 2002; Percy, Page & Cronk, 2004; Tahvanainen & Niemelä, 1987). Some of these studies suggest that cospeciation of insects and plants occurs rarely and speciation in insects is often evoked by host shifts. The problem is to distinguish the two phenomena. Host shifts are often phylogenetically conserved and occur between closely related plant species, cospeciation may thus give patterns identical to those of host switching (Ouvrard, Chalise & Percy, 2015; Percy, Page & Cronk, 2004). Another phenomenon explaining the high number of phytophagous insect species is allopatric speciation, where sister species of insects occupying different geographical ranges occur on the same host taxon (Agrain & Roig-Juñent, 2011; Burckhardt & Basset, 2000; Burckhardt & Ouvrard, 2007; Bush & Butlin, 2004; Claridge, 1995; Domínguez *et al.*, 2016).

Psyllids or jumping plant-lice (Hemiptera: Psylloidea) are phloem-feeding insects, mostly associated with angiospems. Psyllids remain a poorly studied group in terms of taxonomy with only about 4000 described species, which probably comprises only half of its total number in the world (Li, 2011). Despite the fact that psyllids are most species-rich in the tropics and South temperate regions (Burckhardt & Queiroz, 2012), the west Palaearctic fauna remains the best known with around 400 species reported from Europe (Burckhardt, 2004) and around 1000 species from China (Li, 2011). A number of psyllid species are serious agricultural and forestry pests, and some of them transmit plant pathogens (Burckhardt & Lauterer, 1997; Burckhardt *et al.*, 2012; Butler & Trumble, 2012; Halbert & Manjunath, 2004; Hall *et al.*, 2012; Hansen *et al.*, 2008; Hodkinson, 1981; Liefting *et al.*, 2009; Queiroz & Burckhardt, 2007; Taylor & Kent, 2013). Thus, *Bactericera cockerelli* Šulc (Triozidae) is one of the most serious potato pests in the Western Hemisphere (Munyaneza, 2015). The species in native to southern North America and was introduced in some countries of the Americas and New Zealand, where it transmits the potato diseases, the Psyllid Yellows and the Zebra Chip (Butler & Trumble, 2012; EPPO, 2014; Hansen *et al.*, 2008; Liefting *et al.*, 2009). The Asian citrus psyllid, *Diaphorina citri* Kuwayama (Psyllidae), is the most dangerous pest of citrus in Brazil and some areas of the Americas, where it causes Citrus greening disease (Huanglongbing) (Coletta-Filho *et al.*, 2004; Halbert & Manjunath, 2004; Hall *et al.*, 2012).

The majority of psyllids are monophagous or oligophagous (Burckhardt *et al.*, 2014; Hodkinson, 2009), and only few species are confirmed or likely polyphagous, viz. six *Bactericera* species (Triozidae) and *Russelliana solanicola* (Psyllidae) (Burckhardt & Lauterer, 1997; Hodkinson, 1981; Ouvrard & Burckhardt, 2012; Serbina *et al.*, 2015). In total, eight families are recognised in psyllids: Aphalaridae, Carsidaridae, Calophyidae, Homotomidae, Liviidae, Phacopteronidae, Psyllidae and Triozidae (Burckhardt & Ouvrard, 2012). Their immatures are generally highly specific and associated with a restricted number of plant taxa (Hodkinson, 1974; Hodkinson, 1980) on which they complete development (Burckhardt *et al.*, 2014). Higher psyllid taxa are also often associated with a single host-plant taxon or several closely related plant species, for instance, Carsidaridae and Homotomidae families are associated with plants from Malvaceae and Moraceae, respectively (Burckhardt, 2005a). The largest family, Psyllidae (~ 1200 species), is associated mostly with Fabaceae but with several shifts to other plant families (Ouvrard, 2012). Psyllidae combines five probably monophyletic subfamilies: Acizziinae, Aphalaroidinae, Ciriacreminae, Macrocorsinae and Psyllinae (Burckhardt & Ouvrard, 2012). Species of Acizziinae, Ciriacreminae and Macrocorsinae develop predominantly on Fabaceae (Aléné, Hoess & Burckhardt, 2007; Burckhardt, 1987b; Ouvrard, 2012; Taylor & Kent, 2013), while Aphalaroidinae and Psyllinae are associated with a wide variety of hosts (Burckhardt, 1987a; Ouvrard, 2012; White & Hodkinson, 1985).

The subfamily Aphalaroidinae comprises 13 psyllid genera, mostly occurring in the Neotropics, and remains relatively unstudied in terms of taxonomy and host-plant associations (Burckhardt, 1987a; Burckhardt, 2005b; Burckhardt & Wyniger, 2007; Tuthill, 1959; Tuthill, 1964). Only two genera of Aphalaroidinae are from the Old World – the Oriental Asian and Afrotropical *Yangus* and *Pachyparia* from Arabian Peninsula, Egypt and Sudan (Ouvrard, 2012) + (NHMB, unpublished data); other 11 genera inhabit the New World tropics – *Aphalaroida*, *Baccharopelma*, *Connectopelma*, *Ehrendorferiana*, *Freysuila*, *Panisopelma*, *Prosopidopsylla*, *Russelliana*, *Sphinia*, *Telmapsylla* and *Zonopelma* (Burckhardt, 1987a; Burckhardt, 2005b; Burckhardt & Wyniger, 2007). The representatives of Aphalaroidinae are associated with a high number of plant families (13), suggesting that host switching in the subfamily has occurred multiple times to unrelated plants. Within the subfamily, the highest number of psyllid genera (6) are associated with plants from Fabaceae. However, in general, each genus develops on plants from 1–2 families, and only *Russelliana* was reported from six families (Burckhardt *et al.*, 2012; Serbina *et al.*, 2015). Based on the absence of metabasitarsal spurs, *Russelliana* probably forms a monophyletic group, along with other three aphalaroidine genera – *Baccharopelma* (on Asteraceae), *Ehrendorferiana* (on Cupressaceae) and *Panisopelma* (on Zygophyllaceae) (Burckhardt, 1987a; Burckhardt, 2005b; Burckhardt *et al.*, 2004; Burckhardt & Ouvrard, 2007), but more work is needed to describe their relationships.

Russelliana strikes as the most species-rich genus in Aphalaroidinae with currently 19 described species (Burckhardt, 1986; Burckhardt, 1987a; Burckhardt, 2008a; Burckhardt, 2008b; Tuthill, 1959; Tuthill, 1964), and represents an interesting model group for insect–plant studies. Moreover, the genus comprises a number of Solanaceae feeding species, along with a polyphagous and invasive *R. solanicola* (Burckhardt *et al.*, 2012; Serbina *et al.*, 2015), and, taking into account a high number of undescribed species in *Russelliana*, more host associations with Solanaceae are expected to be found. The description of new *Russelliana* species is an initial step in the identification of potential pests, in respect that many Solanaceae feeding psyllids are economically important pests of crop plants and vectors of plant pathogens (Burckhardt & Lauterer, 1997; Burckhardt *et al.*, 2012; Hodkinson, 1981; Taylor & Kent, 2013).

The present paper reviews the taxonomy of *Russelliana* aiming to study, describe and analyse the species diversity within the genus. This covers the descriptions of new taxa, redescription and revision of previously described species, and the analysis of *Russelliana* phylogeny. The host-plant and biogeographical relationships within the genus, along with the patterns of psyllid speciation, are discussed. We also provide an illustrated identification key for all *Russelliana* species.

MATERIAL AND METHODS

Material was examined or is cited from following institutions: BMNH – Natural History Museum, London, UK; CASC – California Academy of Sciences, San Francisco, California, USA; MHNG – Muséum d'histoire naturelle, Geneva, Switzerland; MNNC – Museo Nacional de Historia Natural, Santiago, Chile; NHMB – Naturhistorisches Museum, Basel, Switzerland; USNM – National Museum of Natural History, Washington DC, USA.

Morphological terminology (Figs 1–6) follows mostly Ossiannilsson (1992), Hollis (2004) and Yang *et al.* (2009). Measurements were taken as indicated in Figs 1A–3A, 6A. Following measurements (in mm) (Table 1) and ratios (Table 2) are used: GL = genal processes length; HW = head width; VL = vertex length; VW = vertex width; AL = antennal length (including scape and pedicel); LAB2 = length of median labium segment; LAB3 = length of distal labium segment; FL = forewing length; FW = forewing width; MtFL = metafemur length; MtTL = metatibia length. – Male terminalia: MP = male proctiger length; PL = paramere length; DL = length of distal segment of aedeagus. – Female terminalia: FP = female proctiger length; SP = female subgenital plate length; AP = length of apical process of female subgenital plate. – GL/VL = genal processes length : vertex length ratio; AL/HW = antennal length : head width ratio; LAB = length of median and distal labium segments (labium length without length of proximal segment); FL/HW = forewing length : head width ratio; FL/FW = forewing length : width ratio; MtTL/HW = metatibia length : head width ratio; FP/HW = female proctiger length : head width ratio; FP/SP = female proctiger length : female subgenital plate length ratio; AP/SP = length of apical process of female subgenital plate : female subgenital plate length ratio. Measurements and ratios for *Russelliana lycii* Tuthill are partly taken from Burckhardt (1987) and incomplete due to the unavailability of slide material.

The nomenclature of plant names and plant phylogeny follow the Plant List (2014) and the Angiosperm Phylogeny website (Stevens, 2001 onwards). In cases of discrepancies between the accepted plant name and original label data, the later is added in parentheses.

Photos from dry and slide mounted specimens were taken with a KEYENCE VHX-2000 digital microscope and a Leica Digital Camera DFC320 mounted on a Leica MZ12 dissecting microscope. Drawings of dissected slide mounted specimens were made using a Leica DMLB compound microscope with subsequent digitalizing of the images with the programme Adobe Illustrator CS5.1.

The cladistic analysis was performed with NoNa version 2.0 (Goloboff, 1999) using the interface WinClada version 1.00 (Nixon, 2002). A heuristic search was performed with the following settings: maximum trees to keep = 10.000; number of replications = 5; starting trees per replication = 0; random seed = 0; search strategy = multiple TBR (tree-bisection-reconnection) + TBR. For constructing a consensus tree the command Nelsen (collapse + consensus) was chosen.

In order to avoid further taxonomical confusions, the species names of 24 new species of *Russelliana* are replaced by numbers from 1 to 24.

RESULTS

TAXONOMIC TREATMENT

Russelliana Tuthill, 1959: 11. Type species: *Russelliana solanicola* Tuthill, by original designation and monotypy.

Arepuna Tuthill, 1959: 10. Type species: *Arepuna lycii* Tuthill, by original designation and monotypy; synonymised by Burckhardt (1987a).

Description adult. Head (Fig. 1), in profile, weakly (< 45°) to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal (Fig. 1A, C, D, E) to trapezoidal (Fig. 1B) with indented foveae, anteriorly produced into transverse tubercle (Fig. 1C) or lobe (Fig. 1A, B, D. E) on either side of mid-line, with flat to raised hind margin around lateral ocelli; covered with microscopical to long setae; genal processes conical, slender (Fig. 1A, C, D) to swollen (Fig. 1 B, E), pointed to slightly blunt apically; 0.2–1.1 times as long as vertex; covered with short to long setae. Antennae 10-segmented; 0.8–2.1 times as long as head width; with a subapical rhinarium on segments 4, 6, 8 and 9; segment 10 usually with a subequal pair of terminal setae. Clypeus heart-shaped, weakly protruding in profile. Rostrum relatively short (rarely long); labium segments 0.1–0.5 (rarely 0.6–0.7) times as long as head width; proximal segment 1.1–3.4 times longer than distal segment. Pronotum lacking tubercles, or with one to three tubercles on either side. Propleurites longer as its width; episternum and epimeron subequal. Forewing (Fig. 2) membrane colourless, whitish to bright yellow (rarely brown to black), often becoming darker towards apex, with or without pattern; if pattern absent, membrane (Fig. 2A) often fumose in the middle of cells in apical part and with brown patch along vein Cu_{1b}; if present, pattern (Fig. 2D, E) consists of pale to dark brown stripes and/or dots. Forewing oval, oblong-oval (Fig. 2A), oviform (Fig. 2B, C) to rhomboidal (Fig. 2D, E), widest in the middle (Fig. 2B, C) or in apical third (Fig. 2A, D, E), narrowly or broadly rounded apically; forewing length 2.0–2.9 times as long as its width; veins with short microscopical setae (rarely long) in comparison with vein width, more densely spaced at base of the wing. Vein C+Sc of forewing weakly (Fig. 2A, B) to strongly (Fig. 2C–E) curved; pterostigma long (rarely short); vein Rs straight, weakly sinuous (Fig. 2A–C) or strongly curved to fore margin apically (Fig. 2D, E); cell m_1 short (shorter than vein M) to long (longer than vein M). Forewing surface spinules often present in all cells, weakly to strongly developed, sometimes with radular spinules covering triangular (rarely rounded) areas along the margin of cells r_2, m_1, m_2 and cu_1; sometimes surface spinules absent in apical third of the wing but base of cell cu_2 and area between clavus and vein A always covered with fine surface spinules, and radular spinules covering triangular (rarely rounded) areas along the margin of cells r_2, m_1, m_2 and cu_1. Meracanthus of metacoxae long, spur-shaped; metatibia 0.4–0.9 times as long as head width, without basal spine, with a crown of ungrouped or indistinctly grouped 4–9 apical spurs. Basal metatarsi without black spurs.

Terminalia. Male (Figs 3A, 4A, 5A). Subgenital plate relatively short, elongate to subglobular; covered with short to long setae except for base, rarely with a row of bristles along dorsal margin. Proctiger tubular, barrel-shaped or irregularly subtrapezoidal; straight to weakly produced posteriorly, widest in the middle or in basal third, rarely strongly produced posteriorly and widest in apical third; covered with short to long setae except for base. Paramere oblong-oval (Fig. 3B), shortly (Fig. 4E), narrowly (Figs 3C, D, 4B, D, F, I) or broadly (Figs 3E, 4G, H) lamellar, or irregularly subtrapezoidal (Fig. 4A, C); always with short to long hook-shaped (Fig. 4A, B), recurved (Figs 3C, 4D, E), or finger-shaped (Fig. 3D) apico-anterior process which is on pedicel (Figs 3B–D, 4A–E, G, I) or lacking pedicel (Figs 3E, 4F, H), with sclerotized tooth (rarely absent) situated apically or at base of the lobe, or apically sclerotized median ridge, sometimes with short to long median hump (Fig. 4A, C, H, I), and weakly (Figs 3B, E, 4B, C, F, G, H, I) to strongly (Figs 3C, D, 4A, D, E) bulged apico-posterior lobe; process usually situated of the same level with lobe, rarely interiorly towards lobe (Figs 3B, 4B, E); outer face covered with short to long setae mostly in apical half; inner face covered with short to long setae. Distal segment of aedeagus elongate to massive, weakly to strongly expanding towards apex; with short beak-like (Fig. 5C), long, straight (Fig. 5A, E–H) or hook-shaped (Fig. 5D) anterior process; if process absent, distal segment rounded (Fig. 5B) or angular (Fig. 5I) apically, weakly to strongly inflated anteriorly; with one horn-shaped apico-posterior tubercle (Fig. 5C) to two tubercles of different size, shape and position (Fig. 5A, D–H), sometimes tubercles absent (Fig. 5B, I); lateral lobes always present, short to long, dilated towards apex (Fig. 5B), or large, triangular, dilated towards apex which is rounded or concave (Fig. 5A, C–H), or tubular with subparallel sides (Fig. 5I), apical margin with frayed to entire margin. – Female (Fig. 6A). Terminalia relatively short, rarely long; proctiger usually 1.5–2.8 times longer than subgenital plate (rarely 1.0–1.4). Proctiger cuneate (Fig. 6A, D, E) to subglobular (Fig. 6C), pointed to subacute apically; dorsal margin, in profile, almost straight (Fig. 6A, D) to strongly bent downwards (Fig. 6C), sometimes with subapical indentation (Fig. 6E); covered with short to long setae except for base, usually with long setae along circumanal ring and in median part. Circumanal ring (Fig. 6B) consisting of two unequal rows of pores, outer pores generally round and inner pores long, narrow. Subgenital plate cuneate (Fig. 6A, D) to globular (Fig. 6C, E); rounded apically (Fig. 6C), or with tiny to very long apical process (Fig. 6A, D, E); covered with short to long setae except for base and usually with long setae along ventral margin; often with a row of thick bristles along dorsal margin. Dorsal and ventral valvulae straight, subacute apically; lateral valvulae narrowly rounded apically.

Comment. At present *Russelliana* comprises 19 described species (Burckhardt, 1986; Burckhardt, 1987a; Burckhardt, 2008a; Tuthill, 1959; Tuthill, 1964). In this paper, we formally describe and name 24 new species, along with a revision of the previously described ones. Due to inaccessability of slide material on *Russelliana lycii* Tuthill, its description follows partly Burckhardt (1987). The females of *Russelliana chilensis* Burckhardt are described for the first time, as are those of *Russelliana adunca* Burckhardt. The females attributed to *R. adunca* by Burckhardt (1987) belong to another undescribed species, i.e. *Russelliana 5* sp. nov. Additional species are represented in the material at hand but are not described and named here due to insufficient material or its poor state, meaning that more species of this genus are expected to be found and described.

KEY TO ADULT *RUSSELLIANA* SPECIES

1 Forewing oblong-oval (Fig. 2A) or oviform (Fig. 2B, C), usually more than 2.2 times as long as wide 2
- Forewing rhomboidal (Fig. 2D, E), less than 2.2 times as long as wide, always with brown pattern consisting of dots and patches 39

2 Forewing yellow, with vein C+Sc strongly curved in the middle (Figs 11H, 14G). Paramere broadly lamellar, process lacking pedicel (Figs 21G, 24F). Distal segment of aedeagus strongly inflated apically (Figs 26D, 28F). Dorsal margin of female proctiger, in profile, strongly curved with subapical indentation (Figs 30F, 33D) 3

- Combination of characters different 4

3 Forewing with very dense surface spinules in apical half, leaving no spinule-free stripes along veins, lacking well-defined radular areas with spinules along apical margin. AL/HW > 1.0. Male and female terminalia as in Figs 16G, 30F. Argentina, Chile. On *Fabiana imbricata* .... ***R. fabianae***

- Forewing without surface spinules in apical half, radular spinules covering rounded areas along apical margin of cells r_2, m_1, m_2 and cu_1. AL/HW < 1.0. Male and female terminalia as in Figs 19F, 33D. Chile .... ***R. 23*** sp. nov.

4 Vertex covered with long setae. Genal processes (Figs 8I, 9J) long, GL/VL > 0.7. Antenna long, AL/HW > 1.6. Forewing always with dark brown, strongly contrasted pattern (Figs 12H, 14E). Paramere deeply incised with process and lobe both of subequal length (Figs 22F, 24D). Distal segment of aedeagus angular apically, with long, tubular lateral lobes (Figs 26L, 28D). Female terminalia as in Figs 21D, 33B. On *Mulguraea scoparia* 5

- Combination of characters different 6

5 Forewing (Fig. 12H) long, FL/FW > 2.7; base of cell r_2 light; veins bearing long macroscopical setae clearly visible at 50x magnification, on vein Rs longer than distance between setae. Argentina .... ***R. marionae***

- Forewing (Fig. 14E) short, FL/FW < 2.7; base of cell r_2 dark; veins bearing microscopical setae hardly visible at 50x magnification, on vein Rs much shorter than distance between setae. Chile .... ***R. theresae***

6 Body and forewing colour dirty whitish to pale yellow. Paramere with claw-like process (Fig. 23A, F). Female proctiger covered with short thick bristles in apical third; subgenital plate (Figs 31H, 32D) with very long apical process, AP/SP > 0.7 7

- Combination of characters different 8

7 Genal processes (Fig. 8M) long, GL/VL < 0.3. Forewing oblong-oval, broadest in apical third, cell m_1 long (Fig. 13B). Paramere, in profile, with narrow base and strongly expanded towards apex (Fig. 23A). Distal segment of aedeagus with short beak-like process (Fig. 27D). Argentina .... ***R. 16*** sp. nov.

- Genal processes (Fig. 9C) short, GL/VL > 0.5. Forewing oviform, broadest in the middle, cell m_1 shorter (Fig. 13H). Paramere, in profile, oblong-oval (Fig. 23F). Distal segment of aedeagus broadly, unevenly rounded apically (Fig. 27I). Brazil .... ***R. 19*** sp. nov.

8 Forewing whitish or yellow, without pattern (Figs 10A, F, 12A, 14H). Paramere with hook-shaped process in interior position (Figs 20A, E, 21I, 24G). Distal segment of aedeagus with short beak-like process (Figs 25A, E, 26F, 28G). Female proctiger pointed apically; dorsal margin, in profile, straight or bent downwards (Figs 29A, E, 30H, 33E). On Asteraceae 9

- Combination of characters different 12

9 Thorax black, abdomen bright yellow. Forewing oviform, broadest in the middle, narrowly rounded apically (Fig. 10F). Male and female terminalia as in Figs 15E, 29E. Female subgenital plate along dorsal margin with thick setae apically which are as long as those ventrally. Chile .... ***R. 3*** sp. nov.

- General colour of body yellow. Forewing oblong-oval, broadest in apical third, broadly rounded apically (Figs 10A, 12A, 14H). Terminalia different. Female subgenital plate along dorsal margin with thick setae apically which are much shorter than those ventrally 10

10 Forewing whitish or dirty greyish in apical half (Fig. 10A). Male terminalia as in Fig. 15A. Female proctiger oblong cuneate; dorsal margin, in profile, almost straight (Fig. 29A). Chile .... ***R. 1*** sp. nov.

- Forewing yellow (Figs 12A, 14H). Male terminalia as in Figs 16I, 19G. Female proctiger subglobular; dorsal margin, in profile, strongly bent downwards (Figs 30H, 33E) 11

11 Surface spinules dense, leaving, at most, very narrow spinule-free stripes along veins in apical part. Paramere with process on short pedicel, median hump large and in distance from process, and with prolonged, curved apex of lobe (Fig. 21I). Distal segment of aedeagus with short thick beak-like process (Fig. 26F). Argentina, Bolivia .... ***R. intermedia***

- Surface spinules relatively sparse, leaving narrow spinule-free stripes along veins throughout the wing or almost completely absent in apical part of wing. Paramere with process almost completely lacking pedicel and with short, straight apex of lobe; median hump absent (Fig. 24G). Distal segment of aedeagus with relatively long, slender beak-like process (Fig. 28G). Chile. On *Baccharis* spp .... ***R. 24*** sp. nov.

12 Paramere with thumb-like process that is inserted in the middle of anterior margin; apical half of paramere with conspicuous long thick bristles (Figs 20G, 21E, 23H). Distal segment of aedeagus strongly inflated anteriorly lacking hook or beak-like process (Figs 25G, 26B, 27K). Dorsal margin of female proctiger, in profile, strongly bent downwards; female subgenital plate short (Figs 29G, 30D, 32F), FP/HW < 0.5. On *Dipyrena juncea* 13

- Combination of characters different 15

13 Forewing without pattern, entirely bright yellow, pterostigma long (Fig. 10H). Antenna short, AL < 1.0 mm, AL/HW < 1.3. Paramere process and lobe of subequal length (Fig. 20G). Female subgenital plate with short apical process (Fig. 29G). Argentina, Chile .... ***R. bulbosa***

- Forewing with well-defined dark brown pattern, pterostigma short (Figs 11F, 13J). Antenna long, AL > 1.0 mm, AL/HW > 1.3. Paramere process distinctly shorter than lobe (Figs 21E, 23H). Female subgenital plate rounded apically, without process (Figs 30D, 32F). Chile 14

14 Genal processes (Fig. 7N) long, slender, GL/VL > 0.6. Forewing (Fig. 11F) broad; cell r_2 light in basal half, cell m_1 wide and short .... ***R. diosteae***

- Genal processes (Fig. 9E) short, swollen, GL/VL < 0.6. Forewing (Fig. 13J) narrow; cell r_2 dark brown in basal half, cell m_1 narrow and long .... ***R. sebastiani***

15 Forewing lacking surface spinules in apical half, except for radular spinules 16

- Forewing with surface spinules in apical half, sometimes reduced to narrow stripes in the middle of cells 25

16 AL > 1.0 mm, FL > 2.0 mm 17

- Either AL < 1.0 mm, or FL < 2.0 mm (usually both) 18

17 MtTL/HW > 0.7. Male terminalia as in Fig. 16F; paramere with large sickle-shaped process and distinctly longer lobe (Fig. 21F). Female terminalia as in Fig. 30E. Argentina, Bolivia, Chile, Peru. On *Dunalia* .... ***R. disparilis***

- MtTL/HW < 0.7. Male terminalia as in Fig. 19A; paramere with small hook-shaped process, short median hump and slightly bulged lobe; process, hump and lobe of subequal length (Fig. 24A). Female terminalia as in Fig. 32H. Bolivia .... ***R. similis***

18 Forewing with brown pattern at least in apical third. On *Adesmia* 19

- Forewing lacking distinct dark pattern, though middle of cells along apical margin and area around vein Cu_{1b} often fumous. On other hosts 22

19 Paramere with process lacking pedicel (Fig. 22A). Distal segment of aedeagus with tiny process situated in basal part of apical quarter of segment (Fig. 26G). Female terminalia as in Fig. 30I; $FP > 0.4$ mm, $FP/SP < 1.5$. Chile.........***R. 10*** sp. nov.

- Paramere with process on pedicel (Figs 22H, I, 23I). Distal segment of aedeagus with long process situated in apical part of segment (Figs 27B, C, 27L). Female terminalia different (Figs 31 F, G, 32G); $FP < 0.4$ mm, $FP/SP > 1.5$ 20

20 Forewing lacking pattern in basal third (Fig. 14A). Male terminalia as in Fig. 18I. Female terminalia densely covered with long setae (Fig. 32G). Argentina............ ....***R. 21*** sp. nov.

- Forewing with brown pattern over entire length (Figs 12J, 13A). Male and female terminalia as in Figs 17H, I, 31F, G 21

21 Paramere distinctly widening to apex which is weakly sinuous, without distinct median hump (Fig. 22H). Ventral margin of female subgenital plate weakly curved (Fig. 31F). Argentina...***R. 14*** sp. nov.

- Paramere hardly widening to apex and with distinct median hump (Fig. 22I). Ventral margin of female subgenital plate strongly curved (Fig. 31G). Chile............... ....***R. 15*** sp. nov.

22 Paramere narrowly lamellar, process lacking pedicel, median sclerotised tooth not on hump (Fig. 24C). Distal segment of aedeagus with moderately long process situated almost in the middle of segment (Fig. 28C). Female terminalia as in Fig. 33A. Argentina, Chile. On *22 alatum*.......................................***R. 22*** sp. nov.

- Paramere irregularly subtrapezoidal, hook-shaped process on long pedicel, median sclerotised tooth on large hump (Figs 20D, F, 21C). Distal segment of aedeagus with long, straight or hook-shaped process situated in apical part of segment (Figs 25D, F, L). Female terminalia as in Figs 29D, F, 30B 23

23 Genal processes (Fig. 7F) very short, $GL/VL < 0.4$. Male and female terminalia as in Figs 15F, 29F. Chile. On *Lycium*...***R. 4*** sp. nov.

- Genal processes (Figs 7D, F, L) long, $GL/VL > 0.4$. Male and female terminalia different 24

24 Male terminalia as in Fig. 15D; paramere with large, strongly bulged lobe that is apically about level with process and median hump (Fig. 20D); distal segment of aedeagus with relatively straight process (Fig. 25D). Female terminalia as in Fig. 29D; proctiger stout apically. Argentina, Bolivia .... ***R. adunca***

- Male terminalia as in Fig. 16C; paramere with small lobe, distinctly shorter than process and median hump (Fig. 21C); distal segment of aedeagus with hook-shaped process (Fig. 25L). Female terminalia as in Fig. 30B; proctiger slender apically. Argentina, Chile. On *Lycium chilense*...***R. 7*** sp. nov.

25 Body almost entirely dark brown to black (except for young specimens). Forewing yellow or dark brown to black (Figs 12I, 13C). Terminalia as in Figs 17G, 18B, 31E, I... 26

- Body completely or partially light. Forewing whitish or yellow, with or without dark pattern. Terminalia different 27

26 Forewing yellow (Fig. 12I). Male proctiger strongly bulged posteriorly (Fig. 17G). Paramere large, lobe strongly bulged (Fig. 22G). Female terminalia as in Fig. 31E; $FP/SP < 2.2$. Chile. On *Adesmia* ....***R. 13*** sp. nov.

- Forewing dark brown or black (Fig. 13C). Male proctiger almost straight posteriorly (Fig. 18B). Paramere with small lobe (Fig. 23B). Female terminalia as in Fig. 31I; $FP/SP > 2.2$. Bolivia...***R. nigra***

27 Forewing in apical half with light to dark brown pattern, sometimes very pale. On *Adesmia* (where known) 28

\- Forewing lacking distinct dark pattern, area around vein Cu_{1b} and middle of cells in apical half often fumous, sometimes also apices of veins conspicuously brown. Not on Fabaceae (where known) 35

28 Forewing with very dense surface spinules 29

\- Forewing with spaced surface spinules 33

29 Paramere narrowly lamellar with long process on pedicel (Fig. 24E). Female terminalia as in Fig. 33C; SP > 0.30 mm, FP/SP < 1.6. Argentina, Bolivia .... ***R. vinculipennis***

\- Paramere broadly lamellar with short process with or without pedicel (Figs 20C, 21A, 22B, E). Female terminalia as in Figs 29C, J, 30K, 31C; SP < 0.30 mm, FP/SP > 1.6. Chile 30

30 Rostrum long, LAB > 0.36 mm. Male and female terminalia as in Fig. 17B, 30K. On *A. atacamensis* .... ***R. 11*** sp. nov.

\- Rostrum short, LAB < 0.36 mm. Male and female terminalia different 31

31 Forewing with surface spinules in cell r_2 above bifurcation of vein M very dense. Paramere process on pedicel (Fig. 20C). Female terminalia as in Fig. 29C. On *Adesmia* .... ***R. adesmiae***

\- Forewing with surface spinules in cell r_2 above bifurcation of vein M less dense, forming irregular transverse rows. Paramere with process lacking pedicel (Figs 21A, 22E). Female terminalia as in Figs 29J, 31C 32

32 Genal processes (Fig. 7J) long, GL/VL > 0.5. Antenna short, AL < 0.8 mm. Forewing oblong-oval, broadest in apical third (Fig. 11A), FL/HW > 2.7. Male terminalia as in Fig. 16A. Female terminalia as in Fig. 29J; FP/SP > 1.7 ... ***R. chilensis***

\- Genal processes (Fig. 8H) short, GL/VL < 0.5. Antenna long, AL > 0.8 mm. Forewing oviform, broadest in the middle (Fig. 12G), FL/HW < 2.7. Male terminalia as in Fig. 17E. Female terminalia as in Fig. 31C; FP/SP < 1.7. On *A. boronioides* .... ***R. 12*** sp. nov.

33 Forewing pattern very pale (Fig. 13F). Paramere with process lacking pedicel, without distinct lobe (Fig. 23D). Female subgenital plate with short apical process (Fig. 32B). Chile. On *Adesmia* spp. .... ***R. 18*** sp. nov.

\- Forewing pattern dark (Figs 12F, 13G). Paramere with process on long pedicel, lobe strongly bulged (Figs 22D, 23E). Female subgenital plate with long apical process (Figs 31B, 32C) 34

34 Paramere with lobe longer than process, relatively straight posteriorly (Fig. 22D). Distal segment of aedeagus with long hook-shaped process (Fig. 26J). Female terminalia as in Fig. 31B. Argentina, Bolivia .... ***R. maculata***

\- Paramere with process and lobe of subequal length, lobe strongly bulged posteriorly (Fig. 23E). Distal segment of aedeagus with short beak-like process (Fig. 27H). Female terminalia as in Fig. 32C. Argentina .... ***R. punctulata***

35 Forewing whitish, apices of veins conspicuously brown. Male terminalia as in Fig. 16B. Female terminalia as in Fig. 30A; FP/SP < 2. Chile. On *Chorizanthe* .... ***R. 6*** sp. nov.

\- Combination of characters different 36

36 Small, AL < 0.7 mm, FL < 1.5 mm. Male and female terminalia as in Figs 18G, 32E. Chile. On *22 alatum* .... ***R. 20*** sp. nov.

\- Large, AL > 0.7 mm, FL > 1.5 mm. Male and female terminalia different (Figs 15D, I, 19B, 29D, I, 32I) 37

37 Forewing (Fig. 14C) with very dense surface spinules, reaching veins, covering entire cell c+sc. Paramere with posterior edge of process not angled, lobe evenly

rounded apico-posteriorly (Fig. 24B). Distal segment of aedeagus with moderately long process (Fig. 28B). Female terminalia as in Fig. 32I; proctiger about twice as long as circumanal ring, dorsal margin, in profile, weakly sinuous. Argentina, Bolivia, Brazil, Chile, Peru, Uruguay. Polyphagous................***R. solanicola***

\- Forewing (Figs 10 E, J) with relatively sparse surface spinules, leaving narrow or broad spinule-free stripes along veins, base of cell c+sc always lacking spinules. Paramere process with angled posterior edge, lobe irregularly rounded or angular apico-posteriorly (Figs 20D, I). Distal segment of aedeagus with long process (Fig. 25D, I). Female terminalia as in Figs 29D, I; either proctiger about three times as long as circumanal ring or dorsal margin, in profile, almost straight or slightly convex 38

38 Male terminalia as in Fig. 15D; paramere with large lobe (Fig. 20D). Female terminalia as in Fig. 29D; proctiger about twice as long as circumanal ring, dorsal margin, in profile, almost straight or slightly convex. Argentina, Bolivia........... .... ***R. adunca***

\- Male terminalia as in Fig. 15I; paramere with small lobe (Fig. 20I). Female terminalia as in Fig. 29I; proctiger about three times as long as circumanal ring, dorsal margin, in profile, weakly sinuous. Argentina, Bolivia, Chile. On *Lycium* cf. *chilense* ....***R. 5*** sp. nov.

39 Forewing: male with brown pattern consisting of a single curved stripe stretching from base to apex (Fig. 10B); female with expanded light brown pattern forming two transverse subparallel bands along apical margin of wing, and with a conspicuous dark spot in basal half (Fig. 10C). Male and female terminalia as in Figs 15B, 29B. Chile. On *Lycium* ....***R. 2*** sp. nov.

\- Forewing: male with brown pattern consisting of two oblique stripes, one basally and one apically, respectively (Figs 10I, 11D, I, 12D, 13D); female with different pattern.. 40

40 Forewing pattern hardly dimorphic consisting of two oblique well-defined and homogenously coloured brown stripes (Fig. 10I). Male and female terminalia as in Figs 15H, 29H. Argentina, Brazil. On *Capsicum annuum*.........................***R. capsici***

\- Forewing pattern strongly dimorphic: in male with two many dots in addition to transverse stripes which are partly or entirely composed of small dots (Figs 11D, I, 12D, 13D); in female with pale brown pattern consisting of brown dots, partly confluent and broad stripe parallel to apical margin (Figs 11E, J, 12E, 13E). Terminalia different.. 41

41 Male.. 42

\- Female 45

42 Male proctiger tubular (Figs 16D, 17C). Paramere with narrowly lamellar lobe (Figs 21D, 22C).. 43

\- Male proctiger barrel-shaped (Figs 16H, 18C). Paramere with broadly rounded lobe (Figs 21H, 23C).. 44

43 Genal processes covered with short setae, vertex covered with microscopical setae (Fig. 7M). Paramere with recurved process (Fig. 21D). Argentina. On *Lycium* ....***R. 8*** sp. nov.

\- Genal processes and vertex covered with long setae (Fig. 8F). Paramere with anteriorly directed process (Fig. 22C). Peru. On *Lycium salsum*........................***R. lycii***

44 Forewing with long cell m_1 (Fig. 11I). Distal segment of aedeagus with long, tubular lateral lobes with subparallel sides (Fig. 26E). Male terminalia as in Fig. 16H. Argentina ....***R. 9*** sp. nov.

- Forewing with short cell m_1 (Fig. 13D). Distal segment of aedeagus with long, apically rounded lateral lobes (Fig. 27F). Male terminalia as in Fig. 18C. Chile. On *Nolana* spp. .... ***R. 17*** sp. nov.

45 Female proctiger cuneate; subgenital plate with very short apical process (Figs 30C, 32A) 46

- Female proctiger trapezoidal; subgenital plate broadly rounded apically, lacking process (Figs 30G, 31A) 47

46 Forewing pattern consisting of one dark band along apical margin (Fig. 11E). Female terminalia as in Fig. 30C. Argentina. On *Lycium* .... ***R. 8*** sp. nov.

- Forewing pattern consisting of two dark bands along apical margin (Fig. 13E). Female terminalia as in Fig. 32A. Chile. On *Nolana* cf. *sedifolia* .... ***R. 17*** sp. nov.

47 Vertex lacking macroscopical setae (at 50x magnification). Female terminalia as in Fig. 30G. Argentina .... ***R. 9*** sp. nov.

- Vertex covered with long setae (visible at 50x magnification). Female terminalia as in Fig. 31A. Peru. On *Lycium salsum* .... ***R. lycii***

The species are listed in the alphabetical order.

RUSSELLIANA 1 SP. NOV.

(FIGS 7A, 10A, 15A, 20A, 25A, 29A)

Material examined

Holotype m$: **Chile**: V Region, Province Los Andes, El Juncal, 2200 m, 24.xii.1998, Asteraceae (D. Burckhardt) #6(4) (NHMB, dry).

Paratype. **Chile**: 1 m$, 10 f£, V Region, Province Los Andes, Río Blanco to Portillo, route 60, Aconcagua Valley, 32°50'S 70°08'W, 2200–2400 m, 23.xi.1992, *Nardophyllum* cf. *lanatum*, alpine scrub (D. Burckhardt) #12 (NHMB, dry); 9 f£, same but *Mulguraea scoparia* [*Diostea scoparia*] (D. Burckhardt) #12 (NHMB, dry); 11 m$, 13 f£, 3 immatures, same but Portillo, 32°50'S 70°08'W, 2200 m, 31.xii.1993, ?*Baccharis* sp. (D. Burckhardt) #44 (MHNG, NHMB, dry); 4 m$, 4 f£, same but km 14 Portillo to Río Blanco, Aconcagua Valley, 2100 m, *Lycium* sp., subalpine scrub (D. Burckhardt) #19(4) (MHNG, NHMB, dry); 10 m$, 10 f£, 9 immatures, same but km 10 Portillo to Río Blanco, 2300 m, *Lycium* sp., alpine scrub (D. Burckhardt) #18(4) (MHNG, dry, on slide, 70 % ethanol); 26 m$, 39 f£, 1 immature, same as holotype (D. Burckhardt) #6(4) (NHMB, dry, on slide, 70 % ethanol); 10 m$, 13 f£, same but Province San Felipe de Aconcagua, km 20 Resguardo de Los Patos to Paso del Rubio, 2200–2300 m, 1.i.1999, Asteraceae, semidesert and subalpine scrub (D. Burckhardt) #12(1) (NHMB, dry, on slide, 70 % ethanol).

Description

Coloration: Head including genal processes yellow to green-yellow; clypeus black. Eyes yellow to brown, ocelli red. Antenna yellow to brownish, segments 3–8 with dark brown apices, 9–10 entirely dark brown. Pronotum pale yellow; mesopraescutum pale yellow to yellow, sometimes with two distinct yellow to orange patches along fore margin; mesoscutum pale yellow to yellow, sometimes with distinct four broad and, in the middle, one narrow yellow longitudinal stripes; mesoscutellum pale yellow along the margin, yellow to green-yellow in the middle. Metanotum yellow to green-yellow. Forewing with pale yellow veins and colourless membrane, sometimes yellowish in apical part. Legs yellow to orange, sometimes distal tarsal segment darker, meracanthus of metacoxa yellow. Abdomen yellow to brown, sometimes slightly ligther ventrally; terminalia yellow. Female terminalia with dark apex.

Structure: Head, in profile, strongly inclined from longitudinal body axis at 90°. Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with microscopical setae; genal processes conical, slender, acute apically, slightly shorter than vertex, covered with moderately long setae. Pronotum with one lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing oblong-oval, narrowly, evenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs weakly sinuous, slightly curved to fore margin apically, cell m_1 short; surface spinules faint, present in all cells, leaving narrow spinule-free stripes along the veins, sparsely and irregularly spaced; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 6–7 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; densely hairy. Paramere narrowly lamellar, irregularly rounded apically; with long hook-shaped apico-anterior process on very short pedicel and lobe with apically sclerotised median tooth; lobe situated exterior to process; outer face covered with moderately long setae mostly in apical half, inner face densely, evenly covered with moderately long setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with short beak-shaped anterior process and one horn-shaped apico-posterior tubercle; lateral lobes moderately long, dilated towards apex which is concave. – Female. Proctiger oblong cuneate, pointed apically; dorsal margin, in profile, almost straight; relatively densely covered with moderately long setae in dorsal part. Subgenital plate cuneate, with short apical process; sparsely covered with moderately long setae, dorsal margin with a row of bristles.

Host-plant: unknown. Adults were collected on Asteraceae: ?*Baccharis* sp., *Nardophyllum* cf. *lanatum* (Meyen) Cabrera and an unidentified genus, on Verbenaceae: *Mulguraea scoparia* (Gillies & Hook.) N.O'Leary & P.Peralta, as well as on Solanaceae: *Lycium* sp. Immatures were found on ?*Baccharis* sp., Asteraceae indet. and *Lycium* sp. The material was collected by sweeping and the association with the plants is doubtful. Problematical is also the identification of the plants as several specimens were in poor state. Asteraceae are the most probable hosts. Despite several attempts to find the host in the Río Blanco–Portillo region (1992, 1993, 1995 and 1998) no conclusive results were obtained.

Distribution: Chile (V Region).

Derivation of name: From Greek αδηλος = hidden, secret, unknown, mysterious, etc. for the uncertain host despite several attempts to find it.

Comment: Russelliana 1 resembles *R. 3*, *intermedia* and *24*, in the paramere bearing a long hook-shaped apico-anterior process which is situated interiorly to the lobe, and in the distal segment of the aedeagus bearing a short beak-shaped anterior process and a horn-shaped apico-posterior tubercle. *R. 1* differs from the three species by a colourless membrane of the forewing and an oblong cuneate female proctiger with a relatively straight dorsal margin. *R. 1* differs from *R. 3* and *24* by a multicoloured body colour, from *R. 3* by a shape of the forewing which is broadest in the apical third, and from *R. intermedia* by the absence of the median hump of the paramere.

***RUSSELLIANA 2* SP. NOV.**

(FIGS 7B, 10B, C, 15B, 20B, 25B, 29B)

Material examined

Holotype m$: **Chile**: IV Region, Province Elqui, 5–10 km S Vicuña, 30°05'S 70°40'W, 750–950 m, 5.xii.1993, ?*Lycium* sp., semidesert (D. Burckhardt) #11 (MHNG, dry).

Paratype. **Chile**: 3 m$, 1 immature, III Region, Province Huasco, 20 km S Vallenar, 28°40'S 70°40'W, 750 m, 6.xii.1993, *Lycium* sp. (D. Burckhardt) #15 (MHNG, dry); 13 m$, 15 f£, 2 immatures, IV Region, Province Elqui, along road from Viñita Baja to Condoriaco, 29°45'S 70°50'W, 1000–1400 m, 4.xii.1993, ?*Lycium* sp., dry slope (D. Burckhardt) #7 (MHNG, NHMB, dry, on slide); 7 m$, 4 f£, same as holotype (D. Burckhardt) #11 (MHNG, dry); same but *Adesmia kingii* (D. Burckhardt) #11 (MHNG, dry); 2 m$, 3 f£, same but 15 km E Vicuña, 30°10'S 70°40'W, 850 m, Solanaceae, river bed (D. Burckhardt) #10 (MHNG, dry); 3 m$, 2 f£, 1 immature, same but 15–25 km S Vicuña, 30°15'S 70°40'W, 1300–1700 m, 14.xii.1993, *Lycium* sp., steppe (D. Burckhardt) #33 (NHMB, dry); 1 f£, same but 10 km S Vicuña towards Hurtado, 900 m, 18.xii.1995, *Lycium* sp., semidesert (D. Burckhardt) #7(1) (MHNG, dry); 1 f£, same but ca 45 km ENE La Serena, Viñita Baja to Condoriaco, 800–1000 m, 19.xii.1995, *Lycium* sp., mountain slope (D. Burckhardt) #10(3) (MHNG, dry).

Description

Coloration: Dimorphic, male slightly darker, general body colour yellow to dark brown; female slightly lighter, general body colour yellow to brown, forewing pattern paler than in males. Head including genal processes yellow to dark brown with yellow to brownish dots, sometimes entirely yellow; clypeus yellow to dark brown. Eyes yellow to brown, ocelli orange to red. Antenna yellow, segments 1–2 brownish at base to entirely brown, segments 3–8 with dark brown apices, segments 9–10 entirely dark brown. Thorax brown with distinct yellow spots. Pronotum yellow to dark brown; mesopraescutum pale to dark brown, sometimes with two orange patches along fore margin; mesoscutum pale to dark brown with four broad dark orange longitudinal stripes; mesoscutellum pale to dark brown, sometimes pale yellow along the margin. Metanotum yellow to brown. Forewing with yellow to dark brown veins and membrane with distinct pale to dark brown pattern differing in males and females. Male forewing membrane brown to dark brown consisting of large brown band occupying almost entire wing surface stretching from apical part of costal vein and covering apical part of cell r_1, apical and basal part of cell r_2, entire cells m_1, m_2 and cu_1, apical part of cell cu_2 and median part of cell c+sc, leaving light areas in cells r_2, m_1, m_2 and cu_1 along the margin; membrane lacking pattern colourless to yellowish. Female forewing membrane pale brown consisting of patches scattered over entire surface and dark frequently confluent dots occupying all cells, patch along the margin leaving almost indistinct light areas in cells r_2, m_1, m_2 and cu_1; with few distinct dark brown dots along the margin at the edges of the light areas in cells r_2, m_1, m_2 and cu_1. Legs yellow to brownish with darker orange to dark brown femora, meracanthus of metacoxa pale to bright yellow. Abdomen with terminalia yellow to brownish, sometimes lighter ventrally. Male proctiger and paramere often dark apically. Female terminalia with dark apex.

Structure: Head, in profile, weakly inclined from longitudinal body axis (< 45°). Vertex trapezoidal, flat with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with short setae; genal processes short, swollen, slightly conical apically, covered with moderately long setae. Pronotum with two lateral pronounced and one sublateral, relatively shallow tubercles on either side. Forewing rhomboidal; vein C+Sc strongly, unevenly curved, pterostigma long, vein Rs almost straight, strongly curved to fore margin apically, cell m_1 short; both male and female forewing with large, very dense surface spinules, present in all cells, leaving no spinule-free stripes along the veins, forming hexagons in apical part on pigmented areas, weakly developed on unpigmented areas; radular spinules not pronounced. Metatibia with 5–6 apical spurs.

Terminalia: Male. Proctiger barrel-shaped; sparsely covered with moderately long setae in apical two thirds. Subgenital plate elongate; with sparsely spaced long setae restricted to apical half. Paramere shortly lamellar; with long recurved apico-anterior process on pedicel, broadly rounded apico-posterior lobe with apically sclerotised median tooth; lobe situated exterior to process; both process and lobe of subequal length; outer face densely covered with long setae mostly in apical half, inner face covered with long thick bristles anteriorly and apically. Distal segment of aedeagus massive, broadly, unevenly expanding towards apex, strongly bulged anteriorly; lateral lobes moderately long, dilated towards apex which is rounded and with frayed margin. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, slightly convex; densely covered with long setae. Subgenital plate subglobular, with tiny apical process; densely covered with moderately long setae in apical part and with long setae along ventral margin, dorsal margin with a row of bristles.

Host-plant: Lycium sp. (Solanaceae).

Distribution: Chile (III–IV Regions).

Derivation of name: From Greek αδελφος = brotherly, similar, for its close resemblance to *R. 17*.

Comment: Russelliana 2 resembles *R. 9* and *17* in the weakly inclined head (< 45°), in the short, swollen genal processes, in the rhomboidal forewing with a brown pattern, a strongly curved vein C+Sc and a strongly curved vein Rs to fore margin apically, in the barrel-shaped male proctiger, in the cuneate male subgenital plate, in the shortly lamellar paramere bearing a recurved apico-anterior process and an apically rounded, strongly bulged apico-posterior lobe with a tooth, in the strongly inflated anteriorly distal segment of the aedeagus bearing lateral lobes, with frayed margin apically, in the female subgenital plate, densely covered with long setae and in the presence of sexual dimorphism. *R. 2* differs from *R. 9* and *17* by a more extensive pattern on the male forewing, and from *R. 9* by short, rounded apically, dilated towards apex lateral lobes of the distal segment of the aedeagus, a cuneate female proctiger and a subgenital plate bearing an apical process.

RUSSELLIANA ADESMIAE BURCKHARDT, 1986

(FIGS 7C, 10D, 15C, 20C, 25C, 29C)

Russelliana adesmiae Burckhardt, 1986: 95.

Material examined

Type material. Holotype m$: **Chile**: IV Region, Province Choapa, Agua dulce, 22.v.1987, *Adesmia microphylla* (J. Solervicens) (MNNC, dry). Paratype. **Chile**: 1 m$, 2 f£, same as holotype (J. Solervicens) (MHNG, on slide); 1 m$, 1 f£, same but km 272 Panamericana Norte, 20.viii.1985 (M. Elgueta) (MHNG, on slide); 1 m$, same but *Bahia ambrosioides* (J. Solervicens) (MHNG, on slide); 2 m$, 2 f£, same but 23.i.1987, *Adesmia microphylla* (M. Elgueta) (MHNG, dry).

Additional material. **Chile**: 2 m$, 1 f£, IV Region, Province Choapa, Los Vilos, 31°54'S 71°31'W, 0 m, 2.xii.1993, various vegetation (D. Burckhardt) #2 (MHNG, dry); 1 f£, same but Province Elqui, 50 km S La Serena (E. S. Ross & A. E. Michelbacher) (CASC, dry); 3 m$, 9 f£, 2 immatures, same but 15 km SW Viñita Baja, 29°50'S 70°50'W, 450 m, 4.xii.1993, *Adesmia* sp. (D. Burckhardt) #6 (MHNG, NHMB, dry); 8 m$, 7 f£, same but Province Limarí, Parque Nacional Fray Jorge, area between Quebrada Las Vacas, "Administración", and Rio Limarí, 250 m, 7–9.xii.1990. *Adesmia bedwellii*, open mediterranean scrub (D. Agosti & D. Burckhardt) #2 (MHNG, dry); 19 m$, 25 f£, same but around "Administración", 30°40'S 71°40'W, 100 m, 14–16.xii.1992, *Adesmia* sp. (D. Burckhardt) #25 (NHMB, dry); 6 m$, 10 f£, same but Alto de Talinay, 30°40'S 71°41'W, 500 m, 15.xii.1992, *Adesmia* sp., sclerophyll forest and mediterranean scrub (D. Burckhardt) #26 (NHMB, dry); 19 m$, 11 f£, 1 immature, same but Quebrada La Vaca, 30°40'S 71°40'W, 100–200 m, 15–17.xii.1992, *Adesmia* sp., mediterranean scrub (D. Burckhardt) #27 (NHMB, dry); 10 m$, 18 f£, 2 immatures, same but nr park entrance gate, 100–150 m, 16.xii.1992, *Adesmia* sp. (D. Burckhardt) #28 (NHMB, dry); 16 m$, 22 f£, V Region, Province Los Andes, 25–27 km E Los Andes, 32°54'S 70°18'W, 1250 m, 31.xii.1993, *Adesmia pedicellata*, mediterranean scrub (D. Burckhardt) #42 (MHNG, dry); 7 m$, 9 f£, same but Province Petorca, Cuesta El Melón, 15 km N El Melón, 32°40'S 71°13'W, 450 m, 22.xi.1992, *Adesmia microphylla* (D. Burckhardt) #11 (NHMB, dry); 7 m$, 4 f£, same but 400 m, 22.xii.1995, *Adesmia* sp. (D. Burckhardt) #16(1) (MHNG, dry, 70 % ethanol); 1 f£, same but Alicahue to Chincolco, E Cabildo to La Ligua, 700–1250 m, 21–26.xii.1998, *Adesmia* sp., semidesert and *Acacia caven* steppe (D. Burckhardt) #3 (NHMB, dry); 3 m$, 3 f£, same but Cuesta El Melón, 32°36.4'S 71°14.4'W, 600 m, 23.ii.2009, *Adesmia* cf. *glutinosa*, degraded *Acacia caven* steppe and sclerophyll scrub on slope (D. Burckhardt) #3(1) (NHMB, dry); 2 m$, 2 f£, same but Province San Felipe de Aconcagua, Putaendo, 10 km N San Felipe, 32°37'S 70°42'W, 700 m, 26.xii.1993, *Adesmia* cf. *confusa*, river bed (D. Burckhardt) #35 (MHNG, dry); 10 m$, 16 f£, same but 15 km E Llay-Llay, 32°52'S 70°51'W, 600 m, 28.xii.1993, *Adesmia* cf. *microphylla*, *Acacia caven* steppe (D. Burckhardt) #39 (MHNG, dry); 1 m$, same but km 10 on road El Tártaro to El Guayacán, 1400 m, 24.xii.1995, *Adesmia* sp. (D. Burckhardt) #24(4) (MHNG, dry); 1 m$, same but La Calera, 300 m, 26.xii.1995, *Adesmia* sp., waste land (D. Burckhardt) #26 (MHNG, dry); ?, same but Putaendo, 10 km N San Felipe, 700 m, 27.xii.1995, *Adesmia* sp., river bed (D. Burckhardt) #27(2) (MHNG, dry); 1 m$, 2 f£, same but km 20 Resguardo de Los Patos to Paso del Rubio, 1800 m, 1.i.1999, *Adesmia* sp., semidesert and subalpine scrub (D. Burckhardt) #11(9) (NHMB, dry); 1 f£, same but Resguardo de Los Patos, 32°29.2'S 70°33.9'W, 1350 m, 6.iii.2009, *Adesmia* cf. *glutinosa*, *Acacia caven* scrub (D. Burckhardt) #14(4) (NHMB, dry); 15 m$, 12 f£, same but Province Quillota, Quillota, 32°52'S 71°13'W, 200 m, 1.i.1994, *Adesmia microphylla*, *Acacia caven* steppe (D. Burckhardt) #45 (MHNG, NHMB, dry); 4 m$, 5 f£, 5 immatures, same but La Palma, Fundo Lothar Neserke, 300 m, 30.xii.1998, *Adesmia* cf. *confusa* [*Adesmia* cf. *arborea*], *Acacia caven* steppe and gully with mediterranean sclerophyll forest along very small river (D. Burckhardt) #10b(5) (NHMB, dry, on slide); 21 m$, 34 f£, 3 immatures, same but Province Valparaíso, Estero Catapilco, nr Maitencillo, 32°40'S 71°27'W, 50 m, 22.xi.1992, *Adesmia microphylla*, open sclerophyll forest (D. Burckhardt) #10 (NHMB, dry, on slide, 70 % ethanol); 1 m$, 16 immatures, Region Metropolitana, Province Chacabuco, 5 km N Tiltil, 33°01'S 70°56'W, 700 m, 28.xii.1993, *Adesmia* cf. *glutinosa*, open sclerophyll scrub (D. Burckhardt) #40 (MHNG, dry); 2 m$, 3 f£, same but Province Talagante, Comuna Isla de Maipo, 4.v.1993, *Adesmia glutinosa*, mediterranean scrub (D. Burckhardt) #5(1) (MHNG, dry).

Description
Coloration: Head including genal processes pale yellow to dark brown, genal processes with dark tips, vertex with pale to dark brown pattern; clypeus brown to black. Eyes pale yellow to brown, ocelli orrange to red. Antenna dirty yellow to brownish, segments 1–2, 9–10 entirely dark brown, segments 3–8 with dark brown apices. Pronotum of the same colour as vertex, with the same orange to dark brown pattern, sometimes distinctly paler than mesonotum; mesopraescutum pale yellow to orange, with two brown patches along the fore margin and two orange patches posteriorly, sometimes entirely orange; mesoscutum orange with four broad and, in the middle, one narrow brown longitudinal stripes; mesoscutellum pale yellow along the margin, brown in the middle. Metanotum orange to dark brown. Forewing with pale yellow to brown veins and whitish membrane with conspicuous dark brown pattern consisting of constant patch along vein Cu_{1b} and dots scattered over entire surface, partly confluent in apical part, forming broad submarginal stripe stretching from apical part of costal vein to apex of vein Cu_{1a}, leaving light areas in cells r_2, m_1 and m_2 along the margin; sometimes with relatively distinct median broad stripe stretching from apical part of cell r_1 to base of vein Cu_{1b}. Legs yellow to brown, often with dark brown femur and distal tarsal segment, meracanthus of metacoxa pale to bright yellow. Abdomen yellow to dark brown. Females often slightly lighter with ventrally lighter abdomen. Male terminalia dark brown, sometimes paramere yellow. Female proctiger dark brown, subgenital plate brown.

Structure: Head, in profile, strongly inclined from longitudinal body axis (> 45°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse tubercle on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, distinctly shorter than vertex; covered with moderately long setae. Pronotum with two lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing oval, broadly, unevenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs weakly sinuous, slightly curved to fore margin apically, cell m_1 short; surface spinules very dense, present in all cells, leaving no spinule-free stripes along the veins, irregularly spaced; radular spinules not pronounced. Metatibia with 6–7 spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere broadly lamellar; with apico-anterior process on pedicel, median hump with apically sclerotised median tooth, and slightly bulged apico-posterior lobe; process, hump and lobe of subequal length; outer face sparsely covered with moderately long setae mostly in posterior part, inner face densely covered with moderately long setae and with long setae in basal part. Distal segment of aedeagus elongate; with long anterior process, one large, raised apical and one horn-shaped apico-posterior tubercles; lateral lobes moderately long, dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, strongly convex; densely covered with moderately long setae in dorsal part. Subgenital plate cuneate, with moderately long apical process; sparsely covered with moderately long setae in apical half, dorsal margin with few bristles.

Host-plants: Adesmia bedwellii Skottsb., *A.* cf. *confusa* Ulibarri, *A.* cf. *glutinosa* Hook. & Arn., *A. microphylla* Hook. & Arn. and *A. pedicellata* Hook. & Arn. (Fabaceae).

Distribution: Reported from Chile (IV–V Regions, Region Metropolitana) (Burckhardt, 1986).

Comment: Russelliana adesmiae resembles *R. 11*, in the presence of the three distinct tubercles on the pronotum, in the membrane of the forewing with a distinct brown pattern, in the broadly lamellar paramere bearing an apico-anterior process on a pedicel, in the distal segment of the aedeagus bearing a long anterior process, large, raised apical and horn-shaped apico-posterior tubercles and long, dilated towards apex lateral lobes, and in the cuneate female proctiger, and cuneate subglobular plate bearing a short apical process. *R. adesmiae* differs from *R. 11* by a shorter rostrum and the presence of a median hump of the paramere.

RUSSELLIANA ADUNCA **BURCKHARDT, 1987**

(FIGS 7D, 10E, 15D, 20D, 25D, 29D)

Russelliana adunca Burckhardt, 1987: 384.

Material examined

Type material. Holotype m$: **Bolivia**: Department Chuquisaca, Province Nor Cinti, Padcoya to Camargo, 2800–3200 m, 26–28.xii.1984 (L. E. Peña) (MHNG, dry). Paratype. **Bolivia**: 1 m$, same but Lecori, S Potosi, 3200 m, 26–27.xii.1984 (L. E. Peña) (MHNG, on slide).

Additional material. **Argentina**: 181 m$, 208 f£, Province Chubut, Los Altares Valley, 3.x.1987 (L. E. Peña) (MHNG, NHMB, dry, on slide, 70 % ethanol); 115 m$, 176 f£, 1 immature, same but 3–5.xi.1990. *Baccharis* sp. (L. E. Peña) (NHMB, dry, on slide, 70 % ethanol); 5 m$, 2 f£, same but South Ameghino dam, 5.xi.1990. *Baccharis* sp. (L. E. Peña) (NHMB, 70 % ethanol).

Description

Coloration: Head including genal processes pale yellow to dark brown; clypeus brown to black. Eyes pale to dark brown, ocelli orange. Antenna yellow to brownish, sometimes segment 1 entirely brown and segment 2 brownish at base, segments 4–8 with dark brown apices, 9–10 entirely dark brown. Pronotum pale yellow with yellow spot in the middle, sometimes entirely black; mesopraescutum dirty yellow to orange, often with two pale to dark brown patches along the fore margin, sometimes with two pale to dark brown patches posteriorly; mesoscutum dirty yellow to orange, often with four broad, dark brown and, in the middle, one narrow, yellow to orange longitudinal stripes; mesoscutellum yellow to brown, often orange to brownish in the middle. Metanotum yellow to black. Forewing with bright yellow to dark brown veins and colourless to greyish membrane with indistinct yellow to distinct brownish patch along vein Cu_{1b}, fumose in the middle of all cells and almost transparent along the veins. Legs pale to dirty yellow, sometimes femur and distal tarsal segment darker, meracanthus of metacoxa pale to dirty yellow. Abdomen and terminalia pale to dark brown.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly slightly produced into transverse tubercle on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, distinctly shorter than vertex, covered with long setae. Forewing oblong-oval, broadly, evenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs straight apically, cell m_1 long; surface spinules present in all cells, leaving broad spinule-free stripes along the veins, sparsely and irregularly spaced, sometimes spinules entirely reduced in apical half of the wing; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 7 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with densely spaced moderately long setae. Paramere irregularly subtrapezoidal; with long hook-shaped apico-anterior process on pedicel, median slightly recurved hump with apically sclerotised tooth, and strongly bulged, curved inwards apico-posterior lobe; process, hump and lobe of subequal length; outer face densely covered with moderately long setae mostly in apical half, inner face densely covered with short setae in anterior part and with long setae in posterior and basal part. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with long, straight anterior process, one horn-shaped apical and one angular apico-posterior tubercles; lateral lobes long, strongly dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, weakly sinuous; densely covered with moderately long setae in apical half. Subgenital plate cuneate, with short apical process; densely covered with long setae, dorsal margin with a row of bristles.

Host-plant: unknown. Numerous adults and a single immature were collected from *Baccharis* sp. (Asteraceae).

Distribution: Argentina (Chubut). Reported from Bolivia (Chuquisaca) (Burckhardt, 1987a).

Comment: Female specimens previously assigned to *Russelliana adunca* (Burckhardt, 1987a), in fact, belong to another closely related species, *R. 5* sp. nov. Descriptions for female of *R. adunca* are given for the first time.

Russelliana adunca resembles *R. 4, 5* and *7* in a colourless, slightly greyish forewing without a pattern except for fumose areas in the middle of cells in the apical third of the wing and a brown patch along the vein Cu_{1b}, in the irregularly subtrapezoidal paramere bearing a hook-shaped apico-anterior process on a long pedicel, a median recurved hump with a tooth, and an apico-posterior lobe, in the distal segment of the aedeagus bearing a long anterior process, two tubercles and the large, dilated towards apex lateral lobes, and in the cuneate female proctiger and subgenital plate bearing a short apical process. *R. adunca* differs from *R. 5* and *7* by shorter setae on the female terminalia, from *R. 4* by long genal processes, and from *R. 7* by a long apico-posterior lobe of the paramere with a strongly constricted base, a relatively straight anterior process of the distal segment of the aedeagus, and a relatively stout apex of the female proctiger.

RUSSELLIANA 3 SP. NOV.

(FIGS 7E, 10F, 15E, 20E, 25E, 29E)

Material examined

Holotype m$: **Chile**: IV Region, Province Limarí, Parque Nacional Fray Jorge, Alto de Talinay, 30°40'S 71°41'W, 550 m, 6–7.xii.1990. *Haplopappus foliosus*, mediterranean scrub (D. Agosti & D. Burckhardt) #1b (NHMB, dry).

Paratype. **Chile**: 9 m$, 16 f£, same as holotype (D. Agosti & D. Burckhardt) #1b (MHNG, NHMB, dry, on slide); 1 f£, same but 250 m, 7–9.xii.1990, *Schinus molle* (D. Burckhardt) #2 (NHMB, dry); 1 f£, same but *Baccharis paniculata* [*Neomolina paniculata*] (D. Burckhardt) #2 (NHMB, dry); 6 m$, 21 f£, same but 500 m, 15.xii.1992, *Haplopappus foliosus*, sclerophyll forest and mediterranean scrub (D. Burckhardt) #26 (NHMB, dry, on slide).

Description

Coloration: Head black, genal processes pale yellow, black at base, sometimes entirely black with pale yellow tips; clypeus black. Eyes red to brown, ocelli yellow. Antenna pale yellow, segment 1 brown at least at base, sometimes segments 4–8 with pale brown apices, segments 9–10 brownish. Thorax black. Metanotum yellow with broad, black longitudinal stripe in the middle. Forewing with pale yellow to bright yellow veins and pale yellow to amber-coloured membrane. Legs pale yellow to bright yellow, meracanthus of metacoxa yellow to orange. Abdomen pale yellow to orange; terminalia pale yellow to bright yellow. Female terminalia with dark apex.

Structure: Head, in profile, strongly inclined from longitudinal body axis at 90°. Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with microscopical setae; genal processes conical, slender, subacute apically, same length as vertex, covered with moderately long setae. Pronotum with one lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing oval, narrowly, evenly rounded apically; vein

C+Sc weakly curved, pterostigma long, vein Rs straight, curved backwards apically, cell m_1 short; surface spinules present in all cells, leaving narrow spinule-free stripes along the veins, relatively densely and irregularly spaced; absent at base of cell c+sc; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 5–7 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae in apical two thirds. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere narrowly lamellar, irregularly rounded apically; with long hook-shaped apico-anterior process on very short pedicel and lobe with apically sclerotised median tooth; lobe situated exterior to process; outer face sparsely covered with moderately long setae mostly in apical part, inner face densely, evenly covered with moderately long setae and with few long setae along ventral margin of process. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with short beak-shaped anterior process and one horn-shaped apico-posterior tubercle; lateral lobes long, dilated towards apex which is slightly concave. – Female. Proctiger subglobular, pointed apically; dorsal margin, in profile, strongly bent downwards; densely covered with moderately long setae. Subgenital plate cuneate, with tiny apical process; densely covered with long setae in apical half, dorsal margin with a row of bristles.

Host-plants: Adults were collected on *Baccharis paniculata* DC. and *Haplopappus foliosus* DC. (Asteraceae) which are likely hosts.

Distribution: Chile (IV Region).

Derivation of name: From Latin bicolor = two coloured, referring to the bichrome body colour.

Comment: Russelliana 3 resembles *R. 1*, *intermedia* and *24*; see comments under *R. 1*. *R. 3* differes from the three species by a contrasting yellow-black body colour and a shape of the forewing which is broadest in the middle. It differs from *R. 1* by a yellow membrane of the forewing and a female proctiger with a downwards bent dorsal margin, and from *R. intermedia* by the absence of a median hump of the paramere.

RUSSELLIANA 4 SP. NOV.

(FIGS 7F, 10G, 15F, 20F, 25F, 29F)

Material examined

Holotype m$: **Chile**: IV Region, Province Elqui, along road from Viñita Baja to Condoriaco, 29°45'S 70°50'W, 1000–1400 m, 4.xii.1993, Solanaceae, dry slope (D. Burckhardt) #7 (MHNG, dry).

Paratype. **Chile**: 1 m$, 1 f£, III Region, Province Huasco, ca 10 km W Domeyko, 28°57'S 70°55'W, 600 m, 6.xii.1993, ?*Lycium* sp., steppe (D. Burckhardt) #14 (MHNG, dry); 2 m$, IV Region, Province Elqui, 15 km SW Viñita Baja, 29°50'S 70°50'W, 450 m, 4.xii.1993, ?*Lycium* sp., sparse scrub (D. Burckhardt) #6 (MHNG, dry); 14 m$, 11 f£, 14 immatures, same as holotype (D. Burckhardt) #7 (MHNG, dry); 2 m$, 6 f£, same but 15 km E Vicuña, 30°10'S 70°40'W, 850 m, 5.xii.1993, Solanaceae, river bed and dry slope (D. Burckhardt) #10

(MHNG, NHMB, dry); 2 m$, 5 f£, same but 16 km N Chapilca, nr Río Turbio, road to Llanos de Huanta, ca 80 km E La Serena, 1100 m, 17.xii.1995, *Lycium* sp., along the river (D. Burckhardt) #2(3) (MHNG, dry); 6 m$, 7 f£, 11 immatures, same but ca 45 km ENE La Serena, Viñita Baja to Condoriaco, 800–1000 m, 19.xii.1995, *Lycium* sp., mountain slope (D. Burckhardt) #10(3) (MHNG, dry, on slide, 70 % ethanol).

Description
Coloration: Head including genal processes pale yellow, genae pale yellow to brown; clypeus yellow. Eyes pale yellow to brown, ocelli red. Antenna yellow, segments 4–8 with dark brown apices, segments 9–10 entirely dark brown. Pronotum pale yellow, sometimes with yellow dot in the middle; mesopraescutum pale yellow with two orange patches along the fore margin and often with two yellow to pale orange patches posteriorly; mesoscutum pale yellow with four broad orange and, in the middle, one narrow pale yellow to pale orange longitudinal stripes; mesoscutellum pale yellow along the margin, yellow to orange in the middle. Metanotum pale yellow. Forewing with pale yellow veins and colourless membrane with indistinct brown patch along vein Cu_{1b} and yellowish shadows in apical part of cells r_1, r_2, m_1, m_2 and cu_1. Legs pale yellow, sometimes with slightly darker distal tarsal segment, meracanthus of metacoxa pale yellow. Abdomen and terminalia yellow. Paramere slightly darker apically. Female proctiger dark in apical third, subgenital plate with dark apex.

Structure: Head, in profile, inclined from longitudinal body axis at 45°. Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes very short, conical, subacute apically, covered with moderately long setae. Forewing oval, broadly, evenly rounded apically; vein C+Sc hardly curved, pterostigma long, vein Rs weakly sinuous, almost straight apically, cell m_1 short; surface spinules absent; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 7 apical spurs.

Terminalia: Male. Proctiger tubular; densely covered with moderately long setae, forming longitudinal rows posteriorly. Subgenital plate short, subglobular; with sparsely spaced long setae restricted to median part. Paramere irregularly subtrapezoidal; with apico-anterior process on long pedicel, median recurved hump with apically sclerotised tooth, and long, strongly bulged apico-posterior lobe; both hump and lobe of subequal length and slightly shorter than process; outer face sparsely covered with moderately long setae in anterior and posterior part, inner face sparsely covered with moderately long setae. Distal segment of aedeagus elongate; with long, straight anterior process, one horn-shaped apical and one angular apico-posterior tubercles; lateral lobes long, dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, slightly convex; densely covered with moderately long setae in apical half. Subgenital plate cuneate, with short apical process; relatively sparsely covered with long setae, dorsal margin with few bristles.

Host-plants: Lycium sp. (Solanaceae).

Distribution: Chile (III–IV Regions).

Derivation of name: From Latin brevis = short and gena = cheek, referring to the short genal processes.

Comment: Russelliana 4 resembles *R. adunca*, *5* and *7*; see comments under *R. adunca*. *R. 4* differs from the three species by very short genal processes. It differs from *R. 5* and *7* by shorter setae covering the female terminalia, from *R. 5* by a very long, strongly curved median hump of the paramere, and from *R. 7* by the presence of surface spinules in the apical part of the forewing, a long apico-posterior lobe of the paramere with a strongly constricted base, a relatively straight anterior process of the distal segment of the aedeagus, and a relatively stout apex of the female proctiger.

RUSSELLIANA BULBOSA BURCKHARDT, 1987

(FIGS 7G, 10H, 15G, 20G, 25G, 29G)

Russelliana bulbosa Burckhardt, 1987: 385

Material examined

Type material. Holotype m$: **Argentina**: Province Río Negro, El Bolsón, 680 m, 1.iv.1961 (G. Topal) (MHNG, dry). Paratype. **Argentina**: 5 m$, 5 f£, same as holotype (G. Topal) (MHNG, dry, on slide).

Additional material. **Chile**: 8 m$, 17 f£, 4 immatures, VII Region, Province Talca, Parque Gil de Vilches, Monumento Natural, 35°35'S 71°04'W, 1100 m, 4–5.i.1994, *Dipyrena juncea* [*Diostea juncea*], mixed *Nothofagus* forest (D. Burckhardt) #47 (MHNG, NHMB, dry); 8 m$, 8 f£, 4 immatures, same but sector Piedras blancas, 1350–1600 m, 12.i.1996, *Dipyrena juncea* [*Diostea juncea*] (D. Burckhardt) #43(4) (MHNG, dry, 70 % ethanol); 34 m$, 52 f£, 12 immatures, 4 immature skins, same but sector Majadilla, 1350–1550 m, 13.i.1996, *Dipyrena juncea* [*Diostea juncea*], deciduous and evergreen *Nothofagus* forests (D. Burckhardt) #44(12) (MHNG, dry, on slide, 70 % ethanol); 45 m$, 37 f£, 10 immatures, same but sendero El Enladrillado, El Venado Valley, 1350–1700 m, 14.i.1996, *Dipyrena juncea* [*Diostea juncea*], mixed *Nothofagus* forest (D. Burckhardt) #45(1) (MHNG, dry, 70 % ethanol); 28 m$, 62 f£, 5 immatures, VIII Region, Province Bío-Bío, Parque Nacional Laguna del Laja, sector Chacay, 1200 m, 19.i.1996, *Dipyrena juncea* [*Diostea juncea*], *Austrocedrus* forest and open sclerophyll scrub (D. Burckhardt) #53(3) (MHNG, dry, 70 % ethanol); 1 m$, same but outside Parque Nacional Laguna del Laja, Park entrance to El Abanico, 900–1100 m, 22.i.1996, *Dipyrena juncea* [*Diostea juncea*], dense forest along river (D. Burckhardt) #58(5) (MHNG, dry); 1 m$, same but Province Ñuble, 2.7 km Las Trancas, 29.i.1967 (E. I. Schlinger) (CASC, dry); 1 m$, 1 f£, IX Region, Province Malleco, 10 km W Termas de Tolhuaca, 1100 m, 23.i.1996, *Dipyrena juncea* [*Diostea juncea*], deciduous *Nothofagus* forest (D. Burckhardt) #60(3) (MHNG, dry); 11 m$, 27 f£, 3 immatures, same but Parque Nacional Tolhuaca, sector Laguna Malleco, 900 m, 23–27.i.1996, *Dipyrena juncea* [*Diostea juncea*], mixed *Nothofagus* forest (D. Burckhardt) #61b(14) (MHNG, dry, 70 % ethanol).

Description

Coloration: General colour of body pale yellow to orange. Head including genal processes pale to bright yellow; clypeus pale yellow to brown. Eyes pale yellow to dark brown, ocelli red. Antenna yellow to brownish, segments 3–8 with more or less distinct brown apices, segments 9–10 entirely dark brown. Thorax pale yellow to orange; pronotum of the same colour as vertex, slightly paler than mesonotum, with pale brown spots on either side; mesopraescutum with two pale brown patches along the fore margin; mesoscutum sometimes with four broad pale brown longitudinal stripes. Metanotum pale yellow to brown. Forewing with yellow veins and amber-coloured membrane. Legs pale to bright yellow, sometimes with brownish femur and distal tarsal segment, meracanthus of metacoxa pale yellow. Abdomen and terminalia green/pale yellow to brown. Female proctiger with dark apex. Teneral specimens almost entirely yellow.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal, flat with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with microscopical setae; genal processes conical, slender, subacute apically, slightly shorter than vertex, covered with long setae. Pronotum with two lateral pronounced tubercles on either side. Forewing oblong-oval, narrowly, evenly rounded apically; vein C+Sc strongly, unevenly curved, pterostigma long, vein Rs almost straight apically, cell m_1 short; surface spinules dense, present in all cells, leaving narrow spinule-free stripes along the veins, irregularly spaced, forming transverse rows; absent in basal third of cell c+sc; radular spinules covering rounded areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 6–8 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate elongate, with ventral hump; with densely spaced long setae restricted to median part, gradually becoming shorter towards ventral part. Paramere narrowly lamellar; with thumb-like, evenly rounded apically apico-anterior process on long pedicel and slightly bulged apico-posterior lobe with inwards directed sclerotised anterior tooth situated at apex of the lobe; lobe sligthly longer than process; apical part of anterior edge of lobe forms an angle and apical part of posterior edge rounded; outer face sparsely covered with moderately long setae mostly in apical part, inner face densely covered with long thick bristles apically and posteriorly. Distal segment of aedeagus massive, broadly, unevenly expanding towards apex, strongly bulged anteriorly and concave apically; with curved forward apico-posterior tubercle; lateral lobes long, slightly dilated towards apex which is concave and with frayed margin. – Female. Proctiger subglobular, pointed apically; dorsal margin, in profile, strongly bent downwards; sparsely covered with moderately long setae. Subgenital plate subglobular, with short apical process; densely covered with long setae in apical part and with moderately long setae along ventral margin.

Host-plant: Dipyrena juncea (Gillies & Hook.) Ravenna (Verbenaceae).

Distribution: Reported from Argentina (Río Negro), Chile (VII–IX Regions) (Burckhardt, 1987a).

Comment: Russelliana bulbosa resembles *R. diosteae* and *sebastiani*, in the forewing with a strongly curved vein C+Sc, in the paramere bearing a finger-shaped apico-anterior process and a strongly bulged apico-posterior lobe, densely covered with long thick bristles apically, in the distal segment of the aedeagus strongly expanding to apex, bearing long lateral lobes with a frayed apical margin, and in the subglobular female proctiger with a bent downwards dorsal margin and subglobular subgenital plate. *R. bulbosa* differs from the two species by shorter antenna, a yellow, lacking pattern membrane of the forewing which is narrowly, evenly rounded apically and bearing a long pterostigma, the paramere bearing an apico-anterior process and an apico-posterior lobe of subequal length, the distal segment of the aedeagus bearing a curved forward apico-posterior tubercle, and in the female subgenital plate bearing an apical process. It differs from *R. sebastiani* by slender, longer genal processes, a broader forewing with a shorter cell m_1, a thumb-like apico-anterior process of the paramere, and a strongly inflated anteriorly distal segment of the aedeagus.

***RUSSELLIANA CAPSICI* BURCKHARDT, 1987**

(FIGS 7H, 10I, 15H, 20H, 25H, 29H)

Russelliana capsici Burckhardt, 1987: 387.

Material examined

Type material. Holotype m$: **Brazil**: State São Paulo, Piracicaba, viii–ix.1969, *Capsicum annuum* (M. de Menezes) (BMNH, dry). Paratype. **Brazil**: 14 m$, 5 f£, 3 immatures, same as holotype (M. de Menezes) (BMNH, dry); 1 f£, State Santa Catarina, Nova Teutonia, 16.viii.1943 (F. Plaumann) (BMNH, dry).

Additional material. **Argentina**: 1 m$, Province Buenos Aires, Zelaya, i.1943 (J. B. Daguerre) (MHNG, on slide); 8 m$, 9 f£, 10 immatures, same but Province Entre Ríos, Concordia, Ciudad de Concordia, 30 m, 10.iii.2010. *Capsicum annuum* (J. P. Bouvet) (MHNG, NHMB, dry, on slide, 70 % ethanol). **Brazil**: 13 m$, 23 f£, 8 immatures, 2 immature skins, State Minas Gerais, Río Verde do MT, BR163, 18°55.7/57.1'S 54°50.1/56.0'W, 350–440 m, 13.xi.2012, *Capsicum annuum* (D. Burckhardt & D. L. Queiroz) #68 (6) (NHMB, 70 % ethanol); 1 f£, same but State Paraná, Curitiba, Parque Barigui, 25°24.9/25.6'S 49°18.6'W, 19.vii.2012, *Capsicum annuum* (D. Burckhardt & D. L. Queiroz) #43 (NHMB, 70 % ethanol)*;* 1 m$, 4 f£, same but Parque Passaúna, 25°28.5'S 49°22.7'W, 27–30.xi.2012, *Capsicum annuum* (D. Burckhardt & D. L. Queiroz) #78(2) (NHMB, dry); 4 m$, 5 f£, same but Jardim Botãnico, 25°26.5/6'S 49°14.2/3'W, 930 m, 15.ii.2013, *Capsicum annuum* (D. Burckhardt & D. L. Queiroz) #94A (9) (NHMB, 70 % ethanol); 105 m$, 55 f£, 30 immatures, 22 immature skins, same but 25°26.476'S 49°14.271'W, 915 m, 12.iii.2013 (D. L. Queiroz) #462 (NHMB, 70 % ethanol).

Description

Coloration: General colour of body yellow. Head yellow to brown, genal processes pale to bright yellow; clypeus pale brown to black. Eyes red to dark brown, ocelli orange. Antenna pale yellow, segments 3–8 with with more or less distinct brown apices, segments 9–10 entirely dark brown. Thorax entirely pale to bright yellow; mesopraescutum with two bright yellow to orange patches along the fore margin; mesoscutum with four broad bright yellow to orange longitudinal stripes. Forewing with whitish to dark brown veins and membrane with brown to dark brown pattern consisting of two broad transverse stripes: submarginal one stretching from apical part of costal vein to median part of cell cu_1 leaving light areas in cells r_2, m_1, m_2 and cu_1 along the margin, and median one stretching from median part of vein

C+Sc to apical part of anal vein; membrane between two bands colourless, sometimes with few dark brown dots in cells and sometimes on veins. Legs pale to dirty yellow, sometimes with brownish femur, meracanthus of metacoxa pale yellow. Abdomen yellow to brown; terminalia pale yellow to orange. Female proctiger with dark apex. Females with slightly lighter head and abdomen.

Structure: Head, in profile, weakly inclined from longitudinal body axis (< 45°). Vertex trapezoidal, flat, anteriorly produced into transverse lobe on either side of mid-line, hind margin around lateral ocelli not raised, covered with microscopical setae; genal processes short, swollen, slightly conical apically, covered with short setae. Pronotum with two lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing rhomboidal; vein C+Sc strongly, unevenly curved, pterostigma long, vein Rs almost straight, strongly curved to fore margin apically, cell m_1 short; surface spinules large, very dense, present in all cells, leaving narrow spinule-free stripes along the veins, forming hexagons, less developed on unpigmented areas; radular spinules not pronounced. Metatibia with 5–7 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae in apical half. Subgenital plate elongate; with sparsely spaced moderately long setae in apical half. Paramere narrowly lamellar; with recurved apico-anterior process on pedicel and long apico-posterior lobe with inwards directed sclerotised anterior tooth situated at base of the lobe; lobe about twice times longer than process; outer face sparsely covered with moderately long setae mostly in apical half, inner face densely covered with long thick bristles apically. Distal segment of aedeagus massive, broadly evenly expanding towards apex; with one small apico-posterior tubercle; lateral lobes moderately long, dilated towards apex which is irregularly rounded and with frayed margin. – Female. Proctiger subglobular, pointed apically; dorsal margin, in profile, strongly bent downwards; densely covered with moderately long setae. Subgenital plate subglobular, rounded apically; densely covered with long setae in apical half.

Host-plant: Capsicum annuum L. (Solanaceae).

Distribution: Reported from Argentina (Buenos Aires, Entre Ríos), Brazil (Minas Gerais, Paraná, Santa Catarina, São Paulo) (Burckhardt, 1987a; Burckhardt *et al.*, 2012).

Comment: Russelliana capsici resembles *R. 8* and *lycii* in the weakly inclined head (< 45°), in the short, swollen genal processes, in the forewing with a brown pattern, a strongly curved vein C+Sc and a strongly curved vein Rs to fore margin apically, in the tubular male proctiger, in the cuneate male subgenital plate, in the narrowly lamellar paramere bearing a short apico-anterior process and a long apico-posterior lobe with a tooth, in the broadly expanded towards apex distal segment of the aedeagus bearing lateral lobes with a frayed margin apically, in the subglobular female proctiger with a downwards bent dorsal margin and densely covered by setae subgenital plate. *R. capsici* differs from the two species by the absence of sexual dimorphism. It differs from *R. 8* by less longer setae on the female subgenital plate, and from *R. lycii* by a recurved apico-anterior process of the paramere and a female subgenital plate bearing an apical process.

RUSSELLIANA 5 SP. NOV.

(FIGS 7I, 10J, 15I, 20I, 25I, 29I)

Material examined

Holotype m$: **Chile**: V Region, Province San Felipe de Aconcagua, Putaendo, 10 km N San Felipe, 32°37'S 70°42'W, 700 m, 26.xii.1993, *Lycium* cf. *chilense*, river bed (D. Burckhardt) #35 (MHNG, dry).

Paratype. **Argentina**: 1 f£, Province Jujuy, Iturbe, 31.xii.1984 (L. E. Peña) (MHNG, dry); 1 m$, 11 f£, Province Mendoza, Mendoza Valley, between Uspallata and Potrerillos, 1700 m, 30–31.xii.1995, *Lycium* sp., scrub (D. Burckhardt) #30(1) (MHNG, dry, on slide, 70 % ethanol); 1 m$, same but Potrerillos, 1500 m, 31.xii.1995, *Lycium* sp. (D. Burckhardt) #31(2) (NHMB, on slide); 1 m$, same but Villa Hodel, km 7 on road Cacheuta to Mendoza, 1100 m, 17.i.1997, *Lycium* sp., scrub along road (D. Burckhardt) #12 (NHMB, dry); 1 m$, 7 f£, same but Potrerillos, 1300 m, *Lycium* sp. (D. Burckhardt) #11(1) (MHNG, 70 % ethanol); 7 m$, 11 f£, same but km 18 Mendoza to Villa Vicencia, 700 m, 18.i.1997, *Lycium* sp. (D. Burckhardt) #13(3, 4) (MHNG, on slide, 70 % ethanol). **Bolivia**: 2 f£, Department Chuquisaca, Province Nor Cinti, Lecori, S Potosi, 3200 m, 26–27.xii.1984 (L. E. Peña) (MHNG, dry, on slide); 1m$, 1 f£, same but Padcoya to Camargo, 2800–3200 m, 26–28.xii.1984 (L. E. Peña) (MHNG, dry, on slide); 1 m$, 6 f£, Department La Paz, Province Aroma, 7 km NE Patacamaya, 17°9.5'S 67°56.7'W, 3800 m, 21.iii.2001 (A. Freidberg) (NHMB, dry). **Chile**: 1 m$, 1 f£, IV Region, Province Elqui, Panamericana km 550. 85 km N La Serena, 29°25'S 71°10'W, 200 m, 6.xii.1993, *Nolana* cf. *sedifolia*, steppe (D. Burckhardt) #12 (MHNG, dry); 1 f£, same but 10 km S Vicuña towards Hurtado, 900 m, 18.xii.1995, *Lycium* sp., semidesert (D. Burckhardt) #7(1) (MHNG, dry); 1 m$, same but ca 40 km E La Serena, 5 km SW Vinita Baja, 450 m, 19.xii.1995, *Lycium* sp. (D. Burckhardt) #9(2) (MHNG, dry); 9 m$, 7 f£, 5 immatures, same as holotype (D. Burckhardt) #35 (MHNG, NHMB, dry, on slide); 102 m$, 94 f£, same but 15.xii.1995, *Lycium* sp. (D. Burckhardt) #1(7) (MHNG, dry, on slide, 70 % ethanol); 1 m$, same but Termas de Jahuel, 1000–1100 m, 27.xii.1997, *Acacia caven* steppe with some planted exotic trees (D. Burckhardt) #8 (NHMB, dry).

Description

Coloration: Head including genal processes pale yellow, vertex often with yellow pattern; clypeus bright yellow to dark brown. Eyes pale yellow to brown, ocelli red. Antenna yellow to brownish, segments 3–8 with dark brown apices, segments 9–10 entirely dark brown. Pronotum pale yellow with yellow to orange dot in the middle; mesopraescutum pale yellow with two orange patches along the fore margin and two posteriorly; mesoscutum pale yellow with four broad and, in the middle, one narrow orange longitudinal stripes; mesoscutellum pale yellow along the margin, orange in the middle. Metanotum yellow. Forewing with pale yellow to brownish veins and semitransparent, yellowish membrane with distinct brown patch along vein Cu_{1b} and brownish shadows in apical part of cells r_1, r_2, m_1, m_2 and cu_1. Legs pale to bright yellow, sometimes with slightly darker femur and distal tarsal segment, meracanthus of metacoxa pale yellow. Abdomen and terminalia pale yellow to brown. Male proctiger and paramere slightly darker apically. Female proctiger dark in apical third, subgenital plate with dark apex.

Structure: Head, in profile, inclined from longitudinal body axis at 45°. Vertex subtrapezoidal with indented foveae, anteriorly slightly produced into transverse tubercle on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, distinctly shorter than vertex; covered with moderately long setae. Forewing oval, broadly, evenly rounded apically; vein C+Sc hardly curved, pterostigma long, vein Rs almost straight apically, cell m_1 short; surface spinules relatively dense, present in all cells, leaving narrow spinule-free stripes along the veins, forming indistinct hexagons in apical half; absent at base of cell c+sc; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 6–8 apical spurs.

Terminalia: Male. Proctiger tubular; densely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced long setae, dorsal margin with a row of bristles. Paramere irregularly subtrapezoidal; with apico-anterior process on long pedicel, median slightly recurved hump with apically sclerotised tooth, and bulged apico-posterior lobe; process, hump and lobe of subequal length; outer face sparsely covered with moderately long setae mostly in apical half, inner face sparsely covered with short to moderately long setae and with longer setae along the posterior margin of lobe and the anterior margin at base. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with long, straight anterior process, one horn-shaped apical and one angular apico-posterior tubercles; lateral lobes long, strongly dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, slightly convex, with subapical indentation; densely covered with long setae. Subgenital plate cuneate, with short apical process; densely covered with long setae, dorsal margin with a row of bristles.

Host-plant: Lycium cf. *chilense* Bertero (Solanaceae).

Distribution: Argentina (Jujuy, Mendoza), Bolivia (Chuquisaca, La Paz), Chile (IV–V Regions).

Derivation of name: Anagram of *adunca*, a species to which it closely resembles.

Comment: Reported as *Russelliana* sp. cf. *adunca* from Argentina (Mendoza) (Burckhardt, 2008b). *Russelliana 5* resembles *R. adunca*, *4* and *7*; see comments under *R. adunca*. *R. 5* differs from *R. 4* and *7* by a short median hump of the paramere, from *R. 4* by long genal processes and longer setae on the female terminalia, and from *R. 7* by the presence of surface spinules in the apical part of the forewing, a long apico-posterior lobe of the paramere with a strongly constricted base, a relatively straight anterior process of the distal segment of the aedeagus, and a relatively stout apex of the female terminalia.

RUSSELLIANA CHILENSIS BURCKHARDT, 1987

(FIGS 7J, 11A, 16A, 21A, 25J, 29J)

Russelliana chilensis Burckhardt, 1987: 372.

Material examined
Type material. Holotype m$: **Chile**: VIII Region, Province Ñuble, Las Trancas, 1550 m, 12–13.xii.1983 (L. E. Peña) (MHNG, dry). Paratype. **Chile**: 1 f£, same as holotype (L. E. Peña) (MHNG, dry, on slide).

Additional material. **Chile**: 1 f£, same as holotype but Refugio Las Cabras, 1560 m, 16.ii.1967 (E. I. Schlinger) (CASC, dry); 9 m$, 9 f£, IX Region, Province Cautín, Parque Nacional Conguillío, North entrance, 1100 m, 30.i.1996, *Adesmia* sp., *Nothofagus dombeyi*/*Araucaria* forest and open patches with lava flows (D. Burckhardt) #64(2) (MHNG, NHMB, dry, 70 % ethanol); 6 m$, 6 f£, same but Province Malleco, Malalcahuello, Las Nalcas, 1400 m, 8.iii.1989 (T. Cekalovic) (MHNG, NHMB, dry); 67 m$, 184 f£, same but S Valle, Lonquimay, Curacautín, 1800 m, 29–30.i.1991 (L. E. Peña) (NHMB, dry, on slide, 70 % ethanol).

Description
Coloration: Head including genal processes brown to dark brown, vertex pale yellow with variable orange to dark brown pattern; clypeus dark brown. Eyes yellow to brown, ocelli red. Antenna yellow, segment 1, 8–10 entirely dark brown, segment 2 brownish at base, segment 3 entirely yellow, segments 4–7 with brown apices, segment 6 only a little darker apically. Pronotum pale yellow with orange to brown patch in the middle, sometimes entirely dark brown; mesopraescutum pale yellow with two orange to brown patches along the fore margin and two orange to brown transverse stripes posteriorly; mesoscutum pale yellow with four broad and, in the middle, one narrow orange to brown longitudinal stripes; mesoscutellum pale yellow along the margin, brown in the middle. Metanotum orange to brown. Forewing with yellow to brown veins and yellowish membrane with variable brown pattern consisting of broad stripe parallel to apical margin stretching from apical part of costal vein to apex of vein Cu_{1a}, leaving light areas in cells r_2, m_1 and m_2 along the margin, and patches at the bifurcation of veins R and M+Cu, in apical part of cell r_2 and along vein Cu_{1b}, sometimes forming stripe in the middle of wing stretching from apical part of cell r_1 to vein Cu_{1b}; sometimes with patches in cells c+sc and cu_2. Legs yellow to brownish with darker femur and distal tarsal segment, meracanthus of metacoxa yellow to orange. Abdomen and terminalia brown to black.

Structure: Head, in profile, moderately to strongly inclined from longitudinal axis of body (45–90°). Vertex subtrapezoidal, anteriorly produced into transverse tubercle on either side of mid-line, with raised hind margin around lateral ocelli, covered with microscopical setae; genal processes conical, slender, subacute apically, shorter than vertex, covered with moderately long setae. Pronotum with two lateral pronounced tubercles on either side. Thorax strongly arched dorsally. Forewing oblong-oval, broadly, unevenly rounded apically; vein C+Sc hardly curved, pterostigma long, vein Rs straight apically, cell m_1 short; surface spinules relatively large, dense, present in all cells, leaving no spinule-free stripes along the veins, forming hexagonal pattern; absent at base of cell c+sc; radular spinules not pronounced. Metatibia with 7 apical spurs.

Terminalia: Male. Proctiger tubular; densely covered with moderately long setae. Subgenital plate short, subglobular; with densely spaced moderately long setae. Paramere broadly lamellar; with short apico-anterior process lacking pedicel, median hump with apically sclerotised median tooth, and distinctly bulged posteriorly apico-posterior lobe; process and hump of subequal length, distinctly longer than lobe; outer face sparsely covered with moderately long setae mostly in posterior part, inner face densely covered with moderately long setae. Distal segment of aedeagus elongate, weakly expanding towards apex; with long anterior process and two small apico-posterior tubercles; lateral lobes long, dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, almost straight; densely covered with moderately long setae in apical half. Subgenital plate cuneate, with moderately long apical process; densely covered with moderately long setae in apical part, dorsal margin with few bristles.

Host-plant: Adults were collected on *Adesmia* sp. (Fabaceae) which is a likely host.

Distribution: Reported from Chile (VIII–IX Regions) (Burckhardt, 1987a).

Comment: Descriptions for the female are given for the first time.

Russelliana chillensis resembles *R. 12* in the membrane of the forewing with a brown pattern, in the broadly lamellar paramere bearing a short apico-anterior process lacking a pedicel, a small median hump and an apico-posterior lobe, in the distal segment of the aedeagus bearing a long anterior process, two apico-posterior tubercles and long, dilated towards apex lateral lobes, and in the cuneate female proctiger and cuneate subgenital plate bearing a short apical process. *R. chillensis* differs from *R. 12* by a shape of the forewing which is broadest in the apical third and its less extensive pattern which is mostly restricted to the apical part of the wing, and a strongly bulged posteriorly apico-posterior lobe of the paramere.

RUSSELLIANA 6 SP. NOV.

(FIGS 7K, 11B, 16B, 21B, 25K, 30A)

Material examined

Holotype m$: **Chile**: V Region, Province San Felipe de Aconcagua, Putaendo, 8 km N San Felipe, 12–13.i.1997, *Chorizanthe* sp., dry river bed of Río Aconcagua (D. Burckhardt) #4(2) (NHMB, dry).

Paratype. **Chile**: 6 m$, 14 f£, V Region, Province San Felipe de Aconcagua, Putaendo, 10 km N San Felipe, 700 m, 15.xii.1995, river bed (D. Burckhardt) #1 (MHNG, NHMB, dry); 17 m$, 28 f£, 9 immatures, same but 27.xii.1995, *Chorizanthe* sp. (D. Burckhardt) #27(3) (MHNG, NHMB, dry, on slide, 70 % ethanol); 1 m$, 6 f£, 1 immature, same as holotype (D. Burckhardt) #4(2) (NHMB, dry); 2 m$, 3 f£, same but El Asiento, 10 km NW San Felipe, 900 m, 13–20.i.1997, *Chorizanthe* sp. (D. Burckhardt) #54 (MHNG, 70 % ethanol).

Description

Coloration: Head including genal processes pale yellow to orange; clypeus orange to brown. Eyes yellow to brown, ocelli red. Antenna yellow to brownish, segments 4–8 with dark brown apices, sometimes segment 8 entirely brown, segments 9–10 entirely dark brown. Pronotum pale yellow to orange, sometimes orange in the middle; mesopraescutum pale yellow to orange, often with two dark orange patches along the fore margin and sometimes with two pale orange patches posteriorly; mesoscutum pale yellow with four broad orange longitudinal stripes; mesoscutellum pale yellow along the margin, yellow to orange in the middle. Metanotum yellow to orange. Forewing with whitish to pale yellow veins, gradually becoming brown towards apical part, and whitish membrane with indistinct pale brown patch along vein Cu_{1b}, sometimes yellowish in apical part and slightly brownish at places veins Rs, M_{1+2}, M_{3+4} and Cu_{1a} fall into marginal vein. Legs yellow to orange, distal tarsal segment darker, meracanthus of metacoxa pale yellow to orange. Abdomen and terminalia orange to brown, sometimes entirely yellow. Female terminalia darker in apical third.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly slightly produced into transverse tubercle on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with short setae; genal processes, conical, slender, subacute or slightly blunt apically, distinctly shorter than vertex, covered with short setae. Forewing oblong-oval, narrowly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs almost straight apically, cell m_1 short; surface spinules very faint, present in all cells, leaving no spinule-free stripes along the veins, densely and irregularly spaced; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 5–7 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae in apical two thirds. Subgenital plate short, subglobular; with sparsely spaced moderately long setae restricted to median part. Paramere broadly lamellar, slightly curved with median convexity apically; with short apico-anterior process on pedicel, apically sclerotised median tooth and posteriorly concave lobe; outer face sparsely covered with moderately long setae, inner face densely, evenly covered with moderately long setae. Distal segment of aedeagus elongate, weakly expanding towards apex; with long anterior process, one apical and one curved forward apico-posterior tubercles; lateral lobes moderately long, dilated towards apex which is concave. – Female. Proctiger cuneate, relatively blunt or subacute apically; dorsal margin, in profile, slightly curved, with subapical indentation; densely covered with short setae in apical half. Subgenital plate cuneate, with moderately long apical process; sparsely covered with moderately long setae, dorsal margin with a bristle.

Host-plant: Chorizanthe sp. (Polygonaceae).

Distribution: Chile (V Region).

Derivation of name: Named after its host-plant *Chorizanthe*.

Comment: Russelliana 6 resembles *R. disparilis, nigra, 20, similis* and *solanicola*, in the irregularly subtrapezoidal paramere bearing an apico-anterior process on a pedicel and a median tooth, in the distal segment of the aedeagus bearing an anterior process, two tubercles and long, dilated towards apex lateral lobes, in the cuneate female proctiger and cuneate subgenital plate bearing a short apical process. *R. 6* differs from the five species by an elongate female terminalia. It differs from *R. disparilis* and *nigra* by the presence of a median convexity of the apical margin of the paramere, from *R. disparilis* and *similis* by the presence of surface spinules in the apical part of the forewing, from *R. nigra* and *20* by a colourless membrane of the forewing, and from *R. disparilis* by an apically subacute anterior process of the distal segment of the aedaegus.

RUSSELLIANA 7 SP. NOV.

(FIGS 7L, 11C, 16C, 21C, 25L, 30B)

Material examined

Holotype m$: **Chile**: IV Region, Province Limarí, Parque Nacional Fray Jorge, Quebrada La Vaca, 30°40'S 71°40'W, 100–200 m, 15–17.xii.1992, *Lycium chilense* (D. Burckhardt) #27 (NHMB, dry).

Paratype. **Argentina**: 1 f£, Province Catamarca, San Fernando, NE Tinogasta, 4.xi.1991, *Prosopis* sp. (L. E. Peña) (NHMB, 70 % ethanol); 2 f£, Province La Rioja, Guandacol, 1–3.xii.1983 (L. E. Peña) (MHNG, dry); 2 m$, 2 f£, Province Mendoza, Santa Rosa, Ñacuñán, 8.viii.1996, *Atamisquea emarginata* [*Capparis atamisquea*] (G. Debandi) (NHMB, dry); 3 m$, 4 f£, 1 immature, same but Mendoza Valley, Potrerillos to Cacheuta, 1200 m, 17.i.1997, *Lycium* sp. (D. Burckhardt) #10(3) (MHNG, on slide, 70 % ethanol); 45 m$, 55 f£, same but Potrerillos, 1300 m, *Lycium* sp. (D. Burckhardt) #11(1) (MHNG, 70 % ethanol); 5 m$, 11 f£, same but km 18 Mendoza to Villa Vicencia, 700 m, 18.i.1997, *Lycium* sp. (D. Burckhardt) #13(3, 4) (MHNG, 70 % ethanol, on slide); 1 m$, 2 f£, 1?, same but Zoológico, vii.1997 (S. Roig) (NHMB, dry); 9 m$, 27 f£, Province San Juan, La Ciénaga, 6.iii.1992 (L. E. Peña) (NHMB, on slide, 70 % ethanol). **Chile**: 6 m$, 2 f£, 1 immature, IV Region, Province Limarí, Parque Nacional Fray Jorge, 250 m, 7–9.xii.1990. *Lycium chilense*, open mediterranean scrub (D. Agosti & D. Burckhardt) #2 (MHNG, NHMB, dry, on slide); 9 m$, 9 f£, 1?, same as holotype (D. Burckhardt) #27 (NHMB, dry).

Description

Coloration: Head including genal processes pale yellow, vertex pale yellow along the margin, yellowish to orange in the middle; clypeus yellow to dark brown. Eyes pale yellow to brown, ocelli orange to red. Antenna yellow to brownish, segments 3–8 with dark brown apices, segments 9–10 entirely dark brown. Pronotum pale yellow and distinctly paler than mesonotum, often with yellow dot in the middle; mesopraescutum pale yellow, often with two big orange patches along the fore margin and two orange patches posteriorly; mesoscutum pale yellow, often with four broad and, in the middle, one narrow orange longitudinal stripes; mesoscutellum pale yellow along the margin, often orange in the middle. Metanotum yellow to orange. Forewing with pale yellow veins and colourless to yellowish membrane with indistinct brown patch along vein Cu_{1b}, sometimes with indistinct brownish shadows in apical part of cells r_1, r_2, m_1, m_2 and cu_1 and at base of cell m_2. Legs pale yellow to brownish, sometimes with darker femur, meracanthus of metacoxa pale yellow. Abdomen yellow to brown; terminalia pale yellow to orange. Male proctiger and paramere slightly darker apically. Female terminalia lighter ventrally, with dark apex.

Structure: Head, in profile, strongly inclined from longitudinal body axis (> 45°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse tubercle on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, distinctly shorter than vertex, covered with moderately long setae. Forewing oval, broadly, evenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs weakly sinuous, slightly curved to fore margin apically, cell m_1 short; surface spinules absent; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 7–8 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced long setae. Paramere irregularly subtrapezoidal; with apico-anterior process on long pedicel, long median, slightly recurved median hump with apically sclerotised tooth, and small apico-posterior lobe; both process and lobe of subequal length and distinctly shorter than hump; outer face sparsely covered with moderately long setae mostly in apical part, inner face sparsely covered with moderately long setae and with few longer setae along anterior margin at base. Distal segment of aedeagus moderately elongate; with long hook-shaped anterior process, one small, raised apical and one small apico-posterior tubercles; lateral lobes long, dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, almost straight to weakly sinuous; densely covered with long setae. Subgenital plate cuneate, with short apical process; sparsely covered with long setae, dorsal margin with a row of bristles.

Host-plant: Lycium chilense Bertero (Solanaceae).

Distribution: Argentina (Catamarca, La Rioja, Mendoza, San Juan), Chile (IV Region).

Derivation of name: From Latin didymus = twin for its close resemblence to *Russelliana adunca*, *4* and *5*.

Comment: Russelliana 7 resembles *R. adunca*, *4* and *5*; see comments under *R. adunca*. *R. 7* differs from the three species by a very short apico-posterior lobe of the paramere, a hook-shaped anterior process of the distal segment of the aedaegus, and by a narrow apex of the female proctiger. It differs from *R. adunca* and *4* by longer setae on the female terminalia, from *R. 4* and *5* by the absence of surface spinules in the apical part of the forewing, from *R. 4* by long genal processes, and from *R. 5* by a longer median hump of the paramere.

RUSSELLIANA 8 **SP. NOV.**

(FIGS 7M, 11D, E, 16D, 21D, 26A, 30C)

Material examined

Holotype m$: **Argentina**: Province Mendoza, Mendoza Valley, between Uspallata and Potrerillos, 1700 m, 30–31.xii.1995, *Lycium* sp., scrub (D. Burckhardt) #30(1) (MHNG, dry).

Paratype. **Argentina**: 12 m$, 17 f£, 4 immatures, same as holotype (D. Burckhardt) #30(1) (MHNG, NHMB, dry, on slide, 70 % ethanol).

Description

Coloration: Dimorphic, male slightly darker, general body colour yellow to brownish; female slightly lighter, general body colour yellow, forewing pattern paler than in males. Head whitish to bright yellow, genal processes usually lighter than head and thorax, genae yellow to brown; vertex yellow with bright yellow pattern; clypeus yellow to brown. Eyes yellow to dark brown, ocelli orange to red. Antenna yellow, sometines segments 1–2 orange, segments 3–8 with dark brown apices, segments 9–10 entirely dark brown. Pronotum pale to bright yellow; mesopraescutum pale to bright yellow with two yellow to orange patches along the fore margin and sometimes with two yellow to orange patches posteriorly; mesoscutum pale to bright yellow with four broad yellow to orange longitudinal stripes; mesoscutellum pale to bright yellow. Metanotum pale to bright yellow. Forewing with whitish to dark brown veins and membrane with distinct pale to dark brown pattern differs for males and females. Male forewing membrane with brown to dark brown pattern consisting of two broad transverse stripes: submarginal one stretching from apical part of costal vein to median part of cell cu_1 leaving light areas in cells r_2, m_1, m_2 and cu_1 along the margin, and median one stretching from median part of vein C+Sc to apical part of claval suture; membrane between two bands colourless with sparse dark brown dots scattered over entire surface and sometimes on veins. Female forewing membrane with pale brown pattern consisting of dots occupying all cells, partly confluent in apical part and broad stripe parallel to apical margin stretching from apical part of costal vein to median part of cell cu_1 leaving light areas in cells r_2, m_1, m_2 and cu_1 along the margin. Legs yellow to brownish with darker femur, meracanthus of metacoxa pale to bright yellow. Abdomen yellow to brown; terminalia yellow to orange. Female terminalia with dark apex.

Structure: Head, in profile, weakly inclined from longitudinal body axis (< 45°). Vertex trapezoidal, flat with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with microscopical setae; genal processes short, swollen, slightly conical apically, covered with short setae. Pronotum with two lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing rhomboidal; vein C+Sc strongly, unevenly curved, pterostigma long, vein Rs almost straight, strongly curved to fore margin apically, cell m_1 short; male forewing with large, very dense surface spinules, present in all cells, leaving no spinule-free stripes along the veins, irregularly spaced on pigmented areas, weakly developed on unpigmented areas and absent in the middle of the wing; female forewing with very dense surface spinules, present in all cells, leaving no spinule-free stripes along the veins, irregularly spaced, less developed on unpigmented areas; radular spinules not pronounced. Metatibia with 6 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate elongate; with sparsely spaced moderately long setae. Paramere narrowly lamellar; with recurved apico-anterior process on pedicel, and long apico-posterior lobe with inwards directed sclerotised anterior tooth situated at base of the lobe; lobe more than twice longer than process; outer face covered with moderately long setae mostly in apical half, inner face densely covered with moderately long setae. Distal segment of aedeagus moderately elongate, broadly, evenly expanding towards apex; lateral lobes moderately long, slightly dilated towards apex which is rounded and with frayed margin. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, convex; densely covered with moderately long setae. Subgenital plate subglobular, with tiny apical process; densely covered with moderately long setae and with long setae in ventral part, dorsal margin with a row of bristles.

Host-plant: Lycium sp. (Solanaceae).

Distribution: Argentina (Mendoza).

Derivation of name: From Ancient Greek δι- = two and μορφή = shape, form, figure referring to the strong sexual dimorphism of the species.

Comment: Reported as *Russelliana* sp. cf. *lycii* from Argentina (Mendoza) (Burckhardt, 2008b). *Russelliana 8* resembles *R. capsici* and *lycii*; see comments under *R. capsici*. *R. 8* differs from the two species by longer setae on the female subgenital plate. It differs from *R. capsici* by the presence of sexual dimorphism, and from *R. lycii* by a recurved apico-anterior process of the paramere and a subgenital plate bearing an apical process.

RUSSELLIANA DIOSTEAE BURCKHARDT, 2008

(FIGS 7N, 11F, 16E, 21E, 26B, 30D)

Russelliana diosteae Burckhardt, 2008: 80.

Material examined

Type material. Holotype m$: **Chile**: VII Region, Province Talca, Parque Gil de Vilches, El Enladrillado, El Venado Valley, 1350–1700 m, 14.i.1996, *Dipyrena juncea* [*Diostea juncea*] (D. Burckhardt) #45(1) (MHNG, on slide). Paratype. **Chile**: 1 f£, same as holotype (D. Burckhardt) #45(1) (MHNG, on slide).

Description

Coloration: Head yellowish to greyish, ventrally whitish, genal processes white, black at base, vertex with two dark dots on either side of mid-line; clypeus dark brown. Antenna ochreous with tips of segments 4–7 brown getting darker towards apex, segments 8–10 entirely dark brown to black. Pronotom with four dark dots; mesopraescutum orange anteriorly; mesoscutum with brown longitudinal stripes; mesoscutellum with dark dot in the middle. Metanotum dark brown. Forewing with yellow veins and colourless membrane with brown pattern, consisting of patch along vein Cu$_{1b}$ and two well-defined oblique stripes: submarginal one stretching from apical part of costal vein to base of vein Cu$_{1a}$ leaving light areas in cells r$_2$, m$_1$ and m$_2$ along the margin, and median one stretching from apical part of cell r$_1$ to median part of anal vein. Legs with femora and distal tarsal segment dark brown, tibiae and basal tarsal segment ochreous. Abdomen dark brown. Female with slightly lighter vertex and thoracic dorsum.

Structure: Head, in profile, strongly inclined from longitudinal body axis (> 45°). Vertex subtrapezoidal, flat with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, hind margin around lateral ocelli not raised, covered with microscopical setae; genal processes conical, slender, subacute apically, distinctly shorter than vertex, covered with long setae. Pronotum bearing two lateral pronounced tubercles on either side. Forewing oblong-oval, broadly, unevenly rounded apically; veins bearing short microscopical setae; vein C+Sc strongly, unevenly curved, pterostigma short, vein Rs almost straight apically, cell m$_1$ short; surface spinules present in all cells, leaving no spinule-free stripes along the veins, densely spaced and forming irregular, indistinct hexagons in apical half, very sparse on unpigmented areas; absent at base of cell c+sc; radular spinules weakly pronounced. Metatibia with 5–6 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate elongate; with sparsely spaced moderately long setae. Paramere narrowly lamellar; with thumb-like apico-anterior process on pedicel and long apico-posterior lobe, irregularly rounded apically, with inwards directed sclerotised anterior tooth situated at base of the lobe; lobe distinctly longer than process; outer face densely covered with moderately long setae in apical half, inner face densely patchy covered with moderately long setae and with long thick bristles apically and in basal third. Distal segment of aedeagus massive, broadly, unevenly expanding towards apex, inflated anteriorly; with one horn-shaped apico-posterior tubercle; lateral lobes moderately long, with frayed apical margin. – Female. Proctiger subglobular, subacute apically; dorsal margin, in profile, convex, bent downwards; densely covered with short setae in apical part and with moderately long setae. Subgenital plate subglobular, rounded apically; densely covered with moderately long setae in ventral part.

Host-plant: Dipyrena juncea (Gillies & Hook.) Ravenna (Verbenaceae).

Distribution: Reported from Chile (VII Region) (Burckhardt, 2008a).

Comment: Russelliana diosteae resembles *R. bulbosa* and *sebastiani*; see comments under *R. bulbosa*. *R. diosteae* differs from the two species by a broadly, unevenly rounded apically forewing, and the distal segment of the aedeagus bearing a horn-shaped apico-posterior tubercle. *R. diosteae* differs from *R. bulbosa* by longer antenna, a forewing with a brown pattern bearing a shorter pterostigma, a paramere bearing an apico-anterior process distinctly shorter than an apico-posterior lobe, and a rounded apically female subgenital plate lacking an apical process. It differs from *R. sebastiani* by slender, longer genal processes, a broad forewing with a different, less extensive in its basal third brown pattern and with a shorter cell m_1, a paramere bearing a thumb-like apico-anterior process and a broad apico-posterior lobe, and an distal segment of the aedeagus strongly inflated anteriorly.

RUSSELLIANA DISPARILIS **TUTHILL, 1964**

(FIGS 7O, 11G, 16F, 21F, 26C, 30E)

Russelliana disparilis Tuthill, 1964: 27.

Material examined

Type material. Holotype m$: **Peru**: Region Cusco, 13.vi.1959, *Dunalia* sp. (L. D. Tuthill) (USNM, dry).

Additional material. **Argentina**: 1 f£, Province Mendoza, Mendoza Valley, Punta de Vacas to Uspallata, 1900 m, 16–19.i.1997 (D. Burckhardt) #9 (NHMB, dry). **Bolivia**: 10 m$, 9 f£, 6 immatures, Department Chuquisaca, Province Nor Cinti, Padcoya to Camargo, 2800–3200 m, 26–28.xii.1984 (L. E. Peña) (MHNG, dry, on slide); 2 m$, 5 f£, same but S. Potosi, Lecori, 3200 m, 26–27.xii.1984 (L. E. Peña) (NHMB, dry, on slide). **Chile**: 1 f£, V Region, Province Petorca, La Viña to Alicahue, E Cabildo to La Ligua, 600 m, 21.xii.1998, semidesert, degraded *Acacia caven* steppe and sclerophyll forest along river (D. Burckhardt) #2 (NHMB, dry).

Description

Coloration: Head including genal processes pale to bright yellow, genal processes often with dark tips, genae brown to black, vertex sometimes with yellow to brownish pattern; clypeus dark brown. Eyes yellow to brown, ocelli orange. Antenna yellow to brownish, segments 3–8 with brown apices, segments 9–10 entirely dark brown. Pronotum pale yellow, with brown spots on either side and yellow to brown spot in the middle; mesopraescutum pale yellow, with two orange patches along the fore margin and two orange to brown transverse stripes posteriorly; mesoscutum pale yellow, with four broad and, in the middle, one narrow, orange longitudinal stripes; mesoscutellum pale yellow along the margin, yellow to orange in the middle. Metanotum yellow to dark brown. Forewing with brown veins and colourless membrane, fumose in the middle of cells in apical half and with indistinct brown patch along vein Cu_{1b}; sometimes brownish in apical part of cell cu_2. Legs pale to dirty yellow, sometimes with slightly darker femur and distal tarsal segment, meracanthus of metacoxa yellow. Abdomen and terminalia dirty yellow to dark brown. Female proctiger dark in apical third, subgenital plate with dark apex. Females often slightly lighter with ventrally lighter abdomen.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse tubercle on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, shorter than vertex, covered with long setae. Pronotum with one lateral, relatively pronounced, and one lateral, relatively shallow, tubercles on either side. Forewing oval, broadly, evenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs sinuous, almost straight apically, cell m_1 short; surface spinules absent; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 8–9 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae in apical half. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere irregularly subtrapezoidal; with long sickle-shaped apico-anterior process on short pedicel and long, bulged apico-posterior lobe, broadly rounded apically, with apically sclerotised median tooth; lobe distinctly longer than process; outer face sparsely covered with moderately long setae mostly in posterior part, inner face densely covered with relatively short setae apically and with long setae in basal half. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with blunt anterior process, one apical and one curved forward apico-posterior tubercles; lateral lobes long, dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, almost straight, slightly convex; sparsely covered with moderately long setae. Subgenital plate cuneate, with short apical process; sparsely covered with moderately long setae in apical half, dorsal margin with a row of bristles.

Host-plants: Dunalia sp. (Solanaceae).

Distribution: Argentina (Mendoza), Chile (V Region). Reported from Bolivia (Chuquisaca) and Peru (Cusco) (Burckhardt, 1987a; Tuthill, 1964).

Comment: Russelliana disparilis resembles *R. 6*, *nigra*, *20*, *similis* and *solanicola*; see comments under *R. 6*. *R. disparilis* differs from the five species by a strongly bulged apico-poterior lobe of the paramere, and a blunt anterior process of the distal segment of the aedaegus. It differs from *R. 6*, *nigra*, *20* and *solanicola* by the absence of surface spinules in the apical part of the forewing, from *R. 6*, *20*, *similis* and *solanicola* by the absence of a median hump of the paramere, and from *R. nigra* and *20* by a colourless membrane of the forewing.

RUSSELLIANA FABIANAE **BURCKHARDT, 1987**

(FIGS 8A, 11H, 16G, 21G, 26D, 30F)

Russelliana fabianae Burckhardt, 1987: 369.

Material examined

Type material. Holotype m$: **Chile**: VII Region, Province Talca, Alto Vilches, 6.x.1983 (L. E. Peña) (MHNG, dry). Paratype. **Argentina**: 1 f£, Province Río Negro, El Bolsón, 1.iv.1961 (G. Topal) (MHNG, on slide); 1 m$, 1 f£, same but 680 m, 22.iv.1961 (G. Topal) (MHNG, dry, on slide); 8 m$, 7 f£, same but 360 m, 4.xi.1961 (G. Topal) (MHNG, dry, on slide). **Chile**: 1 f£, same as holotype (L. E. Peña) (MHNG, dry).

Additional material. **Chile**: 4 m$, 16 f£, IV Region, Province Elqui, La Laguna to Nueva Elqui, ca 115 km E La Serena, 2600 m, 17.xii.1995, *Fabiana imbricata* (D. Burckhardt) #5(2) (MHNG, dry, 70 % ethanol); 5 m$, 5 f£, same but La Laguna, ca 120 km E La Serena, 2800–3000 m, *Fabiana imbricata* (D. Burckhardt) #4(2) (MHNG, dry); 1 m$, 3 f£, V Region, Province San Felipe de Aconcagua, Resguardo de Los Patos, 32°29.2'S 70°33.9'W, 1350 m, 6.iii.2009, *Fabiana imbricata*, *Acacia caven* scrub (D. Burckhardt) #14(1) (NHMB, dry); 3 m$, 10 f£, 1 immature, VII Region, Province Talca, Vilches, 35°36'S 71°12'W, 1200 m, 25.xi.1992, *Fabiana imbricata*, mixed *Nothogagus* forest (D. Burckhardt) #15 (NHMB, dry); 2 m$, 6 f£, same but Armerillo to Las Garzas, Maule Valley, 60–80 km E Talca, 35°45'S 71°00'W, 700 m, *Fabiana imbricata*, degraded sclerophyll forest and scrub (D. Burckhardt) #14 (NHMB, dry); 1 m$, 2 f£, 1 immature, same but 15 km E San Clemente, 35°33'S 71°20'W, 400 m, 4.i.1994, *Fabiana imbricata*, sclerophyll scrub mixed with pasture (D. Burckhardt) #46 (MHNG, dry); 24 m$, 18 f£, same but Parque Gil de Vilches, Monumento Natural, 35°35'S 71°04'W, 1100 m, 4–5.i.1994, *Fabiana imbricata*, mixed *Nothofagus* forest (D. Burckhardt) #47 (MHNG, dry); 1 f£, same but sector Piedras blancas, 1350–1600 m, 12.i.1996, *Baccharis* sp. (D. Burckhardt) #43(7) (MHNG, dry); 3 m$, 5 f£, same but *Fabiana imbricata* (D. Burckhardt) #43(1) (MHNG, dry); 7 m$, 15 f£, 2 immature skins, same but sector Majadilla, 1350–1550 m, 13.i.1996, *Fabiana imbricata*, deciduous and evergreen *Nothofagus* forests (D. Burckhardt) #44(1) (MHNG, dry, 70 % ethanol); 11 m$, 13 f£, same but El Enladrillado, El Venado Valley, 1350–1700 m, 14.i.1996, *Fabiana imbricata*, mixed *Nothofagus* forest (D. Burckhardt) #45(2) (MHNG, dry, 70 % ethanol); 1 m$, 1 f£, VIII Region, Province Bío-Bío, 21 km E of Villa Mercedes, 530 m, 21.xi.1981 (R. T. Schuh & N. I. Platnick) (NHMB, dry); 8 m$, 31 f£, same but Parque Nacional Laguna del Laja, sector Chacay, 1200 m, 19.i.1996, *Fabiana imbricata*, *Austrocedrus* forest and open sclerophyll scrub (D. Burckhardt) #53(2) (MHNG, NHMB, dry, 70 % ethanol); 1 m$, 3 f£, same but sector Lagunillas, 1100 m, 21.i.1996, *Fabiana imbricata* (D. Burckhardt) #56(2) (MHNG, dry); 1 m$, 3 f£, same but sector Saltos de Chilcas and del Torbellino, *Fabiana imbricata* (D. Burckhardt) #57(3) (NHMB, dry); 6 m$, 26 f£, 3 immatures, 1 immature skin, same but outside Parque Nacional Laguna del Laja, Park entrance to El Abanico, 900–1100 m, 22.i.1996, *Fabiana imbricata*, dense forest along river (D. Burckhardt) #58(8) (NHMB, dry, 70 % ethanol); 193 m$, 144 f£, 59 immatures, same but Province Ñuble, 20 km W Termas de Chillán, 1000 m, 12.xii.1990. *Fabiana imbricata*, pasture (D. Agosti & D. Burckhardt) #6 (MHNG, dry); 6 m$, 7 f£, IX Region, Province Malleco, Parque Nacional Nahuelbuta, road from "Administración" to Piedra del Aguila, 37°49'S 73°01'W, 1200 m, 24–25.xii.1992, *Fabiana imbricata*, open *Nothofagus obliqua*/*antarctica* forest (D. Burckhardt) #32 (NHMB, dry); 12 m$, 7 f£, 3 immature skins, same but Parque Nacional Tolhuaca, sector Laguna Malleco, 900 m, 23–27.i.1996, *Fabiana imbricata* (D. Burckhardt) #61b(9) (NHMB, dry, 70 % ethanol).

Description
Coloration: General colour of body green-yellow to bright yellow. Head including genal processes and clypeus greenish to pale yellow. Eyes pale yellow, ocelli orange. Antenna green to dirty yellow, segments 4–8 with brownish apices, segments 9–10 entirely dark brown. Thorax greenish to bright yellow; pronotum of the same colour as vertex, distinctly paler than mesonotum; mesopraescutum sometimes with two brownish patches along the fore margin. Forewing with yellow veins and semitransparent, yellowish to brown membrane, usually darker along outer margin. Legs pale yellow to green, with darker femur and distal tarsal segment, meracanthus of metacoxa pale yellow. Abdomen and terminalia green to bright yellow. Female terminalia with dark apex.

Structure: Head, in profile, inclined from longitudinal body axis at 45°. Vertex trapezoidal, flat with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with microscopical setae; genal processes conical, slender, subacute apically, twice shorter than vertex, covered with short setae. Pronotum with two lateral relatively pronounced tubercles on either side. Forewing oviform; vein C+Sc strongly curved in the middle, pterostigma long, vein Rs straight apically, cell m_1 short; surface spinules very dense, present in all cells, leaving no spinule-free stripes along the veins, irregularly spaced; very sparse at base of cell c+sc; radular spinules not pronounced. Metatibia with 7–9 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate relatively elongate; with sparsely spaced moderately long setae. Paramere broadly lamellar; with short apico-anterior process lacking pedicel and apically sclerotised median tooth; outer face with few moderately long setae, inner face densely, evenly covered with moderately long setae. Distal segment of aedeagus massive, broadly, unevenly expanding towards apex, strongly inflated anteriorly and concave apically; with one horn-shaped apico-posterior tubercle; lateral lobes short, with entire apical margin. – Female. Proctiger cuneate, subacute apically; dorsal margin, in profile, convex, strongly indented subapically; densely covered with long setae. Subgenital plate subglobular, with moderately long apical process;

densely covered with moderately long setae in apical half and with long setae along ventral margin, dorsal margin with a row of bristles.

Host-plant: Fabiana imbricata Ruiz & Pav. (Solanaceae).

Distribution: Reported from Argentina (Río Negro), Chile (IV–V, VII–IX Regions) (Burckhardt, 1987a).

Comment: Russelliana fabianae resembles *R. 23*, in the yellow membrane of the forewing which is broadest in the middle and bearing a strongly curved in the middle vein C+Sc, in the broadly lamellar paramere bearing a short apico-anterior process lacking pedicel, in the strongly inflated anteriorly distal segment of the aedeagus bearing a horn-shaped apico-posterior tubercle and short lateral lobes with entire apical margin, in the female proctiger with a convex, strongly indented subapically dorsal margin and subglobular subgenital plate bearing an apical process. *R. fabianae* differs from *R. 23* by longer antenna and the presence of surface spinules in all cells of the forewing.

Russelliana 9 **sp. nov.**

(Figs 8B, 11I, J, 16H, 21H, 26E, 30G)

Material examined
Holotype m$: **Argentina**: Province Chubut, South Ameghino dam, 5.xi.1990 (L. E. Peña) (NHMB, on slide).

Paratype. **Argentina**: 1 m$, 4 f£, same as holotype (L. E. Peña) (NHMB, on slide, 70 % ethanol).

Description
Coloration: Dimorphic, male slightly darker, general body colour brown; female slightly lighter, general body colour yellow to brownish, forewing pattern paler than in males. Head including genal processes pale yellow to brownish; clypeus brown. Eyes brown, ocelli pale yellow. Antenna yellow, segments 4–8 with dark brown apices, segments 9–10 entirely dark brown. Pronotum pale yellow, often dark brown in the middle; mesopraescutum yellow, often with two brownish patches along the fore margin; mesoscutum yellow, often with four broad and, in the middle, one narrow brownish longitudinal stripes; mesoscutellum yellow along the margin, often dark brown in the middle. Metanotum yellow to dark brown. Forewing with whitish to dark brown veins and membrane with distinct pale to dark brown pattern differs for males and females. Male forewing membrane with dark brown pattern consisting of confluent dots and patches, stretching from apical part of costal vein to the middle of cell cu$_1$ forming transverse marginal band leaving light areas in cells r$_2$, m$_1$ and m$_2$, continues along vein Cu$_{1a}$, stretching from apical part of vein Cu$_{1b}$ to median part of vein C+Sc; membrane between bands colourless, with brown dots varying in size and number scattered over entire surface. Female forewing membrane with pale to dark brown pattern consisting of distinct transverse band, leaving light areas in cells r$_1$, r$_2$, m$_1$ and m$_2$, frequently confluent dots, forming variable usually lighter patches varying in size and number scattered over entire surface of the wing, and patch along vein Cu$_{1b}$. Legs pale yellow to brownish, sometimes with darker femur, meracanthus of metacoxa pale yellow. Abdomen pale yellow to brown, lighter ventrally. Male

terminalia brown. Females terminalia yellow to brown, proctiger dark in apical third, subgenital plate lighter than proctiger.

Structure: Head, in profile, weakly inclined from longitudinal body axis (< 45°). Vertex trapezoidal, flat with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, hind margin around lateral ocelli not raised, covered with short setae; genal processes short, swollen, slightly conical apically, covered with short setae. Pronotum with two lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing rhomboidal; vein C+Sc strongly, unevenly curved, pterostigma long, vein Rs almost straight, strongly curved to fore margin apically, cell m_1 long; surface spinules very dense, present in all cells, leaving no spinule-free stripes along the veins, forming transverse rows, less developed on unpigmented areas; radular spinules not pronounced. Metatibia with 6 apical spurs.

Terminalia: Male. Proctiger barrel-shaped; sparsely covered with moderately long setae in apical two thirds. Subgenital plate elongate; with sparsely spaced long setae restricted to median part. Paramere shortly lamellar; with long recurved hook-shaped apico-anterior process on pedicel, broadly rounded apico-posterior lobe with apically sclerotised median tooth; lobe situated exterior to process; both process and lobe of subequal length; outer face sparsely covered with moderately long setae mostly in apical half, inner face covered with long thick bristles anteriorly and apically. Distal segment of aedeagus moderately elongate, broadly, evenly expanding towards apex; with one small apico-posterior tubercle; lateral lobes long, tubular and with frayed apical margin. – Female. Proctiger subglobular, pointed apically; dorsal margin, in profile, strongly bent downwards; sparsely covered with moderately long setae in apical half dorsally. Subgenital plate globular, strongly bulged, broadly rounded apically; densely covered with long setae in apical part, dorsal margin with a row of bristles.

Host-plant: unknown.

Distribution: Argentina (Chubut).

Derivation of name: From Latin globus = sphere referring to the globular female subgenital plate.

Comment: Russelliana 9 resembles *R. 2* and *17*; see comments under *R. 2*. *R. 9* differs from the two species by a less extensive pattern on the male forewing, longer lateral lobes with subparallel sides of the distal segment of aeadeagus, in the subglobular female proctiger and globular subgenital plate lacking an apical process.

RUSSELLIANA INTERMEDIA **BURCKHARDT, 1987**

(FIGS 8C, 12A, 16I, 21I, 26F, 30H)

Russelliana intermedia Burckhardt, 1987: 384.

Material examined
Type material. Holotype m$: **Bolivia**: Department Chuquisaca, Province Nor Cinti, Padcoya to Camargo, 2800–3200 m, 26–28.xii.1984 (L. E. Peña) (MHNG, dry). Paratype. **Argentina**: 1 f£, Province Jujuy, Iturbe, 31.xii.1984 (L. E. Peña) (MHNG, dry). **Bolivia**: 3 m$, 5 f£, same as holotype (L. E. Peña) (MHNG, dry, on slide); 2 f£, same but Lecori, S Potosi, 26–27.xii.1984 (L. E. Peña) (MHNG, dry).

Description
Coloration: Head including genal processes pale yellow to orange, genal processes sometimes with dark tips; clypeus pale to dark brown. Eyes pale yellow to black, ocelli orange to red. Antenna yellow to orange, segments 3–8 with brown apices, 9–10 entirely dark brown. Pronotum of the same colour as vertex, sometimes with yellow to orange spot in the middle; mesopraescutum pale yellow to orange, sometimes with two yellow to orange patches along the fore margin; mesoscutum pale yellow to orange, sometimes with four broad, and, in the middle, one narrow, yellow to orange longitudinal stripes; mesoscutellum pale yellow to orange along the margin, sometimes yellow to orange in the middle. Metanotum pale yellow to orange. Forewing with yellow veins and amber-coloured membrane. Legs bright yellow to orange, meracanthus of metacoxa bright yellow. Abdomen orange to dark brown. Male terminalia yellow to orange. Female terminalia orange to brown, with dark apex.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with microscopical setae; genal processes conical, slender, subacute apically, shorter than vertex, covered with moderately long setae. Pronotum with one lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing oblong-oval, broadly, evenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs straight or weakly sinuous, almost straight apically, cell m_1 short; surface spinules very dense, present in all cells, leaving very narrow spinule-free stripes along the veins, irregularly spaced; very sparse at base of cell c+sc; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 6–7 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced moderately long setae in apical half. Paramere narrowly lamellar; with long hook-shaped apico-anterior process on pedicel, short slightly curved anteriorly median hump with apically sclerotised tooth, and slightly bulged apico-posterior lobe; hump and lobe of subequal length, slightly lower than process; outer face sparsely covered with moderately long setae mostly in posterior part, inner face covered with moderately long setae in apical half and with long thick bristles in basal third. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with short beak-shaped anterior process and one horn-shaped apico-posterior tubercle; lateral lobes long, dilated towards apex which is concave. – Female. Proctiger subglobular, pointed apically; dorsal margin, in profile, strongly bent downwards; relatively densely covered with moderately long setae in apical half. Subgenital plate cuneate, with short apical process; sparsely covered with long setae in apical part and along ventral margin, dorsal margin with a row of bristles.

Host-plants: unknown.

Distribution: Reported from Argentina (Jujuy), Bolivia (Chuquisaca) (Burckhardt, 1987a).

Comment: Russelliana intermedia resembles *R. 1, 3* and *24*; see comments under *R. 1. R. intermedia* differs from the three species by the presence of a median hump and long thick bristles in the basal third of the paramere. It differes from *R. 3* and *24* by a multicoloured body colour, from *R. 1* by a yellow membrane of the forewing and a female proctiger with a downwards bent dorsal margin, from *R. 3* by a shape of the forewing which is broadest in the apical third, and from *R. 24* by more dense surface spinules of the forewing.

RUSSELLIANA 10 **SP. NOV.**

(FIGS 8D, 12B, 17A, 22A, 26G, 30I)

Material examined

Holotype m$: **Chile**: III Region, Province Chañaral, Pedernales, Cordilliera de Domeyko, 26°21'S 69°16'W, 3400 m, 11.xii.1993, *Adesmia hystrix*, desert (D. Burckhardt) #25 (MHNG, dry).

Paratype. **Chile**: 2 f£, 1 immature, II Region, Province El Loa, Calama to San Pedro de Atacama, 3050 m, vii.1997, *Acantholippia trifida* (F. Saiz) (NHMB, dry); 49 m$, 23 f£, 2 immatures, III Region, Province Chañaral, Pedernales, Cordilliera de Domeyko, 26°21'S 69°16'W, 3300 m, 10.xii.1993, *Adesmia hystrix*, desert (D. Burckhardt) #24 (MHNG, dry); 8 m$, 6 f£, same as holotype (D. Burckhardt) #25 (MHNG, dry); 4 m$, 6 f£, same but Quebrada de Paipote, 20 km W Laguna Santa Rosa, 27°05'S 69°20'W, 3500 m, 12.xii.1993, *Adesmia hystrix*, gully with *Adesmia* shrubs (D. Burckhardt) #29 (MHNG, dry); 8 m$, 17 f£, IV Region, Province Elqui, La Laguna, ca 120 km E La Serena, 2800–3000 m, 17.xii.1995, *Adesmia* sp., scattered shrubs (D. Burckhardt) #4(1) (MHNG, dry, on slide, 70 % ethanol).

Description

Coloration: Head including genal processes orange to dark brown, genal processes sometimes with pale yellow tips, vertex yellow, orange to brown along lateral margin, sometimes entirely brown; clypeus dark brown. Eyes yellow to brown, ocelli red. Antenna yellow to brownish, segments 3–7 with dark brown apices, segments 8–10 entirely dark brown. Pronotum pale yellow along the margin, dark orange to brown in the middle; mesopraescutum pale yellow with two orange to brown patches along the fore margin; mesoscutum pale yellow with four broad and, in the middle, one narrow orange to brown longitudinal stripes; mesoscutellum pale yellow along the margin, orange to brown in the middle. Metanotum orange to brown. Sometimes thorax of old specimens entirely brown. Forewing with pale yellow to brownish veins and dirty yellowish membrane with pattern consisting of pale brown broad stripe parallel to apical margin stretching from apical part of costal vein to apex of Cu_{1a}, leaving light areas in cells r_2, m_1 and m_2 along the margin, and brown patch along vein Cu_{1b}; sometimes with indistinct pale brown stripe in the middle of the wing stretching from vein R_1 to vein Cu_{1b}. Legs yellow to brownish, with darker femur and distal tarsal segment, meracanthus of metacoxa yellow to orange. Abdomen yellow to dark brown. Male terminalia yellow with orange to brown subgenital plate. Female terminalia orange to brown, darker in apical third. Males darker, general colour of body brown. Females generally lighter, general colour of body yellow with orange pattern.

Structure: Head, in profile, inclined from longitudinal body axis at 45°. Vertex subtrapezoidal with indented foveae, anteriorly slightly produced into transverse tubercle on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, slightly shorter than vertex, covered with long setae. Pronotum with one lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing oval, narrowly rounded apically; vein C+Sc hardly curved, pterostigma long, vein Rs almost straight, slightly curved to fore margin apically, cell m_1 short; surface spinules absent; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 6–8 apical spurs.

Terminalia: Male. Proctiger tubular; densely covered with short setae. Subgenital plate short, subglobular; with densely spaced moderately long setae. Paramere narrowly lamellar, irregularly rounded apically, posterior margin slightly convex; with short apico-anterior process lacking pedicel, and apically sclerotised median tooth; outer face sparsely covered with moderately long setae mostly in posterior part, inner face densely covered with relatively short setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with very short anterior process in basal part of apical quarter, two small apico-posterior tubercles; lateral lobes short, tapering towards apex, with entire apical margin. – Female. Proctiger cuneate, subacute apically; dorsal margin, in profile, almost straight; densely covered with short setae in apical half. Subgenital plate cuneate, with very long apical process; densely covered with moderately long setae, dorsal margin with a bristle.

Host-plants: Adesmia hystrix Phil. (Fabaceae). Two females and one immature were collected on *Acantholippia trifida* (Gay) Moldenke (Verbenaceae) which seems an unlikely host.

Distribution: Chile (II–IV Regions).

Derivation of name: From Latin longus = long and cauda = tail for the long female terminalia.

Comment: Russelliana 10 resembles *R. 18* in the brown pattern in the apical part of the forewing, in the narrowly lamellar paramere bearing an apico-anterior process lacking a pedicel, and a median tooth, in the distal segment of the aedeagus bearing two small apico-posterior tubecrles, and in the cuneate female proctiger and cuneate subgenital plate. *R. 10* differs from *R. 18* by the absence of surface spinules in the apical part of the forewing, a short apico-anterior process of the paramere, a very short anterior process in the basal part of the apical quarter and a distal segment of the aedeagus bearing short lobes with an entire apical margin, and an elongate female terminalia with a subgenital plate bearing a very long apical process.

RUSSELLIANA 11 SP. NOV.

(FIGS 8E, 12C, 17B, 22B, 26H, 30K)

Material examined

Holotype m$: **Chile**: II Region, Province El Loa, Calama to San Pedro de Atacama, 3050 m, vii.1997, *Adesmia atacamensis* (F. Saiz) (NHMB, dry).

Paratype. **Chile**: 7 m$, 6 f£, 2 immatures, same as holotype (F. Saiz) (NHMB, dry, on slide); 27 m$, 28 f£, 8 immatures, III Region, Province Chañaral, 20–25 km W Pedernales, Cordilliera de Domeyko, 36°23'S 69°25'W, 2500–2700 m, 10.xii.1993, *Adesmia atacamensis*, semidesert (D. Burckhardt) #23 (MHNG, NHMB, dry); 3 f£, same but 12 km SW El Salvador, 26°18'S 69°42'W, 1700 m, *Adesmia atacamensis*, desert (D. Burckhardt) #22 (MHNG, dry); ?, IV Region, Province Elqui, Coquimbo,12 miles N of Los Vilos, 13.xii.1950 (E. S. Ross & A. E. Michelbacher) (CASC, dry); 1 f£, V Region, Province San Felipe de Aconcagua, Putaendo, 10 km N San Felipe, 700 m, 15.xii.1995, *Adesmia* sp., river bed (D. Burckhardt) #1(2) (MHNG, dry); 1 m$, 2 f£, same but *Lycium* sp. (D. Burckhardt) #1(6) (MHNG, dry).

Description

Coloration: Head including genal processes pale yellow, vertex often with orange pattern; clypeus dark brown. Eyes yellow, ocelli red. Antenna pale yellow, segments 3–8 with dark brown apices, segments 9–10 entirely dark brown. Pronotum orange to brownish; mesopraescutum pale yellow with two orange patches along the fore margin and two orange patches posteriorly; mesoscutum yellow with six broad and, in the middle, one narrow orange to brownish longitudinal stripes; mesoscutellum pale yellow along the margin, orange to brownish in the middle. Metanotum orange to brown. Forewing with yellow to brown veins and semitransparent, colourless membrane with conspicuous pale brown pattern consisting of constant patch along vein Cu$_{1b}$ and dots scattered over entire surface, partly confluent in apical part, forming broad submarginal stripe stretching from apical part of costal vein to apex of vein Cu$_{1a}$, leaving light areas in cells r$_2$, m$_1$ and m$_2$ along the margin; sometimes with relatively distinct median broad stripe stretching from apical part of cell r$_1$ to base of vein Cu$_{1b}$. Legs yellow to brownish with darker femur and distal tarsal segment, meracanthus of metacoxa yellow to brown. Abdomen and terminalia yellow to brown, lighter ventrally. Female terminalia darker in apical third.

Structure: Head, in profile, strongly inclined from longitudinal body axis (> 45°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, shorter than vertex, covered with moderately long setae. Pronotum with two lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing oval, broadly, unevenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs weakly sinuous, slightly curved to fore margin apically, cell m$_1$ short; surface spinules faint, very dense, present in all cells, leaving no spinule-free stripes along the veins, irregularly spaced; radular spinules weakly pronounced. Metatibia with 7–8 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced moderately long setae restricted to median part. Paramere broadly lamellar, slightly curved with median convexity apically; with apico-anterior process on pedicel, apically sclerotised median tooth and slightly bulged apico-posterior lobe; both process and lobe of subequal length; outer face covered with moderately long setae in apical half, inner face densely, evenly covered with short setae. Distal segment of aedeagus elongate; with long anterior process, one large, raised apical and one horn-shaped apico-posterior tubercles; lateral lobes long, dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, slightly convex; relatively densely covered with moderately long setae in apical half. Subgenital plate cuneate, with moderately long apical process; densely covered with moderately long setae in ventral part, dorsal margin with a row of bristles.

Host-plant: Adesmia atacamensis Phil. (Fabaceae).

Distribution: Chile (II–V Regions).

Derivation of name: From Latin longus = long and rostrum = beak for its long rostrum.

Comment: Russelliana 11 resembles *R. adesmiae*; see comments under *R. adesmiae*. *R. 11* differs from *R. adesmiae* by a distinctly longer rostrum and the absence of a distinct median hump of the paramere.

RUSSELLIANA LYCII (TUTHILL, 1959)

(FIGS 8F, 12D, E, 17C, 22C, 26I, 31A)

Arepuna lycii Tuthill, 1959: 11.

Material examined

Type material. Holotype m$: **Peru**: Region Lima, Mala Valley, 16.x.1958, *Lycium salsum* (L. D. Tuthill) (BMNH, dry). Paratype. **Peru**: 1 f£, same as holotype (L. D. Tuthill) (BMNH, dry).

Description

Coloration: Dimorphic, male slightly darker, general body colour yellow to brown; female slightly lighter, general body colour yellow to orange, forewing pattern paler than in males. Head including genal processes pale yellow to orange, genal processes with brownish tips; clypeus brown. Eyes pale to dark brown, ocelli orange to red. Antenna pale yellow, segment 1 entirely brown, segments 3–8 with with brown apices, segments 9–10 entirely dark brown. Pronotum yellow to pale brown; mesopraescutum pale yellow with two orange patches along the fore margin; mesoscutum orange, sometimes with indistinct, yellow longitudinal stripes; mesoscutellum bright yellow. Metanotum bright yellow to orange. Forewing with whitish to dark brown veins and membrane with distinct pale to dark brown pattern differs for males and females. Male forewing membrane with brown to dark brown pattern consisting of two broad transverse stripes: submarginal one stretching from apical part of costal vein to apex of vein Cu_{1a} leaving light areas in cells r_2, m_1, m_2 and cu_1 along the margin, and median one stretching from bifurcation of veins R and M+Cu, along the veins M+Cu, Cu and Cu_{1b}, to median part of cell cu_1; membrane between two bands colourless, with scattered brown dots in cells and sometimes on veins. Female forewing membrane with pale brown pattern consisting of dots occupying all cells, partly confluent in apical part, and two broad transverse stripes as on male forewing membrane but distinctly paler. Legs pale to dirty yellow, sometimes with brownish femur, meracanthus of metacoxa pale yellow. Male abdomen orange to dark brown, terminalia dirty yellow to brown. Female abdomen orange to slightly brownish, terminalia yellow.

Structure: Head, in profile, inclined from longitudinal body axis at 45°. Vertex trapezoidal, flat with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, hind margin around lateral ocelli not raised, covered with long setae; genal processes short, swollen, conical apically, covered with long setae. Pronotum with two lateral pronounced and one sublateral shallow tubercles on either side. Forewing rhomboidal; vein C+Sc strongly, unevenly curved, pterostigma long, vein Rs almost straight, strongly curved to fore margin apically, cell m_1 short; surface spinules large, very dense, present in all cells, leaving no spinule-free stripes along the veins, irregularly spaced; radular spinules not pronounced. Metatibia with 6–9 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae in apical half. Subgenital plate elongate; with sparsely spaced moderately long setae restricted to ventral half. Paramere shortly lamellar; with thumb-like apico-anterior process on pedicel and long, slightly tapering towards apex apico-posterior lobe, with inwards directed sclerotised anterior tooth situated at base of the lobe; lobe more than twice longer than process; outer face covered with moderately long setae in apical part, inner face covered with long setae and with long thick bristles apically. Distal segment of aedeagus massive, broadly, unevenly expanding towards apex, inflated anteriorly; lateral lobes relatively short, apex concave and with frayed margin. – Female. Proctiger subglobular, pointed apically; dorsal margin, in profile, strongly bent downwards; densely covered with moderately long setae in apical part. Subgenital plate globular, broadly rounded apically; densely covered with long setae.

Host-plant: Lycium salsum Ruiz & Pav. (Solanaceae).

Distribution: Reported from Peru (Lima) (Burckhardt, 1987a; Tuthill, 1959).

Comment: Russelliana lycii resembles *R. capsici* and *8*; see comments under *R. capsici*. It differs from the two species by a thumb-like, not recurved apico-anterior process of the paramere and a globular female subgenital plate lacking an apical process. *R. lycii* differs from *R. capsici* by the presence of sexual dimorphism.

RUSSELLIANA MACULATA **BURCKHARDT, 1987**

(FIGS 8G, 12F, 17D, 22D, 26J, 31B)

Russelliana maculata Burckhardt, 1987: 374.

Material examined
Type material. Holotype m$: **Bolivia**: Department Chuquisaca, Province Nor Cinti, Lecori, S Potosi, 3200 m, 26–27.xiii.1984 (L. E. Peña) (MHNG, dry). Paratype. **Argentina**: 1 m$, Province Jujuy, Iturbe, 31.xii.1984 (L. E. Peña) (MHNG, on slide). **Bolivia**: 15 m$, 3 f£, same as holotype (L. E. Peña) (MHNG, NHMB, dry, on slide).

Additional material. **Bolivia**: 1 m$, Department Cochabamba, 2 km W Leque Palca, 17°38.2'S 66°58.4'W, 3950 m, 23.iii.2001 (A. Freidberg) (NHMB, dry).

Description
Coloration: Head pale yellow, genal processes yellow with dark tips, genae brown to black, vertex with variable orange to brown pattern; clypeus brown to dark brown. Eyes yellow to brown, ocelli yellow to orange. Antenna yellow to brownish, segments 3–7 with brown apices, 8–10 entirely dark brown. Pronotum of the same colour as vertex, with orange to brown patch in the middle; mesopraescutum pale yellow, with two orange patches along the fore margin and two orange transverse stripes posteriorly, sometimes entirely yellow; mesoscutum pale yellow with four broad and, in the middle, one narrow yellow to brown longitudinal stripes; mesoscutellum pale yellow along the margin, yellow to brown in the middle. Metanotum pale yellow to brown. Forewing with yellow to dark brown veins and colourless membrane with brown pattern consisting of large patch in the apex of cell rs and one along vein Cu_{1b}, and dots varying in size and number mainly in apical two-thirds of the wing. Legs yellow to brown, with darker femur and distal tarsal segment, meracanthus of metacoxa pale yellow. Male abdomen and terminalia brown to almost black. Female abdomen and terminalia yellow to brown, proctiger darker apically. Females lighter, general colour of body yellow.

Structure: Head, in profile, moderately to strongly inclined from longitudinal axis of body (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, shorter than vertex, covered with long setae. Pronotum with two lateral pronounced tubercles on either side. Forewing oblong-oval, broadly, unevenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs almost straight, slightly curved to fore margin apically, cell m_1 short; surface spinules weakly developed, leaving relatively broad spinule-free stripes along the veins, forming transverse rows or indistinct hexagons in apical half, very sparse in basal half; absent at base of cell c+sc; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 6–8 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere broadly lamellar; with apico-anterior process on long pedicel, and long apico-posterior lobe, relatively straight posteriorly, with inwards directed sclerotised anterior tooth situated in the middle of the lobe; lobe distinctly longer than process; outer face sparsely covered with moderately long setae in apical half, inner face densely, evenly covered with long setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with long hook-shaped anterior process and two apico-posterior tubercles; lateral lobes long, strongly dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, strongly tapering in apical third; sparsely covered with moderately long setae. Subgenital plate cuneate, with long apical process; sparsely covered with moderately long setae, dorsal margin with a row of bristles.

Host-plant: unknown.

Distribution: Reported from Argentina (Jujuy), Bolivia (Chuquisaca, Cochabamba) (Burckhardt, 1987a).

Comment: Russelliana maculata resembles *R. punctulata* in the presence of a brown pattern and surface spinules in the apical part of the forewing, in the pronotum bearing two lateral tubercles, in the paramere bearing an apico-anterior process on a long pedicel and a large apico-posterior lobe, in the distal segment of the aedeagus bearing an anterior process, two apico-posterior tubercles and long, dilated towards apex lateral lobes, in the cuneate female proctiger and cuneate subgenital plate bearing a long apical process. *R. maculata* differs from *R. punctulata* by an extensive pattern on the forewing, a longer than a process, straight posteriorly lobe of the paramere, and a long anterior process of the distal segment of the aedeagus.

***RUSSELLIANA 12* SP. NOV.**

(FIGS 8H, 12G, 17E, 22E, 26K, 31C)

Material examined

Holotype m$: **Chile**: XII Region, Province Magallanes, km 140–150 on road from Punta Arenas to Punta Delgada, 0–50 m, 18.i.1991, *Adesmia boronioides* (D. Burckhardt) #46 (MHNG, dry).

Paratype. **Chile**: 56 m$, 52 f£, 3 immatures, same as holotype (D. Burckhardt) #46 (MHNG, NHMB, dry, on slide).

Description

Coloration: Head including genal processes brown to dark brown, vertex pale yellow with variable orange to dark brown pattern; clypeus dark brown. Eyes yellow to brown, ocelli red. Antenna yellow, segment 1, 8–10 entirely dark brown, segment 2 brownish at base, segment 3 entirely yellow, segments 4–7 with brown apices, segment 6 slightly darker apically. Pronotum pale yellow with orange to brown patch in the middle, sometimes entirely dark brown; mesopraescutum pale yellow with two orange to brown patches along the fore margin and two orange to brown transverse stripes posteriorly; mesoscutum pale yellow with four broad and, in the middle, one narrow orange to brown longitudinal stripes; mesoscutellum pale yellow along the margin, brown in the middle. Metanotum orange to brown. Forewing with yellow to brown veins and yellowish membrane with variable brown pattern consisting of broad stripe parallel to apical margin stretching from apical part of costal vein to apex of vein Cu$_{1a}$, leaving light areas in cells r$_2$, m$_1$ and m$_2$ along the margin, and patches at the bifurcation of veins R and M+Cu, in apical part of cell r$_2$ and along vein Cu$_{1b}$, sometimes forming stripe in the middle of the wing stretching from apical part of cell r$_1$ to vein Cu$_{1b}$; sometimes with patches in cells c+sc and cu$_2$. Legs yellow to brownish with darker femur and distal tarsal segment, meracanthus of metacoxa yellow to orange. Abdomen and terminalia brown to black.

Structure: Head, in profile, moderately to strongly inclined from longitudinal axis of body (45–90°). Vertex subtrapezoidal, anteriorly produced into transverse lobe on either side of mid-line, covered with short setae; genal processes conical, slender, subacute apically, distinctly shorter than vertex, covered with moderately long setae. Pronotum with two lateral pronounced tubercles on either side. Forewing oviform; vein C+Sc weakly curved, pterostigma long, vein Rs straight apically, cell m_1 short; surface spinules relatively large, present in all cells, leaving no spinule-free stripes along the veins, densely spaced, forming hexagonal pattern in the middle of cells; absent at base of cell c+sc; radular spinules not pronounced. Metatibia with 7 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital short, subglobular; with sparsely spaced moderately long setae. Paramere broadly lamellar; with short apico-anterior process lacking pedicel, median hump with apically sclerotised tooth, and bulged apico-posterior lobe; lobe situated lower than process and hump; outer face densely covered with moderately long setae mostly in posterior part, inner face densely covered with moderately long setae. Distal segment of aedeagus elongate; with long anterior process and two small apico-posterior tubercles; lateral lobes long, dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, weakly sinuous; densely covered with long setae. Subgenital plate cuneate, with moderately long apical process; densely covered with long setae, dorsal margin with a row of bristles.

Host-plant: Adesmia boronioides Hook.f. (Fabaceae).

Distribution: Chile (XII Region).

Derivation of name: Latinised form of the name Magallanes, the Province in Chile where the species name comes from.

Comment: Russelliana 12 resembles *R. chilensis*; see comments under *R. chilensis*. *R. 12* differs from *R. chilensis* by a shape of the forewing which is broadest in the middle and its more extensive pattern, and a less bulged posteriorly apico-posterior lobe of the paramere.

***RUSSELLIANA MARIONAE* BURCKHARDT, 2008**

(FIGS 8I, 12H, 17F, 22F, 26L, 31D)

Russelliana marionae Burckhardt, 2008: 80.

Material examined

Type material. Holotype m$: **Argentina**: Province Mendoza, above Villa Vicencia, 50 km NW Mendoza, 1800–2200 m, 18.i.1997, *Mulguraea scoparia* [*Diostea scoparia*] (D. Burckhardt) #15(7) (MHNG, dry). Paratype. **Argentina**: 4 m$, 16 f£, 1 immature, same as holotype (D. Burckhardt) #15(7) (MHNG, NHMB, dry, on slide).

Description

Coloration: Head including genal processes pale yellow to brown, genal processes brown at base and with dark tips, vertex with yellow to brown pattern; clypeus dark brown. Eyes grey to dark brown, ocelli orange to red. Antenna pale to dirty yellow, segments 1–2 brownish, segments 3–8 with brown apices, segments 9–10 entirely dark brown. Pronotum of the same colour as vertex, sometimes with brown spots on either side and yellow spot in the middle; mesopraescutum pale yellow to brown, with two orange to brown patches along the fore margin and two or three orange to brown transverse stripes posteriorly; mesoscutum pale yellow to brown, with four broad, and, in the middle, one narrow, orange to dark brown longitudinal stripes; mesoscutellum pale yellow to brownish along the margin, sometimes orange in the middle. Metanotum yellow to dark brown. Forewing with whitish to dark brown veins and semitransparent, colourless membrane with dark brown pattern consisting of stripes and patches over entire surface, stretching from apical part of costal vein to median part of vein Cu_{1a}, along vein Cu_{1a}, and to base of vein M_{1+2}, sometimes leaving light areas in cells m_1 and m_2 along the margin, interrupted patches from base of pterostigma to median part of vein M and in cell cu_2, and patch along vein Cu_{1b}; membrane between bands and patches colourless, with dots varying in size and number. Legs dirty yellow to brown, with dark brown femur and distal tarsal segment, meracanthus of metacoxa pale yellow. Abdomen and terminalia dark brown to black.

Structure: Head, in profile, weakly inclined from longitudinal body axis (< 45°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with long setae; genal processes conical, slender, subacute apically, slightly shorter than vertex, covered with long setae. Pronotum bearing two lateral pronounced tubercles on either side. Forewing oblong-oval, broadly, evenly rounded apically; vein C+Sc hardly curved, pterostigma long, vein Rs weakly sinuous, curved to fore margin apically, cell m_1 short; surface spinules bold, present in all cells, leaving narrow spinule-free stripes along the veins, sparsely and irregularly spaced, becoming sparser towards base, absent or very sparse on unpigmented areas; absent in cell c+sc; radular spinules covering rounded areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 6–7 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere narrowly lamellar; with finger-shaped apico-anterior process on long pedicel and long finger-shaped apico-posterior lobe, evenly rounded apically; both process and lobe of subequal length; outer face covered with moderately long setae mostly in posterior part, inner face sparsely covered with short thick bristles, with few long thick setae apically and bearing a row of long thick setae along anterior margin. Distal segment of aedeagus elongate, weakly, irregularly truncating towards apex; lateral lobes long, tubular, sclerotised. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, conspicuously bent in basal third; relatively sparsely covered with long setae. Subgenital plate subglobular, with short apical process; densely covered with long setae in ventral part.

Host-plant: Mulguraea scoparia (Gillies & Hook.) N.O'Leary & P.Peralta (Verbenaceae).

Distribution: Reported from Argentina (Mendoza) (Burckhardt, 2008a).

Comment: Russelliana marionae resembles *R. theresae* in the vertex covered with long setae, in the forewing with a brown pattern, in the paramere lacking a tooth and bearing a finger-shaped apico-anterior process of subequal length with an apico-posterior lobe, in the apically angular distal segment of the aedeagus lacking tubercles and bearing long, tubular lateral lobes, in the cuneate female proctiger and subglobular subgenital plate bearing a short apical process. *R. marionae* differs from *R. theresae* by a longer forewing with a less extensive wing pattern in the basal half, the presence of long macroscopical setae on the forewing veins, and a paramere bearing a finger-shaped apico-posterior lobe.

RUSSELLIANA 13 **SP. NOV.**

(FIGS 8J, 12I, 17G, 22G, 27A, 31E)

Material examined

Holotype m$: **Chile**: IV Region, Province Elqui, Nueva Elqui towards La Laguna, ca 115 km E La Serena, 2600 m, 17.xii.1995, *Adesmia* sp., scattered shrubs (D. Burckhardt) #5(3) (MHNG, dry).

Paratype. **Chile**: 5 m$, 4 f£, IV Region, Province Elqui, Coquimbo, 5 miles N of Laguna Dam, 3100 m, 6.xii.1950 (E. S. Ross & A. E. Michelbacher) (CASC, dry); 1 m$, 1 f£, 1 immature, same but Nueva Elqui towards La Laguna, ca 115 km E La Serena, 2300 m, 17.xii.1995, *Adesmia* sp. (D. Burckhardt) #3(1, 3) (MHNG, dry); 15 m$, 16 f£, 4 immatures, same as holotype (D. Burckhardt) #5(3) (MHNG, dry, on slide, 70 % ethanol).

Description

Coloration: Head including genal processes yellow to black; clypeus black. Eyes yellow to brown, ocelli orange. Antenna yellow, segment 1 yellow to black, segments 3–8 with dark brown apices, segments 9–10 entirely dark brown. Thorax is either entirely brown to black, or light with brown pattern. When thorax light, pronotum yellow; mesopraescutum yellow to orange with two brown patches along the fore margin; mesoscutum orange with four broad and, in the middle, one narrow brown longitudinal stripes; mesoscutellum brown. Metanotum yellow to black. Forewing with pale yellow veins and semitransparent, unevenly amber-coloured membrane; sometimes with indistinct pale brown patch along vein Cu_{1b}. Legs yellow, femur and distal tarsal segment darker at base, meracanthus of metacoxa yellow to black. Male abdomen and terminalia black, proctiger yellow at least in apical third. Female abdomen and terminalia yellow to black, often yellow ventrally, with dark apex. Males darker, general colour of body black. Females generally lighter, general colour of body yellow to brown.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly produced into conspicuously transverse tubercle on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, slightly shorter than vertex, covered with long setae. Pronotum with one lateral, relatively pronounced, tubercle on either side. Forewing oviform; vein C+Sc strongly, evenly curved, pterostigma long, vein Rs weakly sinuous, almost straight apically, cell m_1 short; surface spinules present in all cells, leaving broad spinule-free stripes along the veins, sparsely spaced and forming transverse rows; very sparse at base of cell c+sc; radular spinules covering rounded areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 7–8 apical spurs.

Terminalia: Male. Proctiger irregularly subtrapezoidal; densely covered with short setae mostly in apical and posterior part. Subgenital plate short, subglobular; with densely spaced short setae, dorsal margin with a row of bristles. Paramere hammer-shaped, curved with median convexities apically; with long hook-shaped apico-anterior process on very short pedicel, apically sclerotised median tooth and strongly bulged posteriorly apico-posterior lobe; outer face covered with short setae mostly in posterior part, inner face densely covered with short setae mostly in anterior part. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with short blunt anterior process and two small apico-posterior tubercles; lateral lobes long, strongly dilated towards apex which is concave. – Female. Proctiger cuneate, subacute apically; dorsal margin, in profile, almost straight; densely covered with moderately long setae in apical half. Subgenital plate cuneate, with short apical process; densely covered with moderately long setae, dorsal margin with a row of bristles.

Host-plant: Adesmia sp. (Fabaceae).

Distribution: Chile (IV Region).

Derivation of name: From Ancient Greek μέλαινα = black referring to the black colour body and dedicated to Melaina, the Greek Goddess of Nightmares.

Comment: Russelliana 13 is rather distinctive from other *Adesmia* feeding species by an oviform forewing with a yellow membrane lacking a pattern and bearing a strongly curved vein C+Sc, an irregularly subtrapezoidal and strongly bulged posteriorly male proctiger, a strongly bulged posteriorly apico-posterior lobe of the paramere, and a short, blunt anterior process of the distal segment of the aedeagus. The species generally resembles *Adesmia*-feeders in the distal segment of the aedeagus bearing an anterior process, two small apico-posterior tubercles and long, dilated towards apex lateral lobes, and in the cuneate female proctiger and cuneate subgenital plate bearing an apical process.

RUSSELLIANA 14 SP. NOV.

(FIGS 8K, 12J, 17H, 22H, 27B, 31F)

Material examined

Holotype m$: **Argentina**: Province Mendoza, Mendoza Valley, Punta de Vacas, 2400 m, 30.xii.1995, *Adesmia* sp. (D. Burckhardt) #28(2) (MHNG, dry).

Paratype. **Argentina**: 7 m$, 11 f£, 1 immature, same as holotype (D. Burckhardt) #28(2) (MHNG, dry, on slide); 4 m$, 6 f£, same but 2100 m, 16.i.1997, *Adesmia* sp. (D. Burckhardt) #8(3) (NHMB, dry); 24 m$, 29 f£, 9 immatures, same but km 12 Las Cuevas to Puente del Inca, 2800 m, *Adesmia* sp., subalpine/alpine scrub (D. Burckhardt) #7(1) (NHMB, dry, on slide, 70 % ethanol).

Description
Coloration: Head including genal processes yellow to brown, genae yellow to black, vertex sometimes with orange to brownish pattern; clypeus dark brown. Eyes yellow to black, ocelli red. Antenna brownish, gradually becoming darker, segments 8–10 entirely dark brown, some specimens with evenly brown antenna. Pronotum pale yellow to brown, sometimes dark orange to brown in the middle; mesopraescutum pale yellow to brown, often with two dark orange to brown patches along the fore margin and two orange transverse stripes posteriorly; mesoscutum yellow to orange with four broad and, in the middle, one narrow orange to brown longitudinal stripes; mesoscutellum pale yellow along the margin, orange in the middle, sometimes entirely brown. Metanotum orange to brown. Forewing with yellow to brown veins and dirty yellowish membrane with indistinct to distinct brown pattern consisting of patch along vein Cu_{1b} and scattered dots in apical third of the wing, often distinctly confluent along the veins along the margin; often with patches in cells c+sc and cu_2. Legs yellow to brown, with darker femur and distal tarsal segment, meracanthus of metacoxa yellow to orange. Abdomen orange to dark brown; terminalia yellow to dark brown. Females often slightly lighter with ventrally lighter abdomen. Teneral specimens lighter, general colour of body yellow; antenna dirty yellow, gradually becoming darker; forewing with indistinct brownish pattern in apical half.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, slightly shorter than vertex, covered with moderately long setae. Pronotum with one lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing oblong-oval, narrowly rounded apically; vein C+Sc hardly curved, pterostigma long, vein Rs weakly sinuous, almost straight apically, cell m_1 long; surface spinules absent; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 6–7 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere narrowly lamellar, weakly sinuous apically, posterior margin slightly convex; with apico-anterior process on pedicel, and apically sclerotised median tooth; outer face sparsely covered with moderately long setae mostly in apical half, inner face densely, evenly covered with moderately long setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with long anterior process and two small apico-posterior tubercles; lateral lobes moderately long, dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, convex, with median indentation; densely covered with moderately long setae. Subgenital plate cuneate, with long apical process; sparsely covered with moderately long setae in apical part and along ventral margin, dorsal margin with a bristle.

Host-plant: Adesmia sp. (Fabaceae).

Distribution: Argentina (Mendoza).

Derivation of name: Named after the Province of Mendoza (Argentina) where the species comes from.

Comment: Reported as *Russelliana* sp. cf. *maculata* from Argentina (Mendoza) (Burckhardt, 2008b). *Russelliana 14* resembles *R. 15*, *21* and *vinculipennis* in the presence of a brown pattern on the forewing, in the narrowly lamellar paramere bearing an apico-anterior process on a pedicel, and a median tooth, in the distal segment of the aedeagus bearing an anterior process, two small apico-posterior tubercles and dilated towards apex lateral lobes, in the cuneate female proctiger and cuneate subgenital plate bearing an apical process. *R. 14* differs from *R. 15* and *21* by the absence of a median hump of the paramere, and from *R. 21* and *vinculipennis* by a forewing pattern restricted mostly to its apical part. It differs from *R. 21* by less dense and long setae on the female terminalia, and from *R. vinculipennis* by the absence of surface spinules in the apical part of the forewing, a longer anterior process of the distal segment of the aedeagus, and a longer apical process of the female subgenital plate.

***RUSSELLIANA 15* SP. NOV.**

(FIGS 8L, 13A, 17I, 22I, 27C, 31G)

Material examined

Holotype m$: **Chile**: III Region, Province Copiapó, Quebrada de Paipote, 20 km W Laguna Santa Rosa, 27°05'S 69°12'W, 3900 m, 12.xii.1993, *Adesmia hystrix*, alpine scrub (D. Burckhardt) #28 (MHNG, dry).

Paratype. **Chile**: 19 m$, 12 f£, 1 immature, same as holotype (D. Burckhardt) #28 (MHNG, dry); 4 m$, same but 27°05'S 69°20'W, 3500 m, *Adesmia hystrix*, gully with *Adesmia* shrubs (D. Burckhardt) #29 (MHNG, dry); 8 m$, 6 f£, IV Region, Province Elqui, Baños del Toro, ca 170 km E La Serena, 29°50'S 70°01'W, 3000 m, 3.xii.1993, *Adesmia hystrix*, dry scrub (D. Burckhardt) #4 (MHNG, dry); 26 m$, 19 f£, same but La Laguna, ca 120 km E La Serena, 2800–3000 m, 17.xii.1995, *Adesmia* sp., scattered shrubs (D. Burckhardt) #4(1) (MHNG, dry, on slide, 70 % ethanol).

Description

Coloration: Head including genal processes yellow to brown, genae brown to black, vertex sometimes with orange to brownish pattern; clypeus dark brown. Eyes yellow to black, ocelli red. Antenna brownish, gradually becoming darker from base to apex, segments 8–10 entirely dark brown, some specimens with evenly brown antenna. Pronotum pale yellow to brown, sometimes dark orange to brown in the middle; mesopraescutum pale yellow to brown, often with two dark orange to brown patches along the fore margin and two orange transverse stripes posteriorly; mesoscutum yellow to orange with four broad and, in the middle, one narrow orange to brown longitudinal stripes; mesoscutellum pale yellow along the margin, orange in the middle, sometimes entirely brown. Metanotum orange to brown. Forewing with yellow to brown veins and dirty yellowish membrane with indistinct to distinct brown pattern consisting of patch along vein Cu_{1b} and scattered dots in apical three quarter of the wing; sometimes with pale patches in cells c+sc and cu_2. Legs yellow to brown with darker femur and distal tarsal segment, meracanthus of metacoxa yellow to orange. Abdomen orange to dark brown; terminalia yellow to dark brown. Females often slightly lighter with ventrally lighter abdomen. Teneral specimens lighter, general colour of body yellow; antenna dirty yellow, gradually becoming darker; forewing with indistinct brownish pattern in apical half.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, slightly shorter than vertex, covered with moderately long setae. Pronotum with one lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing oblong-oval, broadly, unevenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs straight apically, cell m_1 long; surface spinules absent; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 6–8 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae in apical half. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere narrowly lamellar; with short apico-anterior process on pedicel, and median hump with apically sclerotised median tooth; apical part of posterior edge produced into small lobe; outer face sparsely covered with moderately long setae mostly in posterior part, inner face sparsely covered with moderately long setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with moderately long anterior process and two small apico-posterior tubercles; lateral lobes moderately long, slightly dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, convex; densely covered with short setae in apical part. Subgenital plate cuneate, with moderately long apical process; densely covered with moderately long to long setae in ventral part, dorsal margin with a bristle.

Host-plant: Adesmia hystrix Phil. (Fabaceae).

Distribution: Chile (III–IV Regions).

Derivation of name: From Latin monticolus = mountain dwelling referring to montane habitats where the species was collected.

Comment: Russelliana 15 resembles *R. 14, 21* and *vinculipennis,* see comments under *R. 14*. *R. 15* differs from *R. mendoza* and *vinculipennis* by the presence of a median hump of the paramere, and from *R. 21* and *vinculipennis* by a forewing pattern restricted mostly to its apical part. It differs from *R. 21* by less dense and long setae on the female terminalia, and from *R. vinculipennis* by the absence of surface spinules in the apical part of the forewing, a longer anterior process of the distal segment of the aedeagus, and a longer apical process of the female subgenital plate.

RUSSELLIANA 16 SP. NOV.

(FIGS 8M, 13B, 18A, 23A, 27D, 31H)

Material examined
Holotype m$: **Argentina**: Province Mendoza, above Villa Vicencia, 50 km NW Mendoza, 1800–2200 m, 18.i.1997, Asteraceae, low scrub (D. Burckhardt) #15(8) (MHNG, dry).

Paratype. **Argentina**: 11 m$, 20 f£, same as holotype (D. Burckhardt) #15(8) (MHNG, dry, on slide, 70 % ethanol); 1 f£, same but Mendoza Valley, 27 km between Uspallata and Potrerillos, 1500 m, 19.i.1997, Asteraceae (D. Burckhardt) #16(2) (MHNG, dry).

Description
Coloration: General colour of body pale yellow. Head including genal processes whitish to pale yellow; clypeus yellow to brown. Eyes yellow to grey, ocelli yellow. Antenna yellow, segments 3–8 with pale brown apices, 9–10 entirely brown. Thorax whitish to pale yellow. Forewing with bright yellow veins and pale yellow membrane. Legs yellow, meracanthus of metacoxa yellow. Abdomen yellow to brownish, slightly ligther ventrally; terminalia yellow to brownish. Female terminalia darker in apical third.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute or slightly blunt apically, slightly shorter than vertex, covered with moderately long setae. Forewing oblong-oval, broadly, unevenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs almost straight apically, cell m_1 long; surface spinules faint, present in all cells, leaving no spinule-free stripes along the veins, densely and irregularly spaced; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 7 apical spurs.

Terminalia: Male. Proctiger tubular; densely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced long setae. Paramere oblong-oval, irregularly rounded apically, with constricted base; with recurved, claw-like apico-anterior process on very short pedicel, and strongly bulged apico-posterior lobe with apically sclerotised ridge; lobe situated exterior to process; both process and lobe of subequal length; outer face sparsely covered with long setae mostly in apical half, inner face densely, evenly covered with moderately long setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with short beak-like anterior process and one horn-shaped apico-posterior tubercle; lateral lobes short, with entire apical margin. – Female. Proctiger cuneate, subacute apically; dorsal margin, in profile, conspicuously bent in apical third; densely covered with short thick bristles in apical half. Subgenital plate cuneate, with very long apical process; sparsely covered with moderately long setae and with few short thick bristles in apical part.

Host-plant: unknown.

Distribution: Argentina (Mendoza).

Derivation of name: From Latin nanus = dwarf referring to the small body size.

Comment: Russelliana 16 resembles *R. 19*, in the pale yellow body colour, in the oblong-oval paramere bearing a recurved, claw-like apico-anterior process on a pedicel, situated interiorly to apico-posterior lobe, in the distal segment of the aedeagus bearing short lateral lobes with an entire apical margin, in the cuneate female proctiger with a dorsal margin conspicuously bent in its apical third and bearing short thick bristles, and in the cuneate subgenital plate bearing a very long apical process. *R. 16* differs from *R. 19* by long genal processes, a shape of the forewing which is broadest in the apical third, the paramere with a constricted base bearing a process on a very short pedicel, a distal segment of the aedeagus bearing a short beak-like anterior process and a large, horn-shaped apico-posterior tubercle, and a female subgenital plate bearing short thick bristles in its apical third.

RUSSELLIANA NIGRA **BURCKHARDT, 1987**

(FIGS 8N, 13C, 18B, 23B, 27E, 31I)

Russelliana nigra Burckhardt, 1987: 381.

Material examined

Type material. Holotype m$: **Bolivia**: Department Chuquisaca, Province Nor Cinti, Padcoya to Camargo, 2800–3200 m, 26–28.xii.1984 (L. E. Peña) (MHNG, dry). Paratype. **Bolivia**: 4 m$, 8 f£, same as holotype (L. E. Peña) (MHNG, NHMB, dry, on slide).

Description

Coloration: General colour of body dark brown to black. Head, genal processes and thorax dark brown to black; clypeus black. Eyes red to black, ocelli orange to red. Antenna pale to dirty yellow, segments 1, 9 and 10 entirely black, segment 2 black at base, segments 3–8 with black apices. Forewing with dark brown veins and evenly brown membrane. Legs dirty yellow to brownish, with black femur and distal tarsal segment, meracanthus of metacoxa pale yellow. Abdomen and terminalia brown to black. Female proctiger black in apical third. Teneral specimens orange laterally.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse tubercle on either side of mid-line, wirth raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, distinctly shorter than vertex, covered with moderately long setae. Forewing oval, broadly, evenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs weakly sinuous, slightly curved to fore margin apically, cell m_1 long; surface spinules very dense, present in all cells, leaving very narrow spinule-free stripes along the veins, irregularly spaced; faint in cell c+sc and absent in its basal third; radular spinules covering rounded areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 6–8 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere irregularly subtrapezoidal; with sickle-shaped apico-anterior process on very short pedicel and slightly bulged, apically sinuous apico-posterior lobe with apically sclerotised median tooth; both process and lobe of subequal length; outer face sparsely covered with moderately long setae mostly in posterior half, inner face densely, evenly covered with long setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with moderately long anterior process, one apical and one curved forward apico-posterior tubercles; lateral lobes long, strongly dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, slightly convex; sparsely covered with relatively short setae. Subgenital plate cuneate, with short apical process; sparsely covered with relatively short setae in apical half, dorsal margin with a row of bristles.

Host-plant: unknown.

Distribution: Reported from Bolivia (Chuquisaca) (Burckhardt, 1987a).

Comment: Russelliana nigra resembles *R. 6, disparilis, 20, similis* and *solanicola*; see comments under *R. 6. R. nigra* differs from the five species by an evenly brown membrane of the forewing, from *R. 6, 20, similis* and *solanicola* by the absence of a median hump of the paramere, and from *R. disparilis* and *similis* by the presence of surface spinules in the apical part of the forewing. It differs from *R. 6* by a shorter female terminalia, and from *R. disparilis* by a smaller apico-posterior lobe of the paramere and an apically subacute anterior process of the distal segment of the aedeagus.

RUSSELLIANA 17 **SP. NOV.**

(FIGS 8O, 13D, E, 18C, 23C, 27F, 32A)

Material examined

Holotype m$: **Chile**: III Region, Province Chañaral, Parque Nacional Pan de Azúcar, sector Las Lomitas, Quebrada Las Chicas, 26°05'S 70°36'W, 800 m, *N.* cf. *aplocaryoides* / *N.* cf. *confinis* / *N.* cf. *peruviana* / *Nolana* cf. *sedifolia* (D. Burckhardt) #20 (MHNG, dry).

Paratype. **Chile**: 5 m$, 4 f£, III Region, Province Chañaral, Parque Nacional Pan de Azúcar, Quebrada Chango Aracena, sector Mirador, 26°05'S 70°37'W, 300 m, 8.xii.1993, *Nolana* cf. *sedifolia*, semidesert (D. Burckhardt) #19 (MHNG, NHMB, dry); 1 m$, same but Quebrada del Castillo, 26°08'S 70°38'W, 100 m, *Nolana* cf. *sedifolia* (D. Burckhardt) #18 (MHNG, dry); 9 m$, 6 f£, same but Quebrada Pan de Azúcar, 26°07'S 70°36'W, 300 m, 9.xii.1993, *Nolana* cf. *sedifolia* (D. Burckhardt) #21 (MHNG, NHMB, dry); 13 m$, 18 f£, same as holotype (D. Burckhardt) #20 (MHNG, NHMB, dry); 1 m$, 1 f£, same but Province Huasco, Panamericana km 565, 29°20'S 71°01'W, 600 m, 6.xii.1993, *Nolana* cf. *sedifolia*, steppe (D. Burckhardt) #13 (MHNG, dry); 11 m$, 27 f£, 2 immatures, IV Region, Province Elqui, Panamericana km 550. 85 km N La Serena, 29°25'S 71°10'W, 200 m, 6.xii.1993, *Nolana* cf. *sedifolia*, steppe (D. Burckhardt) #12 (MHNG, NHMB, dry, on slide); 1 f£, same but Province Limarí, Parque Nacional Fray Jorge, 250 m, 7–9.xii.1990, *Baccharis salicina* [*Pingraea viscosa*], open mediterranean scrub (D. Agosti & D. Burckhardt) #2 (MHNG, dry).

Description

Coloration: Dimorphic, male slightly darker, general body colour yellow to brownish; female slightly lighter, general body colour yellow to orange, forewing pattern paler than in males. Some specimens with yellow-spotted brown to dark brown vertex and thorax. Head including genal processes pale to bright yellow, genae pale yellow to brownish; clypeus yellow to brown. Eyes yellow, ocelli orange to red. Antenna yellow, segments 3–8 with dark brown apices, segments 9–10 entirely dark brown. Pronotum pale to bright yellow, same colour as vertex and distinctly paler than mesonotum; mesopraescutum pale to bright yellow, often with two orange to brownish patches along the fore margin and sometimes with scattered brownish patches over entire surface; mesoscutum pale to bright yellow, often with four broad orange to brown longitudinal stripes; mesoscutellum pale yellow, sometimes orange to brown in the middle. Metanotum pale yellow to brown. Forewing with whitish to dark brown veins and membrane with distinct pale to dark brown pattern differs for males and females. Male forewing membrane with dark brown pattern consisting of confluent dots, sometimes forming two well-defined broad transverse stripes: shorter submarginal one stretching from apical part of costal vein to base of vein M_{1+2} and longer median one stretching from median part of vein C+Sc, along the veins M+Cu and Cu, to base of vein Cu_{1b}; membrane between two bands colourless with dark brown dots scattered over entire surface and sometimes on veins. Female forewing membrane with pale brown pattern consisting of dark, frequently confluent dots and lighter patches scattered over entire surface, sometimes patches leaving light almost indistinct areas in cells r_2, m_1 and m_2 along the margin; patch along vein Cu_{1b} sometimes reaching vein M. Legs pale yellow with darker femur, meracanthus of metacoxa pale yellow. Abdomen and terminalia pale yellow to brownish, sometimes lighter ventrally. Paramere and female terminalia with dark apices.

Structure: Head, in profile, weakly inclined from longitudinal body axis (< 45°). Vertex trapezoidal, flat with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, hind margin around lateral ocelli not raised, covered with short setae; genal processes short, swollen, slightly conical apically, covered with moderately long setae. Pronotum with two lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing rhomboidal; vein C+Sc strongly, unevenly curved, pterostigma long, vein Rs straight, strongly curved to fore margin apically, cell m_1 short; surface spinules very dense, present in all cells, leaving no spinule-free stripes along the veins, irregularly spaced, less developed on unpigmented areas; radular spinules not pronounced. Metatibia with 6 apical spurs.

Terminalia: Male. Proctiger barrel-shaped; sparsely covered with moderately long setae in apical two thirds. Subgenital plate elongate; with few moderately long setae restricted to apical and ventral part. Paramere shortly lamellar; with long recurved apico-anterior process on pedicel, broadly rounded apico-posterior lobe with apically sclerotised median tooth; lobe situated exterior to process; both process and lobe of subequal length; outer face densely covered with moderately long setae mostly in apical half, inner face covered with long thick bristles anteriorly and apically. Distal segment of aedeagus massive, broadly, unevenly expanding towards apex, strongly inflated anteriorly; with one small apico-posterior tubercle; lateral lobes moderately long, slightly dilated towards apex which is rounded and with frayed margin. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, slightly convex; densely covered with long setae. Subgenital plate subglobular, with tiny apical process; densely covered with long setae in apical part and along ventral margin, dorsal margin with a row of bristles.

Host-plant: Nolana cf. *aplocaryoides* (Gaudich.) I.M. Johnst. / *N.* cf. *confinis* (I.M. Johnst.) I.M. Johnst. / *N.* cf. *peruviana* (Gaudich.) I.M.Johnst. and *N.* cf. *sedifolia* Poepp. (Solanaceae).

Distribution: Chile (III–IV Regions).

Derivation of name: Named after its host *Nolana*.

Comment: Russelliana 17 resembles *R. 2* and *9*; see comments under *R. 2*. *R. 17* differs from *R. 2* by a less extensive pattern on the male forewing, and from *R. 9* by apically rounded, dilated towards apex lateral lobes of the distal segment of the aeadeagus, in the cuneate female proctiger and subglobular subgenital plate bearing an apical process.

RUSSELLIANA 18 SP. NOV.

(FIGS 9A, 13F, 18D, 23D, 27G, 32B)

Material examined

Holotype m$: **Chile**: III Region, Province Huasco, ca 10 km W Domeyko, 28°57'S 70°55'W, 600 m, 6.xii.1993, *Adesmia* cf. *kingii*, steppe (D. Burckhardt) #14 (MHNG, dry).

Paratype. **Chile**: 6 m$, 2 f£, 2 immatures, III Region, Province Chañaral, 20–25 km W Pedernales, 36°23'S 69°25'W, 2500–2700 m, 10.xii.1993, *Adesmia* cf. *kingii*, semidesert (D. Burckhardt) #23 (MHNG, dry); 5 m$, 7 f£, same but Province Copiapó, 30 km NE Copiapó, 27°19'S 70°12'W, 1000 m, 12.xii.1993, *Adesmia* cf. *kingii*, desert (D. Burckhardt) #26 (MHNG, dry); 5 m$, 5 f£, same but Potrero Seco, 27°40'S 70°15'W, 900 m, 13.xii.1993, *Adesmia* cf. *kingii* (D. Burckhardt) #30 (MHNG, dry); 1 m$, 2 f£, same as holotype (D. Burckhardt) #14 (MHNG, dry); 5 m$, 3 f£, same but Panamericana km 565, 29°20'S 71°01'W, *Adesmia* cf. *kingii* (D. Burckhardt) #13 (MHNG, dry); 2 m$, 3 f£, same but 20 km S Vallenar, 28°40'S 70°40'W, 750 m, *Adesmia* cf. *kingii* (D. Burckhardt) #15 (MHNG, dry); 5 m$, 4 f£, same but 35 km N Vallenar, 28°20'S 70°40'W, 7.xii.1993, *Adesmia* cf. *kingii*, semidesert (D. Burckhardt) #16 (MHNG, dry); 1 f£, IV Region, Province Elqui, from Condoriaco to Almte Latorre, 29°40'S 70°53'W, 1200 m, 4.xii.1993, *Adesmia* sp. (D. Burckhardt) #8 (MHNG, dry); 1 m$, same but 15 km SW Viñita Baja, 29°50'S 70°50'W, 450 m, *Adesmia* sp. (D. Burckhardt) #6 (MHNG, dry); 12 m$, 13 f£, same but from Viñita Baja to Condoriaco, 29°45'S 70°50'W, 1000–1400 m, *Adesmia argentea*, dry slope (D. Burckhardt) #7 (MHNG, dry); 1 m$, 1 f£, same but *Adesmia* sp. (D. Burckhardt) #7 (MHNG, dry); 2 f£, same but S Paihuano, 30°02'S 70°30'W, 1000 m, 5.xii.1993, *Adesmia dichotoma* (D. Burckhardt) #9 (MHNG, dry); 11 m$, 4 f£, same but 5–10 km S Vicuña, 30°05'S 70°40'W, 750–950 m, *Adesmia kingii* (D. Burckhardt) #11 (MHNG, dry); 1 m$, 2 f£, same but Panamericana km 550, 29°25'S 71°10'W, 200 m, 6.xii.1993, *Adesmia kingii*, steppe (D. Burckhardt) #12 (MHNG, dry); 10 m$, 11 f£, same but 15–25 km S Vicuña, 30°15'S 70°40'W, 1300–1700 m, 14.xii.1993, *Adesmia argentea* (D. Burckhardt) #33 (MHNG, dry); 5 m$, 5 f£, same but *Adesmia pedicellata* (D. Burckhardt) #33 (MHNG, dry); 4 m$, 2 f£, same but 20 km S Vicuña towards Hurtado, nr Puente El Pangue, 1600 m, 18.xii.1995, *Adesmia* sp., semidesert (D. Burckhardt) #8(2) (MHNG, dry); 6 m$, 8 f£, same but 10 km S Vicuña towards Hurtado, 900 m, *Adesmia* sp. (D. Burckhardt) #7(3) (MHNG, dry, on slide, 70 %

ethanol); 1 m$, 2 f£, same but ca 45 km ENE La Serena, Viñita Baja to Condoriaco, 800–1000 m, 19.xii.1995, *Adesmia* sp., mountain slope (D. Burckhardt) #10(4) (MHNG, dry); 1 m$, 2 f£, same but ca 40 km E La Serena, 5 km SW Viñita Baja, 450 km, *Adesmia* sp. (D. Burckhardt) #9(3) (MHNG, dry); 2 m$, same but Elqui Valley, nr Rivadavia, 750 m, 20.xii.1995, *Adesmia* sp., semidesert (D. Burckhardt) #12(1) (MHNG, dry); 8 m$, 14 f£, V Region, Province Petorca, Alicahue to Chincolco, E Cabildo to La Ligua, 700–1250 m, 21–26.xii.1998, *Adesmia* sp., semidesert and *Acacia caven* steppe (D. Burckhardt) #3(2) (NHMB, dry); 3 m$, 3 f£, same but Province San Felipe de Aconcagua, 5 km N El Tártaro, 30 km N San Felipe, 32°30'S 70°42'W, 1100 m, 26.xii.1993, *Adesmia* cf. *glutinosa* (D. Burckhardt) #37 (MHNG, dry); 5 m$, 8 f£, 1 immature, same but Putaendo, 10 km N San Felipe, 32°37'S 70°42'W, 700 m, *Adesmia* cf. *pedicellata*, river bed (D. Burckhardt) #35 (MHNG, dry); 3 m$, 3 f£, 4 immatures, same but 15 km E Llay-Llay, 32°52'S 70°51'W, 600 m, 28.xii.1993, *Adesmia* cf. *glutinosa*, *Acacia caven* steppe (D. Burckhardt) #39 (MHNG, NHMB, dry); 2 m$, 1 f£, same but 10 km N San Felipe, 700 m, 15.xii.1995, *Adesmia* sp., river bed (D. Burckhardt) #1(2) (MHNG, dry); 3 m$, 6 f£, 1 immature, same but km 10 on road El Tártaro to El Guayacán, 1400 m, 24.xii.1995, *Adesmia* sp., *Acacia caven* steppe (D. Burckhardt) #24(4) (MHNG, dry); 1 f£, same but 10 km N San Felipe, 700 m, 27.xii.1995, river bed (D. Burckhardt) #27(2) (MHNG, dry); 4 m$, 6 f£, same but 8 km N San Felipe, 12–13.i.1997, *Adesmia* sp., dry river bed of Río Aconcagua (D. Burckhardt) #4(4) (MHNG, on slide, 70 % ethanol); 1 f£, same but El Asiento, 10 km NW San Felipe, 900 m, 13–20.i.1997, *Adesmia* sp., mediterranean scrub (D. Burckhardt) #5(10) (NHMB, dry); 15 m$, 10 f£, same but km 20 Resguardo de Los Patos to Paso del Rubio, 1800 m, 1.i.1999, *Adesmia* cf. *glutinosa*, semidesert and subalpine scrub (D. Burckhardt) #11(2) (NHMB, dry, on slide, 70 % ethanol); 3 m$, 3 f£, same but Resguardo de Los Patos, 32°29.2'S 70°33.9'W, 1350 m, 6.iii.2009, *Adesmia* cf. *glutinosa*, *Acacia caven* scrub (D. Burckhardt) #14(4) (NHMB, dry); 2 f£, Region Metropolitana, Province Chacabuco, 5 km N Tiltil, 33°01'S 70°56'W, 700 m, 28.xii.1993, *Adesmia* cf. *confusa*, open sclerophyll scrub (D. Burckhardt) #40 (MHNG, dry).

Additional material. **Chile**: 1 f£, V Region, Province San Felipe de Aconcagua, Termas de Jahuel, 1000 m, 21.i.1997, *Acacia caven* steppe with some planted exotic trees (D. Burckhardt) #17 (NHMB, dry).

Description

Coloration: Head including genal processes pale yellow to orange, genal processes sometimes brownish at base; clypeus yellow to brown. Eyes yellow to greyish, ocelli red. Antenna yellow, segments 3–8 with dark brown apices, segments 9–10 entirely dark brown. Pronotum of the same colour as vertex, distinctly paler than mesonotum; mesopraescutum pale yellow to bright yellow with two dark orange patches along the fore margin and two light orange transverse stripes posteriorly; mesoscutum pale to bright yellow with four broad and, in the middle, one narrow orange longitudinal stripes; mesoscutellum pale yellow along the margin, orange in the middle. Metanotum orange with broad yellow longitudinal stripe in the middle. Forewing with yellowish veins and colourless membrane with pale brown, often indistinct pattern consisting of broad stripe parallel to apical margin stretching from apical part of costal vein to apex of vein Cu_{1a}, leaving light areas in cells r_2, m_1 and m_2 along the margin, and patch along vein Cu_{1b}; sometimes with brown stripe in the middle of the wing stretching from vein R_1 to vein Cu_{1b} and brown patch in apical half of cell cu_2. Legs pale yellow to bright yellow, meracanthus of metacoxa yellow. Abdomen and terminalia pale yellow to brown. Female terminalia with dark apex. Teneral specimens lighter, general colour of body pale yellow; forewing pattern pale brown.

Structure: Head, in profile, strongly inclined from longitudinal body axis (> 45°). Vertex subtrapezoidal with indented foveae, anteriorly slightly produced into transverse tubercle on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, slightly shorter than vertex, covered with long setae. Pronotum with one lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing oblong-oval, broadly, unevenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs almost straight apically, cell m_1 short; surface spinules present in all cells, leaving narrow spinule-free stripes along the veins, sparsely spaced and forming hexagonal pattern; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 7 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere narrowly lamellar, posterior margin slightly convex; with long apico-anterior process lacking pedicel, and apically sclerotised median tooth; outer face sparsely covered with moderately long setae mostly in posterior part, inner face sparsely covered with moderately long setae. Distal segment of aedeagus moderately elongate, expanding towards apex; with short anterior process, one short and one horn-shaped apico-posterior tubercles; lateral lobes moderately long, slightly dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, almost straight or slightly convex; sparsely covered with moderately long setae. Subgenital plate cuneate, with short apical process; sparsely covered with moderately long setae, dorsal margin with few bristles.

Host-plants: Adesmia argentea Meyen, *A.* cf. *confusa* Ulibarri, *A. dichotoma* Clos, *A.* cf. *glutinosa* Hook. & Arn., *A.* cf. *kingii* Phil. and *A.* cf. *pedicellata* Hook. & Arn. (Fabaceae).

Distribution: Chile (III–V Regions, Region Metropolitana).

Derivation of name: From Latin pallidus = pale referring to pale forewing pattern.

Comment: Russelliana 18 resembles *R. 10*; see comments under *R. 10*. *R. 18* differs from *R. 10* by the presence of surface spinules in the apical part of the forewing, a long apico-anterior process of the paramere, a longer anterior process situated in the apical part of the distal segment of the aedeagus bearing longer lateral lobes, and a shorter female terminalia with a subgenital plate bearing a short apical process.

***RUSSELLIANA PUNCTULATA* BURCKHARDT, 1987**

(FIGS 9B, 13G, 18E, 23E, 27H, 32C)

Russelliana punctulata Burckhardt, 1987: 375.

Material examined

Type material. Holotype m$: **Argentina**: Province Jujuy, Iturbe, 31.xii.1984 (L. E. Peña) (MHNG, dry). Paratype. **Argentina**: 22 m$, 21 f£, same as holotype (L. E. Peña) (MHNG, NHMB, dry, on slide).

Description

Coloration: Head dirty yellow, genal processes pale yellow with dark tips or entirely brown, genae brown to black, vertex sometimes with variable orange to brown pattern or entirely brown; clypeus brown to dark brown. Eyes yellow to brown, ocelli orange to red. Antenna yellow to brownish, segments 3–7 with brown apices, 8–10 entirely dark brown. Pronotum of the same colour as vertex, sometimes with orange to brown patch in the middle; mesopraescutum dirty yellow, with two orange to brown patches along the fore margin and two orange to brown transverse stripes posteriorly, sometimes entirely brown; mesoscutum dirty yellow with four broad and, in the middle, one narrow dark brown longitudinal stripes; mesoscutellum pale to dirty yellow along the margin, dark brown in the middle. Metanotum pale yellow to dark brown. Forewing with dark brown veins and colourless membrane, sometimes consisting of indistinct brown pattern of one large patch in the apex of cell rs and one small along vein Cu_{1b}; sometimes with few dots in apical two-thirds of the wing. Legs pale yellow to brown, with darker femur and distal tarsal segment, meracanthus of metacoxa pale yellow. Abdomen and terminalia brown to dark brown.

Structure: Head, in profile, moderately to strongly inclined from longitudinal axis of body (45–90°). Vertex subtrapezoidal, anteriorly produced into transverse lobe on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, shorter than vertex, covered with moderately long setae. Pronotum with two lateral pronounced tubercles on either side. Forewing oblong-oval, broadly, unevenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs almost straight apically, cell m_1 long; surface spinules faint, present in all cells, leaving narrow spinule-free stripes along the veins, sparsely spaced and forming irregular transverse rows mainly in apical part; absent in basal third of cell c+sc; radular spinules covering rounded areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 7–8 apical spurs.

Terminalia: Male. Proctiger tubular; densely covered with short setae. Subgenital plate short, subglobular; with densely spaced relatively short setae and with long setae along the ventral margin. Paramere irregularly subtrapezoidal; with apico-anterior process on long pedicel, and strongly bulged apico-posterior lobe with apically sclerotised median tooth; both process and lobe of subequal length; outer face densely covered with moderately long setae mostly in posterior half, inner face relatively densely covered with moderately long setae in apical half and with long setae anteriorly and posteriorly. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with short beak-like anterior process and two small apico-posterior tubercles; lateral lobes moderately long, slightly dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, weakly sinuous; sparsely covered with short setae. Subgenital plate cuneate, with moderately long apical process; sparsely covered with short setae in apical half, dorsal margin with a row of bristles.

Host-plant: unknown.

Distribution: Reported from Argentina (Jujuy) (Burckhardt, 1987a).

Comment: Russelliana punctulata resembles *R. maculata*; see comments under *R. maculata*. *R. punctulata* differs from *R. maculata* by a forewing pattern restricted mostly to its apical part, a strongly bulged posteriorly apico-posterior lobe of the paramere, and a short anterior process of the distal segment of the aedeagus.

RUSSELLIANA 19 **SP. NOV.**

(FIGS 9C, 13H, 18F, 23F, 27I, 32D)

Material examined

Holotype m$: **Brazil**: State Paraná, Curitiba, Centro Politécnico of UFPR, 4.i.2012 (D. Burckhardt & D. L. Queiroz) #29(1) (NHMB, on slide).

Paratype. **Brazil**: 1 m$, 1 f£, same as holotype (D. Burckhardt & D. L. Queiroz) #29(1) (NHMB, on slide, 70 % ethanol); 2 f£, same but Parque São Lourenço, 25°23.1'S 49°15.9'W, 940 m, 19.x.2012 (D. Burckhardt & D. L. Queiroz) #45 (NHMB, 70 % ethanol); 2 m$, same but 25°23.0'S 49°15.9'W, 920 m, 13.ii.2013 (D. Burckhardt & D. L. Queiroz) #93 (NHMB, 70 % ethanol).

Description

Coloration: General colour of body pale yellow. Head including genal processes whitish to pale yellow; clypeus whitish to pale yellow. Eyes pale yellow to brown, ocelli pale yellow. Antenna pale yellow, segments 3–8 with slightly darker apices, 9–10 entirely brown. Thorax whitish to pale yellow. Forewing with whitish to pale yellow veins and pale yellow membrane, sometimes yellow in the middle of cells in apical part of the wing. Legs whitish to pale yellow, meracanthus of metacoxa whitish to pale yellow. Abdomen and terminalia whitish to pale yellow.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with microscopical setae; genal processes very short, conical, subacute apically, covered with short setae. Forewing oblong-oval, narrowly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs almost straight apically, cell m_1 short; surface spinules very dense, present in all cells, leaving no spinule-free stripes along the veins; radular spinules not pronounced. Metatibia with 6 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with long setae. Subgenital plate short, subglobular; with sparsely spaced long setae. Paramere oblong-oval, irregularly rounded apically; with recurved, claw-like apico-anterior process on long pedicel, and apico-posterior lobe with apically sclerotized ridge; lobe situated exterior to process and longer than process; outer face sparsely covered with long setae mostly in apical half, inner face densely covered with long setae. Distal segment of aedeagus massive, broadly, unevenly expanding towards apex; with one small apico-posterior tubercle; lateral lobes short, with entire apical margin. –

Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, sinuous, conspicuously bent in its apical third; densely covered with short thick bristles in apical half. Subgenital plate cuneate, with very long apical process; sparsely covered with moderately long setae restricted to median part.

Host-plant: unknown.

Distribution: Brazil (Paraná).

Derivation of name: Named in honour of Dalva L. de Queiroz (Embrapa Florestas, Colombo), the collector of this and many other Brazilian psyllid species.

Comment: Russelliana 19 resembles *R. 16*; see comments under *R. 16*. *R. 19* differs from *R. 16* by very short genal processes, a shape of the forewing which is broadest in the middle, an oblong-oval paramere bearing an apico-anterior process on a longer pedicel, and a broadly expanding towards apex distal segment of the aedeagus lacking an anterior process and bearing a small apico-posterior tubercle, and a female subgenital plate lacking short thick bristles.

RUSSELLIANA 20 SP. NOV.

(FIGS 9D, 13I, 18G, 23G, 27J, 32E)

Material examined

Holotype m$: **Chile**: VIII Region, Province Bío-Bío, Parque Nacional Laguna del Laja, sector Lagunillas, 1100 m, 21.i.1996, *22 alatum*, open *Austrocedrus* forest and sclerophyll scrub (D. Burckhardt) #56(7) (MHNG, dry).

Paratype. **Chile**: 2 m$, 1 immature, same as holotype (D. Burckhardt) #56(7) (MHNG, dry); 1 m$, 1 f£, same but Park entrance to El Abanico, 900–1100 m, 22.i.1996, *22 alatum*, dense forest along river (D. Burckhardt) #58(11) (MHNG, on slide).

Description

Coloration: General colour of body yellow to orange. Head including genal processes and clypeus yellow to orange. Eyes yellow to greyish, ocelli orange to red. Antenna yellow to brownish, segments 3–8 with dark apices, segments 9–10 entirely dark brown. Pronotum of the same colour as vertex, sometimes with orange dot in the middle; mesopraescutum pale yellow, often orange in the middle; mesoscutum pale yellow with four broad and, in the middle, one narrow orange longitudinal stripes; mesoscutellum pale yellow along the margin, orange in the middle. Metanotum yellow to orange. Forewing with pale yellow to brownish veins and yellow to brownish membrane, both becoming slightly darker apically. Legs yellow, sometimes with orange femur, meracanthus of metacoxa yellow to orange. Abdomen and terminalia yellow to orange. Paramere and female terminalia with dark apices.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with microscopical setae; genal processes conical, slender, subacute apically, distinctly shorter than vertex, covered with short setae. Forewing oblong-oval, narrowly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs straight or weakly sinuous, almost straight apically, cell m_1 long; surface spinules faint, dense, present in all cells, leaving no spinule-free stripes along the veins, forming indistinct hexagons in apical half; radular spinules covering indistinct areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 7–8 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere irregularly subtrapezoidal; with hook-shaped apico-anterior process on long pedicel, median hump with apically sclerotised tooth, and bulged apico-posterior lobe; process, hump and lobe of subequal length; outer face sparsely covered with moderately long setae mostly in apical part, inner face sparsely covered with relatively short setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with long anterior process, one apical and one curved forward apico-posterior tubercles; lateral lobes long, strongly dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, convex, with median indentation; covered with few moderately long setae in dorsal part. Subgenital plate cuneate, with short apical process; covered with few moderately long setae in apical half, dorsal margin with a row of bristles.

Host-plant: 22 alatum (Gillies ex Hook. & Arn.) Kuntze (Rosaceae).

Distribution: Chile (VIII Region).

Derivation of name: From Latin rutilus = golden red referring to its body colour.

Comment: Russelliana 20 resembles *R. 6, disparilis, nigra, similis* and *solanicola*; see comments under *R. 6. R. 20* differs from the five species by a yellow forewing membrane. It differs from *R. disparilis* and *nigra* by the presence of a median hump of the paramere, and from *R. disparilis* and *similis* by the presence of surface spinules in the apical part of the forewing. *R. 20* differs from *R. 6* by a shorter female terminalia, and from *R. disparilis* by a smaller apico-posterior lobe of the paramere and an apically subacute anterior process of the distal segment of the aedeagus.

RUSSELLIANA SEBASTIANI BURCKHARDT, 2008

(FIGS 9E, 13J, 18H, 23H, 27K, 32F)

Russelliana sebastiani Burckhardt, 2008: 82.

Material examined

Type material. Holotype m$: **Chile**: VII Region, Province Talca, Parque Gil de Vilches, 1100 m, 5.i.1994, *Dipyrena juncea* [*Diostea juncea*] (D. Burckhardt) #47 (MHNG, dry). Paratype. **Chile**: 4 f£, same as holotype but sector Piedras Blancas, 1350–1600 m, 12.i.1996, *Dipyrena juncea* [*Diostea juncea*] (D. Burckhardt) #43(4) (MHNG, dry); 5 m$, 6 f£, 1 immature, same but sector Majadilla, 1350–1550 m, 13.i.1996, *Dipyrena juncea* [*Diostea juncea*] (D. Burckhardt) #44(12) (MHNG, NHMB, dry, on slide); 2 m$, 2 f£, same but El Enladrillado, El Venado Valley, 1350–1700 m, 14.i.1996, *Dipyrena juncea* [*Diostea juncea*] (D. Burckhardt)

#45(1) (MHNG, dry); 3 m$, 3 f£, VIII Region, Province Bío-Bío, Parque Nacional Laguna del Laja, sector Chacay, 1200 m, 19.i.1996, *Dipyrena juncea* [*Diostea juncea*] (D. Burckhardt) #53(3) (MHNG, NHMB, dry).

Description
Coloration: Head and genal processes pale yellow to orange, ventrally white; clypeus black. Eyes grey to dark brown, ocelli orange. Antenna pale yellow, segments 1–2 orange, segments 3–8 with dark brown apices, segments 9–10 entirely black. Pronotum of the same colour as vertex, brown on either side; mesopraescutum pale yellow, with two orange to brown patches along the fore margin; mesoscutum pale yellow, with four broad orange to brown longitudinal stripes; mesoscutellum pale yellow along the margin, brownish in the middle. Metanotum yellow to dark brown. Forewing with white to dark brown veins and yellowish fore margin gradually turning white in the middle of wing where the dark brown pattern starts which is interrupted by white median transverse stripe stretching from median part of vein Rs to bifurcation of vein Cu, and by light areas in cells r_2, m_1, m_2 and cu_1 along the margin. Legs dirty yellow to brownish, with darker femur, meracanthus of metacoxa bright yellow. Abdomen dark brown to black dorsally, yellow to orange ventrally. Male terminalia pale brown, paramere dark brown. Female proctiger brown, with dark apex; subgenital plate orange.

Structure: Head, in profile, strongly inclined from longitudinal body axis (> 45°). Vertex subtrapezoidal, flat with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, hind margin around lateral ocelli not raised, covered with microscopical setae; genal processes short, swollen, with blunt apices, covered with long setae. Pronotum bearing two lateral produced tubercles on either side. Forewing oblong-oval, narrowly, unevenly rounded apically; vein C+Sc strongly, unevenly curved, pterostigma short, vein Rs weakly sinuous, almost straight apically, cell m_1 long; surface spinules very dense, present in all cells, leaving no spinule-free stripes along the veins, forming hexagonal pattern, absent in upper part of cell r_1 and along the fore margin of cell c+sc, less developed on unpigmented areas; radular spinules weakly pronounced. Metatibia with 6 apical spurs.

Terminalia: Male. Proctiger tubular; densely covered with moderately long setae. Subgenital plate elongate; with sparsely spaced long setae. Paramere narrowly lamellar; with slightly recurved apico-anterior process on pedicel and long finger-shaped apico-posterior lobe with inwards directed sclerotised anterior tooth situated at base of the lobe; lobe more than twice longer than process; outer face sparsely covered with moderately long setae mostly in apical half, inner face sparsely covered with short setae and with long thick setae along anterior margin of the lobe. Distal segment of aedeagus moderately elongate, broadly, unevenly expanding towards apex; with one small apico-posterior tubercle; lateral lobes moderately long, dilated towards apex which is slightly concave and with frayed margin. – Female. Proctiger subglobular, subacute apically; dorsal margin, in profile, convex, bent downwards; relatively densely covered with moderately long setae in apical half. Subgenital plate subglobular, rounded apically; sparsely covered with short setae.

Host-plant: Dipyrena juncea (Gillies & Hook.) Ravenna (Verbenaceae).

Distribution: Reported from Chile (VII–VIII Regions) (Burckhardt, 2008a).

Comment: Russelliana sebastiani resembles *R. bulbosa* and *diosteae*; see comments under *R. bulbosa*. *R. sebastiani* differs from the two species by shorter, swollen genal processes, a narrow forewing which is narrowly, unevenly rounded apically and bearing a longer cell m_1, a paramere bearing a slightly recurved apico-anterior process and a narrow apico-posterior lobe, and a distal segment of the aedeagus weakly inflated anteriorly and bearing a small apico-posterior tubercle. It differs from *R. bulbosa* by longer antenna, the presence of a brown forewing pattern bearing a shorter pterostigma, a paramere bearing a process distinctly shorter than a lobe, an apically rounded female subgenital plate lacking an apical process, and from *R. diosteae* by a more extensive forewing pattern in its basal third.

***RUSSELLIANA 21* SP. NOV.**

(FIGS 9F, 14A, 18I, 23I, 27L, 32G)

Material examined

Holotype m$: **Argentina**: Province Mendoza, above Villa Vicencia, 50 km NW Mendoza, 1800–2200 m, 18.i.1997, *Adesmia* sp., low scrub (D. Burckhardt) #15(3) (MHNG, dry).

Paratype. **Argentina**: 11 m$, 15 f£, 5 immatures, same as holotype (D. Burckhardt) #15(3) (MHNG, dry, on slide, 70 % ethanol).

Description

Coloration: Head yellow to brownish, genal processes pale yellow; clypeus brown. Eyes yellow to grey, ocelli orange. Antenna yellow to brownish, segments 3–8 with dark brown apices, segments 9–10 entirely dark brown. Thorax pale yellow to brownish. Forewing with bright yellow to brown veins and semitransparent, yellowish membrane with brown pattern consisting of large patch along vein Cu_{1b} and scattered dots varying in size and number, mainly in apical two thirds of the wing. Legs yellow with darker distal tarsal segment, meracanthus of metacoxa pale yellow. Abdomen and terminalia yellow to brownish, lighter ventrally.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, distinctly shorter than vertex, covered with short setae. Pronotum with one lateral pronounced tubercle on either side. Forewing oval, broadly, evenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs weakly sinuous, almost straight apically, cell m_1 long; surface spinules absent; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 6–7 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate elongate; with sparsely spaced moderately long setae. Paramere relatively narrow lamellar; with apico-anterior process on very short pedicel, and median hump with apically sclerotised tooth; apical part of posterior edge produced into small lobe; outer face sparsely covered with moderately long setae, inner face covered with few moderately long setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with long anterior process and two small apico-posterior tubercles; lateral lobes moderately long, dilated towards apex which is concave. – Female. Terminalia densely covered with long setae. Proctiger cuneate, pointed apically; dorsal margin, in profile, strongly convex. Subgenital plate cuneate, with long apical process.

Host-plant: Adesmia sp. (Fabaceae).

Distribution: Argentina (Mendoza).

Derivation of name: From Latin setosus = hairy referring to the female terminalia which are densely covered with long hairs.

Comment: Russelliana 21 resembles *R. 14*, *15* and *vinculipennis*, see comments under *R. 14*. *R. 21* differs from the three species by denser and longer setae on the female terminalia, from *R. 14* and *15* by a more extensive pattern mainly in the apical two thirds of the forewing, and from *R. mendoza* and *vinculipennis* by the presence of a median hump of the paramere. It differs from *R. vinculipennis* by the absence of surface spinules in the apical part of the forewing, a longer anterior process of the distal segment of the aedeagus, and a longer apical process of the female subgenital plate.

RUSSELLIANA SIMILIS **BURCKHARDT, 1987**

(FIGS 9G, 14B, 19A, 24A, 28A, 32H)

Russelliana similis Burckhardt, 1987: 380.

Material examined

Type material. Holotype m$: **Bolivia**: Department Chuquisaca, Province Nor Cinti, Lecori, S Potosi, 3200 m, 26–27.xii.1984 (L. E. Peña) (MHNG, dry). Paratype. **Bolivia**: 11 m$, 3 f£, same as holotype (L. E. Peña) (MHNG, dry, on slide); 12 m$, 4 f£, same but Padcoya to Camargo, 2800–3200 m, 26–28.xii.1984 (L. E. Peña) (MHNG, NHMB, dry, on slide).

Description

Coloration: Head including genal processes pale yellow; clypeus brown. Eyes yellow to brown, ocelli orange. Antenna yellow to brownish, segments 3–8 with brown apices, segments 9–10 entirely dark brown. Pronotum of the same colour as vertex, with brown spots on either side and yellow to orange spot in the middle; mesopraescutum pale yellow, with two pale to dark brown patches along the fore margin and two yellow to orange transverse stripes posteriorly; mesoscutum pale yellow to orange, with four broad brown and, in the middle, one narrow yellow to orange longitudinal stripes; mesoscutellum pale yellow along the margin, yellow to brown in the middle. Metanotum yellow to dark brown. Forewing with brown veins and colourless membrane, sometimes fumose in the middle of cells in apical half; sometimes with distinct brown patch along vein Cu_{1b}. Legs pale to dirty yellow, with slightly darker femur and distal tarsal segment, meracanthus of metacoxa yellow. Abdomen and terminalia yellow to dark brown. Female proctiger dark in apical third, subgenital plate with dark apex. Females often slightly lighter with ventrally lighter abdomen.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse tubercle on either side of mid-line, with raised hind margin around lateral ocelli, covered with microscopical setae; genal processes conical, slender, subacute apically, shorter than vertex, covered with moderately long setae. Pronotum with one lateral, relatively pronounced, and one lateral, relatively shallow, tubercles on either side. Forewing oblong-oval, broadly, unevenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs almost straight apically, cell m_1 long; surface spinules absent; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 7–9 apical spurs.

Terminalia: Male. Proctiger tubular; relatively densely covered with moderately long setae. Subgenital plate short, subglobular; with relatively densely spaced moderately long setae. Paramere irregularly subtrapezoidal; with short apico-anterior process on very short pedicel, small median hump with apically sclerotised tooth, and slightly bulged posteriorly apico-posterior lobe; lobe slightly longer than process; outer face sparsely covered with moderately long setae mostly in posterior half, inner face densely covered with long setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with long anterior process, one apical and one curved forward apico-posterior tubercles; lateral lobes long, strongly dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, sinuous, with subapical indentation; densely covered with moderately long setae. Subgenital plate cuneate, with short apical process; sparsely covered with moderately long setae, dorsal margin with a row of bristles.

Host-plant: unknown.

Distribution: Reported from Bolivia (Chuquisaca) (Burckhardt, 1987a).

Comment: Russelliana similis resembles *R. 6*, *disparilis*, *nigra*, *20* and *solanicola*; see comments under *R. 6. R. similis* differs from *R. 6*, *nigra*, *20* and *solanicola* by the absence of surface spinules in the apical part of the forewing, from *R. disparilis* and *nigra* by a small median hump of the paramere, and from *R. nigra* and *20* by a colourless membrane of the forewing. It differs from *R. 6* by a shorter female terminalia, and from *R. disparilis* by a smaller apico-posterior lobe of the paramere and an apically subacute anterior process of the distal segment of the aedeagus.

***RUSSELLIANA SOLANICOLA* TUTHILL, 1959**

(FIGS 9H, 14C, 19B, 24B, 28B, 32I)

Russelliana solanicola Tuthill, 1959: 12.

Material examined

Type material. Holotype m$: **Peru**: Region Lima, Santa Eulalia, 28.x.1958, *Datura* sp. (L. D. Tuthill) (USNM, dry).

Rublished records (for details see Serbina *et al.* 2015). **Argentina**: Catamarca, Córdoba, La Rioja, Río Negro, Salta, Tucumán. **Bolivia**: Chuquisaca, Taipina, Tarija. **Brazil**: Minas Gerais, Paraná, São Paulo. **Chile**: I Region (Iquique, Tamarugal), II Region (San Pedro de Atacama, Tocopilla), III Region (Chañaral, Copiapó, Huasco), IV Region (Elqui, Limarí), V Region (Petorca, Quillota, San Felipe de Aconcagua, Valparaíso), Region Metropolitana (Santiago), VI Region (Cachapoal), VII Region (Cauquenes, Talca), VIII Region (Ñuble), IX Region (Malleco). **Peru**: Ancash, Arequipa, Cusco, Huánuco, Lima, Moquegua, Tacna. **Uruguay**: Brisa de la Pinta (BMNH, CASC, FSCA, MHNG, NHMB, dry, on slide, 70 % ethanol).

Additional material. **Argentina**: 1 f£, Province Catamarca, Punta Balasto, 220 m, 26–28.xi.1983 (L. E Peña) (MHNG, dry); 8 m$, 25 f£, same but Province La Pampa, Puelen, 9.xi.1987 (L. E Peña) (MHNG, dry, on slide); 1 m$, Province Jujuy, La Quiaca, 3442 m, 17.ii.1951 (E. S. Ross & A. E. Michelbacher) (CASC, dry); 2 f£, 1 immature, Province Mendoza, above Villa Vicencia, 50 km NW Mendoza, 1800–2200 m, 18.i.1997 (D. Burckhardt) #15 (NHMB, dry). **Bolivia**: 2 f£, Department Cochabamba, Province Chapare, 20 km E Sacaba, 17°25.1'S 65°53.9'W, 3450 m, 24.iii.2001 (A. Freidberg) (NHMB, dry). **Brazil**: 1 f£, State São Paulo, Rio de Janeiro, 19.i.1969, beach area (C. W. & L. B. O’Brien) (CASC, dry). **Chile**: 1 m$, 3 f£, V Region, Province San Felipe de Aconcagua, Termas de Jahuel, 1000 m, 21.i.1997, *Helenium aromaticum* (D. Burckhardt) #17(1) (NHMB, dry); 1 f£, Region Metropolitana, Province Santiago, Quebrada de la Plata, Fugdo, Rinenada, Kaipa, 33°32'S 70°47'W, 510 m, 25.i.1966 (M. E. Irwin) (CASC, dry); 1 m$, IX Region, Malleco, Angol, 29.i.1951 (E. S. Ross & A. E. Michelbacher) (CASC, dry). **Peru**: 1 m$, Region Ayacucho, Huanta, 8.iii.1951 (E. S. Ross & A. E. Michelbacher) (CASC, dry).

Description

Coloration: Head including genal processes pale yellow, genae pale yellow to brown, vertex often pale to dark brown in the middle; clypeus pale to dark brown. Eyes pale yellow to brown, ocelli yellow to orange. Antenna pale to dirty yellow, segments 4–8 with dark brown apices, segments 9–10 entirely dark brown. Pronotum pale yellow, often with pale to dark brown dot in the middle; mesopraescutum pale yellow with two yellow to dark brown patches along the fore margin; mesoscutum pale yellow with four broad pale to dark brown longitudinal stripes and often, in the middle, with one narrow yellow to brownish longitudinal stripe; mesoscutellum pale yellow along the margin, pale to dark brown in the middle. Metanotum yellow to dark brown. Forewing with pale to dark brown veins, becoming darker towards apex, and colourless to greyish membrane with indistinct brown patches along the veins Cu and Cu$_{1b}$, at apices of veins R$_1$, Rs, M$_{1+2}$, M$_{3+4}$, Cu$_{1a}$ and often between bifurcation of vein M and apical part of cell r$_1$. Legs yellow to brownish, with slightly darker distal tarsal segment, meracanthus of metacoxa pale yellow. Abdomen brown. Male terminalia brown to dark brown. Female terminalia dirty yellow to brown; proctiger dark in apical half. Females generally slightly lighter, with ventrally lighter abdomen.

Structure: Head, in profile, strongly inclined from longitudinal body axis at 90°. Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with raised hind margin around lateral ocelli, covered with microscopical setae; genal processes conical, slender, subacute apically, distinctly shorter than vertex, covered with moderately long setae. Forewing oblong-oval, narrowly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs almost straight apically, cell m_1 short; surface spinules very dense, present in all cells, leaving no spinule-free stripes along the veins, irregularly spaced; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 7 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with relatively densely spaced moderately long setae and with long setae along the ventral margin. Paramere irregularly subtrapezoidal, curved with median convexity apically; with hook-shaped apico-anterior process on short pedicel, apically sclerotised median tooth and bulged apico-posterior lobe; both process and lobe of subequal length; outer face sparsely covered with moderately long setae mostly in apical half, inner face densely covered with short to moderately long setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with moderately long anterior process, one horn-shaped apical and one curved forward apico-posterior tubercles; lateral lobes long, dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, sinuous, with subapical indentation; densely covered with short setae. Subgenital plate cuneate, with short apical process; sparsely covered with moderately long setae, dorsal margin with few bristles.

Host-plants: polyphagous, confirmed hosts are *Alternanthera ficoidea* (L.) Sm. (Amaranthaceae), *Baccharis lycioides* J.Rémy, *B. zoellneri* F.H.Hellw. ssp. *minor* F.H.Hellw., *Helenium aromaticum* (Hook.) L.H.Bailey, *Parthenium hysterophorus* L., *Xanthium spinosum* L. (Asteraceae), *Escallonia rosea* Griseb. (Escalloniaceae), *Brugmansia arborea* (L.) Steud., *Datura* sp., *Lycium* sp. and *Solanum tuberosum* L. (Solanaceae); likely but unconfirmed hosts are *Beta vulgaris* L. (Amaranthaceae), *Baccharis neaei* DC., *Flaveria bidentis* (L.) Kuntze, *Helianthus annuus* L., *Tagetes erecta* L., *T. minuta* L. (Asteraceae), *Acnistus arborescens* (L.) Schltdl., *Capsicum annuum* L., *C. baccatum* L., *Cestrum auriculatum* L'Hér., *Datura stramonium* L., *Fabiana imbricata* Ruiz & Pav., *Lycopersicon esculentum* Mill., *Nicotiana glutinosa* L., *Nolana* cf. *sedifolia* Poepp., *Solanum americanum* Mill., *S. chilense* Dunal, *S. corymbosum* Jacq., *S. peruvianum* L., *S. pinnatum* Cav. and *S. valdiviense* Dunal (Solanaceae).

Distribution: The species is native to the Andes Region (Central and Western Argentina, Bolivia, Far Northern–Southern Chile and Peru) and presumably was introduced into eastern South America (Eastern Argentina, Southern Brazil, Uruguay) (Burckhardt, 1987a; Serbina *et al.*, 2015; Tuthill, 1959).

Comment: Russelliana solanicola resembles *R. 6*, *disparilis*, *nigra*, *20* and *similis*; see comments under *R. 6. R. solanicola* differs from *R. disparilis* and *nigra* by a median convexity of the apical margin of the paramere, from *R. disparilis* and *similis* by the presence of surface spinules in the apical part of the forewing, and from *R. nigra* and *20* by a colourless membrane of the forewing. It differs from *R. 6* by a shorter female terminalia, and from *R. disparilis* by a smaller apico-posterior lobe of the paramere and an apically subacute anterior process of the distal segment of the aedeagus.

***RUSSELLIANA 22* SP. NOV.**

(FIGS 9I, 14D, 19C, 24C, 28C, 33A)

Material examined

Holotype m$: **Chile**: V Region, Province Los Andes, El Juncal, 2200 m, 24.xii.1998, *22 alatum,* alpine scrub with low bushes (D. Burckhardt) #6(3) (NHMB, dry).

Paratype. **Argentina**: 2 m$, 8 f£, Province Mendoza, Mendoza Valley, Punta de Vacas, 2400 m, 30.xii.1995, *22 alatum*, subalpine/alpine scrub (D. Burckhardt) #28 (MHNG, NHMB, dry); 5 m$, 9 f£, 2 immatures, same but above Villa Vicencia, 50 km NW Mendoza, 1800–2200 m, 18.i.1997, *22 alatum* (D. Burckhardt) #15(6) (MHNG, on slide, 70 % ethanol). **Chile:** 2 m$,6 f£, V Region, Province Los Andes, Río Blanco to Portillo, route 60, Aconcagua Valley, 32°50'S 70°08'W, 2200–2400 m, 23.xi.1992, *Mulguraea scoparia* [*Diostea scoparia*], alpine scrub (D. Burckhardt) #12 (NHMB, dry); 13 m$, 24 f£, 5 immatures, same but km 10 Portillo to Río Blanco, 2300 m, 23.xii.1995, *22 alatum* (D. Burckhardt) #18(3) (MHNG, NHMB, dry, on slide, 70 % ethanol); 18 m$, 15 f£, 7 immature, same as holotype (D. Burckhardt) #6(3) (NHMB, dry, on slide, 70 % ethanol).

Description

Coloration: General colour of body yellow. Head including genal processes whitish to pale yellow, sometimes orange; clypeus pale yellow to orange. Eyes yellow, ocelli red. Antenna yellow to brownish, segments 3–8 with dark brown apices, segments 9–10 entirely dark brown. Pronotum pale to bright yellow, often same colour as vertex and distinctly paler than mesonotum, sometimes with bright yellow dot in the middle; mesopraescutum pale yellow with two bright yellow to orange patches along the fore margin; mesoscutum pale yellow with four broad and, in the middle, one narrow bright yellow to orange longitudinal stripes; mesoscutellum pale yellow along the margin, bright yellow in the middle. Metanotum pale to bright yellow. Forewing membrane with pale yellow to brownish veins and yellow to brownish membrane, both becoming slightly darker towards apical part. Legs pale to bright yellow, sometimes with orange femur, meracanthus of metacoxa pale to bright yellow. Abdomen and terminalia pale yellow to orange. Female proctiger dark in apical third; subgenital plate with dark apex.

Structure: Head, in profile, moderately to strongly inclined from longitudinal body axis (45–90°). Vertex subtrapezoidal, flat with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with microscopical setae; genal processes conical, slender, subacute apically, shorter than vertex, covered with short setae. Forewing oblong-oval, narrowly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs almost straight apically, cell m_1 long; surface spinules absent; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 4–6 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae mostly in posterior part. Subgenital plate short, subglobular; with sparsely spaced long setae. Paramere narrowly lamellar with constricted base, weakly sinuous apically, posterior margin curved; with short anterior process lacking pedicel and apically sclerotised median tooth; outer face sparsely covered with moderately long setae mostly in posterior part, inner face sparsely covered with short setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with slightly upwards directed anterior process, situated almost in the middle of distal segment and with one short and one horn-shaped apico-posterior tubercles; lateral lobes moderately long, dilated towards apex which is concave. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, almost straight; sparsely covered with relatively short setae in apical half. Subgenital plate subglobular, with short apical process; sparsely covered with moderately long setae in apical part, dorsal margin with a bristle.

Host-plant: 22 alatum (Gillies ex Hook. & Arn.) Kuntze (Rosaceae).

Distribution: Argentina (Mendoza), Chile (V Region).

Derivation of name: Named after its host *22*.

Comment: Russelliana 22 resembles some *Adesmia* feeding species in the narrowly lamellar paramere bearing an apico-anterior process lacking a pedicel, and in the distal segment of the aedaegus bearing two small apico-posterior tubercles. It differs from most of *Adesmia*-feeders by the absence of a brown pattern on the forewing, and a subglobular female subgenital plate.

RUSSELLIANA THERESAE **BURCKHARDT, 2008**

(FIGS 9J, 14E, 19D, 24D, 28D, 33B)

Russelliana theresae Burckhardt, 2008: 85.

Material examined

Type material. Holotype m$: **Chile**: V Region, Province Los Andes, El Juncal, 2200 m, 24.xii.1998, *Mulguraea scoparia* [*Diostea scoparia*], alpine scrub with low bushes (D. Burckhardt) #6(1) (NHMB, dry). Paratype. **Chile**: 27 m$, 19 f£, 4 immatures, same as holotype (D. Burckhardt) #6(1) (NHMB, dry, on slide, 70 % ethanol); 3 f£, 9 immatures, 1 immature skin, same but Río Blanco to Portillo, Aconcagua Valley, 2200–2400 m, 23.xi.1992, *Mulguraea scoparia* [*Diostea scoparia*] (D. Burckhardt) #12 (MHNG, dry); 1 m$, 2 f£, same but 25 km W Portillo, 1900–2100 m, 1.xii.1993, various vegetation (D. Burckhardt) #1 (MHNG, dry); 8 m$, 15 f£, same but Portillo, 32°50'S 70°08'W, 1800 m, 31.xii.1993, *Mulguraea scoparia* [*Diostea scoparia*], alpine scrub (D. Burckhardt) #43 (MHNG, dry); 1 m$, 2 f£, 1 immature, same but 2200 m, *Mulguraea scoparia* [*Diostea scoparia*] (D. Burckhardt) #44 (MHNG, dry); 3 m$, 7 f£, same but km 10 Portillo to Río Blanco, 2300 m, 23.xii.1995, *Mulguraea scoparia* [*Diostea scoparia*] (D. Burckhardt) #18(1) (MHNG, dry); 4 m$, 3 f£, same but km 14 Portillo to Río Blanco, *Mulguraea scoparia* [*Diostea scoparia*] (D. Burckhardt) #19(1) (MHNG, dry); 3 m$, 3 f£, same but km 19 Portillo to Río Blanco, 1900 m, *Mulguraea scoparia* [*Diostea scoparia*] (D. Burckhardt) #20(2) (MHNG, dry); 21 m$, 22 f£, same but along road from Portillo to Río Blanco, 24.xii.1998, *Mulguraea scoparia* [*Diostea scoparia*] (D. Burckhardt) #7(2) (NHMB, dry, on slide, 70 % ethanol).

Description

Coloration: Head including genal processes yellow to brown, genal processes with dark tips, genae brown to dark brown, vertex with orange to brown pattern; clypeus dark brown to black. Eyes yellow to brown, ocelli orange to red. Antenna pale yellow, segments 1–2 yellow to brown, segments 3–8 with brown apices, segments 9–10 entirely dark brown. Pronotum of the same colour as vertex, dark brown on either side and yellow to brown spot in the middle; mesopraescutum pale yellow, with two orange to brown patches along the fore margin and three orange transverse stripes posteriorly; mesoscutum pale yellow, with four broad orange to brown and, in the middle, one narrow orange longitudinal stripes; mesoscutellum pale yellow along the margin, yellow to brown in the middle. Metanotum yellow to dark brown. Forewing with whitish to dark brown veins and semitransparent, colourless membrane with dark brown pattern, similar to *R. marionae*, consisting of two broad stripes: submarginal one stretching from apical part of costal vein to median part of vein Cu_{1a}, along vein Cu_{1a} and to base of vein M_{1+2}, sometimes leaving light areas in cells m_1 and m_2 along the margin, and median one stretching from base of pterostigma, along the veins R, M+Cu and Cu, to base of vein Cu_{1b}; membrane between stripes colourless, with dots varying in size and number. Legs dirty yellow to brown, with dark brown femur and distal tarsal segment, meracanthus of metacoxa pale yellow to orange. Abdomen and terminalia dark brown, sometimes black.

Structure: Head, in profile, weakly inclined from longitudinal body axis (< 45°). Vertex subtrapezoidal, flat with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, hind margin around lateral ocelli not raised, covered with long setae; genal processes conical, slender, subacute apically, about the same length as vertex, covered with long setae. Pronotum bearing two lateral pronounced tubercles on either side. Forewing oblong-oval, broadly, evenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs weakly sinuous, curved to fore margin apically, cell m_1 short; surface spinules very dense, present in all cells, leaving no spinule-free stripes along the veins, irregularly spaced, less developed on unpigmented areas; radular spinules not pronounced. Metatibia with 6–7 apical spurs.

Terminalia: Male. Proctiger tubular; densely covered with long setae. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere narrowly lamellar; with finger-shaped apico-anterior process on long pedicel and long apico-posterior lobe, slightly convex posteriorly, evenly rounded apically; both process and lobe of subequal length; outer face sparsely covered with moderately long setae mostly in posterior half, inner face densely covered with moderately long setae in anterior part, few long setae along anterior margin, sparsely covered with moderately long setae in posterior part and with few long setae apically. Distal segment of aedeagus elongate, weakly, irregularly truncating towards apex; lateral lobes long, tubular, sclerotised. – Female. Proctiger cuneate, pointed apically; dorsal margin, in profile, with median indentation; relatively densely covered with moderately long setae. Subgenital plate subglobular, with moderately long apical process; densely covered with moderately long setae.

Host-plant: Mulguraea scoparia (Gillies & Hook.) N.O'Leary & P.Peralta (Verbenaceae).

Distribution: Reported from Chile (V Region) (Burckhardt, 2008a).

Comment: Russelliana theresae resembles *R. marionae*; see comments under *R. marionae*. *R. theresae* differs from *R. marionae* by a shorter forewing with a more extensive pattern in the basal half, the absence of macroscopical setae on the forewing veins, and a paramere bearing a broader apico-posterior lobe.

RUSSELLIANA VINCULIPENNIS BURCKHARDT, 1987

(FIGS 9K, 14F, 19E, 24E, 28E, 33C)

Russelliana vinculipennis Burckhardt, 1987: 377.

Material examined

Type material. Holotype m$: **Argentina**: Province Jujuy, Iturbe, 31.xii.1984 (L. E. Peña) (MHNG, dry). Paratype. **Argentina**: 1 m$, 2 f£, same as holotype (L. E. Peña) (MHNG, dry, on slide). **Bolivia**: 2 m$, 9 f£, Department Chuquisaca, Province Nor Cinti, Lecori, S Potosi, 3200 m, 26–27.xiii.1984 (L. E. Peña) (MHNG, NHMB, dry, on slide).

Description

Coloration: Head including genal processes pale yellow, genal processes with dark tips, vertex with variable orange pattern or entirely yellow; clypeus brown. Eyes yellow to brown, ocelli orange to red. Antenna dirty yellow, segments 3–8 with brown apices, 9–10 entirely dark brown. Pronotum of the same colour as vertex, often with yellow to orange patch in the middle; mesopraescutum pale yellow, with two yellow to orange patches along the fore margin and two yellow to orange transverse stripes posteriorly; mesoscutum pale yellow with four broad and, in the middle, one narrow yellow to orange longitudinal stripes; mesoscutellum pale yellow along the margin, yellow to orange in the middle. Metanotum yellow to brown. Forewing with brown veins and colourless membrane consisting of dark brown pattern of patch along vein Cu_{1b} and scattered dots covering most of the membrane, sometimes forming distinct transverse band stretching from apical part of costal vein to apex of vein Cu_{1a}, leaving light areas in cells r_2, m_1 and m_2 along the margin. Legs yellow to brownish, with darker femur and distal tarsal segment, meracanthus of metacoxa yellow. Abdomen and terminalia brown to dark brown. Females often with ventrally lighter abdomen.

Structure: Head, in profile, moderately to strongly inclined from longitudinal axis of body (45–90°). Vertex subtrapezoidal, anteriorly produced into transverse lobe on either side of mid-line, with raised hind margin around lateral ocelli, covered with short setae; genal processes conical, slender, subacute apically, shorter than vertex, covered with moderately long setae. Pronotum with two lateral pronounced tubercles on either side. Forewing oblong-oval, broadly, unevenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs almost straight apically, cell m_1 short; surface spinules present in all cells, leaving no spinule-free stripes along the veins, densely and irregularly spaced, less developed on unpigmented areas; absent in cell c+sc except for a group of spinules in the middle, sometimes covering entire cell; radular spinules covering rounded areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 6–9 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere narrowly lamellar, convex apically, posterior margin straight; with hook-shaped apico-anterior process on pedicel and apically sclerotised median tooth; outer face sparsely covered with moderately long setae mostly in apical half, inner face sparsely covered with moderately long setae. Distal segment of aedeagus elongate, weakly expanding towards apex; with short beak-like anterior process and two small apico-posterior tubercles; lateral lobes moderately long, slightly dilated towards apex which is slightly concave. – Female. Proctiger cuneate, subacute apically; dorsal margin, in profile, slightly convex in apical half; densely covered with moderately long setae. Subgenital plate cuneate, with short apical process; sparsely covered with moderately long setae, dorsal margin with a row of bristles.

Host-plant: unknown.

Distribution: Reported from Argentina (Jujuy), Bolivia (Chuquisaca) (Burckhardt, 1987a).

Comment: Russelliana vinculipennis resembles *R. 14*, *15* and *21*, see comments under *R. 14*. *R. vinculipennis* differs from the three species by the presence of surface spinules in the apical part of the forewing, a shorter anterior process of the distal segment of the aedeagus, and a shorter apical process of the female subgenital plate. It differs from *R. 14* and *R. 15* by a more extensive forewing pattern mainly in its apical two thirds, from *R. 15* and *R. 21* by the absence of a median hump of the paramere, and from *R. 21* by less dense and long setae on the female terminalia.

***RUSSELLIANA 23* SP. NOV.**

(FIGS 9L, 14G, 19F, 24F, 28F, 33D)

Material examined

Holotype m$: **Chile**: IV Region, Province Elqui, Coquimbo, 15–25 km S Vicuña, 30°15'S 70°40'W, 1300–1700 m, 14.xii.1993, *Fabiana viscosa*, steppe (D. Burckhardt) #33 (MHNG, dry).

Paratype. **Chile**: 1 f£, IV Region, Province Elqui, Coquimbo, 5 miles N of Laguna Dam, 8000 m, 6.xii.1950 (E. S. Ross & A. E. Michelbacher) (CASC, dry); 3 m$, 2 f£, same as holotype (D. Burckhardt) #33 (MHNG, NHMB, dry, on slide).

Description

Coloration: General colour of body green-yellow to bright yellow. Head including genal processes and clypeus pale yellow. Eyes yellow to greyish, ocelli yellow to red. Antenna pale to dirty yellow, segments 3–7 brownish apically, segment 8 with brown apex, segments 9–10 entirely dark brown. Pronotum of the same colour as vertex, distinctly paler than mesonotum; mesopraescutum green-yellow to bright yellow, sometimes with two distinct orange to brownish patches along the fore margin; mesoscutum green-yellow to bright yellow, sometimes with distinct four broad orange longitudinal stripes; mesoscutellum green-yellow to bright yellow. Metanotum green-yellow to bright yellow. Legs pale yellow, sometimes with slightly darker distal tarsal segment, meracanthus of metacoxa green-yellow to bright yellow. Forewing with yellow veins and semitransparent, evenly yellow membrane. Abdomen and terminalia green-yellow to bright yellow. Female proctiger darker in apical third, subgenital plate with dark apex.

Structure: Head, in profile, inclined from longitudinal body axis at 45°. Vertex trapezoidal, flat with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, hind margin around lateral ocelli not raised, covered with microscopical setae; genal processes conical, slender, subacute apically, twice shorter than vertex, covered with short setae. Pronotum with two lateral relatively pronounced tubercles on either side. Forewing oviform; vein C+Sc strongly curved in the middle, pterostigma long, vein Rs straight apically, cell m_1 short; surface spinules absent; densely and irregularly spaced in cell c+sc except for base and apex; radular spinules covering rounded areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 7–8 apical spurs.

Terminalia: Male. Proctiger tubular; densely covered with relatively short setae. Subgenital plate relatively elongate; with sparsely spaced moderately long setae. Paramere broadly lamellar, almost straight or weakly sinuous posteriorly; with short apico-anterior process lacking pedicel and apically sclerotised median tooth; outer face densely covered with short setae mostly in posterior part, inner face densely, evenly covered with short setae. Distal segment of aedeagus massive, broadly, unevenly expanding towards apex, strongly inflated anteriorly, concave apically; with one horn-shaped apico-posterior tubercle; lateral lobes short, with entire apical margin. – Female. Proctiger cuneate, subacute apically; dorsal margin, in profile, convex, strongly indented subapically; densely covered with long setae. Subgenital plate subglobular, with moderately long apical process; densely covered with long setae, dorsal margin with few bristles.

Host-plant: Adults were collected on *Fabiana viscosa* Hook. & Arn. (Solanaceae) which is a likely host.

Distribution: Chile (IV Region).

Derivation of name: Named after its likely host *Fabiana viscosa*.

Comment: Russelliana 23 resembles *R. fabianae*; see comments under *R. fabianae*. *R. 23* differs from *R. fabianae* by shorter antenna and the absence of surface spinules in the apical part of the forewing.

RUSSELLIANA 24 SP. NOV.

(FIGS 9M, 14H, 19G, 24G, 28G, 33E)

Material examined
Holotype m$: **Chile**: V Region, Province Quillota, Cuesta la Dormida, 10 km W Tiltil, 33°04'S 71°02'W, 1200 m, 15.xi.1992, *Baccharis linearis*, sclerophyll scrub on slope (D. Burckhardt) #1 (NHMB, dry).

Paratype. **Chile**: 10 m$, 21 f£, 1 immature, III Region, Province Huasco, Huasco, 28°27'S 71°05'W, 50 m, 13.xii.1993, *Baccharis* sp., river estuary with dense scrub (D. Burckhardt) #31 (MHNG, dry); 1 f£, IV Region, Province Choapa, Los Vilos, 31°54'S 71°31'W, 0 m, 2.xii.1993, *Baccharis* sp. (D. Burckhardt) #2 (MHNG, dry); 1 f£, same but Province Elqui, Coquimbo, 20 miles E of La Serena, 3.xii.1950 (E. S. Ross & A. E. Michelbacher) (CASC, dry); 2 m$, 2 f£, same but 5 miles N of Laguna Dam, 3100 m, 6.xii.1950 (E. S. Ross & A. E. Michelbacher) (CASC, dry); 2 m$, 5 f£, 1 immature, same but 5 miles W of La Junta, 7.xii.1950 (E. S. Ross & A. E. Michelbacher) (CASC, dry, on slide); 20 m$, 23 f£, 4 immatures, same but between Chapilca and Guanta, ca 100 km E La Serena, 29°50'S 70°30'W, 1100 m, 3.xii.1993, *Baccharis salicina* [*Pingraea marginalis*] (D. Burckhardt) #3 (MHNG, dry); 20 m$, 19 f£, 7 immatures, same but below Juntas, ca 150 km E La Serena, 29°57'S 70°06'W, 1900 m, *Baccharis* sp., dry quebrada with *Baccharis* scrub along river (D. Burckhardt) #5 (MHNG, dry); 4 m$, 11 f£, same but 15 km SW Viñita Baja, 29°50'S 70°50'W, 450 m, 4.xii.1993, *Baccharis* sp. (D. Burckhardt) #6 (MHNG, dry); 13 m$, 14 f£, same but 15 km E Vicuña, 30°10'S 70°40'W, 850 m, 5.xii.1993, *Baccharis salicina* [*Pingraea marginalis*], river bed with *Baccharis* and dry slope with small shrubs (D. Burckhardt) #10 (MHNG, NHMB, dry); 1 m$, 20 f£, Panamericana km 550, 85 km N La Serena, 29°25'S 71°10'W, 200 m, 6.xii.1993, *Baccharis linearis*, steppe (D. Burckhardt) #12 (MHNG, dry); 6 m$, 11 f£, same but 5–25 km S Vicuña, 30°15'S 70°40'W, 1300–1700 m, 14.xii.1993, *Baccharis salicina* [*Pingraea marginalis*] (D. Burckhardt) #33 (MHNG, dry); 33 m$, 35 f£, 2 immatures, same but *Baccharis* sp. (D. Burckhardt) #33 (MHNG, dry); 14 m$, 13 f£, 6 immatures, 2 immature skins, same but 16 km N Chapilca, nr Río Turbio, road to Llanos de Huanta, ca 80 km E La Serena, 1100 m, 17.xii.1995, *Baccharis* sp., very dry quebrada with some scattered shrubs (D. Burckhardt) #2(1) (MHNG, dry, 70 % ethanol); 4 m$, 13 f£, 2 immatures, 1 immature skin, same but 20 km W Vicuña, nr Río Elqui, 500 m, *Baccharis* sp., river bed with *Salix* and *Baccharis* shrubs (D. Burckhardt) #6(1) (MHNG, dry, 70 % ethanol); 29 m$, 32 f£, same but ca 40 km E La Serena, 5 km SW Viñita Baja, 450 m, 19.xii.1995, *Baccharis* sp. (D. Burckhardt) #9(1) (MHNG, dry, 70 % ethanol); 2 f£, same but ca 50 km NE La Serena, Almte Latorre, 1000 m, *Baccharis salicina* [*Pingraea marginalis*] (D. Burckhardt) #11(1) (MHNG, dry); 1 m$, 11 f£, same but Río Claro Valley, Alcohuaz, 1700 m, 20.xii.1995, *Baccharis* sp., semidesert (D. Burckhardt) #14(1) (MHNG, dry, 70 % ethanol); 7 f£, same but Elqui Valley, nr Rivadavia, 750 m, *Baccharis* sp., semidesert with *Baccharis* shrubs and scattered trees in lowest part (D. Burckhardt) #12(7) (MHNG, dry); 2 m$, 2 f£, same but La Herradura, S Coquimbo, 100 m, 21.xii.1995, *Baccharis* sp., sparse scrub nr sea shore (D. Burckhardt) #15(1) (MHNG, dry); 6 m$, 5 f£, same but Province Limarí, Parque Nacional Fray Jorge, Alto de Talinay, 30°40'S 71°41'W, 550 m, 6–7.xii.1990. *Baccharis* sp., mediterranean scrub (D. Agosti & D. Burckhardt) #1b (MHNG, dry); 3 m$, 15 f£, same but area between Quebrada Las Vacas, "Administración", and Río Limarí, 250 m, 7–9.xii.1990. *Baccharis linearis*, open mediterranean scrub (D. Agosti & D. Burckhardt) #2 (MHNG, dry); 5 m$, 2 f£, 2 immatures, same but *Baccharis paniculata* [*Neomolina paniculata*] (D. Agosti & D. Burckhardt) #2 (MHNG, dry); 42 m$, 39 f£, same but *Baccharis salicina* [*Pingraea viscosa*] (D. Agosti & D. Burckhardt) #2 (MHNG, dry); 2 m$, 12 f£, same but Alto de Talinay, 30°40'S 71°41'W, 500 m, 15.xii.1992, *Baccharis paniculata* [*Neomolina paniculata*], sclerophyll forest and mediterranean scrub (D. Burckhardt) #26 (MHNG, dry); 13 m$, 44 f£, same but Quebrada La Vaca, 30°40'S 71°40'W, 100–200 m, 15–17.xii.1992, *Baccharis linearis*, mediterranean scrub (D. Burckhardt) #27 (NHMB, dry); 1 m$, 3 f£, same but *Baccharis paniculata* [*Neomolina paniculata*] (D. Burckhardt) #27 (NHMB, dry); 1 f£, same but nr park entrance gate, 100–150 m, 16.xii.1992, *Baccharis paniculata* [*Neomolina *paniculata*] (D. Burckhardt) #28 (NHMB, dry); 3 m$, 6 f£, V Region, Province Los Andes, km 14 Portillo to Río Blanco, 2100 m, 23.xii.1995, *Baccharis* sp., subalpine scrub (D. Burckhardt) #19(2) (MHNG, dry, 70 % ethanol); 8 m$, 22 f£, 1 immature, same but Portillo to Río Blanco, 24.xii.1998, *Baccharis* sp., gully with a few shrubs and small trees along river and subalpine scrub (D. Burckhardt) #7(1) (NHMB, dry, 70 % ethanol); 6 m$, 7 f£, same but El Juncal, 2200 m, *Baccharis* sp., alpine scrub with low bushes (D. Burckhardt) #6(2) (NHMB, dry, 70 % ethanol); 1 m$, 1 f£, same but Province Petorca, El Guayacán, 20 km E Cabildo, 800 m, 17.v.1993, *Baccharis* sp., mediterranean scrub (D. Burckhardt) #12(1) (NHMB, dry); 1 m$, 2 f£, same but La Viña to Alicahue, E Cabildo to La Ligua, 600 m, 21.xii.1998, *Baccharis* sp., semidesert, degraded *Acacia caven* steppe and sclerophyll forest along river scrub (D. Burckhardt) #2(2) (NHMB, dry); 2 m$, 1 f£, same but Alicahue to Chincolco, 700–1250 m, 21–26.xii.1998, *Baccharis* sp., semidesert and *Acacia caven* steppe (D. Burckhardt) #3(9) (NHMB, dry); 3 f£, same but Province San Felipe de Aconcagua, Putaendo, 10 km N San Felipe, along river Putaendo, 700 m, 17.v.1993, *Baccharis salicina* [*Baccharis salicifolia*], river bed with open bushy vegetation (D. Burckhardt) #10(1, 2) (MHNG, dry); 1 m$, 13 f£, 1 immature, same but Los Patos, 35 km N San Felipe, 100 m, *Baccharis salicina* [*Baccharis salicifolia*], mediterranean scrub (D. Burckhardt) #11(2) (MHNG, dry); 14 m$, 10 f£, 3 immatures, same but Putaendo, 10 km N San Felipe, 32°37'S 70°42'W, 700 m, 26.xii.1993, *Baccharis salicina* [*Pingraea marginalis*], river bed (D. Burckhardt) #35 (MHNG, dry); 2 m$, 5 f£, same but 15 km E Llay-Llay, 32°52'S 70°51'W, 600 m, 28.xii.1993, *Baccharis* sp., *Acacia caven* steppe (D. Burckhardt) #39 (MHNG, dry); 11 m$, 18 f£, 5 immatures, 1 immature skin, same but 10 km N San Felipe, 15.xii.1995, *Baccharis* sp. (D. Burckhardt) #1(3) (MHNG, dry, 70 % ethanol); 5 m$, 4 f£, same but El Tártaro, 20 km N San Felipe, Putaendo Valley, 1100 m, 24.xii.1995, *Baccharis* sp. (D. Burckhardt) #23(6) (MHNG, dry, 70 % ethanol); 1 m$, 1 f£, same but 10 km N San Felipe, 700 m, 27.xii.1995, *Baccharis salicina* [*Pingraea marginalis*], river bed (D. Burckhardt) #27(1) (NHMB, dry); 2 m$, 3 f£, 1 immature, same but 8 km N San Felipe, 12–13.i.1997, *Baccharis salicina* [*Pingraea salicifolia*], dry river bed of Río Aconcagua (D. Burckhardt) #4(3) (MHNG, 70 % ethanol); 1 m$, 10 f£, same but El Asiento, 900 m, 13–20.i.1997, *Baccharis salicina* [*Pingraea salicifolia*], mediterranean scrub (D. Burckhardt) #5(1, 3) (MHNG, NHMB, dry, 70 % ethanol); 4 m$, 12 f£, same but Termas de Jahuel, 1000 m, 21.i.1997, *Baccharis salicina* [*Pingraea salicifolia*], *Acacia caven* steppe with some planted exotic trees (D. Burckhardt) #17(5) (MHNG, 70 % ethanol); 2 m$, 7 f£, same but 1000–1100 m, 27.xii.1997, *Baccharis linearis* (D. Burckhardt) #8(5) (NHMB, dry); 15 m$, 26 f£, 4 immatures, 2 immature skins, same but quebrada nr Jahuel, 900 m, *Baccharis linearis* (D. Burckhardt) #9(1) (NHMB, dry, on slide, 70 % ethanol); 1 m$, 3 f£, same but km 16 Resguardo de Los Patos to Paso del Rubio, 1600 m, 1.i.1999, *Baccharis salicina* [*Pingraea salicifolia*], *Acacia caven* steppe (D. Burckhardt) #13(3) (NHMB, dry); 2 f£, same but km 20 Resguardo de Los Patos to Paso del Rubio, 1800 m, *Baccharis linearis*, semidesert and subalpine scrub (D. Burckhardt) #11(7) (NHMB, dry); 4 m$, same but San Felipe area, Cerro Hormigas, 32°43.3'S 70°43.3'W, 720 m, 4.iii.2009, *Baccharis salicina* [*Baccharis marginalis*], *Acacia caven* scrub with dried grass (D. Burckhardt) #10(1) (NHMB, dry); 3 m$, 3 f£, same but Termas de Jahuel, 32°41.1'S 70°35.4'W, 1180 m, *Baccharis linearis*, *Acacia caven* steppe with some planted exotic trees (D. Burckhardt) #11(4) (NHMB, dry); 1 f£, same but Resguardo de Los Patos, 32°29.2'S 70°33.9'W, 1350 m, *Baccharis linearis*, *Acacia caven* scrub (D. Burckhardt) #14(5) (NHMB, dry); 25 m$, 14 f£, 5 immatures, same as holotype (D. Burckhardt) #1 (NHMB, dry); 2 m$, 1 f£, same but Fundo Francesco Araya, 5.v.1993, *Baccharis salicina* [*Baccharis salicifolia*], mediterranean scrub nr plantation (D. Burckhardt) #7(1) (MHNG, dry); 1 f£, same but La Palma, Fundo Lothar Neserke, 300 m, 30.xii.1998, *Baccharis linearis*, *Acacia caven* steppe and gully with mediterranean sclerophyll forest along very small river (D. Burckhardt) #10b(3) (NHMB, dry); 1 f£, same but Province Valparaíso, 5 miles N of Concón, 16.xii.1950 (E. S. Ross & A. E. Michelbacher) (CASC, dry); 3 m$, 6 f£, same but Embalse Los Aromos, nr Concón, 32°55'S 71°31'W, 100 m, 21.xi.1992, *Baccharis linearis*, mediterranean scrub (D. Burckhardt) #8 (NHMB, dry); 7 m$, 10 f£, same but *Baccharis paniculata* [*Neomolina paniculata*] (D. Burckhardt) #8 (NHMB, dry); 1 f£, same but Mantagua, nr Ritoque, 32°53'S 71°30'W, 20 m, *Baccharis linearis* (D. Burckhardt) #9 (NHMB, dry); 4 m$, 7 f£, same but Estero Catapilco, nr Maitencillo, 32°40'S 71°27'W, 50 m, 22.xi.1992, *Baccharis salicina* [*Pingraea salicifolia*], open sclerophyll forest (D. Burckhardt) #10 (NHMB, dry); 1 f£, Region Metropolitana, Province Chacabuco, Cuesta La Dormida, 7–10 km W Tiltil, 33°04'S 71°02'W, 950–1200 m, 28.xii.1993, *Baccharis* sp., mediterranean sclerophyll scrub (D. Burckhardt) #41 (MHNG, dry); 5 m$, 7 f£, same but Province Maipo, Maipo Valley, Motocoton, 10.i.1985, *Baccharis* sp. (D. Hollis) (BMNH, on slide); 1 m$, 1 f£, same but Province Santiago, between Corral Quemado and Farellones, 1700 m, 19.v.1993, *Baccharis* sp., open mediterranean scrub (D. Burckhardt) #14(1) (MHNG, dry); 2 m$, 1 f£, VI Region, Province Cachapoal, Termas de Cauquenes, 800 m, 10.i.1996, *Baccharis linearis*, mediterranean sclerophyll scrub (D. Burckhardt) #40(3) (MHNG, dry); 1 m$, 7 f£, same but Province Colchagua, Bellavista, Río Claro, 900 m, 11.i.1996, *Baccharis* sp., degraded deciduous forest (D. Burckhardt) #42(7) (MHNG, dry, 70 % ethanol); 5 m$, 7 f£, 1 immature, 1 immature skin, same but La Rufina, Río Tinguiririca, 650 m, *Baccharis linearis* (D. Burckhardt) #41(1) (MHNG, dry, 70 % ethanol); 1 f£, VII Region, Province Cauquenes, Reserva Nacional Los Ruiles, 25 km NW Cauquenes, 35°49'S 72°32'W, 300–450 m, 26–28.xi.1992, *Baccharis neaei*, mixed *Nothofagus* forest (D. Burckhardt) #16 (NHMB, dry); 8 m$, 8 f£, same but Province Talca, Armerillo to Las Garzas, Maule Valley, 60–80 km E Talca, 35°45'S 71°00'W, 700 m, 25.xi.1992, *Fabiana imbricata*, degraded sclerophyll forest and scrub (D. Burckhardt) #14 (NHMB, dry);7 m$, 7 f£, same but Parque Gil de Vilches Monumento Natural, 35°35'S 71°04'W, 1100 m, 4–5.i.1994, *Baccharis* sp., mixed *Nothofagus* forest (D. Burckhardt) #47 (MHNG, dry); 3 m$, 7 f£, same but sendero El Enladrillado, El Venado Valley, 1350–1700 m, 14.i.1996, *Baccharis* sp. (D. Burckhardt) #45(3) (MHNG, dry, 70 % ethanol); 1 m$, VIII Region, Province Bío-Bío, Laguna del Laja, sector Meseta del Toro, 1500 m, 20.i.1996, *Baccharis* sp., *Escallonia*/*Nothofagus antarctica* scrub and *Nothofagus pumilio* forest (D. Burckhardt) #55(7) (MHNG, dry); 1 m$, 2 f£, same but Province Concepción, road Concepción to Cabrero, nr junction to Florida, 300 m, 18.i.1996, *Baccharis linearis*, degraded sclerophyll scrub (D. Burckhardt) #50(1) (NHMB, dry); 4 m$, 4 f£, 1 immature skin, same but Province Ñuble, km 10 road Cabrero to Yungay, nr province border, 200 m, *Baccharis linearis*, sclerophyll scrub (D. Burckhardt) #51(1) (MHNG, NHMB, dry, 70 % ethanol); 1 f£, IX Region, Province Malleco, Parque Nacional Nahuelbuta, 37°49'S 73°01'W, 1300 m, 16–17.xii.1990. *Baccharis zoellneri* ssp. *minor*, *Nothofagus antarctica* forest (D. Agosti & D. Burckhardt) #11 (MHNG, dry); 2 m$, same but 10 km W Termas de Tolhuaca, 1100 m, 23.i.1996, *Baccharis* sp., deciduous *Nothofagus* forest (D. Burckhardt) #60(2) (MHNG, dry); 17 m$, 31 f£, same but sector Laguna Malleco, 900 m, 23–27.i.1996, *Baccharis tricuneata* [*Baccharis 12*], mixed *Nothofagus* forest (D. Burckhardt) #61b(5) (MHNG, dry, 70 % ethanol); 4 m$, 7 f£, X Region, Province Osorno, Parque Nacional Puyehue, sector Mirador, Los Mallines, 700 m, 1–3.ii.1996, *Baccharis* sp., open *Nothofagus nitida* scrub intergrading into sclerophyll rain forest (D. Burckhardt) #72b(3) (MHNG, dry, 70 % ethanol); 2 m$, 6 f£, 16 immatures, same but Province Valdivia, Monumento Natural Alerce Costero, nr sector Mirador, ca 25–30 km W La Unión, 29.xii.1990. 950 m, *Baccharis zoellneri* ssp. *zoellneri*, *Baccharis* scrub and transition to *Nothofagus dombeyi* forest (D. Agosti & D. Burckhardt) #24a (MHNG, dry); 5 m$, 12 f£, 1 immature, XII Region, Province Última, Esperanza, Monumento Natural Cueva del Milodón, 150 m, 11.i.1991, *Baccharis mylodontis*, open scrub with *Nothofagus* (D. Burckhardt) #34 (MHNG, dry).

Additional material. **Chile**: 15 m$, 9 f£, 1 immature, III Region, Province Copiapo, Quebrada de Paipote, 70 km NE Copiapo, 27°09'S 69°54'W, 1800 m, 12.xii.1993, *Baccharis* sp. (D. Burckhardt) #27 (MHNG, dry); 1 f£, same but Province Huasco, 85 km S Vallenar, 29°02'S 70°52'W, 1000 m, *Baccharis* sp. (D. Burckhardt) #32 (MHNG, dry); 5 m$, 6 f£, IV Region, Province Elqui, Pisco Elqui, nr Alcohuaz, 20.i.1985, *Baccharis* sp. (D. Hollis) (BMNH, on slide); 10 m$, 9 f£, same but La Laguna to Nueva Elqui, ca 115 km E La Serena, 2600 m, 17.xii.1995, *Baccharis* sp. (D. Burckhardt) #5(1) (MHNG, dry, 70 % ethanol); 11 m$, 11 f£, same but La Laguna, ca 120 km E La Serena, 2800–3000 m, *Baccharis* sp., scattered shrubs (D. Burckhardt) #4(3) (MHNG, dry, 70 % ethanol); 4 m$, 5 f£, same but 20 km S Vicuña towards Hurtado, nr Puente El Pangue, 1600 m, 18.xii.1995, *Baccharis* sp., semidesert and quebrada with water (D. Burckhardt) #8(1) (MHNG, dry); 2 m$, 2 f£, same but ca 45 km ENE La Serena, Viñita Baja to Condoriaco, 800–1000 m, 19.xii.1995, *Baccharis salicina* [*Pingraea marginalis*], mountain slope (D. Burckhardt) #10(1) (MHNG, dry); 1 m$, 3 f£, V Region, Province Los Andes, 25 km W Portillo, route 60, Aconcagua Valley, 32°50'S 70°08'W, 1900–2100 m, 1.xii.1993, *Baccharis* sp., subalpine/alpine scrub (D. Burckhardt) #1 (MHNG, dry); 3 m$, 1 f£, same but Portillo, 32°50'S 70°08'W, 1800 m, 31.xii.1993, *Haplopappus multifolius*, alpine scrub (D. Burckhardt) #43 (MHNG, dry); 3 m$, 2 f£, 1 immature, same but km 19 Portillo to Río Blanco, 1900 m, 23.xii.1995, *Baccharis* sp. (D. Burckhardt) #20(5) (MHNG, dry, 70 % ethanol).

Description

Coloration: General colour of body pale yellow to orange. Head including genal processes pale yellow to orange; clypeus bright yellow to orange. Eyes green-yellow to black, ocelli orange to red. Antenna yellow to pale brownish, segments 3–8 with dark brown apices, segments 9–10 entirely dark brown. Thorax pale yellow to orange, sometimes with indistinct greenish to brownish pattern: mesopraescutum with two patches along the fore margin; mesoscutum with four broad and, in the middle, one narrow longitudinal stripes; mesoscutellum slightly darker in the middle. Forewing with yellow veins and with semitransparent, amber-coloured membrane. Legs pale yellow to orange, meracanthus of metacoxa pale yellow to orange. Abdomen and terminalia pale yellow to orange. Female terminalia with dark apex.

Structure: Head, in profile, strongly inclined from longitudinal body axis at 90°. Vertex subtrapezoidal with indented foveae, anteriorly produced into transverse lobe on either side of mid-line, with slightly raised hind margin around lateral ocelli, covered with microscopical setae; genal processes conical, slender, subacute apically, shorter than vertex, covered with moderately long setae. Pronotum with one lateral pronounced and one sublateral, relatively shallow, tubercles on either side. Forewing oblong-oval, broadly, unevenly rounded apically; vein C+Sc weakly curved, pterostigma long, vein Rs straight or weakly sinuous, almost straight apically, cell m_1 short; surface spinules faint, present in all cells, leaving narrow to broad spinule-free stripes along the veins, sparsely spaced, forming indistinct hexagons in apical half, sometimes spinules entirely reduced in apical half of the wing; absent at least at base of cell c+sc; radular spinules covering triangular areas along the margin of cells r_2, m_1, m_2 and cu_1. Metatibia with 7–8 apical spurs.

Terminalia: Male. Proctiger tubular; sparsely covered with moderately long setae in apical and posterior part. Subgenital plate short, subglobular; with sparsely spaced moderately long setae. Paramere narrowly lamellar, irregularly rounded apically; with long hook-shaped apico-anterior process on very short pedicel and lobe with apically sclerotised median tooth; lobe situated exterior to process; outer face sparsely covered with moderately long setae mostly in apical part, inner face densely, evenly covered with moderately long setae. Distal segment of aedeagus moderately elongate, weakly expanding towards apex; with short beak-like anterior process and one horn-shaped apico-posterior tubercle; lateral lobes long, slightly dilated towards apex which is concave. – Female. Proctiger subglobular, pointed apically; dorsal margin, in profile, strongly bent downwards; densely covered with moderately long setae in apical half. Subgenital plate cuneate, with short apical process; relatively densely covered with moderately long setae, dorsal margin with a row of bristles.

Host-plants: Baccharis linearis (Ruiz & Pav.) Pers., *B. mylodontis* F.H.Hellw., *B. neaei* DC., *B. paniculata* DC., *B. salicina* Torr. & A.Gray, *B. tricuneata* (L.f.) Pers. and *B. zoellneri* F.H.Hellw. ssp. *minor* F.H.Hellw. and ssp. *zoellneri* F.H.Hellw. (Asteraceae). Adults were collected on *Haplopappus multifolius* Phil. ex Reiche (Asteraceae) which may be an additional host.

Distribution: Chile (III–X, XII Regions, Region Metropolitana).

Derivation of name: From Ancient Greek ξανϑός = yellow referring to its body colour.

Comment: Russelliana 24 resembles *R. 1, 3* and *intermedia*; see comments under *R. 1. R 24* differs from the three species by an evenly bright yellow body colour. *R. 24* differs from *R. 1* by a yellow membrane of the forewing and a female proctiger with a downwards bent dorsal margin, from *R. 3* by a shape of the forewing which is broadest in the apical third, and from *R. intermedia* by less dense surface spinules of the forewing and the absence of a median hump of the paramere.

UNNAMED SPECIES

The following *Russelliana* species represent undescribed taxa that are not formally described and named due to insufficient material, or due to the poor state, the identification of specimens is questionable.

Russelliana sp. 1

Material examined. **Argentina**: 1 f£, Province Chubut, 19.9 km N Malaspina, 550 m, 13.xii.1966 (E. I. Schlinger & M. E. Irwin) (CASC, dry).

Comment: Due to the poor state of the specimen, the further identification is problematical.

Russelliana sp. 2

Material examined. **Argentina**: ? m$, ? f£, Province Mendoza, Luján, Cacheuta, 31.vii.1994, *Larrea divaricata* (G. Debandi) (NHMB, dry).

Comment: The specimens resemble *R. adesmiae* and *11*, in the presence of the three distinct tubercles on the pronotum, and in the membrane of the forewing with a similar distinct brown pattern. Due to the poor state of the specimens, the further identification is problematical.

Russelliana sp. 3

Material examined. **Argentina**: 1 f£, Province Mendoza, Mendoza Valley, Punta de Vacas, 2400 m, 30.xii.1995, *Verbena* sp. (D. Burckhardt) #28 (MHNG, dry); 1 f£, same but above Villa Vicencia, 50 km NW Mendoza, 1800–2200 m, 18.i.1997, *Mulguraea scoparia* [*Diostea scoparia*] (D. Burckhardt) #15(7) (MHNG, dry); 2 m$, 1 f£, same but Zoológico, vii.1997 (S. Roig) (NHMB, dry).

Comment: Reported as *Russelliana* sp. from Argentina (Mendoza) (Burckhardt, 2008b). The specimens resemble *R. marionae* and *theresae,* in the long genal processes, in the long antenna, and in the membrane of the forewing with a distinct brown pattern. They differ from the two species by a smaller body size, and a different forewing pattern.

Russelliana sp. 4

Material examined. **Argentina**: 1 m$, 2 f£, Province Mendoza, above Villa Vicencia, 50 km NW Mendoza, 1800–2200 m, 18.i.1997 (D. Burckhardt) #15 (NHMB, dry).

Comment: The specimens resemble *R. 16* and *19,* in the pale yellow body colour, in the oblong-oval paramere bearing an apico-anterior process on pedicel, situated interiorly to apico-posterior lobe, in the cuneate female proctiger with a dorsal margin conspicuously bent downwards in the apical third and bearing short thick bristles, and in the cuneate subgenital plate bearing a very long apical process. The male specimen differs from the two species by a shape of a process and a lobe of the paramere. The specimens differ from *R. 19* by the long genal processes, a shape of the forewing which is broadest in the apical third, and a female subgenital plate bearing short thick bristles in the apical third.

Russelliana sp. 5

Material examined. **Argentina**: 2 m$, Province Mendoza, km 18 Mendoza to Villa Vicencia, 700 m, 18.i.1997 (D. Burckhardt) #13 (NHMB, dry).

Comment: The specimens resemble *R. 16* and *19,* in the pale yellow body colour, and in the oblong-oval paramere bearing an apico-anterior process on pedicel, situated interiorly to apico-posterior lobe. They differ from the two species by the absence of genal processes, and a shape of a process and a lobe of the paramere. The specimens differ from *R. 16* by a short cell m_1 of the forewing, and from *R. 19* by a shape of the forewing which is broadest in the apical third.

Russelliana sp. 6

Material examined. **Argentina**: 2 m$, 2 f£, 1 immature, Province Mendoza, above Villa Vicencia, 50 km NW Mendoza, 1800–2200 m, 18.i.1997, *Baccharis* sp., low scrub (D. Burckhardt) #15(5) (NHMB, dry).

Comment: The specimens resemble *R. 1*, *3*, *intermedia* and *24*, in the long genal processes and in the long antenna. They differ from the four species by very sparse surface spinules in the apical part of the forewing and their absence in the cell c+sc, and a different shape of the paramere bearing an apico-anterior process on a long pedicel. The specimens differ from *R. 1* by a yellow membrane of the forewing and a female proctiger with a downwards bent dorsal margin, and from *R. 3* by an evenly yellow body colour, and a shape of the forewing which is broadest in the apical third.

Russelliana sp. 7

Material examined. **Bolivia**: 1 f£, Department Chuquisaca, Province Nor Cinti, Padcoya to Camargo, 2800–3200 m, 26–28.xii.1984 (L. E. Peña) (MHNG, dry).

Comment: The forewing membrane is pale brown with an indistinct parallel brown stripe stretching from the bifurcation of a vein M to a base of the cell r_2; surface spinules are very dense, present in all cells and leave no spinule-free stripes along the veins.

Russelliana sp. 8

Material examined. **Bolivia**: 1 f£, Department Cochabamba, 2 km W Leque Palca, 17°38.2'S 66°58.4'W, 3950 m, 23.iii.2001 (A. Freidberg) (NHMB, dry).

Comment: The specimen resembles *R. adesmiae* and *11*, in the membrane of the forewing with a distinct brown pattern, and in the cuneate female proctiger and cuneate subglobular plate bearing a short apical process. It differs from the two species by a bigger body size.

Russelliana sp. 9

Material examined. **Bolivia**: 1 f£, Department Cochabamba, 2 km W Leque Palca, 17°38.2'S 66°58.4'W, 3950 m, 23.iii.2001 (A. Freidberg) (NHMB, dry); 1 f£, Department La Paz, Province Pedro Domingo Murillo, 6 km NE La Paz, 16°25.7'S 68°04.3'W, 4130 m, 19.iii.2001 (A. Freidberg) (NHMB, dry); 1 f£, same but 14 km S El Alto, 16°40.1'S 68°11'W, 3900 m, 20.iii.2001 (A. Freidberg) (NHMB, dry).

Comment: The specimens resemble *R. fabianae* and *23*, in the short antenna, in the yellow membrane of the forewing, in the female proctiger with a convex, strongly indented subapically dorsal margin and subglobular subgenital plate. They differ from the two species by longer genal processes, and from *R. 23* by the presence of very dense surface spinules in all cells of the forewing, leaving no spinule-free stripes along the veins.

Russelliana sp. 10

Material examined. **Chile**: 1f£, I Region, Province Tarapacá, Misituni, 25.xi.1965 (Loksa) (MHNG, on slide).

Comment: The specimen resembles *R. 16* and *19*, in the cuneate female proctiger with a dorsal margin conspicuously bent downwards in the apical third bearing short thick bristles, and in the cuneate subgenital plate bearing a very long apical process. They differ from the two species by the presence of a brown stripe on the membrane of the forewing stretching from a base of the vein Rs, along the vein Cu$_{1b}$, to its apex. The specimen differs from *R. 16* by a shape of the forewing which is broadest in the middle and bearing large surface spinules, and from *R. 19* by the presence of a longer cell m$_1$ of the forewing.

Russelliana sp. 11

Material examined. **Chile**: 1 f£, V Region, Province San Felipe de Aconcagua, Quebrada del Tigre, Zapallar, 32°33'S 71°28'W, 12.viii.1966 (R. H. Gonzalez) (CASC, dry).

Comment: Due to the poor state of the specimen, the further description and identification is problematical.

Russelliana sp. 12

Material examined. **Chile**: 1 f£, IX Region, Loncoche, nr El Liuco, 28–29.i.1985, *Baccharis* sp. (D. Hollis) (BMNH, on slide).

Comment: The specimen resembles *R. 1, 3, intermedia* and *24*, in the long genal processes and in the long antenna. It differs from the four species by very dense surface spinules on the forewing membrane, present in all cells and leaving no spinule-free stripes along the veins, and from *R. 1, intermedia* and *24* by a shape of the forewing which is broadest in the middle. The specimen differs from *R. 1* by a yellow membrane of the forewing and a female proctiger with a downwards bent dorsal margin.

Russelliana sp. 13

Material examined. **Chile**: 1 m$, XII Region, Province Última, Esperanza, Paso de la Laguna Dorotea, W Puerto Natales, 250 m, 10.i.1991, *Senecio tricuspidatus*, pasture with *Nothofagus antarctica* (D. Burckhardt) #33 (MHNG, dry).

The specimen resembles *R. adunca* and *5*, in the colourless membrane of the forewing bearing faint surface spinules. The specimen differs from the two species by longer genal processes and a shape of the paramere bearing a strongly bulged posteriorly apico-posterior lobe.

Russelliana sp. 14

Material examined. **Chile**: 1 f£, II Region, Province Antofagasta, Salar de Ascotán, 4000 m, 21°31'S 68°18'W, vii.1997, *Adesmia atacamensis* (F. Saiz) #Q (NHMB, dry).

Comment: The specimen has short antenna. The forewing membrane is colourless, slightly fumose in the middle of cells in its apical half, and with a pale brown patch along the vein Cu_{1b}.

Russelliana sp. 15

Material examined. **Chile**: 1 f£, II Region, Province Antofagasta, Salar de Ascotán, 4000 m, 21°31'S 68°18'W, vii.1997, *Acantholippia trifida* (F. Saiz) #P (NHMB, dry); 1 m$, 1 f£, Province El Loa, Altos de Caspana, 4100 m, 22°26'S 68°09'W, vii.1997, ?[*Paratrephia lepidophylla*] (F. Saiz) #S (NHMB, dry).

Comment: The forewing membrane is yellow, lacking a pattern; surface spinules are dense, present in all cells and leave no spinule-free stripes along the veins.

Russelliana sp. 16

Material examined. **Chile**: 3 m$, V Region, Province Los Andes, El Juncal, 2200 m, 24.xii.1998, alpine scrub with low bushes (D. Burckhardt) #6 (NHMB, dry).

Comment: The specimens resemble *R. marionae* and *theresae*, in the long genal processes, in the long antenna, in the membrane of the forewing with a distinct brown pattern, and in the paramere bearing a finger-shaped apico-anterior process of subequal length with an apico-posterior lobe. They differ from the two species by the smaller size, and a less extensive forewing pattern which is mostly restricted to its apical part, and from *R. marionae* by a broader lobe of the paramere.

Russelliana sp. 17

Material examined. **Chile**: 2 m$, 3 f£, V Region, Province San Felipe de Aconcagua, km 20 Resguardo de Los Patos to Paso del Rubio, 1800 m, 1.i.1999, ?*Senecio* sp., semidesert and subalpine scrub (D. Burckhardt) #11(3) (NHMB, dry).

Comment: The specimens resemble *R. 1*, *3*, *intermedia* and *24*, in the paramere bearing a long hook-shaped apico-anterior process which is situated interiorly to apico-posterior lobe. They differ from the four species by very long genal processes, and from *R. 3* by an evenly yellow body colour.

Russelliana sp. 18

Material examined. **Chile**: 1 f£, XII Region, Province Magallanes, Estación La Cumbre, Sierra Baguales, 5.xii.1987, *Senecio* sp. (J. Petersen C.) (MHNG, dry).

Comment: The specimen resembles *R. adunca*, *5*, *7* and *similis*, in the colourless membrane of the forewing lacking surface spinules and in the cuneate female terminalia. Due to the absence of male material, the further identification is problematical.

Russelliana spp. immatures

Material examined. **Argentina**: 1 m$, 8 immatures, Province Mendoza, Mendoza Valley, Potrerillos to Cacheuta, 1200 m, 17.i.1997, *Lycium* sp. / *Verbena* sp. (D. Burckhardt) #10(4) (MHNG, 70 % ethanol). **Bolivia**: 1 immature, Department Chuquisaca, Province Nor Cinti, Lecori, S Potosi, 3200 m, 26–27.xii.1984 (L. E. Peña) (MHNG, on slide). **Chile**: IV Region, Province Elqui, La Laguna, ca 120 km E La Serena, 2800–3000 m, 17.xii.1995, *Adesmia* sp., scattered shrubs (D. Burckhardt) #4(1) (MHNG, 70 % ethanol); 1 immature, V Region, Province Los Andes, Río Blanco, Aconcagua Valley, 1400 m, 23.xii.1995, mediterranean scrub (D. Burckhardt) #22 (MHNG, dry); 15 immatures, IX Region, Province Cautín, Parque Nacional Conguillío, 1600 m, Sierra Nevada, subalpine scrub (D. Agosti & D. Burckhardt) #15 (NHMB, dry).

PHYLOGENETIC ANALYSIS

The phylogenetic relationships among *Russelliana* species were analysed with a cladistic analysis using 28 characters. Twenty-seven characters relate to the adult morphology (2 head characters, 6 forewing, 14 male terminalia, 4 female terminalia and 1 character of the presence of sexual dimorphism) and one to ethology (host-plant families) (Table 3). 18 characters are binary and 10 multistate, which are treated as unordered. *Baccharopelma dracunculifoliae* Burckhardt et al. 2004 (Psyllidae: Aphalaroidinae) was chosen as outgroup for rooting the tree. The analysis resulted in 324 trees with following parameters: length = 81, consistency index = 70 and retention index = 90. Figure 34 shows a consensus tree, which was calculated with the Nelsen command.

The consensus tree is fully resolved at the base (clades 1–4). The first clade (1) *R. fabianae + 23* is supported by two synapomorphies related to a unique shape of the paramere and female proctiger, and splited from the rest of species in the cladogram (clade 2).

Next clade (3) is well-supported by a large number of synapomorphies. It comprises clades *R. marionae* + *theresae* (5) and *R. bulbosa* + *diosteae* + *sebastiani* (6). The support of the relationship of *R. sebastiani* within the latter group is weak. Another sister-group is represented by *R. lycii*, described by Tuthill (1959) as *Arepuna lycii*. Burckhardt (1987) redefined the phylogenetic position of the species and synonymized the genus *Arepuna* with *Russelliana*. It is grounded by the following characters common for adults of *R. lycii* and other species in the clade (7): head, genal processes and forewing shape, the presence of a well-defined brown pattern on the forewing, a fork-shaped paramere, an apically inflated distal segment of the aedeagus lacking an anterior process, and a short, subglobular female terminalia. Despite a weak support of the relationships of *R. lycii* with other species from the clade (7), its position in the tree confirms the synonyms of *Arepuna* and *Russelliana*. Again, a weak support is observed in the sister-group relationships of *R. capsici* and *8* and a clade (8) *R. 2 + 9 + 17*. The latter group is supported by two synapomorphies (male proctiger and paramere characters), however, the relationship of *R. 9* within the group is rather weak and not supported by any derived characters. Two psyllids *R. 2 + 17* form a clade (9) supported by a single derived character (the presence of the long thick bristles on the paramere).

The forth clade (4) initiates a split of a small group (clade 10) of two species and a huge group (clade 11) consisting of many species. The tenth clade (10) *R. 16 + 19* is fairly well-supported by three synapomorphies (male terminalia characters). Despite a significant separation of this clade from other *Russelliana*, the support of species relationship within the clade is rather weak. Again, the eleventh clade (11) splits into a group of four species (clade 12) and a huge rest (clade 13) with three groups, one of which has one species and others are represented by two mostly unresolved clades (14, 15).

A monophyly of the clade (12) *R. 1*, *3*, *intermedia* + *24* is supported by a number of morphological characters (male terminalia characters) which, however, hardly separate species within the clade. Within the next clade (13), *R. 22* is not supported by any synapomorphies and its phylogenetic position is unclear. The relationships of five species, *R. disparilis, nigra*, *20, similis* and *solanicola* (clade 14), remain unresolved by the morphological characters. In opposite, four species from the same clade *R. adunca* + *4* +*5* +*7* form a monophyletic group (clade 16), which is reflected in the series of synapomorphies (male terminalia characters).

Next clade (15) is represented by a monophyletic *R. 13*, which is supported by a single derived character, but its phylogenetic position remains uncertain. *R. adesmiae* + *11* form a clade (17), supported by two synapomorphies (male terminalia characters). The relationships of *R. chilensis*, *10, 12* and *18* with other species within the same clade (15) are not supported by any derived characters and remain unresolved. Only *R. chilensis* + *12* form a clade (18), supported by two synapomorphies (male terminalia characters). At the same time, the support of the sister-group relationships of *R. 10* and *R. 18*, and *R. chilensis* + *12* is weak. The relationships of *R. maculata*, *14, 15, punctulata*, *21* and *vinculipennis* within the clade (15) remain poorly resolved.

HOST-PLANTS

Host-plants for 29 species of *Russelliana* are confirmed (Table 5). The majority of species in the genus are monophagous (25 spp.) and only three species seem to be oligophagous. Among them, the most host-rich associations are with plants from Solanaceae and Fabaceae families, associated with 10 and 9 psyllid species, respectively. Five psyllid species are associated with Verbenaceae, two – with Rosaceae, and one species is associated each with Asteraceae and Polygonaceae. The only polyphagous species in the genus, viz. *R. solanicola*, develops on at least ten plants from four families (Amaranthaceae, Asteraceae, Escalloniaceae and Solanaceae) and about three times as many plant species are likely its hosts (Serbina *et al.*, 2015).

The conducted phylogenetic analysis is used for the estimation of potential host-plant taxa for psyllid species lacking host/immature data (Table 5). This estimation is based on the morphological resemblence of psyllid species belonging to the same monophyletic group (Fig. 34). Thus, no immature material was available for *R. 3*, but its adults were collected on *Baccharis paniculata* and *Haplopappus foliosus* (Asteraceae), which are likely hosts, considering the resemblance of *R. 3* with the Asteraceae-feeders (clade 12). Again, only adults but no immatures of *R. chilensis* were collected on unidentified species of *Adesmia* (Fabaceae), and considering its close relationship with *R. 12* (clade 18), which develops on *A. boronioides*, *Adesmia* is also a potential host for *R. chilensis*. It appears that a similar explanation concerns the host-plant association of *R. 23*, which adults have been found on *Fabiana viscosa* (Solanaceae). *R. 23* is morphologically similar to *R. fabianae* (clade 1), associated with *F. imbricata*, suggesting that *F. viscosa* is a likely host for *R. 23*. No host data were available for *R. adunca*, *9*, *intermedia*, *maculata*, *16*, *nigra*, *punctulata*, *similis*, *19* and *vinculipennis*. It is interesting that a single immature and many adults of *R. adunca* (clade 16) were found on *Baccharis* sp. (Asteraceae). However, based on the results of the phylogenetic analysis, we assume that *R. adunca* might develop on Solanaceae as other species in the clade (16) and for this reason *Baccharis* is an unlikely host. Based on the morphological similarities with Solanaceae feeding psyllids, *R. nigra* and *similis* (clade 14) are probably also associated with Solanaceae, along with *R. 9,* which forms a clade (8) with two Solanaceae-feeders, *R. 2 + 17*. We also assume that *R. intermedia* is associated with Asteraceae, considering its resemblance with the Asteraceae-feeders (clade 12). *Adesmia* species (Fabaceae) can be host-plants for *R. maculata, punctulata* and *vinculipennis*, which is reflected in their morphological similarities with the species on *Adesmia* (clade 15). No distinct morphological similarities are found between two psyllid species, *R. 16 + 19* (clade 10), and other *Russelliana,* therefore their hosts remain uncertain.

According to the results of the analysis, the confirmed and estimated Fabaceae (13 spp.), Asteraceae (4 spp.) and Polygonaceae (1 sp.) feeding species are contained each in a single monophyletic group (clades 15, 12, 14, respectively), whereas the Solanaceae-feeders (16 spp.) are assigned to three different groups (clades 1, 7, 16), with four psyllids remaining unresolved (clade 14). Two Rosaceae-feeders, *R. 20* (clade 14) and *R. 22* (clade 13), form a polyphyletic group and the Verbenaceae feeding species (5 spp.) are paraphyletic (clade 3).

BIOGEOGRAPHY

Russelliana is a Neotropical genus with most species occurring in and along the Andes in Argentina, Bolivia, Chile and Peru (Table 5). *R. capsici* occurs in Eastern Argentina and Southern Brazil, *R. 9* – in Eastern Argentina, *R. 19* – in Southern Brazil, and *R. solanicola* is widely distributed over temperate South America but has probably been introduced into Eastern Argentina, Southern Brazil and Uruguay. Currently *Russelliana* comprises most species in Chile (27 spp.) and Argentina (18 spp.). From Bolivia nine species are known, from Brazil and Peru three each and only a single species is known from Uruguay, viz. the likely introduced *R. solanicola*.

The two species on *Mulguraea scoparia* (Verbenaceae), *R. marionae + theresae* (clade 5), from Western Argentina and Central Chile, respectively, are geographically separated and constitute vicariant sister species, in contrast to their host, which failed to speciate into different taxa. The vicariance events can explain the speciation in the clade of Solanaceae-feeders (7): a Peruvian *R. lycii* and three Argentinian *R. capsici + 8 + 9* and two Chilean *R. 2 + 17*. The latest two species are geographically separated from *R. 9* (clade 8) suggesting presence of vicariant event. Geographical vicariance can also explain origin of the *Adesmia* feeding species in the clade *R. chilensis + 12* (18) from Southern and Far Southern Chile, respectively. Speciation event in the clade *R. 16 + 19* (10) fromWestern Argentina and Southern Brazil, respectively, can also be invoked by geographical separation. Similar explanations of insect speciation were found in the associations of the Neotropical psylloids with plants of the genus *Schinus* (Anacardiaceae) (Burckhardt & Basset, 2000), *Baccharis* (Asteraceae) (Burckhardt *et al.*, 2004) and *Larrea* (Zygophyllaceae) (Burckhardt & Ouvrard, 2007).

Localities of some species in *Russelliana* geographically overlap. In addition, a number of closely related psyllids develop on the same host genus (clades 1, 9, 12, 15, 16, 17) and even on the same plant species (clade 6). More information on the phylogeny of *Russelliana* and its hosts is needed to explain these speciation patterns.

It is interesting that *R. 24* (clade 12) is relatively widely distributed and its specimens were collected from Northern to Far Southern Chile on a large number of *Baccharis* species (Asteraceae), suggesting its widely oligophagy. However, its wide distribution compared with other species from the same clade can also reflect insufficient collecting of the latter. *R. adesmia* (clade 17) and *R. 18* (clade 15) were found on a high number of *Adesmia* species (Fabaceae) in Northern and Central Chile, which can be also explained by an intensive collecting in these areas.

DISCUSSION AND CONCLUSIONS

Psyllids are known for their narrow geographical and host ranges within closely related species (Hodkinson, 1974; Hodkinson, 1980). Exceptionally, the subfamily Aphalaroidinae comprises 13 psyllid genera, associated with at least 13 plant families belonging as to monocots so that to two different clades of eudicots, such as Caryophyllales + asterids and rosids (Burckhardt, 2005b; Burckhardt & Wyniger, 2007). The presence of taxa sporadically across angiosperms phylogeny suggests occurrence of host shifts to unrelated plants within the subfamily, which is rare in psyllids due to preferential switching to closely related plants (Ouvrard, Chalise & Percy, 2015; Percy, Page & Cronk, 2004). However, nearly half of the genera (6) in Aphalaroidinae are associated with Fabaceae, suggesting that primitive host association of *Russelliana* ancestors was with plants from this family (Burckhardt, 2005b).

This review brings the number of described species in *Russelliana* to 43, predominantly widely distributed in and along the Andes in Argentina, Bolivia, from Far Northern to Far Southern Chile and Peru, and only four species are known from a few localities in Eastern South America (Table 5). It is not clear if this distributional pattern is an artefact of insufficient collecting in eastern South America, or *Russelliana* species predominantly inhabit the regions of the Andes. Previously, six host-plant families were known; two families are added here. The host-plants of thirteen psyllid species are unknown. Among them, the hosts for eleven psyllids are estimated based on their morphological resemblence with the species from the same monophyletic group (Fig. 34; Table 5). According to the current study, a highest number of *Russelliana* species are hosted by plant species from two different clades of eudicots, asterids (Solanaceae) and rosids (Fabaceae), 16 spp. and 13 spp., respectively. Previously, five *Russelliana* species, including *R. solanicola*, were reported from Solanaceae; six species are added here and five species are likely associated with this family, based on their morphological similarities with psyllids from confirmed solanaceous hosts, bringing a number of Solanaceae feeding species in the genus to 16 (Table 5). Considering a relatively modest number of Solanaceae-feeders in the world psylloid fauna (Burckhardt & Lauterer, 1997; Burckhardt *et al.*, 2012; Hodkinson, 1981; Taylor & Kent, 2013), those in *Russelliana* comprise nearly half of its total number, which emphasizes the importance of further studies on the group. The polyphagous *R. solanicola*, in addition to Solanaceae, is reported from Amaranthaceae, Asteraceae and Escalloniaceae (Serbina *et al.*, 2015). The remaining five species of *Russelliana* are restricted to Verbenaceae, four species are or likely associated with Asteraceae, two species develop on Rosaceae, and one – on Polygonaceae.

According to the phylogenetic results of the current study, we suggest the occurrence of geographical vicariance in species groups belonging to six clades of *Russelliana*: Fabaceae (clade 18), Solanaceae (clades 7, 8), Verbenaceae (clade 5) and clade 10 from unknown plant family.

In total, *Russelliana* on Solanaceae constitutes three monophyletic groups (6 spp., 4 spp. and 2 spp.), which probably involved three independent host shifts including two from unknown hosts (clades 1, 14, 16) and one shift (clade 7) likely from Verbenaceae. The psyllids associated with Fabaceae (13 spp.), Asteraceae (4 spp.) and Polygonaceae (1 sp.) also form each a monophyletic group (clades 15, 12, 14, respectively). The species associated with Verbenaceae (5 spp.) are paraphyletic (clades 5, 6) and those on Rosaceae (2 spp.) are polyphyletic (clades 13, 14). This overall pattern suggests frequent host shifts in *Russelliana*.

The present findings showed a high diversity of *Russelliana* in terms of its species number, a wide biogeographical range and associations with at least forty plant species from eight families (Table 5). Based on the unidentified species listed here, it is probable that *Russelliana* comprises a lot more species and additional host associations are to be found. Despite the close associations of psyllid species with their hosts, the species diversity found in *Russelliana* is better explained by geographical vicariance and host switching to related plant taxa than by cospeciation. However, to examine the plausibility of cospeciation events versus host switching, the reconciling of the two molecular phylogenies of psyllids and plants is required. We suggest future research should focus on the phylogenetic analysis of *Russelliana* immatures, as well as molecular phylogenetic studies that may reveal additional derived characters and help to resolve the problematical species groups. Additional field collections are required as many regions and hosts remain to be examined for *Russelliana*.

Despite groups of related phytophagous insects are often associated with groups of related plant species, almost no evidence of cospeciation that lead to insect speciation are firmly established, suggesting geographical vicariance and host shifts are the most important factors that contributed to the diversity of phytophagous insects on the planet.

ACKNOWLEDGEMENTS

We thank P. A. Brown (BMNH) and P. H. Arnaud (CASC) for the loan of material, and to M. M. Syfert (BMNH) for help with databasing specimens. We are grateful to L. M. Bernardello and A. T. Hunziker (Instituto Multidisciplinario de Biología Vegetal, Córdoba), R. M. dos Santos Isaias (Departamento de Botânica, Universidade Federal de Minas Gerais Belo Horizonte), O. dos Santos Ribas (Museu Botânico Municipal, Curitiba), E. A. Ulibarri (Instituto de Botánica Darwinion, Buenos Aires) and E. Van den Berg (Universidade Federal de Lavras, Lavras) for identifying host-plant specimens. LS is grateful to B. Mennecart and L. Costeur for stimulating discussions and valuable advice. We also express a sincere gratitude to I. Zürcher-Pfander and M. Borer for their kind help at several stages of the study. We gratefully acknowledge collecting permits of CONAF for Chile and CnPQ for Brazil. This study forms a part of the work of LS towards a Ph.D. degree at the University of Basel, funded by a grant of the Swiss Confederation (Federal Commission) and the Freiwillige Akademische Gesellschaft (FAG), Basel.

Table 1. Measurements (in mm) of *Russelliana* spp. adults.

species	specimens	GL	HW	VL	VW	AL	LAB2	LAB3	FL	FW	MtFL	MtTL	MP	PL	DL	FP	SP	AP
1 sp. nov.	2 ♂, 2 ♀	0.10–0.13	0.54–0.61	0.16–0.19	0.30–0.36	0.63–0.75	0.11–0.13	0.06–0.08	1.3–1.5	0.5–0.6	0.25–0.30	0.31–0.36	0.17–0.21	0.07–0.10	0.10–0.11	0.31–0.32	0.18–0.19	0.02–0.04
2 sp. nov.	3 ♂, 2 ♀	0.07–0.08	0.55–0.60	0.15–0.17	0.31–0.35	0.62–0.69	0.13–0.16	0.08–0.10	1.4–1.6	0.7–0.8	0.30–0.32	0.35–0.42	0.19–0.20	0.07–0.08	0.15	0.33–0.34	0.14	0.01
adesmiae	4 ♂, 3 ♀	0.09–0.14	0.59–0.74	0.16–0.19	0.37–0.45	0.69–0.97	0.14–0.15	0.07–0.08	1.6–1.9	0.80	0.31–0.35	0.35–0.40	0.24–0.38	0.12–0.14	0.11–0.12	0.32–0.34	0.15–0.18	0.02–0.03
adunca	3 ♂, 2 ♀	0.09–0.11	0.61–0.72	0.14–0.15	0.39–0.46	0.80–0.95	0.13–0.16	0.08–0.09	1.8–2.0	0.7–0.9	0.33–0.37	0.42–0.45	0.27–0.30	0.12–0.14	0.11	0.30–0.33	0.12–0.13	0.01
3 sp. nov.	2 ♂, 2 ♀	0.14–0.17	0.56–0.65	0.18–0.21	0.34–0.38	0.60–0.69	0.12–0.14	0.06–0.07	1.3–1.6	0.6–0.7	0.28–0.33	0.30–0.34	0.19–0.20	0.09	0.10–0.11	0.33–0.35	0.12–0.15	0.01
4 sp. nov.	1 ♂, 1 ♀	0.05	0.62	0.14	0.34	0.70–0.74	0.14	0.12–0.13	1.5–1.6	0.6–0.7	0.28–0.31	0.38–0.40	0.23	0.10	0.09	0.29	0.13	0.02
bulbosa	4 ♂, 2 ♀	0.15–0.17	0.73–0.78	0.20–0.21	0.43–0.48	0.84–0.88	0.13–0.16	0.06–0.08	1.7–2.1	0.8–0.9	0.37–0.43	0.41–0.45	0.30–0.31	0.11–0.12	0.17–0.18	0.38–0.40	0.22	0.01–0.02
capsici	1 ♂, 1 ♀	0.06–0.07	0.52–0.56	0.15–0.17	0.31–0.34	0.70	0.14–0.15	0.05–0.06	1.50	0.6–0.7	0.32–0.33	0.39–0.39	0.22	0.13	0.16	0.25	0.16	
5 sp. nov.	2 ♂, 3 ♀	0.09–0.11	0.60–0.67	0.16–0.18	0.38–0.40	0.88–1.05	0.15–0.20	0.14–0.15	1.5–1.9	0.7–0.8	0.31–0.37	0.45–0.52	0.25	0.11–0.12	0.09–0.12	0.35–0.51	0.17–0.25	0.02–0.04
chilensis	2 ♂, 3 ♀	0.10–0.12	0.65–0.70	0.19–0.20	0.39–0.42	0.65–0.76	0.15–0.19	0.09–0.10	1.8–2.0	0.80	0.35–0.38	0.43–0.46	0.30–0.31	0.19–0.20	0.15	0.39–0.41	0.20–0.21	0.04–0.05
6 sp. nov.	2 ♂, 3 ♀	0.06–0.08	0.46–0.50	0.15–0.17	0.29–0.31	0.58–0.65	0.13–0.15	0.07–0.08	1.2–1.3	0.4–0.5	0.24–0.27	0.30–0.34	0.21–0.22	0.10	0.10	0.34–0.39	0.28–0.35	0.04–0.05
7 sp. nov.	3 ♂, 3 ♀	0.07–0.10	0.57–0.65	0.15–0.17	0.35–0.41	0.65–0.84	0.12–0.16	0.07–0.12	1.4–1.6	0.6–0.7	0.26–0.34	0.35–0.43	0.21–0.24	0.09–0.10	0.09–0.10	0.27–0.33	0.11–0.13	0.02
8 sp. nov.	3 ♂, 3 ♀	0.05–0.07	0.53–0.60	0.15–0.18	0.30–0.40	0.68–0.83	0.14–0.16	0.08–0.09	1.2–1.5	0.6–0.8	0.31–0.37	0.39–0.43	0.23–0.25	0.13	0.15–0.16	0.33–0.34	0.19–0.20	0.01
diosteae	1 ♂, 1 ♀	0.16–0.18	0.95–0.10	0.24–0.26	0.55–0.58	1.48	0.12	0.05–0.06	2.1–2.4	0.9–1.0	0.49–0.52	0.45	0.35	0.17	0.21	0.45	0.20	
disparilis	2 ♂, 3 ♀	0.14–0.16	0.73–0.77	0.20	0.46–0.50	1.05–1.19	0.16–0.18	0.08–0.10	2.0–2.4	0.9–1.0	0.41–0.42	0.55–0.60	0.25–0.26	0.14	0.15	0.39	0.16–0.17	0.02–0.03
fabianae	2 ♂, 2 ♀	0.10–1.11	0.75–0.78	0.21–0.22	0.45–0.48	0.80–0.87	0.23–0.25	0.13–0.15	1.8–1.9	0.8–0.9	0.41–0.42	0.43–0.47	0.31	0.17–0.20	0.15–0.17	0.45–0.47	0.25	0.04
9 sp. nov.	1 ♂, 1 ♀	0.08	0.58–0.63	0.16	0.35–0.40	0.68–0.75	0.10–0.12	0.05–0.06	1.4–1.7	0.6–0.8	0.30–0.33	0.37	0.29	0.07	0.13	0.28	0.12–0.14	
intermedia	2 ♂, 2 ♀	0.12–0.15	0.57–0.65	0.17–0.20	0.34–0.43	0.76–0.85	0.13–0.15	0.07–0.08	1.6–1.9	0.7–0.8	0.30–0.33	0.35–0.40	0.22–0.23	0.11	0.12	0.32	0.12	0.01
10 sp. nov.	2 ♂, 2 ♀	0.10–0.11	0.58–0.60	0.16–0.18	0.37–0.40	0.66–0.78	0.15–0.16	0.08–0.10	1.4–1.6	0.6–0.7	0.32–0.36	0.42–0.45	0.25–0.26	0.19	0.13–0.15	0.46–0.49	0.42–0.44	0.15–0.16
11 sp. nov.	1 ♂, 2 ♀	0.08–0.10	0.58	0.16–0.17	0.37–0.39	0.80	0.18–0.20	0.18–0.20	1.6–1.7	0.70	0.35–0.37	0.49–0.52	0.25	0.13	0.12	0.38	0.19–0.20	0.03–0.05
lycii	1 ♂, 1 ♀	0.06	0.52–0.55	0.15–0.17		0.73–0.78			1.3–1.4	0.6–0.7		0.37	0.24	0.10	0.12	0.27	0.14	
maculata	4 ♂, 1 ♀	0.09–0.13	0.65–0.71	0.19–0.20	0.43–0.47	0.89–1.02	0.18–0.20	0.11–0.13	1.7–2.0	0.80	0.36–0.41	0.46–0.51	0.30–0.32	0.18–0.20	0.12–0.13	0.45	0.28	0.06
12 sp. nov.	2 ♂, 2 ♀	0.10–0.12	0.75–0.81	0.25–0.27	0.41–0.47	0.88–1.01	0.18–0.22	0.10–0.12	1.6–1.9	0.7–0.9	0.41–0.45	0.51–0.54	0.32	0.21	0.15	0.43–0.44	0.26–0.28	0.04
marionae	2 ♂, 2 ♀	0.15–0.17	0.72–0.76	0.16–0.19	0.42–0.46	1.39–1.52	0.15–0.18	0.05–0.07	2.2–2.5	0.8–0.9	0.44–0.48	0.50–0.60	0.33–0.35	0.19–0.20	0.15–0.17	0.40–0.42	0.18–0.19	0.02
13 sp. nov.	1 ♂, 1 ♀	0.13–0.15	0.73–0.78	0.19–0.21	0.43–0.48	0.74–0.94	0.14–0.15	0.09–0.10	1.9–2.0	0.9–1.0	0.41–0.43	0.53	0.38	0.19	0.16	0.45	0.24	0.02
14 sp. nov.	4 ♂, 4 ♀	0.10–0.13	0.58–0.66	0.17–0.20	0.38–0.45	0.66–0.82	0.15–0.17	0.06–0.08	1.5–1.7	0.7–0.8	0.31–0.35	0.32–0.44	0.20–0.23	0.13–0.14	0.11–0.12	0.36–0.37	0.18–0.23	0.04–0.06
15 sp. nov.	2 ♂, 3 ♀	0.13–0.15	0.61–0.66	0.17–0.18	0.42–0.45	0.76–0.90	0.14–0.17	0.08–0.09	1.6–1.8	0.7–0.8	0.33–0.37	0.43–0.45	0.22–0.23	0.12–0.13	0.10–0.11	0.33–0.35	0.21–0.24	0.04
16 sp. nov.	2 ♂, 2 ♀	0.07–0.10	0.45–0.50	0.13–0.15	0.28–0.30	0.52–0.57	0.11–0.13	0.06–0.07	1.2–1.5	0.5–0.6	0.24–0.27	0.30–0.32	0.16–0.19	0.07–0.08	0.09–0.10	0.40–041	0.19–0.24	0.08–0.12
nigra	2 ♂, 2 ♀	0.09–0.10	0.66–0.70	0.18	0.41–0.47	0.83–0.89	0.15–0.19	0.09	1.8–1.9	0.7–0.8	0.35–0.36	0.41–0.46	0.22–0.23	0.11	0.12	0.35	0.15–0.16	0.02
17 sp. nov.	2 ♂, 2 ♀	0.09–0.11	0.57–0.62	0.16–0.19	0.33–0.38	0.58–0.66	0.13–0.16	0.08–0.09	1.3–1.5	0.6–0.8	0.32–0.37	0.37–0.40	0.18	0.08–0.09	0.14–0.15	0.31–0.32	0.14–0.16	0.01
18 sp. nov.	4 ♂, 4 ♀	0.08–0.11	0.54–0.57	0.15–0.16	0.33–0.36	0.65–0.80	0.12–0.15	0.07–0.09	1.4–1.6	0.6–0.7	0.30–0.31	0.37–0.41	0.21–0.23	0.16–0.18	0.11–0.13	0.37–0.39	0.24–0.28	0.02–0.03
punctulata	3 ♂, 4 ♀	0.13–0.18	0.75–0.82	0.20–0.22	0.46–0.52	1.01–1.07	0.15–0.20	0.09–0.11	2.0–2.4	0.9–1.0	0.40–0.44	0.50–0.54	0.34–0.36	0.15–0.18	0.10	0.37–0.42	0.26–0.29	0.04–0.05
19 sp. nov.	1 ♂, 1 ♀	0.03–0.05	0.46–0.49	0.15	0.29–0.30	0.69–0.71	0.15	0.06	1.5–1.8	0.6–0.7	0.30–0.34	0.40–0.43	0.23	0.11	0.12	0.50	0.31	0.16
20 sp. nov.	2 ♂, 1 ♀	0.08–0.10	0.54–0.58	0.19–0.21	0.30–0.32	0.65–0.70	0.11–0.15	0.07	1.3–1.5	0.5–0.6	0.26–0.30	0.32–0.36	0.20–0.21	0.09	0.11	0.28	0.11	0.01
sebastiani	2 ♂, 2 ♀	0.12–0.15	0.86–0.98	0.24–0.27	0.52–0.60	1.44–1.48	0.12–0.15	0.06–0.07	1.7–2.1	0.6–0.8	0.43–0.50	0.37–0.42	0.27	0.12	0.10	0.33–0.34	0.18–0.20	
21 sp. nov.	2 ♂, 2 ♀	0.10	0.56–0.58	0.16–0.17	0.35–0.39	0.74–0.78	0.12–0.13	0.05–0.07	1.4–1.6	0.6–0.7	0.30–0.32	0.37–0.42	0.21–0.23	0.12–0.13	0.11	0.29–0.30	0.17–0.18	0.04–0.05
similis	4 ♂, 3 ♀	0.12–0.15	0.71–0.79	0.22–0.23	0.47–0.55	1.07–1.10	0.14–0.18	0.07–0.09	2.0–2.3	0.8–0.9	0.39–0.42	0.46–0.52	0.28–0.30	0.15–0.16	0.14–0.15	0.40–0.42	0.17–0.19	0.01–0.02
solanicola	7 ♂, 7 ♀	0.06–0.09	0.54–0.65	0.13–0.17	0.31–0.43	0.79–1.03	0.14–0.17	0.08–0.11	1.4–2.0	0.6–0.8	0.30–0.39	0.40–0.49	0.22–0.28	0.11–0.12	0.10–0.12	0.31–0.39	0.16–0.26	0.02–0.03
22 sp. nov.	2 ♂, 2 ♀	0.08–0.10	0.50–0.55	0.18–0.19	0.29–0.30	0.60–0.67	0.13–0.14	0.08–0.09	1.3–1.4	0.50	0.26–0.27	0.33–0.35	0.19–0.20	0.12–0.12	0.10	0.34–0.35	0.15–0.16	0.01
theresae	3 ♂, 3 ♀	0.17–0.20	0.64–0.72	0.18–0.21	0.40–0.48	1.05–1.16	0.13–0.16	0.06–0.08	1.8–2.2	0.7–0.9	0.41–0.49	0.45–0.53	0.30–0.33	0.20–0.21	0.16–0.17	0.40–0.51	0.24–0.26	0.03–0.04
vinculipennis	3 ♂, 4 ♀	0.09–0.12	0.67–0.78	0.20	0.43–0.50	0.90–1.10	0.15–0.18	0.08–0.12	1.6–2.1	0.7–1.0	0.37–0.45	0.46–0.55	0.26–0.28	0.16–0.19	0.11–0.13	0.35–0.54	0.30–0.33	0.03–0.04

species	specimens	GL	HW	VL	VW	AL	LAB2	LAB3	FL	FW	MtFL	MtTL	MP	PL	DL	FP	SP	AP
23 sp. nov.	2 ♂, 1 ♀	0.09–0.10	0.65–0.70	0.18–0.20	0.39–0.43	0.56–0.62	0.15	0.10	1.5–1.7	0.7–0.8	0.32–0.35	0.37–0.40	0.27–0.28	0.16	0.15–0.16	0.38	0.21	0.04
24 sp. nov.	1 ♂, 1 ♀	0.13–0.14	0.64	0.18	0.38–0.39	0.87	0.10–0.13	0.07	1.6–1.7	0.6–0.7	0.32–0.34	0.36–0.38	0.20	0.11	0.12	0.33	0.15	0.02

Table 2. Ratios of *Russelliana* spp. adults.

species	GL/VL	AL/HW	LAB (in mm)	FL/HW	FL/FW	MtTL/HW	FP/HW	FP/SP	AP/SP
1 sp. nov.	0.6–0.8	1.1–1.4	0.19–0.20	2.3–2.7	2.4–2.7	0.6–0.7	0.5–0.6	1.6–1.8	0.1–0.3
2 sp. nov.	0.4–0.5	1.1–1.2	0.21–0.26	2.5–2.7	2.1–2.2	0.6–0.7	0.6	2.4	0.1
adesmiae	0.5–0.7	1.2–1.4	0.19–0.22	2.6–2.9	2.2–2.4	0.6–0.7	0.5–0.6	1.9–2.3	0.2
adunca	0.6–0.7	1.1–1.4	0.21–0.24	2.6–3.0	2.3–2.5	0.6–0.7	0.4–0.5	2.5	0.1
3 sp. nov.	0.7–0.9	1.1–1.2	0.18–0.21	2.2–2.4	2.3–2.4	0.5	0.5	2.3–2.8	0.1
4 sp. nov.	0.4	1.1–1.2	0.26–0.27	2.4–2.6	2.3–2.4	0.6	0.5	2.2	0.2
bulbosa	0.8	1.1–1.2	0.19–0.23	2.3–2.7	2.3–2.4	0.5–0.6	0.5	1.7–1.8	0.1
capsici	0.4	1.3	0.20	2.7–2.9	2.2–2.3	0.7	0.4	1.6	
5 sp. nov.	0.5–0.6	1.3–1.6	0.25–0.35	2.5–2.9	2.3–2.5	0.7–0.8	0.5–0.7	2.0–2.1	0.1–0.2
chilensis	0.5–0.6	0.9–1.1	0.24–0.29	2.7–2.8	2.3–2.6	0.6–0.7	0.6	2.0	0.2–0.3
6 sp. nov.	0.4–0.5	1.2–1.4	0.21–0.22	2.5–2.7	2.5–2.7	0.6–0.7	0.7–0.8	1.1–1.3	0.2
7 sp. nov.	0.6	1.1–1.5	0.20–0.28	2.4–2.7	2.3–2.5	0.6–0.8	0.5	2.3–2.5	0.2
8 sp. nov.	0.3–0.5	1.2–1.5	0.22–0.25	2.3–2.6	2.0–2.2	0.7–0.8	0.6	1.7–1.8	0.1
diosteae	0.6–0.8	1.5	0.17	2.2–2.4	2.3	0.5	0.5	2.3	
disparilis	0.7–0.8	1.4–1.6	0.24–0.28	2.7–3.1	2.4	0.7–0.9	0.5	2.3–2.4	0.1–0.2
fabianae	0.5	1.0–1.1	0.37–0.39	2.3–2.5	2.2–2.4	0.6	0.6	1.8–1.9	0.2
9 sp. nov.	0.5–0.6	1.1–1.3	0.15–0.21	2.3–2.8	2.2–2.3	0.6	0.4–0.5	2.0–2.5	
intermedia	0.7–0.8	1.3–1.4	0.20–0.22	2.8–2.9	2.3	0.6–0.7	0.5	2.7	0.1
10 sp. nov.	0.6	1.1–1.3	0.24–0.25	2.4–2.8	2.2–2.8	0.7–0.8	0.8	1.0–1.2	0.6
11 sp. nov.	0.5–0.6	1.4	0.36–0.40	2.8–2.9	2.3	0.8–0.9	0.7	1.9–2.0	0.2–0.3
lycii	0.35–0.40	1.4	0.16–0.17	2.4–2.6	1.9–2.0	0.6–0.7	0.5	1.9	
maculata	0.5–0.7	1.3–1.5	0.29–0.32	2.6–2.8	2.3–2.5	0.7–0.8	0.6	1.6	0.3
12 sp. nov.	0.4	1.1–1.3	0.28–0.34	2.1–2.3	2.1–2.3	0.6–0.7	0.5	1.6–1.7	0.2
marionae	0.7–0.8	1.9–2.1	0.20–0.25	3.1–3.2	2.7–2.9	0.7–0.8	0.5–0.6	2.1–2.3	0.1
13 sp. nov.	0.7–0.8	1.0–1.2	0.23–0.25	2.6	2.1–2.2	0.7	0.6	1.9	0.1
14 sp. nov.	0.6–0.7	1.0–1.3	0.21–0.25	2.6–2.7	2.2–2.5	0.5–0.7	0.5–0.6	1.6–2.0	0.2–0.4
15 sp. nov.	0.7–0.9	1.2–1.5	0.23–0.25	2.5–2.8	2.3–2.4	0.7	0.5–0.6	1.5–1.6	0.2
16 sp. nov.	0.5–0.8	1.1–1.2	0.17–0.20	2.7–3.0	2.3–2.6	0.6–0.7	0.8	1.7–2.1	0.7–1.0
nigra	0.5–0.6	1.2–1.3	0.24–0.28	2.7–2.9	2.4–2.5	0.6–0.7	0.5	2.2–2.3	0.1–0.2
17 sp. nov.	0.5–0.6	1.0–1.1	0.22–0.25	2.3–2.4	2.0–2.2	0.6	0.5	2.0–2.2	0.1
18 sp. nov.	0.5–0.7	1.2–1.5	0.19–0.23	2.5–2.9	2.3–2.5	0.7	0.6–0.7	1.4–1.5	0.1
punctulata	0.7–0.8	1.3–1.4	0.25–0.30	2.6–2.9	2.4–2.6	0.6–0.7	0.5	1.3–1.5	0.2
19 sp. nov.	0.2–0.3	1.4–1.5	0.21	3.3–3.6	2.6–2.7	0.9	1.0	1.6	1.1
20 sp. nov.	0.4–0.5	1.1–1.3	0.18–0.22	2.4–2.6	2.4–2.5	0.6	0.5	2.5	0.1

species	GL/VL	AL/HW	LAB (in mm)	FL/HW	FL/FW	MtTL/HW	FP/HW	FP/SP	AP/SP
sebastiani	0.5–0.6	1.5–1.7	0.19–0.22	1.9–2.1	2.6–2.7	0.4	0.3–0.4	1.7–1.9	
21 sp. nov.	0.6	1.3–1.4	0.18–0.19	2.6–2.7	2.3–2.7	0.6–0.7	0.5	1.7	0.3–0.4
similis	0.5–0.7	1.4–1.5	0.22–0.27	2.6–3.0	2.4–2.6	0.6–0.7	0.5–0.6	2.2–2.4	0.1
solanicola	0.4–0.6	1.4–1.7	0.22–0.27	2.3–3.0	2.3–2.6	0.7–0.8	0.5–0.6	1.5–2.0	0.1–0.2
22 sp. nov.	0.4–0.5	1.2–1.3	0.21–0.22	2.4–2.6	2.4–2.6	0.6–0.7	0.6–0.7	2.1–2.3	0.1
theresae	0.9–1.1	1.6–1.7	0.20–0.24	2.8–3.0	2.5–2.7	0.7–0.8	0.6–0.7	1.7–2.0	0.1–0.2
vinculipennis	0.5–0.6	1.3–1.5	0.24–0.30	2.3–2.9	2.1–2.4	0.7–0.8	0.5–0.7	1.2–1.6	0.1
23 sp. nov.	0.5–0.6	0.8–0.9	0.25	2.3–2.4	2.1	0.5–0.6	0.5	1.8	0.2
24 sp. nov.	0.7–0.8	1.4	0.17–0.20	2.4–2.7	2.4–2.5	0.6	0.5	2.2	0.2

Table 3. Adult characters and states of *Russelliana* species used in the cladistic analysis (cf. Table 4, Fig. 34).

1. Head inclined from longitudinal body axis weakly (< 45°) (0); strongly (> 45°) (1).
2. Genal processes slender (0); swollen (1).
3. Forewing oval, oblong-oval or oviform (0); rhomboidal (1).
4. Forewing pattern absent (0); present (1).
5. Vein C+Sc of forewing weakly curved (0); strongly curved (1).
6. Vein Rs of forewing straight or slightly curved to fore margin apically (0); curved to fore margin apically (1).
7. Vein Cu of forewing short (less than twice longer than vein Cu_{1b}) (0); long (more than twice longer than vein Cu_{1b}) (1).
8. Brown patch along vein Cu_{1b} of forewing absent (0); present (1).
9. Male proctiger tubular (0); barrel-shaped (1); irregularly subtrapezoidal (2).
10. Male subgenital plate short, subglobular (0); elongate (1).
11. Paramere lamellar or subtrapezoidal (0); suboval (1); forked, deeply or shallowly incised (2).
12. Paramere apico-anterior process hook-shaped (0); claw-like (1); finger-shaped (2); recurved (3).
13. Paramere apico-anterior process situated anteriorly (0); interiorly (1).
14. Paramere apico-anterior process lacking pedicel (0); on pedicel (1).
15. Paramere lamellar or subtrapezoidal, subtypes: suboval, forked or elongate, with process lacking pedicel (0); subtrapezoidal, with process on pedicel, long hump and long lobe (1); narrowly lamellar, with apico-anterior process on pedicel (2); broadly lamellar, with process lacking both pedicel and hump (3); subtrapezoidal, with process on pedicel, long hump and short lobe (4); subtrapezoidal, with process on pedicel, short hump and short lobe (5) broadly lamellar, with process on pedicel and with short hump (6); broadly lamellar, with process lacking pedicel and with short hump (7); narrowly lamellar, with apico-interior process on pedicel (8).
16. Paramere forked, deeply or shallowly incised, subtypes: suboval, lamellar or subtrapezoidal (0); deeply incised, both process and lobe of subequal length (1); shallowly incised, both process and lobe of subequal length (2); shallowly incised, with short recurved process and long lobe (3); shallowly incised, with thumb-like process and long lobe (4).
17. Paramere sclerotisation with apico-median tooth (0); absent (1); with claw-like tooth (2); with apical ridge (3); with tooth directed anteriorly (4); with tooth on hump, directed posteriorly (5).
18. Long thick bristles on paramere apico-anterior process absent (0); present (1).
19. Apex of aedeagus bulbous, rounded or angular (0); inflated with anterior process (1).
20. Distal segment of aedeagus without tubercle or with a small tubercle (0); with one tubercle (1); with two tubercles (2).
21. Two tubercles of distal segment of aedeagus absent (0); apical and curved forward apico-posterior (1); horn-shaped apical and angular apico-posterior (2); small, raised apical and small apico-posterior (3); large, raised apical and horn-shaped apico-posterior (4); small apico-posterior, closely situated (5); small apico-posterior, distantly situated (6).

22. Lateral lobes on distal segment of aedeagus short, with entire apical margin (0); long, triangular, with indented apical margin (1); moderately long, with frayed apical margin (2); long, tubular, sclerotised (3).
23. Female proctiger subglobular or bent downwards (0); cuneate (1).
24. Dorsal margin of female proctiger straight or bent downwards (0); strongly curved, indented subapically (1).
25. Apical process on female subgenital plate present (0); absent (1).
26. Female subgenital plate cuneate (0); subglobular (1).
27. Sexual dimorphism absent (0); present (1).
28. Host-plant family Asteraceae (0); Fabaceae (1); Polygonaceae (2); Rosaceae (3); Solanaceae (4); Verbenaceae (5).

Table 4. Matrix for adult characters of *Russelliana* species (cf. Table 3, Fig. 34).

Baccharopelma dracunculifoliae	00000000000000000000000000000
R. 1 sp. nov.	1000000000000118040110110000-
R. 2 sp. nov.	01111100112301022100002100114
R. adesmiae	10010001000001600013411100001
R. adunca	1000000100000110501321100000-
R. 3 sp. nov.	10000000000011804011010000000
R. 4 sp. nov.	10000001000001105013211000004
R. bulbosa	10001010012201042001020000105
R. capsici	01111100012301032000020000104
R. 5 sp. nov.	10000001000001105013211000004
R. chilensis	10010001000000700012611000001
R. 6 sp. nov.	10000001000001500013111000002
R. 7 sp. nov.	10000001000001405013311000004
R. 8 sp. nov.	01111100012301032000021000114
R. diosteae	10011011012201042001020000105
R. disparilis	10000001000001-00013111000004
R. fabianae	00000000010000300000001100004
R. 9 sp. nov.	0111110011230102200002001111-
R. intermedia	1000000000000118040110100000-
R. 10 sp. nov.	10010001000000000001250100001
R. 11 sp. nov.	10010001000001600013411100001
R. lycii	01111100012201042000020011114
R. maculata	10010001000001-000125110000-
R. 12 sp. nov.	10010001000000700012611000001
R. marionae	00010101002201011000031000105
R. 13 sp. nov.	10000001200001-00012511000001
R. 14 sp. nov.	10010001000001200012511000001
R. 15 sp. nov.	10010001000001200012511000001
R. 16 sp. nov.	1000000000110100301100100000-
R. nigra	1000000100000150001311100000-
R. 17 sp. nov.	01111100112301022100002100114
R. 18 sp. nov.	10010001000000000012511000001
R. punctulata	10010001000001-000125110000-
R. 19 sp. nov.	1000000000110100300100100000-
R. 20 sp. nov.	10000000000001500013111000003
R. sebastiani	11011000012201042000020000105
R. 21 sp. nov.	10010001010001200012511000001
R. similis	1000000100000150001311100000-
R. solanicola	1000000100000150001311100000-
R. vinculipennis	1001000100000120001251100000-
R. 23 sp. nov.	00000000010000300000001100004
R. 22 sp. nov.	10000000000000000012511000003

R. theresae	0001010100220101100003100105
R. 24 sp. nov.	1000000000001180401101000000

Table 5. Host-plant and distribution information on forty-three species of *Russelliana*. Potential hosts of the species without host/immature data are evaluated from the phylogenetic analysis (see results and discussion) and marked with an asterisk (*).

species	host-plants	distribution
	Asteraceae	
1 sp. nov.	Asteraceae*	Chile (V Region)
3 sp. nov.	*Baccharis paniculata**, *Haplopappus foliosus**	Chile (IV Region)
intermedia	Asteraceae*	Argentina (Jujuy), Bolivia (Chuquisaca)
24 sp. nov.	*Baccharis linearis*, *B. mylodontis*, *B. neaei*, *B. paniculata*, *B. salicina*, *B. tricuneata*, *B. zoellneri* ssp. *minor* and ssp. *zoellneri*, *Haplopappus multifolius**	Chile (III–X, XII, Metropolitana Regions)
	Fabaceae	
adesmiae	*Adesmia bedwellii*, *A.* cf. *confusa*, *A.* cf. *glutinosa*, *A. microphylla*, *A. pedicellata*	Chile (IV–V Regions)
chilensis	*Adesmia* sp.*	Chile (VIII–IX Regions)
10 sp. nov.	*Adesmia hystrix*	Chile (II–IV Regions)
11 sp. nov.	*Adesmia atacamensis*	Chile (II–V Regions)
maculata	Fabaceae*	Argentina (Jujuy), Bolivia (Chuquisaca, Cochabamba)
12 sp. nov.	*Adesmia boronioides*	Chile (XII Region)
13 sp. nov.	*Adesmia* sp.	Chile (IV Region)
14 sp. nov.	*Adesmia* sp.	Argentina (Mendoza)
15 sp. nov.	*Adesmia hystrix*	Chile (III–IV Regions)
18 sp. nov.	*Adesmia argentea*, *A.* cf. *confusa*, *A. dichotoma*, *A.* cf. *glutinosa*, *A.* cf. *kingii*, *A.* cf. *pedicellata*	Chile (III–V, Metropolitana Regions)
punctulata	Fabaceae*	Argentina (Jujuy)
21 sp. nov.	*Adesmia* sp.	Argentina (Mendoza)
vinculipennis	Fabaceae*	Argentina (Jujuy), Bolivia (Chuquisaca)
	Polygonaceae	
6 sp. nov.	*Chorizanthe* sp.	Chile (V Region)
	Rosaceae	

species	host-plants	distribution
20 sp. nov.	*22 alatum*	Chile (VIII Region)
22 sp. nov.	*22 alatum*	Argentina (Mendoza), Chile (V Region)
	Solanaceae	
adunca	Solanaceae*	Argentina (Chubut), Bolivia (Chuquisaca)
2 sp. nov.	*Lycium* sp.	Chile (III–IV Regions)
4 sp. nov.	*Lycium* sp.	Chile (III–IV Regions)
capsici	*Capsicum annuum*	Argentina (Buenos Aires, Entre Ríos), Brazil (Minas Gerais, Paraná, Santa Catarina, São Paulo)
5 sp. nov.	*Lycium* cf. *chilense*	Argentina (Jujuy, Mendoza), Bolivia (Chuquisaca), Chile (IV–V Regions)
7 sp. nov.	*Lycium chilense*	Argentina (Catamarca, La Rioja, Mendoza, San Juan), Chile (IV Region)
8 sp. nov.	*Lycium* sp.	Argentina (Mendoza)
disparilis	*Dunalia* sp.	Argentina (Mendoza), Bolivia (Chuquisaca), Chile (V Region), Peru (Cusco)
fabianae	*Fabiana imbricata*	Argentina (Río Negro), Chile (IV–V, VII–IX Regions)
9 sp. nov.	Solanaceae*	Argentina (Chubut)
lycii	*Lycium salsum*	Peru (Lima)
nigra	Solanaceae*	Bolivia (Chuquisaca)
17 sp. nov.	*Nolana* cf. *aplocaryoides* / *confinis* / *peruviana*, *N.* cf. *sedifolia*	Chile (III–IV Regions)
similis	Solanaceae*	Bolivia (Chuquisaca)
solanicola	*Alternanthera ficoidea* (Amaranthaceae), *Baccharis lycioides*, *B. zoellneri* ssp. *minor*, *Helenium aromaticum*, *Parthenium hysterophorus*, *Xanthium spinosum* (Asteraceae), *Escallonia rosea* (Escalloniaceae), *Brugmansia arborea*, *Datura* sp., *Solanum tuberosum* (Solanaceae)	Argentina (Catamarca, Córdoba, Jujuy, La Pampa, La Rioja, Mendoza, Río Negro, Salta, Tucumán), Bolivia (Chuquisaca, Cochabamba, Taipina, Tarija), Brazil (Minas Gerais, Paraná, São Paulo), Chile (I–IX, Metropolitana Regions), Peru (Ancash, Arequipa, Ayacucho, Cusco, Huánuco, Lima, Moquegua, Tacna), Uruguay (Brisa de la Pinta)
23 sp. nov.	*Fabiana 23**	Chile (IV Region)
	Verbenaceae	
bulbosa	*Dipyrena juncea*	Argentina (Río Negro), Chile (VII–IX Regions)
diosteae	*Dipyrena juncea*	Chile (VII Region)
marionae	*Mulguraea scoparia*	Argentina (Mendoza)
sebastiani	*Dipyrena juncea*	Chile (VII–VIII Regions)
theresae	*Mulguraea scoparia*	Chile (V Region)

species	host-plants	distribution
	unknown	
16 sp. nov.		Argentina (Mendoza)
19 sp. nov.		Brazil (Paraná)

LEGENDS TO FIGURES

Figure 1. *Russelliana* spp. A, *R. bulbosa* Burckhardt; B, *R. capsici* Burckhardt; C, *R. chilensis* Burckhardt; D, *R. 4* sp. nov.; E, *R. sebastiani* Burckhardt. A, morphology and measurements of head, dorsal view (for explanations of abbreviations see material and methods); B–E, head, dorsal view.

Figure 2. *Russelliana* spp. A, *R. adunca* Burckhardt; B, *R. 3* sp. nov.; C, *R. 23* sp. nov.; D, *R. 2* sp. nov., m$; E, *R. 2* sp. nov., f£. A, morphology and measurements of forewing (for explanations of abbreviations see material and methods); B–E, forewing.

Figure 3. *Russelliana* spp. A, *R. 24* sp. nov.; B, *R. 19* sp. nov.; C, *R. sebastiani* Burckhardt; D, *R. theresae* Burckhardt; E, *R. 23* sp. nov. A, morphology and measurements of m$ terminalia, lateral view (for explanations of abbreviations see material and methods); B–E, m$ terminalia, lateral view.

Figure 4. *Russelliana* spp. A, *R. adunca* Burckhardt; B, *R. 3* sp. nov.; C, *R. 7* sp. nov.; D, *R. 8* sp. nov.; E, *R. 9* sp. nov.; F, *R. 10* sp. nov.; G, *R. 11* sp. nov.; H, *R. 12* sp. nov.; I, *R. 15* sp. nov. A, morphology of paramere, inner face; B–I, paramere, inner face.

Figure 5. *Russelliana* spp. A, *R. 5* sp. nov.; B, *R. 2* sp. nov.; C, *R. 3* sp. nov.; D, *R. 7* sp. nov.; E, *R. 11* sp. nov.; F, *R. 12* sp. nov.; G, *R. 21* sp. nov.; H, *R. solanicola* Tuthill; I, *R. theresae* Burckhardt. A, morphology of distal segment of aedeagus; B–I, distal segment of aedeagus.

Figure 6. *Russelliana* spp. A, *R. 5* sp. nov.; B, *R. solanicola* Tuthill; C, *R. 9* sp. nov.; D, *R. 16* sp. nov.; E, *R. 23* sp. nov. A, morphology and measurements of f£ terminalia, lateral view (for explanations of abbreviations see material and methods); B, section of f£ pore ring, inner pores above; C–E, f£ terminalia, lateral view.

Figure 7. *Russelliana* spp., head, dorsal view. A, *R. 1* sp. nov.; B, *R. 2* sp. nov.; C, *R. adesmiae* Burckhardt; D, *R. adunca* Burckhardt; E, *R. 3* sp. nov.; F, *R. 4* sp. nov.; G, *R. bulbosa* Burckhardt; H, *R. capsici* Burckhardt; I, *R. 5* sp. nov.; J, *R. chilensis* Burckhardt; K, *R. 6* sp. nov.; L, *R. 7* sp. nov.; M, *R. 8* sp. nov.; N, *R. diosteae* Burckhardt; O, *R. disparilis* Tuthill.

Figure 8. *Russelliana* spp., head, dorsal view. A, *R. fabianae* Burckhardt; B, *R. 9* sp. nov.; C, *R. intermedia* Burckhardt; D, *R. 10* sp. nov.; E, *R. 11* sp. nov.; F, *R. lycii* Tuthill; G, *R. maculata* Burckhardt; H, *R. 12* sp. nov.; I, *R. marionae* Burckhardt; J, *R. 13* sp. nov.; K, *R. 14* sp. nov.; L, *R. 15* sp. nov.; M, *R. 16* sp. nov.; N, *R. nigra* Burckhardt; O, *R. 17* sp. nov.

Figure 9. *Russelliana* spp., head, dorsal view. A, *R. 18* sp. nov.; B, *R. punctulata* Burckhardt; C, *R. 19* sp. nov.; D, *R. 20* sp. nov.; E, *R. sebastiani* Burckhardt; F, *R. 21* sp. nov.; G, *R. similis* Burckhardt; H, *R. solanicola* Tuthill; I, *R. 22* sp. nov.; J, *R. theresae* Burckhardt; K, *R. vinculipennis* Burckhardt; L, *R. 23* sp. nov.; M, *R. 24* sp. nov.

Figure 10. *Russelliana* spp., forewing. A, *R. 1* sp. nov.; B, *R. 2* sp. nov., m$; C, *R. 2* sp. nov., f£; D, *R. adesmiae* Burckhardt; E, *R. adunca* Burckhardt; F, *R. 3* sp. nov.; G, *R. 4* sp. nov.; H, *R. bulbosa* Burckhardt; I, *R. capsici* Burckhardt; J, *R. 5* sp. nov.

Figure 11. *Russelliana* spp., forewing. A, *R. chilensis* Burckhardt; B, *R. 6* sp. nov.; C, *R. 7* sp. nov.; D, *R. 8* sp. nov., m$; E, *R. 8* sp. nov., f£; F, *R. diosteae* Burckhardt; G, *R. disparilis* Tuthill; H, *R. fabianae* Burckhardt; I, *R. 9* sp. nov., m$; J, *R. 9* sp. nov., f£.

Figure 12. *Russelliana* spp., forewing. A, *R. intermedia* Burckhardt; B, *R. 10* sp. nov.; C, *R. 11* sp. nov.; D, *R. lycii* Tuthill, m$; E, *R. lycii* Tuthill, f£; F, *R. maculata* Burckhardt; G, *R. 12* sp. nov.; H, *R. marionae* Burckhardt; I, *R. 13* sp. nov.; J, *R. 14* sp. nov.
Figure 13. *Russelliana* spp., forewing. A, *R. 15* sp. nov.; B, *R. 16* sp. nov.; C, *R. nigra*; D, *R. 17* sp. nov., m$; E, *R. 17* sp. nov., f£; F, *R. 18* sp. nov.; G, *R. punctulata* Burckhardt; H, *R. 19* sp. nov.; I, *R. 20* sp. nov.; J, *R. sebastiani* Burckhardt.
Figure 14. *Russelliana* spp., forewing. A, *R. 21* sp. nov.; B, *R. similis* Burckhardt; C, *R. solanicola* Tuthill; D, *R. 22* sp. nov.; E, *R. theresae* Burckhardt; F, *R. vinculipennis* Burckhardt; G, *R. 23* sp. nov.; H, *R. 24* sp. nov.

Figure 15. *Russelliana* spp., m$ terminalia, lateral view. A, *R. 1* sp. nov.; B, *R. 2* sp. nov.; C, *R. adesmiae* Burckhardt; D, *R. adunca* Burckhardt; E, *R. 3* sp. nov.; F, *R. 4* sp. nov.; G, *R. bulbosa* Burckhardt; H, *R. capsici* Burckhardt; I, *R. 5* sp. nov. Scale lines = 0.1 mm.
Figure 16. *Russelliana* spp., m$ terminalia, lateral view. A, *R. chilensis* Burckhardt; B, *R. 6* sp. nov.; C, *R. 7* sp. nov.; D, *R. 8* sp. nov.; E, *R. diosteae* Burckhardt; F, *R. disparilis* Tuthill; G, *R. fabianae* Burckhardt; H, *R. 9* sp. nov.; I, *R. intermedia* Burckhardt. Scale lines = 0.1 mm.
Figure 17. *Russelliana* spp., m$ terminalia, lateral view. A, *R. 10* sp. nov.; B, *R. 11* sp. nov.; C, *R. lycii* Tuthill; D, *R. maculata* Burckhardt; E, *R. 12* sp. nov.; F, *R. marionae* Burckhardt; G, *R. 13* sp. nov.; H, *R. 14* sp. nov.; I, *R. 15* sp. nov. Scale lines = 0.1 mm.
Figure 18. *Russelliana* spp., m$ terminalia, lateral view. A, *R. 16* sp. nov.; B, *R. nigra* Burckhardt; C, *R. 17* sp. nov.; D, *R. 18* sp. nov.; E, *R. punctulata* Burckhardt; F, *R. 19* sp. nov.; G, *R. 20* sp. nov.; H, *R. sebastiani* Burckhardt; I, *R. 21* sp. nov. Scale lines = 0.1 mm.
Figure 19. *Russelliana* spp., m$ terminalia, lateral view. A, *R. similis* Burckhardt; B, *R. solanicola* Tuthill; C, *R. 22* sp. nov.; D, *R. theresae* Burckhardt; E, *R. vinculipennis* Burckhardt; F, *R. 23* sp. nov.; G, *R. 24* sp. nov. Scale lines = 0.1 mm.

Figure 20. *Russelliana* spp., paramere, inner face. A, *R. 1* sp. nov.; B, *R. 2* sp. nov.; C, *R. adesmiae* Burckhardt; D, *R. adunca* Burckhardt; E, *R. 3* sp. nov.; F, *R. 4* sp. nov.; G, *R. bulbosa* Burckhardt; H, *R. capsici* Burckhardt; I, *R. 5* sp. nov. Scale lines = 0.1 mm.
Figure 21. *Russelliana* spp., paramere, inner face. A, *R. chilensis* Burckhardt; B, *R. 6* sp. nov.; C, *R. 7* sp. nov.; D, *R. 8* sp. nov.; E, *R. diosteae* Burckhardt; F, *R. disparilis* Tuthill; G, *R. fabianae* Burckhardt; H, *R. 9* sp. nov.; I, *R. intermedia* Burckhardt. Scale lines = 0.1 mm.
Figure 22. *Russelliana* spp., paramere, inner face. A, *R. 10* sp. nov.; B, *R. 11* sp. nov.; C, *R. lycii* Tuthill; D, *R. maculata* Burckhardt; E, *R. 12* sp. nov.; F, *R. marionae* Burckhardt; G, *R. 13* sp. nov.; H, *R. 14* sp. nov.; I, *R. 15* sp. nov. Scale lines = 0.1 mm.
Figure 23. *Russelliana* spp., paramere, inner face. A, *R. 16* sp. nov.; B, *R. nigra* Burckhardt; C, *R. 17* sp. nov.; D, *R. 18* sp. nov.; E, *R. punctulata* Burckhardt; F, *R. 19* sp. nov.; G, *R. 20* sp. nov.; H, *R. sebastiani* Burckhardt; I, *R. 21* sp. nov. Scale lines = 0.1 mm.
Figure 24. *Russelliana* spp., paramere, inner face. A, *R. similis* Burckhardt; B, *R. solanicola* Tuthill; C, *R. 22* sp. nov.; D, *R. theresae* Burckhardt; E, *R. vinculipennis* Burckhardt; F, *R. 23* sp. nov.; G, *R. 24* sp. nov. Scale lines = 0.1 mm.

Figure 25. *Russelliana* spp., distal segment of aedeagus. A, *R. 1* sp. nov.; B, *R. 2* sp. nov.; C, *R. adesmiae* Burckhardt; D, *R. adunca* Burckhardt; E, *R. 3* sp. nov.; F, *R. 4* sp. nov.; G, *R.*

bulbosa Burckhardt; H, *R. capsici* Burckhardt; I, *R. 5* sp. nov.; J, *R. chilensis* Burckhardt; K, *R. 6* sp. nov.; L, *R. 7* sp. nov. Scale lines = 0.1 mm.

Figure 26. *Russelliana* spp., distal segment of aedeagus. A, *R. 8* sp. nov.; B, *R. diosteae* Burckhardt; C, *R. disparilis* Tuthill; D, *R. fabianae* Burckhardt; E, *R. 9* sp. nov.; F, *R. intermedia* Burckhardt; G, *R. 10* sp. nov.; H, *R. 11* sp. nov.; I, *R. lycii* Tuthill; J, *R. maculata* Burckhardt; K, *R. 12* sp. nov.; L, *R. marionae* Burckhardt. Scale lines = 0.1 mm.

Figure 27. *Russelliana* spp., distal segment of aedeagus. A, *R. 13* sp. nov.; B, *R. 14* sp. nov.; C, *R. 15* sp. nov.; D, *R. 16* sp. nov.; E, *R. nigra* Burckhardt; F, *R. 17* sp. nov.; G, *R. 18* sp. nov.; H, *R. punctulata* Burckhardt; I, *R. 19* sp. nov.; J, *R. 20* sp. nov.; K, *R. sebastiani* Burckhardt; L, *R. 21* sp. nov. Scale lines = 0.1 mm.

Figure 28. *Russelliana* spp., distal segment of aedeagus. A, *R. similis* Burckhardt; B, *R. solanicola* Tuthill; C, *R. 22* sp. nov.; D, *R. theresae* Burckhardt; E, *R. vinculipennis* Burckhardt; F, *R. 23* sp. nov.; G, *R. 24* sp. nov. Scale lines = 0.1 mm.

Figure 29. *Russelliana* spp., f£ terminalia, lateral view. A, *R. 1* sp. nov.; B, *R. 2* sp. nov.; C, *R. adesmiae* Burckhardt; D, *R. adunca* Burckhardt; E, *R. 3* sp. nov.; F, *R. 4* sp. nov.; G, *R. bulbosa* Burckhardt; H, *R. capsici* Burckhardt; I, *R. 5* sp. nov.; J, *R. chilensis* Burckhardt. Scale lines = 0.1 mm.

Figure 30. *Russelliana* spp., f£ terminalia, lateral view. A, *R. 6* sp. nov.; B, *R. 7* sp. nov.; C, *R. 8* sp. nov.; D, *R. diosteae* Burckhardt; E, *R. disparilis* Tuthill; F, *R. fabianae* Burckhardt; G, *R. 9* sp. nov.; H, *R. intermedia* Burckhardt; I, *R. 10* sp. nov.; K, *R. 11* sp. nov. Scale lines = 0.1 mm.

Figure 31. *Russelliana* spp., f£ terminalia, lateral view. A, *R. lycii* Tuthill; B, *R. maculata* Burckhardt; C, *R. 12* sp. nov.; D, *R. marionae* Burckhardt; E, *R. 13* sp. nov.; F, *R. 14* sp. nov.; G, *R. 15* sp. nov.; H, *R. 16* sp. nov.; I, *R. nigra* Burckhardt. Scale lines = 0.1 mm.

Figure 32. *Russelliana* spp., f£ terminalia, lateral view. A, *R. 17* sp. nov.; B, *R. 18* sp. nov.; C, *R. punctulata* Burckhardt; D, *R. 19* sp. nov.; E, *R. 20* sp. nov.; F, *R. sebastiani* Burckhardt; G, *R. 21* sp. nov.; H, *R. similis* Burckhardt; I, *R. solanicola* Tuthill. Scale lines = 0.1 mm.

Figure 33. *Russelliana* spp., f£ terminalia, lateral view. A, *R. 22* sp. nov.; B, *R. theresae* Burckhardt; C, *R. vinculipennis* Burckhardt; D, *R. 23* sp. nov.; E, *R. 24* sp. nov. Scale lines = 0.1 mm.

Figure 34. A cladogram of adult *Russelliana* spp. from the morphological data matrix in Table 4, with distribution (Arw = Western Argentina, Are = Eastern Argentina, Bo = Bolivia, Br = Brazil, Cnf = Far Northern Chile (I, II Regions), Cn = Northern Chile (III, IV Regions), Cc = Central Chile (V, Metropolitana, VI Regions), Cs = Southern Chile (VII–X Regions), Csf = Far Southern Chile (XI, XII Regions), P = Peru, U = Uruguay) and host family information when it is known (Ast = Asteraceae, Fab = Fabaceae, Ros = Rosaceae, Sol = Solanaceae, Ver = Verbenaceae). Species clades with missing host/immature data are marked with an asterisk (*). For more information on hosts and distribution see Table 5. Some species clades are numbered from 1 to 18 (see results and discussion). Character numbers above the branches and character states are listed in Table 3; full circles indicate derived characters (synapomorphies/autapomorphies), empty circles correspond to primitive characters (symplesiomorphies).

REFERENCES

2014. The Plant List *Version 1.1. Published on the Internet*.

Agrain FA, Roig-Juñent SA. 2011. Systematics and cladistics of *Megalostomis* Chevrolat, and the biogeography of Clytrini (Coleoptera: Cryptocephalinae). *Systematic Entomology* **36:** 672–704.

Aléné DC, Hoess R, Burckhardt D. 2007. Ciriacreminae (Hemiptera: Psylloidea) from Gabon. *Mitteilungen der schweizerischen entomologischen Gesellschaft* **80:** 135–159.

Becerra JX, Venable DL. 1999. Macroevolution of insect-plant associations: The relevance of host biogeography to host affiliation. *PNAS* **96:** 12626–12631.

Bernays EA, Chapman RE. 1994. *Host-Plant Selection by Phytophagous Insects*. Springer US.

Burckhardt D. 1986. A new *Russelliana* species (Homoptera: Psyllidae) on *Adesmia* (Leguminosae). *Revista Chilena de Entomología* **14:** 95–97.

Burckhardt D. 1987a. Jumping plant-lice (Homoptera: Psylloidea) of the temperate Neotropical region. Part 1: Psyllidae (subfamilies Aphalarinae, Rhinocolinae and Aphalaroidinae). *Zoological Journal of the Linnean Society* **89:** 299–392.

Burckhardt D. 1987b. Jumping plant-lice (Homoptera: Psylloidea) of the temperate Neotropical region. Part 2: Psyllidae (subfamilies Diaphorininae, Acizziinae, Ciriacreminae and Psyllinae). *Zoological Journal of the Linnean Society* **90:** 145–205.

Burckhardt D. 2004. Psylloidea – Fauna Europaea Database.

Burckhardt D. 2005a. Biology, Ecology, and Evolution of Gall-inducing Psyllids (Hemiptera: Psylloidea). In: Raman A, Schaefer CW and Withers TM, eds. *Biology, Ecology, and Evolution of Gall-inducing Arthropods: volume 1.* Enfield, NH, USA: Science Publishers, Inc. 143–157.

Burckhardt D. 2005b. *Ehrendorferiana*, a new genus of Neotropical jumping plant-lice (Insecta: Hemiptera: Psylloidea) associated with conifers (Cupressaceae). *Organisms Diversity & Evolution* **5:** 317–319.

Burckhardt D. 2008a. Jumping plant-lice (Hemiptera, Psylloidea) associated with *Diostea* (Verbenaceae). *Deutsche Entomologische Zeitschrift* **55:** 79–89.

Burckhardt D. 2008b. Psylloidea. In: Claps L, Debandi G and Roig-Juñet S, eds. *Biodiversidad de Artrópodos Argentinos*: SAE Ediciones. 189–199.

Burckhardt D, Basset Y. 2000. The jumping plant-lice (Hemiptera, Psylloidea) associated with *Schinus* (Anacardiaceae): systematics, biogeography and host-plant relationships. *Journal of Natural History* **34:** 57–155.

Burckhardt D, Espirito-Santo MM, Fernandes GW, Malenovsky I. 2004. Gall-inducing jumping plant-lice of the Neotropical genus *Baccharopelma* (Hemiptera, Psylloidea) associated with *Baccharis* (Asteraceae). *Journal of Natural History* **38:** 2051–2071.

Burckhardt D, Lauterer P. 1997. A taxonomic reassessment of the triozid genus *Bactericera* (Hemiptera: Psylloidea). *Journal of Natural History* **31:** 99–153.

Burckhardt D, Ouvrard D. 2007. The taxonomy, biogeography and host plant relationships of jumping plant-lice (Hemiptera: Psyllidae) associated with creosote bushes (*Larrea* spp., Zygophyllaceae). *Systematic Entomology* **32:** 136–155.

Burckhardt D, Ouvrard D. 2012. A revised classification of the jumping plant-lice (Hemiptera: Psylloidea). *Zootaxa* **3509:** 1–34.

Burckhardt D, Ouvrard D, Queiroz D, Percy D. 2014. Psyllid host-plants (Hemiptera: Psylloidea): resolving a semantic problem. *Florida Entomologist* **97:** 242–246.

Burckhardt D, Queiroz DL. 2012. Checklist and comments on the jumping plant-lice (Hemiptera: Psylloidea) from Brazil. *Zootaxa* **3571:** 26–48.

Burckhardt D, Queiroz DL, Rezende MQ, Queiroz EC, Bouvet JPR. 2012. The capsicum psyllid, *Russelliana capsici* (Hemiptera, Psylloidea), a pest on *Capsicum annuum* (Solanaceae) in Argentina and Brazil. *Mitteilungen der schweizerischen entomologischen Gesellschaft* **85:** 71–78.

Burckhardt D, Wyniger D. 2007. The systematic position of *Psylla phorodendri* Tuthill with comments on the New World genus *Freysuila* Aleman (Hemiptera, Psylloidea, Aphalaroidinae). *Mitteilungen der schweizerischen entomologischen Gesellschaft* **80:** 63–70.

Bush GL, Butlin RK. 2004. Sympatric Speciation in Insects. *Adaptive Speciation*: 229–248.

Butler CD, Trumble JT. 2012. The potato psyllid, *Bactericera cockerelli* (Sulc) (Hemiptera: Triozidae): life history, relationship to plant diseases, and management strategies. *Terrestrial Arthropod Reviews* **5:** 87–111.

Chapman RF. 2007. Foraging and Food Choice of Phytophagous Insect. *Chemical Ecology, University of Arizona, Phoenix*.

Claridge MF. 1995. Species concepts and speciation in insect herbivores: Planthopper case studies. *Bolletino di zoologia* **62:** 53–58.

Coletta-Filho HD, Targon MLPN, Takita MA, De Negri JD, Pompeu JJ, Machado MA. 2004. First Report of the Causal Agent of Huanglongbing (“*Candidatus* Liberibacter asiaticus”) in Brazil. *American Phytopathological Society* **88:** 1382.

Del Río CJ. 2000. Malacofauna de las Formaciones Paraná y Puerto Madryn (Mioceno marino, Argentina): su origen, composición y significado bioestratigráfico. *INSUGEO, Serie Correlación Geológica* **14:** 77–101.

Domínguez MC, Agrain FA, Flores GE, Roig-Juñent SA. 2016. Vicariance events shaping Southern South American insect distributions. *Zoologica Scripta*.

Donato M. 2006. Historical biogeography of the family Tristiridae (Orthoptera: Acridomorpha) applying dispersal–vicariance analysis. *Journal of Arid Environments* **66:** 421–434.

EPPO. 2014. PQR – EPPO Plant quarantine retrieval system.

Futuyma DJ, Mitter C. 1996. Insect-plant interactions: the evolution of component communities. *Philosophical Transactions of the Royal Society of London Series B-Biological Sciences* **351:** 1361–1366.

Goloboff PA. 1999. *NONA (NO NAME), Version 2*. Published by the author: Tucumán, Argentina.

Halbert SE, Manjunath KL. 2004. Asian citrus psyllids (Sternorrhyncha: Psyllidae) and greening disease of citrus: a literature review and assessment of risk in Florida. *The Florida Entomologist* **87:** 330–353.

Hall DG, Richardson ML, Ammar E-D, Halbert SE. 2012. Asian citrus psyllid, *Diaphorina citri*, vector of citrus huanglongbing disease. *Entomologia Experimentalis et Applicata* **146:** 207–223.

Hansen AK, Trumble JT, Stouthamer R, Paine TD. 2008. New Huanglongbing (HLB) *Candidatus* species,"*C*. Liberibacter psyllaurous", found to infect tomato and potato is vectored by the psyllid *Bactericerca cockerelli* (Sulc). *Applied and Environmental Microbiology* **74:** 5862–5865.

Hare JD. 1990. Ecology and Management of the Colorado Potato Beetle. *Annual Review of Entomology* **35:** 81–100.

Hodkinson ID. 1974. The biology of the Psylloidea (Homoptera): a review. *Bulletin of Entomological Research* **64:** 325–339.

Hodkinson ID. 1980. Present-day distribution patterns of the holarctic Psylloidea (Homoptera: Insecta) with particular reference to the origin of the nearctic fauna. *Journal of Biogeography* **7:** 127–146.

Hodkinson ID. 1981. Status and taxonomy of the *Trioza* (*Bactericera*) *nigricornis* Forster complex (Hemiptera: Triozidae). *Bulletin of Entomological Research* **71:** 671–679.

Hodkinson ID. 2009. Life cycle variation and adaptation in jumping plant lice (Insecta: Hemiptera: Psylloidea): a global synthesis. *Journal of Natural History* **43:** 65–179.

Hollis D. 2004. *Australian Psylloidea: jumping plant-lice and lerp insects*. Australian Biological Resources Study: Canberra, Australia.

Li F. 2011. *Psyllidomorpha of China (Insecta: Hemiptera).* Science Press: Beijing, China.

Liefting LW, Weir BS, Pennycook SR, Clover GRG. 2009. ‘*Candidatus* Liberibacter solanacearum’, associated with plants in the family Solanaceae. *International Journal of Systematic and Evolutionary Microbiology* **59:** 2274–2276.

Louis J, Shah J. 2013. *Arabidopsis thaliana–Myzus persicae* interaction: shaping the understanding of plant defense against phloem-feeding aphids. *Frontiers in Plant Science* **4:** 1–18.

Munyaneza JE. 2015. Zebra chip disease, *Candidatus* liberibacter, and potato psyllid: a global threat to the potato industry. *American Journal of Potato Research* **92:** 230–235.

Nixon KC. 2002. WinClada ver. 1.00.08. Ithaca, New York.

Ossiannilsson F. 1992. The Psylloidea (Homoptera) of Fennoscandia and Denmark. In: Kristensen NP, ed. *Fauna Entomologica Scandinavica*. Leiden, The Netherlands: Brill E. J. 1–346.

Ouvrard D. 2012. Psyl'list – The World Psylloidea Database.

Ouvrard D, Burckhardt D. 2012. First record of the onion psyllid *Bactericera tremblayi* (Wagner, 1961) in France (Insecta: Hemiptera: Sternorrhyncha: Psylloidea), new symptoms on leek crops and reassessment of the *B. nigricornis*-group distribution. *EPPO Bulletin* **42:** 585–590.

Ouvrard D, Chalise P, Percy D. 2015. Host-plant leaps versus host-plant shuffle: a global survey reveals contrasting patterns in an oligophagous insect group (Hemiptera, Psylloidea). *Systematics and Biodiversity***:** 1–21.

Percy DM. 2002. Distribution patterns and taxonomy of some legume-feeding psyllids (Hemiptera: Psylloidea) and their hosts from the Iberian Peninsula, Morocco and Macaronesia. *Insect Systematics & Evolution* **33:** 291–310.

Percy DM. 2003. Radiation, diversity, and host-plant interactions among island and continental legume-feeding psyllids. *Evolution* **57:** 2540–2556.

Percy DM, Cronk QCB. 2002. Different fates of island brooms: contrasting evolution in *Adenocarpus*, *Genista*, and *Teline* (Genisteae, Fabaceae) in the Canary Islands and Madeira. *American Journal of Botany* **89:** 854–864.

Percy DM, Page RDM, Cronk QCB. 2004. Plant-insect interactions: double-dating associated insect and plant lineages reveals asynchronous radiations. *Systematic Biology* **53:** 120–127.

Queiroz D, Burckhardt D. 2007. Introduced *Eucalyptus* psyllids in Brazil. *Journal of Forest Research* **12:** 337–344.

Rull V. 2011. Neotropical biodiversity: timing and potential drivers. *Trends in Ecology & Evolution* **26:** 508–513

Serbina L, Burckhardt D, Birkhofer K, Syfert MM, Halbert SE. 2015. The potato pest *Russelliana solanicola* Tuthill (Hemiptera: Psylloidea): taxonomy and host-plant patterns. *Zootaxa* **4021:** 33–62.

Smith BT, McCormack JE, Cuervo AM, Hickerson MJ, Aleixo A, Cadena CD, Pérez-Emán J, Burney CW, Xie X, Harvey MG, Faircloth BC, Glenn TC, Derryberry EP, Prejean J, Fields S, Brumfield RT. 2014. The drivers of tropical speciation. *Nature* **515:** 406–409.

Southwood TRE. 1978. The components of diversity. *Symposium of the Royal Entomological Society, London* **9:** 19–40.

Stevens PF. 2001 onwards. Angiosperm Phylogeny Website. *Version 13*.

Tahvanainen J, Niemelä P. 1987. Biogeographical and evolutionary aspects of insect herbivory. *Annales Zoologici Fennici* **24:** 239–247.

Taylor GS, Kent DS. 2013. Potential economic pests of solanaceous crops: a new species of *Solanum*-feeding psyllid from Australia and first record from New Zealand of *Acizzia solanicola* (Hemiptera: Psyllidae). *Zootaxa* **3613:** 257–273.

Tuthill LD. 1959. Los Psyllidae del Perú Central (Insecta: Homoptera). *Revista Peruana de Entomologia Agricola* **2:** 1–27.

Tuthill LD. 1964. Conocimientos Adicionales sobre los Psyllidae (Homoptera) del Perú. *Revista Peruana de Entomologia* **7:** 25–32.

White IM, Hodkinson ID. 1985. Nymphal taxonomy and systematics of Psylloidea (Homoptera). *Bulletin of the British Museum (Natural History) Entomology* **50:** 153–301.

Yang MM, Burckhardt D, Fang SJ. 2009. *Psylloidea of Taiwan. Volume I. Families Calophyidae, Carsidaridae, Homotomidae and Phacopteronidae, with overview and keys to families and genera of Taiwanese Psylloidea (Insecta: Hemiptera)*. National Chung Hsing University.

Figure 1

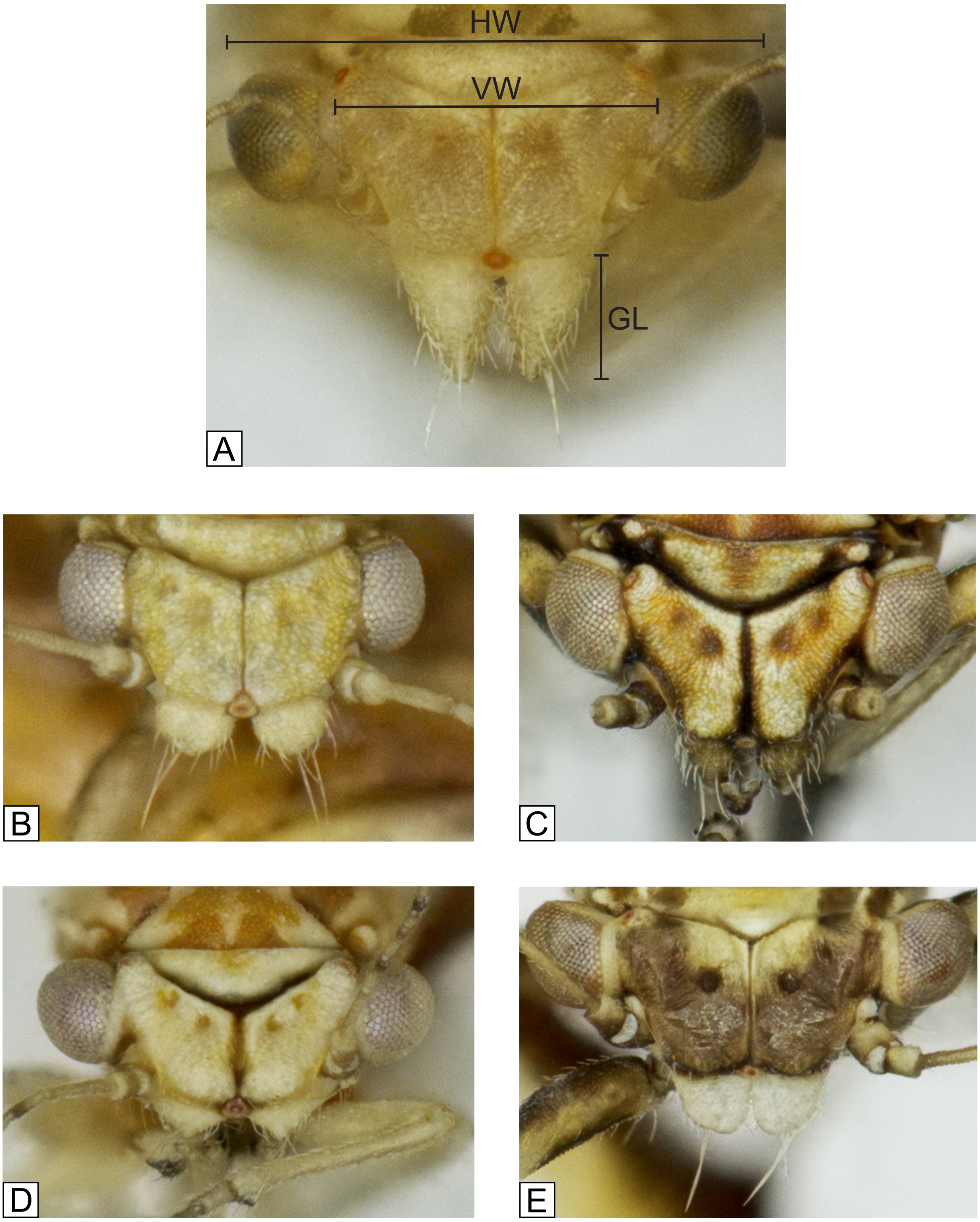


Figure 2

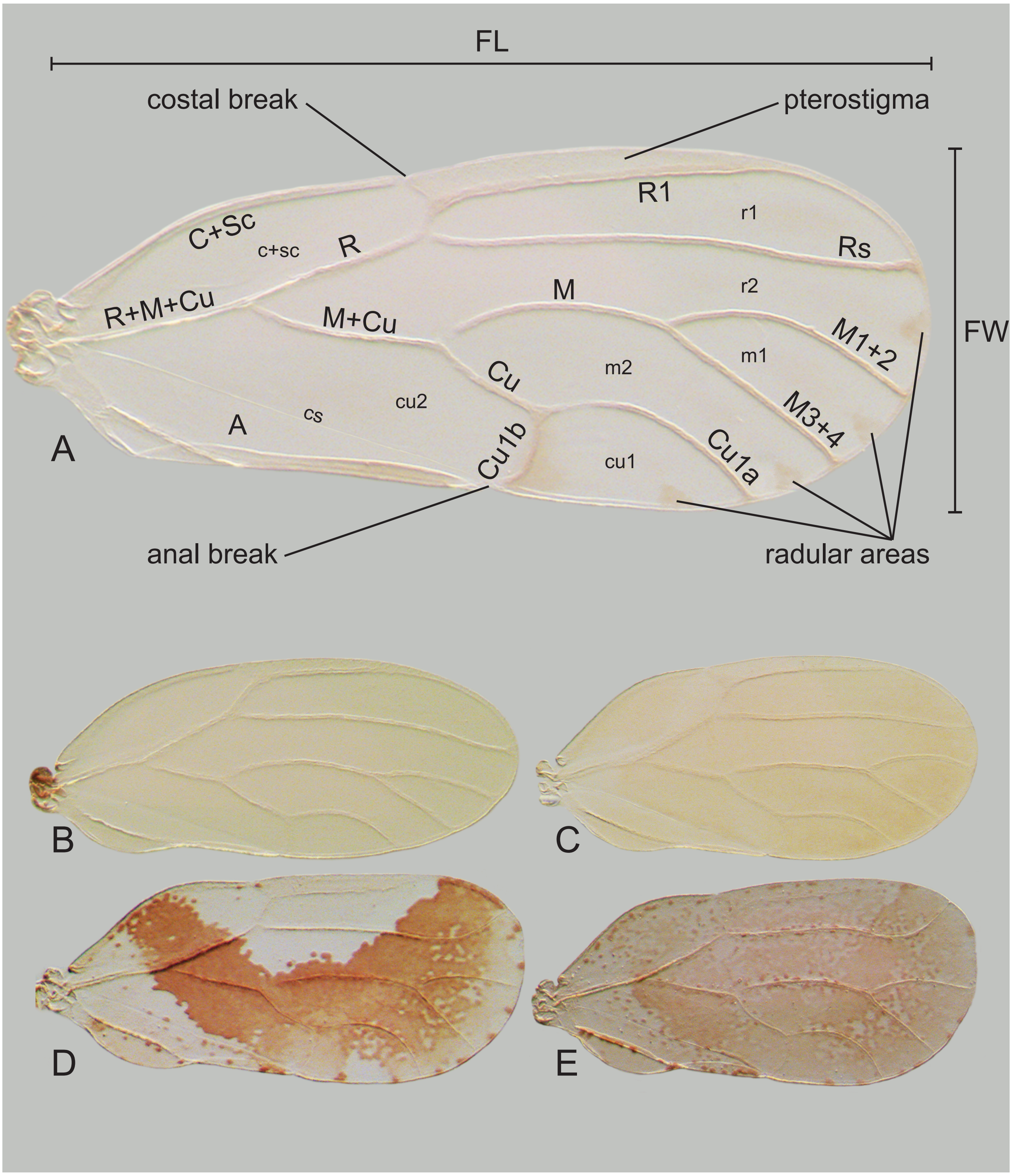

FL
costal break
pterostigma
R1
r1
C+Sc
c+sc
R
Rs
R+M+Cu
M
r2
M+Cu
M1+2
FW
m1
m2
Cu
cu2
M3+4
cs
A
A
Cu1b
cu1
Cu1a
anal break
radular areas
B
C
D
E

Figure 3

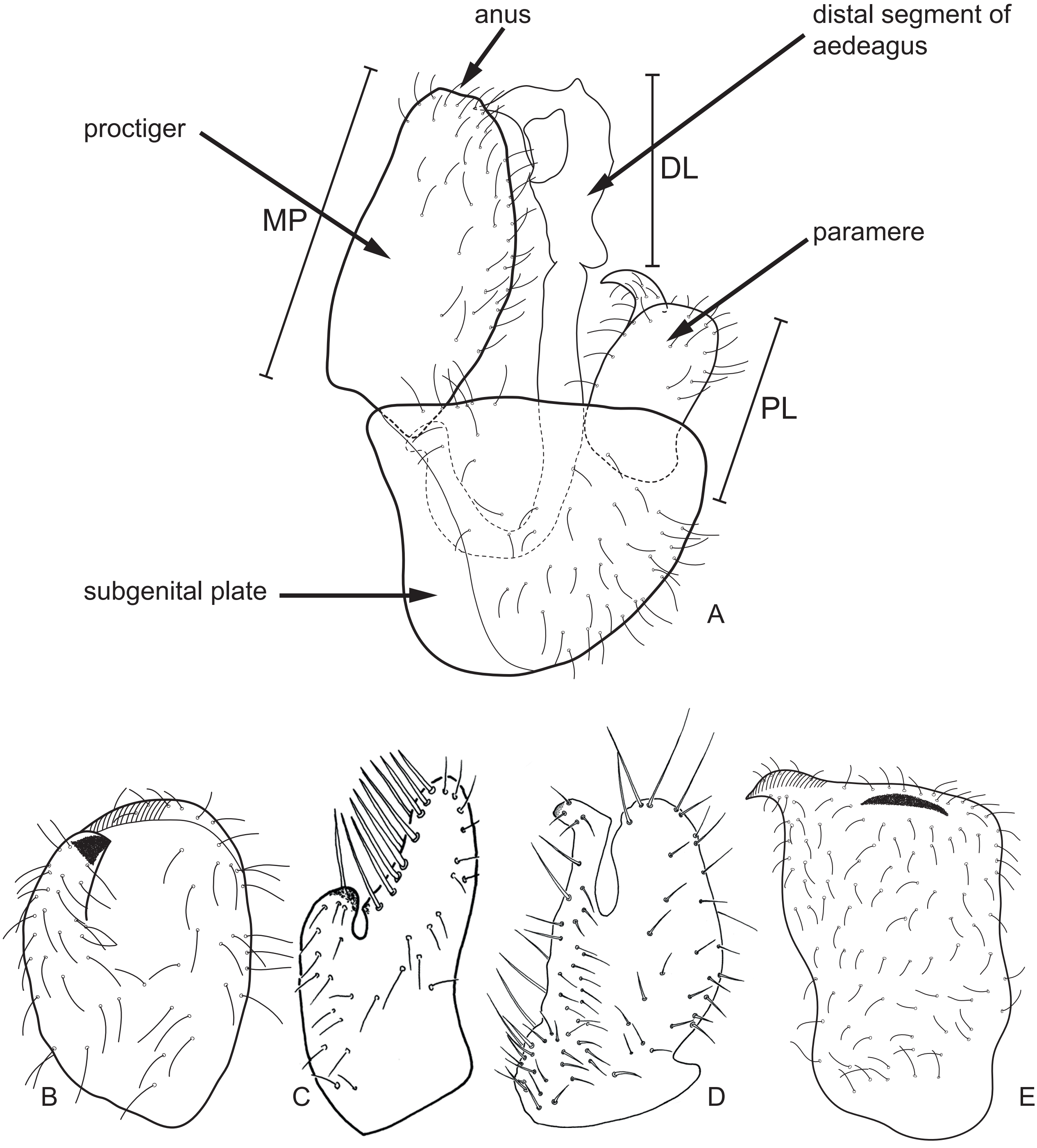

anus
distal segment of aedeagus
proctiger
DL
MP
paramere
PL
subgenital plate
A
B
C
D
E

Figure 4

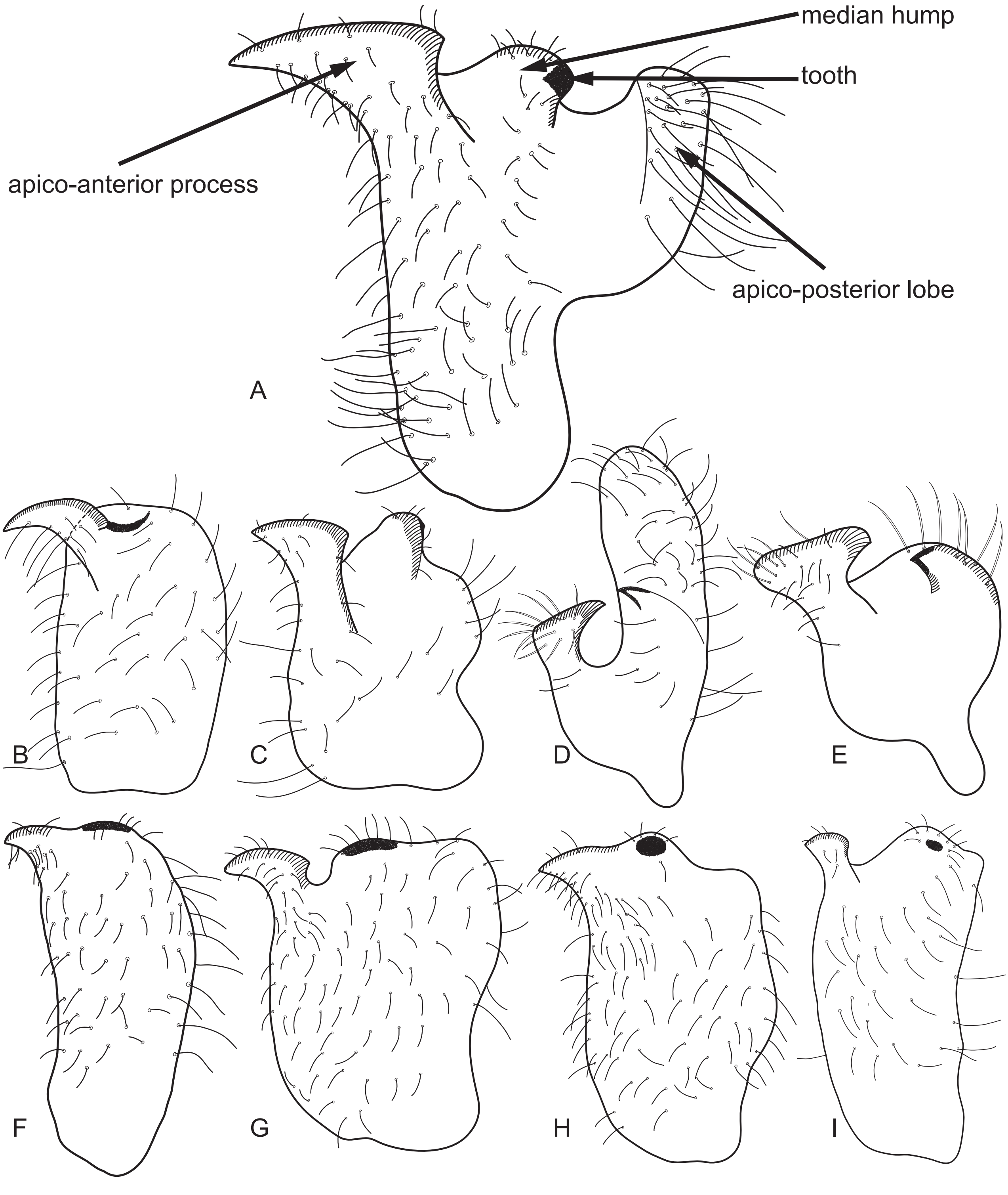

median hump
tooth
apico-anterior process
apico-posterior lobe
A
B
C
D
E
F
G
H
I

Figure 5

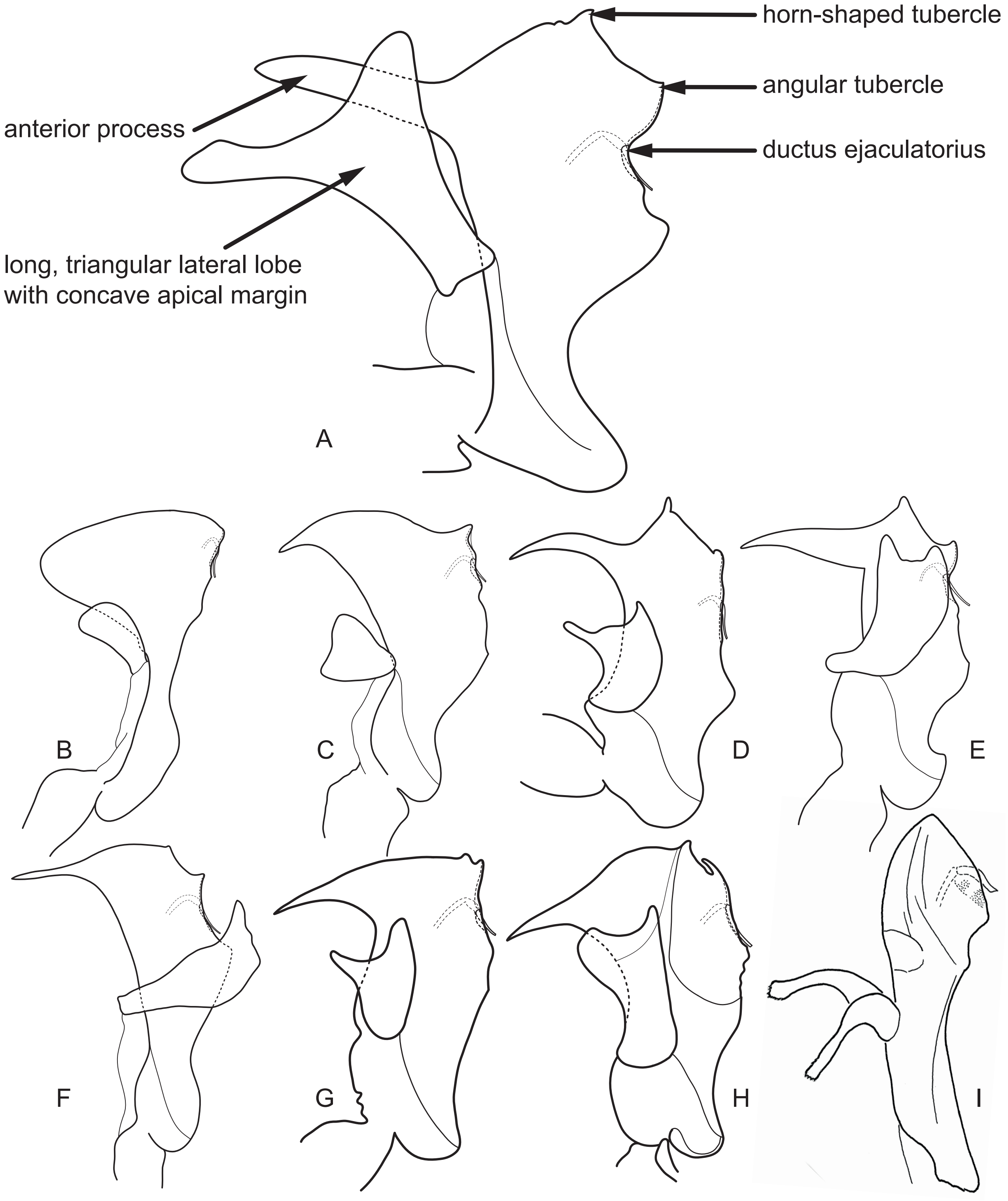

horn-shaped tubercle
angular tubercle
ductus ejaculatorius
anterior process
long, triangular lateral lobe
with concave apical margin
A
B
C
D
E
F
G
H
I

Figure 6

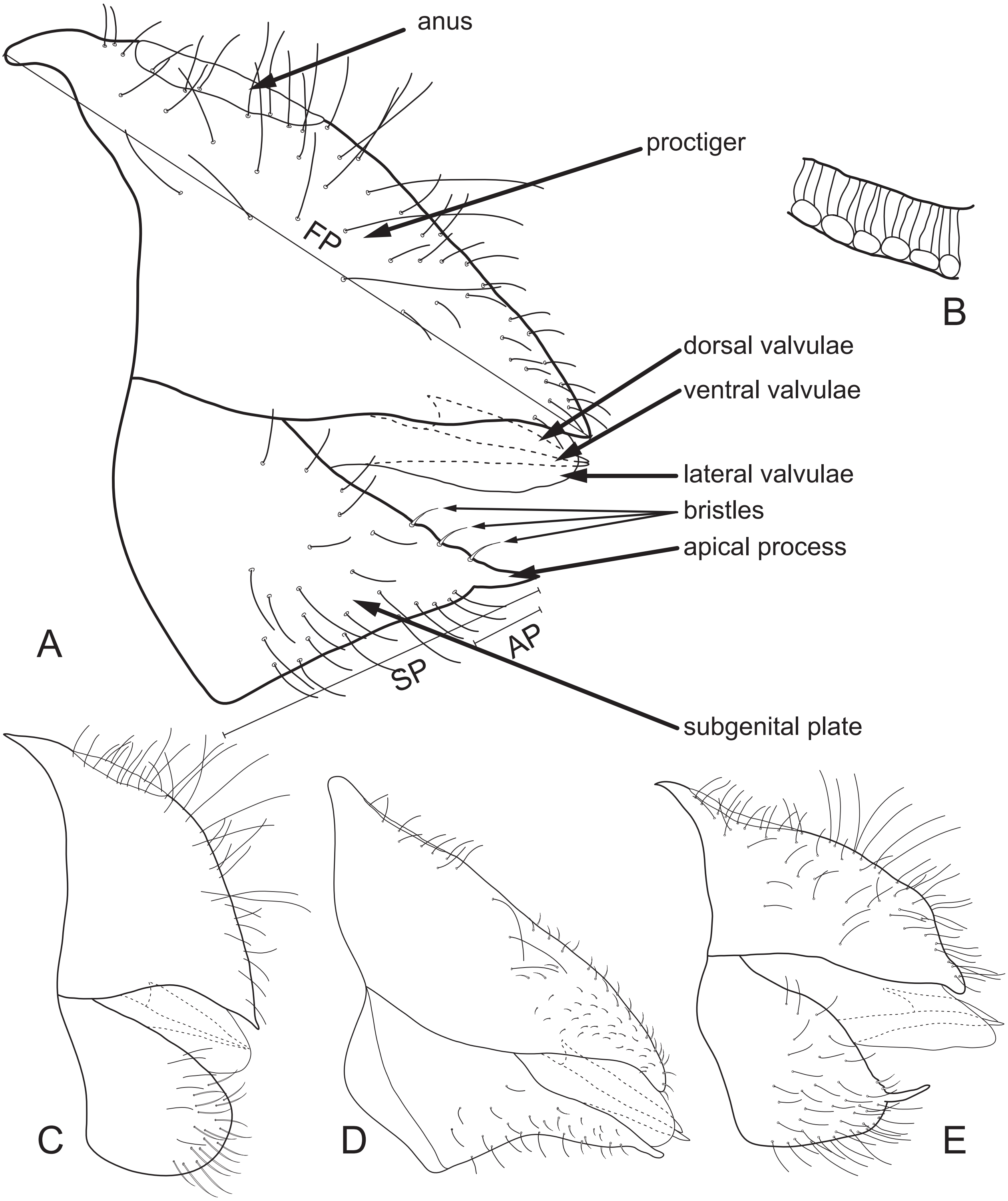

anus
proctiger
FP
dorsal valvulae
ventral valvulae
lateral valvulae
bristles
apical process
AP
SP
subgenital plate
A
B
C
D
E

Figure 7

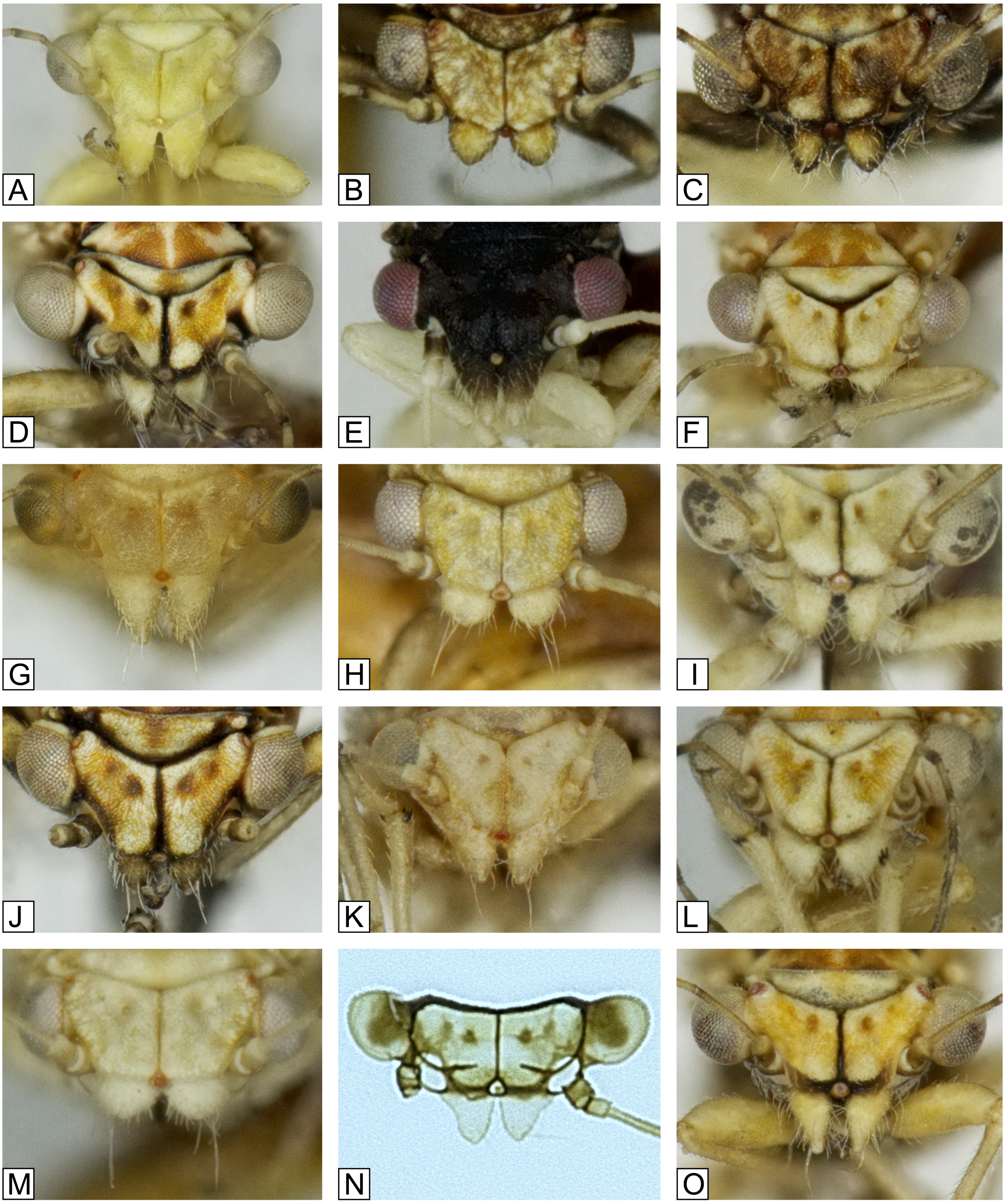


Figure 8

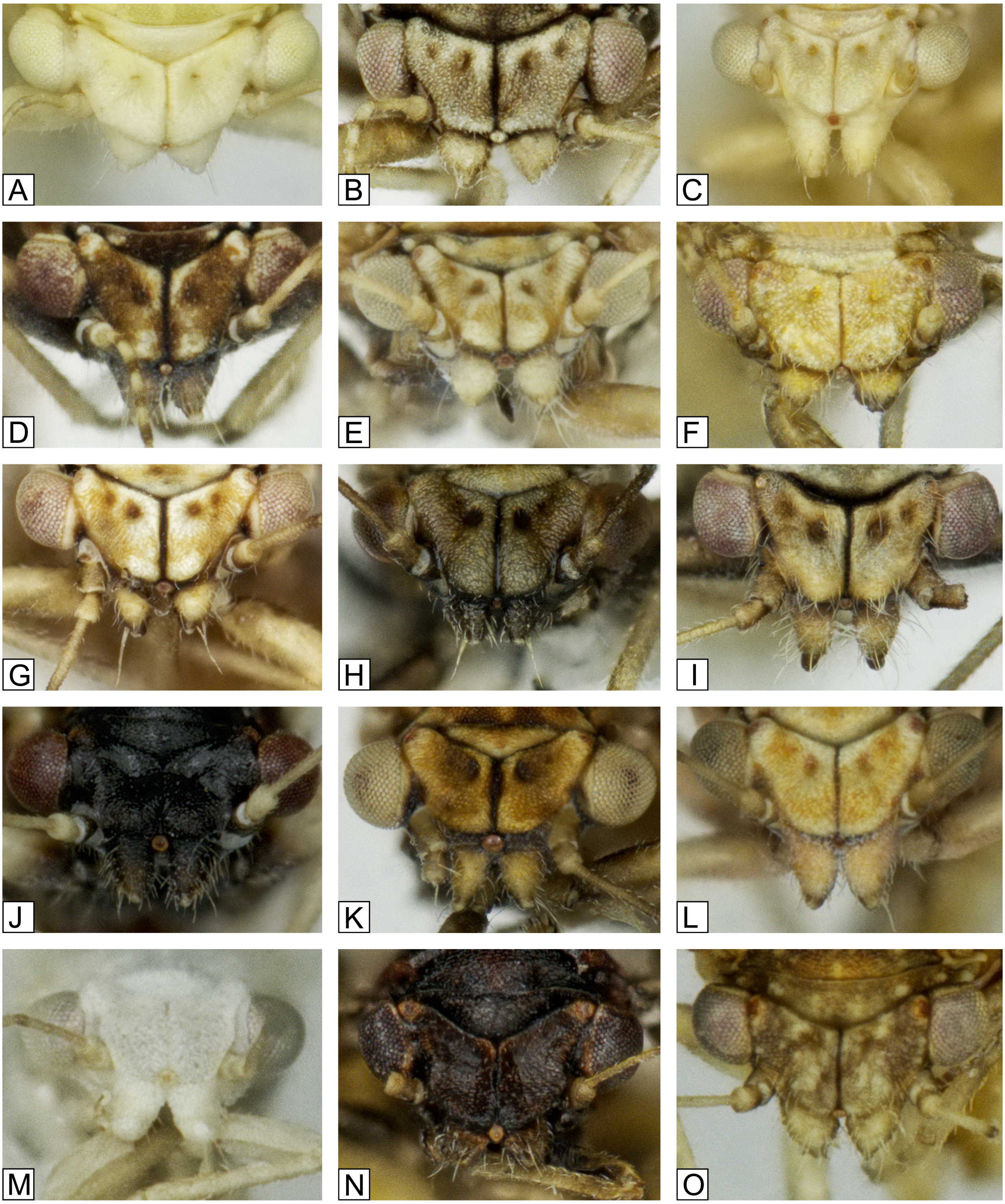


Figure 9

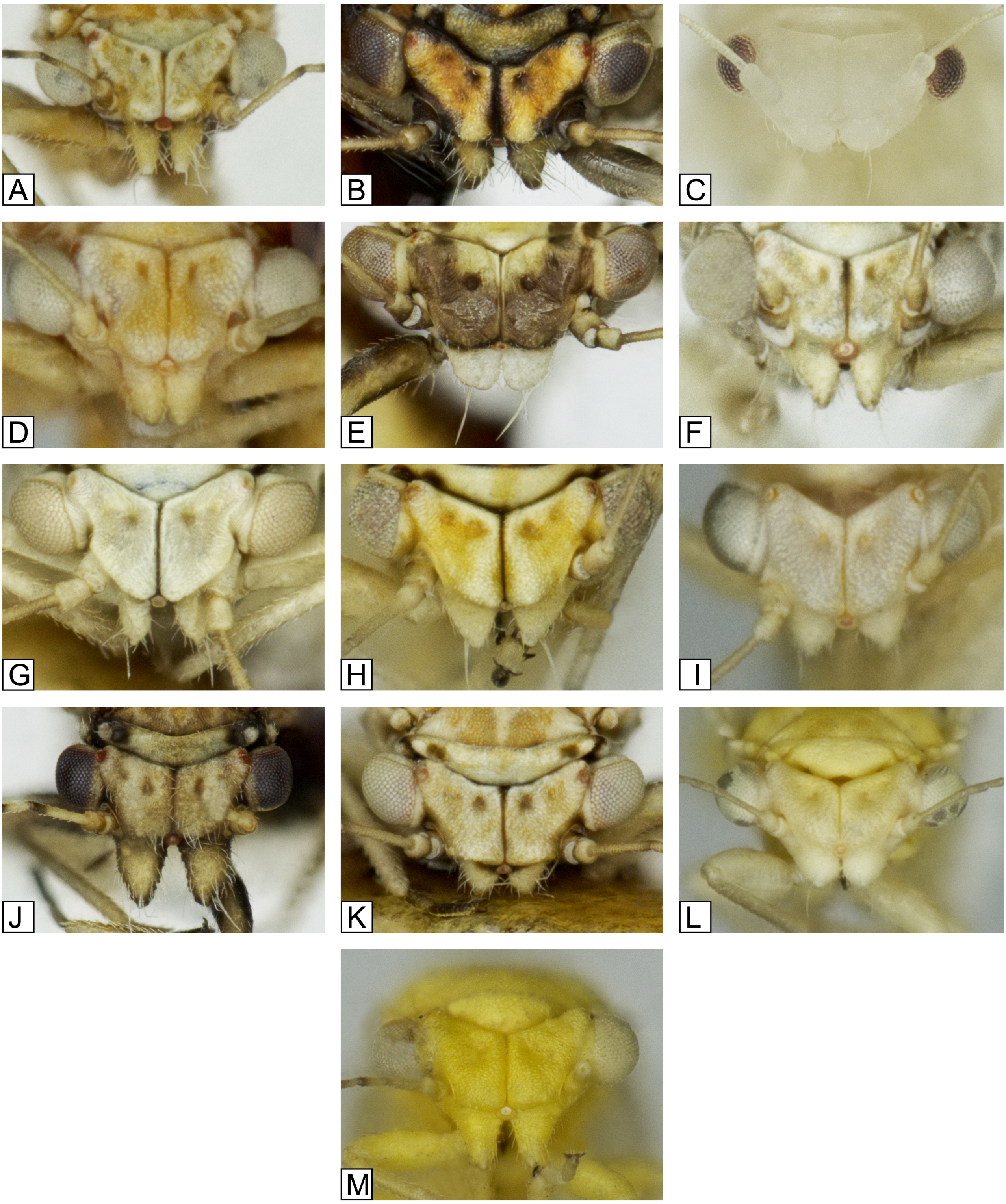


Figure 10

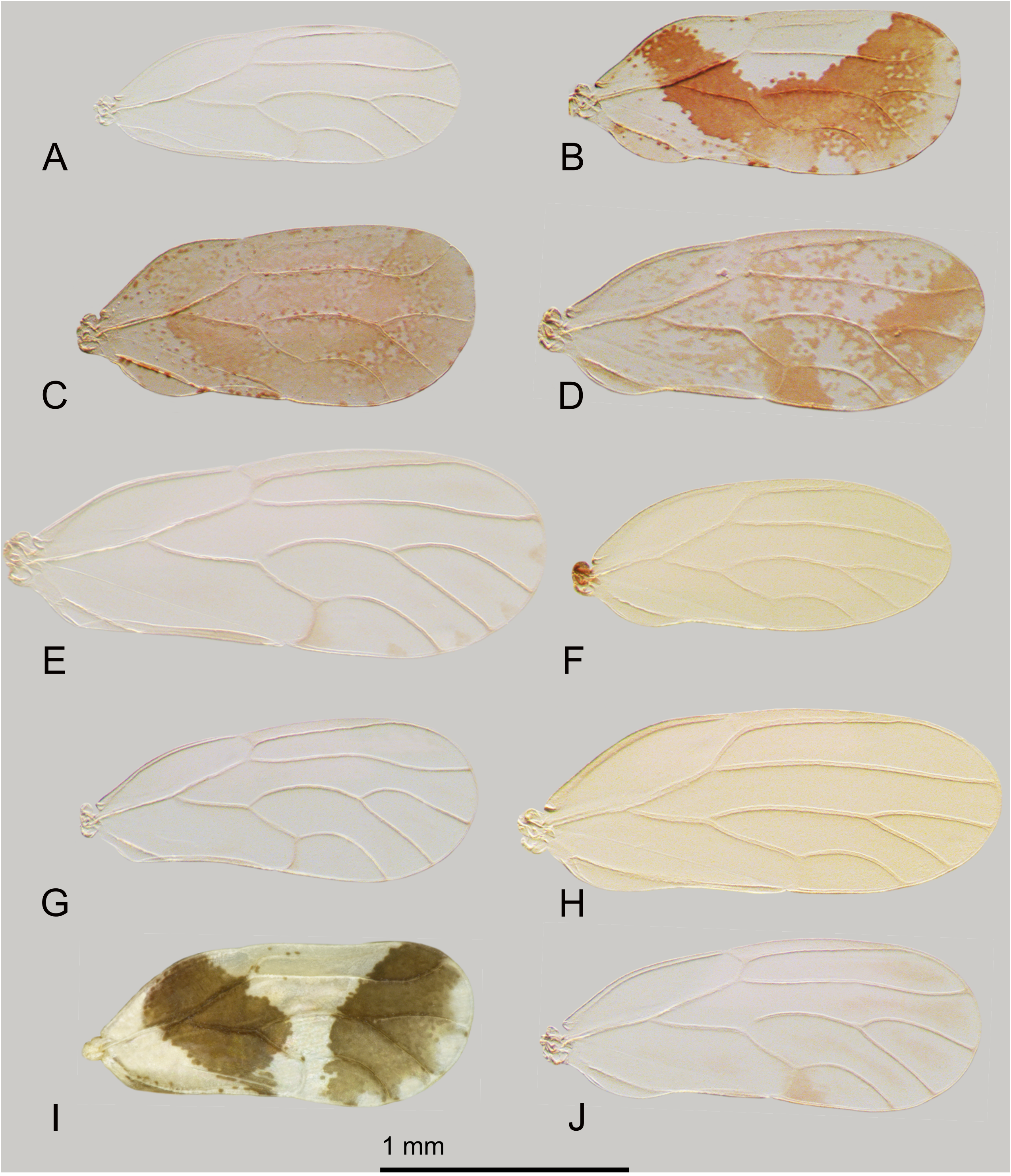


Figure 11

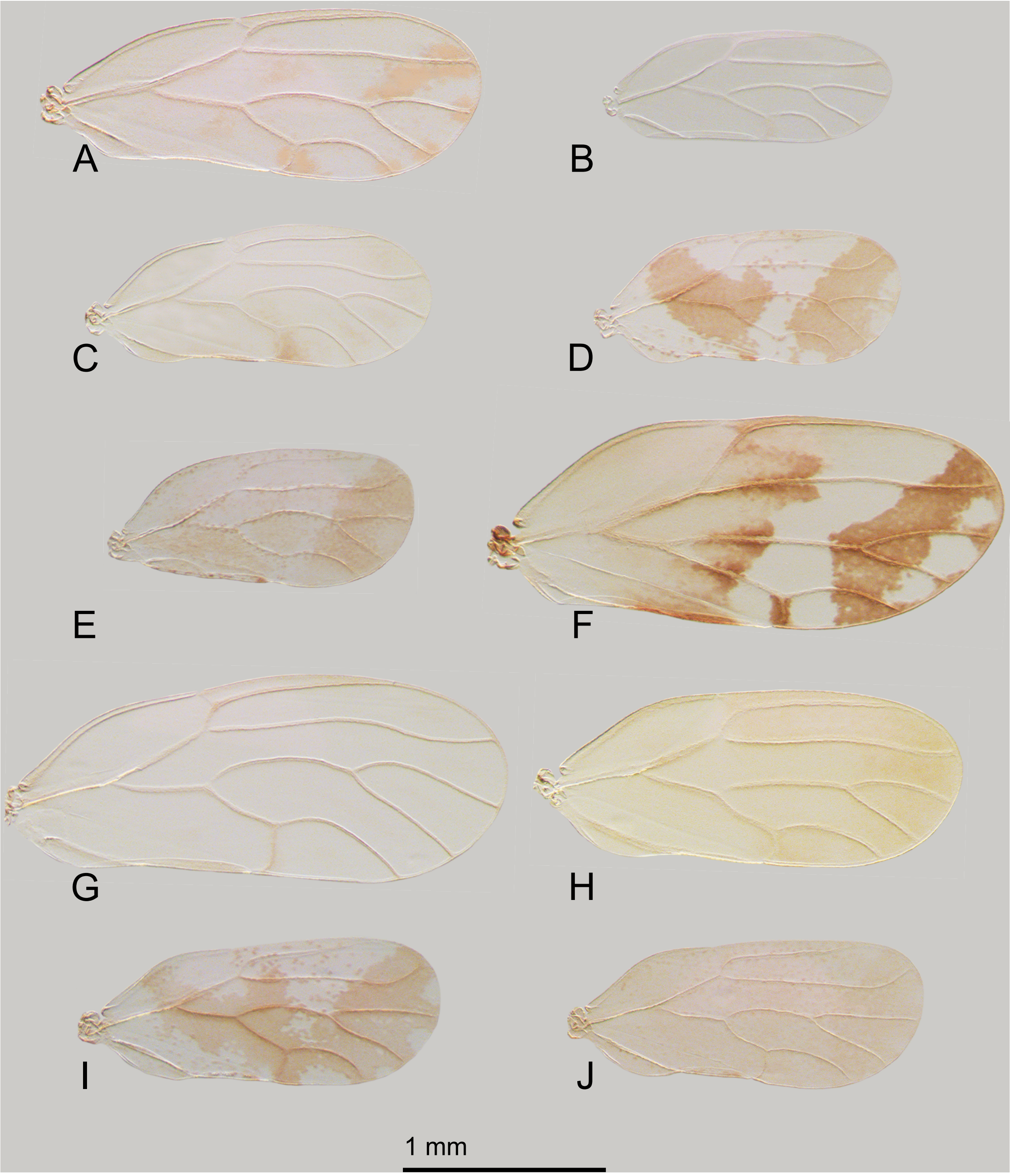


Figure 12

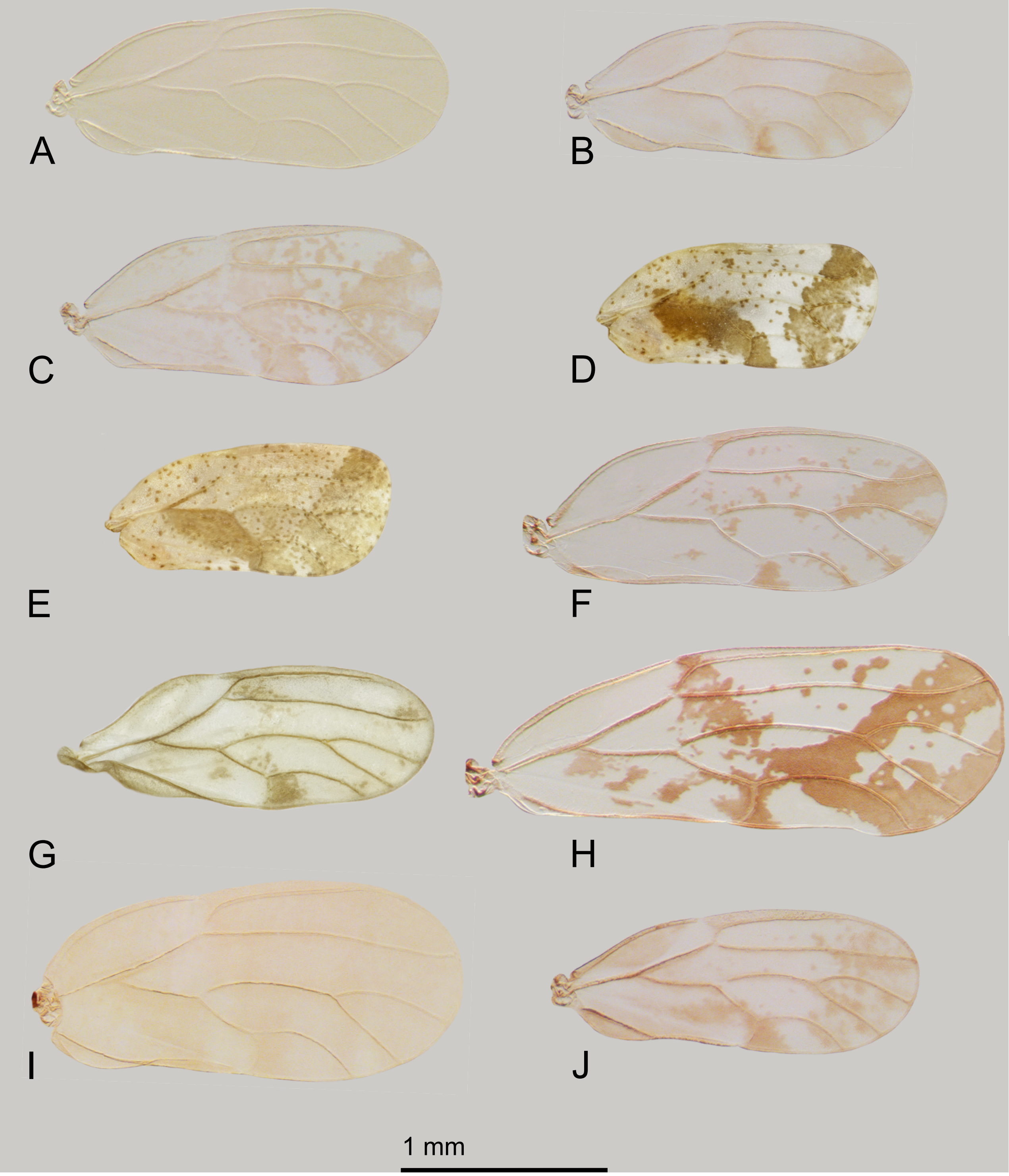


Figure 13

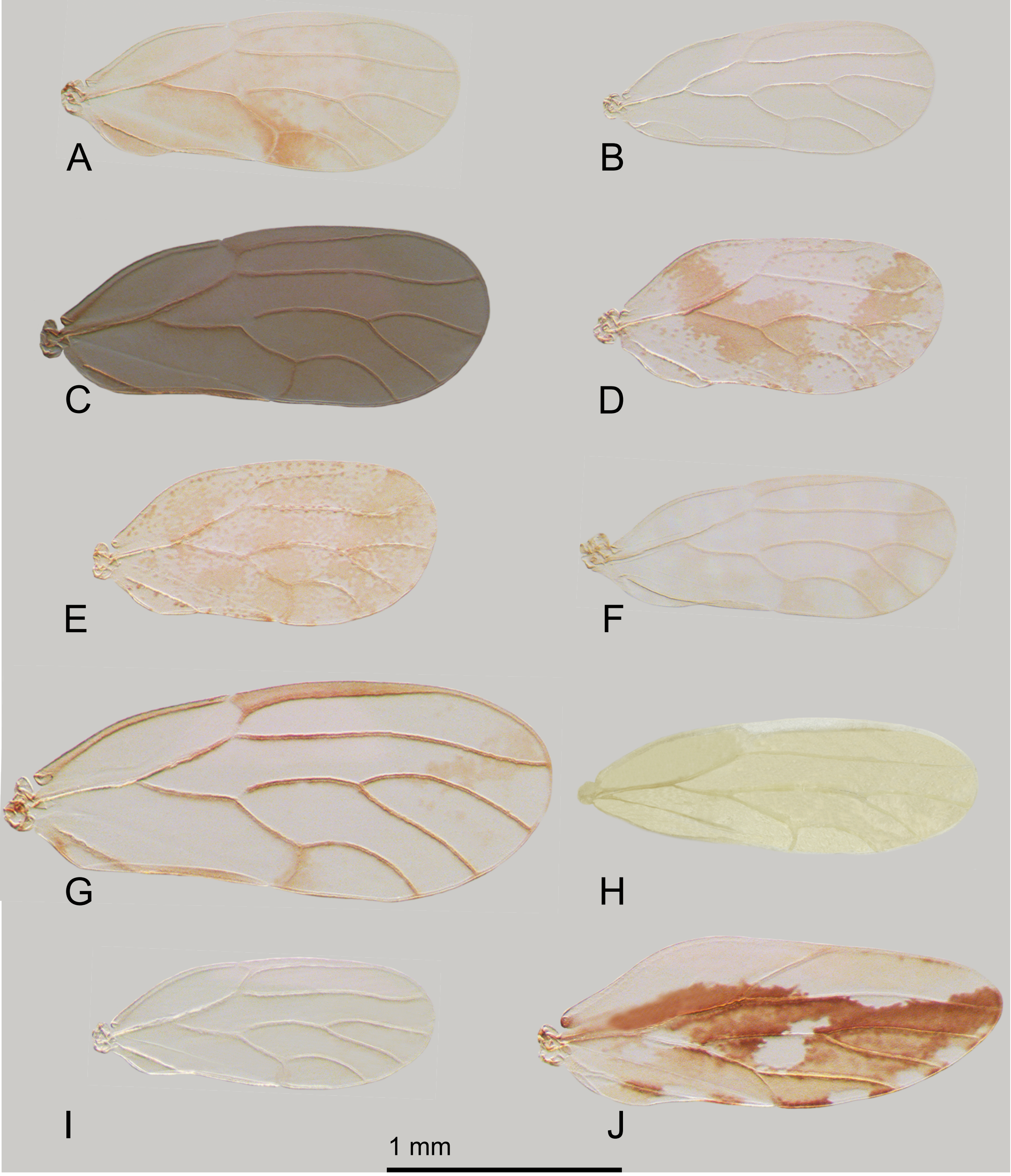


Figure 14

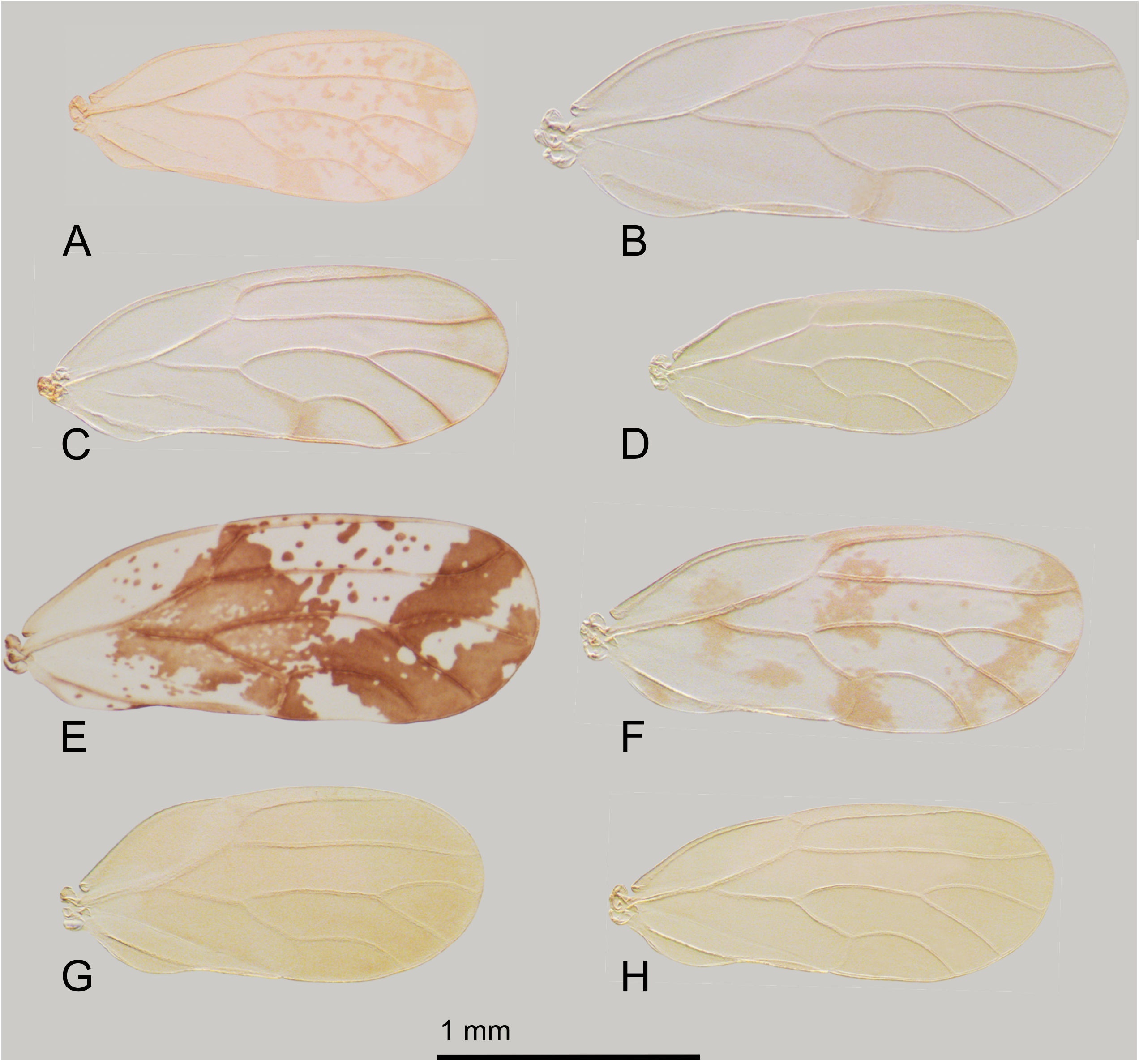


Figure 15

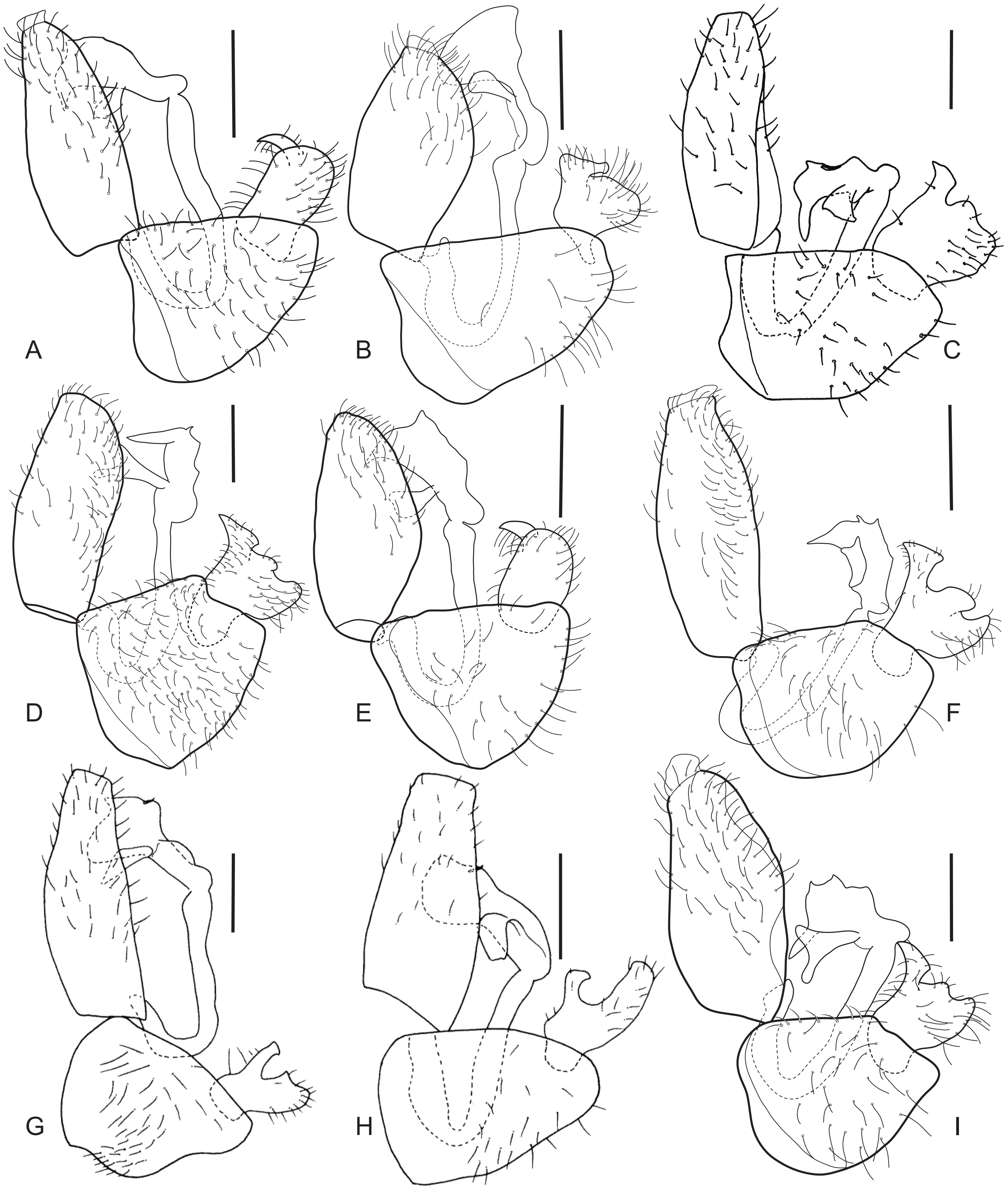


Figure 16

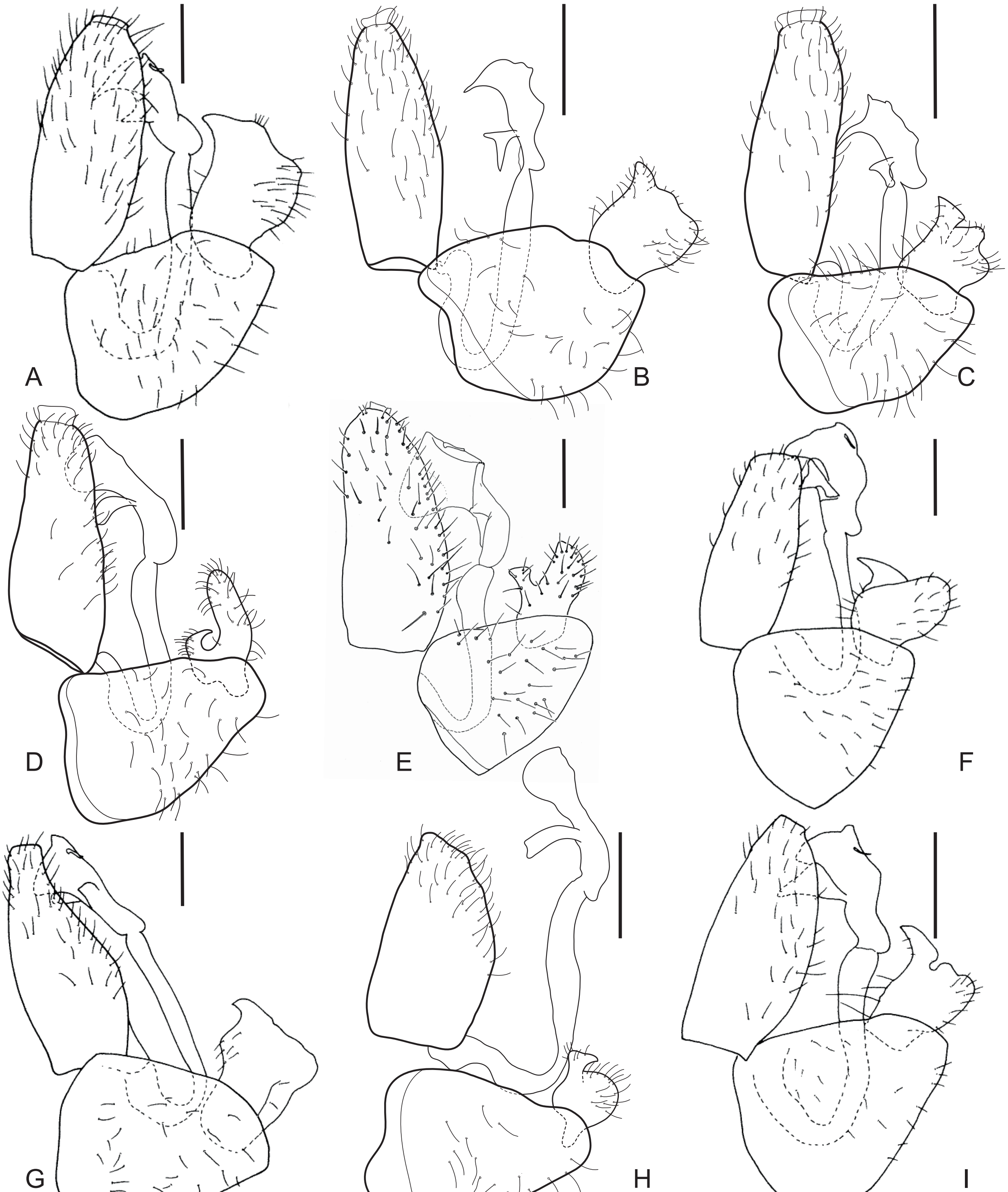


Figure 17

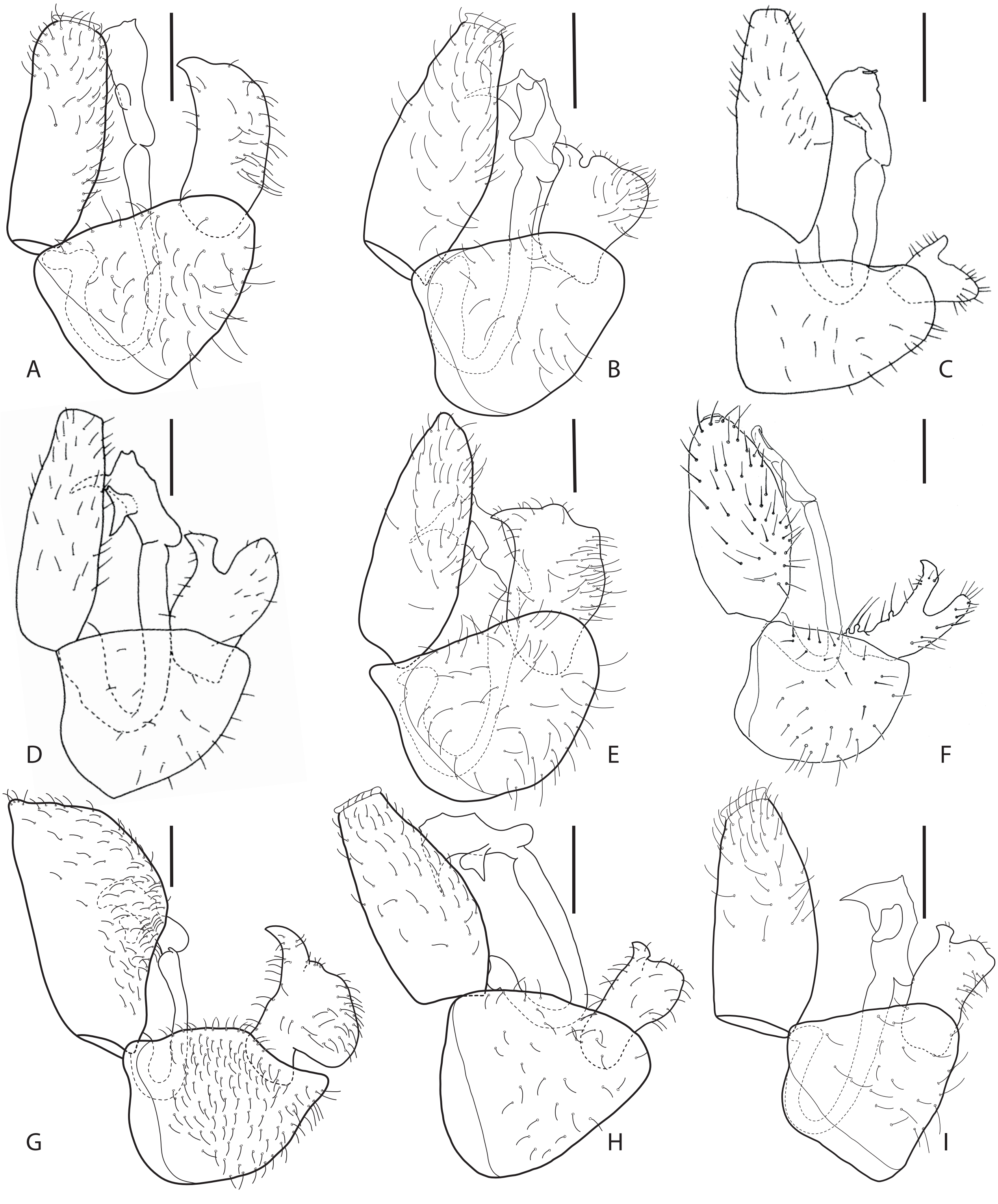


Figure 18

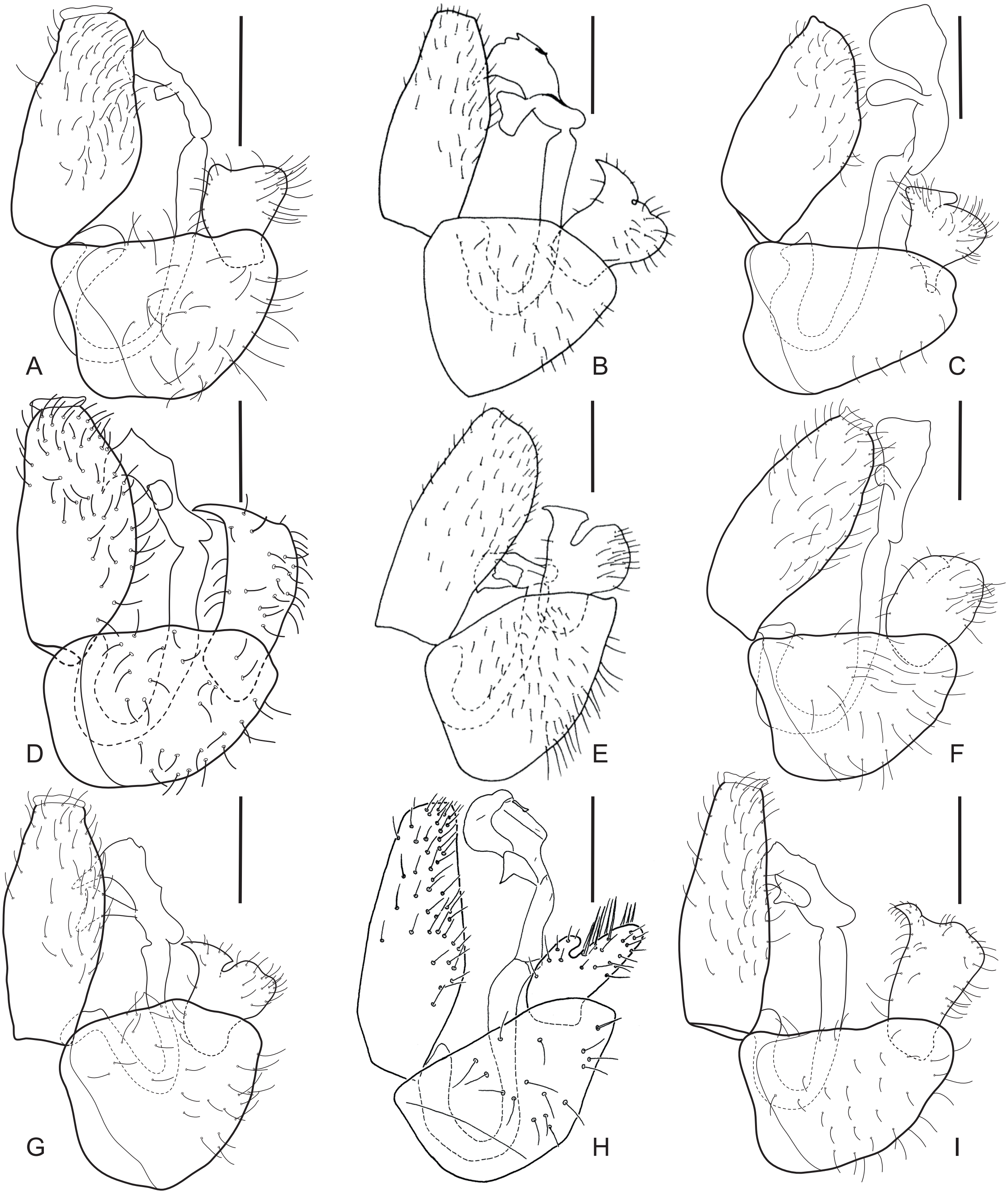


Figure 19

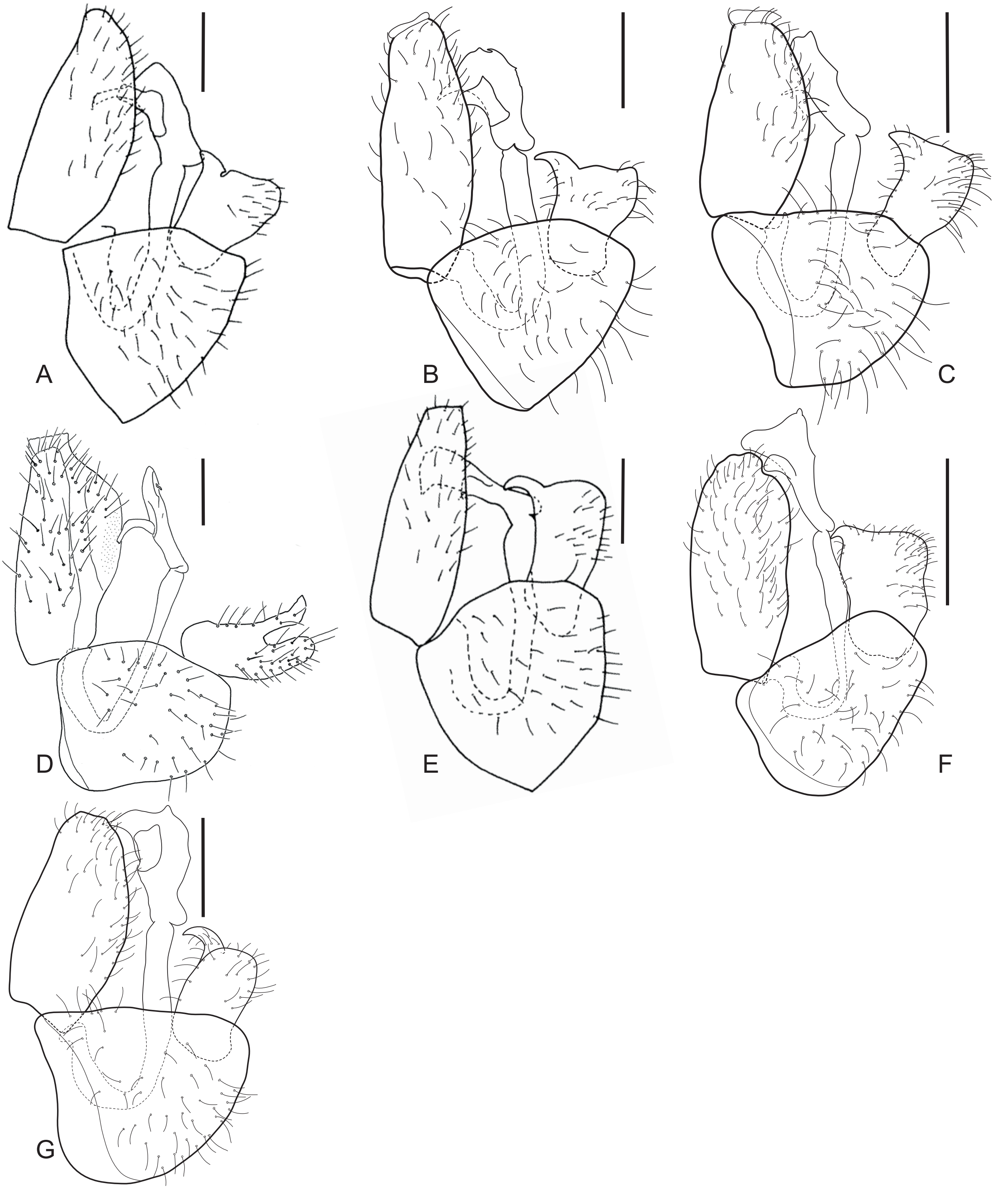


Figure 20

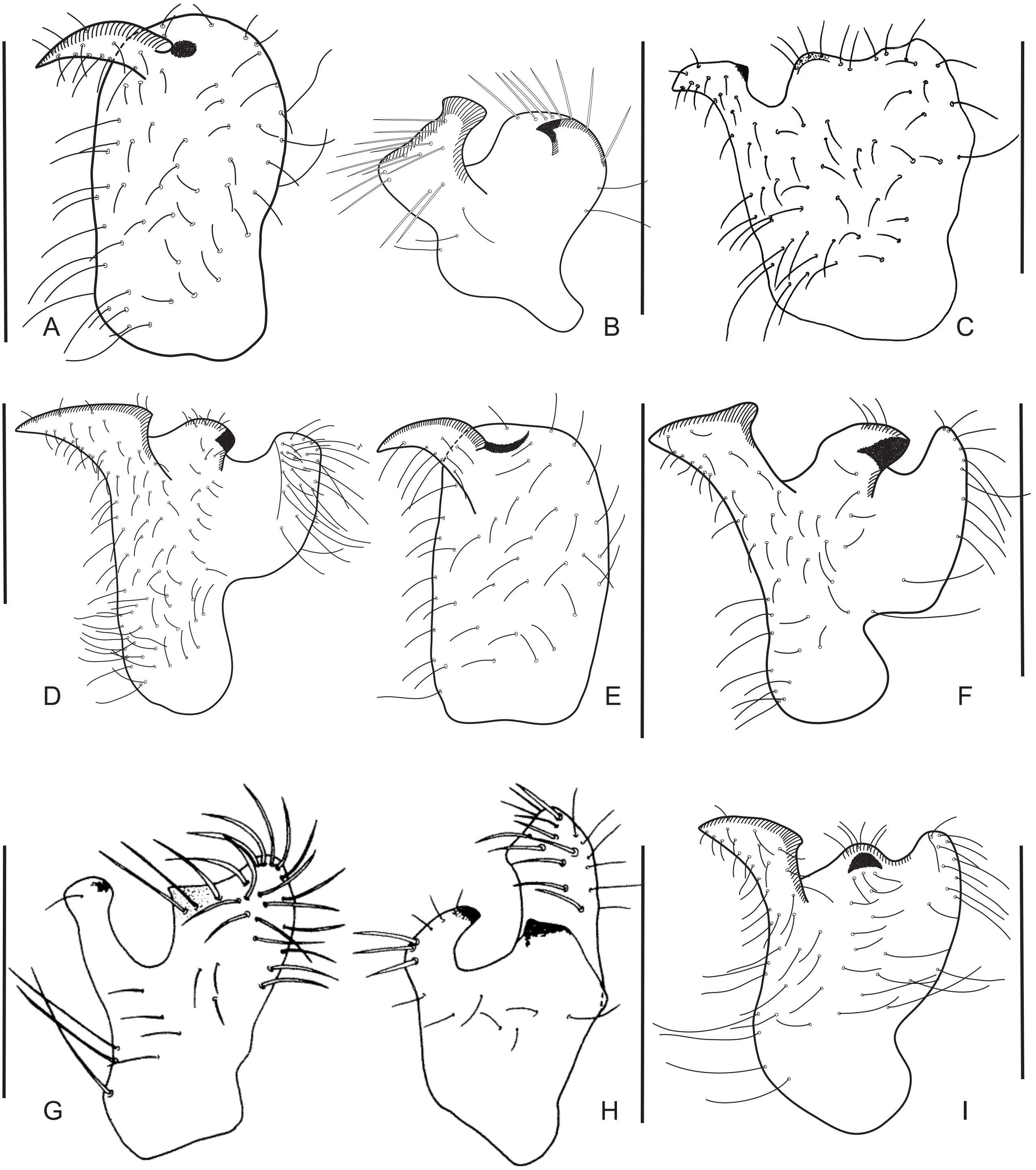


Figure 21

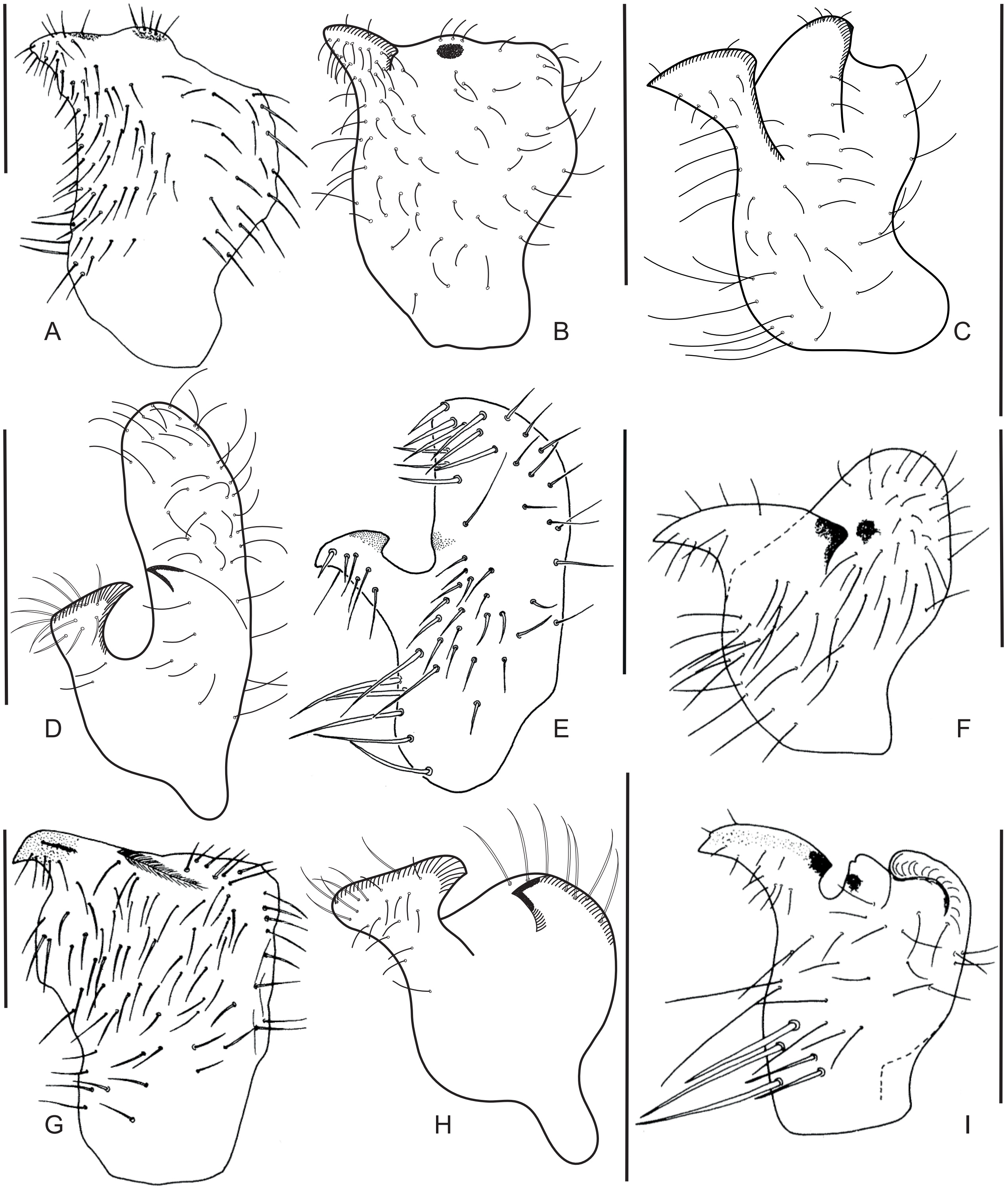


Figure 22

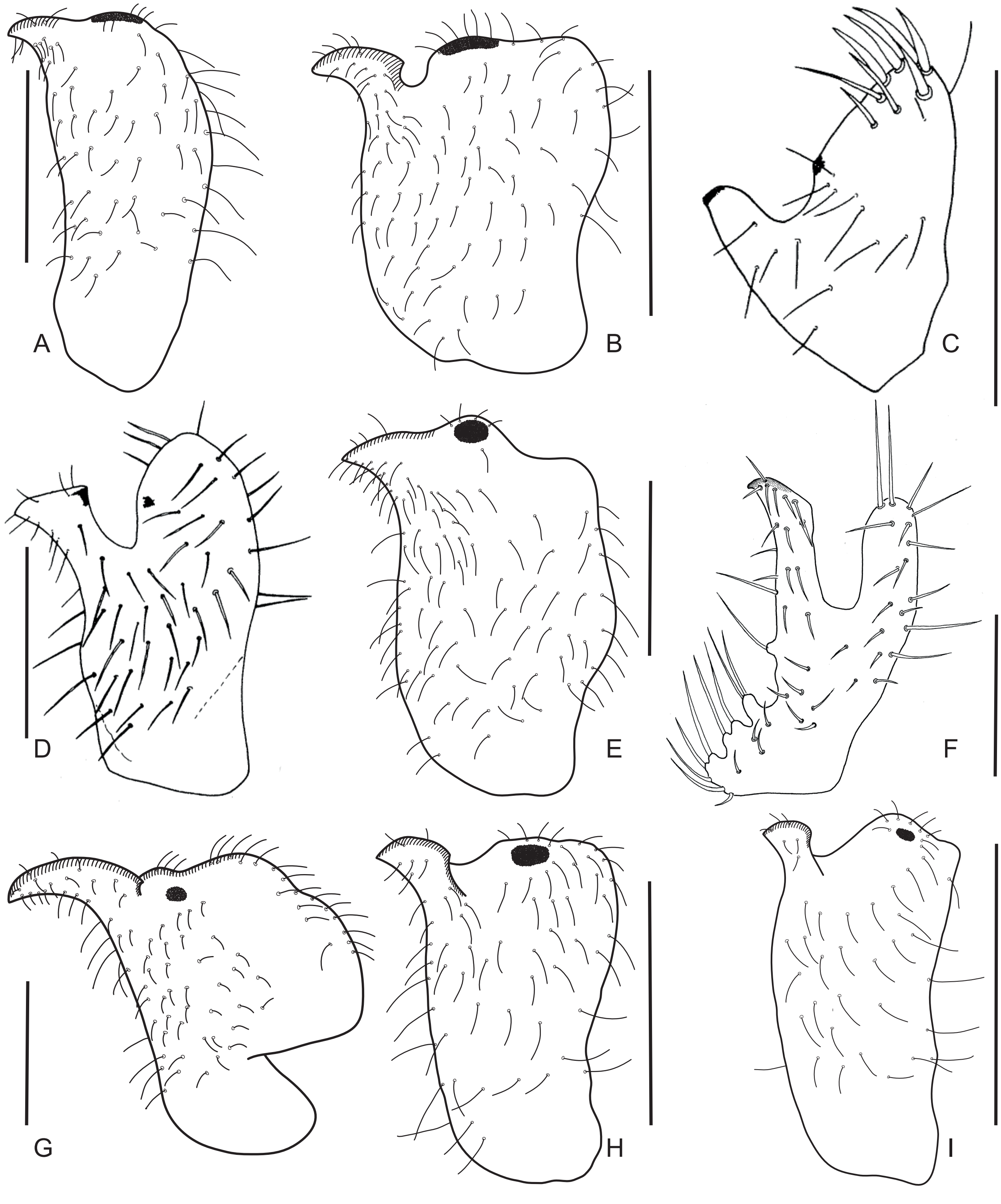


Figure 23

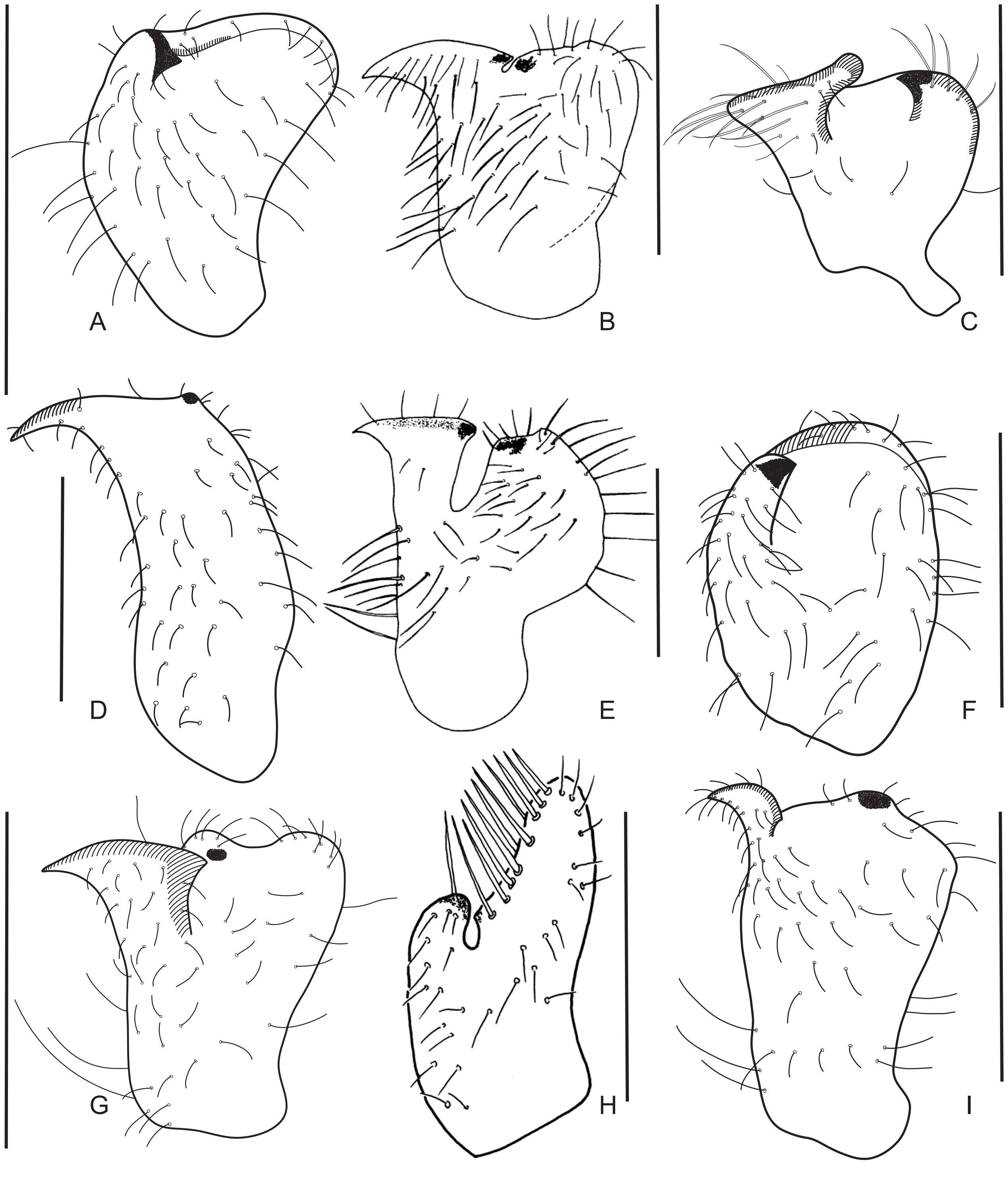


Figure 24

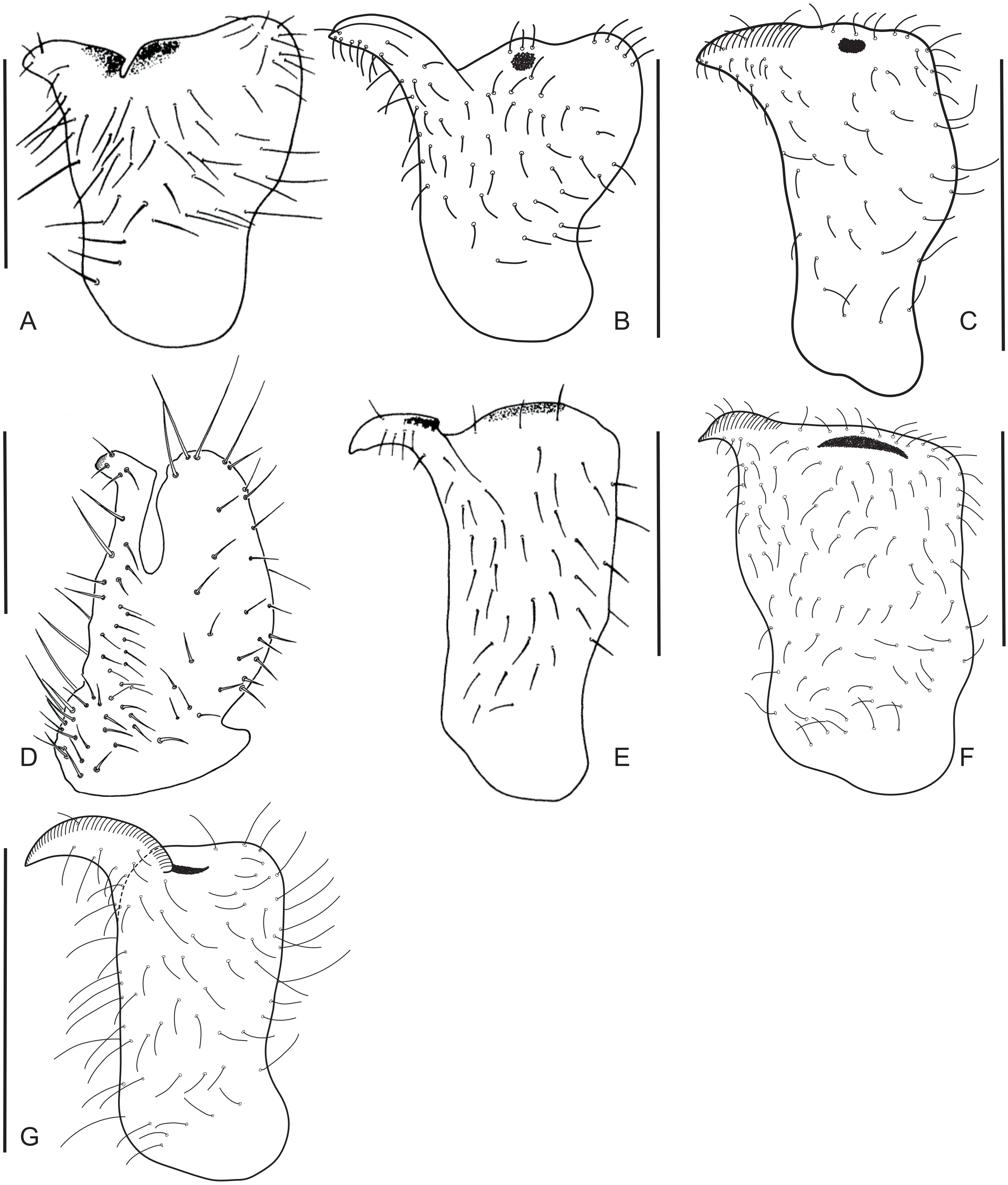


Figure 25

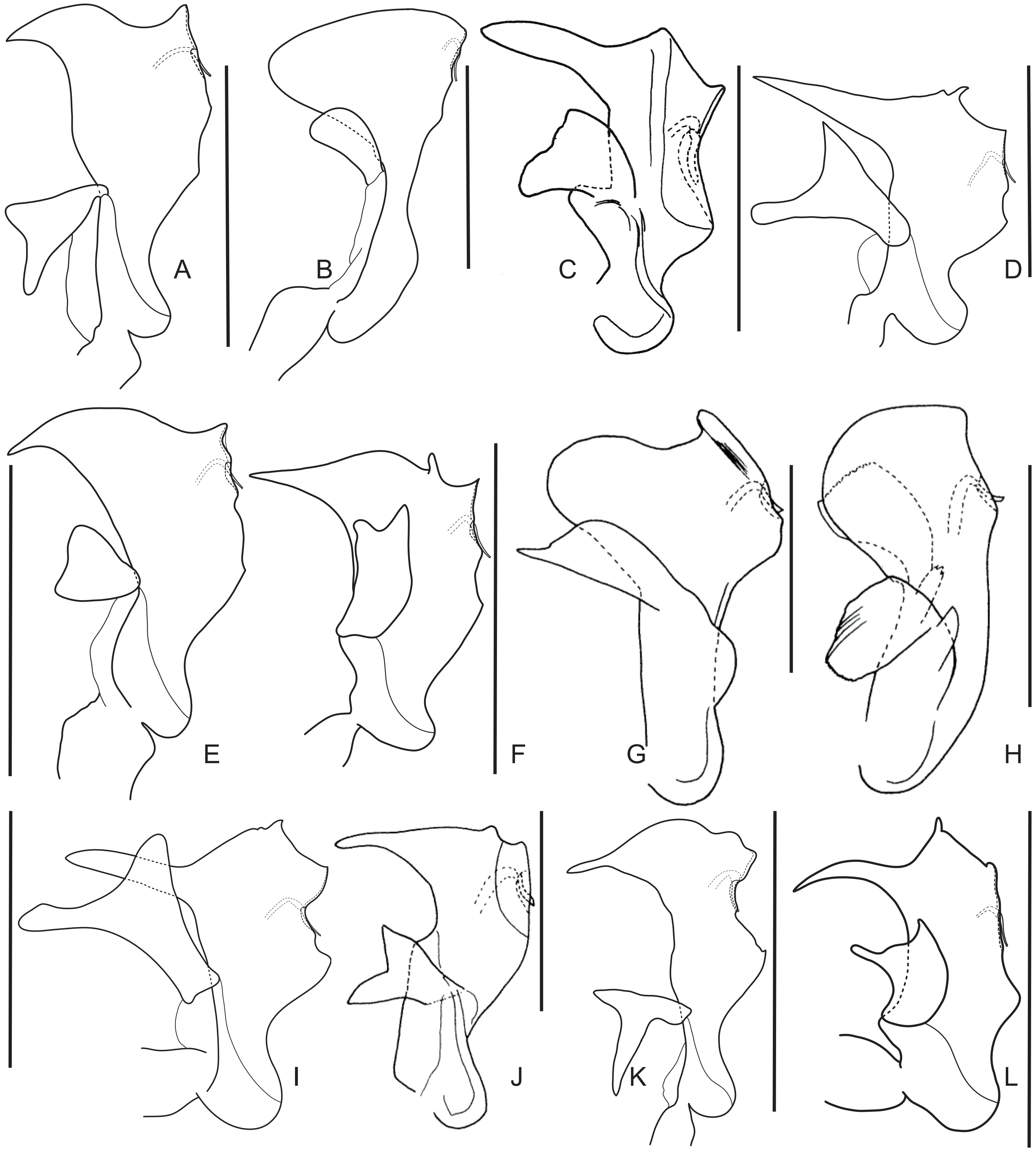


Figure 26

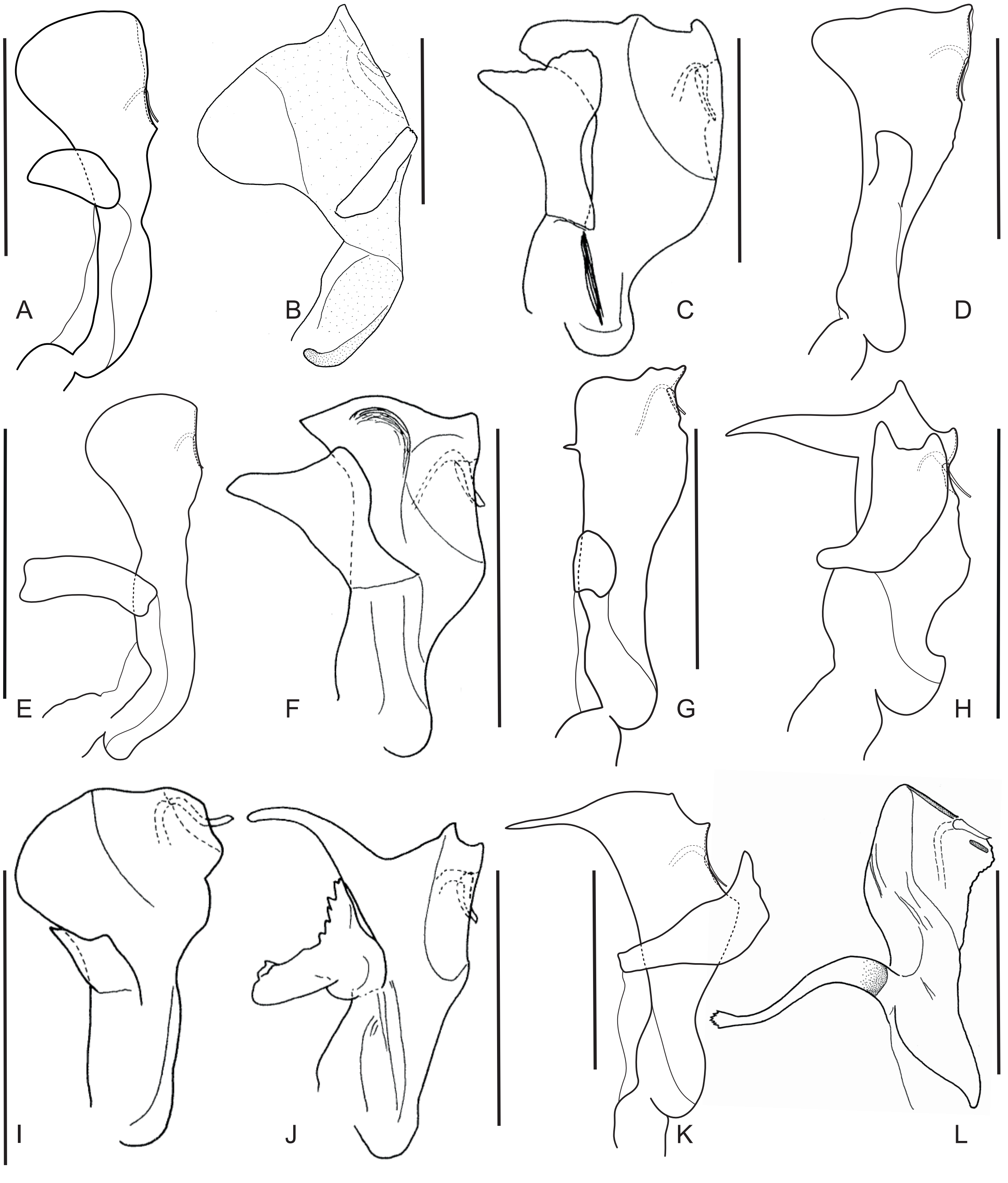


Figure 27

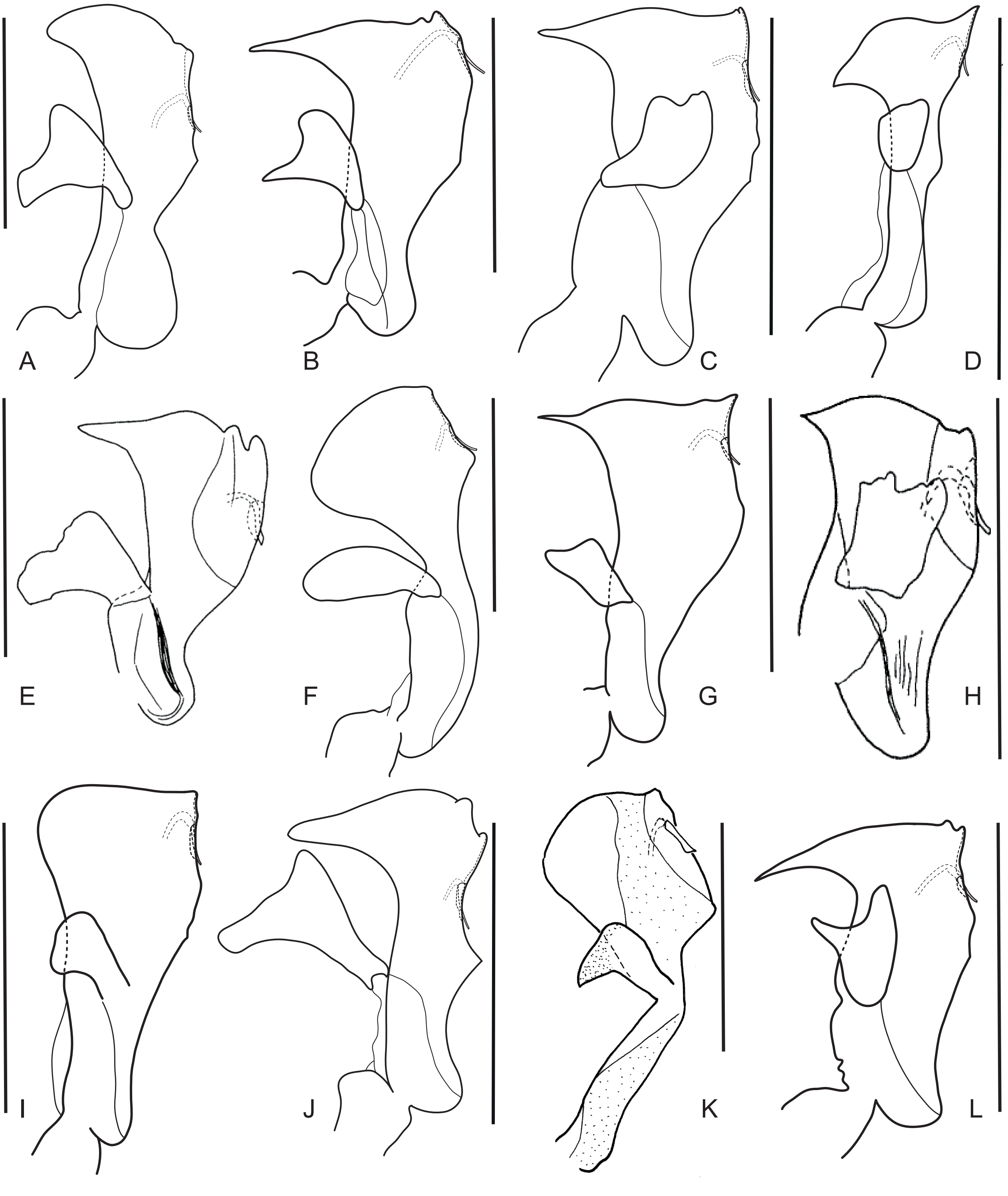


Figure 28

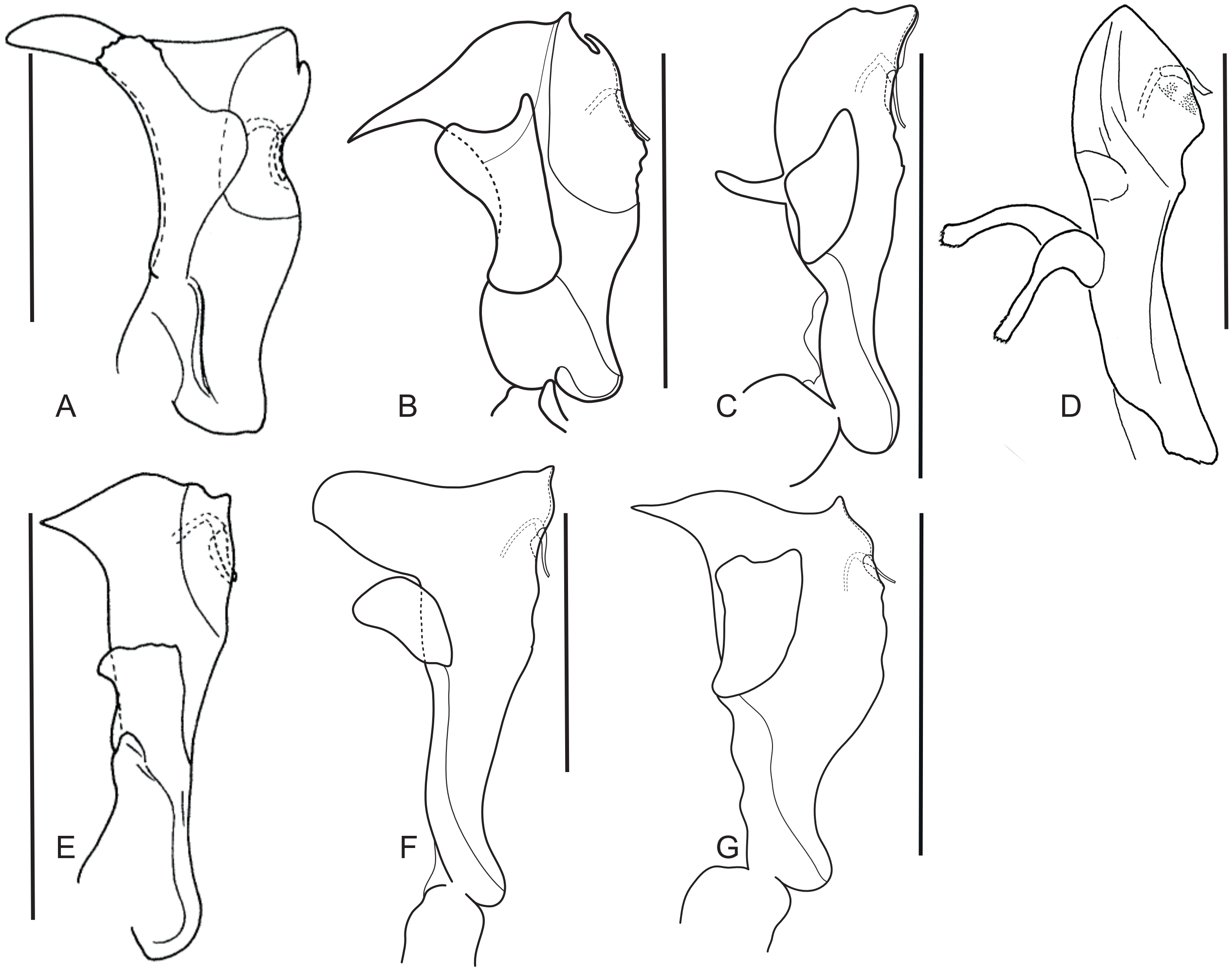


Figure 29

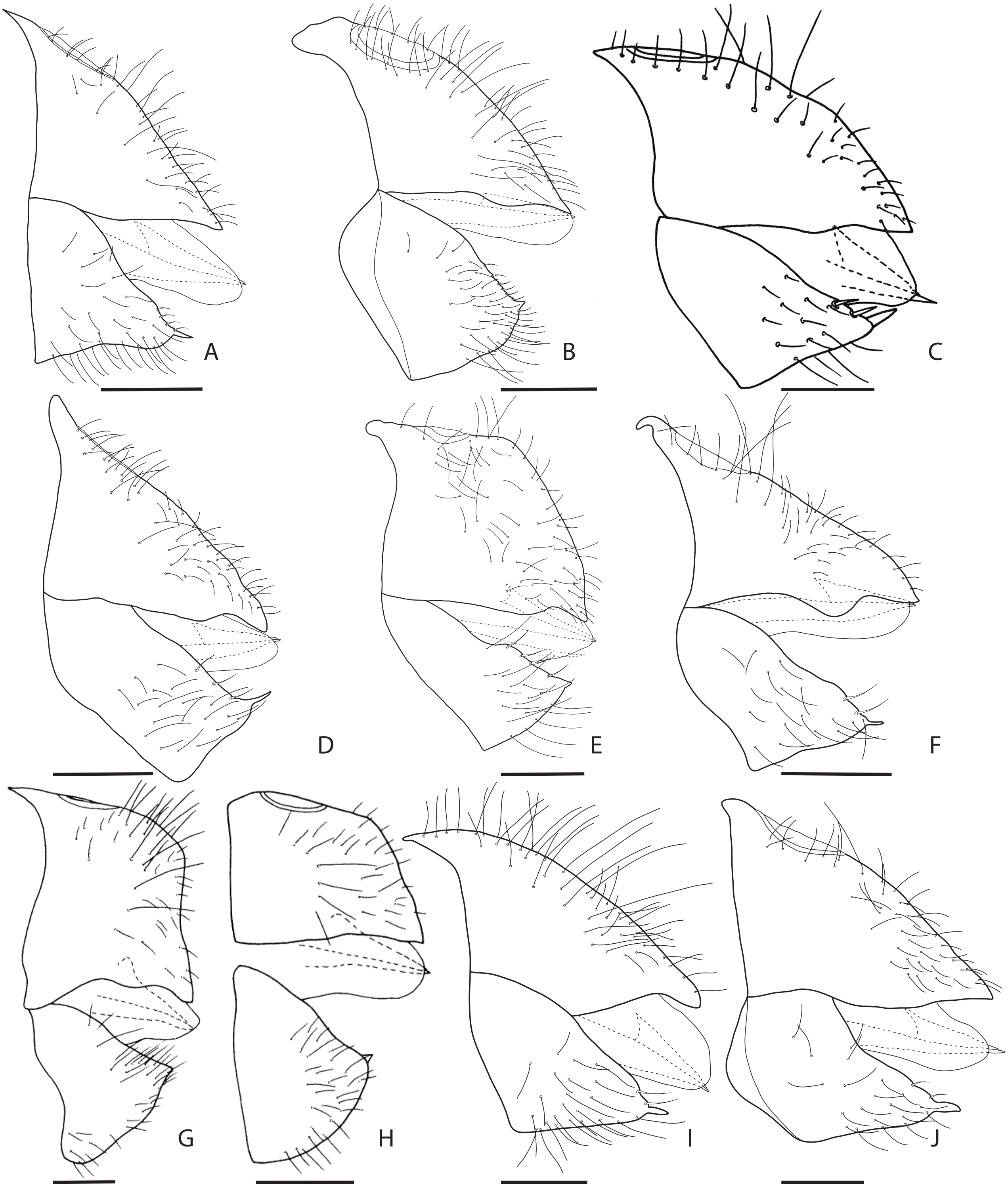


Figure 30

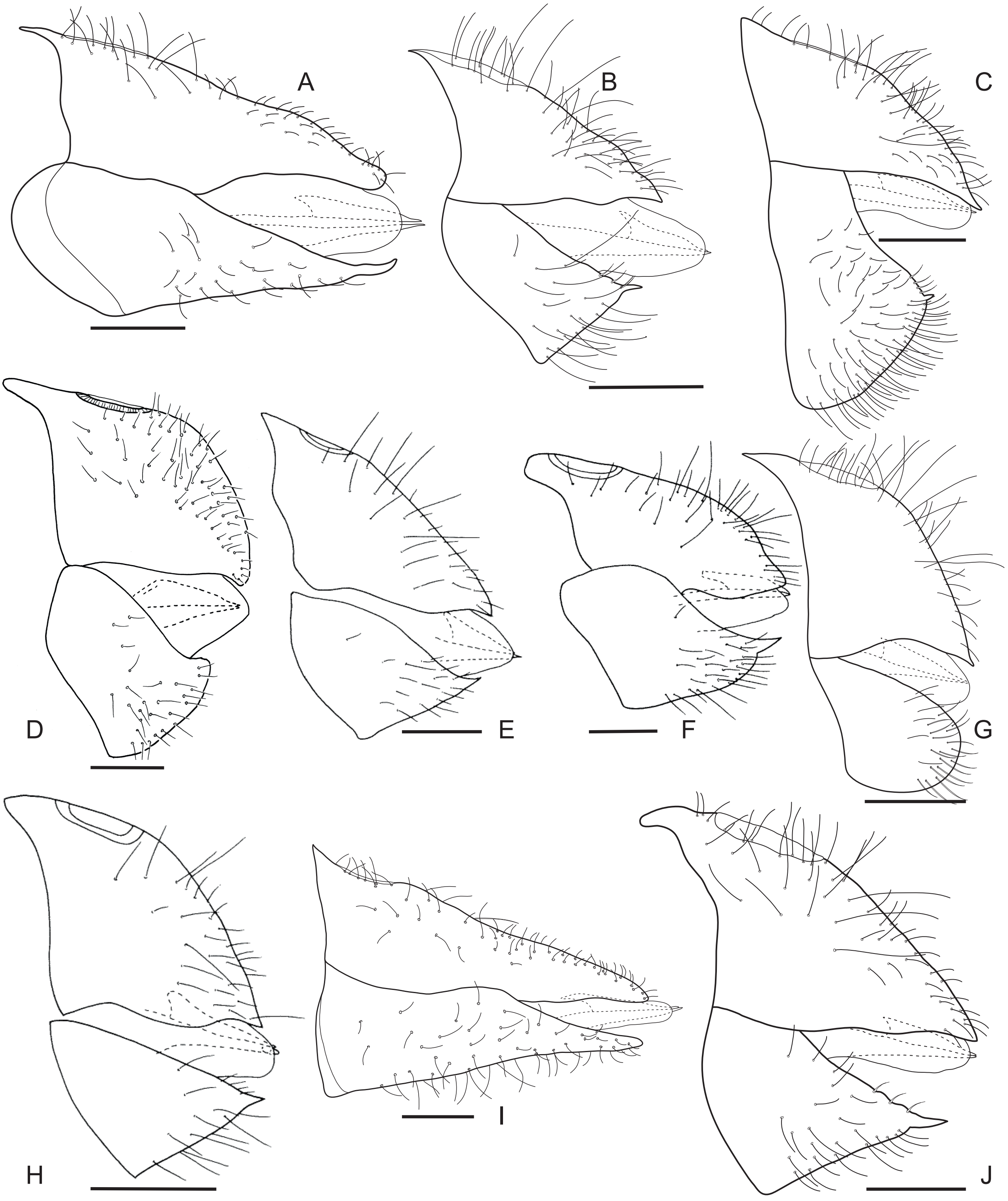


Figure 31

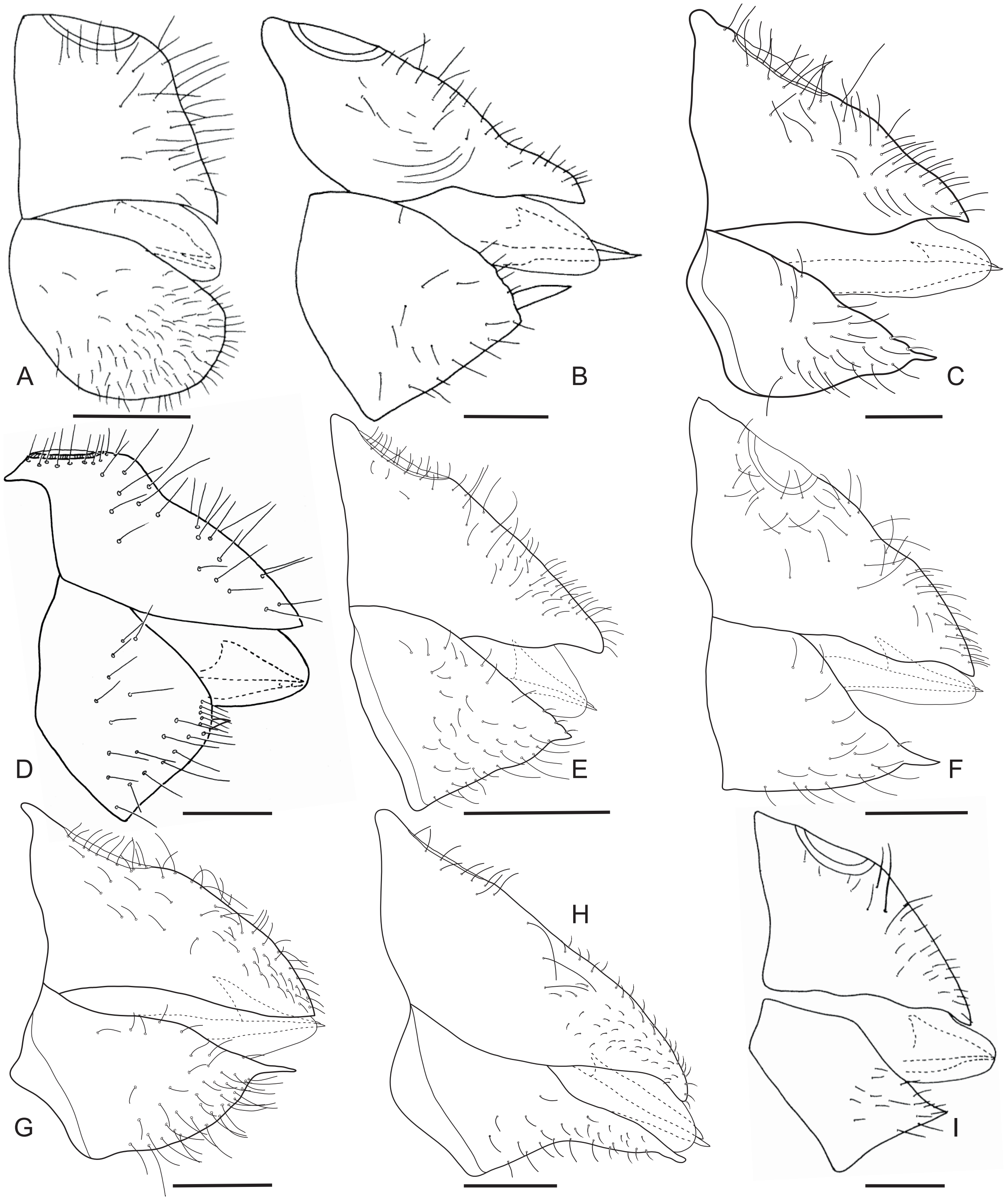


Figure 32

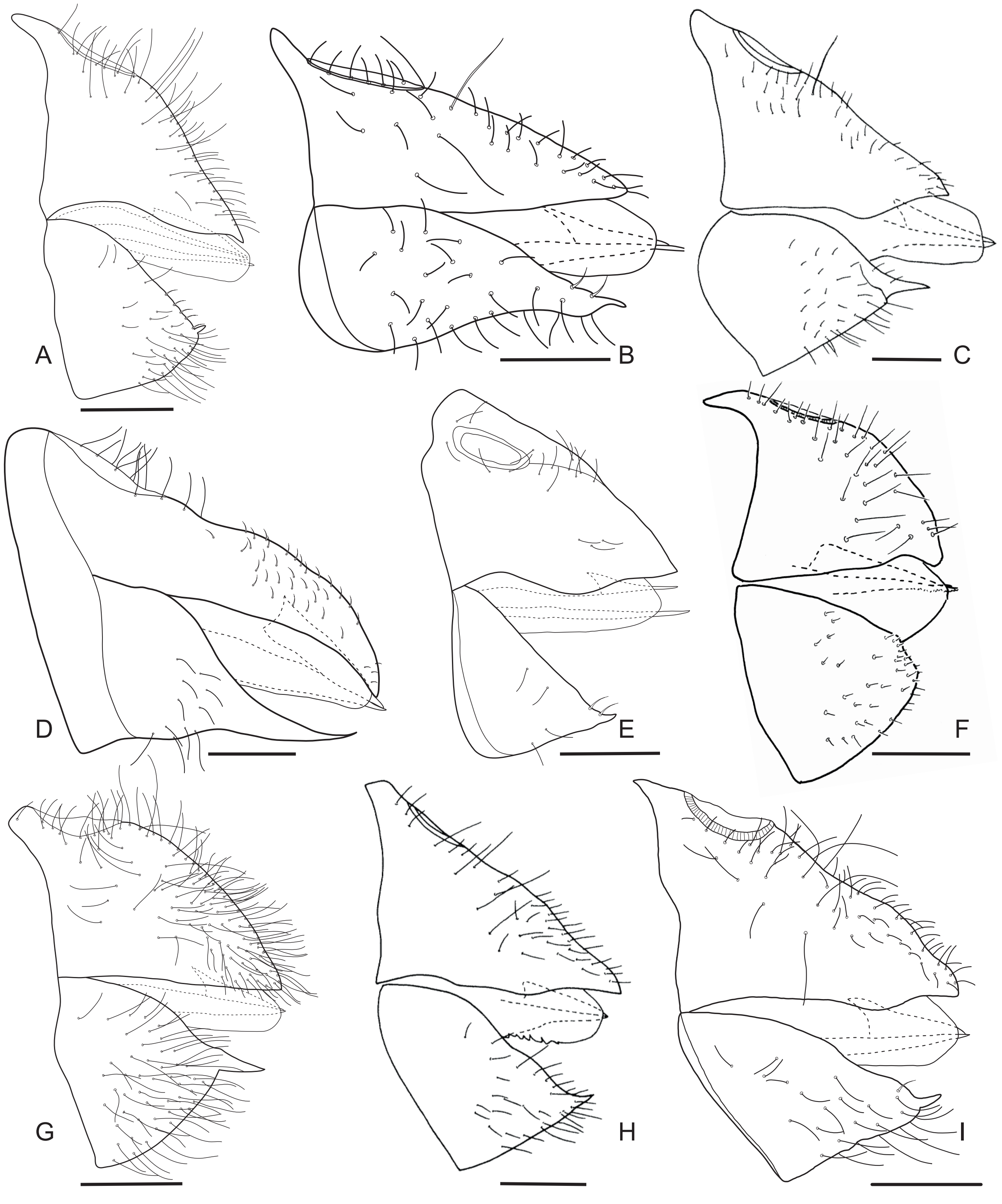


Figure 33

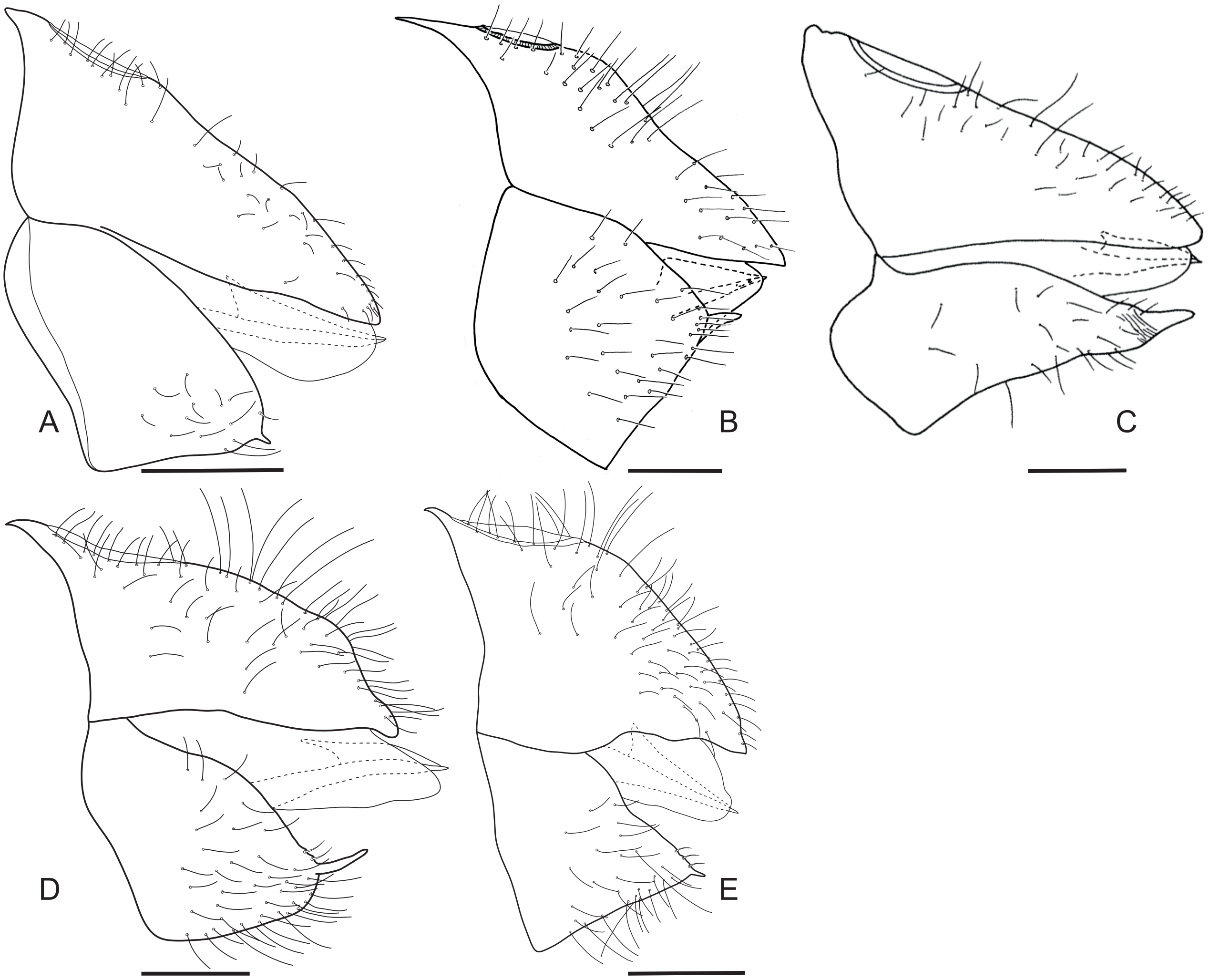
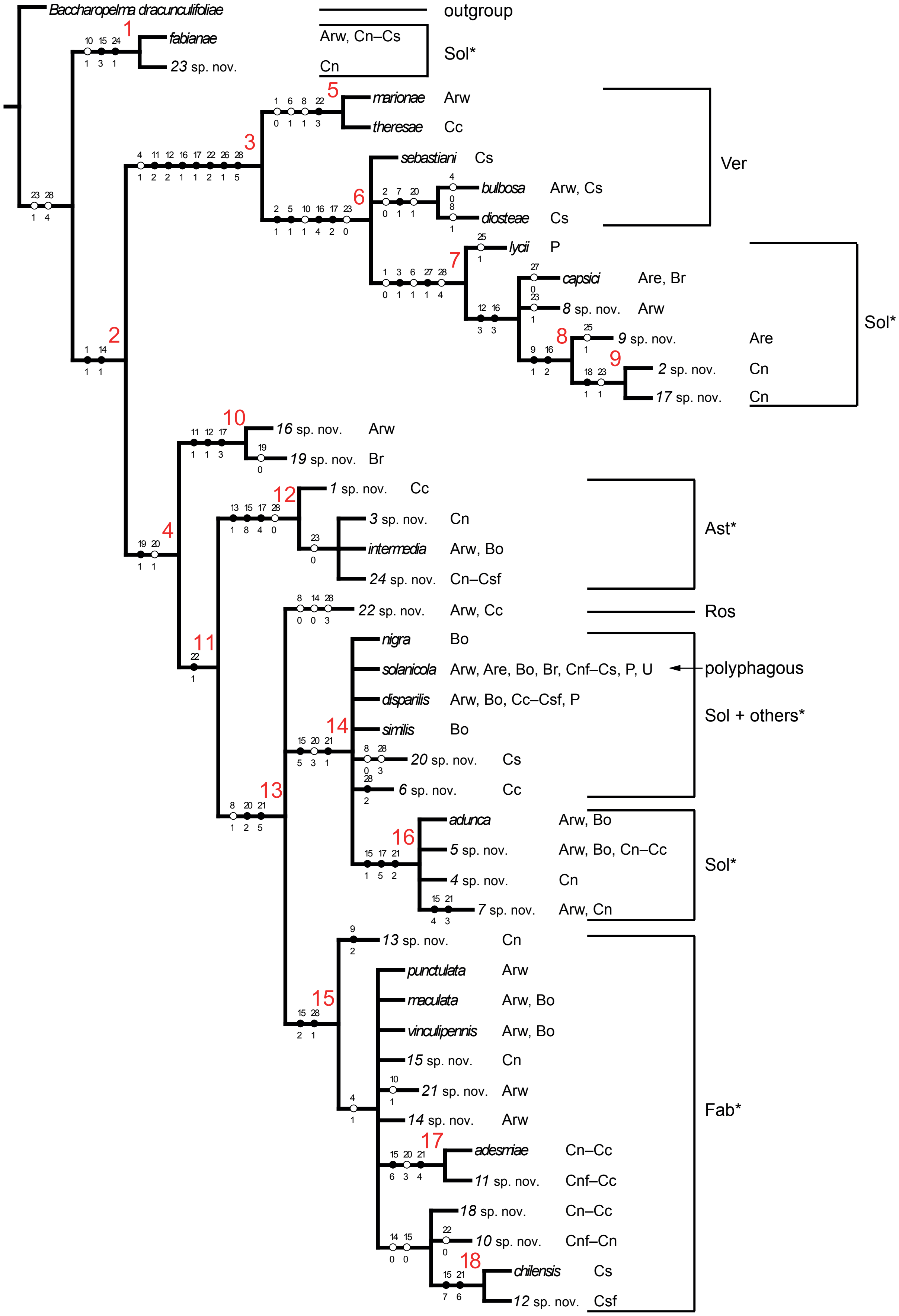


Figure 34


Baccharopelma dracunculifoliae
outgroup
1
fabianae
23 sp. nov.
Arw, Cn–Cs
Cn
Sol*
10 15 24
1 3 1
23 28
1 4
5
marionae Arw
theresae Cc
1 6 8 22
0 1 1 3
3
4 11 12 16 17 22 26 28
1 2 2 1 1 2 1 5
sebastiani Cs
6
bulbosa Arw, Cs
diosteae Cs
2 5 10 16 17 23
1 1 1 4 2 0
2 7 20
0 1 1
Ver
lycii P
7
capsici Are, Br
8 sp. nov. Arw
1 3 6 27 28
0 1 1 1 4
12 16
3 3
8
9 sp. nov. Are
9
2 sp. nov. Cn
17 sp. nov. Cn
9 16
1 2
18 23
1 1
Sol*
2
1 14
1 1
10
16 sp. nov. Arw
19 sp. nov. Br
11 12 17
1 1 3
19
0
12
1 sp. nov. Cc
3 sp. nov. Cn
intermedia Arw, Bo
24 sp. nov. Cn–Csf
13 15 17 28
1 8 4 0
23
0
Ast*
4
19 20
1 1
22 sp. nov. Arw, Cc
8 14 28
0 0 3
Ros
11
22
1
nigra Bo
solanicola Arw, Are, Bo, Br, Cnf–Cs, P, U
polyphagous
disparilis Arw, Bo, Cc–Csf, P
similis Bo
Sol + others*
14
15 20 21
5 3 1
20 sp. nov. Cs
8 28
0 3
6 sp. nov. Cc
28
2
13
8 20 21
1 2 5
16
adunca Arw, Bo
5 sp. nov. Arw, Bo, Cn–Cc
4 sp. nov. Cn
7 sp. nov. Arw, Cn
15 17 21
1 5 2
15 21
4 3
Sol*
13 sp. nov. Cn
9
2
punctulata Arw
maculata Arw, Bo
vinculipennis Arw, Bo
15 sp. nov. Cn
21 sp. nov. Arw
10
1
14 sp. nov. Arw
15
15 28
2 1
4
1
17
adesmiae Cn–Cc
11 sp. nov. Cnf–Cc
15 20 21
6 3 4
18 sp. nov. Cn–Cc
10 sp. nov. Cnf–Cn
22
0
14 15
0 0
18
chilensis Cs
12 sp. nov. Csf
15 21
7 6
Fab*

Chapter IV

The jumping plant-lice (Hemiptera: Psylloidea) of Belarus

Serbina, L., Burckhardt, D. & Borodin, O.

Revue suisse de Zoologie, 2015, 122 (1): 7–44

Листоблошки (Hemiptera: Psylloidea) фауны Беларуси [Psyllids (Hemiptera: Psylloidea) of Belarus]

Serbina, L., Burckhardt, D. & Borodin, O.

Proceedings of the Belarusian State University, 2015, 10 (1): 393–397

Revue suisse de Zoologie (mars 2015) 122 (1): 7-44 ISSN 0035-418

The jumping plant-lice (Hemiptera: Psylloidea) of Belarus

Liliya Serbina[1, 2], Daniel Burckhardt[1] & Oleg Borodin[3]

[1] *Naturhistorisches Museum, Augustinergasse 2, CH-4001 Basel, Switzerland*
[2] *Institut für Natur-, Landschafts- und Umweltschutz an der Universität Basel, St. Johanns-Vorstadt 10, CH-4056 Basel, Switzerland*
[3] *National Academy of Sciences, Akademicheskaya street 27, 220072 Minsk, Belarus*
Corresponding author: Liliya Serbina. E-mail: liliia.serbina@unibas.ch, liliya_serbina@mail.ru

Abstract: A checklist of the known psyllids of Belarus is given: 12 species (one of them doubtful) have been previously reported and 43 species are added here, bringing the number of confirmed species to 54. The psylloid fauna of the country remains poorly known. Based on information from surrounding countries, another 73 species can be expected. An illustrated identification key is provided for the 127 species whose occurence in Belarus has been confirmed or is likely.

Keywords: Psyllids - Sternorrhyncha - host-plants - faunistics - identification key - Europe - Palaearctic Region.

INTRODUCTION

Jumping plant-lice or Psylloidea, a superfamily of Sternorrhyncha, are plant-sap sucking insects (Photo 1). Most psyllid species are associated with dicotyledonous plants, and are usually highly host-plant specific. At present there are almost 4000 described psyllid species world-wide (Li, 2011) representing probably less than half of the actually existing species number. Despite the fact that psyllids are most species-rich in the tropics and south temperate regions, the west Palaearctic fauna is the one which is best studied with around 400 species reported from Europe (Burckhardt, 2004). The study of Eastern European psyllids was initiated by Flor (1861) with a survey on the fauna of Livonia followed by a large number of publications dealing with the European part of the former Soviet Union (Gegechkori & Loginova, 1990).

The information on the psyllid fauna of Belarus is, however, scarce with only 12 recorded species of which one is doubtful (Loginova, 1961, 1962b; Palyakova, 1969; Byazdzenka *et al.*, 1973; Gorlenko *et al.*, 1988; Sidlyarevich & Bolotnikova, 1992; Petrov, 2004, 2011; Petrov *et al.*, 2011; Petrov & Sautkin, 2013).

In the last 15 years psyllids were collected in all administrative regions of Belarus, mostly as by-catch of an Auchenorrhyncha survey. The aim of the present paper is to provide an updated checklist of psyllids from Belarus based on literature data and recently collected material. We also provide an illustrated identification key for the species recorded and those potentially occurring in Belarus, as the existing keys are outdated or incomplete.

MATERIAL AND METHODS

Unless stated otherwise, the material was collected by O. Borodin, is dry mounted and deposited in the Laboratory of Terrestrial Invertebrates of the State Science and Production Association "Research and Practical Centre of the National Academy of Sciences of Belarus for Bioresources" (Gosudarstvennoye Nauchno-Proizvodstvennoye Ob'yedineniye "Nauchno-Prakticheskiy Tsentr Natsional'noy Akademii Nauk Belarusi po Bioresursam") in Minsk. Material from the Naturhistorisches Museum, Basel (Switzerland) was examined for comparison.

For the transliteration of names and organisations from the Cyrillic to the Latin alphabet the BGN/PCGN system was used.

Morphological terminology mainly follows Ossiannilsson (1992), Hollis (2004) (wing venation) and Burckhardt (2010). Botanical nomenclature and classification follows Sautkina *et al.* (1999). Additional information on psyllid host-plants is available in Ossiannilsson (1992) and Ouvrard (2014). Generally useful identification keys are by Loginova (1964), Klimaszewski (1975) and Ossiannilsson (1992), though they are more or less outdated and should be used with caution. Photos and drawings were prepared from slide mounted specimens located in the Naturhistorisches Museum, Basel. Photos were made with KEYENCE VHX-2000 digital microscope.

Manuscript accepted 28.07.2014
DOI: 10.5281/zenodo.14578

Photo 1. Living *Livia junci*, photo kindly provided by Gernot Kunz.

Following abbreviations are used:
Checklist: BSU – Belarusian State University, MKAD – Minsk automobile ring road (Minskaya kol'tsevaya avtomobil'naya doroga).
Identification key: AEL – length of distal portion of aedeagus, ALHW – antenna length : head width ratio, FPHW – female proctiger length : head width ratio, MP – male proctiger length.

SYSTEMATIC ACCOUNT

Checklist

The checklist is alphabetical using the classification of Burckhardt & Ouvrard (2012).

Aphalaridae

Aphalarinae

Aphalara affinis (Zetterstedt, 1828)

Material examined: Minsk: 1 adult without abdomen, Molodechno district, nr Myasota, 6.ix.2002.

Aphalara avicularis Ossiannilsson, 1981

Material examined: Brest: 1♀, Stolin district, Belousha, 15.viii.2005.

Comments: The record of *A. polygoni* by Loginova (1961) from the Vitebsk region may concern *A. avicularis* or *A. freji*. Without revising the original material it is not possible to decide which species is concerned.

Aphalara freji Burckhardt & Lauterer, 1997

Material examined: Gomel': 1♂, Lel'chitsy district, 0.5 km NE Krasnoberezh'ye, river Ubort' floodplain, 5.viii.2004. – Minsk: 1♀, Minsk district, Shchemyslitsy, Dubrava Natural Monument, 26.ix.2013, on conifers (L. Serbina). – 3♂, same but nr Aksakovshchina, Wildlife sanctuary Podsady, 28.ix.2013, mixed forest. – 5♂, 1♀, same but nr Tarasovo, nr Gardeners' partnership Zvezdnoye, 29.ix.2013.

Comments: The record of *A. polygoni* by Loginova (1961) from the Vitebsk region may concern *A. avicularis* or *A. freji*. Without revising the original material it is not possible to decide which species is concerned.

Craspedolepta crispati Lauterer & Burckhardt, 2004

Material examined: Minsk: 4♂, 2♀, Volozhin district, Rakov, 28.vii.1997, meadow.

Craspedolepta flavipennis (Foerster, 1848)

Material examined: Minsk: 1♀, Myadel' district, Logoviny, train station, 5.vii.2009, meadow (L. Serbina).

Craspedolepta latior Wagner, 1944

Material examined: Minsk: 2♂, 1♀, Minsk district, river Ptich' bank, nr train station Ptich', 15.vii.2009 (L. Serbina). – 1♀, same but Molodechno district, nr Vyazynka, canal bank, 9.vii.2002. – 11♂, 27♀, same but Myadel' district, Logoviny, nr train station, 5.vii.2009, meadow (L. Serbina). – 1♂, 1♀, same but nr Naroch', 9.vii.2009.

Craspedolepta malachitica (Dahlbom, 1851)

Material examined: Gomel': 1♀, Kalinkovichi district, 0.5 km E Turovichi, 23.vii.2005, dry meadow, on *Artemisia* sp. – Grodno: 1 adult without abdomen, Mosty district, 3.5 km NW Peski, river Zel'vyanka floodplain, 24.vi.2005 (Y. Gerashchenko). – Minsk: 4♀, Minsk district, Shchemyslitsy, Dubrava Natural Monument, 15.v.2008 (L. Serbina). – 2♀, same but river Ptich' bank, nr train station Ptich', June 2008. – 1♀, same but Molodechno district, nr Povyazyn', 1.vii.2001. – 2♂, same but nr canal bank, 9.vi.2002. – 1♂, same but nr Radoshkovichi, slope Minsk-Vileyka channel system, 22.vi.2005. – 1♀, same but nr Sitsevichi, 12.vii.2005, pine forest (A. Egiyan). – 2♂, 6♀, same but river Udranka bank, nr bus stop, 14.vii.2009 (L. Serbina). – 1♂, 2♀, same but Myadel' district, nr Naroch', 2.vii.2009. – 10♂, 24♀, same but Logoviny, nr train station, 5.vii.2009. – 84♂, 99♀, same but nr Naroch', 9.vii.2009. – 1♀, same but Volozhin district, nr Kaldyki, 11.vii.2007, mixed forest. – Vitebsk: 2♀, Lepel' district, nr Domzheritsy, nr boarding school and pond, 31.vii.2001, on *Artemisia dracunculus*. – 1♀, same but river Buzyanka, 300 m upstream from boat station, 1.viii.2001.

Craspedolepta nervosa (Foerster, 1848)

Material examined: Grodno: 1♀, Mosty district, 3.5 km NW Peski, 24.vi.2005, river Zel'vyanka floodplain. – Minsk: 1♀, Borisov district, 2 km NW Peresady, nr train station "Proletarskaya pobeda", lowland, 6.viii.2002, pine forest. – 1♀, same but Logoysk district, nr Besyady, river Udra floodplain, 26.vi.2002. – 1♀, same but Kupalovskiy National Park, nr Lekarovka, 7.vii.2004, dry meadow. – 4♂, 3♀, same but 0.5 km SW Matski, hill, meadow. – 1♀, same but Minsk district, nr train station Kryzhovka, 3.vi.2001, meadow in pine forest. – 1♂, 1♀, same but nr Chirovichi, 9.vi.2002, dry meadow. – 1♂, same but Shchemyslitsy, nr Biological Faculty, BSU, 18.vi.2002. – 1♀, same but Dubrava Natural Monument, 19.vi.2002. – 1♀, same but nr Biological Faculty, BSU, 1.vii.2002. – 1♂, 3♀, same but 19.vi.2006 (L. Serbina). – 1♂, same but Molodechno district, nr Vyazynka, 16.vi.2001, dry meadow. – 1♀, same but 2.vii.2001. – 1♂, same but 0.5 km E Vyazynka, hill, 3.vii.2001. – 1♂, same but nr Vyazynka, canal bank, 12.vi.2002. – 1♂, 3♀, nr Shipulichi, river Zapadnaya Berezina bank, 27.vi.2002. – 1♂, same but river Udranka bank, nr bus stop, 14.vii.2009 (L. Serbina). – 1♂, 1♀, same but Myadel' district, nr Naroch', 2.vii.2009. – 2♂, 3♀, same but Logoviny, nr train station, 5.vii.2009, meadow. – 3♂; same but 0.5 km S Nikol'tsy, Gomza Dendrological Garden, 6.vii.2009. – 1♂, 1♀, same but Soligorsk district, 7 km from Soligorsk, 24.vi.2004 (A. Egiyan). – 1♀, same but 25.vi.2004. – 1♀, same but Stolbtsy district, nr train station Kolosovo, 26.v.1993, field in front of pine forest (V. Karasev). – Vitebsk: 2♂, 2♀, Gorodok district, 17.vi.2008, dry meadow, on *Achillea millefolium*.

Craspedolepta omissa Wagner, 1944

Material examined: Minsk: 1♀, Logoysk district, Kupalovskiy National Park, nr Lekarovka, 7.vii.2004, dry meadow. – 1♀, same but Minsk district, 2 km NE Shchemyslitsy, along train station, 12.vii.2005, forest plantation. – 2♂, 1♀, same but river Ptich' bank, nr train station Ptich', 15.vii.2009 (L. Serbina). – 2♀, same but Botanical Garden (Minsk), 16.vii.2009. – 1♂, same but Molodechno district, nr Vyazynka, station, hill, 3.vii.2001. – 2♂, 2♀, same but nr station Shipulichi, 27.vi.2002, river Zapadnaya Berezina bank, on *Artemisia* sp. – 1♂, same but Myadel' district, nr Naroch', 2.vii.2009 (L. Serbina). – 6♂, 10♀, same but Logoviny, nr train station, 5.vii.2009. – 1 adult without abdomen, same but nr Antonisberg, 300 m behind resting place, meadow. – 3♂, 5♀, same but 0.5 km S Nikol'tsy, Gomza Dendrological Garden, 6.vii.2009. – 1♀, same but nr Naroch', 9.vii.2009. – 1♂, same but Vileyka district, nr hydraulic station, 0.5 km N Budishche, 9.vii.2005, dry meadow.

Craspedolepta subpunctata (Foerster, 1848)

Material examined: Minsk: 1♀, Molodechno district, nr Vyazynka, 16.vi.2001, willow thicket. – 1♀, same but nr Chirovichi, 9.vi.2002.

Rhinocolinae

Rhinocola aceris (Linnaeus, 1758)

Material examined: No locality data, 1♂, 1♀ (S. Buga).

Liviidae

Euphyllurinae

Psyllopsis discrepans (Flor, 1861)

Material examined: Gomel': 1♀, Khoyniki district, Orevichi, Polesskiy Natural Reserve, 21.viii.1991, Malaise trap. – Minsk: 15♂, 30♀, Soligorsk district, 7 km from Soligorsk, 24.vi.2004 (A. Egiyan).

Psyllopsis distinguenda Edwards, 1913

Material examined: Vitebsk: 1♂, 1♀, Gorodok district, Carla-Marksa Street, 17.vi.2008, on *Fraxinus* sp. (S. Buga).

Psyllopsis fraxini (Linnaeus, 1758)

Records: Recorded by Petrov (2011) from the south central region of the Belarusian Ridge.

Psyllopsis fraxinicola (Foerster, 1848)

Material examined: Minsk: 1♂, Soligorsk district, 7 km from Soligorsk, 24.vi.2004 (A. Egiyan).

Strophingia ericae (Curtis, 1835)

Material examined: Grodno: 2♀, Iv'yev district, Naliboki pushcha, 4 km NE Malaya Chapun', 22.vi.2002, pine forest, on *Calluna* sp.

Liviinae

Camarotoscena speciosa (Flor, 1861)

Material examined: Minsk: 1♂, Minsk, alley nr Lyubimov Ave., 23.iv.2013, on *Tilia* sp. – 3♀, same but Botanical Garden (Minsk), 26.iv.2013, on *Rhododendron* sp. (L. Serbina).

Psyllidae

Psyllinae

Arytaina genistae (Latreille, 1804)

Material examined: Vitebsk: 2♂, 1♀, Lepel' district, nr Kraytsy, 1 km along road in direction Perechodtsy, 2.viii.2001, pine forest.

Baeopelma foersteri (Flor, 1861)

Records: Recorded by Loginova (1962b) as *Psylla foersteri* from the Vitebsk region.

Material examined: Gomel': 2♂, 3♀, Zhitkovichi district, Khvoyensk, 11.vii.1999, pine forest, on *Alnus glutinosa* (S. Buga). – 3♂, same but 1.5 km SW Novyye Milevichi, river Sluch' floodplain, 4.viii.2004. – 15♂, 9♀, same but 2 km SW Otskovannoye, 5.viii.2004. – 1♂, same but nr Novyye Milevichi, nr river Sluch', 15.ix.2004. – Minsk: 1♂, 2♀, Logoysk district, 0.5 km SW Matski, hill, 7.vii.2004, meadow. – 1♀, same but Minsk district, Kupalovskiy National Park, nr Lekarovka, dry meadow, on *Alnus incana*. – 1♂, 1♀ same but Botanical Garden (Minsk), 16.vii.2009, on *Alnus* sp. (L. Serbina). – 2♂, 1♀, same but river Ptich' bank, nr train station Ptich', 22.vii.2009. – 3♂, 5♀, same but Myadel' district, Naroch', nr Antonisberg, 30.vi.2005, (A. Egiyan). – 4♂, 3♀, same but 1.vii.2005, on *Alnus incana*. – 1♀, same but nr Naroch', 3.vii.2009, on *Alnus* sp. (L. Serbina). – 1♂, same but 0.5 km S Nikol'tsy, Gomza Dendrological Garden, 6.vii.2009. – 1♀, same but Soligorsk district, Soligorsk, 25.vi.2004 (A. Egiyan). – 5♂, 4♀, same but Volozhin district, Rakov, river Isloch' floodplain, 28.vii.2004. – 3♂, 6♀, same but on *Alnus glutinosa*. – 2♂, 2♀, same but nr Kaldyki, 19.vii.2007, mixed forest, on *Alnus* sp. (L. Serbina). – Mogilev: 1♀, Klichev district, Lozovitsa, 20.vii.1997, pine forest. – Vitebsk: 1♀, Postavy district, lake Chetvert' south bank, 10.vii.2005.

Cacopsylla ambigua (Foerster, 1848)

Material examined: Brest: 2♂, Drogichin district, Wildlife sanctuary "Zvonets", 16.vi.1999. – Gomel': 2♀, Zhitkovichi district, 1.5 km SW Novyye Milevichi, river Sluch' floodplain, 4.viii.2004, on *Salix* sp. – Grodno: 1 adult without abdomen, Iv'yev district, Naliboki pushcha, 0.5 km S Potashnya, nr river, 22.viii.2002, meadow (E. Shestakov). – Minsk: 4♂, 8♀, Logoysk district, nr Gayany, 28.vi.2004, on *Salix* sp. – 1♂, 2♀, same but Minsk district, train station Kryzhovka, river Poplav bank, 3.vi.2001, floodplain meadow. – 2♀, same but nr Shchemyslitsy, NW Dubrava Natural Monument, 6.vi.2002. – 1♀, 1 adult without abdomen, same but 15.vi.2002. – 4♀, same but 18.vi.2002. – 2♀, same but 4.vii.2002. – 1♂, 1♀, same but field between MKAD Kurasovshchina and South-West district, 24.v.2003. – 1♂, same but Shchemyslitsy, nr Biological Faculty, BSU, 19.vi.2006. – 1♂, 4♀, same but Molodechno district, nr Vyazynka, 16.vi.2001, bog. – 1♂, 3♀, same but nr station Shipulichi, river Zapadnaya Berezina floodplain, meadow edge, 27.vi.2002. – 1♀, same but nr Vyazynka, 20.v.2003. – Vitebsk: 1♂, Gorodok district, 2 km NE Machalovo, river Lovat' floodplain, 4.vi.2000, bog (S. Buga).

Cacopsylla brunneipennis (Edwards, 1896)

Material examined: Minsk: 2♂, 3♀, Logoysk district, Gayany, 28.vi.2004. – 2♂, 3♀, same but Minsk district, nr Aksakovshchina, Wildlife sanctuary Podsady, 28.ix.2013, mixed forest, on conifers (L. Serbina).

Cacopsylla crataegi (Schrank, 1801)

Records: Recorded from Belarus by Gorlenko *et al*. (1988) as *Psylla crataegi* and by Petrov & Sautkin (2013) as *Cacopsylla crataegi* from the Minsk region.

Cacopsylla hippophaes (Foerster, 1848)

Material examined: Minsk: 1♂, 3♀, Minsk district, nr Tarasovo, nr Gardeners' partnership Zvezdnoye, 29.ix.2013, on *Hippophae rhamnoides* (L. Serbina).

Cacopsylla ledi (Flor, 1861)

Material examined: Gomel': 1♀, Zhitkovichi dictrict, Pripyatskiy National Park, 11.vii.1999, pine forest, on *Ledum* sp. – Minsk: 1♀, Myadel' district, 1 km SW Kochergi, 16.vii.2005, pine forest, on *Ledum* sp. – 1♀, same but Leytsy, 5.v.2008. – Mogilev: 1♀, Klichev district, Razvadovo, 20.vii.1997, pine forest, on *Ledum* sp. – 1♂, 1♀, same but Lozovitsa, 31.viii.1997. – 1♀, Razvadovo, 23.vii.1998. – 3♀, same but 17.viii.1998. – 1♂, same but, 17.ix.2000, pine forest. – Vitebsk: 1♂, Dokshitsy district, Krulevshizna, 11.vii.2000, pine forest (L. Chumakov). – 1♀, same but 22.x.2000. – 1♀, same but Rossony district, 0.8 km N Osinniki, 11.ix.1998, pine forest, on *Ledum* sp.

Cacopsylla mali (Schmidberger, 1836)

Records: Recorded by Byazdzenka (1973) as *Psylla mali* from the Minsk region.

Material examined: Minsk: 1♂, Logoysk district, Kupalovskiy National Park, nr Lekarovka, 7.vii.2004, dry meadow. – 1♂, 2♀, same but Minsk district, Shchemyslitsy, Dubrava Natural Monument, 16.ix.1997, on *Malus sylvestris* (S. Buga). – 1♀, same but 15.vii.2009, on *Malus* sp. (L. Serbina). – 1♀, same but Molodechno district, nr Vyazynka, 16.vi.2001, bog. – 2♀, same but 29.vii.2001. – 1♀, same but nr station Shipulichi, river Zapadnaya Berezina floodplain, 27.vi.2002. – 2♀, same but Myadel' district, Naroch' orchards, 2.vii.2009 (L. Serbina). – 1♀, same but Volozhin district, nr Kaldyki, 11.vii.2007, mixed forest.

Cacopsylla mali (Schmidberger, 1836) group

Material examined: Minsk: 1♀, Logoysk district, Kupalovskiy National Park, nr Lekarovka, 7.vii.2004, meadow. – 1♀, same but Minsk district, Shchemyslitsy, Dubrava Natural Monument, 15.vi.2002. – 1♀, same but nr Biological Faculty, BSU, 1.vii.2002. – 1♀, same but Molodechno district, nr Vyazynka, 1.vi.2001. – 1 adult without abdomen, same but Myadel' district, nr Naroch', 4.vii.2009 (L. Serbina). – 1♂, same but Nesvizh district, nr Nesvizh, 29.vi.2004, on *Prunus cerasifera*.

Comment: Due to the poor state of the material the specimens cannot be identified to species. They could be any member of the *C. mali* group: *C. mali*, *C. peregrina*, *C. sorbi* or *C. ulmi*.

Cacopsylla moscovita (Andrianova, 1948)

Material examined: Grodno: 1♂, 1♀, Iv'yev district, Naliboki pushcha, 4.5 km E Malaya Chapun', 22.viii.2002, on *Salix* sp.

Cacopsylla parvipennis (Löw, 1877)

Material examined: Minsk: 1♀, Myadel' district, 2 km W Cheremshitsy, river Narochanka floodplain, 9.vii.2005.

Cacopsylla peregrina (Foerster, 1848)

Material examined: Minsk: 3♂, 7♀, Logoysk district, Kupalovskiy National Park, nr Lekarovka, 7.vii.2004, dry meadow. – 1♂, 1♀, same but Minsk district, stop "Kurasovshchina", 9.ix.1997, on *Crataegus* sp. (S. Buga). – 4♀, same but stop "Bol'nitsa", 13.ix.1997. – 4♂, 4♀, same but Shchemyslitsy, Dubrava Natural Monument, 21.v.1999. – 3♀, same but station "Polzhelishche", 18.ix.1999. – 2♀, same but Shchemyslitsy, track nr bus stop "Filial BGU", 11.vii.2009 (L. Serbina). – 1♂, 1♀, same but 22.vii.2009. – 15♀, same but 29.vii.2009. – 3♂, 4♀, same but Volozhin district, nr Kaldyki, 19.vii.2007, mixed forest.

Cacopsylla pulchella (Löw, 1877)

Material examined: Gomel': 8♂, 2♀, Khoyniki district, Orevichi, 21.v.-18.vi.1991, Malaise trap. – 2♂, same but Zhitkovichi district, 14 km from Chvoensk, Pripyatskiy National Park, 26.viii.1999, pine forest. – Minsk: 2♂, Molodechno district, nr Vyazynka, 16.vi.2001, dry meadow.

Cacopsylla pulchra (Zetterstedt, 1838)

Material examined: Gomel’: 1♂, Zhitkovichi district, Pripyatskiy National Park, 20.x.1998, pine forest. – Minsk: 1♂, Logoysk district, Gayany, 28.vi.2005. – 2♂, 1♀, same but Minsk district, nr Aksakovshchina, Wildlife sanctuary Podsady, 28.ix.2013, mixed forest, on conifers (L. Serbina). – 1♂, same but Molodechno district, nr Vyazynka, 16.vi.2001, bog, on *Salix* sp.

Cacopsylla pyri (Linnaeus, 1758)

Records: Recorded from Belarus by Palyakova (1969), Gorlenko *et al.* (1988) as *Psylla pyri*.

Cacopsylla pyrisuga (Foerster, 1848)

Records: Recorded from Belarus by Palyakova (1969) as *Psylla pyrisuga*.

Cacopsylla saliceti (Foerster, 1848) group

Material examined: Grodno: 1♀, Iv’yev district, Naliboki pushcha, 2 km S Potashnya, 23.vi.2002, on *Salix* sp. – 1♀, same but 4.5 km E Malaya Chapun’, 28.ix.2002. – Minsk: 1♀, Minsk district, nr Kryzhovka station, 3.vi.2001, alder forest. – 1♀, same but Myadel’ district, Leytsy, 25.vi.2008. – 1♀, same but 0.5 km S Nikol’tsy, Gomza Dendrological Garden, 6.vii.2009, on *Salix* sp. (L. Serbina).

Comment: Single females of this species group cannot be correctly identified to species.

Cacopsylla sorbi (Linnaeus, 1767)

Material examined: Minsk: 38♂, 32♀, Myadel’ district, Naroch’, nr Antonisberg, 28.vi.2005, on *Sorbus* sp. (A. Egiyan).

Cacopsylla ulmi (Foerster, 1848)

Records: Recorded by Petrov (2011) from the south central region of the Belarusian Ridge.

Material examined: Gomel’: 3♂, 3♀, Khoyniki district, Orevichi, Pripyatskiy National Park, 23.vii.1991, Malaise trap. – 6♂, 32♀, same but Polesskiy Natural Reserve, 21.viii.1991. – 1♀, same but Zhitkovichi district, Khvoyensk, truck patch, 14.vii.1999 (S. Buga). – Minsk: 1♂, Minsk district, Shchemyslitsy, nr train station “Roshcha”, 15.vii.2009, on *Ulmus* sp. (L. Serbina).

Chamaepsylla hartigii (Flor, 1861)

Material examined: Minsk: 1♀, Logoysk district, Kupalovskiy National Park, nr Lekarovka, 7.vii.2004, dry meadow, on *Betula pendula*.

Psylla alni (Linnaeus, 1758)

Material examined: Brest: 4♂, 2♀, Gantsevichi district, 3 km SE Borki, 23.vii.2005, pine forest. – Gomel’: 2♀, Zhitkovichi district, 1.5 km SW Novyye Milevichi, river Sluch’ floodplain, 4.viii.2004. – 3♂, 5♀, 2 km, same but SW Otskovannoye, 5.viii.2004. – Grodno: 1♀, Mosty district, 3.5 km NW Peski, river Zel’vyanka floodplain, 23.vi.2005. – 1♀, same but 24.vi.2005. – Minsk: 62♂, 66♀, Logoysk district, nr Gayany, roadside lowland, 28.vi.2004, on *Alnus incana*. – 1♀, same but Kupalovskiy National Park, nr Lekarovka, 7.vii.2004. – 3♂, 6♀, same but 0.5 km SW Matski, hill, meadow. – 3♂, 4♀, same but Molodechno district, nr Vyazynka, 16.vi.2001, bog. – 6♂, 3♀, same but 1.vii.2001, on *Alnus* sp. – 2♂, 4♀, same but river Udranka bank, nr bus stop, 2.vii.2008, on *Alnus incana* (L. Serbina). – 1♂, same but nr Naroch’, 3.vii.2009, on *Alnus* sp. – 2♀, same but Nesvizh district, park “Al’ba”, 29.vi.2004. – 2♂, 5♀, same but Volozhin district, Rakov, river Isloch’ floodplain, 28.vii.2004, on *Alnus glutinosa*. – Vitebsk: 1♂, Gorodok district, 0.3 km SW Zadrach’ye, river Zadrach bank, 7.vi.2000, on *Alnus incana* (S. Buga).

Psylla betulae (Linnaeus, 1758)

Material examined: Mogilev: 1♀, Klichev district, Razvadovo, 23.vii.1988, pine forest.

Psylla buxi (Linnaeus, 1758)

Records: Recorded by Petrov *et al.* (2011), Petrov & Sautkin (2013) from the Minsk region.

Psylla fusca (Zetterstedt, 1828)

Material examined: Minsk: 1♀, Logoysk district, Kupalovskiy National Park, nr Lekarovka, 26.vi.2002, dry meadow. – 28♂, 23♀, same but nr Gayany, downhill, 28.vi.2004, on *Alnus incana*. – 1♂, 1♀, same but Kupalovskiy National Park, nr Lekarovka, 7.vii.2004, dry meadow. – 5♂, 4♀, same but 0.5 km SW Matski, hill, meadow. – 1 adult without abdomen, same but Molodechno district, nr Vyazynka, station, 1.vii.2001. – 1♂, same but 2.vii.2001, on *Alnus* sp. – 1 adult without abdomen, same but 29.vii.2001, linden alley. – 20♂, 17♀, same but river Udranka bank, nr bus stop, 2.vii.2008, on *Alnus incana* (L. Serbina). – 1♂, same but Volozhin district, nr Kaldyki, 19.vii.2007, mixed forest, on *Alnus* sp.

Triozidae

Bactericera acutipennis (Zetterstedt, 1828)

Material examined: Vitebsk: 3♂, 1♀, Dokshitsy district, nr station Krulevshizna, 20.x.2000, pine forest (L. Chumakov).

Bactericera curvatinervis (Foerster, 1848)

Material examined: Minsk: 1♂, Minsk district, nr Aksakovshchina, Wildlife sanctuary Podsady, 28.ix.2013, mixed forest, on conifers (L. Serbina). – 1♂, 2♀, same but nr Tarasovo, nr Gardeners' partnership Zvezdnoye, 29.ix.2013. – Vitebsk: 1♂, Dokshitsy district, nr station Krulevshizna, 20.x.2000, pine forest (L. Chumakov).

Bactericera ? femoralis (Foerster, 1848)

Material examined: Vitebsk: 1♀, Dokshitsy district, station Krulevshizna, 20.x.2000, pine forest (L. Chumakov).

Comment: Due to the poor state of the specimen at hand the identification is questionable and it could be also *Bactericera acutipennis* or *B. bohemica*.

Bactericera reuteri (Šulc, 1913)

Material examined: Gomel': 2♂, Khoyniki district, Orevichi, Pripyatskiy National Park, 23.vii.1991, Malaise trap.

Bactericera striola (Flor, 1861)

Records: Recorded by Loginova (1962b) as *Trioza striola* from the Vitebsk region.

Bactericera substriola Ossiannilsson, 1992

Material examined: Minsk: 1♂, Minsk district, Shchemyslitsy, Dubrava Natural Monument, 4.vii.2002, on *Salix* sp. – 1♂, same but Molodechno district, station Shipulichi, river Zapadnaya Berezina bank, 27.vi.2002.

Trichochermes walkeri (Foerster, 1848)

Records: Recorded from Belarus by Petrov (2004).

Material examined: Minsk: 1♂, Molodechno district, nr Vyazynka, 29.vii.2001.

Trioza anthrisci Burckhardt, 1986

Material examined: Minsk: 1♂, 1♀, Minsk district, nr Tarasovo, nr Gardeners' partnership Zvezdnoye, 29.ix.2013, on conifers (L. Serbina). – 1♀, same but Molodechno district, station Shipulichi, canal bank, 27.vi.2002. – Vitebsk: 1♂, Postavy district, lake Chetvert' south bank, 10.vii.2005.

Trioza apicalis Foerster, 1848

Records: Recorded from Belarus by Sidlyarevich & Bolotnikova (1992).

Trioza cerastii (Linnaeus, 1758)

Material examined: Minsk: 1♀, Volozhin district, nr Kaldyki, 11.vii.2007, mixed forest (L. Serbina).

Trioza flavipennis Foerster, 1848

Material examined: Minsk: 1♀, 3♀, Minsk district, nr Aksakovshchina, Wildlife sanctuary Podsady, 28.ix.2013, mixed forest, on conifers (L. Serbina).

Trioza galii Foerster, 1848

Material examined: No locality data, 1♂ (S. Buga).

Trioza proxima Flor, 1861

Material examined: Minsk: 1♀, Minsk district, nr Aksakovshchina, Wildlife sanctuary Podsady, 28.ix.2013, mixed forest, on conifers (L. Serbina).

Trioza remota Foerster, 1848

Material examined: Gomel': 4♀, Zhitkovichi district, Pripyatskiy National Park, 20.x.1998, pine forest (L. Chumakov). – Minsk: 2♂, 3♀, Minsk district, Shchemyslitsy, Dubrava Natural Monument, 26.ix.2013, on conifers (L. Serbina).

Trioza urticae (Linnaeus, 1758)

Material examined: Gomel': 9♂, 10♀, Zhitkovichi district, Krasnosel'ye, Pripyatskiy National Park, 21.v.1991, Malaise trap. – 1♂, 6♀, same but Orevichi, 21.v.-18.vi.1991. – 8♂, 20♀, same but 23.vii.1991. – Minsk: 3♂, 3♀, Logoysk district, Kupalovskiy National Park, nr Besyady, river Udra floodplain, 26.vi.2002, on various plants including *Urtica dioica*. – 1♂, 1♀, same but Minsk district, nr train station Kryzhovka, river Poplav bank, 3.vi.2001, floodplain meadow. –

1♂, same but nr Chirovichi, hill, 9.vi.2002, dry meadow. – 13♂, 4♀, same but Shchemyslitsy, Dubrava Natural Monument, 15.v.2008, on *Urtica dioica* (L. Serbina). – 1♂, same but 15.viii.2008. – 1 adult without abdomen, same but 25.vi.2009. – 2♂, 2♀, same but Botanical Garden (Minsk), 16.vii.2009. – 2♂, 14♀, same but Shchemyslitsy, Dubrava Natural Monument, 27.vii.2009. – 4♂, 2♀, same but 26.ix.2013, on conifers. – 1♂, 1♀, same but nr Aksakovshchina, Wildlife sanctuary Podsady, 28.ix.2013, mixed forest. – 1♂, same but nr Tarasovo, Gardeners' partnership Zvezdnoye, 29.ix.2013. – 7♂, 3♀, same but on conifers. – 2♂, 7♀, same but Molodechno district, nr Vyazynka, 16.vi.2001. – 1♂, 1♀, same but 17.vi.2001, alder forest. – 3♂, 4♀, same but nr train station Shipulichi, river Zapadnaya Berezina bank, 27.vi.2002. – 1♀, same but nr Sitsevichi, riverbank, behind station, 18.v.2007. – 3♀, same but river Udranka bank, nr bus stop, 2.vii.2008 (L. Serbina). – 1♂, 1♀, same but Myadel' district, nr Naroch', 4.vii.2009, on *Urtica dioica*. – 8♂, 10♀, same but Volozhin district, nr Kaldyki, 11.vii.2007, mixed forest. – Vitebsk: 2♂, Dokshitsy district, Krulevshizna, 20.x.2000, pine forest (L. Chumakov).

Trioza velutina Foerster, 1848

Material examined: Minsk: 1♂, Molodechno district, nr Sitsevichi, riverbank, behind station, 18.v.2007.

DISCUSSION AND CONCLUSION

Despite the fact that the psylloid fauna of Central and Eastern Europe is generally well studied (Gegechkori & Loginova, 1990; Klimaszewski, 1975), little is known from Belarus with only 12 recorded species one of which is doubtful, i.e. *Aphalara polygoni* (Loginova, 1961, 1962b; Palyakova, 1969; Byazdzenka *et al.*, 1973; Gorlenko *et al.*, 1988; Sidlyarevich & Bolotnikova, 1992; Petrov, 2004, 2011; Petrov *et al.*, 2011; Petrov & Sautkin, 2013). Based on recent collections we confirm the presence of 4 previously recorded species and add 43 species, bringing the number of confirmed Belarusian psyllid species to 54. The majority of these are widely distributed in Europe and slightly more than half of them are associated with woody plants. The rest of the species is either introduced (*Cacopsylla pulchella*) or represents possible boreal elements ("peatbog" species as *Cacopsylla ledi*, *Psylla betulae*, *Bactericera acutipennis*). *Craspedolepta crispati* is rare and has been recorded from only a few countries (Lauterer & Burckhardt, 2004).

The 54 species represent probably less than half of the number of species existing in the country by comparison with the surrounding countries: Poland 112 spp. (Klimaszewski, 1975; Głowacka, 1989, 1991; Głowacka & Migula, 1996; Drohojowska & Głowacka, 2011; Kuznetsova *et al.*, 2012), Northwest Russia 47 spp. (Loginova, 1954, 1961, 1962a, b, 1966, 1967, 1968, 1972a, b), Lithuania 12 spp. (Vengeliauskaitė, 1974; Malumphy *et al.*, 2009) and the former Livonia (now parts of Estonia and Latvia) 43 spp. (Flor, 1861) (Appendix 2). There are no published data available for the psyllid fauna from the North of Ukraine and it is, therefore, not included in Appendix 2. Based on the occurrence of their respective host-plants following additional species (not listed in Appendix 2) can be also expected to occur in Belarus: *Aphalara longicaudata* Wagner & Franz, 1961, *A. polygoni* Foerster, 1848*, A. ulicis* Foerster, 1848*, Craspedolepta campestrella* Ossiannilsson, 1987*, C. innoxia* (Foerster, 1848)*, Arytaina maculata* (Löw, 1886), *Cacopsylla affinis* (Löw, 1880), *C. breviantennata* (Flor, 1861), *C. picta* (Foerster, 1848), *C. rhamnicola* (Scott, 1876), *C. rhododendri* (Puton, 1871), *Psylla betulaenanae* Ossiannilsson, 1970*, Trioza scottii* Löw, 1880.

To stimulate further research on Belarusian psyllids we provide here an illustrated identification key for 127 species whose occurrence in the country has been documented or is likely given that they have been reported from adjacent countries (Appendix 2) or their host-plants occur in Belarus. Targeted field work sampling on potential host-plant is necessary to find also the more localised and rarer species.

ACKNOWLEDGEMENTS

We thank S. Buga, A. Egiyan, V. Karasev, E. Shestakov, L. Chumakov and Y. Gerashchenko for collecting part of the material discussed here. We are also grateful to L. Costeur, S. Buga, O. Nesterova and F. Sautkin for valuable advice to LS during her study. The critical comments and valuable suggestions on a previous manuscript draft by J. Hollier and I. Malenovsky are gratefully acknowledged. This study was partially funded by a grant of the Swiss Confederation (Federal Commission) to LS.

REFERENCES

Burckhardt D. 2004. Fauna Europaea: Psylloidea. *In*: Fauna Europaea, version 1.0. http://www.faunaeur.org/full_results.php?id=12489 (accessed 10 January 2014).

Burckhardt D. 2010. Pictorial key of Central European *Cacopsylla* species associated with Rosaceae. http://www.psyllidkey.eu/index.html (accessed 10 January 2014).

Burckhardt D., Ouvrard D. 2012. A revised classification of the jumping plant-lice (Hemiptera: Psylloidea). *Zootaxa* 3509: 1-4.

Byazdzenka T.T., Palyakova T.J., Osipaŭ U. G. 1973. Yablynevaya veratsennitsa (*Psylla mali* Schmdbg.) u Belarusi. *Vestsi AN BSSR. Seriya sel'skagaspadarchykh navuk* 3: 62-64.

Drohojowska J. & Głowacka E. 2011. The jumping plant-lice (Hemiptera: Psylloidea) of the Tatra National Park. *Polish Journal of Entomology* 80: 265-275.

Flor G. 1861. Die Rhynchoten Livlands in systematischer folge beschrieben. *Archiv für die Naturkunde Liv-, Ehst- und Kurlands, Dorpat*, 637 pp.

Gegechkori A.M. & Loginova M.M. 1990. Psillidy (Homoptera, Psylloidea) SSSR: annotirovannyi spisok. *Metsniereba*, *Tbilisi, Georgia*, 161 pp.

Głowacka E. 1989. Koliszki (Psylloidea) Sudetów. *Acta Biologica Silesiana* 13: 21-30.

Głowacka E. 1991. Psyllids (Insecta: Psylloidea) new for Poland in the collection from Mielnik vicinity (north-eastern Poland). *Annals of the Upper Silesian Museum* 2: 155-160.

Głowacka E., Migula P. 1996. Koliszki Psylloidea Gorców. *Parki Narodowe i Rezerwaty Przyrody* 15: 59-71.

Gorlenko S.V., Blintsov A.I, Pan'ko N.A. 1988. Ustoychivost' drevesnykh introdutsentov k bioticheskim faktoram. *Nauka i tekhnika*, *Minsk*, 189 pp.

Hollis D. 2004. Australian Psylloidea: jumping plant-lice and lerp insects. *Australian Biological Resources Study*, *Canberra, Australia*, 216 pp.

Klimaszewski, S. M. 1975. Psylloidea Koliszki (Insecta: Homoptera). *Fauna Polski* 3: 1-295.

Kuznetsova V.G., Labina E.S., Shapoval N.A., Maryanska-Nadachowska A., Lukhtanov V.A. 2012. *Cacopsylla fraudatrix* sp. n. (Hemiptera: Psylloidea) recognised from testis structure and mitochondrial gene COI. *Zootaxa* 3547: 55-63.

Lauterer P., Burckhardt D. 2004. The West Palaearctic species of the *Craspedolepta flavipennis* (Foerster) complex (Hemiptera, Psylloidea). *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 77(3-4): 251-275.

Li F. 2011. Psyllidomorpha of China (Insecta: Hemiptera). *Science Press*, *Beijing, China*, 1976 pp.

Loginova M.M. 1954. Listobloshki roda *Psyllopsis* Löw (Homoptera, Psyllidae) i osobennosti ikh biologii v usloviyakh Stalingradskoy oblasti. *Trudy zoologicheskogo instituta* 15: 35-53.

Loginova M.M. 1961. A revision of the species of the genera *Aphalara* Frst. and *Craspedolepta* Enderl. (Homoptera, Psylloidea) in the fauna of the USSR. I. *Entomologicheskoe Obozrenie* 40(3): 602-623.

Loginova M.M. 1962a. New psyllids (Homoptera, Psylloidea) from the USSR. *Trudy zoologicheskogo instituta* 30: 185-220.

Loginova M.M. 1962b. Psyllid fauna (Homoptera, Psylloidea) of Leningrad region. *Trudy Zoologicheskogo Instituta* 31: 33-45.

Loginova M.M. 1964. Podotrjad Psyllinea (pp. 437-482). *In:* Bei-Bienko, G. Y. (eds.). Opredelitel' nasekomykh Evropeyskoy chasti SSSR. *Nauka, Moscow,* 1.

Loginova M.M. 1966. Fauna and biology of psyllids (Homoptera, Psylloidea) from Moldavian SSR. *Trudy Moldavskogo NII sadovodstva, vinogradarstva i vinodeliya* 13: 131-148.

Loginova M.M. 1967. Review on palaearctic psyllids of the genus *Psylla* Geoffr. (Homoptera: Psylloidea), associated with willows. *Annales Zoologici* 24(7): 427-461.

Loginova M.M. 1968. New data on the fauna and biology of the Caucasian Psylloidea (Homoptera). *Trudy Vsesoyuznogo Entomologicheskogo Obshchestva* 52: 275-328.

Loginova M.M. 1972a. Podotrjad Psylloidea – psillidy, ili listobloshki. *Nasekomye i kleshchi – vrediteli sel'skokhozyaystvennykh kul'tur* 1: 139-146.

Loginova M.M. 1972b. The psyllids (Psylloidea, Homoptera) of the Mongolian People's Republic. *Nasekomye Mongolii* 1(1): 261-324.

Malumphy C., Ostrauskas H., Pye D. 2009. Contribution to the knowledge of jumping plant-lice (Hemiptera, Psylloidea) of Lithuania. *Acta Zoologica Lituanica* 19(2): 128-131.

Ossiannilsson F. 1992. The Psylloidea (Homoptera) of Fennoscandia and Denmark (pp. 1-346). *In:* Kristensen N. P. (eds.). Fauna Entomologica Scandinavica. *Brill E. J., Leiden, The Netherlands,* 26.

Ouvrard D. 2014. Psyl'list – the world Psylloidea database. http://www.hemiptera-databases.com/psyllist/ (accessed 13 March 2014).

Palyakova T.J. 1969. Da biyalogii grushavykh veratsennits u Belarusi. *Vestsi AN BSSR. Seriya sel'skagaspadarchykh navuk* 5: 87-89.

Petrov D.L. 2004. Fonovyye vidy teratformiruyushchikh nasekomykh Belarusi. *Vestnix BGU* 2(2): 63-71.

Petrov D.L. 2011. Teratformiruyushchiye chlenistonogiye yuga tsentral'nogo regiona Belorusskoy gryady *BGU*: 32-40.

Petrov D.L., Sautkin F.V. 2013. Nasekomyye-galloobrazovateli – vrediteli kustarnikovykh rasteniy zelenykh nasazhdeniy Belarusi. *Vestnik BGU* 2(1): 65-71.

Petrov D.L., Sautkin F.V., Ivanov V.V. 2011. Fitofagi – vrediteli kustarnikovykh rasteniy. *BGU*, *Minsk*, 36 pp.

Sautkina T.A., Tret'yakov D.I., Zubkevich G.I., Kozlovskaya N.V., Parfenov V.I., Blazhevich R.Y., Skuratovich A. N., Dmitriyeva S.A., Semerenko L.V., Simonovich L.G., Shvets I.V., Mlynarchik M.P., Yakovleva I.M., Vynayev G.V., Dzhus M.A., Tichomirov V.N., Dubovik D.V., Mazan I.F, Pobirushko V.F. 1999. Opredelitel' vysshikh rasteniy Belarusi (pp. 472). *In:* Parfenov V. I. (eds.). *Dizayn PRO, Minsk*.

Sidlyarevich V.I., Bolotnikova V.I. 1992. Entomofagi vrediteley ovoshchnykh kul'tur. *Urozhay*, *Minsk*, 126 pp.

Vengeliauskaitė A. 1974. Plant jumping-lice (pp. 86-88). *In:* Pileckis S. & Žuklys L. (eds.). Handbook for the plant protection worker. *Mintis, Vilnius.*

APPENDIX 1

Identification key to adult psyllids of Belarus

(*Cacopsylla merita* and *Eryngiofaga deserta* are not included in the key as their occurrence in Belarus is unlikely).

1 Vein R+M+Cu of forewing bifurcating into veins R and M+Cu (Fig. 1)........ 2

– Vein R+M+Cu of forewing trifurcating into veins R, M and Cu. – Triozidae (Fig. 2) 84

2 Metacoxa slender with flattened, tubercular meracanthus. On *Acer* – Aphalaridae, Rhinocolinae .... ***Rhinocola aceris***

– Metacoxa massive with distinct, spur-shaped meracanthus 3

3 Vertex longer than wide. Segment 2 the longest antennal segment. On monocots (*Carex*, *Juncus*). – Liviidae, Liviinae, *Livia* 4

– Vertex shorter than wide. Segment 3 the longest antennal segment. On dicots 6

4 Vertex, in dorsal view, forming narrowly rounded anterior lobes with deep median cleft between lobes. Forewing short, oval, with evenly curved anterior margin, bearing indistinct dots in apical half. On *Juncus*........ ***Livia junci***

– Vertex, in dorsal view, forming broadly rounded anterior lobes with shallow indentation between lobes. Forewing longer, oblong oval or rhomboidal, in the middle with almost straight anterior margin, pattern different. On *Carex*........ 5

5 Forewing with subparallel fore and hind margins, without dark band along apical and anal margin. On *Carex* .... ***Livia crefeldensis***

– Forewing widening towards apical third, with broad dark band along apical and anal margin. On *Carex* .... ***Livia limbata***

6 Basal spine of metabia always absent; apical metatibial spurs spaced in equal intervals, forming open crown; if grouped, then vertex flattened and rectangular with anterior lobes, or evenly passing into genae 7

– Basal spine of metatibia often developed; apical metatibial spurs always grouped. Head with distinct, though sometimes small, genal processes. – Psyllidae, Psyllinae 37

7 Head bearing genal processes. On *Fraxinus* – Liviidae, Euphyllurinae, *Psyllopsis* 8

– Head without genal processes, genae rounded anteriorly........ 11

8 Body green, forewing lacking dark pattern. Paramere axe-shaped (Fig. 3). Female proctiger distal to circumanal ring abruptly tapered (Fig. 4)........ ***Psyllopsis fraxinicola***

– Body with dark areas, forewing with dark veins and more or less expanded dark pattern. Male and female terminalia different........ 9

9 Forewing lacking continuous marginal band apically; membrane dark at apices of veins M and Cu, in the middle of vein Cu$_{1a}$ and along vein Cu$_{1b}$ (Fig. 5). Thorax yellow-orange, dark brown dorsally. Paramere, in profile, hammer-shaped with large anteriorly directed lobe (Fig. 6). Apex of female proctiger broad (Fig. 7). .... ***Psyllopsis discrepans***

– Forewing with dark band along apical margin stretching from fore to hind margin (Figs 8, 11). Thorax yellow with brown or black pattern. Paramere, in profile, with posteriorly directed lobe (Figs 9, 12). Apex of female proctiger narrow (Figs 10, 13) 10

10 Forewing pattern very dark, extended and well-delimited (Fig. 8). Paramere with large rectangular posterior lobe (Fig. 9). Female proctiger with slight hump distal to circumanal ring (Fig. 10)........ ***Psyllopsis distinguenda***

– Forewing pattern slightly lighter, more reduced, often forming only narrow band, and less clearly delimited towards interior (Fig. 11). Paramere with small triangular posterior lobe (Fig. 12). Female proctiger straight or concave distal to circumanal ring (Fig. 13). .... ***Psyllopsis fraxini***

11 Metabasitarsus without black spurs. On *Populus* – Liviidae, Liviinae .... ***Camarotoscena speciosa***

– Metabasitarsus with 2 black spurs 12

12 Male proctiger without posterior lobes (Fig. 14). ALHW always < 1.0. On *Calluna vulgaris*. – Liviidae, Euphyllurinae .... ***Strophingia ericae***

– Male proctiger with long, wing-like posterior lobes. ALHW often > 1.0. – Aphalaridae, Aphalarinae........ 13

13 Vertex with distinct angular anterior lobes which are separated by narrow transverse groove from genae. Clypeus more or less distinctly protruding from lower head surface. – *Aphalara* 14

– Vertex with weakly developed anterior lobes, smoothly passing into genae. Clypeus short, pressed against lower head surface, not strongly protruding from genae. – *Craspedolepta* 24

14 Forewing with dark pattern consisting of well-defined spots or patches. Apical dilatation of aedeagus with large dorso-apical membranous sack. Circumanal ring of female proctiger never expanded caudally 15

– Forewing without well-defined dark pattern but sometimes infuscate. Apical dilatation of aedeagus without or with small dorso-apical membranous sack. Circumanal ring on female proctiger usually expanded caudally (exceptions *A. longicaudata*, *A. purpurascens*) 17

15 Clypeus long, clearly visible from above; cylindrical, constricted subapically. Forewing narrow, with dark patches concentrated in apical third, basal half clear. On *Polygonum* .... ***Aphalara maculipennis***

– Clypeus short, not or hardly visible from above; conical, apically blunt or subacute. Forewing broad, with dark patches extending also into basal half 16

16 Surface spinules of forewing forming short rows of 2-4 spinules (Fig. 15). Paramere produced apico-posteriorly (Fig. 17). On *Rumex* .... ***Aphalara exilis***

– Surface spinules of forewing forming longer rows (Fig. 16). Paramere not produced apico-posteriorly (Fig. 18). On *Rumex* .... ***Aphalara ulicis***

17 Head and thorax dark brown or black. On *Stellaria graminea* .... ***Aphalara affinis***

– Head and thorax ochreous with orange or brownish markings 18

18 Forewing with surface spinules arranged in irregular, transverse rows (Figs 19, 22-23) 19

– Surface spinules of forewing arranged in irregular squares or rhombi (Figs 24-26) 22

19 Paramere with posterior extension apically (Fig. 20). Female terminalia long (Fig. 21). On *Polygonum bistorta* .... ***Aphalara longicaudata***

– Paramere not extented postero-apically. Female terminalia shorter 20

20 Body dimensions large (length from head to apex of forewing when folded over body ≥ 2.9 mm). Forewing membrane amber-coloured, surface spinules arranged in very dense, transverse rows (Fig. 22). On *Caltha* .... ***Aphalara calthae***

– Body dimensions small (≤ 3.2 mm). Forewing membrane colourless or fumose, surface spinules arranged in sparse rows (Fig. 23) 21

21 Circumanal ring caudally consisting of several rows of pores. On *Polygonum*, *Rumex* .... ***Aphalara polygoni***

– Circumanal ring caudally consisting of two rows of pores. On *Rumex* .... ***Aphalara purpurascens***

22 Male paramere with anterior finger-like process situated subapically (Fig. 27). Aedeagus as in Fig. 28. Female terminalia as in Fig. 29. On *Polygonum* .... ***Aphalara borealis***

– Male paramere with anterior finger-like process situated close to apex (Figs 30, 33). Aedeagus as in Figs 31, 34. Female terminalia as in Figs 32, 35 23

23 Tip of distal portion of aedeagus directed in an angle of about 30° to longitudinal axis of segment (Fig. 31). On *Polygonum aviculare* group .... ***Aphalara avicularis***

– Tip of distal portion of aedeagus directed in an angle of about 90° to longitudinal axis of segment (Fig. 34). On *Polygonum* .... ***Aphalara freji***

24 Forewing with pattern consisting of well-defined, dark spots of 10-30 µm diameter 25

– Forewing without pattern, or with pattern consisting of dark bands, or membrane irregularly infuscate 29

25 Body bearing macroscopic setae which often are covered in wax and thus resemble scales. On *Artemisia abrotanum* .... ***Craspedolepta alevtinae***

– Body lacking macroscopic setae 26

26 Forewing with surface spinules completely covering membrane (Fig. 36). Terminalia as in Figs 41-42. On *Artemisia* .... ***Craspedolepta artemisiae***

– Forewing with surfaces spinules forming hexagonal pattern (Figs 37-38) 27

27 Forewing with dark spots densely spaced, partly confluent in apical part. On *Artemisia campestris* .... ***Craspedolepta campestrella***

– Forewing with dark spots sparsely spaced, not confluent in apical part of wing (Figs 39-40) 28

28 Dark spots on forewing dark brown or almost black; surface spinules relatively sparsely spaced (Fig. 37). Terminalia as in Figs 43-44. On *Artemisia vulgaris* .... ***Craspedolepta latior***

– Dark spots on forewing pale to yellow brown; surface spinules relatively dense (Fig. 38). Terminalia as in Figs 45-46. On *Artemisia absinthum, A. maritima* .... ***Craspedolepta malachitica***

29 Male paramere with large apical triangular posterior lobe, and subapical anterior process which is very long and directed backwards (Fig. 47). Female proctiger ending in two points (Fig. 48). On *Chamerion* .... ***Craspedolepta subpunctata***

– Male paramere, in profile, club-shaped, or if triangular, then anterior process not directed backwards (Figs 50, 53, 57, 61, 63, 65-66). Female proctiger ending in a single point 30

30 Body length from head to apex of forewing when folded over body < 3.2 mm 31

– Body length > 3.5 mm 35

31 Forewing without dark patches or stripes 32

– Forewing with yellow to brown patches or stripes 33

32 Surface spinules of forewing arranged in irregular transverse rows (Fig. 49). Male paramere with large triangular apex and long straight anterior process on inner surface (Fig. 50). Female proctiger more than 4 times longer than pore ring length (Fig. 51). On *Daucus* .... ***Craspedolepta innoxia***

– Surface spinules of forewing widely spaced, sometimes partially reduced not forming transverse rows (Fig. 52). Male paramers club-shaped, with short, claw-like anterior process (Fig. 53). Female proctiger less than 4 times as long as pore ring length (Fig. 54). On *Artemisia vulgaris* .... ***Craspedolepta omissa***

33 Forewing pattern with dark brown, well-delimited patches forming bands along outer margin and in the middle stretching between the apices of veins R_1 and Cu_{1b}, and a spot in cell cu_2 (Fig. 55). Male proctiger with broad wing-like posterior processes lacking a basal hook (Fig. 56). Paramere as in Fig. 57. Female subgenital plate suddenly narrowed subapically (Fig. 58). On *Chamerion* .... ***Craspedolepta nebulosa***

– Forewing pattern ochreous to brown, forming bands along the veins in apical half or a band along wing margin. Male proctiger with narrow single-like processes bearing a basal hook. Paramere different, with rounded to angular apical dilatation. Female subgenital plate evenly tapered 34

34 Antenna usually 8-segmented. Forewing pattern distinct, restricted to narrow stripes along veins in apical half (Fig. 59). Terminalia as in Figs 61-62. On *Achillea* .... ***Craspedolepta nervosa***

– Antenna usually 10-segmented. Forewing pattern forming a band along outer wing margin (Fig. 60). Terminalia as in Figs 63-64. On *Achillea* .... ***Craspedolepta bulgarica***

35 Anterior margin of vertex strongly indented in the middle with two distinct tubercles anteriorly; antero-lateral margin of vertex dorsal of antennal insertion distinctly concave. Forewing yellowish to brownish ochreous. On *Leontodon* .... ***Craspedolepta flavipennis***

– Anterior margin of vertex weakly indented in the middle with two indistinct tubercles anteriorly; antero-lateral margin of vertex dorsal of antennal insertion more or less straight. Forewing semitransparent to whitish. 36

36 Forewing veins dark brown, membrane light, sometimes with light brownish spots or brownish tinge apically. Paramere stalk robust, apical spoon-like part shorter and rounded as in Fig. 65. Female terminalia as in Fig. 67. On *Senecio integrifolius* .... ***Craspedolepta crispati***

– Forewing veins concolorous with membrane, membrane with yellowish tinge and brownish dots in apical third. Paramere stalk slender, apical spoon-like part longer and subangular as in Fig. 66. Female terminalia as in Fig. 68. On *Leontodon* .... ***Craspedolepta sonchi***

37 Metabasitarsus with only one outer black spur, rarely also with much smaller inner spur. Propleurites divided by vertical suture 38

– Metabasitarsus with two well-developed black spurs which are subequal in size. Propleurites divided by diagonal suture 44

38 Either genal processes longer than vertex, or length ratio of veins Cu / Cu_{1b} of forewing 0.9-1.1. Paramere usually slender. – *Livilla* 39

– Character combination different 41

39 Forewing oval, strongly convex, coriaceous. On *Cytisus*, *Genista* .... ***Livilla ulicis***

– Forewing oblong oval, flat, membranous (Figs 69-70) 40

40 Forewing long and narrow, branches of vein M forming an acute angle, pattern as in Fig. 69. On *Genista* .... ***Livilla horvathi***

– Forewing short and broad, branches of vein M forming a right angle, pattern as in Fig. 70. On *Chamaecytisus*, *Cytisus* .... ***Livilla radiata***

41 Forewing broadest in apical third, lacking colour pattern. Paramere very slender, curved caudad, digitiform apically. Dorsal margin of female proctiger, in profile, concave. On *Cytisus scoparius* .... ***Arytainilla spartiophila***

– Forewing broadest in the middle or in basal third, with conspicuous brown pattern. Paramere broader, parallel-sided, in profile, truncate apically with large, forward pointing apical tooth. Dorsal margin of female proctiger, in profile, straight. – *Arytaina* 42

42 Forewing broadest in the middle, fore margin relatively flat. Paramere broad, dorsal margin distinctly concave. On *Cytisus*, *Genista* .... ***Arytaina genistae***

– Forewing broadest in basal third, fore margin strongly curved. Paramere narrow, dorsal margin weakly convex. On *Chamaecytisus ratisbonensis* .... ***Arytaina maculata***

43 Antennal segment 9 longer than 10 44

– Antennal segment 9 shorter than 10 48

44 Genal processes short and broad. Forewing with costal break and pterostigma developed; membrane yellow, veins concolorous. Dorsal margin of female proctiger serrate in apical third. On *Alnus* .... ***Baeopelma foersteri***

– Character combination different. – *Psylla* 45

45 Forewing with cell cu_1 almost as high as long; membrane yellowish, veins concolorous, yellow or green. On *Buxus* .... ***Psylla buxi***

– Forewing with cell cu_1 at most 1.5 times as long as high. On Betulaceae 46

46 Forewing lacking costal break and pterostigma. On *Alnus* .... ***Psylla fusca***

– Forewing bearing costal break and pterostigma 47

47 Genal processes short, rounded. Forewing with dark brown or black veins in apical two thirds. On *Alnus* .... ***Psylla alni***

– Genal processes longer, conical. Forewing veins paler. On *Betula* 48

48 Body length, including forewings when folded over the body, longer than 3.5 mm in males and 4.1 mm in females. Forewing colourless or with yellow tinge. On *Betula* .... ***Psylla betulae***

– Body length, including forewings when folded over the body, shorter than 3.7 mm in males and females. Forewing amber-coloured. On *Betula* .... ***Psylla betulaenanae***

49 Metatibia with 4 apical spurs. On *Betula*. .... ***Chamaepsylla hartigii***

– Metatibia with 5 apical spurs. – *Cacopsylla* 50

50 Dorsal surface spinules in cell r_2 of forewing above bifurcation of vein M arranged in squares or rhombi of about 20 µm length; surface spinules in cell c+sc restricted to apical portion of cell or entirely reduced; surface spinules reduced in basal part of r_2, at most a few spinules present; fields of surface spinules tapering along apical wing margin; forewing membrane always colourless; pterostigma oblong cuneate, evenly tapering. Antenna shorter than 1.75 mm, if longer, then forewing longer than 3 mm. Male paramere simple, lamellar. Female terminalia short, cuneate 51

– Forewing spinulation different, or wing membrane yellowish or brownish, or pterostigma elongate with subparallel margins. If antenna longer than 1.75 mm, then forewing shorter than 3.0 mm. Male paramere often complex. Female terminalia different 54

51 Antenna shorter than 1.2 mm. On *Crataegus* .... ***Cacopsylla peregrina***

– Antenna longer than 1.3 mm 52

52 Antenna longer than 1.75 mm. On *Ulmus* .... ***Cacopsylla ulmi***

– Antenna shorter than 1.55 mm 53

53 Antennal segments 4-8 with black apex. On *Sorbus* .... ***Cacopsylla sorbi***

– Antennal segments 4-8 with yellow or ochreous apex. On *Malus* .... ***Cacopsylla mali***

54 Dorsal surface spinules of forewing in cell r_2 above bifurcation of vein M irregularly, densely spaced (2-10 µm) or arranged in transverse rows 55

– Dorsal surface spinules of forewing forming more or less even squares or rhombi of 20 µm distance in cell r_2 above bifurcation of vein M 62

55 Surface spinules arranged in transverse rows 56

– Surface spinules densely, irregularly spaced 58

56 Paramere, in profile, with large basal lobe. Dorsal margin of female proctiger straight or weakly convex. On *Salix* .... ***Cacopsylla elegantula***

– Paramere, in profile, lamellar with anteriorly directed apical tooth. Dorsal margin of female proctiger sinuous. On *Salix* 57

57 Thorax brown, abdomen green. Terminalia ochreous or brown. On *Salix* .... ***Cacopsylla abdominalis***

– Body colour evenly light or reddish. On *Salix* .... ***Cacopsylla intermedia***

58 Forewing with an apical dark brown band or completely brown to dark brown 59

– Forewing light, at most yellow or ochreous 60

59 Forewing bearing dark band apically (Fig. 71). Metatibia without genual spine. Male subgenital plate bearing apical tubercular extension (Fig. 72). Female proctiger and subgenital plate ending in thorn-like processes (Fig. 75). On *Sorbus* .... ***Cacopsylla breviantennata***

– Forewing irregulary dark without distinct apical ribbon (Fig. 73). Metatibia with genual spine. Male subgenital plate rounded apically (Fig. 74). Female proctiger and subgenital plate evenly tapering in profile (Fig. 76). On *Prunus* .... ***Cacopsylla pruni***

60 Forewing bearing ventral surface spinules in cell c+sc. Surface spinules on forewing very densely arranged. On *Salix* .... ***Cacopsylla ambigua***

– Ventral surface spinules lacking in cell c+sc. Surface spinules on forewing more sparsely arranged. 61

61 Forewing oval, widest in the middle; wing apex near apex of vein M_{1+2}. Antenna shorter than 1.0 mm. On *Salix repens* and *S. rosmarinifolia* .... ***Cacopsylla parvipennis***

– Forewing widest in apical third; wing apex at the middle of outer margin of cell r_2. Antenna longer than 1.0 mm. On *Salix* .... ***Cacopsylla flori***

62 Forewing bearing dark brown patches on tips of veins, at the bifurcation of vein M, and in the middle of vein Cu_{1a}. On *Cercis siliquastrum* .... ***Cacopsylla pulchella***

– Forewing pattern different 63

63 Dorsal surface spinules covering entire cell c+sc of forewing apart from stripes along veins; forming extended fields in other cells which taper towards wing margin; membrane colourless or fumate but never with brown, strongly contrasting stripe along vein Cu_{1b}. 64

– Dorsal surface spinules of forewing more or less reduced, or not tapering towards wing margin, or wing pattern consisting with dark, strongly contrasted stripe along vein Cu$_{1b}$............ 67

64 Antenna usually longer than 1.2 mm. Genal processes broad and blunt. Paramere broad, lanceolate (Fig. 77). Dorsal margin of female proctiger, in profile, weakly sinuous, apex narrowly rounded (Fig. 78). On *Pyrus* .... ***Cacopsylla pyrisuga***

– Antenna usually shorter than 1.1 mm. Paramere narrow or with apical processes. Dorsal margin of female proctiger concave in the middle, or apex truncate 65

65 Paramere, in profile, with square base bearing 2 apical processes (Fig. 79). Dorsal margin of female proctiger, distal of circumanal ring, evenly concave; apex rounded (Fig. 80). On *Malus*............ ***Cacopsylla picta***

– Paramere, in profile, elongate; apex with inward and forward pointing tooth. Dorsal margin of female proctiger raised in the middle; apex angular............ 66

66 Paramere long, in profile, narrowed in the middle. Apex of distal segment of aedeagus weakly curved (Fig. 81). On *Crataegus*............ ***Cacopsylla melanoneura***

– Paramere short, in profile, evenly tapering from base to apex. Apex of distal segment of aedeagus strongly curved, hook-shaped (Fig. 82). On *Crataegus* ....***Cacopsylla affinis***

67 Forewing with fields of surface spinules tapered along apical wing margin; membrane bearing dark brown patch along vein Cu$_{1b}$ (Figs 83-84)............ 68

– Character combination different............ 69

68 Areas of radular spinules of cells m$_1$, m$_2$ and cu$_1$ of forewing light; dark patch along vein Cu$_{1b}$ not reaching bifurcation of Cu, not narrowed in proximal half (Fig. 83); surface spinules forming extended fields in cells c+sc and r$_1$. On *Sorbus* ....***Cacopsylla albipes***

– Areas of radular spinules of cells m$_1$, m$_2$ and cu$_1$ of forewing more or less dark; dark patch along vein Cu$_{1b}$ reaching bifurcation of Cu, straight in proximal half (Fig. 84); surface spinules reduced in cells c+sc and r$_1$. On *Crataegus*. ....***Cacopsylla crataegi***

69 Surface spinules of forewing forming very narrow fields. On *Rhamnus* ....***Cacopsylla rhamnicola***

– Surface spinules of forewing forming extended fields 70

70 Forewing with fields of surface spinules tapering towards apical margin; clavus with brown apex. 71

– Character combination different............ 72

71 Paramere sickle-shaped (Fig. 85). Female proctiger strongly narrowed in the middle (Fig. 86). On *Pyrus*............ ***Cacopsylla pyri***

– Paramere lamellar (Fig. 87). Female proctiger cuneate (Fig. 88). On *Pyrus* ....***Cacopsylla pyricola***

72 Antenna longer than 1.6 mm 73

– Antenna shorter than 1.3 mm 75

73 Metatibia with 1+1+(2-3)+1 sclerotised apical spurs. Antennal segments 3-7 yellowish or ochreous with dark brown apex. Fields of surface spinules tapering along apical wing margin. On *Viscum* ....***Cacopsylla visci***

– Character combination different............ 74

74 Body colour dark brown. Paramere with short, angular apical, sclerotised apex (Fig. 89). Valvula 2 of female terminalia with straight ventral margin (Fig. 91). On *Hippophae* ....***Cacopsylla zetterstedti***

– Body colour green or yellow. Paramere with long, curved apical, sclerotised apex (Fig. 90). Valvula 2 of female terminalia with concave ventral margin (Fig. 92) On *Hippophae*............ ***Cacopsylla hippophaes***

75 Pterostigma cuneate, broad and short, with converging margins ending in the middle of vein Rs; wing membrane yellowish or ochreous, veins ochreous or light brown 76

– Pterostigma long and narrow, with subparallel margins ending in apical third of vein Rs; wing membrane colourless or dark, veins light or dark............ 79

76 Fore margin of forewing relatively straight. On *Rhododendron.* ....***Cacopsylla rhododendri***

– Fore margin of forewing strongly curved............ 77

77 Surface spinules entirely covering cell c+sc of forewing. On *Vaccinium* ....***Cacopsylla myrtilli***

– Surface spinules absent from basal third of cell c+sc of forewing............ 78

78 On *Vaccinium myrtillus* .... ***Cacopsylla fraudatrix***

– On *Ledum palustre* ....***Cacopsylla ledi***

79 Male paramere bearing subapical lobe along hind margin............ 80

– Male paramere lacking subapical lobe along hind margin 82

80 Paramere lacking basal lobe at hind margin. On *Salix.* ....***Cacopsylla moscovita***

– Paramere bearing basal lobe at hind margin............ 81

81 Basal lobe at hind margin of paramere not incised dorsally. On *Salix.* ....***Cacopsylla saliceti***

– Basal lobe at hind margin of paramere strongly incised dorsally. On *Salix.* ....***Cacopsylla iteophila***

82 Apex of paramere forming simple, backwards directed sclerotised tooth. On *Salix* .... ***Cacopsylla pulchra***

– Apex of paramere with two strongly sclerotised teeth 83

83 Paramere, in rear view, with a tooth in apical third; in profile, as in Fig. 93. On *Salix* .... ***Cacopsylla brunneipennis***

– Paramere, in rear view, with lobe in the middle of inner margin; in profile, as in Fig. 94. On *Salix* .... ***Cacopsylla nigrita***

84 Metatibia with 1+3 sclerotised apical spurs 85

– Metatibia with 1+2 sclerotised apical spurs 107

85 Forewing with extended dark pattern consisting of small points; fore margin straight to concave between apices of veins Rs and M_{1+2} (Fig. 95). On *Rhamnus cathartica* .... ***Trichochermes walkeri***

– Forewing pattern different; fore margin convex. – *Trioza* p.p. 86

86 Forewing short and broad, angular apically; branching of vein M distinctly distal to $Rs–Cu_{1a}$ line. Antennal colour strongly contrasted, segment 3 light, segments 4-10 dark........ 87

– Forewing elongate, sometimes rounded apically; $Rs–Cu_{1a}$ line proximal to or on branching of vein M. Antennal colour variable. 89

87 Genal processes short. Paramere, in profile, strongly narrowed in apical quarter, forming anterior tubercle and posterior process (Fig. 96). Female subgenital plate truncate apically, consequently strongly convex dorsally (Fig. 97). Terminal setae on antennal segment 10 subequal. On *Valerianella* .... ***Trioza centranthi***

– Genal processes long. Male paramere in apical quarter regularly narrowing to apex (Figs 98, 100). Female subgenital plate evenly tapering to apex, dorsal margin almost straight (Figs 99, 101). Terminal setae on antennal segment 10 strongly unequal. 88

88 Forewing without surface spinules. Male paramere robust, angular apically; distal portion of aedeagus with large apical hook (Fig. 98); female subgenital plate, in profile, with obtuse apex (Fig. 99). On *Galium* and other Rubiaceae .... ***Trioza galii***

– Forewing with surface spinules. Male paramere slender, curved apically (Fig. 100); female subgenital plate, in profile, with small sharp tooth at apex (Fig. 101). On *Galium*. .... ***Trioza velutina***

89 Forewing with surface spinules present at most in cell cu_2. Male paramere long and slender, lamellar (Fig. 102). Female terminalia long, dorsal margin of proctiger more or less straight (Fig. 103). On *Urtica* ...... ***Trioza urticae***

– Forewing with surface spinules present in all cells, covering smaller or larger areas........ 90

90 Terminal antennal setae strongly differing in length, both distinctly shorter than antennal segment 10; shorter seta very short, stout and truncate apically. Axes of genal processes diverging forward; genal processes relatively massive and blunt, evenly narrowed. Body orange to reddish, sometimes brownish to black........ 91

– Terminal antennal setae different; axes of genal processes parallel, or genal processes slender and pointed or fusiform, or body yellowish or greenish........ 94

91 Surface spinules of forewing spaced at 5-10 µm intervals or forming transverse rows in the middle of cell r_2 at level of branching of vein M, never reduced along outer wing margin. Male paramere basally robust (Fig. 104), female terminalia short with proctiger, in profile, dorsally straight (Fig. 105). On *Hieracium* .... ***Trioza proxima***

– Surface spinules of forewing forming regular rectangles or rhombes of 15-10 µm distance, sometimes reduced along outer wing margin. Terminalia different........ 92

92 Male paramere with weak subapical constriction. Female proctiger cuneate, regularly tapering to apex, short, about twice as long as circumanal ring. On *Mycelis* .... ***Trioza foersteri***

– Male paramere with strong subapical constriction (Fig. 106, 108). Female terminalia different 93

93 Male paramere about as long as or longer than proctiger, apical portion bent inwards and weakly backwards (Fig. 106). FPHW less than 0.8, proctiger truncate apically (Fig. 107). On *Taraxacum* .... ***Trioza dispar***

– Male paramere shorter than proctiger or apical portion straight, directed upwards (Fig. 108). FPHW more than 0.8, proctiger regularly narrowed apically (Fig. 109). On *Hieracium*........ ***Trioza tatrensis***

94 Surface spinules of forewing in cell r_2 at level of branching of vein M densely spaced in a distance of 6-12 µm........ 95

– Surface spinules of forewing in cell r_2 at level of branching of vein M arranged in regular rectangles or rhombi in a distance of 10-20 µm 97

95 Forewing distinctly angular apically; vein Cu much more than twice as long as Cu_{1b}, cell cu_1 flat. Male paramere slender in apical half; apex turned backwards. Female proctiger blunt apically. On *Aegopodium* .... ***Trioza flavipennis***

– Forewing irregularly rounded apically; vein Cu at most slightly more than twice as long as Cu_{1b}, cell cu_1 high. Male paramere massive in apical half; apex turned inwards or forwards (Fig. 110). Female proctiger pointed apically (Fig. 111) 96

96 Male parameres with large antero-basal lobe. Distal aedeagal segment with large apical hook. Female subgenital plate short, truncate apically. Lateral abdominal setae present on tergites 3 and 4 in males, and 4 and 5 in females.

Relative lengths of terminal antennal segment : shorter terminal antennal seta : longer terminal antennal seta = 1.0 : 0.4 : 0.7. On *Cardamine*, *Stellaria* .... ***Trioza rotundata***

– Male parameres without distinct antero-basal lobe. Distal aedeagal segment with short hook. Female subgenital plate long, pointed apically. Lateral abdominal setae present on tergites 3 in males, 4 in females. Relative lengths of terminal antennal segment : shorter terminal antennal seta : longer terminal antennal seta = 1.0 : 0.3 : 0.8. On *Valerianella tripteridis*.......... ***Trioza tripteridis***

97 Forewing with very long, sinuous vein Rs; membrane transparent, colourless, wing margin with dark dots at intersections of veins and near radular spinules. One terminal antennal seta less than three times shorter than the other seta. On *Rhamnus* .... ***Trioza rhamni***

– Combination of characters different 98

98 Body almost completely dark brown or black 99

– Body green, yellow or reddish; sometimes thorax dark but abdomen green 100

99 Forewing membrane dirty whitish. Apex of paramere pointing forwards. Female proctiger truncate apically. On *Saxifraga* .... ***Trioza saxifragae***

– Forewing membrane ochreous. Apex of paramere pointing backwards. Female proctiger subacute apically. On *Astrantia major* .... ***Trioza schrankii***

100 Body straw-coloured or ochreous. Paramere simple, broadly lamellar. Female proctiger short, about twice as long as circumanal ring. On *Rumex scutatus* .... ***Trioza rumicis***

– Body green, light yellow, sometimes thorax brown. Paramere with inner process or with broad base and narrow apical portion. Female proctiger about three times as long as circumanal ring 101

101 Forewing broadly irregularly rounded apically. Male proctiger with posterior lobe; paramere with inner process (Fig. 112). On *Cerastium* .... ***Trioza cerastii***

– Forewing angular apically. Male proctiger without posterior lobe; paramere without inner process 102

102 Body always, also in overwintered specimens, yellow or green, never yellowish orange, or with brown to black spots 103

– Body never exclusively yellow or green; either yellow-orange or with brown to black spots 105

103 Antennal segments 6-8 brown. Basal portion of male paramere with distinct antero-apical tubercle (Fig. 113). Female proctiger, in profile, with weakly sinuous dorsal margin (Fig. 114). On *Cirsium* .... ***Trioza cirsii***

– Antennal segments 6-8 light. Male and female terminalia different 104

104 Basal portion of male paramere angled antero-apically. Female terminalia long. On *Cirsium*...... ***Trioza agrophila***

– Basal portion of male paramere oblique antero-apically. Female terminalia short. On *Senecio*... ***Trioza senecionis***

105 Postero-apical process of paramere very slender and straight. Female subgenital plate much shorter than proctiger. On *Chrysanthemum* .... ***Trioza chrysanthemi***

– Postero-apical process of paramere wider and curved. Female subgenital plate about as long as proctiger 106

106 Paramere with very small anterior lobe (Fig. 115). Female subgenital plate slender apically. On *Achillea* .... ***Trioza abdominalis***

– Paramere with large anterior lobe. Female subgenital plate massive apically. On *Knautia* .... ***Trioza munda***

107 Branching of vein M of forewing distinctly distal to Rs–Cu$_{1a}$ line; vein Rs straight or concavely curved to fore margin; forewing angular apically 108

– Branching of vein M of forewing proximal to or about on Rs–Cu$_{1a}$ line, or vein Rs sinuate, or apex of forewing broadly rounded 110

108 Genal processes short. Forewing very narrow with low cell cu$_1$; surface spinules absent. Male paramere narrow (Fig. 116); female terminalia as in Fig. 117. On *Laurus* .... ***Trioza alacris***

– Genal processes longer. Forewing broader; cell cu$_1$ higher; surface spinules present or absent. Male paramere broad, female terminalia different 109

109 Large species, forewing longer than 2.65 mm. Surface spinules of forewing always present. Terminalia as in Figs 118-119. On *Quercus* .... ***Trioza remota***

– Small species, forewing shorter than 2.6 mm. Surface spinules present or absent. Terminalia different. On Amaranthaceae .... ***Trioza chenopodii***

110 Body green or yellow 111

– Body colour different 113

111 Antennal segments 4-6 yellow or light ochreous; apical two or three dark segments strongly contrasting with the lighter more basal segments. On Apiaceae .... ***Trioza apicalis***

– Antennal segments 4-6 dark ochreous or light brown; antennal segments gradually becoming darker from segment 3 to apex 112

112 Paramere with short dorsal projection and narrow anterior lobe (Fig. 120). Female subgenital plate with terminal process forming a long parallel sided projection (Fig. 121). On *Anthriscus* and other Apiaceae ... ***Trioza anthrisci***

– Paramere with long dorsal projection and narrow anterior lobe (Fig. 122). Female subgenital plate with short and regularly tapering terminal process (Fig. 123). On *Laserpitium* .... ***Trioza laserpitii***

113 Surface spinules present in distal cells of forewing 114

– Surface spinules absent, or present at most in cell cu_1 120

114 Surface spinules absent from cell r_1 of forewing .... ***Bactericera maura***

– Surface spinules present in cell r_1 of forewing 115

115 Antennal segments 4-7 dark 116

– Antennal segments 4-7 light 117

116 Surface spinules entirely covering cell r_1 of forewing. Abdominal venter whitish, distinctly lighter than dorsum. Male paramere, in profile, sinuous with wide base and slender apex (Fig. 124). Ventral margin of female subgenital plate straight or concave subapically. On *Salix*. .... ***Bactericera albiventris***

– Surface spinules of forewing present only in basal half of cell r_1. Abdominal venter not whitish, or the same colour as dorsum. Male paramere, in profile, straight, with mostly subparal margins (Fig. 125). Ventral margin of female subgenital plate straight or convex subapically. On *Salix*. .... ***Bactericera salicivora***

117 Surface spinules in apical half of forewing covering the whole surface up to the veins; wing angular apically (Fig. 2). Terminalia as in Figs 126-127. On *Comarum palustre* .... ***Bactericera acutipennis***

– Surface spinules leaving spinule-free stripes along veins of forewing 118

118 Antennal segments 4 and 6 with each a group of rhinaria, therefore strongly dilated apically. Terminalia as in Figs 128-129. On *Alchemilla* .... ***Bactericera femoralis***

– Antennal segments 4 and 6 with each 1 rhinarium, not strongly dilated apically 119

119 Surface spinules of forewing also present in distal half of cell r_1 and entirely covering cell c+sc. On *Potentilla anserina* .... ***Bactericera reuteri***

– Surface spinules of forewing present only in proximal half of cell r_1 and strongly reduced in cell c+sc. On *Geum* .... ***Bactericera bohemica***

120 Genal processes at most as long as two thirds of vertex. Antenna entirely dark brown to black. Terminalia as in Figs 130-131. Polyphagous on dicotyledonous herbs .... ***Bactericera nigricornis***

– Genal processes about as long as vertex. At least antennal segment 3 light 121

121 Antenna completely black. On *Artemisia* .... ***Bactericera calcarata***

– At least antennal segment 3 light 122

122 Antennal segments 3-5 partly or entirely light. On *Sanguisorba* .... ***Bactericera modesta***

– Antennal segment 3 light, 4 and 5 dark 123

123 Forewing widest in the middle. On *Berberis vulgaris* .... ***Trioza scottii***

– Forewing widest in apical thirds. On *Salix* 124

124 Forewing with vein A entirely dark .... ***Bactericera curvatinervis***

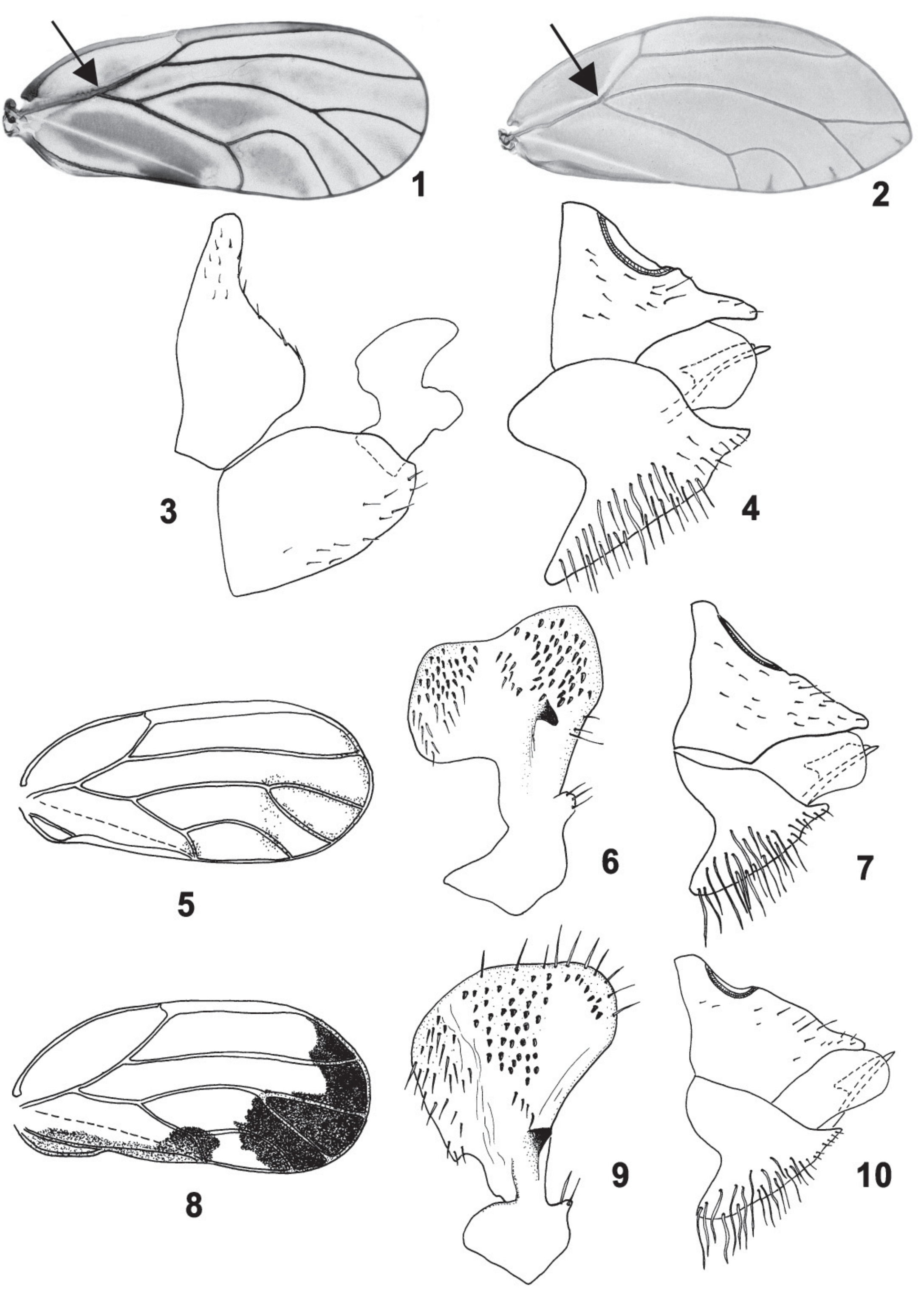
– Dark colour on vein A of forewing reduced to a spot 125

125 Dark spot on vein A of forewing distinct. Male paramere, in profile, more or less straight with large anteriorly directed tooth (Fig. 132). Female proctiger short with apical two thirds of dorsal outline strongly convex .... ***Bactericera striola***

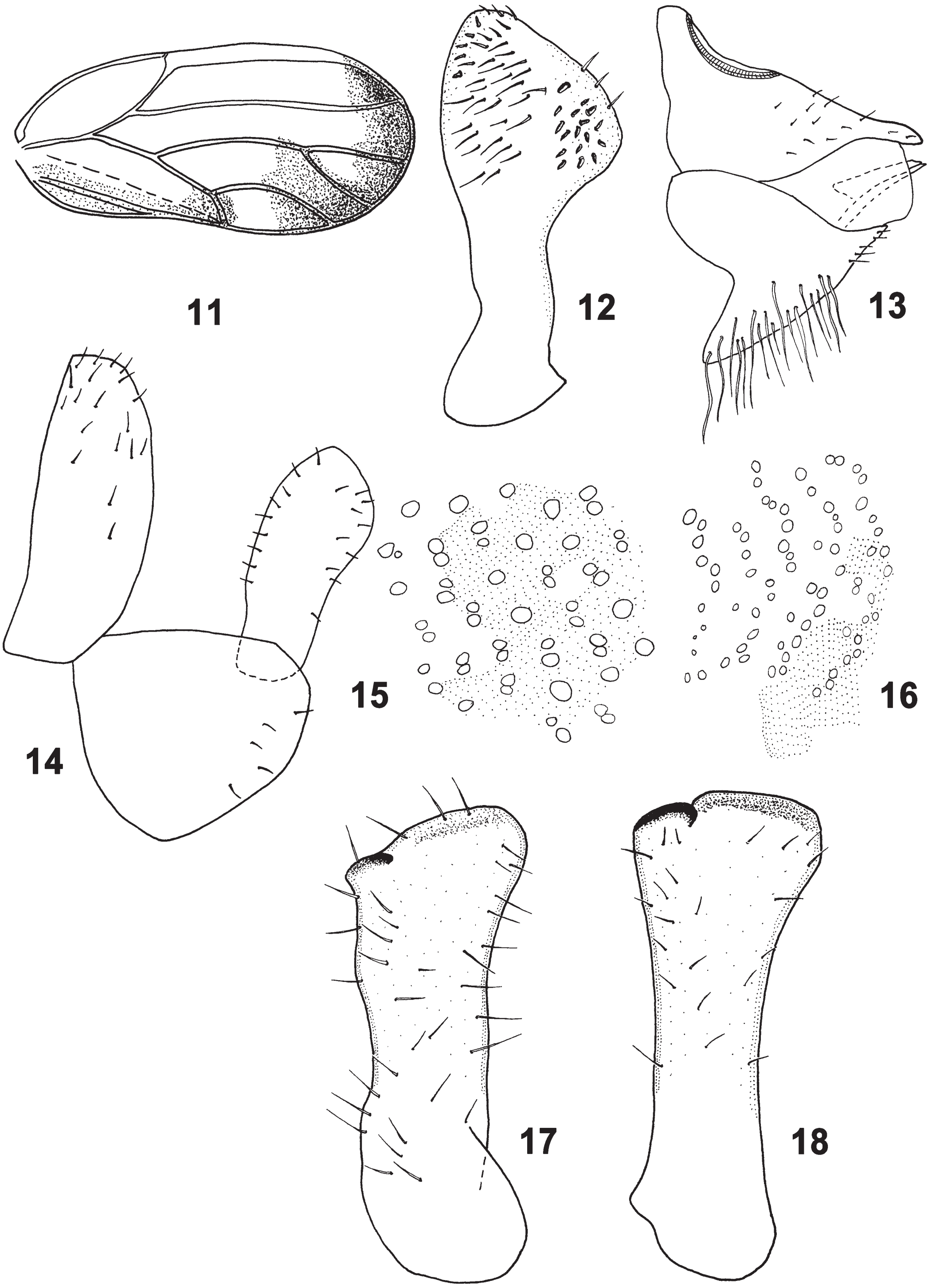
– Dark spot on vein A of forewing indistinct. Male paramere sickle-shaped or with small apical hook. Female proctiger longer with apical two thirds of dorsal outline straight or concave 126

126 Male parameres, in profile, sickle-shaped. Female subgenital plate long with indistinct, long apical process .... ***Bactericera substriola***

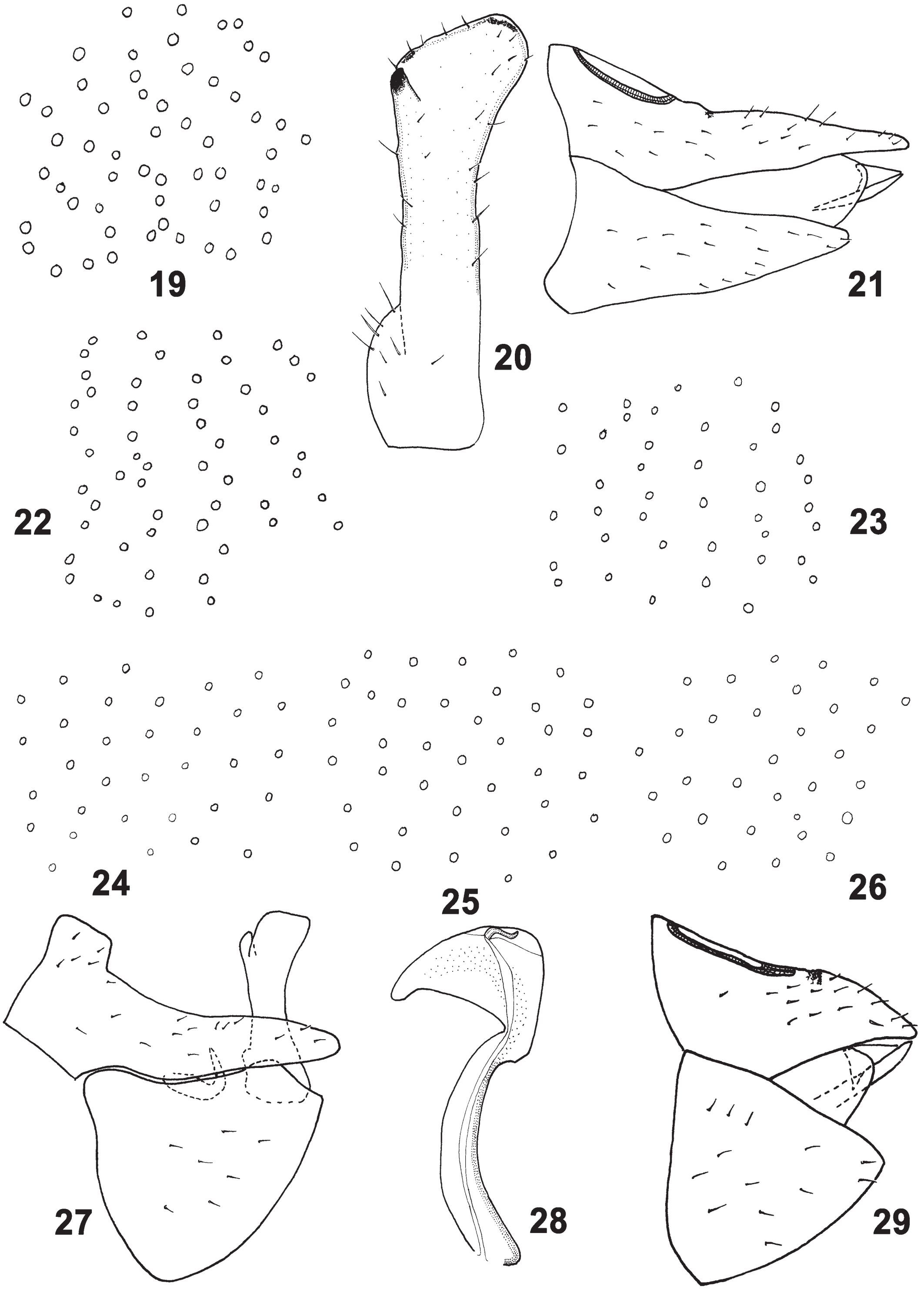
– Male parameres, in profile, straight, lamellar, with small apical tooth. Female subgenital plate short with distinct short apical process .... ***Bactericera parastriola***



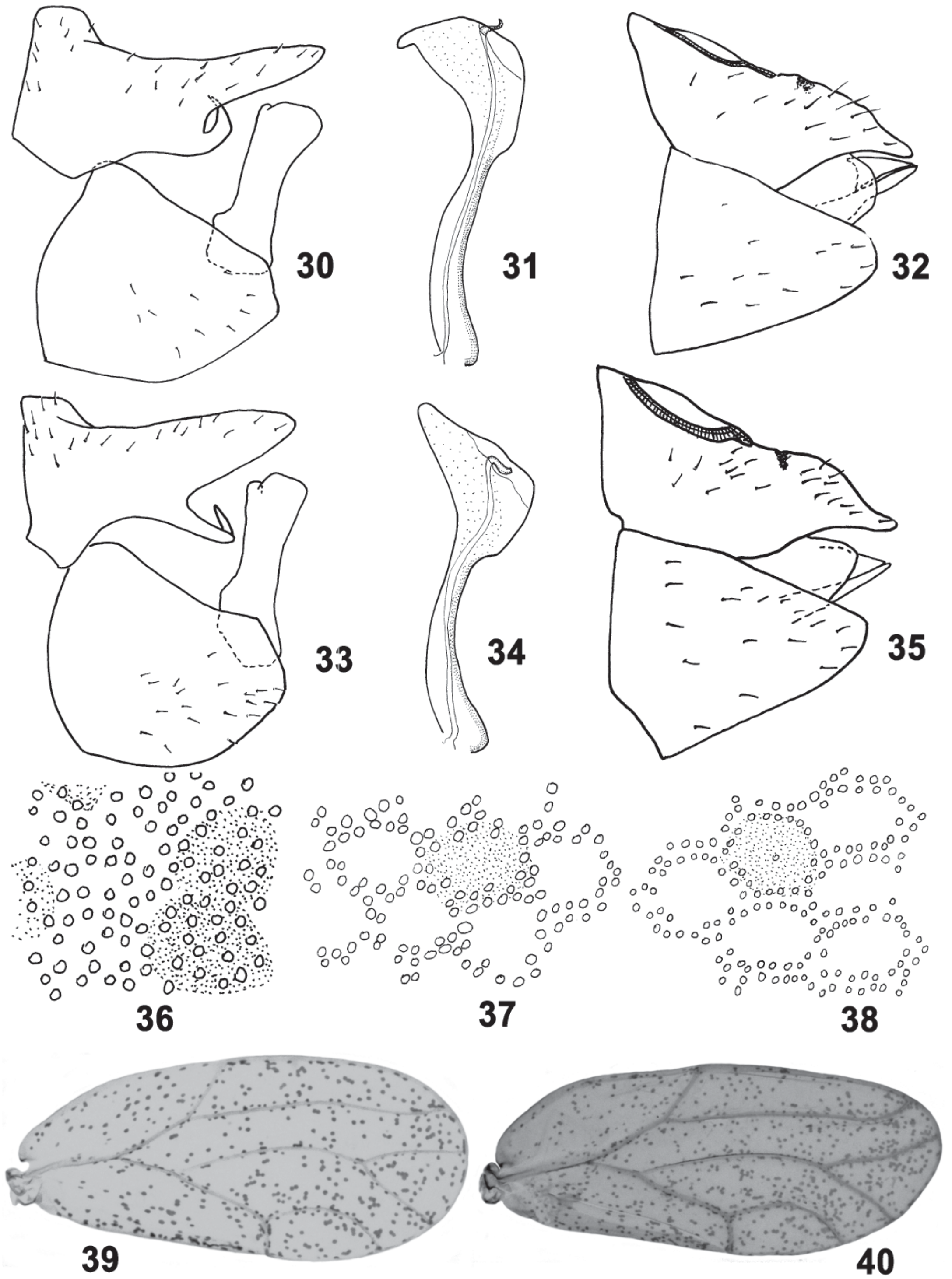
Figs 1-10. (1) *Cacopsylla pyricola,* forewing. (2) *Bactericera acutipennis*, forewing. (3) *Psyllopsis fraxinicola*, male terminalia. (4) *Psyllopsis fraxinicola*, female terminalia. (5) *Psyllopsis discrepans*, forewing. (6) *Psyllopsis discrepans*, paramere. (7) *Psyllopsis discrepans*, female terminalia. (8) *Psyllopsis distinguenda,* forewing. (9) *Psyllopsis distinguenda,* paramere. (10) *Psyllopsis distinguenda,* female terminalia.



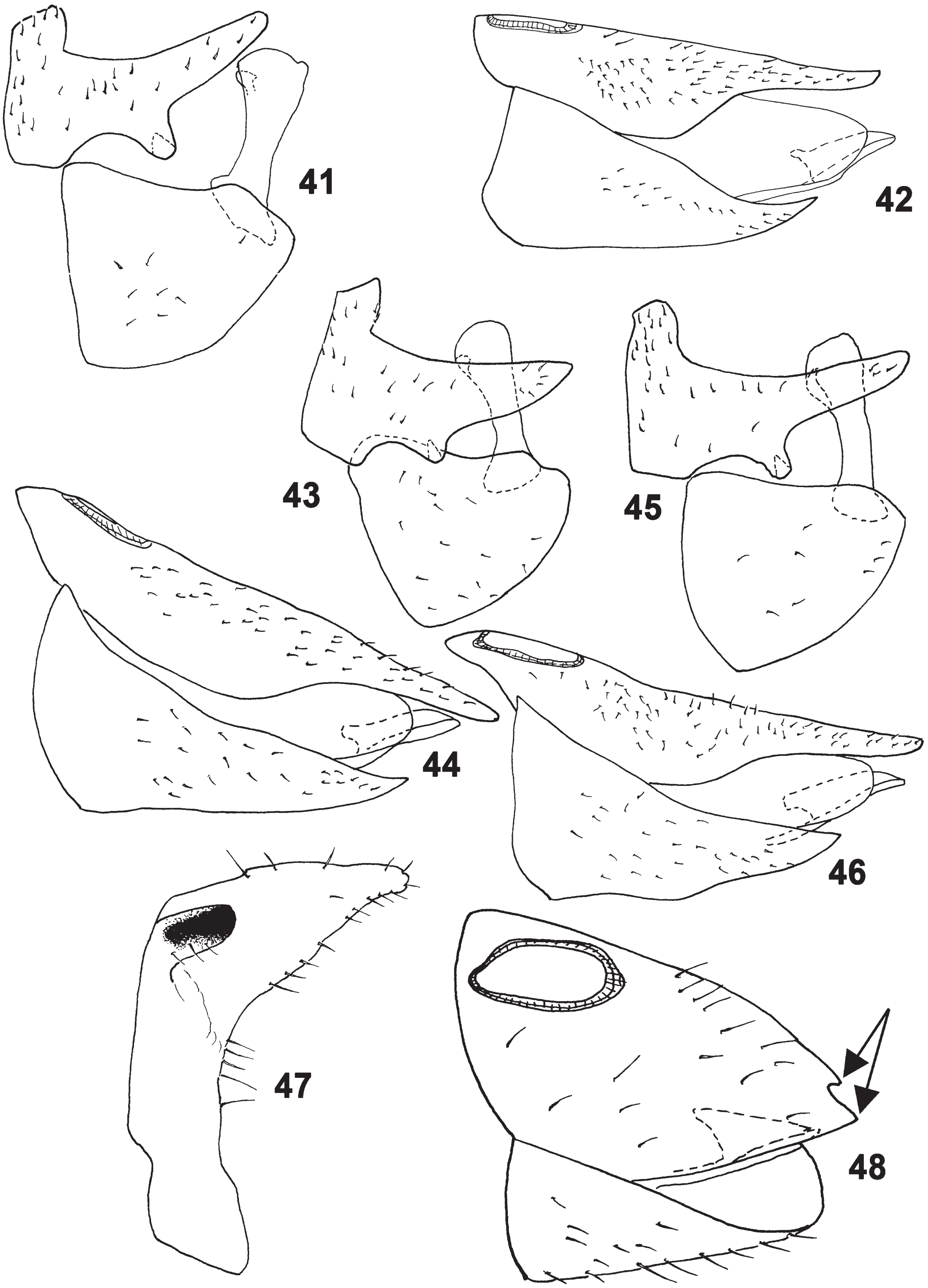
Figs 11-18. (11) *Psyllopsis fraxini,* forewing. (12) *Psyllopsis fraxini,* paramere. (13) *Psyllopsis fraxini,* female terminalia. (14) *Strophingia ericae*, male terminalia. (15) *Aphalara exilis,* forewing surface spinules. (16) *Aphalara ulicis,* forewing surface spinules. (17) *Aphalara exilis,* paramere. (18) *Aphalara ulicis*, paramere.



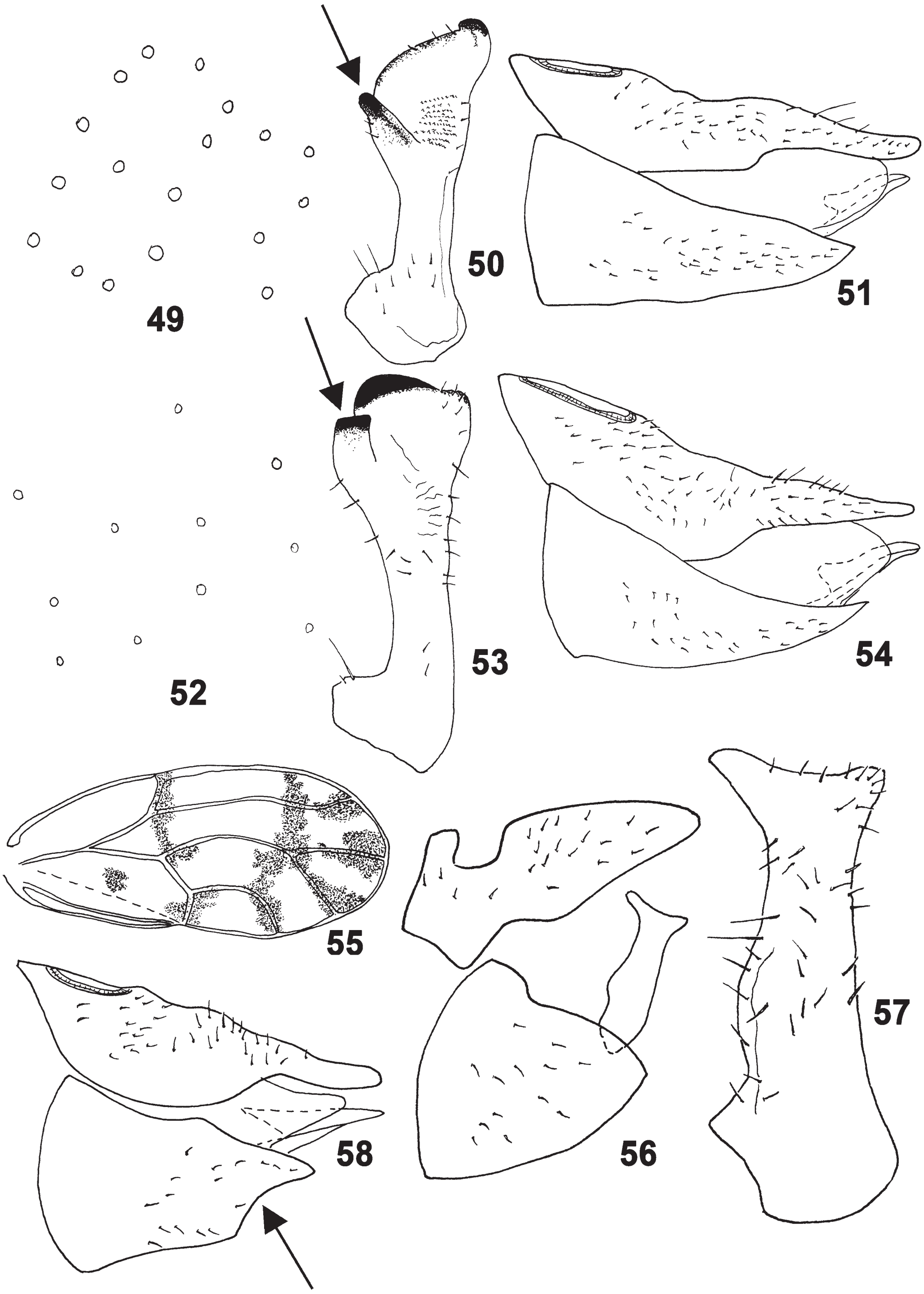
Figs 19-29. (19) *Aphalara longicaudata*, forewing surface spinules. (20) *Aphalara longicaudata*, paramere. (21) *Aphalara longicaudata*, female terminalia. (22) *Aphalara calthae,* forewing surface spinules. (23) *Aphalara polygoni*, forewing surface spinules. (24) *Aphalara borealis*, forewing surface spinules. (25) *Aphalara avicularis*, forewing surface spinules. (26) *Aphalara freji*, forewing surface spinules. (27) *Aphalara borealis*, male terminalia. (28) *Aphalara borealis*, aedeagus. (29) *Aphalara borealis*, female terminalia.



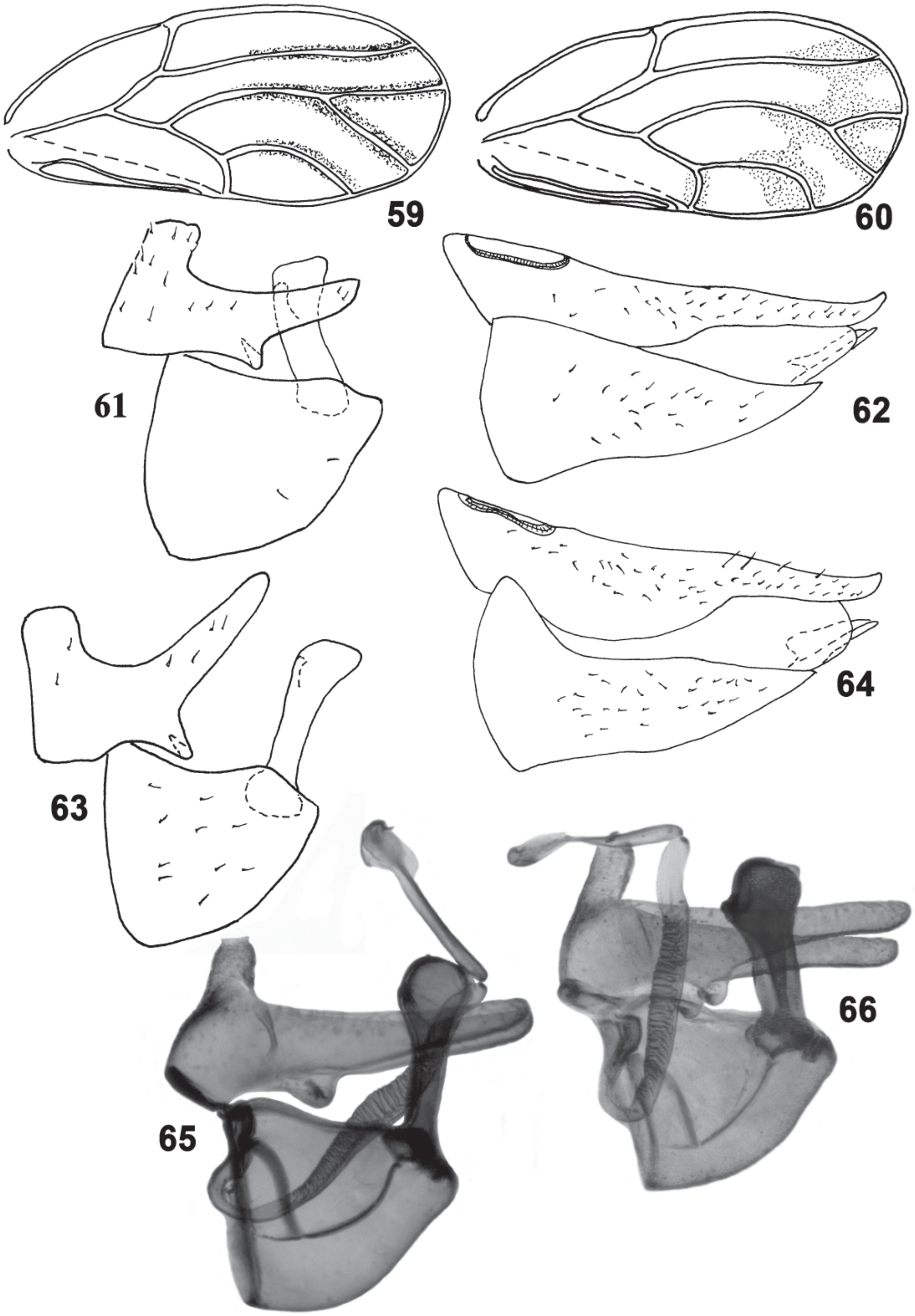
Figs 30-40. (30) *Aphalara avicularis*, male terminalia. (31) *Aphalara avicularis*, aedeagus. (32) *Aphalara avicularis*, female terminalia. (33) *Aphalara freji*, male terminalia. (34) *Aphalara freji*, aedeagus. (35) *Aphalara freji*, female terminalia. (36) *Craspedolepta artemisiae*, forewing surface spinules. (37) *Craspedolepta latior*, forewing surface spinules. (38) *Craspedolepta malachitica*, forewing surface spinules. (39) *Craspedolepta latior*, forewing. (40) *Craspedolepta malachitica*, forewing.



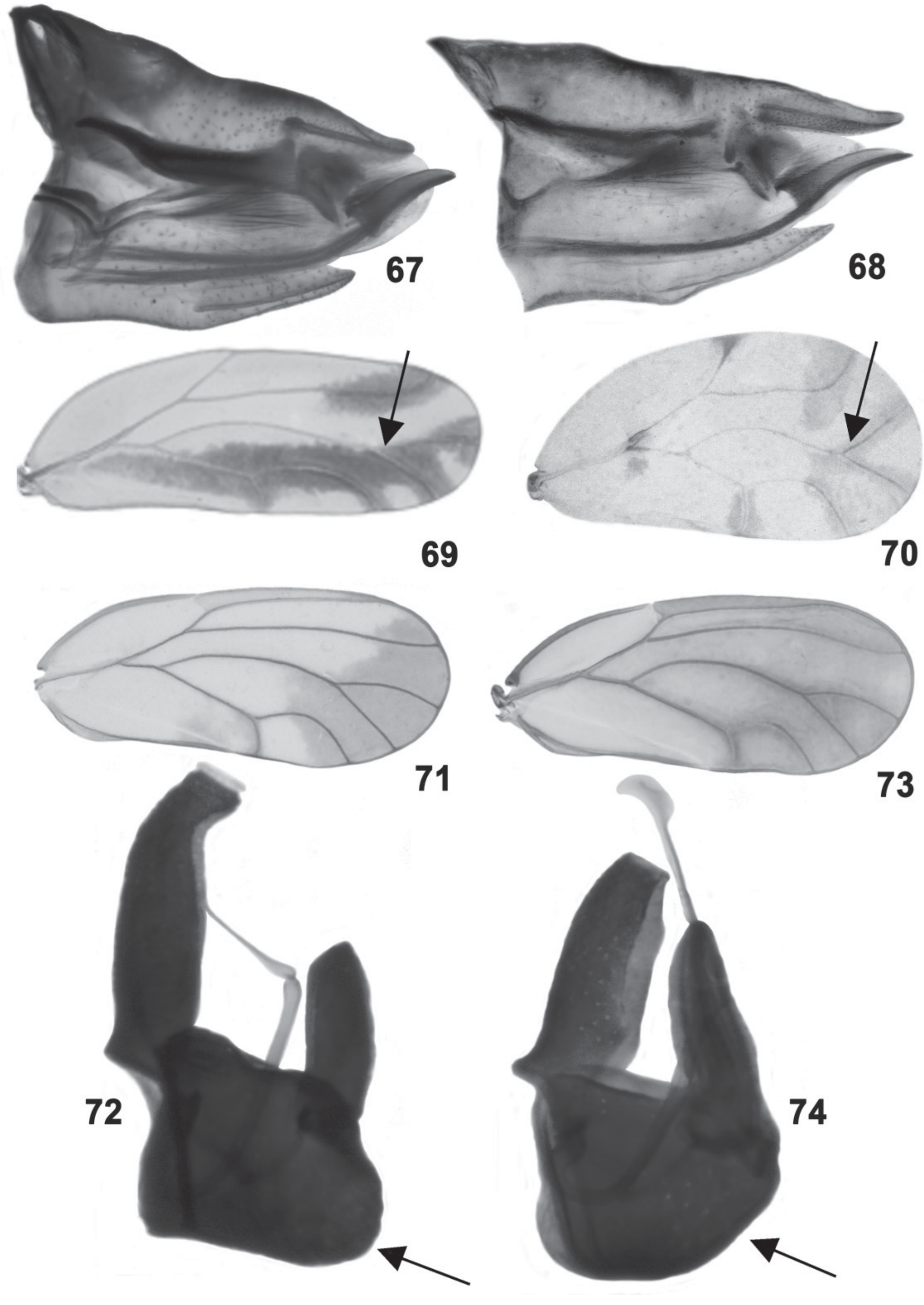
Figs 41-48. (41) *Craspedolepta artemisiae*, male terminalia. (42) *Craspedolepta artemisiae*, female terminalia. (43) *Craspedolepta latior*, male terminalia. (44) *Craspedolepta latior*, female terminalia. (45) *Craspedolepta malachitica*, male terminalia. (46) *Craspedolepta malachitica*, female terminalia. (47) *Craspedolepta subpunctata*, paramere. (48) *Craspedolepta subpunctata*, female terminalia.



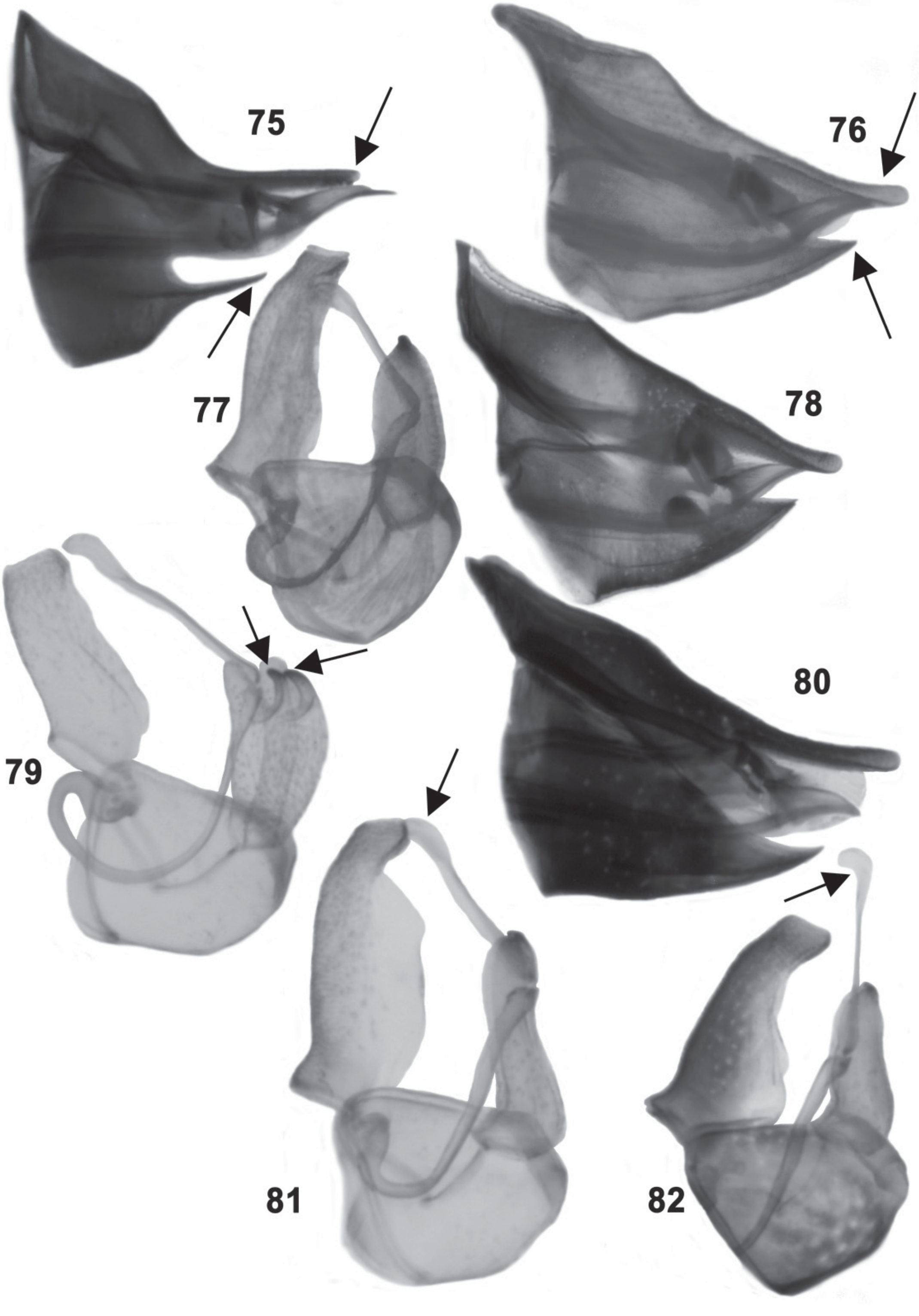
Figs 49-58. (49) *Craspedolepta innoxia*, forewing surface spinules. (50) *Craspedolepta innoxia*, paramere. (51) *Craspedolepta innoxia*, female terminalia. (52) *Craspedolepta omissa*, forewing surface spinules. (53) *Craspedolepta omissa*, paramere. (54) *Craspedolepta omissa*, female terminalia. (55) *Craspedolepta nebulosa*, forewing. (56) *Craspedolepta nebulosa*, male terminalia. (57) *Craspedolepta nebulosa*, paramere. (58) *Craspedolepta nebulosa*, female terminalia.



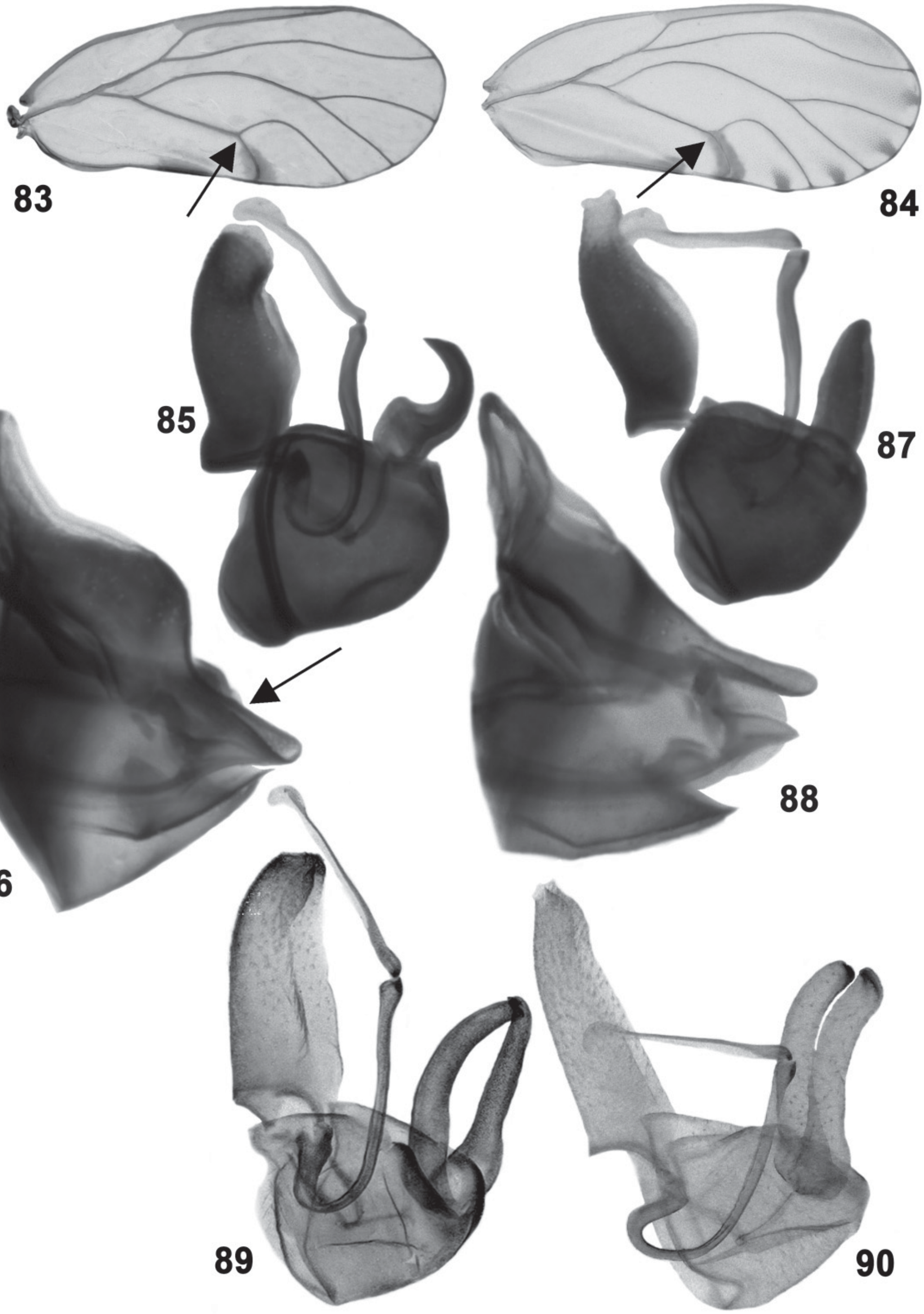
Figs 59-66. (59) *Craspedolepta nervosa*, forewing. (60) *Craspedolepta bulgarica*, forewing. (61) *Craspedolepta nervosa*, male terminalia. (62) *Craspedolepta nervosa*, female terminalia. (63) *Craspedolepta bulgarica*, male terminalia. (64) *Craspedolepta bulgarica*, female terminalia. (65) *Craspedolepta crispati*, male terminalia. (66) *Craspedolepta sonchi*, male terminalia.



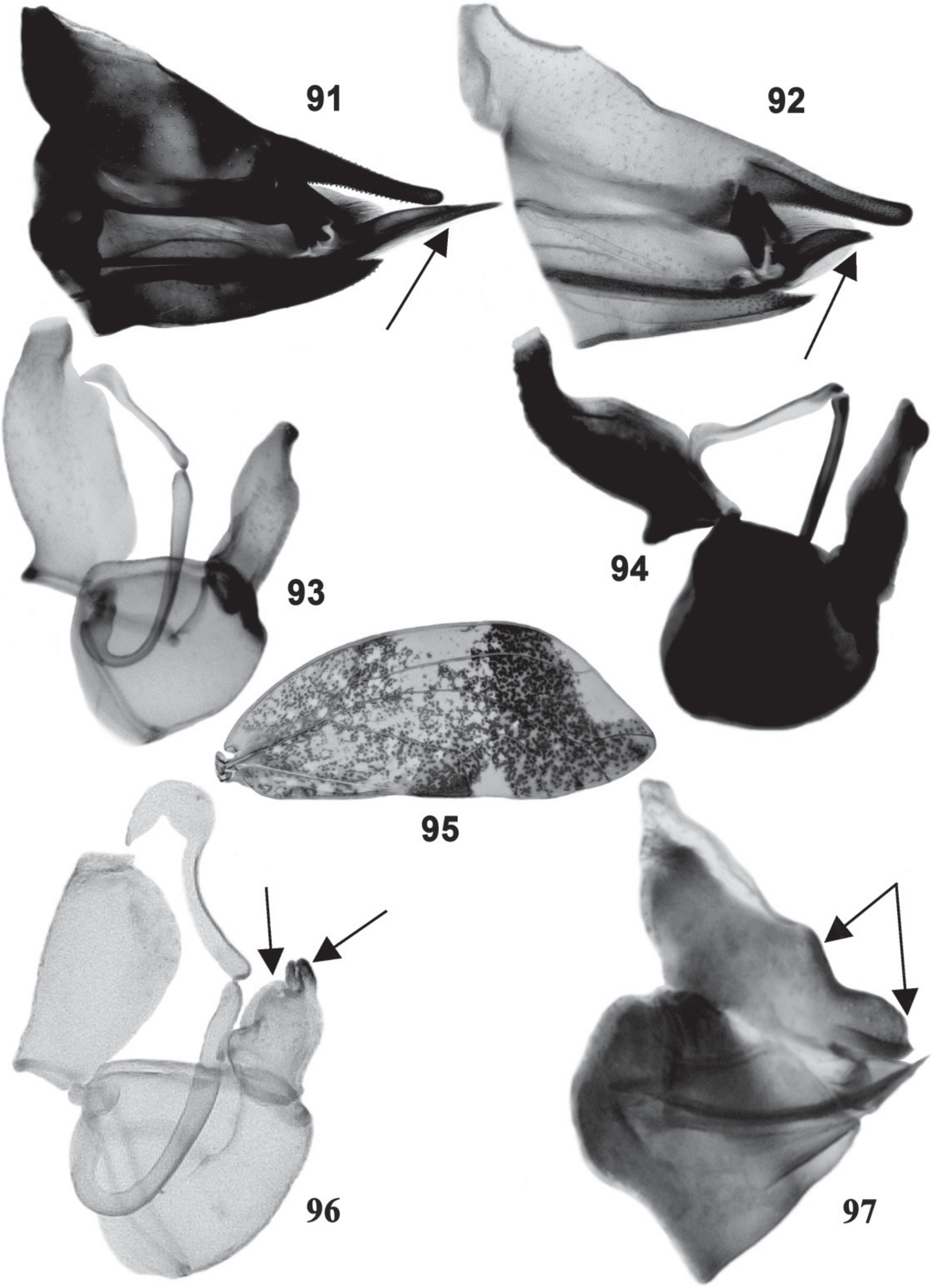
Figs 67-74. (67) *Craspedolepta crispati*, female terminalia. (68) *Craspedolepta sonchi*, female terminalia. (69) *Livilla horvathi*, forewing. (70) *Livilla radiata*, forewing. (71) *Cacopsylla breviantennata*, forewing. (72) *Cacopsylla breviantennata*, male terminalia. (73) *Cacopsylla pruni*, forewing. (74) *Cacopsylla pruni*, male terminalia.



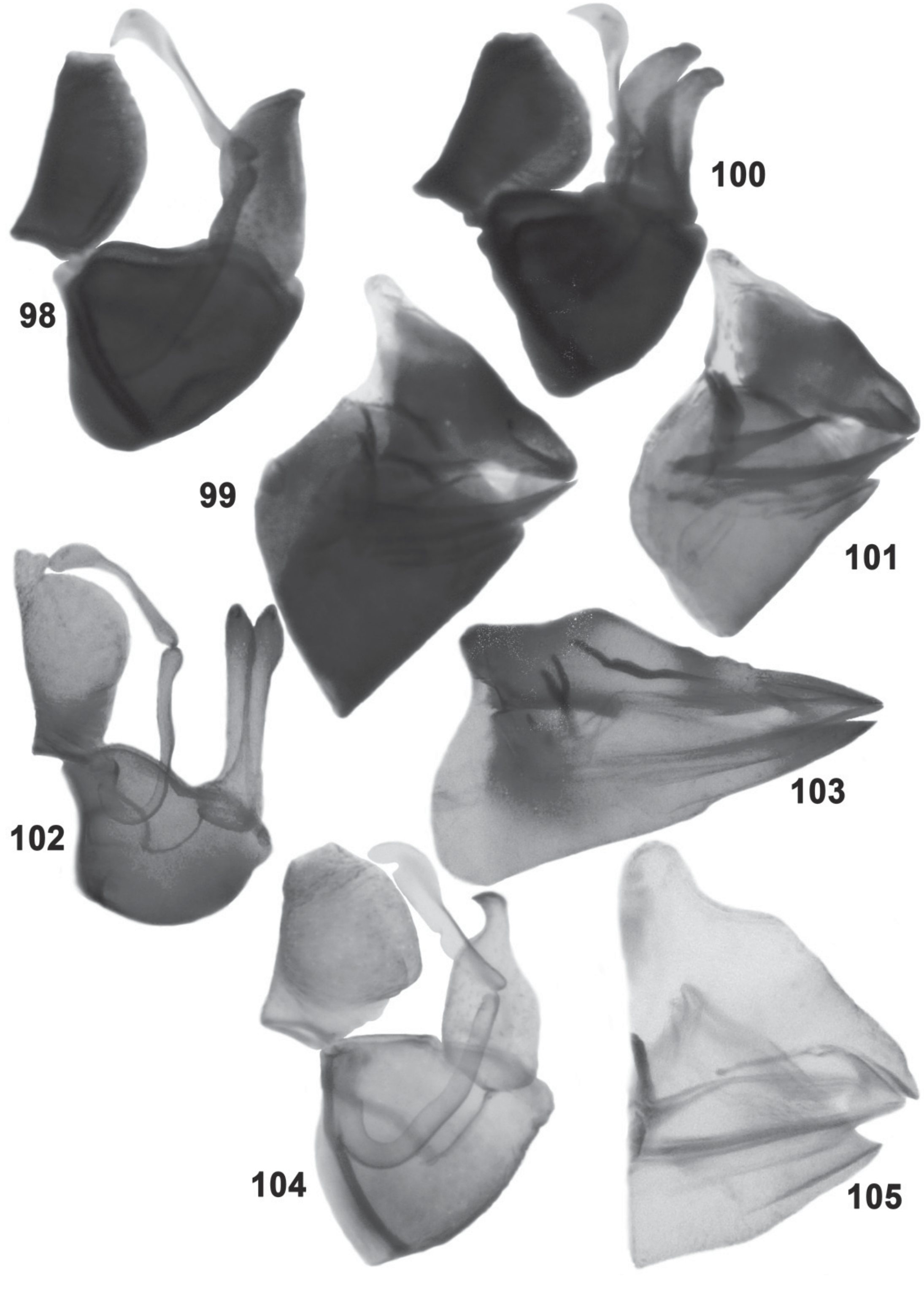
Figs 75-82. (75) *Cacopsylla breviantennata*, female terminalia. (76) *Cacopsylla pruni*, female terminalia. (77) *Cacopsylla pyrisuga*, male terminalia. (78) *Cacopsylla pyrisuga*, female terminalia. (79) *Cacopsylla picta*, male terminalia. (80) *Cacopsylla picta*, female terminalia. (81) *Cacopsylla melanoneura*, male terminalia. (82) *Cacopsylla affinis*, male terminalia.



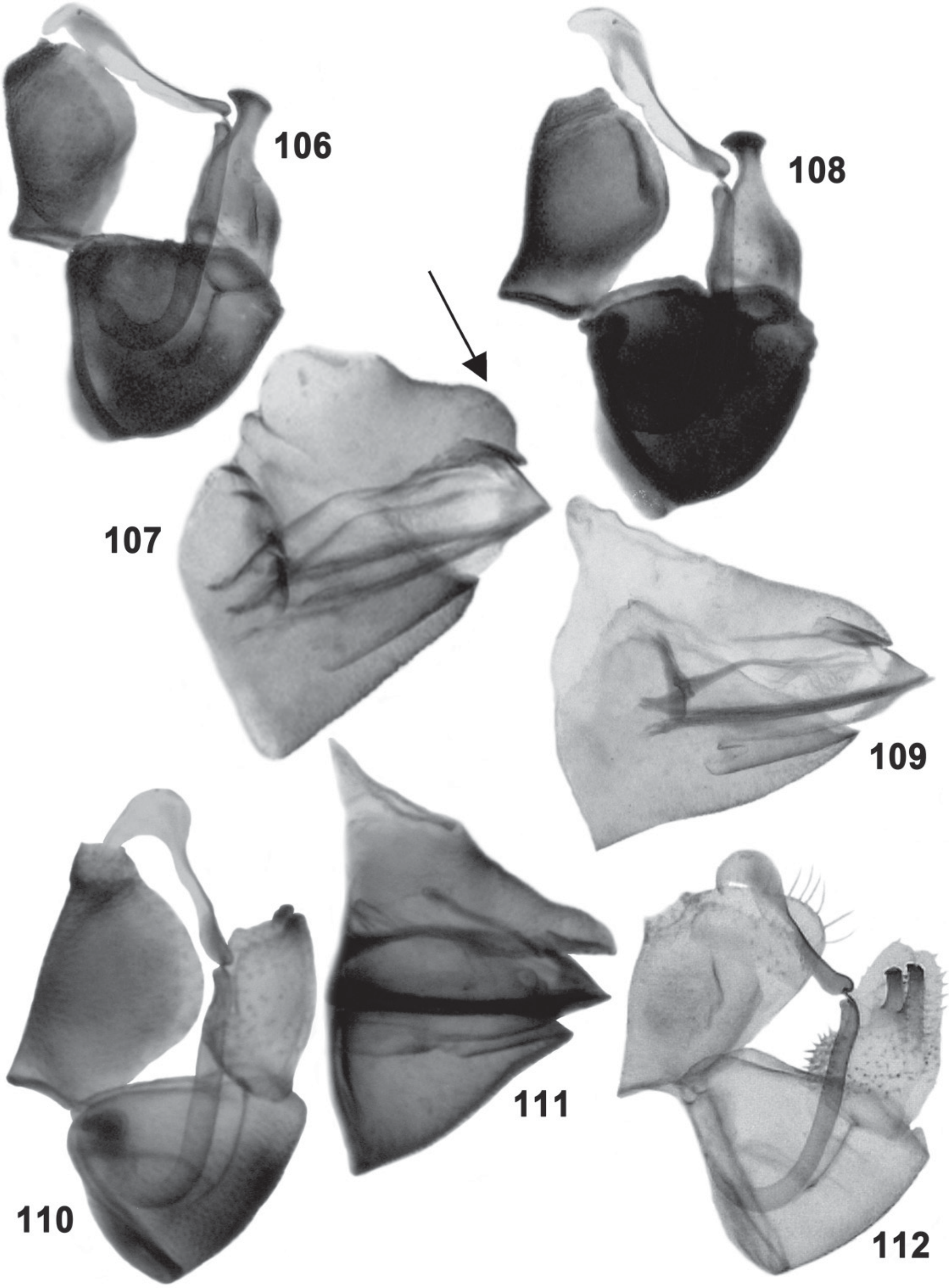
Figs 83-90. (83) *Cacopsylla albipes*, forewing. (84) *Cacopsylla crataegi*, forewing. (85) *Cacopsylla pyri*, male terminalia. (86) *Cacopsylla pyri*, female terminalia. (87) *Cacopsylla pyricola*, male terminalia. (88) *Cacopsylla pyricola*, female terminalia. (89) *Cacopsylla zetterstedti*, male terminalia. (90) *Cacopsylla hippophaes*, male terminalia.



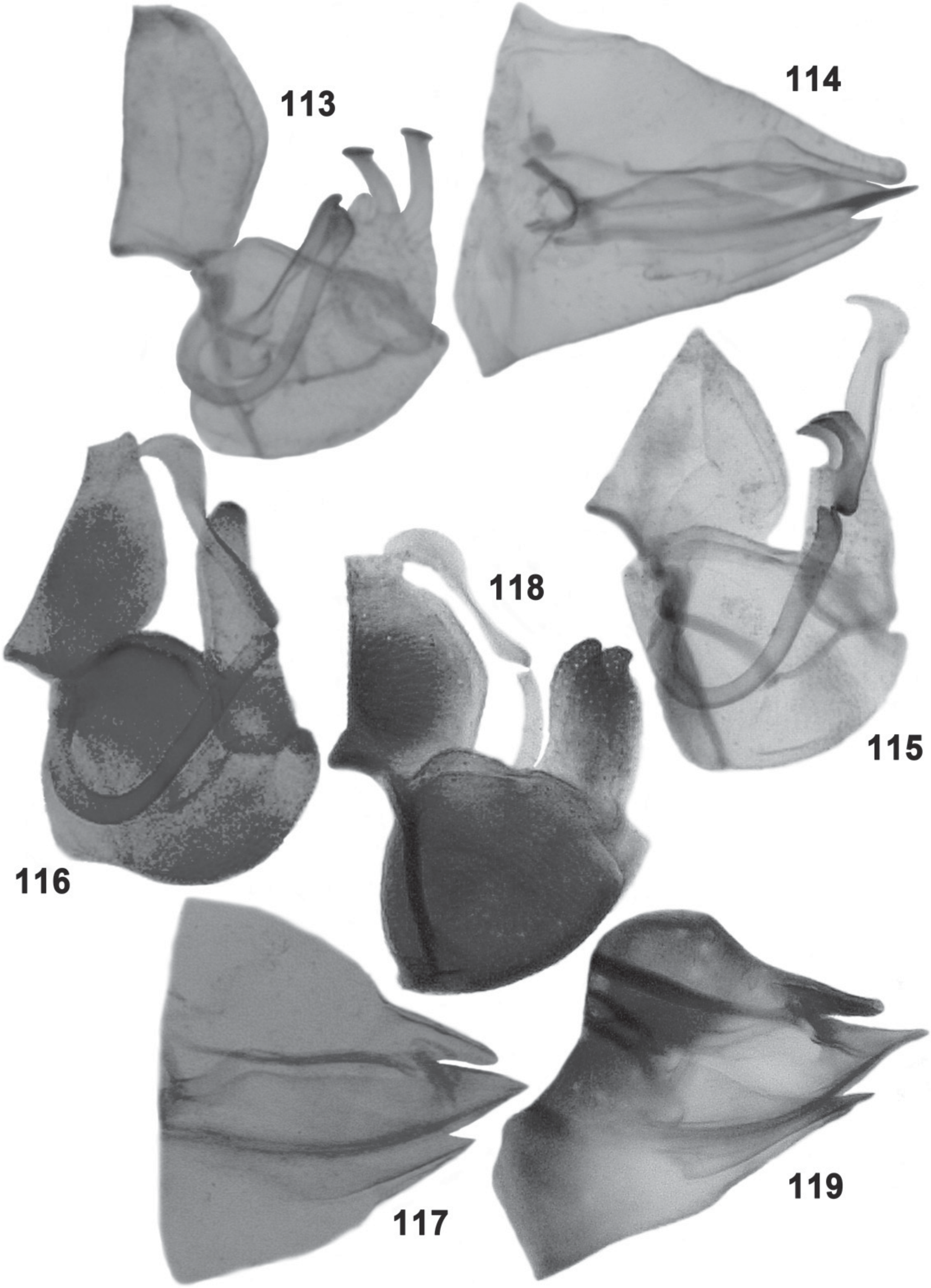
Figs 91-97. (91) *Cacopsylla zetterstedti*, female terminalia. (92) *Cacopsylla hippophaes*, female terminalia. (93) *Cacopsylla brunneipennis*, male terminalia. (94) *Cacopsylla nigrita*, male terminalia. (95) *Trichochermes walkeri*, forewing. (96) *Trioza centranthi*, male terminalia. (97) *Trioza centranthi*, female terminalia.



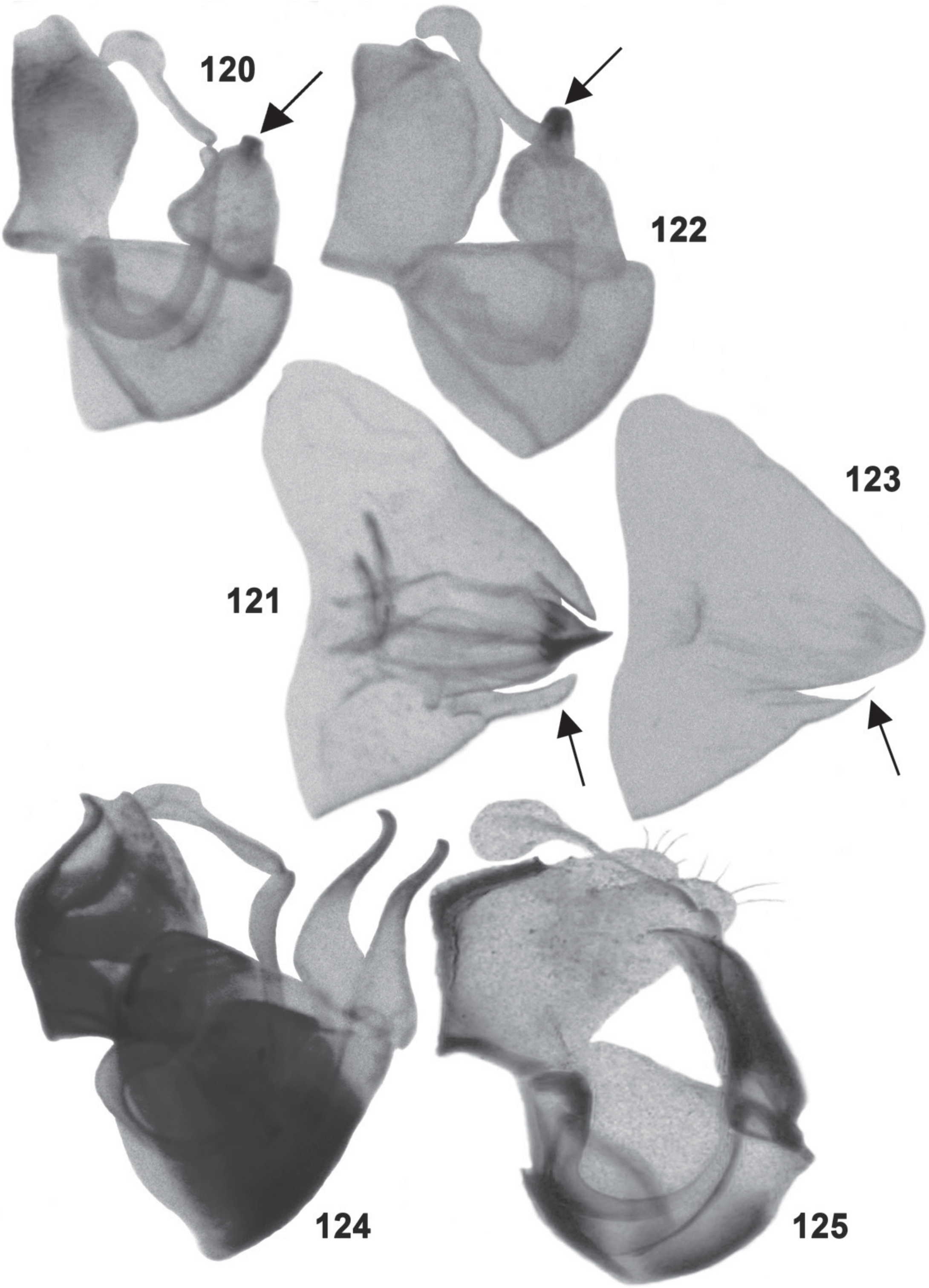
Figs 98-105. (98) *Trioza galii*, male terminalia. (99) *Trioza galii*, female terminalia. (100) *Trioza velutina*, male terminalia. (101) *Trioza velutina*, female terminalia. (102) *Trioza urticae*, male terminalia. (103) *Trioza urticae*, female terminalia. (104) *Trioza proxima*, male terminalia. (105) *Trioza proxima*, female terminalia.



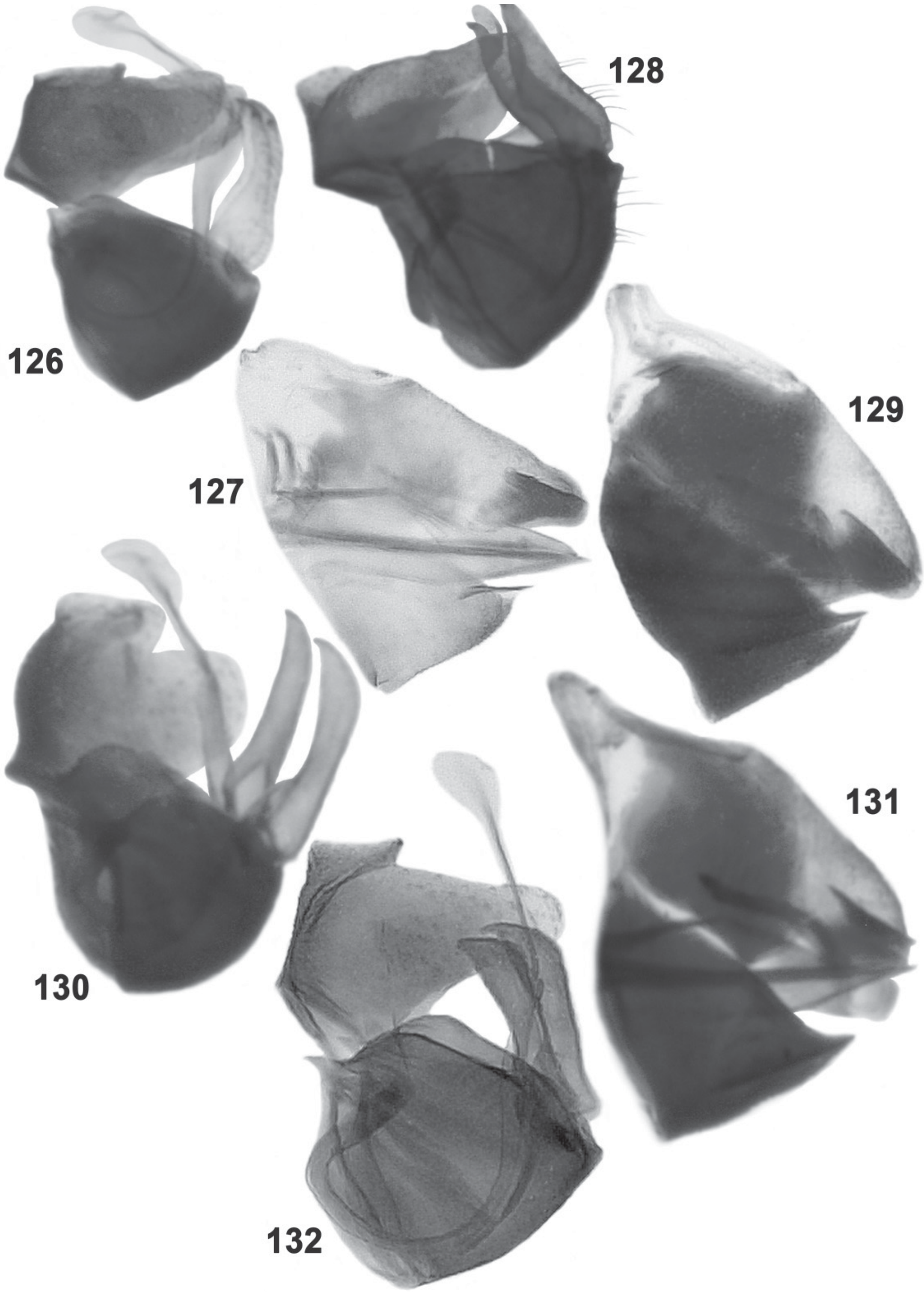
Figs 106-112. (106) *Trioza dispar*, male terminalia. (107) *Trioza dispar*, female terminalia. (108) *Trioza tatrensis*, male terminalia. (109) *Trioza tatrensis*, female terminalia. (110) *Trioza rotundata*, male terminalia. (111) *Trioza rotundata*, female terminalia. (112) *Trioza cerastii*, male terminalia.



Figs 113-119. (113) *Trioza cirsii*, male terminalia. (114) *Trioza cirsii*, female terminalia. (115) *Trioza abdominalis*, male terminalia. (116) *Trioza alacris*, male terminalia. (117) *Trioza alacris*, female terminalia. (118) *Trioza remota*, male terminalia. (119) *Trioza remota*, female terminalia.



Figs 120-125. (120) *Trioza anthrisci*, male terminalia. (121) *Trioza anthrisci*, female terminalia. (122) *Trioza laserpitii*, male terminalia. (123) *Trioza laserpitii*, female terminalia. (124) *Bactericera albiventris*, male terminalia. (125) *Bactericera salicivora*, male terminalia.



Figs 126-132. (126) *Bactericera acutipennis*, male terminalia. (127) *Bactericera acutipennis*, female terminalia. (128) *Bactericera femoralis*, male terminalia. (129) *Bactericera femoralis*, female terminalia. (130) *Bactericera nigricornis*, male terminalia. (131) *Bactericera nigricornis*, female terminalia. (132) *Bactericera striola*, male terminalia.

APPENDIX 2

Psyllids reported from Belarus, Poland, Northwest Russia, Lithuania and the former Livonia. Sources: 1 – species recorded in the present paper; 2 – Klimaszewski (1975); 3 – Loginova (1961); 4 – Loginova (1962b); 5 – Loginova (1968); 6 – Loginova (1972a); 7 – Loginova (1962a); 8 – Loginova (1966); 9 – Loginova (1954); 10 – Petrov *et al*. (2011); 11 – Petrov & Sautkin (2013); 12 – Loginova (1967); 13 – Gorlenko *et al.* (1988); 14 – Byazdzenka *et al.* (1973); 15 – Palyakova (1969); 16 – Loginova (1972b); 17 – Petrov (2004); 18 – Sidlyarevich & Bolotnikova (1992); 19 – Kuznetsova *et al.* (2012); 20 – Malumphy *et al.* (2009); 21 – Vengeliauskaitė (1974); 22 – Głowacka (1989); 23 – Głowacka (1991); 24 – Głowacka & Migula (1996); 25 – Drohojowska & Głowacka (2011); 26 – Ossiannilsson (1992); 27 – Flor (1861); 28 – Petrov (2011).

Species	Belarus	Poland	Northwest Russia	Lithuania	Livonia
Aphalaridae					
Aphalarinae					
Aphalara affinis	1	2	3, 4		27
Aphalara avicularis	1, 3 as *A. polygoni*, see checklist	26			27 p.p. as *Aphalara polygoni*
Aphalara borealis	2				
Aphalara calthae	2	3, 4			
Aphalara exilis	2	3, 4, 5, 6		27	
Aphalara freji	1, 3 as *A. polygoni*, see checklist	2 as *Aphalara polygoni*		27 p.p. as *Aphalara polygoni*	
Aphalara maculipennis	2				
Aphalara purpurascens	2 as *A. rumicicola*, 24 as *A. crispicola*				
Craspedolepta alevtinae	2 as *C. alevtinae smreczynskii*				
Craspedolepta artemisiae	2			27 as *Aphalara artemisiae*	
Craspedolepta bulgarica	2	4, 5, 7			
Craspedolepta crispati	1				
Craspedolepta flavipennis	1	2	4		27 p.p. as *Aphalara picta*
Craspedolepta latior	1	2	4		
Craspedolepta malachitica	1	2			
Craspedolepta nebulosa	2	4			
Craspedolepta nervosa	1	2	4, 5		27 as *Aphalara nervosa*
Craspedolepta omissa	1	2			
Craspedolepta sonchi	2	4		27 p.p. as *Aphalara picta*	
Craspedolepta subpunctata	1	2	4		

Species	Belarus	Poland	Northwest Russia	Lithuania	Livonia
Rhinocolinae					
Rhinocola aceris	1	2	4, 5		27
Liviidae					
Euphyllurinae					
Psyllopsis discrepans	1	2		20	
Psyllopsis distinguenda	1	2			
Psyllopsis fraxini	28	2	4, 9		27 as *Psylla fraxini*
Psyllopsis fraxinicola	1	2	9	20	27 as *Psylla unicolor*
Strophingia ericae	1	2 as *Aphalaroida ericae*	4		27 as *Rhinocola ericae*
Liviinae					
Camarotoscena speciosa	1	2			27 as *Rhinocola speciosa*
Livia crefeldensis	2 as *Diraphia crefeldensis*				27 as *Livia crefeldensis*
Livia junci	2 as *Livia juncorum*	4, 8 as *Livia juncorum*		27 as *Livia juncorum*	
Livia limbata	2 as *Diraphia limbata*				
Psyllidae					
Psyllinae					
Arytaina genistae	1	2			
Arytainilla spartiophila			20		
Baeopelma foersteri	1, 4 as *Psylla foersteri*	2 as *Psylla foersteri*	4 as *Psylla foersteri*		27 as *Psylla foersteri*
Cacopsylla abdominalis	2				
Cacopsylla albipes	2				
Cacopsylla ambigua	1	2	4, 5, 8, 12 as *Psylla ambigua*		27 as *Psylla melina*
Cacopsylla brunneipennis		1	2 as *Cacopsylla klapaleki*		
Cacopsylla crataegi	11, 13	2			
Cacopsylla elegantula	2				
Cacopsylla flori	2			27 as *Psylla insignis*	
Cacopsylla fraudatrix	19				
Cacopsylla hippophaes	1	2			
Cacopsylla intermedia	22				

Species	Belarus	Poland	Northwest Russia	Lithuania	Livonia
Cacopsylla iteophila	2				
Cacopsylla ledi	1	2			27 as *Psylla ledi*
Cacopsylla mali	1, 13, 14 as *Psylla mali*	2	4 as *Psylla mali*	21	27 as *Psylla mali*
Cacopsylla melanoneura	2		20		
Cacopsylla merita	23	12 as *Psylla merita*			
Cacopsylla moscovita	1	2	4, 12 as *Psylla moscovita*		
Cacopsylla myrtilli	2				
Cacopsylla nigrita	2	4, 12 as *Psylla nigrita*		27 as *Psylla pineti*	
Cacopsylla parvipennis	1	2	4, 12 as *Psylla parvipennis*	27 as *Psylla saliceti*	
Cacopsylla peregrina	1	2		20	27 as *Psylla crataegicola*
Cacopsylla pruni	2	8 as *Psylla pruni*			
Cacopsylla pulchella	1				
Cacopsylla pulchra	1	2	4, 5, 12 as *Psylla pulchra*		
Cacopsylla pyri	13, 15 as *Psylla pyri*	2	4 as *Psylla pyri*	21	27 as *Psylla pyri*
Cacopsylla pyricola	2				
Cacopsylla pyrisuga	15 as *Psylla pyrisuga*	2			
Cacopsylla saliceti	2			27 as *Psylla salicicola*	
Cacopsylla sorbi	1	2	4, 6 as *Psylla sorbi*		
Cacopsylla ulmi	1, 28	2	8 as *Psylla ulmi*		
Cacopsylla visci	2				
Cacopsylla zetterstedti	2				
Chamaepsylla hartigii	1	2 as *Psylla hartigi*	4 as *Psylla hartigi*		27 as *Psylla hartigii*
Livilla horvathi	2 as *Floria horvathi*				
Livilla radiata	2 as *Alloeoneura radiata*				
Livilla ulicis	2				
Psylla alni	1	2	4		27
Psylla betulae	1	2	4		27
Psylla buxi	10, 11	2 as *Spanioneura buxi*			
Psylla fusca	1	2	4		27 as *Psylla perspicillata*

Species	Belarus	Poland	Northwest Russia	Lithuania	Livonia
Triozidae					
Bactericera acutipennis	1	2	4, 8 as *Trioza acutipennis*		27 as *Trioza acutipennis* and *T. munda*
Bactericera albiventris	2 as *Heterotrioza albiventris*	4, 5, 8 as *Trioza albiventris*	27 as *Trioza albiventris*		
Bactericera bohemica	2	4, 16 as *Trioza bohemica*			
Bactericera calcarata	24				
Bactericera curvatinervis	1	2	4 as *Trioza curvatinervis*		
Bactericera femoralis	1, see checklist	2	4, 5 as *Trioza femoralis*		27 as *Trioza femoralis*
Bactericera maura	2	5 as *Trioza maura*			
Bactericera modesta	2				
Bactericera nigricornis	2		20	27 as *Trioza nigricornis*	
Bactericera parastriola	25				
Bactericera reuteri	1	2			
Bactericera salicivora	2	4, 5 as *Trioza salicivora*			
Bactericera striola	4 as *Trioza striola*	2	4, 16 as *Trioza striola*		27 as *Trioza striola*
Bactericera substriola	1				
Eryngiofaga deserta	23				
Trichochermes walkeri	1, 17	2			27 as *Trioza walkeri*
Trioza abdominalis	2 as *Trioza abdominalis abdominalis*	4		27	
Trioza agrophila	2				
Trioza alacris	2 as *Heterotrioza alacris*				
Trioza anthrisci	1	2 as *Heterotrioza pallida*	4 as *Trioza pallida*		
Trioza apicalis	18	2 as *Heterotrioza apicalis*	21	27 as *Trioza viridula*	
Trioza centranthi	2				
Trioza cerastii	1	2	4		
Trioza chenopodii	2 as *Heterotrioza chenopodii*				
Trioza chrysanthemi	24				
Trioza cirsii		2 as *Trioza viridula*			
Trioza dispar	2				

Species	Belarus	Poland	Northwest Russia	Lithuania	Livonia
Trioza flavipennis	1	2	4	20	27
Trioza foersteri	2				
Trioza galii	2	4, 8		27	
Trioza laserpitii	25				
Trioza munda	2				
Trioza proxima	1	2	4		
Trioza remota	1	2 as *Heterotrioza remota*	20	27 as *Trioza dryobia*	
Trioza rhamni	2	4, 5, 8		27 as *Troza abieticola*	
Trioza rotundata	2				
Trioza rumicis	2				
Trioza saxifragae	2				
Trioza schrankii	1	2 as *Trioza schranki*			
Trioza senecionis	2				
Trioza tatrensis	2				
Trioza tripteridis	25				
Trioza urticae	1	2	4	20	27
Trioza velutina	1	2 as *T. galii* (in part)			27

УДК 551

ЛИСТОБЛОШКИ (HEMIPTERA: PSYLLOIDEA) ФАУНЫ БЕЛАРУСИ

Л.А. Сербина[1,2], Д. Буркхардт[1], О.И. Бородин[3]
[1]*Музей Естествознания, Augustinergasse 2, 4001 Базель, Швейцария*
[2]*Институт охраны природы, ландшафта и окружающей среды Университета Базеля, St. Johanns-Vorstadt 10, 4056 Базель, Швейцария*
[3]*Национальная академия наук, улица Академическая 27, 220072 Минск, Республика Беларусь*
e-mail: liliya_serbina@mail.ru, liliia.serbina@unibas.ch

Введение

Псиллиды, или листоблошки (Psylloidea) – группа сосущих насекомых-фитофагов, преобладающее большинство которых является узкими олигофагами, специализированными к развитию на ограниченном круге растений (преимущественно двудольных покрытосемянных). Некоторые виды псиллид являются серьезными вредителями сельского хозяйства, декоративных и лесных насаждений, некоторые представители являются переносчиками возбудителей заболеваний растений. На данный момент в мировой фауне псиллид насчитывается около 4000 описанных видов, что, согласно существующим взглядам, составляет примерно половину от возможного их числа [1]. Несмотря на то, что видовое разнообразие псиллид наиболее высокое в тропических широтах, фауна псиллид западной части Палеарктики является наиболее изученной и насчитывает примерно 400 зарегистрированных видов листоблошек [2]. Изучение псиллид в Восточной Европе было инициировано G. Flor [3], который проводил свои исследования на территории Ливонии, позже фауна псиллид на территории европейской части СССР усиленно изучалась А.М. Гегечкори и М.М. Логиновой [4]. В то же время фауна листоблошек Беларуси была долгое время практически не изучена. К моменту начала наших исследований в регионе было известно только 12 зарегистрированных видов листоблошек [5–14]. При этом достоверность идентификации одного вида (*Aphalara polygoni* Foerster, 1848) остается под вопросом.

Целью нашей работы было изучение видового разнообразия листоблошек на территории Беларуси и предоставление актуального списка видов псиллид на основании доступной литературной информации и собранного материала.

Методы исследования

Сбор материала осуществлялся методом кошения стандартным энтомологическим сачком в течение полевых сезонов 1999–2013 гг. на территории всех административных областей Беларуси. На данный момент собранный материал хранится в Государственном научно-производственном объединении «Научно-практический центр Национальной академии наук Беларуси по биоресурсам» (г. Минск). Установление видовой принадлежности собранных видов псиллид проводилось с помощью сравнения собранного материала с коллекцией псиллид, хранящейся в Музее Естествознания в Базеле (Швейцария). Полезными, но информационно устаревшими источниками для определения видовой принадлежности листоблошек являются определительные таблицы, предложенные М.М. Логиновой [15], S.M. Klimaszewski [16] и F. Ossiannilsson [17].

Результаты и обсуждение

Несмотря на то, что фауна псиллид центральной и восточной Европы в целом хорошо изучена [4, 16], фауна псиллид Беларуси изучена достаточно плохо. Зарегистрированные к началу наших исследований виды псиллид принадлежат к 3 семействам: Liviidae – *Psyllopsis fraxini* (Linné, 1758), Psyllidae – *Baeopelma foersteri* (Flor, 1861), *Cacopsylla crataegi* (Schrank, 1801), *Cacopsylla mali* (Schmidberger, 1836), *Cacopsylla pyri* (Linné, 1758), *Cacopsylla pyrisuga* (Foerster, 1848), *Cacopsylla ulmi* (Foerster, 1848), *Psylla buxi* (Linné, 1758) и Triozidae – *Bactericera striola* (Flor, 1861), *Trichochermes walkeri* (Foerster, 1848), *Trioza apicalis* Foerster, 1848.

В результате наших исследований было подтверждено наличие 4 ранее зарегистрированных видов листоблошек, а также обнаружено 43 новых для Беларуси вида. Таким образом, проведенные исследования позволяют заявить о наличии на территории Беларуси, по крайней мере, 54 видов листоблошек, относящихся к 4 семействам: Aphalaridae (11 видов), Liviidae (6 видов), Psyllidae (22 вида) и Triozidae (15 видов). Среди выявленных видов псиллид более половины развиваются на древесных растениях. Преобладающее количество видов псиллид, зарегистрированных на данный момент в Беларуси, широко распространены в остальных странах Европы.

На основании анализа литературных данных по фауне псиллид соседних регионов – Польши [16, 18–22], северо-западной части России [5, 6, 23–29], Литвы [30, 31] и бывшей Ливонии (современная часть Латвии и Эстонии) [3], можно сделать вывод, что 54 вида листоблошек, отмеченные к настоящему времени, составляют меньше половины от возможного видового состава. Вероятность присутствия некоторых видов псиллид может быть подтверждена произрастанием на территории Беларуси соответствующих видов растений [32], на которых данные виды развиваются.

На основании анализа вышеупомянутых источников мы полагаем возможным обнаружение в Беларуси еще 73 видов псиллид, принадлежащих к 4 семействам – Aphalaridae (15 видов), Liviidae (3 вида), Psyllidae (26 видов) и Triozidae (29 видов). Информация по количеству зарегистрированных видов псиллид, а также по общему количеству предполагаемых видов псиллид фауны Беларуси, представлена в таблице 1.

Исходя из полученных данных, можно ожидать, что наиболее богатыми по количеству видов семействами являются Psyllidae и Triozidae, а наиболее многочисленными родами – *Cacopsylla* и *Trioza* (таблица 1).

Таблица 1 – Количество зарегистрированных на данный момент видов псиллид фауны Беларуси относительно их родовой принадлежности.

семейство	подсемейство	род	количество зарегистрированных видов	общее количество видов*
Aphalaridae	Aphalarinae	*Aphalara*	3	11
		Craspedolepta	7	14
	Rhinocolinae	*Rhinocola*	1	1
Liviidae	Euphyllurinae	*Psyllopsis*	4	4
		Strophingia	1	1
	Liviinae	*Camarotoscena*	1	1
		Livia	0	3
Psyllidae	Psyllinae	*Arytaina*	1	2
		Arytainilla	0	1
		Baeopelma	1	1
		Cacopsylla	15	35
		Chamaepsylla	1	1
		Livilla	0	3
		Psylla	4	5
Triozidae		*Bactericera*	5	14
		Trichochermes	1	1
		Trioza	9	29
Итого			54	127

*Общее количество видов псиллид, ожидаемых для фауны Беларуси на основании литературных данных [5–14, 32] и количества зарегистрированных видов.

Выводы

На основании проведенных исследований и анализа литературных данных в настоящее время на территории Беларуси зарегистрировано 54 вида листоблошек. По причине отсутствия современных идентификационных ключей по псиллидам Беларуси и для мотивации дальнейших исследований по белорусским псиллидам, мы предлагаем новые иллюстрированные идентификационные ключи для 127 видов листоблошек, присутствие которых было подтверждено к настоящему моменту, или данные виды псиллид были зарегистрированы в соседних регионах, или вероятность их присутствия может быть подтверждена наличием на территории Беларуси видов растений, на которых данные виды псиллид развиваются. Данные идентификационные ключи а также актуальный аннотированный список видов псиллид фауны Беларуси будут доступны в выпуске научного журнала Revue Suisse de Zoologie, который выйдет в печать в марте 2015 г. [33]. Несмотря на проведенные исследования, фауна псиллид Беларуси остается достаточно плохо изученной, и большое количество видов псиллид еще может быть обнаружено на территории Республики (по меньшей мере 73 вида). Целенаправленная работа по сбору материала с определенных видов растений является необходимой для обнаружения более редких видов листоблошек.

Список литературы

1. Li, F. Psyllidomorpha of China (Insecta: Hemiptera). Psyllidomorpha of China / F. Li. – Beijing: Science Press, 2011. – 1976 p.

2. Burckhardt, D. Fauna Europaea: Psylloidea. Fauna Europaea, version 1.0, 2004. http://www.faunaeur.org/full_results.php?id=12489 (по состоянию на 10 января 2014).

3. Flor, G. Die Rhynchoten Livlands in systematischer folge beschrieben. Archiv für die Naturkunde Liv-, Ehst- und Kurlands / G. Flor. – Dorpat, 1861. – 637 p.

4. Гегечкори, А.М. Псиллиды (Homoptera, Psylloidea) СССР: Аннотированный список / А.М. Гегечкори, М.М. Логинова. – Тбилиси: Мицниереба, 1990. – 161 с.

5. Логинова, М.М. Ревизия родов *Aphalara* Frst. и *Craspedolepta* Enderl. (Homoptera, Psylloidea) фауны СССР. I / М.М. Логинова // Энтомологическое обозрение, 1961. – Т. 40, ч. 3.– С. 602–623.

6. Логинова, М.М. К фауне псиллид Ленинградской области / М.М. Логинова // Труды Зоогического Института Академии Наук СССР, 1962. – Т. 31. – С. 33–45.

7. Палякова, Т.Е. Да біялогіі грушавых верацэнніц у Беларусі / Т.Е. Палякова // Весці АН БССР. Сер. с.-г. навук, 1969. – N. 5. – С. 87–89.

8. Бядзенка, Т.Ц. Яблыневая верацэнніца (*Psylla mali* Schmdbg.) у Беларусі / Т.Ц. Бядзенка, Т.Е. Палякова, У.Г. Осіпаў // Весці АН БССР. Сер. с.-г. навук, 1973. – N. 3. – С. 62–64.

9. Горленко, С.В. Устойчивость древесных интродуцентов к биотическим факторам / С.В. Горленко, А.И. Блинцов, Н.А. Панько. – Минск: Наука и техника, 1988. – 189 с.

10. Сидляревич, В.И. Энтомофаги вредителей овощных культур / В.И. Сидляревич, В.И. Болотникова. – Минск: Урожай, 1992. – 126 с.

11. Петров, Д.Л. Фоновые виды тератформирующих насекомых Беларуси / Д.Л. Петров // Вестник БГУ, Сер. 2, 2004. – N. 2. – С. 63–71.

12. Петров, Д.Л. Тератформирующие членистоногие юга центрального региона Белорусской гряды. Структура биологического разнообразия центрального региона Белорусской гряды (на примере модельных групп беспозвоночных и позвоночных животных) / Д.Л. Петров. – Минск: БелИСА, 2011. – С. 32–40

13. Петров, Д.Л. Фитофаги – вредители кустарниковых растений / Д.Л. Петров, Ф.В. Сауткин, В.В. Иванов. – Минск: БГУ, 2011. – 36 с.

14. Петров, Д.Л. Насекомые – галлообразователи – вредители кустарниковых растений зеленых насаждений Беларуси / Д.Л. Петров, Ф.В. Сауткин // Вестник БГУ, Сер. 2., 2013. – N. 1. – С. 65–71.

15. Логинова, М.М. Подотряд псиллиды, или листоблошки (Homoptera, Psylloidea) / М.М. Логинова // Определитель насекомых европейской части СССР. – 1964. – Т. 1. – С. 437–482.

16. Klimaszewski, S.M. Psylloidea Koliszki (Insecta: Homoptera) / S.M. Klimaszewski // Fauna Polski, 1975. – V. 3.– P. 1–295.

17. Ossiannilsson, F. The Psylloidea (Homoptera) of Fennoscandia and Denmark / F. Ossiannilsson // N.P. Kristensen (eds.). – Leiden: Fauna Entomologica Scandinavica, 1992. – V. 26. – P. 1–346.

18. Głowacka, E. Koliszki (Psylloidea) Sudetów / E. Głowacka // Acta Biologica Silesiana, 1989. – V. 13. – P. 21–30.

19. Głowacka, E. Psyllids (Insecta: Psylloidea) new for Poland in the collection from Mielnik vicinity (north-eastern Poland) / E. Głowacka // Annals of the Upper Silesian Museum, 1991. – V. 2. – P. 155–160.

20. Głowacka, E. Koliszki Psylloidea Gorców / E. Głowacka, P. Migula // Parki Narodowe i Rezerwaty Przyrody, 1996. – V. 15. – P. 59–71.

21. Drohojowska, J. The jumping plant-lice (Hemiptera: Psylloidea) of the Tatra National Park / J. Drohojowska, E. Głowacka // Polish Journal of Entomology, 2011. – V. 80. – P. 265–275.

22. Kuznetsova, V.G. *Cacopsylla fraudatrix* sp. n. (Hemiptera: Psylloidea) recognised from testis structure and mitochondrial gene COI / V.G. Kuznetsova, E.S. Labina, N.A. Shapoval, A. Maryanska-Nadachowska, V.A. Lukhtanov // Zootaxa, 2012. – V. 3547. – P. 55–63.

23. Логинова, М.М. Листоблошки рода *Psyllopsis* Löw (Homoptera, Psyllidae) и особенности их биологии в условиях Сталинградской области / М.М. Логинова // Труды Зоологического Института, 1954. – Т. 15. – С. 35–53.

24. Логинова, М.М. Новые псиллиды (Homoptera, Psylloidea) СССР / М.М. Логинова // Труды Зоологического Института, 1962. – Т. 30. – С. 185–220.

25. Логинова, М.М. Фауна и биология псиллид (Homoptera, Psylloidea) Молдавской ССР / М.М. Логинова // Труды Молдавского НИИ садоводства, виноградарства и виноделия, 1966. – Т. 13. – С. 131–148.

26. Логинова, М.М. Обзор палеарктических видов рода *Psylla* Geoffr. (Homoptera: Psylloidea), связанных с ивами / М.М. Логинова // Annales Zoologici, 1967. – Т. 24, ч. 7. – С. 427–461.

27. Логинова, М.М. Новые данные по фауне и биологии псиллид (Psylloidea, Homoptera) Кавказа / М.М Логинова // Труды Всесоюзного Энтомологического общества, 1968. – Т. 52. – С. 275–328.

28. Логинова, М.М. Подотряд Psylloidea – псиллиды, или листоблошки / М.М. Логинова // Насекомые и клещи – вредители сельскохозяйственных культур, 1972. – Т. 1. – С. 139–146.

29. Логинова, М.М. Псиллиды (Psylloidea, Homoptera) Монгольской Народной Республики / М.М. Логинова // – 1972. – Т. 1, ч. 1. – С. 261–324.

30. Vengeliauskaitė, A. Plant jumping-lice. Handbook for the plant protection worker / A. Vengeliauskaitė // S. Pileckis, L. Žuklys (eds.).– Vilnius: Mintis, 1974. – P. 86–88.

31. Malumphy, C. Contribution to the knowledge of jumping plant-lice (Hemiptera, Psylloidea) of Lithuania / C. Malumphy, H. Ostrauskas, D. Pye // Acta Zoologica Lituanica, 2009. – V. 19, N. 2. – P. 128–131.

32. Определитель высших растений Беларуси / Под ред. В.И. Парфенова. – Минск: Дизайн Про.,1999. – 471с.

33. Serbina, L. The jumping plant-lice (Hemiptera: Psylloidea) of Belarus / L. Serbina, D. Burckhardt, O. Borodin // Revue Suisse de Zoologie (утверждена на публикацию, выйдет в печать в марте 2015 г.).

PSYLLIDS (HEMIPTERA: PSYLLOIDEA) OF THE FAUNA OF BELARUS

L.A. Serbina[1,2], D. Burckhardt[1], O.I. Borodin[3]
[1] *Naturhistorisches Museum, Augustinergasse 2, CH–4001 Basel, Switzerland*
[2] *Institut für Natur-, Landschafts- und Umweltschutz an der Universität Basel, St. Johanns-Vorstadt 10, CH-4056 Basel, Switzerland*
[3]*National Academy of Sciences, Akademicheskaya str. 27, 220072 Minsk, Belarus*
e-mail: liliya_serbina@mail.ru, liliia.serbina@unibas.ch

Psyllids or jumping plant-lice (Hemiptera: Psylloidea) – is a small group of plant-sap sucking insects. The current study aims to clarify the number of psyllid species known from Belarus. Based on the available literature and collected material, the presence of 54 species of jumping plant-lice has been confirmed. The psylloid fauna of the country remains poorly known and we expect that there are more species than previously recorded. An updated checklist of the known psyllids of Belarus and a new illustrated identification key will be available in the March 2015 issue of the Journal Revue Suisse de Zoologie.

GENERAL DISCUSSION

The present thesis examined the taxonomy and host-plant associations within a poorly studied group of phytophagous insects, the psyllids or jumping plant-lice, from the western Palaearctic (Belarus) and south temperate Neotropical regions. In **Chapter I**, I investigated whether the potato pest *R. solanicola* is a single polyphagous species or a complex of monophagous, morphologically similar species (host races/cryptic species). The results of the multivariate analyses suggested a high polyphagy of *R. solanicola* on ten plant species from four families (Amaranthaceae, Asteraceae, Escalloniaceae and Solanaceae). A large number of specimens were collected along the Andes in natural or semi-natural habitats, usually on native plants. *R. solanicola* was also found in a few localities in eastern Argentina, Brazil and Uruguay. In Brazil, the psyllid species has only been collected on introduced or cultivated plants in man-made habitats. This pattern suggested that the species is probably native to the Andean region and was introduced into eastern South America. Taking into consideration the probable capacity of *R. solanicola* to transmit plant pathogens (Chávez *et al.* 2003; Tenorio *et al.* 2003; Jeffries 2006; Salazar 2006), combined with its polyphagy and invasive nature, this species has a high potential to become a serious threat to agriculture. The results of the ecological modelling in **Chapter II** strongly suggested that *R. solanicola* has the highest probability for a successful invasion in many parts of the world. Globally, regions that grow potatoes as a crop and are climatically suitable for *R. solanicola*, include western South America, Mexico, southern and eastern Africa, central and south-eastern Asia, and southern Australia. Moreover, a potential increase in potato yield under future climate scenarios may promote an increase of invasion risk by *R. solanicola* through human trade and a higher density of host-plants. Based on the results from **Chapter I**, *R. solanicola* has been already introduced into eastern South America, which stresses the importance of its early detection.

The phylogenetic results of my study (**Chapter III**) showed that, along with five previously described and six newly described species on Solanaceae, additional five psyllids from *Russelliana* are likely associated with Solanaceae as well, bringing a number of Solanaceae-feeders in the genus to 16 species. Considering a relatively modest number of Solanaceae feeding psyllids in the world (25 described + at least 12 undescribed species), those in *Russelliana* comprise nearly half of its total number, which emphasizes the importance of further studies on the group. In addition, according to the results of the SDMs (**Chapter II**), Solanaceae-feeders in *Russelliana* have a higher environmental breadth than non-Solanaceae feeding species in the genus, suggesting that the former species have a potential of spread and invasion worldwide, along with *R. solanicola*.

The present findings (**Chapter I and III**) showed that *Russelliana* is the most species-rich genus in the subfamily Aphalaroidinae and comprises forty-three species, associated with forty plant species from eight families belonging to two different clades of eudicots (Stevens 2001 onwards) – Caryophyllales + asterids (Amaranthaceae, Asteraceae, Escalloniaceae, Polygonaceae, Solanaceae and Verbenaceae) and rosids (Fabaceae and Rosaceae). A developed identification key with illustrations for the 43 species (**Chapter III**) will be a useful tool for recognizing the morphologically similar species in *Russelliana* and a prerequisite in future strategies of pest management in South America. *Russelliana* species are predominantly distributed in and along the Andes in Argentina, Bolivia, from Far Northern to Far Southern Chile and Peru, and only three species are known from a few localities in eastern Argentina, southern Brazil and Uruguay. If this pattern is an artefact of insufficient collecting in eastern South America remains to be demonstrated.

According to the phylogenetic results (**Chapter III**), cospeciation in *Russelliana* does not seem to be a major driving force for speciation which contradicts the general assumption of cospeciation as the most important factor contributed to the diversity of herbivorous insects. The wide range of *Russelliana* hosts suggests several shifts to related and unrelated hosts. According to the cladistic analysis, the Asteraceae (4 spp.), Fabaceae (13 spp. on *Adesmia*) and Polygonaceae (1 sp., on *Chorizanthe*) were colonised once, the Rosaceae (2 spp., on *Tetraglochin*) twice, the Verbenaceae (5 spp.) once, however, forming a paraphyletic group, and the Solanaceae at least three times independently. Whether there is cospeciation between the 13 species on Fabaceae cannot be judged as the psyllid cladogram is not sufficiently resolved and the phylogenetic relationships in *Adesmia* have not been analysed. Geographical vicariance can be demonstrated for five species pairs but a better resolved cladogram may have shown additional vicariant species pairs. In summary, despite the close associations between psyllid species and their hosts, the species diversity found in *Russelliana* is better explained by geographical vicariance and host switching than by cospeciation with host taxa.

In addition to the revision of *Russelliana*, I studied a poorly known psyllid fauna of Belarus (**Chapter IV**). Based on the collections made in the last 15 years in all administrative regions of Belarus, I confirmed the presence of 4 previously recorded psyllid species and added 43 species new to the fauna, bringing the number of confirmed Belarusian psyllids to 54. Based on the comparison of the psyllid diversity in the surrounding countries (Poland, Northwest Russia, Lithuania and the former Livonia (now parts of Estonia and Latvia)) and the occurrence of the respective host-plants, I expect to find additional 73 species in Belarus. Additionally, I provided an illustrated identification key for the 127 species, whose occurrence in Belarus has been documented or is likely. This key is a useful tool for applied entomologists dealing with agricultural, forestry and ornamental pests. To inform the local entomologists and stimulate further research on psyllids of Belarus, a summary of the results was also published in the local University journal, Proceedings of the Belarusian State University (2015).

References

Chávez, R., Salazar, L., Upadhya, M., Chujoy, E., Cabello, R., Garcia, A. & Linares, J. (2003) The occurrence of genetic resistance and susceptibility to the new potato virus SB–29 among tetraploide potato populations (*Solanum tuberosum* L., 2n = 4x = 48 AAAA) in an arid agroecosystem. *IDESIA*, 21 (1), 9–22.

Jeffries, C. (2006) Potato. FAO/lPGRI Technical guidelines for the safe movement of germplasm. Available from: http:// pdf.usaid.gov/pdf_docs/PNACJ008.pdf (accessed 15 January 2015).

Salazar, L.F. (2006) Emerging and re-emerging potato diseases in the Andes. *Potato Research*, 49, 43–47.

Stevens, P.F. (2001 onwards) Angiosperm Phylogeny Website. Available from: http://www.mobot.org/MOBOT/research/APweb/ (accessed 15 January 2015).

Tenorio, J., Chuquillanqui, C., Garcia, A., Guillén, M., Chavez, R. & Salazar, L.F. (2003) Sintomatología y efecto en el rendimiento de papa de un nuevo virus transmitido por el psílido *Russelliana solanicola*. *Fitopatología*, 38, 32–36.

CURRICULUM VITAE

Personal details

Name	Liliya Serbina

Date of birth	June 7, 1988
Place of birth	Kharkov, the Soviet Union
Marital status	Single
Address	Mülhauserstrasse 78 4056 Basel Switzerland
Phone	+4178 813 50 30
E-Mail	liliya_serbina@mail.ru liliia.serbina@unibas.ch

Education

January 2013 – until present *Ph.D.* in Entomology, University of Basel, Philosophisch-Naturwissenschaftliche Fakultät, under supervision of PD Dr Daniel Burckhardt and Prof. Dr Bruno Baur.

September 2010 – May 2012 *Master* in Ecology, Lund University, Faculty of Ecology, under supervision of Dr Lene Friis Møller and Dr Sam Dupont.

September 2005 – May 2010 *Master* in Biology and Chemistry, Belarusian State University, Faculty of Biology, Department of Zoology, under supervision of Prof. Dr Sergej Buga.

Work experience

September 2007 – May 2010 Laboratory assistant, Belarusian State University, Faculty of Biology, Department of Zoology.

Scholarships

January 2013 – December 2015 Swiss Government Scholarship, Federal Commission (University of Basel).

September 2005 – May 2009 Belarusian Government Scholarship (Belarusian State University).

Grants and financing

January – July 2016 Grant of Freiwillige Akademische Gesellschaft Basel. Prolongation of Ph.D. (Naturhistorisches Museum Basel).

July 2015 Financial refund by University of Basel. Attendance of *“7th European Hemiptera Congress”* (Graz, Austria).

August 2014 Grant of Schweizerische Entomologische Gesellschaft. Financial refund by University of Basel. Attendance of *“Xth European Congress of Entomology”* (York, United Kingdom).

August 2009 Grant of Ministry of Education of Belarus. Project title *“Homopterous insects (Insecta: Homoptera), developing on ornamental plants under conditions of Central Region of Belarus”* (Belarusian State University).

July 2008 Grant of Ministry of Education of Belarus. Practice on Marine Zoology (White Sea Biological Station, Moscow State University).

Awards

2010 Award of Belarusian State University, first category among graduation papers in Belarus. Project title *“Psyllids (Homoptera, Psylloidea) of Belarus”* (Belarusian State University).

Member of Associations

September 2006 – May 2010 Scientific Student Zoological Circle (Belarusian State University).

April 2014 – until present Swiss Entomological Society.

Attended Congresses and Meetings

July 2015 *“7th European Hemiptera Congress”*, Graz, Austria.

March 2015 Tagung der Schweizerischen Entomologischen Gesellschaft, Zurich, Switzerland.

August 2014 *“Xth European Congress of Entomology”*, York, United Kingdom.

May 2009 *"XXXVIII Miedzynarodowe Seminarium Kol Naukowy"*, Olsztyn, Poland.
April 2009 International Conference of Young Scientists *"Young Researchers in Science – 2009"*, Minsk, Belarus.
April 2008 Student Scientific Practical Conference *"From idea to innovation"*, Mozyr, Belarus.

Languages
German (B2)
February 2013 – May 2015 German language courses at the Sprachenzentum (University of Basel).
September 2005 – December 2006 German language courses at the Goethe-Institute (Minsk).
Swedish (A1)
December 2010 – February 2011 Swedish language courses at the Eductus Centre (Lund University).
English (C1)
September 2007 – May 2010 English language cources at the International House, (Minsk); Academic IELTS Certificate.
Russian (Native language).

Hobbies
Dance classes, yoga
Making historical medieval clothes, sewing (an official member of Mittelalterverein "Basilisk", Basel).

Scientific publications:

Buga, S., Sautkin, F., Leshinskaya, N. & Serbina, L. (2009) Nonterato-forming phytophagous pests of ornamental plants. Minsk, *BSU*, 44 p. (in Russian).

Sautkin, F., Buga, S. & Serbina, L. (2011) Homopterous insects (Insecta: Homoptera), developing on ornamental plants under conditions of Central Region of Belarus. – The structure of the biological diversity of Central Belarusian Ridge (on the example of model groups of invertebrates and vertebrates). Minsk, *BSU*, 74–82. (in Russian).

Serbina, L., Burckhardt, D. & Borodin, O. (2015) The jumping plant-lice (Hemiptera: Psylloidea) of Belarus. *Revue Suisse de Zoologie*. *Revue suisse de Zoologie*, 122 (1), 7–44.

Serbina, L., Burckhardt, D., Birkhofer, K., Syfert, M.M. & Halbert, S.E. (2015) The potato pest *Russelliana solanicola* Tuthill (Hemiptera: Psylloidea): taxonomy and host-plant patterns. *Zootaxa*, 4021 (1), 33–62.

Serbina, L., Burckhardt, D. & Borodin, O. (2015) Листоблошки (Hemiptera: Psylloidea) фауны Беларуси (Psyllids (Hemiptera: Psylloidea) of Belarus). Proceedings of the Belarusian State University, 10 (1), 393–397. (in Russian).

Serbina, L. & Burckhardt, D. (in preparation) Systematics, biogeography and host-plant relationships of the Neotropical jumping plant-louse genus *Russelliana* (Hemiptera: Psylloidea). *Zoological Journal of the Linnean Society*.

Syfert, M.M., Serbina, L., Burckhardt, D., Knapp, S. & Percy, D. (submitted) Assessing the emergence of new crop pests: ecological modelling and analysis of the potato psyllid *Russelliana solanicola* (Hemiptera: Psylloidea) and its wild relatives. *Journal of Pest Science.*

Abstracts from international and national scientific congresses:

Serbina, L. (2008) Jumping plant-lice associated with alder under conditions of Belarus. *From idea to innovation: Materials of the XV Republican Student Scientific-Practical Conference*, *Mozyr*, *April 24, 2008*, 2, 60–61. (in Russian).

Serbina, L. (2008) Psyllids (Psyllinea, Homoptera) of high bogs. Preliminary Study Resume. *XXXVII Miedzynarodowe Seminarium Kol Naukowych (Olsztyn, 9–10 May 2008),* 95.

Serbina, L. (2009) Jumping plant-lice (Homoptera: Psyllinea) associated with willows under conditions of Belarus. *Basic and Applied Research in Biology: Materials of the Ist International Scientific Conference of Students, Post-graduates and Young Scientists, Donetsk, February 23–26, 2009*, 1, 243–244. (in Russian).

Serbina, L. (2009) Psyllid fauna (Phynchota: Sternorrhyncha: Psyllinea) of the Southern and Central Belarusian Ridge. *III Masherovskie chteniya: Materials of the Republican Student Scientific-Practical Conference. Natural Sciences, Vitebsk, March 24–25, 2009,* 120–121. (in Russian).

Serbina, L. (2009) Psyllids (Homoptera, Psyllinea) of Polesye landscape and geographical province of Belarus. *Sustainable economic development: condition, problems and prospects: III International Scientific-Practical Conference, Pinsk, April 23–25, 2009,* 2, 61. (in Russian).

Sautkin, F. & Serbina, L. (2009) Homoptera – pests of medicinal plants of Belarus. *From idea to innovation: Materials of the XV Republican Student Scientific-Practical Conference, Mozyr, April 23, 2009*, 148. (in Russian).

Serbina, L. (2009) Psyllids (Psyllinea, Homoptera) – phytophagous of cultivated plants of Belarus. *"Young Researchers in Science – 2009": International Conference of Young Scientists, Minsk, April 21–24, 2009.* (in Russian).

Serbina, L. (2009) Psyllids (Psyllinea, Homoptera) fauna of Belarus. Preliminary Study Resume. *XXXVIII Miedzynarodowe Seminarium Kol Naukowych (Olsztyn, 8–9 maja 2009),* 107–108.

Serbina, L. & Burckhardt, D. (2014) Systematics and host-plant relationships of the neotropical psyllid genus *Russelliana* (Hemiptera, Psylloidea). *Abstracts, 10th European Congress of Entomology, York, 3–8 August 2014.*

Serbina, L. & Burckhardt, D. (2015) Taxonomy and host-plant patterns of the potato pest *Russelliana solanicol*a Tuthill (Hemiptera: Psylloidea). *Abstracts, Mitteilungen der Schweizerischen Entomologischen Gesellschaft, Zürich (Agroscope), 6 March 2015.*

Serbina, L., Burckhardt, D., Birkhofer, K., Syfert, M. & Halbert, S.E. (2015) Taxonomy and host-plant patterns of the potato pest *Russelliana solanicol*a Tuthill (Hemiptera: Psylloidea). *Abstracts, 7Th European Hemiptera Congress, Graz, 19–24 July 2015.*