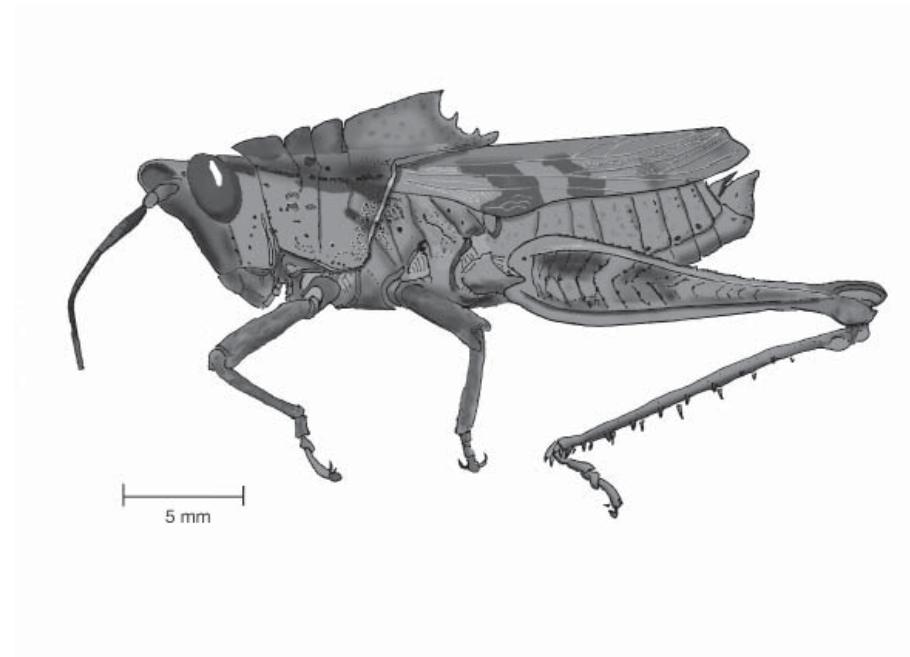


Publications on Orthopteran Diversity

The Grasshoppers (Caelifera) of Costa Rica and Panama

C.H.F. Rowell



Published by
The Orthopterists' Society

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This publication was made possible by financial support from the Freie Akademische Gesellschaft, Basel, Switzerland, which is gratefully acknowledged.

PUBLICATIONS ON ORTHOPTERAN DIVERSITY

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ISBN XXXXXX



PUBLISHED XXXX 2013

C.H.F. ROWELL

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DEDICATION

To the peoples of Costa Rica and Panama and their elected governments, in appreciation of their efforts towards the conservation of their beautiful countries and of their warm hospitality to strangers.

PREFACE AND ACKNOWLEDGEMENTS

There are many books about the tropics, but few specifically about tropical insects. There are many books about insects, but few of them are about grasshoppers. A book about tropical grasshoppers is thus a curiosity. Even for professional entomologists this book may be surprising, for almost all the animals described here live in tropical rain forest, perhaps the last terrestrial habitat which most specialists associate with insects of this sort. How does any one come to write such an anomaly?

My fascination with the forest grasshoppers of Central America developed gradually. For much of my professional life I specialized in insect neurobiology and worked on grasshoppers, but these were the laboratory strains of economically important locust species (*genera Schistocerca* and *Locusta*), not much more closely related to the real insects of the outside world than the laboratory rat is to wild rodents. I first realised that acrididoid grasshoppers lived in tropical wet forest during the decade of the 1960s, which I spent in Uganda. I found these multicoloured, flightless and songless insects astonishingly unlike the “orthodox” grasshoppers of the savannas and of the temperate zone. During the same period I met my subsequent friend and colleague Nick Jago on one of his early collecting trips in East Africa, and learnt from him that the taxonomy of these odd insects was far from settled. He showed me undescribed genera and species that he had just found in the forests near my home, some of them insects with which I was already very familiar. The idea that such conspicuous creatures were undescribed and unknown to science piqued my curiosity, and I started to collect for him, sending him samples of insects picked up in remote montane woodlands. A gratifyingly large number of these turned out to be new species or extensions of the known range of their species or genus; their pursuit became a hobby.

At the end of that decade I moved to California, and, homesick for the tropics, soon found the opportunity to visit Costa Rica within the framework of the teaching programme operated by the Organization for Tropical Studies. This admirable organization, which has done so much to open the minds of North American biologists and the fauna and flora of the Neotropics to one another, was at that time relatively replete with funds. Its resources included monies to bring scientists with experience of other parts of the Tropics into the field courses for graduate students. There I found my niche, and joined a talented group of graduate students and faculty on OTS Course 73-1, in the bewildering position of knowing nothing about the details of what I was seeing and experiencing, but feeling that it had all happened to me before in a previous African existence.

The strongest effect this first sight of the Neotropics had was to make evolution real to me. There are staggeringly detailed resemblances between the plants and animals of Costa Rica and of Uganda. Some of them occur in organisms deeply cleft from one another in phylogeny, where it could only be due to common adaptation, not common descent. Nothing provided a better example than the forest grasshoppers. Here they were, all the curious, apparently trivial, deviations from the textbook type of their kind which I had grown to know in East Africa repeated with precision, but in phylogenetic lines that had been separated from those of the Old World tropical forests for fifty million years. That implied that these apparent quirks of structure and behaviour were actually selected for, and had adaptive significance for life in the forest. On 20th January 1973, on the day that I first saw *Ampelophilus*, *Taeniophora*, *Homeomastax* and *Silvitettix* in the almost unbroken forests that then surrounded Rincón de la Osa, I knew that I had a research project - what were the selective forces that produced these properties which were common to the world's rain-forest grasshoppers?

As it turned out, much stood in the way of even approaching that question. What was known of these insects already? How did they live, and what plants did they eat? What was their geographic distribution? Where was the relevant literature? How complete was their taxonomy? Who could tell me what the names of individual species were, who could identify my specimens, and how was I to approach these persons? What was to be done with undescribed species? Getting the answers to these and similar questions has occupied much of my time in the past 40 years, and has led to this book. It caused me to make dozens of visits to Costa Rica and to collect all over the country; it also entailed learning the art of taxonomy and the use of museum collections, something totally unexpected for someone with my original training in the experimental and behavioural biology of living organisms. The puzzles inherent in classical taxonomy eventually motivated me to learn the new techniques of molecular systematics and apply them to grasshoppers, and this was the main work of my laboratory in my last University years. From all these activities I have gained enormous pleasure, but especially in the new acquaintances made and friendships formed. Some years ago I decided to extend my enquiry to Panama as well, and in doing so started much of the story afresh.

The list of all the persons who have helped me would be very long. I thank all of them who ever see this book, and hope they will forgive me if they do not find their name in the following list of people to whom I am particularly indebted. In Costa Rica I think especially of Adolfo Cantón of Progresso in the Valle de la Estrella, and of two superb field naturalists, Phil DeVriess and Dan Janzen; of Gary Hartshorn, originally of the Tropical Science Center in San José, then director of the Organisation for Tropical Studies; and of the late Luis Diego Gómez, formerly Director of the Museo Nacional de Costa Rica, later Director of the Las Cruces Botanical Gardens; of the staffs of the Organization of Tropical Studies, of the Parques Nacionales de Costa Rica, and of the Instituto Nacional de Biodiversidad,

and especially of Angel Solís of that organization; of Rafael Corrales of the Oficina de Exploración Petrolera, and of my dear friend Elecxa Rojas, proprietor of the Cacts Hotel, San José, to all of whom I owe a great deal of professional and logistic help. In Panama I am particularly indebted to Diomedes Quintero, director of the invertebrate museum of the University of Panama, and Roberto Cambra of the same institution, but also to the entomologists of the Smithsonian Tropical Research Institute, the authorities of ANAM, Departamento de Manejo de Vida Silvestre, and to numerous Panamanian friends. Jeremy Jackson and Nancy Knoulton, originally of STRI, helped enormously by their generous hospitality in Panama City. For instruction in grasshopper taxonomy and/or access to their collections I thank above all Carlos Carbonell, but also Dan Otte, Don Azuma, Jason Weintraub and the late Rad Roberts, Christiane Amedegnato, Mario Descamps, Nick Jago and Tom Hubbell. For assistance in the field and the laboratory I thank Beth Braker, Martine Rahier, Christen Hyde, Norbert Elsner, Viktor Meier, Ursi Regueiro, Ingrid Singh, Urs Stiefel and Lesbia De Gracia. In recent years Alba Bentos-Pereira has made field work in Panama and the taxonomic processing of our resulting collections much more efficient and enjoyable than they would otherwise have been. Rob Colwell and the late Denis Owen first introduced me to the ideas of evolutionary ecology, Mildred Matthias to the systematics of Neotropical plants, Paul Flook showed me the techniques of molecular systematics, and Irene Vegas taught me Spanish and some understanding of the peoples of Latin America; I cannot thank them all enough.

Lastly, but perhaps most importantly, I thank all the Costa Ricans and Panamanians who allowed me (and in many cases personally helped me) to collect grasshoppers on their properties, and who often were pleased with and appreciative of my interest in their faunas. These people and others like them will be the backbone of any future conservation of the environment of their countries.

It is a pleasure to acknowledge the input of Glenn and Nancy Morris, who, as editor and editorial assistant, made many useful suggestions and alerted me to many errors. Claudia Hemp and Bob Behrstock kindly read and commented on several chapters. My wife Lauren edited many passages for me, and tolerated long periods of neglect while I worked on the book.

Publication was supported by a greatly appreciated grant from the Freie Akademische Gesellschaft, Basel, Switzerland.

ABOUT THIS BOOK

The purpose of this book is to present in condensed form most of what is currently known of the grasshoppers (*Orthoptera Caelifera*) of Costa Rica and Panama. That this goal can be even contemplated by a single author is a sign of how extremely limited our knowledge of the biology of the Tropics truly is.

Costa Rica is biologically one of the best known of tropical lands, and grasshoppers are relatively large, conspicuous insects, and rather limited in the number of their species in comparison with many other groups of insects. The fact that nearly half the presently known Costa Rican grasshoppers have been described directly or indirectly as a result of the collecting work of my associates and myself in the past 30 years says more about the richness of the tropical fauna and the paucity of previous systematic work there than of our industry. Of all Costa Rican insects, perhaps only the larger day-flying butterflies are known taxonomically at the depth that temperate-zone biologists assume to be normal and universal, and even they only found their biographer with the publication of Phil DeVries' (1987) standard-setting work.

The situation in Panama is considerably worse than in Costa Rica. Despite the large volume of biological research carried out in the former Canal Zone, especially by the Smithsonian Tropical Research Institute (STRI), there has been very little country-wide collecting. Outside of the Canal Zone our knowledge is confined to a very few localities. Until very recently there was no publication on the systematics of Panamanian grasshoppers more recent than 1924. The distribution maps of Panamanian species in this book show how few areas have been surveyed. The matter is not made easier for field workers by the political and/or security problems associated with some parts of the country, such as southern Darien and some of the indigena comarcas, where the fauna is still unknown to science, if not to the inhabitants.

What is the interest of acridoid grasshoppers? There is a zoological and philosophical value attached to all knowledge of any group of animals. Grasshoppers are an appealing and interesting group for at least three reasons, which might be categorised as biological, economic, and educational.

First, for the biologist, they represent one of the archetypal herbivorous insects. Herbivorous (plant eating) insects are one of the most numerous and ecologically important groups of animals on the planet; they comprise an estimated one-third of all described species. The modern grasshoppers appear to have descended without fundamental change from the first insects to assume this way of life, some three hundred million years ago. The plant chewing grasshoppers and the plant sucking bugs, together with their near relatives, are both much older than the holometabolous insect herbivores so familiar nowadays, the butterflies and moths, the flies, the beetles, the sawflies, and so on.

These latter groups evolved more or less with the modern Angiosperm plants, but the older insects were already well established long before. Perhaps unsurprisingly, some modern grasshoppers and related Orthopteran groups specialise on algae, lichens, ferns and other early land plants: it is a legitimate speculation that some taxa at least have been doing so continuously since the times of the dinosaurs or before. Unfortunately, the earliest known fossils of grasshoppers are not older than the Jurassic, but the bite marks common on earlier fossil leaves leave little doubt as to what the ancestors of these insects did for a living. With such a lengthy opportunity for coevolution, we may expect detailed adaptations between plant host and insect parasite. Further, these adaptations are likely to be different from those seen between plants and holometabolous herbivores, with their very specialised larval feeding and adult dispersive stages. Larval grasshoppers, in contrast, have a structure and diet very similar to that of their adult stage.

The second reason to study grasshoppers is that some are of practical interest to agriculturalists. A few species are herbivores of economic importance - or, expressed differently, they compete effectively with our own species for food. One thinks immediately of the locusts, feared since the dawn of agriculture and still periodically threatening large human populations with disaster and famine, and the *raison d'être* for large, expensive control organizations. The Central American fauna includes several species of the widespread and classical genus *Schistocerca*; one of these, *S. piceifrons*, can under some conditions change from a relatively static grasshopper into a mobile swarming locust, capable of damaging many crop plants.

Thirdly, grasshoppers are large, conspicuous, widely distributed, often beautifully marked and coloured creatures of great aesthetic appeal, which lend themselves well to the needs of teachers and students of biology in schools and universities, and of amateur naturalists. All of these people are well-placed to fill in the details of grasshopper natural history, of their ecology, behaviour and distribution, presently unknown to science. These interest groups, the professional and amateur biologists who live in Costa Rica and Panama or who visit those countries in such numbers, compose the audience for whom this book is intended. Such persons may well wish to know more of these easily observed but little known animals, which are to be found in the same localities as the birds and the mammals, the butterflies and the flowering plants, that usually first attract people into the field.

The book is laid out in two sections. The first hopes to give the minimum entomological knowledge required to appreciate the remainder of the book: an outline of grasshopper biology, structure, and systematics, and the morphological terminology used in taxonomic descriptions. The second and larger part is composed of illustrated descriptions of all known species of Costa Rica and Panama, together with notes on their recognition in the field, their taxonomy, biology and biogeography. This section is organized by family and subfamily,

each of which has its own chapter. As the order of evolution of the acridid subfamilies is still unknown, they are here treated alphabetically.

I have tried to make the book useful to both the amateur naturalist and the professional biologist. The former will be mostly interested in the colour plates, which should allow rapid identification, and the paragraphs on the natural history of each species. For the purposes of the latter group of readers, I have included references to the relevant literature, where specific issues may be followed up, and such things as keys to genera and species. The existence of a comprehensive modern online resource on grasshopper systematics (the Orthoptera Species File (OSF) at <http://orthoptera.speciesfile.org/HomePage.aspx>, authored by Eades, Otte and their colleagues, makes access to the literature much easier than it was until recently. This database also contains photographs of many species, some of them taken in the wild. Insect systematics is largely based on internal genital structures, and grasshoppers are no exception. For the professional I have included references to published descriptions of the genitalia of all our species, but have rarely provided any new drawings or descriptions, except in a few cases where there was no published alternative. The amateur will not need these details.

I have always disliked using handbooks in which the illustrations and maps are separated from the text, as is the case with many popular bird and flower books. The reasons for this highly inconvenient layout are financial: colour plates are expensive, and best grouped together to economise on special paper and processes. In this book I have duplicated the colour plates with gray scale copies which can be printed along with the text; these give the reader at least some idea of what is being talked about, and the colour versions are available at the back of the book.

Note that all maps and figures in this book are numbered, and their number is preceded by an abbreviation of the chapter in which they are located. Thus Fig R1 is the first figure in the chapter on the Romaleinae, and Map G10 is the 10th map in the chapter on the Gomphocerinae.

AN OVERVIEW OF THE GRASSHOPPERS

I restrict the term “grasshopper” to the short-horned grasshoppers and their allies, superfamilies of the Suborder Caelifera of the Order Orthoptera. I use the term Orthoptera in its narrower, modern sense, which excludes the many other groups (such as cockroaches, termites, mantises, stick- and leaf-insects, and so on) which were included in the term in the nineteenth century and occasionally up to the present day in North America. The Caelifera are a diverse group, but they share common properties which differentiate them from the other subdivision of the Order, the Ensifera. The best known representatives of the Ensifera are the crickets (Superfamily Grylloidea) and the bush crickets or katydids or long-horn grasshoppers (Superfamily Tettigonioidea). The Ensifera are defined by a suite of characters including antennae longer than the body, long ovipositor and cerci, tympanal ears (if present) carried on the forelegs, and stridulation usually achieved (if at all) by rubbing the two forewings (the tegmina or elytra) together. The Caelifera, on the other hand, have antennae no longer than the body and usually much shorter, and short ovipositor and cerci. Those with ears have tympana on the first abdominal segment, never on the legs, and stridulation, when it occurs, can be produced by almost any imaginable leg and/or wing movement, excluding only the tegmen/tegmen method of the Ensifera.

All the Caelifera are obligate herbivores. Some species will eat carrion or immobilised insects (e.g. moulting conspecifics!) on occasion, and some Tettigids have been suspected of ingesting nematodes along with organic mud, but the main energy source is always plant material. Typically they can walk, climb and fly, and have large powerful hind legs allowing for jumping and swimming, and which (being spined) can be used to repel aggressors, predators or unwanted partners. The sexual and social behaviour of most grasshoppers is little known. A few subfamilies, especially in the temperate zone, stridulate and use their songs for territorial spacing, attraction of the opposite sex and courtship, but most grasshoppers (especially in the tropics) do not have this ability. Tympanic ears are more commonly found than is sound production, and as in the Lepidoptera these primarily serve the detection of ultrasound and hence predator avoidance. Their use in intraspecific signalling, e.g. song reception, is probably secondary.

The Caelifera are usually divided into 7-8 higher taxa. Within Costa Rica and Panama only the following six are represented, here listed as independent superfamilies:

- Tridactyloidea
- Tetridoidea
- Proscopioidea
- Eumastacoidea
- Pyrgomorphoidea
- Acridoidea

These superfamilies can readily be separated on the basis of their morphology, even by the amateur. The following paragraphs give general descriptions of these groups. The specific characteristics of each are to be found in later chapters.

The **Tridactyloidea** are the earliest surviving branch of the Caelifera, much more isolated phylogenetically than are the remaining superfamilies, and include three very distinct families. Two of these are found in Central America, the **Tridactylidae** and the **Rhipipterygidae**.

The **Tridactylidae** are very small (< 5mm) burrowing insects, specialised algal feeders found in damp soil or sand. They lack a common name in most European languages. The scientific name comes from the fact that the tarsus of the back leg is reduced to a single lobe, forming, together with two well-developed tibial spurs, a short “three-fingered” foot. The tarsi of the other legs have only 2 joints. Two genera and four species are known from our area.

The **Rhipipterygidae** are subaerial and more grasshopper-like in their habits; they are small, usually all black or black-and-white insects, common in wet forest and marshes, often on ferns, and are very nimble fliers. They are endemic to the Neotropics; in our region two genera and 11 species are recorded. The species of Tridactylids and Rhipipterygids are difficult to separate without the use of a microscope and technical genital characters, and almost nothing is known of the biology of the Costa Rican or Panamanian species.

The **Tetridoidea** (grouse-locusts or thorn-back grasshoppers) are a common, world-wide group of rather small insects, readily identified by the unusual hypertrophy of the pronotum. Many occur in damp places, including swamps, forest litter and on the bark of forest trees; they often eat algae or moss, sometimes organic mud. Little is known of the numerous neotropical forms, and even their systematics has been severely neglected for well over half a century. There is currently no living person who can identify neotropical tettigids, without previously undertaking a museum and literature research programme.

Neither of the above two superfamilies are considered further in this book.

The **Proscopioidea** contains only the single family **Proscopiidae**. Proscopiids are large, striking, usually wingless insects, looking more like stick insects (Order Phasmida; North American: walking-sticks) than conventional grasshoppers. Originating in South America, where they are often abundant, to date they are known in Central America from only 2-3 species of *Pseudoproscopia* in Costa Rica and Panama. These insects cannot be confused with any other Central American grasshoppers, and are very rare.

The **Eumastacoidea** are a diverse group of insects

with an almost world-wide distribution. However, only two families, each represented by a single subfamily, are to be encountered in Costa Rica & Panama, though other subfamilies are to be met with both further north and further south on the continent. They too are unmistakable. The **Eumastacinae** are found throughout the American wet tropics, and nowhere else; they are frequently associated with and eat ferns, though they will eat other plants as well. Of our two genera, *Homeomastax* extends from Honduras to Ecuador, and *Helicomastax* is confined to Panama. The **Episactidae** are known from Hispaniola and from the Central American Plateau. The Costa Rican species *Episactus tristani* is the southernmost representative of the subfamily **Episactinae**. Our Eumastacines are small insects, about 10 mm long. They have very short, almost imperceptible antennae, their forewings have a reverse taper, and they tend to splay their folded hind legs out sideways when at rest. Many are brightly coloured, at least as adults. The Episactidae are superficially similar, but all are apterous.

Eumastacoids and Proscopioids share many morphological details, and seem to be each other's closest relatives; accordingly, the Proscopiidae are sometimes placed within the Eumastacoidea and denied a superfamily of their own.

The **Pyrgomorphidae**, the only family of their superfamily, the **Pyrgomorphoidea**, are a predominantly Old World group, especially important in Africa, S.W. Asia and Australia, but extending northwards into temperate zones of Asia and Europe as well. The few American genera, however, which may derive from relatively recent colonisations from Asia (Kevan 1977), are less diverse. In effect there are three ecological groups: one living on the forest floor in tropical South America, one in the deserts of Baja California, and a third group, characteristic of the Mexican and Central American Plateau, composed of flightless, dorso-ventrally flattened and rather sluggish grasshoppers, often very common on dicotyledenous shrubs and forbs. The most southern of these plateau genera, *Prosphena*, extends from the Mexican border to Nicaragua and thence along the highlands of Guanacaste onto the Meseta Central of Costa Rica, and is our only Pyrgomorph. It cannot be confused with any other native grasshopper.

All the remaining grasshoppers in Costa Rica and Panama are members of the superfamily **Acridoidea** and although very diverse, they can be recognized by exclusion. Two acridoid families and 14 subfamilies are represented in Costa Rica.

The **Romaleidae** as understood by recent authors are confined exclusively to the Americas and contain two subfamilies. Most of the **Romaleinae** are rather large, conspicuous insects, of very varied ecological preference and way of life. Some are powerful fliers, associated with the wet forest canopy (*Titanacris*, *Tropidacris*), or (*Xyleus*) with the dry parkland woodlands of Guanacaste and Southern Panama. Some (such as *Taeniopoda* or *Chromacris*) defend themselves against molestation by emitting

distasteful secretions as froth from the thoracic spiracles, rather than by retreat or flight. As is often the case with animals using this strategy, they have bright colours and striking displays (aposematism), which assist predators sensitive to their chemicals to recognize them. Many who know the southern United States of America will be familiar with the lubber grasshoppers, members of this group. Another group (the tribe *Phaeopariini*) (e.g. *Phaeoparia*, *Maculiparia*) specialises on the grasses of shaded forest paths and edges.

Members of the other subfamily, the **Bactrophorinae**, are quite different. They are mostly medium or small in size and are confined to the forests. One of our genera (*Taeniophora*) inhabits the light-gap vegetation, but typically they are tree dwellers; mainly they live in the canopy (e.g., *Caenolampis*, *Nautia*), but one group (e.g. *Rhiconderma*, *Mezentia*) is specialised for life on the branches and stems. Almost all are flightless, but very powerful leapers. Although quite well represented in Costa Rica & Panama, this group reaches its apogee in the forests of South America.

The subfamilies of the **Acrididae** fall into two distinct groups. In the first are those which are confined to tropical America and appear to have evolved there in isolation. In the second are subfamilies with a circumpolar, largely temperate distribution, which to varying extents have colonised the regions to the south of their original homelands (for a further discussion see Carbonell, 1978), including tropical Central America. In the first, endemic, group the subfamilies Copiocerinae, Leptysminae, Rhytidochrotinae, Proctolabinae and Pauliniinae have Costa Rican and Panamanian members. The cosmopolitan subfamilies are represented by the Melanoplinae, Cyrtacanthacridinae, Oedipodinae, Acridinae and Gomphocerinae. Representatives of these latter five subfamilies are known to virtually all naturalists: they dominate the acridid fauna of the temperate zones, are well represented in Old World savanna, and are highly successful in habitats subject to human disturbance throughout the world's tropics. The endemic Neotropical subfamilies are much less familiar, largely because they are effectively confined to two relatively inaccessible habitats, wet tropical forest and swamp.

The majority of the **Copiocerinae** is associated with palms. At the northern (Mexico) and southern (temperate S. America) ends of the subfamily's range other ways of life and morphologies appear, but our common genus *Copiocera* is typical of the Neotropical tribe Copiocerini: a distinctive, elongated wet-forest palm specialist of interesting biology.

The **Eucopiocerae** are a group erected to provide a home for a homogenous group of flightless Central American grasshoppers that have been variously attached to the Copiocerinae or the Ommatolampinae. They extend from Mexico to Costa Rica, and all are apterous specialists on monocotyledenous plants. Our only representative is *Leptalacris*, found in the montane forests of Costa Rica.

The **Leptysminae** have pronounced host-plant specialisation, and fall into two groups of genera. One group (e.g. *Cornops*, *Stenopola*) is specialised to live on broad-leaf monocots associated with swamp and river edges, including for example various Araceae, Cannaceae, and the infamous water hyacinth (*Eichhornia*, *Pontaderiaceae*). *Gueteresia* has remained true to the Araceae but followed them into a habitat which is unusual for the subfamily - it is a feeder on araceous epiphytes of canopy trees in wet forest. The second group of leptysmine genera are specialised on graminoid monocotyledonous plants, usually of wet places. Most of the remaining Central American leptysmines (e.g. *Leptysma*, *Stenacris*) fit this description. *Cylindrotettix*, however, is found in dry grassland on the Pacific slope. Leptysmines extend into the temperate zones of both North and South America.

The **Rhytidochrotinae** are a distinctive small subfamily, most numerous in northern S. America. All genera but one are completely wingless. In Costa Rica and Panama the known genera are mostly small insects associated with ferns, forbs and shrubs in and around montane wet forest. These are the most northerly known representatives of the subfamily; most have been discovered only in recent years and appear to be endemic. The commonest and most speciose genus, *Hylopedetes*, is oligophagous, with a strong preference for certain ferns.

The **Pauliniinae** are highly specialised for life on floating freshwater vegetation, eating exclusively plants from that habitat, even laying their eggs in them. The only representative is *Paulinia acuminata* which extends from Uruguay up the Atlantic coast of South and Central America as far as Belize. It is present in both Costa Rica and Panama, but is not common in either country.

The two remaining endemic Neotropical subfamilies make up the bulk of the local fauna, and they share some properties. Both are large groupings, and appear to derive from more than one centre of radiation: in both there seem to be distinctive Central and South American clusters, perhaps more than one of each. Both extend widely, from southern Mexico to the southern edge of Brazil.

The **Ommatolampinae** are the largest and most diverse of the endemic subfamilies. Their representatives in tropical Central America include specialised inhabitants of the canopy, of light-gaps and of other forest habitats, wide-range generalists of disturbed forest (*Abracris*), and montane and savanna forms. The most distinctively Central American genera (e.g. *Rhachicreagra*, *Microtylopteryx*, *Ateliacris*) are flightless, wet forest understorey or light-gap insects. The subfamilies Leptysminae and Rhytidochrotinae are closely related to the more basal Ommatolampinae, and in the long run may not be separable from them.

The **Proctolabinae** are confined to wet forest, and together with the Bactrophorinae and Ommatolampinae make up the most typical elements of the acridoid fauna of

that ecological zone. The Amazonian fauna is especially large and diverse and is mostly arboreal. In Costa Rica and Panama, however, and indeed in Central America as a whole, there are basically only two ecological types. One, which is flightless, is a specialised oligophage living on characteristic forbs or shrubs of light gaps in forest (*Drymophilacris*, *Lithoscirtus*, *Ampelophilus*, *Tela*, etc). The other is winged and is either exclusively arboreal or commutes between the canopy and the light gaps. Some of these genera are oligophagous, e.g. associated with the Ulmaceous tree *Trema* (e.g. *Leioscapheus*, *Kritacris*, *Zosperamerus*), but others are generalist. These two ways of life correspond largely, but not completely, to the major tribal divisions of the subfamily.

Turning finally to the cosmopolitan subfamilies, the **Melanoplinae** are perhaps the most characteristic group of North American grasshoppers and will be well known to naturalists from that area. They are equally dominant in the comparable habitats of temperate S. America. One of their tribes, the Podismini, is well represented in Eurasia. In the tropics, by contrast, and especially in the lowlands, they are sparse. Costa Rica and Panama have only two Melanopline genera (*Aidemona* and *Baeacris*), characteristic of somewhat drier zones of montane and alpine habitats. Recently, molecular systematic investigations have suggested that the Melanoplinae may have originated in South America, rather than in the Holarctic zone as normally assumed; the Andean group Jivari seem to be the most primitive living representatives of the family.

The **Cyrtacanthacridinae**, using the term in its modern and restricted sense, are represented in Costa Rica and Panama only by *Schistocerca*, a troublesome genus to economic entomologists, farmers and taxonomists alike. It is hard to say exactly how many species of *Schistocerca* occur in Costa Rica and Panama (the current consensus is four), but at least one is to be found in nearly every habitat except the high mountains and primary wet forest. There is only one other extant New World genus of this subfamily (*Halmenus* of the Galapagos islands, apparently derived from *Schistocerca*), the great majority is native to the warmer regions of the Old World.

The distinctive **Oedopodinae** (the “band-wings” of the U.S. entomologist), so abundant in North America, make a poor showing south of Mexico. Three of the four Costa Rican genera are typical for their group, with the habit (geophily) of sitting on bare ground, where they are cryptically coloured, with red or yellow hind wings exposed only in flight and a characteristic stridulatory apparatus (p. 291); two of them (*Helastis*, *Lactista*) are common in the drier parts of Western Costa Rica and Southern Panama. *Chortophaga*, in contrast, is an insect of cool wet montane pastures.

Relatively few **Gomphocerinae** are to be found in the Neotropics either; the subfamily is more characteristic of Eurasia, the drier parts of Africa, and temperate North and South America. The subfamily is defined by its distinctive stridulatory apparatus (p. 205). (It is the prevalence of

Gomphocerines and Oedipodines in Europe and North America that has given rise to the erroneous impression that song or stridulation is the typical form of intraspecific communication in the Acrididae, though it is actually a rarity). Almost the entire subfamily is specialised for feeding on grasses (Poaceae or Gramineae), and consequently most of our forms are characteristic of either the modern anthropogenic savanna vegetation of Guanacaste, the Meseta Central of Costa Rica, and the Pacific provinces of Panama, or of disturbed habitats. *Orphulella punctata* is probably the commonest acridid in the region, found on pasture, suburban lawns, field and plantation edges and along paths throughout the country. It would probably be rare if man were absent. The genus *Silvitettix*, however, is unique among our genera of the 5 cosmopolitan subfamilies in that it has successfully adapted to the wet forest habitat; it is speciose and found throughout the forests of Central America and northern South America, where it eats small bambusoid grasses.

Lastly, the **Acridinae**: for the taxonomist this is an unsatisfactory group when considered on a global scale, comprising several apparently unrelated tribes. In our area, however, the Acridines present no taxonomic problem, clearly lacking the stridulatory apparatus of the other two subfamilies and having obliquely truncate tegmina. There are only two genera, both grass feeders. *Metalepta* is found in the lowlands wherever there is coarse, damp grass, and is well known as the grasshopper with the widest range on the American continent, extending from Argentina to Southern Canada; *Orphula*, by contrast, is rather local, and found principally in cool submontane pastures.

Anatomical Glossary

The following terms are anatomical and necessary to understand descriptions of grasshoppers. The definitions given here are short and often greatly simplified. Further anatomical details can be obtained from any good textbook of entomology, or from such specialist publications as Thomas (1963) or Albrecht (1953).

Items printed in *italics* have their own entry, or are defined elsewhere in the body of the glossary text. Those marked with an asterisk * are illustrated in one of the accompanying diagrams.

As is common knowledge, the insect body is segmented, and divided into three main parts, the *head*, *thorax* and *abdomen*. The major anatomical terms are here grouped accordingly.

Segment, segmental. Segments are serially repeating elements of bodily organisation, showing a basic homology with each other (“serial homology”). Body plans based on such principles are said to be metamerically organised, and are seen, for example, in the worms (Annelida), the Arthropods, such as the insects and the crustacea, and the Vertebrates (where the segmentation is less obvious but clear in embryology). The modern insect body is characterised by having a *head* formed from 6 fused segments, a *thorax* of three segments, and an *abdomen* of 11 segments. In the arthropods, the primitive segment bears a single pair of jointed appendages or limbs: in modern insects these are represented by the legs, the antennae, the mouthparts, and by the cerci and the ovipositor.

Integument. The relatively hard outer surface of the insect exoskeleton. Its surface texture (e.g. smooth, rugose, punctate, granular; polished, etc.) is often a taxonomic character.

Sclerite. Any discrete structure of hard integument. The term includes minute structures serving as muscle attachments embedded in membrane (e.g. in the phallic complex, or the cervical membrane), as well as major skeletal components such as the *terga*, *pleura* and *sterna* of the body segments.

Tergum (plural terga). The tergum is the dorsal plate of the arthropod segment, and in insects is seen in its simplest form in the abdominal segments. The central part of the tergum, not including the marginal anterior and posterior areas which join to the intersegmental membranes, is called the *notum** (plural *nota*). In the grasshopper, the thoracic terga are variously specialised: the prothoracic notum is enlarged to form the *pronotum** (q.v.) and the *pterothoracic** terga are an integral part of the mechanism by which the wings are moved.

Pleuron (plural pleura). The pleuron is the lateral integumental plate of the arthropod segment. Developmentally, the formation of the pleura is intimately connected with the development of the leg bases. Consequently, in insects they are well developed

and easily seen in the leg-bearing thoracic segments, but in the effectively legless abdomen the pleura are absent, and the abdominal segment is bounded by the tergum and the sternum only. The leg bases of the primitive appendages of the ancestral abdominal segments are thought to have been fused with the abdominal sterna, giving them a “coxosternal” composition (Snodgrass 1935). Each thoracic pleuron is subdivided by an oblique groove into two parts, an anterior *episternum** and a posterior *epimeron**. This groove is the external manifestation of a vertical infold in the pleuron, the pleural suture, which serves to stiffen the sclerite against the contraction of the vertical muscles.

Sternum* (plural Sternae). The sternum is the ventral integumental plate of an arthropod segment. The pro-, meso- and metasterna are the ventral plates of the pro-, meso- and metathoracic segments respectively. Each sternum is subdivided into various parts, referred to collectively as *sternites*. They have individual names, such as *presternum*, *basisternum* and *spinasternum*, but these are not used in this book.

The head.

Antenna*, plural antennae. The main tactile and olfactory appendages of the head. They are moveable, mounted on flexible membrane in sockets just anterior to the compound eyes, and can be moved by extrinsic musculature. The two most basal segments, the *scape** and the *pedicel**, are larger than the rest. The scape contains intrinsic muscles which insert on the pedicel, allowing for movement of the latter relative to the former. The flagellum comprises the remainder of the antenna, and is composed of up to about 25 segments or antenniferous, which are usually fairly similar to each other in size and shape, and more slender than the scape and the pedicel. The flagellum contains no intrinsic muscles, and is moved only passively. In the Eumastacoidea and Proscopioidea the length of the flagellum is greatly reduced.

Ensiform. Said of flattened, blade-like antennae, from Latin *ensis*, a sword.

Filiform. Threadlike. Said of slender antennae of circular cross section, often as opposed to ensiform.

Clypeus.* A sclerite interposed between the bottom of the *frons* and the top of the *labrum*. Together the clypeus and labrum form the anterior wall of the buccal cavity containing the mandibles.

Fastigium*, plural fastigia. (Latin for a triangular gable end). This is the extension of the vertex lying anterior to the *interocular space*; it ends at the top of the *frontal ridge*, and in some grasshoppers the two merge smoothly into one another (**Fig. Gloss7**). More commonly they are clearly divided from one another, sometimes by a ridge or a furrow. The area of contact between the two structures is quite frequently produced

Fig. Gloss1. (Page 11) The main features of the grasshopper head and male abdomen, seen from the side. The thorax is treated in **Fig. Gloss2**, below. The drawing is of the apterous Ommatolampine *Ateliacris annulicornis*, selected to avoid the complication of the wings.

The head: the occiput is not shown, being hidden by the anterior edge of the pronotum in this view. The fastigium is the area between the rostrum and the eye, dorsal to the lateral ocellus, and is best seen in dorsal view (e.g. **Fig. Gloss7**).

The abdomen: the first 10 abdominal segments are labelled with Roman numerals. The complex of the supra-anal plate, cercus and paraproct together account for the 11th and final segment.

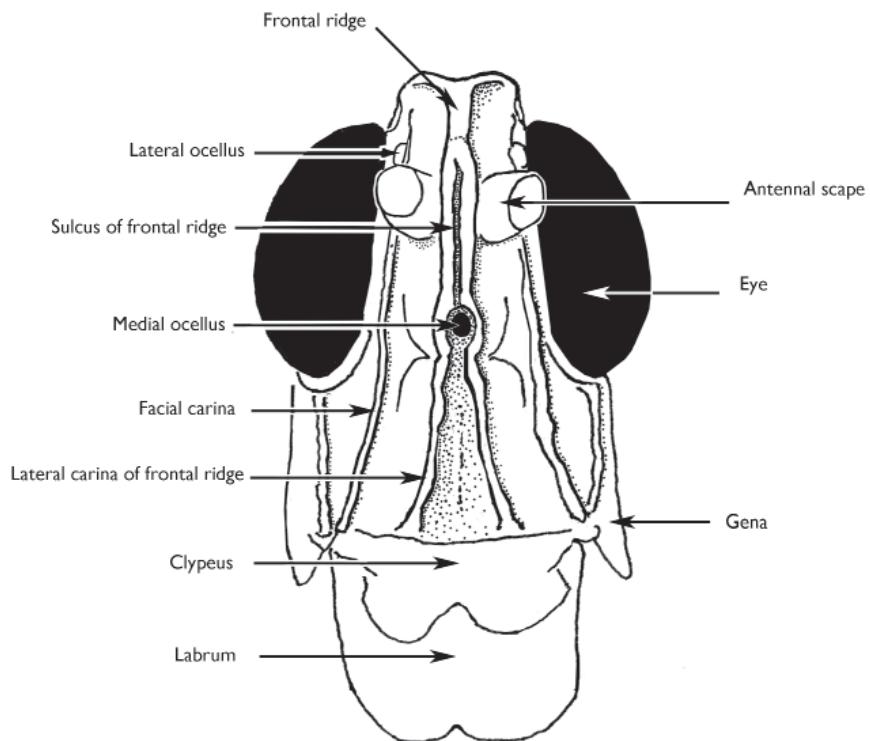
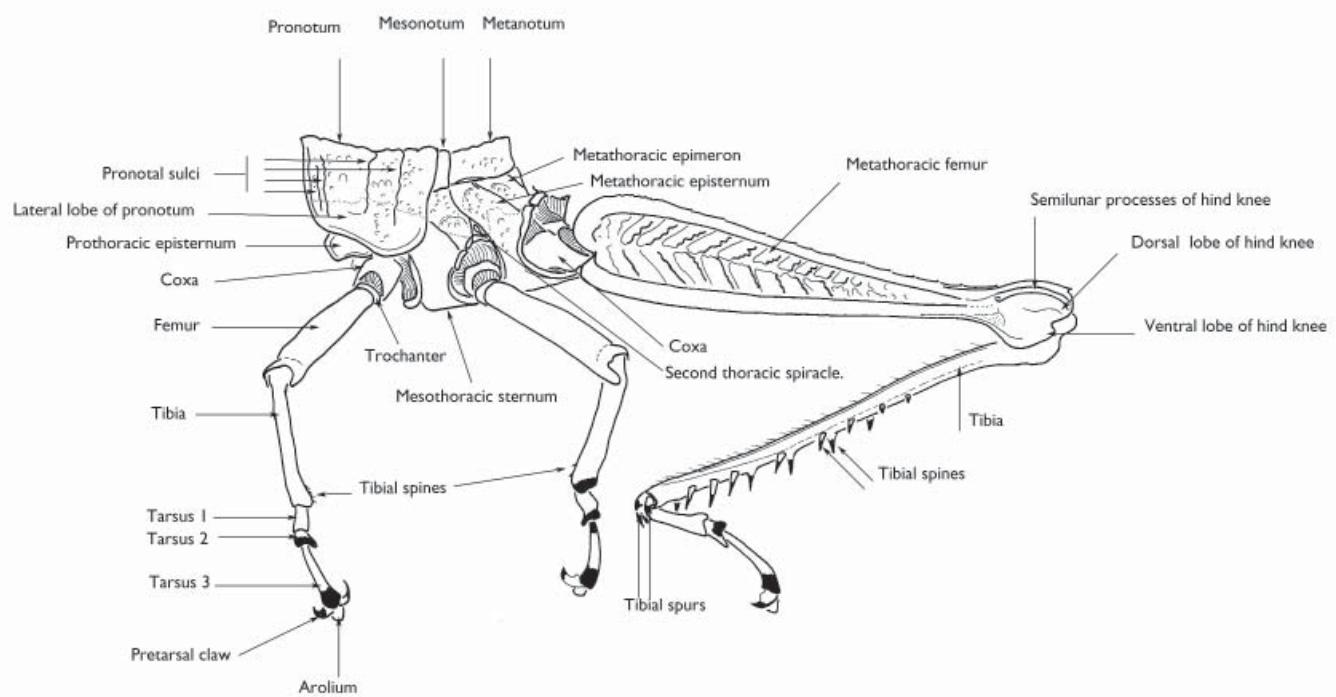
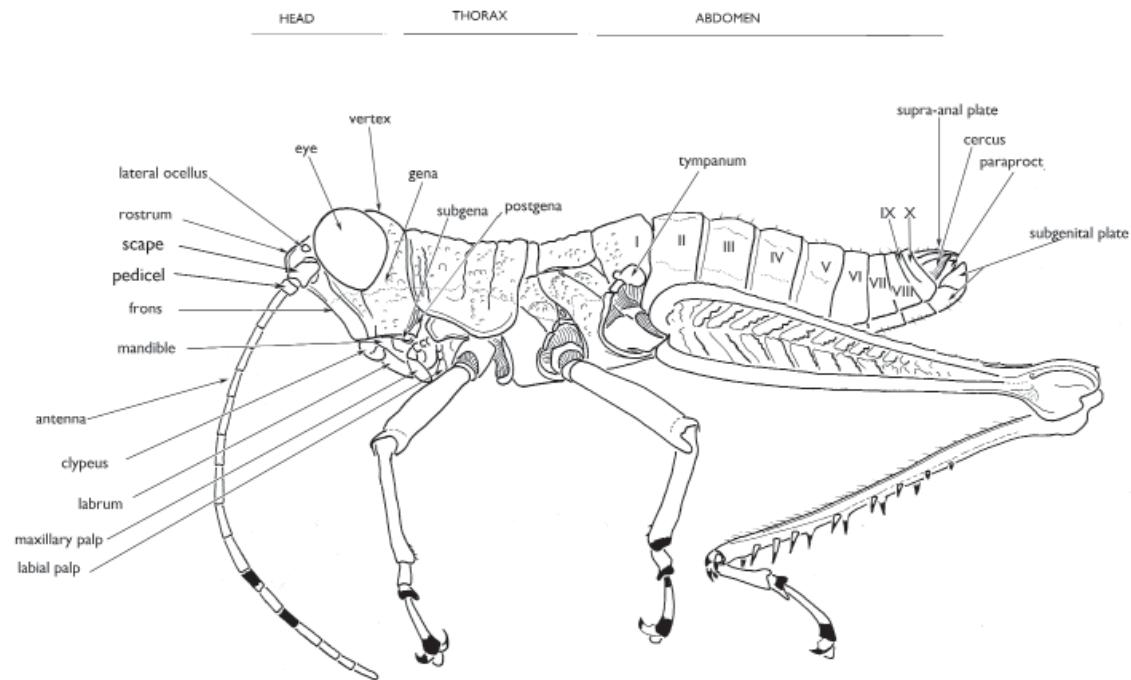


Fig. Gloss2. Main features of the head of a grasshopper, seen from the front. This particular genus (*Colpolopha*) has a narrow sulcate frontal ridge, and unusually prominent facial carinae. The antennae have been truncated at the scape. See also **Fig. Rom3**.

Fig. Gloss3. (Page 11) The main features of the grasshopper thorax, as seen from the side. The drawing is the same as in **Fig. Gloss1** above. In this species the anterior pronotal sulci are rather weakly developed. The semilunar processes of the hind knee, shown here, are not defined in the glossary: they are cuticular compression springs, that store energy derived from the contraction of the extensor tibiae muscle when the leg is locked in its flexed position immediately before the jump is released. Recent work (Burrows & Sutton 2012) has shown that they consist of a sandwich of stiff, heavily tanned integument and of an elastic, rubber-like protein, resilin.



forward as a *rostrum* (**Fig. Gloss1**). As the name suggests, the *fastigium* is often basically triangular in shape when viewed from above, being wide directly in front of the eyes and then tapering to the frontal ridge. Its precise form and ornamentation with *carinae* or *sulci* is important in taxonomy, especially at the generic and species level. For example, the position of the “transverse arcuate sulcus of the fastigium” (a self-explanatory name) is important within the Gomphocerinae, and the presence of a longitudinal medial fastigial furrow is a defining character of the Pyrgomorphidae, (and of the Mexican and South East Asian Xyronotidae and several smaller Old World groups).

Foveola, plural *foveolae*. Small pit-shaped areas or depressions in the integument (diminutive of Latin *fovea*, a pitfall). Such features occur regularly on the sides of the *fastigium* of various oedipodine, acridine and gomphocerine genera and are therefore of taxonomic importance. They require a stereo microscope for their proper examination and have no utility in field work.

*Frons**. Latin for face or front or forehead. Applied to the anterior surface of the insect head, from the *fastigium* above to the dorsal edge of the clypeus below and extending laterally to the compound eyes (**Fig. Gloss2**). Below the eyes the frons is often delimited by facial *carinae* running vertically downwards from the eyes towards the mouthparts, separating the frons from the *genae*.

*Frontal ridge**. A raised area in the mid line of the *frons*, running between the antennal sockets. At about half height it bears the medial *ocellus*. Frequently the frontal ridge fades out (“becomes obsolete”) below the ocellus, or it may continue fully developed as far as the *clypeal suture*, as in **Fig. Gloss2**. The lateral edges of the frontal ridge may be decorated by raised *carinae**, and it is frequently *sulcate**, i.e. deeply furrowed in the midline.

*Genae**, plural *genae*. Latin for cheek. The posterior lateral areas of the integument of the head, ventral to the vertex, below and behind the eye, separated from the mouthparts by a narrow *subgenal strip*.

*Interocular space** (abbr. IOS). The area of cuticle separating the edges of the two compound eyes in the anterior part of the vertex, visible only in dorsal view. Taxa with relatively large protuberant eyes tend to have a very narrow IOS.

*Mandibles**. See also under *mouthparts*. The mandibles are the main chewing organs. Their inner edges are melanized, hardened and provided with either blunt or sharp teeth. The form of this “dentition” varies with the typical food plant, e.g. grass feeders have different (blunter) tooth patterns than grasshoppers eating mostly the leaves of dicotyledenous herbs.

Mouthparts. Surviving paired appendages of the head segments, other than the antennae. So called because they surround the mouth and are used in feeding. They comprise the *labrum**, the *mandibles**, the *maxillae* and the *labium*. The maxillae and the

mandibles are recognizable as paired, separate, limbs; the labrum and labium have undergone a greater or lesser degree of fusion into single midline structures. Both the maxillae and the labium each bear 2 short segmented appendages or *palps**, which are primarily used as moveable tactile and olfactory sense organs in food selection. The last segments of the palps are sometimes flattened into paddle shaped structures and may be contrastingly coloured (e.g. *Silvitettix*, *Ateliacris*); they can then play a role in intraspecific visual communication.

Occiput. The posterior and dorsal part of the head capsule, running behind the vertex and the *genae*. At its posterior edge it merges with the *postoccipital strip*, to which the neck membrane is attached.

*Ocellus**, plural *ocelli*. Grasshoppers have a pair of lateral ocelli, sited just in front of the compound eyes, above the antennal sockets on the sides of the *fastigium*, and a single medial ocellus in the centre of the frontal ridge. The ocelli are often but misleadingly called “simple eyes”. They are light-sensitive organs, but do not form an image on their retinæ: they function as light intensity meters, and are used to detect angular deviations with respect to the horizon (pitch or roll) during flight, being part of the flight stability apparatus. Many flightless grasshoppers have consequently lost or reduced their ocelli, and their role, if any, in flightless insects is unknown.

Orthognath, *prognath*, *opisthognath*. These terms describe the position of the mouth with relation to the compound eyes. In *orthognathous* (also called *hypognathous*) insects the long axis of the head is vertical and the mouth consequently lies vertically below the eyes. The great majority of grasshoppers are of this type. In *prognathous* insects the axis is inclined forwards and the mouth is located in front of the eyes and the face slopes outwards and downwards. Many predaceous beetles are of this type. In *opisthognathous* insects the mouth lies behind the eyes, and the face slopes backwards and downwards. Grasshoppers such as the gomphocerine *Syrbula* (**Fig. G4**) or the Romaleine *Legua* (**Fig. R8**) approach this condition.

*Palps**, *maxillary and labial*. See under *mouthparts*.

*Rostrum**. In some taxa the area of the head anterior to the compound eyes is produced forward, involving hypertrophy of the *fastigium* and the frontal ridge. The resultant structure is the rostrum, which is usually only a small angular projection on an otherwise rounded profile, but in some taxa (e.g. *Bactrophora*) can be several centimetres in length. In some taxa the antennæ are mounted on the rostrum, rather than behind it, as is more usual. See also under *fastigium*.

*Scape**, *pedicel*, *flagellum*. See under *Antenna*.

*Vertex**. The vertex is the top of the head, running between the *occiput* and the *fastigium*, dorsal to the *genae*. In most grasshoppers it is slightly domed in lateral view. It houses the powerful mandibular muscles.

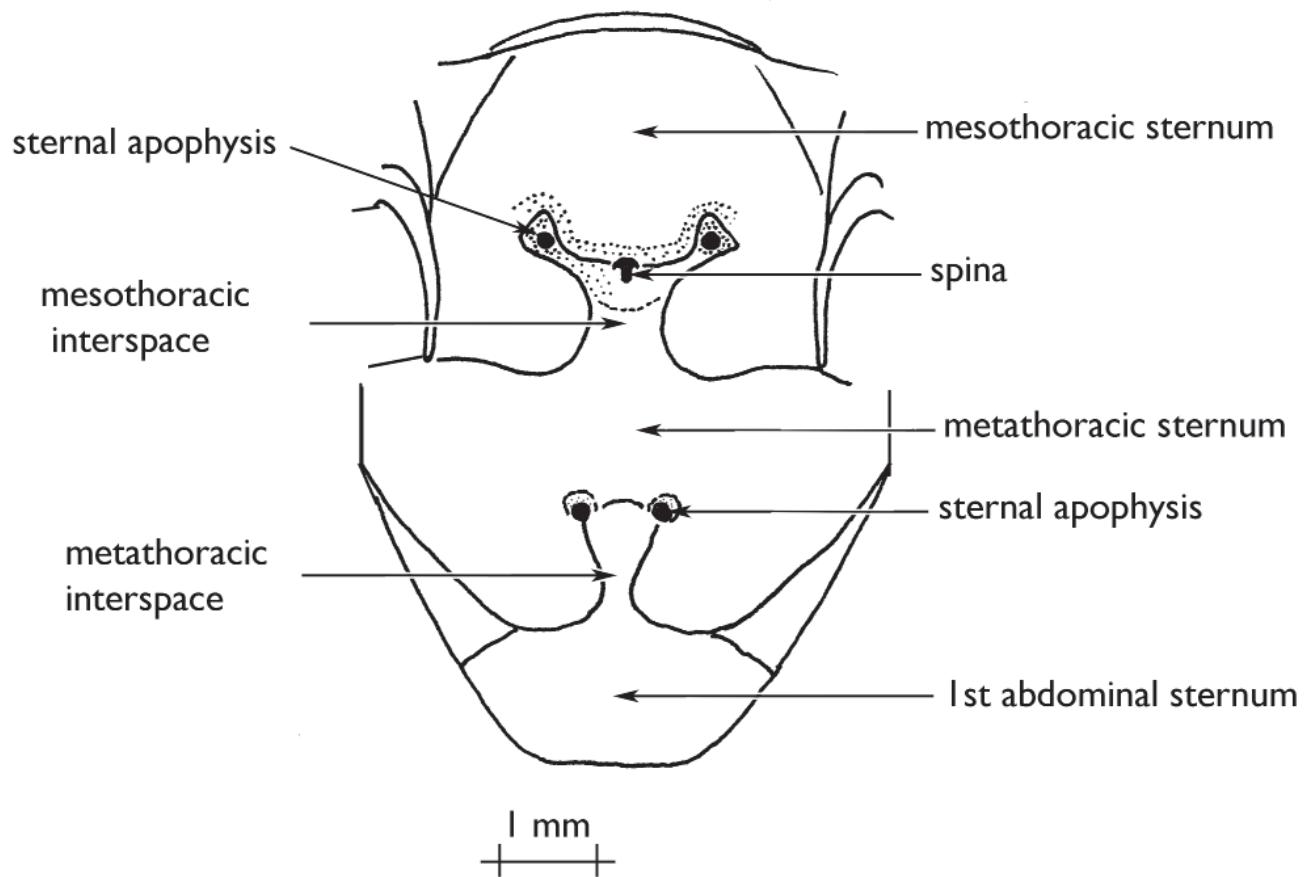


Fig. Gloss8. The fused segmental sterna flooring the pterothorax, as seen in *Vilerna polita* (Ommatolampinae). The spina and sternal apophyses are invaginations in the integument giving rise to apodemes anchoring internal muscles. The shape of the midline areas labelled meso- and metathoracic interspaces is of taxonomic significance.

The thorax.

The insect thorax is composed of three segments, the *prothorax**, *mesothorax* and *metathorax*. All three bear paired walking legs. In almost all grasshoppers, the hind (metathoracic) legs are enlarged and modified for jumping. The meso and metathoracic segments also bear wings; these two segments are fused together in the socalled *pterothorax*.*

Prothorax. The prothorax is the most anterior of the three thoracic segments. It bears the prothoracic or fore legs, but no wings, unlike the other two thoracic segments (see under *Pterothorax*). The prothorax of grasshoppers has two special morphological features: a) its *tergum* is modified into a hoodlike structure called the *Pronotum** (q.v.) with expanded deflected margins which largely cover the prothoracic pleura and, in most subfamilies, also cover the meso and metathoracic terga; b) in many acridoid taxa the probasisternite (see under *Sternum*) bears a ventrally projecting midline structure, often conical or cylindrical in shape, called the *prosternal process*, which has value as a taxonomic character. In some taxa it appears to play a part in proprioception, its sensory hairs responding to the position of the prothoracic coxae.

Pterothorax. The pterothorax consists of the two wing-bearing thoracic segments, the meso- and metathorax. They are fused with one another, forming a rigid box which contains the flight musculature and indeed all the mechanical components of flight. It also bears both the mesothoracic (mid) leg and the metathoracic (hind) leg.

Pronotum*; abbr. PN. The pronotum (see also under *Prothorax*) is a hypertrophic development of the prothoracic notum, with enlarged margins which cover partially or completely the prothoracic pleura and the meso- and metathoracic terga. (In the Tettiguoidea the hypertrophy of the pronotum is carried still further.) It is an obvious and taxonomically important structure, offering many morphological characters. The extended lateral margins are referred to as the *lateral lobes** of the *pronotum*, and the more or less flattened area on the dorsal surface of the thorax is the *disc** of the *pronotum*. The pronotum bears up to four more or less deeply incised transverse grooves, the *pronotal sulci**, which may or may not cross the disc. These sulci correspond to invaginations which serve as muscle attachments inside the thorax. Their shape and position are often important taxonomic characters. The most conspicuous sulcus is usually the most posterior one. The portion of the pronotum anterior to this sulcus is known as the *prozona**, the area behind it as the *metazona**; the relative length of the two is also a taxonomic character. The posterior margin of the metazona may be prolonged in the midline to cover the bases of the elytra and wings, and its shape – straight, produced, angular (acute or obtuse), rounded, or concave – is a taxonomic character, as is the shape of the anterior margin of the prozona, which may overhang the *occiput* and vertex to a greater or lesser extent. The disc often bears a *medial pronotal carina**, a ridge running

antero-posterior along the midline, which may be either weakly or strongly developed, or even *cristate*. The lateral margins of the disc, at the top of the lateral lobes, are often bounded by similar *lateral pronotal carinae**. The medial and lateral carinae are probably originally mechanical stabilising structures, strengthening and stiffening the prothorax against the compressive forces of its longitudinal muscles.

Carina, plural *carinae*. Diminutive form, *carinula*, -ae. A superficial ridge on the integument. In grasshoppers used especially for the pronotal carinae (see *Pronotum*) and the longitudinal ridges of the hind femur, but can be applied to structures anywhere on the insect body.

Cristate. An adjective derived from “crest”. Applied most commonly to the medial pronotal carina of some grasshoppers which have a crest-shaped pronotum (see e.g. our *Nicarchus* or *Xyleus* or *Lophacris*).

Disc of PN.* See under *pronotum*.

Epimeron*, **Episternum***. (plurals *epimera*, *episterna*) The two parts of a thoracic lateral segmental sclerite (= *pleuron*). The epimeron is posterior to the episternum. Both end ventrally on the rim of the coxal cavity but their anterior or posterior extremities run past the coxal cavity and are fused with the sternum. The prothoracic episternum appears in lateral view as a small triangular sclerite below the anterior ventral angle of the pronotal lobe. See also under *pleuron* above.

Lateral carina of the pronotum. See under *pronotum*.

Lateral lobes of the pronotum. See under *pronotum*.

Medial carina of the pronotum. See under *pronotum*.

Meso-, metasternal interspaces*. The sterna of the meso- and metathorax and of the first abdominal segment are fused together to form a rigid plastron-like surface. The interlocking parts of the sterna (**Fig. Gloss8**) delimit areas of integument in the midline which vary between taxa in their shape and relative length and width. These can have taxonomic value.

Sellate, selliform. Saddle-shaped (from Latin *sella*). Said of the pronota of some grasshoppers to describe their shape.

Sulcus*. A furrow or groove. See also under *Pronotum*.

Tectate, roof shaped, from the latin *tectum*, roof. Used to describe a pronotal disc which slopes downwards to each side of the medial pronotal carina.

The thoracic legs.

Coxa, plural coxae.* The coxa is the first (i.e. basal, most proximal) segment of the arthropod leg. It is mounted on pliable membrane inside the coxal aperture of the thoracic sternum and pleuron. In grasshoppers it is always short and robust.

*Trochanter.** The second segment of the insect leg. In grasshoppers it is reduced to a small ring of integument, which articulates with the more proximal coxa, and is permanently fused with the proximal end of the third segment, the *femur*.

Femur, plural femora.* The third segment of the insect leg. Usually a fairly long tubular structure, ending distally at the “knee”, where it articulates with the fourth segment, the *tibia*. In grasshoppers the femur of the hind (metathoracic) leg is elongated and flattened and tapers towards the knee, and contains the powerful extensor tibiae muscle which generates the energy for jumping. The femur is often provided with longitudinal *carinae*, especially the hind femur: these divide the surface of the femur into 6 zones, (external and internal lateral faces, external and internal dorsal faces and external and internal ventral faces). Femoral carinae may be ornamented with hairs, spines or knobs and may even be serrate.

Tibia, plural tibiae.* The fourth segment of the insect leg. Proximally it articulates with the femur at the knee, and with the first tarsal segment of the foot at its distal end. In grasshoppers the tibia is usually a relatively slender segment, often more or less rectangular in cross section, and with angular edges often provided with spines. The spines of the hind tibia are especially well developed, and serve to assist in locomotion by engaging the vegetation, and in repelling assailants with their sharp points. The tibia ends in four articulated spurs, one pair either side of the tarsal segment, which aid in take-off by engaging the substrate. The number, size, disposition and shape of tibial spines and spurs are taxonomic characters.

Tarsus, plural tarsi.* Primitively, the insect foot is composed of 5 serially connected tarsi. In grasshoppers the most proximal three tarsi are fused into a single segment. The original fourth and fifth tarsal segments thus become the second and third tarsal segments of the grasshopper foot. The shape and length of the foot varies according to habitat; in arboreal grasshoppers the second tarsal joint is elongated, and the whole foot is longer than in geophilous species. The underside of the tarsal segments is supplied with pads (the *tarsal pulvilli*) presumed to increase friction with the substrate. (Note that in Tridactyloids the foot is reduced to a single tarsal segment.)

Pretarsus. The final segment of the insect leg is composed of a number of minute sclerites articulating with two strong claws* and a flexible, sometimes sticky, terminal pad called the *arolium**. All these structures assist in climbing and in attaching to the substrate.

Lobes of hind knee, upper and lower. The “knee” joint between the femur and the tibia (q.v.) is partially shielded by vertical flanges derived from the femur, extending down over the articulation. These flanges are especially obvious on the hind femur. There they are notched on their posterior edge, dividing them into an upper* and a lower lobe*. The shape of the posterior edges of these lobes is a taxonomic character: e.g., the lower knee lobe is typically acute-angular in the Leptysminae and the Oxyinae.

*Spurs, tibial.** See under *tibia*.

The wings.

Aptery, apterous.* The state of having no wings.

Brachyptery, brachypterous.* The state of having shortened wings; usually implies too short for flight, but still clearly visible, perhaps extending to the fourth or fifth abdominal tergum.

Microptery, micropterous.* The state of having extremely reduced wing rudiments. They may be easily visible, or nearly invisible, sometimes hidden under the posterior margin of the pronotum. Always implies flightlessness.

Cycloid. Tending to a circular shape. A term applied to the hindwings, especially of arboreal Proctolabinae. In these wings, the anterior area, (the *remigium*) which normally projects beyond the fan-like posterior part of the wing (the *vannus*), is reduced, so that the vannal area predominates. For examples and discussion, see Rowell & Flook 2004: 48, and their Fig. 8.

Venation of the wings. The membranes of the elytra and the hind wings are supported by a complex venation, a series of cuticular tubes originally communicating with the haemocoel which supply the growing structure with blood, and which allow its inflation and extension after the final moult by transmitting the haemolymph pressure to the unexpanded wing or elytron. In adults, the more peripheral veins are progressively blocked off over time and become just hollow supporting tubes. The main elements of the venation are the primary longitudinal veins, which fan out over the wing from its base. The spaces between the primary longitudinal veins are filled with a fine network of much smaller veins, called the *archedictyon* or *reticulum*. Some elements of this network can be thickened and fused together to form secondary longitudinal veins (see under *intercalary vein* below). The layout of the primary longitudinal veins is a highly conserved character, and is important in insect systematics; especially so, as most fossil insects consist, unfortunately, only of the wings. There is a standard nomenclatural system for the veins of the grasshopper wing, codified by Ragge (1955) (see **Fig. Gloss6**). The spaces between the longitudinal veins are called *areas*, and are named after the vein which bounds their anterior margin. Thus for example the *medial area* is the area of wing membrane lying immediately behind the media vein and extending back to the cubitus vein.

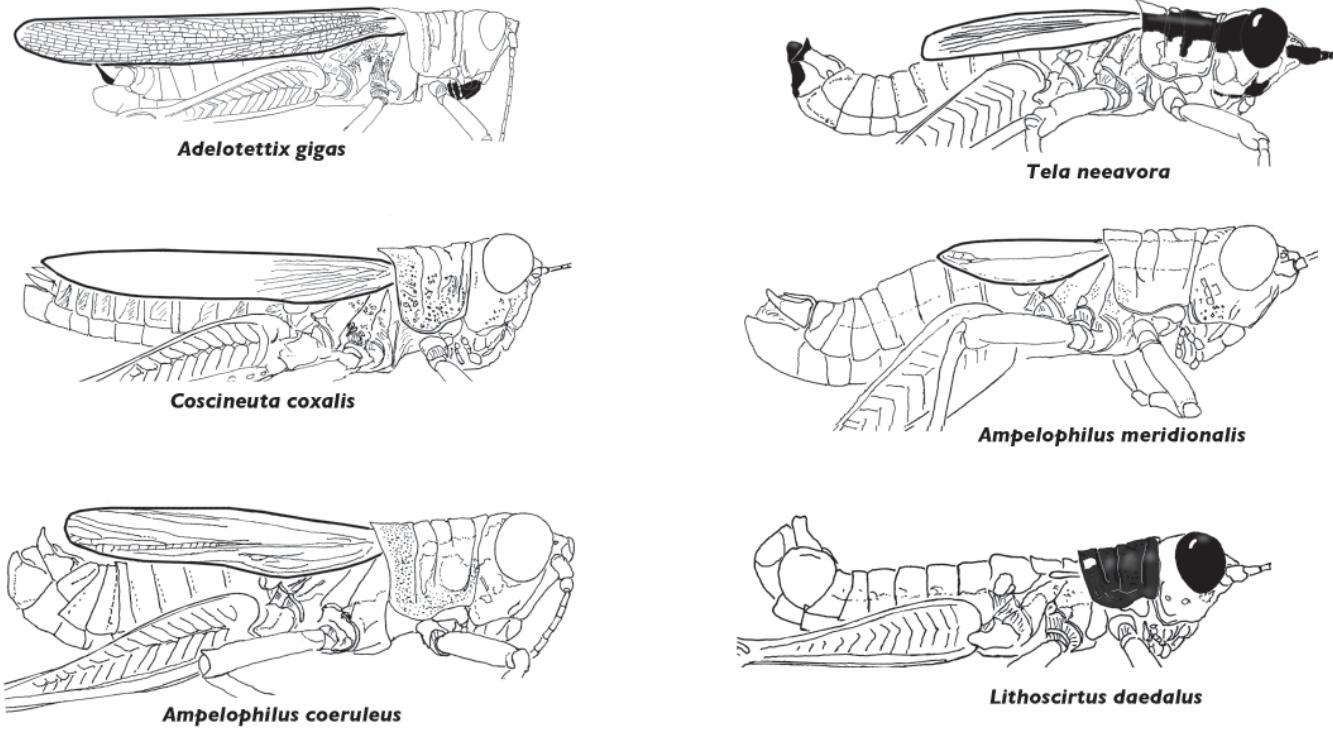


Fig. Gloss4. Brachyptery. Six Proctolabine taxa are shown (not to scale!). Those in the left hand column can all fly. *Adelotettix* shows no wing reduction at all, and flies very well. *Coscineuta* shows first signs of brachyptery, but also flies competently; the much lighter-bodied male flies well. *A. coeruleus* flies with some difficulty. The right hand column species are all flightless. *Tela neeavora* is clearly brachypterous, but can spread its wings and “parachute” if it falls from its perch. *A. meridionalis* is approaching the micropterous, with squamate wings, which it cannot spread. *L. daedalus* is obviously micropterous. No proctolabine is completely apterous, but *Ateliacris*, shown in **Figs Gloss1 & 2**, is.

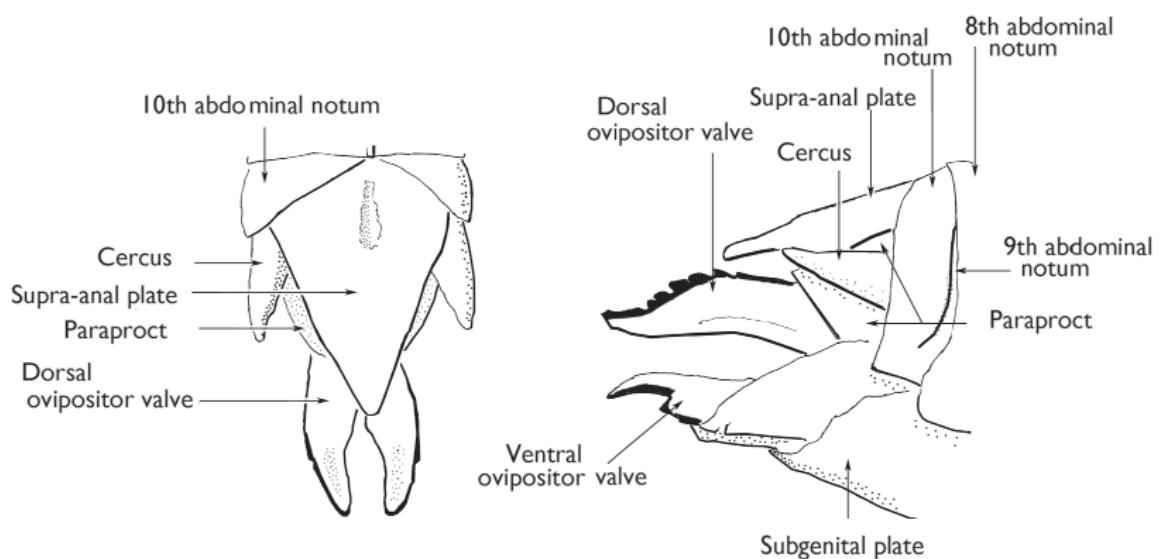


Fig. Gloss5. Major features of the female terminalia in dorsal and side view.

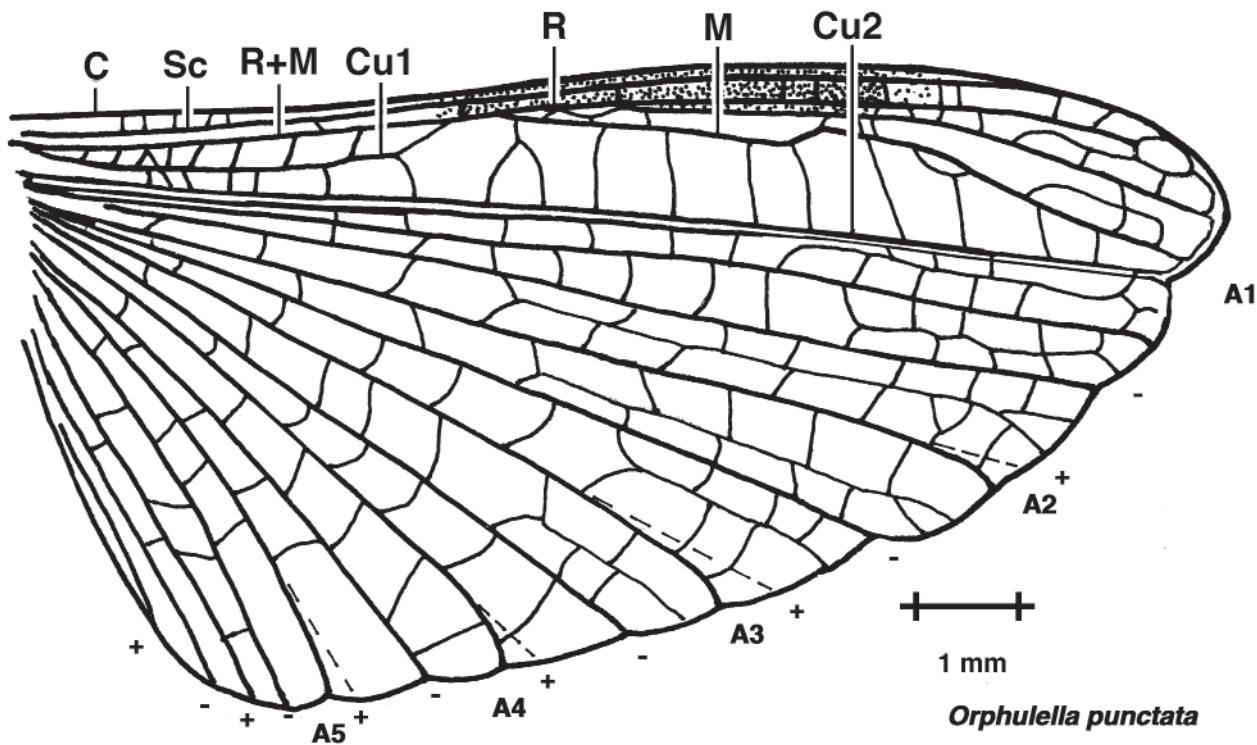


Fig. Gloss6. A grasshopper hind wing, to show the standard terminology of the venation. The + and - signs around the periphery indicate convex and concave fold lines when the wing is furled. C, costa; Sc, subcosta; R, radius; M, media; Cu, cubitus; A, anal. See also Fig. G26.

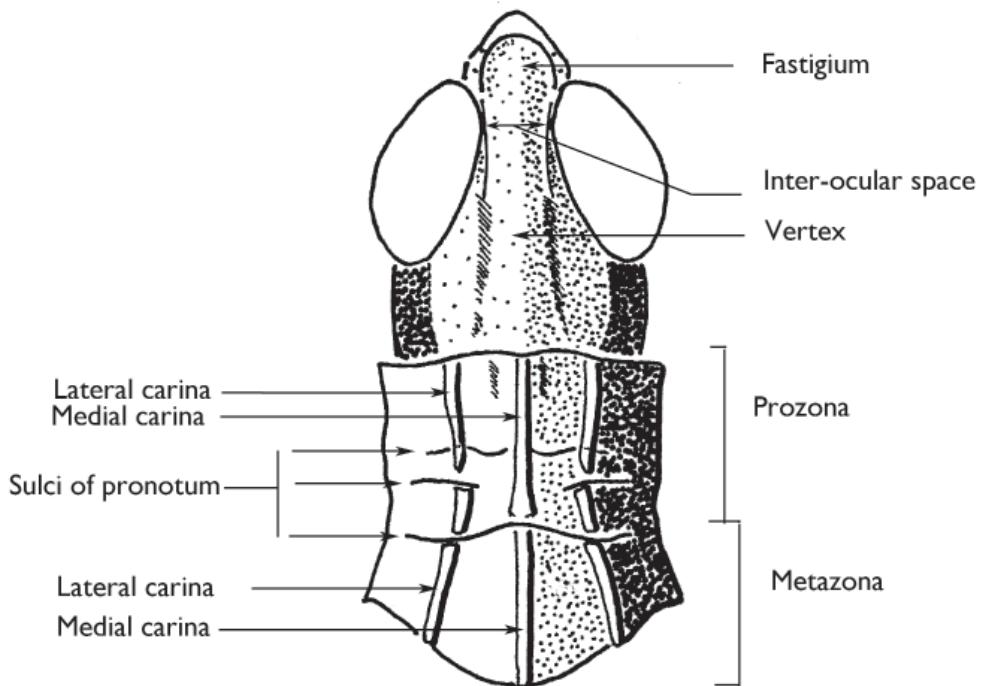


Fig. Gloss7. Gomphocerine grasshopper showing main dorsal features of head and pronotum. See also Fig. G36.

Intercalary vein. A secondary longitudinal vein in a forewing (=elytron or tegmen) which is formed by the fusion and thickening of elements of the archedictyon, the network of fine veins that runs between the primary longitudinal veins. An intercalary vein running through the medial area of the tegmen forms the stridulatory file of members of the Oedipodinae. See **Fig. Oel**.

Tegmen, plural *tegmina* (=elytron, plural *elytra*). The mesothoracic (fore-)wing of a grasshopper. Adjectival forms, tegminal, elytral.

squamate*. Literally scale-like, applied to greatly reduced (micropterous) wings when of this shape.

Wing*. In taxonomic writing the word wing is always taken to mean the hind (metathoracic) wing of the grasshopper; the forewing is referred to as the tegmen or elytron, q.v.

The abdomen.

Abdomen. The abdomen is derived from 11 body segments. The first (most anterior) abdominal segment is fused with the metathoracic segment and hence differs structurally from the other abdominal segments. It also bears the *tympanum**, a characteristic structure of the Acridoidea and Pyrgomorphoidea.

Tympanum.* (From Greek *tympanon*, a drum head). A roughly circular area of thin membrane tightly stretched over a notch in the ventral edge of the tergum of the first abdominal segment. The tympanic membrane is an extension of the membrane running between the tergum and sternum. On the interior face of the tympanum there is a tympanal sense organ, a cluster of mechanoreceptor cells, which respond to soundwave-induced vibration and distortion of the membrane. The tympanum is a hearing organ, roughly analogous to our own eardrum, though the mechanism of sound transduction is quite different. In some taxa the rim of the tympanum is enlarged to form a funnel-shaped structure or meatus around the tympanum, which then lies near the bottom of the funnel; more commonly, the tympanic membrane lies in the same plane as the outer integument. The first abdominal spiracle lies at the anterior edge of the tympanum, and is sometimes mistaken for it, especially in *atympanate* grasshoppers (q.v.).

Tympanate, atympanate. Having or not having a tympanum. Acridoidea and Pyrgomorphoidea are primitively tympanate, but there is a strong correlation between flight and the presence of a tympanum. (Probably this is due to selection pressure exerted by bat predation.) Flightless grasshoppers often have a reduced tympanum, or lose it completely and so are secondarily atympanate, as in most of our Rhytidochrotinae.

Abdominal segments II-VII. The second to seventh abdominal segments are very alike in structure, progressively smaller towards the posterior, and usually devoid of any specialised external features.

Abdominal segments VIII-XI. The 8th to 11th abdominal segments make up the tip of the abdomen, the so-called *terminalia*, a zone of great taxonomic significance, which contains the *genitalia*, the *ovipositor**, the sensory *cerci** and the anal region, with its specialised sclerites, the *epiproct** and the *paraprocts**. The terga of the 9th and 10th segments are fused.

Genitalia. A general term for all the external morphological structures associated with copulation and reproduction. In both sexes the basic reproductive structure is the genital cavity.

Genital cavity. In both sexes, a cavity into which the genital products are liberated through the gonopores, and where the copulatory apparatus is located. The floor of the genital cavity is the *subgenital plate* (q.v.). Regarding insect reproduction, it is important to realise that the egg is not normally fertilised directly after copulation, as it is in e.g. vertebrates. Instead, copulation serves merely to establish or replenish the store of sperm which the female maintains alive in her spermatheca. The spermatheca is connected to the female genital cavity by its own duct, the *spermathecal duct*. Fertilisation typically takes place as the egg is laid: it emerges from the common oviduct at the gonopore into the female genital cavity, is fertilised there by sperm derived from the spermatheca, deflected by the egg guide into the proper position between the ovipositor valves, and then laid. Copulation and fertilisation can thus be separated by many months.

Subgenital plate* (abbr. SGP). The subgenital plate is derived from the sternum of the 8th (female) or 9th (male) abdominal segment, and in both sexes forms the floor of the genital cavity.

In the male the tip of the abdomen is formed by the subgenital plate; the genital cavity is open dorsally, though covered by the paraprocts and the supra-anal plate, and is more or less filled by the phallic complex, which includes the male gonopore.

In the female the genital cavity is a horizontal invagination of the ventral intersegmental membrane starting behind the posterior margin of the 8th abdominal sternum. Both the common oviduct and the spermathecal duct open into the anterior end of the genital cavity and its posterior aperture is flanked by the ovipositor valves. The internal (dorsal) surface of the female subgenital plate bears a vertical fin-shaped stucture, the egg-guide, which lies between the bases of the ovipositor valves and can be seen when these are opened.

The shape of both male and female subgenital plates are important taxonomic characters in many grasshopper taxa.

Spermatheca, spermathecal duct. The spermatheca is an ampulla with an epidermis of glandular cells, and a thin cuticular lining. It is connected to the genital cavity by a long spermathecal duct. Frequently the apical ampulla is supplemented by a more or less branched and convoluted tube, the pre-apical diverticulum (see pp. 184,201). Some anatomists believe that the spermatheca was originally a paired organ, which has undergone fusion to a single midline structure. The spermatheca is an important taxonomic

character in some groups (e.g. the Proscopioidea). It can only be observed, however, by a dissection followed by clearing and microscopic examination, which makes it inaccessible to the naturalist. The *bursa copulatrix* (see **Figs Euc3, Om4**) is the widened and often morphologically elaborated basal part of the spermathecal duct. It receives the *aedeagus*, or in some cases the *spermatophore*, of the male during copulation, and is a taxonomic character. It opens into the *genital chamber*, just dorsal to the common oviduct. At its distal end the bursa gives rise to the spermathecal duct proper, running to the spermatheca.

Preapical diverticulum. See under *spermatheca*.

Comstock-Kellogg pouches. Paired glandular pockets near the opening of the common oviduct. Their presence or absence is a taxonomic character at the subfamily level, but their function, possibly pheromonal, is not well understood.

Egg guide. A vertical fin-shaped sheet of the integument found near the posterior edge of the female subgenital plate, on its dorsal surface. It lies between the bases of the ventral ovipositor valves, and from the exterior ventral view seems to represent the attenuate tip of the SGP. For function see under *Subgenital plate*.

*Ovipositor**. In most Orthoptera, the ovipositor is formed from 3 pairs of sclerites or valvulae, which are generally thought to be derived from the primitive paired appendages of the 8th and 9th abdominal segments. In the grasshoppers, the second pair of valvulae are reduced in size and are only visible on dissection; the obvious dorsal and ventral ovipositor valves which project from the tip of the female abdomen are the 3rd and 1st pair of valvulae respectively. The ovipositor valves are variously hooked, toothed, or provided with cutting edges, or with spoon- or shovel-shaped tips, and are moved by powerful muscles which enable them to bore into a variety of substrates, depending on the taxon. Primitively it seems that most grasshoppers dug a hole in moist earth or sand, and many do so to this day. Others bore into the pith of hollow stems or leaf petioles, rotten wood or other friable substrate. The female abdomen is capable of remarkable elongation at the intersegmental membranes during oviposition, allowing it to extend the boring to a considerable depth. Usually the eggs are deposited in a matrix of proteinaceous foam which provides physical protection and humidity regulation to the developing eggs. Some oligophage grasshoppers instead lay their eggs in a thin foam layer sandwiched between two leaves of their food plant. In these, the ovipositor valves are modified, either to flat spatulate blades or to cylindrical rods (see e.g. the Lithoscirtae of the Proctolabinae).

Phallus, phallic complex. The acridid phallus is a complex structure serving several functions. In most insects and all known Orthoptera, sperm is not inserted into the female in a free-swimming, liquid state, but is instead packaged in a proteinaceous envelope to form a body known as the *spermatophore*. In some

cases the entire spermatophore is preformed in the male spermatophore duct, the final stage of the genital canal, and it is this that is inserted into the female genital cavity, where it is digested, liberating the sperm which eventually make their way to the spermatheca. This appears, for example, to be the method employed in *Homeomastax* (Eumastacinae; Rowell & Bentos-Pereira 2001).

In the Acrididae, the spermatophore is formed during copulation, partially within the *spermatophore sac* of the male, partly in the female ducts, by a complicated process of differential secretion and compressive pumping of the *ejaculatory sac* of the male, such that the distal end of the spermatophore becomes a narrow tube running up the lumen of the spermathecal duct and into the spermatheca. (The *ejaculatory sac* is the area of the genital canal of the male immediately preceding the spermatophore sac, and separated from it by a skeletal pinch valve, the *gonopore process*). This process has been observed in *Locusta* (Oedipodinae) and in *Gomphocerus* (Gomphocerinae) (Gregory 1965; Hartmann 1970).

In the ensiferan Orthoptera, the spermatophore is enlarged to include a *spermatophylax*, a nutritive mass of protein, which is eaten by the female after copulation, it being left protruding from her genital cavity. To date this is not known to occur in Caelifera.

In some non-Orthopteran insects the spermatophore is dispensed with, and the sperm are deposited directly into the spermathecal duct or even the spermatheca itself by the *aedeagus* of the male, which is then correspondingly long and filamentous for this purpose. No instances of this are yet known in the Orthoptera, but several Proctolabine genera (e.g. *Poecilocloeus*, *Balachowskyacris*) have aedeagal valves of this sort, and *Helicomastax* (Eumastacinae) also has long filaments in the phallus which look suitable for insertion into the spermathecal duct of the female. These genera may practice direct insemination.

The phallic complex thus has both intromittent and complex hydrodynamic functions to do with spermatophore formation. In most of the caeliferan superfamilies (with the exception of the Tettigidoidea) it is a complex structure with numerous sclerites and an elaborate musculature (Snodgrass 1937; Eades 2000). The sclerites and tubes of the phallus are derived from embryonic pouches formed from the walls of the genital duct; they do not seem to bear any relation to the primitive paired appendages of the abdominal segments (Snodgrass 1937). The sclerites themselves appear to be mainly formed as sclerifications of the membrane of the genital duct and its surrounding membranes, that form three more or less concentric layers, known as the endophallic, ectophallic and epiphallic layers respectively, after the sclerites that form within them. The intromittent structure, the *aedeagus*, is formed from the posterior extremities of the endophallus, sometimes supplemented by other structures. Being a complex structure, the phallic complex lends itself admirably to taxonomic use, and its extraction and preparation are among the most important manual skills of the grasshopper taxonomist.

Spermatophore sac, ejaculatory sac. See under *Phallic complex*.

Epiphallus, ectophallus, endophallus. See under *Phallic complex*.

*Cercus**, plural *cerci*. Short appendages of the tip of the abdomen. In grasshoppers they are formed at least partly from the paired segmental appendages of the 11th abdominal segment, although there may be some contribution from the appendages and musculature of the 10th segment as well. They arise behind the posterior margin of the 10th abdominal tergite, beside the lateral margins of the *supra-anal plate** and the *paraprocts**, which are also derived from the 11th segment. Snodgrass (1935) considered the cerci to be homologous with the uropods of malacostran crustaceans.

In grasshoppers (other than the Tridactylidae) the cerci consist of only one segment, and in their simplest form are short conical structures, almost always richly provided with mechanoreceptor hairs. In females they do not vary greatly, but in males, in which the cerci play a part in providing both the sensory environment and the mechanical manipulations necessary for copulation, they are often very complex structures. This complexity makes them valuable taxonomic characters, as it is often species specific. Among the Neotropical grasshoppers, the subfamily Proctolabinae have particularly ornate male cerci. Note that in the Ensifera the cerci are much longer and multisegmental, and look and function more like a caudal pair of antennae.

Furcula. Latin *furca*, fork, plus diminutive. Term applied to the presence of paired points or processes on the posterior edge of the 10th abdominal tergum of some male grasshoppers, overhanging the base of the supra-anal plate. These may vary in size from the microscopic to very conspicuous hornlike structures, and can be structurally complex.

Supra-anal plate, abbr. SAP,* = *epiproct*. The supra-anal plate is derived from the tergum of the 11th abdominal segment, with incorporation of a posterior part of the 10th abdominal tergite. It is a roughly triangular plate lying behind the apparent tenth tergite, and covering, as the name implies, the anus. In the male it also covers the dorsal opening of the genital cavity. The phallic complex in its position of rest lies below and slightly in front of the SAP. The shape and ornamentation of the SAP are important taxonomic characters in grasshoppers.

Lingulate. Having a tongue-like terminal projection (Latin *lingua*, tongue), e.g., the supra-anal plate of several grasshopper species.

*Paraprocts.** The paraprocts are a pair of tegumentary flaps, situated either side of the anus. They are derived from the sternum of the 11th (last) abdominal segment. In most grasshoppers they are largely hidden under the supra-anal plate or epiproct, but in some they project laterally beyond the edge of the epiproct and can then be coloured and patterned (as in some Podismini). Occasionally they bear processes (in some Eyprepocnemidinae and in the Tridactyloidea).

Some further definitions

Crepitation. Production of a rattling sound in flight by means of rapid partial folding and unfolding of the specialised hind wings, characteristic of some grasshopper taxa, especially some genera of Oedipodinae and Acridinae.

Dimorphic, polymorphic. Having two or more distinct forms within a single species. The commonest form is sexual dimorphism, in which males and females differ in shape or coloration, and which is genetically programmed. Many grasshoppers are polymorphic for coloration, with a green/brown polymorphism of their ground colour being most common, especially in grassland forms. This green/brown polymorphism is expressed according to environmental conditions during the development of the individual, especially humidity.

Emarginate. Said of an edge having a concave embayment in it.

Epiphytic, endophytic oviposition. Said of laying eggs either on (epi-) or within (endo-) the tissues of a plant (Greek *phyton*): characteristic of oligophage (foodplant specialist) species, ensuring that the larvae hatch on an acceptable foodplant.

Habitus. A term for the general appearance of the whole animal. This book is illustrated by habitus drawings of grasshoppers.

Inculta sedis. Latin for uncertain seat or position. A taxonomic term, used to describe taxa which cannot with confidence be placed in a higher ranking taxon. Examples are the T_{de}Eucopiocerae (pg. 197) and the genus *Marellia* (pg. 371), which cannot be easily placed in any currently defined subfamily.

Melanised. Describes areas of the integument which have been rendered hard and black by tanning of their proteins and the deposition of the pigment melanin.

Obsolete. Said of a structure which is less well developed than its homologue elsewhere. Usually implies reduction or regression, relative to the primitive state.

Plesiomorphic, apomorphic. Terms used in Hennigian cladistics for ancestral and derived character states respectively. Within a monophyletic clade of organisms, character states which are similar in all members of the clade are probably ancestral, derived from the common ancestor; hence plesiomorphic; those distinguishing the individual members have evidently been acquired (or lost) more recently, and are said to be derived (apomorphic.)

s.l., (sensu lato), s.str. (sensu stricto). Abbreviations of Latin phrases meaning “broadly defined” or “narrowly defined”.

Serrate, serrulate. Saw-like (from the Latin *serra*). Describes carinae or other structures furnished with regular spines or teeth.

Stridulation. The production of sound by moving one part of the body over another part, such that the friction between the two causes one or both to vibrate. Frequently the vibrating part is coupled to a larger radiating surface to amplify the sound intensity. The term *stridulatory mechanism* refers to the many different ways this is achieved. In those subfamilies of the Acridoidea that sing, almost all have their own typical stridulatory mechanism, which indeed is often considered part of the definition of the taxon. Examples are to be found in the two different femuro-elytral mechanisms typical of the Oedipodinae and Gomphocerinae respectively, or the alar-elytral mechanism of the Romaleinae, described in the relevant sections of this book.

Styliiform. From latin *stylus*, a pointed rod-like writing instrument. Applied for example to the cerci of some grasshoppers, which are straight and pointed.

Sub-. In taxonomy, a prefix used to moderate a descriptive adjective: thus in the phrase “supra-anal plate subtriangular” it is stated that the SAP is more or less but not perfectly triangular. Similarly “subobsolete” would imply that a structure is almost but not quite obsolete (i.e. not totally regressed).

Taxon, plural *taxa*. A general term for a name of any rank in the taxonomic hierarchy. A species, a genus, a tribe or a family - all are taxa, “the products of taxonomy”.

The Orthoptera are divided into 2 suborders, of which only one, the Caelifera, is treated in this book.

Suborder Caelifera Ander 1936

The Caelifera are externally distinguishable from the other suborder of the Orthoptera, the Ensifera Chopard 1920, by the following characters:

- antennae with <30 segments (including flagellomeres).
- ovipositor reduced to 2 pairs of functional valves (rather than the original 3 seen in the Ensifera), with a specialized transverse musculature.
- first three tarsal segments fused, giving a foot with maximally three free segments (secondarily reduced further in the Tridactyloidea and Tetrigoidea).
- well-developed arolium between the tarsal claws [except (secondarily lost?) in the Tridactyloidea and Tetrigoidea].
- stridulatory mechanisms, if present, varied, but never tegminal/tegminial, as is common within the Ensifera.
- tympana, if present, located on 1st abdominal segment.
- cercus composed of a single segment (except in the family Tridactylidae, where 2-segmented).

The Caelifera comprise to date over 11,000 valid described species in nearly 2500 valid genera world wide. These are currently divided into 8-9 superfamilies:

- Tridactyloidea**
- Tetrigoidea**
- Eumastacoidea**
- Proscopioidea**
- Tanaoceroidea**
- Trigonopterygoidea**
- Pneumoroidea**
- Pyrgomorphoidea**
- Acridoidea**

Molecular systematics indicates that this is the temporal order of divergence, with the Tridactyloidea as the earliest and the Acridoidea as the most recent of living branches. There is some doubt as to whether the Eumastacoidea and the Proscopioidea are separate offshoots (as indicated here) or are members of the same clade; neither morphology nor molecular techniques have so far given a clear answer. They are certainly more similar to each other than to the other superfamilies.

(The term "Acridomorpha" was coined by Dirsh, originally [1966] to cover the latter 5 superfamilies listed above, but later [1975] used by him to include all but the first two, in which sense it has since been used by some subsequent authors [e.g. Amedegnato, Eades]. Because of this inherent ambiguity the

term cannot be recommended, even as a clade name).

The Pneumoroidea are confined to Africa, the Trigonopterygoidea to S.E. Asia and Mexico, and the Tanaoceroidea to North America. The remaining 6 superfamilies are all represented in our area.

Artificial key to Caeliferan superfamilies in southern Central America. (See also section "Overview" in the Introduction).

Important note: this key will NOT give correct results in other parts of the world!

- | | |
|---|---|
| <p>I</p> <ul style="list-style-type: none"> Hind legs with strongly reduced tarsi and prominent tarsal spurs (thus giving the "three-fingered" look alluded to by their name); front and middle legs with only 2 tarsal segments; male with paraproct appendages, thus giving the initial impression of having two pairs of cerci; cerci with 2 segments (Family Tridactylidae) or a single segment (Family Ripipterygidae). Small, dark-coloured insects (5 mm or less), subterranean or subaerial in habitat. | <p>..... Tridactyloidea</p> |
| <p>IA</p> <ul style="list-style-type: none"> Hind feet with three free tarsal segments. | <p>..... 2</p> |
| <p>2</p> <ul style="list-style-type: none"> Arolia absent, fore and middle feet with only two tarsal segments; prosternum produced into a collar that partially covers the mandibles; pronotum produced into a dorsal crest and/or a long backwardly directed spine; elytra reduced to scales, but wings fully developed. | <p>..... Tetrigoidea</p> |
| <p>2A</p> <ul style="list-style-type: none"> Arolia present, all feet with three tarsal segments; other characters not as above. | <p>..... 3</p> |
| <p>3</p> <ul style="list-style-type: none"> Antennae with 14 or fewer segments, shorter than front femora; abdominal tympanum always absent. | <p>..... 4</p> |
| <p>3A</p> <ul style="list-style-type: none"> Antennae with 15 or more segments, longer than front femora; tympanum often present on 1st abdominal segment. | <p>..... 5</p> |
| <p>4</p> <ul style="list-style-type: none"> Small grasshoppers of normal proportions, prothorax shorter than front femora, apterous or alate. | <p>..... Eumastacoidea (p. 24)</p> |
| <p>4A</p> <ul style="list-style-type: none"> Elongate, phasmid-like, entirely apterous insects, females often of very large size, prothoracic segment markedly longer than front femora; head conical and elongate in dorsal view, tapering towards the front. | <p>..... Proscopioidea (p. 47)</p> |
| <p>5</p> <ul style="list-style-type: none"> Fastigium split by a longitudinal medial suture or groove on its dorsal surface into two halves; dorsal basal (i.e. proximal end) lobe of hind femur shorter than ventral lobe. (The only local genus, <i>Prophena</i>, is spindle shaped and brachypterous | |

with a strongly receding concave profile to the
face.) **Pyrgomorphoidea** (p.

53)

5A Fastigium lacking longitudinal medial suture; dorsal
basal lobe of hind femur as long as or longer than ventral lobe.
..... **Aridoidea** (p. 57)

Superfamily Eumastacoidea Burr 1899

The superfamily Eumastacoidea are almost worldwide in distribution, but are predominantly tropical and absent from Europe, New Zealand and Antarctica. They have long been considered a relatively early branch of the Caelifera, a view confirmed by molecular systematic investigations, which place them after the Tridactyoidea and Tetridoidea but before the remaining superfamilies (Flook & Rowell 1997, 1999). Like the more familiar Acridoidea they are subaerial herbivores of higher plants, but differ from them in numerous details of morphology, of which the superficially most obvious are the absence of an abdominal tympanum, and, in most of the superfamily, very short antennae and a laterally spread posture of the jumping hind legs when at rest.

Currently the Eumastacoidea contain nearly 300 genera and more than 1000 species (OSF on-line, Eades et al. 2003), making them the second largest Caeliferan superfamily after the Acridoidea. Since their original recognition as a systematic group by Stål (1876), the eumastacoids have been the subject of several major revisions, which have taken them to family and then to superfamily status and produced an increasing number of subfamilies. The most recent of these revisions is that of Descamps (1973a), who recognized 4 groupings of families, 7 families and 31 subfamilies, principally on the basis of the male genitalia. Many of the taxa of the Eumastacoidea are geographically isolated; in view of their antiquity (Jurassic) it seems likely that the fragmentation of Pangaea and later of Gondwanaland has influenced their diversification. Thus, for example, the exclusively American Eumastacidae are most closely related to the Australian Biroellidae and Morabidae, a grouping confirmed by both morphological and molecular systematic data. This corresponds to an earlier landmass.

Only two eumastacoid families, the Eumastacidae and the Episactidae, have representatives in Central America.

Family Eumastacidae Burr 1899

Etymology.

The type genus was originally called *Mastax* Perty 1832 (Greek *Mastax* = jaw) but this name was preoccupied in Coleoptera. Burr renamed it *Eumastax*, "True mastax".

Selected literature.

- Burr, M. 1899: 75.
- Burr, 1903:15.
- Bolívar, C. 1930: X, 9. > Eumastacidae.
- Rehn, J.A.G. 1948: 77. > Key to subfamilies.
- Dirsh, V.M. 1956: 233. > Eumastacidae.
- Dirsh, V.M. 1961: 356, 360.
- Rehn, J.A.G. & Grant, Jr. H.J. 1961: 120. > Eumastacidae.
- Dirsh, V.M. 1965: 17. > Key to subfamilies.
- Sharov, A.G. 1971: 89, 97. > Eumastacidae Burr, 1889; Member of Locustopoidea.
- Podgornaya, L.I. 1971: 299-302.
- Descamps, M. 1973: 208. > Review of the superfamily.
- Dirsh, V.M. 1975: I-171. > Member of superfamily Eumastaciidae.
- Descamps, M. 1979: 118.
- Kevan, D.K.M. 1982: 368. > Eumastacidae.
- Otte, D. 1994: I. > Eumastacidae.
- Flook, P.K. & Rowell, C.H.F. 1997: 89-103. > Molecular phylogenetics.
- Klee, S., Flook, P.K., & Rowell, C.H.F. 2000: 349-353.
- Eades, D.C. 2000: 204.
- Matt, S. et al. 2008: 43-55. > Molecular phylogenetics.

Earlier authors (and some more modern ones!) tend to equate the family Eumastacidae with the superfamily Eumastacoidea, thus including all eumastacids. Here, however, it is understood in the sense of Descamps 1973, as one of seven different eumastacoid families.

In its most conservative concept the family contains at least 8 subfamilies, all confined to the Americas. Only one of these subfamilies, the Eumastacinae, occurs in our area.

Diagnosis.

The formal diagnosis of the family depends primarily on phallic characters (see Descamps 1973). In our region, however, all eumastacoid grasshoppers which have clearly visible wings are members of this family and of the subfamily Eumastacinae. Episactines, the other Central American eumastacoid group, are apterous, and also have spined upper margins to the dorsal face of the 1st hind tarsal segment.

Selected literature.

- Burr, M. 1899: 75.
- Burr, 1903:15.
- Bolívar, C. 1930: X, 9. > Eumastacidae.
- Rehn, J.A.G. 1948: 77. > Key to subfamilies.
- Dirsh, V.M. 1956: 233. > Eumastacidae.

Subfamily Eumastacinae

Burr 1899

Selected literature.

- Burr, M. 1899: 75-112, 253-304, 345-350, 3 pls.
- Bruner, L. 1900-1910 (1901): 19.
- Burr, M. 1903: 2, 15.
- Rehn, J.A.G. 1904: 670.
- Kirby, W.F. 1910.: 65.
- Handlirsch, A.P.J. 1925: 465.
- Bolívar, C. 1930. : XXXII.
- Rehn, J.A.G. 1948: I-22, I pl. > Note: Eumastaces group.
- Rehn, J.A.G. 1948: 115. > Eumastacinae.
- Bei-Bienko, G.Y. & Mishchenko, L.L. 195:127[134].
- Rehn, J.A.G. & Grant, H.J. Jr. 1958: 310.
- Rehn, J.A.G. & Grant, H.J. Jr. 1961. Monographs Acad. nat. Sci. Philad. 12:120 > Eumastacidae.
- White, M.J.D. 196: 271.
- White, M.J.D. 1970: 65.
- Descamps, M. 1971: 99.
- Descamps, M. 1973c: 946.
- Descamps, M. 1973:b 215. > Key to genera.
- Descamps, M. 1974: 56.
- Descamps, M. 1979c: 120.
- Otte, D. 1994: 28. > Eumastacinae.
- Rowell, C.H.F. & Perez-Gelabert, D. 2006: 192. > Eumastacidae: Eumastacinae.

Diagnosis.

(After Descamps 1973). Fastigium not projecting; lateral carinae of frontal ridge continuous with those of margins of fastigium. Antennae with 13 or 14 segments, antennal organ usually on 4th segment from tip. Male cerci typically short and straight; male subgenital plate cup-shaped, entirely sclerified. (Other characters all phallic.)

No. included genera.

Twelve.

Range.

The great majority of Eumastacinae are tropical South American; only two genera, *Homeomastax* and *Helicomastax*, have been recorded in Central America and only the latter is apparently endemic there.

Homeomastax

Descamps 1979

Descamps 1979c: 136.

Type species: *Eumastax surda* Burr 1899.

Type locality: Chiriquí, Panama (holotype female).

Location of type specimen: Wien Museum (Brunner Collection).

Etymology.

Greek *homoios*, like or resembling; *mastax*, *mastacos*, jaw, mouth, a common noun in eumastacoid names. “Resembling (Eu) mastax”. Coined by Descamps to distinguish the group from other members of the genus *Eumastax*. He had previously (1971) referred to it as the “surda group of *Eumastax*.”

Other literature.

- Descamps, M. 1971. 133, 137. > As the surda group of *Eumastax*.
- Rowell, C.H.F. et al. 1984. > Feeding behaviour.
- Rowell, C.H.F. & Bentos-Pereira, A. 2001a: 209-254. > Review of genus.

Diagnosis.

Male antenna with 14 segments, female with 13-14, antennal organ on 7th segment from tip; pallium not projecting; supra-anal plate subtriangular, without latero-apical angles; macropterous, rarely brachypterous; hind femora in pregenicular region red or ringed red and black; spermatophore sac devoid of projecting chitinous filaments.

No. of included spp.

Twenty-two. In our area, 14.

Generic Range.

Western Ecuador, Western and Northwestern Colombia, Panama, Costa Rica, Nicaragua and Honduras.

The genus was originally subsumed within *Eumastax* Burr, and first split off by Descamps (1979). Rowell & Bentos-Pereira (2001a) divided the genus into four species groups, on the basis of similarities in the male phallic complex. Of these the bouvieri group is almost exclusively S. American, with but one representative (*H. brachyptera*) in Central Panama. The other three groups are mostly or exclusively Central American; species of the surda group are found principally on the Pacific slope, those of the kressi group on the Caribbean slope, and those of the silvicola group in the mountains of northern Costa Rica. One Central American species, *H. dentata*, is known only from the female and cannot be allocated to a group.

Field characteristics.

At the genus level *Homeomastax* and *Helicomastax* are instantly distinguished within our fauna by their habitual posture, with spread and depressed hind femora, and their characteristic bright colours. The larvae are cryptically coloured, dull green

with brown bands and speckles, the adults brightly coloured in shades of metallic blue, green and yellow, with smoky grey wings and red-ringed hind femora (**Plates Eu1, Eu3**); the proximal parts of the carinae of the hind femora are thickened and melanized. Species identification, on the other hand, is difficult. All the species are coloured and patterned similarly and differ only in size, relative length of the wings, subtle differences in the structures of the tip of the abdomen and above all in the male internal genitalia, for which a microscope and a dissection are required; details are given in Rowell & Bentos-Pereira (2001a), which should be consulted in critical circumstances.

In the field, species are best identified by their geographical location, for most seem to be allopatric. The males of most species and the females of some can be identified when dead by using a hand lens and the drawings of the subgenital plates provided (**Figs Eu2, 3**). The lengths of the elytra and hind femora (E & F) and their ratio (E/F) are also useful [see Table 23 of Rowell & Bentos-Pereira (2001a)].

Natural history.

Homeomastax are a wet-forest genus. They are most often found on ferns, which all species eat, but they also eat many other plants, including some tree-ferns (Cyatheaceae -rarely!), *Costus* (Zingiberaceae), *Anthurium* (Araceae), *Piper* (Piperaceae), *Schistocarpha* (Asteraceae) and seedlings of trees, including *Pentaclethra* (Mimosaceae) and members of the Rubiaceae and Flacourtiaceae. There are no striking ecological differences between the different species. Unlike most forest grasshoppers, they are not confined to light gaps or the canopy, although they occur in both, and especially larval groups can be found on ferns in deep shade in the forest interior. They have been collected from the canopy by insecticidal fogging in the Osa, Costa Rica. The eggs are relatively enormous, 9-10 mm long and 2 mm wide, almost as large as the abdomen of the female, and are usually matured only 2-3 at a time, but some females contain 6. The sawlike ovipositor valves suggest endophytic oviposition, but there is no direct evidence for this.

A. The *surda* species-group.

I. *Homeomastax surda* (Burr, 1899)

Eumastax surdus Burr 1899: 90, 258, 264.

Type locality: Chiriquí, Panama (nec "Peru") (holotype female). Probably the lowland city of Chiriquí Viejo is indicated, rather than the mostly upland province of Chiriquí.

Location of type specimen: Naturhistorisches Museum, Vienna.

Etymology.

Latin *surdus*, deaf or mute. Both adjectives are applicable, but to the superfamily rather than just this species.

Subsequent literature.

- Bruner, L. 1901: 22, 23, pl. 2, figs 14, 14a. > As *Eumastax*
- *surda*, correction of gender.
- Kirby, W.F. 1910: 77.
- Hebard, M. 1924a: 92. > In error, misidentification of *H. veraguae*.
- Hebard, M. 1933: 126.
- Rehn, J.A.G. & Rehn, J.W.H. 1934: 64. > Redescription and allocation of putative male.
- Descamps, M. 1971: 139.
- Descamps, M. 1973b: 955.
- Descamps, M. 1979c: 136. > Transfers to *Homeomastax*; designates as type species of genus.
- Rowell, C.H.F. & Bentos-Pereira, A. 2002a: 218. > Confirmation of identity of Rehn & Rehn's specimens.

Rehn & Rehn (1934) did not examine the female holotypes of either *H. surda* (Burr) or *H. dentata* (Saussure). They selected putative males of both species on the basis of either geographical proximity (*H. dentata*) or ecological similarity (*H. surda*) to the original type localities, and on this slender basis redescribed both species. Subsequent usage of these specific names has been based on the figures given by Rehn & Rehn (1934) and later by Descamps (1971), who also used the Philadelphia material of the former authors. Rowell & Bentos-Pereira (2001a) showed that in the case of *H. surda* (but not *H. dentata*) Rehn and Rehn's guesses were correct.

Diagnosis.

Habitus, **Fig. Eu1**, **Plate Eu1**. Subgenital plates of males and females as in **Figs Eu2, Eu3**. Female subgenital plate acutely pointed apically, lateral lobes well sclerified, separated medially by a depression; margins with a few small vertical spines, not visible in ventral aspect. Male subgenital plate in lateral view pointed, dorsal edge straight, margin not notched medially, in axial view with a short medial carina. Costal vein of elytron meets anterior margin more distally (at about 45% wing length) than in other species (at about 25%).

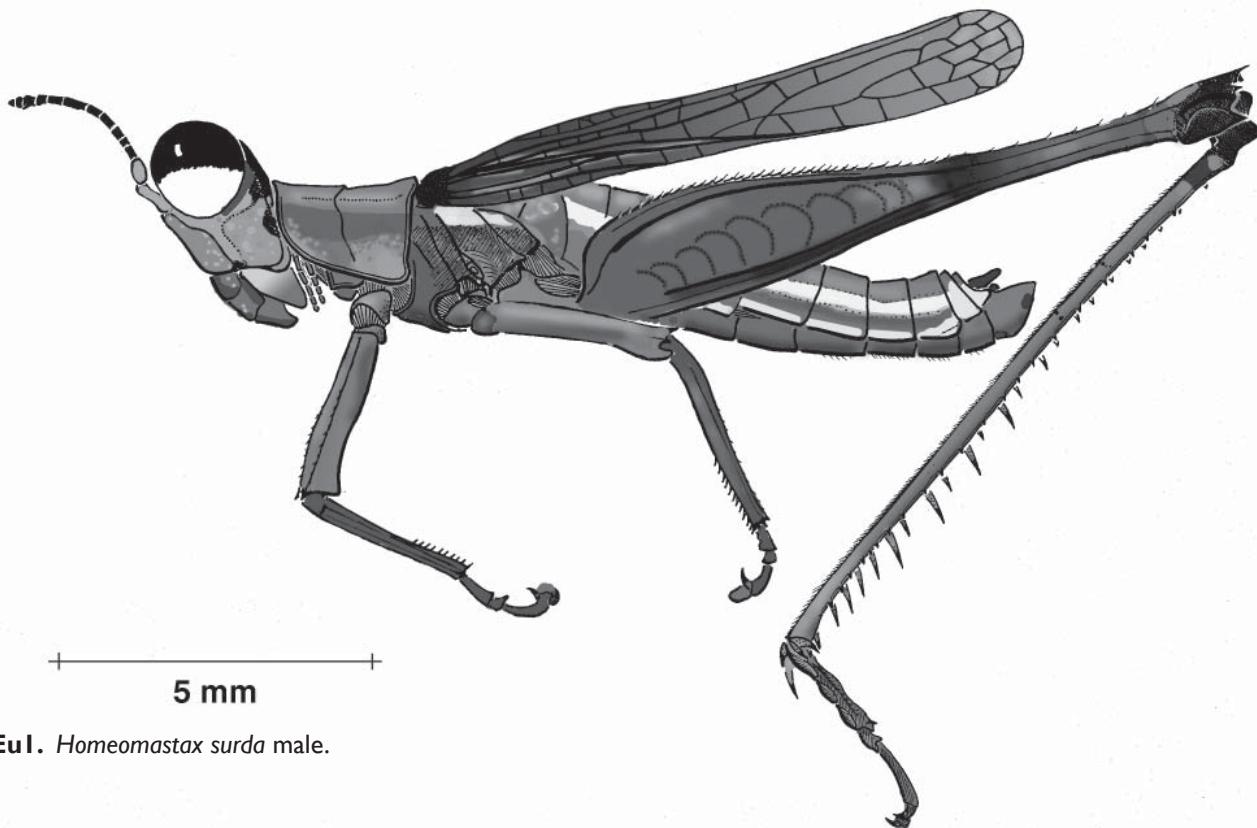


Fig. Eu1. *Homeomastax surda* male.

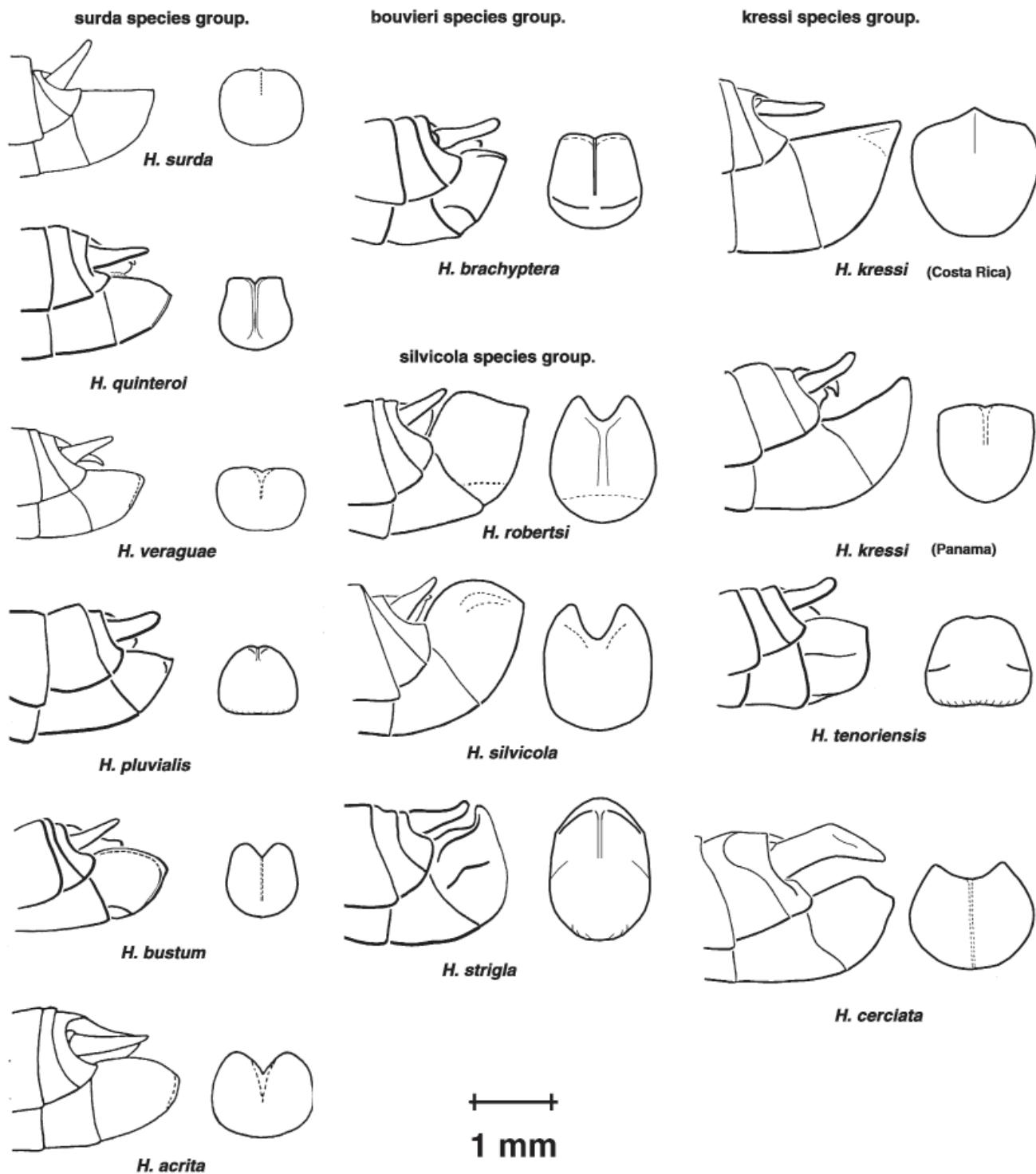


Fig. Eu2. *Homeomastax* (Costa Rican and Panamanian spp. only). Male terminalia in lateral and axial views. Scale bar one millimetre

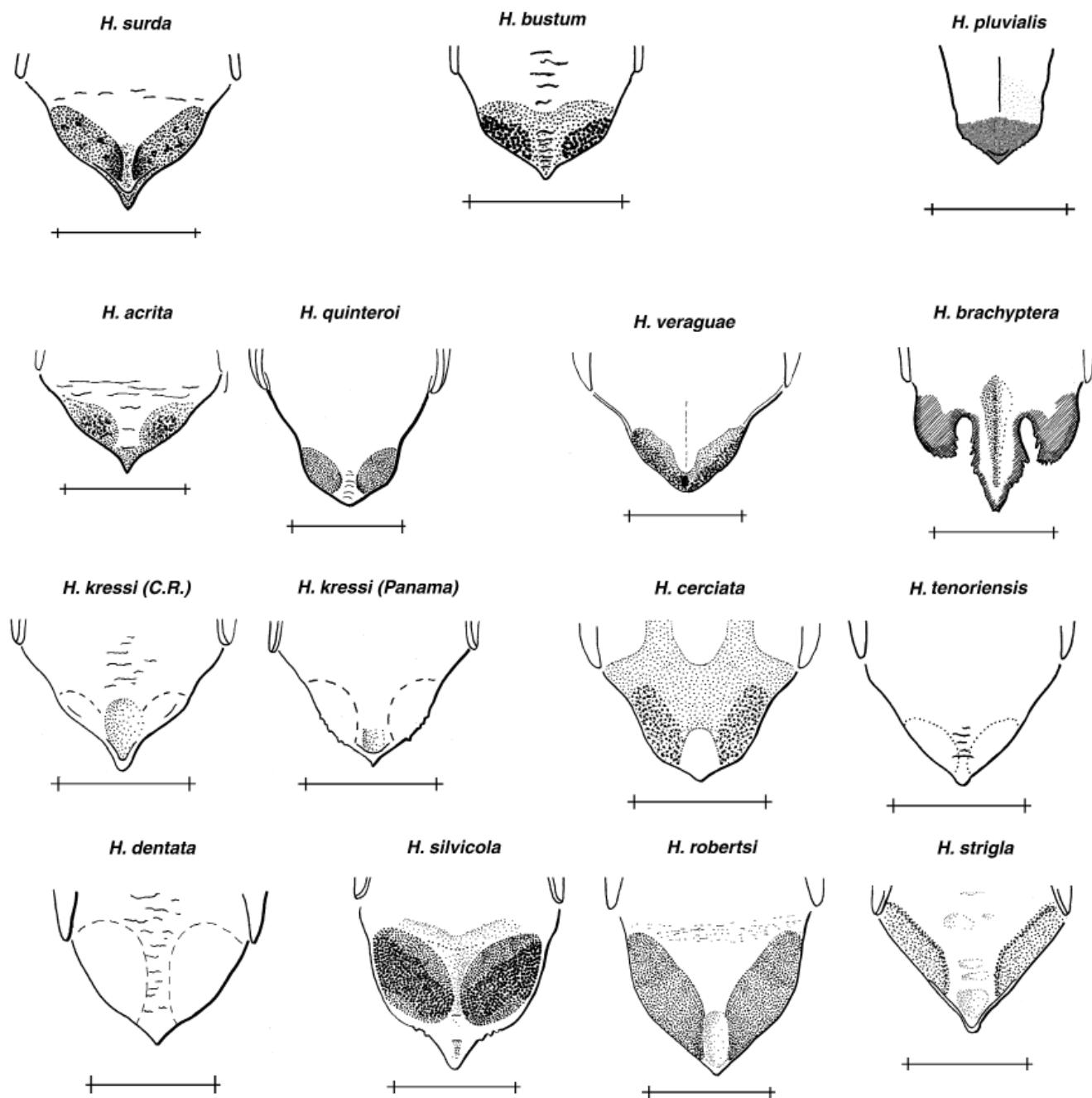


Fig. Eu3. *Homeomastax* (Costa Rican and Panamanian spp. only.) Female subgenital plates in ventral view. Scale bars one millimetre,

Description.

Small in size, especially in males; only *H. acrita* and *H. brachyptera* have a shorter male femur on average. Moderately long winged (male E/F = 0.89). Markedly dimorphic in size; male/female ratios 0.76-0.82, mean 0.79. 20-21 outer hind tibial spines, 20-22 inner spines. Male frons whitish in dried specimens, basal antennal segments blue, in females yellow-orange; clypeus and labrum blue. Distal part of femur a clear red with little or no dark shadowing.

Distribution.

Lowland (up to 600 m) Pacific slope of Costa Rica, south of 10°N, and of extreme southwestern Panama, west of 82°W. There is little suitable habitat remaining in the Panamanian portion of this range. In Costa Rica, however, the range includes at least three National Parks, those of Carara, Quépos and Corcovado. In the Osa peninsula, *H. surda* is sympatric with *H. bustum*, one of the few instances of sympatry in this genus.

2. *Homeomastax veraguae* (Hebard 1933)

Eumastax veraguae Hebard 1933: 127.

Type locality: Panama: Colón: "Guamina" (probably in error for Juan Mina, 9°09'N, 79°40'W), Río Chagres.

Location of type specimen: ANS Philadelphia (holotype currently lost).

Etymology.

From the geographical name "Veraguas". Although the specific name suggests an origin in the modern province of Veraguas, that term was used historically for all of Western Panama, including Portobelo (D. Quintero, pers. comm.), and it is presumably in this sense that Hebard used it. The species has **not** been recorded from Veraguas province.

Subsequent literature.

- Hebard, M. 1923: 178 as *Eumastax cerciata*, partim. > Misidentification.
- Hebard, M. 1924: 92 as *Eumastax surdus*, partim. > Misidentification.
- Rehn, J.A.G. & Rehn, J.W.H. 1934: 68. > Description of putative female.
- Descamps, M. 1971: 138.
- Descamps, M. 1979: 136. > Transfers to *Homeomastax*.
- Rowell, C.H.F. & Bentos-Pereira, A. 2001a: 221. > Confirmation of identity of Rehn and Rehn's female.

The holotype male was originally identified by Hebard (1924) as *H. surda*; only later (1933) did he recognize it to be a separate species. Rehn and Rehn (1934) described as the female, a specimen from the type series of *H. cerciata* Hebard 1923, apparently on purely geographical grounds. Their guess was shown correct by Rowell & Bentos-Pereira 2001a.

Diagnosis.

Male and female subgenital plates as in **Figs Eu2, Eu3**.

Female subgenital plate with lateral lobes only barely sclerified, rounded at tip, with a slight medial carina, almost no marginal teeth. Male subgenital plate almost identical with that of *H. surda*, but with a slight medial notch, a more pronounced carina, and slightly more convex dorsal edge; cerci slightly longer. 

Description.

Of medium size for the group. The longest winged species of the *surda* species-group (E/F = 1.01). Markedly sexually dimorphic in size (male/female ratios 0.76 - 0.83, mean 0.80. Twentythree outer and 21 inner hind tibial spines (female), 26 and 22 in the male. Face white tinged blue in dried male specimens, white with vermilion-tinged infra-orbital carinae in females. Red part of femur shadowed with brown distally and proximally, leaving only a narrow band of clear colour.

Distribution.

Apparently confined to the lowland areas of the provinces of Colón and Panama, corresponding roughly to the former Panama Canal Zone, and the region of Chagres National Park to its East, and including the islands of the Archipiélago de las Perlas.

3. *Homeomastax bustum* Rowell & Bentos-Pereira 2001

Rowell & Bentos-Pereira 2001a: 224.

Type locality: COSTA RICA: Puntarenas: Tárcoles: Reserva Biológica Carara, Sendero de los Enterrados, 450-530 m. Location of type specimens (ANS Philadelphia).

Etymology.

Latin *bustum*, a place of burial, referring to the type locality.

Diagnosis.

Can be distinguished with certainty only by the male internal genitalia. Male and female subgenital plates as in **Figs Eu2, 3**. Female subgenital plate almost identical with that of *H. surda*, but shorter, somewhat more heavily sclerotized at tip. Margin decorated with vertical spines, as in *H. surda*. Male subgenital plate not distinguishable from that of *H. acrita*, bluntly pointed, dorsal margin slightly convex in lateral view, medially notched and carinate.

Description.

One of the larger species of the *surda* species-group. The specimens from the Osa are nearly 10% larger than those from Carara. Elytra of medium length; relative length the same as for *H. surda*, longer than in *H. acrita*, shorter than in *H. veraguae*. Sexual dimorphism in size well developed: male/female ratios 0.80 - 0.85, mean 0.82. 24 outer and 21 inner hind tibial spines (female), 26 and 22 in male. Face and basal antennal segments yellowish white in the only nondiscoloured male specimen, but may be faded; red portion of femur without dark rings or shading. Available female specimens all discoloured.

Distribution.

To date, known certainly only from the higher inland part of the Carara biological reserve in West Central Costa Rica and from the Osa Peninsula, where it occurs sympatrically with *H. surda*.

This is probably the species to which belong the specimens described erroneously as *H. dentata* (Saussure) by Rehn and Rehn (1934). The corresponding localities are not far from Carara and their drawings of the male subgenital plate are compatible.

4. *Homeomastax pluvialis* Rowell & Bentos-Pereira 2001

Rowell and Bentos-Pereira 2001a: 225.

Type locality: COSTA RICA, Prov. Cartago, P.N. Tapantí, 1500-1600 m, in cop.

Location of type specimens: ANS Philadelphia.

Etymology.

Latin *pluvialis*, of rain, referring to the exceedingly wet climate of the type locality.

Diagnosis.

Male and female subgenital plates as in **Figs Eu2, 3**.

Female subgenital plate compressed laterally, appearing very narrow in ventral view, medially carinate proximally. In all specimens examined, this structure has a heavily sclerotized, almost black tip; the paired thickenings of the lateral lobes are seen only in cleared preparations. Male subgenital plate most similar to that of *H. surda*; differs from latter in the somewhat more rounded tip in lateral view, the very short medial carina, and in having a black border along the dorsal edge. Cerci shorter and blunter than all other surda-group species-apart from the S. American *H. carrikeri*.

Description.

One of the largest members of the surda species group, but with noticeably short wings ($E/F = 0.60$); only *H. brachyptera* from Panama has relatively still shorter ones. Sexual dimorphism in size slight: male/female ratios 0.84 - 0.94, mean 0.89; note however that only a single male has been measured. Twenty-four outer and 22 inner hind tibial spines (female), 21 and 21 in the male. Frons and basal antennal segments whitish in dried male, in females frons whitish, basal antennal segments blue with a vermillion spot at the joint, vermillion marks on infra-orbital carinae. Red portion of femur shadowed with brown proximally and distally in both sexes.

Distribution.

To date known with certainty only from the type locality, in montane rain forest in the northeastern Talamanca mountains of Central Costa Rica, on the Atlantic side of the watershed.

5. *Homeomastax acrita* Rowell & Bentos-Pereira 2001

Rowell and Bentos-Pereira 2001a: 227.

Type locality: COSTA RICA: Puntarenas: S. Vito de Jaba, Finca Las Cruces. 1100 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *akritos*, mixed up, doubtful, an allusion to the confused taxonomic history of this sp., for which see Rowell & Bentos-Pereira (2002) and the entry for *H. dentata* below.

Other literature.

- Rowell, C.H.F. et al. 1983: 207. > Ecology - as *H. dentata*, in error, following Rehn and Rehn (1934) and Descamps 1971.
- Rowell, C.H.F. 1998. > Distribution - as *H. dentata*, in error, following Rehn and Rehn (1934) and Descamps 1971.

Diagnosis.

Male and female subgenital plates as in **Figs Eu2, 3**. Female subgenital plate similar to but shorter than that of *H. surda*; distinguished from *H. surda* and *H. bustum* by absence of marginal spines. Male subgenital plate not distinguishable from that of *H. bustum*: relatively long, dorsal edge slightly convex in lateral view, slightly truncate at tip; small medial notch in axial view, thereby distinguished from *H. surda*.

Description.

The smallest Central American species: only *H. carrikeri* (Colombia) is smaller. Shorter-winged than *H. surda* ($E/F 0.77$). Markedly dimorphic in size: male/female ratios 0.76-0.82, mean 0.79. Twentythree (female) or 20-21 (male) outer and inner hind tibial spines. Male frons and basal antennal segments whitish in dried specimens, in females vermillion. Red part of femur shadowed with brown distally and proximally, leaving only a narrow band of clear colour.

Distribution.

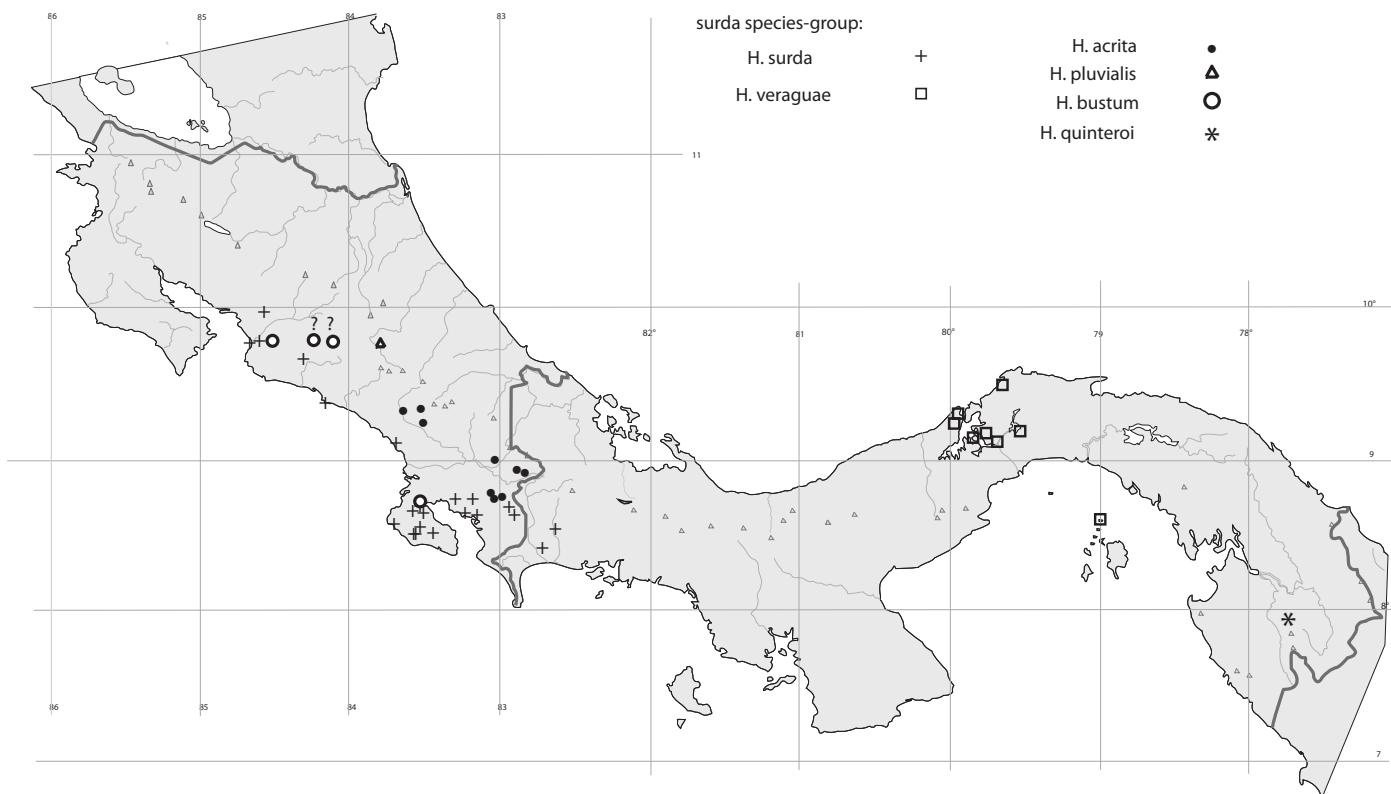
Highland (above 700 m) southern Pacific slope of Costa Rica, south of $9^{\circ}20' N$, extending to the Panamanian border at Cañas Gordas and probably into Western Panama. All known localities are on the eastern sides of the basin of the complex of rivers that flows into the Pacific as the Rio Grande de Térraba from the Valle de El General and the Valle de Coto Brus. The Fila Costeña bounds this basin to the west; on its seaward side *H. surda* is found.

6. *Homeomastax quinteroi* Rowell & Bentos-Pereira 2001

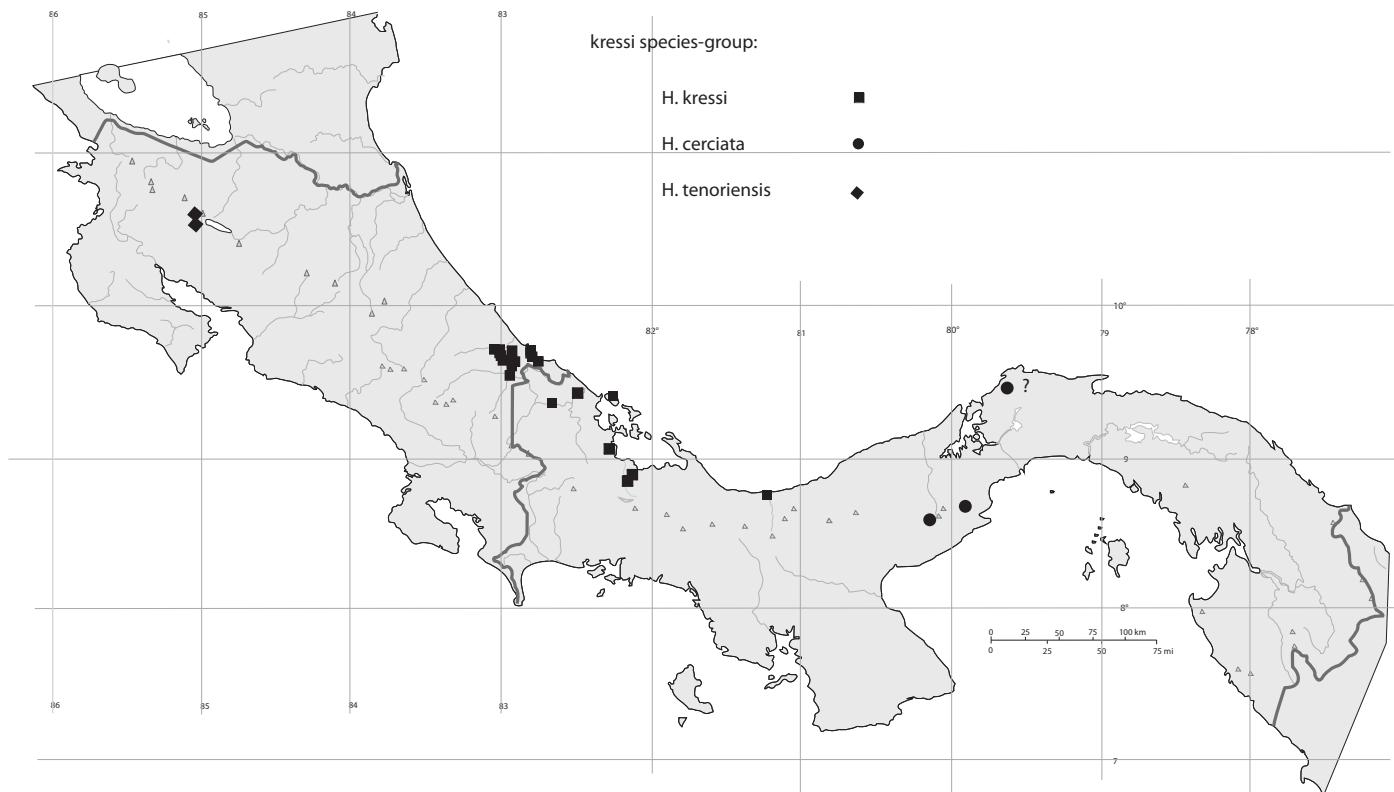
Rowell & Bentos-Pereira 2001a: 229.

Type locality: PANAMA: Prov. Darién: P.N. Darién: Pirre: Estación Rancho Frio.

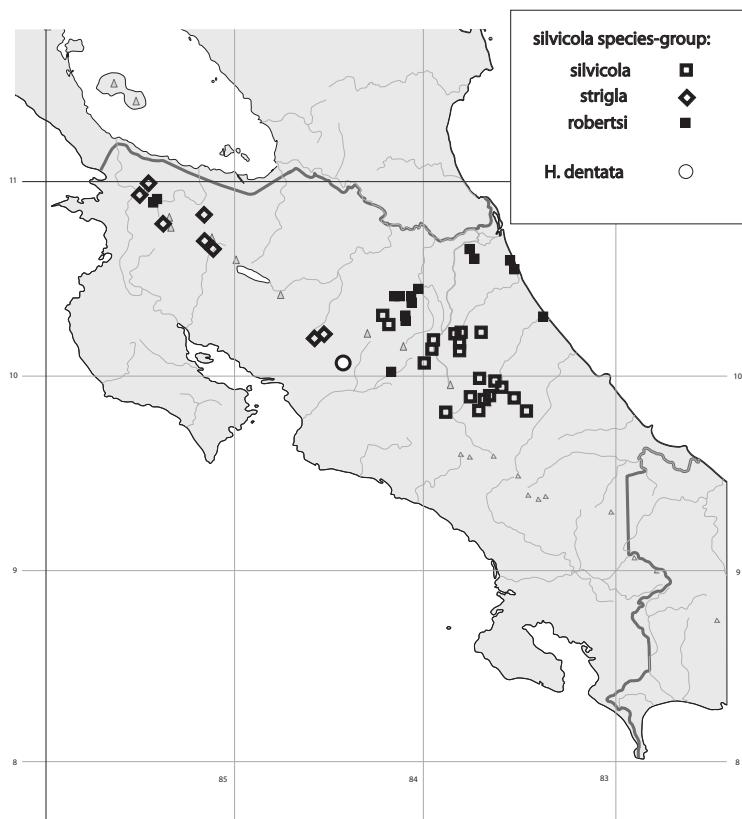
Location of type specimen: ANS Philadelphia.



Map Eu1. *Homeomastax*, known distribution of species of the surda group. The two northern records of *H. bustum* with question marks, correspond to the specimens erroneously described as *H. dentata* by Rehn & Rehn (1934). See text for details.



Map Eu2. *Homeomastax*, known distribution of species of the kressi group. The type locality for *H. cerciata* marked with question mark (near Portobelo) is probably erroneous.



Map Eu3. *Homeomastax*, known distribution of species of the silvicola group.

Etymology.

Named for Professor Diomedes Quintero of the Museo de Invertebratos G.B. Fairchild, Universidad de Panama.

Diagnosis.

Male and female subgenital plates as in **Figs Eu2, 3**.

Female SGP distinctive, narrowing abruptly immediately anterior to lateral lobes, then running more or less parallel-sided to a bluntly rounded tip. Margin devoid of spines. Male cerci slender, pointed, slightly upwardly inflected in lateral view, more or less straight in dorsal view. Male subgenital plate of same type as in *H. bustum* and *H. veraguae*; short, dorsal edge in lateral view straight or very slightly convex; tip rounded in profile, then dropping in two straight sections to suture; in axial view upper margin slightly notched medially, with a long and strong medial carina running from the notch ventrally; in dorsal view tip bluntly rounded, the median carina projecting as a ridge.

Description.

A medium large member of the surda group, long winged (male E/F 0.98) and long legged. Markedly sexually dimorphic in size, male/female ratios = 0.77-0.81, mean 0.79.

Distribution.

To date known only from type locality in Darién, but may well extend into nearby Colombia.

B.The bouvieri species-group.**7. *H. brachyptera* Rowell & Bentos-Pereira 2001**

Rowell and Bentos-Pereira 2001a: 233.

Type locality: PANAMA: Prov. Coclé: Cerro Copé, 1830 m

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *brachys*, short and *pteron*, wing.

Diagnosis.

E/F <0.6, the shortest wings found so far in the genus.

Frons predominantly yellow, as opposed to white or blue in other species, and without vermilion marks in female. Posterior margin of pronotum less rounded, more angular, than in other species, forming an angle of approximately 130°.

Male and female subgenital plates as in **Figs Eu2, 3**.

Female subgenital plate deeply trilobate, the individual lobes medially grooved and with melanized, ornamented borders. Male subgenital plate similar to that of *H. veraguae*, but shorter and with a longer medial carina.

Description.

A rather small species with very short wings. Sexual

dimorphism in size moderate: male/female ratios 0.82-0.87, mean 0.84 (Table 23). Female with 22 outer hind tibial spines and 23 inner ones, male with 22 and 22. Male with white basal antennal segments and frons, the latter yellowish ventral to the medial ocellus; clypeus and labrum blue; female with greenish basal antennal segments, face yellow, clypeus and labrum blue.

Distribution.

To date known only from the type locality in West-Central Panama, where it is found on both Atlantic and Pacific sides of the watershed.

C.The kressi species-group.**8. *Homeomastax kressi* (Rehn & Rehn 1934)**

Eumastax kressi Rehn & Rehn 1934: 59.

Type locality: N. end of Suretka trail along Duroy River (V. de la Estrella), Costa Rica.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Descamps, M. 1971: 156.
- Descamps, M. 1979: 136; transfer to *Homeomastax*.
- Rowell, C.H.F. & Bentos-Pereira, A. 2002: 235.

Etymology.

Named for Samuel Kress, Agricultural Superintendent of the United Fruit company in Costa Rica at the time of Rehn's visits there.

Diagnosis.

Subgenital plates of male and female as in **Figs Eu2, 3**. Female subgenital plate with rather small lateral lobes, a well-marked terminal depression just before the tip and a few weak marginal teeth; the Panamanian population has better developed teeth. Male subgenital plate long, pointed in both lateral and dorsal view, upper margin in lateral view straight (Costa Rica) or convex (Panama). Male cerci thin, incurved, slightly upwardly inflected at tip in lateral view.

Description.

A rather large, fairly long-winged species (male E/F = 0.92), of moderate sexual dimorphism, male/female ratios 0.80-0.86, mean 0.83 (Table 23). Female with 24 inner and outer hind tibial spines, male with 25 outer and 22 inner spines. Basal antennal segments, face, clypeus and labrum generally whitish; in females the facial carinae are marked with vermilion. Costa Rican specimens are darker, with blue-black pedicel and blackish margins to clypeus and labrum; red portion of femur shadowed proximally and distally with brown. Individuals from the Panamanian end of the species range have somewhat more

slender ectophallic sclerites and small differences in the shape of the subgenital plates (**Fig. Eu2**); they are also slightly (3-9%), but nonsignificantly, smaller and shorter winged.

Distribution.

Costa Rica & Panama. Lowland Caribbean forest from the Valle de la Estrella (S.E. Costa Rica), via the Ríos Sixaola, Changuinola, Teribé and Guarumo at least as far as Calovébora in West-Central Panama; extends from sea level to 800 m altitude in the valley of the Río Guarumo.

9. *Homeomastax cerciata* (Hebard 1923)

Eumastax cerciata Hebard 1923: 178.

Type locality: Panama, Prov. Colón, Porto Bello (=Portobelo). Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Hebard, M. 1924: 92.
- Rehn, J.A.G. & Rehn, J.W.H. 1934: 79. > Redescription of female.
- Descamps, M. 1971: 138.
- Descamps M. 1979: 136. > Transfers to *Homeomastax*.
- Rowell, C.H.F. & Bentos-Pereira, A. 2001a: 239.

Diagnosis.

Subgenital plates of male and female as in **Figs Eu2**,

3. Female subgenital plate rather short and blunt with a short obtuse point, most of surface darkly pigmented, margin devoid of teeth. Male subgenital plate similar to that of *H. robertsi*, with a convex but sinuate upper margin in side view, but more carinate medially. Male cerci unmistakable and unique within the genus, large, heavily built, abruptly deflected downwards by 60° at half-length.

Description.

One of largest species of the genus, long winged (E/F = 0.96). Sexual dimorphism relatively small, male/female ratios 0.87-0.91, mean 0.89. 23 outer and 24 inner hind tibial spines (female), 23 and 21 in a male. Basal antennal segments, frons, genae, clypeus and labrum whitish in both sexes when dried. Red portion of femur shadowed proximally and distally with brown.

Distribution.

To date known only from Portobelo (the type series) and from Cerro Campana, both in Central Panama. The species found in the lowlands near Portobelo is, however, *H. veraguae*; the type series of *H. cerciata* probably came from higher ground in the modern Chagres National Park behind Portobelo or may have been mislabelled.

Natural history.

On ferns in montane forest.

10. *Homeomastax tenoriensis* Rowell & Bentos-Pereira 2001

Rowell and Bentos-Pereira 2001a: 241.

COSTA RICA, Prov. Guanacaste, Volcán Tenorio, near summit of road from Tierras Morenas to Bajo Los Cartagos, 1040 m. Location of type specimen: ANS Philadelphia.

Diagnosis.

Subgenital plates of male and female as in **Figs Eu2**, 3. Female subgenital plate intermediate between those of *kressi* and *cerciata*; lateral lobes weakly sclerotized and not prominent, margin devoid of teeth. Male subgenital plate short, with a faint medial carina, but no medial notch; in lateral view the posterior surface forms a right angle with the straight dorsal rim, in dorsal view smoothly rounded with a minute apical lip. Male cercus slightly inwardly curved, with bluntly rounded, slightly swollen tips.

Description.

Somewhat smaller than Costa Rican *kressi*, markedly more brachypterous (male E/F = 0.72) and slightly more sexually dimorphic in size: male/female ratios 0.79-0.88, mean 0.82. Outer hind tibial spines of female 21, inner tibial spines 20; in male, 19-20 for both. Male face white, basal segments of antennae and clypeus and labrum blue; in female all greyish white, face marked with vermillion. Red portion of femur with heavy brown shading proximally and distally. General coloration rather dull for the genus.

Distribution.

Known to date only from montane forest on the southern slopes of Volcán Tenorio, the southernmost peak of the Cordillera de Guanacaste. This is one of the few *Homeomastax* species which is sympatric with another: *H. strigla* is also found in this locality.

D. The *silvicola* species-group.

11. *Homeomastax silvicola* (Rehn & Rehn 1934)

Eumastax silvicola Rehn & Rehn 1934: 72.

Type locality: Costa Rica, Prov Heredia, Guápiles, La Emilia, 1000'. Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Rehn, J.A.G. 1905a: 675. > As *Eumastax dentata* (misidentification).
- Descamps, M. 1973b: 138.
- Descamps, M. 1979, Annls Soc. ent. Fr. (N.S.) 15(1): 136: transfers to *Homeomastax*.
- Rowell, C.H.F. & Bentos-Pereira, A. 2001a: 243.

Etymology.

Latin *silva*, forest, and *colo*, *cultus*, dwelling in.

Diagnosis.

Subgenital plates of male and female as in **Figs Eu2**,

3. Female subgenital plate shorter and more slender than in *robertsi*, margin devoid of teeth, lateral lobes less developed. In both species there is a transverse depression just anterior to the shallow lateral lobes. Male subgenital plate in lateral view with a smoothly convex dorsal margin (not sinuate as in *robertsi*); cerci short and smoothly tapered.

Description.

A medium sized species with no especially extreme measurements or proportions. Sexual dimorphism moderate: male/female ratios 0.82 - 0.89, mean 0.85. Female with 24 inner and outer hind tibial spines, male with 23 and 23. Frons whitish in dried specimens, in female marked with vermillion on carinae, in male bluish ventrally; basal antennal segments, clypeus and labrum, blue.

Distribution.

Northern foothills of the Cordillera Central and of the N.E.Talamancas, Costa Rica, from 300-900 m. Not to date recorded from the lowland plain.

12. *Homeomastax robertsi* (Descamps 1973)

Eumastax robertsi Descamps 1973b: 953.

Type locality: Costa Rica, Prov. Heredia, Sarapiquí, Puerto Viejo, Finca La Selva.

Location of type specimen: ANS Philadelphia.

Selected literature.

- Descamps, M. 1979: 136. > Transfers to *Homeomastax*.
- Marquis, M.I. 1991: 205. > Food plants.
- Rowell, C.H.F. & Bentos-Pereira, A. 2001a: 245.

Etymology.

Named for H.R. Roberts, Philadelphian entomologist who contributed much to the knowledge of Costa Rican grasshoppers, making the first canopy collections there.

Diagnosis.

Subgenital plates of male and female as in **Figs Eu2, 3**.

Female subgenital plate somewhat longer than in *H. silvicola* and with wider lateral lobes, margin sparsely toothed. Descamps' (1973b) figure is of an extreme example – the subgenital plate is shorter in most individuals. Male subgenital plate with upper margin in lateral view convex but sinuate, the apex more acute than in *H. silvicola*; this is the best character to distinguish the species.

Description.

Slightly larger than *H. silvicola* in the female, and with fractionally longer wings. Sexual dimorphism moderate: male/female ratios 0.79 - 0.87, mean 0.84 (Table 23). Twenty-six outer and 21 inner hind tibial spines (female), male with 22 and 23. Male with basal antennal segments and frons blue, clypeus and labrum dark blue; female with blue pedicel, scape vermillion proximally, blue distally, frons vermillion, clypeus and labrum blue.

Distribution.

Northeastern Costa Rica and southeastern Nicaragua, from sea level to 1000 m. There is no clear boundary separating the upper part of its zone of occurrence from that of *H. silvicola*.

13. *Homeomastax strigla* Rowell & Bentos-Pereira 2001

Rowell and Bentos-Pereira 2001a: 246.

Type locality: COSTA RICA, Prov. Guanacaste, P.N. Rincón de la Vieja, fila above R. Colorado, 930 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *strigla*, witch, a reference to the type locality (translatable as the “witch’s nook”).

Diagnosis.

Subgenital plates of male and female as in **Figs Eu2, 3**. Female subgenital plate similar to that of *H. silvicola*, but more slender and with longer, narrower, ornamented margins. Male subgenital plate very distinctive – short in lateral view, with a large vertical lip medially; medially carinate to a variable extent. Some males have a short but distinct pallium covering the posterior part of the opening of the SGP, an unusual character for this genus.

Description.

One of the largest species of the genus (only *H. cerciata* is comparable). Male E/F = 0.85. Sexual dimorphism moderate: male/female ratios 0.80 - 0.91, mean 0.86. 24 (male) - 26 (female) outer hind tibial spines, 21 inner spines. Frons white in dried specimens, in female tinged vermillion on carinae; basal antennal segments, clypeus and labrum blue in male, greyish white tinged blue in female.

Distribution.

Confined to montane forest of the peaks of the volcanic Cordillera de Guanacaste and the southern part of the Cordillera de Tilarán, between 500 and 1400 m. On V.Tenorio it is sympatric with *H. tenoriensis*. As discussed under *H. dentata* below, that species and *H. strigla* may in fact be synonymous, in which case the range of the latter should be extended somewhat to the south.

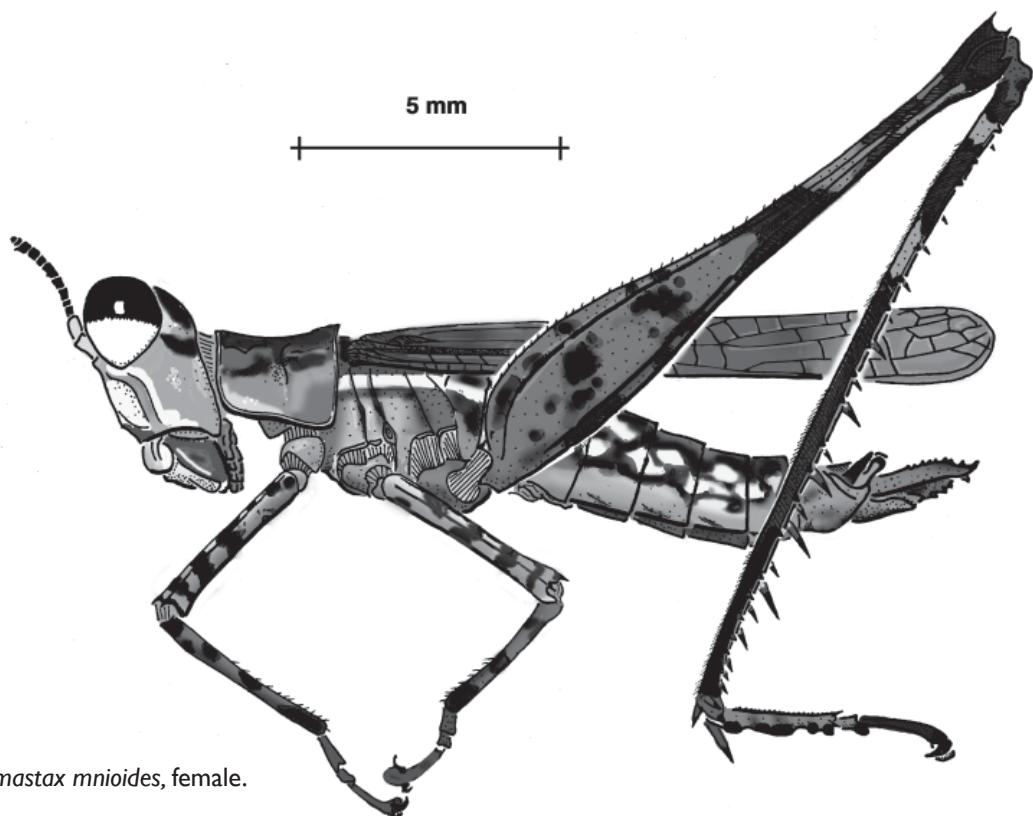


Fig. Eu4. *Helicomastax mnioides*, female.

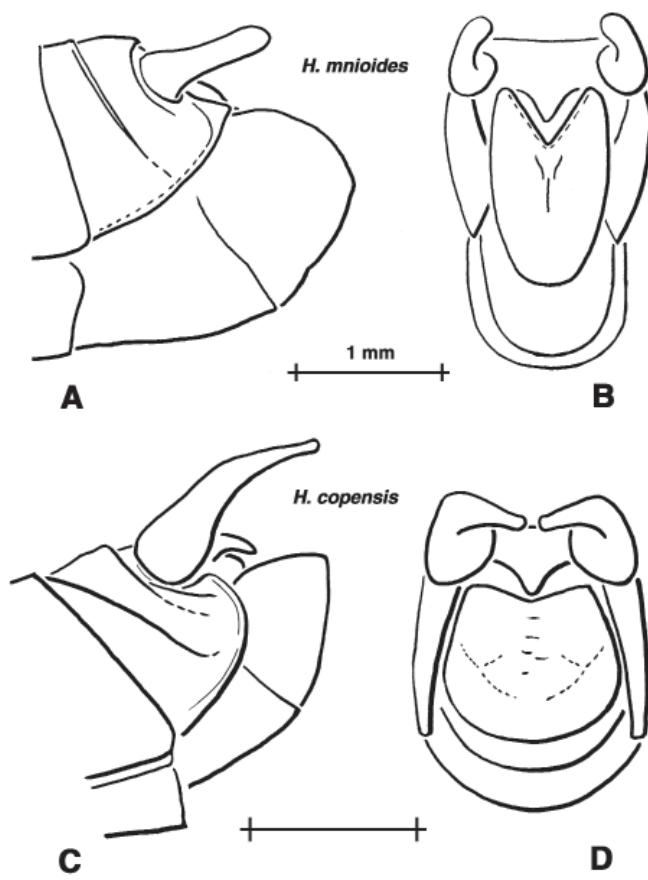


Fig. Eu5. *Helicomastax* spp. Male terminalia.

E. Species known only from females, not assigned to a species-group.

14. *Homeomastax dentata* (Saussure 1903)

Eumastax dentatus Saussure 1903: 91.

Type locality: Costa Rica, Palmares, near San Ramón, at head of R. Grande de Tárcoles, ca 3000 feet.

Location of type specimen: holotype female: MNHN Paris.

Etymology.

Latin *dentatus*, toothed. It is not known what feature Saussure had in mind. The species is not obviously more toothed than others of its genus.

Subsequent literature.

- Kirby, W.F. 1910: 77 > As *Eumastax dentata* (correction of gender).
- Rehn, J.A.G. & Rehn J.W.H. 1934: 70. > Redescription and allocation of male, in error – probable misidentification of *H. bustum*.
- Descamps, M. 1971: 139. > In error, following Rehn & Rehn 1934.
- Descamps, M. 1973b: 949. > In error, misidentification of *H. bustum*.
- Descamps, M. 1979: 136. > Transfers to *Homeomastax*.
- Rowell, C.H.F. et al. 1983: 207. > Ecology – in error, following Rehn & Rehn (1934) and Descamps (1971), misidentification of *H. acrita*.
- Rowell, C.H.F. 1998: 226. > Distribution – in error, misidentification of *H. acrita*.
- Rowell, C.H.F. & Bentos-Pereira, A. 2001a: 247.

See remarks under *H. surda* concerning the description of the putative males of *surda* and *dentata* by Rehn and Rehn (1934) and their failure to examine the original types. Examination of the female holotype of *H. dentata* shows that this is not the same species as the “*dentata*” of Rehn & Rehn and later authors. The morphometric ratios of the type fit exactly those of *H. silvicola* Rehn and Rehn 1934, and slightly less well those of *H. strigla* Rowell & Bentos-Pereira 2001 and of *H. bustum* Rowell & Bentos-Pereira 2001a, but correspond to no other species. The female subgenital plate is compatible with all these identifications. In size, however, the holotype of *dentata* is larger than any known specimen of any of these three species, though *H. strigla* approaches it. The type locality of *dentata* is close (about 25 km) to known modern localities of *strigla*, and further from those of the other species. Unfortunately the area is now urbanised, and new topotypic examples are not likely to be found. In the absence of topotypic material which includes females of the same size as the type, *dentata* cannot be redescribed. If a more recently described species is in fact synonymous with it, this is most likely to be *H. strigla*.

Distribution.

Known only from type locality in West-Central Costa Rica.

Helicomastax Rowell & Bentos-Pereira 2001

Rowell & Bentos-Pereira 2001b: 255.

Type species: *Helicomastax mnioides* Rowell & Bentos-Pereira, 2002

Type locality: Chiriquí, Panama

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *helix*, *helikos*, spiral. Refers to the coiled ectophallic filaments of the male phallus (see Diagnosis below).

Diagnosis.

Helicomastax is externally almost identical with *Homeomastax* Descamps 1979, but has radically different genital structures. In the male the ectophallic sclerites give rise on their anterior medial surface to a pair of chitinous filaments, which enter the spermatophore sac dorsally, run in a circular course within the sac and emerge from its opening ventrally and posteriorly as two fine whip-like projections; these extend dorsally above the ectophallic sclerites, and can often be seen with a hand lens in the intact animal. The complex of spermatophore sac, endophallic plate and ectophallic sclerites forms a sclerotized capsule; the posterior extremities of the endophallic plate are not inserted into the ectophallic membrane, as in other eumastacine genera, but are free and project to the exterior.

The spermathecal duct of the female is longer and more convoluted than in other eumastacine genera, presumably in association with the filaments of the male, which are hypothesized to be inserted into the duct during copulation.

Field characters.

Of the two known species, one (*mnioides*) is uniquely coloured, and the other (*copensis*) looks exactly like a *Homeomastax*, but has male cerci different from those of all species of that genus.

No. of included species.

Two. Both occur within our area.

Generic range.

Central and Western Panama. **Map Eu4.**

Natural history.

Both known species are sympatric with local species of *Homeomastax*, and do not seem to differ markedly from them in ecology.

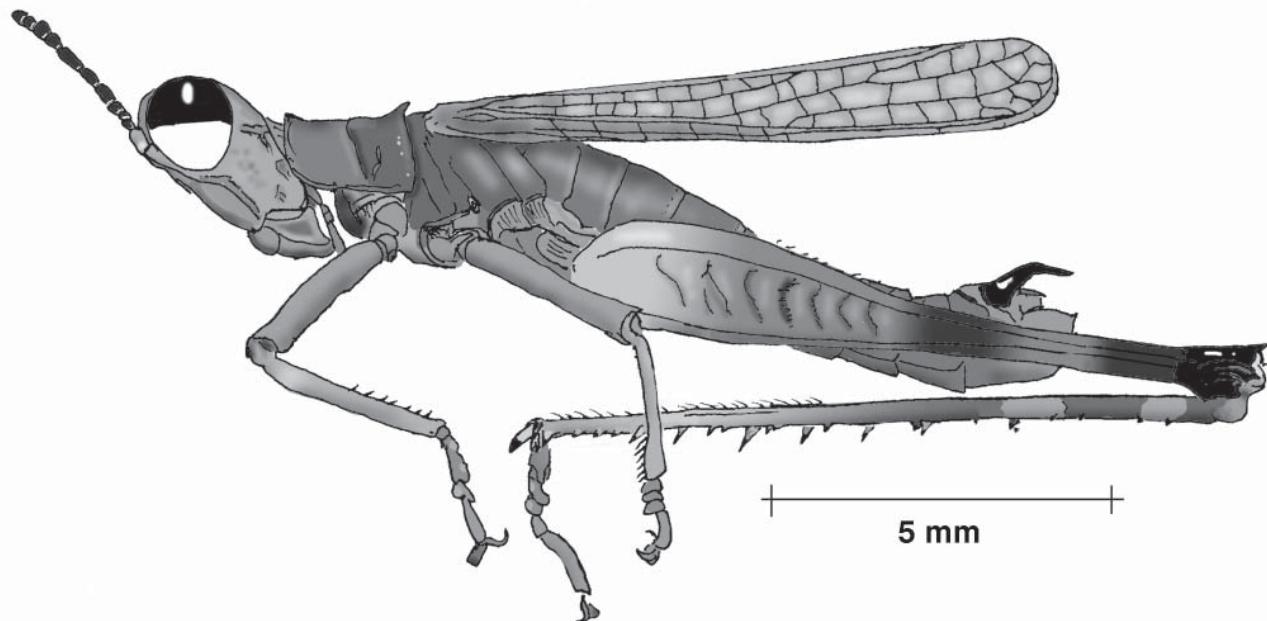
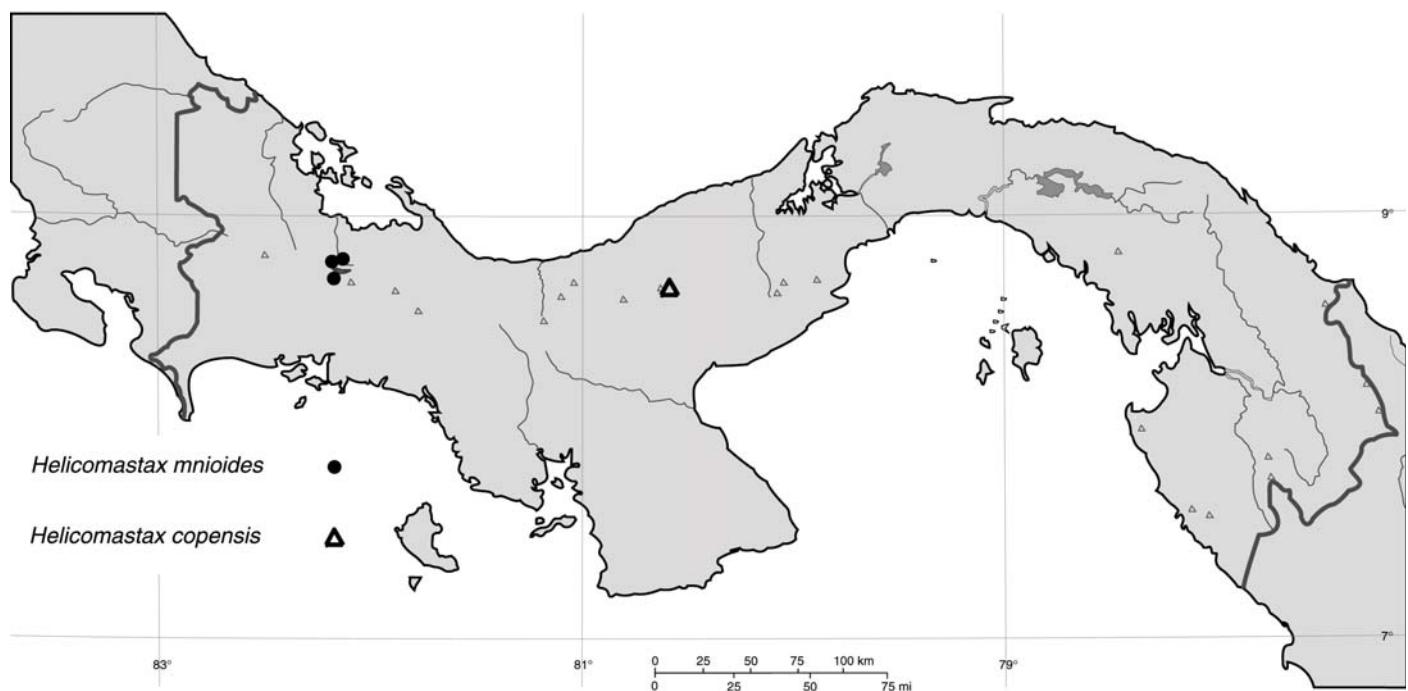


Fig. Eu6. *Helicomastax copensis*, male.



Map Eu4. *Helicomastax*- known distribution.

1. *Helicomastax mnoides* Rowell & Bentos-Pereira 2001.

Rowell & Bentos-Pereira 2001b: 256.

Type locality: PANAMA, Prov. Bocas del Toro, Quebrada Felix, 2 km NW of summit of rd. from Fortuna to Chiriquí Grande, 900 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *mnion*, moss, and *-oides*, similar to, alluding to the moss-like coloration.

Diagnosis.

Male cerci (**Fig. Eu5A, B**) short and blunt, somewhat widened towards the tip in side view, only slightly inwardly flexed in dorsal view. Male subgenital plate rather short, laterally compressed, narrow in axial view with a small medial carina dorsally; dorsal margins markedly convex in lateral view. Female subgenital plate (**Fig. Eu3**) trilobed, the lateral lobes wide, almost as long as the medial lobe and with small spines on the posterior margins. Habitus, **Fig. Eu4, Plate Eu2**.

Description.

Both sexes with 17-18 inner and 20 outer hind tibial spines. Markedly sexually dimorphic in size: M/F = 0.80, but there are few differences between the sexes in proportions. E/F = 0.84 (males), 0.85 (females). Males are noticeably more variable in size than are females: the ratio of standard deviation to mean is 2-3× larger in males. This large range of variation is not seen in males of *H. copensis*.

Field characters.

Differs markedly from all other Central American eumastacids in retaining in the adult the typical cryptic larval coloration. General colour light olive green, with banding and speckling in dark olive brown. Antennal flagellum black, basal segments yellow green. Face yellow green, clypeus and labrum tinged blue. Wings and elytra dusky brown. All femora with 4-5 broken bands of dark olive brown, 3-4 similar bands on fore and mid tibiae. The male is somewhat more brightly coloured; the terga of the abdomen bear a lateral yellow stripe and the subgenital plate is bluish; on fore and mid legs, and on the tibiae and distal femur of the hind leg, the olive green is replaced by grey-blue. Females (see also **Fig. Eu4**) have the abdominal tergites mottled olive brown and olive green; the yellow lateral stripe is restricted to the pterothorax. Not all individuals of *H. mnoides* have red distal femora; when absent the red colour is replaced by light olive green in females, light blue-grey in males.

Distribution.

Known only from the area around the type locality, near Fortuna in the highlands of W. Panama. There it is found on both sides of the Atlantic-Pacific watershed.

Natural history.

On ferns in wet montane forest. The older fronds of

ferns in the habitat are frequently overgrown with algae and mosses and the coloration is highly cryptic on this background. Sympatric with *Homeomastax kressi* (Rehn & Rehn 1934) at lower altitudes (800 m) on the Atlantic slope.

2. *Helicomastax copensis* Rowell & Bentos-Pereira 2001

Rowell & Bentos-Pereira 2001b: 257.

Type locality: PANAMA: Prov. Coclé: Cerro Copé, 830 m.

Location of type specimen: ANS Philadelphia.

Female unknown.

Etymology.

Copensis, coming from Cerro Copé, the type locality.

Diagnosis.

Almost indistinguishable from a *Homeomastax* externally (Habitus: **Fig Eu6, Plate Eu3**). Male cerci (**Fig. Eu5C, D**) markedly different from those of *H. mnoides* and of all species of *Homeomastax*: long, reaching approximately to posterior margin of the subgenital plate, robust basally, thereafter thin, gently tapering to a fine point; in dorsal view divergent basally, but inwardly flexed at about midlength, forceps-like; in lateral view curved ventrally downwards towards the tip. Subgenital plate (**Fig. Eu5C, D**) pointed and rather slender in lateral view, dorsal margin slightly convex, thickened; in dorsal view the tip is produced to a rounded point; in axial view not at all compressed laterally, shallowly notched (corresponding to the convexity of the dorsal margin), in some but not all individuals with a fine medial carina.

Distribution.

Known only from the type locality in Central Panama.

Map Eu4.

Description.

Slightly longer winged than *H. mnoides*, E/F = 0.88 (males). Male with 20-22 inner and outer hind tibial spines. Coloration as in *Homeomastax*.

Field characters.

Looks exactly like a rather long-winged *Homeomastax*. At the type locality, however, the sympatric species of *Homeomastax* is *H. brachyptera*, which has very short wings (and is much more common). This provides an easy method of distinguishing the two at this locality.

Natural history.

On ferns in montane forest, on both sides of the Atlantic-Pacific watershed.

Family Episactidae

Burr 1899

Selected literature.

- Descamps, M. 1973:200. > Eumastacoidea: Episactidae.
- Kevan, D.K.M. 1982: 368. > Episactidae.
- Otte, D. 1994: 22. > Eumastacidae: Episactinae.
- Perez-Gelabert, D.E., Hierro B. & Otte D. 1997: 153. > Key to alate forms in Hispaniola.
- Rowell, C.H.F. & Perez-Gelabert, D. 2007 [2006]:191-240. > Eumastacoidea: Episactidae.

The modern Episactinae were recognized as the taxon Episacti by Burr, 1899 and raised by him to subfamily rank in 1903. They are an exclusively Central American group, extending from S. Mexico to central Costa Rica and are closely related to the exclusively Antillean Espagnolinae. These two groups share some characters with the Mexican Teicophryinae. Descamps (1973) raised this assemblage to family rank as the Episactidae, adding to it the Madagascan subfamily Miraculinae. Amedegnato (1993) suggested that the admitted morphological resemblances of the latter to the other Episactidae might be convergent; molecular studies would be desirable here, but have not yet been performed.

While it would simplify the biogeography of the Eumastacoidea if the Episactidae could be phylogenetically linked with the pan-American Eumastacidae, as suggested by Amedegnato, and thus placed within Descamps' division Stenophalli, this has not to date been possible. On the contrary, both morphological (Descamps 1973) and molecular systematic (Matt 1998; Matt et al. 2007) data rather suggest a position within the predominantly South East Asian Cryptophalli; this of course makes Descamps' controversial placement of the Miraculinae more plausible. A possible African source for the Miraculinae has been discussed by Rowell (2010).

Diagnosis.

Together with other Cryptophalli, the Episactidae have the dorsal face of the 1st hind tarsal segment armed with spines, either along both inner and outer edges or along the outer edge alone. The male cerci are never simply conical. The endophallic plate (the "penis" of Descamps 1973) is almost always very short, shorter than half the length of the ectophallus. The interocular space is comparatively wide. The tibiae of the fore and middle legs are provided with two rows of spines on their ventral faces.

Within the Cryptophalli, the Episactidae are distinguished from the Old World Chorotypidae by the following characters:

- subgenital plate of male always divided into 2 parts, by a well-marked transverse suture separating sternites 9 and 10.
- epiphallus disc-shaped or bridge-shaped, lophi well differentiated and hook-shaped (or very rarely absent, as in *Teicophrys robertsi*).
- male 10th abdominal tergite always visible in side view.

Subfamily Episactinae

(Burr 1903)

Type genus: *Episactus* Burr (designated Rehn 1948: 123).

Subsequent literature.

- Burr, M. 1903: 2, 12.
- Bolivar, C. 1930: XXXII.
- Rehn, J.A.G. 1948: 122. > Episactinae.
- Bei-Bienko & Mishchenko. 1951: 111[117].
- Rehn, J.A.G. & Grant, H.J. Jr. 1958: 317.
- Descamps, M. 1971: 110.
- Descamps, M. 1973: 201. > Episactinae.
- Descamps, M. 1974: 553.
- Otte, D. 199: 22. > Episactinae, Episactini.
- Rowell, C.H.F. & Perez-Gelabert, D. 2006: 198 et seq. > Review.
- Matt, S., Flook, P.K. & Rowell, C.H.F. 2008: 43 - 55. > Molecular systematics.

No. included genera.

Four genera (possibly five, if the Chinese *Pielomastax* Chang 1937 is included) have been attributed to this subfamily. Acceptance of *Pielomastax* there requires genital information which is not yet been forthcoming (Descamps 1973).

Diagnosis.

Apterous. Antennae with 6-10 flagellar segments; antennal organ on the distal segment. Fastigium short, blunt, rounded in dorsal view. Carinae of all femora and tibiae usually end in points and finely toothed throughout their length. Dorsal carinae of hind femora not provided with strong spines. Subgenital plate of male subcupuliform, entirely sclerified, the posterior margin armed with spines of variable size and number, often imbricating with the supra-anal plate. Ovipositor valves long and thin, laterally compressed, often forceps-like, with toothed margins.

Epiphallus flat, usually shield-shaped but sometimes disc- or bridge-shaped, with the anterior margin excavated and well-developed hooked lophi. Ectophallus variably sclerified, armed with several pairs of spinous or toothlike projections, including paired sclerites either side of the ventro-apical evagination. Anterior lateral region of ectophallus thickened and/or sclerotized to form a weak lateral plate, usually concave. Ejaculatory sac of relatively large size; a small U-shaped sclerite often surrounds the opening of the ejaculatory duct. Endophallic plate short, reduced to paired rods. The spermatophore sac and genital trough open apically (compare with the Eumastacidae, where the opening is mainly dorsal). Subepiphallus sac absent or only weakly developed.

Spermatheca simple, globular, without appendages; course of duct variable between taxa.

Range of subfamily.

Mexico, Guatemala, Belize, El Salvador, Honduras, Nicaragua, Costa Rica.

Episactus: Costa Rica, Guatemala, Mexico, El Salvador.

Gymnotettix: Guatemala, Honduras.

Lethus (=*Mayamastax*): Honduras, Mexico, Belize, Nicaragua, El Salvador.

Paralethus: El Salvador.

Only 1 genus (*Episactus*) occurs in our region.

Episactus Burr, 1899

Burr 1899: 94, 254. *Episactus* - replacement name for *Epeisactus* Brunner von Wattenwyl 1893: 115. The latter is an invalid name, no type species having been described or properly indicated.

Type species: *Episactus brunneri* Burr, 1899: 254, designated Rehn 1905: 801.

Type locality: Guatemala.

Location of type specimen: NHM Vienna.

Etymology.

Obscure.

Subsequent literature.

- Bruner, L. 1900-1910 (1901): Plate 2, no text.
- Rehn, J.A.G. 1905b: 802.
- Kirby, W.F. 1910: 74 .
- Rehn, J.A.G & Rehn, J.W.H. 1934: 21.
- Rehn, J.A.G. 1948: 123.
- Descamps, M. 1973b: 200.
- Rowell, C.H.F. & Perez-Gelabert, D. 2006: 214. > Review.

Synonymy.

= *Parepisactus* Saussure 1903: 88 (not of Giglio-Tos 1898), synonymized Rehn & Rehn 1934: 25.

Diagnosis.

Antennal flagellum with 7 segments, of which numbers 4-6 are dorsoventrally flattened and broad in dorsal view, the more distal and more proximal segments being narrower. Head, thorax and most of abdominal segments with a sharp median carina. Distal margin of male subgenital plate semicircular or triangular, and provided with numerous short hooked spines. The only eumastacoids in our region a) with spines on the dorsal borders of the first tarsal segment of the hind foot (see family diagnosis) and b) which are apterous.

Male has the medial posterior region of the 3rd abdominal sternum inflated and projecting downwards – the cuticle covering this process is of an unusual crinkly texture, and the structure may have a physiological function. A tendency towards the development of this structure is seen in the males of other episactines, but is best developed in *Episactus*.

Male genitalia. Epiphallus emarginate on anterior edge, lophi hooked; dorsal fold inflated; both internal and external ectophallic sclerites present, pointed at their tips; apical shields with one or two pairs of lateral spines; ventro-apical sclerites with two pairs of spines; lateral plates poorly developed, concave, with one pair of lateral spines.

Ovipositor typical of the subfamily: long, laterally compressed, somewhat pointed, toothed on margins; dorsal valves thin, slightly incurved at the tips, forceps-like. Female subgenital plate terminating in a roughly rectangular or triangular medial projection.

No. species known.

Three. Only one species is found in our region.

Generic range.

Mexico, Guatemala, El Salvador, Costa Rica. Very probably Honduras and Nicaragua as well.

I. *Episactus tristani* Rehn and Rehn 1934

Rehn and Rehn 1934: 27.

Type locality: Costa Rica: La Carpintera, Candelaria Mts., 6100 ft (=1830 m.), (male holotype); Las Cónicas, Dulce Nombre, nr. Cartago (female allotype).

Location of type specimens: ANS Philadelphia.

Etymology.

Named for José Fidel Tristán, Costa Rican geologist and naturalist. Tristán, who later was Director of the Museo Nacional, was Director of the Liceo in S. José at the time of Rehn's visits. He collected grasshoppers with Rehn, and dragonflies with the Calverts, during the first 30 years of the 20th century.

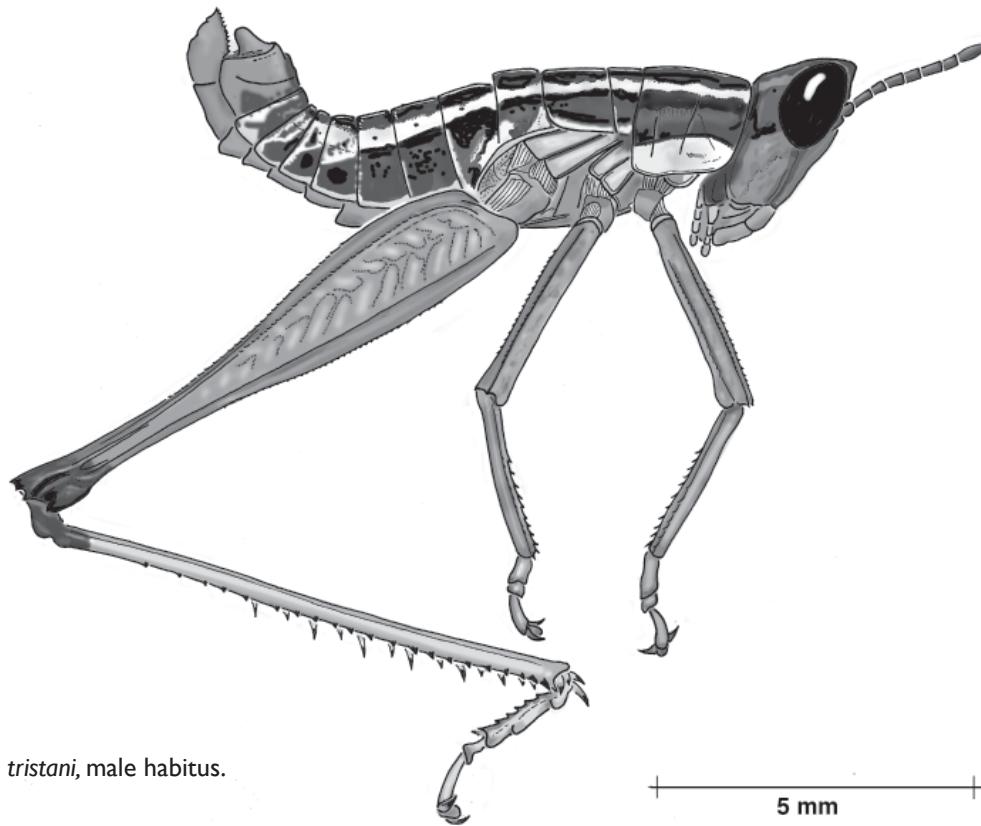
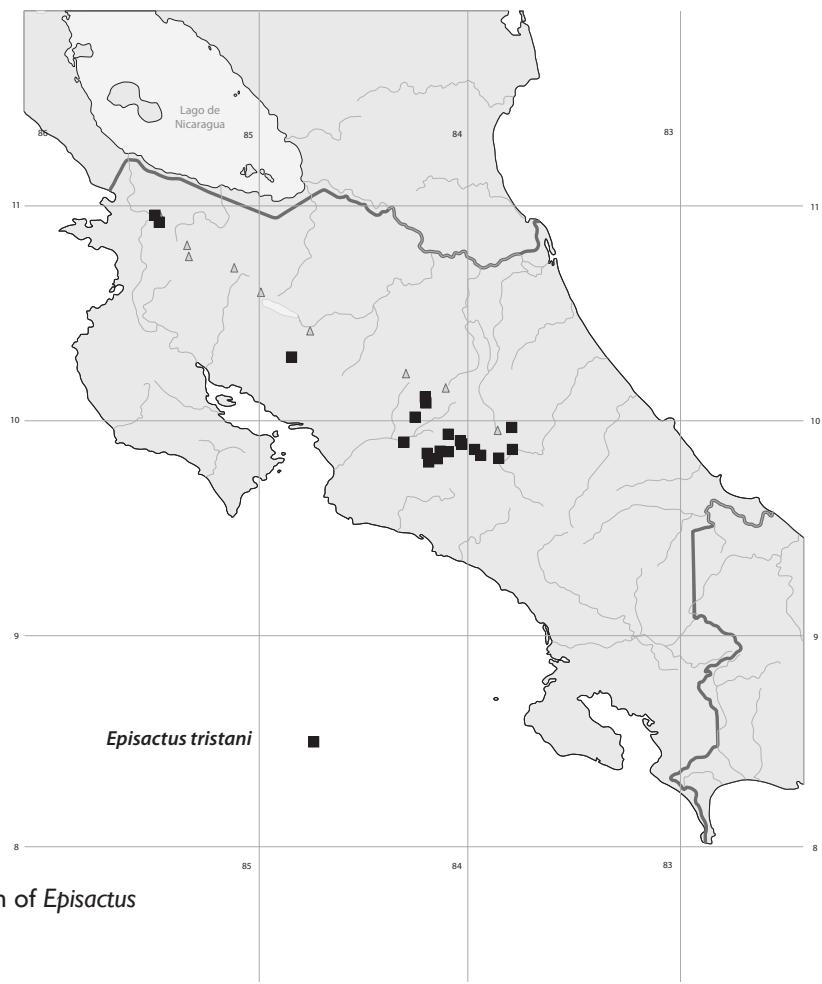


Fig. Ep1. *Episactus tristani*, male habitus.



Map Ep1. Known distribution of *Episactus tristani* in Costa Rica.

Synonymy.

- =*Parepisactus saltator* Saussure 1903: 88 (in part), synon. Rehn & Rehn 1934: 27.
(The type material of *P. saltator* includes specimens of both *E. tristani* and *E. brunneri*).
=*Episactus brunneri* Bruner 1900'1910 (1901): Plate 2, Figs. 15-16 only, no text (misidentification), synon. Rehn & Rehn 1934: 27.
= *Episactus brunneri* in Rehn 1905b: 802 (misidentification), synon. Rehn & Rehn 1934: 27.
(*Episactus brunneri* Burr 1899 is a distinct, though similar species, to date known only from Guatemala).

Diagnosis.

Male habitus, **Fig EpI, Plate EpI**. Males 11-14 mm in length, females 14-19 mm; male femur 9-13 mm in length, female 9-12 mm. Sexual dimorphism in size ca 0.90. As the only species present in our area, the generic diagnosis applies. Male subgenital plate semicircular in dorsal view, provided with 20 small spines along its edge. Female subgenital plate with an oblong medial terminal process, the posterior margin of which is rounded and bears three minute finger-shaped projections.

Field characters.

An unmistakable species, small, apterous, striped longitudinally in black and a paler colour, either white, yellow or bright pale green, with an orange-red tip to the abdomen, a dark blue and black head, and pale blue thoracic pleura. The larvae in contrast are dull brown and very cryptic. Unusual among grasshoppers in that the females are often more brightly coloured than the males; in Costa Rica the latter tend towards a predominantly black and white coloration.

Distribution.

Occurs patchily at mid-elevations, descending to about 900 m., on the Meseta Central and throughout the mountains of central and northern Costa Rica, other than the Talamanca main range. Most, but not all, localities are on the Pacific slope. Absent from lowland forest. It is present at Pedregal on Volcán Cacao in Northern Guanacaste and thus probably extends over the border into Nicaragua. Also present in El Salvador (whence specimens are larger than the Costa Rican examples and with a more prominent pale medial stripe in bright green, but otherwise identical). Apparently absent from Panama. **Map EpI**.

Natural history.

E. tristani seems to have a preference for Compositae, and is sometimes clearly associated with *Verbascina turbescens*. Unlike many Eumastacinae it shows no association with ferns [this is also true of the related Antillean Espagnolinae (D. Pérez, pers. comm.)], and refuses them in captivity. Where it occurs, it is sometimes abundant on vegetation to about 2 m in height along partially shaded hedgerows, montane forest paths, at forest edges, in forest light-gaps, and in coffee plantations with shade trees. Several other episactid genera (e.g. *Lethus*, *Paralethus* and all the Antillean genera) are cryptically coloured and live

on the surface of the soil. *Episactus* (other than *E. oresterus*) and *Gymnotettix* (Guatemala and Honduras) appear to be the exceptions, being brightly coloured and living in vegetation. Courtship is elaborate and apparently visual; the male takes up a position with his long axis at 90° to that of the female, about 30 mm removed from her and opposite her pterothorax, and makes vigorous and accelerating "stridulatory" movements of the hind femora, which however produce no audible noise. The male follows retreating females, apparently guided by her red "tail-light" in a manner similar to that seen in the lithoscirtin proctolabines, though with inverted sexual roles.

Superfamily Proscopioidea (Serville 1838)

Serville. 1838 [1839]. Histoire naturelle des insectes.

Orthoptères. 565, 570 > Proscopides.

Type genus: *Proscopia* Klug, 1820.

The superfamily Proscopioidea contains but one family, the **Proscopiidae**, which are perhaps the most distinctive and easily recognized of all Orthopteran taxa. They are greatly elongated, slender insects, more nearly resembling large Phasmids than other grasshoppers. Sexual dimorphism in size is pronounced, and some females are the longest members of the entire order, being up to 15 cm long. Relative to other Caelifera, the thoracic segments are especially elongated, the prothorax being longer than both the antennae and the prothoracic femora. Most modern Proscopiids are apterous, but some genera (*Astroma*, *Anchocoema* and *Anchotatus*) have greatly reduced wings used in display, though not in flight. *Eoproscopia*, an early Cretaceous fossil from Brasil (Heads 2007), was fully winged.

The superfamily is almost entirely restricted to South America, and it is thought that it originated and developed there. Two or three species of the genus *Pseudoproscoptia* are found in Panama and Costa Rica. It is assumed that these are derived by northward immigration from South America over the Panamanian isthmus during the past 4 million years; other modern *Pseudoproscoptia* spp. are found in Northern Brazil, Colombia, French Guiana and Peru. To date, no proscopiids have been found north of Costa Rica.

Natural history.

Proscopiids occupy a wide range of habitats, from Andean desert grassland and Uruguayan savannah to Amazonian and Central American rain forest. At least one species has been given agricultural pest status in Brazil (Amedegnato 1985) and *Stiphra* sp. are recorded as serious pests of fruittrees there (Lima, 1936). The majority seems to eat broad-leaved plants, but some are grass feeders.

Systematics and taxonomy.

Many aspects of their morphology link the Proscopiids with the Eumastacids: neck sclerites, short antennae, some features of the male genitalia, chromosomal numbers. There has accordingly been considerable discussion as to whether they are an aberrant family of the Eumastacoidea or should be allotted their own superfamily. The most recent morphological global revision, that of Descamps (1973), concluded that they are a separate superfamily. Molecular systematic analyses (Matt 1998; Matt et al. 2008, using mitochondrial ribosomal RNA genes) have so far been ambivalent, but a majority of them tend to support Descamps' conclusion.

Currently the Proscopioidea contain about 22 genera and 152 species, but the group is under active revision

by Bentos-Pereira and new taxa are to be expected. Only recently, with the pioneering works of Liana (1972, 1980) and of Jago (1989), has it become obvious that the anatomy of the spermatheca and the phallus are of critical importance in the systematics of the group, and the implications of this are only now being explored. The current nomenclature of the phallic sclerites, which are completely unlike those of the Acridoidea (but see De Domenico 2011), derives from Jago's paper.

Liana (1980) first split the family into three subfamilies. The current arrangement is as follows:

Hybusinae (Liana 1980)

.....1 genus, 4 spp.

Proscopiinae (Serville 1838):

Proscopiini (Serville 1838)

.....6 genera, 47 spp.

Tetanorhynchini (Bentos-Pereira 2003)

.....6 genera, 73 spp.

Other genera

.....10 genera, 62 spp.

Xeniinae (Liana 1980)

.....3 genera, 16 spp.

Incpta sedis

.....6 genera, 12 spp.

Totals:32 genera, 214 spp.

[These numbers are from the OSF on-line (Eades et al. 2003) accessed April 2012, and exclude *Eoproscopia*].

Of these higher taxa, only the Proscopiini are represented in Central America, and by only a single genus, *Pseudoproscoptia*.

Selected subsequent literature.

- Blanchard, E. 1845.: 264. > Proscopiidae.
- Walker, F. 1870: 485. > Proscopidae.
- Brunner von Wattenwyl, K. 1890: 87. > Proscopiden.
- Hebard, M. 1924: 161. > Key to genera.
- Mello-Leitão, C. de. 1939: 292, 302. > Revision.
- Liebermann, J. 1939 10: 142.
- Mello-Leitão, C. de. 1939: 279. > Proscopidos.
- Ander, K. 1939: 6. > Acridoidea: Proscopiidae.
- Soukup, J. 194: 242-259. > Proscopidos.
- Dirsh, V. 1956: 240. > Proscopiidae.
- Liana, A. 1972: 381-459.
- Descamps, M. 1973: 77-95. > Proscopoidea (sic).
- Dirsh, V. 1975 > Proscopiidea.
- Carbonell, C.S. 1977: .5.
- Liana, A. 1980: 230. > Proscopiidae.
- Vickery, V.R., Kevan, D.K.M. 1983: 3003. > Proscopiidae.
- Amedegnato, C. 1985 > Proscopioidea.
- Jago, N.D. 1990[1989]: 252. > Key to genera; Male genitalia.
- Otte, D. 1994: 110. > Eumastacoidea: Proscopiidae.
- Flook, P.K. & Rowell, C.H.F. 1997: 89-103. > Molecular

phylogenetics, Proscopioidea.

- Bentos-Pereira, A. 2003.: 159-171. > Erects tribe Tetanorhynchini.
- Heads, S. 2007 499-507. > First fossil.
- Bentos-Pereira, A. 2007[2006]: 117-141. > Eumastacoidea: Proscopiidae. New genera.
- Bentos-Pereira, A. 2007[2006]: 143-148. > Eumastacoidea: Proscopiidae. Redefines tribe Proscopiini.
- Matt, S., Flook, P.K. & Rowell, C.H.F. 2008): 49. > Molecular phylogenetics, Proscopioidea.
- De Domenico, F.C. & Bentos-Pereira, A. 2011: 71. > New synonymies.
- De Domenico, F.C. 2011 > Genitalia homologies.

Pseudoprosopia Bentos-Pereira 2006

Bentos-Pereira. 2006. Jour. Orth. Res. 15(2):121.

Type species: *Proscopia scabra* Klug partim.

No. of described species.

Nine.

Geographical range.

Costa Rica, Panama, Colombia, French Guiana, Brazil, Peru.

Generic diagnosis.

(From Bentos-Pereira 2006a.) Apterous insects, sexually dimorphic. Females very large and robust, males small and gracile. Male head with globose eyes, a small pyramidal fastigium, slightly inclined forwards and downwards, and the head very strongly narrowed below and behind the eyes. Head of female almost conical; the fastigium is variable, from small and pyramidal to large and quadrangular.

Phallic complex includes a complete epiphallus with strong plates 1 and 2 that are joined together. The plates 4, which border the median cleft and unite behind and below it, are variably sclerified. The endophallus is completely membranous, composed principally of a funnel-shaped structure, from which arise a small elongate spermatheca and a very thick ejaculatory duct, which is reinforced by a sclerite along its entire length. This sclerite can take the form of a complete tube or a channel.

The spermathecae are usually simple. They consist of a terminal ampulla with two diverticuli of different sizes, and a relatively short duct with a lumen of almost constant diameter, which in some species has digitiform prolongations. The copulatory chamber is always membranous.

Coloration varied. Generally the body is dark chestnut brown to black with tints of dark green, but some species have

numerous spots of red or yellow on the epistome, pleura, pallium and epiproct of males, or, in females, segmentally repeated patches of white or yellow on the abdomen.

As noted by Bentos-Pereira (2006b:147), the Central American species differ from the rest of their genus in some anatomical characters, suggesting that their geographical remoteness has been maintained for some time, and that they may share a recent common ancestor.

I. *Pseudoprosopia septentrionalis* (Bruner 1905)

Bruner 1905:313-315, plate I; 1908:342 (as *Taxiarachus septentrionalis*).

Location of type specimen: ANSP.

Subsequent literature.

- Kirby, W.F. 1910: 87. > Mistakenly attributes to Rehn.
- Caudell, A.N. 1911: 159. > Mentions Kirby's error.
- Hebard, M. 1924: 93. > Transfers to *Proscopia*. Lectotype selected.
- Mello-Leitao, C. de 1939: 417.
- Carbonell, C.S. 1977: 24.
- Otte, D. 1978: 34. > Location of types.
- Jago, N.D. 1989: 272. > Transfers to *Corynorhynchus*, (and mistakenly attributes species to Brunner).
- Bentos-Pereira, A. & Rowell, C.H.F. 1999: 628. > Restores to *Proscopia*, (mentions Jago's error); redescription.
- Bentos Pereira, A. 2006a: 236. > Transfers to *Pseudoprosopia*.

Recognition.

See **Figs ProscI-3, Plate ProscI.**

Coloration. The males and one of the two known Costa Rican adult females are dark brown insects with no contrasting markings. The other Costa Rican female has the first 4 abdominal tergites edged ventrally with white, producing a pale lateral stripe along the anterior abdomen. A Panamanian female (see next section) has similar markings.

Distribution, natural history.

Costa Rica, Panama. All the Central American proscopiids are very rare. Until recently *P. septentrionalis* was known from only four specimens, 2 males and 2 females. All were found in forest understorey vegetation in seasonally moist Pacific lowland forest of S.W. Costa Rica. In 2007 a University of Panama group found a mating pair plus a second unmated male at Cerro Azul, near Panama City. This pair was found on a bush of *Cheiloclinium cognatum* (Celastraceae), and continued to eat this plant in captivity.

2. *Pseudoprosopia panamensis* (Bentos-Pereira & Rowell, 1999)

Bentos-Pereira and Rowell 1999: 635 (as *Proscopia panamensis*).
Location of type specimen: STRI.

Subsequent literature.

- Bentos-Pereira 2006a: 236. > Transfers to *Pseudoprosopia*.

Recognition.

Externally very similar to *P. septentrionalis*, especially the males, which are however somewhat more robust in build. Females of the two species are easier to distinguish, having markedly different subgenital plates. See key to species below, and **Figs Prosc2 & 3**. The males have a greener cast than do those of *septentrionalis*.

Distribution, natural history.

Known only from Central Panama (Provs. Panamá, Coclé, and Veraguas). Only two adult males and five adult females have been captured to date, plus more numerous larvae. These were found on ferns along forest trails, including *Ptyrogramma colomelanos* (L) (Adiantaceae).

3. “*Proscopia* sp.” Bentos-Pereira & Rowell, 1999

Bentos-Pereira and Rowell 1999: 638.

The authors drew attention to the presence a third species of “*Proscopia*” in both Panama and Costa Rica. The available material, however, was inadequate for a formal description; the taxon is known only from a larval female and a damaged and incomplete adult male. It is probable that when more material becomes available further investigation will show this too to be a member of the genus *Pseudoprosopia*.

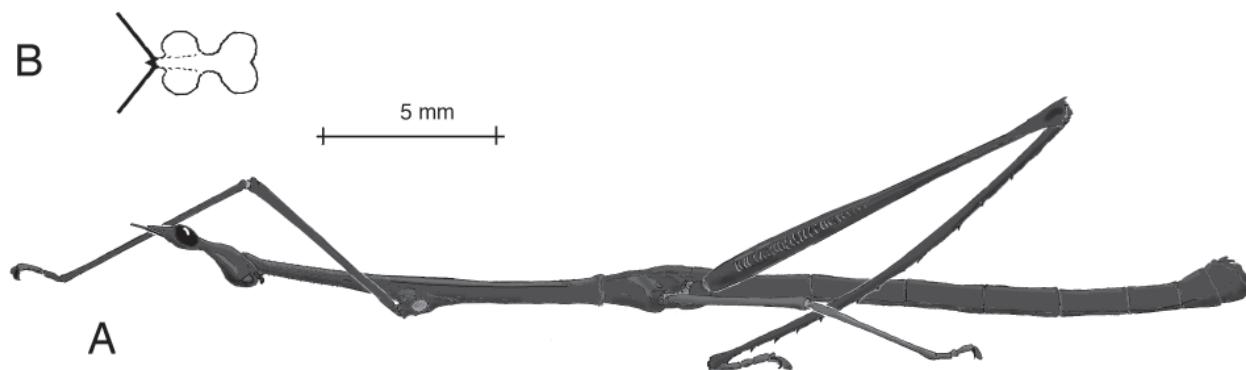


Fig. Prosc1. A, *Pseudoprosopia septentrionalis*, male. Habitus. NOTE: Due to inadequate original material, this drawing may contain minor errors. B, outline of head of male from above.

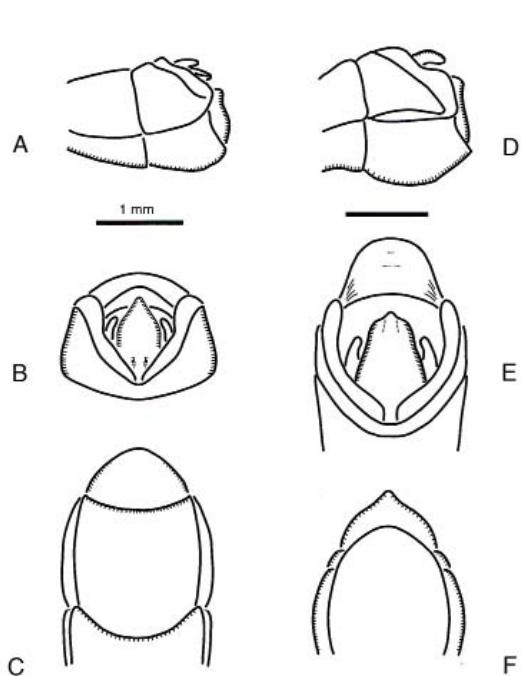


Fig. Prosc2. *Pseudoprosopia* spp., male terminalia. A-C, *P. septentrionalis*. D-F, *P. panamensis*. Scale bar 1 mm (from Bentos-Pereira & Rowell 1999).

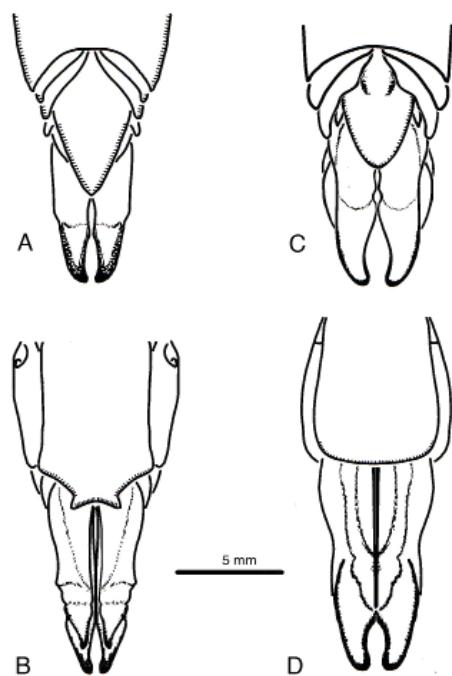
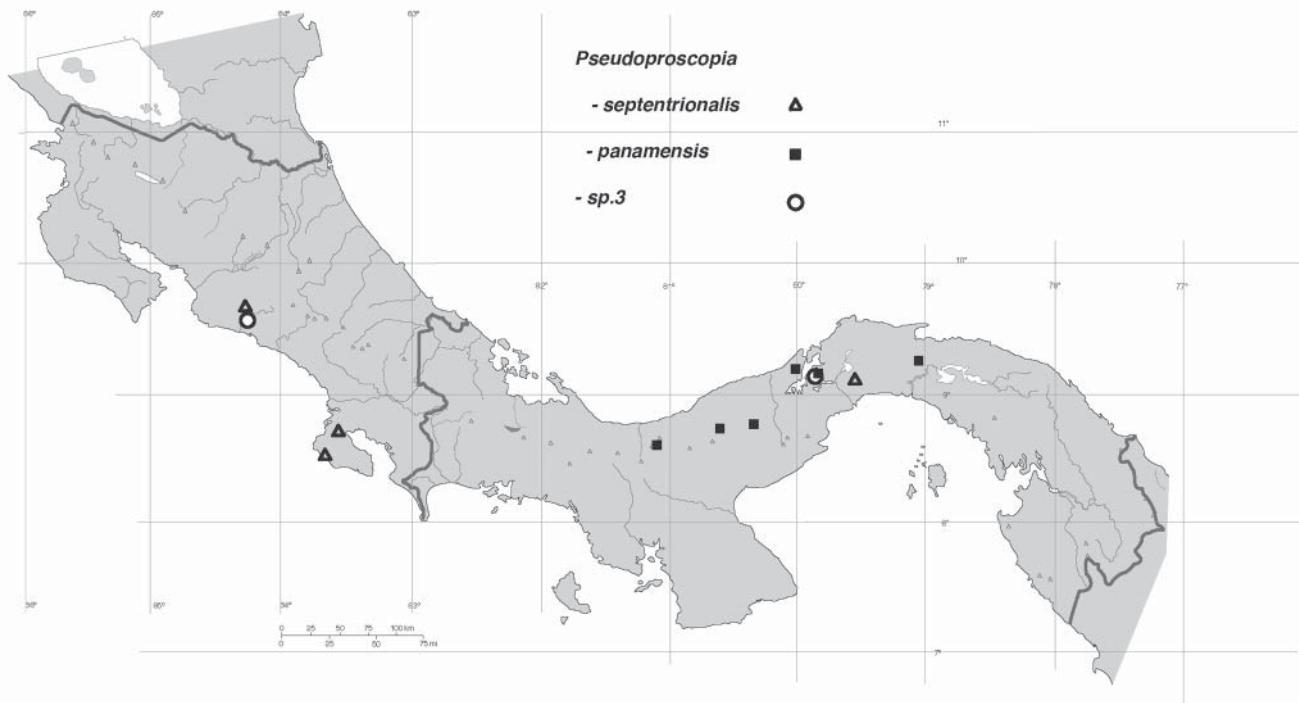


Fig. Prosc3. *Pseudoprosopia* spp., female terminalia. A-B, *P. septentrionalis*. C-D, *P. panamensis*. Scale bar 5 mm (from Bentos-Pereira & Rowell 1999).



Map Prosc1. Distribution of *Pseudoprosopia* spp. in Costa Rica and Panama.

Key To Species of *Pseudoprosopia* in Central America:

Character	<i>septentrionalis</i>	<i>panamae</i>	" <i>Prosopia</i> " sp.
MALES			
Phallus:	Closed behind and below by fused plates 4	Not closed by plates 4	No data
Medial dorsal slit of phallus			
General build	More gracile	More robust	Somewhat shorter overall.
Fastigium, tip of rostrum	Dorso-ventrally compressed, downward sloping. Tip rounded.	Fastigium similar to <i>septentrionalis</i> . Tip slightly truncate.	Fastigium shorter than sept., with medial carina. Tip more truncate than <i>panamae</i> .
Supra anal plate	Ends in rounded process.	Shield shaped. Ends in sharply pointed medial process.	Ends in sharply pointed medial process.
Subgenital plate	Short and rounded.	When extended, longer and more pointed	rounded and obtuse.
Metathoracic median tubercle	Present.	Absent.	Absent.
Thoracic ornament	Tubercles, especially above pleural suture.	Numerous granules & transverse striae.	Generally devoid of ornament. Anterior pronotum with granular cuticle.
No. spines on metathoracic tibiae (int./ext.)	17/11	10/16	No data
Length of pronotum (mm)	26.2	23.7	18.2
Cerci	Slender, pointed, incurving.	Shorter, blunter, straighter.	No data
FEMALES			
Spermatheca	Type I, single ampulla.	Type 4, twinned ducts and ampillae.	(No data)
Fastigium, tip of rostrum	Slightly inclined upwards.	Seen from side, dorsal margin is more sinuous than in <i>septentrionalis</i> . Rostrum is shorter.	Probably longer than in <i>septentrionalis</i>
SAP	Slightly thickened margin, acute tip.	Obtuse tip.	(tip broken)
Subgenital Plate	Rounded, with a spatulate rhomboid projection medially.	Rounded and smooth, no medial projection	Posterior margin straight
Thoracic ornament	Meso- and metathoracic episterna with line of short spines. Pleura granular.	Metathoracic epimeron with medial carina. Pleura granular.	Meso- and metanotum have an additional lateral carina relative to the other 2 species.
No. spines on metathoracic tibiae(int./ext.)	9/16	16/11	8/17

Superfamily Pyrgomorphoidea

Brunner von Wattenwyl 1874

The superfamily contains only one family, the

Pyrgomorphidae. In their external morphology they closely resemble the Acridoidea, and older classifications included them in that superfamily, or grouped them with some Old World taxa as the superfamily Pamphagoidea. Modern workers have transferred most of the former members of the Pamphagoidea to the Acridoidea, leaving the Pyrgomorphidae as an isolated group. Preliminary molecular analyses (Flook & Rowell 1997) indicate that the Pyrgomorphoidea are monophyletic, and the sister group of the Acridoidea as currently understood.

Family Pyrgomorphidae

Brunner von Wattenwyl 1874

Diagnosis.

The Pyrgomorphidae are defined by their phallic structure. The ectophallus is capsule-like, usually at least partly sclerotised; cingulum well developed, but true cingular apodemes absent. The penis is formed from paired sclerites, but these are not divided into basal and apical valves, and gonopore processes (see Acridoidea, p. 57) are absent. The spermatophore sac lies dorsally to the endophallic sclerites, not ventrally as in the Acridoidea. The ejaculatory sac is ventral. The epiphallus and the female spermatheca are of various very diverse types.

Externally, the few New World pyrgomorphs can be recognized by the following combination of characters:

- 1) Lower basal lobe of hind femur longer than the upper one.
- 2) Prosternal process present.
- 3) External apical spine of hind tibia present (**Fig. Pyr1**).
- 4) Anterior part of fastigium with a dorsal furrow or fissure (**Fig. Pyr2**).
- 5) Head conical, often with an oblique row of tubercles leading from behind the eye to the pronotal lateral lobe (**Fig. Pyr3**).

The Pyrgomorphoidea are a large superfamily, distributed almost world wide, especially numerous in the tropical and warm temperate regions of the Old World. They are currently divided into 151 valid genera, containing 468 valid species and 109 valid subspecies. Their higher classification is controversial; to illustrate the extremes, Kevan et al. (1969, 1974 and intervening papers of the same series) divided them into 10 “series” and 30 tribes, and Dirsh (1975) into 13 subfamilies. At the other extreme, the OSF2 (Eades et al. 2003) currently recognizes only 2 subfamilies, the Orthacridinae Bolívar 1905 and the Pyrgomorphinae Brunner von Wattenwyl 1874. The historical vissitudes of the various systems are reviewed by Kevan and Akbar (1964). A full-scale molecular systematic investigation to identify the major clades within the family would be a great help.

Only fourteen pyrgomorph genera occur in the New World, and all are endemic (Kevan 1977). Nine of these genera occur only in Mexico; a further group of four genera are restricted to the forests of northern South America. Only one genus (*Prospheona*) occurs in our region. It is generally thought that the New World taxa are derived from two or three discrete waves of immigration from Asia, possibly via Beringia (Kevan & Akbar 1964; Kevan 1977; Carbonell 1977).

Most pyrgomorphs are wide spectrum generalist feeders, often including in their diet chemically defended dicotyledonous plants. Several Old World pyrgomorph taxa (e.g. *Phymateus*, *Phyteumas*, *Zonocerus*, *Taphronota*, *Poekilocerus*) sequester poisonous or distasteful compounds from their foodplants, and utilise them as defensive compounds – often these taxa are aposematically coloured and/or have dynamic displays and sometimes subsocial larvae. In this strategy they are convergent with several New World romaleine genera (e.g. *Romalea*, *Chromacris*, *Taeniopoda*), but no New World pyrgomorphs are known to do this. The popularity of the Sphenarium group as food items among the indigenous peoples of southern Mexico also suggests that they do not sequester toxins.

Prospheona Bolívar 1884

Bolívar, I. 1884. An. Soc. espan. Hist. Nat. 13: 446.

Type species *Prospheona scudderii* Bolívar, I. Monospecific genus.

Kevan, D.K.M., Singh, A. & Akbar, S.S. 1964: 280.

Kevan, D.K.M. (Ed.). 1977: 417.

Kevan, D.K.M. 1978 (1977): 10. > Map.

Otte, D. 1994: 130. > Sphenarium Group > *Prospheona*.

Prospheona scudderii Bolívar 1884

Bolívar, I. 1884: 447.

Type locality: Guatemala (no other data).

Location of type: ANSP Philadelphia.

Subsequent literature.

- Karsch, F.A.F. 1888: 343. > *Prospheona scudderii*.
- Rehn, J.A.G. 1905c: 404. > *Prospheona scudderii*.
- Bolívar, I. 1909: 9.
- Rehn, J.A.G. 1951: 243.
- Rehn, J.A.G. 1953: 102. > Lectotype designation, distribution.
- Kevan, D.K.M., Singh, A. & Akbar, S.S. 1964: 280. > Redescription.
- Kevan, D.K.M., Akbar, S.S. & Y.C. Chang. 1973 (1972): 268.
- Kevan, D.K.M. 1977: 417.
- Kevan, D.K.M. 1978 (1977): 17. > Map.
- COPR (Centre for Overseas Pest Research). 1982: 575. > Minor economic importance in El Salvador.

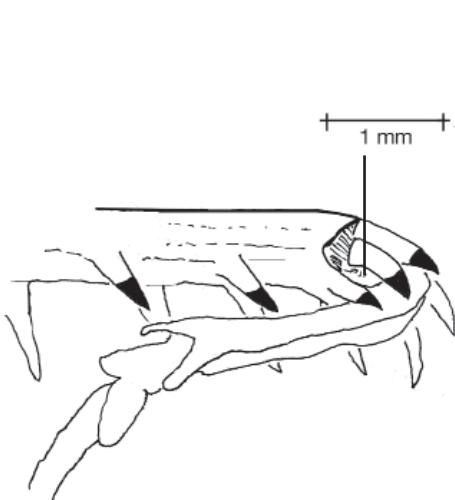


Fig. Pyr1. *Prophena scudderri*, lateral view of right hind foot to show external apical spine of hind tibia (arrowed).

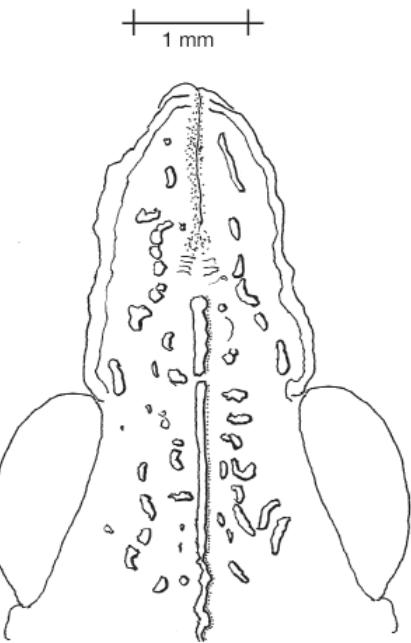


Fig. Pyr2. *Prophena scudderri*, dorsal view of fastigium.

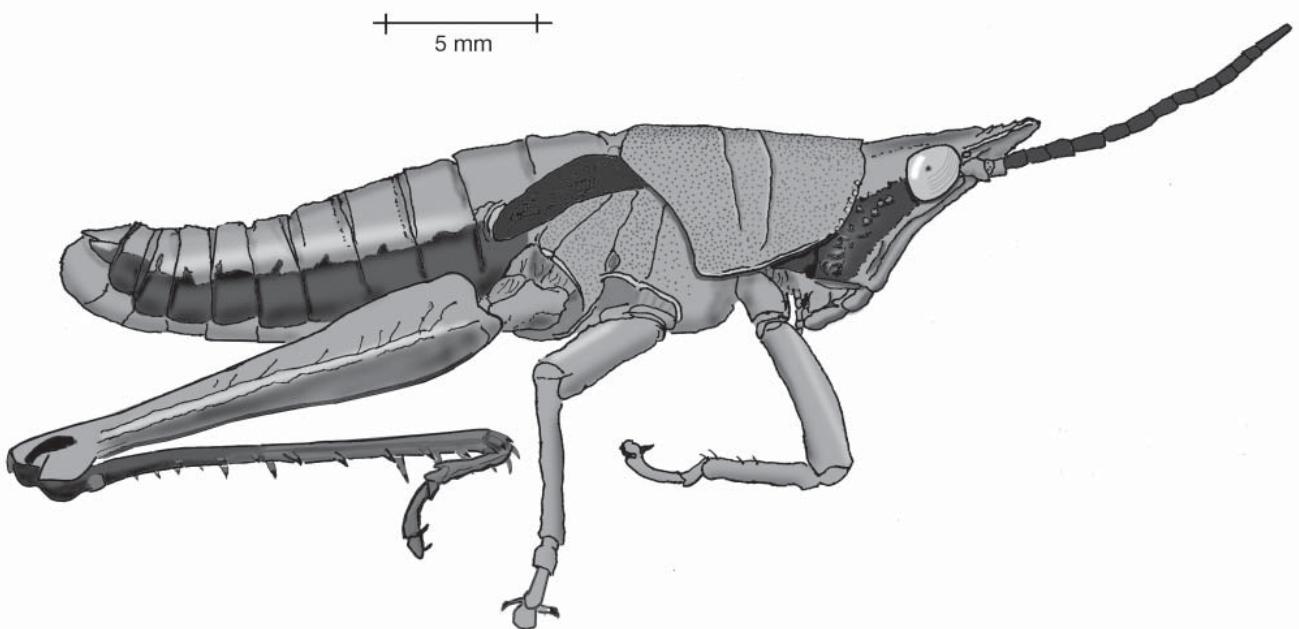


Fig. Pyr3. *Prophena scudderri*, male.

- Rowell, C.H.F. 1987: 473, 478. > Ecology (in Costa Rica).
- Otte, D. 1994. Orthoptera Species File 3:130. > *Prospheona scudderri*.
- Flook, P.K. & Rowell, C.H.F. 1997: 89-103.

Diagnosis.

As our only pyrgomorphid, the familial description applies. Of medium size ($L = 25-32$ mm, $F = 12-13$ mm), markedly fusiform in shape. Brachypterous, the short wings are often contrastingly coloured and extend to the tympana, which they partially cover. Habitus, **Fig. Pyr3, Plate Pyr1**.

Kevan et al.'s (1964) description is as follows: "Body bulky, short, very strongly fusiform, finely rugose-punctate. Antennae rather long, slightly thickened before the middle, segments slightly to distinctly longer than wide, basal segments shorter, slightly flattened. Head elongate, conical; frons strongly oblique, frontal ridge weak, narrowly sulcate and compressed between the antennae, lateral frontal carinae distinct, rather evenly curved; eyes rather small, ovate; vertex horizontal with a distinct median carinula; fastigium of vertex much longer than wide, narrowed forwards, foveolae long, the sulcus between them about half as long as the fastigium. Pronotum conical, much narrower in front than behind, anterior margin of the disc truncate, posterior margin deeply bilobed, transverse sulci indistinct, the typical one crossing the disc at about two thirds of its length, median and lateral carinae indistinct to obsolete; lateral pronotal lobe deeper behind than in front, with anterior margin oblique, almost straight, inferior margin sinuous, posterior margin oblique and strongly

excavated, infero-posterior angle slightly greater than a right angle. Prosternal tubercle transverse, compressed, somewhat collar-like, truncate apically. Mesosternal interspace much wider than long. Tegmina tongue-like, broadest at base. Abdomen strongly tapering posteriorly; tympana large and distinct; epiproct simple, triangular, cerci short, conical, subgenital plate rounded, not enlarged."

Field characters.

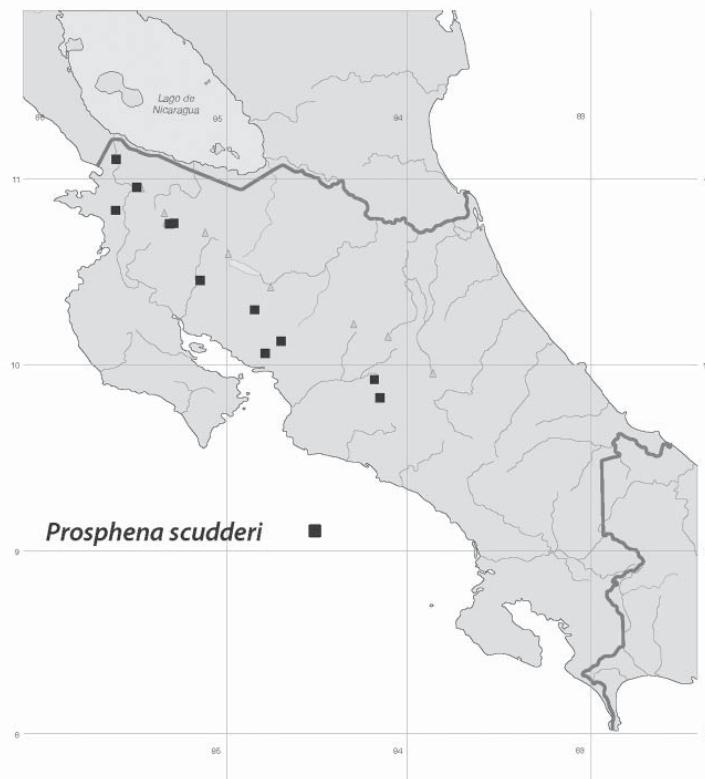
Very distinctive in shape. The species is highly variable in both size and coloration; some individuals are a uniform green or yellow-brown, in others there is striking purple-brown coloration of some areas, especially of the short tegmina. The antennae are dark brown, the hind tibia red. In the hand, the Pyrgomorph familial characters (external apical spine of hind tibia, distally grooved fastigium) are readily seen.

Distribution.

El Salvador, Guatemala, Honduras, Nicaragua, Costa Rica. Not to date recorded from Mexico or Panama. In Costa Rica largely confined to the Pacific slope of the northern half of the country, but occasional on the Meseta Central too, e.g. specimens recorded from Escazú and Tarbaca. **Map Pyr1**.

Natural history.

In Costa Rica, a typical inhabitant of sunny scrubland (*Lantana*, *Verbasina*, *Stachytarpheta*) with numerous aromatic Lamiaceae herb species. A rather sluggish insect that walks rather than jumps when disturbed. The larvae are green, yellow or brown, and closely resemble the adults in form and behaviour.



Map Pyr1. Localities for *Prospheona scudderri* in Costa Rica.

Superfamily Acridoidea

MacLeay 1821

The Acridoidea are the most recent superfamily of the Caelifera, according to molecular systematic analysis; this agrees with the conclusions of morphologists, who consider its members to possess the most derived structures, especially those related to the copulatory structures of the male. These structures are of fundamental importance in the definition of the caeliferan superfamilies.

Diagnosis.

The Acridoidea are defined by their possession of gonopore processes on the anterior ventral surface of the paired endophallic sclerites. These act like a spring-loaded clothes peg to divide the lumen of the terminal part of the male reproductive tract into two parts, the proximal ejaculatory sac and the distal spermatophore sac. These sacs are connected by the gonopore, which is normally pinched shut by the gonopore processes. Transverse muscles running horizontally between the expanded anterior apodemes of the endophallic plates, combined with a fulcrum between the two plates, cause the gonopore processes to be spread apart, so as to open the gonopore (Snodgrass 1935). This is part of a mechanism which allows the muscular compression of the sacs and the extrusion of their contents during copulation; see Eades (2000) for a detailed discussion.

The Acridoidea are not only the most modern of the extant caeliferan superfamilies, they are also an overwhelming majority (>70% of all caeliferan species) worldwide. They are currently divided into 7 to 11 families; the most recent enumeration is that of Eades (2000), who recognizes 11 families. Their definition is based primarily on genital characters. Many of these families are small, 7 are confined to the Old World and 2 to South America. Only two acridoid families, the Romaleidae and the Acrididae, are represented in Central America.

Molecular systematics has so far failed to support the monophyletic status of the Romaleidae, raising the possibility that the family may in fact be merely an arbitrary grouping of convergent genera of primitive Acrididae.

Artificial key to families of Acridoidea in southern Central America based on external characters.

I Apical external spine of hind tibia present (except in the genus *Maculiparia*). Prosternal process always present, though sometimes reduced to a collar-like form. Stridulatory mechanism, if present, of alar/elytral type. (*Maculiparia* possesses such a stridulatory mechanism). **Romaleidae** (p. 59)

IA Apical external spine of hind tibia always absent (at least, absent in all Central American forms). Prosternal process present or absent. Stridulatory mechanism, if present, of femuro-elytral type. **Acrididae** (p. 171)

Family Romaleidae

Brunner von Wattenwyl 1893

A large and characteristic family of exclusively American grasshoppers, the Romaleidae contains two major subfamilies, the Romaleinae and the Bactrophorinae. Currently (Eades et al. 2003, accessed April 2012) it contains 108 valid genera and 467 valid species. The two subfamilies are very different in both morphology and ecology, and best dealt with separately, as below.

Despite being differentiated at the family level, the Romaleidae are not superficially very different from the Acrididae. The distinction is made on the basis of phallic anatomy (see “Diagnosis” below). Preliminary mitochondrial DNA sequences do not clearly support their differentiation either, and it may be that in the long term their familial status will be abandoned, and their subfamilies transferred to the Acrididae.

Diagnosis.

This rests primarily on the internal anatomy of the male genitalia. The sclerites of the aedeagus, either 2 or 4 in number, are all derived from posterior prolongations of the endophallic plates; the (ectophallic) arch of the cingulum, to which the dorsal aedeagal valves are attached in the Acrididae, is absent. In a number of romaleine genera, however, including the North American *Romalea* itself, the ventral sclerites are secondarily divided into two, resulting in an aedeagus with 4 apparent sclerites (Amedegnato 1977; Roberts & Carbonell 1992; Eades 2000:193), superficially convergent with the acridid situation. The central part of the endophallus always consists of a single dorsolateral sclerite. In females, the lateral diverticulum of the spermatheca is absent or very small.

Externally, the terminal external spine on the tibia of the hind leg (**Fig. R1**, arrow 1) is usually present, but there is no longitudinal furrow in the fastigium (typical of the Pyrgomorphoidea (**Fig Pyr2**, p. 54), which also have the terminal external spine). Finally, there is always a prosternal spine or process, and this is placed centrally or posteriorly (very rarely anteriorly) on the prosternum.

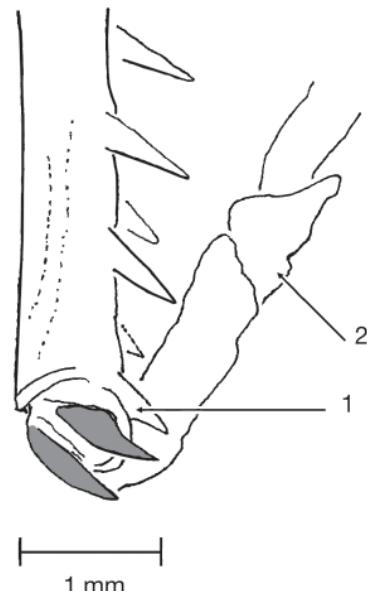


Fig. R1. *Colpolopha bruneri*. Terminal external spine on the tibia of the left hind leg (1) and short second tibial joint (2). Spurs shaded. The first character is typical of the family Romaleidae, the second of the subfamily Romaleinae.

Subfamily Romaleinae Brunner von Wattenwyl 1893

The Romaleinae are a large and diverse group, comprising some 70 genera and about 270 valid species. Most taxa are South American, but the subfamily extends from Argentina and Chile through Central America into Mexico and the southern States of the USA. Roberts (1941) first gave them formal subfamily rank, but they have been recognized as a natural group since the work of Brunner von Wattenwyl (1893).

Apart from aquatic or subterranean habitats, the Romaleinae include forms that have adapted to almost every niche available to a grasshopper. They are found in grassy savannas, swamps, desert, rain forest, dry forest, in the rain forest canopy, among shrubs, in herbs, or on the surface of the ground. Some are generalists, some specialist feeders. Some are apterous, others brachypterous, some are powerful long-distance fliers. The more specialised forms are often strongly convergent with other, more or less unrelated, grasshoppers that are adapted to the same environment; for example, the canopy-dwelling *Trybliophorus* looks like a bactrophorine, and the Tropidacridini closely resemble Old World rain-forest canopy cyrtacanthacridines. A rather large number of romaleines are distasteful or toxic and aposematically coloured; in this they resemble the predominantly Old World Pyrgomorphidae. In both groups the distasteful compounds are often sequestered from the foodplants.

The ecological and anatomical diversity of the Romaleinae is reflected in the difficulties of their higher classification. Some genera were early grouped (Brunner von Wattenwyl 1893; Giglio-Tos 1898). Rehn and Grant (1959, 1960) in a major revision, split the subfamily into 17 tribes, but though many of these seem quite plausible, most have not found general favour with orthopterists. Several of their tribes contained only one or a very few genera, and diagnoses were weak or totally lacking. Further, some genera were left “incerta sedis”, without a home in this scheme. Molecular systematics has also had difficulty with the group; the taxa so far analysed (only about a dozen) do not fall readily into a single clade; a new and better analysis is urgently required.

A few romaleine tribes have been recognized by more recent authors; these include the Phaeopariini (Jago 1980; Carbonell 2002), Hisychiini (Descamps 1979; Rowell 1999), Eurostacrini (Amedegnato 1997), Leguini (Amedegnato & Poulain 1986), Procolpiini (Rowell 1997), and Tropidacrini (Descamps & Carbonell 1985), and most of these tribes are also currently recognized by the OSF. All other romaleine genera are there relegated to a catch-all tribe, Romaleini. Eades (2000) refers to a tribe Romaliini, but implies a genital criterion distinct from that used by Rehn and Grant (1969) for their Romaleini.

An old, but possibly still unresolved, issue concerns

the relationship, if any, of the Romaleinae to the Old World Teratodinae (NE Africa, Iran, India), placed in the Acrididae. These resemble some romaleines in habit (though given the diversity of the latter this is almost inevitable!) and more importantly have the same curious stridulatory mechanism (see “Diagnosis” below). There was a virulent printed exchange on the subject in the 1950s, spearheaded by Uvarov and Dirsh on the one side and Rehn on the other (Rehn & Grant 1959; Uvarov & Dirsh 1961 and earlier works). Modern opinion generally favours Rehn, but in retrospect it appears that this was largely due to the intervening death of his opponents – remarkably little evidence was presented by either side.

Given new estimates of the antiquity of the divergence of the major taxa of Acridoidea (from molecular sequence data, e.g. Flook & Rowell 1997) and the universal acceptance of plate tectonics since 1960, the proposition that the teratodines could conceivably be related to the Romaleinae no longer seems so patently absurd as it evidently did to Rehn. Again, a new analysis using modern techniques is called for, and more morphological study of the teratodine phallus. Eades (2000) considered the teratodine phallic anatomy to be acridid in nature, and not romaleid.

A further romaleine question concerns the apparent antiquity of all of the North American and some of the Central American genera, which are clearly different from the modern South American genera and tribes. The present-day concentration of the subfamily in South America, and the South American distribution of other taxa thought to be allied to them (the Bactrophorinae and Ommexechidae), seem to indicate a South American origin of the subfamily. However, that continent was mostly isolated from North America until very recently (3-4 million years ago), whereas the North American romaleids seem to have a much longer period of independent evolution behind them. It is difficult to explain why this group alone apparently succeeded in colonizing northwards at a very early date, while other South American grasshoppers (with the possible exception of certain Central American ommatolampines such as *Microtylopteryx*) apparently did not do so.

Diagnosis.

The subfamily is characterized, with a few exceptions, by an alar-elytral stridulatory mechanism which is unique among New World grasshoppers. What are apparently veins A1 and A2 of the hind wing are placed close together, and between them run a series of strong denticulated arched veinlets acting as scrapers during stridulation, which create friction with the overlying elytra. Behind these veins, between A2 & A3, which are widely separated, there is a hyaline area with widely spaced cross veins (“specula” or mirrors, sometimes referred to as tympanal areas), likely to act as a radiator during stridulation (**Fig. R2**), which have a reduced venation and are thus suitable for vibration.

The second tarsal segment of the hind foot is usually

short (**Fig. R1**, arrow 2), except in arboreal genera such as *Legua*, differentiating the subfamily from the Bactrophorinae, where it is always long. Most romaleines are of medium to large size, and the subfamily includes the largest acridoid grasshoppers known, *Titanacris* and *Tropidacris*.

Tribe Colpolophini Rehn & Grant 1959

The tribe contained originally only three genera, *Colpolopha*, *Draconota*, and *Helionotus*, all South American. Only *Colpolopha* extends into C.America. The OSF2 Online subsumes this Tribe (along with many others) within the Tribe Romaleini Brunner von Wattenwyl. Carbonell (2004) considered *Colpolopha* to be most closely related to *Prionolopha* and *Xyleus*, but did not formally group them into a tribe.

Colpolopha Stål 1873

Author: Stål 1873a: 52.

Type species: *Colpolopha sinuata* Stål 1873a: 53.

Type locality: Remedios, Antioquia, Nova Grenada (= Colombia).

Location of type specimen: Stockholm Museum.

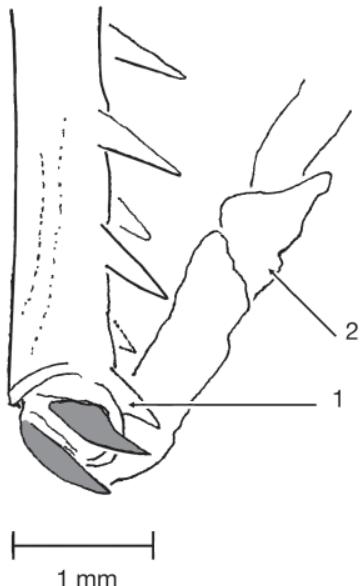


Fig. R1. *Colpolopha bruneri*. Terminal external spine on the tibia of the left hind leg (1) and short second tibial joint (2). Spurs shaded. The first character is typical of the family Romaleidae, the second of the subfamily Romaleiniae.

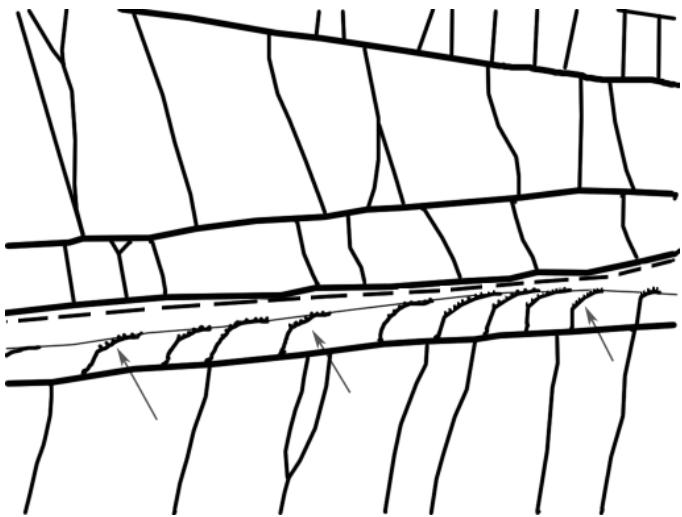


Fig. R2. A romaleine subfamily character: the stridulatory apparatus of the hind wing (here in *Taeniopoda varipennis*). Three of the toothed scraper veins are arrowed. The specular area lies immediately behind these, at the bottom of the figure.

Subsequent literature.

- Stål, C. 1873b: 45. > Redescription of genus.
- Rehn, J.A.G. 1904a: 406.
- Kirby, W.F. 1910: 362-3.
- Bruner, L. 1911: 47.
- Hebard, M. 1923: 227. > Gives additional measurements.
- Günther, K.K. 1940: 477.
- Rehn, J.A.G. & Grant, H.J. 1959: 233. > Tribe Colpolophini.
- Uvarov, B.P. & Dirsh, V.M. 1961: 158.
- Amedegnato, C. 1974: 198.

Etymology.

Greek *lophos*, crest; and *colpotes*, sinuous. A reference to the high and deeply embayed pronotal carina.

No. of currently known species.

Ten. The genus is in need of revision. In our area: two.

Range of genus.

Brasil, Peru, Guyana, French Guiana, Venezuela, Colombia, Panama, Costa Rica. From Colombia northwards found only on the Pacific slope.

Diagnosis.

(Based on C.American species only). Medium to large grasshoppers. Antennae flattened and ensiform at the base, more cylindrical distally, rather short and thick. Frons strongly concave and receding in profile, the frontal ridge produced dorsally into a pronounced rostrum. Frontal ridge, narrow and smooth in its most dorsal part, then deeply sulcate in its more ventral part. The sulcus of the dorsal region is very narrow, widening around the medial ocellus, and becoming much broader and shallower below the ocellus (**Fig. R3**).

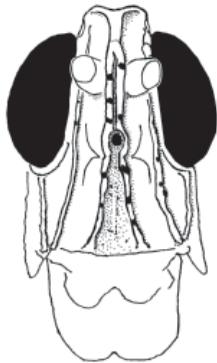


Fig. R3. *Colpolopha bruneri*, head in frontal view.

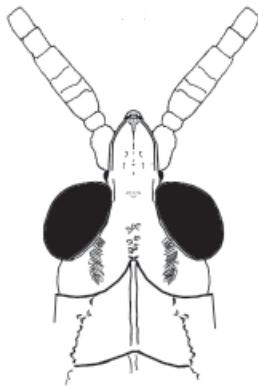


Fig. R4. *Colpolopha bruneri*, head in dorsal view.

Facial and subocular carinae strong, of angular cross section. Fastigium horizontal, slightly concave, proximally more or less parallel sided, tapering at the tip to join the narrow frontal ridge. The fastigium is elongate and approaches the vertex in overall length (**Fig. R4**).

Pronotum very characteristic; widest just behind the third sulcus, and in dorsal view tapering to the front and to the rear from that point. Medial carina forms a high arcuate crest, which is produced to overhang the vertex at its anterior margin (**Fig. R4**), and to form a long acute angled point at the hind margin, extending almost to the base of the hind femur. The dorsal edge of the posterior extension of the pronotum is deeply excavated (**Figs R5 & 6**) and the edge decorated with small spines, which vary between individuals but are more or less species-specific in general form (**Fig. R7**). Prosternal process short and conical, pointed, in some individuals transversely flattened.

The fore and middle legs are rather short and weak. Hind femur long and slender, extending well beyond end of abdomen. Dorsal carina of femur ornamented with numerous short tubercles. Hind knee with rounded lower lobes. Hind foot short, only 1/4 of length of hind tibia. Eight internal and 9 external tibial spines, external apical spine present (**Fig. R1**). Wings and elytra fully developed, elytra reach to the supra-anal plate. The wings are often brightly coloured, pink, yellow or orange.

Supra-anal plate, triangular, narrow, with a medial longitudinal ridge and some sculpturing proximally. Male furcula present, small but well melanized, with one or two points each side. Male subgenital plate short and rounded, with a prominent terminal beak. Cerci simple, conical and finely pointed.

Ovipositor valves short and strong, with concave digging surfaces, the margins smooth and not toothed. Female subgenital plate smoothly pointed in the midline, but flanked by a short angular lobe on each side.

I. *Colpolopha bruneri* Rehn 1905

Rehn 1905b: 406.

Type locality: Tárбaca, Prov. San Jos , Costa Rica.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Bruner, L. 1900-1910 (1907): 228.

Etymology.

Named for Lawrence Bruner (1856-1937), Professor of Entomology, University of Nebraska. In the 1890s he spent several years in Central and South America. He published more than 20 papers on the grasshoppers of the Neotropics, and wrote (1900-1910) the Orthoptera/Caelifera section of the landmark *Biologia Centrali Americana* (1893-1910). Twenty-five species of the Costa Rican list are of his authorship. As important as his own taxonomic work, he introduced his student M.A. Carriker [Melbourne Armstrong Carriker (1879 – 1965)] to Costa Rica, who later became a most important collector.

Diagnosis.

Habitus **Fig. R5, Plate R1**. Pronotal medial carina cut by three sulci. Hind margin of metazonal crest of pronotum ornamented with 3-4 spines of very variable size and shape (**Fig. R7**). Elytron tapers to a point at the tip, vannal area of hind wing scarlet or pink, remigium blackish. General body colour varying shades of brown and grey, with considerable individual variation. Males are commonly a lighter, more greyish, hue than females, that tend to reddish brown. In some individuals of either sex there are a few small yellow spots on the elytra.

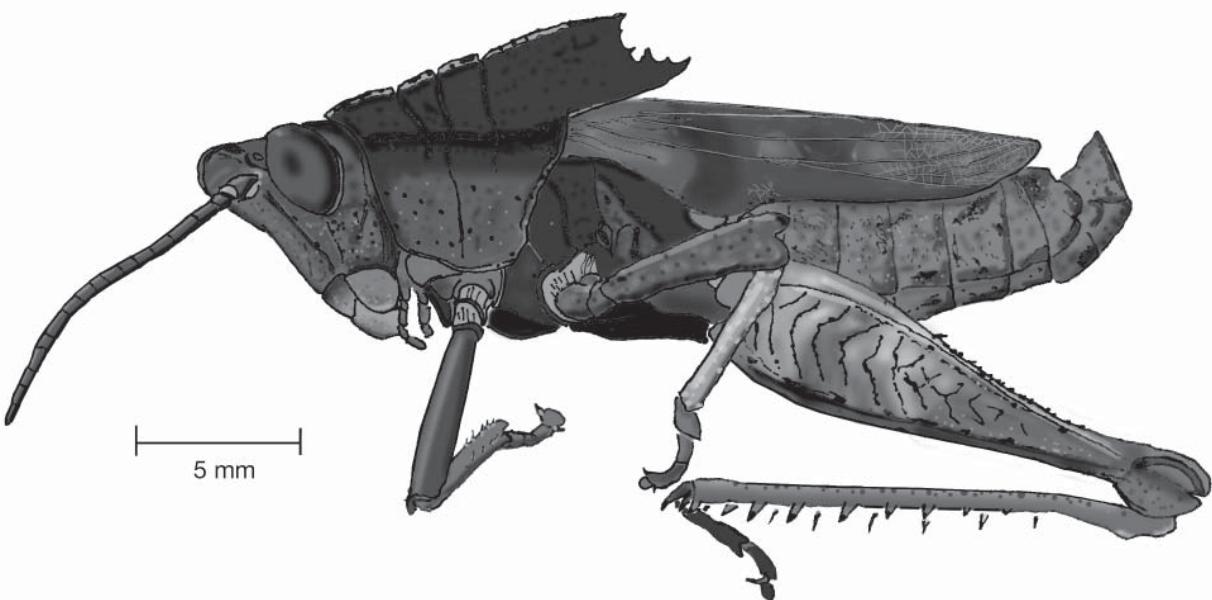


Fig. R5. *Colpolopha bruneri*. Male habitus.

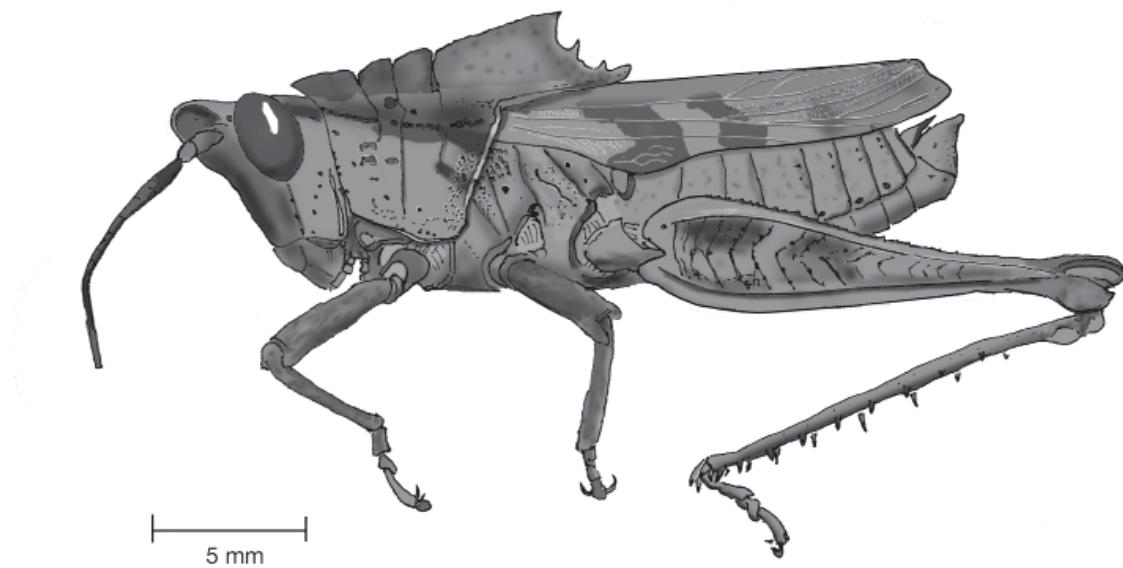


Fig. R6. *Colpolopha rehni*. Male habitus.

Distribution.

Costa Rica, plus a single old record from Panama. Characteristic of Pacific slope seasonal moist forest life zone, from southern Guanacaste Province and the middle of the Nicoya Peninsula south to the Río Barú, including the Pacific drainage of the Meseta Central, from sea level up to 1600 m. One record from Cartago City, just over the watershed on the Atlantic slope of the Meseta Central. See Map RI.

Natural history.

A typical species of seasonal forest understorey, usually found in the herb layer. Often in groups. Probably polyphagous. The animals are very cryptic when resting on leaf litter.

2. *Colpolopha rehni* Hebard 1923

Hebard 1923: 226.

Type locality: Costa Rica, Prov. S. José, Carrillo (but see under "Distribution" below).

Location of type specimen: ANS Philadelphia (holotype female).

Subsequent literature.

- Hebard, M. 1924a: 102.

=*Colpolopha "sinuata"* (misidentification, not *sinuata* of Stål 1873) in Bruner 1900-1910, Plate II, Fig. 25, 25a, synon. Hebard 1923: 226.

=*Colpolopha "latipennis?"* (misidentification, not *latipennis* of Stål 1878) in Bruner 1900-1910, 228, synon. Hebard 1923: 226.

=*Colpolopha "latipennis?"* (misidentification) in Bruner 1913: 461, synon. Hebard 1923: 226.

Etymology.

Named for Hebard's colleague J.A.G. Rehn, (1881-1965), Philadelphian entomologist and zoologist, who made two major collecting trips to Costa Rica and published (1905b & c) the first papers on the grasshoppers of that country.

Diagnosis.

Habitus **Fig. R6, Plate R2.** Differs from *C. bruneri* in having tegmen obliquely truncate and somewhat concave at the tip, with the leading edge longer than the trailing edge; hind wing mostly brown, not uniformly pink; spines of the rear edge of the pronotal crest sharper and more numerous than in *bruneri* (**Fig. R7**). The median pronotal crest is more deeply incised by the three sulci. Antennae somewhat longer and more slender. The traces of dark transverse banding on the elytron and hind femur are more obvious than in *C. bruneri*.

Distribution.

Colombia (Cundinamarca); Eastern Panama; very dubiously Costa Rica(?). See Maps RI & R2.

There is no record of this species from Costa Rica

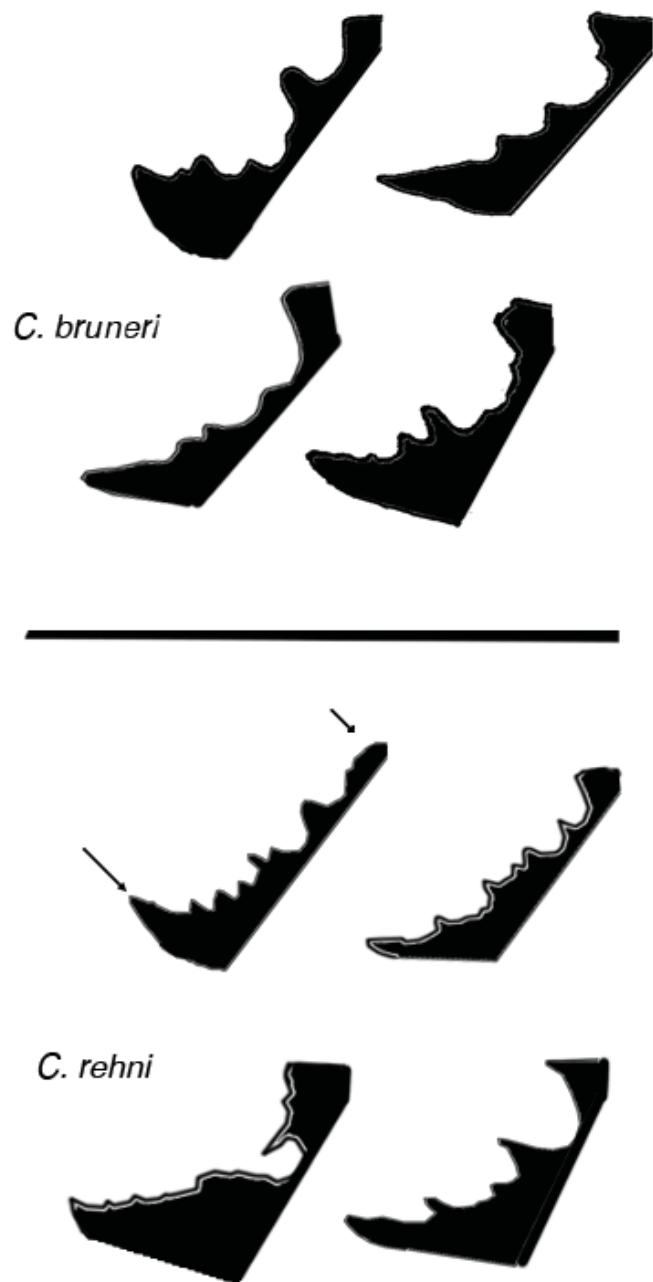


Fig. R7. *Colpolopha* spp. Profile of posterior margin of pronotum in lateral view, of 4 individuals each of *C. bruneri* (upper set) and *C. rehni*, to show individual and interspecific variation. All are scaled to equal height, as determined by the arrowed points in the lower left figure.

other than the type specimen, and I greatly doubt the accuracy of its label data (see the remarks below (p. 84) under *Syletria* (Phaeopariini), where another ANSP specimen was wrongly attributed to Carrillo). The undoubtedly Costa Rican species *C. bruneri* inhabits seasonal forest of the Pacific slope, and does not occur in country similar to that found in Carrillo, the alleged type locality. This area is typical Caribbean slope wet forest, and has been extensively collected in recent years, since Carrillo was made accessible by road, and is now part of a National Park.

Further, no *Colpolopha* species is known from the Caribbean slope of Panama most similar to Carrillo, e.g., in Bocas del Toro. Numerous specimens of *C. rehni* have, however, been collected recently in Darién, on the Pacific slope of Eastern Panama, where it is apparently not uncommon, and Hebard 1924 records a single specimen from the Canal Zone (at Bas Obispo, now under water).

Hebard (1923) coined the name *rehni* to cover 2 specimens previously misidentified by Bruner as *sinuata* Stål and *latipennis* Stål respectively. Reference to Bruner (*Biol. Centroamericana*) shows that he had in truth no specimen of *sinuata*, just an alleged field sighting (!) and the "*latipennis*" specimen was given to him by T. Heyde, with locality given only as "Central America". Heyde seems to have collected mostly in Nicaragua, from whence no *Colpolopha* is currently known, but which might well harbour *C. bruneri*. Hebard (1923: 226) claims to have seen both of Bruner's specimens, and says they are both female, but his table of measurements gives only one entry, corresponding to Heyde's specimen.

Natural history.

Biology unknown.

Tribe Hisychiini Descamps 1979

Diagnosis.

The tribe comprises 7 genera (*Acrideumerus*, *Acridophaea*, *Cloephoracris*, *Hisychius*, *Pareusychius*, *Porphoracris*, *Pseudohisychius*). Only *Cloephoracris* extends north of South America.

Known range of tribe.

Amazonian Brasil and Peru, Ecuador, Colombia, Panama, Costa Rica.

Natural history.

Hisychins are rather little-known, rare grasshoppers of wet forest light gaps and understorey. They are of medium to large size, completely apterous, as adults often decorated with conspicuous thoracic tubercles. There are 2 pairs of aedeagal valves, both endophallic in origin (Descamps 1979: 19).

Cloephoracris Descamps 1979

Descamps 1979a: 21.

Type species: *C. nodulithorax* Descamps 1979.

Type locality: Colombia: Nariño: Guyacana.

Location of type specimen: MNHN Paris.

Subsequent literature.

- Rowell, C.H.F. 1999: 5. > New spp., key to species.

Etymology.

Greek *kloios*, a collar; *pherō*, to bear; *acris*, conventionally used for grasshopper. The nodular pronotum could have inspired this name.

No. of known species.

Four. In our region, 3.

Range of genus.

Colombia (Nariño), Panama, Costa Rica.

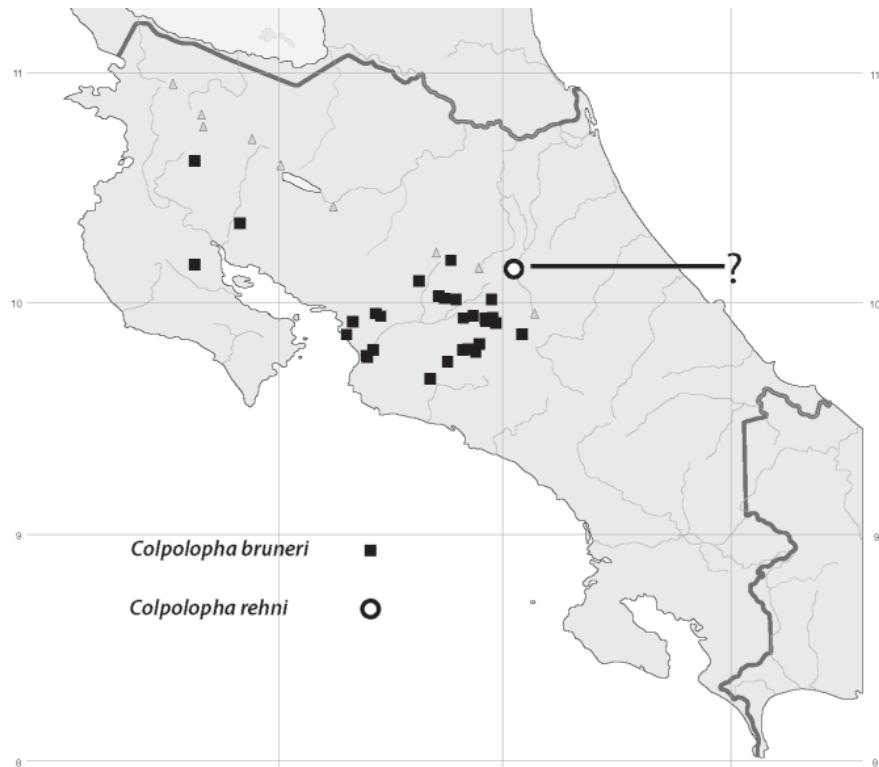
Diagnosis.

Medium to large grasshoppers. Apterous. Pronotum devoid of longitudinal carinae, the midline incised by two sulci. Dorsa of thoracic and first abdominal segments and outer face of hind femur decorated with more or less prominent bosses. Furcula present in males, the complexly shaped teeth appressed to the surface of the supra-anal plate.

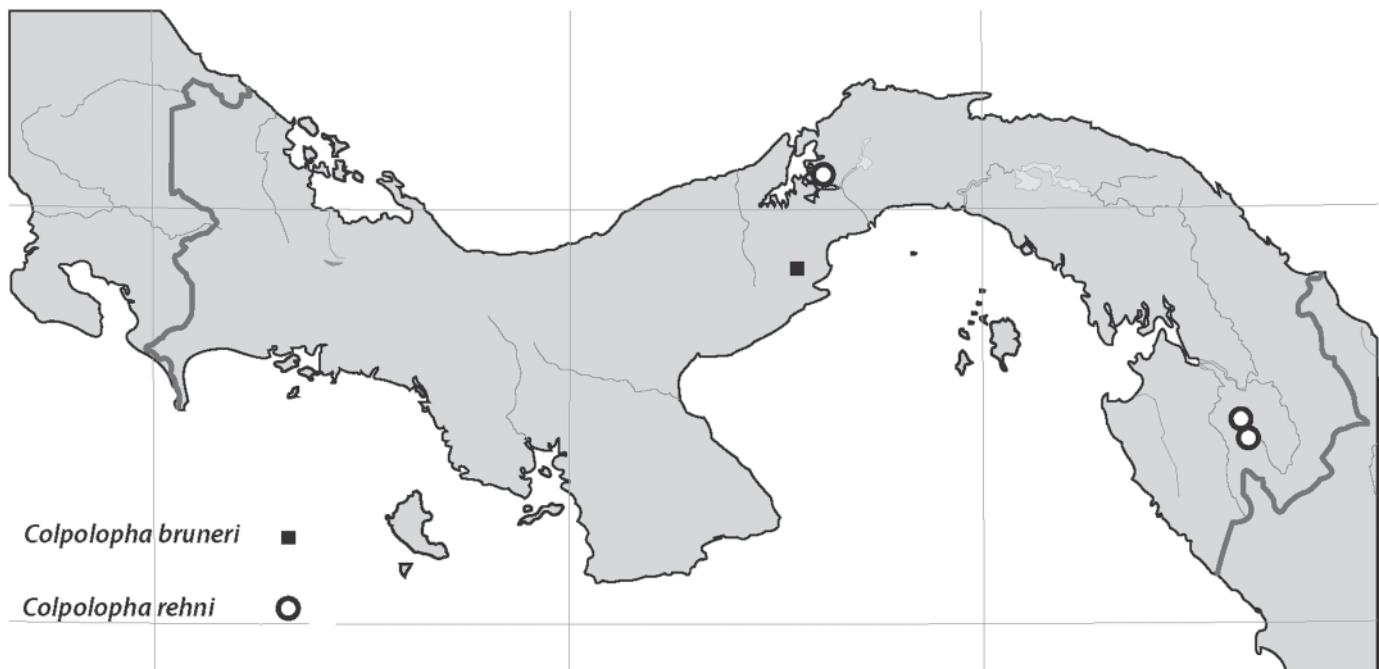
Males are often marked in unusual shades of blue or purple on a green background. Females are more cryptic, predominantly brown.

Key to Central American species of *Cloephoracris* (males only).

- | | | |
|----|--|--|
| I | Fastigium long (Rowell 1999, Fig. 8A, B) | 2 |
| IA | Fastigium short (Rowell 1999, Fig. 8C; Descamps 1979a, Fig. 4) | 3 |
| 2 | Fastigium deeply grooved distally (Rowell 1999, Fig. 8A). General colour dark green; head, grooves between meso- and metanota, knee and distal parts of hind femur dark blue (Panama) | <i>festae</i> (Giglio-Tos 1897). |
| 2A | Fastigium moderately grooved distally (Rowell 1999, Fig. 8B). General colour blue-grey, head brownish, hind knees and tibial spines black. Thoracic nodules very large (Costa Rica) | <i>caesia</i> Rowell 1999. |
| 3 | General colour olive green, head orange, thorax mottled brown. External and internal carinae of hind femur lined prominently in black, interrupted by clear nodules. Thoracic nodules small (Costa Rica) | <i>disrupta</i> Rowell 1999. |
| 3A | Head, thorax and hind knees chocolate brown, remainder of body and legs green (Colombia) | <i>nodulithorax</i> Descamps 1979. |



Map RI. Localities of *Colpolopha* spp. in Costa Rica. The alleged type locality of *C. rehni*, in Carrillo, is almost certainly false (see text, p.65). *C. bruneri* is centred on the drainage of the Rio Grande de Tárcoles.



Map R2. Localities of *Colpolopha* spp. in Panama. There is a single old record of *C. rehni* from the Canal Zone; modern records are all from Darien. *C. bruneri* has been recorded in Panama only from Cerro Campana.

1. *Cloephoracris caesia* Rowell 1999

Rowell 1999: 10.

Type locality: Costa Rica: Prov. Limón: Valle de la Estrella: Reserva Biológica Hitoy-Cerere, Est. Miramar. 200 m.

Location of type specimen: INBio, Costa Rica.

Etymology.

Latin *caesius*, blue-grey, referring to the ground colour of the male.

Diagnosis.

Habitus **Fig. R8, Plate R3.** Larger than other species; F (male) = 22 mm. Nodules very large and prominent.

Field characters.

Males are blueish grey, with black knees and an orange head. Females are reddish brown. Large in size and apterous.

Distribution.

Caribbean and Pacific lowland forest of Southern Costa Rica: Valle de la Estrella and Osa Peninsula. Also in the lowlands of Bocas del Toro, just south of Costa Rican border. **Map R3.**

Natural history.

Unknown.

2. *Cloephoracris disrupta* Rowell 1999

Rowell 1999: 15.

Type locality: Pozo Azul de Pirrís, Costa Rica.

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *disrupta*, interrupted, referring to the patterning on the hind femur (see below).

Diagnosis.

Habitus, **Fig. R9, Plate R4.** Distinguished from other species of the genus by its smaller size and the presence of a very dark blackish green line outlining the outer face of the hind femur, interrupted by raised clear nodules. Males: body colour dark green. Hind knees, hind tibiae, purple to black; supra-anal plate, green tinged purple; genicular membrane, shining white; hind feet, brownish. Head purple brown, drying orange; antennae slate grey, and eyes dark brown.

Distribution.

Pacific slope of SW Costa Rica, from Río Grande de Tárcoles to Osa Peninsula, **Map R3.**

Natural history.

Found in seasonal humid lowland forest. Otherwise unknown.

3. *Cloephoracris festae* (Giglio-Tos 1897)

Hisychius festae Giglio-Tos 1897: 3.

Type locality: Panama: Prov. Darién, „Rio Cianati“ (Italian language phonetic spelling of Río Chanatí).

Location of type specimen: Torino (holotype male).

Subsequent literature.

- Bruner, L 1907: 247.
- Kirby, W.F. 1910: 391.
- Descamps, M. 1979a: 22. > Transfers to *Cloephoracris* n.g.
- Rowell, C.H.F. 1999: 5. > Key to species.

Etymology.

Named for Dr. Enrico Festa (1868-1939), Italian naturalist and explorer, native of Moncalieri, near Torino, who led a collecting expedition to Ecuador, Darien and Colombia in 1895-98.

Diagnosis.

Habitus **Fig. R10, Plate R5.** Medium sized for genus, thoracic nodules rather small and unobtrusive. Coloration: males green, with blue head; thoracic sulci, hind tibiae, dark blue. Knees black. Genicular membranes of knees shining white. Females reddish brown.

Distribution.

Colombia (Chocó); Panama, from Darién west to at least Prov. Panamá and Colón. **Map R3.**

Natural history.

Feeds on *Pavonia* (Malvaceae) in forest light gaps, probably a foodplant specialist.

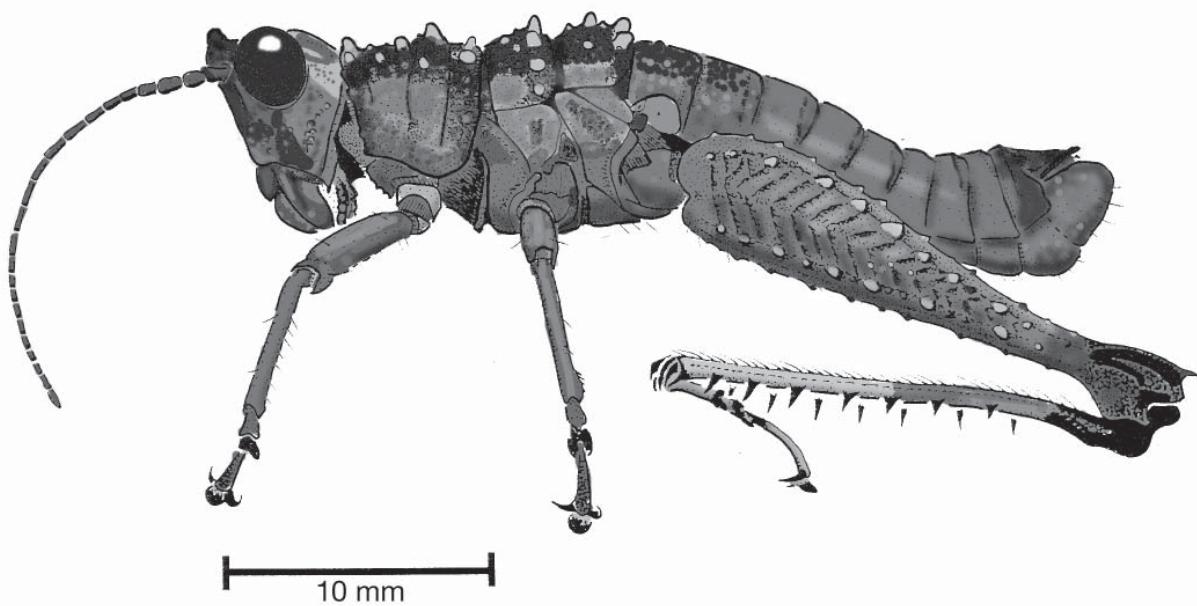


Fig. R8. *Cloephoracris caesia*, male habitus.

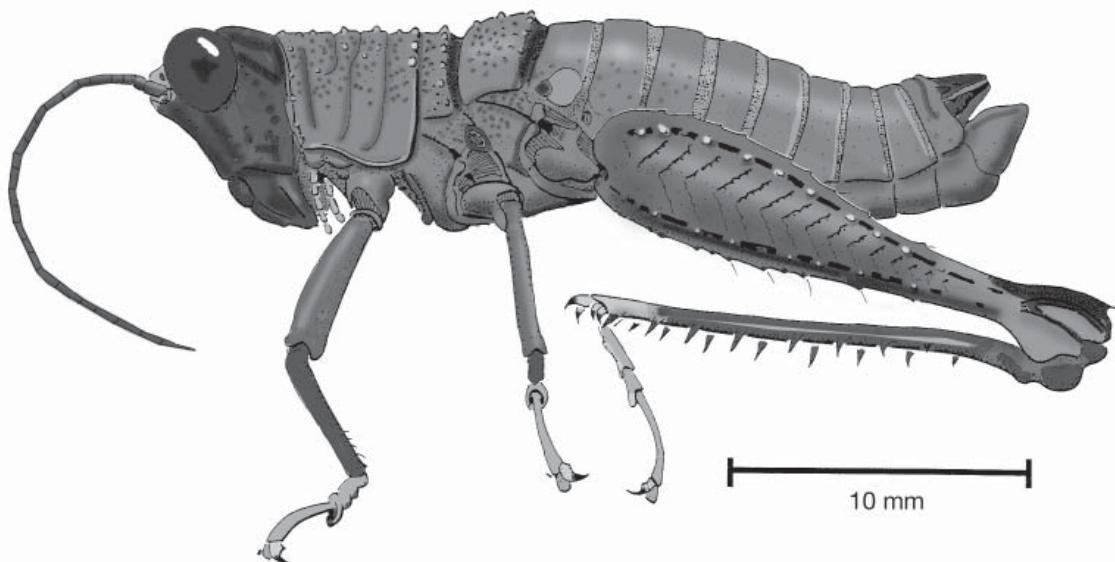


Fig. R9. *Cloephoracris disrupta*, male habitus.

Tribe Leguini
Amedegnato & Poulain 1986

Diagnosis.

(From Amedegnato & Poulain 1986: 438). Elongate insects, green or brown in general colour and having coloured hind wings. Head equal to or longer than pronotum, fastigium very elongate, equal to or exceeding length of the head behind the eyes. Eyes small, interocular space wider than the antennal scape, inserted near tip of the fastigium. Mouthparts very specialised, with the galea of the maxillae prolonged forwards, reaching halfway to the clypeal suture. Prosternal process more or less flattened at its apex and bilobed; mesosternal space narrow and closed. Stridulatory apparatus present but not strongly developed. Posterior femora rather slender, with smooth carinae; second tarsal joint of hind foot elongate. Supra-anal plate triangular. Subgenital plate elongate, considerably longer than the supra-anal plate, laterally compressed. Male cerci conical and slightly curved inwards. Ovipositor valves unspecialised.

The tribe comprises to date only three South American genera (*Ampiacris*, *Legua*, *Proracris*), of which only *Legua* extends into Central America.

Known range of tribe.

Peru, Brasil, Panama, Costa Rica: to date, apparently unrecorded from Colombia. In view of the rarity and cryptic nature of these insects, it is probable they are more widely distributed but unreported.

Natural history.

Associated with canopy palm trees in wet forest.

Legua
Walker 1870

Walker 1870: 502.

Type species: *Gryllus (Locusta) crenulatus* Stoll 1823.

Subsequent literature.

- Gerstaeker, A. 1889: 39.
- Kirby, W.F. 1910: 408. > Locustidae vel Acridiidae, Cyrtacanthacriinae.
- Hebard, M. 1924a: 114.
- Willemse, C. 1928: 18.
- Rehn, J.A.G. 1955a. > Correction of original description of *crenulatus* and of genus *Legua*, with erection of tribe Leguini (as division of subfamily Cyrtacanthacridinae).
- Dirsh, V.M. 1961: 393. > Assignment to Romaleidae.
- Uvarov, B.P. & Dirsh, V.M. 1961: 158.
- Amedegnato, C. 1974: 198. > Assignment to Romaleinae.
- Amedegnato, C. & Poulain, S. 1986: 438. > Redefinition of tribe.

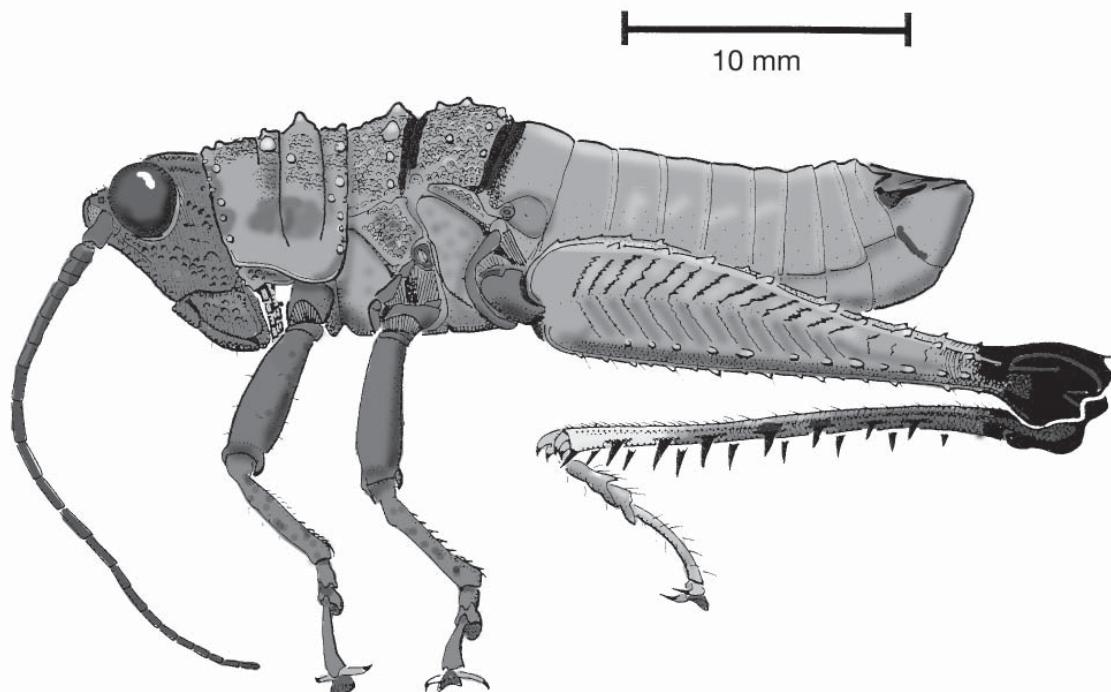
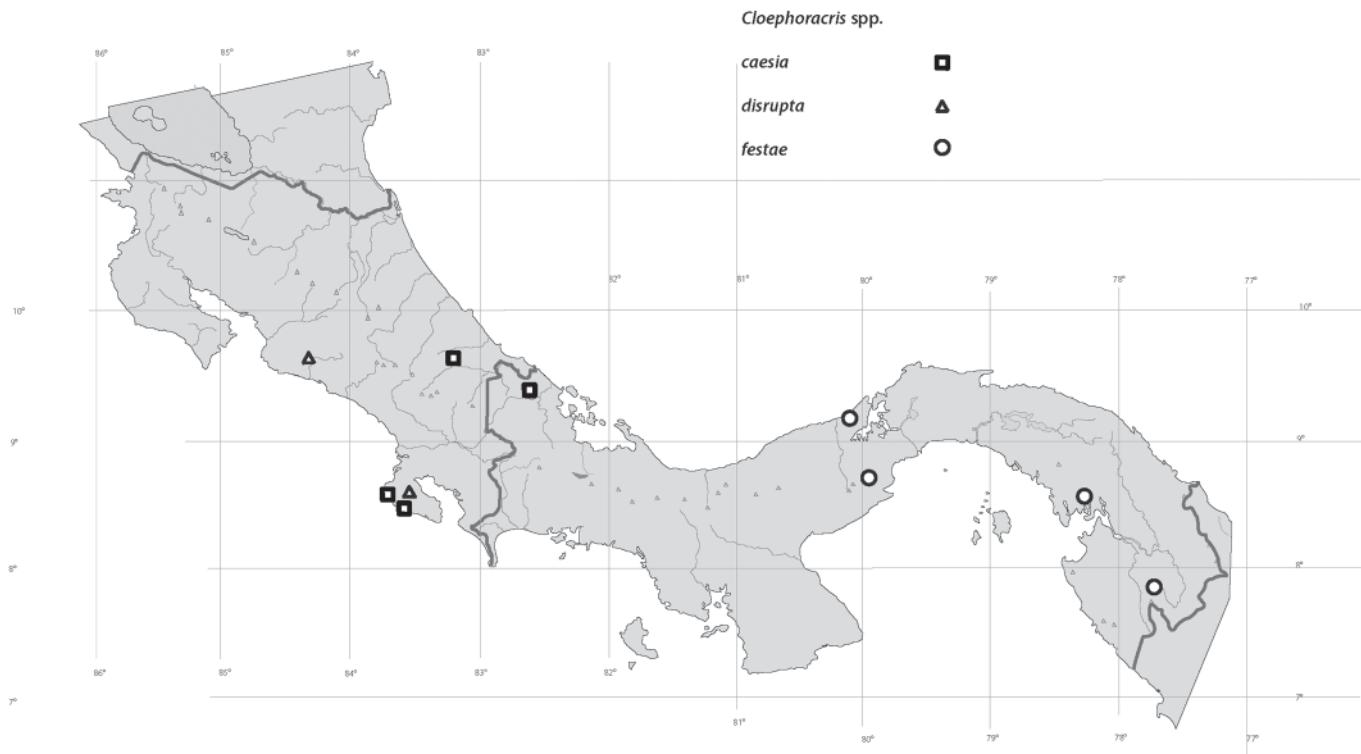


Fig. R10. *Cloephoracris festae*, male habitus.



Map R3. Localities of *Cloephoracris* spp. All are in forest.

See Amedegnato & Poulain 1986: 437 for historical discussion.

Etymology.

Probably a geographical name. As pointed out by Carbonell [2000, *Metalepta* 20(2):10], Legua is the name of a town in Saintonge (now Charente-Maritime), France. Spelt as Le Gua, it is currently the name of two French communes, one in Isere, the other in Charente, neither of which have any obvious connection to this grasshopper. However, Legua (Spanish for league) also occurs as a place name in tropical Central America, e.g. in Costa Rica, and it is quite possible that Walker's name derived from a specimen locality.

No. of described species.

Two. In our area, one.

Range of genus.

Costa Rica, Panama, Brasil (Mato Grosso).

I. *Legua crenulata* (Stoll 1813)

Gryllus (Locusta) crenulatus Stoll 1813: 14.

Type locality: unknown. The original specimen is labelled "Africa", clearly in error. Location of type specimen: RMNH Leiden.

Subsequent literature.

- Burmeister, H. 1838: 610. > Transfers to *Mesops*.
- Walker, F. 1870: 503. > Transfers to *Legua* n.g.
- Hebard, M. 1924a: 114.
- Willemse C. 1928: 3. > Correction of probable type locality to America.
- Rehn, J.A.G. 1955a. > Correction of original description.
- Amedegnato, C. & Poulain, S. 1986: 438.

Synonymy.

=*Acridium (Opsomala) stolli* Haan 1842: 148, synon. Walker 1870: 503.

Diagnosis.

Habitus **Fig. R11, Plate R6.** Unmistakable: long cylindrical green body, long narrow pointed green elytra, salmon pink or orange wings. Galea of maxillae expanded and folded upwards over mandibles. The head is conical and exceedingly opistognathous. Tip of male subgenital plate flattened laterally and prolonged into an upward curving point (**Fig. R11**). Furcula absent. The typically romaleine phallic structure is illustrated by Amedegnato and Poulain (1986: Fig. 44-48).

The larvae are elongate, in the early instars striped longitudinally in whitish-orange and black. Later larvae are green.

Distribution.

Costa Rica and western Panama (Prov. Bocas del Toro to at least Prov. Colón), to 350 m. Not to date recorded from Colombia or Nicaragua. **Map R4A & B.**

Natural history.

Strongly associated with canopy palm trees of Caribbean lowland forest, especially the genus *Welfia*, which it also eats. At rest, sits on the underside of a palm frond, body aligned with the midrib. Probably not uncommon, but rarely captured, as usually too high up for access. Sometimes comes to light at night. Probably lays eggs in palm trees; the ovipositor valves are occasionally found coated with fibrous vegetable material, but not with soil.

Tribe Phaeopariini Giglio-Tos 1898

- Giglio-Tos 1898: 46.
- Hebard 1923: 256.
- 1924a: 128.
- 1924b: 186.
- Amedegnato 1974: 17.
- Carbonell 2002: I-148 (Revision of Tribe).

Diagnosis.

Tegmino-alary stridulatory mechanism found in other Romaleinae often absent; external apical spine of hind tibia found in other Romaleinae sometimes reduced or absent; predominantly gramnivorous habits. Usually rather elongate insects of medium size, often with a disproportionately large head.

No. of described genera.

Eleven. Only three of these (*Maculiparia*, *Phaeoparia* and *Costarica*) extend into Central America, and most species of the first two genera are South American.

Range of tribe.

Brasil, Peru, Bolivia, Ecuador, Colombia, Guyana, French Guiana, Suriname, Venezuela, Colombia, Panama, Costa Rica.

Natural history.

Apparently all grass feeders, mostly on forest grasses.

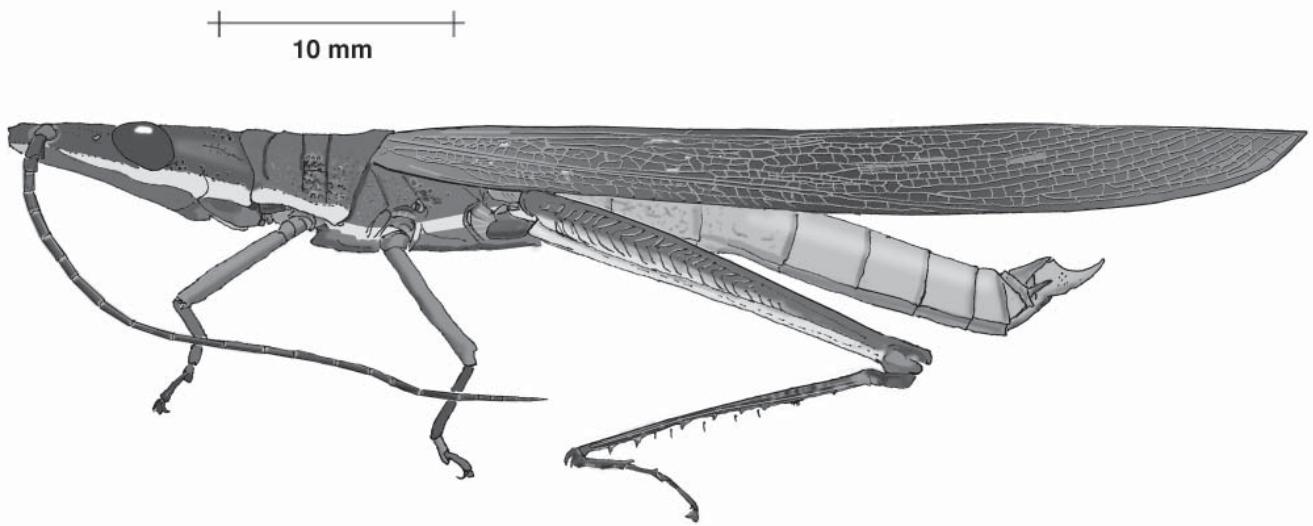
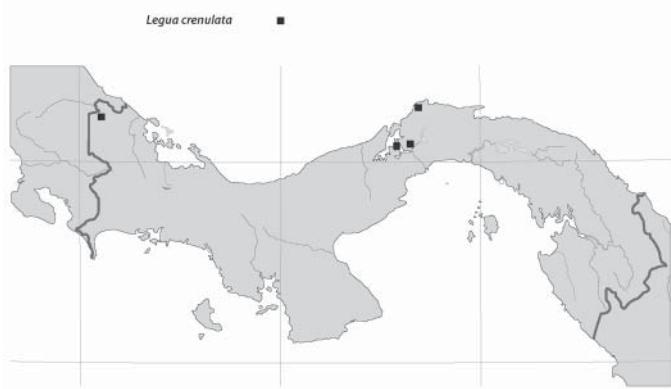
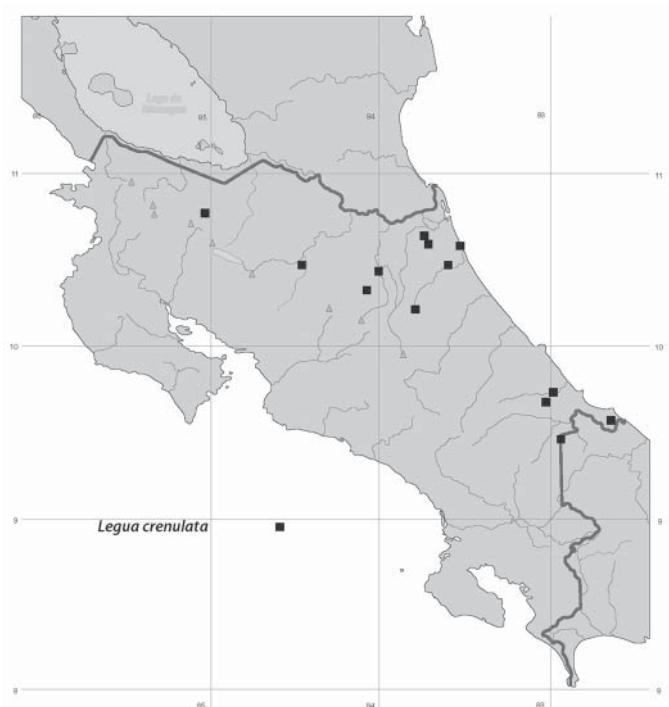


Fig. R11. *Legua crenulata*, male habitus.



Map R4A. *Legua crenulata*, localities in Panama.



Map R4B. *Legua crenulata*, localities in Costa Rica.

Key to Central American genera of Phaeopariini.
(modified from Carbonell 2002).

I Frons and vertex in side view forming an acute angle (ca 30°, see **Fig R15**); fastigium concave in side view, transition fastigium to frons angular. *Costarica* Koçak & Kemal 2008.
IA Frons and vertex in side view forming an angle of 40° or more; fastigium flat or convex in lateral view, transition fastigium to frons rounded (e.g. **Fig R12**). 2

2 Fastigium prominent and narrow in dorsal view, as long or longer than interocular distance. Tenth abdominal tergite of male deeply notched medially, often reaching margin of 9th tergite (**Fig. R12**). Male cerci simple, conical, straight or slightly curved inwards. *Phaeoparia* Stål 1873

2A Fastigium short and wide, shorter than interocular distance. Tenth abdominal tergite of male shallowly notched, not reaching 9th tergite. Male cerci usually abruptly bent inwards at mid length (**Fig. R11**), often with a bulbous apex.

..... *Maculiparia* Jago 1980

Maculiparia
Jago 1980

Author: Jago 1980: 21.

Type species: *Phaeoparia annulicornis* Stål 1873, by original designation.

Type locality: Colombia, Antioquia, Remedios.

Location of type specimen: Stockholm.

Subsequent literature.

- Carbonell C.S. 2002: 53. > Revision of Tribe.
- Rowell, C.H.F. 2006: I. > New species from Panama.

The genus was split from *Phaeoparia* Stål by Jago 1980.

No. species currently known.

Thirteen.

Range of genus.

Peru, Ecuador, Brasil, Colombia, Guyana, Venezuela, Panama.

Etymology.

Latin *macula*, spot, referring to the typical black spots on the female tegmen (see e.g. **Plate R10**) and “-paria” from the original genus *Phaeoparia*.

Diagnosis.

(Central American spp. only; South American species are more diverse, see Carbonell 2002).

Antennae filiform. Fastigium of vertex downwardly notched in lateral view immediately before its junction with the frontal ridge; head rounded and blunt in side view. Palps flattened and spatulate at tips, pale coloured. Male tergite A10 visible between the points of the furcula, which are widely separated. Male supra-anal plate complex, with a wide squarish basal part and a narrow tongue-like apical part. Male cerci bent sharply inwards apically, and slightly clubbed at the tip (**Fig. R13**). Male subgenital plate produced, somewhat rounded at the tip in dorsal view. Hind knee with small apical spine at end of dorsal carina, ventral lobes pointed. Eight to 9 external spines on hind tibia, 9-10 internal. External apical spine of hind tibia absent in all the Central American species. Females (and sometimes males too) have shiny black maculae on tegmina.

1. *Maculiparia rotundata* (Stål 1878)

Phaeoparia rotundata Stål 1878: 57.

Type locality: Panama, Chiriquí.

Location of type specimen: Vienna.

Subsequent literature.

- Giglio-Tos, E. 1897: 9.
- Kirby, W.F. 1910: 436.
- Bruner, L. 1900-1910 (1908): 297.
- Hebard, M. 1924b: 128.
- Hebard, M. 1933b: 130.
- Sjöstedt 1933:83.
- Jago, N.D. 1980: 221. > Transfers to *Maculiparia* n. g.
- Carbonell, C.S. 2002: 57. > Revision of genus.
- Rowell, C.H.F. 2006: I. > New spp.

Diagnosis.

Habitus, **Fig. R12, Plate R7**. Macropterous: tegmina with rounded apices, not quite reaching end of abdomen. Apex of fastigium in lateral view markedly convex and slightly produced. Anterior medial margin of prothorax straight or slightly concave. Posterior margin produced into an obtuse angle, which is however abruptly truncated. Posterior margin of 10th abdominal tergite of male arcuate, with little or no medial notch, and two widely separated, short, pointed furculae. Male cerci slender, somewhat clubbed at tip, incurved by less than 90° (**Fig. R13**). External apical spine of hind tibia absent.

Coloration.

For this tribe, a brightly coloured species. Antennae cream basally, black apically, black and cream in midlength. Head pale yellow, except for dark brown post-ocular stripe. Palps white. Disc of pronotum pale yellow, lobes dark brown. Thoracic pleura, dark brown. Anal area of tegmina yellow (continuing the colour of the pronotal disc when the wings are folded), anterior portion dark brown, with a single dark spot, becoming pinkish towards the tip; wings salmon pink. Abdominal tergites reddish brown. Male terminalia yellowish, tinged with salmon pink at edges and

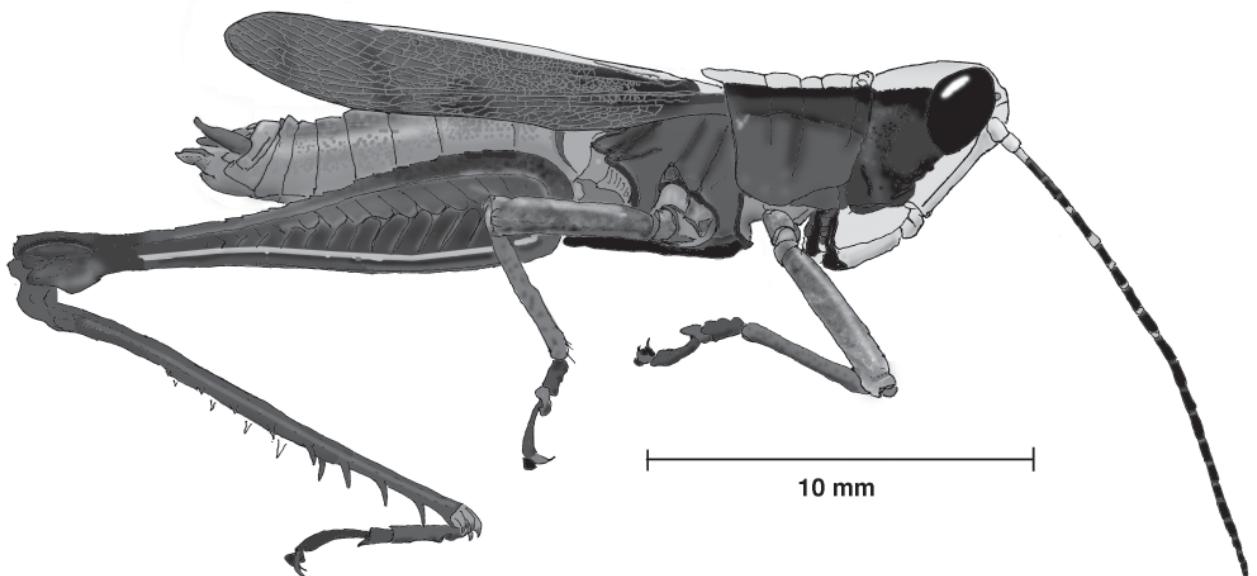


Fig. R12. *Maculiparia rotundata*, male habitus.

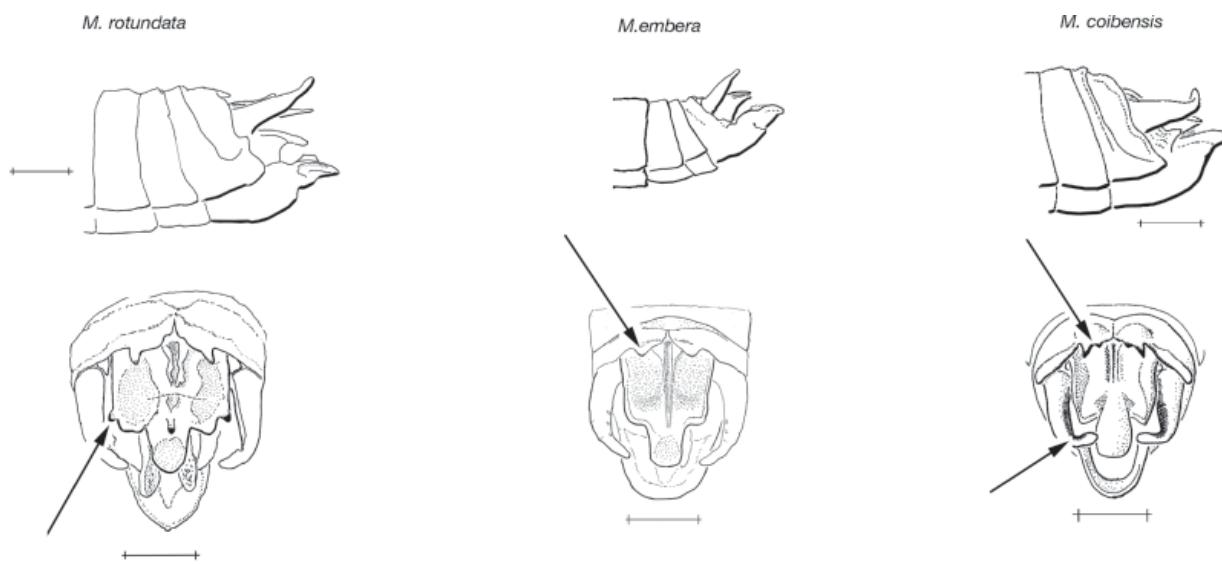


Fig. R13. *Maculiparia* spp., male terminalia. Scale bars, 1 mm. The arrows indicate diagnostic features.

extremities. Legs dark green; lower lobe of hind knee, hind tibia and tarsi rose red. Underside of feet blackish brown, tarsal spines black.

Females dull dark brown, underside lighter. Outer ventral carina of hind femur tinged with orange, outer ventral face dark blackish brown. Tibiae and tarsi mottled black and brown. Tegmina decorated with two shiny black spots.

Field characters.

In the field, males are conspicuous, with dark brown and yellow coloration of head and thorax and dark green and red hind legs; they fly readily, showing the pink hind wing. Females are heavy, passive, dull brown and cryptic.

Distribution.

Panama, from Prov. Darién west to at least Prov. Coclé (the type locality is Chiriquí, (most probably the lowland city of Chiriquí Viejo) but there are no modern records from that most Western province); Western Colombia (Valle del Cauca, Nariño); Ecuador (Bolívar, Pichincha, Guayas, Tungurahua). Note the exclusively southern Central American distribution; it does not get into the Andes or the Magdalena Valley, and is absent from Costa Rica.

The South American forms are placed by Carbonell (2002: 59) in the subspecies *Maculiparia rotundata carrikeri* (Hebard), in which the tegmina are longer and truncated at the tip. The nominate subspecies is the Panamanian form. **Map R5.**

Natural history.

Abundant in forest clearings, forest edges, and along forest paths where there is grass.

2. *Maculiparia coibensis* Rowell 2006

Maculiparia coibensis Rowell 2006: 2.

Type locality: Panama: Provincia Veraguas: Isla Coiba: Playa Blanca-Cativales.

Location of type specimen: ANSP.

Etymology.

Coming from Isla Coiba, the type locality.

Diagnosis.

Habitus, **Fig. R14, Plate R8.** Smaller than *M. rotundata*; P, L, and F (male/female) respectively 3.81/5.53. 19.01/31.20, and 12.69/16.50 mm. Brachypterous: tegmina extend into 2nd abdominal tergite. Dorsal and lateral surfaces of thorax moderately rugose, integument of abdomen smooth and polished. Apex of fastigium truncated and vertical in lateral view; in *rotundata* it is markedly convex and somewhat produced. Anterior medial margin of pronotum slightly convex;

posterior margin produced to a blunt obtusely angulate point, not truncated. Male furculae similar to those of *M. rotundata*, but processes more pointed and melanised. Male cerci slender, slightly clubbed at apex, curved inwards by more than 90 ° (**Fig. R13**). Sexual dimorphism pronounced, L_{male}/L_{female} = 0.61, P_{male}/P_{female} = 0.69. External apical spine of hind tibia absent.

Coloration.

Male: entire dorsal surface, from fastigium to supra-anal plate, including the dorsomedial region of the eyes and the trailing edge of the elytra, pale straw colour.

Remainder of eye, postocular stripe, leading edge of elytron, and abdominal pleura, dark brown. Lobes of pronotum, thoracic pleura, upper and outer faces hind femora, light chestnut. The male tegmen does not bear black spots. Hind knee, tibiae and tarsi darker coloured, brown tinged olive green. Front and middle legs, straw. Antennae pale basally, dark brown from 3rd flagellar segment to apex.

Female: dull brown throughout, with three blackish brown spots on the tegmen, and small black markings at the anterior and posterior margins of the pronotum. The hind knees are darker than the general body colour.

Distribution.

Known to date only from the island of Coiba, off the SW coast of Panama. The mainland in this region is largely deforested, but the species has not been found in the relict forests of the area, and *M. coibensis* may be a true island endemic. It is sympatric on Coiba with *M. rotundata* (De Gracia & Cambra, 2002). **Map R5.**

3. *Maculiparia embera* Rowell 2006

Maculiparia embera Rowell 2006:4.

Type locality: Panama, Prov. Darien, Comarca Emberá, Rio Sambú, Jigurundó.

Location of type specimen: ANSP.

Etymology.

Named for the Emberá, indigenous people of Eastern Panama, in whose territories the species occurs.

Diagnosis.

Habitus, **Fig. R15, Plates R9 & R10.** Smaller than *M. rotundata*, but slightly larger than *M. coibensis*; P, L, and F (male/female) respectively 4.09/6.02, 20.16/29.43, and 13.44/18.5 mm. Sexual dimorphism pronounced, L_{male}/L_{female} = 0.68. Seven to eight external hind tibial spines, median value 8; nine to 10 internal spines, median value nine. External apical spine of hind tibia absent.

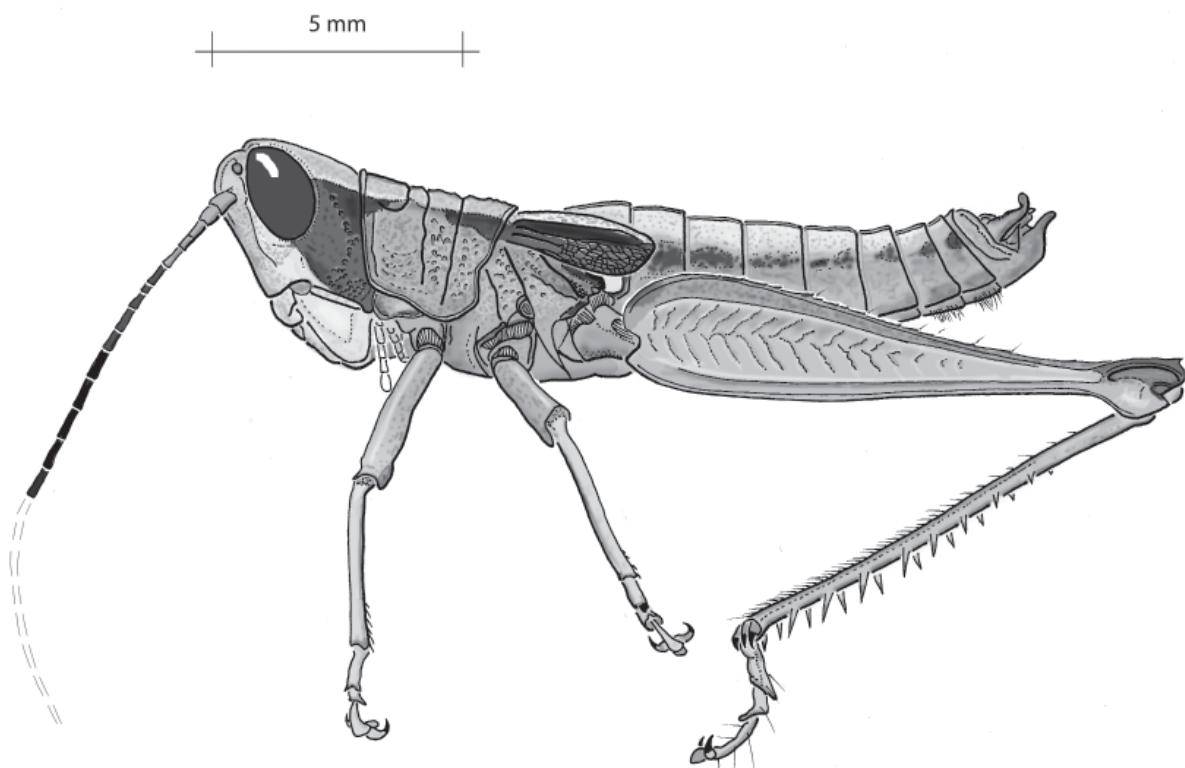


Fig. R14. *Maculiparia coibensis*, male habitus.^a

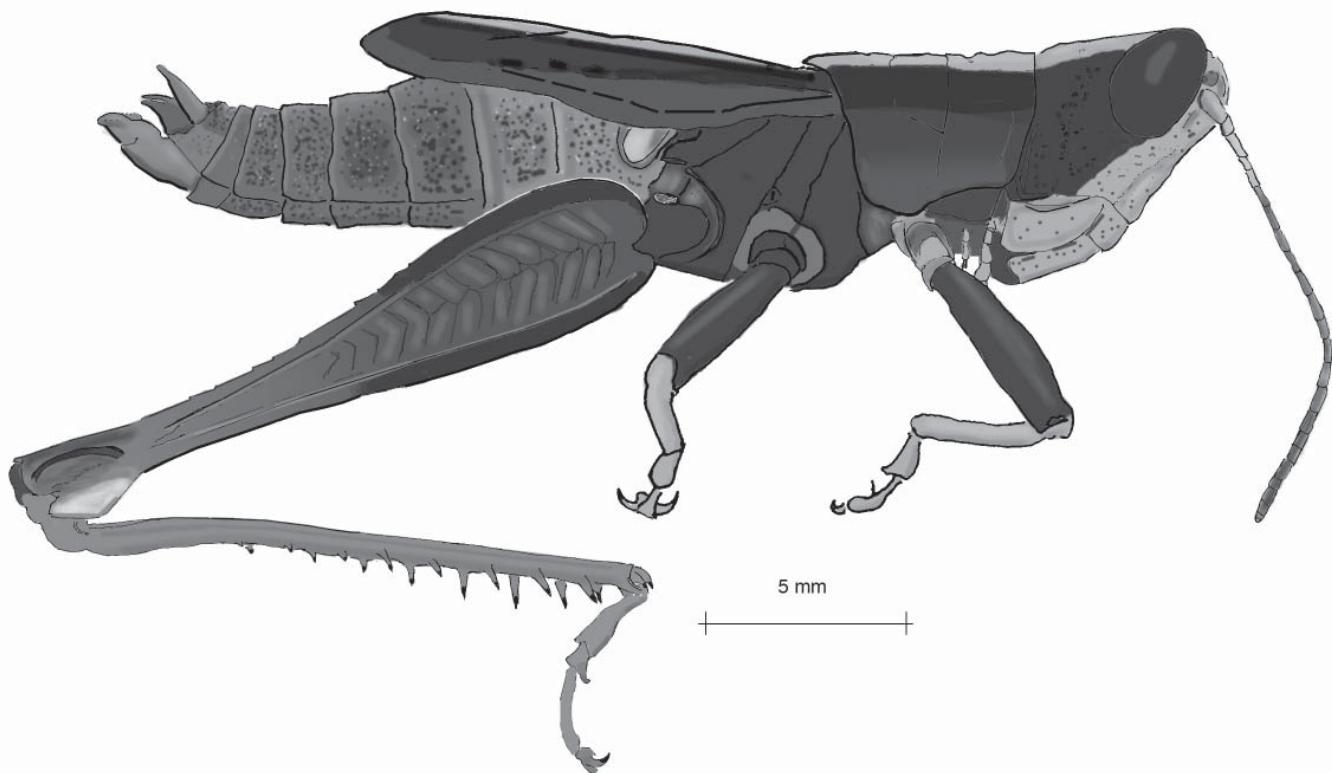


Fig. R15. *Maculiparia embera*, male habitus.

Rostrum slightly longer than in *M. rotundata*, and frons more concave in lateral view. Slightly brachypterous: tegmina vary in length, and in different individuals extend into 3rd, 4th, or 5th abdominal segment.

Trailing edges of the tegmina touching and overlapping slightly in midline. Dorsal and lateral surfaces of thorax moderately rugose, integument of abdomen smooth and polished. Anterior medial margin of pronotum slightly convex, posterior margin produced rearwards to a bluntly rounded point, which is not truncated as it often is in *M. rotundata*.

Terminalia (Fig. R13). Male furcula distinctly different from that of both *M. rotundata* and *M. coibensis*, with two small rounded projections placed close to the midline. Supra-anal plate subquadrate proximally, with a medial groove and rounded distal corners, terminating distally in a truncate lingulate process. Male cerci slender, slightly clubbed at apex, but curved gently inwards by less than 90° in dorsal view; the other two species have more abruptly incurved cerci (Fig. R13). Internal male genitalia differ from those the other two species principally in having the dorsal margin of the lophi prominently excavated by a V-shaped notch. The cingular apodemes are shorter and wider, the cingulum tending towards a discoid shape in dorsal view.

Posterior edge of female subgenital plate almost straight, slightly notched in the midline, and with a sharply inflected egg guide. Ovipositor valves smooth and pointed. Antennae with 23 segments, slightly shorter than in the male. Bursa copulatrix short and simple. Spermatheca simple, with a very short preapical diverticulum.

Coloration.

Male: antennae pale yellow basally, then blackish brown to apex. Entire face pale yellow, with sparse darker spotting. Dorsal surface of head and thorax, from fastigium to the ends of the elytra, pale straw colour. Eye, postocular stripe, upper lobes of pronotum, leading edge of elytron, thoracic pleura, dark brown shading to blackish dorsally. Lower lobes of pronotum chestnut; abdomen, upper and outer faces of hind femora, varying shades of brown, lighter than the thoracic pleura. The lower external carina of the femur bears a narrow yellow stripe, more conspicuous in fresh specimens. Hind knee darkly coloured dorsally, paler ventrally. Hind femur rarely dark green, but usually brown. Hind tibia and tarsi, bright red. Front and middle tibae and tarsi straw, femora dark brown. Male tegmen bears traces of black spots similar to those of the female. Wing orange.

Female: dull brown throughout, with 3 blackish brown spots on the tegmen, and small black markings at the anterior and posterior margins of the pronotum. The hind knees are darker than the general body color.

Distribution.

Widely distributed and sometimes common in forested areas of the Pacific drainage of Darien province. It is not known whether it occurs in the Caribbean drainage of that province.

Map R5.

Natural history.

Typically phaeoparine, found in native grasses in forest light gaps and along trails through forest.

All our three species of *Maculiparia* appear to be members of the *annulicornis* species group (Carbonell 2002), and include its only brachypterous members if so.

Phaeoparia Stål 1873

Stål 1873b: 36, 56.

Type species: *Gryllus (Locusta) lineaalba* Linnaeus 1764: 150. Type locality (of neotype): French Guiana, Trois Sauts (Oyapock). See Carbonell 2002:36 for details.

Etymology.

"Greek *phaeos*, dusky brown, and *pareio*, *pareion*, cheek, probably alluding to the conspicuous brown postocular and genal band present in all species known by Stål" (Carbonell 2002: 32).

Subsequent literature.

- Amedegnato, C. 1974: 199.
- Jago, N.D. 1980: 218. > Redescription of genus.
- Carbonell, C.S. 2002: 40. > Review of genus.

Synonymy.

=*Saparus* Giglio-Tos 1898: 60, synon. Jago 1980: 218.

Aristia Stål 1876: 54, synon. with *Phaeoparia* by Jago 1980: 218, was reinstated by Carbonell 2002:32. It is monotypic (*A. mordax* Stål), and occurs only in Colombia.



Map R5. *Maculiparia* spp., localities in Panama.

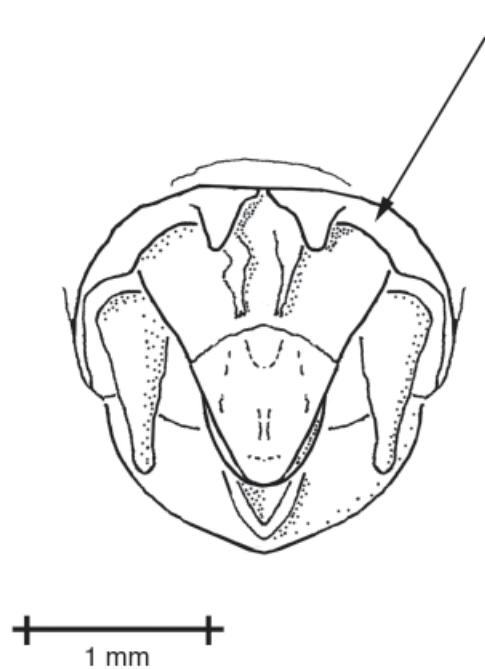


Fig. R16. *Phaeoparia phrygana*: male terminalia, dorsal view. The arrow indicates the deeply notched abdominal tergite X, characteristic of the genus.

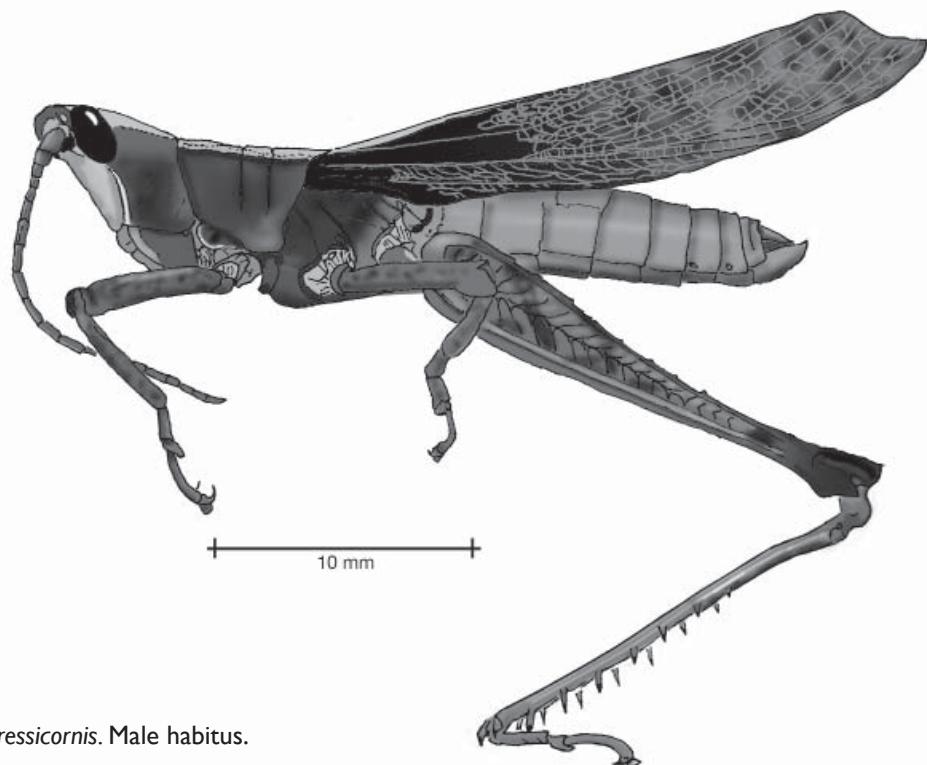


Fig. R17. *Phaeoparia depressicornis*. Male habitus.

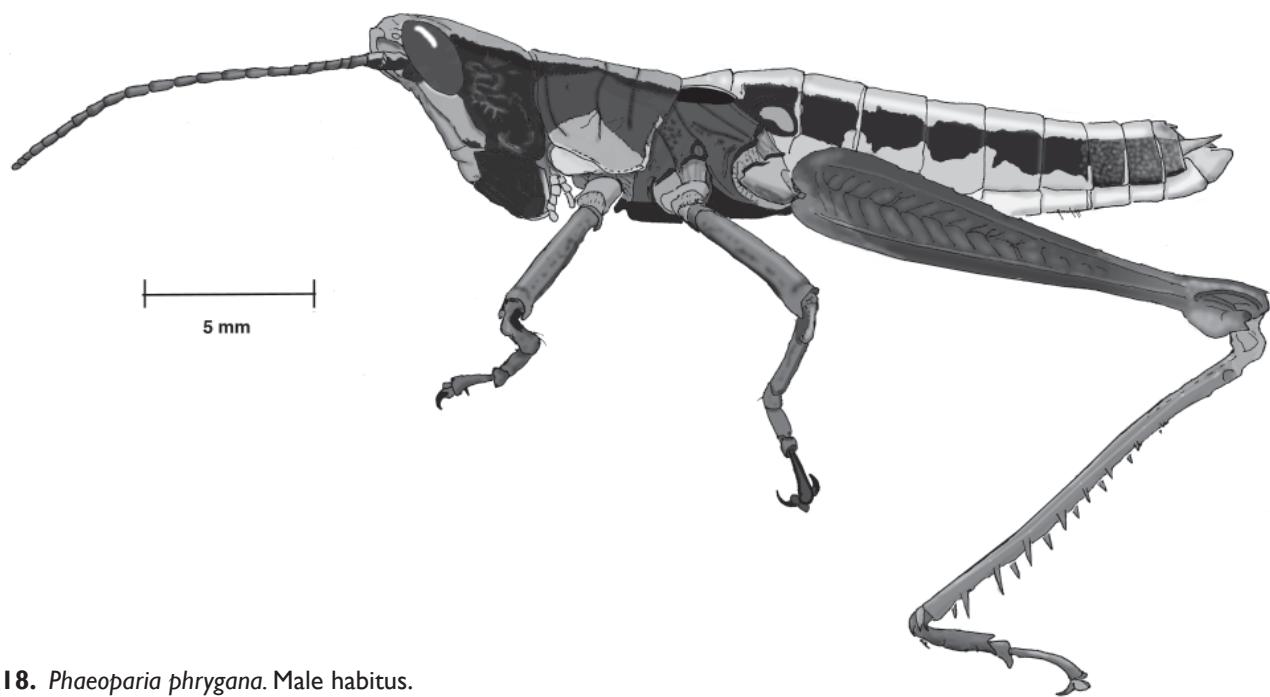
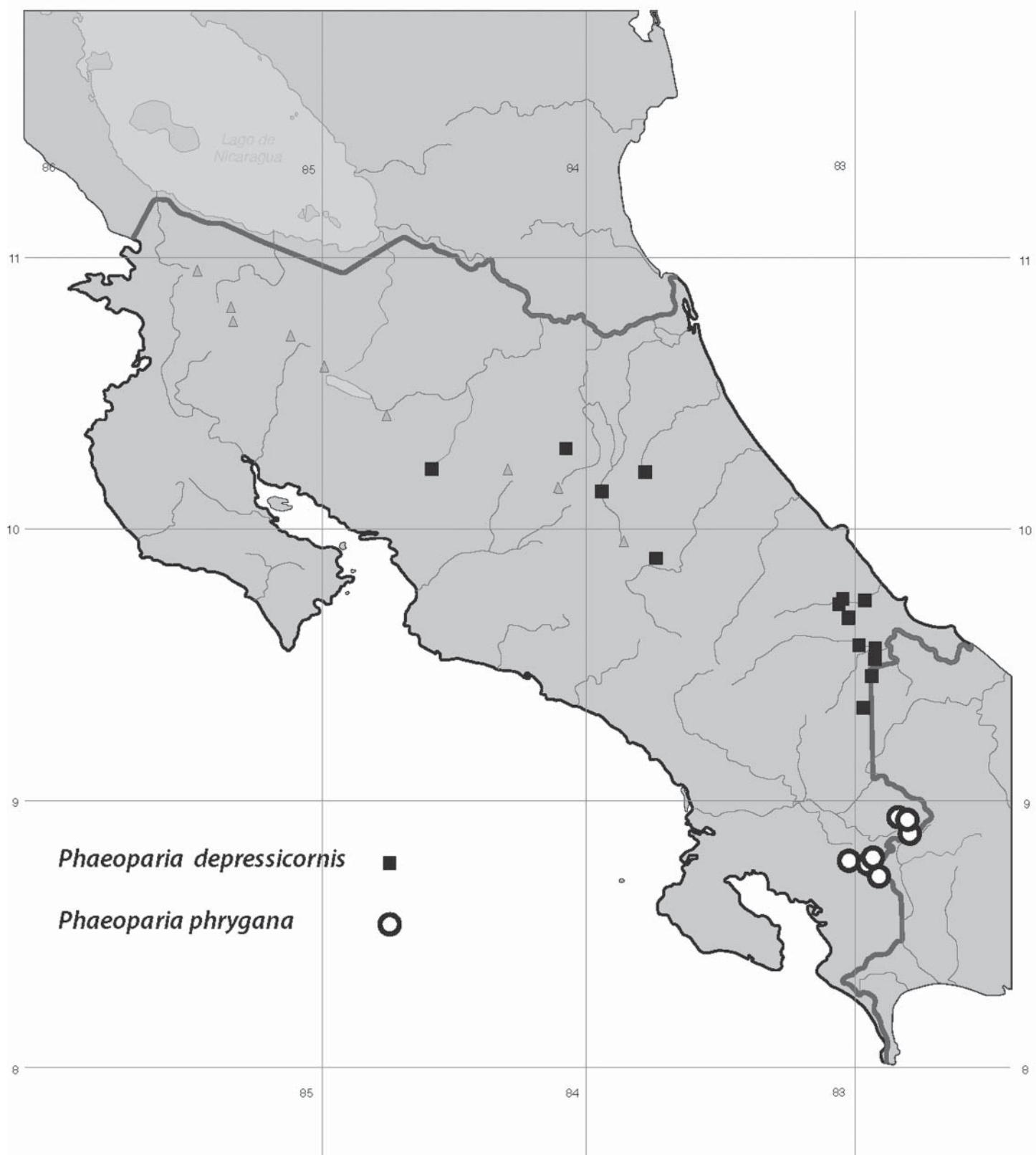


Fig. R18. *Phaeoparia phrygana*. Male habitus.



Map R6. *Phaeoparia* spp., localities in Costa Rica.

Diagnosis.

(C. American species only) Male: tergite of Abd.10 with deep medial incision reaching to tergite 9 between the closely spaced furculae (see **Fig. R16**); furculae simple and triangular. Supra-anal plate simple, triangular, with rounded tip. Cerci simple, straight. External apical spine of hind tibia present or absent. Tegmina never bear the shiny black spots characteristic of females of *Maculiparia*.

1. *Phaeoparia depressicornis* (Bruner 1908)

Aristia depressicornis Bruner 1900-1910 (1908): 277.

Type locality: Juan Viñas, Costa Rica.

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *depressus*, flattened, and *cornu*, horn. Refers to the ensiform antennae.

Subsequent literature.

- Kirby, W.F. 1910: 475.
- Rehn, J.A.G. & Hebard, M. 1912: 120. > Designation of lectotype.
- Hebard, M. 1924a: 129.
- Otte, D. 1978: 28.
- Jago, N.D. 1980: 219. > Transfers to *Phaeoparia*.
- Carbonell, C.S. 2002: 43.

Diagnosis.

Habitus, **Fig. R17, Plate R11**. Antennae ensiform, and rather long in the male. Macropterous, tegmina reach to hind knees and comfortably exceed the abdomen; wide relative to their length and obliquely and concavely truncate at their tips. Anterior margin of pronotum weakly emarginate, posterior margin obtuse angular; in male the division between disc and lateral lobes is angular, though lateral carinae are not present. External apical spine present. Male subgenital plate somewhat elongate and pointed. Teeth of male furculae short and acute.

Male internal genitalia are figured by Carbonell 2002: Fig. 61.

Field characters.

Size, marked sexual dimorphism, concavely truncate elytra, ensiform antennae and habitat in damp forest grasses all suggest *Metalepta* at first sight. Distinguished from that genus at rest by its much heavier head and in flight by the orange or rose-pink hind wings. Flight is rather weak, and usually occurs only in males. General colour of male shades of brown, with a paler dorsal stripe. The elytra are blotched in darker brown and their venation is dull yellowish. Hind tibiae and tarsi red, the front legs are often olive green. Females are large (45 mm overall length) and sluggish and a uniform dark brown.

Distribution.

Caribbean slope of most of Costa Rica (to 600 m) and of Panama (to 1300 m) from Bocas del Toro to Darién. Hebard's (1924) doubts as to the accuracy of Giglio-Tos's identification of a Darién larva are unjustified, undoubtedly adults have recently been recorded from there. May well extend north into Eastern Nicaragua. Patchy in distribution, e.g. it is apparently absent from the Sarapiquí, though it occurs commonly nearby, for example near Guápiles.

Natural history.

Found in native forest grasses in light gaps and along trails in wet forest. Hind wings often attacked and sometimes completely destroyed by mites. Sometimes very abundant, especially in Prov. Bocas del Toro of Panama. Graminivorous.

2. *Phaeoparia phrygana* Jago 1980

Jago 1980: 222.

Type locality: Costa Rica, Prov. Puntarenas: S.Vito de Jaba, Finca Las Cruces.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *phryganon*, dry stick, firewood, probably a reference to the dull coloration, especially of the female.

Subsequent literature.

- Carbonell, C.S. 2002: 44.

Diagnosis.

Habitus, **Fig. R18, Plate R12**. Much smaller than *Ph. depressicornis*. Very brachypterous, tegmina do not reach tympanum. External apical spine absent. Antennae only slightly ensiform, almost filiform in males. Anterior and posterior margins of pronotum medially emarginate. Male subgenital plate rather short and rounded. Teeth of male furculae short and blunt.

Male internal genitalia are figured by Carbonell 2002: Fig. 58.

Field characteristics.

In the field, males are relatively conspicuous with bright black and yellow coloration and are slim and active in habit. Females are heavy, passive and cryptic, dull brown in colour.

Distribution.

Extreme SW Costa Rica, on southern Fila Costeña and the Pacific slopes of the Talamanca range to 1700 m altitude, and extending to Volcan Barú in western Panama. **Map R6, R7**.

Natural history.

In native grasses in forest light gaps and along trails



Map R7. *Phaeoparia* spp., localities in Panama.

through forest. Very sporadic, sometimes fairly common, usually rather scarce.

Costarica
Koçal & Kemal 2008

Koçal & Kemal 2008: 3.

Type species *Rowellia costaricensis* Carbonell 2002: 30.

Etymology, synonymy.

Replacement name for *Rowellia* Carbonell 2002, preoccupied by *Rowellia* Carpenter 1864 (Mollusca).

Diagnosis.

Habitus, **Fig. R19, Plate R13.** Body elongate and compressed, especially in male; sexual dimorphism in size pronounced. Macropterous, tegmina extending beyond both hind knees and tip of abdomen, obliquely and concavely truncate at the apices. Antennae ensiform, especially in female. Head elongate. Fastigium in dorsal view triangular, longer than the interocular space, with lateral carinulae. Face strongly backward slanting, straight or slightly concave in profile. Eyes long, narrow, slanting. Anterior margin of pronotum minutely emarginate medially, posterior margin obtuse angulate, truncated. External apical spine of hind tibia present. Male furculae broad and triangular, pointing outwards, close together, separated by a deep medial notch extending to the 9th tergite. Cerci simple, slender, slightly curved inwards; subgenital plate elongate, acutely pointed.

Male internal genitalia are figured by Carbonell 2002: Fig. 58; the cingulum is an unusual shield-like structure, having the apodemes largely united medially, and its posterior end wide and bifurcated.

I. *Costarica costaricensis* (Carbonell 2002)

Carbonell 2002: 31, as *Rowellia costaricensis*.

Type locality: Costa Rica, Prov. Heredia, Puerto Viejo de Sarapiquí, Finca La Selva.

Location of type specimen: ANS Philadelphia.

Diagnosis.

Monospecific genus, the generic diagnosis applies.

Field characters.

At first sight very reminiscent of *Metalepta brevicornis* (Acrididae, Acridinae) with which it shares the ensiform antennae, truncate elytra, yellowish back wings visible in flight, and preference for moist grassy places. Distinguished by the rather heavier head, and (in the hand) by the prosternal process and the external apical spine. Can be distinguished from *Phaeoparia* by the more slender and more laterally compressed form, the pointed and markedly opistognath head, and the yellow, not pink, hind wings.

Distribution.

Caribbean plain of Eastern Costa Rica. Known from the lower Sarapiquí, from the area north of San Ramón (up to 1000 m) and from the Valle de la Estrella. This is the most northerly species of the tribe known to date. **Map R8.**

Natural history.

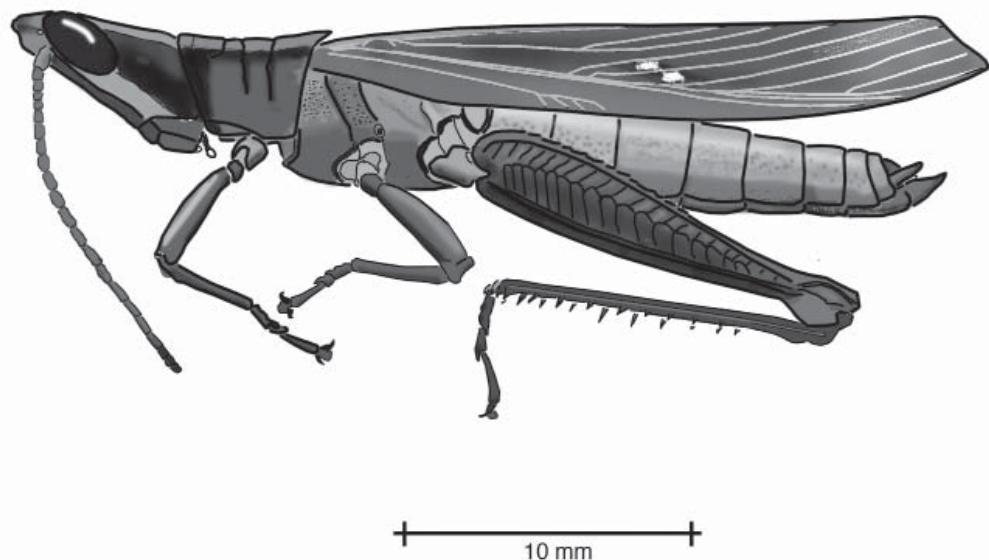
A rare inhabitant of grassy places in lowland Caribbean rain forest, including both natural light gaps and man-made clearings. The female is more agile and prone to flight than in most Phaeoparines.

Syletria
Rehn 1905

Rehn 1905: 433.

Type specimen *S. angulata* Rehn 1905: 433.

This is a synonym of *Coptacra* from S. E. Asia (formally synonomized by Carbonell 2002: 6). Rehn erroneously described it as coming from Carrillo, Costa Rica, apparently due to a labelling error originating in the ANS Philadelphia. He originally suggested it might be related to *Saparus*, a South American Phaeoparin genus now synonomized with *Phaeoparia*.



10 mm

Fig. R19. *Costarica costaricensis*, male habitus.



Map R8. Known localities of *Costarica costaricensis*.

Tribe Prionolophini Rehn & Grant 1959

Diagnosis.

Pronotum with medial carina forming a regularly arcuate or subarcuate crest, with highest point in metazona. Posterior margin of pronotum acute angular, produced. Internal tibial spines slightly longer than external spines. Male furcula absent. Male subgenital plate produced, with entire apex. Prosternal process thickened, laterally compressed, with blunt apex.

Current genera.

Rehn and Grant (1959) included here *Alcamenes*, *Prionolopha* and *Xyleus*, as well as various synonyms of these three genera. Only *Xyleus* extends into Central America.

The OSF does not recognize Rehn and Grant's tribes, and places these three genera, together with most other Romaleine genera, in a tribe Romaleinae Brunner von Wattenwyl. Carbonell (2004), however, considers *Xyleus*, *Prionolopha* and *Colpolopha*, but not *Alcamenes*, to form a natural group. Rehn and Grant placed *Colpolopha* elsewhere, in their *Colpolophini* (see p. 85 above)

Caudell (1932) rediscovered Gistel's early work.

Carbonell (2004: 65) summarizes the nomenclatural history of the genus.

Etymology.

Greek *Xyleus*, woodcutter. Carbonell (2004) suggests the origin of the name lies in the resemblance of most species to chips of wood (Greek *xylon*).

No. of known species.

Twenty. In our area, only one, with two subspecies.

Range of genus.

Argentina, Paraguay and Uruguay to Mexico, but omitting regions which are climatically speaking exclusively wet forest. The genus favours sparse dry forest and wooded savanna or park land. The centre of distribution, where all species are currently found, is in south-central South America.

Generic diagnosis.

(After Carbonell 2004) Head: antennae flattened, slightly to moderately ensiform: eyes large, elliptical, moderately prominent, more so in males than in females; vertex prolonged before eyes in a triangular fastigium, somewhat excavated dorsally; dorsal medial carinula running from fastigium to occiput.

Pronotum: dorsal carina elevated, crest-like, cut by 3 transverse sulci; lateral carinae prominent, diverging to the rear; lateral lobes vertical, in definite angle with disc; prosternal tubercle compressed or swollen, always retrose. Meso- and meta-sternal spaces subquadrate. Tegmina and wings well developed in all known species excepting *X. campisi* (Ecuador) which is brevialate. Tegmina rather narrow, with marked precostal lobe and variously shaped apices. Wings wide, stridulatory area well developed in both sexes. Remigium rather narrow, usually coloured in shades of brown, fuscous or umber, like the tegmina. The whole margin of the vannal area is marked by a dusky band of the same colour as the remigium, rather wide at its limit with the remigium but gradually narrowing backwards. The rest of the vannum is coloured in variable shades of scarlet to orange. This colour may be different in different species, and also variable within each species.

Legs not particularly strong, except the hind ones: hind femora with well marked carinae, the medial dorsal one more or less markedly serrulate, the upper external and media ventral ones frequently so. Brunner's organ present. Hind tibiae armed with rather large spines, apical external spine present. Male abdominal terminalia with dorsum of 10th segment deeply incised medially, supra-anal plate rhomboidal, cerci straight, subconical, subgenital plate apically pointed. Male genitalia species-specific, form of cingulum and apical endophallic valves particularly useful as species characters. Female with ovipositor of the soil-laying type.

Xyleus Gistel 1848

Gistel 1848: XI.

Type species: *Tropinotus discoideus* Serville 1831: 273.

Type locality: Brazil. Location of type specimen: MNHN Paris.

=*Tropinotus* Serville 1831: 272.

- Walker 1870: 529.
- Stål 1873a: 52; 1873b: 27; 1876a: 37 (as *Tropeonotus*).

=*Tropidonotus* Stål 1878a: 14; 1878b: 19.

[Both *Tropeonotus* & *Tropidonotus* preoccupied by reptile genera: new names accordingly erected by both Gistel 1848: XI (*Xyleus*) and Bolívar 1906: 396 (*Diedronotus*).]

=*Diedronotus* Bolívar 1906: 396, synon. Caudell 1932: 3.

- Bruner 1900-1910 (1907): 225.
- Kirby 1910: 359.
- Rehn 1918: 329.
- Uvarov 1940c: 379, as *Xyleus*.
- Uvarov & Dirsh 1961: 158, as *Xyleus*.
- Amedegnato 1974: 198, as *Xyleus*.
- Carbonell 2004: 63 (revision of genus).
- Campos de Domenico 2005 (larval development).

Gistel's generic name was overlooked for nearly a century. In the first decades of the 20th century Bolívar's replacement name, *Diedronotus*, was universally used, until

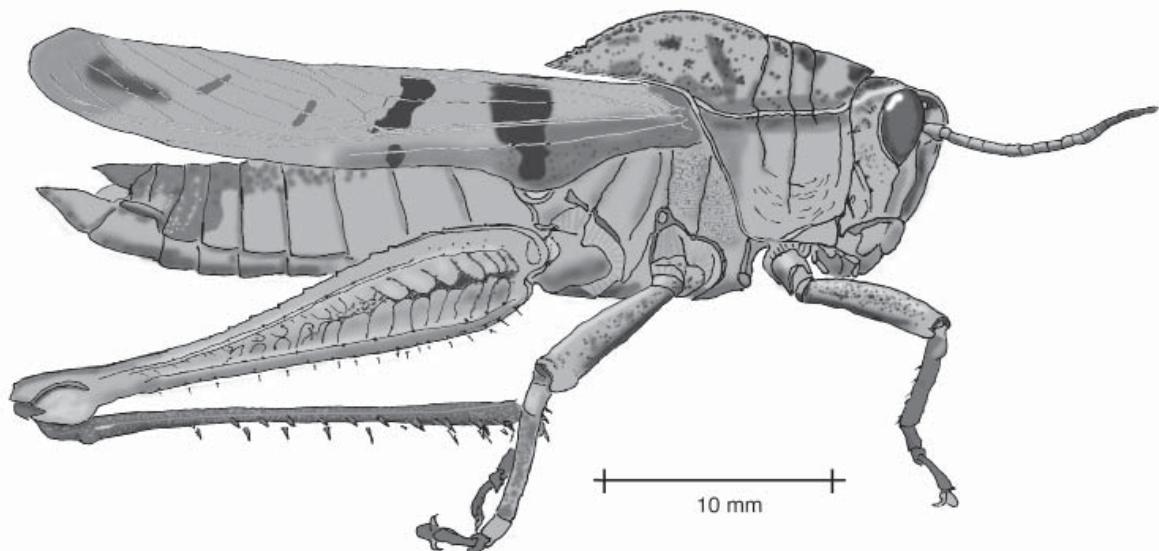


Fig. R20. *Xyleus discoideus mexicanus*, male habitus.

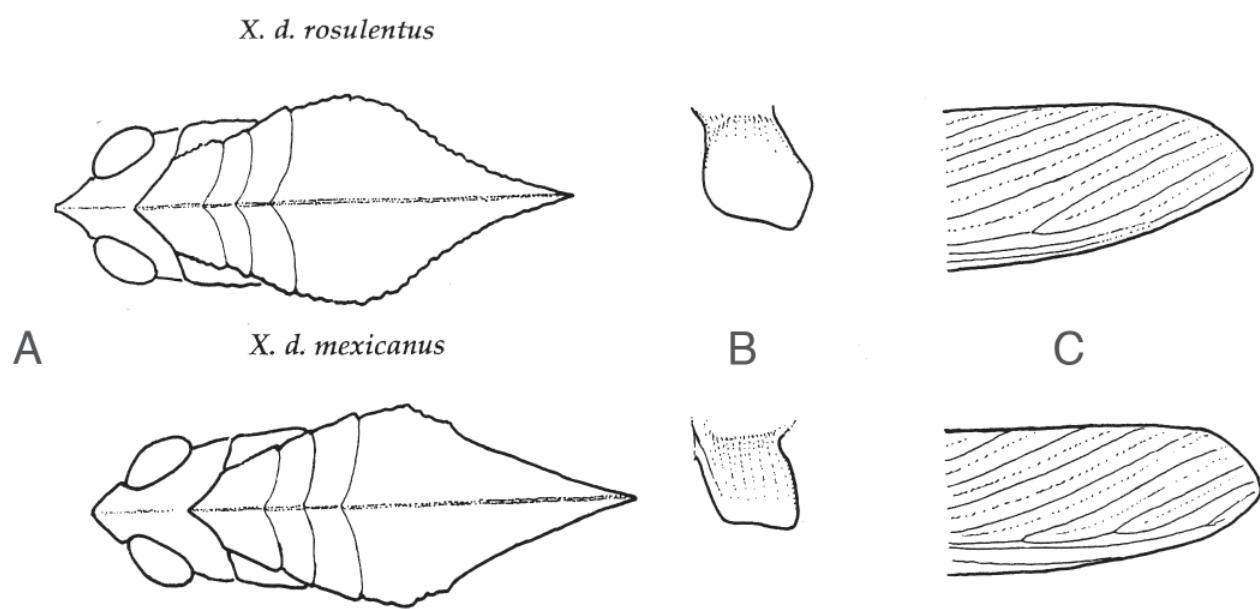


Fig. R21. *Xyleus*: differences between the subspecies *X. d. mexicanus* and *X. d. rosulentus*. A, head and pronotum, dorsal view. B, prosternal process viewed from the left side. C, tip of elytron. (After Carbonell, 2004.)

Field characters.

The combination of the high pronotal crest and the pink, black-banded hindwings is unmistakable in the field. Flying males can be mistaken for a pink-winged oedipodine, but the females are much larger than any local oedipodine species. The flight path is also straighter than that of an oedipodine. Adults are usually various shades of grey, yellow or brown, rarely green; larvae are uniformly green or (rarely) brown, and can be recognized by the extreme lateral compression and the very high pronotal crest (**Fig. R22**, opposite), more exaggerated than that of the adult.

Natural history.

Xyleus is polyphagous, mostly eating Asteraceae, Malvaceae and other herbaceous dicotyledenous plants in clearings, forest edges, or in wooded savanna. In South America it has been described as eating various agricultural crops, such as tobacco and sugar cane, and garden plants, but is rarely if ever important (COPR, 1982). In Guanacaste larvae are common between June and September, and adults continue to be present throughout the dry season, from December to March, which is unusual in Costa Rican grasshoppers.

Distribution.

Hebard (1924) and later Carbonell (2004) both consider that the two Central American taxa *X. rosulentus* (Stål 1878) and *X. centralis* (Rehn 1918) [=*mexicanus* (Bruner 1906)] are conspecific, and give their range as Nicaragua to Colombia. In Costa Rica *Xyleus* is common in dry woodland of the Pacific slope, from northern Guanacaste to at least the Río Térraba in the south, including the Pacific drainage of the Meseta Central. There is a single record from Cachí (Prov. Cartago), on the Caribbean side of the watershed (**Map R9**). In Panama most records are from the Canal Zone (Provs. Panama and Colón), but it is also found in the Provs. Chiriquí, Veraguas, Herrera, Coclé, Darién, and probably elsewhere (**Map R10**).

The northern part of the range of *Xyleus* is occupied exclusively by the species *X. discoideus* (Serville 1831). This species extends from Uruguay northwards along the coast of S. America, with the exception of the Amazonian area, into Venezuela and on into Central America. It was divided by Carbonell (2004) into 5 local subspecies, two of which occur in our area. These subspecies are defined primarily by genital characters, and are rather difficult to distinguish externally.

I. *Xyleus discoideus mexicanus* (Bruner 1906)

Tropidonotus mexicanus Bruner 1906: 645, 1907:225.

Type locality: Mexico, Yucatan, Temax.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Kirby, W.F. 1910:360. > As *Diedronotus mexicanus*.
- Muma, M.H. 1952:5.

- Rehn, J.A.G. & Grant, H.J. 1959: 250. > As *Xyleus mexicanus*.
- Descamps, M. 1975:52, 1976: 298.
- Otte, D. 1978: 35.
- Carbonell, C.S. 2004: 79. > New status as subsp of *X. discoideus*.

Synonymy.

=*Diedronotus centralis* Rehn 1918: 329, synonomized by Carbonell (2004: 80).

Type locality: El Pelón, Guanacaste Prov., Costa Rica.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Bruner, L. 1900-1910 (1907): 225. > Misidentified as *Tropidonotus rosulentus* Stål.
- Caudell, A.N. 1932: 3. > Transfers to *Xyleus*.
- Hebard, M. 1932: 29.
- Rehn, J.A.G. & Grant, H.J. 1959: 250.
- Otte, D. 1978: 55.
- Carbonell, C.S. 2004: 80. > Synonym of *X. d. mexicanus*.

Diagnosis.

Habitus, **Fig. R20. Plate R14**. In dorsal view, pronotum shows lateral angles almost rounded, but marked with small lateral points (**Fig. R21**). The tips of the elytra are more rounded than in *X. d. rosulentus*, and the prosternal tubercle in lateral view is more nearly subrectangular (**Fig. R21**). The best characters for identification are in the phallic complex, especially the posterior end of the cingulum (see Carbonell 2004, Fig. 6). Number of hind tibial spines: 10-13.

Coloration is very variable, most commonly ochre or light brown, sometimes green, with greater or lesser degrees of darker markings. The elytral bands are always dark brown, the hind wings orange or rose.

Distribution.

Common in suitable habitats throughout Guanacaste Province and the northern part of Puntarenas Province, Costa Rica. **Maps R9 & R10**.

2. *Xyleus discoideus rosulentus* (Stål 1878)

Trapidonotus (sic) *rosulentus* Stål 1878: 19.

Type locality: Nova Grenada (= Colombia), Damel.

Location of type specimen: Stockholm.

Subsequent literature.

- Bruner, L. 1900-1910 (1907): 225. > As *Tropidonotus rosulentus*.
- Hebard, M. 1924: 102. > As *Diedronotus rosulentus*.
- Rehn, J.A.G. 1913: 330. > In Argentina; as *Diedronotus discoideus*.
- Carbonell, C.S. 2004: 80. > New status as subsp of *X. discoideus*.

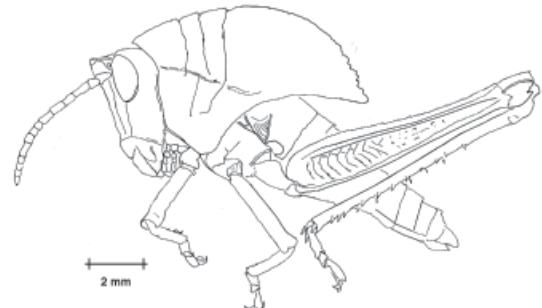
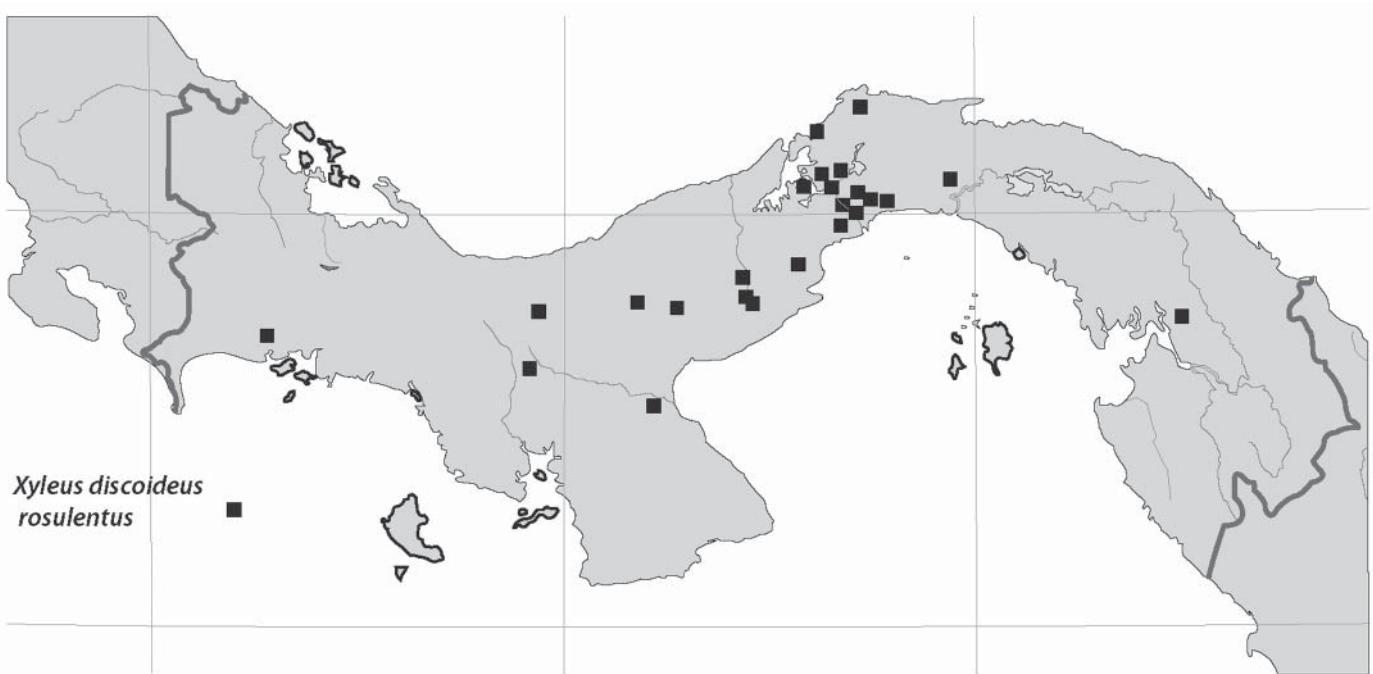
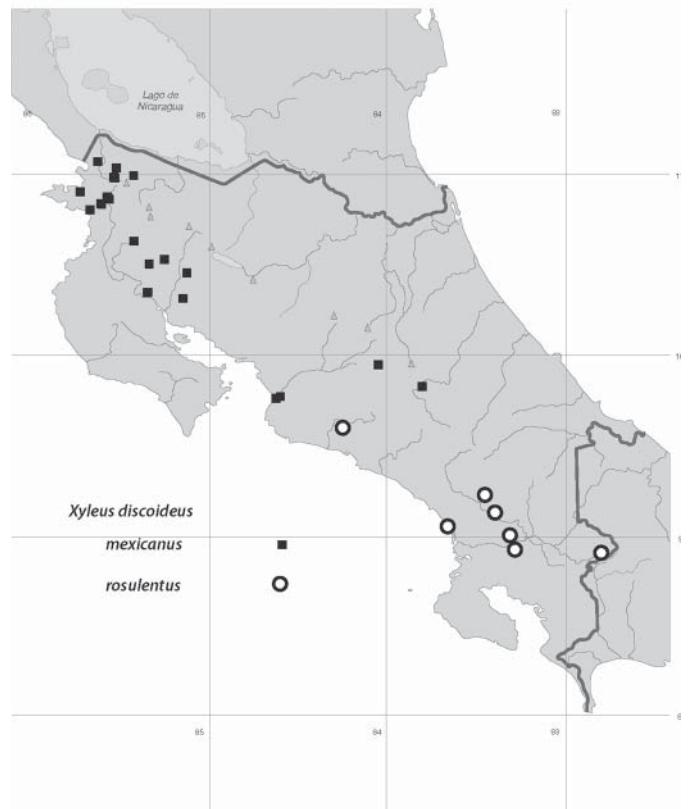


Fig. R22. *Xyleus d. mexicanus*. Female third instar larva, to show the disproportionately large pronotal crest characteristic of all larval stages. Their coloration is plain green.



Diagnosis.

In dorsal view, pronotum shows lateral angles completely rounded, without any traces of angulation. (**Fig. 21**). Best characters for identification are in the phallic complex, especially the cingulum (see Carbonell 2004, Fig. 6). Number of hind tibial spines: 10-11, usually fewer than in *X.d. mexicanus*.

Coloration is again very variable, most commonly ochre or light brown with greater or lesser degrees of darker markings. I have never seen a green individual of this subspecies. The elytral bands are always dark brown, the hind wings orange or rose. In Central Panama individuals with numerous longitudinal dark stripes are frequent.

Distribution.

Extends from Central Western Costa Rica southwards through Panama into northern Colombia. Most northerly record is at the Río Tarcoles, Puntarenas Prov. **Maps R9, R10.**

Natural history.

See entry under genus, above.

Tribe Procolpini Giglio-Tos 1898

Included genera.

Giglio-Tos (1898) included in this group the 5 genera *Aeolacris*, *Munatia*, *Procolpia*, *Prorrhachis* and *Xomacris*. Rehn and Grant (1959) and Rowell (1999) followed suit. Of these genera, most are S. American and only *Munatia* and *Procolpia* occur in Central America.

Diagnosis.

Generally elongate shape, ensiform antennae, well developed rostrum, fully developed wings and tympana, smoothly elongated male subgenital plate, and inequality between the external and internal row of the hind tibial spines, the latter being notably long and curved.

Tribal range.

Argentina, Paraguay, Bolivia, Amazonian Brasil, Amazonian Peru, Ecuador, French Guiana, ?Venezuela, Colombia, Panama, Costa Rica, Guatemala, Mexico.

Munatia

Stål 1875

Stål 1875, Bih. Kongl. Sv. Vetensk. Handl. 3: 28.

Type species: *M. punctata* Stål 1875,

Etymology.

"Munatius Plancus was a Roman general, appointed by Caesar as governor of Transalpine Gallia, founder of Lyon and other French cities. He backed Brutus against Antonius but later submitted to the triumvirate" [Carbonell 2000, Metaleptea 20(2):10]. "Munatia Plancina (died 33 AD) was a Roman noblewoman who lived in the early times of the Empire founded by Augustus. She was the wife of the governor of Syria, Gnaeus Calpurnius Piso. The couple was accused of having poisoned Germanicus, the nephew and adopted son of the Emperor Tiberius. At first Munatia Plancina was acquitted but when the trial was renewed she committed suicide. She was probably the granddaughter of Munatius Plancus." (http://en.wikipedia.org/wiki/Munatia_Plancina).

Subsequent literature.

- Stål, C. 1878: 15.
- Rehn, J.A.G. 1905: 404..
- Bruner, L. 1900-1910 (1907) : 223.
- Kirby, W.F. 1910: 366.
- Rehn, J.A.G. 1955b: 37-39. > Gives differential diagnosis with *Procolpia*.
- Rehn, J.A.G. & Grant, H.J. 1959: 239. > Tribe Procolpini.
- Uvarov, B.P. & Dirsh, V.M. 1961 30: 158.
- Amedegnato, C. 1974,: 198. > Attribution to Romaleinae)
- Rowell, C.H.F. 1998: 27. > Revision of genus.

Diagnosis.

The tribal characters given above, plus the following. Rostrum somewhat rounded in profile. Frontal ridge below medial ocellus absent (male) or obsolete (female). Infra-ocular carinae weak or obsolete. Fastigium smooth-sided, without lateral processes. Lateral carinae of pronotum absent, medial carina well marked, in lateral view straight or forming a low curving crest, not incised by transverse sulci, and not markedly higher in prozona than elsewhere; anterior margin of pronotum only weakly notched medially. Elytra long and slender with narrow rounded tips (also true of some other species of the tribe), and with no proximal lobe on the costal margin. Wing dominated by the anal region; radial and medial areas strongly reduced, especially in the male, in which the remigium forms only a narrow elongate strip at the leading edge, somewhat or markedly longer than the anal area. Alar stridulatory apparatus very reduced or absent, transverse veins of the first anal area obsolete or incomplete and usually without denticles.

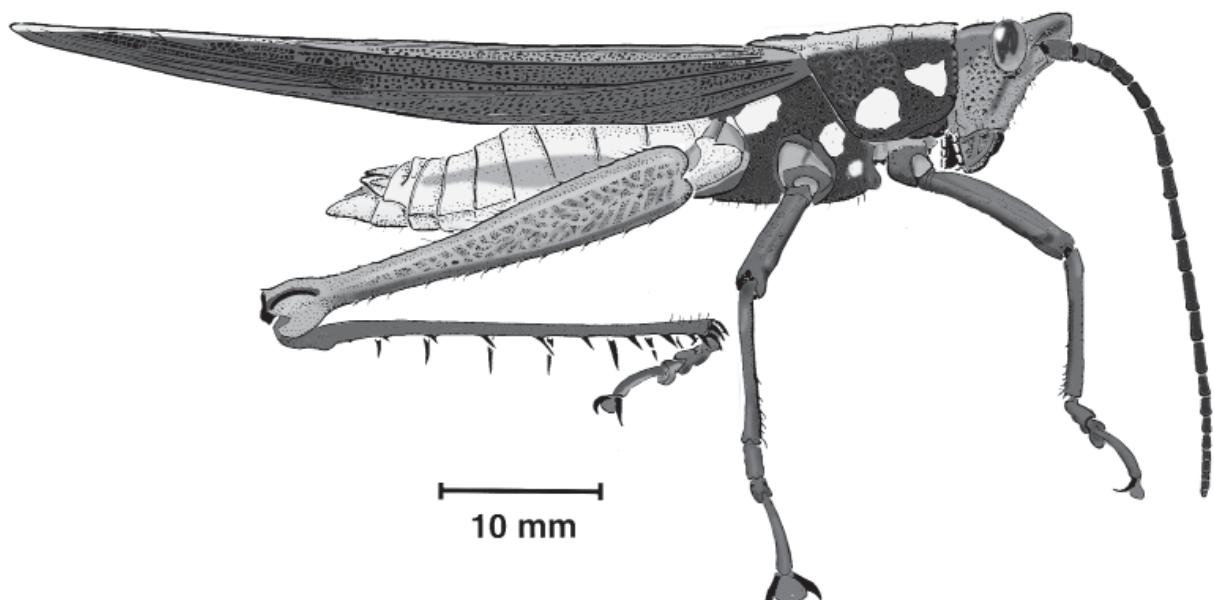


Fig. R23. *Munatia punctata*, male habitus.

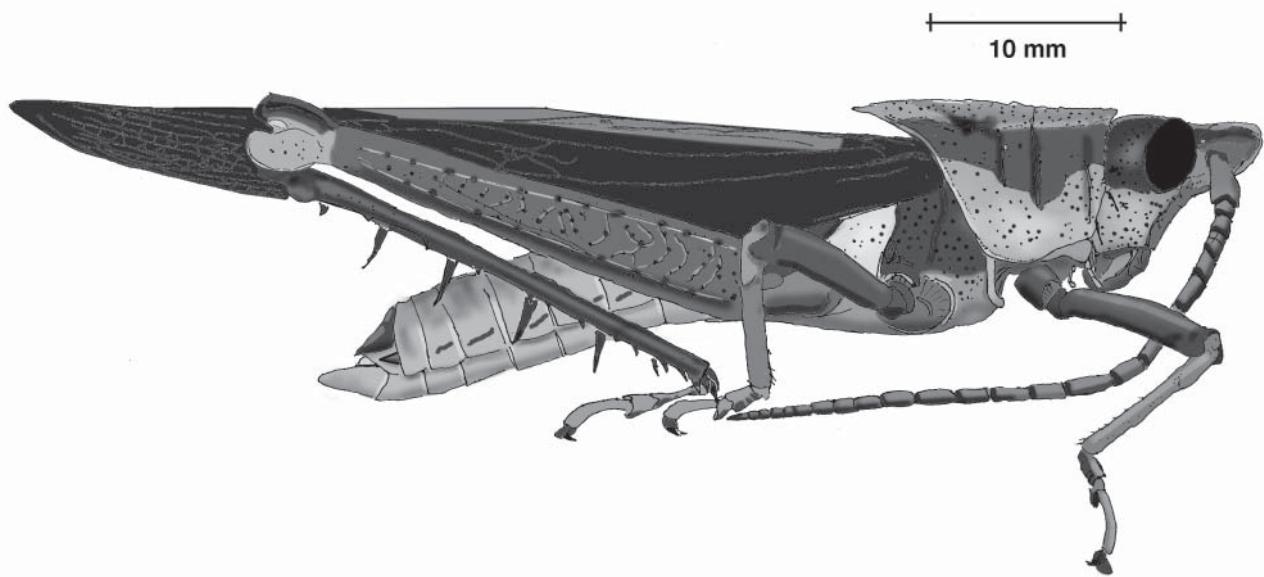


Fig. R24. *Munatia biolleyi*, male habitus.

Fenestration of the 2nd alar area absent. Terminal medial tooth of metathoracic knee small in the adult. Marginal spines of hind tibiae always simple and of circular cross-section, never laterally flattened and dorsoventrally produced at base; 8–10 external and 8–9 internal spines on hind tibia, the bottom 3 and the upper 1–2 internal spines short, the remainder long and curved inwards. Abdominal segments with well-marked medial carina. Male furcula simple, weak. Male supra-anal plate triangular, rounded at tip, simple, with a proximal medial longitudinal furrow bordered by melanized edges. Male subgenital plate twice as long as supra-anal plate. Male cercus simple, conical. Simple paired endophallic aedeagal valves with a weak subapical, latero-posteriorly directed process, and with weak transverse ridges on dorso-lateral surfaces of their tips [very similar to that of *Xomacris* (Amedegnato & Poulain, 1986: Fig. 90)]. Epiphallus with large pointed lophi.

Larvae, like those of *Procolpia*, have a high pronotal crest and a large dorsal spine on hind knee, both decreasing in relative size with increasing instar. Early instars are predominantly dark brown, with small orange and black markings.

No. of known species.

Two, both within our area.

Range of genus.

S. Nicaragua, Costa Rica, Western Panama.

I. *Munatia punctata* Stål 1875

Stål 1875: 28.

Type locality: Chiriquí, Panama.

Location of type specimen: Stockholm Museum.

Type locality of allolectotype female: Costa Rica.

Location of allolectotype: ANS Philadelphia.

Subsequent literature.

- Pictet, A. & Saussure, H. de. 1887: 340.
- Rehn, J.A.G. 1905: 405. > Misidentification of *M. bolleyi*, as shown by his Figure of wing outlines.
- Bruner, L. 1907: 209, 223. > In part misidentification of *M. bolleyi*, specimens examined by present author.
- Rowell, C.H.F. 1998: 29. > Revision of genus.
Redescription. Designation of allolectotype female.

Etymology.

Latin *punctatus*, spotted, referring to the pattern on the male pronotum.

Synonymy.

= *Munatia decorata* Carl 1916: 506, Fig. 12 (syn. Rowell 1999: 29).

Diagnosis.

Males: Habitus **Fig. 23, Plate R15.** Overall length (rostrum to wingtip) about 65 mm, (in females 70 mm). Lateral lobe of pronotum brown, with 2 pairs of circular yellow or gold spots, not touching the ventral margin of lobe. Frons, genae, pronotum, thoracic pleura and outer face of hind femur devoid of black tubercles. All longitudinal veins of elytron unbranched, except for the radius (**Fig. 26**); elytron with green or yellow margins along proximal regions of both leading and trailing edges.

Females: Medial carina of pronotum low and straight, not at all arcuate (**Fig. R25**). Distal medial surface of subgenital plate smooth and convex. Black tubercles absent and venation of elytron unbranched, as in male.

Field characters.

The large size and bright yellow pronotal spots of the male are diagnostic; can be confused at first sight only with *Agriacris tricristata* within our area, but there the golden spots are on the elytra, not the pronotum. Females are very large, plain light green in colour and with a low, straight pronotal crest (**Fig. R25**; distinguishes from *M. bolleyi*) and are fully winged (distinguishes from females of *Agriacris tricristata*).

Distribution.

Costa Rica and extreme Western Panama, in montane forest between 600 and 1600 m. **Map R11**

Natural history.

Males are active and conspicuous, females sluggish, cryptically coloured and more rarely collected. Larvae are recorded from April to October; adults are first seen in July, are common from August to November, and occur as isolated individuals through January and March. These data are compatible with a one-year generation time, the eggs being laid towards the end of the year and hatching with the onset of the rains in March/April.

The larvae early aggregate into groups. These groups can contain more than 100 individuals of mixed ages, which suggests that the progeny of more than one egg pod may coalesce. They are visually attracted to each other, collecting by a proffered mirror, as in the related romaleine *Chromacris*, or the African pyrgomorphid genus *Phyteumas* (Rowell, unpublished data and 1967). The early larvae are reddish brown in colour and conspicuously marked with two bright yellow patches. They are strongly compressed laterally, hold the hind legs flexed high over their backs, knees together and feet off the substrate, and often lie on their sides – and so look at first sight like anything but grasshoppers. These groups of young larvae bear a striking superficial resemblance to those of a similarly coloured and equally gregarious reduviid bug which occurs in the same environment, and although no experimental data are available, it seems likely that there is a mimetic relationship between the two. Later instars too tend to stay in groups at first but occur as solitary individuals by the fifth instar – presumably (as in

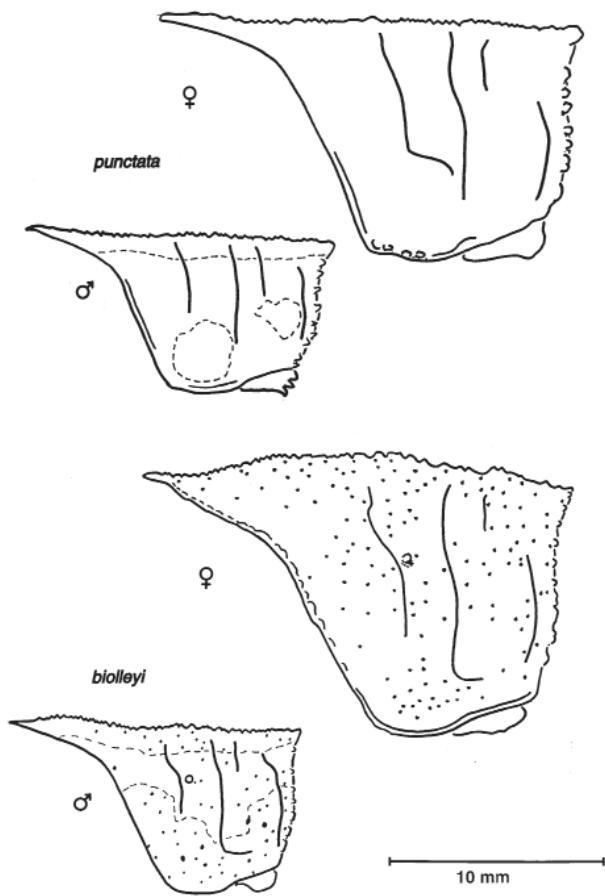
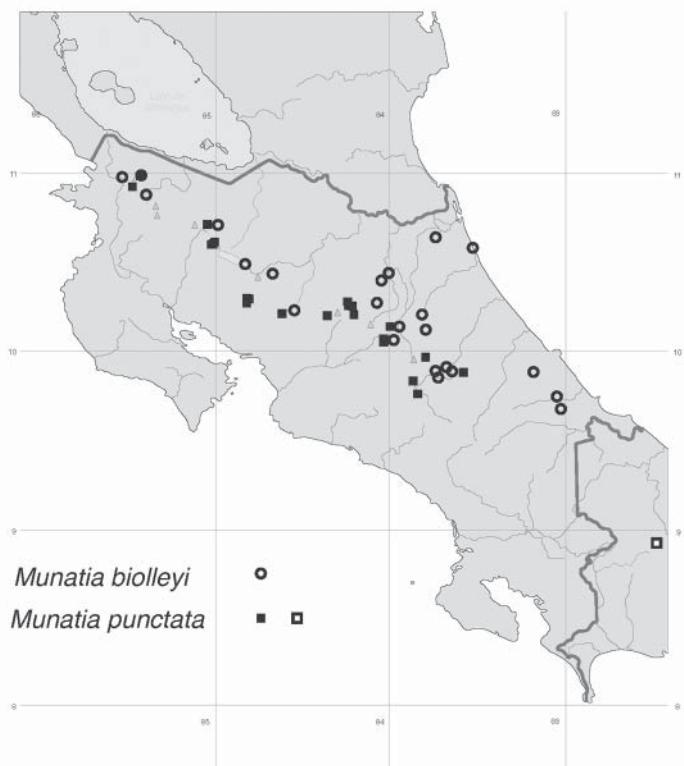


Fig. R25. *Munatia* spp. Profiles of pronota. Upper pair, *M. punctata*, female and male. Lower pair, *M. bolleyi*, female and male.

Phymateus) dispersal is caused by loss of visual contact due to the more cryptic coloration.

M. punctata is moderately polyphagous, eating a variety of trees, shrubs and herbs, including *Hyptis* (Lamiaceae), *Lantana* (Verbenaceae), *Croton* and *Alchornia* (Euphorbiaceae) and *Clibadium* and *Vernonia* (Asteraceae). Most larval groups have been found on *Lantana* or *Clibadium*. All of these plants are strongly odorous or otherwise chemically defended. It has not been seen to feed on monocotyledons, either in the wild or when offered them in captivity. It also refuses many dicotyledenous leaves, including those of species of *Solanum* (Solanaceae), *Hibiscus* (Malvaceae), *Phenax* (Urticaceae), *Conyza* and *Erechtites* (Asteraceae).

2. *Munatia bolleyi* Carl 1916

Carl 1916: 504.

Type locality: (of paratype, selected by C.S. Carbonell): Carrillo, Prov. Cartago, Costa Rica.

Location of type specimen: MHN Geneva.

Subsequent literature.

- Rehn, J.A.G. 1905: 405. > Misidentified as *M. punctata* Stål.
- Hebard, M. 1924a: 100.
- Rowell, C.H.F. 1998: 40. > Designation of lectotype, redescription.

Etymology.

Named for the Swiss naturalist Paul Biolley (1862-1908). He was appointed in 1885 to found a teachers' training college in Costa Rica; he also taught in the high schools of S. José. Ultimately he became a curator of the National Museum. Biolley was the first serious resident collector of grasshoppers in Costa Rica, and made important collections of these and other insects, many of which he sent to de Saussure in Geneva. Unfortunately, he died young at age 46.

Diagnosis.

Similar to *M. punctata*, but distinguished by the following characters.

Males: Habitus **Fig. R24, Plate R16.** Lateral lobe of pronotum without discrete gold spots; instead, two diffuse yellow or pale green areas extend to ventral margin and are often fused. Frons, genae, pronotum, thoracic pleura and outer face of hind femur with numerous small black tubercles. Radius, media and cubitus veins of elytron branched (**Fig. R26**); elytron with green or yellow margin along proximal region of trailing edge only.

Females: Medial carina of pronotum raised and clearly arcuate (**Fig. R25**). Distal medial surface of subgenital plate bearing two minutely toothed ridges, separated by a deep medial

groove. Black tubercles present and longitudinal elytral veins branched, as in male.

Field characters.

Large size and long pointed elytra distinguish this species from all other grasshoppers of our region except *M. punctata* and the male of *Agriacris tricristata*; the male is easily separated from these by the absence of large golden spots. Both sexes give the impression of a dark-brown grasshopper with a paler (yellow or green) dorsal longitudinal stripe and hind legs. (In the male the lower parts of both head and pronotal lobes are pale green too). Females of *M. punctata* are uniform green and the medial carina of the pronotum is flat, not somewhat arcuate as in *M. bolleyi* (**Fig. R25**). Both sexes superficially very like *Procolpia lankesteri*, especially in coloration, but that species has truncate ends to the elytra, not pointed ones, and is much less slender in build.

Distribution.

Caribbean lowlands of SE Nicaragua, Costa Rica and extreme Western Panama, from sea level to about 700 m.

Natural history.

Similar to that of *M. punctata*, apart from a preference for lowland forest; polyphagous, found in forest light gaps and to some extent up forest trees. At least the third instar larvae (and probably all stages) are social, as in *M. punctata*.

Procolpia Stål 1873

Stål 1873b: 52.

Type species: *Xiphicera emarginata* Serville 1831: 271.

Type locality: Brazil.

Location of type specimen: Stockholm Museum.

- Stål, C. 1878, Systema Acrid.: 15
- Stål, C. 1873b: 28,45.
- Giglio-Tos, E. 1898: 41.
- Bruner, L. 1906: 640, 643.
- Bruner, L. 1900-1910 (1907): 209, 223.
- Kirby, W.F. 1910: 364.
- Rehn, J.A.G. 1955b: 37-57. > Revision of genus. Differential diagnosis with *Munatia* given.
- Uvarov, B.P. & Dirsh, V.M. 1961: 158.
- Amedegnato, C. 1974: 198.

Etymology.

Greek *kolpotes*, sinuous, *pro*, in front; curved or sinuous in front, presumably a reference to the profile of the face.

No. of described species in genus.

Eight. In our area, one.

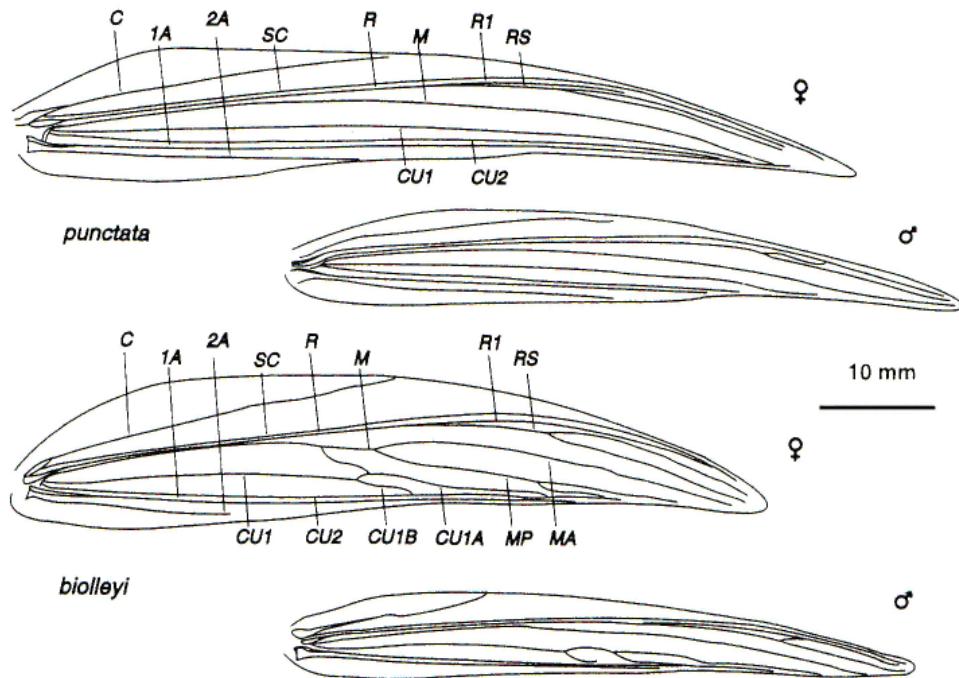


Fig. R26. *Munatia* spp. Venation of elytron. Upper pair, *M. punctata*, female and male. Lower pair: *M. biolleyi*, female and male.

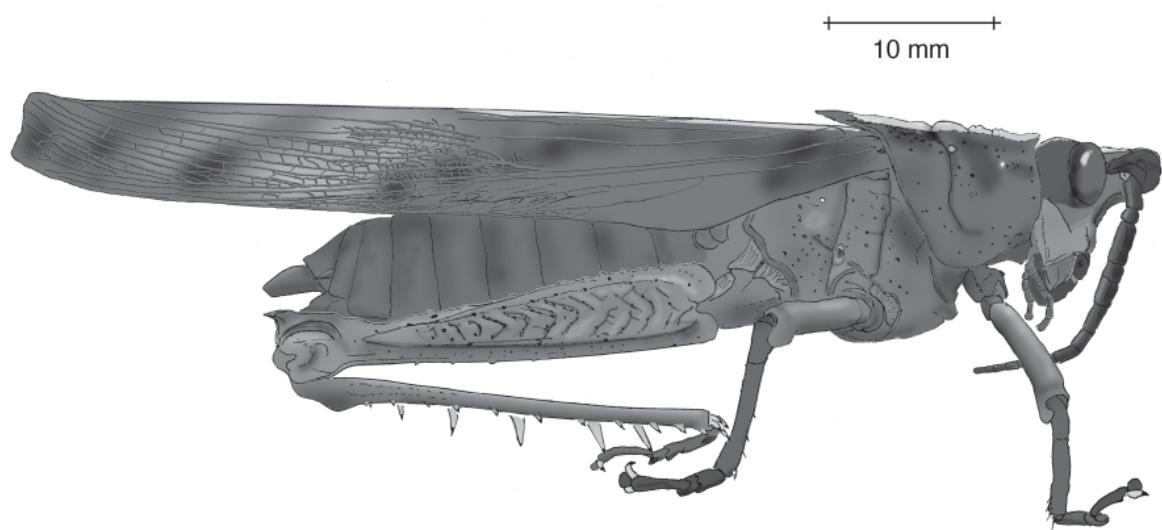


Fig. R27. *Procolpia lankesteri*. Female habitus.

Range of genus.

South America from Paraguay and Northern Argentina to Brazil and Bolivia, possibly to Peru and Venezuela. Not yet recorded from Colombia, but present in Panama, Costa Rica, Guatemala and S. E. Mexico, and hence possibly all of forested Central America.

I. *Procolpia lankesteri* Rehn 1955

Rehn 1955b: 46.

Type locality: Pozo Azul de Pirrís, Costa Rica.

Location of type specimen: ANS Philadelphia (holotype female).

Type material includes specimens from Pozo Azul de Pirrís, Costa Rica, misidentified as *P. emarginata* Serville by Bruner 1907: 223, and from Panama, misidentified as *P. inclarata* Walker by Hebard 1924a: 101.

Etymology.

Named for Charles Lankester (1879–1969), a British manager of coffee plantations in the Cartago region of Costa Rica. He founded the Lankester Gardens near Paraiso to house his extensive orchid collection (gathered during deforestation for establishing coffee). An enthusiastic amateur naturalist, he hosted Rehn and collected grasshoppers with him during the latter's visits to Costa Rica.

Diagnosis.

Habitus **Fig. R27, Plate R17.** Distinguished from *Munatia* by its heavier build, especially the broader and much deeper thorax; disc of pronotum deeply depressed immediately behind the third sulcus; elytra with truncate and slightly concave tips; uniform red-brown colour apart from dorsal longitudinal yellow stripe, no green markings; antennae shorter, more ensiform; face more pronouncedly concave in profile, fastigium as long as the rest of the head in dorsal view. The hind femur is decorated with blunt denticles on the dorsal medial and the ventral carinae. Larvae with high pronotal crest and large dorsal spine on hind knee, both decreasing in relative size with increasing instar; numerous fine white hairs, many arising from black tubercles; prominently stepped median carina of abdominal segments.

Distribution.

Costa Rica, Panama; Rehn (1955) claims a Peruvian specimen, but this seems likely to be a misidentification. With the exception of one 1906 specimen from Juan Viñas (Río Reventazón, Caribbean drainage) all Costa Rican specimens come from the southern half of the Pacific slope; modern specimens are all from the Osa Peninsula. Three Panamanian specimens are known, two from Prov. Panama (one from Gamboa, the other from the Río Trinidad). The third one is from Darién. **Maps R12 & R13.**

Natural history.

A rare member of the fauna of seasonal wet forest, probably chiefly arboreal. Nothing is known of its foodplants. Captures of adults in the Osa Peninsula cluster in the dry season between February and May, but this may reflect trapping effort rather than seasonality; larvae have been captured May to July.

**Tribe Romaleini
Brunner von Wattenwyl 1893****Diagnosis.**

At the present time this tribe, at least as used in the OSF (Eades et al., 2003), appears to consist simply of all those Romaleines fitting no other tribe. Previous authors have however used the name in various more restricted senses.

***Agriacris*
Walker 1870**

Walker 1870: 644.

Type species: *Agriacris ferox* Walker 1870: 645.

Type locality: Colombia.

Location of type specimen: BMNH London.

Etymology.

Greek *agros*, field, open countryside, and *acris*, conventionally used for grasshopper.

Subsequent literature.

as *Gryllus* sensu Thunberg 1824, partim (not *Gryllus* Linnaeus 1758).

as *Xiphicera*, *Xiphocera* of authors, partim, (not *Xiphicera* Lamarck 1817).

as *Agriacris* Walker 1870: 644.

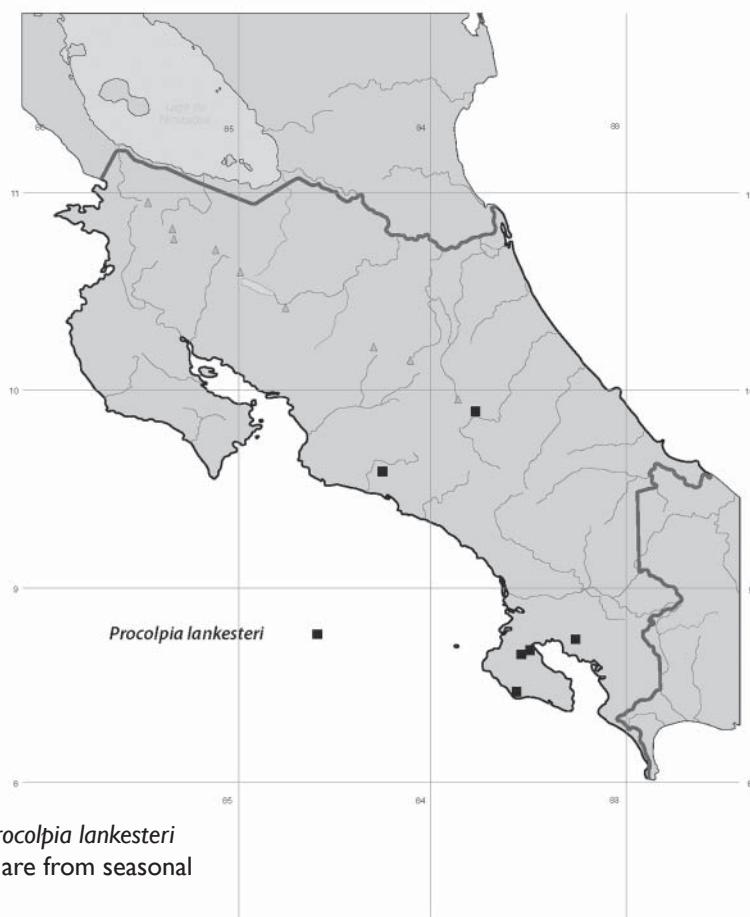
- Hebard, M. 1923: 220.
- Hebard, M. 1924b: 176.
- Rehn, J.A.G. & Grant, H.J. 1959: 254. > Elaeochlorini.
- Liebermann, J. 1969: 84.
- Roberts, H.R. & Carbonell, C.S. 1992: 78. > Revision of genus.

Synonymy.

=*Elaeochlora* Stål 1873a: 52.

- Stål 1873b: 28.
- Stål 1878: 16.
- Pictet and Saussure 1887: 343.
- Liebermann 1969: 81–91.

Synonymized with *Agriacris* by Roberts and Carbonell 1992: 79.



Procolpia lankesteri ■



Map R13. Recorded localities of *Procolpia lankesteri* in Panama.

Diagnosis.

(Modified from Roberts & Carbonell 1992). Habitus,

Fig. R28, Plate R18. Medium to large insects. Pronounced sexual dimorphism, males are much smaller and more slender. Winged, but frequently brachypterous, especially in females. Frons in profile straight or concave, eyes large, fastigium slightly longer than interocular distance. Frontal ridge sulcate, tapering upwards. Antennae longer than head plus pronotum in males, shorter in females, flattened basally. Pronotum with strongly rugose cuticle, especially on disc; pro- and metazona subequal in length. Anterior margin of pronotum straight or slightly overhanging the vertex, posterior margin produced rearwards to an angular or rounded point. Median carina of pronotum well developed, usually forming a low crest, incised by three transverse sulci. Lateral carinae represented by a row of tubercles, well marked in the metazona, in pronotum less developed and running downwards towards a point located half way to the antero-ventral angle of the lobe. Prosternal process conical, pointed, vertical. Hind femora robust, with small teeth along the ventral and dorsal medial carinae, the latter terminating at the knee in a small blunt point. Lower lobes of knee rounded; nine external and eight internal tibial spines, the internal spines being much longer. External apical spine present. Hind wings usually red or orange in colour, specialised for stridulation, with well developed specula. Male furcula present, small. Male cerci simple, conical. Male subgenital plate elongate, pointed. Female subgenital plate simple, ovipositor valves robust, straight, with smooth margins. Aedeagus with two pairs of endophallic sclerites, the upper ones long and robust, reflexed upwards and backwards, the lower ones small and fine, largely hidden by membranous sheaths (see Roberts & Carbonell 1992, Fig 4E).

No. of known species.

Eleven. Only one species occurs in our area.

Range of genus.

Bolivia, Peru, Ecuador, Brazil, Venezuela, Guyana, Colombia, Panama, Costa Rica.

I. *Agriacris tricristata* (Serville 1839)

Xiphicera tricristata Serville 1839: 613.

Type locality: Lebas, Colombia.

Location of type specimen: MNHN Paris.x

Etymology.

Latin *trias*, in threes; *cristatus*, cristate. See diagnosis below.

Subsequent literature.

- Walker, F. 1870, 521.
- Kirby, W.F. 1910: 367. > Transfers to *Aeolacris*.
- Hebard, M. 1923: 219. > Transfers to *Agriacris* (misprinted as *Argiacris*).
- Hebard 1924a: 101.

Synonymy.

=*Xiphicera octolunata* Serville 1839: 615.

Type locality: Lebas, Colombia.

Location of type specimen: MNHN Paris.

Subsequent literature.

- Walker, F. 1870, 521.
- Hebard, M. 1923: 219. > Transfers to *Agriacris* and synonymizes with *A. tricristata*.

Diagnosis.

Monospecific genus in our area; the generic diagnosis applies. Large in size: overall length (fastigium to tip of abdomen) 32-37 mm in males, 51-63 mm in females. Medial carina of pronotum forms a low raised tuberculate crest. This is divided by the sulci into four zones, the anterior three of which are prominent and give rise to the specific name. In the male this crest is dark purple brown, contrasting with the otherwise green pronotum. Elytra long and slender in males, tapering to a rounded tip, exceeding the tip of the abdomen, nearly reaching the hind knee. Females are brachypterous, the elytra terminating at about 2/3 the length of the abdomen. They are all green, with a lighter coloured stripe along the vannal area of the elytra. They have maximally a single pair of yellow spots on the elytra, usually none at all.

Field characters.

Males unmistakable, with 3 or 4 bright yellow spots on each long green elytron. [Roberts & Carbonell (1992) remark on the sad circumstances which led to the loss through synonomization of Serville's very appropriate name, *octolunata*, which refers to this striking character]. Females are very large, thick bodied and entirely green, usually lacking the yellow elytral spots of the males, but some individuals have one or two such spots. They are more brachypterous, and the antennae are less ensiform, than in the similarly all-green female of *Munatia punctata*; they are much less brachypterous and less robust than the similarly all-green female of *Cibopteryx*. In both sexes the vannal area of the elytron is a lighter green, producing a paler stripe along the ridge of the folded elytra. The hind wings are salmon pink or orange in the vannal area; the specula are transparent, and the remigium is brown or blackish.

Distribution.

N. Colombia (Magdalena), all of Panama, and extreme SW Costa Rica. **Map R14.** Fairly common in cut-over, bushy land derived from degraded forest ("charral"). The genus as a whole is characteristic of lowland wet forest.

Natural history.

Markedly polyphagous, eating among other things *Ipomoea* (Convolvulaceae), and various Asteraceae, Solanaceae, Euphorbiaceae and Malvaceae. In Costa Rica, adults are present from late August onwards.

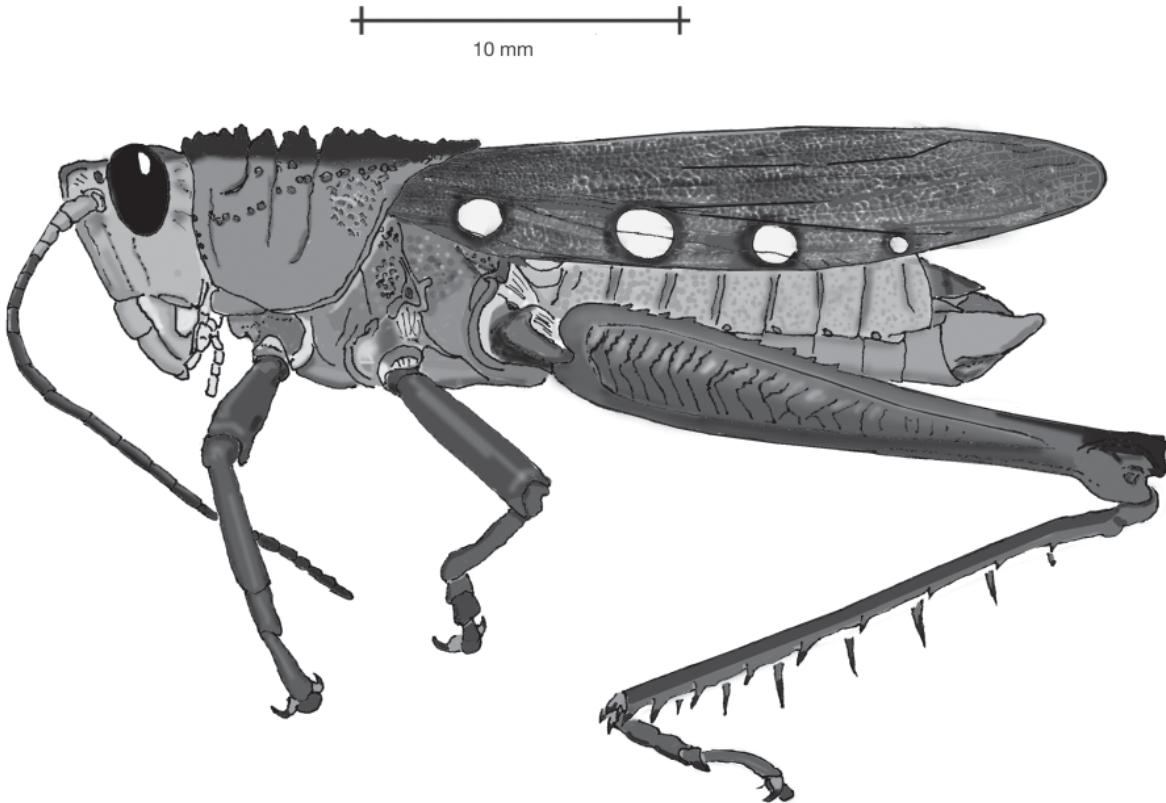
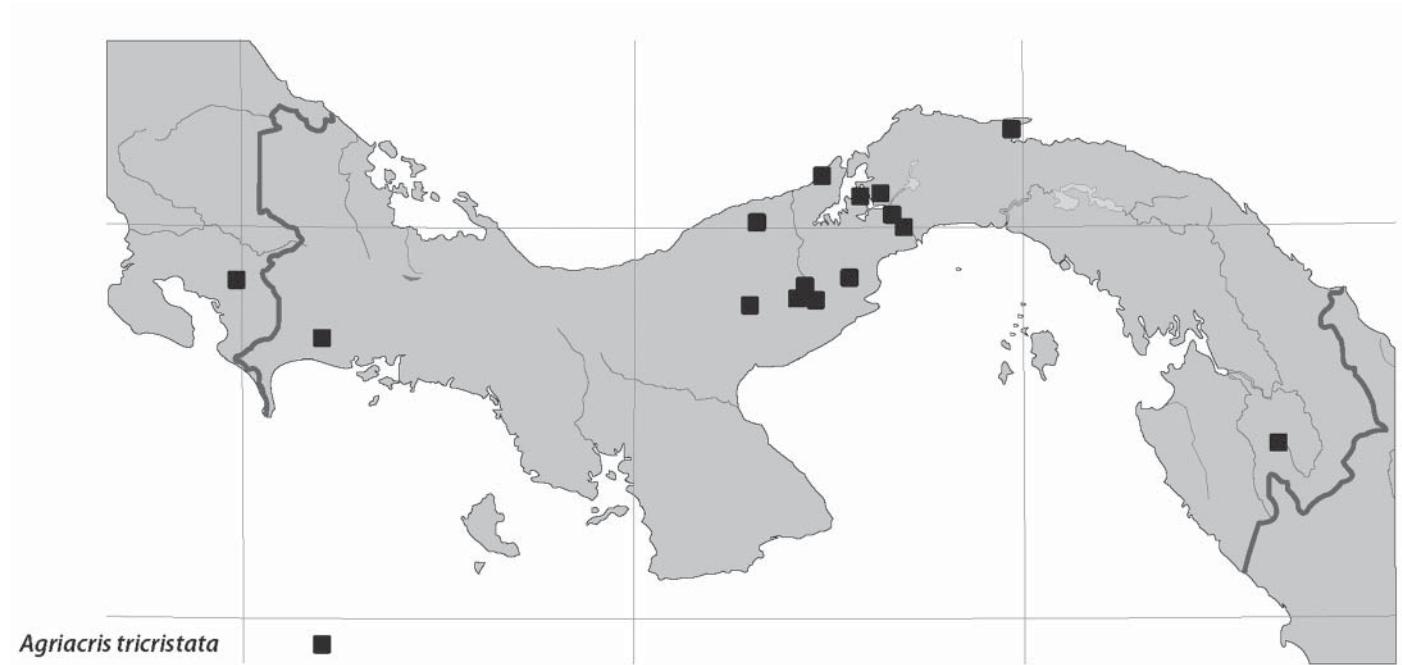


Fig. R28. *Agriacris tricristata*, male habitus.



Map R14. Localities of *Agriacris tricristata* in Costa Rica and in Panama. Its range barely extends into the Costa Rican southwest, but covers most, very possibly all, of Panama (and extends further into northern Colombia).

Chromacris
Walker 1870

Walker 1870: 643.

Type species: *Gryllus speciosus* Thunberg 1824 (subsequent designation by Rehn 1904).

Type locality: Brazil.

Location of type specimen (lectotype, designated by Roberts & Carbonell 1982: 51): Upsala Museum.

Subsequent literature.

- Bruner, L. 1900-1910 (1908): 237.
- Bruner, L. 1911: 57.
- Rehn, J.A.G. 1904: 532.
- Kirby, W.F. 1910: 373.
- Rehn, J.A.G. & Grant, H.J. 1959: 260. > Tribe Chromacrini
- Uvarov, B.P. & Dirsh, V.M. 1961: 158.
- Amedegnato, C. 1974: 198.
- Roberts, H.R. & Carbonell, C.S. 1982: 46. > Revision of genus.

Diagnosis.

Medium sized grasshoppers, lacking both a crest on the pronotum and a protruding fastigium. All our species of the genus are dark green insects with yellow markings and red, orange or yellow hind wings. The species of the genus are most readily distinguished by their colour patterns, especially those of the wings, hind femora and antennae.

Fastigium steeply sloping, joining the sulcate frontal ridge smoothly. Antennae filiform, slightly flattened, longer than head and pronotum together. Integument of head and abdomen smooth, of thorax rugose and pitted. Prozona about as long as metazona; lateral pronotal carinae absent, medial carina weak and confined to metazona, which ends in a rectangular point. Disc crossed by three deep sulci. Anterior margin of pronotum somewhat produced over the vertex. Prosternal process conical, pointed, slightly flattened laterally. Hind femora long and slender, comfortably exceeding the tip of the abdomen. Eight external and eight internal tibial spines, external apical spine present. Fully alate, elytra with rounded tips exceeding the hind knees.

Males devoid of furcula; supra-anal plate triangular, medially sulcate. Rim of subgenital plate comes to a blunt point. Male cerci cylindrical, bluntly pointed, straight. Epiphallus a narrow bridge, almost devoid of ancorae, but with characteristic long thin digitate lophi. Aedeagus consists of only 2 endophallic valves, very short and barely protruding in side view of the phallus. There is little genital differentiation between the species.

Can be confused only with the related South American genus *Xestrotrachelus*, which does not occur in Central America.

No. of known species.

Nine. In our area, three.

Range of genus.

Argentina, Paraguay, Uruguay, Bolivia, Peru, Brasil, Venezuela, Guyana, Ecuador, Colombia, Panama, Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala, Belize, Mexico.

Natural history.

One of the relatively few Romaleine genera which is a foodplant specialist; most species are confined to species of *Solanum*, though some extend their range to include various Asteraceae and Bignoniaciae. Adults are agile fliers and often attempt to escape when disturbed; however, they are aposematically coloured and sometimes give static “warning displays” with raised elytra and unfurled, brightly coloured hind wings when handled. Some species emit a bad-smelling froth of blood and air from the thoracic spiracles when taken in the hand. Larvae are conspicuously gregarious and very brightly coloured, in orange and black, or yellow and black; this coloration may possibly be aposematic but also serves to maintain group cohesion through visual orientation to the neighbour. They move as a group onto and away from foodplants and tend to cluster on the centre of a leaf while feeding, heads pointing outward, eating from the edge of the leaf inwards. Adults initially continue to live gregariously, like the larvae, but gradually disperse over time, probably due to loss of visual contact consequent on their more cryptic coloration [Rowell (1968) analysed experimentally similar behaviour in an African pyrgomorphid, *Phymateus* (now *Phyteumas*) *purpurea*].

I. *Chromacris colorata* (Serville 1839)

Type species: *Acridium coloratum* Serville 1839: 674.

Type locality of holotype, “S. Carolina”, presumably an error.

Location of type specimen: originally MNHN Paris, now lost. Of lectotype of *Rh. pedes* Saussure, MHN Geneva.

Subsequent literature.

- Walker, F. 1870: 644. > Transfers to *Chromacris*.
- Stål, C. 1873b: 51. > Transfers to *Rhomalea*
- Rehn, J.A.G. 1902: 12.
- Rehn, J.A.G. 1904: 532(?). > Restores to *Chromacris*.
- Bruner, L. 1907: 238.
- Roberts, H.R. & Carbonell, C.S. 1982: 49.

Synonymy.

=*Rhomalea pedes* Saussure 1859: 392 (synon. Roberts & Carbonell 1982: 49, with designation of lectotype).

Type locality of lectotype: Mexico.

Diagnosis.

Habitus Fig. R29, Plate R19. Eight-twelve most proximal antennal segments bright yellow, distal segments at least partially black. Hindwings red, black to wing base along leading

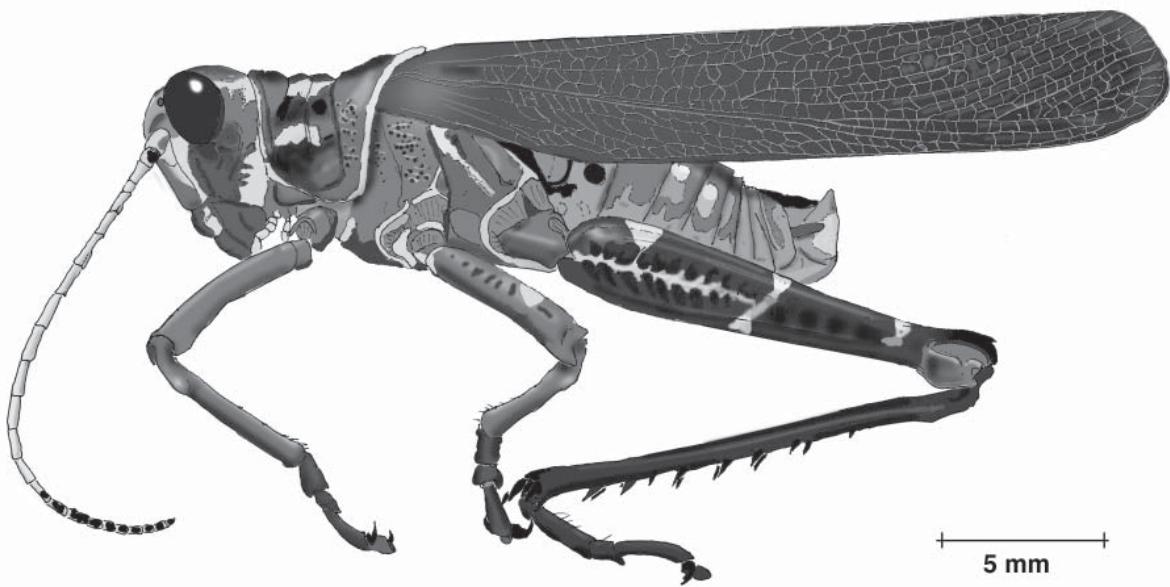


Fig. R29. *Chromacris colorata*, male habitus.

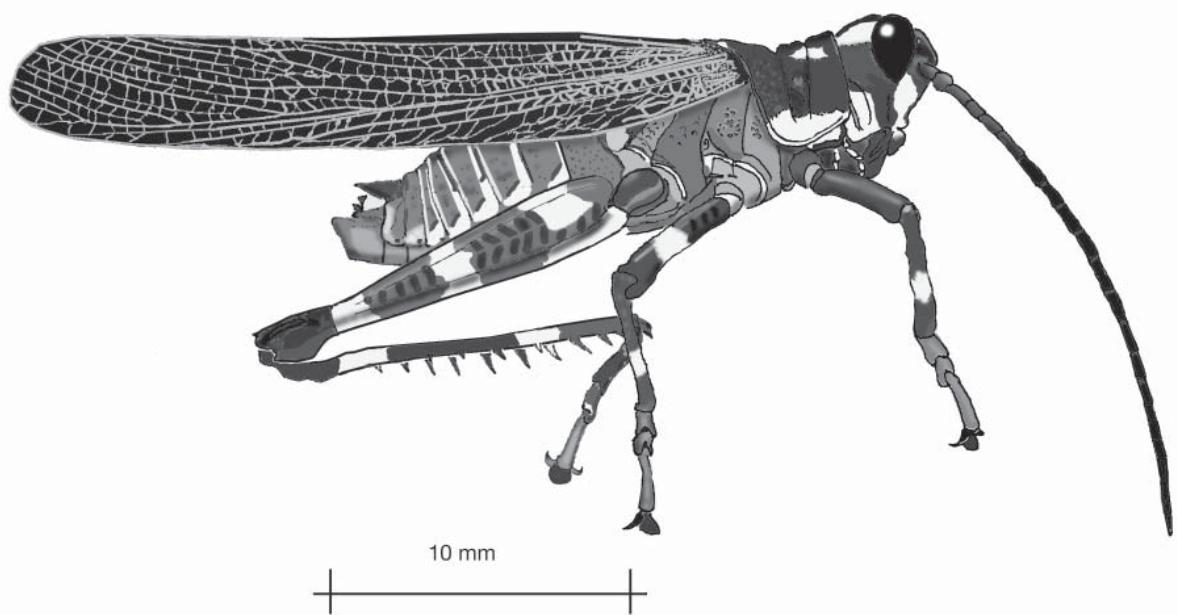


Fig. R30. *Chromacris psittacus*, male habitus.

edge. External dorsal face of hind femur with three small areas of yellow on the dark green ground, with a longitudinal medial yellow stripe on the proximal outer face.

Distribution.

Mexico (Nuevo Leon, Tamaulipas, San Luis Potosí, Veracruz, Oaxaca, Guerrero, Morelos, Jalisco, Nayarit, Sinaloa, Yucatán); Guatemala; Belize; El Salvador; Nicaragua; N.W. and West Central Costa Rica (Guanacaste, N. Puntarenas and the upper valley of Río El General). Apparently not recorded from Honduras. Does not extend into Panama. **Map R16.**

Natural history.

This is the red-winged, dry forest and wooded savanna *Chromacris* species in our region. Usually found on species of *Solanum*, including *S. hazenii* and *S. ochraceo-ferrugineum*; but as larvae also found eating *Arradiaea patellifera* (Bignoniacae) and *Millerea* sp. (Asteraceae). Gregarious as larvae, that bunch rather than disperse when disturbed. In Guanacaste, gregarious larvae roost during the day away from their foodplant, and move into it as a group at dusk to feed.

2. *Chromacris psittacus* (Gerstaecker 1873)

Type species: *Rhomalea psittacus* Gerstaecker 1873: 185.

Type locality (of lectotype, designated by Roberts & Carbonell 1982: 54): allegedly Bogotá, Colombia - but very doubtful).

Location of lectotype specimen: Berlin Museum.

Subsequent literature.

- Rehn, J.A.G. 1905: 414.
- Bruner, L. 1900-1910 (1907): 239. > transfers to *Chromacris*
- Kirby, W.F. 1910: 373.
- Hebard, M. 1923: 230.
- Hebard, M. 1924a: 103.
- Roberts, H.R. & Carbonell, C.S. 1982: 54.

Diagnosis.

Habitus **Fig. 30, Plate R20.** Antennae all black, hind femur green ringed with 3 yellow bands, hind tibia blackish green with two yellow rings. Hind wings orange, the black marking does not extend to the wing base. The South American species *C. icterus* (Ecuador, Colombia, Peru, Brasil) is very similar but has only a single yellow femoral band. Larvae of *C. psittacus* can be distinguished from those of *C. trogon* by the shape of the anterior yellow mark on the pronotum: in *psittacus* this is longer (anterior-posterior dimension) than wide, in *trogon* the reverse.

Distribution.

Colombia (Cundinamarca), Venezuela (Zulia), Panama, Costa Rica. Carbonell & Roberts (1982) recognize the population extending from Costa Rica to Venezuela and N. Colombia as *C.p. psittacus*. This is the only *Chromacris* species

in Panama. In Costa Rica it is found chiefly on the Caribbean slope east and south of the Rio Reventazón, and as far north as Siquirres and San Carlos. On the Pacific slope there are only a few scattered records. **Map R16.**

Natural history.

As other members of the genus, but strictly confined to Solanaceae at all stages.

3. *Chromacris trogon* (Gerstaecker 1873)

Type species: *Rhomalea trogon* Gerstaecker 1873: 186.

Type locality: Costa Rica (no other data).

Location of type specimen: Zoological Museum Berlin.

Subsequent literature.

- Rehn, J.A.G. 1904: 532 > transfers to *Chromacris*
- Kirby, W.F. 1910: 373.
- Roberts, H.R. & Carbonell, C.S. 1982: 53.

Diagnosis.

Habitus **Fig.31, Plate R21.** Antennae all black. Hind wings orange or yellow; as in *C. psittacus*, there is no black leading edge in the proximal part of the wing. Hind femur plain green with black chevrons but no yellow rings. Hind tibiae green in females, blue-black in males, with no rings. (Larvae of *C. trogon*, however, have banded hind femora, unlike the adult; they can be distinguished from those of *C. psittacus* only by the shape of the anterior yellow mark on the pronotum: in *trogon* this is wider than long, in *psittacus* the reverse).

Distribution.

Costa Rica, Nicaragua, Honduras, Belize, Guatemala. Carbonell & Roberts (1982) recognize the population extending from Costa Rica to Nicaragua as *C. t. trogon*. This species overlaps and eventually replaces *C. psittacus* in the wet forest zone of N.E. and N. Central Costa Rica and from there extends northward along the Caribbean slope to Belize. In Costa Rica it crosses onto the Pacific slope in the Cordillera de Tilarán and the Cordillera del Norte and from there extends south through Guanacaste, the Pacific drainage of the Meseta Central, along the lower Western slopes of the Cordillera de Talamanca all the way to the Coto Brus and the Panamanian border, but there is only one record from Panama itself. **Map R15.**

Natural history.

As other members of the genus, but strictly confined to Solanaceae at all stages; usually found on *S. umbellatum* or *Witheringia solanacea*.

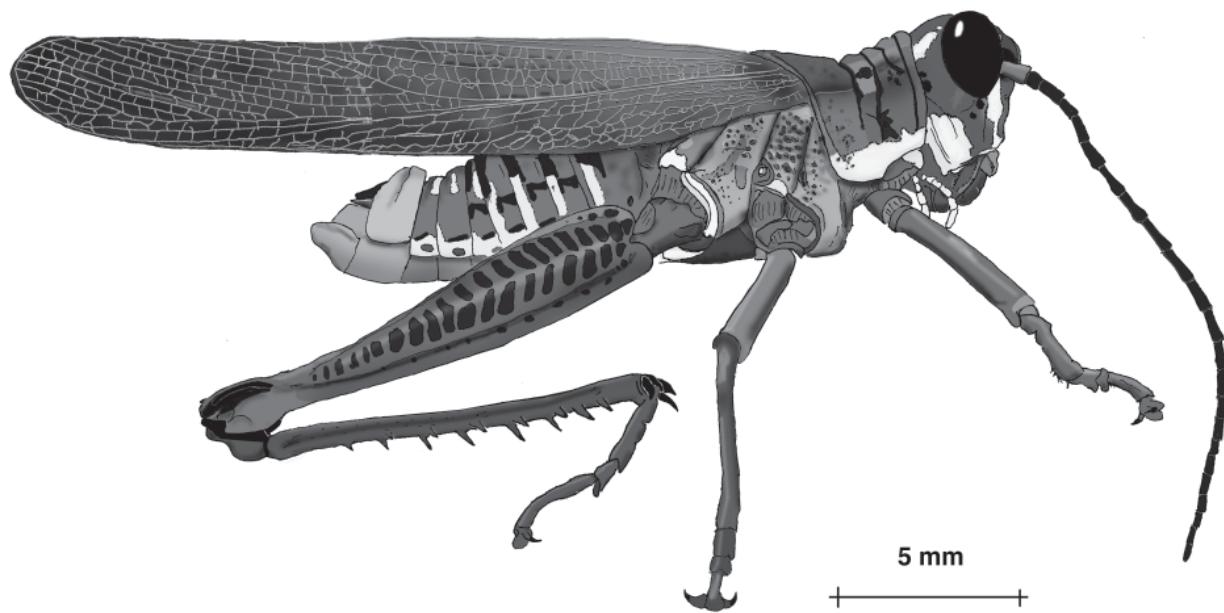
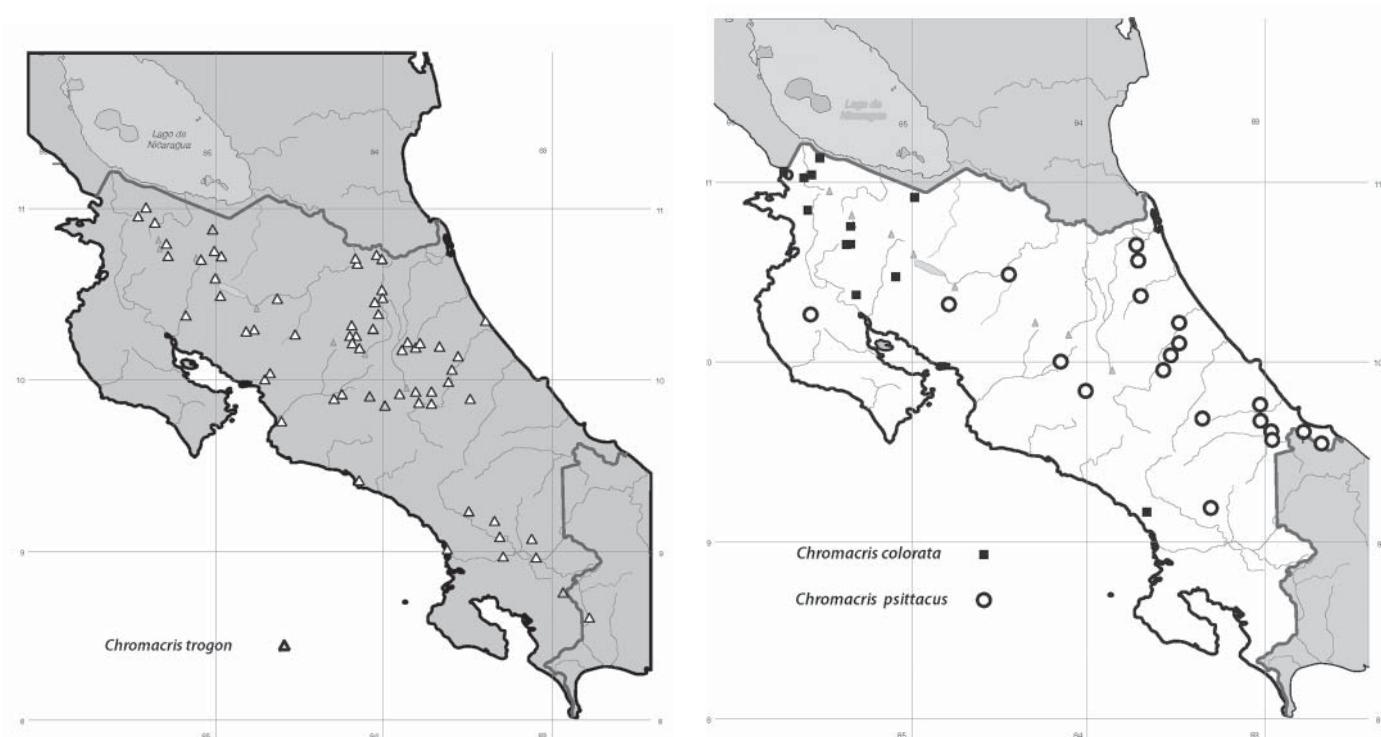


Fig. R31. *Chromacris trogon*. Male habitus.



Maps R15 & R16. Localities of *Chromacris* spp. in Costa Rica. *C. trogon* is widely distributed, especially common in montane and submontane forest of the northern and central regions, but also occurs in the drainage of the Rio General and in the Coto Brus. There is a single old record from extreme Western Panama. *C. colorata* is confined to Pacific slope savanna environments. *C. psittacus* is a forest edge form, commoner on the Caribbean slope.

Cibotopteryx

Rehn 1905

Rehn 1905b: 408.

Type species: *Cibotopteryx variegata* Rehn 1905.

Subsequent literature.

- Bruner, L. 1907: 229.
- Kirby, W.F. 1910: 367.
- Rehn, J.A.G. & Grant, H.J. 1959: 233. > Tribe Elaeochlorini.
- Uvarov, B.P. & Dirsh, V.M. 1961: 158.
- Amedegnato, C. 1974: 198. > Assignment to Romaleinae.

Etymology.

Greek *kibotos*, box, chest; *pteros*, wing. A reference to the curiously crumpled form of the elytron.

Diagnosis.

At least in our area monospecific. See the specific diagnosis below.

No. of known species.

Two are described. The Costa Rican (*C. variegata*) and Guatemalan (*C. rehni*) forms are however probably synonymous (though the larvae may possibly differ), in which case *variegata* is the older and hence valid name. A single specimen of the genus (Cal. Acad. Sci.) has been captured in central Panama; it seems slightly different from *variegata*, and may represent an undescribed species.

Range of genus.

Panama (new record); Costa Rica, El Salvador, Guatemala, Mexico (Chiapas). Apparently unreported so far from Honduras and Nicaragua, but probably occurs there.

I. *Cibotopteryx variegata* Rehn 1905

Rehn 1905b: 408.

Type locality: Guatél (sic), Costa Rica. (This is Rehn's misspelling of Guaitil, Prov. S. José, in the valley of the Río Grande de Candelaria).

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Bruner, L. 1900-1910(1907): 229.
- Hebard, M. 1932: 269. > Distribution.

Diagnosis.

Habitus, Fig. R32, Plate R22. Brachypterous and flightless, the elytra extending maximally to 2/3 the length of the abdomen. Head somewhat rostrate, the fastigium slightly longer than the width of the interocular space, triangular, with a slight raised rim, horizontal, the tip curving down smoothly into the frontal ridge. Frons straight in profile below the rostrum.

Frontal ridge sulcate except at its dorsal extremity. Antennae longer than head and pronotum together, slightly flattened basally, 19-21 flagellar segments.

Pronotum rugose and tuberculate, the anterior margin decorated with about 30 small tubercles. Lateral carinae reduced to a series of large blunt tubercles; a secondary row of tubercles angles downwards from the crossing with the second sulcus across the lateral lobes towards the anteroventral angle. The medial carina is cristate, higher in the prozona, and deeply incised by three sulci. The posterior margin of the pronotum is produced to an acute point. The anterior margin is weakly convex and overhangs the vertex slightly. Elytra green, inflated, with an obtuse angular or rectangular tip; the longitudinal veins are raised, giving a ridged appearance. The venation is coarse and thick and much lighter in colour than the membrane. Hind wings yellow, with greatly reduced venation, but with intact stridulatory mechanism. Hind legs long and slender, medial carinae of hind femur very weakly denticulate, hind knee bears a blunt apical point and has rounded lower lobes. Nine external and nine internal tibial spines, the inner row being much longer and more curved.

Male furcula: the posterior edge of the 10th abdominal tergite is decorated with a row of 8-10 irregular melanised points, of which the medial and the outermost pairs are the largest. Male cerci simple, conical (Rehn's description of them is inaccurate – perhaps there was an undetected printers' error). Male supra-anal plate triangular, bisected by a weak transverse ridge, and deeply sulcate in the midline. Subgenital plate short and rounded, slightly beaked in midline; pallium protuberant and thick. Ovipositor valves robust, straight, with practically smooth edges. Female subgenital plate simple, with two small lobes either side of the medial egg guide.

At first sight, with its tuberculate and cristate pronotum, *Cibotopteryx* recalls *Agriacris*, in accordance with Rehn and Grant's (1959) tribal placement; but closer examination shows that the two are probably not related. The aedeagus consists of only a single pair of endophallic sclerites, and the epiphallus is of a different type.

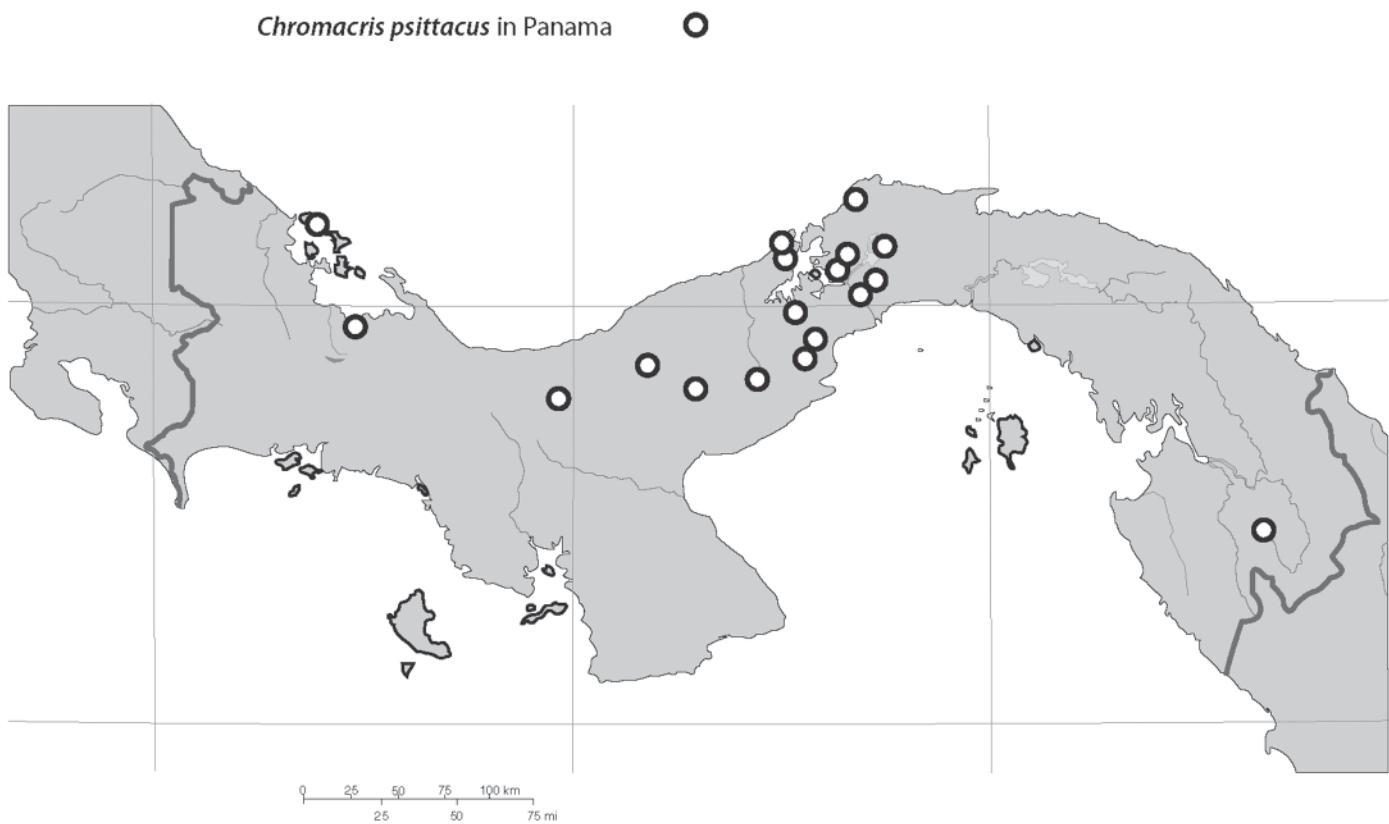
Field characters.

General colour leaf green. In the male, the bright pink-purple tibia, and pronotal lobes obliquely striped in white or cream, are conspicuous. Both sexes have strange short inflated elytra with more or less right angled tips. The females are very large and squat, and can be green or brown.

Larvae are blackish, with a broken ring in white around the tympanum. The serrate pronotal carina is conspicuous.

Distribution.

In Costa Rica confined to the Pacific drainage of the Meseta Central, and seasonally humid woodland of the Pacific slope in San José and central Puntarenas Provinces, between the Río Guacimal and the Río Barú. There is one specimen from



Map R17. Localities for *Chromacris psittacus* in Panama. All are forest edge habitats, irrespective of altitude.

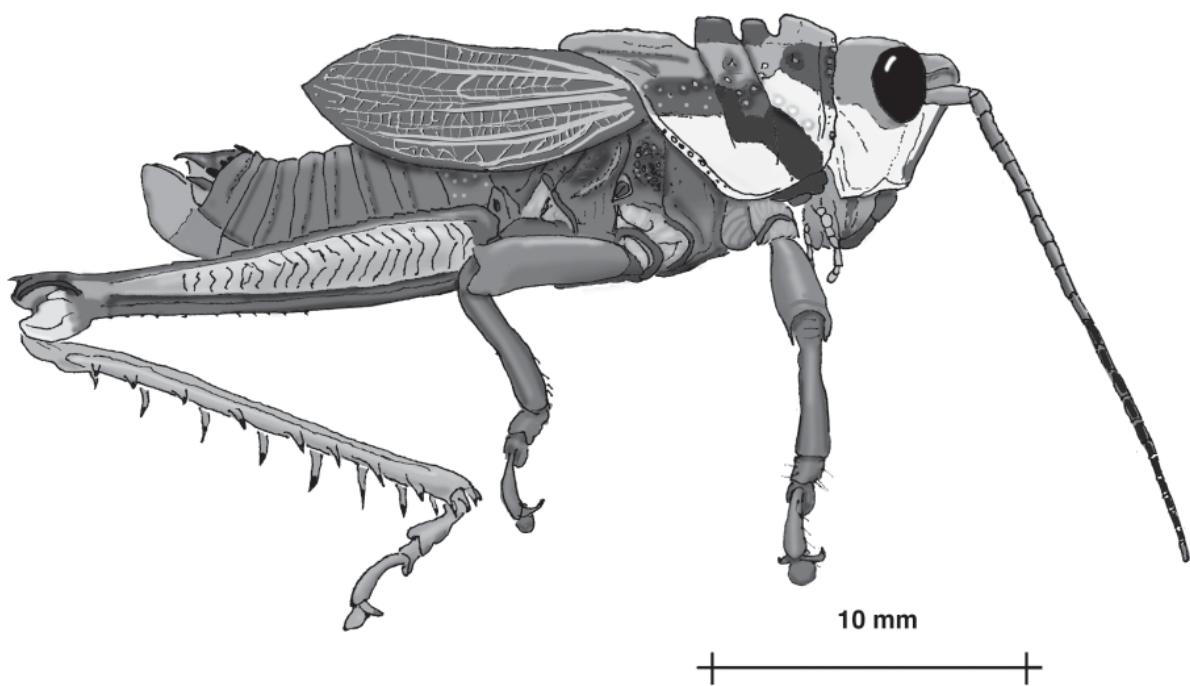


Fig. R32. *Cibotopteryx variegata*.

Hatillo, a suburb of San José city. **Map R18.** The Guatemalan, Salvadorian and Panamanian examples of this genus are also from the Pacific slope.

Natural history.

Apparently polyphagous. Eats a variety of woody shrubs, including *Bytneria* (Sterculiaceae), and species of *Piper* and *Solanum*. Numbers fluctuate markedly, common in some years, absent in others. Occurs from sea level to at least 1000 m. Tends to occur in groups of adults of both sexes.

Taeniopoda Stål 1873

Stål 1873b: 32 & 50.

Type species: *Rhomalea picticornis* Walker (designated by Rehn 1904).

Type locality: Mexico, Oaxaca.

Location of type specimen: BMNH, London (cotypes, male & female).

Etymology.

Latin *taenia*, ribbon, *pes*, foot.

Subsequent literature.

- Brunner von Wattenwyl, K. 1893: 134. > Taeniopodae, including *Dictyophorus* (Pyrgomorphidae!)
- Kirby, W.F. 1910: 371.
- Hebard, M. 1925a: 253-274. > Revision of genus.
- Rehn, J.A.G. & Grant, H.J. 1961: 252. > Tribe Romaleini.
- Uvarov, B.P. & Dirsh, V.M. 1961: 158.
- Amedegnato, C. 1974: 198.
- Ortega & Marquez, M.C. 1987: 47.

No. of known species.

Twelve. The genus is in great need of a modern revision; most species are defined only on colour pattern and are notoriously variable in size, shape of pronotum and coloration.

Generic range.

Panama, Costa Rica, Nicaragua, Honduras, Guatemala, Belize, El Salvador, Mexico; S.W. USA. Most described species are Mexican, only 2 enter our area.

Diagnosis.

(Within our region only). Medium to large size, with considerable variation. Pronotum cristate, deeply incised by the third sulcus, and higher in the metazona than in the prozona. The pronotum is produced backwards over the elytra as a more or less angulate point, and more weakly forwards at the anterior midline, overhanging the vertex. Lateral carinae of the pronotum reduced to a series of tubercles in the metazona, extending slightly past the third sulcus just into the prozona. Fastigium

downward sloping, not rostrate. Hind legs long and slender, with numerous slender tibial spines. Wings red or pink, with a well developed resonant speculum which is blackish or grey and contrasts with the rest of the wing. Antennal flagellum yellow or orange basally, with blackish tips.

Remarks on our “species” of *Taeniopoda*.

Taeniopoda occurs in our area in at least 3 distinct colour forms. Two of these have been given specific names: *variipennis* Rehn and *reticulata* Fabricius (= *maxima* Bruner), and the third form (that I here refer to as colour form *dubia*) was described but not named in Rehn's (1905) original record of the latter species (though this was under the erroneous specific name *centurio* Drury, later corrected).

The major difference between the 3 forms is in the patterning of the tegmina. In all three, the ground colour of the membrane is black or very dark brown. The reticulum of veins which supports the membrane is of a different, contrasting colour (yellow-green in *variipennis*, light pinkish brown in *reticulata*). In the two named species, this contrasting colour is not confined to the reticulum, but “bleeds” onto the membrane as well. Sometimes it entirely fills the cell bounded by the veins, more commonly a small black area is left in its centre, giving a characteristic maculate appearance to the tegmen (see Figs R33 & R34). In the *dubia* colour form the contrasting colour is confined to the reticulum, all the tegminal membrane is black, and the tegmen thus appears reticulated but not maculated.

I am unable to find evidence that these three colour forms differ systematically in any other way – their genital and pronotal anatomies display at least as much variation within the groups as between them, and they vary greatly in overall size. It seems quite possible that all three actually belong to a single, polymorphic species, but I refrain from making a formal synonymy in the absence of molecular evidence.

There is a rough correlation between colour form and habitat, with the *variipennis* form being found principally in drier areas on the Pacific slope, and the dark *reticulata* form principally on the wetter Caribbean slope, though it occurs sporadically over the entire country.

I. *Taeniopoda reticulata* (Fabricius 1771).

Gryllus reticulatus Fabricius 1781: 362.

Type locality: “Bengal”, in error.

Location of type specimen: BMNH, London.

Etymology.

Latin *reticulata*, netted, presumably a reference to the patterning of the elytron, see above, and Fig. R33 & R34.

Subsequent literature.

- Fabricius, J.C. 1787. > *Mantissa insectorum exhibens species*



Map R18. Localities of *Cibopteryx variegata* in Costa Rica.
Like *Colpolopha brunneri*, it is centred on the drainage of the
Rio Grande de Tarcoles.

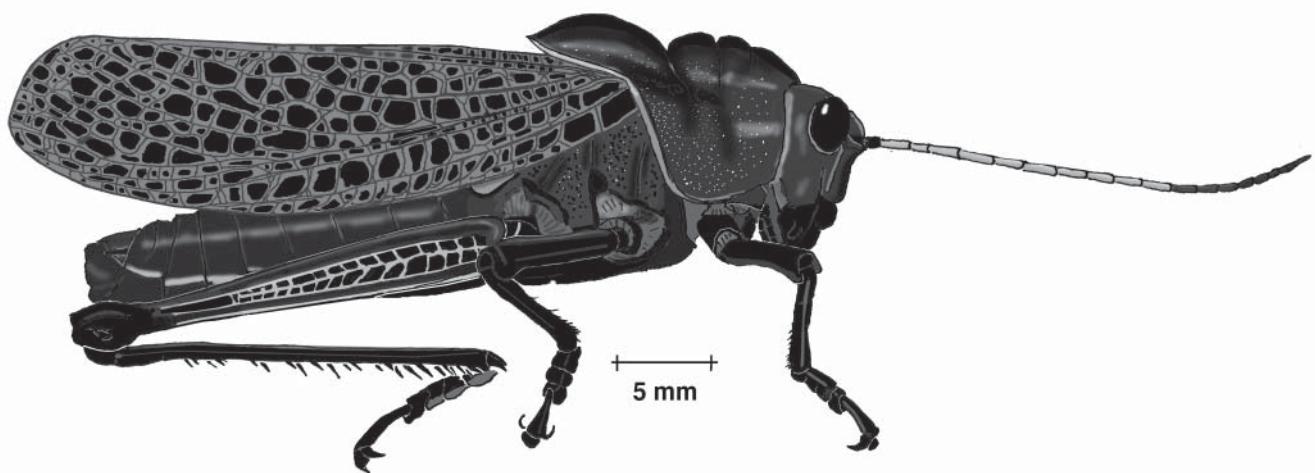


Fig. R33. *Taeniopoda reticulata*. Male habitus.

nuper in Etruria collectas a Ptro Rossio 1:231 (as *Acheta reticulata*).

- Kirby, W.F. 1910. > A Synonymic Catalogue of Orthoptera (Orthoptera Saltatoria, Locustidae vel Acrididae) 3(2): 372.
- Hebard, M. 1924. Trans. Amer. Entomol. Soc. 50(851): 103.

Synonymy:

=*Taeniolopoda maxima* Bruner, L. 1900-1910(1907): 233, 235, syn. Hebard 1924a: 103.

Type locality: Limón, Costa Rica (lectotypes).

Location of type specimen: ANS Philadelphia.

Rehn & Hebard 1912: 118 (designation of lectotype).

Hebard 1924: 103 (synonym of *T. reticulata*).

Diagnosis.

Habitus, **Fig. R33, Plate R23.** Adult black with red-brown (or pink or purple) elytral venation, hind wings crimson. Antennae yellow, with the distal segments shading from dark brown to black. Larvae gregarious, black with red outlining on prothorax.

Distribution.

Panama (to date only the forested regions of Changuinola and Darién); Costa Rica (distributed over the entire country, but commonest on the Caribbean slope). The most typical examples of this colour form come from the Caribbean coast. **Maps R19 & R20.**

Natural history.

Larvae are gregarious. Adults highly polyphagous, with a strong liking for Liliaceae (e.g. *Hymenocallis*), but also on mangroves, citrus, weeds of cultivation, etc. They tend to move from the foodplant to shady places in the middle of the day, re-emerge later to cluster on foodplant and feed from evening to the following morning. Adults have a marked dynamic display, raising the elytra to expose the red wings, and frothing from the thoracic spiracles if further molested. This does not however prevent them from being eagerly eaten by domestic pigs and chickens. The efficacy of the defence is probably a function of the nature of the previously eaten plants, influencing the sequestration of repellent chemicals.

2. *Taeniolopoda variipennis* Rehn 1905

Rehn 1905: 410.

Type locality: San José, Costa Rica.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Hebard, M. 1925. Trans. Amer. Entomol. Soc. 5(4): 271.
- Hebard, M. 1932. Trans. Amer. Entomol. Soc. 58: 271.
- COPR (Centre for Overseas Pest Research). 1982. The Locust and Grasshopper Agricultural Manual 115 > Bionomics, biology.

Etymology.

Latin *varius*, different; *pinna*, feather, wing. Rehn's account suggests that he used this name because the females' wings are often relatively shorter than those of the male.

Diagnosis.

Habitus, **Fig. R34, Plate R24.** Head, pronotum, legs and reticulum of wing normally of greenish yellow coloration, but sometimes light brown. In the colour form *dubia* (see above) the ground colour is black with brown or purple tones, similar to the situation in *T. reticulata*. In all colour forms the scape and pedicel of antennae are black, the flagellum yellow or orange basally, the terminal 4-6 segments black or dark brown.

Distribution.

Mexico (Veracruz), W. Nicaragua, Costa Rica, Panama (new distributional record).

In Costa Rica (**Map R19**), *T. variipennis* occurs principally on the Pacific slope, especially in Guanacaste Province, the western part of the Meseta Central south to at least the Río Grande de Tárcoles, and in a few scattered savanna habitats in southern Puntarenas province; it is typical of dry forest and the savannas derived from them. There are however also a few records from the Caribbean slope, including localities from whence *T. reticulata* is recorded also. In Panama (**Map R20**), recorded from numerous localities in the Canal Zone, including Panama City, but also from Chiriquí, Veraguas and Coclé provinces. It is apparently absent from the wet forested northern coast.

The colour form *dubia* (see above) has been recorded from almost the whole of Costa Rica, except the extreme Caribbean sea board, including the Pacific coast of the Nicoya peninsula and the San Carlos plains.

Natural history.

Similar to that of *T. reticulata*. The larvae are gregarious, and mostly active at night. Polyphagous, eating a variety of herbs and shrubs.

Tribe Tropidacrini Brunner von Wattenwyl 1893

Rehn and Grant (1959: 262) and subsequently Descamps and Carbonell (1985) consider that the only certain members of this tribe are *Tropidacris* and *Titanacris*, but refrain from giving a tribal definition. Both genera are characterised by very large size, having the prozona and metazona of the pronotum about equal in length, having a pronotal crest which is better developed on the prozona, and lacking lateral carinae on the prozona entirely. The fastigium merges roundly with the

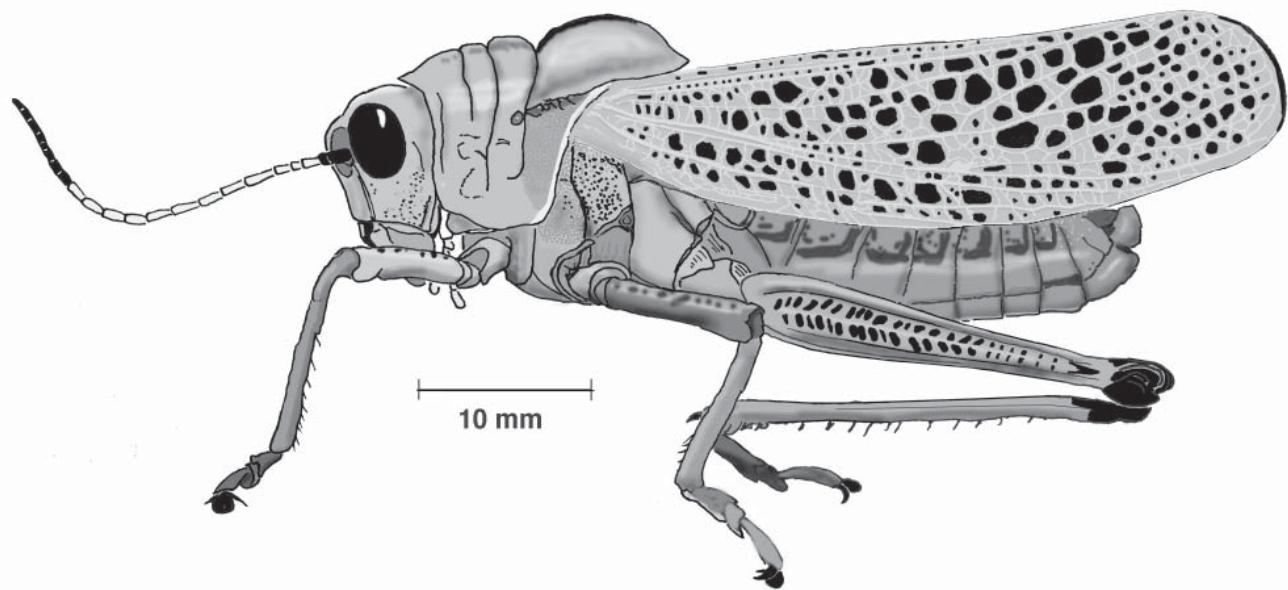
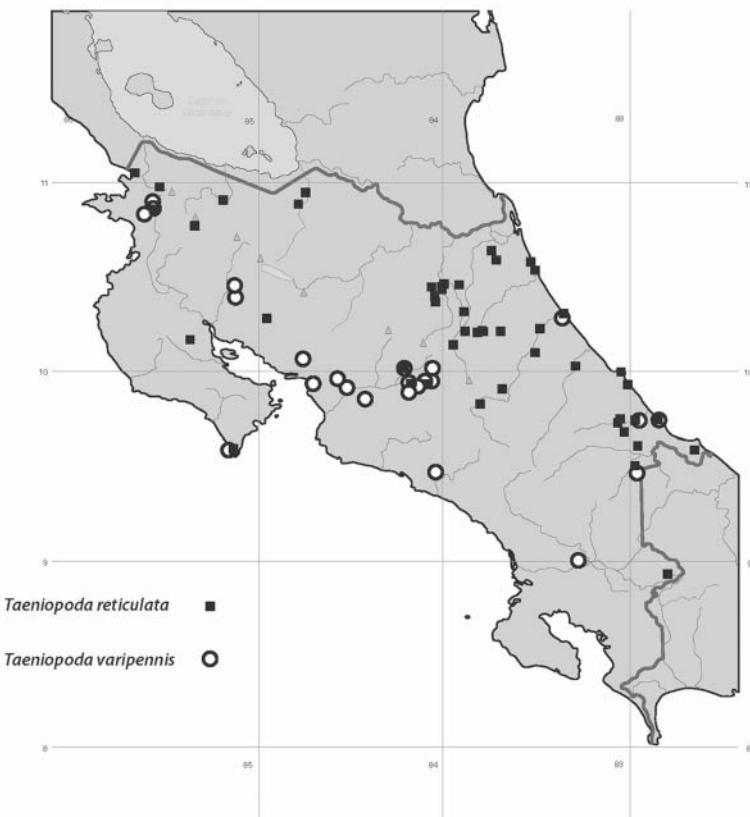


Fig. R34. *Taenioptoda varipennis*, male habitus.



Map R19. Localities of *Taenioptoda* spp. in Costa Rica. Note that *varipennis*, which may be only a colour form of *reticulata*, is almost completely confined to the Pacific slope.

frontal ridge and is not at all produced. The outer and inner faces of the hind femora are decorated with two or more rows of spots of contrasting colour. The epiphalllic lophi are large, upright and close set.

Titanacris Scudder 1869

Scudder 1869b: 352.

Type species: *Acrydium albipes* De Geer 1773: 487.

Type locality: Suriname (no other data).

Location of type specimen: Naturhistorika Riksmuseet, Stockholm.

Etymology.

Greek *Titan*, a child of Uranus and Gaea, characterised by great size and strength; *acris*, conventionally used for grasshopper.

Subsequent literature.

- Walker, F. 1870: 547.
- Stål, C. 1873b: 31.
- Stål, C. 1878a: 18.
- Pictet, A. & Saussure, H. de. 1887: 362.
- Brunner von Wattenwyl, K. 1893: 134.
- Giglio-Tos, E. 1898: 42.
- Kirby, W.F. 1910: 377.
- Liebermann, J. 1939: 598.
- Roberts, H.R. 1941: 240.
- Uvarov, B. & Dirsh, V.M. 1961: 158.
- Amedegnato, C. 1974: 198.
- Descamps, M. & Carbonell, C.S. 1985, 259-285. > Review of genus.

Synonymy.

= *Lophacris* Scudder 1869a: 337, Synon. Stål, 1878a: 18.

- Scudder 1869b: 353.
- Walker 1870: 549
- Thomas 1873: 237.
- Stål 1878a: 18.
- Scudder 1897: 207.
- Kirby 1910: 378:
- Roberts 1941: 240.
- Uvarov & Dirsh 1961: 158.
- Amedegnato 1974: 198.
- Descamps 1978b: 314.

No. of known species.

Seven. In our area, three.

Range of genus.

Tropical wet forest from Peru and Brasil to Mexico. Not yet recorded from El Salvador.

Diagnosis.

(After Descamps & Carbonell 1985). All species are of very large size. The smallest individuals (males of *T. ornatifemur*) are more than 50 mm from frons to wingtip, and females of *T. gloriosa* can be twice this size. All are predominantly light green in colour, with only small areas or markings in other colours. The elytra lack secondary cross veins between the main longitudinal veins. The hind wings are plainly coloured in red or violet, without dark maculation, and the usual vannal stridulatory specialisations are present. Medial pronotal crest well developed in both the prozona and the metazona. The median dorsal carina of the hind femur is serrulate, not smooth, and the external and internal faces of all femora are decorated with a row or rows of spots in a contrasting colour. External apical spine of hind tibia present. The supra anal plate has lateral tubercles, and the epiphalllic lophi are large and pointed.

Natural history.

All members of this genus are inhabitants of the crowns of the trees of tropical wet forest, and are normally taken only by chance or when they are attracted to light at night. Probably all are generalists on tree leaves, like the related genus *Tropidacris*. According to Nieto (1857), quoted by Descamps & Carbonell (1985:26), the larvae are gregarious, like those of *Tropidacris*.

1. *Titanacris gloriosa* (Hebard 1924)

Hebard 1924: 104.

Type locality: Panama: Canal Zone, Paraíso.

Location of type specimen: NMNH, Washington (holotype male).

Subsequent literature.

Descamps, M. & Carbonell, C.S. 1985: 272.

Diagnosis.

Very large [mean frons to wing-tip 85mm/121 mm (male/female)]. External face of hind femur with 2 rows of ivory-coloured spots basally, merging to a single row at about half length; hind tibiae ochraceous and orange. Vannal area of hind wing red anteriorly and dark purple posteriorly.

Distribution.

Panama, Colombia (Magdalena), Venezuela (Trujillo).

Most Panamanian records are from the Canal Zone. **Map R21.**

2. *Titanacris ornatifemur* Descamps & Carbonell 1985

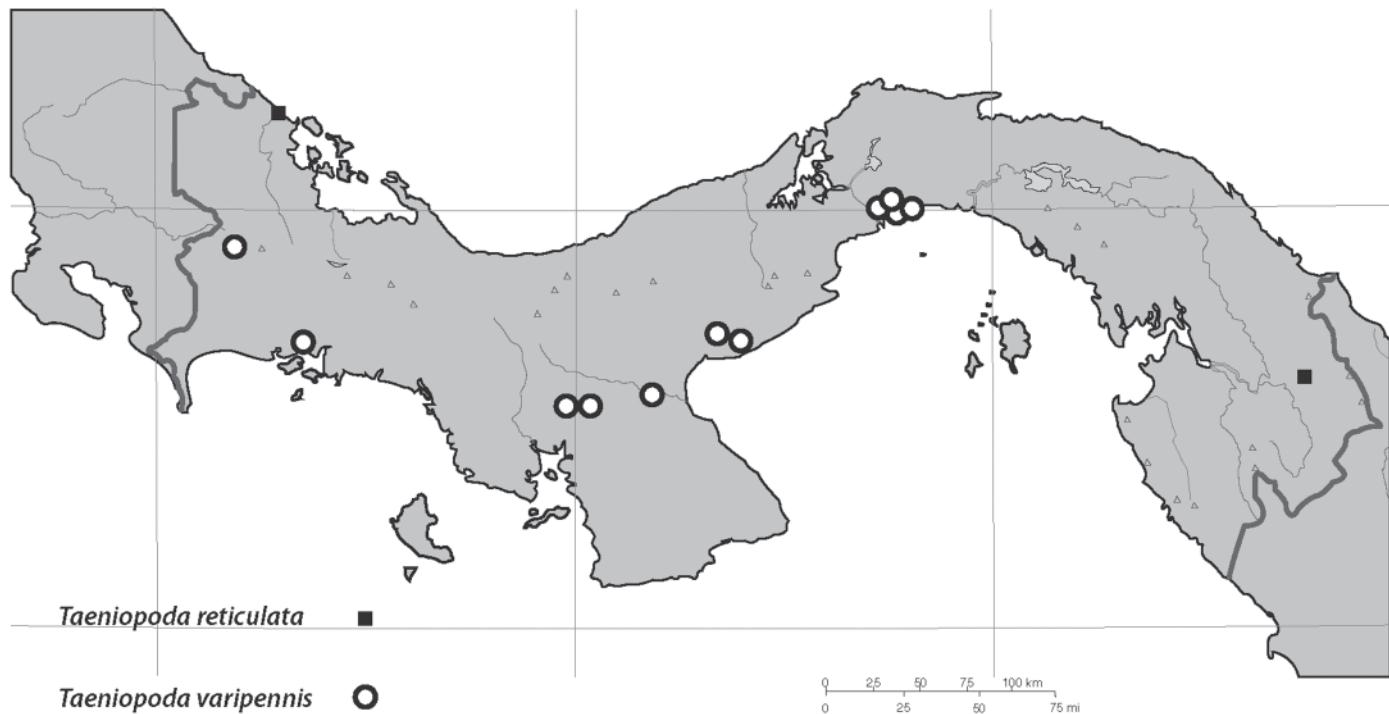
Descamps & Carbonell 1985: 282.

Type locality: Boruca, Prov. Puntarenas, Costa Rica.

Location of type specimen: ANS Philadelphia.

Diagnosis.

Anatomy **Fig R36.** Slightly smaller than the other Central American members of the genus [mean frons to wing-tip 54 mm / 73 mm (male / female)]. Pronotal crest relatively flat,



Map R20. Localities of *Taeniopoda* spp. in Panama. Note that *varipennis*, which may be only a colour form of *reticulata*, is confined to the Pacific slope, and *reticulata* to areas of wet forest (Caribbean coast and Darién).

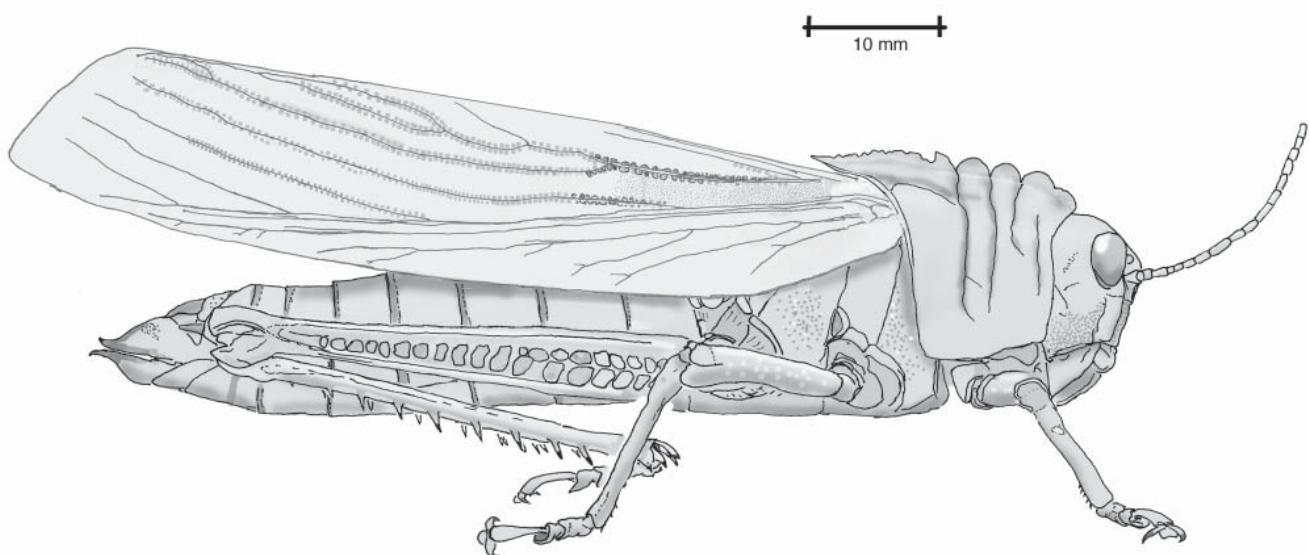


Fig. R35. *Titanacris velasquezi*, female habitus.

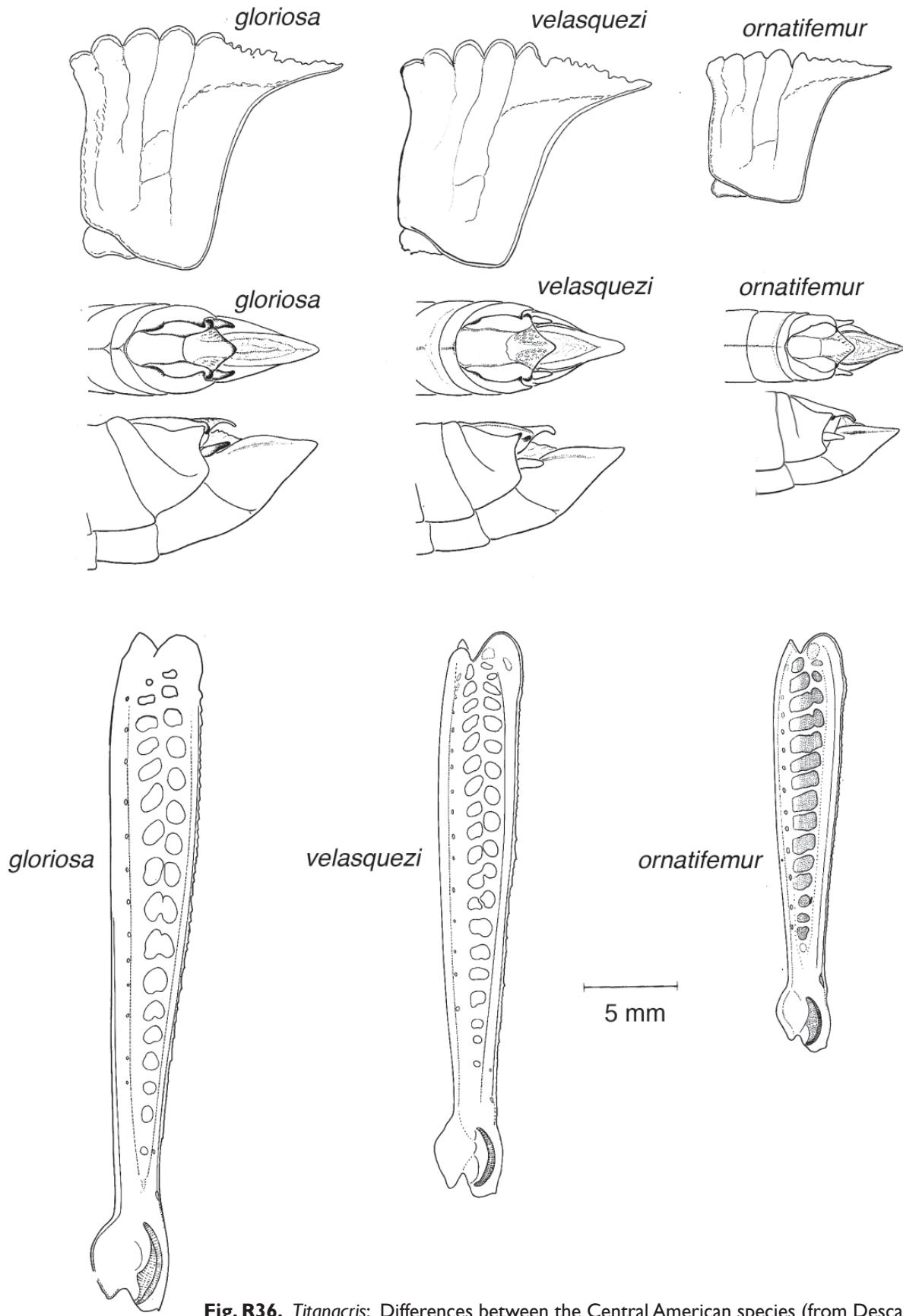


Fig. R36. *Titanacris*: Differences between the Central American species (from Descamps & Carbonell 1985). LH column, *T. gloriosa*; centre column, *T. velasquezi*; RH column, *T. ornatifemur*.

(**Fig.R36**), with no red coloration. Spots on hind femur bright red, forming two rows basally and coalescing by pairs to form a single row for most of the femur. Hind tibiae yellow-green. Vannal area of hind wing red.

Natural history.

The type series consists of 7 males and 2 females, all with the same data. This large number suggests that the collector (M.A. Carriker) either found an eclosing group, or more probably that they came to light, as is the habit of several species of this genus.

Distribution.

Known only from the type series and a few single records from W. Panama and S.W. Costa Rica; the type locality is now deforested. This species has not been seen or captured for many decades, and may well be seriously threatened, or even extinct. **Map R21**.

3. *Titanacris velasquezi* (Nieto 1857)

Acridium velasquezi Nieto 1857: 359.

Type locality: nr. Cordoba, Veracruz, Mexico.

Location of type specimen: Type lost..

Subsequent literature.

- Scudder, S.H. 1869b: 354. > transfers to *Lophacris*.
- Walker, F. 1870: 549.
- Thomas, C. 1873: 238.
- Scudder, S.H. 1901: 164.
- Descamps, M. 1978: 314.
- Pictet, A. & Saussure, H. de. 1887: 364. > Transfers to *Titanacris*.
- Bolívar, C. 1896: 16. > Colombia.
- Scudder, S.H. 1901: 32 6.
- Bruner, L. 1900-1910 (1907): 241. > Misidentified as *T. gloriosa*, cf. Hebard 1924: 104.
- Bruner, L. 1911: 63. > Misidentification.
- Liebermann, J. 1939: 599.
- Descamps, M. & Carbonell, C.S. 1985: 274.

Diagnosis.

Habitus **Fig. R35, Plate R25**. Pronotal crest markedly arched, with a wide orange-yellow border. Vannal area of hind wing red; two parallel rows of yellow or pinkish spots on hind femur, coalescing to form a single row only in apical third of femur.

Distribution.

Mexico (Veracruz, Yucatan, Tabasco, Oaxaca, Quintana Roo); Guatemala; Belize; Honduras; Costa Rica, Colombia. In Costa Rica, a rarely seen inhabitant of lower montane rain forest, recorded only from Carrillo, Sarapiquí, and from Pitilla, Volcan Orosí. **Map R21**.

Tropidacris Scudder 1869

Scudder 1869b: 346.

Type species: *Tropidacris rex* Scudder 1969: 338.

Type locality: Guayaquil, Ecuador.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Stål, C. 1873: 158.
- Walker, F. 1870: 548
- Brunner von Wattenwyl, K. 1893: 134.
- Giglio-Tos, E. 1898: 42.
- Kirby, W.F. 1910: 379.
- Liebermann, J. 1939: 597.
- Roberts, H.R. 1941: 240.
- Rehn, J.A.G. & Grant, H.J. 1959: 263.
- Amedegnato, C. 1974: 198.
- Carbonell, C.S. 1984: 1.
- Carbonell, C.S. 1986: 367. > Revision of genus.

Etymology.

Greek *tropis*, *tropidos*, keel, and *acris*, grasshopper, referring to the high crest on the pronotal prozona.

Synonymy.

= *Eutropidacris* Hebard 1923: 232, synon. Marshall 1983: 386.

- Liebermann 1939: 593, 594.
- Roberts 1941: 240.

No. known species.

Three. In our area, one.

Range.

Argentina to Mexico, excluding Chile.

Diagnosis.

Habitus **Fig. R37, Plate R26**. Distinguished from all genera except *Titanacris* by the tribal characters given above. Distinguished from *Titanacris* by, a) the presence of numerous cross veins between the longitudinal veins of the elytra, b) the densely tessellated hind wings (except in *T. descampsi*, Amazonas), c) the relatively weak medial crest in the metazona, d) the smooth median dorsal carina of the hind femur, e) the supra-anal plate is devoid of lateral tubercles, and f) the epiphalllic lophi are truncated at their apices, and not pointed. The stridulatory veins of the vannal aea of the hind wing are relatively poorly developed.

I. *Tropidacris cristata* (Linn 1758)

Gryllus crista thoracica quadrifida Linnaeus (P. Sundio) 1749: 502.

Type locality: Suriname (presumed).

Location of type specimen (lectotype): Linnaean Society, London.

- Linnaeus 1758: 431; 1764: 137 (partim).

Gryllus cristatus Fabricius 1775: 208.

- Fabricius 1781: 362; 1793: 46.
- Thunberg 1815: 224; 1824: 402.

Acridium cristatum Erichson 1848: 582.

- Scudder 1868: 4.

Tropidacris cristata Scudder 1869b: 351.

- Walker 1870: 549.
- Campos 1923: 23.
- Marshall 1983: 380 (designation of lectotype).
- Carbonell 1986: 378.

Lophacris cristata Kirby 1910, partim.

=*Gryllus Locusta dux* Stoll 1813: 6, nec *dux* Drury, synon (under *Acridium latreillei*) Serville 1839: 652.

=*Acridium dux* Duncan 1840: 257, nec *dux* Drury.

=*Tropidacris dux* Scudder 1869b: 347 partim.

Cited as such by various subsequent authors, among whom Bruner 1907 (1900-1909) refers to material from Costa Rica.

=*Acridium latreillei* Perty 1834: 123, synon. Carbonell 1984: 8.

=*Tropidacris rex* Scudder 1869a: 338; 1869b: 348, synon. Carbonell 1984: 8.

=*Tropidacris princeps* Stål 1873b 48, synon. Carbonell 1984: 8.

For full bibliographic references to the synonymized species, see Carbonell 1986.

Field characters.

The only species of the genus in our part of Central America, hence the generic diagnosis applies. Only *Titanacris* approaches it in size, and it can be distinguished from that genus at a glance by the much darker blue-green coloration of the elytra and pronotum and the darkly spotted hind wings. Larvae are distinctively marked with vertical bands of blackish brown and yellow-green (**Fig. R38, Plate R27**), and tend to be gregarious, though not to the same degree as say those of

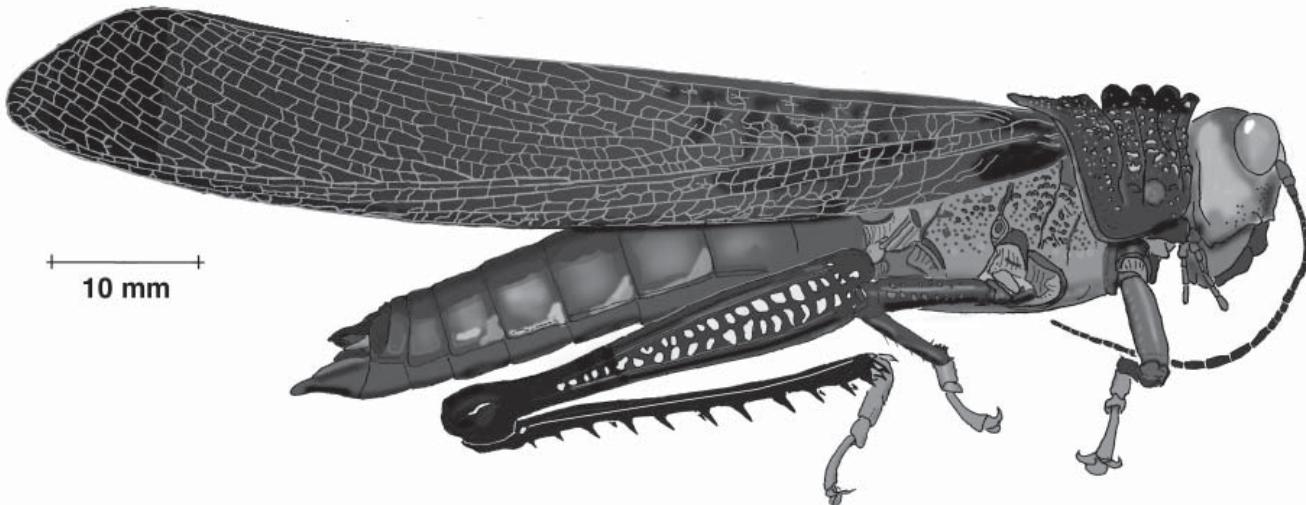
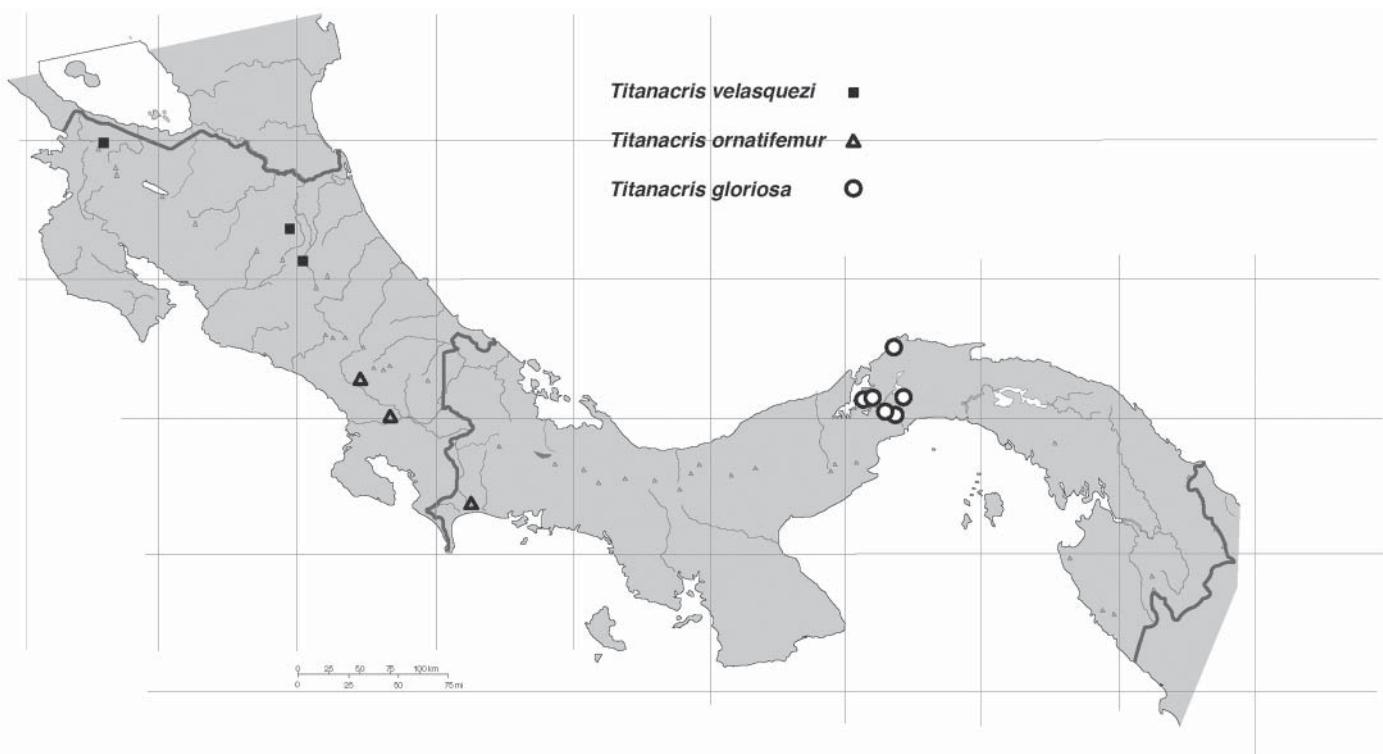
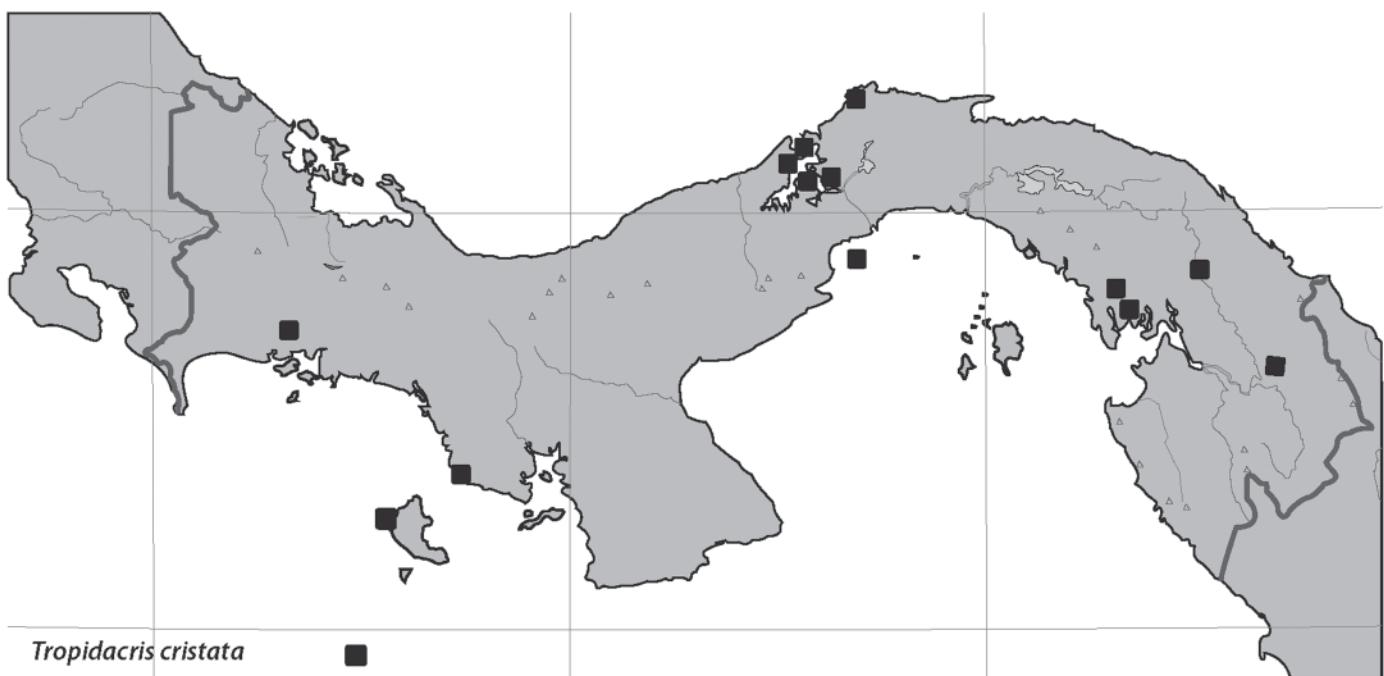


Fig. R37. *Tropidacris cristata*. Male habitus.



Map R21. Recorded localities of *Titanacris* spp. in Costa Rica and Panama. Note the N-S distribution of the species, and that whereas *T. velasquezi* extends North to Mexico, and *T. gloriosa* extends South into Colombia, *T. ornatifemur* has been recorded only from the three localities shown here.



Map R22. Localities of *Tropidacris cristata* in Panama. The species probably occurs throughout the country.

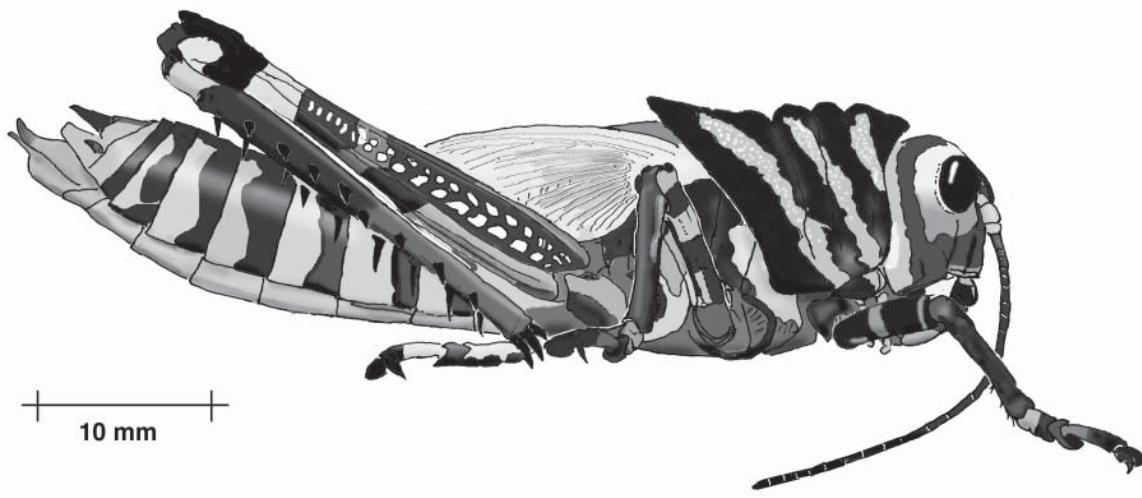
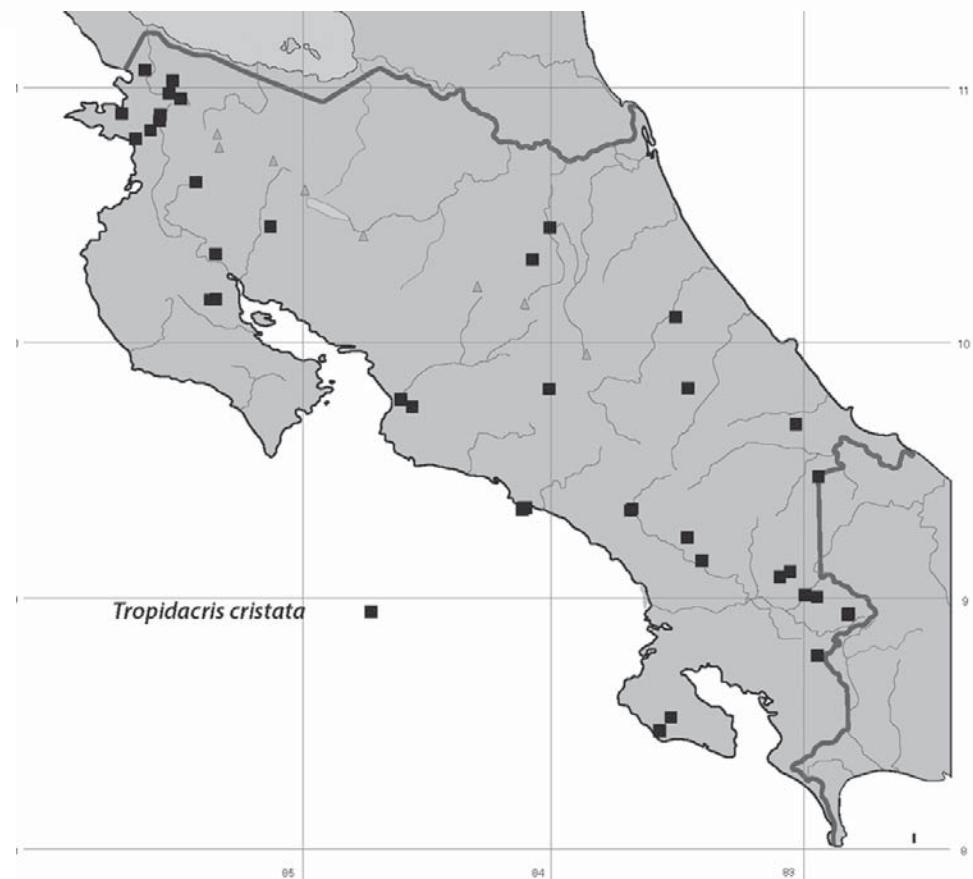


Fig. R38. *Tropidacris cristata*. Fifth instar female larva.



Map R23. Localities of *Tropidacris cristata* in Costa Rica. Its distribution covers the entire country, though it is perhaps commoner on the Pacific slope.

Chromacris. As in the latter genus, the striking larval coloration is probably an aid to visual orientation to neighbours, and also perhaps aposematic, in view of the distasteful larval food plant *Quassia* (Simarubaceae).

Well known to entomologists as the largest of all Acridoid grasshoppers.

Distribution.

From Paraguay, Brazil and Northern Argentina north through all South and Central American countries (except Chile) to Mexico, and including Trinidad and Tobago and the Windward Islands. Carbonell (1986) recognizes 3 subspecies, of which the nominate *T. c. cristata* (Linnaeus 1758) extends from Brazil to the northern border of Costa Rica, where it occurs in all wooded habitats except the upper montane (>1800 m) and alpine regions. Common in the Canal Zone of Panama. North of Costa Rica the subspecies *T. c. dux* (Drury 1773) is found. **Maps R22 & R23.**

Natural history.

Polyphagous on many species of broad-leaved trees, shrubs, and on palms, and occasionally recorded as an agricultural pest, e.g. of beans or mango trees or coconut palms. In Costa Rican forests larvae are most often found on *Quassia amara* - "bitter wood" (Simarubaceae); like those of *Titanacris*, they are gregarious. The population is markedly variable from year to year, being very common in some periods, especially in the Pacific South West of Costa Rica (e.g. the Valle de El General, the Coto Brus), and rather rare in others. A powerful flier, often coming to light at night. Popularly known as "langosta".

Subfamily Bactrophorinae

Amedegnato 1974

The Bactrophorinae are a distinctive group of Neotropical grasshoppers, the great majority of which are South American. Currently some 208 species in 45 genera are described, with more in preparation.

Amedegnato (1974) gave them subfamily rank (originally under the name Trybliophorinae, but the original type genus *Trybliophorus* later transpired to be a romaleine) and grouped them with the Romaleinae as the family Romaleidae. This familial allotment of the Bactrophorinae is made primarily on the basis of their male genitalia, which Amedegnato (1977) interpreted as being an early version of the form characteristic of the rest of the Romaleidae; in that work and elsewhere (e.g. Amedegnato & Descamps 1983) she refers to them as the most archaic of all the Cryptosacci [a term coined by Roberts (1943) to denote the more advanced families of grasshoppers – it is derived from the male genital anatomy]. This view was based on the very simplified phallic anatomy of some taxa. Molecular systematics confirm that the subfamily are indeed a rather early branch of the Acridoidea, but to date have not succeeded in linking them to the Romaleinae in a single clade corresponding to a family Romaleidae (Rowell & Flook 1999). Phylogenetic analysis (Amedegnato et al. 2012) shows that the taxa with most reduced phallic anatomy (the Rhicnoderma genus group) are actually a crown group and not at all primitive within their tribe, suggesting a secondary phallic reduction rather than a plesiomorphic state.

Diagnosis.

Bactrophorines are mostly of small to medium size, usually brachypterous or micropterous, with powerful jumping hind legs, large globular protruding eyes, long antennae and the second tarsal joint of the hind foot almost as long as or even longer than the first joint (this last character differentiates them from all romaleines found in our area, though not from some S. American canopy romaleines). The feet and the lower surfaces of the abdomen are richly provided with sensory hairs. Some are cryptic, but many are brightly coloured, and they probably rely on visual intraspecific communication; they have no stridulatory apparatus and often no tympanum. Like the Romaleinae, they have external apical spines on the hind tibiae and a prosternal process.

Natural history.

The subfamily is almost entirely confined to tropical wet forest environments. Little is known so far of their food plant preferences (but see Amedegnato 1997), and virtually nothing of their sexual behaviour. Most of them are arboreal and rather rarely captured; at ground level they are most often found after wind storms or tree felling, or in the case of females, during or after oviposition. Males are almost always rare in collections. In some of the subtribes the ovipositor valves are more or less modified and rod-like, suggesting epiphytic oviposition,

but this has not been actually observed to date. A few genera (*Taeniohora*, *Lagarolampis*) frequent shrubs or herbs of the light gaps or understorey trees, rather than the canopy.

Systematics.

Amedegnato (1977) divided the subfamily into three tribes: the Bactrophorini, Taeniophorini and Ophthalmolampini, and the last of these into 4 subtribes: the Ophthalmolampae, Nautiae, Lagarolampae and Helicopacrae. Of these various taxa, only the (monogeneric) Helicopacrae are absent from our area. The Taeniophorini and Ophthalmolampini were reviewed by Descamps (1978a, 1983) who adopted Amedegnato's divisions; the Bactrophorini were analysed cladistically by Amedegnato et al. 2012.

Tribe Bactrophorini

Amedegnato 1974

The Bactrophorini are predominantly arboreal forms adapted for lying along medium-sized twigs; the thoracic sterna are concave to accommodate such a support, and the wide, hair-fringed hind femora are arranged at rest to disrupt the outline of the animal and allow it to blend with the twig. They are extremely convergent with the quite unrelated African genera *Mecostibus* and *Mecostiboides* (Lentulidae) and the Madagascan *Euthymia* (Hemiacridinae), that have a similar way of life. The unusually shaped fastigia of some genera (e.g. *Bactrophora* and some purely S. American taxa) probably serve a similar disruptive purpose. Females are usually bark coloured, males sometimes similarly coloured but often tend to be green and with smaller black, white, yellow and red markings. Both sexes are remarkably cryptic in their natural habitat. Most genera of the tribe are rare in collections, and their taxonomy is hindered by a shortage of specimens.

A cladistic analysis of the morphological characters of the tribe (Amedegnato, Poulain & Rowell 2012) indicates that it is composed of two separate clades. One is principally C. American, extending northwards as far as Southern Mexico, but its most primitive members, *Bactrophora* and *Hyleacris*, also occur in or are confined to Amazonia. The other clade is almost exclusively S. American, centred on the Amazon, but one genus, *Mezentia*, extends into C. America as well. These phylogenies and distributions lend support to the hypothesis that the tribe is originally S. American, and has colonised northwards into Central America.

Tribal diagnosis.

Size moderate to large. Body form cylindrical, sometimes massive. Head orthognath or moderately prognath (except in *Mayalina*, outside our area). Fastigium variable, from extremely elongated (*Bactrophora*) to almost absent (*Rhicnoderma*, *Mezentia*). Lateral carinae of the face and frontal ridge well marked. Eyes relatively small for the subfamily, at least in our area. Interocular space wide, equal to or greater than the width of the frontal ridge between the antennae. Antennae filiform, with 20-25 flagellar segments.

Pronotum usually cylindrical or sometimes (*Mezentia*, *Cristobalina*) selliform, very short, often exposing the mesothoracic notum. Disc of pronotum cut by up to 4 sulci. Lateral and medial pronotal carinae absent, except in the females of *Lempira* and *Pararhicnoderma*, where the median carina is more or less nodular; or in *Cristobalina* and *Mayalina*, where it is cristate and toothed. Posterior margin of pronotum rectangular, slightly excurred in brachypterous genera. Anterior margin of pronotum typically slightly emarginate in the midline, with two flanking projections overhanging the vertex. Prosternal process sometimes cylindrical, but typically transverse, anteroposterior compressed, the corners produced, with a tendency to become more or less bifid. Meso- and metasternum slightly concave. Mesosternal interspace variable.

Fore- and midfemora short, robust, sometimes laterally compressed. Hind femora fairly short, not exceeding the tip of the abdomen, length of femur divided by its maximum width varies from 3.5 to ≥ 5.0 . Hind tibiae noticeably hairy; 6-9 external and internal tibial spines, the inner spines sometimes (*Mezentia*) strongly developed and inwardly curved. Hind tarsi very elongate, cylindrical and hairy.

Brachypterous or apterous; rudimentary tegmina present in *Bora* and *Cristobalina*. Tegmina, if present, densely reticulate, wings cycloid, blackish in colour except in *Bactrophora*, where they are orange, and *Mezentia*, where they are pale yellow or dark brown. Tympanum present or absent. Tenth abdominal tergite often divided, sometimes specialised. Supra-anal plate more or less triangular, divided into two by a transverse furrow, sometimes with a long tongue-shaped posterior process. Male cerci variable, from short and styliform to complex, depending on the genus. Ovipositor valves robust, except in *Mayalina*. Male subgenital plate normal or long and pointed, sometimes bifid at the tip. Female subgenital plate usually normal, but ornamented with raised ridges in the *Mezentia* genus group.

Genitalia.

The phallus is characterised by a particular type of epiphallus, and in some genera (the *Rhicnoderma* genus group) by having the middle part of the endophallus in the form of two simple elongate rods.

a/ Epiphallic layer. Lateroventral sclerites present or absent. When present, sometimes very large and more or less specialised. Epiphallus bridge-shaped, varying from very small (width less than 20% of the length of the middle and posterior parts of the endophallus, *Rhicnoderma* genus group) to considerably larger (50-80%). Ancorae very inconspicuous, barely visible, usually poorly differentiated from the anterior processes of the lateral plates. Lophi usually digitiform and hooked, sometimes with a tendency to being flattened and fused with the posterior processes of the lateral plates. Oval sclerites sometimes present, varying in size.

b/ Ectophalllic layer. Cingulum poorly differentiated, sometimes capsular, frequently having an internal mediodorsal ridge; cingular apodemes almost absent or only roughly indicated, never long, always flat and sometimes massive. The rami meet or even fuse ventrally, are simple without any particular elaboration, or have a posteroventral projection from the zone of fusion. Zygoma with a mediodorsal projection, varyingly developed, either unitary or bilobed.

The ectophalllic sheath covering the ends of the endophalllic sclerites varies in form among the various genus groups, and sometimes (*Rhicnoderma* genus group) forms "aedeagal valves" in which the endophalllic sclerites play no part. Arch of the cingulum absent, but sometimes there is a yoke (a "pseudoarch") formed from a thickening of the ecto-endophalllic fold (*Mezentia* genus group).

c/ Endophallic layer. Ejaculatory and spermatophore sacs both voluminous, sometimes bifid. The ejaculatory sac is often provided with tendon-like apodemes. The endophalllic sclerites sometimes (*Rhicnoderma* genus group) have the form of long fine laterodorsal rods, completely lacking a differentiated posterior part and without a flexure. The apodemes of the endophalllic sclerites are of variable size. Gonopore process thick and digitiform.

Female genitalia. Subgenital plate with well developed Comstock-Kellogg pouches. Post-vaginal sclerites present, but not very thick, mostly without columellae. Basivalvular sclerites present, but poorly differentiated. Base of the bursa copulatrix generally tubular, the orifice reinforced by a small crescent-shaped sclerite. Spermatheca with no pre-apical diverticulum.

Included genera.

The tribe currently comprises 11 genera (*Andeomezentia*, *Bactrophora*, *Bora*, *Cristobalina*, *Hyleacris*, *Lempira*, *Mezentia*, *Panamacris*, *Pararhincnoderma*, *Rhincnoderma* and *Silacris*), extending from Mexico (Yucatan, Vera Cruz, Guerrero) to Brazil (Pará) and Amazonian Peru (Loreto). Only 5 genera, *Bactrophora*, *Mezentia*, *Panamacris*, *Pararhincnoderma* and *Rhincnoderma*, occur in our area.

Natural history.

The Bactrophorini are almost exclusively forest dwellers. Many show a preference for the foliage of leguminous trees such as *Inga* (Mimosaceae) and *Pterocarpus* (Fabaceae), but *Rhincnoderma humilis* is extraordinarily polyphagous, eating more than 20 families of trees, shrubs, herbs and creepers, at least under outbreak conditions such as occurred in the P.N. Carara, Costa Rica, in 1991.

Bactrophora
Westwood 1842

Westwood 1842: 66.

Type species: *Bactrophora dominans* Westwood 1842: 66.

Type locality: unknown.

Location of type specimen: BMNH London.

Subsequent literature.

- Walker, F. 1870: 596.
- Kirby, W.F. 1910: 406.
- Martinez, S. 1921: 504.
- Rehn, J.A.G. 1938: 89. > Revision of genus.
- Amedegnato, C. 1974: 199.

=*Scolocephalus* Bruner 1905: 314, synon. Bruner 1900 -1910: 250.

=*Scolecocephalus* Kirby 1910: 406 (amended name for *Scolocephalus*, invented by Kirby 1910), synon. Rehn 1938: 89.

No. known species.

Two, with others awaiting description (MNHN Paris).

Known range of genus.

British Guiana; Colombia (Cundinamarca, Sta Fe de Bogotá); Brazilian and Peruvian Amazon; Costa Rica.

Etymology.

Greek *bactron*, staff or rod, *phoreus*, bearer; referring to the long rodlike rostrum.

Diagnosis.

Unmistakeable due to the long, laterally flattened rostrum, derived from the fastigium. No other Central American genus or species has anything comparable. (NB: in the larva the rostrum is much shorter). This is also the only Central American bactrophorin which is not at all dorsoventrally compressed. Brachypterous. The wings are coloured, usually orange.

I. *Bactrophora mirabilis* (Bruner 1905)

Scolecephalus mirabilis Bruner 1905: 315.

Type locality: COSTA RICA: Prov. S. José: Pozo Azul de Pirris..

Location of type specimen:ANS Philadelphia.

Subsequent literature.

- Bruner, L. 1900-1910 (1908): 250. > Transfers to *Bactrophora* Westwood (and misidentifies as *B. dominans*, a S. American sp.).
- Kirby,W.F. 1910: 406. > Restores to *Scolecephalus*, amended name for *Scolecephalus*.
- Rehn, J.A.G. 1938: 89. > Transfers back to *Bactrophora*.
- Rehn, J.A.G. 1938: 97.
- Roberts, H.R. 1973: 60.
- Amedegnato et al. 2012: 91 et seq. .

Etymology.

Latin *mirabilis*, strange or wonderful. Another reference to the extraordinary rostrum.

Diagnosis.

Habitus, see **Fig. B1 & Plate B1**. The head is highly distinctive (see generic characters above). Antennae thick filamentous, with 21 flagellar segments, about as long as pronotum and head together (including the rostrum). Body form elongate, cylindrical. Medial and lateral carinae of the pronotum absent; disc cut by three sulci, the most anterior almost obsolete. Posterior margin of pronotum almost straight, anterior margin slightly emarginate in the midline. Pronotum profusely decorated with small rounded tubercles, some shiny black, some bright red. Prosternal process cylindrical, vertical with a bluntly rounded tip. Pro- and mesothoracic femora short and laterally compressed. Hind femur shorter than abdomen. Hind tibia laterally compressed proximally, 6-7 internal and external hind tibial spines, including the external apical spine. Slightly brachypterous, tegmina extend in to the fifth abdominal tergite. Wings orange. Male subgenital plate simple, pointed. Cerci of both sexes simple, conical, slightly inwardly curved. Ovipositor valves (**Fig. B2**) robust. Supra-anal plate divided transversely, with a long lingulate tip. Thoracic sterna, the bases of all legs, and the entire hind tibia thickly covered with sensory hairs.

Field characters.

Coloration: the large females (overall length 85 mm) are reddish or purplish brown with blackish mottling. The hind wings are orange, as is the inner face of the hind femur. Males are smaller (overall length, 45-50 mm), olive green-brown, with a more or less distinct pale whitish band from the genae across the lateral lobes of the pronotum on to the thoracic pleura and continued along the lower outer face of the hind femur. The abdominal plura are reddish brown.

Dried museum specimens of both sexes soon turn a uniform dark brown.

Natural history.

Largely unknown. Clearly a canopy dweller; it has been obtained by canopy fogging (Roberts 1973). Females are usually found during or after egg laying in the ground, males after storms which have dislodged them from above.

Distribution.

To date known only from the lowland forests of S.W. Costa Rica, S. of Río Grande de Tárcoles. **Map B1**. Modern specimens are all from the Osa Peninsula. In view of the generic distribution (see above), it may well be present in the forests of Caribbean Panama.

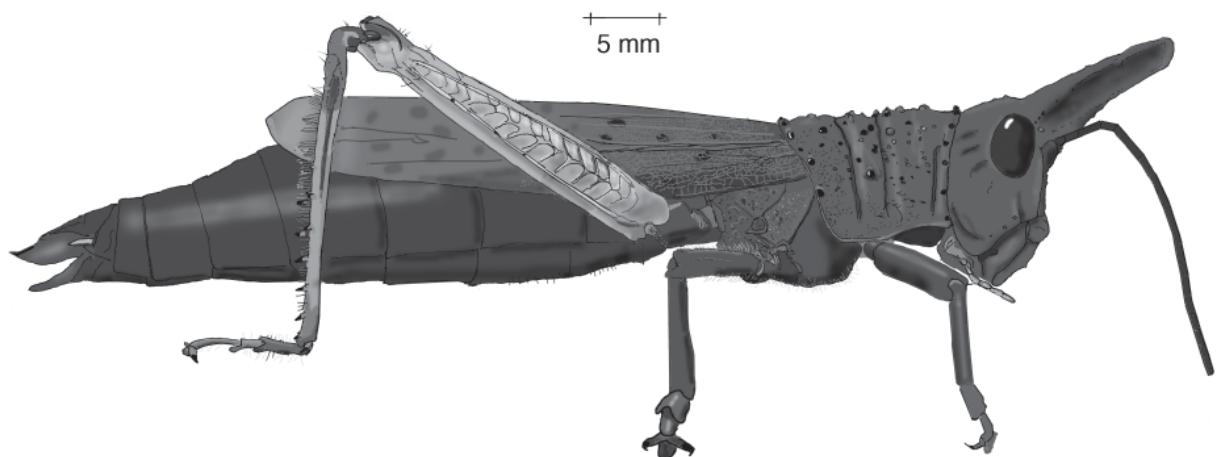


Fig. B1. *Bactrophora mirabilis*, female habitus.

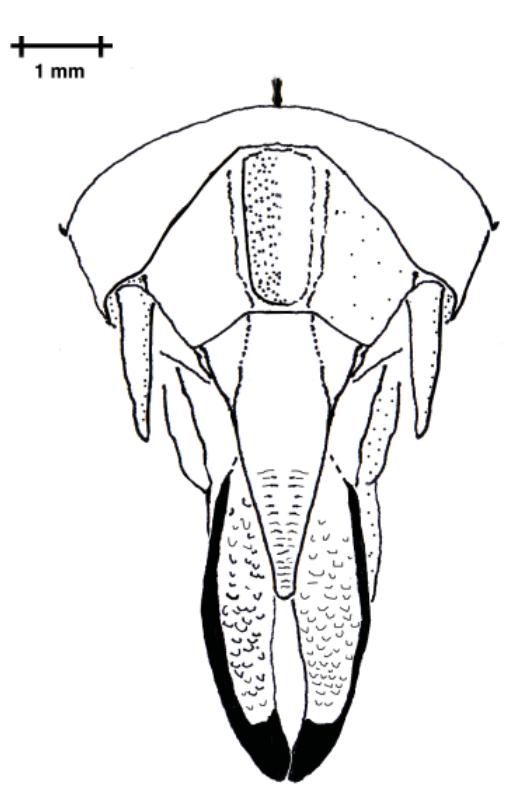


Fig. B2. *Bactrophora mirabilis*, female terminalia, dorsal view.



Map B1. Localities of *Bactrophora mirabilis* in Costa Rica.

Mezentia

Stål 1878

Author: Stål 1878a: 588.

Type species: *M. gibbera* Stål 1878a: 88.

Etymology.

“Mezentius, king of Etruria, famous for his cruelty. His subjects rebelled and set his palace on fire, but he managed to escape. Killed by Aeneas during the Trojan wars” [Carbonell 2000, Metalepta 20(2):10]. As in most of Stål’s names derived from characters from the classics, there is no obvious reason why this taxon was so named.

Subsequent literature.

- Brunner von Wattenwyl, K. 1893: 135.
- Giglio-Tos, E. 1898: 43.
- Bruner, L. 1900-1910: 247.
- Kirby, W.F. 1910: 390.
- Hebard, M. 1924a: 112.
- Rehn, J.A.G. 1938: 76. > Revision of genus.
- Amedegnato, C. 1974: 199.
- Rowell, C.H.F. 2012:b 281!

Known range of genus.

Honduras, Costa Rica, Panama, Colombia.

The recent erection of *Andeomezentia* (Amedegnato & Poulin 1994) and *Hylaezentia* (Amedegnato, Poulin & Rowell 2012) to accommodate Amazonian species formerly included in *Mezentia* has removed Brazil (Amazonas) and Peru (Loreto) from the range of the genus.

No. currently known species.

Three, plus an undescribed fourth species from Colombia (MNHN Paris).

Diagnosis.

Habitus, **Fig B3, Plate B2**. A rather large bactrophorine, brachypterously winged and tympanate. Sexual dimorphism very marked, the females are nearly twice the size of the males, heavy-bodied subcylindrical animals up to 55 mm in length.

Antennae thick filiform, 18-21 flagellar segments. Head orthognathous, the fastigium sloping downwards at about 30° to join the deeply sulcate frontal ridge. Fastigio-facial angle somewhat produced. Vertex and occiput smooth, not tuberculate. Lateral carinae of face prominent.

Pronotum with 4 sulci, all but the most anterior cross the disc. Medial and lateral carinae absent. Anterior margin of disc emarginate in the midline, the embayment being flanked by two blunt points, each somewhat tuberculate. Posterior margin slightly convex, gently rounded. Metazona and posterior part of prozona tuberculate, inflated and noticeably higher than

the anterior portion of the prozona in lateral view. Prosternal process short, bluntly rounded, subcylindrical, only slightly widened in the transverse axis, not transversely elongated as in the Rhicnoderma genus group. Thoracic sterna slightly concave. Tympanum large, mostly covered by the tegmina. Tegmina short, variously attaining the third to seventh abdominal segment, with a prominent pale longitudinal venation, with expanded precostal area and emarginate trailing edge towards the wing tip. Wings cycloid, usually opaque dark brown in colour in our region (in the Honduran sp. *M. cutteri* the wings are transparent and pale yellow, in *M. gibbera* sometimes clear).

Hind femora wide and relatively short, extending just beyond the tip of the abdomen. Dorsal carina and external ventral carina weakly serrate. Hind tibiae with 5 internal and 5 external spines including the apical spines. Hind foot long, more than half the length of the tibia, with subequal segments; foot formula 35-38: 27-31: 32-35.

The plantar surfaces of all the tarsi are provided with pulvilli modified into sucker-like structures, presumably adapted to gripping smooth bark.

All abdominal segments with a well-marked medial carina. Tenth abdominal segment of male strongly inflated and extended transversely, the posterior margin thickened, sclerotised and ornamented with 5 sharp downwardly directed melanised teeth, the outer ones having double apices (**Fig. B6**). Male supra-anal plate subtriangular, with a thickened proximal margin, and terminating in a slender ligulate process. The proximal edges of the plate are strongly thickened, and each bears a low pointed lateral process. The proximal half of the supra-anal plate has a number of sharp melanised teeth, similar to but smaller than those seen on the 10th abdominal segment.

Male cerci large, laterally compressed, the proximal portion extending downwards, then sharply flexed through 90° to run parallel to the body axis to their tips, which are slightly upwardly curved (**Fig. B7**). Distal portion of cercus grooved on the dorsal surface, with melanised tips. Male subgenital plate conical, pointed.

Female supra-anal plate triangular, transversely divided, devoid of ornamentation, but the margins slightly angular where the male has sharp points. Female cerci simple, short, styliform, slightly inwardly curved. Ovipositor valves large and robust, with smooth edges. Female subgenital plate with paired lateral points (**Fig. B4**).

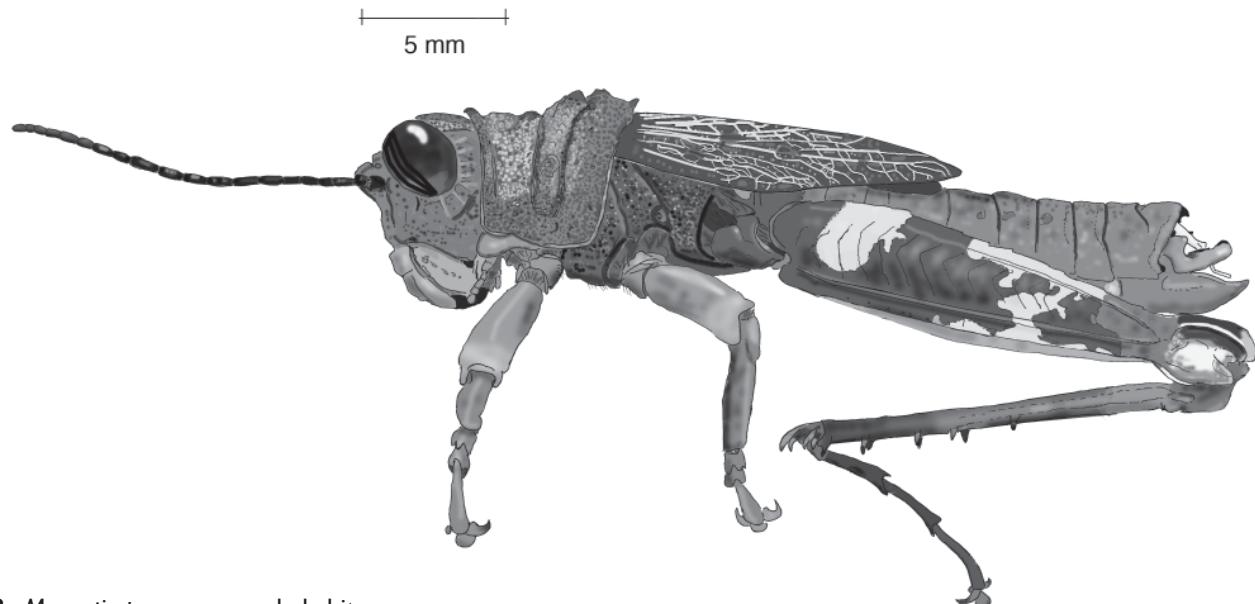


Fig. B3. *Mezentia proracera*, male habitus.

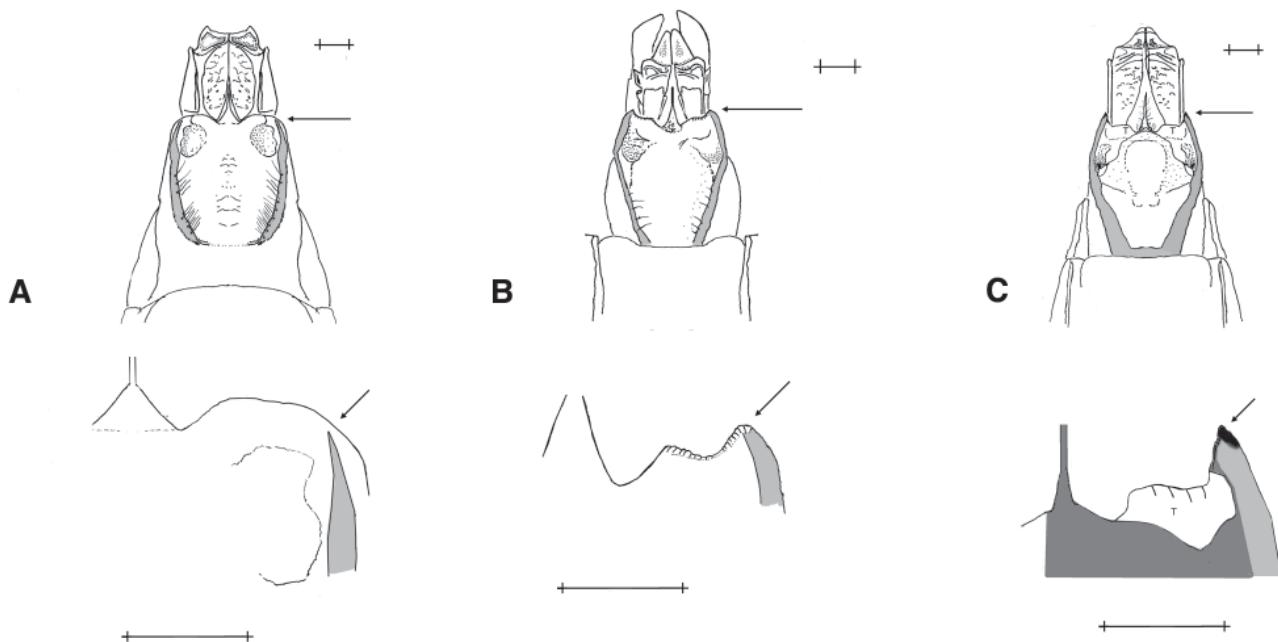


Fig. B4. *Mezentia* spp. Female subgenital plates, ventral aspect. A, *M. prymnacera*. B, *M. proracera*. C, *M. gibbera*. Scale bars, 1 mm. Arrows indicate diagnostic features.

Key to Central American species of Mezentia.

All *Mezentia* species are closely similar. The major distinguishing features are in the male terminalia, especially the supra-anal plate and cerci, and the female subgenital plate. See **Figs B4-6**)

Females:

I Hind wings, pale yellow, semitransparent; tegminal membrane (between the veins) light green, internal and ventral faces of hind femora, internal face of hind tibia, blue black. External ventral carina of hind femur smooth (N. Honduras). Smaller (L = ca 45 mm), and with smoother integument than other species of the genus.

..... *M. cutteri* Rehn 1938.

IA Hindwings opaque dark brown; tegminal membrane dark brown or dark green, proximal internal face of hind femur and distal internal face of hind tibia, shiny black; ventral face of hind femur, inner face of hind knee, reddish. External ventral carina of hind femur slightly serrate (Costa Rica or Panama).

..... 2.

2 Posterior region of pronotum ornamented with numerous reddish tubercles. Tips of tegmina barely attain third abdominal tergite. Posterior margin of subgenital plate ends in two melanised lateral points, each flanked medially by a patch of transparent integument (labelled T in **Fig. B4C**). (Caribbean slope of Panama).

..... *M. gibbera* Stål 1878.

2A Tegmina extend almost to 4th abdominal tergite. Posterior margin of subgenital plate not provided with lateral points.

..... 3.

3 Tegminal membrane dull brown, little or no red coloration on the venation. Posterior margin of subgenital plate entire and slightly convex (**Fig. B4A**) (Cordillera Norte of Costa Rica).

..... *M. prymnacera* Rowell 2012b

3A Tegminal membrane dark green with prominent dark red blotching on the venation. Posterior margin of subgenital plate slightly concave with fine striations (**Fig. B4B**). (Lowland forest of Costa Rica, Pacific and Caribbean slopes).

..... *M. proracera* Rowell 2012b

Males:

I Posterior margin of 10th abdominal tergite adjacent to supra-anal plate orthogonally recessed, forming an almost rectangular aperture (**Fig. B5 A**). Horizontal limb of male cercus in side view little or not at all longer than vertical limb. In dorsal view, tips of cerci do not extend as far as tip of supra-anal plate. Lingulate tip of supra-anal plate narrow and strap-like (Cordillera Norte of Costa Rica).

..... *M. prymnacera* Rowell 2012b

IA Posterior margin of 10th abdominal tergite adjacent to supra-anal plate concave, curved inwards.

..... 2

2 Posterior margin of 10th abdominal tergite recessed in an arch-like concavity above supra-anal plate. Horizontal limb of male cercus clearly longer than vertical limb. Tips of cerci extend at least to tip of supra-anal plate, sometimes to tip of subgenital plate. Lingulate tip of supra-anal plate wide (**Fig. B5 B**). (Lowland forest of Costa Rica, both Pacific and Caribbean slopes).

..... *M. proracera* Rowell 2012b

2A Shapes of recess in 10th abdominal tergite, and of tip of supra-anal plate, both lie between the two extremes described above. Tips of cerci blunt, almost squared-off in dorsal view (**Fig. B5 C**), and do not attain the tip of the supra-anal plate (**Fig B5 C**). Lateral points on the margin of supra-anal plate very well developed (Caribbean slope of Panama).

..... *M. gibbera* Stål 1878.

The male of *M. cutteri* Rehn is unknown.

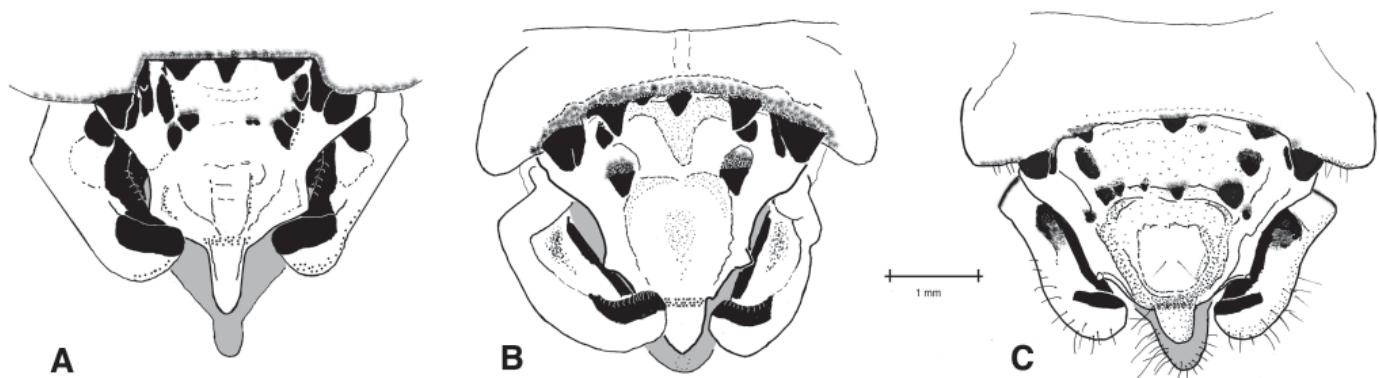


Fig. B5. *Mezentia* spp., male terminalia, dorsal view. A, *M. prymnocerca*. B, *M. proracerca*. C, *M. gibbera*.

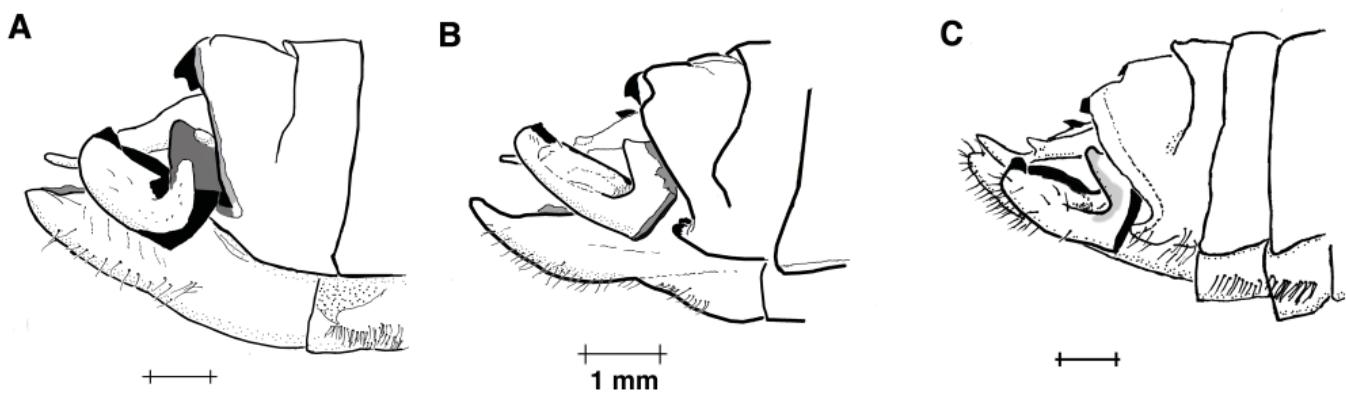


Fig. B6. *Mezentia* spp., male terminalia, lateral view. A, *M. prymnocerca*, B, *M. proracerca*. C, *M. gibbera*.

1. Mezentia gibbera Stål 1878

Stål, 1878a: 88.

Type locality: PANAMÁ (no other data).

Location of type specimen: Naturhistorisches Museum, Wien.

Subsequent literature.

- Bruner, L. 1906: 247.
- Kirby, W.F. 1910: 390.
- Hebard, M. 1924a: 112.
- Rehn, J.A.G. 1938: 77.
- Roberts, H.R. 1973: 60.

Etymology.

Latin *gibber*, humpbacked, bent, presumably referring to the inflated metazona, which projects above the level of the prozona and abdomen. This character is however generic rather than specific.

Diagnosis.

Posterior region of pronotum ornamented with numerous reddish tubercles. Tips of tegmina barely attain third abdominal tergite in female, but extend into the 4th tergite in males. Posterior margin of female subgenital plate ends in two melanised lateral points, each flanked medially by a patch of transparent integument (**Fig. B4C**). Male supra-anal plate decorated with numerous black points (**Fig. B5C**). Horizontal limb of male cercus (**Fig. B6C**) shorter and deeper than in *M. proracerca*, but less so than in *M. prymnacerta*.

Known distribution.

Panama: Canal Zone, Bocas del Toro and Darién. Not so far recorded from Costa Rica. Rarely seen – the original description was made from a specimen dissected from the stomach of a shot bird! **Map B2.**

2. Mezentia proracerca Rowell 2012

Rowell 2012b: 285.

Type locality: COSTA RICA, Prov. Heredia: P.N. Braulio-Carrillo, Estación Magsasay, (Sarapiquí).

Location of type specimen: INBio.

Etymology.

Greek *prora*, prow of a light boat. Derivation: the tips of cerci are tapering and boat-shaped in dorsal view.

Diagnosis.

Habitus, see **Fig. B3 & Plate B2**. The main distinguishing features are given in the key above. Most readily recognized by the shape and patterning of the male supra-anal plate with a wide lingulate terminal process (**Fig. B5**), and the relatively long and narrow horizontal limb of the male cercus (**Fig. B6**). The shape of the margin of the female subgenital plate (**Fig. B4**) is also diagnostic.

Internal face of hind tibia, proximally light green, distally shiny black. Internal face of hind femur, pale green or whitish, with two prominent transverse bands in dark green. In a 4th instar male larva the proximal inner face of the femur was dark blue and there was a single black transverse band distally.

Distribution.

To date known only from lowland Caribbean and Pacific slope forests of Northern and Central Costa Rica. **Map B2.**

Natural history.

Unknown. Some specimens have been taken from light traps, indicating more mobility than might be expected. A 4th instar male larva was taken by the author on the trunk of an *Inga* tree near Puerto Viejo, Cost Rica, and in captivity ate *Inga* leaves. However, an adult male from the same area refused this food. This larva was a mottled light gray in colour, closely matching its bark substrate, with none of the characteristic blotched green patterning of the adult male. This suggests that the larvae may be capable of background homochromy, as is common in some acridid subfamilies, e.g. the Oedipodinae.

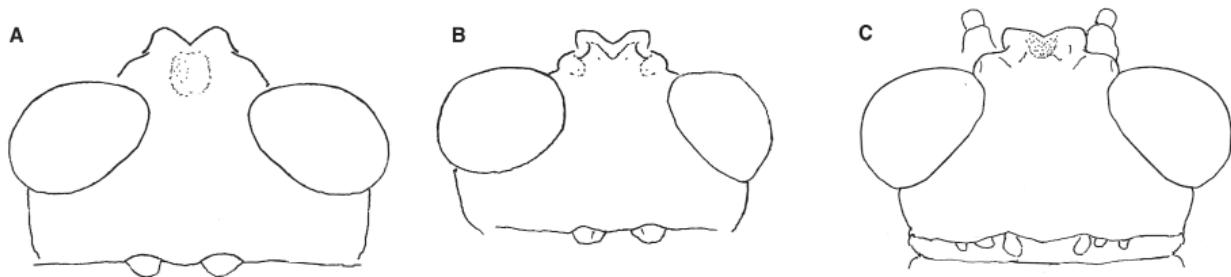
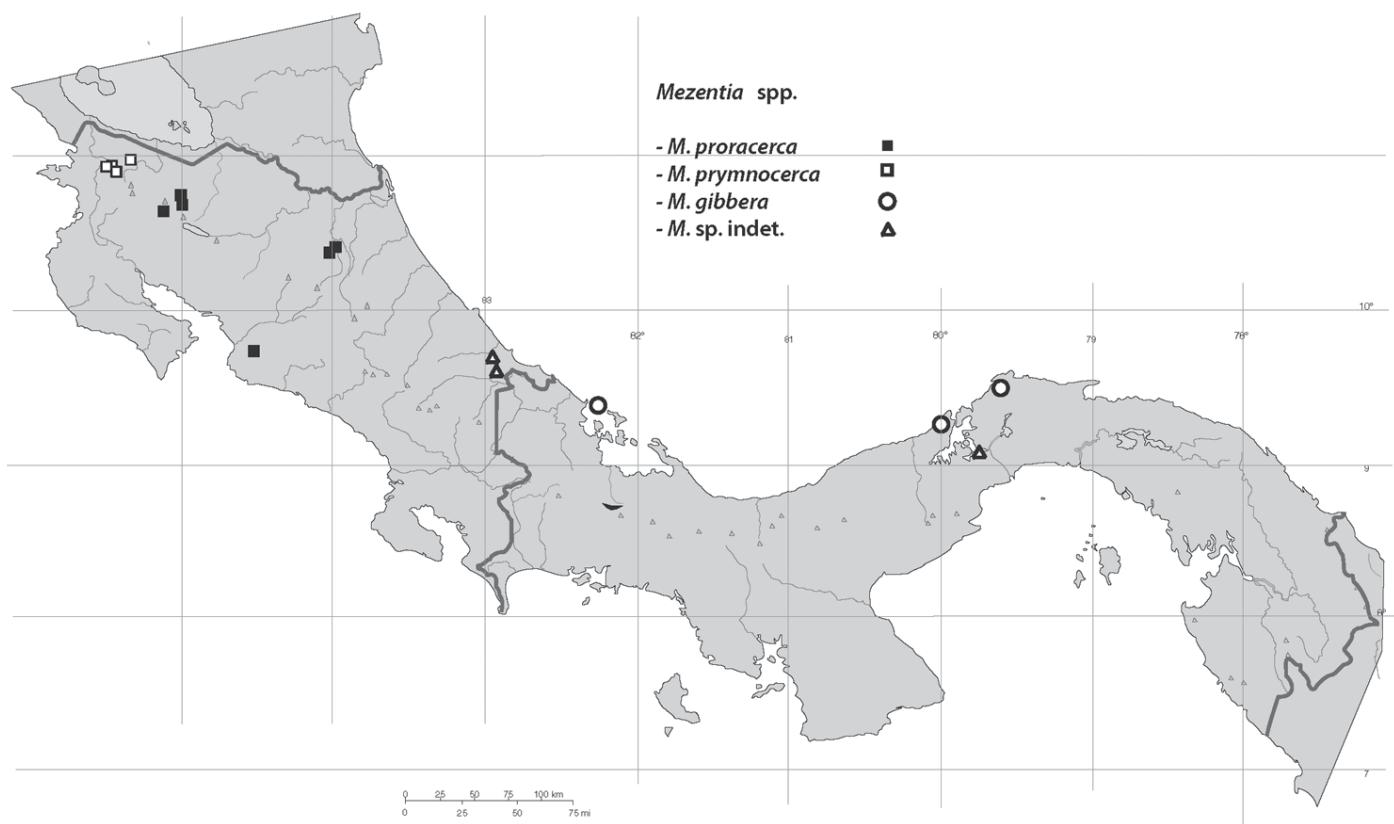


Fig. B7. *Mezentia* spp. Female fastigia, dorsal view. A, *M. prymnacerca*. B, *M. proracerca*. C, *M. gibbera*.



Map B2. Known localities of *Mezentia* spp. in Costa Rica and Panama.

3. *Mezentia prymnacera* Rowell 2012

Rowell 2012: 284.

Type locality: COSTA RICA, Prov. Guanacaste, Volcán Cacao, 1000-1400 m.

Location of type specimen: INBio.

Etymology.

Greek *prymna*, stern of a boat. Derivation: tips of cerci are blunt.

Diagnosis.

The main distinguishing features are given in the key above. Most readily recognized by the shape and patterning of the male supra-anal plate (**Fig. B5 A**), and the relatively short and deep horizontal limb of the male cercus (**Fig. B6 A**). The shape of the margin of the female subgenital plate (**Fig. B4 A**) is also diagnostic. The fastigium, in dorsal view, is longer and its apices more pointed than in the other species (**Fig. B7 A**).

Distribution, natural history.

Known only from the type specimens, taken from a Malaise trap in montane forest on Volcan Cacao. Map B2.

4. Other *Mezentia* spp.

There is at least one other spp. of the genus in central Panama, apart from *M. gibbera*. It is known from an adult

female specimen captured in the P.N. Soberania (See **Map B2**), and is much smaller than *M. gibbera*. It could conceivably be one of the Costa Rican species (*proracerca* or *prymnacera*), but determination must await the capture of an adult male. The specimens recorded from the Valle de la Estrella (Costa Rica – **Map B2**) need redetermination in the light of recent descriptions of new species.



Fig. B8. *Panamacris magnifica*, male habitus.

Panamacris
Rehn 1938

Rehn 1938: 46.

Type species: *Rhincnoderma magnificum* Hebard 1924.

Subsequent literature.

- Amedegnato, C. 1974: 199.
- Amedegnato, C. et al. 2012: 91 et seq.

No. of currently known species.

One, monospecific genus.

Range of genus.

Central Panama, to at least 850 m.

Diagnosis.

Similar to *Rhincnoderma* (q.v.) but more slender, especially the hind femora, and the ventral carina of the hind femur is prominently toothed. The thoracic episterna and epimera are inflated. The coloration of the two sexes is closely similar and unusually variegated and brilliant for this tribe.

Cladistic analysis (Amedegnato et al. 2012) suggests that *Panamacris* is the sister genus of *Rhincnoderma*.

I. *Panamacris magnifica* (Hebard 1924)

Hebard 1924: 110 (as *Rhincnoderma magnificum*). Type locality: PANAMA: Canal Zone, Gatún.
Location of type: ANS Philadelphia (holotype female).

Subsequent literature.

- Rehn, J.A.G. 1938: 48. > Transfers to *Panamacris* n.g.

Diagnosis.

(Fig. B8, Plate B3). See generic diagnosis. The species is vividly coloured, being shiny brownish black, with patches of pale leaf green on the head and metathorax, while the pronotum and mesothorax are mainly orange and yellow.

Distribution.



Known only from Central Panama, including the Canal Zone and Cerro Copé. Has only rarely been seen or captured.

Natural history.

Unknown, but presumed similar to that of *Rhincnoderma* species.

Pararhincnoderma
Rowell 2012

Rowell 2012a: 8.

Type species: *Pararhincnoderma laselvae* Rowell 2012a.

No. of currently known species.

Four described species from Costa Rica, plus three other undescribed species, from Mexico, Honduras and Guatemala respectively (MNHN Paris).

Known range of genus.

S. Mexico to Costa Rica.

Diagnosis.

Medium-sized, apterous and atympanate insects.

Females are 30 to 35 mm in overall length, cylindrical in form, often with a highly rugose and often warty integument, green, brown or olive brown in colour. Males are smaller (length of body (L) or of hind femur (F) 65-90% of female), more slender, somewhat flattened dorsoventrally, with smoother cuticle, and are ornamented with a horizontal pale band running across the lateral pronotal lobes to the thoracic pleura (but never affecting the mesoepisternum), and are generally more brightly coloured.

Interocular space often bears a transverse row of three prominent nodules, and is twice as wide as the frontal ridge, the latter measured between the antennae. Fastigium essentially obsolete, vertex curves smoothly down into the frons, the fastigium itself is almost vertical. Margins of fastigium and of frontal ridge demarcated by irregular nodules. Frontal ridge above medial ocellus deeply sulcate bounded by nodular carinae; below the ocellus, obsolete.

Pronotum cylindrical, disc crossed by up to 4 sulci, the second from the front usually more or less obsolete, the third being the most marked. Lateral pronotal carinae absent. Medial carina represented in some but not all spp. by a more or less linear row of irregular swellings. Anterior margin of pronotum emarginate medially, more so than in *Rhincnoderma*, the embayment flanked by two small processes projecting over the occiput. Posterior margin of pronotum straight. Metazona very short, leaving mesonotum largely exposed. Prosternal process (Fig. B13) similar to that of *Rhincnoderma*, a long transverse ridge, the outer corners each bearing a small erect tubercle. Mesosternal interspace transverse; metasternal lobes touching. All thoracic sterna slightly concave.

Apterous and atympanate. Fore and middle femora laterally compressed, wide. Hind femur not exceeding abdomen in length, 4.5 - 5.8× longer than wide; dorsal and ventral carinae coarsely and shallowly serrate. Inner and outer faces of the hind tibiae often of different, species-specific colours. Lobes of hind knee rounded, with a very small subterminal spine. Hind tibia with 5-6 external spines, plus external apical spine. Foot

long, the three tarsal segments being subequal, but the second segment is the shortest. Foot formula 35-37: 28-30: 34-35.

Abdominal segments less rugose, with a continuous fine medial carina. At the anterior edge of the second abdominal segment of the female this carina bears a small, slightly raised tubercle. This structure is rather variable in size and shape between conspecific individuals, but its presence is diagnostic for the genus. Tenth abdominal tergite completely divided. Supra-anal plate triangular with a smoothly rounded tip, transversely divided. Cerci styliform, simple. Male subgenital plate pointed, only slightly exceeding the supra-anal plate in length, the tip minutely bifid or (*P. uatsiensis* only) entire.

The species of *Parahicnoderma* are all very similar, differing most obviously in color pattern, with few other differences.

Key to species of *Parahicnoderma*.

A. Males:

1. Brightly and contrastingly coloured. Pale stripe on pronotal lobes continuous, not divided into 2 discrete patches.

..... 2

IA General coloration more or less cryptic, in shades of olive green. Pale stripe on pronotal lobes generally divided into 2 discrete patches.

..... 3

2. Pale stripe on pronotal lobes extends backwards over thoracic pleura to 1st abd segment but does not extend over its tergum. It also extends forwards onto the genae as far as the hind margin of the eye. Inner face of hind knee, knee and all of hind tibiae bright red. Occiput and disc of pronotum brown. Tip of SGP entire.

..... *uatsiensis* (Sixaola region, S.E. Costa Rica).

2A Brightly coloured, similar to *Rh. uatsiensis*, but more heavily marked with black. Inner face of knee and all but outer face of hind tibia shiny black; occiput, dorsolateral thoracic stripe and parts of pronotal disc black. Only 1st and 2nd hind tarsal segments red. The white colour on segment A1 extends completely over the tergum, forming a pale band around the animal. No white colour on genae. Tip of male SGP bifid.

..... *cacaoensis*

(Cordillera del Norte, Costa Rica, from Tilarán northwards).

3 General coloration mottled dark green (in fresh material). Disc of pronotum with numerous small tubercles. Pale stripe on pronotal lobes usually but not always divided into two patches. Hind knee brown dorsally, outer ventral knee lobe green. Ventral face of femur dark blue in life, in dried specimens turning blackish brown. Outer face of hind tibia pale greyish brown or green, inner face dark blue in life, drying to dark brown. Only 1st and 2nd hind tarsal segments red. Tip of SGP minutely bifid.

..... *laselvae* (Caribbean plain of Costa Rica)

3A General coloration olive green or olive brown. Disc of pronotum smooth, not tuberculate. Pale stripe on pronotal lobes divided into two patches. No postocular stripe. Legs leaf green, hind knee olive brown. Hind tibia and first two tarsal segments red. Tip of SGP minutely bifid.

..... *janzeni* (S.Vito de Jaba, S.W. Costa Rica).

B. Females:

Females are best identified by their associated males. Where this is not possible, the pattern of nodular ornamentation on the head and pronotum (see Fig. B14) should allow identification.

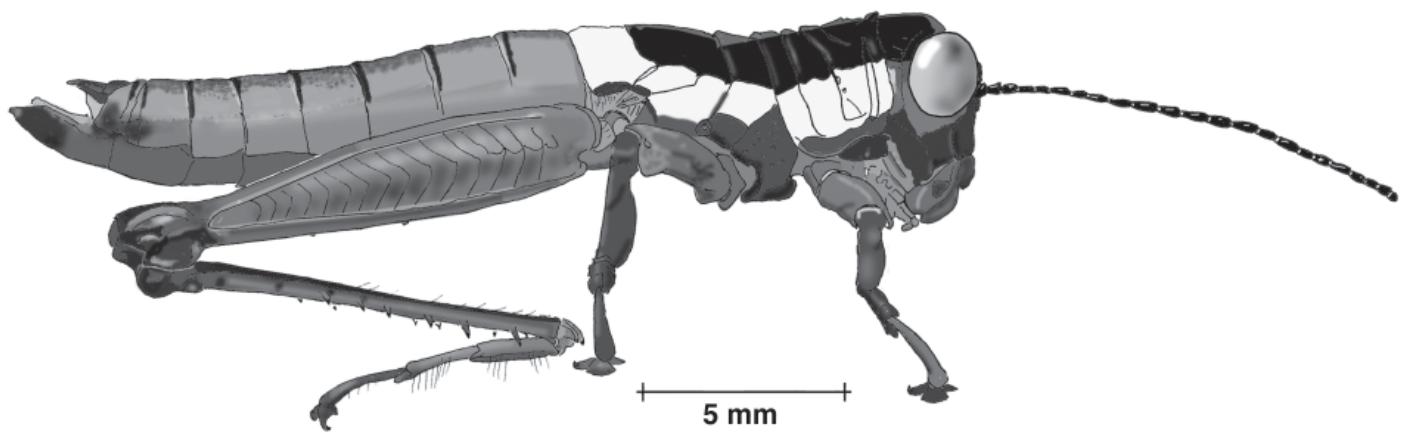


Fig. B9. *Pararhicnoderma cacaoensis*, male habitus.

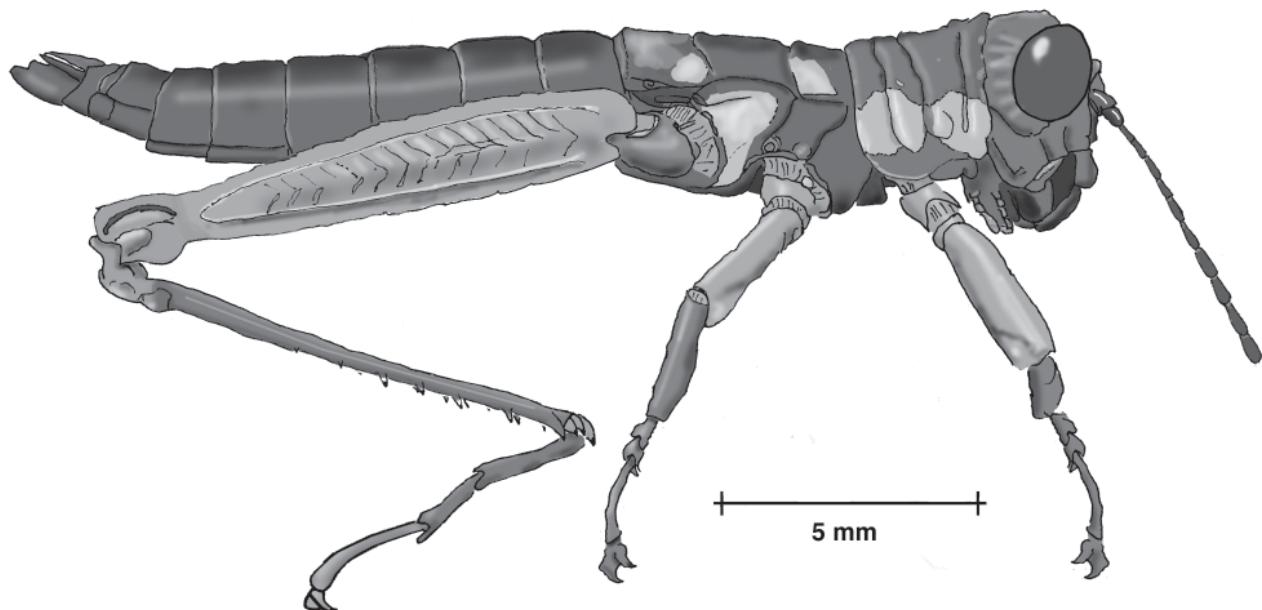


Fig. B10. *Pararhicnoderma janzeni*, male habitus.

1. *Pararhicnoderma cacaoensis* Rowell 2012

Rowell 2012a: 10.

Type locality: COSTA RICA: Prov. Guanacaste: S.W. slope of Volcan Cacao, 1000–1400 m.

Location of type: INBio.

Diagnosis.

Males (**Fig. B9, Plate B4**). Coloration: Head and eyes brown, palps green, postocular stripe absent, but a pale stripe crosses the pronotal lobes and thoracic pleura and ends on the first abdominal pleura. It then continues dorsally over the 1st abdominal tergite, giving a white ring around the animal in dorsal view. Pronotal disc dark brown, pronotal lobes olive brown below the pale stripe. Abdomen chestnut brown dorsally, shading to olive green laterally. Abdominal sterna yellowish. Legs green; hind knee, shiny black, especially on its inner face; lower lobe of outer face green. Hind tibia: outer face light brown, remaining faces shiny black. Tarsus: first and second segments pink, third segment olive green.

Brown coloration of thoracic tergites separated from the white lateral stripe by a broad black band, which extends forward over the pronotum to cover the vertex and occiput. Joints between abdominal segments ringed with black. Antennal scape green, flagellum black, 20 flagellar segments.

Females. Integument much more rugose than in male. Fastigium with two transverse rows of paired, laterally elongated tubercles. Interocular space variably rugose, but usually with 2, sometimes 3 small tubercles, arranged transversely. Pronotum decorated with a single prominent medial swelling situated on the disc between the first and second pronotal sulci, composed of several tubercles; this structure is diagnostic of the females of this species (**Fig. B14, D-F**).

Coloration. Olive brown or olive green, speckled with isolated black spots. Most individuals show one or two diffuse transverse darker bands on the hind femur. Inner face of hind knee and hind tibia shiny black, sometimes this colour extends onto outer face of knee and inner face of hind femur. Outer face of hind tibia grey-brown or olive green. Tarsus: first and second segments pink, third segment olive green.

Distribution.

A typical inhabitant of cloud forest on the Cordillera del Norte, Costa Rica, from Tilarán north through the mountains of Guanacaste, and may well extend into Nicaragua. Map B3.

Natural history.

Usually found on Fabaceous trees, such as *Lonchocarpus* and *Pterocarpus*, and eats their foliage in captivity.

2. *Pararhicnoderma janzeni* Rowell 2012

Rowell 2012a:14.

Type locality: COSTA RICA: Prov. Puntarenas: San Vito de Jaba, Location of type: UMMZ.

Etymology.

Named for the collector, the eminent entomologist Daniel H. Janzen, in recognition of his outstanding contributions to Costa Rican biology and conservation.

Diagnosis.

For habitus, see **Fig. B10, Plate B5**.

Male. Slender and elongate, integument of thorax punctate but mostly smooth, not nodular. Antennae with 19 segments. Moderately sexually dimorphic, the ratio m/f varies between 0.69 (pronotum) and 0.76 (hind femur). Fastigium ornamented with a single transverse row of tubercles. Interocular space has numerous rugosities, but lacks the transverse row of 3 well-defined tubercles seen in some other species. Prosternal process transverse and chisel shaped, diverging slightly towards its tip; edge of terminal ridge slightly undulant, no tubercles at the outer corners.

Coloration. General coloration olive green, fore and mid legs green. Postocular stripe absent. Pale band on pronotal lobes partially or completely interrupted at the level of the third pronotal sulcus, but then continued again to the posterior margin of the pronotum. Mesoepisternum and mesoepimeron devoid of pale colour, but a cream coloured patch on the lower lateral part of the mesothoracic tergum, a large one on the metathoracic episternum and epimeron, with a small patch anteriorly and laterally on the metathoracic tergum (see **Fig. B10**). Hind femur pale leaf green, knee olive, with brown semilunar processes. Hind tibia proximally olive, then red on all faces. First and second tarsal joints red, third joint olive green.

Female. More robust and integument more rugose. A single swelling in the midline of the pronotum at the level of the first pronotal sulcus (**Fig. B14, J-L**), posterior margin of pronotum decorated with evenly spaced dark patches. Tubercles of fastigium and interocular space as described for the male. Coloration mottled olive brown and green, legs olive green, hind tibia and tarsi as in male.

Distribution.

To date known only from the type locality. Other specimens of the same species were taken there by D.C.F. Rentz in 1969 (ASNP), but could not be located for examination for the present work. **Map B3**.

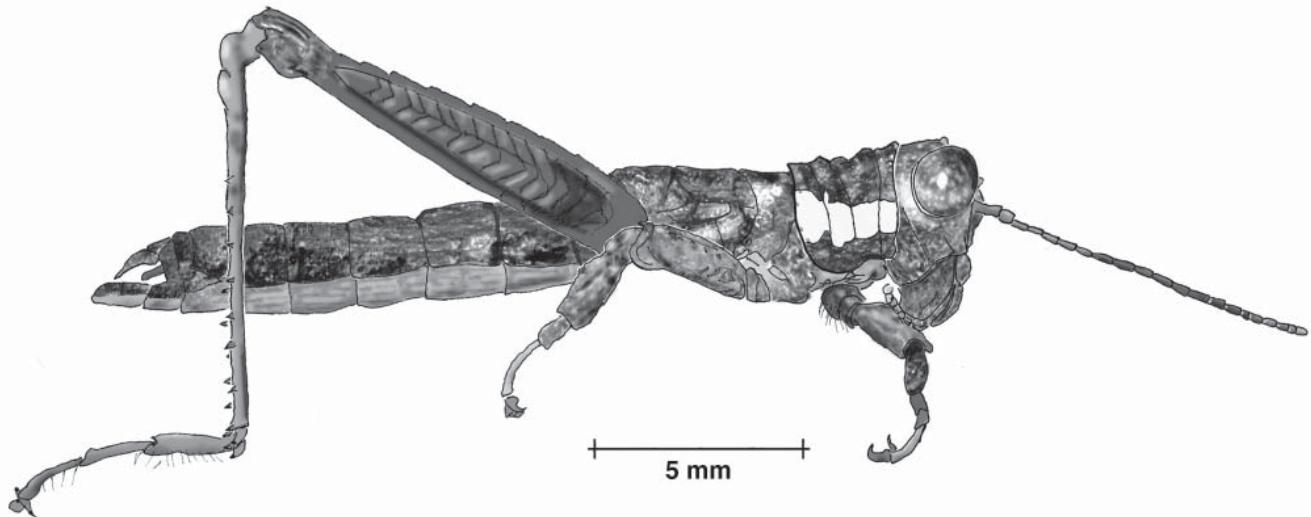


Fig. B11. *Pararhicnoderma laselvae*, male habitus.

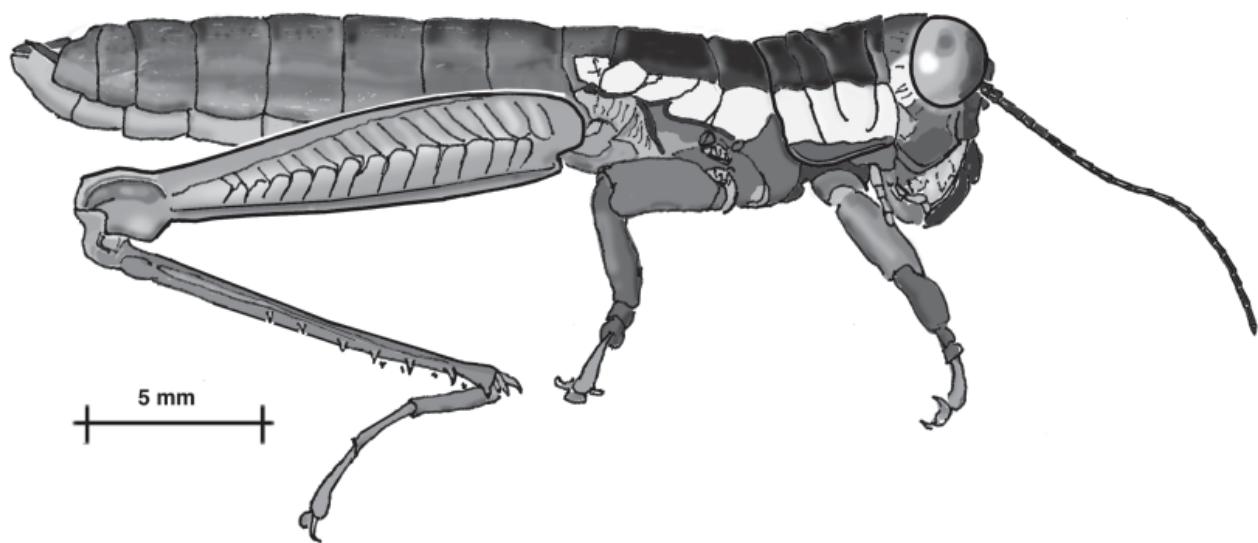


Fig. B12. *Pararhicnoderma uatsiensis*, male habitus.

3. *Parahicnoderma laselvae* Rowell 2012

Rowell 2012a: 11.

Type locality: COSTA RICA: Prov. Heredia, Puerto Viejo, Finca La Selva, 40m.

Location of type: ANSP.

Etymology.

Name derived from the type locality.

Diagnosis.For habitus, see **Fig. B11, Plate B6**.

Male: Noticeably more sexually dimorphic than the previous species – male is much smaller and more slender than the female. Sexual dimorphism $Lm/f.= 0.65$ to 0.73 . Integument rugose and granular.

Fastigium with two horizontal rows each of two tubercles, those of the lower row being laterally elongated. Interocular space with a transverse row of three distinct round tubercles. The paired projections of the anterior margin of the pronotum are also decorated with smaller tubercles (**Fig. B14, A-C**). The midline of the disc of the pronotum bears two or three small swellings, considerably smaller than that seen in the female of *Rh. cacao*, situated between the sulci and visible in profile (**Fig. B14, B**), lying between the first and second, second and third, and third and fourth sulci respectively. Hind femur with a prominent “herringbone” pattern on the outer face, with nodular decoration. Tip of lower lobe of hind knee truncate, slightly rounded. Dorsal carina of femur coarsely but shallowly serrate (**Fig. B14, A & B**). Ventral surfaces of legs and abdomen richly provided with whitish hairs. Tip of subgenital plate minutely bifid.

Coloration. (See **Plates 19 & 20**). General coloration in life dark moss green, heavily marbled with olive brown and black. Antennae basal segments green, flagellar segments brown, lightening to pale red-brown at the tips, with 3 - 4 narrow yellow bands. Palps green. Eyes brown, mottled with white. Postocular band pale, cream coloured, indistinct or absent on the head, continued more distinctly across the pronotal lobes, and very weakly onto the lateral regions of the mesothoracic tergum. In some but not all males the pale pronotal band is interrupted at the level of the third pronotal sulcus, forming two discrete patches of pale colour. Underside yellow grey. Legs green. Hind femur: outer face dark leaf green, hind knee brown dorsally, outer ventral knee lobe green. Ventral face of femur dark blue in life, in dried specimens turning blackish brown. Outer face of hind tibia pale greyish brown or green, inner face dark blue in life, drying to dark brown. First two tarsal joints pink, third joint olive green. Intersegmental membranes of the leg joints are blueish purple in life.

Female: relatively robust, integument rugose and granular. Head and pronotum bear the same array of tubercles and swellings as detailed for the male (**Fig. B14, A-C**) and the antennae are similarly coloured, with pale-banded tips.

Coloration. General coloration green, marbled with brown and black. The hind femur is less uniformly green than in the male, and has traces of two darker transverse bands. Coloration of hind knees, tibiae and tarsi as in male. The striking dark blue of the living insect fades to a dark brown in dried specimens.

Distribution, natural history.

Known principally from the Puerto Viejo area, Sarapiquí, in the lowland Caribbean plain of N.E. Costa Rica on understorey trees and shrubs. The Rio Toro Amarillo near Guápiles, locality of the second paratype pair, is less than 30 km distant from the type locality and also on the Caribbean plain.

Also recorded from Bijagua, which is at the extreme Western edge of the Caribbean forest zone. **Map B3**.

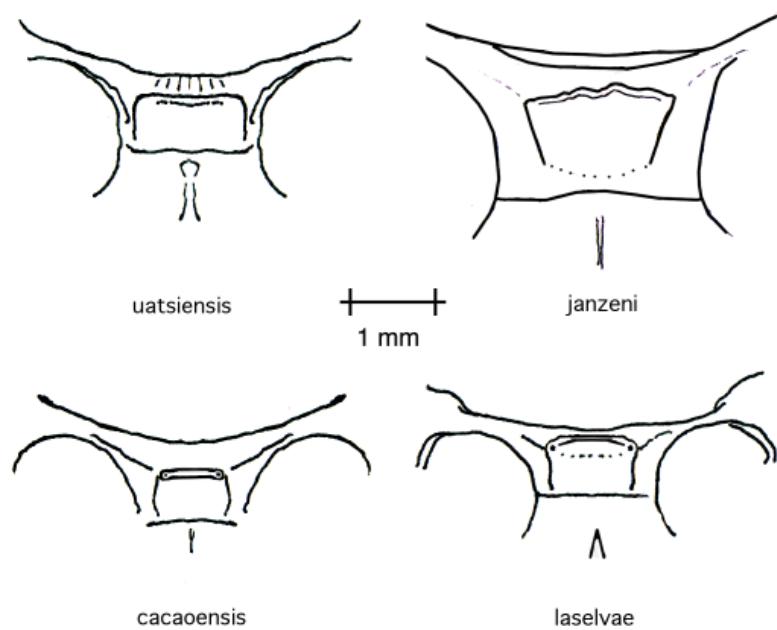
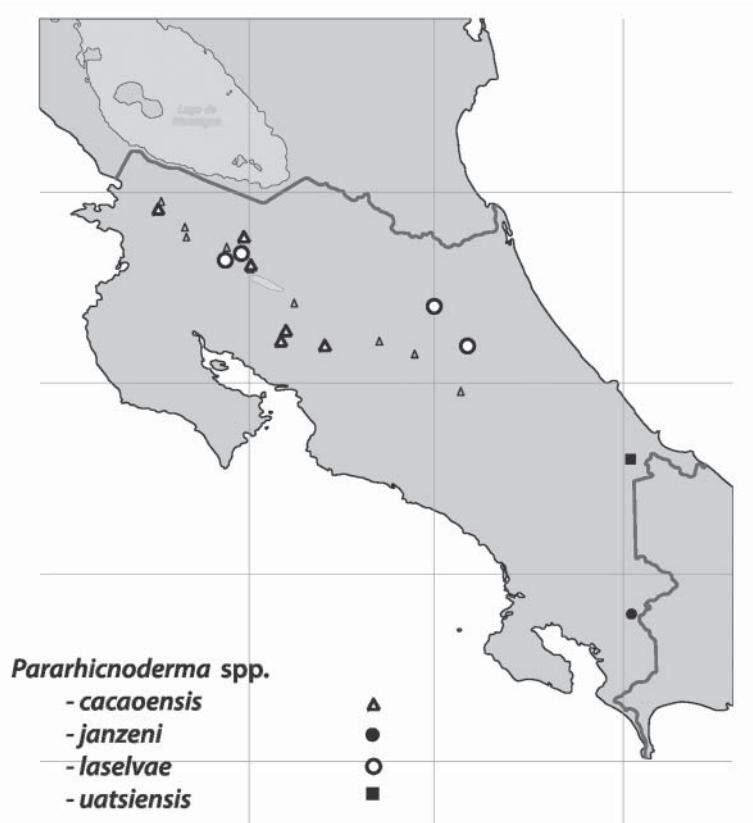


Fig. B13. *Pararhynchoderma* spp. Prosternal processes.



Map B3. *Pararhynchoderma* spp. in Costa Rica. *P. laselvae* is on the Caribbean plain, *P. cacaoensis* on the Cordillera del Norte.

4. *Pararhicnoderma uatsiensis* Rowell 2012

Rowell 2012a: 9.

Type locality: COSTA RICA: Prov. Limón: Cerro Uatsi (this lies between the Valle de la Estrella and Valle del Sixaola, above Bri-brí), 600 m.

Location of type: ANSP.

Diagnosis.

Habitus, see **Fig. B12, Plate B7**.

Male: Integument finely punctate, but relatively smooth for the genus, not nodular. Antennae brown basally, shading to black distally, 20 flagellar segments. Fastigium with only a single pair of transversely elongated tubercles. Interocular space more or less smooth, lacking three prominent tubercles arranged in a transverse line. Prosternal process transverse, chisel-shaped, without obvious tubercles at its extremities. Dorsal carinae of hind femur only very slightly serrate. Male SGP bluntly conical, the tip entire and not bifid in dorsal aspect.

Coloration. Head and eyes brown, palps green, postocular stripe cream, continued across the pronotal lobes and thoracic pleura and ending on the first abdominal pleura, but not extending to the tergum of this segment. Pronotal disc dark brown, pronotal lobes olive brown below pale stripe. Abdomen chestnut brown dorsally, shading to olive green laterally. Abdominal sterna yellowish. Legs green; hind knee olive brown dorsally, outer ventral lobe of hind knee olive green, with an angular tip. Internal ventral lobe of hind knee bright red. Hind tibiae and first two tarsal segments bright red on both internal and external faces. Distal tarsal segment olive green.

Female: fastigium with only a single pair of transversely elongated tubercles. Interocular space more or less smooth, lacking prominent tubercles arranged in a transverse line. (If present at all, these are broad and indistinct, as in **Fig. B14G-I**). Pronotal sulci: the first is well marked but does not cross disc dorsally. The second sulcus is more or less completely obsolete, but a very small segment is visible in midline of disc only. The third and fourth are well marked and cross the disc. Disc of pronotum devoid of large swellings, tubercles confined to the two processes of the anterior margin (**Fig. B14**).

Coloration. Light olive green, finely mottled with light brown and speckled with small black spots. Inner, ventral and dorsal faces of hind tibia and first two tarsal segments red, but outer tibial face is mottled olive brown (see **Plate B7**).

Distribution.

Currently known only from the type locality in S.E. Costa Rica. **Map B3**.

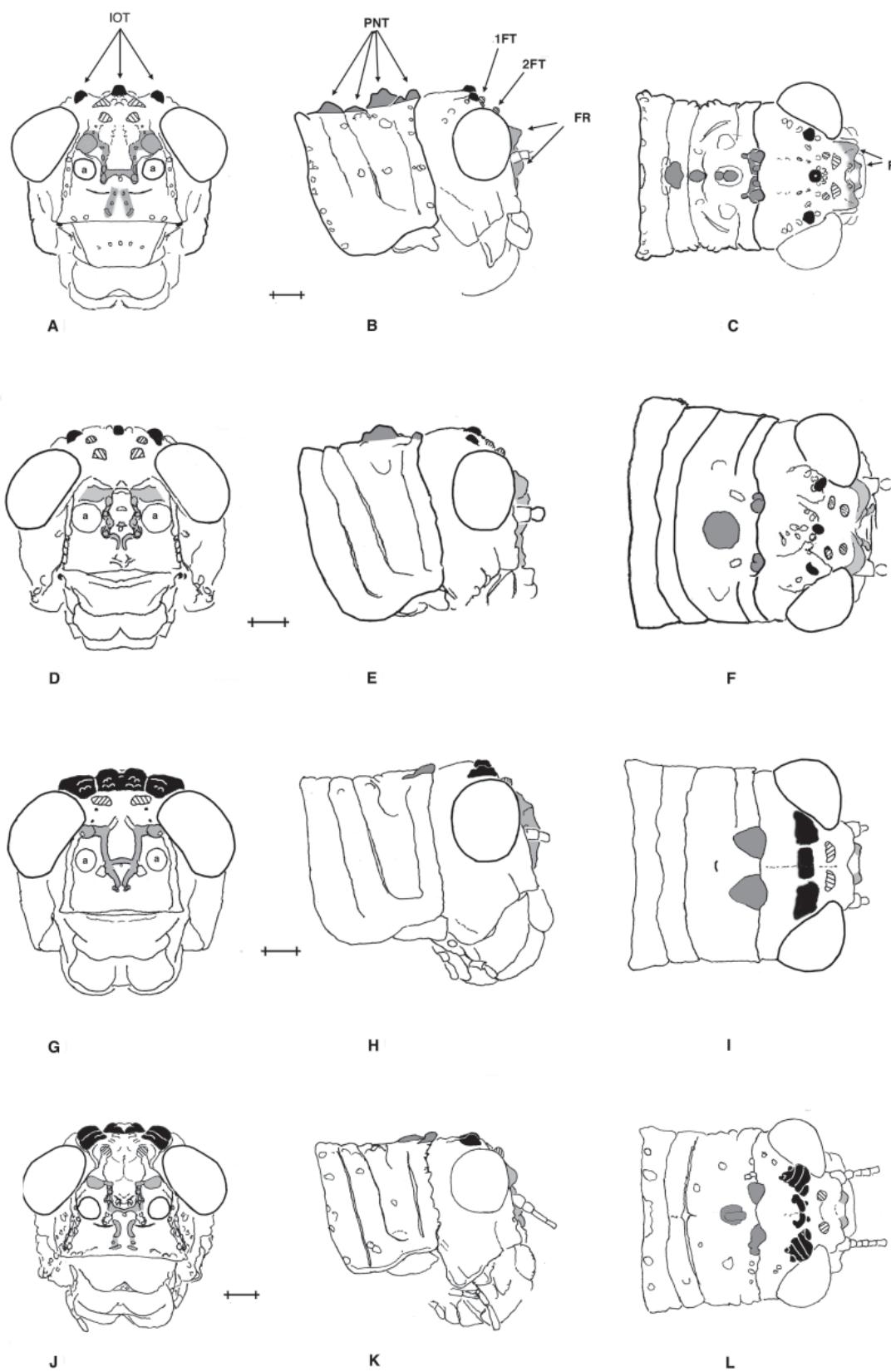


Fig. B14. *Parahicnoderma* spp. Female head and pronotum, Axial, lateral and dorsal views. Row 1, *P. laselvae*. Row 2, *P. cacaoense*. Row 3, *P. uastiensis*. Row 4, *P. janzeni*. Scale bars 1 mm. Note that the shading of the tubercles in these diagrams is for navigation only; it does not represent darker coloration.

Rhicnoderma
Gerstaecker 1889

Gerstaecker 1889: 28.

Type species: *Rh. olivaceum* Gerstaecker.

Subsequent literature.

- Rehn, J.A.G. 1938: 48.
- Dirsh, V. 1965d: 442.
- Amedegnato, C. 1974: 199.
- Otte, D. 1995: 21.
- Eades, D. 2000: 204.
- Rowell, C.H.F. 2012a.: I.
- Amedegnato, C. et al. 2012.

No. of currently known species.

Three, plus an undescribed species from El Sumidero, Chiapas, Mexico (MNHN Paris).

Range of genus.

S. Mexico (Yucatan, Vera Cruz, Guerrero, Tabasco, Chiapas) to Costa Rica and Western Panama.

As originally conceived, the genus was rather diverse, and later workers (Rehn 1938, Amedegnato et al. 2012) have tended to split it up. The scheme of the latter authors is followed here: *Rhicnoderma* is split into *Rhicnoderma* Gerstaecker s.s.t., *Panamacris* Rehn and *Lempira* (Rehn), (the last genus is known only from Honduras, Guatemala, El Salvador and Mexico, outside of our area). *Pararhicnoderma* Rowell is a closely similar genus.

Etymology.

Greek *rheicnos*, shrivelled, shrunken, *derma*, *dermatis* skin, hide. The name is rather unfortunate, as most species do not have a wrinkled integument, rather a shiny smooth one which is densely pitted on the head and thoracic nota.

Diagnosis.

Medium to large size (overall length up to 51 mm).

Apterous and atympanate cylindrical grasshoppers with a short blunt head with virtually no fastigium. Pronotum bears up to 4 shallow sulci, medial and lateral pronotal carinae absent. Cuticle of thoracic terga and occiput of head densely punctate. Hind femora equal to or shorter than the tip of the abdomen. Thoracic sterna concave. Prosternal process transverse, ridge-like, with a minute point at each end. Especially in males, the tergum of the first abdominal segment is usually more lightly coloured than its neighbours in most colour forms, giving in dorsal view a pale ring around the body at its widest point. Male subgenital plate pointed at the tip, the tip entire and undivided, only slightly longer than the supra-anal plate.

I. *Rhicnoderma olivaceum* Gerstaecker 1889

Gerstaecker 1889: 28.

Type locality: PANAMA: Chiriquí.

Location of type specimen: Museum of Zoology, University of Greifswald, Germany.

Etymology.

Latin *olivaceus*, resembling the olive (in colour, understood).

Synonymy.

= *Rh. glabra* Bruner 1900-1910 (1907), syn. Rehn 1938.

Diagnosis.

The species is known from only 6 specimens. The only known male is the allotype of *Rh. glabra* Bruner. (See **Fig. B15, Plate B8**). In these illustrations the coloration is based on a) the present day appearance of the 85 year old museum specimen and b) the field notes given in Rehn 1938. It is probable that the true colours are greener than here shown.

The female is a large insect, up to 51 mm in length. The generic description applies. All known female specimens are or were a uniform olive green in colour, with brown tinges to the hind knee and hind tibia (colour photo in Rowell 2012a). Eyes brown. The prothoracic episternum in lateral view projects beyond the anterior edge of the adjacent pronotum, and is asymmetrically rounded at its tip; in other species of the genus it is the same length as the adjacent pronotal margin, and often irregularly toothed in outline.

The male is much smaller, 32 mm in length. Body colour was originally greenish brown; Rehn (1938) says that when fresh the meso and metathoracic episterna were conspicuously coloured white. There is now no trace of this on the pinned specimen. Hind femur green, hind knees brownish; hind tibia and tarsi red. The prothoracic episternum is asymmetrically rounded at the tip and projects forward, as in the female.

Distribution.

See **Map B4**.

Two females have been captured in W. Panama: the holotype in Chiriquí (probably near the city of Chiriquí Viejo) and most recently a second example near Bahía Honda, Veraguas Prov., in 2001. Two females and one male (originally described as *Rh. glabra* Bruner), were captured in Pozo Azul de Pirrís, Prov. S. José, Costa Rica (most recently in 1927). In Costa Rica the known distribution overlaps that of *Rh. humilis*. Roberts (1973) reported a single larval male from insecticide fogging of the canopy in the Osa peninsula. However, examination of his specimen (ANSP) shows that it is in fact a misidentified *Pararhicnoderma janzeni*.

If *olivaceum* is in fact normally a canopy dweller, as Roberts speculated, this could explain its apparent great rarity.

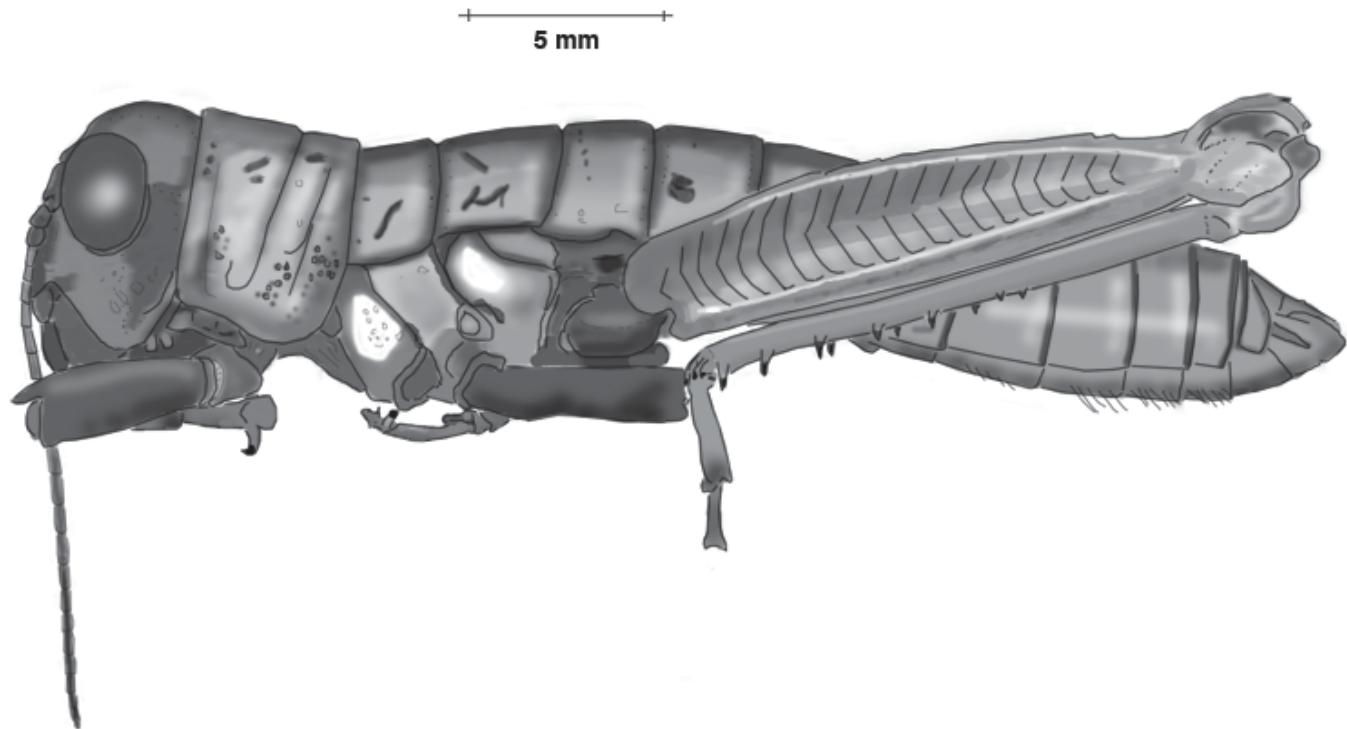


Fig. B15. *Rhicnoderma olivaceum*, male habitus.

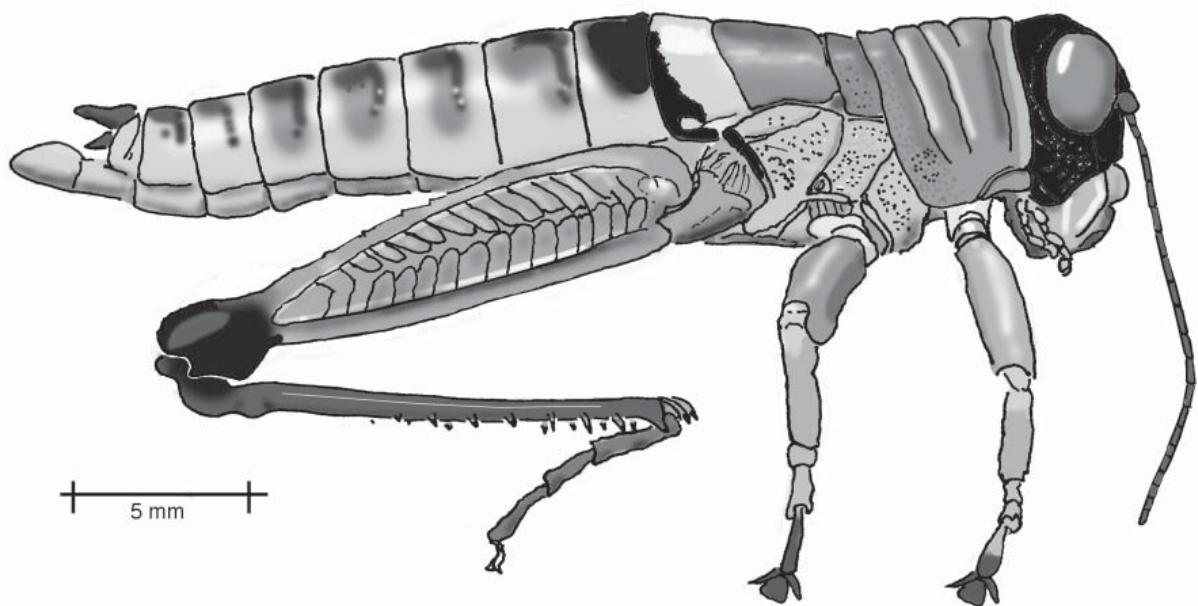


Fig. B16. *Rhicnoderma humilis*, male habitus.

Natural history.

Apparently confined to Pacific lowland forest.

2. *Rhicnoderma humilis* Rehn 1905

Rehn 1905: 415

Type locality: COSTA RICA: Prov. S.José, Tarbaca.

Location of type specimen: ANSP

Subsequent literature.

- Rehn, J.A.G. 1905: 415.
- Bruner, L. 1900-1910: 248, 250.
- Kirby, W.F. 1910: 391.
- Rehn, J.A.G. 1938: 55/
- COPR (Centre for Overseas Pest Research). 1982: 127.

Etymology.

Latin *humilis*, humble, or low on the ground. The taxon is indeed often found on understorey trees and vines, but not normally on the ground itself.

Taxonomic note.

Both the Mexican *Rh. basalis* and *Rh. humilis* occur intermittently throughout the literature as “*basale*” and “*humile*”. This confusion dates back to inconsistent usage by both Rehn and Bruner. The OSF on-line (Eades et al 2003) lists the -e forms as junior synonyms of the -is forms.

Diagnosis.

Habitus, **Fig. B16, Plate B9**. A typical member of the genus. The generic description applies. The male is dimorphic, being either a uniform mottled olive green or (as figured) brightly coloured with a black head, leaf green thorax, a white band at the base of the abdomen and yellow abdominal segments. The hind femora are green with black knees and bright red tibiae.

Females are very varied in coloration, from uniform green through varied shades of brown to mostly black. The darker forms have a conspicuous pale band over the first abdominal segment. In green females the inner face of the hind femur and hind tibia is dark blue. In some brown females the inner surface of the hind femur is shiny black or purple. Hind knees black, hind tibiae red, as in the male.

Larvae are speckled brown, and the inner surface of the hind femur is purplish in colour and doubly banded with black.

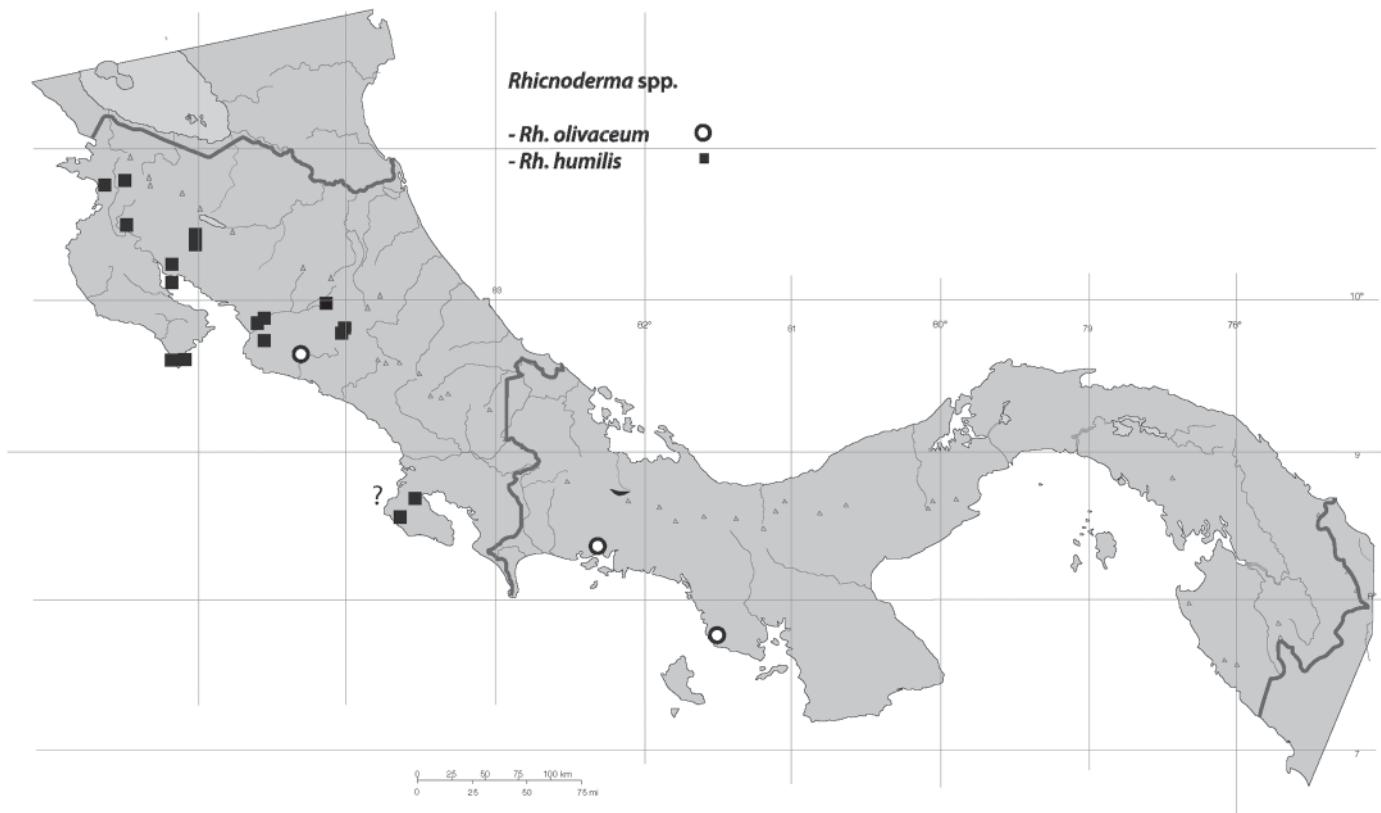
Distribution.

Costa Rica, Pacific slope. From northern Guanacaste and Nicoya to Tilarán and the Western Meseta Central and thence south to the Osa Peninsula, usually in the lowlands and often in dry woodland. Not to date recorded from Panama.

O. humilis and the southern Mexican *O. basalis* Bruner are extremely similar to each other and may well represent races of the same taxon, which perhaps extends the whole length of the Pacific slope of Central America, a possibility already envisaged by Rehn (1938: 55,60).

Natural history.

Usually uncommon, though widely distributed. Occasionally the population is subject to outbreaks, when the species is very numerous in certain areas (e.g. in the Reserva Biologica Carara in 1991, or in R.B. Cabo Blanco in 2001). Under these conditions it is extremely polyphagous, eating everything from *Heliconia* and palm leaves to the foliage of many different dicotyledenous trees and herbs.



Map B4. *Rhicnoderma* spp., localities in Costa Rica and Panama.

Tribe Taeniophorini Brunner von Wattenwyl 1893

Diagnosis.

The male subgenital plate is split or bilobed at the end; the supra-anal plate is never divided into two transversely (thus contrasting with the Ophthalmolampinae and Bactrophorini); the male cerci are subrectangular in profile and bilobed; the face is smooth and not pitted.

No. of included genera.

Four (*Hylephilacris*, *Megacephalacris*, *Megacheilacris*, *Taeniophora*). In our area, two.

Tribal range.

From Amazonian Brazil through Ecuador, Venezuela and Colombia to Panama and Costa Rica.

Natural history.

Most Taeniophorini, including all those in our area, live in or at the edges of forest, but a few (*Megacheilacris* spp. in Colombia) are found in open savannah, apparently a secondary adaptation.

***Megacheilacris* Descamps 1978**

Author: Descamps 1978: 382.

Type species: *Megacephalacris bullifemur* Descamps &

Amedegnato 1971, by original designation.

Type locality: Colombia: Dept. Narino, El Ingenio, 2050 m.

Location of type specimen: MNHN Paris (holotype male).

No. currently known species.

Three. In our area, one.

Known distribution of genus.

Colombia; Panama.

Diagnosis.

Very similar to *Taeniophora*, q.v., but shorter, stumper, and with a relatively large head. Differs from that genus in having a much wider intraocular space, equal to or wider than the antennal flagellum, and in having the abdominal tympanum vestigial or absent. Front femora of the male unarmed (in the closely related genus *Megacephalacris* (Colombia) the dorsal surface of the prothoracic femur of the male is armed with one or several spines). The dorsal valves of the ovipositor do not have such a prominent shoulder near their tip as in *Taeniophora*. The prosternal process is a broad rounded transverse swelling with no point or projection on its posterior face.

I. *Megacheilacris megacephala* (Bruner 1907)

Taeniophora megacephala Bruner 1900-1910 (1907): 208.

Type locality: PANAMA (no further data).

Location of type specimen: ANSP (holotype female). The male is unknown.

Subsequent literature.

- Hebard, M. 1924: 110.
- Descamps, M. & Amedegnato, C. 1971: 117. > Transfer to *Megacephalacris*, n.g.
- Descamps, M. 1978: 382. > Transfers to *Megacheilacris*, n.g.

Known distribution.

Panama: Canal Zone. Very rare, apparently known from only 2-3 museum specimens, one taken by light-trap, and some photographs of the wild animal. The known specimens are all females, and discoloured. No male specimens are available for description; the male is known only from colour photographs made in the wild by A. Santos. This individual was photographed in 2005 on a *Heliconia* leaf near Summit, on the road from Panama City to Gamboa, in the Parque Nacional Soberania. This area is regularly collected by biology students of the University of Panama, but no further specimens have been seen.

Diagnosis.

Small (overall length (female) = 14 mm. Somewhat

brachypterous, tegmina extend to 9th abdominal segment. Coloration (Plate B10) is striking and very distinctive.

Pronotum and tegmina are longitudinally striped in black and light leaf green; the head is black with metallic blue markings on the vertex and the genae; the fastigium is red, the eyes black; all femora are maroon, shading to black distally; tibiae reddish, abdomen and feet ochraceous. Antennae with 24 flagellar segments, pale brown, the penultimate three segments blackish, the tip segment white.

Note: the habitus illustration (Plate B10, Fig. B17) is drawn from a pinned dried female from Los Cumbres, C.Z., Panama, which preserves the pattern of its markings, but not the original colour. The coloration is copied from that of the photographed male. In the closely related genus *Taeniophora*, the sexes are coloured identically.

Natural history.

Possibly a canopy dweller, but Descamps (1978) points out that the other 2 known species of the genus (*M. gramicola* and *M. bullifemur*, both Colombian) are both found in grassland, not forest, and speculates that this maybe true of the entire genus. The individual of *megacephala* photographed at forest edge nr. Gamboa, CZ, Panama (see above) had apparently been eating *Heliconia*. The foodplant preference may thus be for monocotyledons, rather than for the Poaceae.

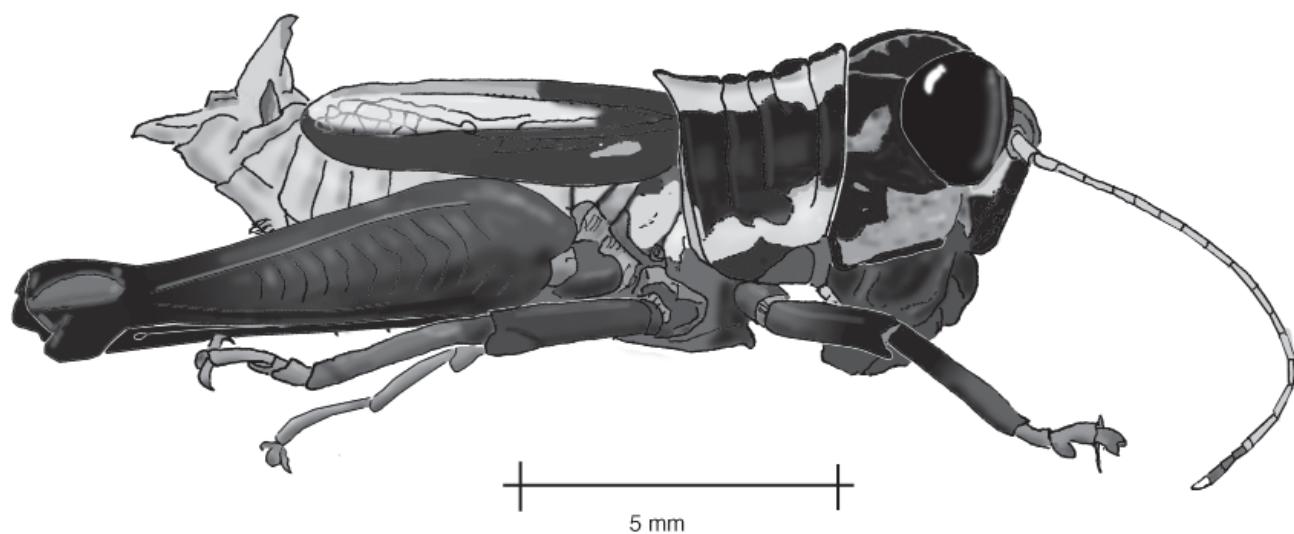


Fig. B17. *Megacheilacris megacephala*, female habitus.

Taeniothora
Stål 1873

Author: Stål 1873: 34, 53.

Type species: *Taeniothora dentipes* Stål.

Type locality: Colombia, Dept. Antioquia, Remedios.

Location of type specimen: Stockholm (holotype male).

Subsequent literature.

- Stål, C. 1878: 42, 88.
- Giglio-Tos, E. 1898: 43.
- Bruner, L. 1900-1910: 211.
- Kirby, W.F. 1910: 390. > Type designation.
- Hebard, M. 1924: 107.
- Descamps, M. & Amedegnato, C. 1971: 117.
- Amédégnato, C. 1974: 199.
- Descamps, M. 1978: 379. > Tribal revision.
- Descamps, M. & Rowell, C.H.F. 1984: 158.
- Rowell, C.H.F. 2012b: 286.

No. of currently known species.

Seventeen

Known range of genus.

Ecuador, Colombia, Panama, Costa Rica. Most of the known species are found in N.W. Colombia.

Etymology.

Latin *taenia*, ribbon, Greek *phoreus*, bearer: “ribbon bearer”, probably referring to the characteristic longitudinal stripes of alternating dark and light pigment on head, prothorax and tegmina in this genus.

Diagnosis.

In some (but unfortunately not all) species the male has a short sharp spine on the dorsal surface of the prothoracic femur (**Fig. B21**); if this is present, it is diagnostic of the genus. The development of this structure varies between species and between populations within the species. In some species, including our *T. panamae*, occasional individuals have a spine or at least a small ridge on the dorsal surface of the mesothoracic femur too. The genus is also readily recognized by the male cercus. This is short and flattened laterally and divided apically into two lobes. The upper and more external lobe is thin and erect, fin-like, the lower and inner lobe is usually thickened and subcylindrical in shape, but sometimes (our *T. rubrosignata*, the Colombian *T. tenuipes*) elongated and developed into a hook-like structure (**Fig. B23**). The phallic structure is homogenous, and not discriminatory between species. In all species the dorsal ovipositor valves have a prominent shoulder on the outer edge of their tip when viewed from above.

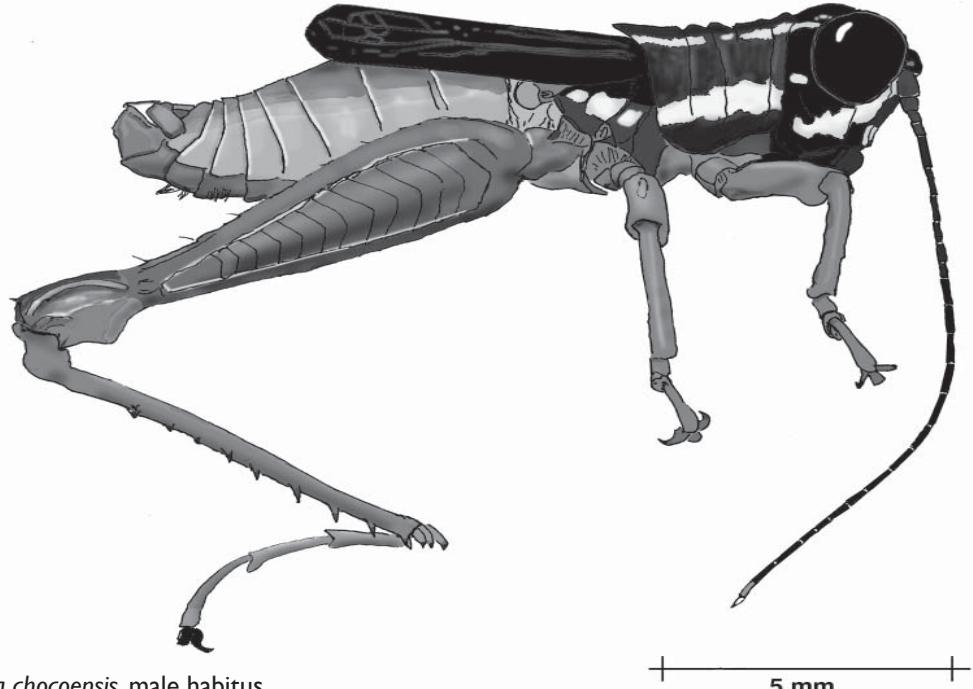


Fig. B18. *Taeniothora choocoensis*, male habitus.

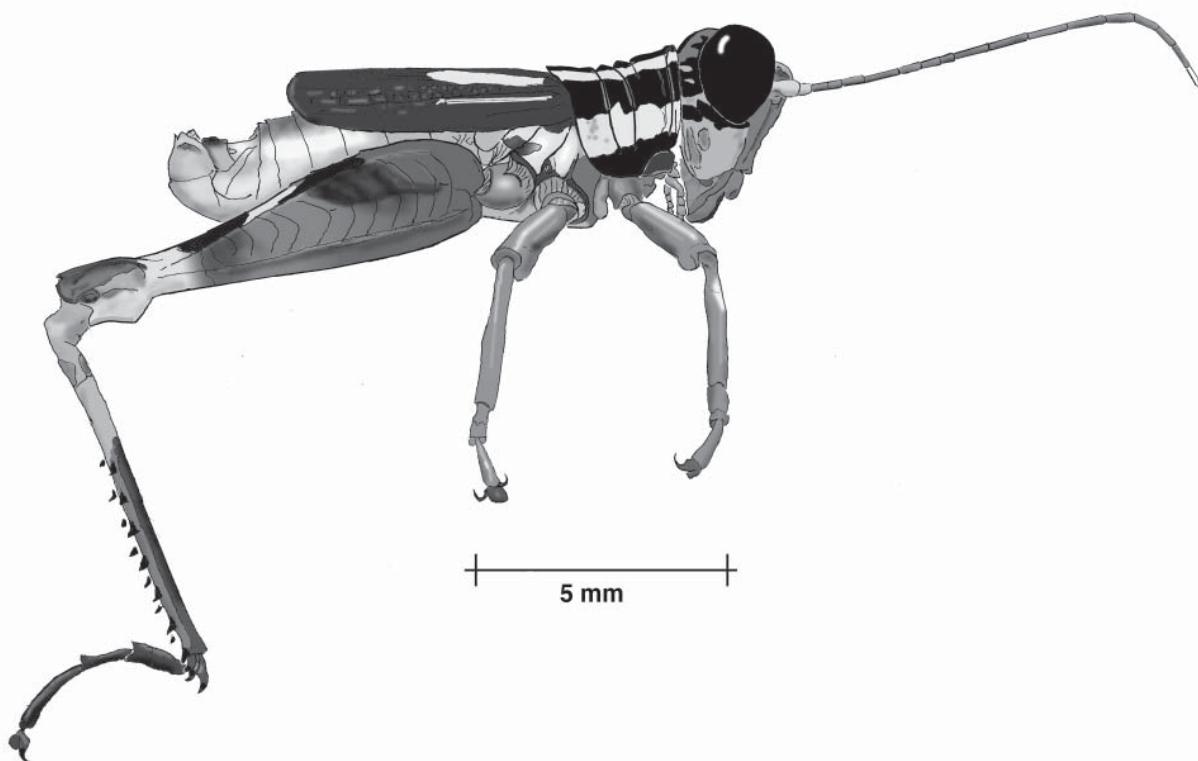


Fig. B19. *Taeniophora femorata*, male habitus.

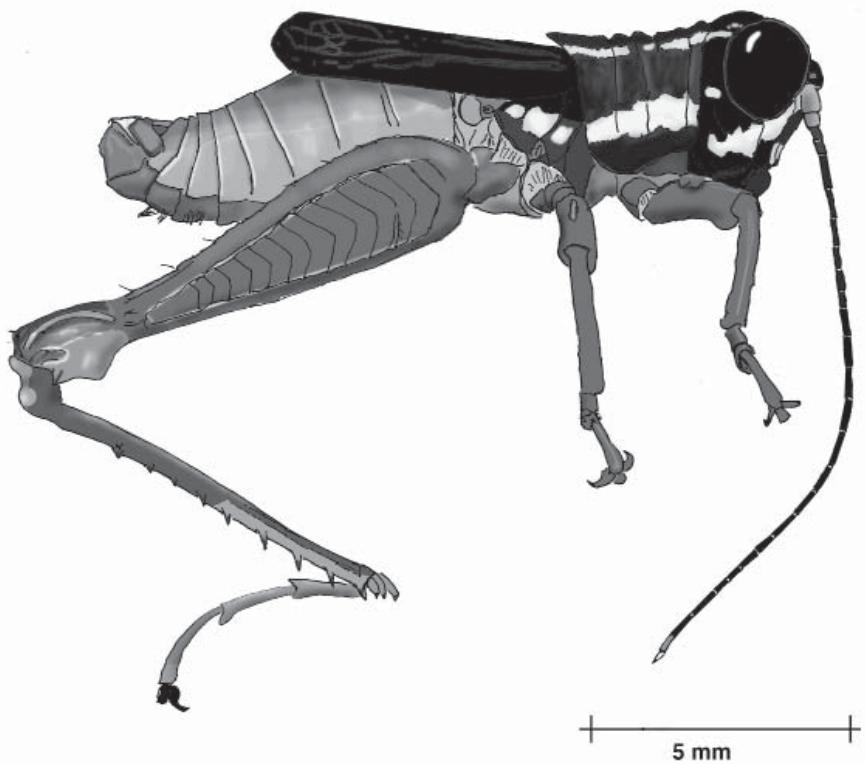


Fig. B20. *Taeniophora panamae*, male habitus.

Natural history.

Taeniophora species are forest edge and light-gap grasshoppers, not canopy dwellers. They are often found associated with Asteraceae or Solanaceae (herbs, shrubs, or vines), on which some species at least are specialists.

I. *Taeniophora chocoensis* Hebard 1923

Hebard 1923: 234.

Type locality: COLOMBIA: Chocó, Boca Murindo.

Location of type specimen: ANSP Philadelphia (holotype male).

Subsequent literature.

- Descamps, M. & Amedegnato, C. 1971: 132.
- Descamps, M. 1978: 380.

Known distribution.

Colombia (Chocó, Nariño, El Valle); Panama (Darién).

There is only a single Panamanian record to date (Hebard 1924), the species seems to be a principally Colombian species at the edge of its range in Darién.

Diagnosis.

Habitus **Fig. B18, Plate B11.** Antennae dark brown, pronotum and tegmina longitudinally striped in dark brown and yellow, pro- and mesothoracic legs red, hind femur green, hind knee and hind tibiae red. The first impression is of a *T. panamae* with red legs. The prothoracic femur usually has no spine (unarmed), but occasionally one is present on both the pro and the mesothoracic femora (Descamps 1978: 381).

Natural history.

Unknown.

2. *Taeniophora femorata* Bruner 1908

Bruner 1908: Biol. Cent.-Amer., Orth. 2: 245.

Type locality: COSTA RICA: Prov. S. José: Pozo Azul de Pirrís.

Location of type specimen: ANSP Philadelphia (lectotype male).

Subsequent literature.

- Rehn, J.A.G. & Hebard, M. 1912: 119. > Lectotype designated.
- Kirby, W.F. 1910: 390.
- Hebard, M. 1924: 109.
- Roberts, H.R. 1973: 60.
- Descamps, M. 1978: 381.

Diagnosis.

Habitus **Fig. B19, Plate B12.** Pro- and mesothoracic thoracic femora unarmed. Antennae black with white tips, pronotum and tegmina longitudinally striped in black and pale blue. The more dorsal blue stripe on the folded tegmen is much wider than the lower one. Pro- and mesothoracic legs green, hind femur bright red, doubly banded with black. The more anterior femoral band is much weaker and more or less confined

to the dorsal part of the femur. No other Central American grasshopper has this coloration. *T. pirrensis* is similarly coloured, but has only single blue bands on the tegmina, and only one black mark on the hind femora. It is also smaller.

Field characters.

The vivid coloration (see above) is unmistakeable.

Distribution.

Patchily distributed on the Pacific slope of Costa Rica from the northern boundary of Puntarenas Province southwards to the Osa peninsula and extreme W. Panama (Chiriquí Province), from sea level up to 1100 m in the Río Mosca in Costa Rica (but usually not above 600 m). The Panamanian records are from the early part of the 20th century, and the species has not been seen in Chiriquí province in recent years. It has not to date been found on the Caribbean slope of either country. In Costa Rica most easily seen in the P.N. Manuel Antonio, Quépos.

Natural history.

A specialist on various species of Asteraceae, including *Vernonia patens*, *Vernonia brachiata*, *Wedelia* sp. and some forest vines. Often found in tight groups of up to 20 individuals.

3. *Taeniophora panamae* Hebard 1924

Hebard 1924: 107.

Type locality: PANAMA: Colón, Porto Bello.

Location of type specimen: USNM Washington (holotype male).

Subsequent literature.

- Roberts, H.R. 1973: 59. > Diagnosis, habitats.

Diagnosis.

Habitus **Fig. B20, Plate B13.** Male cercus with a cup-like depression on the posterior axial surface of the inner fork. Prothoracic femoral spine present in all males examined to date.

Field characters.

Prothorax and tegmina longitudinally striped in black (or dark blackish brown) and bright yellow. Head black and yellow. Antennal flagellum black with white tips. All legs green, hind knee brown. The colour pattern taken by itself is reminiscent of *Leptomerinthopora brevipennis* (Ommatolampinae), though more contrasty, but both the general form of the insect and its foodplants are quite different.

Distribution.

Not infrequent in Pacific slope forests of Costa Rica from the northern boundary of Puntarenas province south to the Osa Peninsula and the Golfo Dulce. In Panama known from Darién, the Canal Zone, Cerro Gaital and Cerro Copé. There are a very few records from the Caribbean slope: in Panama, one from Western Panama (Rio Teribé) and another from Portobelo,

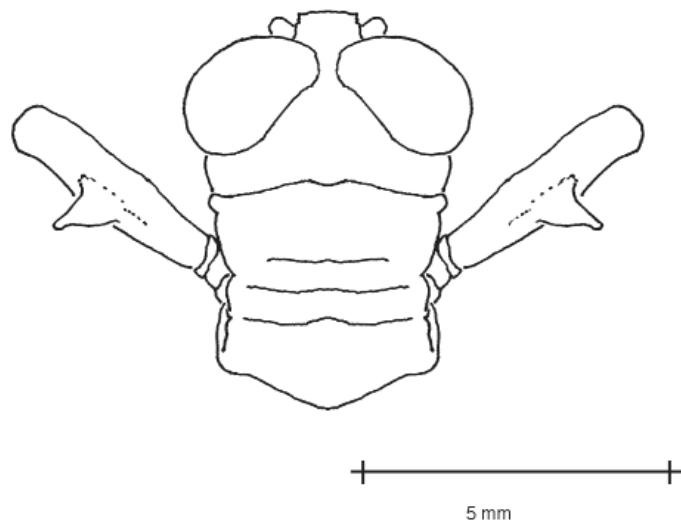


Fig. B21. *Taeniophora panamae* male, to show femoral spines on forelegs.

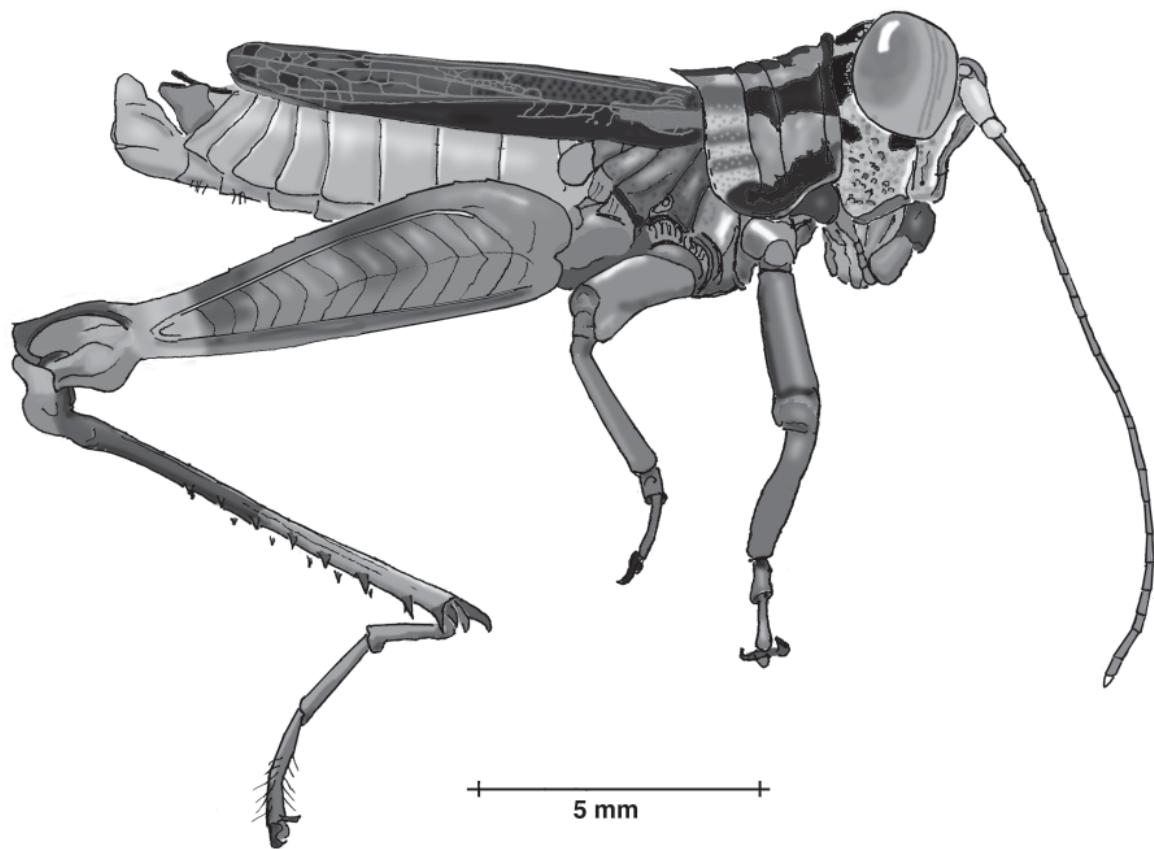


Fig. B22. *Taeniophora rubrosignata*, male habitus.

the type locality; in Costa Rica, a single record from the Valle de la Estrella, not far distant from the Rio Teribé.

Natural history.

A Solanaceae specialist, often found grouped on the foodplant. In south-central Costa Rica sometimes sympatric with *T. femorata* (e.g. in the Osa), but they are ecologically separated by foodplant.

4. *Taeniothora rubrosignata* Descamps & Rowell 1984

Descamps & Rowell 1984: 58

Type locality: COSTA RICA: Heredia Prov., Puerto Viejo, Finca La Selva, 45 m.

Location of type specimen: MNHN Paris (holotype female).

Etymology.

Latin, *rubrosignata* “marked with red”.

Subsequent literature.

- Rowell, C.H.F. 2012b: 288. > Description of male.

Diagnosis.

Habitus **Fig. B22, Plate B14**. Almost uniform grey-blue in life (dries to greenish brown in pinned specimens), with faint yellow bands on hind femur and a conspicuous red mark at the base of the tegmen. In an aberrant female from the Valle de la Estrella the hind femur is red-brown with yellow bands. The male cercus has the lower lobe produced into an upwards and inwards pointing hook (**Fig. B23**). The male subgenital plate is longer than in our other species, and at the tip the space between the two pointed “fins” is filled by cuticle marked with two longitudinal dark stripes. Male femora all unarmed.

Known distribution.

Costa Rica (entire Caribbean lowlands to 500 m; Golfo Dulce and Osa Peninsula), but nowhere common. May well extend into Panama and/or Nicaragua but not as yet recorded there.

Natural history.

Foodplants unknown. Found in forest understorey as often as in light gaps.

5. *Taeniothora pirrensis* Rowell 2012

Rowell 2012c: 287.

Type locality: PANAMA, Prov. Darién, Parque National Darién, Pirre, Estación Rancho Frio, 80 m.

Location of type specimen: (ANSP).

Etymology.

Specific name derived from the type locality.

Diagnosis.

Habitus **Fig. B24, Plate B15**. Tegmina short, reaching to posterior margin of 4th abdominal segment, overlapping dorsally. Tympanum present, large. Pro- and mesothoracic femora robust, but unarmed, completely lacking the dorsal spines characteristic of many species of the genus. Hind femora robust, equalling or exceeding the tip of the abdomen in length. Dorsal medial carina of hind femur slightly rugose, ends on knee in a small spine. Outer face of hind femur with prominent raised chevron ridges, corresponding to the extensor muscle attachments. Hind tibia with 8 external and 8 internal spines, including the apical ones.

Coloration. Head predominantly olive green, with a large black triangle on the occiput, black postocular stripe, small black markings on the gena and a black border along its ventral edge. Labrum tinged red, palps and sides of mandibles green. Fastigium and dorsal parts of frontal ridge probably red in life, at least in females. Antennae light brown, darkening distally, but with a whitish extreme tip. Pronotum black, longitudinally striped with four light blue-green stripes. The midline of the pronotal disc is black, but in the metazona only is bisected longitudinally by a thin green line situated where one might expect a medial carina. Thoracic pleura mostly black, with lighter colour in the centre of each sclerite, and reddish ventral edges. Mesothoracic episternum red. Tegmina black, each with a broad longitudinal pale green central stripe which does not quite extend to the tip of the wing. Pro- and mesothoracic legs green, the femora with reddish bases. Hind femur bright red on all faces, but shading to orange-brown at the knee. Usually there is a single small black spot placed centrally on the dorsal medial carina near the knee. This is often larger in females and can then extend over the internal and external dorsal faces of the femur, giving the impression of a black band when viewed from above. Hind tibia green, shading to black distally, tibial spines black. Tarsi green with black lining on their distal margins. Abdomen (and underside of thorax) light olive brown, upper forks of male cerci blackish. Two tiny black erect processes on the anterior surface of the supra-anal plate (**Fig. B25**), and two larger black marks on its distal edge. Male and female are coloured similarly, apart from differences in the size of the femoral black spot.

Female: larger than the male but closely similar in structure. The upper valves of the ovipositor are noticeably indented near their tip, forming a prominent shoulder in dorsal view.

Distribution.

Known only from the type locality. See also in DeGracia et al. 2012.

Natural history.

Capture in Malaise traps indicates that the species is

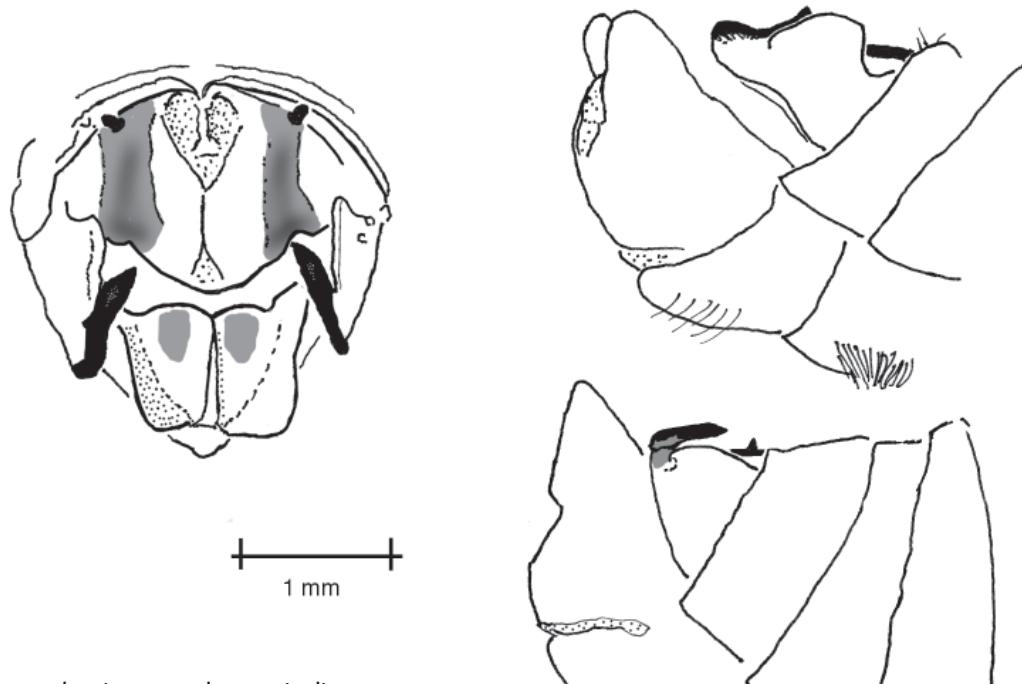


Fig. B23. *Taeniophora rubrosignata*, male terminalia.

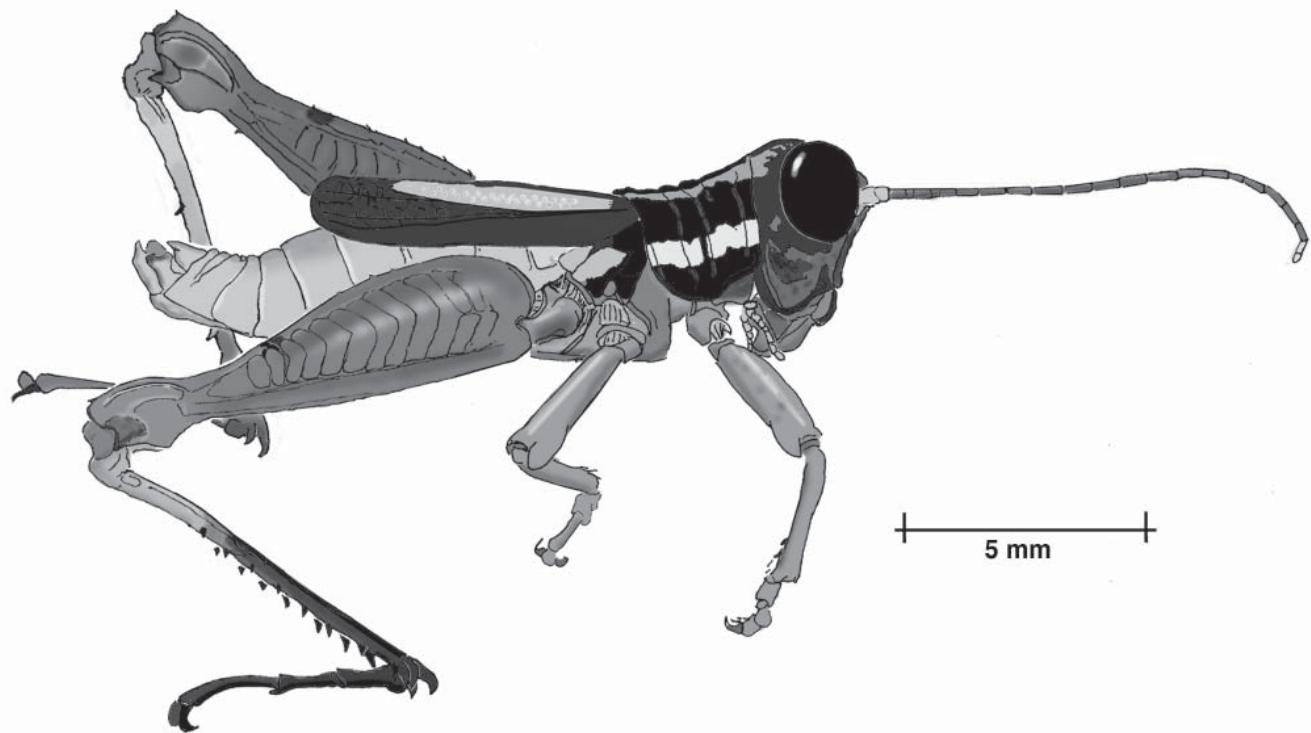


Fig. B24. *Taeniophora pirrensis*, male habitus.

not strictly arboreal. Commonly found on understorey herbage.
Food plant unknown.

6. *Taeniothora santosi* Rowell 2012

Rowell 2012b: 288.

Type locality: PANAMA, Prov Panamá, Cerro Azul, Las Nubes.

Location of type specimen: ANSP.

Etymology.

Named for the collector, Alonso Santos of the University of Panama.

Diagnosis.

Habitus: **Fig. B26, Plate B16.** Similar in general coloration and morphology to *T. panamae*, but differs as follows:

- Smaller size ($F_{male} = 9.62$ mm v. (*panamae*) 11.45mm).
- Male femora all unarmed (just a slight thickening of the dorsal carina of the mesothoracic femur).
- Almost the entire lateral lobe of pronotum pale yellow, with thin black-brown horizontal stripes above and below.
- All green areas in *panamae* are dark brown in *santosi*.
- No pale markings on the tegmina.
- No pale markings on posterior edge of eye.
- The male cercus is indistinguishable from that of *T. panamae*.

The female is unknown.

Natural history.

Unknown. The species is known only from the male holotype and has not been seen in the wild since. As the type locality is frequently collected by personnel of the University of Panama, it is presumably very uncommon.

Tribe Ophthalmolampini Descamps 1977

Diagnosis.

Male subgenital plate simple (except in *Zoumolampis*, which can be distinguished by its specialised 8th abdominal tergite); supra-anal plate compound, divided into two transversely; cerci never bilobed. Brachypterous or micropterous. Integument of face densely pitted.

Number of included genera.

Thirty-six.

Range of genus.

Amazonian Brazil and Peru to Honduras.

Subtribe Ophthalmolampae Descamps 1978

Diagnosis.

Prozona as long as or longer than the distance from the anterior margin of pronotum to the tip of the fastigium. Seven external tibial spines (including apical spine), lateral lobes of pronotum monochrome. The phallic complex is remarkable for the extreme hypertrophy of the endophallus. The male supra-anal plate is compound, incorporating the tergites of A10 and A11; the frequently melanised posterior margin of the A10 tergite then forms a black line across the SAP.

No. of included genera.

Nine. In our area, only one, *Caenolampis*.

Range of subtribe.

From Amazonian Brazil, Bolivia and Peru through Guyana, French Guiana, Venezuela, Colombia, Ecuador, Panama and Costa Rica. All genera apart from *Caenolampis* are exclusively South American.

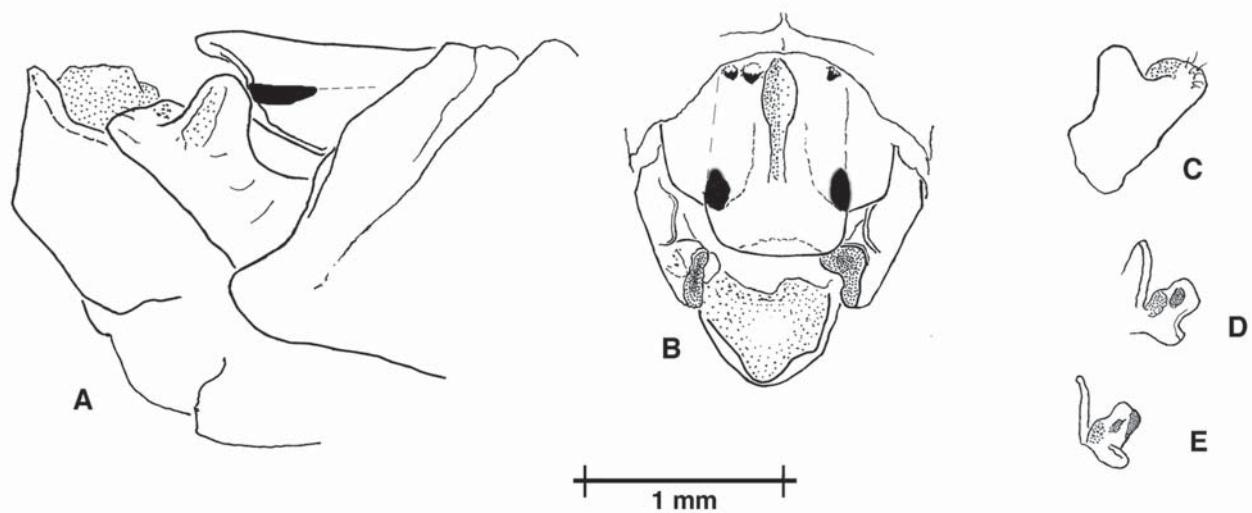


Fig. B25. *Taenioptera pirrensis*, male terminalia. A, lateral view. B, dorsal view. C, cercus, lateral view. D, cercus, oblique axial view. E, cercus, axial view.

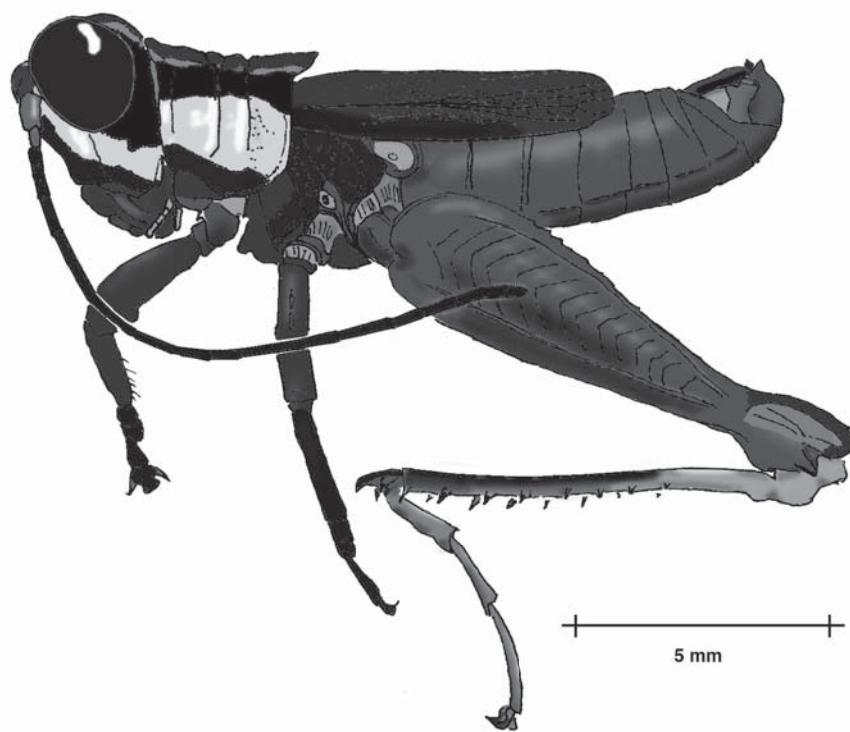


Fig. B26. *Taenioptera santosi*, male holotype.

Caenolampis
Descamps 1978

Descamps 1978: 468.

Type species: *Ophthalmolampis osae* Roberts, by original designation.

Subsequent literature.

- Descamps, M. & Rowell, C.H.F. 1984: 159.
- Rowell, C.H.F. 2012b: 289.

No. known species.

Four. In our area, 3.

Range of genus.

Ecuador to Costa Rica.

Natural history.

Canopy species of rain forest, to 1100 m altitude.

Females often come to the ground at night.

Diagnosis.

The only ophthalmolampin genus known in Central America. It superficially resembles *Nautia*, but can be distinguished by the double row of black plaques on the outer face of the hind femur. The number of plaques varies, but at least 6 pairs are always present. (Some individuals of *Nautia* have a black speckle on the femur, but never discrete plaques; *Chromolampis* (Guyana and Venezuela) is closely related to *Caenolampis*, and has similar plaques). Antennae strongly ensiform, dark brown (usually purple in *Nautia*), as long as or much (3x) longer than head and pronotum together. Fastigium strongly projecting. Posterior ventral angle of pronotal lobe with a very small tooth. Tegmen brown, with a longitudinal band in which the reticulum veins are white; this gives the superficial impression of a white band marked with brown spots of various sizes. Dorsal and ventral carinae of hind femur weakly toothed. Feet pink. Subgenital plate of female with a large lobe each side of the egg guide. In all *Caenolampis* species the ovipositor valves are long, delicate and spatulate, presumably indicating epiphyllous oviposition.

Descamp's (1978) definition of the genus states that the metazona is longer than the prozona. This is an error (holotypes of *C. robertsi*, *C. copensis*, and *C. osae* examined – only in *C. osae* does the metazona even equal the prozona in length).

Key to Central American species of *Caenolampis*

I Fastigium of vertex slightly downward sloping in side view. Face uniformly greenish, with no pale band running from the base of the antennae below the eye to the lower gena. Cross veins of yellow band on tegmina densely packed, leaving only very small brown patches between them, as in *C. copensis*. Outer ventral lobe of hind knee yellow green. (S.W. Costa Rica, Osa Peninsula). *osae* (Roberts 1973).

IA Fastigium of vertex more or less horizontal in side view. Face dark brown, with a prominent pale white or yellow band running from the base of the antenna to the posterior ventral angle of the gena. 2

2 Antennae markedly flattened at their base: 4th flagellar segment 0.8 - 0.9 mm wide. Hind knees blackish brown, with a pale yellow, white or pink patch on outer ventral lobe. Distal part of male supra-anal plate almost devoid of melanised decorations (**Fig. B30**). Cross veins of white band on tegmina loosely packed, leaving large brown patches between them. Male cerci usually only moderately upturned, the extremities are about 45° to the horizontal. Metazona 88% of prozona (Caribbean plain of Costa Rica and Panama) *robertsi* Descamps 1978.

2A Antennae less wide at their base: 4th flagellar segment only 0.5 mm wide. Hind knees uniform reddish brown. Distal part of male SAP has two black tubercles and on its outer margins two melanised patches (**Fig. B32 B**). Cross veins of yellow band on tegmina densely packed, leaving only very small brown patches between them, as in *C. osae*. Male cerci strongly upturned at their tips, extremities approaching the vertical. Metazona 68% of prozona (highlands of Central Panama). *copensis* Rowell 2012.

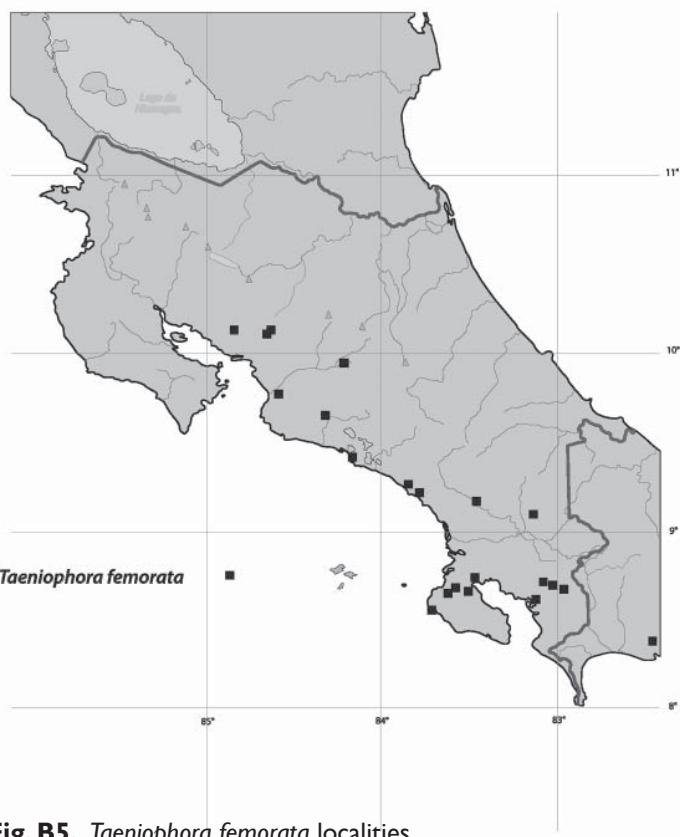


Fig. B5. *Taeniothora femorata* localities.



Fig. B6. *Taeniothora rubrosignata* localities.

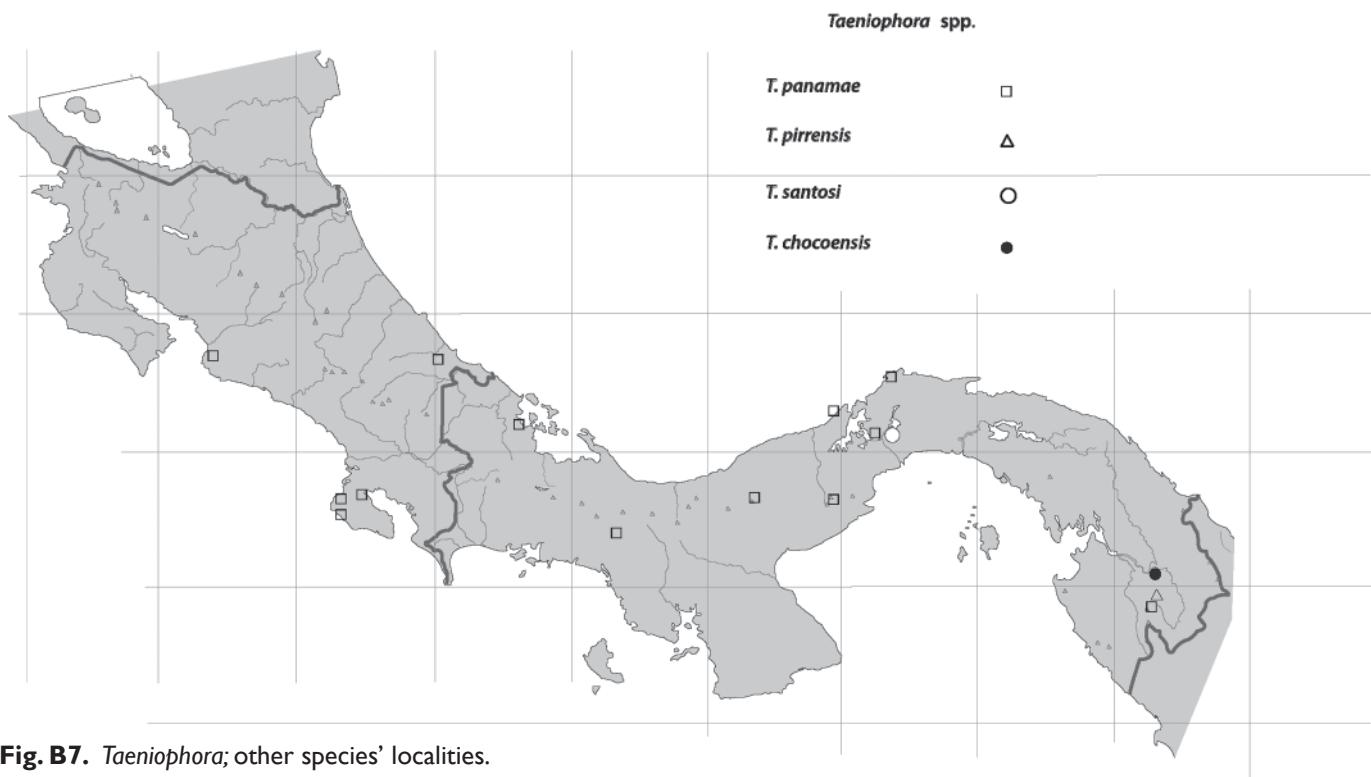


Fig. B7. *Taeniothora*; other species' localities.

I. *Caenolampis osae* (Roberts 1973)

Ophthalmolampis osae Roberts 1973: 58.

Type locality: COSTA RICA: 8 km S. of Rincón, Osa Peninsula.

Location of type specimen: ANSP, holotype male.

Subsequent literature.

- Descamps, M. 1978: 468. > Transfers to *Caenolampis* n.g.
- Descamps, M. & Rowell, C.H.F. 1984: 159. > Errors in Descamp's 1978 description corrected.

Known distribution.

S.W. Costa Rica, Osa Peninsula.

Diagnosis.

See Fig. B17. Face unicolorous, with no white or yellow band in front of the eye; lower lobe of hind knee lacking pale patch. Antennae less wide at base than in *C. robertsi*.

The species is known only from the male holotype.

Note that the habitus illustration by Hodebert in Descamps & Rowell (1984, Fig. 47) gives a good impression of the animal, but is erroneous in detail – e.g. there are 10 pairs of black plaques on the hind femur of the holotype, not 8 as shown.

Natural history.

Unknown.

2. *Caenolampis robertsi* Descamps 1978

Descamps 1978: 470.

Type locality: COSTA RICA: Prov. Heredia: Guápiles: near La Emilia, 1000 ft.

Location of type specimen: ANSP, holotype male.

Subsequent literature.

- Descamps, M. & Rowell, C.H.F. 1984: 159. > Errors in original description corrected.

Known distribution.

Costa Rica, Panama. See Map B8. Widely distributed throughout the Caribbean forest zone, and probably extends all along the north coast of Panama.

Diagnosis.

See key to species. Habitus, Fig. B28, Plate B18.

General colour, green. Face dark brown with white band slanting downwards in front of and below eye. Ventral outer lobe of hind knee much paler than upper part. Pale band on elytron with conspicuous brown blotching.

Natural history.

Probably the commonest, or at least the most frequently seen, canopy species in lowland and submontane Caribbean forest. Females are frequently found on tree trunks in the early morning, ascending to the canopy after nocturnal visits to the ground.

Comment.

Specimens of *Caenolampis robertsi* from Panama and the Costa Rican/Panamanian Caribbean border zone are intermediate between *C. osae* and *C. robertsi* in some pattern characters: face greenish (as in *C. osae*) and with only a very indistinct white stripe, but lower lobe of hind knee much paler than upper part (as in Costa Rican *C. robertsi*). The male supra-anal plate seems to be identical in the two species. The distinction in slope of the fastigium given by Descamps does not apply to all specimens, and is not marked even in the two type specimens. All this suggests that the two taxa may in fact be part of a single variable species. More specimens of *C. osae* are necessary to resolve this.

3. *Caenolampis copensis* Rowell 2012

Rowell 2012b: 290.

Type locality: PANAMA: Coclé: Cerro Copé, 850 m.

Location of type specimen: ANSP, holotype male.

Known distribution: Panama (type locality only).

Female unknown.

Diagnosis.

Habitus Fig. B30, Plate B19. At first sight very similar to *C. robertsi*. Coloration: antennae, dark brown; head, thorax, abdomen and legs emerald green. Face green with brown speckle. Frontal yellow stripe produced downwards and backwards as a slanting stripe across genae. Vertex and fastigium brown, bordered by the bright yellow longitudinal postocular stripes. Brown and yellow stripes continued backwards from vertex over pronotum and tegmina, which extend almost to genitalia. Hind femora with ventral and dorsal rows of 8 black plaques. Hind feet pink.

Distinguished from *C. robertsi* by the relatively much longer antennae, the colour of the hind knees (uniform reddish or purplish brown) and by the presence of more melanic ornamentation on the distal portion of the male SAP (absent in *C. robertsi*) (Figs B30 & B31).

Natural history.

Unknown.

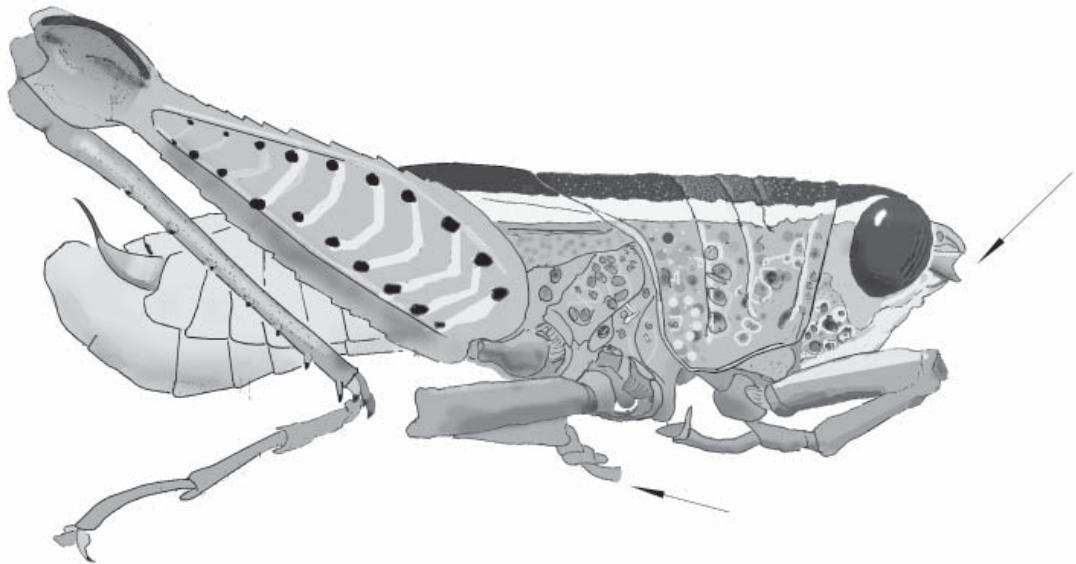


Fig. B27. *Caenilampis osae*, holotype male. Arrows mark the missing antennal flagellum and mesothoracic tarsus, absent from the type specimen. They can be assumed to be similar to those of *C. robertsi*.

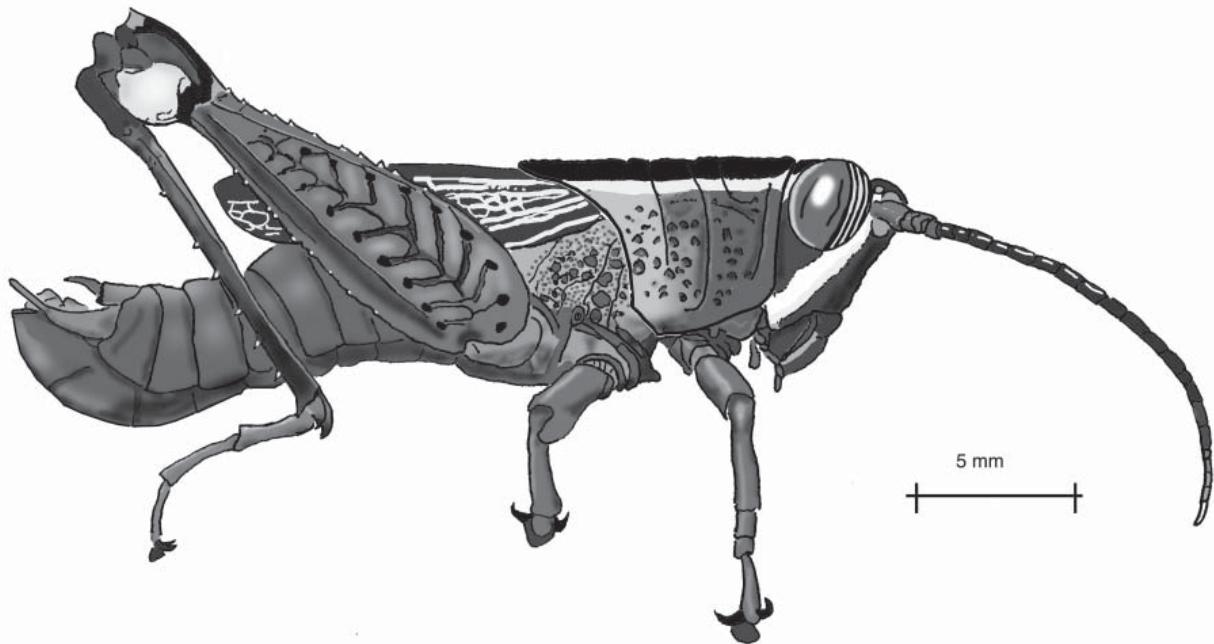


Fig. B28. *Caenolampis robertsi*, male habitus.

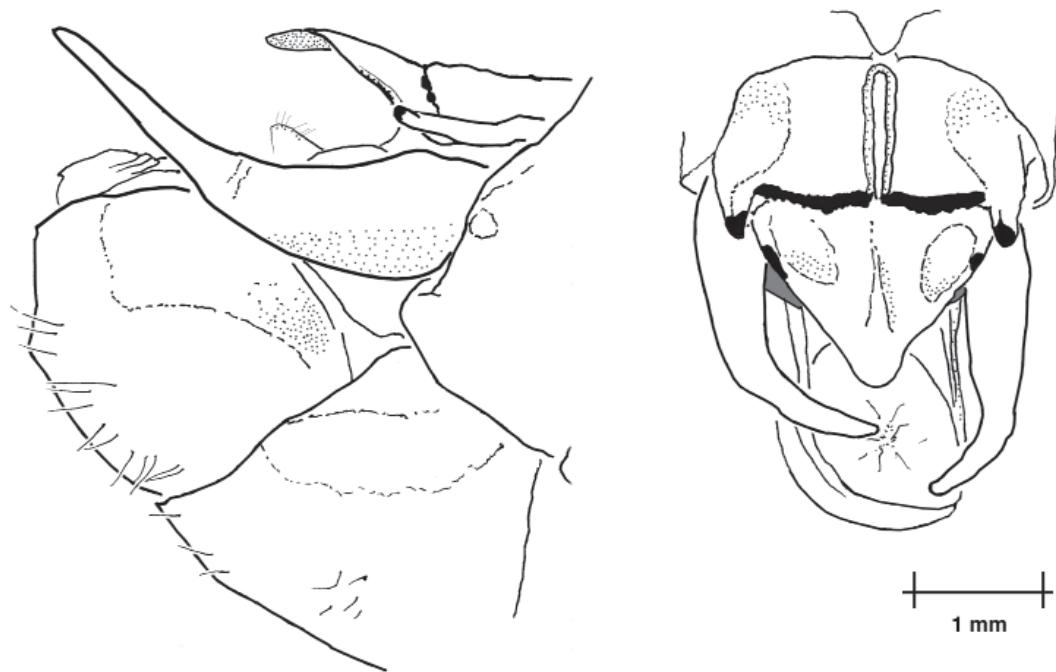


Fig. B29. *Caenolampis robertsi*, male terminalia. A, lateral view. B, dorsal view.

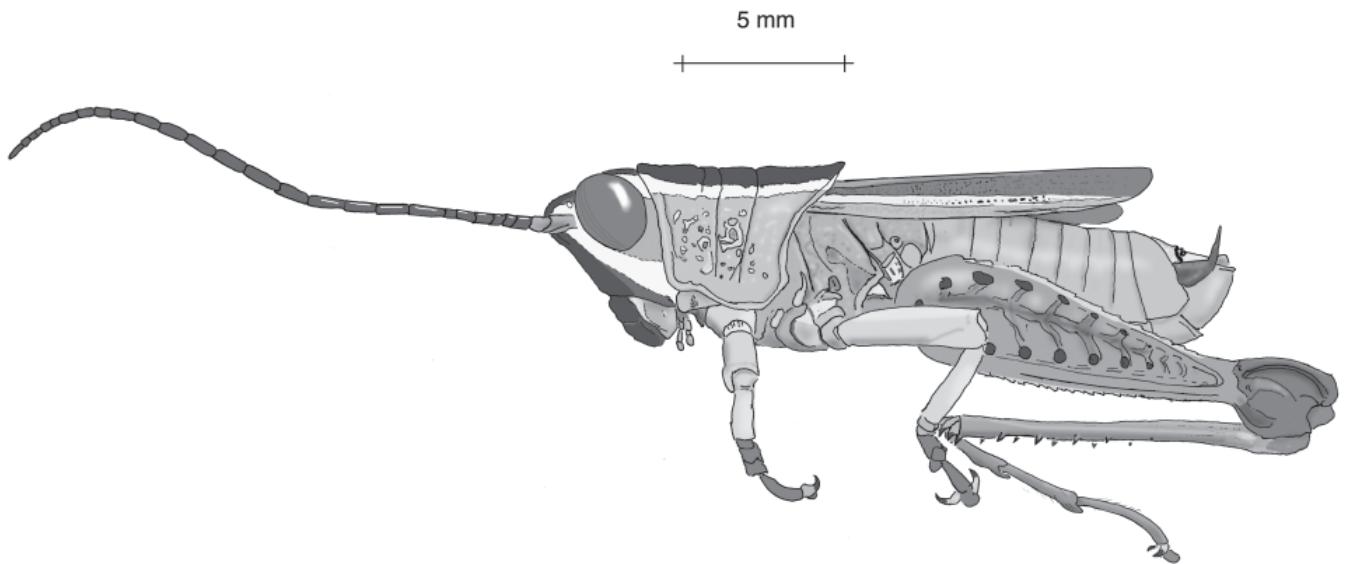


Fig. B30. *Caenolampis copensis*. Male habitus.

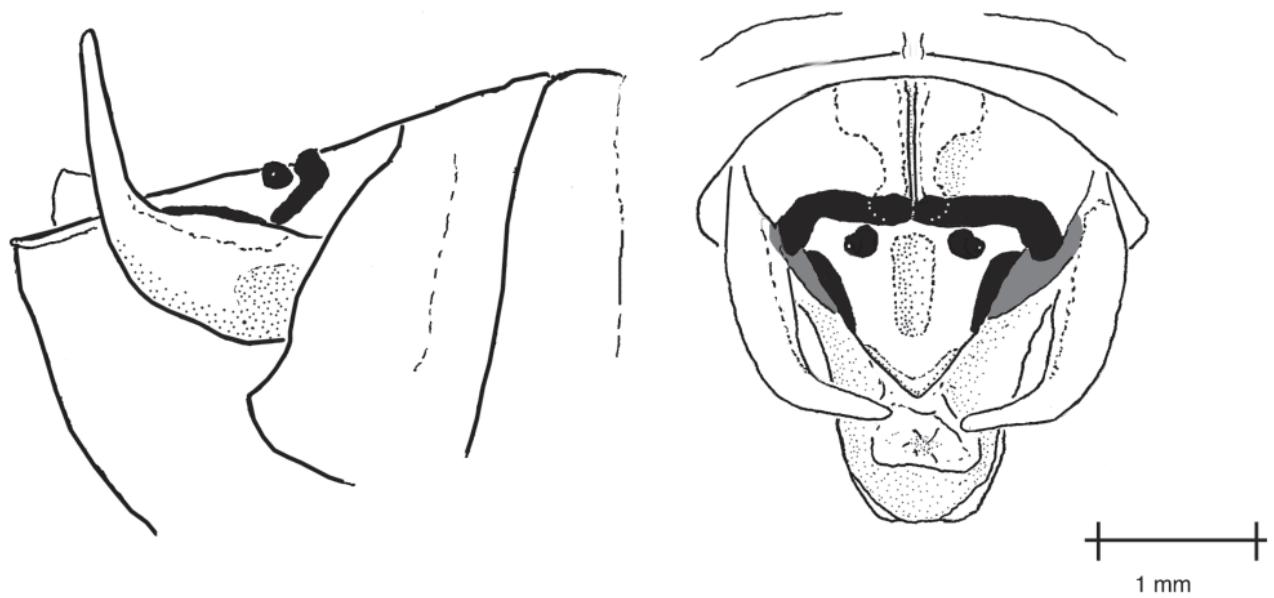
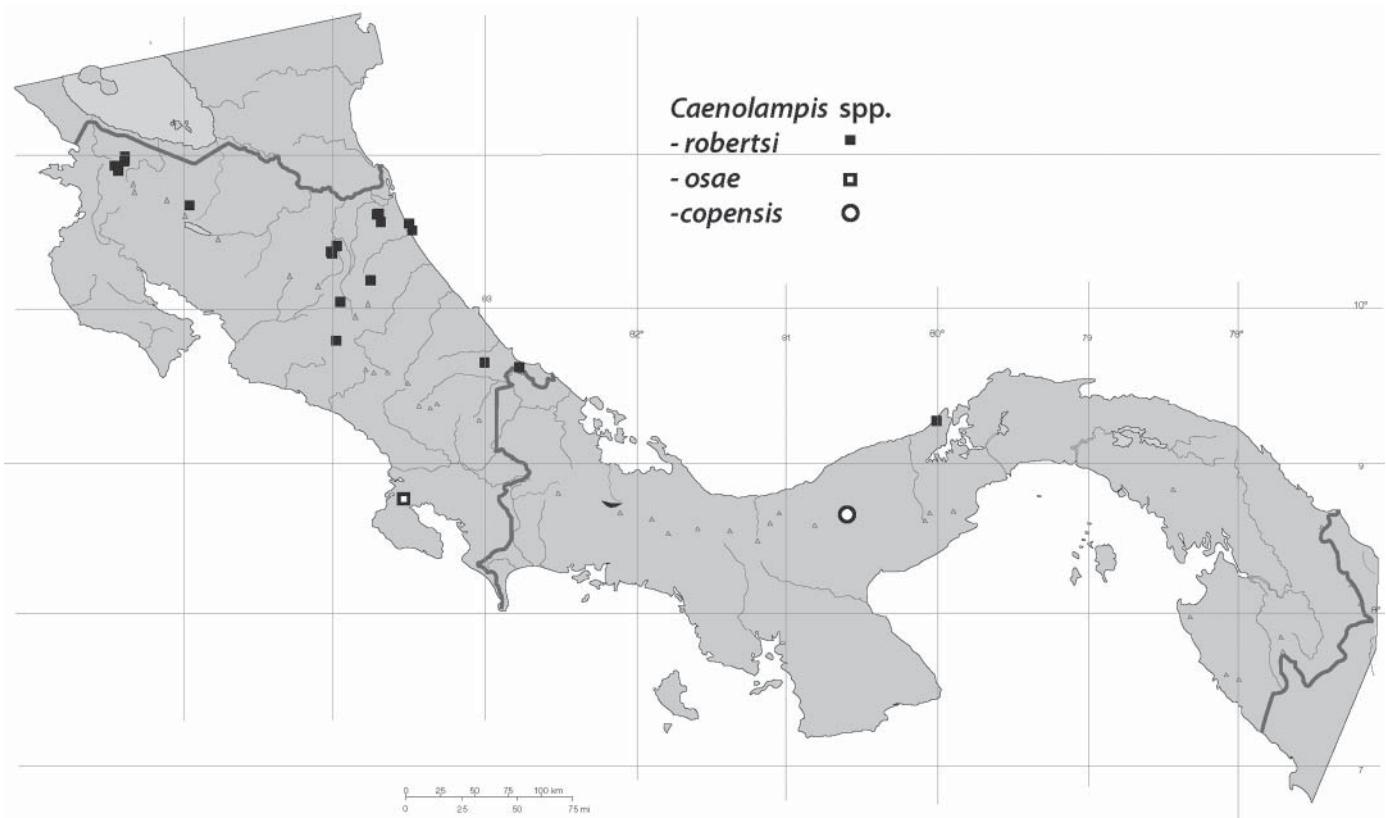


Fig. B31. *Caenolampis copensis*. Male terminalia. A, lateral view. B, dorsal view.



Map B8. Localities of *Caenolampis* spp. in Costa Rica and Panama.

Subtribe Nautiae

Descamps 1978

Tribal diagnosis.

Prozona shorter than distance from fastigium to anterior margin of pronotum; vertex projects vertically beyond than pronotum; male supra-anal plate divided transversely anterior to the middle (but not obvious in male *Nautia*); carinae of hind femur, especially the dorsal internal carina, provided with numerous short spines.

No. of included genera.

Seven (*Drypetacris*, *Euprepacris*, *Nautia*, *Nothonautia*, *Orthnacris*, *Pseudonautia*, *Xenonautia*). Only *Nautia* occurs outside of South America.

Nautia Stål 1878

Stål, 1878: 42, 87.

Type species: *Nautia flavosignata* Stål.

Subsequent literature.

- Bruner, L. 1900-1910 (1907): 242.
- Kirby, W.F. 1910: 389.
- Amedegnato, C. 1974: 199. > Assignment to Bactrophorinae (as Trybliophorinae).
- Descamps, M. 1978: 410. > Revision of genus.

Synonymy.

=*Odedelometopon* Rehn 1905: 418 (synon. Bruner 1907).

Known range of genus.

Nicaragua, Costa Rica, Panama, Colombia.

No. of known species.

Eight. In our area, six. Two species originally assigned to *Nautia* by Bruner (1907) (*N. ornatipes* and *N. vittagenea*) were transferred to other genera by Descamps in his 1978 revision.

Diagnosis.

Apart from the subtribal characters given above, *Nautia* and *Drypetacris* have 8 external hind tibial spines and markedly ensiform antennae. *Nautia* alone has the base of the SAP bordered with black; the cerci are straight and more or less pointed.

Field characters.

Among Costa Rican and Panamanian bactrophorines, *Nautia* can be confused only with *Caenolampis*, with which it shares its relatively large size, heavy antennae, brown and gold pronotum and tegmina, and green legs and abdomen. It can be readily distinguished from that genus, however, by the frequently reddish-purple antenna (brown in *Caenolampis*) and by the

absence of the rows of black plaques on the outer face of the hind femur seen in *Caenolampis*. *Nautia conspersipes* and some specimens of *N. flavosignata* have the hind femora sprinkled with small dark green or black spots, but these are uniformly arranged and much smaller than are the plaques of *Caenolampis*.

Although easy to identify as a genus, most species of *Nautia* (except the striking black and blue-green *N. atrata*, Fig. B34) are difficult to tell apart. The best discriminatory characters are the relative length of the tegmina, the coloration of the hind knee and the form of the female ovipositor valves. Variations in thoracic markings are not reliable indicators. Males without associated females are especially problematic. There are really not enough specimens available to assess rigorously the validity of the various described species, which may in part represent the extremes of clines. Some molecular data would be most welcome.

Natural history.

Nautia species are wet forest canopy dwellers. Their food plants are unknown. Most specimens collected are adult females, captured on or near the ground, perhaps indicating terrestrial egg laying, despite the fact that the narrow, spatulate and elongate ovipositor valves suggest epiphylllic oviposition; males are much less commonly taken, usually only after stormy weather or by insecticide fogging of the canopy.

Key to Central American species of *Nautia* (modified from Descamps, 1978).

This key should be used together with Descamps' diagrams of female subgenital plates, ovipositor valves and pronotal patterning (Fig. B32/33).		
I	Tegmina at least 1.2× as long as pronotum.	..... 2
IA	Tegmina equal to or shorter than pronotum.	..... 4
2	Tegmina longer than distance from tip of fastigium to posterior margin of pronotum, extending into Ab.5 tergite. Hind femora green, sometimes finely spotted with black. Hind knee mostly pale brown, hind knee arches black. Upper ovipositor valves with smooth margins, rounded and symmetrical at their tips. Lower ovipositor valves [Fig. 32-5] much shorter than upper ones. Cerci relatively long, thickish, but narrowing at tip, with sharp points. (Panama (C.Z.) and Costa Rica).	..... <i>flavosignata</i> Stål.
2A	Tegmina shorter than distance from tip of fastigium to posterior margin of pronotum, but longer than pronotum.	..... 3
3	Tegmina shorter than distance from tip of fastigium to posterior margin of pronotum, but longer (1.25×) than pronotum, extending into Ab.4 tergite. Hind femora clear	

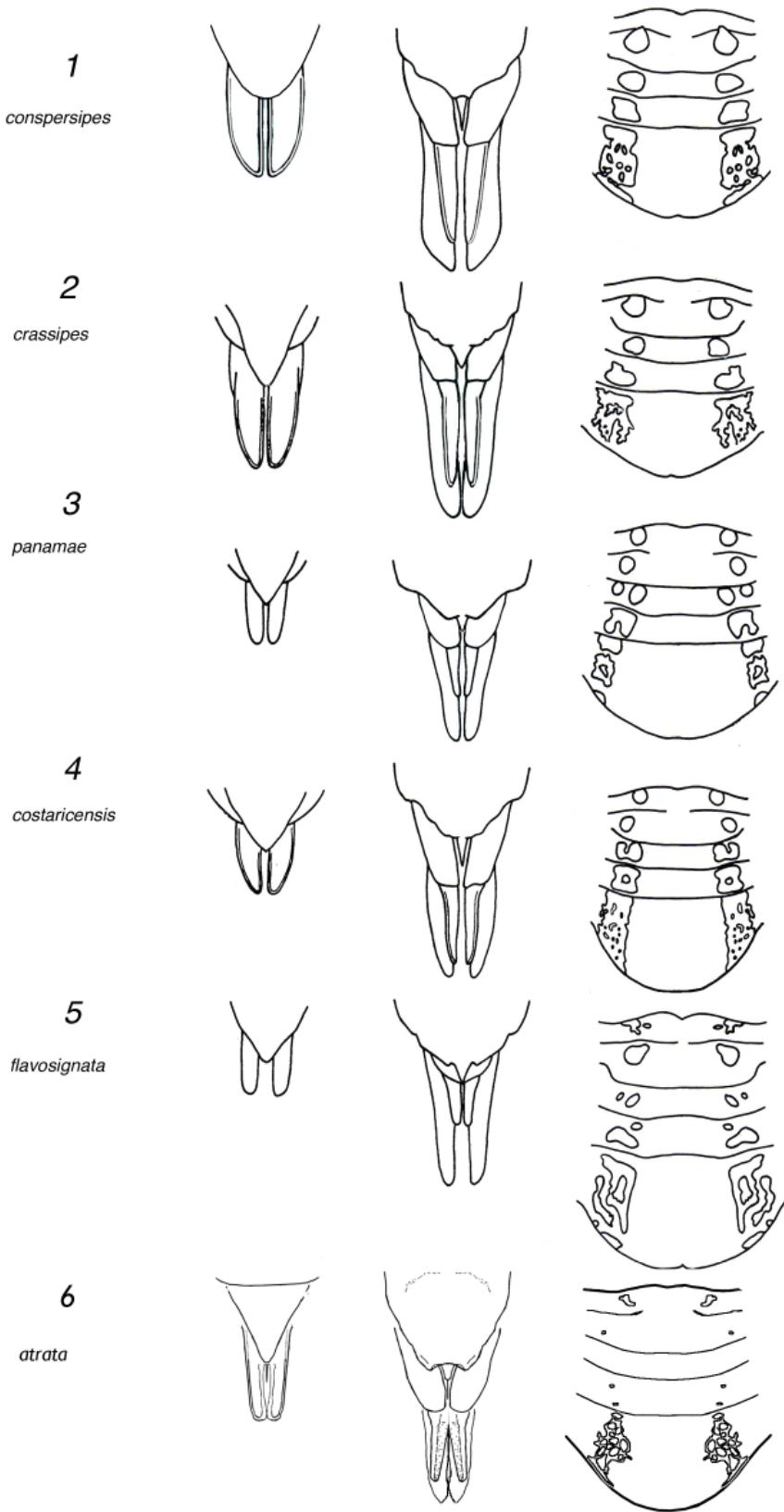


Fig. B32/33. Comparison of female *Nautia* spp. Left hand column, tip of female abdomen in dorsal view. Centre column, tip of female abdomen in ventral view. Right hand column, example of patterning of pronotal disc. Note however that the pronotal patterning varies greatly between individuals of any given species. Row 1, *N. conspersipes*; Row 2, *N. crassipes*; Row 3, *N. panamae*; Row 4, *N. costaricensis*; Row 5, *N. flavosignata* (all after Descamps 1978). Row 6, *N. atrata* (after Rowell 2012).

emerald green; hind knee completely black. Upper ovipositor valves with smooth edges, slightly diverging at their base, but angled in distally to touch at their tips. Ventral valves in side view about 2/3 as long as upper valves (**Fig. B32-6**). Predominant colour black, including fore and mid legs; yellow markings on pronotum greatly reduced (Caribbean coast of Panama).

..... *atrata* Rowell

3A Tegmina equal to or shorter than distance from tip of fastigium to posterior margin of pronotum, but longer (1.5 - 1.7×) than pronotum, reaching post margin of Ab.4 tergite. Hind femora pale green with a dense fine speckle in very dark green, hind knee arches black. Dorsal ovipositor valves (**Fig. B32-1**) wider and more robust than in 2 above, lower valves relatively long and tapering but still somewhat shorter than upper valves. Cerci relatively long, smoothly tapering, with rounded tips. (Nicaragua, North East Costa Rica).

..... *conspersipes* Bruner

4 Tegmina equal to or slightly shorter than pronotum, reaching posterior margin of Ab.3 tergite. Hind femora clear green with black knee arches. Lower ovipositor valves (**Fig. B32-2**) nearly as long as upper valves. Cerci relatively short and blunt. [Panama (C.Z.), S.E. Costa Rica].

..... *crassipes* Descamps

4A Tegmina equal to or slightly shorter than pronotum. Hind femora clear green with black knee arches. Lower ovipositor valves (**Fig. B32-3**) only half as long as upper valves. [Panama (C.Z.), Darien]

..... *panamae* Descamps

4B Similar to 4, but hind knee entirely yellow-brown, and upper ovipositor valves broad with cutting edges. Lower valves almost as long as upper valves (**Fig. B32-4**). (Pacific slope of Costa Rica)

..... *costaricensis* Descamps

1. *Nautia? atrata* Rowell 2012

Rowell 2012b: 294.

Type locality: PANAMA: Bocas del Toro, 10 km. W. of Punta Peña on road to Almirante.

Location of type specimen: ANS Philadelphia (holotype female).

In the absence of a male, the generic placement is tentative.

Etymology.

Latin *atratus*, clad in black.

Known range.

Type locality only. Male unknown.

Diagnosis.

(Habitus **Plate B20**, **Fig. B35**). Almost entirely black. Sides and underside of abdomen blue green. Hind femora emerald green, hind knees black. Yellow markings of pronotum greatly reduced in comparison with other species of the genus

(**Fig. B32/33**).

Natural history.

Unknown. The holotype was captured in the understorey of primary forest.

2. *Nautia conspersipes* Bruner 1907

Bruner 1900-1910 (1907): 243

Type locality: NICARAGUA: Chontales.

Location of type specimen: ANS Philadelphia (lectotype female)

Known range.

South-central Nicaragua, N.E. Costa Rica. (See **Map B9**).

Subsequent literature.

- Kirby, W.F. 1910: 389.
- Rehn, J.A.G. & Hebard, M. 1912: 118. > Designation of lectotype.
- Hebard, M. 1924: 107.
- Descamps, M. 1978: 416.

Etymology.

Latin *conspersus*, sprinkled, *pes*, foot. Refers to the speckled hind femora.

Diagnosis.

Habitus, **Plate B21**, **Fig. B35**. Slightly larger than most of the other *Nautia* species. Easily recognizable by the relatively dense black or dark green speckle on the green hind femur, the black knee arches, and the purple antennae.

3. *Nautia costaricensis* Descamps 1978

Descamps 1978: 419.

Type locality: COSTA RICA: Prov. Puntarenas, Osa Peninsula, Rincón.

Location of type specimen: ANS Philadelphia (holotype male).

Known range.

Costa Rica, chiefly known from the Pacific slope. A single record from the Valle de la Estrella on the Caribbean slope.

Diagnosis.

(**Plate B22**, **Fig. B36**). Usually olive brown or olive green, with a darker blue-black head, and well developed yellow markings on the pronotum. The hind femora are emerald green with many paler tubercles, but no black or dark green spots. The hind knees are olive brown or reddish rather than black. For other characters see key to species.

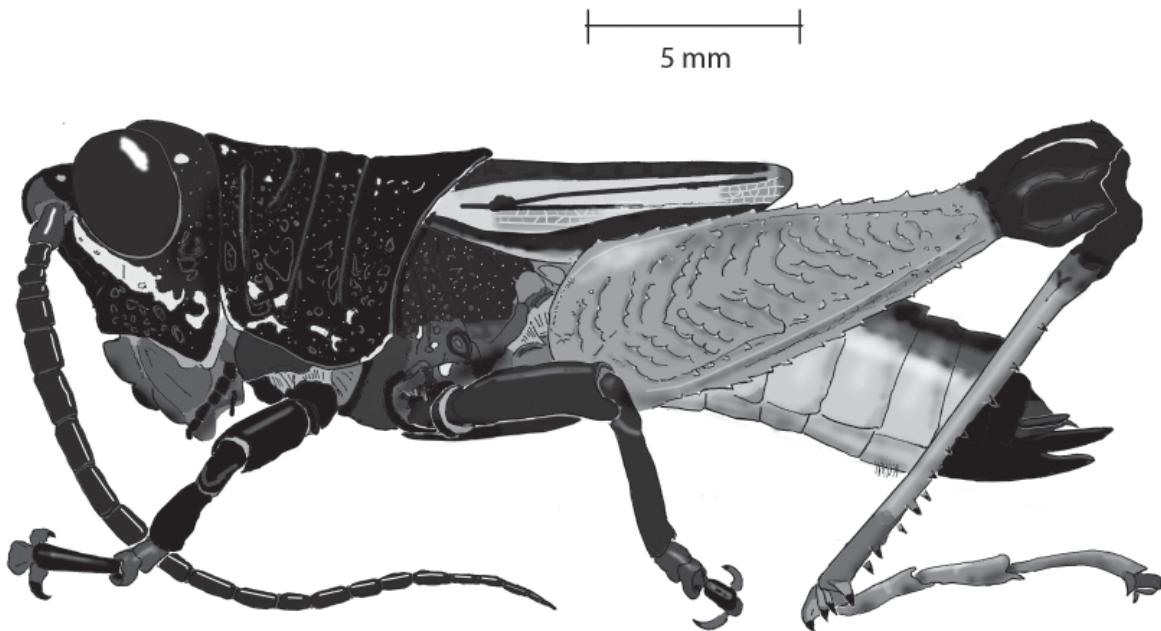


Fig. B34. *Nautia atrata*, female holotype, habitus.

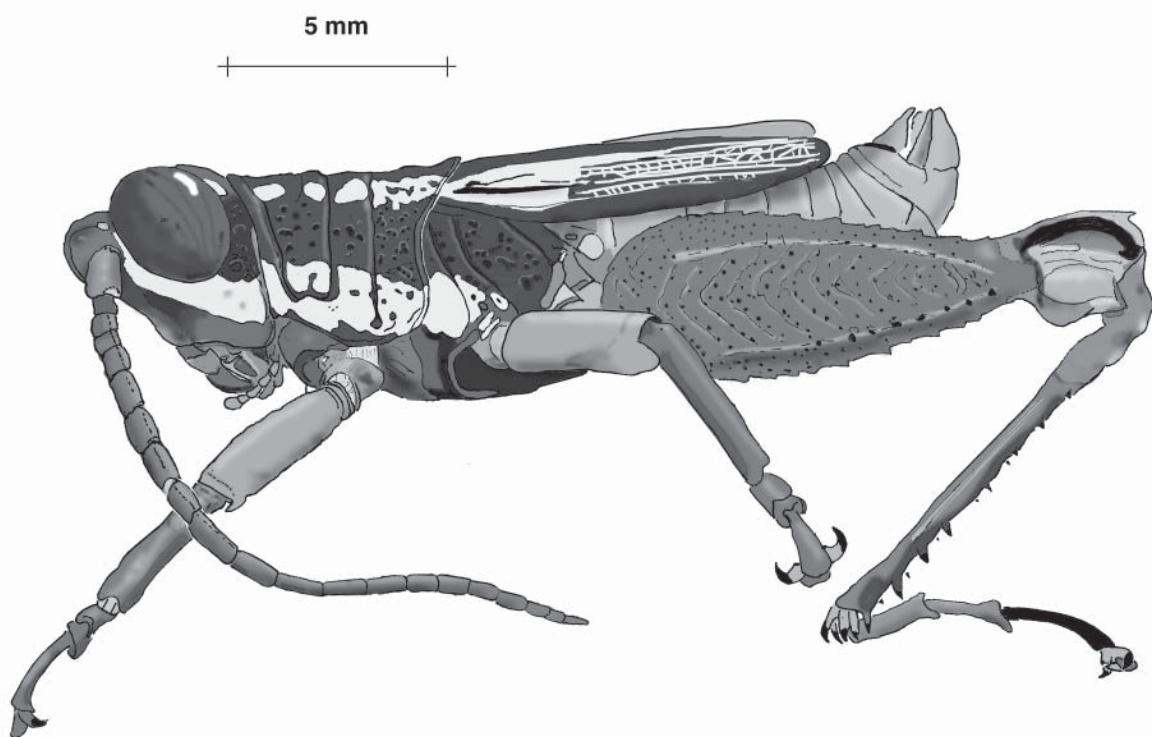


Fig. B35. *Nautia conspersipes*, male habitus.

4. *Nautia crassipes* Descamps 1978

Descamps 1978: 416.

Type locality: PANAMA: Canal Zone, Gatún.
Location of type specimen: ANS Philadelphia.**Known range.**

Central and Eastern Panama, SW Costa Rica.

Etymology.Latin *crassus*, thick, *pes*, foot. Presumably refers to the hind femora.**Diagnosis.**

Hind femora green with no dark spotting. Hind knees black. Lower ovipositor valves nearly as long as upper ones (Fig. B32-2).

6. *Nautia panamae* Descamps 1978

Descamps 1978: 416.

Type locality: PANAMA: Canal Zone, Barro Colorado Island.
Location of type specimen: USNM Washington (holotype female).**Known range.**

Central and Eastern Panama. Not to date recorded from Costa Rica.

Diagnosis.

Clear green hind femora, unspotted. Hind knees black. Lower ovipositor valves only half the length of upper valves (Fig. B32-3).

5. *Nautia flavosignata* Stål 1878

Stål 1878: 87.

Type locality: PANAMA: (no other data).

Location of type specimen: NHM Vienna (holotype female).

Known range.

Panama, Costa Rica.

Etymology.Latin “*flavosignata*”, marked with yellow, referring to the patterning of the pronotum (a generic rather than a specific attribute).**Synonymy.**= *N. flavomarginata* Stål 1878: 87.

Kirby 1910: 389.

Descamps 1978: 415 (synon. of *flavosignata*).= *Oedelometopon petasatum* Rehn 1905: 418.Bruner 1900-1910 (1907): 243 (transfers to *Nautia*).

Roberts 1973: 58.

Descamps 1978: 415 (synon. of *flavosignata*).**Subsequent literature.**

- Hebard, M. 1924: 107.
- Roberts, H.R. 1973: 57.
- Descamps, M. 1978: 415.

Diagnosis.

Hind femora green, often finely spotted with black. Hind knee pale brown, knee arches black. See Key To Species for more detail.

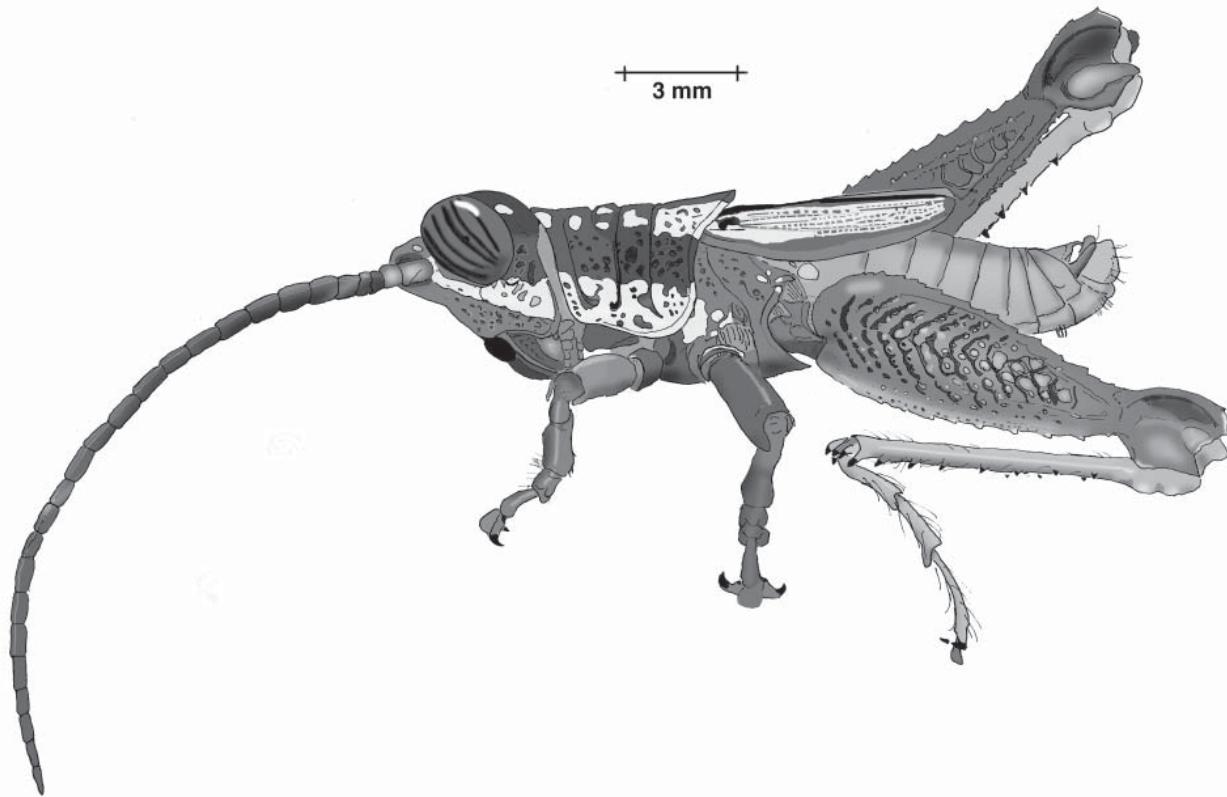
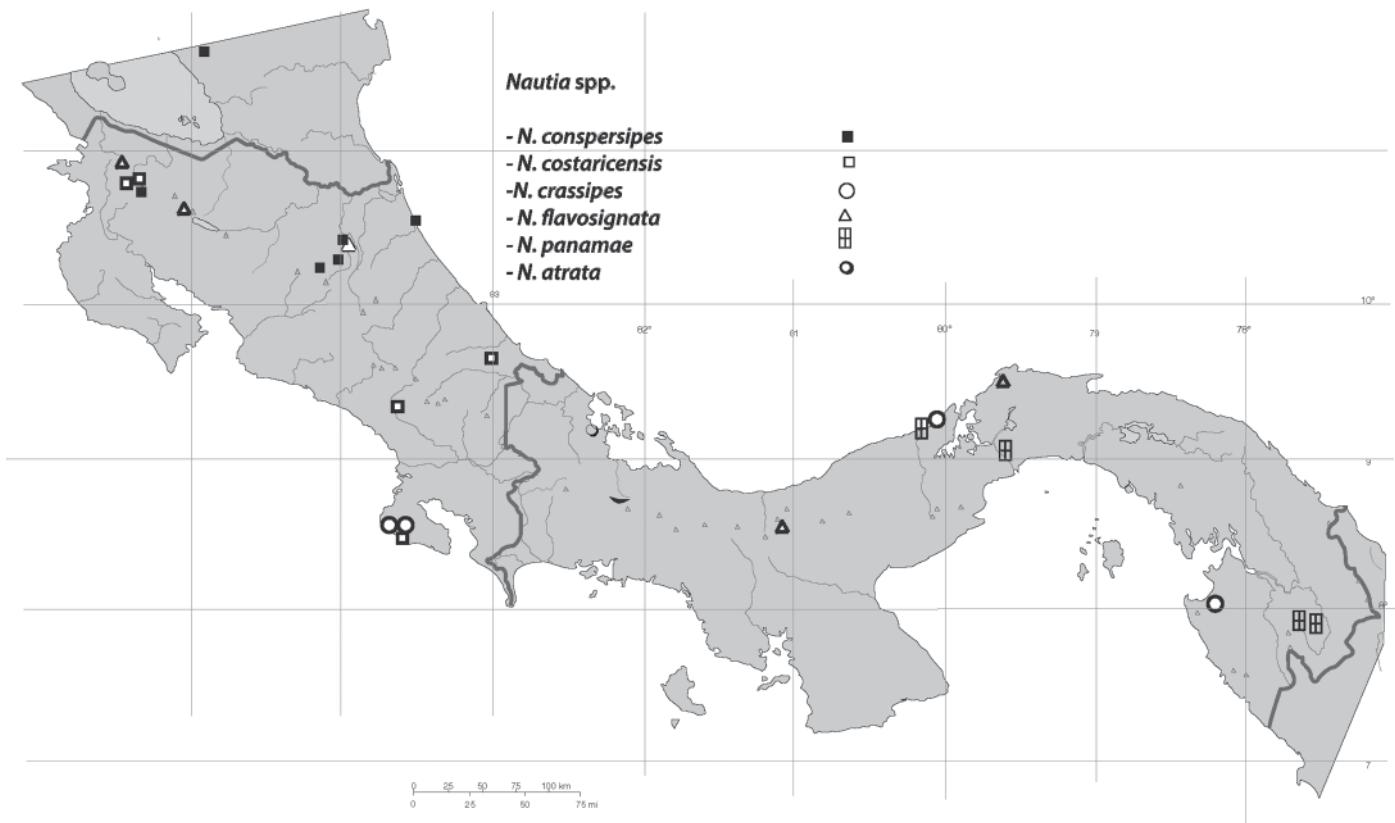


Fig. B36. *Nautia costaricensis*, male habitus.



Map B9. Distribution of *Nautia* spp. in Costa Rica and Panama.

Subtribe Lagarolampae

Descamps 1978

Diagnosis.

All members of this subtribe are atympanate, micropterous or brachypterous, and the interocular space is very narrow, less than the width of the antennal flagellum. Antennae usually filiform. Male cerci styliform. The valves of the ovipositor are of the usual acridoid form, suggesting that the eggs are laid in the ground, as indeed is known to be the case in the genus *Zoumolampis* (pers. obs.). In the other ophthalmolampine subtribes the valves are more or less elongate, possibly suggesting epi- or endophytic rather than subterranean oviposition.

No. included genera.

Seven (*Elutrolampis*, *Habrolampis*, *Hekistolampis*, *Helolampis*, *Inbiolampis*, *Lagarolampis*, *Tikaodacris* and *Zoumolampis*). In our area, three.

Range of genus.

Brazil, Peru, Ecuador, French Guiana, Colombia, Panama, Costa Rica, Nicaragua, Honduras.

Lagarolampis

Descamps 1978

Descamps 1978: 386.

Type species: *Lagarolampis amazonica* Descamps 1978: 387.

Type locality: COLOMBIA: Putumayo, Río Mocoa, 500m.

Location of type specimen: MNHN Paris.

Known generic range.

Amazonian Peru, Ecuador, Colombia, Panama, Costa Rica.

No. known species.

Six. In our area, three.

Subsequent literature.

- Rowell, C.H.F. 1999: 307-324. > New spp.

Diagnosis.

Male supra-anal plate ornamented with paired melanized bosses. Most species of the genus have green abdomen and legs, with the head and pronotum (and sometimes pterothorax and basal abdominal segments too) black and bearing a variable number of white dots. *L. gamboensis* is the exception, being green and purple in coloration. Antennae are red in all Central American species.

Natural history.

Lagarolampis spp. appear to be mostly rather rare members of the forest understorey fauna. At Fort Sherman, Canal Zone, Panama, however, *L. gamboensis* is also found in the canopy (Rowell, pers. obs.; L. De Gracia, pers. comm.) and this may prove to be true of other species too. Foodplants unknown.

Key to Central American species of *Lagarolampis*.

I	Head and pronotum black with white markings.	..... 2
IA	Head and pronotum green and purple.	..... gamboensis
2	Thoracic epimera and episterna and 1st abdominal segment green. White spots on ventral pronotal lobes confluent.	..... cararensis
2A	Thoracic epimera and episterna and 1st abdominal segment black with white markings. White spots on ventral pronotal lobes discrete.	..... maculata

1. *Lagarolampis cararensis* Rowell 1999

Rowell, 1999: 309.

Type locality: COSTA RICA: Puntarenas Prov., Res. Biol. Carara, 25 m.

Location of type specimen: ANS Philadelphia.

Known distribution.

Costa Rica; Pacific slope humid lowland forest S. of Rio Grande de Tárcoles.

Diagnosis.

Habitus **Fig. B37, Plate B23**. Only head and pronotum black. Lower spots on pronotal lobes confluent, forming a continuous white band. Tegmina sexually dimorphic, being relatively much smaller in the male.

Natural history.

Known only from the type specimens, which were copulating in the understorey of primary forest, about 1.5 m from the ground.

2. *Lagarolampis gamboensis* Rowell 1999

Rowell, 1999: 318

Type locality: PANAMA: Colón, Gamboa, Pipeline Rd, 100-200 m. Location of type specimen: ANS Philadelphia.

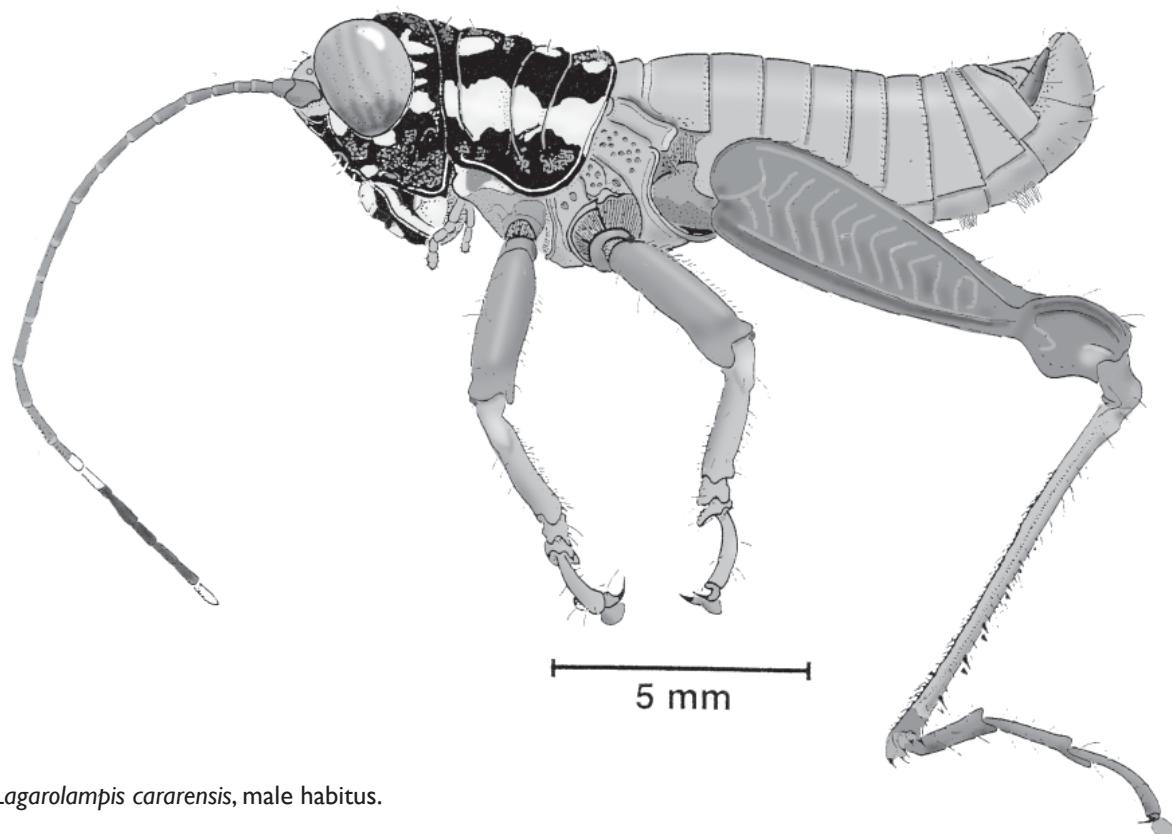


Fig. B37 *Lagarolampis cararensis*, male habitus.

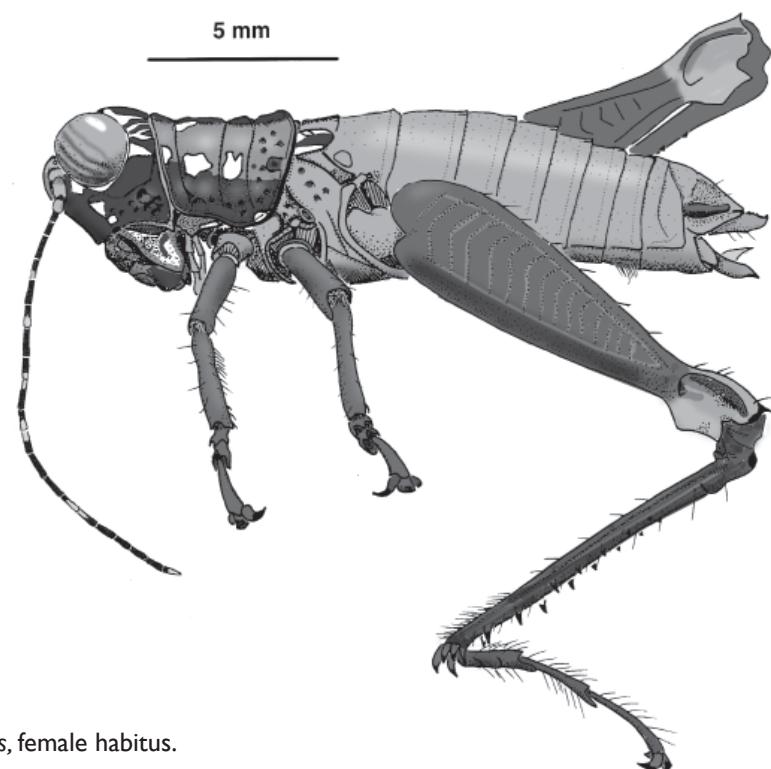


Fig. B38. *Lagarolampis gamboensis*, female habitus.

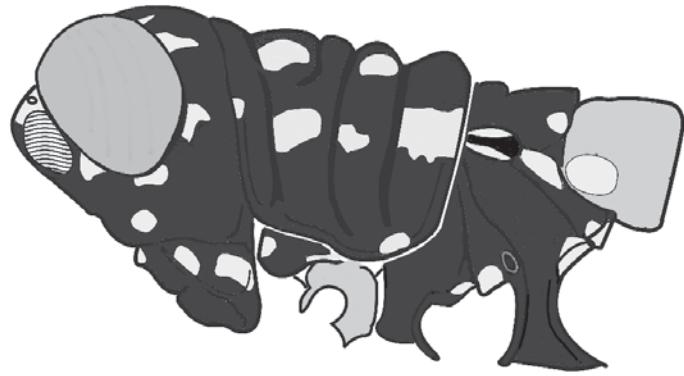
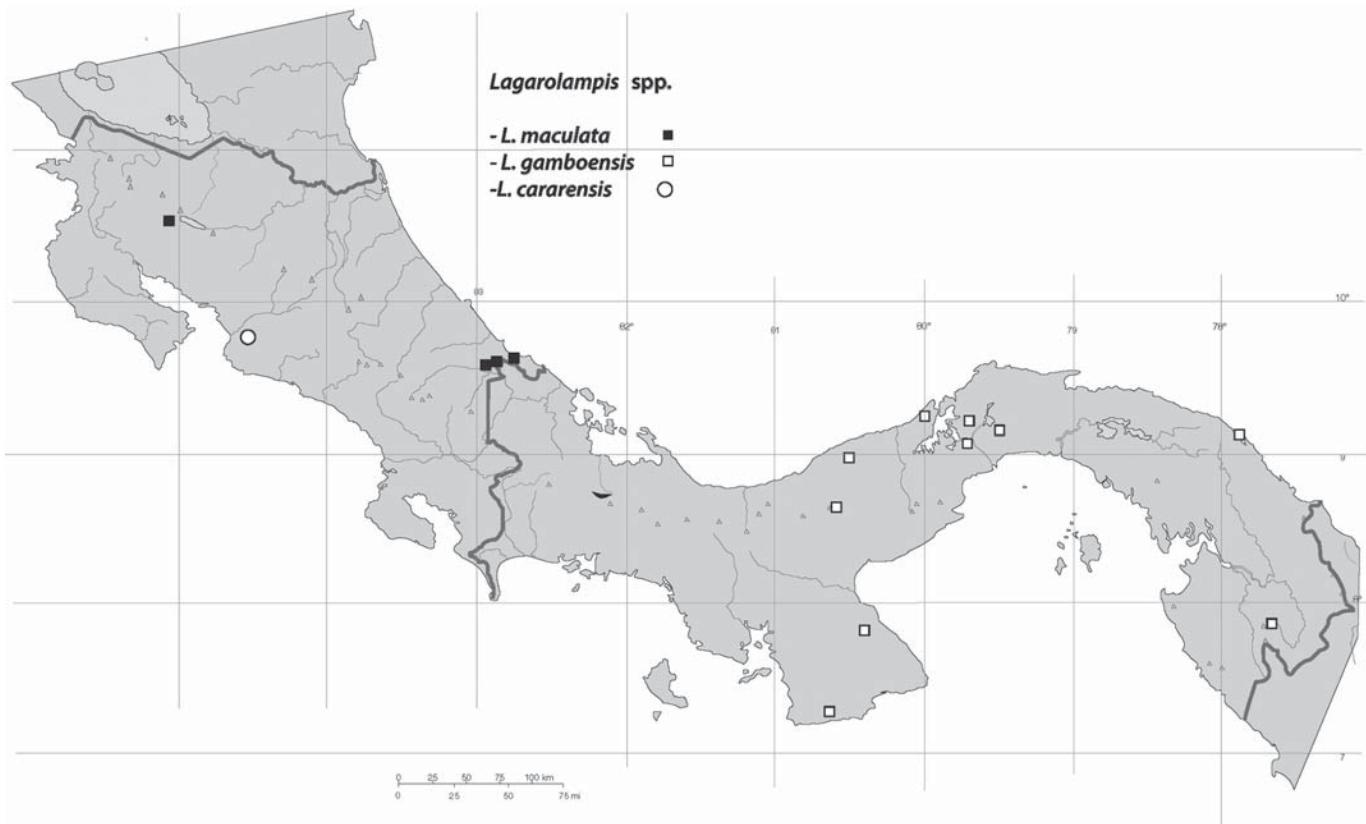


Fig. B39. *Lagarolampis maculata*, male head and thorax, lateral view, to show distribution of light spotting. Compare with **Fig. B37**. The cross hatched area in front of the eye is the antennal socket..



Map B10. Distribution of *Lagarolampis* spp. in Costa Rica and Panama.

Etymology.

Latin *gamboensis*, coming from Gamboa.

Habitus Fig B38, Plate B24. The patterning of light and dark areas is similar to other species of the genus, but their black and white is here replaced by purple and green.

Known distribution.

PANAMA: Veraguas, Colón, Comarca Kuna Yala, Darién.

Map B10.**Natural history.**

Occurs in varied forest types, from ground level to the top of 70 m. canopy trees, as shown by observations from a research crane (Rowell, pers. obs.). This suggests a generalist feeding strategy. Epiphytes, the other possible explanation, were rare in the crane-accessed forest.

3. *Lagarolampis maculata* Rowell 1999

Rowell, 1999: 315.

Type locality: COSTA RICA: Guanacaste, Río Naranjo, Hacienda Montezuma, 500 m. asl.

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *maculata*, spotted.

Known distribution.

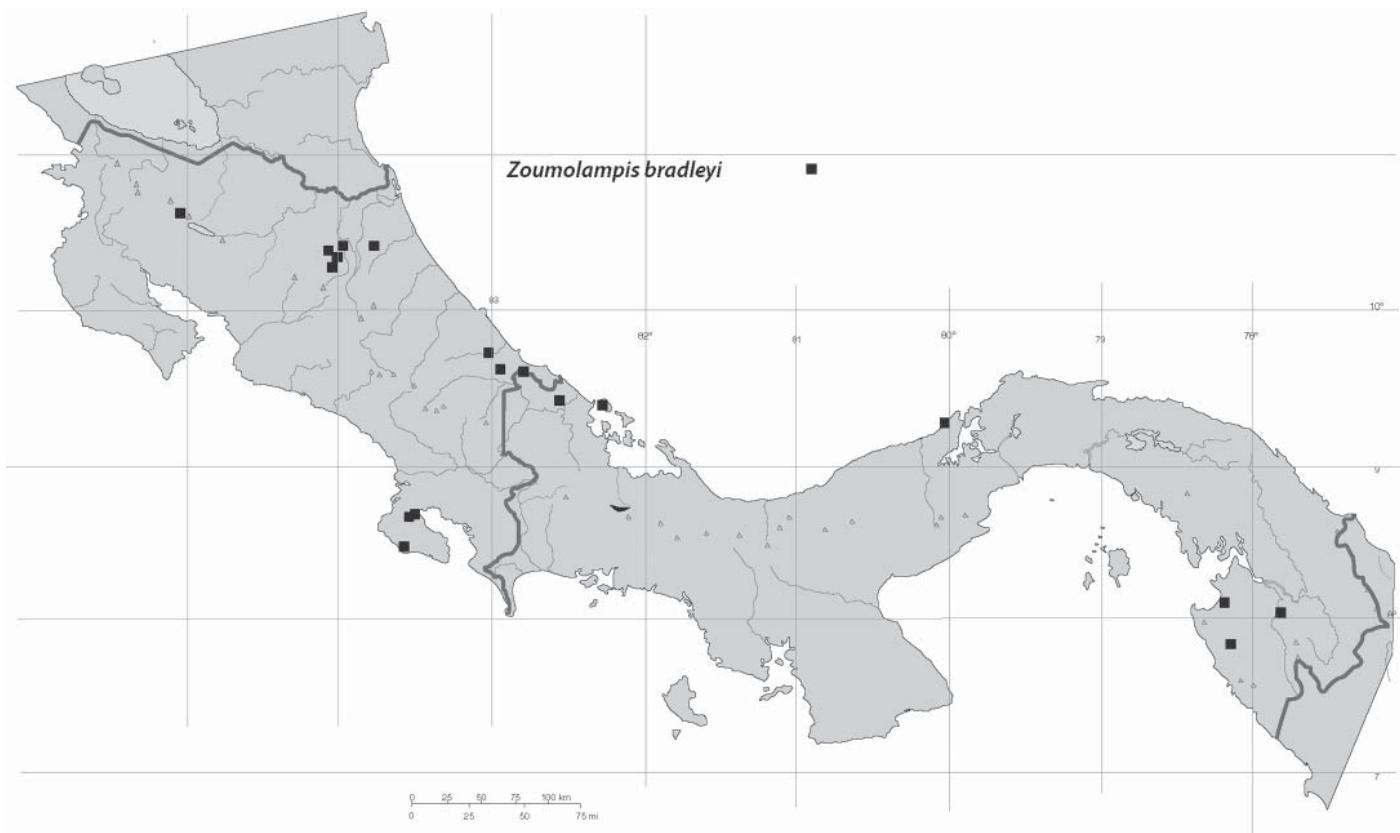
Costa Rica; entire Caribbean slope forest up to 1000 m, extending slightly over continental divide at the type locality. Not as yet recorded from Panama. **Map B10.**

Diagnosis.

Head, pronotum, pterothorax, tegmen and first abdominal tergum black. White spots discrete, not confluent. Tegmina not sexually dimorphic. See **Fig. B39, Plate B25.**

Natural history.

Larvae live in groups on the foodplant(s?), which include at least the tree *Cordia aliodora* (Boraginaceae). The degree of food-plant specificity is not known.



Map B11. Localities of *Zoumolampis bradleyi* in Costa Rica and Panama.

Zoumolampis
Descamps 1978

Descamps 1978: 397.

Type species: *Ophthalmolampis bradleyi* Rehn 1929

No. of known species.

One. In our area, I.

Generic range.

Honduras to Panama. In Panama, extends from the western border east to Darién.

Etymology.

Obscure. Greek *zoma* is a belt or girdle, but doesn't seem very apt. Perhaps refers to the striped elytron?

Diagnosis.

Unique among Central American bactrophorines in having pink, black and white "candy-striped" tegmina and, in the male, long paired medial processes on the 8th abdominal tergite and small paired processes on the rim of the subgenital plate (Figs B40 & B41, Plate B26).

Diagnosis.

Habitus Fig. B40, Plate B26. Antennae blue or pink, eyes (in life) dove grey with black pseudopupil, head green. Postocular stripe variously developed, can be black or dark green with a white edging, as illustrated. Pronotal disc green, the margins ornamented with lateral swellings between the sulci. Pronotal lobes, thorax, abdomen, legs, green. Hind knees marked with black; hind femur with black dots on both internal and external faces. As noted by Descamps (1978), coloration is very variable over the geographical range of the species. Northern individuals have fewer dark markings, and the black stripe on the otherwise pink and white tegmen may be completely absent.

Natural history.

A canopy dweller. Females often found on ground or are caught in terrestrial Malaise traps during or after egg laying, but males are taken only after storms or by insecticide fogging of the canopy. Foodplant unknown, but in Caribbean Costa Rica both adults and larvae frequently found in *Pentaclethra* trees (Mimosaceae).

I. *Zoumolampis bradleyi* (Rehn 1929)

Rehn 1929: 10, as *Ophthalmolampis bradleyi*.

Type locality: COSTA RICA: Prov. Limón, Suretka Trail (between the valleys of the Ríos Sixaola and Estrella).

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Liebermann, J. 1945e: 8.
- Roberts, H.R. 1973: 58.
- Descamps, M. 1978: 397. > Transfers to *Zoumolampis* n.g.

Etymology.

Named for the collector of the female holotype, Dr. J. Chester Bradley (1884-1975), Professor of Entomology at Cornell University. He wrote the Preface to the 1st edition of the International Code of Zoological Nomenclature, 1961, and was a President of the Entomological Society of America.

Known distribution.

Honduras, Nicaragua, Costa Rica, Panama; entire Caribbean slope forest below 1000 m. In Costa Rica extends over continental divide in N. Guanacaste Prov. and in the Osa Peninsula, and also found near the Pacific coast of Panama in Darién. Map B11.

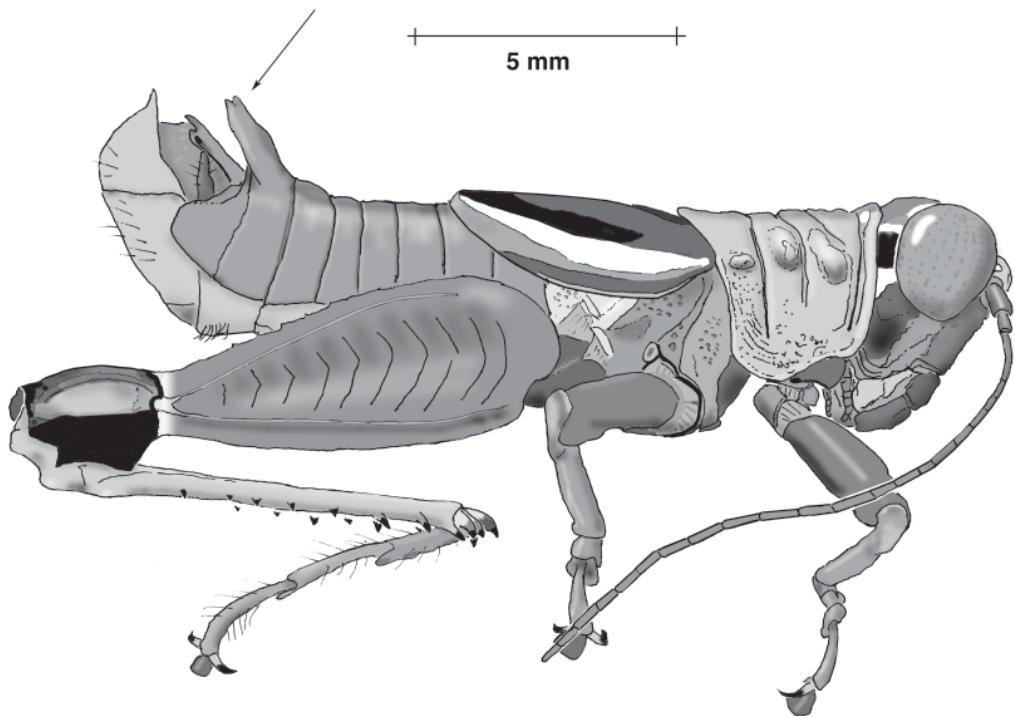


Fig. B40. *Zoumolampis bradleyi*, male habitus. The arrow marks the paired projections of tergite Ab8.

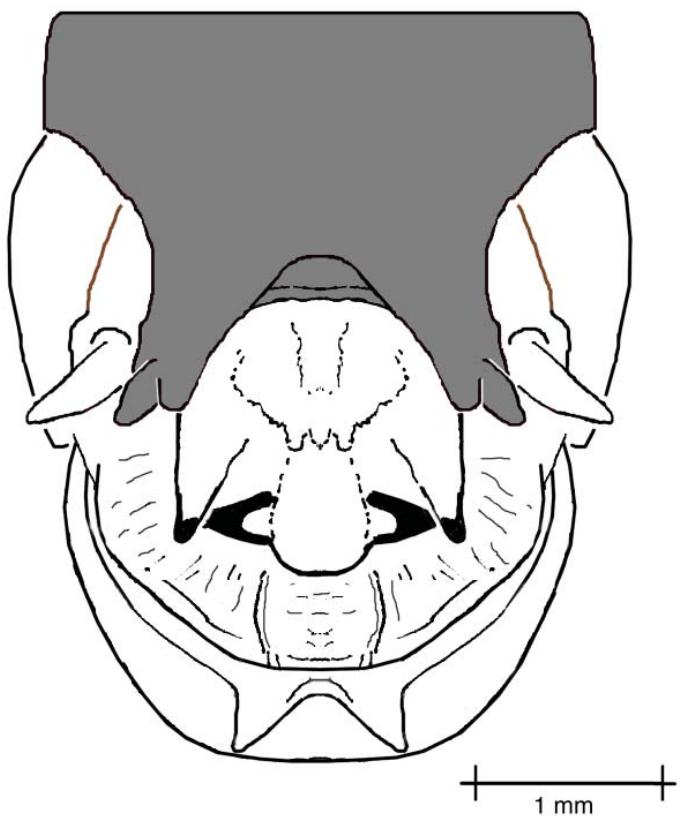


Fig. B41. *Zoumolampis bradleyi*, male terminalia, dorsal view. The 8th abdominal tergite is shaded.

Inbiolampis
Rowell 2012

Type species: *Inbiolampis herediensis* Rowell 2012.

Etymology.

Generic and specific name derived from INBio, the abbreviation for the Instituto Nacional de Biodiversidad of Santo Domingo de Heredia, Costa Rica, in recognition of their valuable work in surveying the insects and other organisms of that country. The unique type specimen derives from their collecting.

Diagnosis.

Typical Lagarolampan genus; the subtribal definition applies. Habitus, **Fig. B42, Plate 27.** Alate but brachypterous, atympanate. Fastigium short, transverse, and downwards slanting. Frontal ridge, well developed and parallel sided above medial ocellus, increasingly obsolete below the ocellus. Integument of frons, vertex and genae densely pitted. Antennae filiform, shiny black, length unknown (broken in specimen).

Pronotum cylindrical, lateral and medial carinae absent. Metazona shorter than (61% of) prozona. Four narrow pronotal sulci, all but the most anterior cross the disc. All surfaces of pronotum, except in the cream coloured lateral stripe, heavily pitted. Anterior and posterior margins of pronotal disc weakly produced, bluntly rounded; anterior margin slightly notched in the midline. Prosternal process massive, subconical, with a bluntly round tip. Mesosternal interspace about as wide as long, definitely not longitudinal. Metasternal lobes almost but not quite touching. Integument of meso- and metathoracic pleura pitted. Ventral margins of metathoracic episterna and epimera slightly produced and outwardly flared. Tegmina overlap in the dorsal midline, and extend onto the third abdominal tergite. Hind femora slightly exceed the tip of abdomen, 3.5 times longer than their maximal width. Dorsal and ventral carinae weakly serrate, the dorsal carina more so. Dorsal medial carina ends in a small spine on the knee. Ventral external lobe of knee pointed, and directed slightly downwards. Tibia with eight external and internal spines (including terminal spines). Interior tibial spurs much longer than external ones. Foot slightly more than half as long as tibia. Second tarsal segment longer than first segment, but shorter than the third and most distal one; foot formula 27:31:43.

Abdominal tergites devoid of a medial carina, tergites 9 and 10 fused. Supra-anal plate (**Fig. B43**) triangular, with a smooth dorsal surface and rounded tip; the extreme posterior margins slightly thickened. Ovipositor valves long and slender, but stylet-, not rod-like (i.e. laterally compressed, not circular in cross section). Dorsal face of superior valves and ventral face of inferior valves concave, tips pointed and in profile very slightly hooked. Subgenital plate with a simple triangular posterior margin converging on the base of a slender pointed egg guide, inclined upwards at about 30-40°. Cerci simple, conical, and curved slightly outwards.

Male unknown. Were it found to have a specialised 8th abdominal tergite, the genus should probably be incorporated into a redefined *Zoumolampis*.

I. *Inbiolampis herediensis* Rowell 2012

Rowell 2012b: 291.

Type locality: COSTA RICA: Prov. Heredia, P.N. Braulio Carrillo, Estación El Ceibo.

Location of type specimen: INBio.

Diagnosis.

Female. Habitus, **Fig. B42, Plate 27.** The generic description applies. Small to medium in size (L = 20.2 mm).

Coloration. Head apart from mouthparts mostly black, fastigium and basal antennal segments green. Antennal flagellum black. Frons greenish black, with small white patches just above the extremities of the frontoclypeal suture. Labrum and palps green, lateral areas of mandibles whitish. Eyes protuberant, drying brown (colour in living animal unknown). Postocular stripe white or cream, slanting downwards to the rear.

Pronotum dorsally black, lateral lobes black tinged with green. Postocular stripe continued as a narrow white or cream stripe across lateral lobe, and almost to the tip of the otherwise purple-red tegmen. The wing is about half the length of the tegmen, and similarly purple in colour. All legs green; hind knee reddish, except for a large green patch on the ventral outer lobe. Tibia green, hind feet red. Abdomen green, with brown shading on dorsal tergites.

Natural history.

Unknown; members of the subtribe typically inhabit understorey trees or bushes in wet forest, which well describes the site of capture of the type specimen. The relatively long second tarsal joint of the hind foot suggests an arboreal way of life.

Distribution.

Known only from the type locality, in Caribbean slope forest on the northern foothills of the Cordillera Central, Costa Rica. **Map B12.**

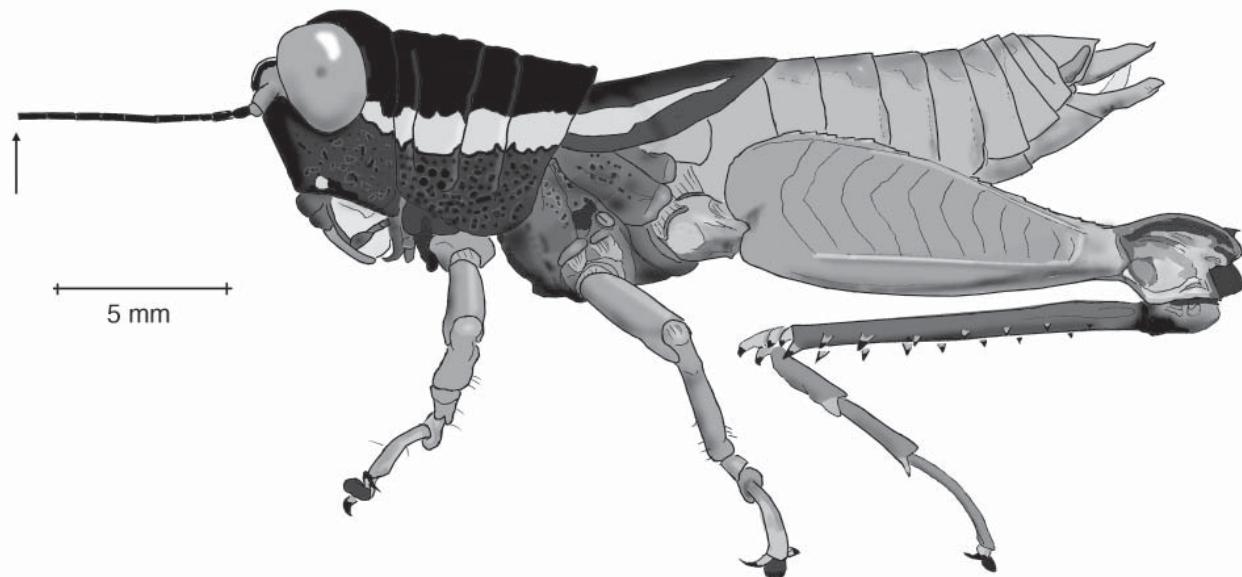


Fig. B42. *Inbiolampis herediensis*, female habitus. The arrow marks the broken antenna of the holotype.

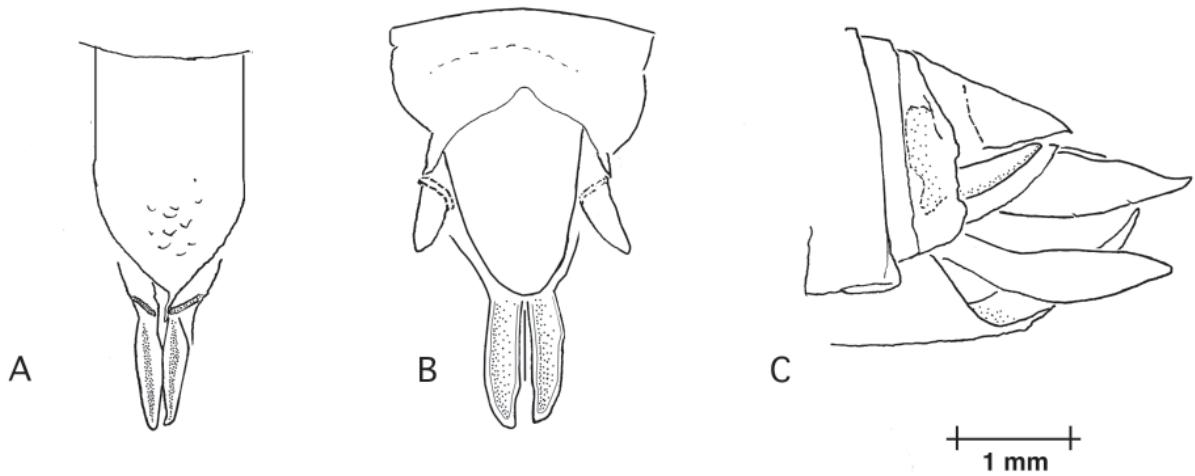


Fig. B43. *Inbiolampis herediensis*, female terminalia. A, ventral. B, dorsal. C, lateral view.



Map B12. *Inbiolampis herediensis*, type locality.

Family Acrididae

Macleay 1821

Most (about 65%) of living grasshoppers belong to this family, which shows great structural, ecological and behavioural diversity.

The name of the family goes back to the higher taxa *Acridina* (Macleay 1821), *Acridites* (Latreille 1825), and *Acridodea* (Fieber 1844). The modern form *Acrididae* was first used by Siebold in 1848.

Diagnosis.

The Acrididae have a history of being used as a receptacle for taxa that do not fit the definition of other, smaller groups with well defined characters. Recently Eades (2000) has proposed a strict definition based on male internal genital structure. This definition has the disadvantage of excluding a few small Old World groups that have no obvious family connection elsewhere, but has the advantages of clarity and brevity, and applies to all New World taxa. Eades defines the Acrididae as acridoid grasshoppers having in their phallic complex a well-developed arch sclerite (devoid of the lateral extensions seen in the similar structure in the Old World Charilaidae). No other group of New World grasshoppers has a comparable structure. In the Acrididae this sclerite is basal to the dorsal aedeagal valves. In the female, the preapical diverticulum of the spermatheca is always present and usually well developed.

There are no external characters which by their presence define the Acrididae; for the Central American fauna one can merely say that Acrididae are those acridoid grasshoppers which do not have not have the external characters defining the Romaleidae or Pyrgomorphidae; especially, they lack the external terminal spine of the hind tibia. Only two of the New World subfamilies include taxa that stridulate (Oedipodinae, Gomphocerinae), the other subfamilies are all silent.

The Acrididae world-wide are divided into approximately 30 subfamilies, 11 of which occur in our area:

- Acridinae
- Cyrtacanthacridinae
- Copiocerinae
- Gomphocerinae
- Leptysminae
- Melanoplinae
- Oedipodinae
- Ommatolampiniae
- Pauliniinae
- Proctolabinae
- Rhytidochrotinae

As their order of evolution has not yet been

determined, these are treated alphabetically in the following chapters of this book.

Artificial key to subfamilies of the Acrididae in southern Central America, based on external characters only.

(Note, this key will not work in other regions!)

(Genital characters are given later for each subfamily.)

I	Prosternum devoid of medial process. Femuro-elytral stridulatory mechanism often present.	2
IA	Prosternum with a medial spine, boss or protuberance between the coxal openings. Femuro-elytral stridulatory mechanism absent	..... 4
2	Tip of elytra obliquely truncate. No stridulatory apparatus present. Antennae more or less ensiform	..... Acridinae
2A	Tip of elytra rounded. Stridulatory apparatus usually present on elytron and hind femur. Antennae usually filamentous.	..... 3
3	Stridulatory apparatus usually (but not always) present, consisting of supernumerary serrated vein in radial area of elytron and a scraper edge on inner surface of hind femur. Hind wings usually with a darker marginal band, proximal area often yellowish or pink. (If stridulatory apparatus absent, hindwings red basally and hind tarsi banded with red and black (<i>Heliaustus sumichrasti</i>)).	..... Oedipodinae
3A	Stridulatory apparatus usually (but not always) present, consisting a row of small pegs on lower inner face of hind femur and a sharpened radial vein on the elytron. Hind wings usually clear or somewhat smoky, never with a marginal dark band	..... Gomphocerinae
4	Anterior face of compound eyes, lateral ocelli and tip of fastigium lie almost in the same transverse plane when viewed dorsally. Antennae threadlike. Lateral carinae of pronotum completely absent; alate or brachypterous. Hind tibiae and tarsi markedly flattened dorsoventrally to form a paddle-like structure for swimming. Male subgenital plate truncate, ovipositor valves weak.	..... Pauliniinae
4A	Insect not as above	..... 5
5	Male cerci abruptly angled in side view, the distal portion running vertically; always alate. Usually elongate slender insects, with distal portion of hind femora slightly flattened dorsoventrally.	..... Leptysminae
5A	Male cerci not as above.	..... 6

- 6** Pronotum short, leaving tergites of metathorax exposed.
Apterous insects, usually small, and in our area usually
without a functional tympanum.
..... **Rhytidochrotinae**
- 6A** Pronotum covers tergites of metathorax **7**
- 7** Male subgenital plate produced posteriorly and deeply
cleft medially. Large alate insects, with a long, usually
pointed, prosternal spine (genus *Schistocerca*).
..... **Cyrtacanthacridinae**
- 7A** Male subgenital plate not as above **8**
- 8** Male subgenital plate not cup-like. Male cercus with
medially directed basal apodeme, or if this absent, then
forked at tip in lateral or dorsal view.
..... **Ommatolampinae**
- 8A** Male subgenital plate cup-like, open dorsally **9**
- 9** End of male abdomen not inflated. Pallium normal. Male
cerci simple. Elongate insects associated with palms
..... **Copiocerinae**
- 9A** End of male abdomen inflated. Male cerci frequently of
complex form. Pallium thickened, wrinkled.
..... **10**
- 10** Fastigium terminates in a thickened transverse ridge
which separates it from frontal ridge (or, if ridge absent,
small micropterous insects with dark blue or green
iridescent coloration and melanized, inwardly flexed
male cerci [genus *Lithoscirtus*]). Alate, brachypterous or
micropterous. Face in profile flat or concave. Second
tarsal segment of hind foot long (>20% of foot).
..... **Proctolabinae**
- 10A** Fastigium not as above. Alate or brachypterous, but
not micropterous. Face convex in profile. Second hind
tarsal segment short (<20% of foot).
..... **Melanoplinae**

Subfamily Acridinae

MacLeay 1821

The Acridinae are a large and probably polyphyletic assemblage of acridid grasshoppers of world-wide distribution. Almost all are specialists on Poaceae (=Gramineae). Molecular systematics indicates that the best defined clade comprises the African members of the subfamily, but the relation of these to other Acridinae is not well understood.

Diagnosis (New World taxa only).

Prosternal process absent. The Acridinae are defined principally by the absence of characters typical of the other acridid subfamilies that also lack a prosternal process; especially, they have no stridulatory mechanism. It can therefore be difficult to distinguish them from members of the Gomphocerinae or Oedipodinae which have secondarily lost their femoral/elytral stridulatory specialisations. The internal and external genitalia are not distinctive, being similar to those of the Gomphocerinae.

In our region, the group comprises only two genera belonging to the New World tribe Hyalopterygini. However, there are both morphological and molecular systematic grounds for believing that this tribe is in fact most closely allied to the tribe Orphulellini of the Gomphocerinae, and is not closely related to any of the Old World acridines (see below).

Tribe Hyalopterygini

Brunner von Wattenwyl 1893

Type genus: *Hyalopteryx* Charpentier 1843.

Diagnosis (after Otte 1981).

Prosternal spine absent. No stridulatory mechanism. Hind wings of male with a speculum of enlarged cells in the cubital area (**Fig. A1**), the origin of the name *Hyalopteryx* = greek “Glassy wing”. In Central American taxa, the antennae are at least somewhat ensiform, and the elytra are obliquely truncate.

Otte (1981) raised the possibility that the Hyalopterygini could be of gomphocerine origin, merely having lost the femoral stridulatory organ. This hypothesis is supported by 1) the similar structure of the hind wing of the males (the enlarged cells of the speculum are created in exactly the same way as in the gomphocerine Orphulellini, by the shortening of Cu1 and the displacement forwards of M, so creating a large space between M and Cu2 (compare **Figs A1 and A6 with Fig. G26**), 2) the details of the internal male genitalia, especially the trituberculate epiphalllic lophi, and 3) the clustering of *Metalepta* with *Orphulella* in analyses of gene sequences for mitochondrial RNA.

No. of genera included.

Seven. In our region, two.

Range of tribe.

Argentina to south-eastern Canada. Most of this range is however due to a single genus, *Metalepta*. The great majority of genera and species are local and South American.

Metalepta

Giglio-Tos 1897

Brunner von Wattenwyl 1893: 118.

Giglio-Tos 1894: 22.

Bruner 1895: 63.

Giglio-Tos 1897a: 2 (as *Metalepta*).

Giglio-Tos 1897b: 22.

Brunner von Wattenwyl (1893) created the genus name without designating a type species. Bruner (1895) used *Metalepta* (sic) with *notochloris* (Palisot de Beauvoir), and Giglio-Tos (1894) with *brevicornis* (Linn)

Type species: *Gryllus brevicornis* Linn 1763.

Type locality: America.

Location of type specimen: lost.

Etymology.

Greek *metalepteon*, changed completely; the relevance to this taxon is obscure to me.

Subsequent literature.

- Bruner, L. 1900-1910: 35. > As *Truxalis*.
- Kirby, W.F. 1910: 103. > As *Truxalis*.
- Gurney, A.B. 1940: 92. > Redesignates type species.
- Rehn, J.A.G. 1944b: 222. > Recognises 2 spp., *b. brevicornis* and *b. adspersa*.
- Jago, N.D. 1971: 205, 215.
- Amedegnato, C. 1974: 202.
- Otte, D. 1981: 216, 227.
- Donato, M. & Cigliano, M.M. 2000: 145-173. > Review of genus; redescription; raises *adspersa* to specific rank.

Generic diagnosis.

[Modified after Otte (1981) and Donato & Cigliano (2000).]

Medium-large, F_{male} 12-18 mm, F_{female} 17-25 mm. Sexual dimorphism marked, 0.71:1. Antennae subensiform. Fastigium elongated, shallowly excavated, apex rounded, with a median ridge extending back to level of eyes, lateral foveolae absent. Frontal ridge with deep V-shaped groove. Sides of pronotum parallel, pronotal disc flattened and rectangular, posterior margin slightly angulate; median carina present, cut by the main (3rd) sulcus; lateral carinae present, subparallel or diverging slightly towards the rear, cut by two (the 2nd and 3rd) sulci. Hind femora elongate, hind knees with somewhat rounded upper and pointed lower lobes, upper lobes longer. Hind tarsi with 12 exterior and 13-14 interior spines. Medial and lateral tarsal spurs subequal, inner spurs twice as long as outer ones.

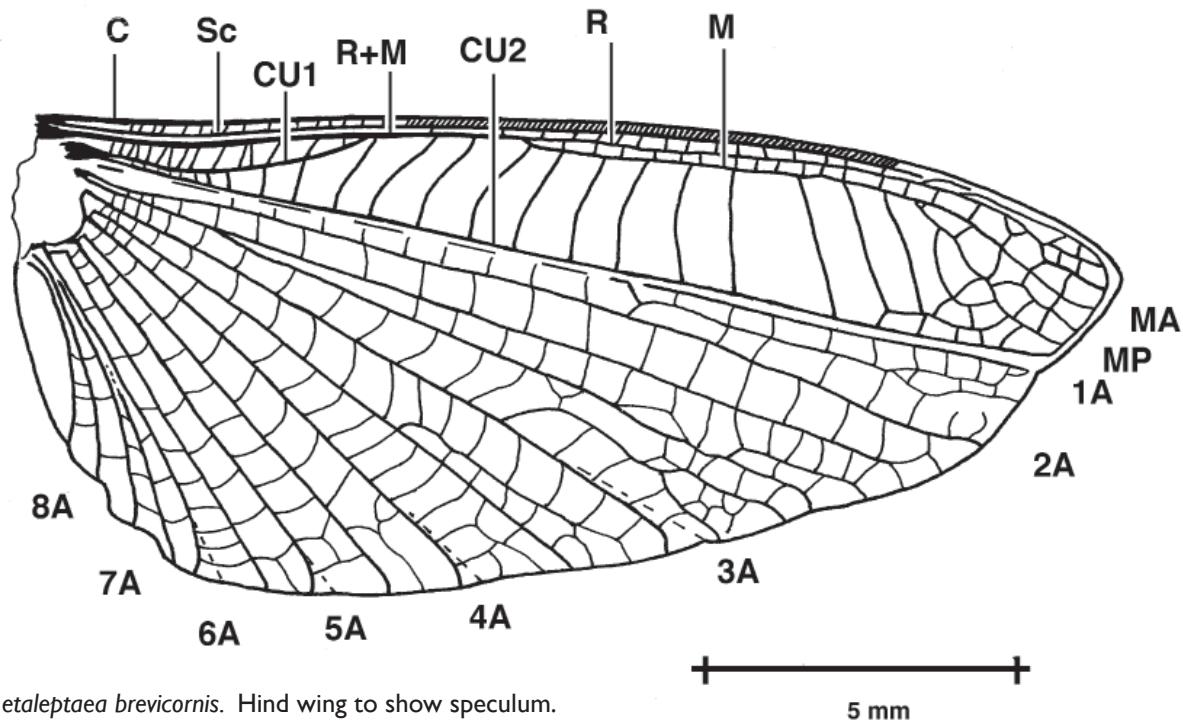


Fig.A1. *Metalepta brevicornis*. Hind wing to show speculum.

Elytra obliquely truncate at tip, pointed at extremity. Hind wing of male with a speculum of 9-14 enlarged cells in cubital area (**Fig.A1**), yellow green proximally, clear or brownish distally. Male subgenital plate conical and pointed.

Phallic complex. Epiphallus with trituberculate lophi, fenestrated, posterior processes angular, anterior processes rounded and projecting dorsally; ancorae pointed, inwardly curved; bridge narrow; oval sclerites present. Ventrolateral sclerites present, only lightly sclerified. Apodemes of cingulum broad in dorsal view, subparallel, rami small. Arch of cingulum robust; dorsal valves of aedeagus as wide or wider than ventral valves in lateral view, both pairs of valves tilted upwards at about 70°. Endophallic plates wide in lateral view, with a small posterior projection on the dorsal surface. Flexure narrow. Gonopore processes narrow, nearly vertical.

Female subgenital plate rounded, pointed or trapezoid. Spermatheca with pre-apical diverticulum, longer than the apical sac.

No. species known.

Two. In our region, 2.

Range of genus.

Argentina to Ontario, Canada.

1. Metalepta brevicornis (Linn 1763)

Gryllus brevicornis Linn 1763: 398.

Type locality: North America.

Location of type specimen: lost.

Etymology.

Latin *brevicornis*, short-horned. The antennae are not especially short, but their ensiform shape may give them that appearance.

Subsequent literature.

- Fabricius, J.C. 1775: 279. > Transfers to *Truxalis*.
- Thunberg, C. 1815b: 224. > As *Truxalis brevicornis*.
- Burmeister, H. 1838: 607. > As *Tryxalis brevicornis*.
- Walker, F. 1870: 500. > Transfers to *Pyrgomorpha*.
- Thomas, C. 1873: 67. > As *Pyrgomorpha brevicornis*.
- Giglio-Tos, E. 1897a: 2. > Transfers to *Metalepta*.
- Giglio-Tos, E. 1897b: 22. > As *Metalepta*.
- Bruner, L. 1900-1910: 35. > As *Truxalis brevicornis*.
- Kirby, W.F. 1910: 103 > As *Truxalis brevicornis*.
- Hebard, M. 1922: 103-108 > As *Truxalis brevicornis*.
- Hebard, M. 1924a: 93 > As *Truxalis brevicornis*.
- Gurney, A.B. 1940: 92. > Restores to *Metalepta*.
- Liebermann, J. 1939b: 149 > As *Metalepta*.
- Rehn, J.A.G. 1944b: 222 > As *Metalepta*. Recognizes 2 subspecies.
- Jago, N.D. 1971: 215. > Supports allocation to Acridinae.
- Otte, D. 1981: 217, 227.
- Bentos-Pereira, A. & Lorier, E. 1991: 631-653. > Comparison of morphology with Leptysminae &

Pauliniinae.

- Donato, M. & Cigliano, M.M. 2000: 145-173. >
Redescription. Recognizes two species.

Synonymy.

=*Acrydium ensicornum* DeGeer 1773: 499, synon. Kirby 1910: 103.
=*Truxalis notochlorus* Palisot de Beauvois 1805: 80, synon. Kirby 1910: 104.
=*Truxalis viridulus* Palisot de Beauvois 1807: 81, synon. Kirby 1910: 104.
=*Truxalis notochloris* Bruner 1895: 63, synon. Kirby 1910: 104.
=*Opsomala punctipennis* Serville 1839: 590, synon. Kirby 1910: 103.
=*Oxycoryphus burkhartianus* Saussure 1861: 314, synon. Kirby 1910: 104.
=*Opomala stenobothroides* Walker 1871: 52, synon. Kirby 1910: 104.

Diagnosis.

Habitus **Fig. A2**, (actually *adspersa*, but effectively identical). Male subgenital plate relatively short, 1.9 - 2.1 times as long as cercus (**Fig. A3**); epiphallus with internal and external tubercles of lophi small and convex on dorsal surface, lateral processes not markedly flared laterally. Female subgenital plate with rounded posterior margin, sometimes medially notched.

Coloration. Males have dark brown or blackish sides to head, pronotum and the basal part of the lateral field of the elytron, and a contrasting dorsal stripe (usually green, sometimes yellow) running from the frons over the vertex, the disc of the pronotum, and the dorsal field of the elytron. Hind legs light brown, front and middle legs green. Hind wings are pale yellowish. Females are normally a uniform green or light brown, rarely green with a brown dorsal stripe, the opposite of the male coloration.

Field characters.

The species *brevicornis* and *adspersa* are indistinguishable in the field. Both can be confused at first glance with alate Phaeopariini (Romaleinae), which also occur in grass and possess obliquely truncated wings, parallel lateral pronotal carinae and ensiform antennae, and which lack both the external apical tibial spine and the alar/elytral stridulatory mechanism typical of other romaleines. *Metalepta* can be distinguished from these insects by the fenestrated hind wings of the male, the relatively smaller head, and the absence of a prosternal process. Further distinguished in the male by the coloration (see above) which is unlike that of any Central American phaeoparin.

In the wild the male often sits with the hind femora depressed and held out laterally, reminiscent of the resting posture of a eumastacid. Crepitates in flight. Females are considerably larger and much more sluggish.

Distribution.

Southern Canada to Costa Rica. Prior to the recent separation into 2 species, *M. brevicornis* s. l. was well known as the acridid with the widest geographical range in the New World

(see “range of genus” above); for this reason it was adopted as the emblem of the Pan-American Acridological Society, a forerunner of the present Orthopterists’ Society. *M. brevicornis* s. str. was reported by Donato & Cigliano (2000) to extend from North America to Costa Rica, and *M. adspersa* from Panama south. However, their geographical sample was heavily biased towards the temperate extremes of the range, and few tropical examples were examined. The actual border between the two species appears to be in south-central Costa Rica on the Pacific coast and at approximately the international boundary on the Atlantic coast (**Map A1**).

Natural history.

Most typically associated with long damp grass, especially at the margins of pools and swamps, where it overlaps the habitat of leptysmine grasshoppers such as *Stenopola*, *Stenacris* and *Leptysmina*, and is in some ways morphologically convergent with them (see Bentos-Pereira & Lorier 1991). In temperate North and South America it appears to be confined to such habitats (see e.g. Blatchley 1920, Otte 1981) but in the tropics it is more catholic. Common in damp pasture land if the grass is not grazed too short, and in *Imperata* grassland. Generally common and often abundant in “charral” and other second growth areas; also found at forest edges and in larger tree-fall clearings and light gaps in wet forest. Both sexes are commonly heavily infested with mites, and the hind wings may be totally shredded by them. The eggs are laid in the ground.

2. *Metalepta adspersa* (Blanchard 1843)

Blanchard 1843: 216.

Type locality: BOLIVIA: Santa Cruz de la Sierra (of lectotype female, designated by Donato & Cigliano 2000).

Location of lectotype: MNHN Paris.

Etymology.

Latin *adspersus*, bespattered, sprinkled, seasoned, from verb *aspergere*. The pale ground colour of the abdomen and ventral thorax is often speckled with darker colour (see **Plate A1**).

Subsequent literature.

- Giglio-Tos, E. 1897a,b > Synonomizes with *M. brevicornis*.
- Rehn, J.A.G. 1944: 229. > Restores to subspecific rank as *M. b. adspersa*.
- Liebermann, J. & Ruffinelli, A. 1946: 10. > As *M. b. adspersa*.
- Donato, M. & Cigliano, M.M. 2000: 145-173. > Restores to specific rank.

Diagnosis.

Habitus **Fig. A2**, **Plate A1**. Distinguished from *M. brevicornis* by having a slightly longer subgenital plate in the male, 2.2-2.4 times as long as cercus (**Fig. A3**), internal and external tubercles of the epiphallus lophi larger and with concave dorsal

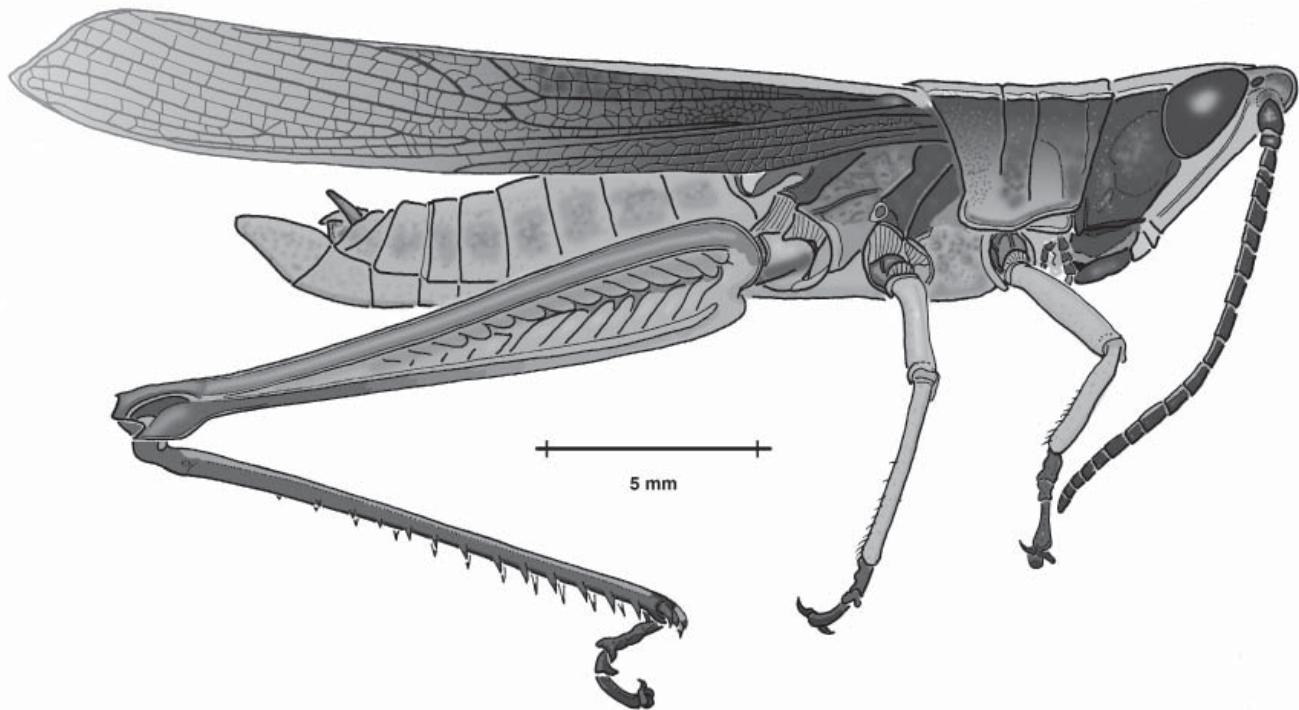


Fig.A2. *Metalepta adspersa*, male habitus. *M. brevicornis* would be identical, apart from a slightly shorter subgenital plate in the male (see **Fig.A3** below).

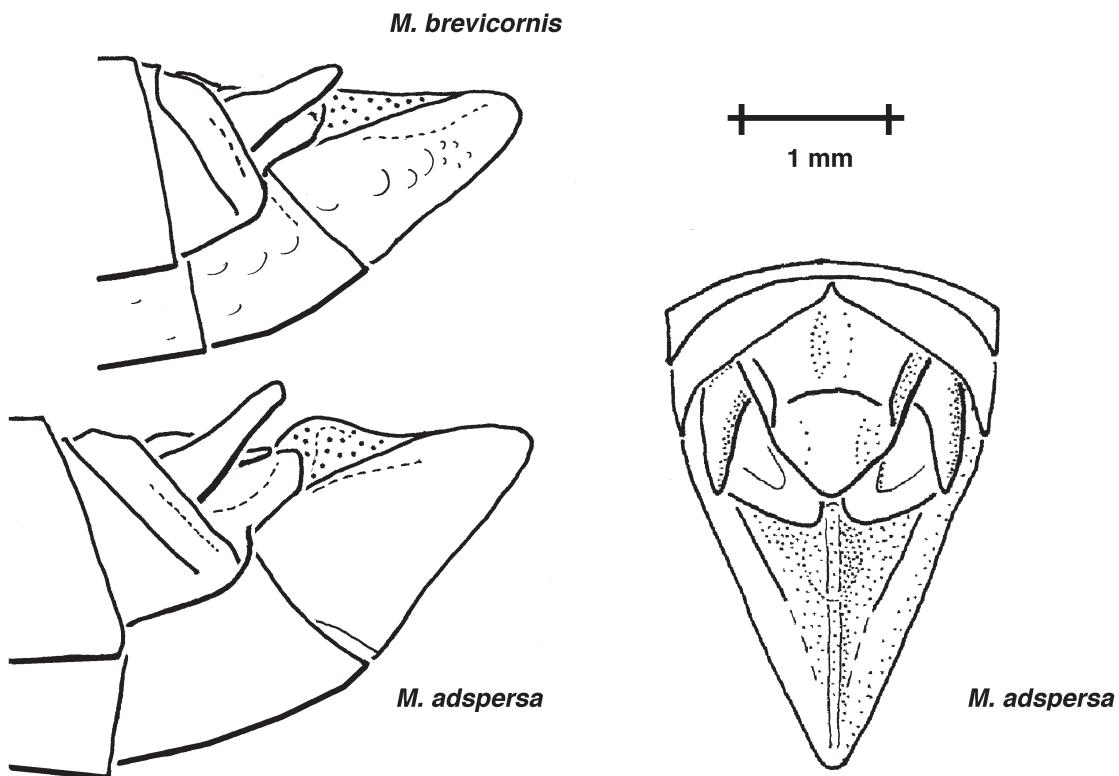


Fig.A3. Male terminalia of *Metalepta* spp. Left, lateral view; right, dorsal view.

surfaces, posterior processes of the epiphallus elongated and flared laterally, and by having a triangular or slightly trapezoid posterior margin to the female genital plate.

Distribution.

Southern Costa Rica and Western Panama south through South America to Argentina. See comments under *M. brevicornis* above.

Field characters, natural history.

See under *M. brevicornis* above.

Comment.

The differences between the species *adspersa* and *brevicornis* are extremely slight. Species status is however probably justified. The strongest evidence is the very narrow zone of apposition between the two in southern Costa Rica and the apparent absence of intermediate forms in that zone. This speaks against a cline.

Orphula

Stål 1873

Stål, C. 1873: 105.

Orphula was originally a subgeneric name in *Truxalis* (*Orphula*) *paganus* in Stål 1873: 105.

Type species: *Gomphocerus (Hyalopteryx) paganus* Stål 1860: 339.

Type locality: Rio de Janeiro.

Location of type specimen: Stockholm Museum.

Etymology.

Obscure. Greek *Orphos* is a sea perch (a fish), which seems unlikely. Greek *orphnos* means dark or dusky, which would fit better ("little dusky thing"), but would imply that Stål either made a spelling mistake in deriving the name or, more probably, wrote it in this form for the sake of euphony.

Subsequent literature.

- Brunner von Wattenwyl, K. 1893: 119.
- Bruner, L. 1900-1910: 30,72.
- Kirby, W.F. 1910: 117.
- Hebard, M. 1932b: 236.
- Jago, N.D. 1971: 215.
- Amedegnato, C. 1974: 202.
- Otte, D. 1981: 218 & 227.

Synonymy.

=*Sisantum* Bruner 1904: 68, synon. Otte 1981: 228.

=*Thyriptilon* Bruner 1904: 68, synon. Otte 1981: 228.

=*Cumarala* Hebard 1923: 202, synon. Otte 1981: 228.

No. of species known.

Six, possibly seven.

Range of genus.

Paraguay, Argentina, Brasil, Venezuela, Colombia, Costa Rica, Honduras, El Salvador, Guatemala, Mexico.

Diagnosis.

Similar to *Metalepte*, especially to the male of that genus, but distinguished from it by the following characters: shorter body form; hind knees without pointed lower lobes; less ensiform antennae; presence of small lateral foveolae ventral to edges of fastigium; frontal ridge flat or only shallowly grooved; disc of pronotum widening posterior to last sulcus; apex of male subgenital plate more rounded, less pointed; elytra somewhat less obliquely truncate, rounded at the extreme tip rather than pointed; somewhat expanded costal margin of elytron. Sexual dimorphism less than in *Metalepte*. Elytra exceed both abdomen and hind knees in length. Medial carina of pronotum present, cut by one (3rd) sulcus. Lateral carinae present, parallel in prozona, diverging posteriorly in metazona, cut by the 3rd and sometimes weakly by the 2nd sulcus. Ten to 11 external and 13-14 internal hind tibial spines.

Phallic complex of same type as *Metalepte*, but ventrolateral plates almost totally unsclerotized, apodemes of cingulum with broader lateral wings, and different lophi of the epiphallus; the outer lateral tubercle is large, flattened and plate-like, the apical minute and transparent, and the internal one is detached from the other two, flattened and with a rounded sclerotized tip.

Orphula azteca (Saussure 1861)

Oxycoryphus aztecus Saussure 1861: 315.

Type locality: MEXICO, Cordova.

Location of type specimen: MHN Geneva, holotype male.

Subsequent literature.

- Walker, F. 1870: 786. > As *Oxycoryphus*.
- Thomas, C. 1873: 203. > As *Oxycoryphus*.
- Bruner, L. 1900-1910: 73. > As *Orphula*.
- Kirby, W.F. 1910: 118.
- Hebard, M. 1932b: 236.
- Otte, D. 1981: 219, 241.

Synonymy.

=*Oxycoryphus mexicanus* Saussure 1861: 314, synon. Otte 1981: 241 (this species had previously been synonomized erroneously with *Orphulella punctata* by Hebard 1923: 207).

=*Oxycoryphus zapotecus* Saussure 1861, synon. Hebard 1932b: 236.

=*Orphulella neglecta* Rehn 1900: 94, synon. Hebard 1932b: 236.

=*Sisantum notochloris* Bruner 1904: 69, synon. Otte 1981: 241.

=*Orphula meridionalis* Bruner 1904, synon. Hebard 1932b: 236.

=*Orphula guatemalae* Bruner 1906: 10, synon. Hebard 1932b: 236.

Diagnosis.

Habitus, Fig. A5, Plate A2. As the only local species,

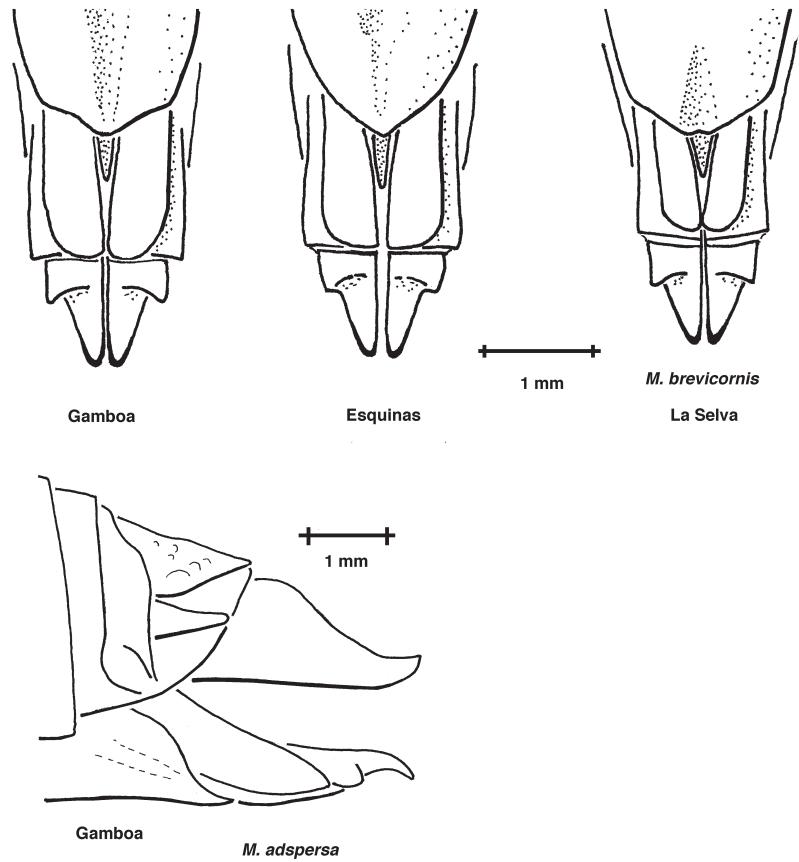
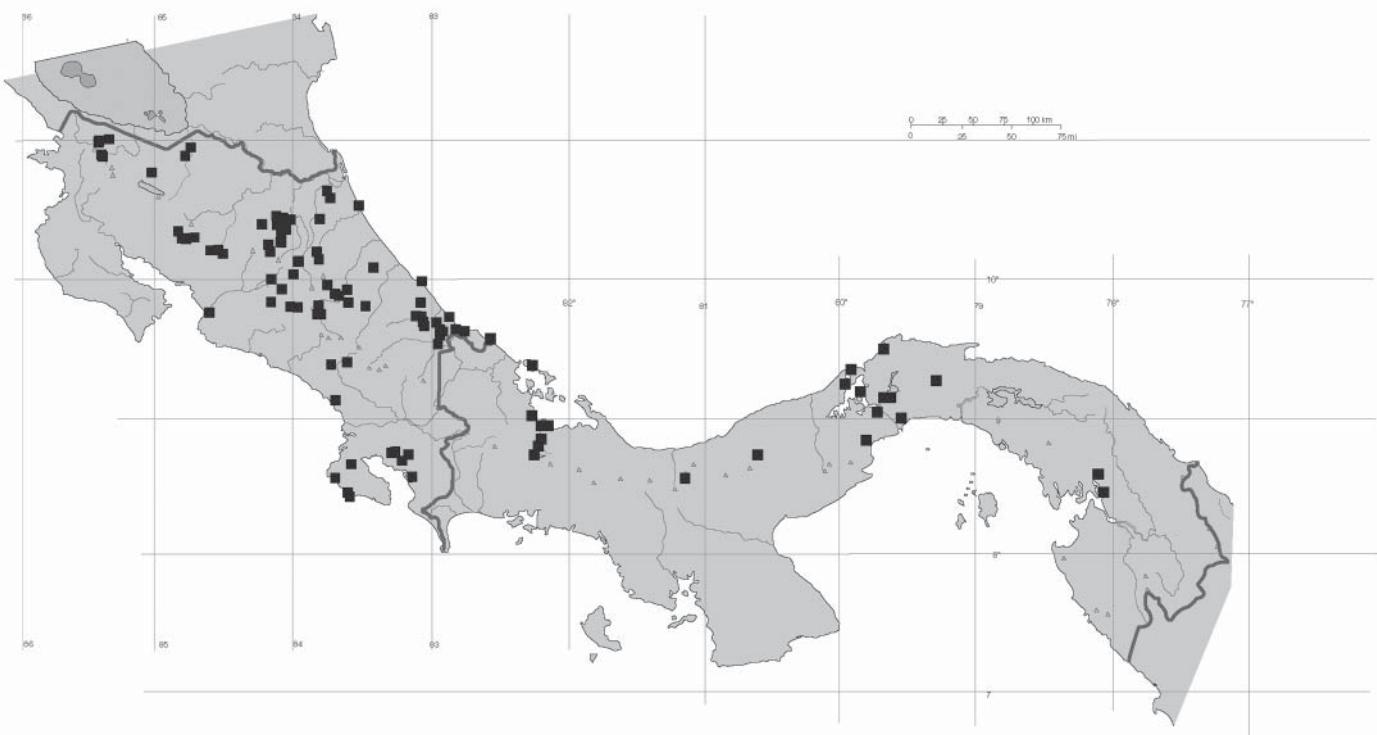


Fig. A4. *Metalepta* spp. Female terminalia. Left, *M. adspersa* (Panama); right, *M. brevicornis* (Costa Rica).



Map A1. Localities of *Metalepta* spp. in Costa Rica and Panama. To a first approximation, all Panamanian records are *adspersa*, all Costa Rican ones *brevicornis*, except in the extreme SW.

the generic diagnosis applies. F_{male} 10.3-14.0 mm, F_{female} 13.6-17.5 mm; sexual dimorphism m:f = 0.83:1 on average. The species is characterised by expanded cells present in the cubital area of male elytron (as well as in the hind wing) (Fig. A6), which are not present in other species of the genus. These cells are absent in the female, and probably contribute to the flight crepitation of the male. Proximal part of male SGP with a polished medial strip contrasting with the pitted cuticle of its surrounds.

Female subgenital plate (Fig. A7) with a sinuate rear margin, approaching the three-lobed condition, medially grooved distally, rugose, the lateral lobes sclerotized and darker in colour; egg-guide long and thin, half as long as lower valve. Female cerci short and blunt, almost truncate; supra-anal plate with a transverse ridge.

Coloration: The green or yellow dorsal stripe and the orange hind tibiae contrast markedly with the blackish sides of head, pronotum and lateral field of elytra. In flight or in the hand, the yellow abdominal tergites are conspicuous. In females the contrast is usually less. Antennae red or chestnut at base, darkening at tip to black. Rarely, the dorsal field of the elytron (but not the stripe on head and pronotum) is purple. The hind wing is somewhat smoky peripherally. Male specimens from El Salvador and Guatemala are often very darkly coloured, and can appear as black insects with a green dorsal stripe.

Field characters.

Most likely to be confused with species of *Orphulella* or *Orphulina*, which it closely resembles in general aspect. Differs from those genera in its obliquely truncated elytra, absence of stridulatory mechanism in male (but this is also true of some species of *Orphulella*), a higher number of femoral spines, and longer antennae. The lateral carinae of the pronotum are not at all constricted anterior to the last sulcus in adults, and only very slightly in larvae. Males do not have the expanded front and middle femora characteristic of *Orphulella* and related genera. In the field, *Orphula* is distinguished by the clicking noise produced in flight by the males. It is also somewhat more vivid in coloration than the species of *Orphulella* found in our area and, especially in the female, larger in size.

Distribution.

Mexico (Veracruz, Chiapas), Guatemala, El Salvador, Honduras, Western Costa Rica. Apparently absent from Panama. Almost certainly present in SW Nicaragua, but no substantiated records known to me.

In Costa Rica (Map A2), occurs in Guanacaste and the northern part of Puntarenas Province down to the Rio Pirris, and from the Pacific drainage of the Meseta Central. Not known from the Atlantic drainage. From sea level to at least 1750 m. in Tarbaca, Prov. S. José.

Natural history.

Often common in suitable habitat (grasslands, pasture, savanna, open dry forest). An active, conspicuous species, which flies readily on hot days, showing its bright colours. Eggs are laid in the ground.

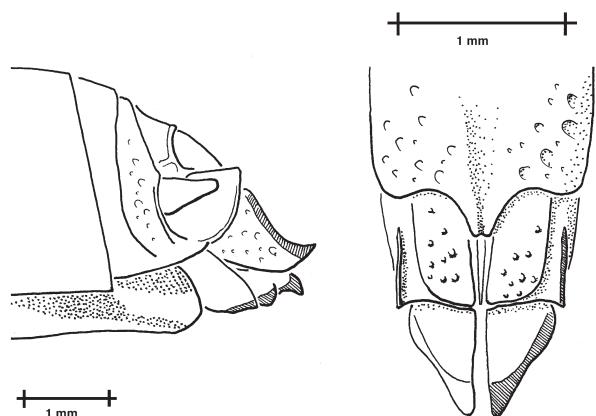
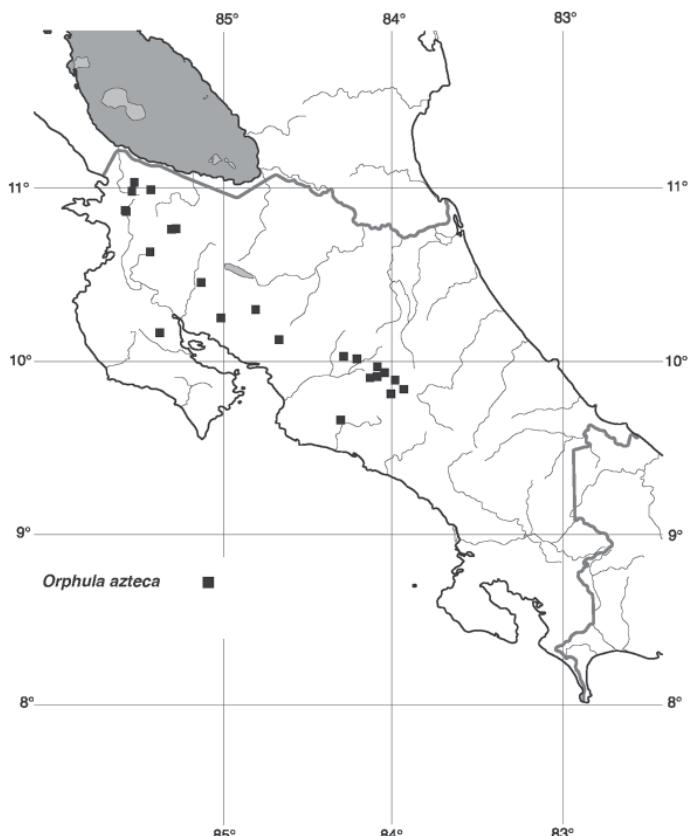


Fig. A7. *Orphula azteca*, female terminalia. Lateral and ventral views.



Map A2. Localities of *Orphula azteca* in Costa Rica. The species has not been recorded from Panama.

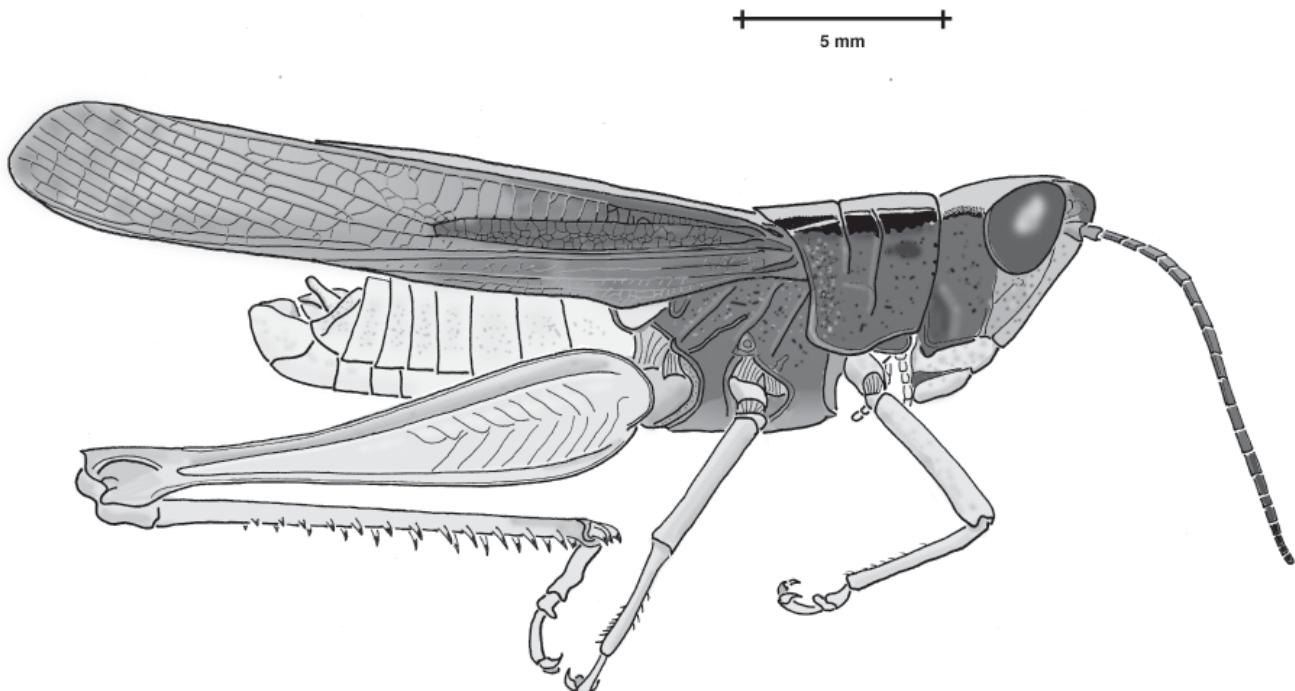


Fig. A5. *Orphula azteca*, male habitus.

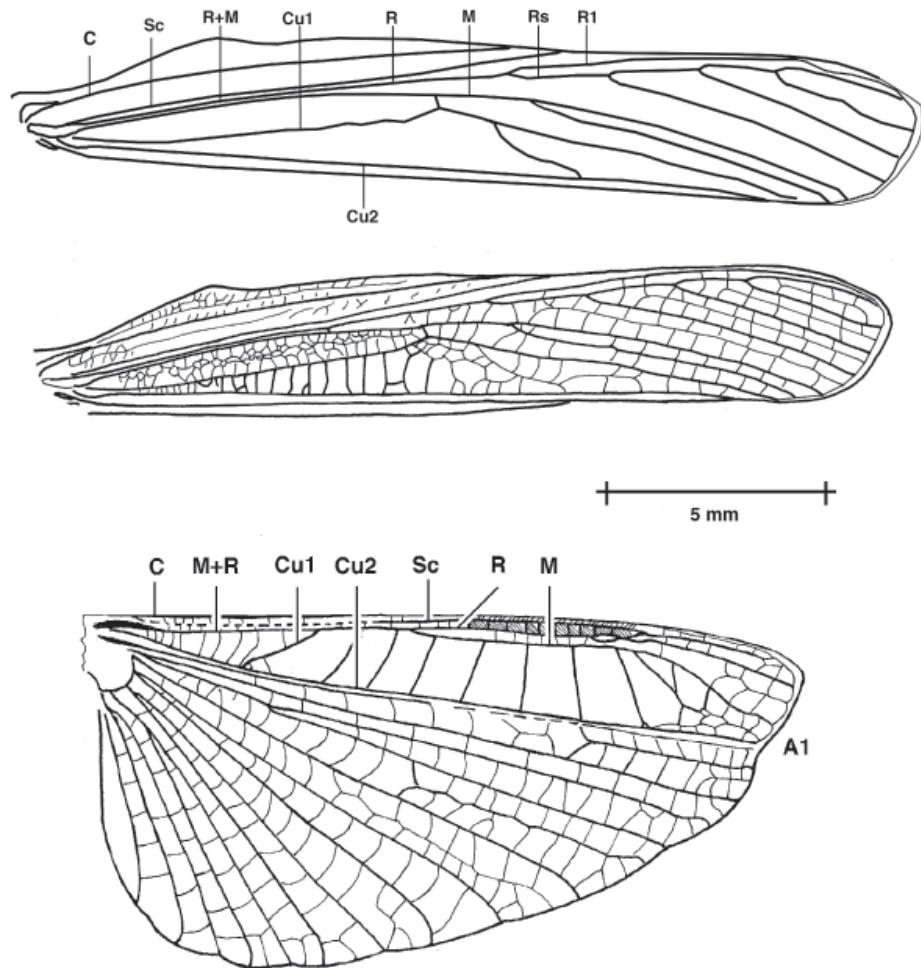


Fig. A6. *Orphula azteca*, male. Elytron and wing. Note the expanded cells of the anterior cubital areas of both. In the uppermost figure, only the main longitudinal veins are shown.

Subfamily Copiocerinae

Brunner von Wattenwyl 1893

Amedegnato 1974: 200.

Amedegnato 1977: 273. Diagnosis, key to genera.

The Copiocerinae are an exclusively New World and largely Neotropical group. Long recognized as a natural grouping [in *Divisio 9* of Stål (1878), as the Copiocerae of Brunner von Wattenwyl (1893:136) or Giglio-Tos, (1898)], they were first given subfamily status by Amedegnato 1974, 1977. In her original formulation they comprised 6 groups, the Eucopiocerae (Mexico, Central America), the Copiocerae (Tropical America), the Hippacrae and Monachidiae (tropical South America), and the Adimantae and Aleuasini (mainly temperate South America).

The boundaries of the subfamily are not very clear, and various genera and groups have been moved in and out of the taxon in recent decades. The Eucopiocerae (see pg 199) and the Antillean genus *Dellia* are especially problematic. The Antillean Dellini have been added subsequently, transferred there (by Amedegnato, Ruiz-Baliu & Carbonell 1995) from their original Ommatolampinae (Amedegnato 1974, 1977). There is some semantic confusion between the names Dellini (Amedegnato 1974) and Clematodini (Rehn & Eades 1961a); in Amedegnato's arrangements the former group includes both the Eucopiocerae and *Dellia*. The South American tribe Aleuasini does not group with other Copiocerinae in molecular systematic analyses, is morphologically divergent, and may be misplaced. There is however no ambivalence about the members of the core subtribe Copiocerae, in which the few Costa Rican and Panamanian species are placed. Both morphological (Amedegnato 1977) and molecular (Rowell & Flook 2004) systematics agree that the nearest relatives of the Copiocerinae are the Proctolabinae.

Diagnosis.

The Copiocerinae share several formal characters with the Melanoplinae and Proctolabinae, to the exclusion of the other acridid subfamilies. Like them, they have a long vermiciform preapical diverticulum of the spermatheca (**Fig. C1**), and the anterior sclerites of the endophallus are compressed laterally; externally, they have a prosternal tubercle or spine, and the male subgenital plate is cup-like and open dorsally; however, it is not expanded laterally, the pallium is normal (vide Melanoplinae), and there is no hypertrophy of the lateroventral sclerites of the phallic complex (vide Proctolabinae). A transverse groove separates the vertex from its fastigium. All the Copiocerines found in our area are elongate, slender, fully winged and fully tympanate insects with an oblique, straight frons, a roughly cylindrical pronotum with no longitudinal carinae, and filiform antennae. The prosternal process is strongly compressed in the anterior-posterior dimension (**Fig. C2-C**). The males have an only weakly developed furcula. The male cerci are simple, never complex as in many proctolabines and some melanoplines.

Tribe Copiocerini

Brunner von Wattenwyl 1893

Amedegnato 1974: 200.

Amedegnato 1977: 273. Diagnosis, key to genera

Descamps, 1984: 6. Review; key to genera.

This taxon is divided into several subtribes, of which only one is represented in our area.

Subtribe Copiocerae

Brunner von Wattenwyl 1893

Diagnosis.

In our area, elongate, fully winged grasshoppers associated with palms. Both the globular phallic complex with its especially well developed epiphalllic structures, and the spermatheca with its long vermiciform preapical diverticulum of varying diameter are characteristic. The pronotum is more or less cylindrical and lacks lateral carinae.

No. of included genera.

Thirteen. In our area, two.

Subtribal range.

South America east of the Andes south to Paraguay and northern Argentina; Trinidad; Central America north to Honduras.

Copiocera

Burmeister 1838

Burmeister 1838: 602, 611.

Type species: *Xiphicera erythrogaster* Perty 1834: 122.

Etymology.

Latin *copia*, abundance, plenty; Greek *keras*, *keratos*, horn. Refers to the long and prominent antennae.

Subsequent literature.

- Walker, F. 1870: 520.
- Brunner von Wattenwyl, K. 1893:137.
- Kirby, W.F. 1910: 420.
- Rehn, J.A.G. 1905a: 417.
- Descamps, M. & Amedegnato, C. 1970: 878.
- Amedegnato, C. 1974: 200.
- Descamps, M. 1984b: 30. > Review of genus.

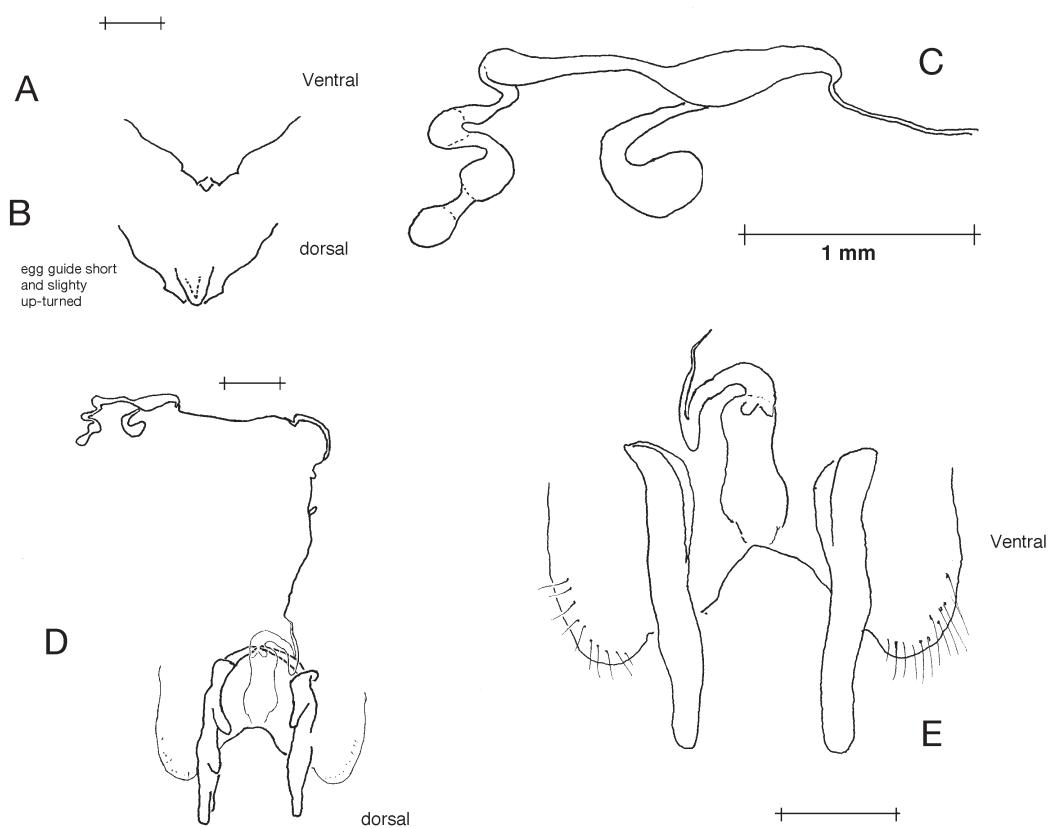


Fig. C1. *Copiocera specularis*: female reproductive structures. A,B, subgenital plate, ventral and dorsal surfaces. C, spermatheca. D, spermatheca, duct and lower ovipositor valves. E, bursa copulatrix.

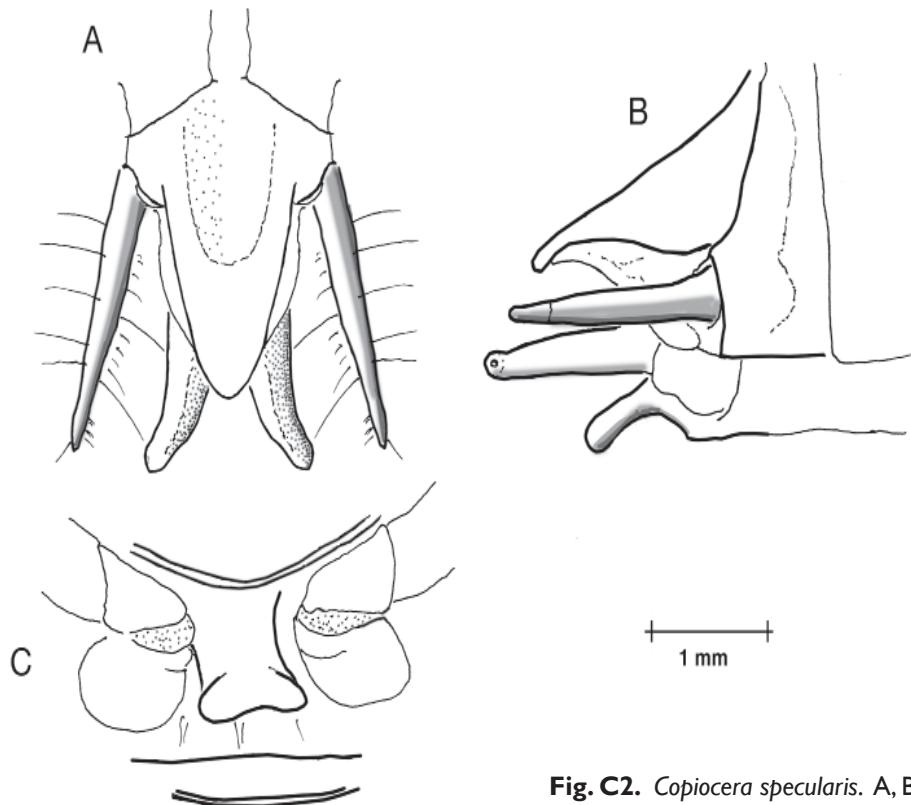


Fig. C2. *Copiocera specularis*. A, B, female terminalia, dorsal and lateral views. C, prosternal process, oblique ventral view.

Synonymy.

= *Glaphyracris* Walker 1870: 653, synon. Kirby 1910: 420.

Diagnosis.

Habitus, Fig. C3. Plate C1. Fastigium subtriangular at its apex; antennae filiform or (outside our region) ensiform; pronotum crossed by three fine sulci. Pronotal process compressed frontally, transverse, expanded at the tip to form two hornlike projections (**Fig. C2-C**). Hind tibiae and hind femora of approximately equal length; 5-6 external spines on hind tibia, divided into two groups, proximal and distal, by a slightly longer gap above the third most distal spine; 2nd tarsal joint of hind foot half the length of the first joint. Tips of elytra rounded; male cerci long, straight or (outside our region) incurved at the tips; supra-anal plate triangular; ovipositor valves highly modified for epiphylloous oviposition, rod like, the upper ones straight and divergent, the lower ones straight or curving downwards (**Fig. C2-A,B**). Female subgenital plate simply triangular at its tip, lacking lateral lobes (**Fig. C1-A**).

Field characters.

All *Copiocera* are medium large grasshoppers, slim, elongate, alate, dark green or brown (but often with bright colours on the abdomen or wings), with long dark antennae, closely associated with palms. The distinctions between the described species are small and are largely based on chromatic characters. Descamps divided them into 3 groups, which are probably more robust taxonomically than the presumed "species". Two of these groups are represented in the fauna of our region, but one (*C. austera* of the erythrogasta group) is right at the edge of its range. *C. harroweri* and *C. specularis* together constitute the *specularis* group.

The most closely related genera seem to be the Amazonian *Eumecacris* and *Copiocerina*.

No. known species.

Sixteen. In our area, three.

Generic Range.

Tropical South America from Brasil and Bolivia north to Colombia and Venezuela; Trinidad; Panama, Costa Rica, Nicaragua, Honduras. Not as yet recorded from other Central American countries.

1. *Copiocera specularis* Gerstaecker 1889

Gerstaecker 1889: 35.

Type locality: Chiriquí, Panama (this is probably the lowland locality of Chiriquí Viejo).

Location of type specimen: Ernst-Moritz-Arndt Universitaet, Greifswald.

Etymology.

Latin *speculum, specularis*, mirror. Probably a reference to the reflective blue rear wings.

Subsequent literature.

- Rehn, J.A.G. 1905c: 417.
- Bruner, L. 1908: 264.
- Kirby, W.F. 1910: 420.
- Descamps, M. 1984: 38.

Diagnosis.

Females about 55 mm in length from fastigium to end of elytra, males about 38 mm. Integument of head smooth, of thorax shallowly pitted, with smooth patches on the lateral lobes of the pronotum. Medial carina of pronotum represented only by a smooth line in the metazona. Fastigium about twice as long as the interocular space is wide, tapering forward, slightly grooved in the midline.

Male cerci are cylindrical and straight with obtuse tips. Dorsal ovipositor valves straight and rod like, ventral valves shorter and curved downwards (as in *C. harroweri*). The distinction between these two species is made only on coloration (see Field characters below).

Field characters.

Visible parts plain dark green in colour, very rarely dark brown, except for the black antennae which have orange or yellow or white tips. The dorsal surface of the abdomen under the wings is either rose-pink with dark intersegmental bands, or light blue, but with the metathoracic and first 2 abdominal terga invariably blue, even in otherwise pink-coloured specimens. All females seem to have the pink abdomen, but about half of the males have a blue one.

Hind wings light blue, the inner lateral surface of the hind femur dark blue [Descamps (1984) writes that this is dark brown, but I have never seen this coloration in Central American specimens - it may be an artifact of dried specimens]. The interior ventral face of the hind femur is dark brown, black or dark blue. No banding on the legs. Most individuals have yellow hind knees but the clarity of this marking varies greatly. Some individuals have the anterior border of the pronotum lined with yellow, most do not.

Larvae in their second and third instars are very differently coloured from the adults. The ground colour is beige with light brown markings. There is a medial carina on all the thoracic and abdominal segments, picked out in yellow, broadening in the middle of each segment. In the abdominal region, there is a darker spot to either side of the medial carina in each segment. Antennae beige, with 3-4 indistinct darker bands, lighter at tip. Pro- and mesothoracic legs light green. Hind legs beige, inner face of femur bears two black bands, hind knee black. Tibiae blackish brown, foot beige. Cerci straight and simple, longer than subgenital plate.

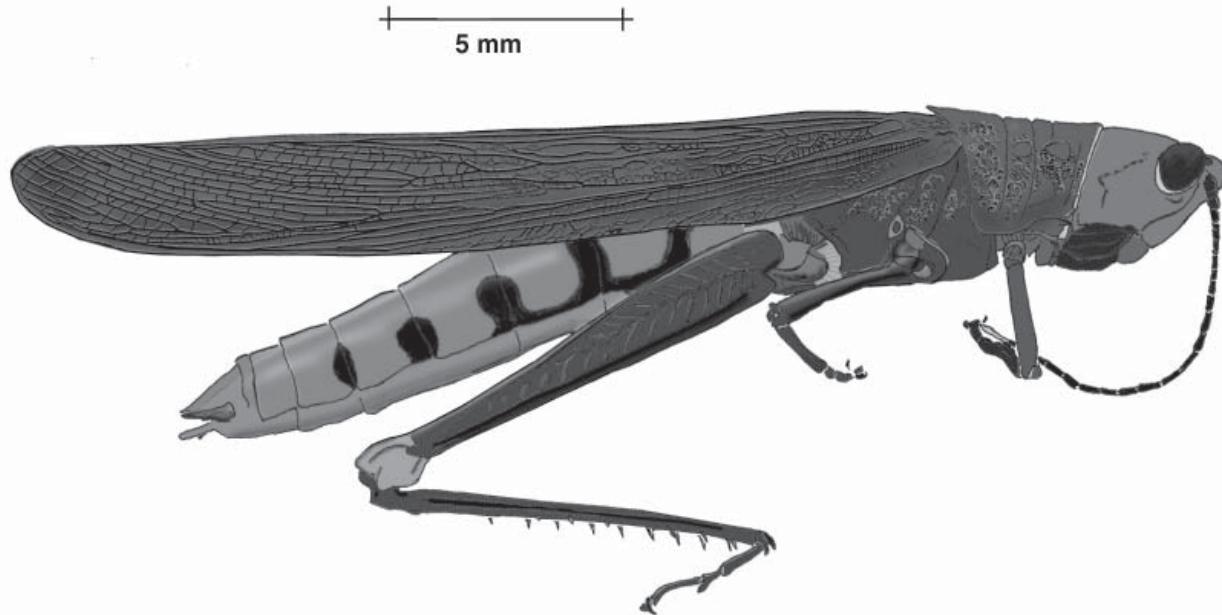
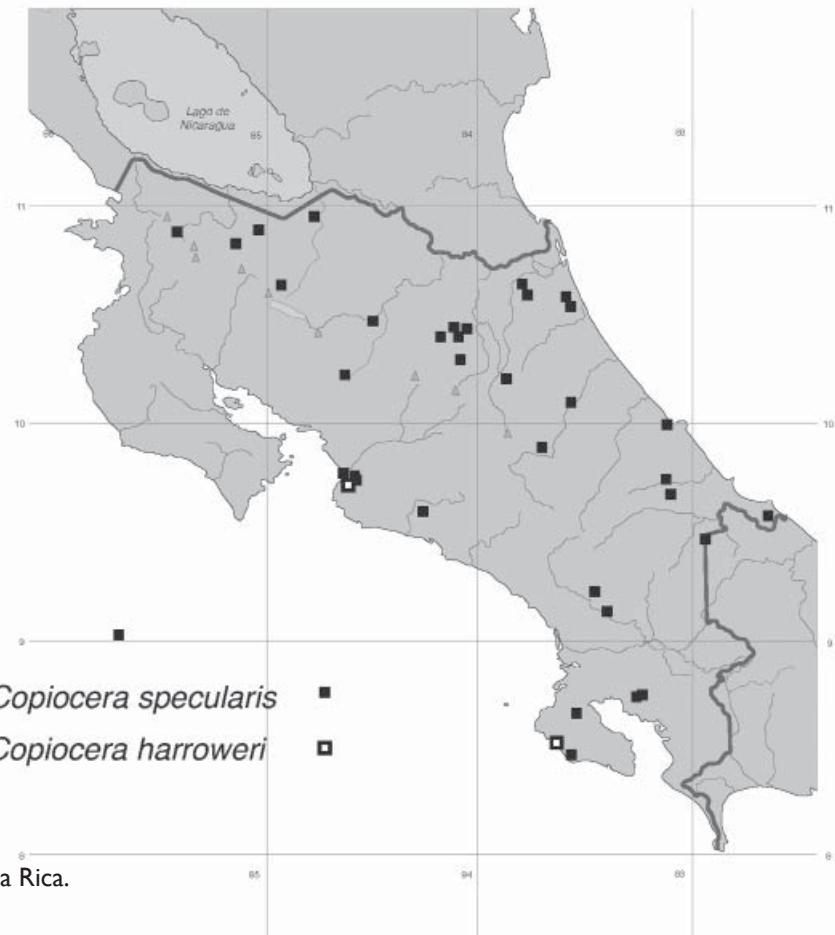


Fig. C3. *Copiocera specularis*, female habitus.



Map CI. *Copiocera* spp. in Costa Rica.

Distribution.

Panama, Costa Rica and Nicaragua, one dubious record from Ecuador. Probably extends into Honduras (whence only larval specimens known) or further north on the Caribbean plain. In Panama, known from Darién, the Canal Zone and the type locality in extreme Western Panama. In Costa Rica, recorded from virtually all major forested areas on both Pacific and Atlantic slopes, from sea level to 800 m., relatively common. **Map C1, C2.**

Natural history.

Lives in and among rain forest palms, especially the genera *Welfia* and *Socratea*, but also eats other smaller palms, e.g. *Prestoea decurrens*, *Geonoma congesta* and *Asteroxyne martiana*. Often rests on the underside of the frond, body aligned with the rhachis, head uppermost. The eggs are laid on the frond in groups of 10 or more, embedded in foam (Braker 1989b). *C. specularis* has a distinct odour, reminiscent of chocolate, and can sometimes be found by this alone. The possibility of pheromonal signalling should be investigated. Males are active diurnal fliers, and are also sometimes taken in light traps. Females are more sluggish, but are voracious feeders, in captivity consuming some 20 cm² of palm frond in 24 hours.

2. *Copiocera harroweri* Hebard 1924

Hebard 1924: 120.

Type locality: Gatún, Panama.

Location of type specimen: ANS Philadelphia.

Etymology.

Named for the U.S. collector, D.E. Harrower, who collected in the Canal Zone during the period of the construction of the canal.

Subsequent literature.

- Descamps, M. 1984: 38.

Diagnosis.

According to Descamps, anatomically identical with *specularis*, but internal and interior ventral face of hind femur red or yellow; nota of T3 and A1 and 2 red or yellow, but never blue. This is a very small distinction, probably not warranting specific rank, especially considering the sympatry in Panama and the variability of coloration in *C. specularis* in general. The phallic structures of the two "species" appear to be identical. In the Costa Rican specimens, the upper surface of the knee and the anterior lateral margins of the pronotum are lined with yellow.

Distribution.

Venezuela, Western lowland Colombia, Panama, Costa Rica. In Panama known only from lowland rain forest in the Canal Zone and from near Puerto Armuelles, on the Pacific coast near the Costa Rican border. In Costa Rica, a specimen was captured in the P.N. Carara, nr. Tárcoles, in Pacific lowland forest, a new distributional record, and more recently a second specimen in the Osa peninsula. **Maps C1 & C2.**

Natural history.

Unknown – presumed to be identical with that of *C. specularis*. The original collector (Harrower, in Panama) noted "always associated with palms" (quoted in Hebard 1924).



3. *Copiocera austera* Gerstaeker 1889

Gerstaeker 1889: 35.

Type locality: Iquitos, Peru.

Location of type specimen: EMAU Greifswald.

Other literature.

Liebermann 1955: 339.

Descamps 1984: 35.

Etymology.

Latin *austerus*, rough, harsh, stern, gloomy, sad, austere: presumably a reference to the lack of bright colours.

Diagnosis.

Antennae somewhat flattened at their base, rather than being purely filiform. The lower part of the frontal ridge is slightly depressed, rather than straight. Females differ from those of the other two C. American species (above) in having the ventral valves of the ovipositor straight, and not angled downwards. Male cerci cylindrical and straight, as in the other two species.

Field characters.

About the same size as or slightly larger than *C. specularis*, olive or reddish brown with no bright colours, though base of abdomen tinged yellow. Some Amazonian specimens (Descamps 1984: 35) have a yellow patch on the hind knee and the base of the abdomen is red or yellow.

Distribution.

Amazonian Brasil, Peru and Bolivia; Colombia; Guyana; Trinidad; Panama. In Panama known only from a single poorly preserved female specimen (MNHN Paris) from Darién (no other data). Apparently primarily a South American species, at the very edge of its range in E. Panama.

Natural history.

Unknown – presumed to be identical with that of *C. specularis*.

Copiotettix Descamps 1984

Descamps 1984, Mem. Mus. natn. Paris (Zool.) 130: 27.

Type species: *C. megacephala*.

Diagnosis.

In general aspect (Fig. C4) similar to *Copiocera*, though smaller; it has similar rodlike ovipositor valves, suggesting a similar epiphyllous oviposition strategy. Antennae long and filiform. Differs from *Copiocera* as follows: in the shape of the

prosternal process – here this is antero-posteriorly flattened, triangular, with a rounded or acute tip, sharply slanted backwards. (This triangular shape also distinguishes the genus from the otherwise very similar Mato Grossan genus *Sinop*, where the process is subrectangular in shape.) The external tibial spines of the hind leg are evenly spaced, and not divided into two groups. The hind tibia is slightly shorter than the hind femur. The male supra-anal plate (Fig. C5) is subrectangular with a terminal medial point, whereas that of *Copiocera* is triangular. The male cerci are curved inward, and are not straight as in our species of *Copiocera*. *Copiotettix* is also distinctively coloured: both known species are immediately distinguishable from *Copiocera* by the red femora of the front and middle legs.

Within the genus the two species are most easily distinguished by the colour of the face and the lower lateral lobes of the pronotum – yellow in *venezuelae*, green in *megacephala*.

No. known species.

Two. Both occur in our area.

Range.

Venezuela, Panama, Costa Rica (new distributional record). Likely to occur in Colombia too.

1. *Copiotettix megacephala* Descamps 1984

Descamps 1984: 28.

Type locality: Panama: Canal Zone: Isla Barro Colorado.

Location of type specimen: UMMZ, Ann Arbor.

Etymology.

Greek “*megacephala*”, big head. The head is large only in comparison with the slim pointed head of *Copiocera*: it is not an especially striking feature.

The female ovipositor valves and cerci are noticeably shorter than those of *C. venezuelae* (Fig. 70, Descamps 1984). The female subgenital plate bears two points lateral to the median process, which are shorter and broader than the comparable structures in *C. venezuelae*.

Field characters.

Readily distinguished from *C. venezuelae* by the predominantly green colour of the head and genae, with only a few small yellow markings. The yellow line along the ventral edge of the pronotal lobes is very narrow.

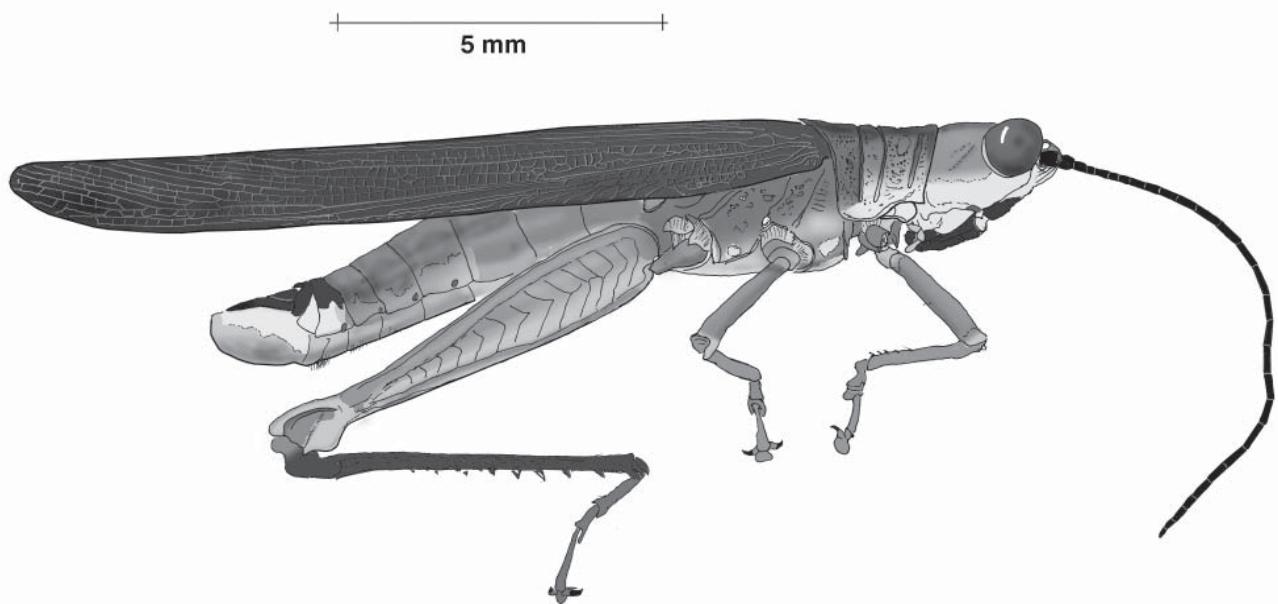


Fig. C4. *Copiotettix venezuelae*, male habitus.

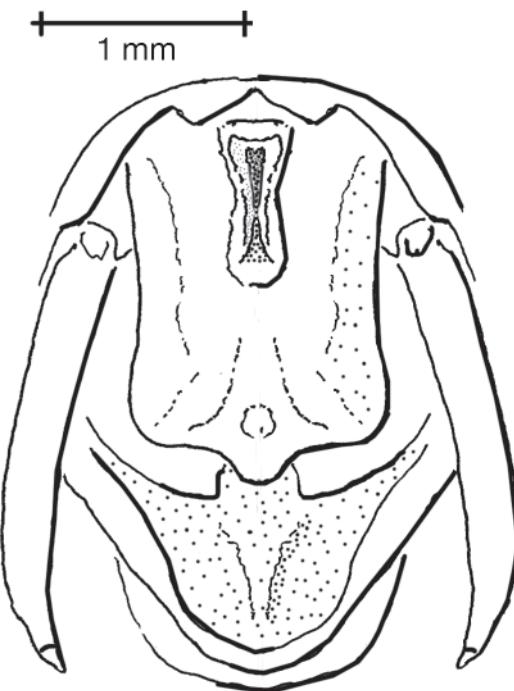


Fig. C5. *Copiotettix venezuelae*, male terminalia.

Natural history.

Effectively unknown. Ovipositor similar to that of *Copiocera*, presumably it performs similar epiphyllous oviposition on palms. Tends to be collected at light, so probably night active. Uncommon.

Distribution.

Panama. Most recorded specimens are from Barro Colorado Island, Panama. Presumably it occurs throughout the adjoining forest zones of the provinces of Panama and Colón. A single pair were captured in the P.N. Darién, at Pirre.

2. *Copiotettix venezuelae* Descamps 1984

Descamps 1984: 29.

Type locality: Venezuela: Bolívar, Caicara – San Juan de Manapiare, km 168.

Location of type specimen: Instituto de Zool. Agricola, Maracay.

Diagnosis.

Habitus, **Fig. C4, Plate C2**. The female ovipositor valves and cerci are markedly longer and thinner than those of *C. megacephala* (Fig. 75, Descamps 1984). The female subgenital plate bears two points lateral to the median process, which are longer and finer than the comparable structures in *C. megacephala*.

Field characters.

Slightly smaller than *Copiocera specularis*, females 43 mm from fastigium to tips of the elytra, males 30mm. Ground colour green. Fore and mid femora red; face, fastigium, genae and a broad ventral strip on pronotal lobes yellow, abdomen blue in males and red and blue in females. The predominantly yellow face and head are noticeably different from that of *C. megacephala*.

Natural history.

See *C. megacephala*.

Distribution.

Venezuela and Costa Rica. In Venezuela known only from the type specimen. The only known Costa Rican specimens were taken in forest on the Osa Peninsula, close to the Panamanian border, on the Pacific coast, in September. Not as yet recorded from Panama or Colombia. The presence of a different species (*megacephala*) of the genus in Panama suggests that the distribution of *C. venezuelae* may be truly disjoint, and not just an artifact of poor sampling. Fortunately, the two species are easily distinguishable.



Map C3. *Copiotettix* spp. in Costa Rica and Panama.

Subfamily Cyrtacanthacridinae Kirby 1910

A subfamily of mostly large or medium sized grasshoppers, almost world wide in distribution but mostly found in the Old World Tropics. Currently there are 48 genera and 164 valid species. Nearly all are fully winged and active fliers. The subfamily includes several migratory locust species and others of considerable agricultural importance (e.g. the genera *Schistocerca*, *Austracris*, *Nomadacris*, *Patanga*, *Anacridium*), and is accordingly very well studied.

Diagnosis.

Large to medium size, head tending to the globular, frons straight or slightly convex in profile, fastigium short, foveolae absent. Antennae filiform. Pronotum lacking lateral carinae, tectiform or slightly concave. Prosternal process well developed, often sharply pointed. Mesosternal interspace open, mesosternal lobes usually rectangular. Tympanum present, wings and elytra nearly always fully developed (the only exceptions are *Congoa* in W. Africa and *Halmenus* in the Galapagos). Stridulatory apparatus absent. Hind femur slender, external apical tibial spine absent.

Natural history.

Most Cyrtacanthacridines preferentially eat the leaves of woody shrubs and trees, though some species are mainly herbaceous feeders, and swarming locusts are notoriously polyphagous. Some Old World taxa (e.g. *Taiacris*) are confined to tropical forest canopies, with a morphology and way of life convergent with that of the Neotropical “Tropidacres” (*Romaleinae*); others are typical of bushed savanna country (e.g. *Ornithacris* spp.) and *Pachynotacris amethystina* is a typical wet forest light-gap species. Much of what we know about the physiology and ecology of phase polymorphism in grasshoppers and of their neurobiology comes from laboratory research on the cyrtacanthacridid locusts.

Distribution.

Predominantly tropical or subtropical grasshoppers. The Old World Desert Locust, *Schistocerca gregaria*, periodically erupts in Africa and W. Asia, and then temporarily appears in areas of Europe, and even North America, from which it is normally absent. Only three genera have been recorded from the New World: *Schistocerca*, which is speciose and widely distributed from Argentina to the Canadian border; *Halmenus*, in the Galapagos, which is closely related to and probably derived from *Schistocerca*, and the enigmatic and apparently extinct *Nichelius* (see Carbonell 1994), known only from a single ancient specimen from Cuba. Only *Schistocerca* occurs in our area.

Schistocerca Stål 1873

Stål, 1873b: 64

Type species *Libellula americana* Drury 1773 (subsequent designation by Rehn 1904).

Type locality Southeastern U.S.A., Georgia.

Etymology.

Greek *schistos*, cleft or split, and *cercos*, tail, referring to the notched end of the male subgenital plate.

Subsequent literature.

A vast category, due to the agricultural importance of the genus. The OSF online (Eades et al. 2003) should be consulted for starters. Many titles are concerned with phase determination and its physiology, or aspects of control. Another good source for these aspects is COPR (1982). Baron (1972) gives an accessible popular account of *Schistocerca gregaria*.

The most important modern systematic works are:

- Dirsh, V.M. 1974. > Revision of genus.
- Harvey, A.W. 1981. > Partial revision.
- Jago, N.D., Antoniou, A.A., Grunshaw, J.P. 1982. > Partial revision.
- Lovejoy, N.R. et al. 2006.. > Molecular systematics of genus.
- Song, H. 2004.. > Systematic relationships, species.
- Song, H. 2005. > Morphological cladistic phylogeny of the subfamily.
- Song, H. 2009.
- Song, Moulton, Hiatt, Whiting (2013) > Molecular systematics of genus.
-

No. of species included.

Currently the genus contains 37 technically valid species and 66 valid subspecies (Eades et al. 2003, consulted 2010), but many other names have been used in the literature. All but one (*S. gregaria*, with 2 valid subspp.) are New World in provenance.

No. of species in our area.

Not quite certain, but 4 species names are currently in use: (*centralis*, *nitens*, *pallens*, and *piceifrons*).

Distribution.

Members of the genus are found throughout our region, in almost all habitats except swamp, high mountain and dense wet forest.

Diagnosis.

(Condensed from Dirsh 1974). Large to medium size. Integument finely punctate. Antennae filiform, usually as long or longer than head and pronotum together. Fastigium trapezoidal, with shallow longitudinal depression; frontal ridge low, almost

parallel sided, shallowly sulcate or with a slight depression at the ocellus. Pronotum tectiform or saddle shaped, median carina obtuse, indistinct in prozona. Metazona slightly longer than prozona, posterior margin acute angular to rounded. Prosternal process cylindrical, subconical, straight or curved backwards, touching or almost touching the mesosternum, its apex rounded or acute (**Fig. Cyrt3**). Tegmina fully developed, from slightly shorter than abdomen to comfortably exceeding it in length. Male supra-anal plate elongate angular; sometimes with paired tubercles in its central area, apex attenuate. Female supra-anal plate simple, angular. Male cercus (**Fig. Cyrt6**) wide, laterally compressed, at apex truncate or bilobate, slightly incurved. Female cercus short, triangular, laterally compressed. Male subgenital plate deeply incised at its apex.

Comments.

a/ Species divisions within this genus are very difficult to determine and to define. I personally regard the morphological criteria published to date as unsatisfactory, at least as regards Central American material, and have little or no confidence in either the published records or my own determinations. The situation is worsened by the great variability in coloration of all our species.

b/ Dirsh (1974) attempted a classical morphological approach to a revision of the genus, stressing morphometric ratios originally developed for phase research within *Schistocerca gregaria*. One of his results was to synonymise all the species showing locust phase tendencies under the name *S. americana*. Hybridisation experiments, however, then showed genetic incompatibility between several of these classically recognised and geographically separated populations (Harvey 1979, 1982; Jago et al. 1979, 1982), indicating significant genetic isolation. This led to the abandonment of *S. americana* sensu Dirsh and the restoration of several species: *S. gregaria* (Africa and Asia), *S. piceifrons* (Mexico and Central America, Peru), *S. americana* s. str (USA and NE Mexico), *S. serialis* (West Indies), and *S. cancellata* (S America) (Harvey 1981), even though there is little or no morphological differentiation between them. *S. centralis* and *S. pallens*, too, though not locust species, are morphologically (Song 2004) and genetically (Harvey 1981, Lovejoy 2006 - data for *pallens* only) closely allied to *S. cancellata*, and thus present the same problems of identification and differentiation as the rest of this group. The best molecular phylogeny to date (Lovejoy et al. 2006) shows *S. nitens* as a further member of the "americana" clade containing *piceifrons*, *pallens* and *cancellata* (and thus presumably *centralis* too, see above). All the species in our area are thus very closely related, partially explaining their confusing similarity. Until our *Schistocerca* fauna is subjected to a modern combined investigation similar to that performed by Yassin et al. (2009) on Andean locusts, uncertainties will prevail.

c/ An unresolved controversy concerns the origins of New World species of this genus and their phylogenetic relation to the Old World species *S. gregaria*. The commonly accepted

view is that the former represent an American radiation after colonisation across the Atlantic by the latter; *S. gregaria* is demonstrably (Ritchie & Pedley 1989) capable of this feat. The alternative view is that the reverse migration took place, and the Old World *S. gregaria* is derived from a New World form, probably close to the very similar *S. americana*. This puzzle would of course be resolvable by a reliable phylogeny of the genus (Song 2004). Unfortunately, to date, phylogenetic reconstructions based on morphology (Song 2004, 2009) and molecules (Lovejoy et al. 2006, Yassin et al. 2009, Song et al. 2013) have produced conflicting results, which have been interpreted as favoring both the above alternatives. The molecular data favour the "out-of-Africa" hypothesis.

1. *Schistocerca centralis* Dirsh 1974

Dirsh 1974: 87.

Type locality: NICARAGUA: Pochomil.

Location of type specimen: NHM, London.

Etymology.

Latin *centralis*, of the centre; perhaps because the localities of the type series are all in Central America.

Distribution.

Nicaragua, Costa Rica, Panama.

Diagnosis.

Habitus, **Fig. Cyrt1**, **Plate Cyrt1**. Usually slightly smaller than our other local species. Prosternal process (**Fig. Cyrt3**) somewhat tapering, slightly backwards sloping (as in *piceifrons*). Most commonly a dull brown in color with few or no dark maculations, but with a pale dorsal stripe extending from the fastigium to the tip of the elytra. Pronotal lobes are occasionally, though rarely, striped as in *piceifrons* or *pallens*. Hind wing transparent. Male cercus variable, most commonly slightly tapering towards a rounded tip (**Fig. Cyrt4**).

Natural history.

Widely distributed and usually quite common throughout Central America. A sedentary species, never observed to form swarms or show a behavioural or chromatic response to crowding, even under laboratory conditions. Commoner in drier regions. Larvae are pale green or pale brown, with few or no dark markings.

2. *Schistocerca nitens* (Thunberg 1815)

Thunberg 1815: 236, as *Gryllus nitens*

Type locality, "North America".

Location of type specimen: UZIU Uppsala.

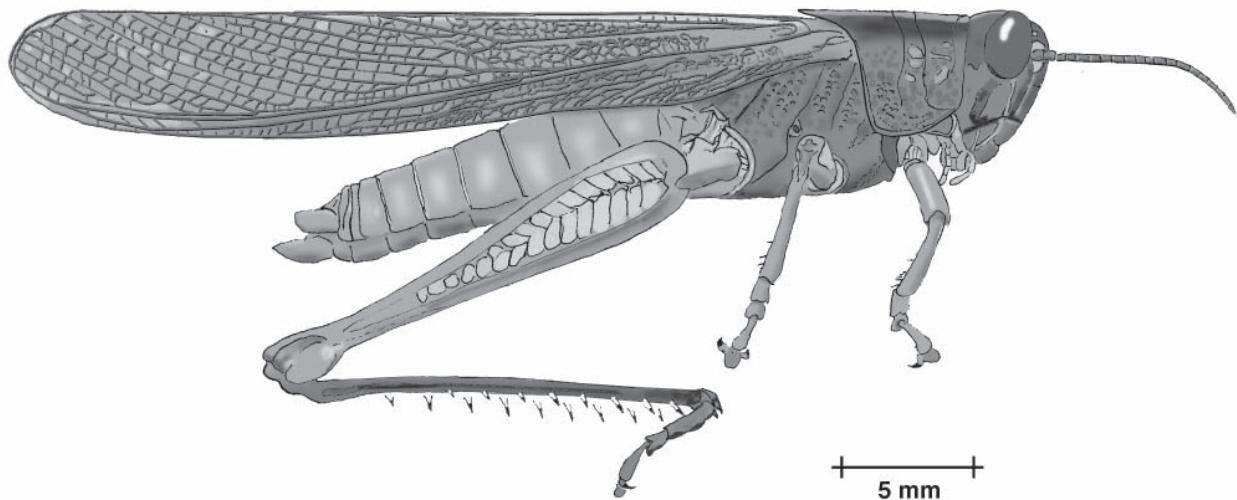


Fig. Cyrt1. *Schistocerca centralis*, male.

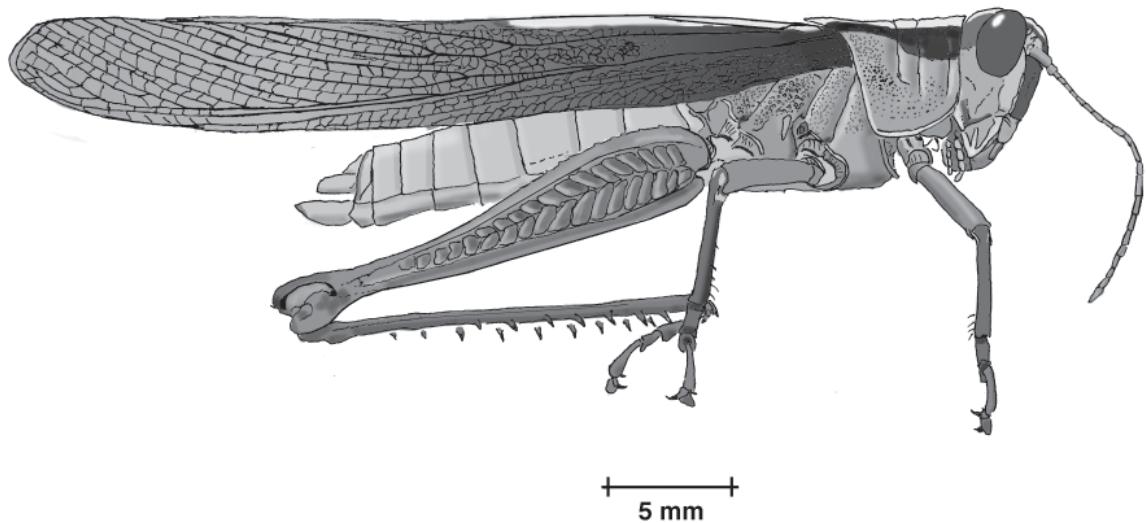


Fig. Cyrt2. *Schistocerca nitens*, male. This illustration shows the green “malachitica” form, typical of wet forest margins.

Etymology.

Latin *nitens*, shining, flourishing.

Synonymy.

- = *aurantia*, Scudder, 1899, syn. Dirsh 1974.
- = *australis* Scudder, 1899, syn. Dirsh 1974.
- = *bogotensis* Scudder, 1899, syn. Dirsh 1974.
- = *boyacae* Hebard, 1923, syn. Dirsh 1974.
- = *carinata* Scudder, 1899, syn. Dirsh 1974.
- = *concolor* (Walker, 1870), syn. Dirsh 1974.
- = *consobrinum* (Walker, 1870), syn. Dirsh 1974.
- = *crocotaria* Scudder, 1899, syn. Dirsh 1974.
- = *gracilis* Scudder, 1899, syn. Dirsh 1974.
- = *gulosa* Scudder, 1899, syn. Dirsh 1974.
- = *implecta* (Walker, 1870), syn. Dirsh 1974.
- = *lividus* (Thunberg, 1824), syn. Dirsh 1974.
- = *luridescens* (Walker, 1870), syn. Dirsh 1974.
- = *malachitica* Rehn, 1905, syn. Dirsh 1974.
- = *maya* Scudder, 1899, syn. Dirsh 1974.
- = *mellea* Scudder, 1899, syn. Dirsh 1974.
- = *occidentale* (Scudder, 1869), syn. Dirsh 1974.
- = *perturbans* Scudder, 1899, syn. Dirsh 1974.
- = *proprium* (Walker, 1870) syn. Dirsh 1974.
- = *pyramidata* Scudder, 1899 syn. Dirsh 1974
- = *scutellare* (Walker, 1870) syn. Dirsh 1974.
- = *semivittatum* (Walker, 1870), syn. Dirsh 1974.
- = *separata* Scudder, 1899, syn. Dirsh 1974.
- = *sonorensis* Scudder, 1899, syn. Dirsh 1974.
- = *strenuum* (Walker, 1870), syn. Dirsh 1974.
- = *vaga* (Scudder, 1876), syn. Dirsh 1974.
- = *vitticeps* (Walker, 1870), syn. Dirsh 1974,
- = *zapoteca* Scudder, 1899, syn. Dirsh 1974.

Distribution.

Southwest USA, Mexico, Central America, South America to Argentina.

Diagnosis.

An exceedingly variable species in both morphology and coloration, which has been described under numerous names (see **Synonymy** above). Usually a rather large species, in our area only the most robust examples of *piceifrons* are comparable in size. The most reliable feature is the prosternal process, which is typically cylindrical and vertical, not sloped backwards (**Fig. Cyrt3**), at its tip rounded or even slightly inflated but never sharply pointed. Further, the hind wings are usually distinctly yellow in colour, whereas those of our other local species are transparent. The lateral lobes of the pronotum are usually unicoloured, with no contrasting stripes. A paler dorsal stripe on vertex and pronotal disc is usually present. Male cercal shape quadrate, somewhat longer than wide, but varying in overall length. Tip obliquely truncate, with almost no suggestion of upper and lower lobes (**Fig. Cyrt4**).

The numerous brown forms of *nitens*, commoner on the Pacific slope, have very variable amounts of black markings

on the elytra and femora, and usually red or dark purplish hind tibiae. On the Caribbean slopes of both Costa Rica and Panama a distinctive dark green form is found, with a yellow or pale green dorsal stripe, brownish or purplish elytra, and yellow or red or pale green hind tibiae (**Fig. Cyrt2, Plate Cyrt2**). This has been described under the names *S. separata* Scudder, *S. crocotaria* Scudder (both of Scudder's types are from Chontales, Nicaragua), and *S. malachitica* Rehn (with type locality Turrialba, Costa Rica). This is the easiest of our local *Schistocerca* forms to recognize, and is usually found in moist environments or at forest edges.

Natural history.

Larvae in the wild are usually green in colour. They are superficially similar to, but larger than, those of *Abracris flavolineata*, which often occur in the same habitat. Under laboratory conditions, the larvae of the N. American form of this species (= *S. vaga* Scudder) have been shown to respond to both crowding and low humidity by an increased probability of changing from green to brown coloration (Rowell & Cannis 1972). This fits with the observation that wild brown larvae are commoner on the drier Pacific slope than on the Caribbean.

Mixed populations of *S. nitens* and *S. pallens* were reported to cause serious damage to sugar cane in Venezuela in 1951, 1958–1959 and 1960, but elsewhere only negligible damage to crops has been attributed to these species (COPR 1982).

3. *Schistocerca pallens* (Thunberg 1815)

Thunberg 1815: 237, as *Gryllus pallens*.

Type locality: "South America".

Location of type specimen: UZIU Uppsala.

Etymology.

Latin *pallens*, pale coloured, yellowish.

Synonymy.

- = *formosa* Bruner, 1911, syn. Dirsh 1974.
- = *gratissima* Rehn, 1908, syn. Dirsh 1974.
- = *idonea* Scudder, 1899, syn. Dirsh 1974.
- = *pectoralis* (Walker, 1870), syn. Dirsh 1974.
- = *viridescens* (Walker, 1870), syn. Dirsh 1974.
- = *vittafrons* Bruner, 1908, syn. Dirsh 1974.
(Type locality Boruca, Costa Rica).

Diagnosis.

Habitus **Fig. Cyrt5**. More slender than *piceifrons* or *nitens*. Prosternal process beak-shaped, pointed at its tip, curved sharply backwards to touch or almost touch the mesosternum (**Fig. Cyrt3**). First abdominal tergite is blue in life, but fades at death. No phase polymorphism or chromatic or behavioural response to crowding (Antoniou & Robinson 1974); all known populations are sedentary. *S. pallens* occurs in a great

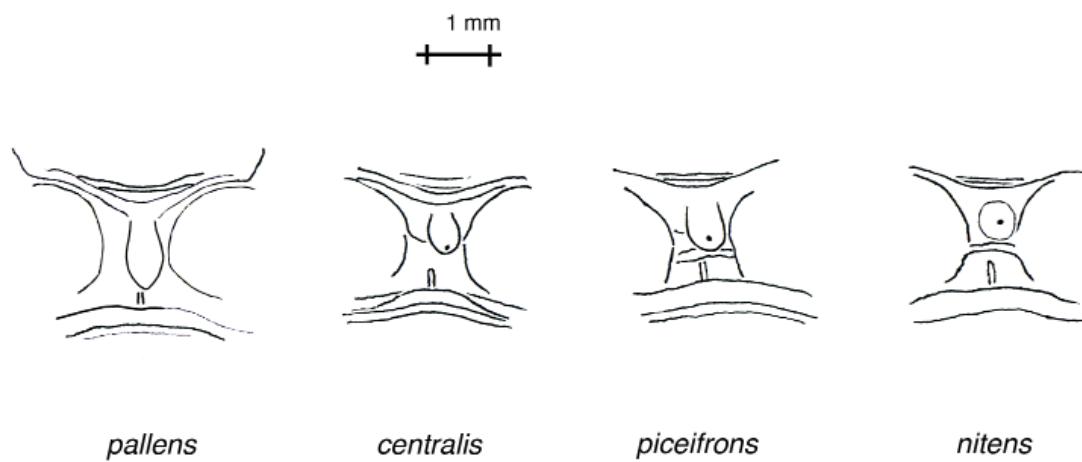


Fig. Cyrt3. *Schistocerca* spp. Prosternal process, oblique ventral view. Only *nitens* has a completely vertical process, only *pallens* a strongly slanted one. *Piceifrons* is more slanted than is *centralis*.

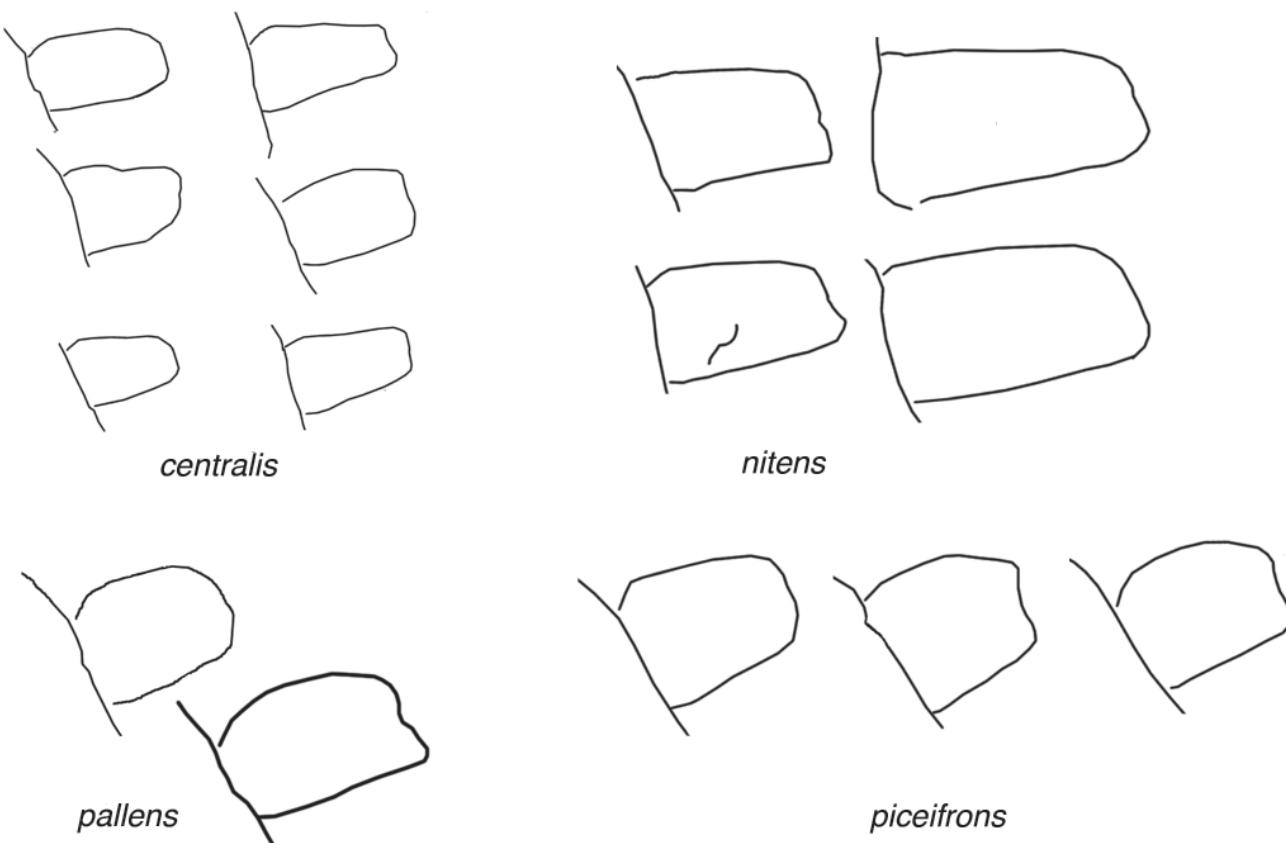


Fig. Cyrt4. *Schistocerca* spp. Lateral views of male cerci. All are shown at the same magnification.
Note that interindividual variation is comparable to the interspecific variation. The character is thus not very useful for interspecific differentiation in our area.

variety of colour forms, varying from mostly yellow (hence the specific name) to heavily patterned, as in typical *piceifrons*, with prominently striped lateral pronotal lobes (**Fig. Cyrt5**, **Plate Cyrt3**) and darkly spotted elytra. The white stripe on the leading edge of the elytron, emphasised in the original description, is often absent.

Distribution, natural history.

The Antilles and Florida (USA) south through Central and South America to Argentina. Harvey (1981) thinks it possible that this large range comprises more than one species, and Song (<http://www.schistocerca.org/key.htm>, accessed 2007) notes differently patterned regional forms. In Costa Rica this species is commonly found at the vegetated margins of Pacific coast beaches. There are no reported cases of crop damage due to this species from within our area.

4. *Schistocerca piceifrons* (Walker 1870)

Walker 1870: 578, as *Acridium piceifrons*.

Type locality: MEXICO: Orizaba.

Location of type specimen: NHM, London.

Etymology.

Latin *piceus*, pitch black; *frons*, forehead or front.

Synonymy.

= *S. benedicto* Dirsh 1974, syn. Harvey 1981.

= *S. patiana* (Posada-Aragno 1879), syn. Harvey 1981.

= *S. urichi* Lynch Arribálzaga 1918, syn. Harvey 1981.

= *S. vicarium* (Walker 1870), syn. Harvey 1981.

Diagnosis.

Habitus **Fig. Cyrt6**, **Plate Cyrt4**. Usually larger than our other local species of *Schistocerca*, except for large specimens of *nitens*. A phasic species: mature gregarious-phase adults are bright yellow in colour, and gregarious phase larvae are black and pink, but these are rarely seen in our area. In live material the notch in the tip of the male SGP is diagnostic – the notch is V-shaped, tapering downwards, and the tips of the flanking lobes are sharply pointed. Unfortunately the notch distorts on drying, and so is not useful for museum specimens. The pronotal process slants backwards (**Fig. Cyrt3**), as in *S. centralis*, but not to the extent seen in *S. pallens*. Elytra comfortably exceed the tip of the abdomen, and are marked with sharply defined dark patches. The hind wing is colourless. Hind tibiae reddish. Usually boldly patterned, with striped lateral lobes to the pronotum. Despite the specific name, the frons is **not** black.

Distribution.

Southern Mexico, Central America.

Natural history.

This is the swarming locust of Central America, which occasionally erupts and is then of major agricultural significance, especially for cereal and legume crops. Its biology was reviewed by Harvey (1983). The most serious recorded invasion of our area took place in 1915, and another lasted from 1939 until 1954. In its solitarious, non swarming form it is present as a permanent breeding population in the dry woodland and savanna areas of North West Costa Rica and thence up the Pacific coast into Guatemala, El Salvador and Mexico. The nearest known outbreak zone to our area is around the Gulf of Fonseca in Nicaragua, whence swarms occasionally penetrate as far south as Panama; other outbreak zones are in Southern Mexico (especially Yucatán) and Northern Honduras (Bredo 1963; Harvey 1983).

A second subspecies of *piceifrons*, *S.p. peruviana*, occurs in the central Peruvian Andes. Harvey (1983) considered this to be the swarming locust of Ecuador, Colombia and Peru, but Yassin et al. (2009) state that this is actually *S. interrita*, and that *S. p. peruviana* is a sedentary form. The two species *interrita* and *piceifrons* are clearly separated in both morphological (Song 2004) and molecular (Yassin et al.) analyses. Yassin et al.'s analysis places *S. interrita* outside of the "americana" clade that embraces all other swarming species of the genus, including *S. p. piceifrons*. If this interpretation is correct, it implies that swarming behaviour has evolved independently in two different clades within the genus.

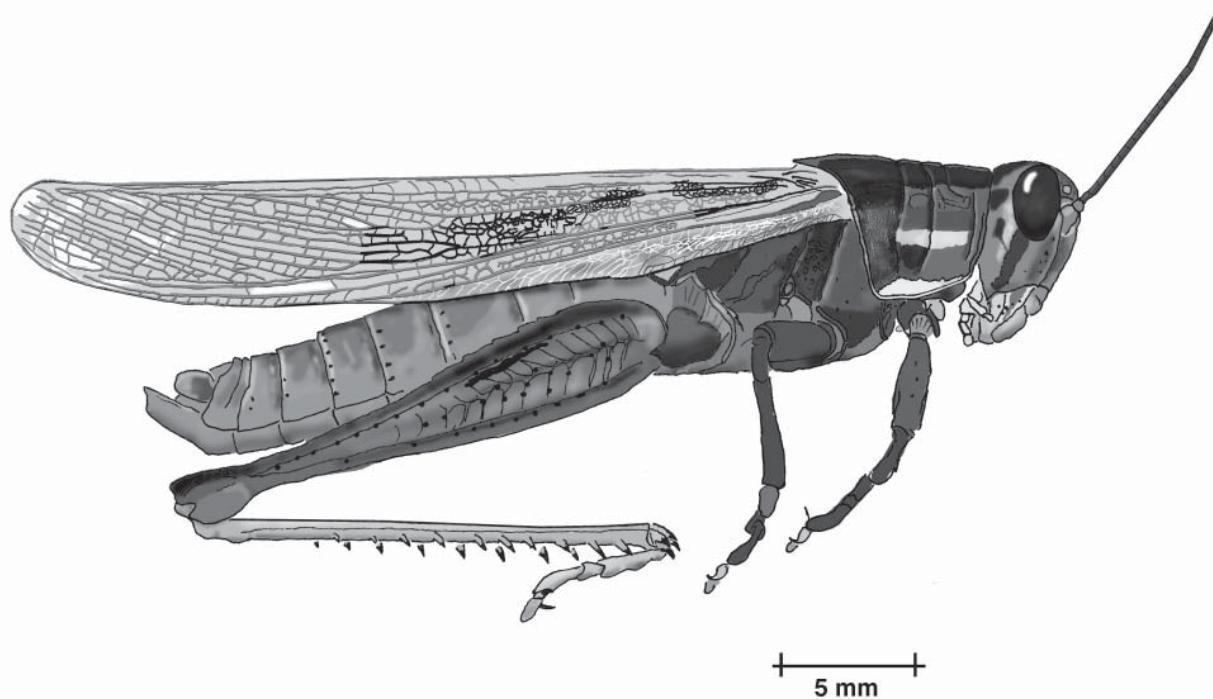


Fig. Cyrt5. *Schistocerca pallens*, male.

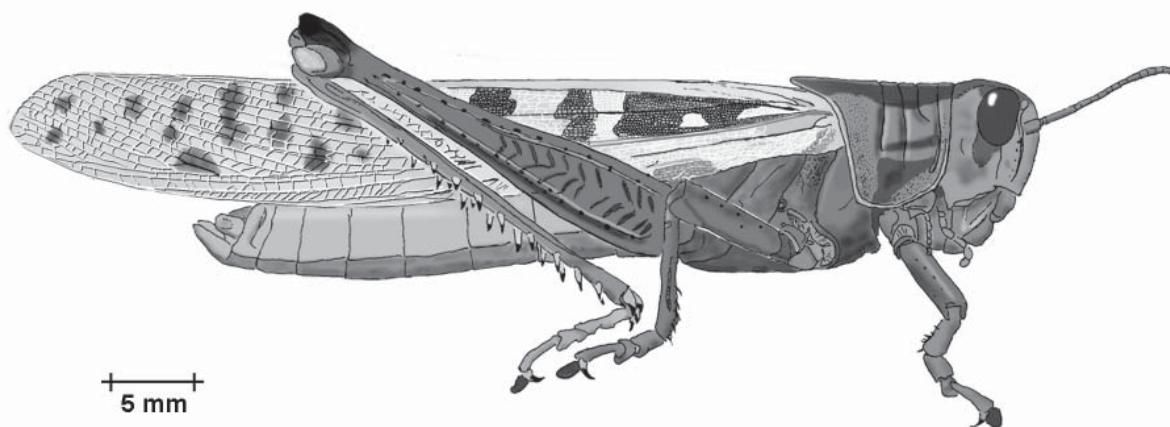
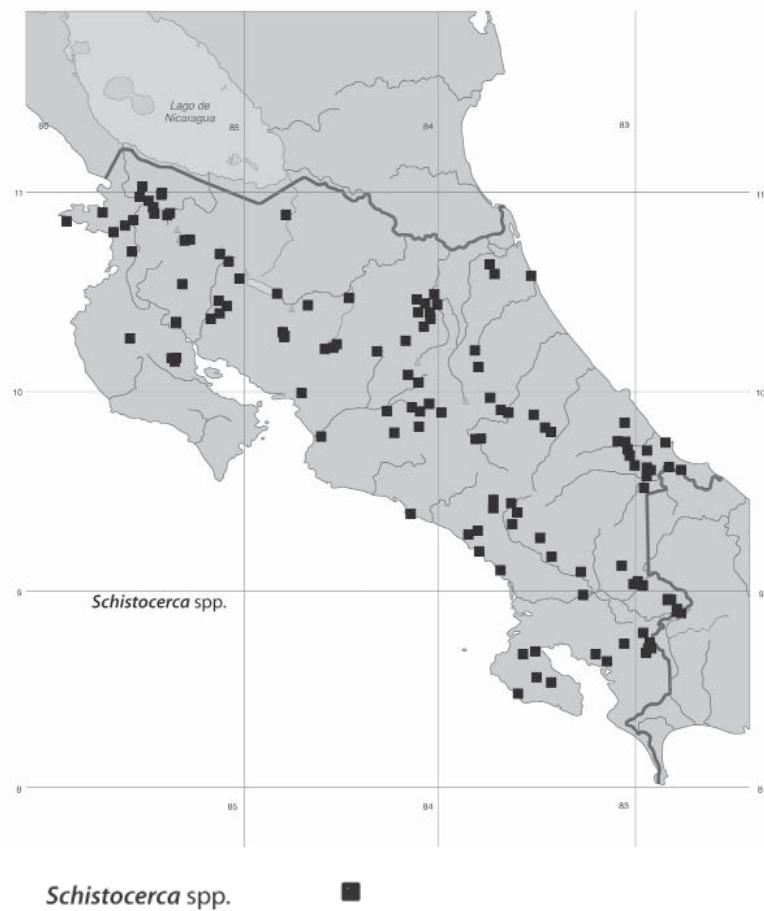
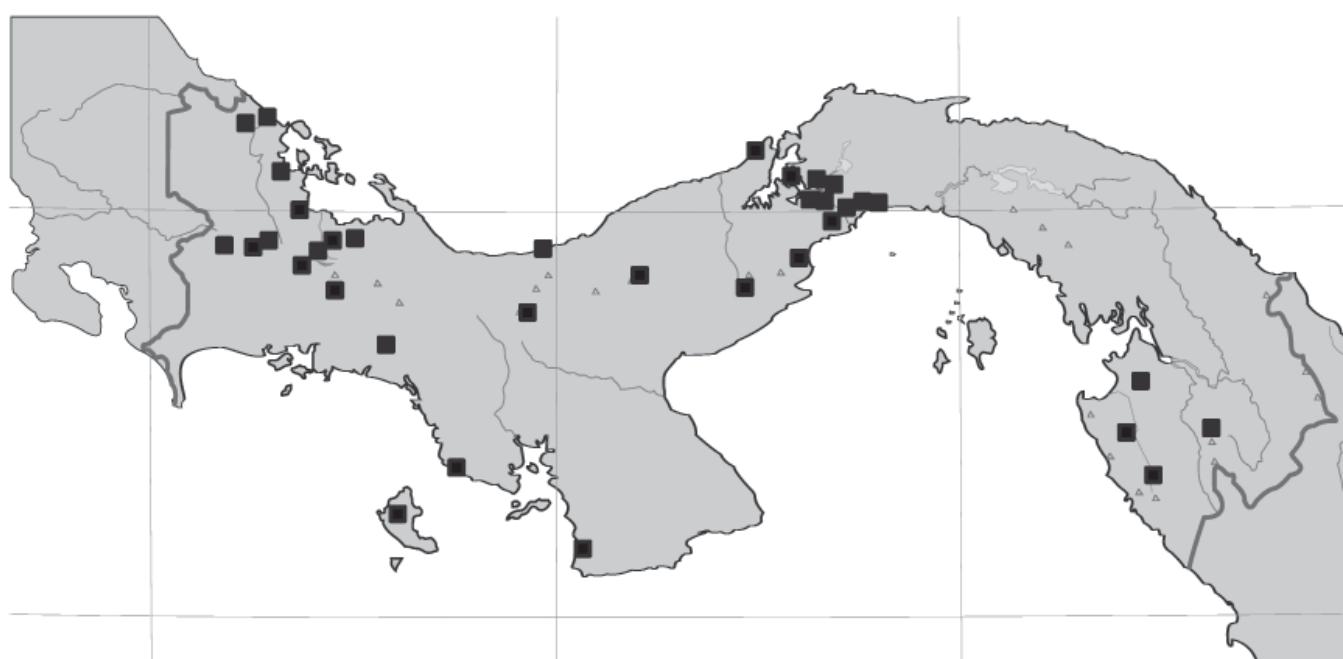


Fig. Cyrt6. *Schistocerca piceifrons*, male.



Map Cyrt1. Localities for *Schistocerca* spp. in Costa Rica.
Note: these records come from varied sources, and the species determination can not be guaranteed. Most are probably *S. nitens*, but some are *S. pallens*, *S. piceifrons* and *S. centralis*, especially on the Pacific slope.



Map Cyrt2. Localities for *Schistocerca* spp. in Panama. Note: the same uncertainty as to species noted in the caption to **Map Cyrt1** applies here too..

Eucopiocerini Descamps 1975

Descamps 1975b:119, as Eucopiocerae
Type genus: *Eucopiocera* Bruner 1900-1910 (1908).

A tribe comprising a group of problematic genera, which have been variously placed in either the Copiocerinae or the Ommatolampinae. All its members are flightless elongate monocot specialists, confined to montane forests of Central America and Mexico. Descamps' original (1975b) grouping consisted of the Mexican genera *Eucopiocera* Bruner, *Chapulacris* Descamps and *Halffterina* Descamps; he gave this group an “-ae” ending, indicating he considered it a subtribe (of the Ommatolampinae). However, *Clematodes* Scudder (Mexico), *Apoxitettix* Descamps (El Salvador, Honduras), and *Leptalacris* Descamps & Rowell (Costa Rica) seem to belong to it as well. Apart from *Leptalacris*, all these genera have been previously grouped in the tribe Delliini (Amedegnato 1974) and *Clematodes* was earlier placed in a Clematodini (Rehn & Eades 1961), both Tribes of the Copiocerinae; but the genera *Dellia* Stål, *Thamnacris* Descamps & Amedegnato and *Bucephalacris* Giglio-Tos contained in Amedegnato's arrangement seem to differ from the rest of the assemblage. Because of its differences from the other members of both the Ommatolampinae and the Copiocerinae this group may well merit separate subfamilial status. Here it is raised to the status of an independent tribe, *incerta sedis* with respect to subfamily.

Tribal range.

Mexico to Costa Rica.

No. of included genera.

Six. In our area, one.

Leptalacris Descamps & Rowell 1978

Descamps & Rowell 1978: 352.
Type species: *Leptalacris fastigiata* Descamps & Rowell 1978: 353.

Etymology.

Greek *leptaleos*, fine, slender, delicate; *acris*, conventionally used for grasshopper.

Descamps (in Descamps & Rowell 1978) originally put the Costa Rican *Leptalacris* in the Ommatolampinae Clematodinini Amedegnato, 1974 (otherwise an Amazonian tribe), exclusively on male genital grounds. However, some of the major points of resemblance are, unsettlingly, in reduced structures (the aedeagal sclerites, arch and ventrolateral sclerites). The remainder of the endophallus and the epiphallus are more positively similar, but there are considerable differences in the structure of the endophallic apodemes and the ejaculatory sac. More importantly, the female internal genitalia (see below and Fig. Euc3) differ greatly from those of Clematodinini, which have a well-developed bursa, a long thin tubular apical diverticulum and almost no preapical diverticulum at all. *Leptalacris* seems to fit much better within the Eucopiocerae (Rowell 2008).

Diagnosis (Modified from Descamps & Rowell 1978).

Male. Habitus, **Fig. Euc4, Plate Euc1**. Small, elongate. Head opistognath: profile of face concave; fastigium longer than eye, more than twice as long as wide at the base, concave dorsally, with a medial ridge; interocular space a little wider than the base of the antennal flagellum (**Fig. Euc1A & B**). Antennae slightly ensiform, flagellum with 18 segments, basal segments of flagellum triangular in section. Frontal ridge lamelliform at the fastigiofacial angle, grooved between the antennae, progressively obsolete below medial ocellus, lateral carinae of the face reduced to a line of irregular projections.

Pronotum short, without carinae, the disc crossed by two fine sulci. Anterior margin excurved, posterior margin slightly bisinuate. Metazona shorter than distance between the two sulci. Ventral margin of the lateral lobes bisinuate. Prosternal process vertical, widening from the base distally, compressed frontally, the anterior face flat, the posterior face convex. Mesosternal lobes subcontinuous, metasternal lobes contiguous. Apterous. Tympanum present, small. Dorsal surface of head, thorax and 1st abdominal segment rugose. Legs thin. Nine external and 10 internal spines on hind tibia. Hind foot 1/3 as long as femur, 1st hind tarsal segment almost as long as the 3rd, 2nd segment short (18% of foot).

Distal abdominal sterna with tufts of hairs, especially the 7th sternite. Posterior margin of 10th tergite a furcula, with a pair of rounded, nonmelanized lobes. Supra-anal plate elongate,

triangular, with a raised margin, divided transversely, medially grooved in proximal part, tip rounded (the subcircular terminal process shown in Descamps & Rowell 1978, Fig 4, is highly atypical). Cerci simple, conical, blunt. Subgenital plate short, bluntly rounded at tip (**Fig. Euc1C & D**).

Male genitalia (illustrated in Descamps & Rowell 1978, Figs 2-9). Ancorae sharp and clearly defined; lophi plate-like, erect, directed forward and upward. Ventrolateral sclerites very small. Two ventroapical invaginations. Cingular apodemes long, wide at their base, pointed at the tip; internal margins subparallel, external margins diverging posteriorly, rami wide and encircling completely the aedeagus. Endophallic sclerites fractured; apodemes narrow and twisted, flattened dorsoventrally; the middle region expanded laterally and ventrally over the spermatophore sac; gonopore process small, digitiform; arch of cingulum weak; dorsal sclerites of aedeagus rudimentary; ventral sclerites weak and indistinct at their extremities. The aedeagal valves are effectively comprised only of sclerotised ectophallic membrane, and are joined dorsally at their base. Ejaculatory sac extraordinarily large, hanging vertically beneath the endophallic apodemes, spermatophore sac rather small.

Female (Fig. Euc2 & 3). Antennae much shorter and more ensiform than in male, but also with 18 segments. Ovipositor valves rather slim, edges smooth. Subgenital plate semicylindrical, with a straight or slightly wavy posterior margin. Egg-guide short, 1/3 as long as exposed part of ventral valves, pointed, somewhat upturned. Comstock-Kellogg glands present, large. Postvaginal sclerites simple, no columellae. Bursa copulatrix practically absent, spermathecal duct starts directly from the vaginal cavity at the level of the basiventral sclerites, with two small sclerites at its base. Preapical diverticulum of spermatheca spherical, at end of a thin duct; apical diverticulum very large, a thin-walled cylindrical sac, with loose pleated walls.

No. known species.

One.

I. *Leptalacris fastigiata* Descamps & Rowell 1978

Descamps & Rowell 1978: 352.

Type locality: COSTA RICA: Prov. Puntarenas, Monteverde.

Location of type specimen: MNHN Paris.

Etymology.

Latin *fastigium*, gable, slope, fastigium (in entomological sense), referring to the prominently elongate fastigium.

Subsequent literature.

- Descamps, M. & Rowell, C.H.F. 1984: 147, Figs 11-13. > Description of neallotype female.

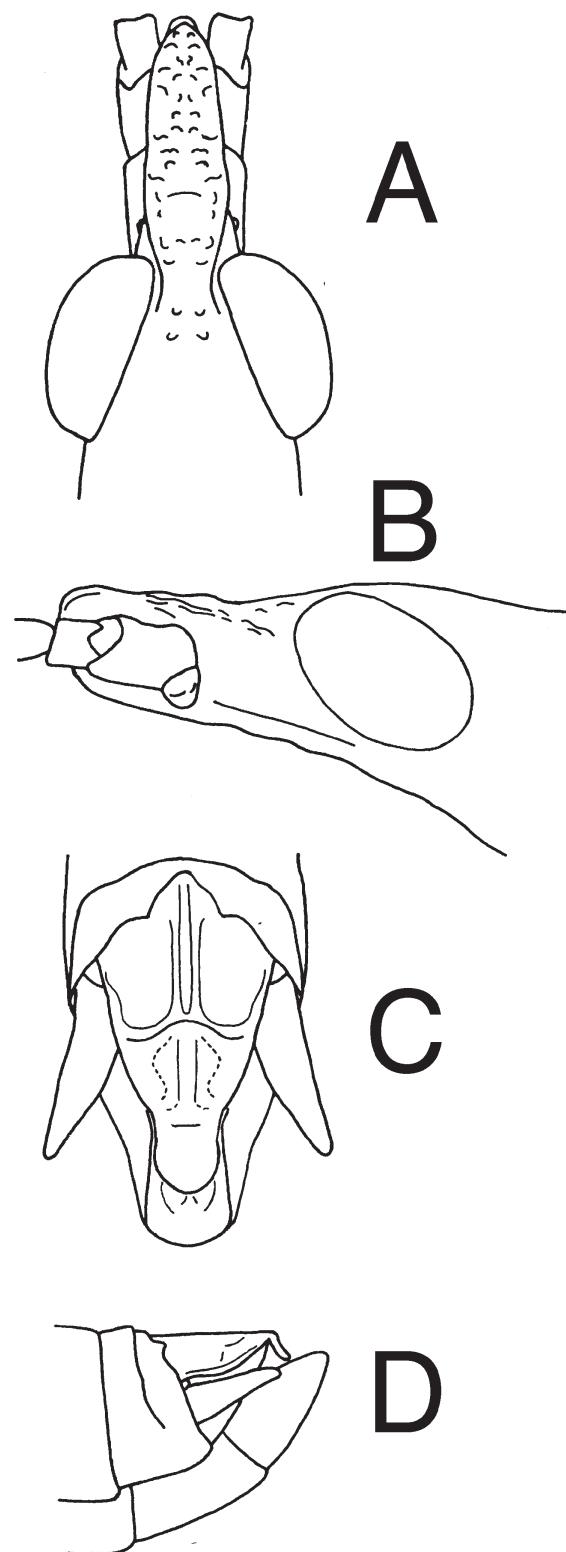


Fig. Euc1. *Leptalacris fastigiata*, male. A, anterior part of head, dorsal view. B, the same, lateral view. C, terminalia, dorsal view. D, the same, lateral view. Modified from Descamps & Rowell 1978.

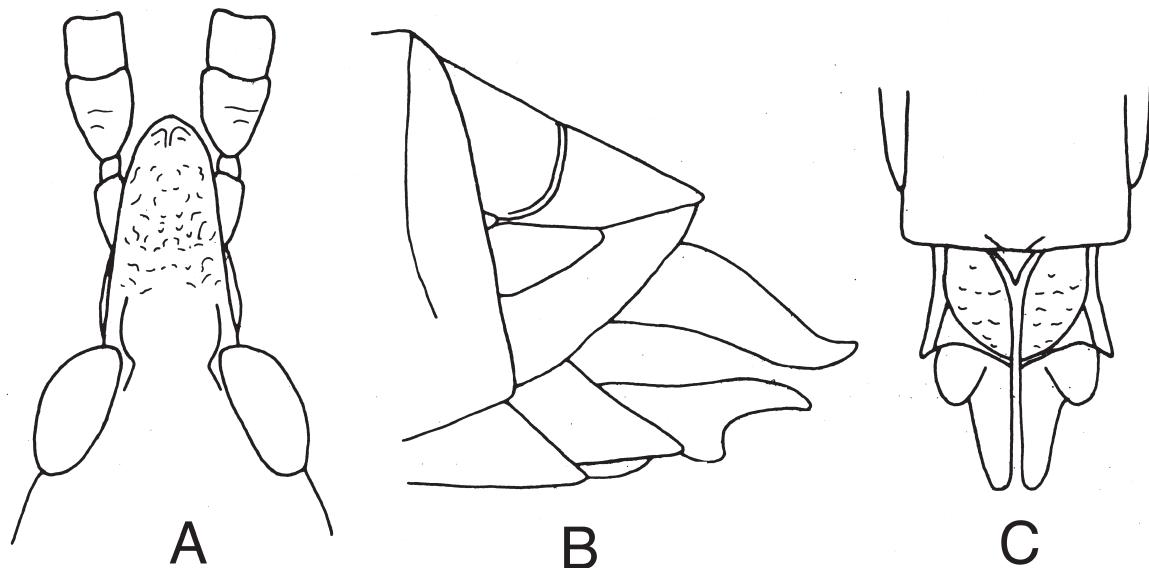


Fig. Euc2. *Leptalacris fastigiata*, female. A, anterior part of head, dorsal view. B, terminalia, lateral view. C, the same, ventral view.
Taken from Descamps & Rowell 1984.

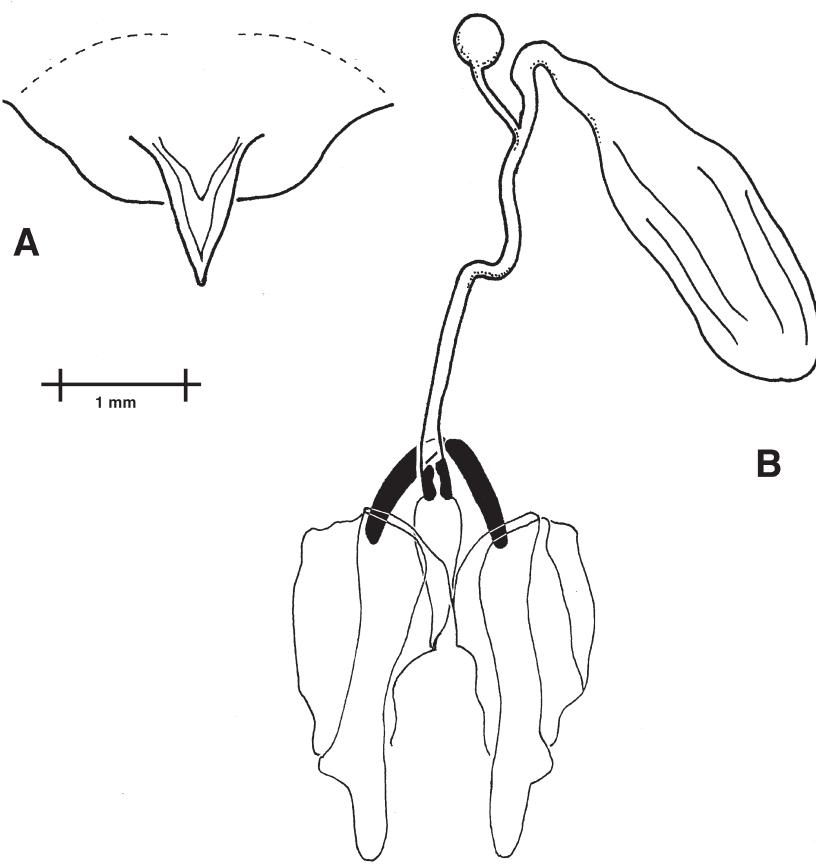
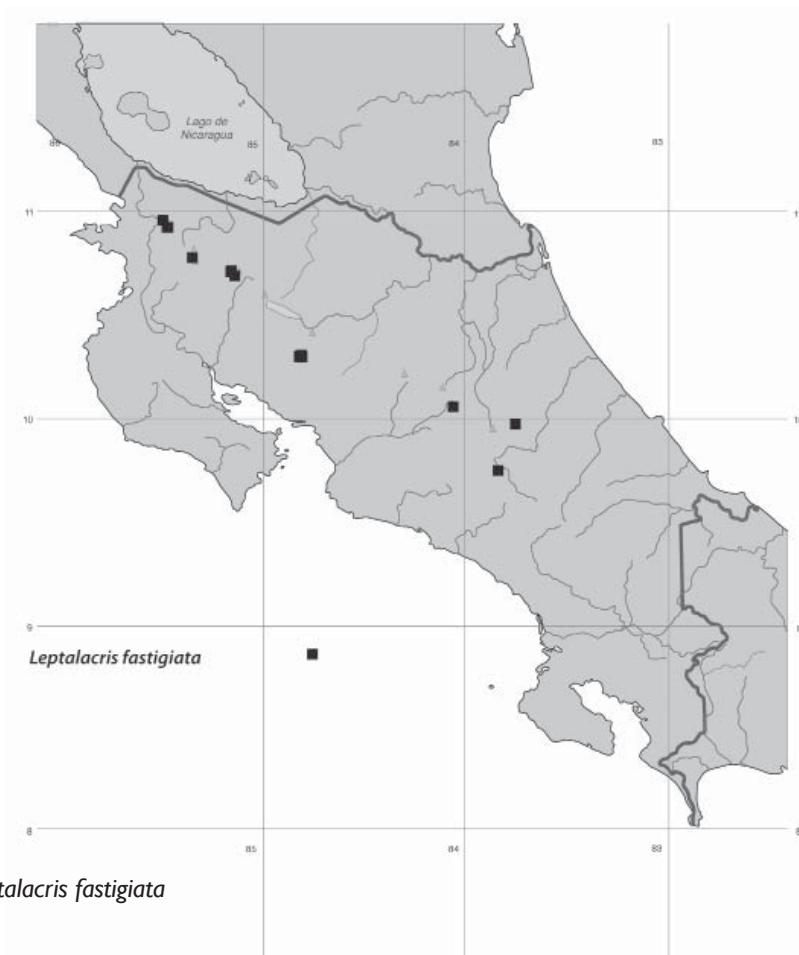


Fig. Euc3. *Leptalacris fastigiata*, female. A, tip of subgenital plate, dorsal view. B, bursa copulatrix, spermatheca and ventral ovipositor valves. Vaginal sclerites in black.



Map Euc1. Localities for *Leptalacris fastigiata* in Costa Rica.

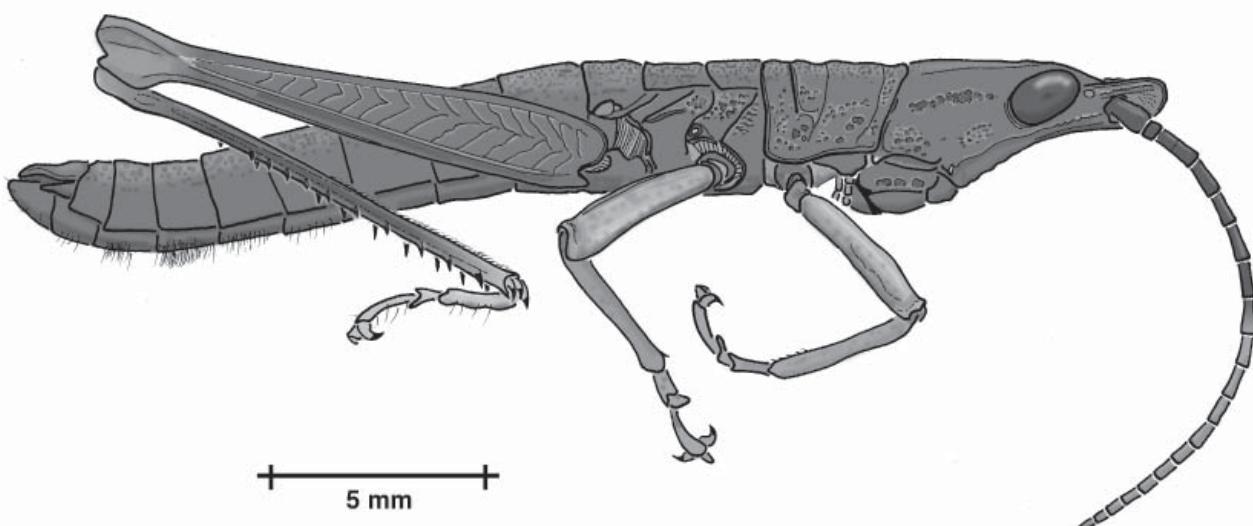


Fig. Euc4. *Leptalacris fastigiata*, male habitus.

Diagnosis.

Monospecific genus, the generic diagnosis applies. Medium (male) to medium-large (female) grasshoppers, average overall length 27.7 mm (females), 25 mm (males), hind femur 14.4. mm (females), 12.1 (males). Sexual dimorphism 0.73 (pronotum midline) to 0.79 (overall length). Relative to the female, the antennae are much longer (78% more), the male has a somewhat (10%) longer and more slender hind femur; and the hind foot is slightly longer (7%). Females have the margins of the pronotum decorated with small black tubercles, absent in males.

Coloration. Green and brown morphs of both sexes occur among adults: brown females and dark green males with pale reddish knees and light brown front and mid legs are commonest. Antennae black proximally, grading to reddish brown distally; eyes red-brown. Larvae are grass green with a dorsal yellow or brown stripe.

Field characters.

Unmistakable elongated shape with long narrow rostrum, almost reminiscent of a small proscopiid at first glance. Cryptic in coarse grass, jumps weakly. Larger and more heavily built than the similarly elongate gomphocerine *Achurum sumichrasti*, which, moreover, is fully alate as an adult, and occurs principally in dry lowland savanna.

Distribution.

Costa Rica. Widely but patchily distributed above 1000 m in the Cordillera del Norte (Monteverde, Tilarán; V. Miravalles; V. Rincón de la Vieja; V. Cacao), the Cordillera Central (Cerro Zurquí, Guayabo), and the NE slopes of the Talamancas (Tapantí). Apparently absent from the southern Talamancas and western Panama. May well extend into Nicaragua.

Map Euc1.**Natural history.**

Inhabits grassy clearings in cloud forest. Will eat some species of grass in captivity, but not *Chusquea* (a bambusoid grass) in which it is often found. Natural food plant unknown. The morphology of the mandibles and the form of the faeces both suggest grammivory, and this is the rule in other genera of the Eucopiocerinae (Amedegnato pers. comm.).

Subfamily Gomphocerinae

Fieber 1853

A large subfamily of world-wide distribution, including nearly 170 genera. The majority of gomphocerines are specialised eaters of grasses (Poaceae), although outside of our area there are exceptions to this rule. They are consequently most common and diverse in areas with ancient natural grasslands, especially the North and South temperate zones and parts of the Old World Tropics. In our region, predominantly forested until recently, there are conversely only a small number of gomphocerines. Most of our species are found in the dry forest and savannah regions of the Pacific slope, or in other recent man-made grasslands.

Diagnosis.

Acridid grasshoppers lacking a prosternal process and possessing a stridulatory saw or file on the lower inner face of the hind tibia, used in conjunction with one or more raised and sharpened veins on the elytron (usually the radius); elytron lacking a raised and serrated intercalary vein of the medial area (diagnostic of the Oedipodinae). This simplified diagnosis strictly speaking also includes the Eremogryllinae, but that subfamily is confined to the Old World.

(It should be noted that the stridulatory file on the hind femur is composed of teeth or pegs of microscopic dimensions, and can rarely be seen with the naked eye; a microscope is necessary. In males, where the file is usually better developed, it is often possible to hear a feeble sound if the insect is held to the ear and its hindleg moved gently across the wing, as in stridulation; this is often a good way of checking for a gomphocerine in the field, but is not infallible, some true gomphocerines cannot be induced to "chirp" in this way. A positive result is always diagnostic, however).

Problems arise with this diagnosis when the femoral stridulatory file of gomphocerines (or the serrated intercalary vein of oedipodines) is secondarily lost, as appears to be the case in several taxa; under these circumstances it is difficult logically to separate either subfamily from the Acridinae (q.v.), especially as the phallic complexes of all three subfamilies are very similar. This fact has given rise to considerable discussion in the morphological literature over the boundaries (if any) between the three subfamilies Gomphocerinae, Oedipodinae and Acridinae. Some molecular systematic analyses (e.g. Rowell & Flook 1998) suggest that the three lines are phylogenetically quite distinct and not closely related to each other. They also suggest that the Gomphocerinae are one of the more modern subfamilies of the Acrididae, whereas the Oedipodinae seem to be a very early branch. Other authors (Chapco & Contreras [2011]) have come to the opposite conclusions.

In our region, all gomphocerines additionally have rounded ends to the elytra and filiform or only slightly flattened

antennae (cf. Acridinae), and unicoloured hindwings, either clear or smoky, but never banded (cf. Oedipodinae). The second tarsal joint of the hind foot is relatively very short, only about 15% of the length of the foot.

The ovipositor valves of the Central American taxa show little variation; all are relatively wide and short, hooked at the tips, with non-serrulate edges. The dorsal valves are concave in dorsal view, with protuberant transverse ridges in their anterior portion. As far as is known, all our species oviposit in soil.

The internal male genitalia have been relatively little used in taxonomic studies of the Gomphocerinae, apparently due to a widespread belief that they show little variation. In comparison with some other acridid subfamilies this is undoubtedly so, but all the genera in our area and most of the species show convincing differences. Exceptionally, for this book, I have figured the phallic complexes of all the Gomphocerinae dealt with here, as in most cases the reader cannot be referred to another publication which shows them. In general, the aedeagus is laterally compressed. The aedeagal valves are moderately long, subequal, and usually sharply upturned, almost vertical. The apodemes of the cingulum are U- or V-shaped in dorsal view, the rami of variable size and form, and the zygoma often has small paired horns or projections pointing rearwards. The epiphallus is distinctive, with multilobed plate-like lophi, which are often fenestrated at their base. Oval and ventrolateral sclerites are usually present, though the latter are sometimes situated dorsally, level with the tips of the aedeagal valves. Dirsh (1975) described the phallic complex of the subfamily as follows (I have replaced some of his anatomical terms with more modern equivalents): "Epiphallus bridge-shaped; bridge short and narrow; ancorae short, acute at apexes, articulated with ends of bridge; lophi bilobate, rarely monolobate, attached to branches extending from bases of bridge; lateral plates narrow or relatively wide, with angular posterior projections. Ectophallus membranous, except for strongly sclerotized, well developed cingulum; dorsal aedeagal valves present. Endophallus strongly sclerotized, endophallic plates large and wide dorsoventrally, endophallic apodemes strongly excurved sideways at proximal ends; gonopore processes present; ventral aedeagal (endophallic) valves relatively wide, upcurved; flexure long and relatively wide".

The Gomphocerinae of the New World, mostly in the temperate zone, are currently divided into about 13 tribes or "genus groups". Of these, only four are represented in Panama and Costa Rica. Many of these groups are still informal, i.e., based on general resemblance, rather than exclusive morphological traits or phylogenetic analysis, and some may not be monophyletic.

Tribe Amblytropidiini

Carbonell 1995

Otte 1981: 159 (as Amblytropidia genus group).
Carbonell 1995: 91.

Type genus: *Amblytropidia* Stål 1873.

Diagnosis.

None provided by author.

No. included genera.

Eight. In our area, two.

Tribal range.

Northern USA to Argentina.

Amblytropidia

Stål 1873

Stål 1873: 93.

Type species: *Amblytropidia ferruginosa* Stål 1873: 93 & 107,
designation by Rehn 1904a, p. 513.

Type locality: Brazil.

Location of type specimen: Stockholm Museum.

Etymology.

Greek *amblys*, blunt, *tropis*, *tropidos*, ridge, keel. Possibly a reference to the rather weak medial carina, or the convex frontal ridge?

Subsequent literature.

- Brunner von Wattenwyl, K. 1893: 120.
- McNeill, J. 1897: 197, 226, 233.
- Scudder, S.H. 1897: 28.
- Scudder, S.H. 1898: 235.
- Bruner, L. 1900-1910: 29, 62.
- Rehn, J.A.G. 1904a: 513.
- Kirby, W.F. 1910: 114.
- Bruner, L. 1911a: 24.
- Jago, N.D. 1971: 239.
- Amedegnato, C. 1974: 203.
- Otte, D. 1981: 168, 225.

No. of described species.

Twenty-three, mostly in S. America. The genus is badly in need of revision. In our area, two species only.

Generic range.

Southern USA to Argentina; Trinidad, Hispaniola.

Diagnosis.

Antennae filiform, slightly flattened basally. Fastigial foveolae absent, occluded by lateral margins of fastigium.

Fastigium with a weak median carina (sometimes extending over the vertex to the pronotum), flat or convex, with or without lateral carinae (**Fig. G1,B**). Frontal ridge broad, convex, confluent with fastigium. Vertex slightly convex in lateral view (**Fig. G1,A**), with or without a variable number of weak longitudinal carinae. Medial carina of pronotum present, cut by only the most posterior sulcus. Lateral carinae of pronotum variably developed, but angle between disc and lobes always sharp and approximately 90°; more or less parallel, but diverging slightly towards the rear; cut by 2 or 3 sulci (**Fig. G1,B**).

Posterior margin of disc angulate (**Fig. G1,B**). Elytra as long as or longer than abdomen. Hind wings (**Fig. G3**) devoid of expanded cells in medial area and without a thickened anterior margin. Hind femora smooth and polished, without darker bands. Stridulatory file present. Hind tibia with 10-15 outer and inner spines in Central American species. External tibial spurs (**Fig. G1,C**) short, subequal, internal spurs both longer than external spurs, medial internal spur considerably longer than the lateral [but not so long as in *Rhammatocerus* (**Fig. G40**)].

Male. Hind wing venation (**Fig. G3**) unmodified, without enlarged cells or thickened anterior margin. Furcula absent; margin of 10th tergite somewhat thickened, with two small depressions either side of midline (**Fig. G1D**). Supra-anal plate triangular, simple, rounded at tip, with a slight medial depression proximally. Cerci simple, conical. Subgenital plate moderately prolonged into an upwardly slanting rounded point (**Fig. G1,E**).

Phallic complex: (**Fig. G2**) Epiphallus (**Fig. G2,D-F**) with trilobate lophi. Oval sclerites present, rather small and weak. Ventrolateral sclerites present, weakly defined, representing merely thickenings of the membrane with numerous trichode sensilla. Smaller trichoid sensilla present on membrane between epiphallus and zygoma (i.e. on the “basal fold” of Snodgrass 1935). Apodemes of cingulum more or less straight in dorsal view, diverging in form of a V, zygoma with two small pointed projections (**Fig. G2G,H**); rami of cingulum long and narrow, almost encircling aedeagal valves in a hoop-like manner (**Fig. G2G,H**). Endophallic apodemes widely flared laterally (**Fig. G2,G**), gonopore processes long and thin (**Fig. G2,H**), dorsal edge of endophallic plates produced into thin vertical wings (arrows in **Fig. G2,H**). Aedeagal valves (**Fig. G2,H**) upwardly turned at about 60° to horizontal, flexure rather short and wide. Ejaculatory and spermatophore sacs of moderate size, ejaculatory duct thick and robust. There are no apparent differences between the phallic complexes of our two species.

Female. Supra-anal plate (**Fig. G2,B**) subtriangular, with a broad, rhomboidal tip. Ovipositor valves (**Fig. G2,B,C**) short, hooked, smooth edged, without marginal teeth. Dorsal valves distally concave on dorsal surface, proximally provided with rough transverse ridges. Subgenital plate (**Fig. G2,A**) trilobate, smooth.

Field characters.

Distinctive in general form: medium size, predominantly

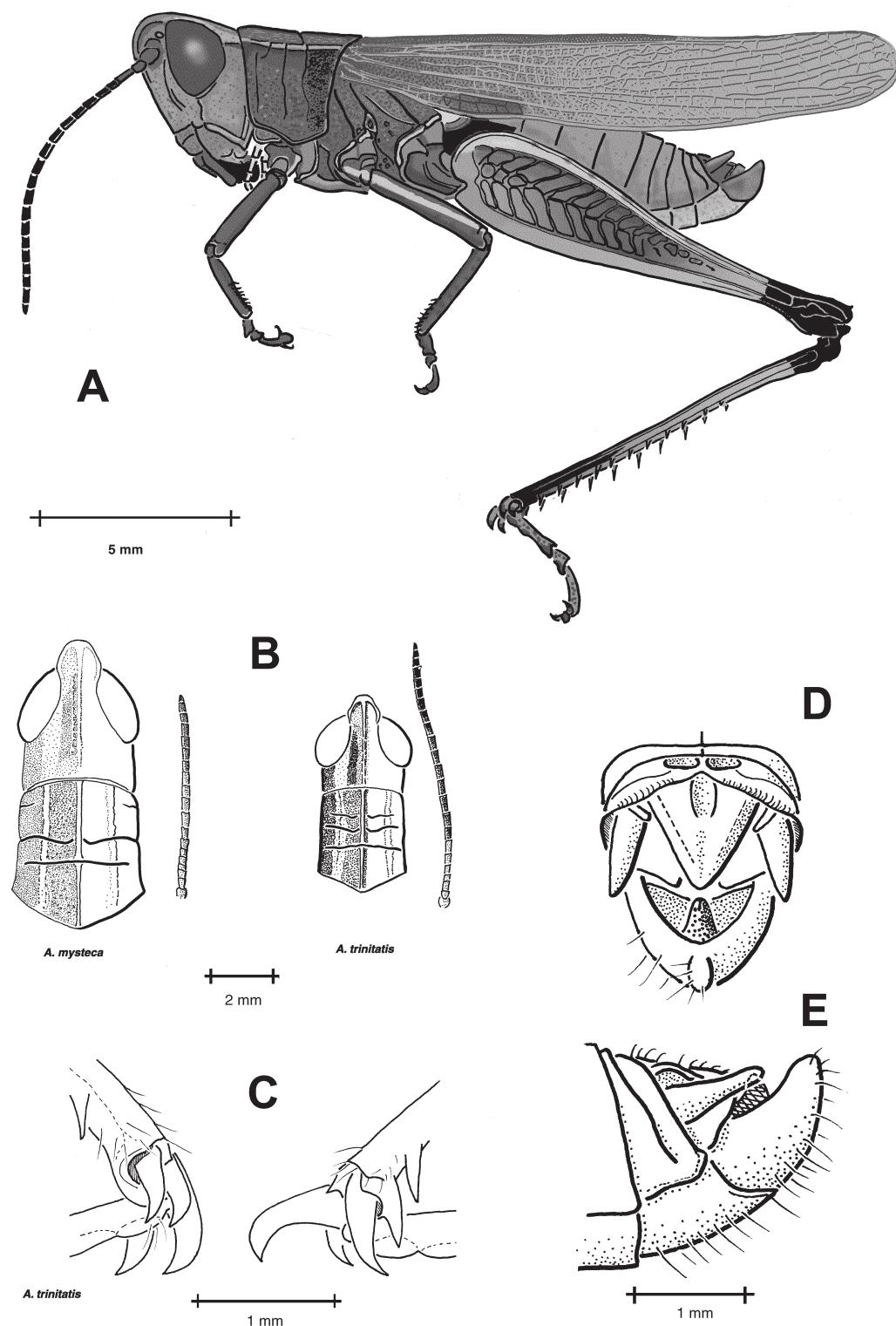


Fig. G1. *Amblytropidia*. A, *A. trinitatis*, male, habitus (see also Plate G1). B, head, pronotum and antennae of *A. trinitatis* and *A. mysteca*, in dorsal view. C, *A. trinitatis*, right hind tarsal spurs, viewed from the external (left) and internal (right) sides. D, *A. trinitatis*, tip of male abdomen, dorsal view. E, as D, lateral view.

brownish colour, disc of pronotum parallel-sided, profile of head blunt and rounded in both lateral and dorsal views. In both our species the dorsal surface of the male abdomen is bright orange and conspicuous in the field. The dark green and orange coloration of many males of *A. trinitatis* (q.v.) is also very easily recognized.

I. *Amblytropidia mysteca* (Saussure 1861)

Stenobothrus (Rhammatocerus) mystecus Saussure 1861:317.

Type locality: MEXICO: Veracruz, Orizaba.

Location of type specimen: MHN Geneva.

Etymology.

Possibly from Greek *mystax*, *mystacos*, upper lip.

Relevance obscure.

Subsequent literature.

- Walker, F. 1870: 756. > As *Stenobothrus (Rhammatocerus) mystecus*.
- Thomas, C. 1873: 205.
- Rehn, J.A.G. 1902a: 9. > Transfers to *Amblytropidia*.
- Rehn, J.A.G. 1904: 518.
- Bruner, L. 1904: 63, 66; 1906: 631.
- Kirby, W.F. 1910: 115.
- Hebard, M. 1932b: 233.
- Otte, D. 1981: 170 & 232.

Synonymy.

=*A. auriventris* MacNeill 1897, synon. Rehn 1902: 9.

=*A. costaricensis* Bruner 1904, synon. Otte 1981: 232.

=*A. ingenita* Bruner 1904: 67, synon. Hebard 1925: 271.

=*A. subhyalina* Scudder 1875a: 511, synon. Bruner 1904: 68.

=*Stenobothrus canadensis* Provancher 1876, synon. Blatchley 1920 under *A. occidentalis*.

=*Stenobothrus occidentalis* Saussure 1861:317, synon. Otte 1981: 232.

=*Stenobothrus subconspersus* Walker 1870: 755, synon. Scudder 1899b under *A. occidentalis*.

Diagnosis.

F male = 15.1 mm, F female = 18.9 mm. Carinae of fastigium indistinct in both sexes, but especially so in females. Middle antennal segments short and broad; length less than 1.5× width; antenna shorter than head and pronotum together (**Fig. G1B**). Lateral pronotal carinae cut by only 2 sulci, the most readily usable character (**Fig. G1B**). Hind tibia with 15 outer and 15 inner spines. Male hind femur with 68 stridulatory teeth (N = 1).

Field characters.

Uniform dull brown or straw colour, apart from the orange of the distal dorsal abdomen of the male. Hind knees

usually (but not always!) brown, not black. Somewhat larger than most specimens of *A. trinitatis*.

Distribution.

SE and SW USA, Mexico, Guatemala, Costa Rica. In Costa Rica (**Map G1**) confined to the Pacific watershed, apart from one old record from Juan Viñas. Most records of this species in Costa Rica are from the northwest coast, or from the western slopes of the Meseta Central, but it also occurs, though less commonly, as far south as Boruca (arrowed in **Map G1**). Its presence in Panama is very doubtful.

2. *Amblytropidia trinitatis* Bruner 1904

Amblytropidia trinitatis Bruner 1904: 65.

Type locality: TRINIDAD, no other data.

Location of type specimen: University of Nebraska State Museum.

Etymology.

Latin “of the Trinity” (Spanish *Trinidad*). The name is derived from that of the type locality.

Subsequent literature.

- Bruner, L. 1906b: 630.
- Otte, D. 1981: 172 & 233.

Synonymy.

=*Amblytropidia insignis* Hebard 1923: 198, synon. Otte 1981: 233.

• Hebard 1924a: 94.

• Hebard 1933b: 42..

=*Amblytropidia magna* Bruner 1904: 63, synon. Otte 1981: 233.

=*Amblytropidia pulchella* Hebard 1932: 234, synon. Otte 1981: 233.

Diagnosis.

F male = 12.75 mm, F female = 18.2 mm. Carinae of fastigium distinct in both sexes. Middle antennal segments long and thin, 2-2.5× longer than wide; antennae longer than head and pronotum together (**Fig. G1B**). Lateral carinae cut by 3 sulci - this is the safest character to use to discriminate between the two C. American species (**Fig. G1B**). Hind knees entirely black (**Fig. G1A, Plate G1**). Stridulatory file with 58 teeth (N = 1). Hind tibia with 11-12 outer and 10-11 inner spines, 7-8 on fore and middle tibia.

Field characters.

Smaller and less robust than *A. mysteca*, and the hind knee is black, not brown. Colour of males is variable: in dry areas (e.g. lowlands of Guanacaste) the elytra and thorax are brown, but in wetter areas of Costa Rica and in Panama they are brightly coloured (**Plate G1**); head and thorax dark green, frons yellowish; hind femora bright orange; all femora bear a dorsolateral yellow stripe; the orange colour of the abdomen extends to the ventral surface too (note however that the

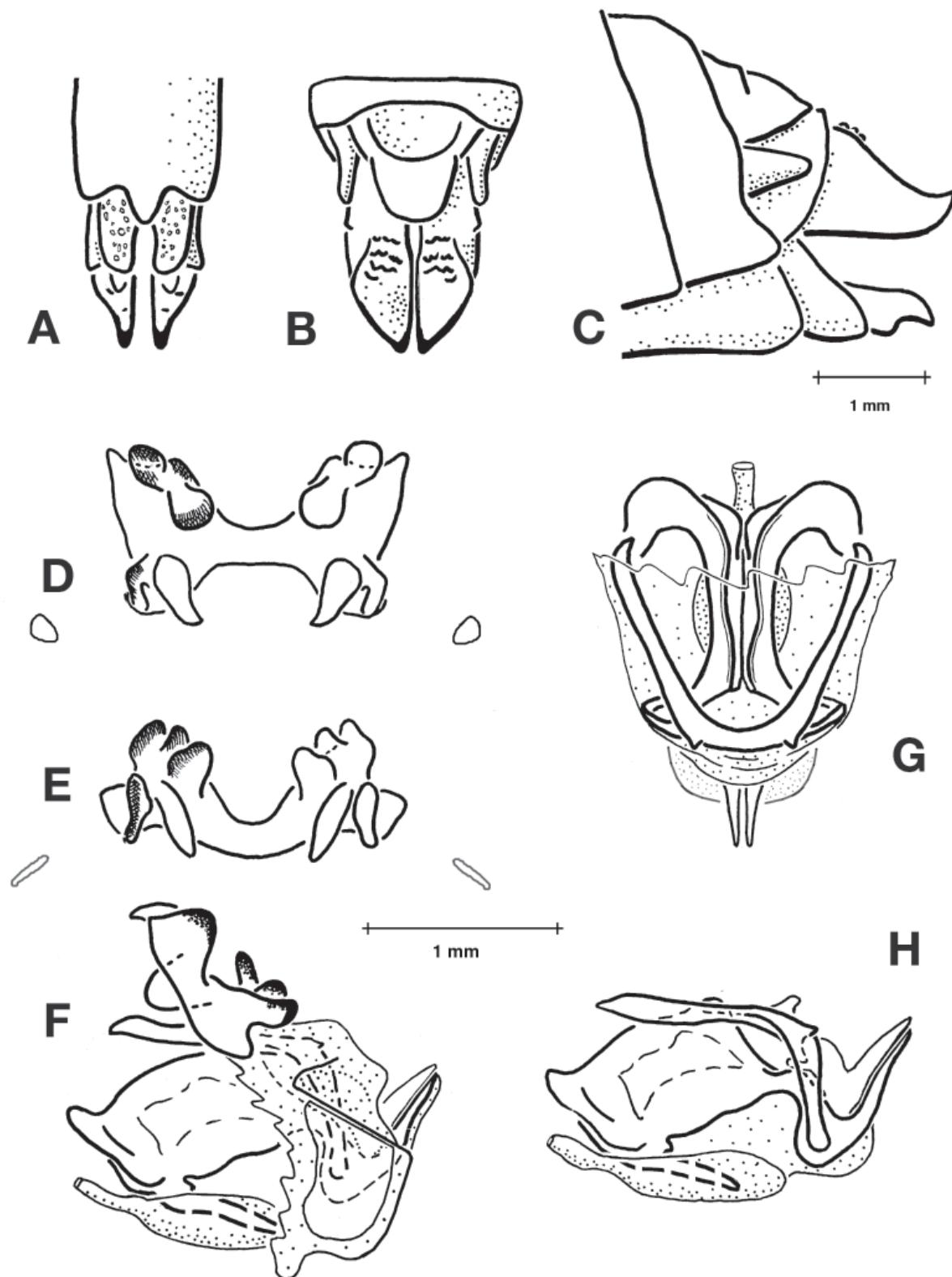


Fig. G2. *Amblytropidia trinitatis*. A, B, tip of female abdomen. A, ventral surface. B, dorsal surface. C, lateral view. D-H, male phallus. D, epiphallus in dorsal view. E, epiphallus in axial view. F, entire phallic complex, lateral view. G, phallic complex without epiphallus, dorsal view. H, as G, but entire epiphallus later removed, lateral view.

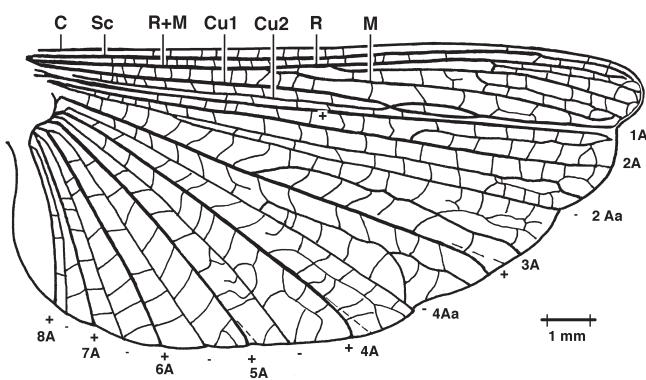
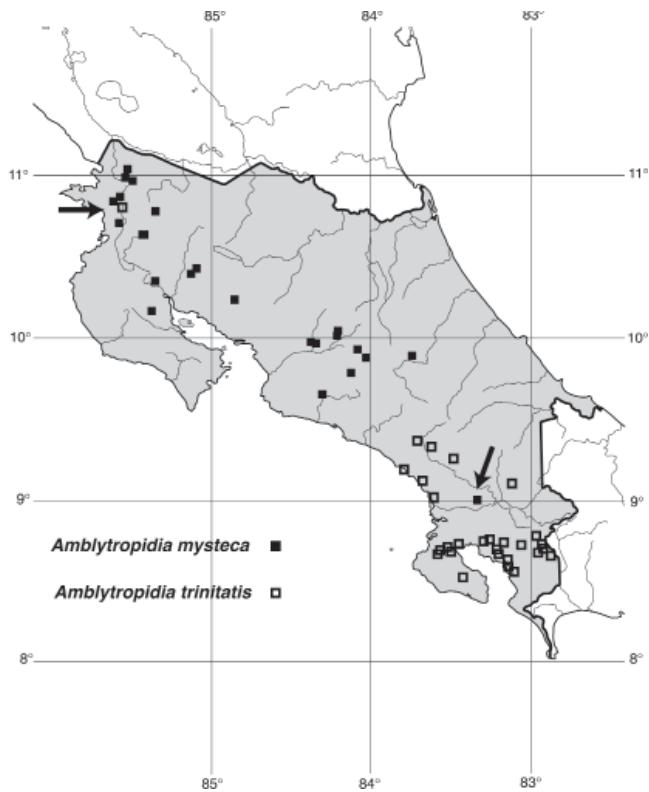


Fig. G3. *Amblytropidia trinitatis* male, wing.



Map G1. Localities for *Amblytropidia* spp. in Costa Rica. The two arrows mark the extreme N/S records for the two spp., and so delimit the area of overlap.

specific name *auriventris* MacNeill is confusingly a junior synonym of *mysteca*, not of *trinitatis*!). Hind wings smoky brown, except for a paler area near the base. Females are all brown, except for the black hind knees.

Distribution.

Mexico (Veracruz, Tabasco); Guatemala, Belize, Honduras, Costa Rica, Panama. In South America, Colombia, Venezuela, Guyana, Trinidad.

In Costa Rica (**Map G1**) confined to the Pacific slope, overwhelmingly in the southern part of the country. In Panama, common and widely distributed on the entire Pacific slope up to 1000m from Chiriquí to Darién, and extends over the watershed to the Caribbean coast in the former Canal Zone.

In SW Costa Rica often sympatric with *Silvitettix communis* and replaces it completely in some lowland wooded areas, such as the region around Esquinas, north of the Golfo Dulce; the same is true in central Panama, where local *Silvitettix* species are confined to higher altitudes.

3. *Amblytropidia mysteca* X *trinitatis*?

In parts of Guanacaste Province, Costa Rica, specimens intermediate between *mysteca* and *trinitatis* occur – they have the size, coloration, larger number of hind tibial spines and habitat of classical *mysteca*, but have the three pronotal carinae and the longer antennae of *trinitatis*. It cannot be excluded that this is actually a separate species, but a hybrid form seems to be the most likely explanation.

Syrbula Stål 1873

Stål 1873: 102.

Type species: *Syrbula leucocerca* Stål (synonym of *Syrbula admirabilis* (Uhler)), designated by Kirby 1910: 107.

Type locality: Texas, USA.

Location of type specimen: Naturhistoriska Riksmuseum, Stockholm.

Etymology.

Obscure.

Subsequent literature.

- Kirby, W.F. 1910: 107. > Designation of type species.
- Jago, N.D. 1971: 238.
- Otte, D. 1981: 174, 229.

Synonymy.

=*Herus* Rehn 1900: 91, syn. Kirby 1910: 107.

No. known species.

Three. In our area, only one.

Range.

E. and S. USA; Mexico; Costa Rica

Generic diagnosis.

(Modified after Otte 1981.) Male antennae variable;

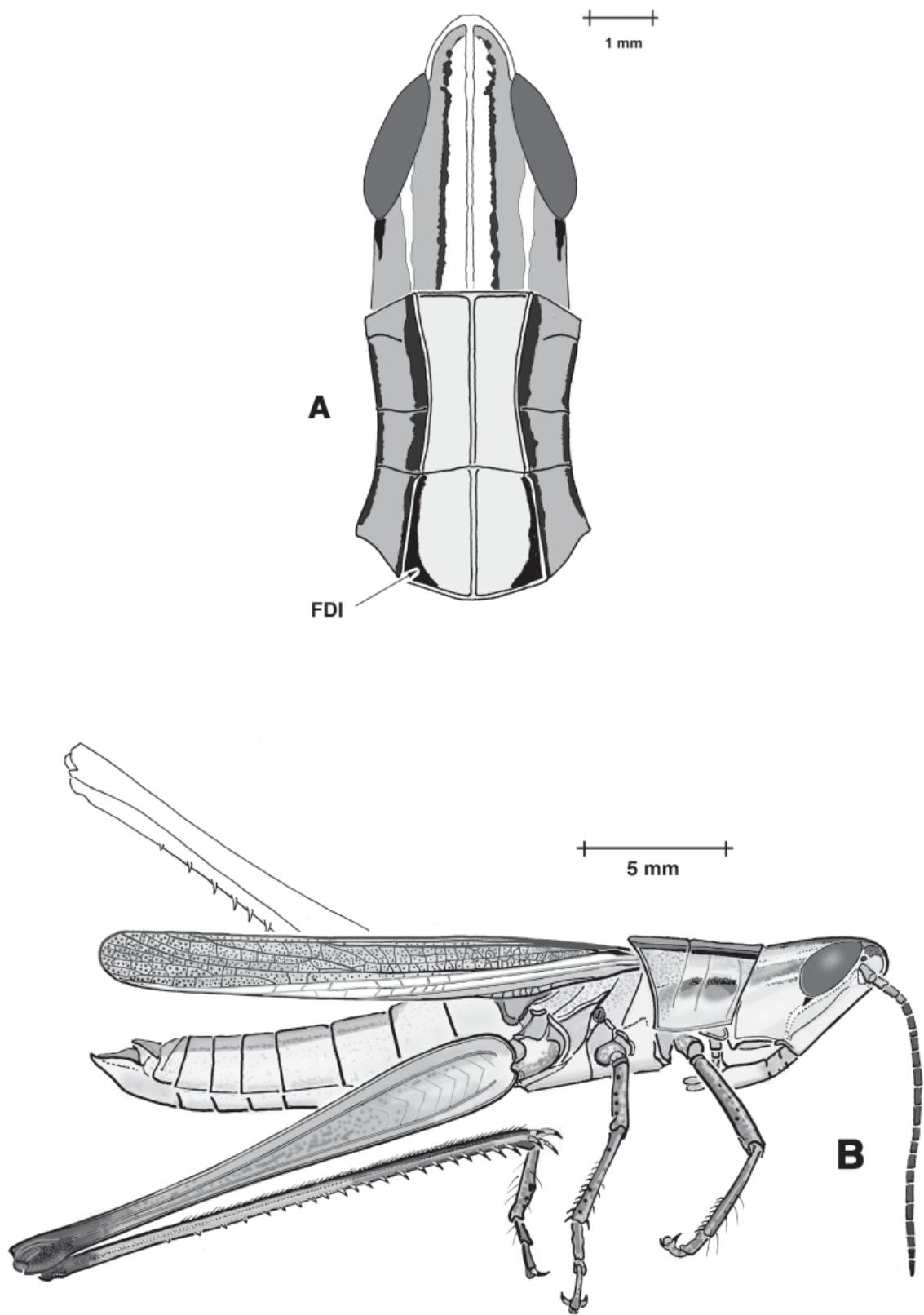


Fig. G4. *Syrbula festina*, male. A, head and pronotum, dorsal view. FDI: fascia dorsalis interior. B, habitus.

filiform, clubbed or ensiform, female antennae always ensiform. Vertex almost horizontal in lateral view, only slightly convex (**Fig. G4A**). Fastigium with a well-marked lateral rim, largely convex and with a median carina (**Fig. G4B**). Lateral foveolae not visible from above. Frontal ridge slightly convex, flat or slightly concave. Frontal profile straight, markedly receding. Anterior margin of pronotum straight, posterior margin bluntly angular. Medial carina of pronotum strongly developed, cut by posterior sulcus. Lateral pronotal carinae well developed; slightly to strongly constricted on prozona and always cut by at least the posterior sulcus. Disc of pronotum with continuous or triangular posterior dark marks on the disc of the pronotum (the *fascia dorsalis interior* or FDI (see **Fig. G4A** and Otte 1981, Fig. 36). Elytra as long or longer than abdomen, but shorter than hind femora. Hind femora very slender, exceeding abdomen in length. Hind tibiae with 16-22 external spines.

Male. Supra-anal plate subtriangular. Furcula almost obsolete. Cerci simple, conical. Subgenital plate pointed and somewhat elongated (but not to the extent seen in *Achurum*), with a dorsal keel (**Fig. G6A,B**).

Female. Ovipositor (**Fig. G6C**) short and broad, valves hooked and pointed in lateral view; edges smooth, devoid of teeth; dorsal surface of upper valve with elevated transverse ridges proximally, concave distally. Subgenital plate (**Fig. G6D**) trilobate at posterior margin, medial process ("egg-guide") short. Cerci simple, angled slightly outwards towards tip. Supra-anal plate triangular, with transverse ridge, medial furrow in proximal part.

Syrbula festina Otte 1979

Otte 1979: 231.

Type locality: MEXICO: Oaxaca, 5.5 mi (= ca 9 km) E. of Tehuantepec, on Route 190,

Location of type specimen: University of Michigan Museum of Zoology.

Etymology.

Latin *festinus*, swift, hasty. Presumably a reference to its behaviour when hunted with a net!

Subsequent literature.

- Otte 1981: 178, 249.

Diagnosis.

F male = 19.2 mm, F female = 24.7 mm. Habitus **Fig. G4,B, Plate G2**. Antennae in male (**Fig. G4,A**) dark brown to black distally but with pale basal segments, slightly ensiform; in female antennae are more ensiform and paler in colour; 20 segments in both sexes. Head largely green or light brown, but vertex with a median ivory band bordered by thin black lines (**Fig. G4,B**). Palps green. Side of head (**Fig. G4,A**) green or

brown, but with an ivory streak joined to a black streak from back of eye towards lateral lobes of pronotum. A thin white line extends from the base of the antenna along the anterior border of the eye almost to the corner of the mandible; at the lower edge of the eye is a small black spot. Thorax and abdomen largely green. Lateral pronotal carinae moderately constricted (**Fig. G4,B**), especially in female. Lateral lobes green with a rather diffuse black or brown horizontal line dividing prozona into subequal parts, more distinct in males than females (**Fig. G4,A**). Disk of pronotum with a pale brown, ivory, or pale green median band bordered on either side by darker colour; in females the same coloration is produced along the abdominal segments as well. Elytron green or greyish; dorsal field dark brown in males, light brown or straw coloured in females, lateral field dark, with a pale green or white horizontal streak above base of hind legs. Fore and middle legs, brownish. Hind femora unbanded, green proximally, reddish brown distally, with darker knees. All carinae of hind femur thin and very sharply defined. Stridulatory file with 88 teeth in male, 77 in female (N = 1). No medial spine at end of knee. Hind tibia pale brown proximally, darkening distally, with 21 external spines and 18 internal ones, all black tipped. Tarsi brown; last segment unusually short, first tarsal segment is significantly longer than second and third segments together. Male supra-anal plate (**Fig. G6,A**) weakly divided into proximal and distal portions by a transverse ridge; proximal area flat, with a raised lateral rim, distal area with medial depression and tectate edges, tip with lateral protuberances.

Phallic complex: Epiphallus (**Fig. G5,A,C**) with large plate-like, trituberculate lophi; bridge shallow. Oval sclerites present, ventrolateral sclerites absent. Cingulum (**Fig. G5,D**) with two horizontal projections on zygoma, tips of apodemes slender and hooked. Endophallic plates (**Fig. G5,E**) with a short dorsal projection, apodemes not widely flared, flexure narrow and short, aedeagal valves slanted upwards at about 70°. Ejaculatory sac relatively small, with transverse ribbing on ventral surface, ejaculatory duct unusually wide.

Field characters.

Pointed head; prominent dark-light-dark dorsal stripe extends from fastigium to posterior margin of pronotal disc; this forms an hour-glass shape on pronotum (**Fig. G4,A**), especially in females. Green/brown polymorphic. Larval *Rhammatocerus viatorius* are very similarly marked, and are sympatric with this species; they, however, have a rounded profile to the head. Larvae of *Syrbula festina* are plain brown or green, without distinctive markings; the shape of the head is the best character by which to recognize them.

Distribution.

Mexico (Oaxaca, Chiapas), Costa Rica (new distributional record).

In Costa Rica (**Map G2**) known to date only from northern Guanacaste Province. The apparently disjunct

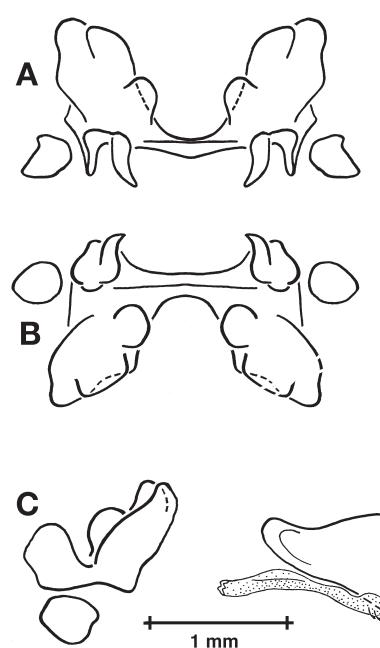


Fig. G5. *Syrbula festina*, phallic complex. A, epiphallus, axial view. B, epiphallus, dorsal view. C, epiphallus, lateral view. D, cingulum and endophallus, dorsal view. E, endophallus, lateral view.

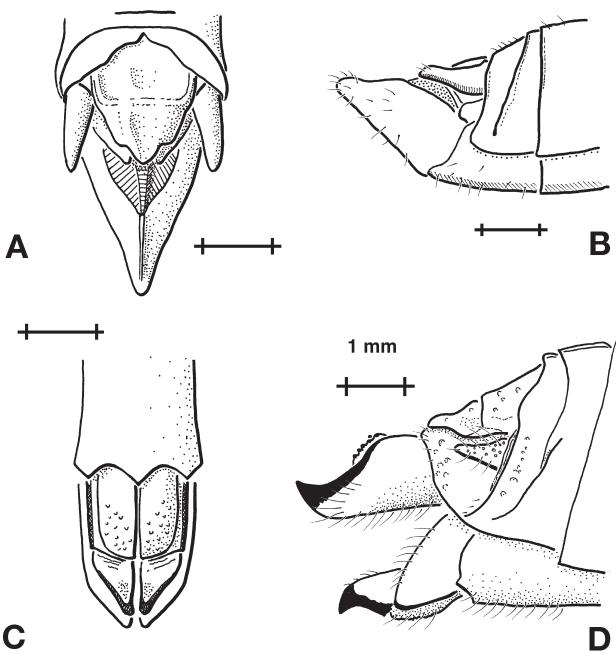


Fig. G6. *Syrbula festina*, terminalia. A, male, dorsal view. B, male, lateral view. C, female, ventral view. D, female, lateral view.



Map G2. The sole Costa Rican locality to date for *Syrbula festina*.

distribution is suspect: the species probably occurs on the Pacific slopes of other Central American countries to the north of Costa Rica too.

Natural history.

In savanna derived from dry forest, together with *Rhammatocerus* and *Achurum*. Strongly seasonal; first adults appear in late August.

Silvitettix

Bruner 1904

Bruner 1904: 55.

Type species: *Silvitettix communis* Bruner by monotypy.

Etymology.

Latin *silva*, forest; *tettix*, conventionally used for grasshopper.

Subsequent literature.

- Kirby, W.F. 1910: 112.
- Jago, N.D. 1971: 271.
- Otte, D. & Jago, N.D. 1979: 258. > Review of genus.
- Otte, D. 1981: 66 & 229.

Synonymy.

=*Ochrotettix* Bruner 1900-1910: 56, synon. Jago 1971: 271.

=*Leuconotus* Bruner 1900-1910: 57, synon. Jago 1971: 271.

=*Oaxacella* Hebard 1932b : 231, synon. Jago 1971: 271.

=*Charpentieracris* Descamps & Amedegnato 1970, synon. Otte & Jago 1979: 258.

Diagnosis.

Antennae dorsoventrally flattened at base (**Fig. G8A**), but not ensiform. Vertex convex in side view, frontal profile almost straight, sharply receding (**Figs G9, G10**); frontal ridge moderately to deeply grooved above medial ocellus, and extending ventrally beyond it. Foveolae of fastigium absent. Medial carina of pronotum present; lateral carinae of pronotum obsolete, replaced in some but not all (*communis*!) species by supplementary carinae nearer the midline. Costal area of elytron not expanded. Stridulatory file present; tooth number varies within a species by up to 50%, only that of *S. bolleyi* is distinctive. Tibial spines variable in number, from 8-12; usually 9-10 external, 10-11 internal. Fully winged or brachypterous; in our region always brachypterous, elytra not extending beyond the 6th abdominal segment.

Male. Furcula of male very weakly developed, consisting of two small rounded or rectangular lobes. Cerci simple, conical, with a remarkably varied assortment of hair sensilla. Supra-anal plate subtriangular, rounded at tip, with a proximal medial concavity, the sides shallowly tectate, with or without a transverse groove. Subgenital plate rounded, ending in a small dorsally directed peak, varying slightly between species (**Figs G9-11**).

Phallic complex (**Fig. G12**): Epiphallus wider posteriorly than anteriorly, giving a V-shaped appearance in dorsal view. Posterior processes acute, usually pointed. Lophi bilobate, the more posterior, outer lobes also tending to be themselves doubly lobed. Oval sclerites very weak or obsolete. Ventrolateral sclerites absent, but a thin medial disc-shaped sclerotization present ventrally and medially in ectophallic

Tribe Compsacrinae Carbonell 1995

Otte 1981: 63, 226, as "Silvitettix genus group".
Carbonell 1995: 90.

Diagnosis.

None provided by the authors. Type genus: *Compsacris* Bolívar 1890.

No. of included genera.

Six (after Eades et al.); five (after Carbonell 1995); seven (after Carbonell, Ruiz-Baliu & Amedegnato; the last authors additionally include the genera *Staurorhectus*, *Compsacrella*, and *Notopomala*). In our region, only one.

Range of tribe.

Central Mexico to at least Peru and Bolivia; depending on inclusion of other genera, to Uruguay, Paraguay and Argentina, and to Cuba.

membrane beneath flexure of endophallus. Zygoma of cingulum provided with paired pointed processes overhanging the aedeagal valves. Gonopore processes long and slender. Ejaculatory sac large and disc-shaped, the ventral surface with fine transverse cuticular ribbing. Ejaculatory duct wide and irregular in diameter. The different species are very similar in genital structure: the differences are in the proportions of the epiphallus, especially of the lophi and posterior processes, in the detailed shape of the ventral aedeagal valve, and in the size and inclination of the horns of the zygoma.

Female (Fig. G13). Supra-anal plate (Fig. G13,I) subtriangular, elongate, with rounded tip; deep medial proximal depression; tectate, sides sloping downwards. Ovipositor valves (Fig. G13K) long, rather broad, hooked and pointed, edges devoid of teeth; upper valves provided with rough transverse ridges on proximal dorsal surface, concave distally. Subgenital plate (Fig. G13,J) bluntly pointed distally, edge bisinuate, approaching a trilobed condition; midline surface lightly pitted.

Internal genitalia (Fig. G13,G, H): bursa copulatrix long, slender and thin-walled, tapering gradually into duct without clear boundary. Spermatheca with rather large and globular apical reservoir, single pouch- or finger-shaped lateral diverticulum. The different species vary only slightly in the shape of the diverticulum.

No. known species.

Eighteen (one here synonymized).

Generic range.

Mexico; all of the Central American countries; Colombia; French Guiana; Guyana; Peru; Bolivia; Brazil.

Field characters of genus.

All the Central American species are brachypterous (distinguishes from all other regional gomphocerines except *Orphulella pernix* (N. Guanacaste, Costa Rica). The supplementary carinae of the pronotum (see Diagnosis) readily distinguish *Silvitettix* from *O. pernix* (and from other, extra-regional brachypterous *Orphulella* species) - they are parallel, whereas the lateral carinae of *Orphulella* are sharply constricted towards the metazona and present an hour-glass appearance when viewed dorsally.

The different species within our region are relatively difficult to distinguish morphologically, other than by their coloration, and seem very similar ecologically too. Their stridulation is common in courtship but is inaudible to the human ear (ultrasonic); it is not yet known whether they differ in their songs. The specific distinctions in the number of stridulatory teeth given by Otte & Jago (1979) were based on too few individuals; when larger samples are used, many of these differences disappear, and only *S. biolleyi* has a distinctive number. The males of all our species are of more or less the same size and shape; have abdomen and venter orange or yellow; blackish

knees; the transverse arcuate sulcus of the fastigium is more or less central; palps with somewhat expanded, flattened, white or yellow tips; a pale medial stripe running from fastigium to at least the posterior edge of the pronotum (whence the synonymized generic name *Leuconotus*); lateral field of elytron blackish, dorsal field light coloured (except in some *communis* individuals, where black). These characters do not help in species discrimination. For specific characters, see the key to males and the individual descriptions below.

Females (Fig. G9,A) are much larger than males, and more sombrely coloured in shades of brown; they are also very variable in their coloration, especially the pronotum (see e.g. Otte and Jago [1979], Figs I & II), whereas the males of a given population are constant. They are best identified by the associated males. After comparing Otte & Jago's (1979) keys with my specimens I find it difficult to believe that Central American females can be effectively keyed or separated. The only characters that seem to apply consistently are a) no. of stridulatory teeth – *S. biolleyi* has 80 or more teeth (rudimentary in the female), the other species significantly fewer; b) no. of internal and external spines on the hind legs – *S. communis* and *S. maculatus* usually have only 9 external and 10 internal spines, the other species usually have more. The other characters suggested by the above authors (e.g. shape of posterior margin of prothorax, relative accentuation of the pronotal carinae, relative length of the elytra) seem to submerge in the variation to be found within each species. These difficulties are however not very serious considering that a) males are usually more obvious and more frequently caught than females and b) there is good geographical separation between the two species which could be confused morphologically (*communis* and *maculatus*). The female of *gorgasi* is unknown.

Relationships between species.

Of the five species of the genus found within our area the southernmost three (*communis*, *centralis* and *gorgasi*) seem to be closely related. They have a similar arrangement of pronotal sulci (Fig. G8) and carinae, similar coloration, similar supra-anal plates, and the internal genitalia of at least *communis* and *centralis* are practically identical (in view of this absence of specific differentiation the unique holotype of *gorgasi* was not dissected). The other two species (*maculatus* and *biolleyi*) do not seem to be especially close either to the *communis* group or to each other.

Natural history.

At least within our region, the species of *Silvitettix* are very homogenous in their ecology. All are specialist feeders on forest grasses (e.g. *Digitaria* spp., *Alyria* spp.). They require some sun, but not too much of it, being highly permeable and dessicating quickly if placed in dry air. They are found in light gaps and along trails in moist or wet forest where these support suitable grass species, and most abundantly at forest edges. They are seldom found more than 20 metres from woodland, and are rare in, or absent from, true dry forest (e.g. of northern Guanacaste, where they are replaced by *Orphulella pernix*). In

Costa Rica and Panama, *Silvitettix* is characteristic of montane forest and of the woodlands of the Pacific slope, and is generally absent from the Caribbean lowlands (**Maps G3 & 4**).

Artificial key to males of Costa Rican and Panamanian species of *Silvitettix*.

(Use in conjunction with **Fig. G7**.)

- I Face, cheeks, and entire lateral lobe of pronotum black. Medial and supplementary carinae of pronotum indistinct or obsolete (Central Costa Rica to Western Panama). *Silvitettix communis*
- IA not as above. 2
- 2 Elytron noticeably shorter ($\times 0.8$ or less) than head and pronotum together. Fastigium at least $1.2\times$ as long as wide. Lateral lobe of pronotum and head grey-green, hind femora light grey-green or straw coloured, usually with a basal and ventral black mark on the internal face (**Fig. G7**) (Central and Northern Costa Rica). *Silvitettix maculatus*
- 2A Elytron about as long as (at least $0.9\times$) or longer than head and pronotum together. 3
- 3 Stridulatory file with 80 or more teeth. Fastigium as wide as or wider than long. Hind femur green, yellow or brown, but always with a prominent pale pregenicular ring (**Fig. G7**) (N.E. Costa Rica). *Silvitettix bolleyi*
- 3A Stridulatory file with 70 or fewer teeth. Supplementary carinae of pronotum indistinct. Fastigium as long as or longer than wide (Central Panama). 4
- 4 Elytra longer than head and pronotum together.
Stridulatory file with 60 or more teeth. *Silvitettix gorgasi*
- 4A Elytra as long as or shorter than head and pronotum together. Stridulatory file with fewer than 60 teeth.
Extreme basal lobes of hind femur lighter in colour than rest of femur (**Fig. G7**). *Silvitettix centralis*

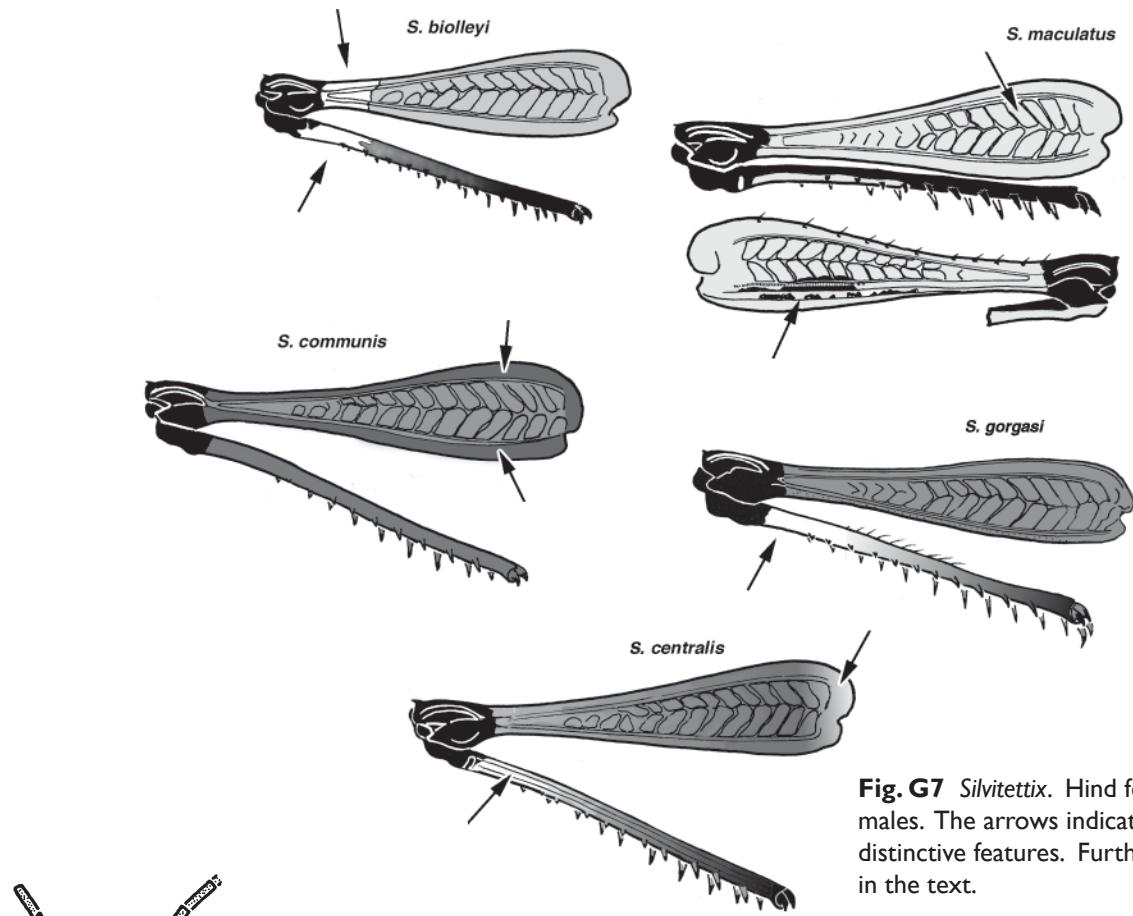


Fig. G7 *Silvitettix*. Hind femora of males. The arrows indicate species distinctive features. Further explanation in the text.

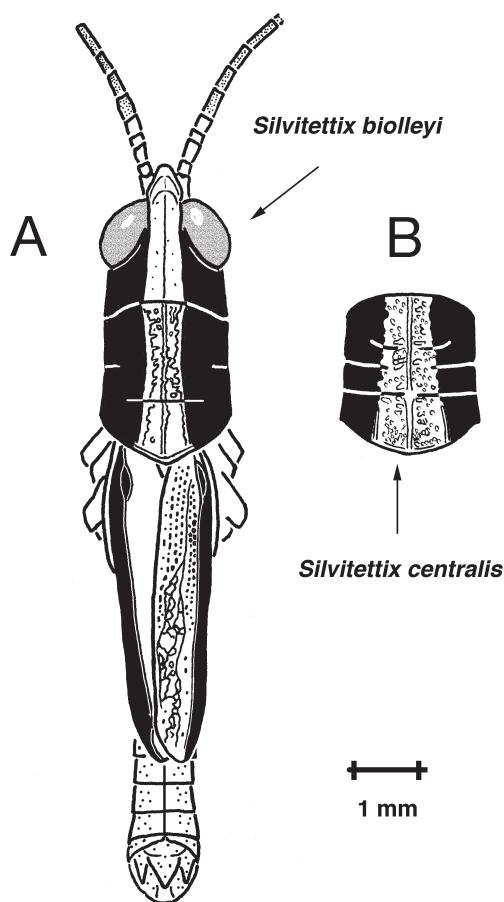


Fig. G8. *Silvitettix* spp., dorsal views of pronotum. A, *S. biolleyi* B, *S. centralis*. Note differences in pattern of sulci.

I. *Silvitettix communis* Bruner 1904

Silvitettix communis Bruner 1900-1910 (1904): 56.

Type locality: COSTA RICA: Prov. S. José, near S. Ignacio, Monte Redondo.

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *communis*, common, universal.

Subsequent literature.

- Rehn, J.A.G. & Hebard, M. 1912: 110 > Designation of lectotype.
- Jago, N.D. 1971: 280.
- Otte, D. & Jago, N.D. 1979: 266.
- Otte, D. 1981: 71.

Synonymy.

=*S. hephaistotecnus* Jago 1971: 281, synon. Otte & Jago 1979: 266.

- Otte 1981: 248.

Diagnosis.

The most distinctive of our 5 species. Rather small for genus ($F = 9.09 - 10.48$ mm, mean 9.93 ± 0.41 mm). Habitus **Fig. G9, A & B**, Plates **G6 & G7**.

Coloration (male): Antennae black. Face and cheek and pronotum lobes black. Pronotum disc either black or straw. Fore and mid legs light reddish brown. Hind femora purple, red or orange, dorsolateral and ventrolateral faces somewhat darker than outer face (**Fig. G7**). Hind tibia brown or black with no pale annulus. Dorsal field of elytron usually straw coloured, as in other species, but black in some individuals.

Posterior margin of pronotum: rounded.

Carinae of vertex and pronotum: medial carina present but not strongly marked. Other carinae obsolete. The area where the supplementary carinae would be in other species is crossed by one distinct posterior sulcus and two variably developed anterior ones, similar to the situation in *S. gorgasi* and *S. centralis* (**Fig. G8**).

Sculpturing of cuticle of pronotal disc and vertex: medium coarse pitting.

Frontal ridge: narrowest at or just above medial ocellus.

Fastigium a little longer than wide at base ($1.02 - 1.33 \times$, mean $1.14 \times$).

Relatively long elytra, about same length as head and pronotum ($0.94 - 1.14 \times$, mean $1.02 \times$).

Hind tibial spines: (8)-9-(10) external and 10-(11) internal spines (these numbers apply to both sexes).

Antennae of medium length (average $0.88 \times$ as long as hind femur).

Male subgenital plate ending in a smooth rounded point.

Male supra-anal plate simple, with no transverse ridges and no proximal shoulders.

Stridulatory teeth: 36-52 teeth, average 44.1 ± 5.2 .

Distribution.

Southern Costa Rica and extreme South Western Panama (Chiriquí Province). From the northern rim of the Meseta Central through Central and Southern Costa Rica to the Panamanian border, and from there to Volcan Barú. Descends to sea level on the Pacific slope but restricted to montane areas on the Caribbean slope. **Map G3**.

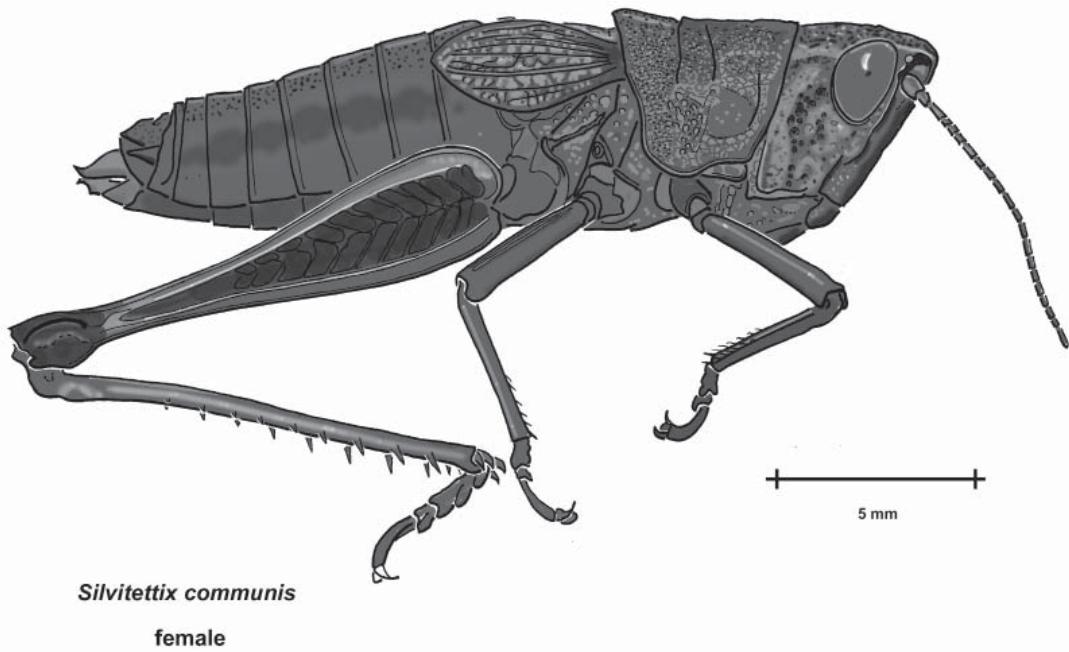
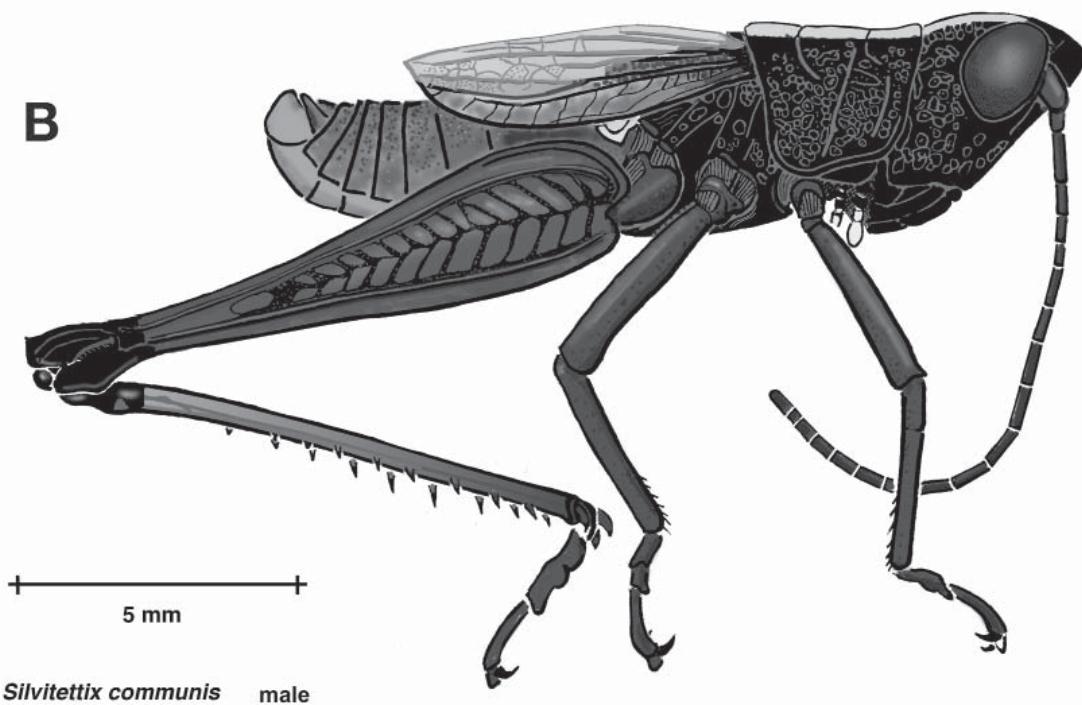
A**B**

Fig. G9. *Silvitettix communis*, male and female habitus.

2. *Silvitettix bolleyi* (Bruner 1904)

Bruner 1900-1910 (1904): 57, as *Leuconotus bolleyi*.
Type locality: COSTA RICA: Río Grande, 1800 feet.
Location of type specimen: ANS Philadelphia.

Etymology.

Named for Paul Biolley, Swiss schoolteacher, naturalist and collector in Costa Rica in the early part of the 20th century. For more details see p. 92.

Subsequent literature.

- Rehn, J.A.G. & Hebard, M. 1912: 111. > Designation of lectotype.
- Jago, N.D. 1971: 280. > Transfers to *Silvitettix*.
- Otte, D. & Jago, N.D. 1979: 268.
- Otte, D. 1981: 72.

Synonymy.

=*Silvitettix thalassinus* Jago 1971: 279 (new synonym).

Comment – synonymy.

The distributions of *S. bolleyi* and *S. thalassinus* in Costa Rica overlap exactly, and there are no differences between the means and ranges of the dimensions measured, or of the number of stridulatory pegs on the hind femur. These latter exceed in number those of all other species of the genus. The two names merely represent the green (high humidity) and brown (low humidity) forms of the same species; a change in colour form can be seen within the life of a single individual when reared in captivity under appropriate conditions of humidity (Rowell, unpubl. obs.)

Subsequent literature.

- Otte, D. & Jago, N.D. 1979: 276.
- Otte, D. 1981: 81 & 248.

Diagnosis.

(Habitus Fig. G10A. Plate G3).

Size: small ($F = 9.62 - 11.51$ mm, mean 10.32 ± 0.56 mm).

Coloration (male): Antennae brown basally, black distally (as in *maculatus*). Palps green. Head, legs, pronotum and thoracic pleura, leaf green or brown; pronotal lobes darken dorsally towards the pale medial stripe (greenish yellow in green forms, straw in brown ones). Pale yellow or green annulus at top of tibia and a pale pregenicula annulus on femur sharply delimit the blackish coloration of the hind knee. Can have a dark mark similar to that of typical *maculatus* on inner face of femur. Tibia blackish green or blackish brown.

Posterior margin of pronotum: obtuse angulate.

Carinae of vertex and pronotum: median carinae fairly well developed, but that of vertex less pronounced than in *maculatus*. Supplementary carina present, bordering pale medial

stripe, cut by only one posterior sulcus (Fig. G8A).

Sculpturing of cuticle of pronotal disc and vertex: usually rather smooth, only slightly pitted – contrasts with the other 3 spp.

Frontal ridge: constricted just above medial ocellus. Fastigium usually shorter than wide ($0.78 - 1.04 \times$, mean $0.93 \times$).

Elytra slightly longer than head and pronotum ($0.98 - 1.16 \times$, mean $1.08 \times$).

Spines of hind tibia: (9-10)-11 external; 11-(12) internal (both sexes). Both numbers tend to be higher than in other species of the genus.

Antennae: comparatively short ($0.79 \times$ length of femur on average).

Male subgenital plate obliquely truncated at tip in lateral view, in dorsal view the internal posterior margin is produced into a slot-like embayment.

Male supra-anal plate with a weak transverse ridge, distal portion with longitudinal wrinkles in mid line.

Stridulatory teeth: range 79-122 teeth, mean 100.7 ± 11.2 .

Distribution.

Costa Rica; Nicaragua; Honduras; El Salvador; Mexico. In Costa Rica (Map G3), north from the Río Grande through the eastern side of the Meseta Central to the Pacific lowlands of northern Puntarenas and Guanacaste Provinces. Occasional on the northern volcanoes (e.g. V. Cacao, where sympatric with *S. maculatus*). The green form ("thalassinus") is commoner at the southern (wetter) end of the species range, in southern Guanacaste and northern Puntarenas, and also occurs on the wet volcanoes of northern Guanacaste.

3. *Silvitettix maculatus* Otte & Jago 1979

Silvitettix maculatus Otte & Jago: 257.

Type locality: BELIZE, 36 road miles S. of El Cayo, on Mountain Pine Ridge Road. (The paratypes (in ANS Philadelphia) are a series from Monteverde and other localities in Costa Rica). Location of type specimen: University of Michigan Museum of Zoology.

Etymology.

Latin *maculatus*, spotted, referring to the dark mark on the inner hind femur.

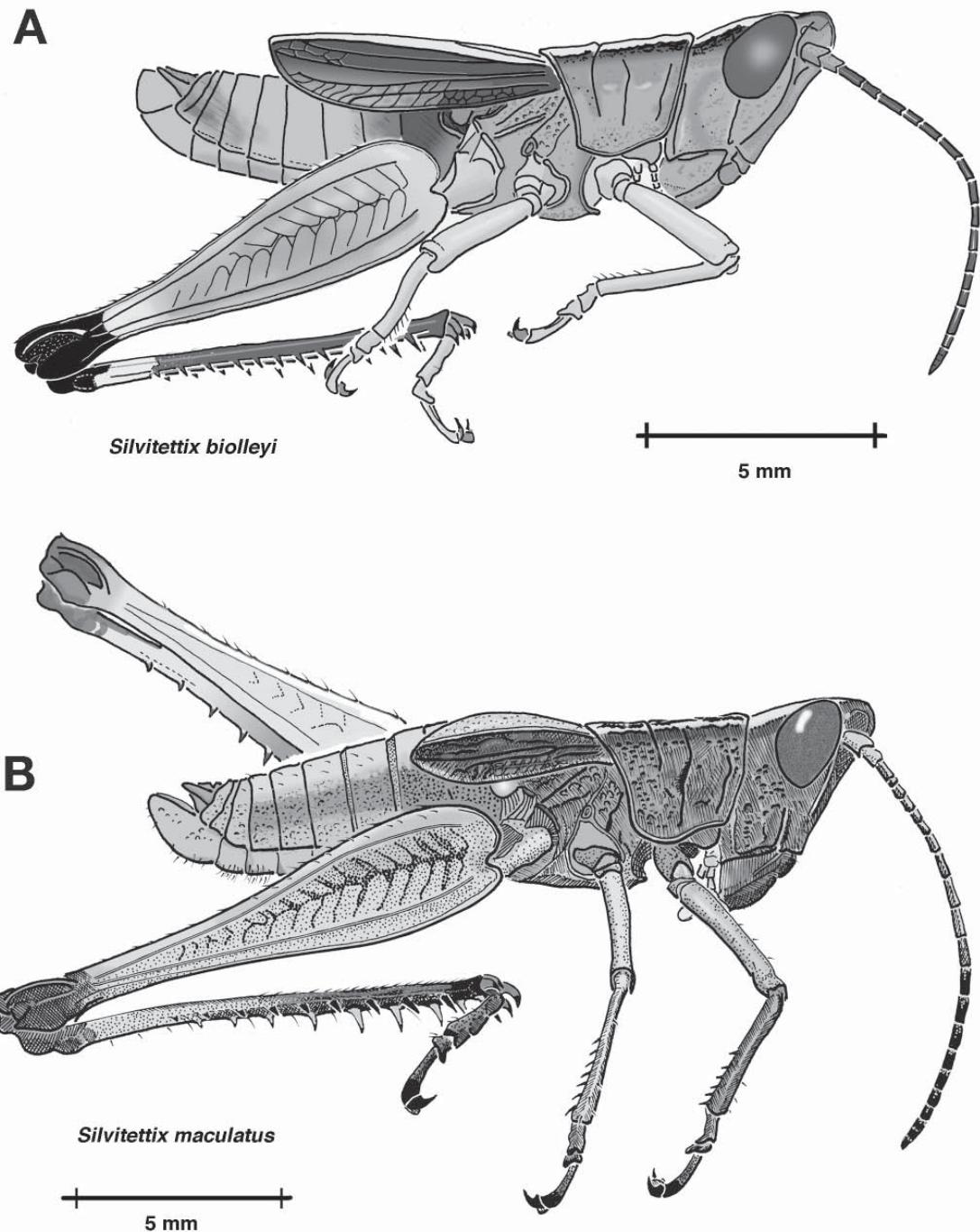


Fig. G10. *Silvitettix* males. A, *S. bolleyi*. B, *S. maculatus*.

Subsequent literature.

- Otte, D. 1981: 75, 248.

Diagnosis.

(Habitus **Fig. G10,B, Plate G4.**) The largest and most elongate of the 5 local species.

Size: Large ($F = 10.61 - 13.26$ mm, mean 11.74 ± 0.94 mm).

Coloration: Antennae pale brown basally, black distally. Palps, greenish white. Head, lobes of prothorax, front and middle legs, all grey green; the legs are somewhat lighter in shade (in badly preserved dried specimens the grey green turns brown or blackish). Hind femora light grey-green or yellow or straw-coloured. Dark mark (the “macula” of the specific name) usually (but not always!) present on ventral margin of inner face of hind femur, crossing stridulatory file (**Fig. G7**); 3-4 small black spots present on dorsal medial carina of hind femur. Hind knees dusky. Hind tibia light brown proximally, blackish distally. All tarsi and hind tibial spurs reddish purple. Abdominal sterna, subgenital plate, orange. In some populations (e.g. at Monteverde) males are less brightly coloured than usual, with the distal abdomen and femora dull straw rather than orange and the underside greenish.

Posterior margin of pronotum: usually rounded, sometimes angulate.

Carinae of vertex and pronotum: median carina well developed, more so than in *communis*. Supplementary carinae present, bordering pale medial stripe.

Sculpturing of cuticle of pronotal disc and vertex: medium coarse, about same as in *communis*.

Frontal ridge: margins more or less parallel above medial ocellus (contrasts with other spp.).

Fastigium noticeably longer than wide ($1.18 - 1.37 \times$, mean $1.24 \times$).

Elytra short, only about 2/3 as long as head plus pronotum ($0.61 - 0.78 \times$, mean $0.70 \times$).

Tibial spines: (8)-9-(10) external spines and (9)-10 internal ones (both sexes).

Antennae rather short ($0.81 \times$ length of femur on average) – but longer in northern populations.

Subgenital plate produced into a somewhat truncate point in side view, the tip of which is slightly keeled in dorsal view.

Supra-anal plate with a transverse ridge but no proximal shoulders.

Stridulatory teeth: 36-56 teeth, average 45.9 ± 7.1 .

Distribution.

Belize and Costa Rica. In Costa Rica (**Map G3**) in montane forest, from the upper Sarapiquí through Tilarán to the Cordillera del Norte. The paratype listed by Otte and Jago (1979) from Parque Bolívar, Ciudad de S. José, Costa Rica, is actually a misidentified specimen of *S. communis*.

The alleged disjunct distribution is very suspicious. A larger sample of the Belizean population (known only from the holotype!) should be compared with the Costa Rican one, which may well represent another species.

4. *Silvitettix gorgasi* (Hebard 1924)

Leuconotus gorgasi, Hebard 1924: 97.

Type locality: PANAMA: Panama City.

Location of type specimen: ANS Philadelphia, holotype male.

Etymology.

Named for Surgeon-General of the US Army William Gorgas (1854-1920), chief sanitary officer for the Panama Canal Project in the early 20th century. Known for his work on the transmission of yellow fever.

Subsequent literature.

- Jago, N.D. 1971: 278 > Transfers to *Silvitettix*.
- Otte, D & Jago, N.D. 1979: 276.
- Otte, D. 1981: 81 & 248.

Diagnosis.

(Habitus **Fig. G11,B**). Size: medium large for genus ($F = 11.1$ mm in type). Differs slightly from other species in the shape of the head; the vertex is flatter, less convex; the fastigium is rather short and wide; the rostrum is shorter. The slope of the frons and the relative size of the eye are however the same as in *S. centralis*.

Coloration (male): the unique type is (faded to?) a uniform brown, other than for the black hind knees and the blackish distal hind tibia; tibial spines tipped with black. This may or may not correspond to the real coloration.

Posterior margin of pronotum; obtuse angulate. Carinae of vertex obsolete. Median carina of pronotum present, weak. Supplementary carinae of pronotum weak, cut or at least contacted by 3 sulci, as in *centralis*.

Sculpturing of pronotal disc; deeply pitted. There is also extensive pitting, more than in other species, on the mesothoracic epimeron and the metathoracic epimeron and episternum. Vertex almost smooth.

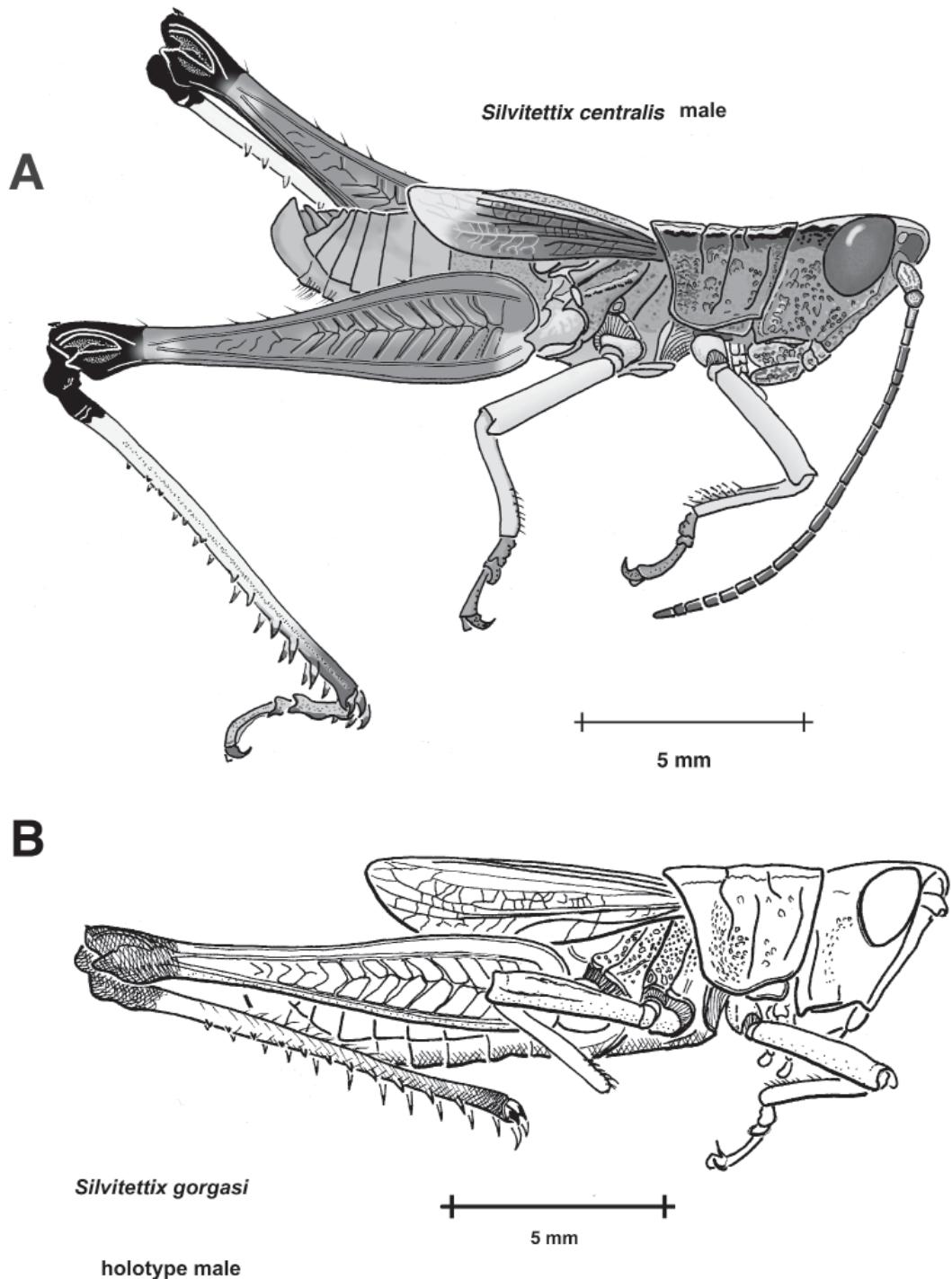
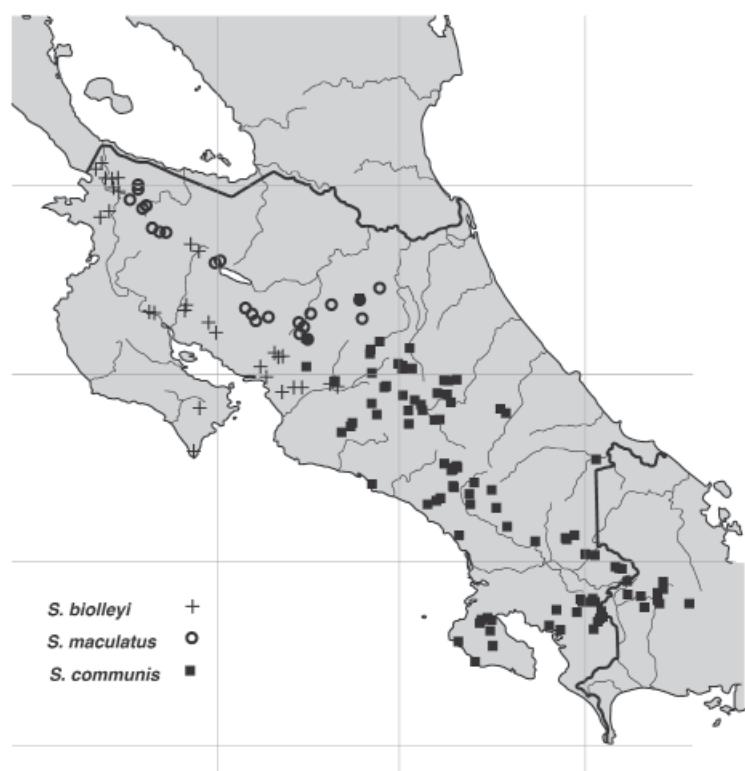
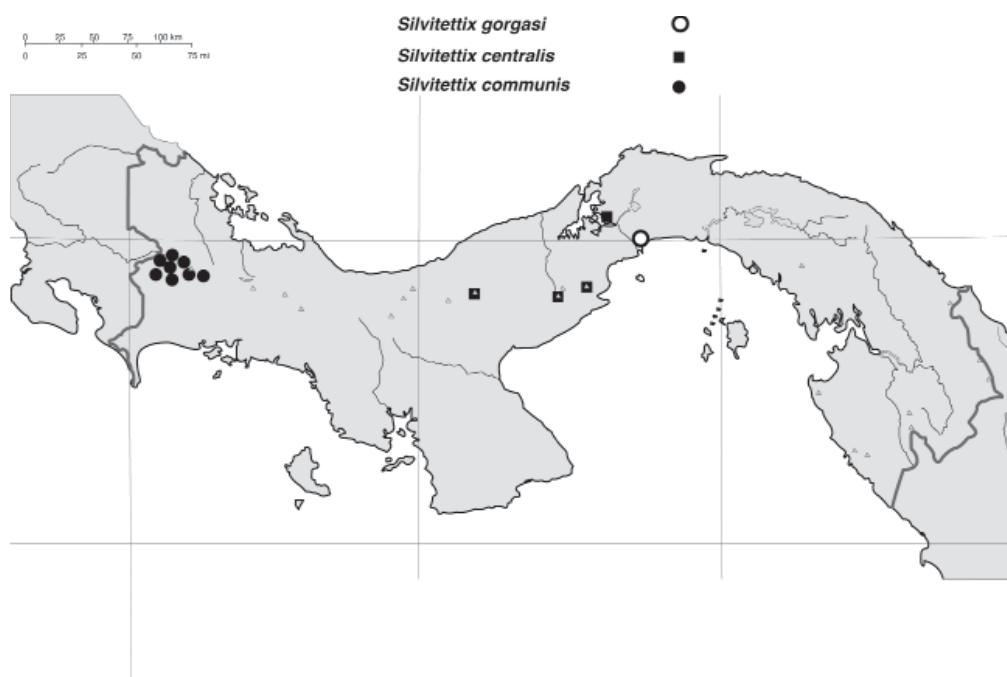


Fig. G11. *Silvitettix*. A, *S. centralis*, male. B, *S. gorgasi*, holotype male. The specimen is discoloured to a uniform dark brown..



Map G3. Distribution of *Silvitettix* spp. in Costa Rica and extreme Western Panama.



Map G4. Distribution of *Silvitettix* spp. in Panama.

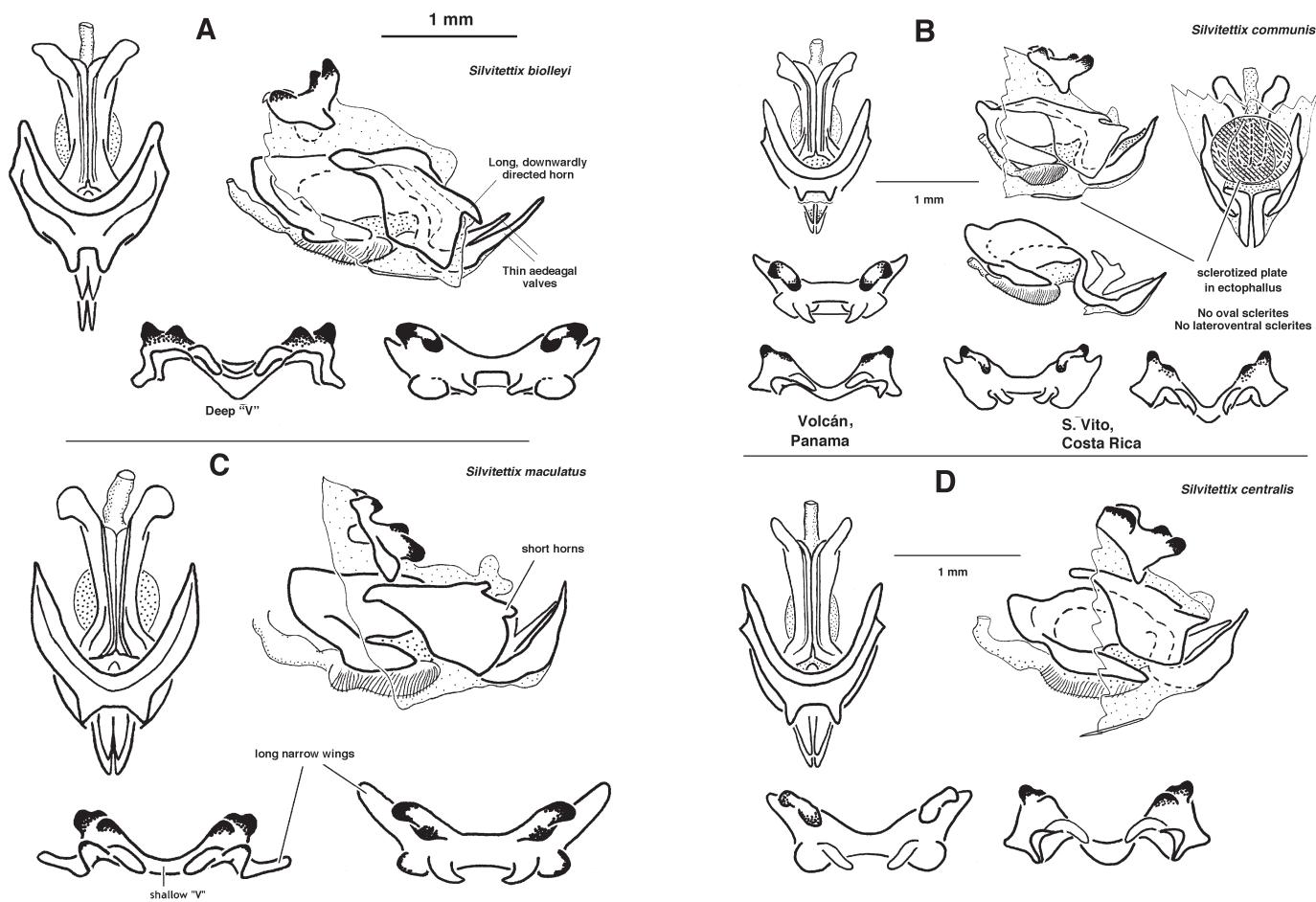


Fig. G12. Phallic structures of *Silvitettix* spp. A, *S. bolleyi*. B, *S. communis*. C, *S. maculatus*. D, *S. centralis*.

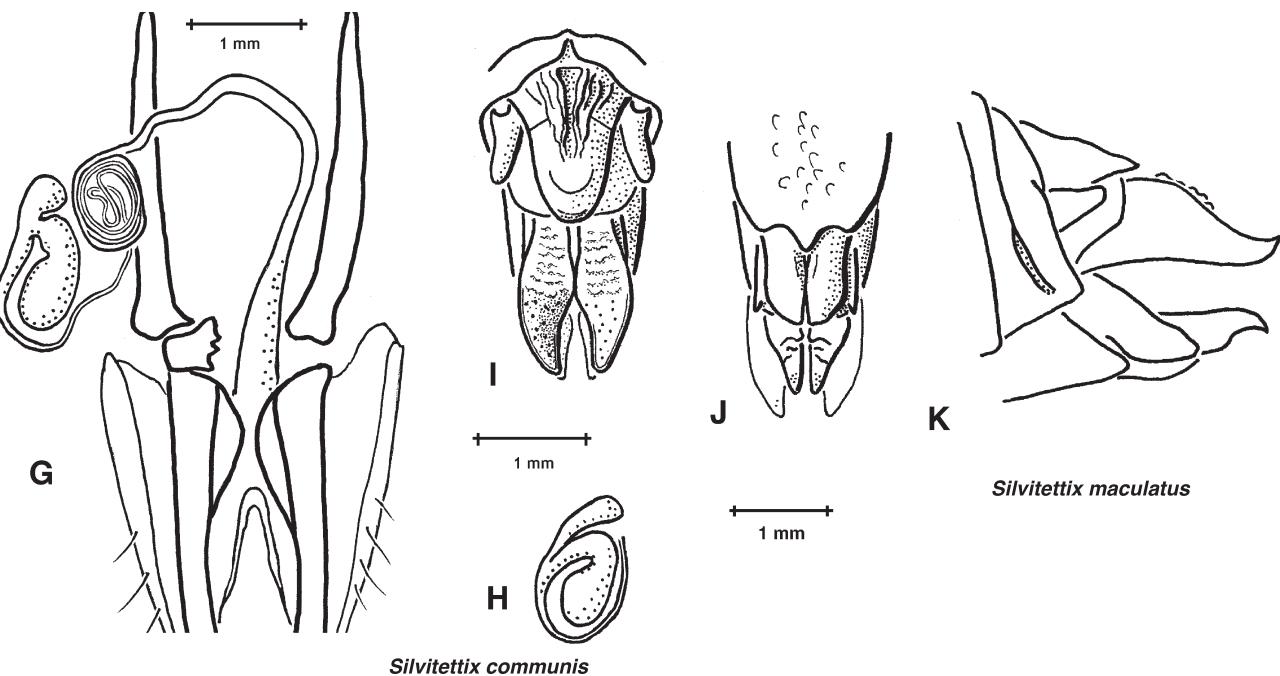


Fig. G13. Female reproductive structures in *Silvitettix* spp. G, H. Spermatheca. I, J, K. Female terminalia in dorsal, ventral and lateral view. All *S. maculatus*, except 13H, *S. communis*.

Frontal ridge; more deeply grooved than in *centralis* and more dilated between and above antennae. Medial ocellus not visible in type.

Fastigium about as long as wide (1.1 \times).

Elytra relatively long for genus, longer than head and pronotum together (1.17 \times).

Internal and external spines of hind tibia: 11.

Antennae: missing.

Male subgenital and supra-anal plates similar to those of *S. centralis*; the subgenital plate terminates in a rounded point, the supra-anal plate has proximal shoulders but no transverse ridge.

Stridulatory teeth (according to Otte & Jago): 64.

Distribution.

(Map G4). Known only from the type specimen, a male. As no other specimens of *Silvitettix* have ever been captured in the neighbourhood of Panama City, despite much suitable habitat and collecting effort, it can be doubted whether the published type locality is correct. See also comment under *S. centralis* below.

5. *S. centralis* n. sp.

Silvitettix centralis Rowell, this book.

Type locality: PANAMA: Prov. Panamá, Cerro Campana, 750-950 m. Location of type specimen: ANS Philadelphia.

Etymology.

Latin “of the centre”, referring to its geographical distribution in Panama.

Diagnosis.

Habitus Fig. G10A, Plate G5.

Size: rather large for this genus ($F = 10.04 - 12.07$ mm, mean 11.44 ± 0.52 mm).

Coloration (male): local populations differ considerably; those of Cerro Campana and the Canal Zone are brightly coloured (as described below), but those of Cerro Copé and Valle de Antón are very dull and heavily suffused with blackish pigment.

Antennae black, brownish at base. Head dark green.

Extremity of fastigium, upper part of frontal ridge, blackish brown. Pronotal lobes dark green, blackish at edge of medial pale stripe. Lateral field of elytron blackish brown, dorsal field and wing tip pale. Abdomen orange. Front and middle legs, pale olive. Hind femur, reddish brown, knee black. Hind tibia black immediately below knee, thereafter pale grey, darkening distally. All feet suffused with dark brown.

Posterior margin of pronotum: obtuse angulate to rounded.

Carinae of vertex and pronotum: median and supplementary carina present; latter only well developed in

posterior part of metazona, elsewhere continued by the pale/dark pigment transition; this is cut by three sulci, one continuous, two discontinuous and rather variable (see figure), as in *communis* and *gorgasi*. In the other 2 regional species (*bolleyi*, *maculatus*) only the posterior, continuous sulcus cuts this area (Fig. G8).

Sculpturing of cuticle of pronotal disc and vertex: finely pitted, more punctate than in *maculatus* or *communis*.

Frontal ridge: slightly constricted just above medial ocellus.

Fastigium somewhat longer than wide (0.99 - 1.29 \times , mean 1.12 \times).

Elytra about as long as head and pronotum (0.89 - 1.04 \times , mean 0.97 \times).

Spines of hind tibia: 10-(11) external; 11 internal.

Male subgenital and supra-anal plates similar to those of *S. gorgasi*; the subgenital plate terminates in a rounded point, the supra-anal plate has proximal shoulders but no transverse ridge.

Antennae: long, almost equal to hind femora (0.96 \times length of femur on average).

Stridulatory teeth: 30-59 teeth, average 43 ± 7.8.

Distribution.

Central Panama, from the region of the Canal to Cerro Copé. Very rare in the lowlands, where known from only a single specimen from Gamboa, but common in montane forest (Map G4). For variation between populations, see under “coloration” above.

Comment.

In view of the geographical overlap, it must be considered whether this species could be the same taxon as the unique, badly preserved and extensively damaged type of *S. gorgasi*. The coloration of the latter is so degraded that no comparison is possible, and its antennae, feet and one cercus are missing. In length of femur, fastigial proportions and number of tibial spines *gorgasi* lies within the observed range of variation of *centralis*, the pronotal carinae and sulci and the subgenital and supra-anal plates are similar. The type of *gorgasi* is clearly different from the *centralis* population only in the number of stridulatory teeth (64 versus a range of 30-59) and in the length of the elytron (1.17 \times head + pronotum, versus a range of 0.89-1.04 \times); the pitting of the pronotal disc and the groove of the frontal ridge are also more pronounced, and the shape of the head is very slightly different, as detailed above under *gorgasi*. Should the range of these characters in *centralis* be extended in the future to include the values for *gorgasi*, the former name should logically be considered a junior synonym of the latter. I personally suspect that *gorgasi* and *centralis* will ultimately prove to be conspecific, and the name *centralis* thus a junior synonym.

Tribe Mermiriini Brunner von Wattenwyl 1893

Brunner von Wattenwyl 1893: 119 - as Mermiriae
Otte 1981: 179 (as "Mermiria genus group").
Eades et al. (accessed 2012) (as Mermiriini)
Type genus: *Mermiria* Stål 1873.

Diagnosis.

(After Otte 1981). Lateral foveolae hidden from view; very slender; strongly ensiform antennae; distinct and parallel lateral carinae of pronotum; medium to broad postocular bands, and usually a medial carinula on the fastigium.

No. of included genera.

Three. In our region, one.

Tribal range.

Southern Canada to Panama.

Natural history.

All members of the tribe are grassland dwellers, highly cryptic in their elongate shape and longitudinal markings.

Achurum Saussure 1861

Saussure 1861: 313.

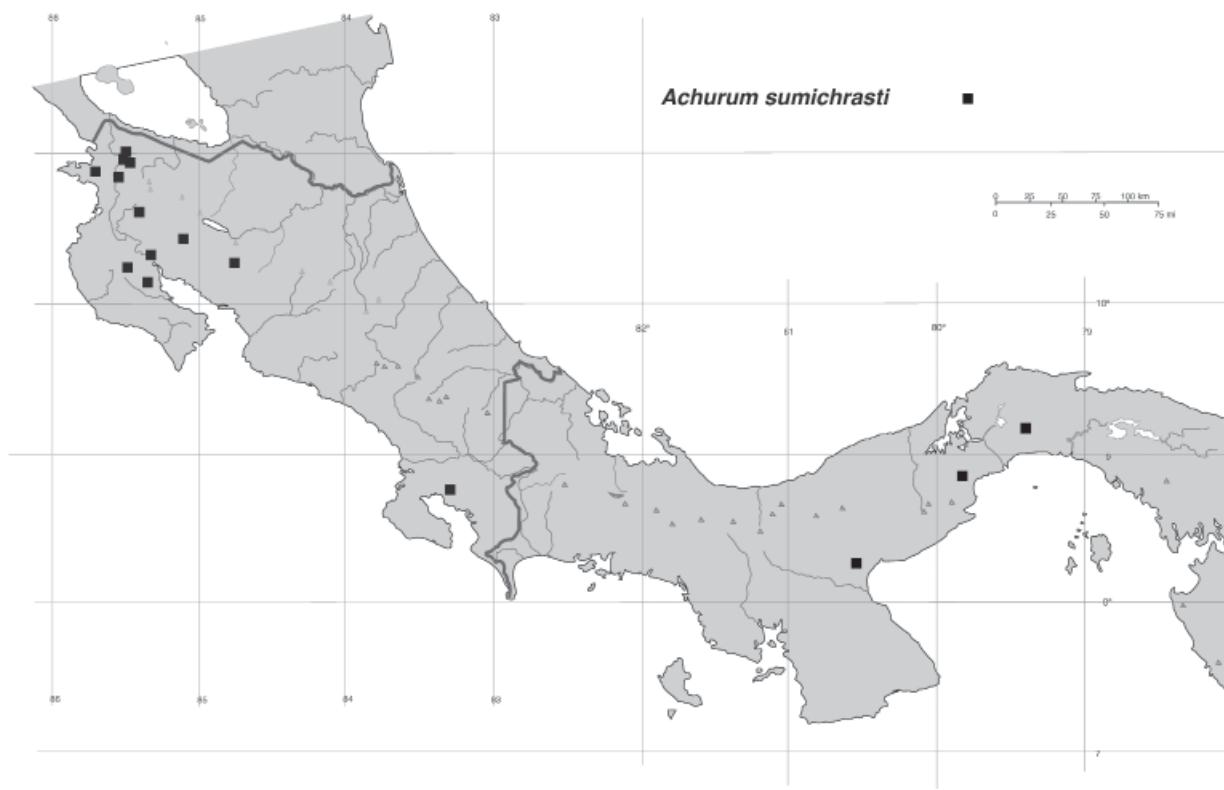
Type species: *Truxalis sumichrasti* Saussure, subsequently designated by MacNeill 1897: 202.

Etymology.

According to C. S. Carbonell (pers. com.) possibly named after the city of Achurum (or Achyr or Achiai), in the Ukraine (Long. 53° 54' E, lat. 49° 32' N).

Subsequent literature.

- Saussure, H. de 1861: 313. > Used *Achurum* as a "divisio" of *Tryxalis*.
- Thomas, C. 1873: 195. > Used of *Achurum* as a subgenus of *Tryxalis*.
- Walker, F. 1870: 518. > First use of *Achurum* as genus name.
- Stål, C. 1873: 89, 101.
- Brunner von Wattenwyl, K. 1893: 118.
- Scudder, C. 1897: 25.
- Scudder, C. 1898: 232.
- Burr, M. 1902: 154.
- Bruner, L. 1900-1910 (1902): 26.
- Bruner, L. 1904: 34.



Map G5. Localities for *Achurum sumichrasti* in Costa Rica and Panama.

- Kirby, W.F. 1910: 102.
- Hebard, M. 1922: 89-93.
- Hebard, M. 1926: 48-49.
- Jago, N.D. 1969: 282. > Review: redescription, key to species.
- Jago, N.D. 1971: 241.
- Otte, D. 1981: 185, 225.

Synonymy.

=*Radinotatum* McNeill 1897b: 199-201, synon. Jago 1969: 285.
=*Rhadinotatum* Scudder 1897 (misspelling of *Radinotatum*), synon. with the latter name by Kirby 1910: 101.

Diagnosis.

(Habitus **Fig. G14, Plate G8.**) Markedly elongated form. Antennae about as long as head and pronotum together; basal 6 flagellar segments with a flattened lateral wing, the distal nine without. Temporal foveolae absent. Fastigium as long or longer than width of compound eye, forming a rostrum which is T-shaped in cross section and somewhat truncate at the end; medial carina well developed (**Fig. G16D**). Frontal ridge grooved longitudinally, the sides meeting dorsally. Angle between frons and vertex acute, frons slightly concave. Pronotal disc weakly tectiform with clear medial and lateral carinae; lateral carinae parallel or slightly diverging posteriorly; transverse sulci weak. Alate or brachypterous. All legs small and rather weak. Hind femora slender; upper and/or lower genicular lobes elongate; no terminal spine on dorsal carina of knee (**Fig. G16A**). Stridulatory file reduced or absent. External and internal hind tibial spurs subequal, the internal ones longer than the external (Fig. 16B). Male subgenital plate tricarinate, extending well beyond level of supra-anal plate. Cerci simple, slender, conical. Ovipositor valves (**Fig. G16C, E**) retractile, normally more or less hidden under supra-anal plate and parameres.

Male genitalia (**Fig. G15**) also very distinctive, slim and elongate. Epiphallus almost planar, with trituberculate lophi. Oval sclerites apparently absent, ventrolateral sclerites reduced to a lightly sclerotized collar around the aedeagal valves. Tips of ventral aedeagal valves broad in lateral view, obliquely truncate at tip. Cingulum slender, rami very delicate. Dorsal and ventral aedeagal valves of the same length, running vertically in lateral view. Arch sclerite situated a long way posterior to the zygoma, valves thin and needle like. Endophallus with prominent dorsal process pointing dorsally and posteriorly, flexure very long and thin and almost vertical; gonopore processes slender, wings of apodemes small. Spermatophore sac relatively enormous, ejaculatory sac short and wide.

No. known species.

Three. In our area, one.

Generic range.

Southern USA to Panama.

Achurum sumichrasti (Saussure 1861)

Truxalis sumichrasti Saussure 1861: 313.

Type locality: "Temperate Mexico".

Homotype (designated by Jago 1969: 286): Mexico, Gro., 16 m. S. of Chilpancingo, 4000 ft. (= 1229 m.).

Location of type specimen: NHM Vienna. Of homotype: ANS Philadelphia.

Etymology.

Named for F. Sumichrast (1828-1882), a Swiss zoologist and collector who assisted H. de Saussure on his collecting trip to Mexico and the West Indies, 1854-56. For further details, see under *Heliastus sumichrasti*, (Oedipodinae), p. 295

Subsequent literature.

- McNeill, J. 1897b: 202. > Transfers to *Achurum*.
- Rehn, J.A.G. 1904: 516.
- Jago, N.D. 1969: 285. > Designation of homotype.
- Jago, N.D. 1971: 241.
- Otte, D. 1981: 186, 231.

Synonymy.

=*Truxalis acridoides* Stål 1873: 52, synon. Hebard 1922: 91.

=*Achurum hillardi* Gurney 1959: 117, synon. Otte 1981: 231.

Diagnosis.

(Habitus **Fig. G14, Plate G8.**) The only local species of the genus; the generic diagnosis applies. Distinguished from the other two (North American) species of the genus by the combination of fully developed elytra extending beyond tip of abdomen, and subequal dorsal and ventral outer genicular lobes of the hind femur (**Fig. G16A**). Fourteen-16 external hind tibial spines, 16-17 internal ones. Medium large: male femur 12.5 mm, female 15.8 mm. Females can exceed 50 mm overall, from tip of antenna to tip of wings, but are very slender.

Field characters.

Cannot be mistaken for any other taxon known from our region. Long tube-like form and elongated rostrum give a marked resemblance to the grass in which this animal lives. (Some Colombian species of *Cylindrotettix* [Leptysminae] are superficially rather similar, but are not to date known from Panama). Green/brown polymorphic: while all-brown forms do occur, usually both sexes have a dorsal green stripe from the fastigium to the tip of the elytra, and females often have green hind femora too.

Larvae have a remarkably extended supra-anal plate, much longer than the subgenital plate, greatly increasing their resemblance to a grass flower. This disappears in the final moult, presumably because it is incompatible with copulation. A similar structure and ontogeny occurs in the Australian pyrgomorph *Psednura* Burr 1903, which mimics the rushes in which it lives.

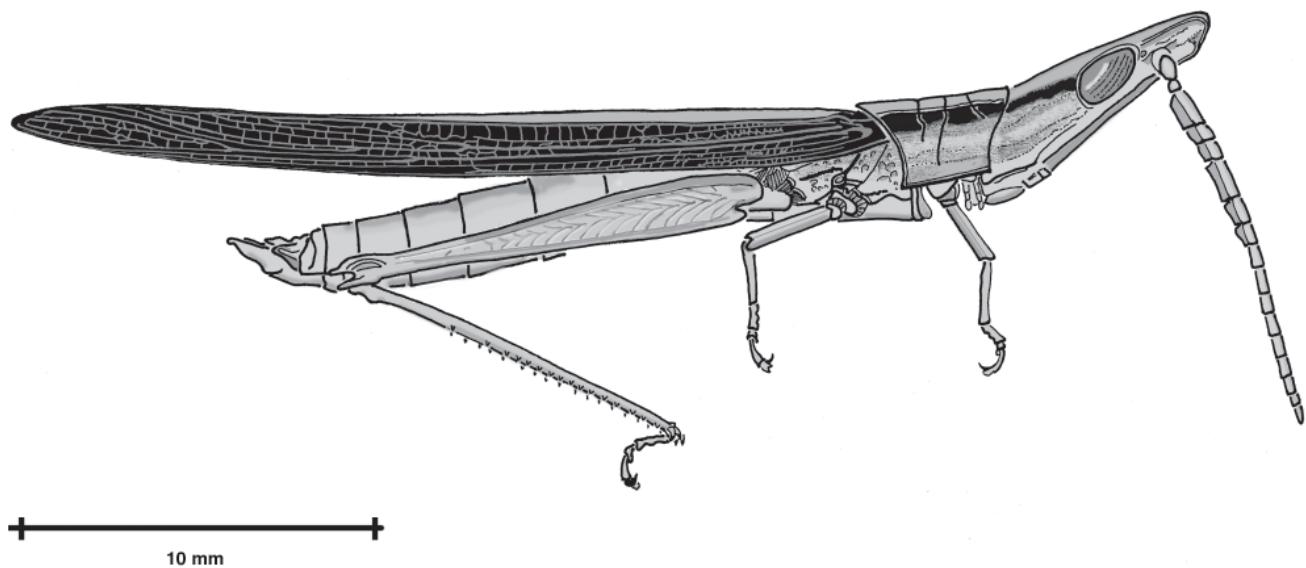


Fig. G14. *Achurum sumichrasti*, male.

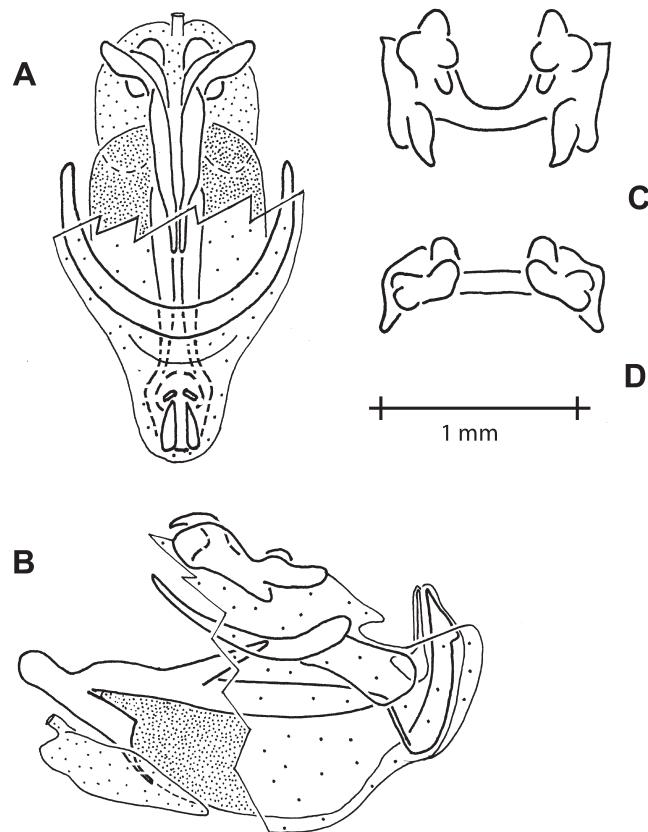


Fig. G15. *Achurum sumichrasti*, phallic complex. A, entire complex minus epiphallus, dorsal view. B, as A, lateral view. C, D, epiphallus, dorsal and axial views.

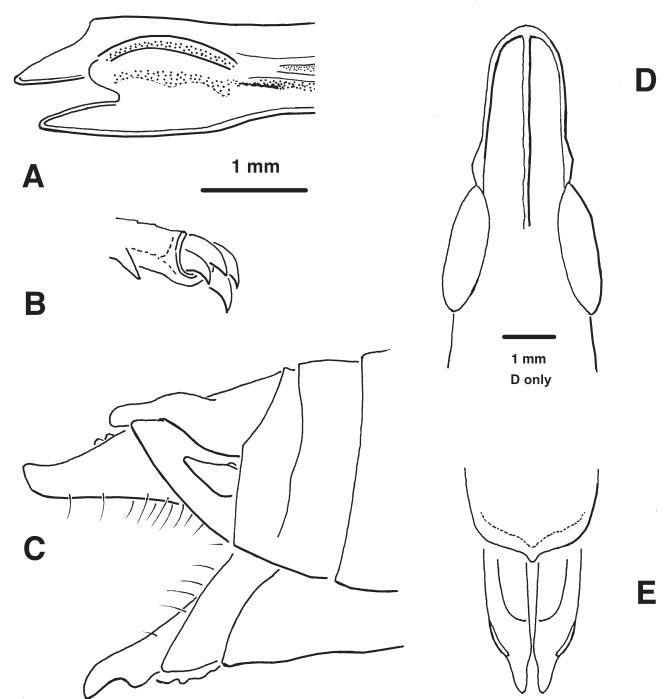


Fig. G16. *Achurum sumichrasti*. A, detail of hind knee, external face. B, hind tibial spurs. C, female terminalia, lateral view. D, fastigium, dorsal view. E, female subgenital plate, ventral view.

Distribution.

USA to Panama. In Costa Rica and Panama (**Map G5**) found in dry grassy areas throughout the Pacific slope of both countries, but patchily distributed. From sea level to at least 1500 m. in Tilarán. Most recorded Costa Rican specimens are from Guanacaste, but it probably occurs in grasslands all down the west coast.

Natural history.

A characteristic member of the fauna of savanna grassland derived from dry or seasonally wet forest. Often occurs in open grassland, far from any trees. In Guanacaste, larvae but not adults are present in July and early August, adults appearing from mid-August onwards. Will accept as food only a small proportion of the species of grass found in its environment; among the acceptable species is *Aristida cepillacea*. Differs considerably ecologically from what is considered the same taxon in North America, which is found in oak woodland or even in wet bogs (see Jago 1969).

Tribe Orphulellini Otte 1979

Otte 1979: 131: 53.

Otte 1981: 83.

Diagnosis.

In all members of the tribe the fore- and middle femora of males are somewhat expanded dorsoventrally, as seen in side view. This thickening is not very striking, and is only convincing when compared with the situation in other tribes (see **Fig. G17**); it appears, however, to be the only tribal character that applies to all included taxa. For other, less universal, tribal characters, see Otte 1979 and 1981.

Many taxa of this tribe show reduction or loss of the femoral stridulatory file. According to Otte (1970, 1979) they do not stridulate during courtship, which presumably explains this morphology. Curiously, despite this reduction in stridulatory behaviour, they tend to have a thickened and sclerotized region on the leading edge of the hind wing, where it could be contacted by the file, and more or less enlarged cells in the medial area. This has been suggested (Uvarov 1965, Otte 1979) to be a resonatory device, and within the tribe there is indeed a rough correlation between the degree of development of the file and of the hindwing cells. Interestingly, however, the cells are created in exactly the same way as in the *Hyalopterigiiini* (Acridinae), i.e., by the shortening of Cu1 and the displacement forwards of M, so creating a large space between M and Cu2 (compare **Figs G26 and G22 with A2**). In that tribe too there is no femuroalar stridulatory mechanism, but there is crepitation in flight, and it may be that this is the function of the cells in both lines.

The genera and species of Orphulellini are among the most difficult to determine of all the Central American fauna, especially the females. The most useful external characters are usually the shape of the female subgenital plate, the nature of the lateral pronotal carinae, the details of the fastigium, the presence or absence of a stridulatory file and in some cases the venation of the male hind wing.

No. of included genera.

Four. In our area, three.

Tribal range.

Canada to Argentina.

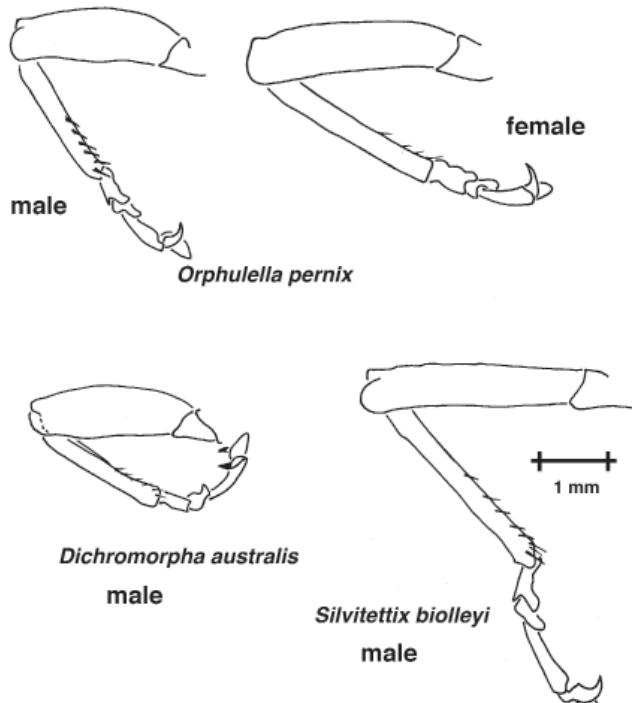


Fig. G17. Fore legs of *Orphulella*, upper line, and *Dichromorpha*, lower left (tribe Orphulellini) and of *Silvitettix* (tribe Compsacrinae, lower right) to show expanded femur in males of the Orphulellini.

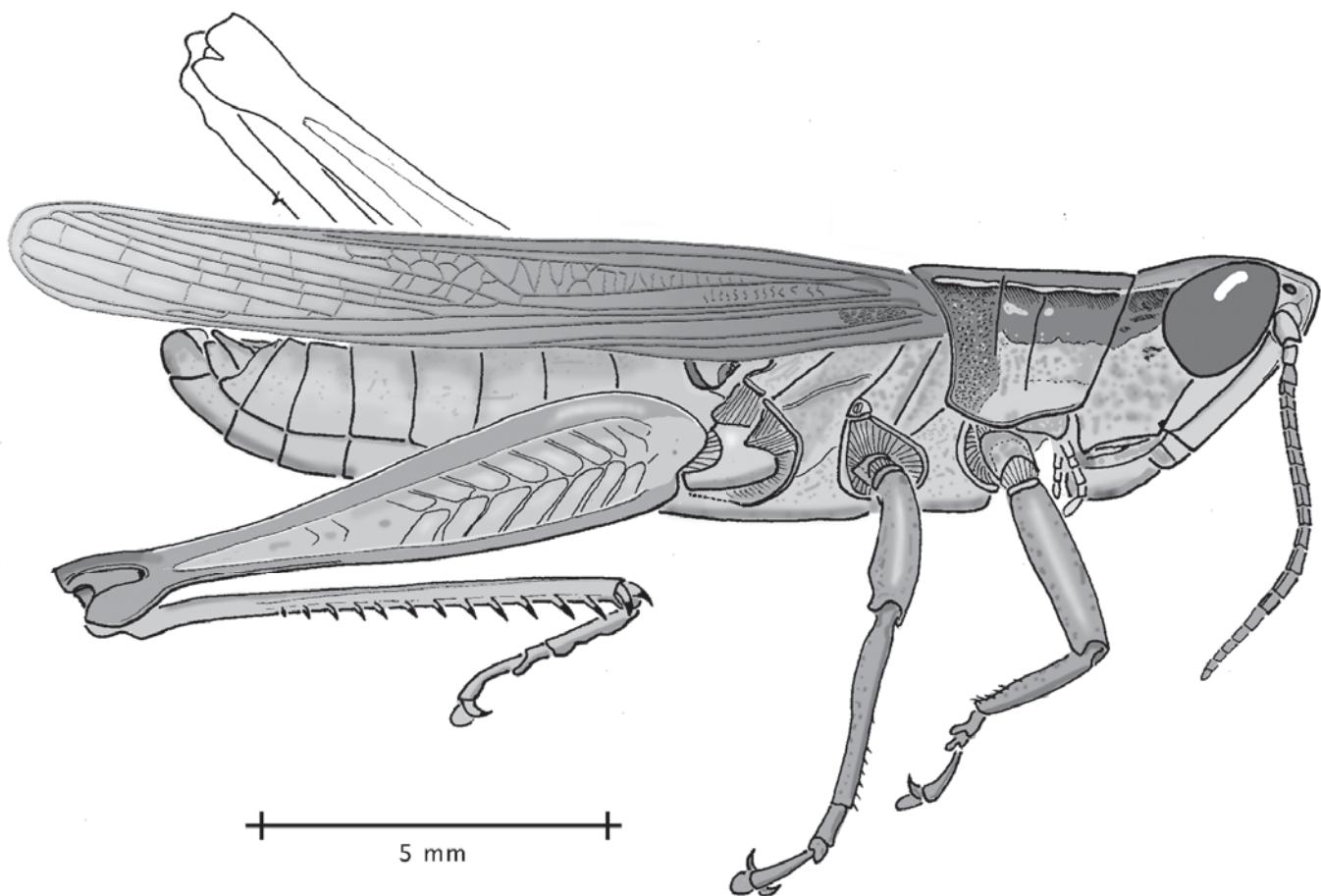


Fig. G18. *Dichromorpha prominula* (male).

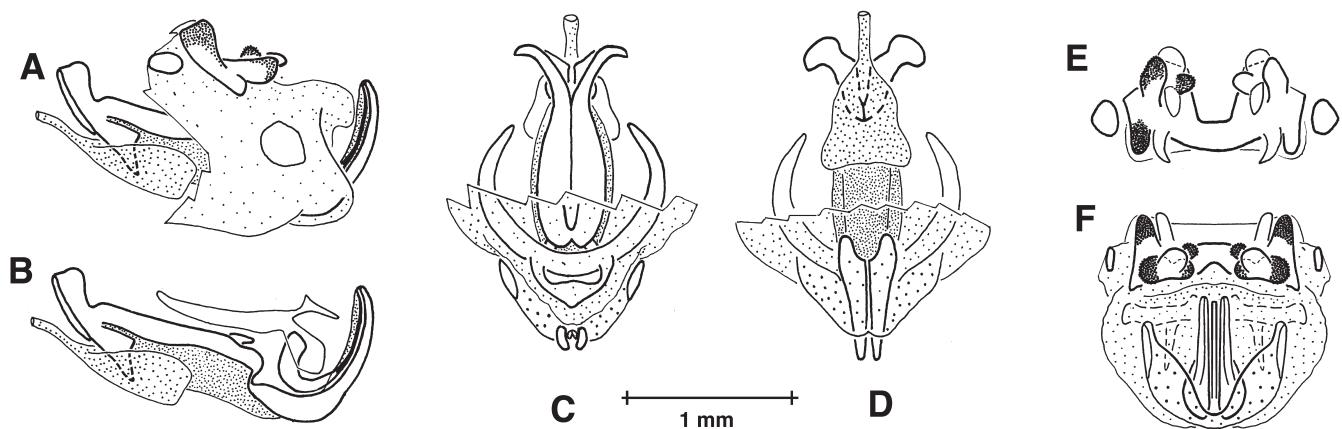


Fig. G19. *Dichromorpha australis*, male genitalia. A, phallic complex, lateral view. B, as A, but minus epiphallus and ectophallic membrane. C, as B but dorsal view. D, as B, but ventral view. E, epiphallus, axial view. F, phallic complex, axial view, including epiphallus, dorsal view.

Artificial key to local genera of Orphulellini.

- I Lateral carinae more or less straight, parallel or diverging towards the rear, but not angled inwards at mid-length (**Figs G20, G21**). Disc of pronotum crossed by one or two (but never three) sulci. **Dichromorpha**
- IA Lateral carinae angled inwards at midlength, forming a more or less hour-glass shape in dorsal view; disc of pronotum thereby constricted in the middle (**Fig. G25,C; G34**). 2
- 2 Hind knee with medial terminal spine (**Fig. G20C**), although sometimes minute. Head shorter than pronotum in dorsal midline aspect, either slightly (0.95× - *O. concinnula*, with clear orange hind femora) or obviously (0.7 - 0.8× - the other two species). Female subgenital plate with prominent lateral lobes and long, triangular, membranous egg-guide, flanked at its base by chisel-shaped, lightly sclerotised lobes with longitudinal striations (**Figs G25E, G28A, G33A**). **Orphulella**
- 2A Hind knee completely devoid of medial terminal spine (**Fig. G36B**). Head as long or slightly longer than pronotum in dorsal midline aspect. Female subgenital plate with very short lateral lobes and short, rounded, sclerotized egg-guide (**Fig. G36E**). Usually with a whitish stripe running from lower frons to hind coxae, via genae, margins of lateral lobes and thoracic episterna. **Orphulina**

Dichromorpha
Morse 1896

Morse 1896: 326.

Type species: *Chloealtis viridis* Scudder 1875, by original designation.

Type locality: USA: Connecticut, Norton.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *di*, two, double; *chroa*, colour of the skin; *morphe*, form shape: “two colour forms”, presumably because the genus (like very many others!!) is green/brown polymorphic.

Subsequent literature.

- Kirby, W.F. 1910: 125.
- Jago, N.D. 1971: 233.
- Amedegnato, C. 1976: 203.
- Otte, D. 1979: 75.
- Otte, D. 1981: 101 & 237.
- Vickery, V.R. & Kevan, D.K.M. 1983: 1177.

Synonymy.

= *Clinocephalus* Morse 1896, syn. Otte 1979: 75.

No. known species.

Four. In our area, one.

Genus range.

Markedly disjunct distribution: Argentina, Paraguay, Uruguay and Brazil; Panama, Costa Rica, Mexico and Eastern USA.

Diagnosis.

(**Figs G18-G22**. Habitus **Fig G18**, Plates **G9**-

II.) Lateral carinae parallel or slightly diverging towards the posterior (**Figs G20, G21**), not at all constricted towards the centre of the pronotal disc; wings either brachypterous or (as in our area) fully developed. Parallel carinae are unique among orphulellines of our area. However, there are some females of *Orphulella punctata* where the constriction of the lateral carinae is minimal. Disc of pronotum crossed by 1 or 2 sulci, never by 3 (differentiates from most *Orphulina* and *Orphulella*). Medial apical spine of hind knee present, but minute and blunt, almost obsolete in some individuals. Hind wing of male with about 9 expanded cells in the medial area (**Fig. G22**). Eleven-12 hind tibial spines.

Male supra-anal plate (**Fig. G20,B**) subtriangular, with rounded tip, slightly shorter than paraprocts. Subgenital plate tapers to a rounded point, well provided with hairs. Cerci simple, straight, with blunt points.

Phallic complex (**Fig. G19**) rather small. Epiphallus almost planar; lophi basally fenestrated, trituberculate, the two subapical lobes melanized, the apical one transparent; anterior process of lateral plate short but sclerotized, posterior corner angular; ancorae slender, sharply pointed, somewhat curved towards the midline. The different species differ only in the details of the lophi of the epiphallus. Basal fold large. Ventrolateral sclerites present, variously developed, forming a cup-like structure around the base of the aedeagal valves when the phallus is retracted. Cingular apodemes curved and slender, horse-shoe shaped in dorsal view. Zygoma a triangular beak, joined to centre of apodemes by twin struts; rami short and vertical. Arch sclerite strongly developed, the dorsal aedeagal sclerites more or less fused and forming a single dorsal valve. Endophallic apodemes widely divergent, gonopore processes short and robust. Endophallic plates flattened dorsally (giving a T-shaped cross section), with a short medial projection arising near the posterior end. Flexure short and narrow. Ventral aedeagal sclerites curved smoothly upwards in lateral view, becoming laterally flattened and spatulate towards the tip, surrounding the dorsal valve. Ejaculatory sac wide and flat, triangular in ventral view, spermatophore sac relatively narrow in lateral view but wider than the endophallic plates in ventral view.

Female terminalia (**Figs G21C-E**): supra-anal plate triangular, rounded at tip, the proximal medial area slightly concave, shorter than the paraprocts. Cerci short and slender, rounded at tip, shorter than paraprocts. Dorsal ovipositor

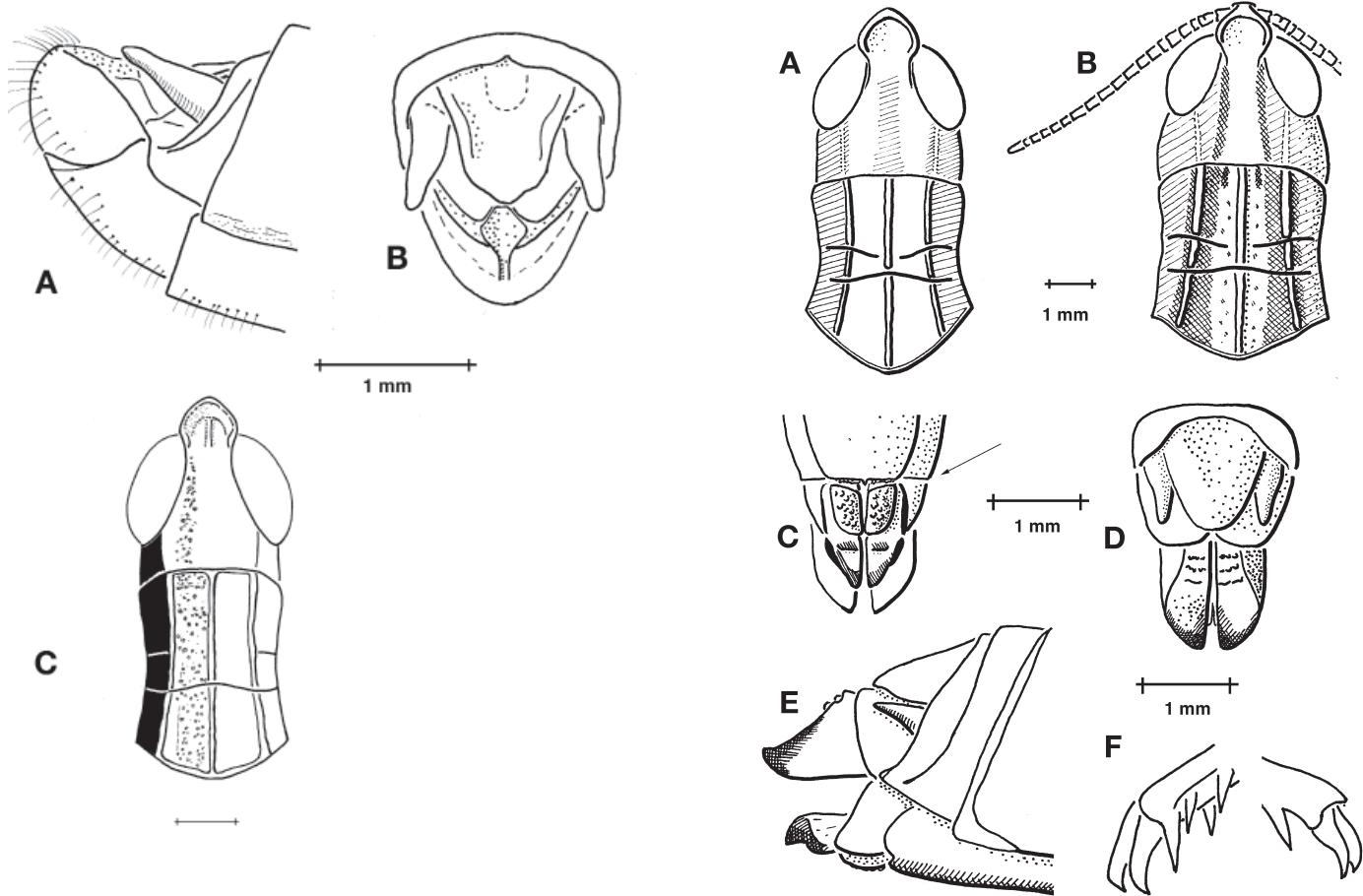


Fig. G20. *Dichromorpha prominula*, male. A, B, abdominal terminalia, lateral and dorsal view. C, head and pronotum, dorsal view.

Fig. G21. *Dichromorpha prominula*, females. A, B, head and pronotum, dorsal view. A from Costa Rica, B from Panama. C, D, E, tip of abdomen. C, ventral view. D, dorsal view. E, lateral view. F, tibial spurs, internal (left) and external (right) aspects.

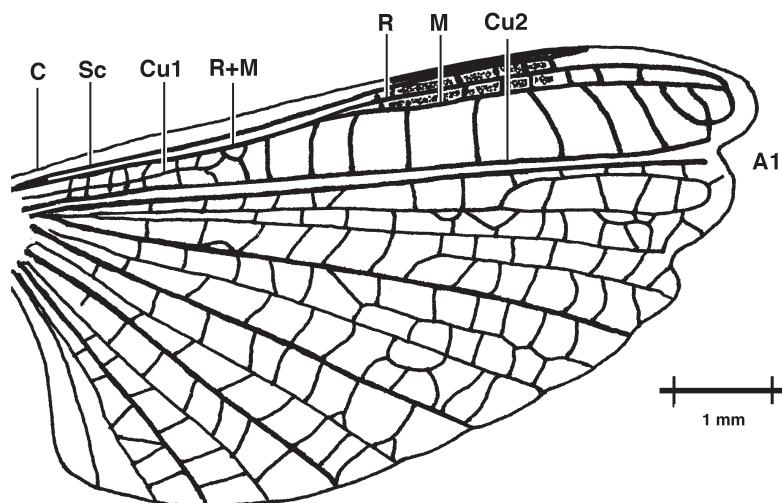


Fig. G22. *Dichromorpha australis*, wing of male.

valves short and broad, slightly hooked at tip, concave distally, provided with three raised transverse ridges proximally. Ventral valves shorter than dorsal valves, heavily sclerotized, hooked at tip. Subgenital plate smooth and cylindrical in shape with almost straight posterior margin, less sclerotized than in *Orphulella*, and with less projecting lateral lobes (compare Figs G21C and G25E; lateral lobes arrowed in both figures).

Dichromorpha prominula (Bruner 1904)

Orphulella prominula Bruner 1900-1910 (1904): 82.
Lectotype locality: MEXICO: Mazatlán.
Location of type specimen: ANS Philadelphia.

Etymology.

Latin *prominens*, projecting, plus diminutive? Possibly referring to the long wings projecting beyond the femora., or the more rostrate head, relative to "other" *Orphulella* spp.

Subsequent literature:

- Kirby, W.F. 1910: 123.
- Hebard, M. 1932: 238. > Transfers to *Dichromorpha*.
- Otte, D. 1979: 77.
- Otte, D. 1981: 105 & 237.

Synonymy.

=*Dichromorpha longipennis* Bruner 1900-1910 (1904): 87, synon.
Hebard 1932: 239.

- Rehn & Hebard 1912: 60.

Diagnosis.

(Figs G18-G22.) Green/brown polymorphic. Habitus, Fig. G18. Antennae slightly ensiform at base. Anterior internal margin of fastigium more rounded (Fig. G20, G21) than in *Orphulella punctata*, where it is more triangular (Fig. G25). Head in lateral view somewhat longer and more pointed than in *O. punctata* (compare Figs G20 and G21), similar to that of *Orphulina*, 0.8× as long as pronotum in dorsal midline. Lateral carinae (see generic diagnosis and Fig. G21) cut by two sulci (in Mexican specimens only one [Otte 1981, and Fig G18]). Males have the femora of the fore and middle legs distinctly thickened when viewed from the side (see Fig. G17 and tribal diagnosis). Tegmina long and narrow, comfortably exceeding both abdomen and hind femora (Fig. G18). Cells of hind wing significantly enlarged (Fig. G22). Overall length (fastigium to tip of elytra) 19-20 mm (males), 22-28 mm (females). Hind femora almost monochrome, without contrasting markings, $F = 11.0-14.1$ mm (female), 9-10.5 (male). External hind tibial spines 11-12, internal spines 11-12, black tipped (in *O. punctata* usually 9 and 10); hind tibial spurs slender and rather straight, subequal within the outer and inner pairs (Fig. G21F). Hind tarsi thin. Sexual dimorphism pronounced: average ratio of male to female measurements, 0.71. Genital characters as in tribal diagnosis.

Field characters.

Females at least are virtually indistinguishable from those of *O. punctata* in the field, apart from the slightly longer elytra and usually slightly larger size. They lack the spotted hind femora seen in most (but not all!) of the latter species, and the pronotal carinae are usually different, but hard to see if the specimen is not in the hand. Some pale females of *O. punctata* with minimally constricted lateral carinae can be distinguished from female *D. prominula* only with great difficulty, using the profile of the head, the form of the fastigium, the number of spines on the hind tibia, the length of the elytra and the details of the subgenital plate (see Diagnosis above). Males are most easily confused with *O. balloui*, which has a similar form and profile, but which has constricted pronotal carinae and usually more contrasty coloration.

Comment.

In both North and South American species the male usually has a dark postocular band extending to the tegmina; it is not yet known whether this applies to the C.American populations, as no males have yet been caught.

The Central American individuals differ in some particulars from the previously described populations from N. America, and may prove to be one or more different species. More material is required, especially males. Usually this genus is without an FDI, but in both the females from Panama there is a continuous FDI diverging slightly towards the posterior. The same individuals have a more rounded fastigial depression than the Costa Rican specimens (Figs G21A, B) and unusually contrasty markings (see Plate G11), reminiscent of *Orphulina balloui*; the Costa Rican examples, however, are almost monochrome.

Distribution.

Mexico: Pacific slope of Mexico from Sonora to Guerrero. Costa Rica, Panama (new distributional records). In all probability the apparently disjunct distribution is an artifact due to lack of collection in the intervening countries. In our region apparently very rare, but may well be commoner and more widely distributed than currently thought, being mistaken for *Orphulella punctata*; known from only a few females from Western Costa Rica (Prov. Guanacaste) and two females from Panama (Prov. Colón & Panamá). (The illustrations of the male shown here were made from Mexican [*prominula*] or Uruguayan [*australis*] specimens).

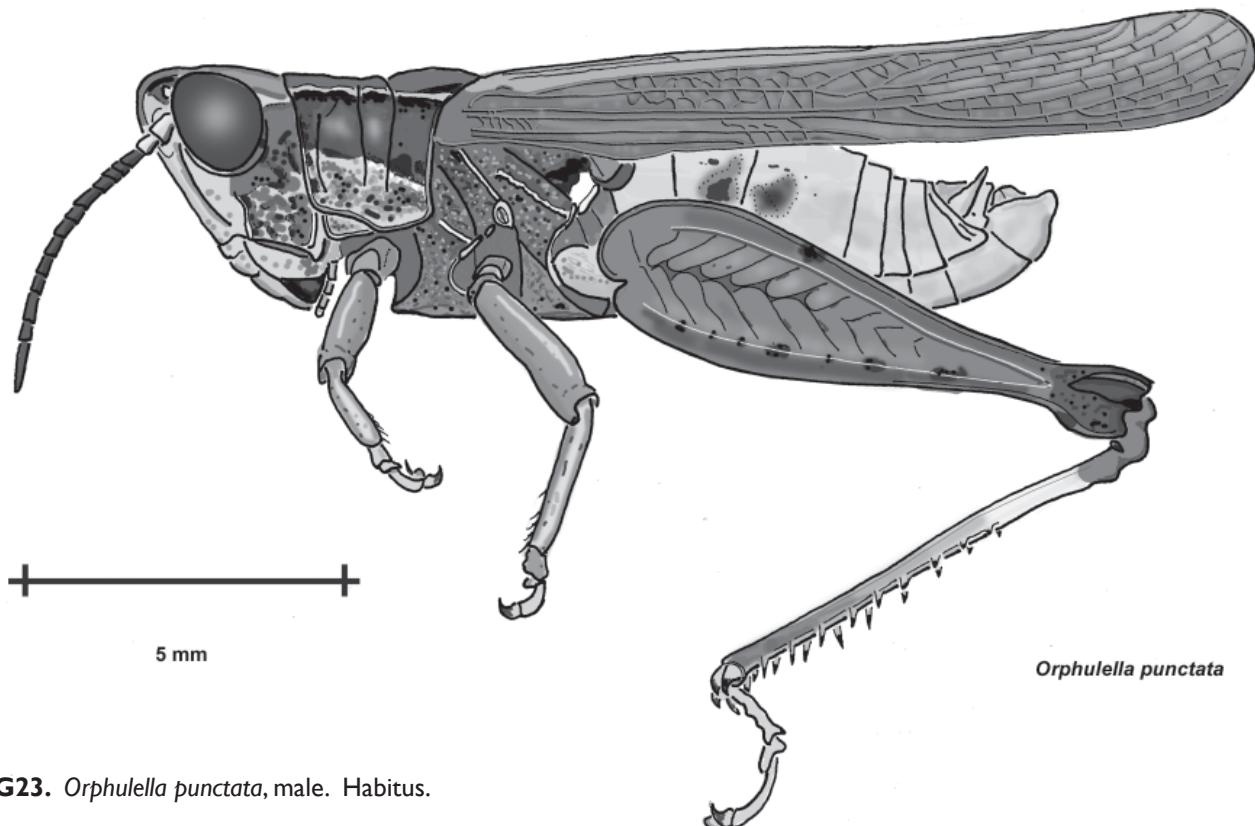


Fig. G23. *Orphulella punctata*, male. Habitus.

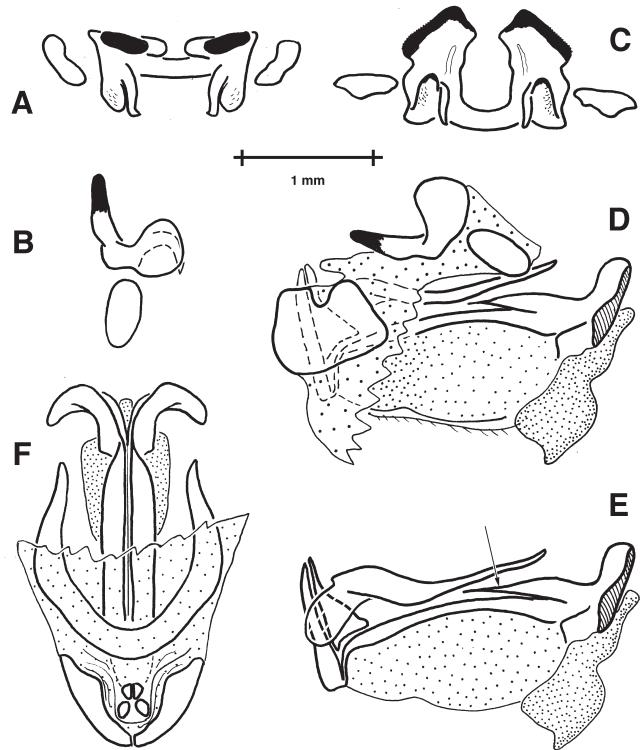


Fig. G24. *Orphulella punctata*, phallic complex. A, C, epiphallus, dorsal, axial and lateral views. D, phallic complex, lateral view. E, F, phallic complex minus epiphallus, lateral and dorsal views.

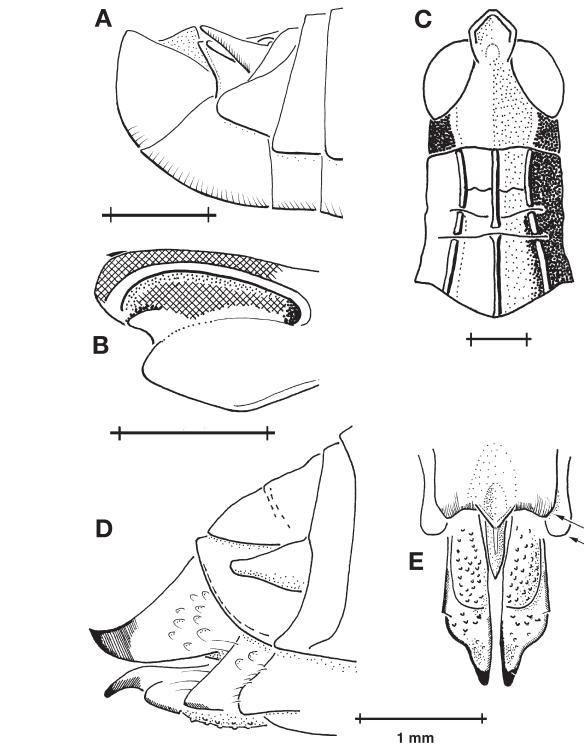


Fig. G25. *Orphulella punctata*. A, male terminalia, lateral view. B, hind knee. C, male head, pronotum, dorsal view. D, E, female terminalia, lateral and ventral views.

Orphulella
Giglio-Tos 1894

Giglio-Tos, E. 1894: 10.

Type species: *Stenobothrus gracilis* Scudder (synon. of *Orphulella speciosa* (Scudder)). Designation by Rehn 1904: 518.

Type locality: USA: Nebraska, Platte.

Location of type specimen: ANS Philadelphia.

Etymology.

Diminutive of *Orphula*, a superficially similar genus of the Acridinae.

Subsequent literature.

- Morse, A.P. 1896: 407.
- Scudder, S.H. 1899: 177.
- Bruner, L. 1902: 31; 1904: 74.
- Rehn, J.A.G. 1904: 518.
- Kirby, W.F. 1910: 119.
- Jago, N.D. 1971: 233. > Synonymized under *Orphulina*.
- Restored by Otte, D. 1979a: 54.
- Otte, D. 1981: 228.

Synonymy.

=*Orphula* MacNeill 1897 (not of Stål 1873), synon. Kirby 1910: 119.

=*Linoceratum* Bruner 1900-1910 (1904): 84, synon. Rehn 1916: 217.

=*Parachloebata* Bruner 1900-1910 (1904): 83, synonymized by Otte 1979a.

=*Isonyx* Rehn 1906b: 36, synon. Otte 1979a.

Diagnosis.

Lateral carinae of pronotum always constricted. Pronotal disk usually with posterior triangular dark marks (*fascia dorsalis interior*, FDI [see under *Syrbula* above (Fig. G4) and Otte 1981, Fig. 36]). Profile of metazona slightly convex in lateral view. Antennae filiform or slightly flattened at base, rather short. Males have the femora of the fore and middle legs distinctly thickened when viewed from the side (see Fig. G17 and tribal diagnosis). Costal area of elytron more or less expanded. Hind knee with a minute medial apical spine (Fig. G25B); knee lobes smoothly rounded. Stridulatory pegs present in some species, absent in others, and variable in number when present. The large cells of the medial area of the male hind wing are similarly variably developed (Fig. G26). Tibial spurs subequal on each side, the internal ones only slightly longer than the external ones. On the sides of the abdomen, usually hidden by the hind femora, are 2-3 dark blotches. Male cerci slender, simple, pointed (Fig. G23). Female subgenital plate with long, triangular, membranous egg-guide, flanked at its base by chisel-shaped, lightly sclerotised lobes with longitudinal striations and often prominent lateral lobes (Figs G25E, G28A, G33A).

Male genitalia: (Figs G24, G30, G32). Epiphallus

slender and ornate, with long thin ancorae and multilobed, flat, sometimes fenestrated lophi. Bridge narrow and bowed. Oval sclerites large. Ventrolateral sclerites well developed and somewhat melanized, as two convex plates which are actually situated dorsolaterally, touching posteriorly in the midline, level with the tips of the aedeagal valves. Cingulum slender, with weak rami and thin curved apodemes. Endophallus with long curved gonopore processes, dividing the very large ejaculatory and spermatophore sacs. Flexure narrow. Endophallic valves sharply upturned, thick and winged proximally, narrow apically. Arch sclerite small, dorsal aedeagal sclerites pointed and slender and almost vertical, approximately the same length as the ventral ones but typically slightly longer or shorter than them.

No. of known species.

Nineteen. In our area, three.

Relationships.

O. punctata and *O. pernix* seem closely related, being very similar in both coloration and genital structures, while *O. concinnula* differs considerably from both.

Generic range.

Canada; USA; Mexico, all of Central America; all of South America north of 35°S (mid-Argentina, Paraguay and S. Uruguay); Cuba, Haiti and Dominican Republic, Puerto Rico, St. Martin (Leeward Islands).

I. *Orphulella punctata* (DeGeer 1773)

Acrydium punctatum DeGeer 1773: 503.

Type locality: unknown.

Location of type specimen: Naturhistoriska Riksmuseum, Stockholm (lectotype, desig. Otte 1979a: 61).

Etymology.

Latin *punctum*, spot, dot; *punctatus*, spotted.

Subsequent literature.

- Stål, C. 1873: 106. > Transfers to *Truxalis*.
- Giglio-Tos, E. 1894: 12. > Transfers to *Orphulella*.
- Rehn & Hebard 1912: 112, designation of lectotype.
- Hebard, M. 1924a: 96.
- Otte, D. 1981: 90 & 243.

Synonymy.

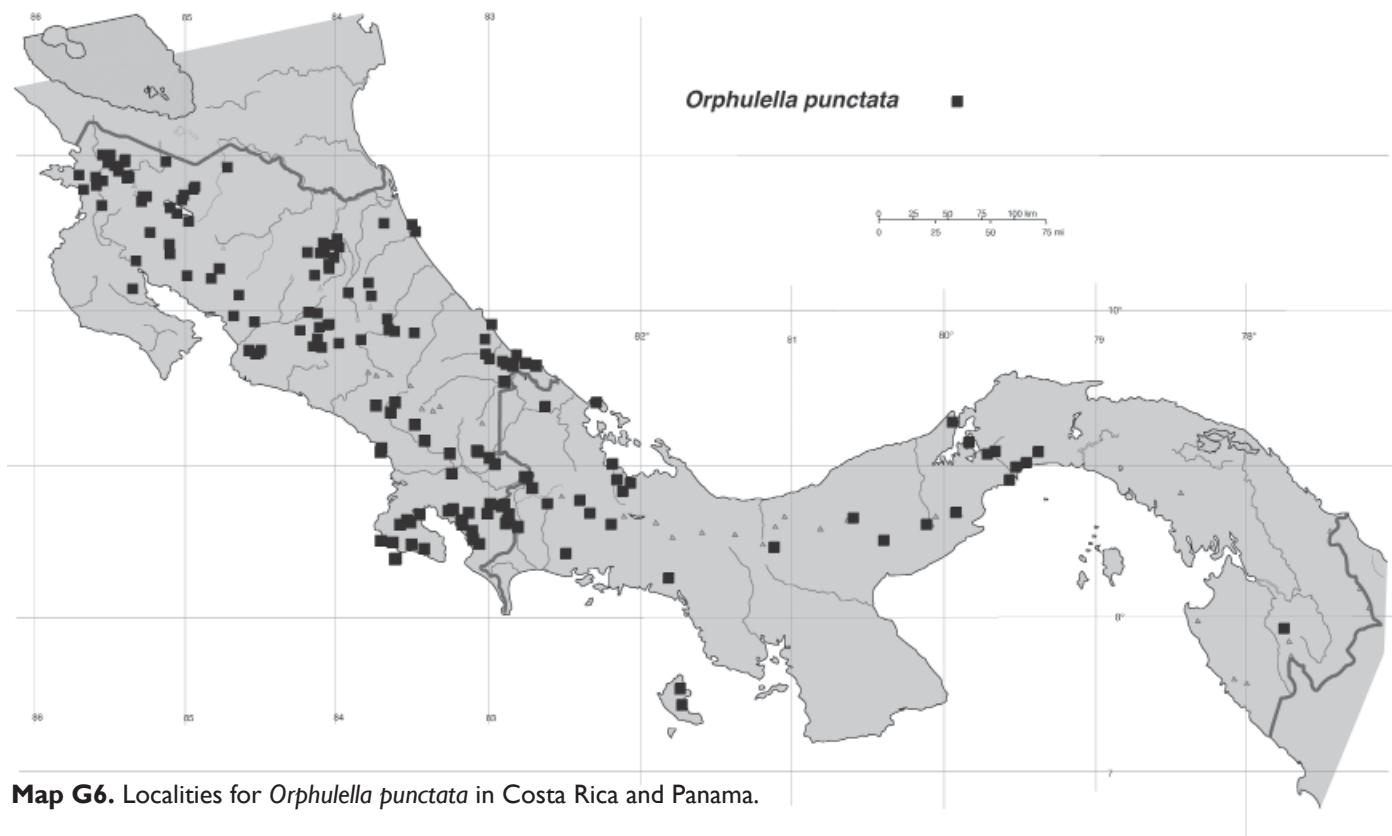
=*Orphula olivacea* Giglio-Tos 1898: 39, synon. Liebermann 1939: 152.

=*Orphulella compacta* Bruner 1911: 19, synon. Otte 1979a: 61.

=*Orphulella costaricensis* Bruner 1900-1910: 82, synon. Hebard 1923:

207.

=*Orphulella elegans* Giglio-Tos 1894: 12, synon. Otte 1979a.



Map G6. Localities for *Orphulella punctata* in Costa Rica and Panama.

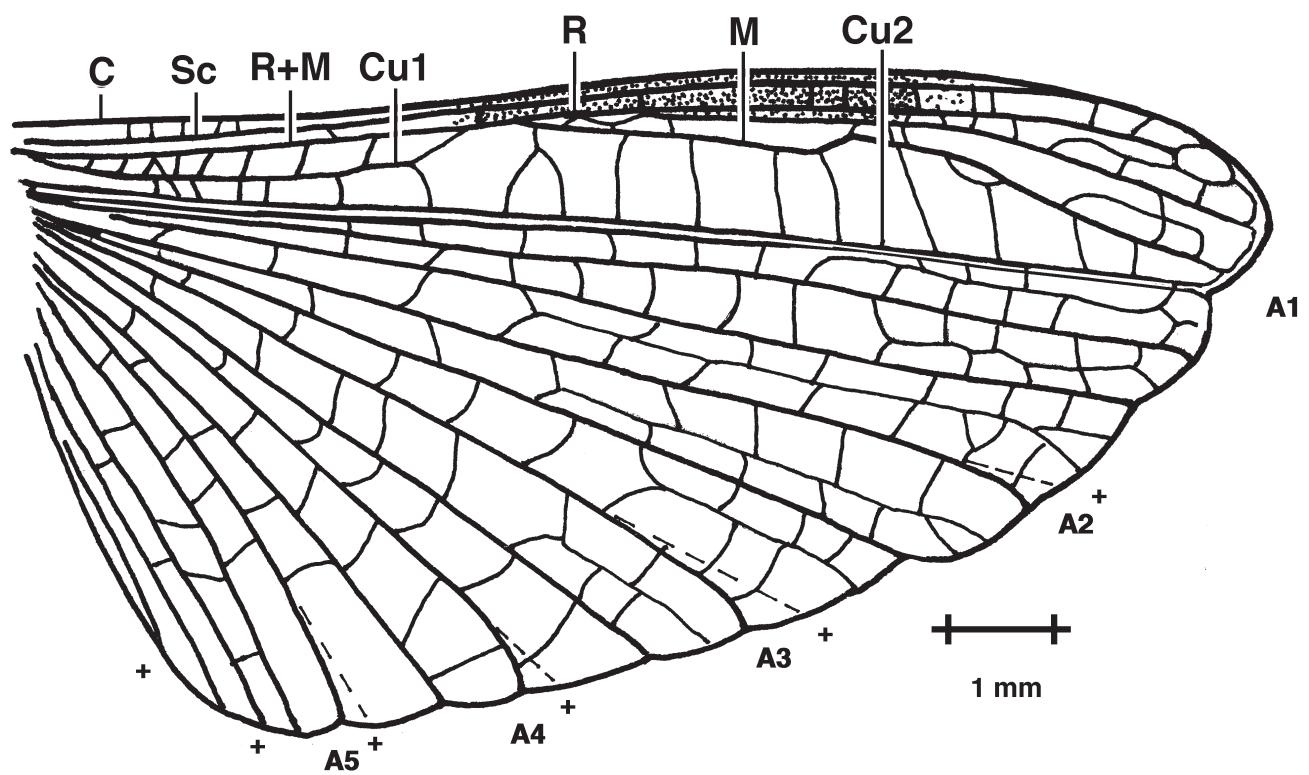


Fig. G26. *Orphulella punctata*, male. Wing. Note cells of medial area significantly enlarged.

=*Orphulella gracilis* Giglio-Tos 1894: 11, synon. Otte 1979a.
 =*Orphulella grossa* Bruner 1911: 18, synon. Otte 1979a: 61.
 =*Orphulella insularis* Bruner 1906: 150, synon. Otte 1979a: 61.
 =*Orphulella interrupta* Bruner 1911: 19, synon. Otte 1979a: 61.
 =*Orphulella meridionalis* Bruner 1904: 81, synon. Hebard 1923: 207.
 =*Oxycoryphus totonacus* Saussure 1861: 315, synon. Hebard 1923: 208.
 =*Oxycoryphus zapotecus* Saussure 1861: 316, synon. Otte 1979a: 61.
 =*Stenobothrus arctatus* Walker 1870: 761, synon. Otte 1979a: 61.
 =*Stenobothrus costalis* Walker 1870: 759, synon. Otte 1979a.
 =*Stenobothrus expandens* Walker 1870: 758, synon. Otte 1979a: 62.
 =*Stenobothrus gratiosus* Walker 1870: 758, synon. Otte 1979a: 61.
 =*Stenobothrus mexicanus* Walker 1870: 756, synon. Bruner 1911: 14.
 =*Stenobothrus tepanecus* Saussure 1861: 319, synon. Otte 1979a: 61.
 =*Stenobothrus viridissimus* Walker 1870: 761, synon. Otte 1979a.
 =*Truxalis intricata* Stål 1873: 106, synon. Rehn 1906b: 38.

Diagnosis (Fig. G23, Plate G12).

Antennae short, filiform, purplish red in life. Anterior internal margin of fastigium V-shaped (Fig. G25C). Head 0.7× as long as pronotum in dorsal midline. Lateral pronotal carinae (Fig. G25C) prominent throughout their length, always somewhat constricted in the middle, and cut by 2 or 3 sulci; posterior FDI present; posterior margin of pronotum angulate; lateral pronotal lobes in males often have an indistinct pale stripe running anteriorly and upwards from the lower hind margin (Fig. G23). Cells of medial area of male hind wing significantly enlarged (Fig. G26). Hind femora usually with small dark spots among the lower outer carinula and usually with a larger spot or two along the outer dorsal marginal area (Fig. G23). Hind femora of male with 6-53 stridulatory pegs (mean = 25), F = 8.5 - 10.8 mm (males), 11.5 - 13 mm (females). Hind tibia with 8-9 external spines, 10-11 internal ones. Female subgenital plate (Fig. G25E) as in generic description, but with very prominent, posteriorly projecting, lateral lobes. Strongly sexually dimorphic in size (ratio 0.77:1).

Phallic complex (Fig. G24) large, lophi of epiphallus (Fig. 24A-C) are unitary flat plates, not subdivided, but with traces of fenestration. Medial crest of endophallic plates terminates in a thin, pointed, posteriorly directed process (Figs 24F, G, arrowed).

Field characters.

Especially the females are very polymorphic in colour, with green, yellow, brown or purple ground colour and highly variable markings. Males are less variable, though also green/brown polymorphic, usually about 50% of each form being present. In most (but not all!) males there is a conspicuous white spot on the dark distal metathoracic epimeron (Fig. G21). This is the most obvious field character (note however that *Aidemona*

azteca (Melanoplinae), otherwise very different in coloration, has a similar spot, as does *O. pernix* - the latter, however, is brachypterous). Hind femora of variable colour, but usually with 3-5 small dark spots along the lower outer carina and often a single more diffuse dark patch on the upper outer carina (Fig. G23). Antennae reddish or purplish in life, drying brown. Eyes dark brown. A medial stripe of green or pale brown runs from the fastigium along the pronotal disc and the dorsal field of the tegmina. The lateral pronotal carinae are conspicuously pale, giving an hour-glass appearance seen from above, with dark triangles (FDIs) posteriorly between the diverging carina and the medial green or pale brown stripe (Fig. G25C). Genae always darker than frons, and this shade or a still darker one is continued onto the lower pronotal lobes (contrasts with the continuous pale colour of *concinnula*). Above this, and below the lateral carinae, the lobes are dark. Lateral area of tegmen (i.e., the leading edge) blackish or brown. In many brown forms, especially females, there is intricate patterning in darker and light brown superimposed on the colours described above, including the lateral area of the tegmen.

Males are readily distinguished from those of *O. concinnula*, which look rather similar, by their stridulatory apparatus – this can be heard by moving the femur against the elytron while holding the animal to the ear. In *O. concinnula* the genae are always light coloured, green or straw, not darker than the frons. The brighter coloration of *O. concinnula* (see below) and its unspotted hind femora are also distinctive.

Distinguished from *Orphulina* by the more angulate inner margin of the fastigium and of the hind margin of the pronotum, by the presence of the apical spine of the hind knee (Fig. G25B), by the relatively longer pronotum and shorter head, and by the structure of the female subgenital plate. For more details see under *Orphulina*.

Distribution.

Mexico; all of Central America; South America to latitude 35°S (middle Argentina and S. Uruguay). In the Caribbean, recorded from Cuba, Hispaniola, Puerto Rico, Tobago, Grenada, St. Vincent, Guadeloupe, Dominica, St. Eustatius, Montserrat, Martinique, St. Croix, St. Lucia.

Probably nowadays the commonest grasshopper in Central America, and one of the most variable in colour and patterning, which explains the large number of synonyms. In Costa Rica and Panama found where ever there is grass, except in shady forest or at high altitude. Very common on grazed pasture land and mown lawns.

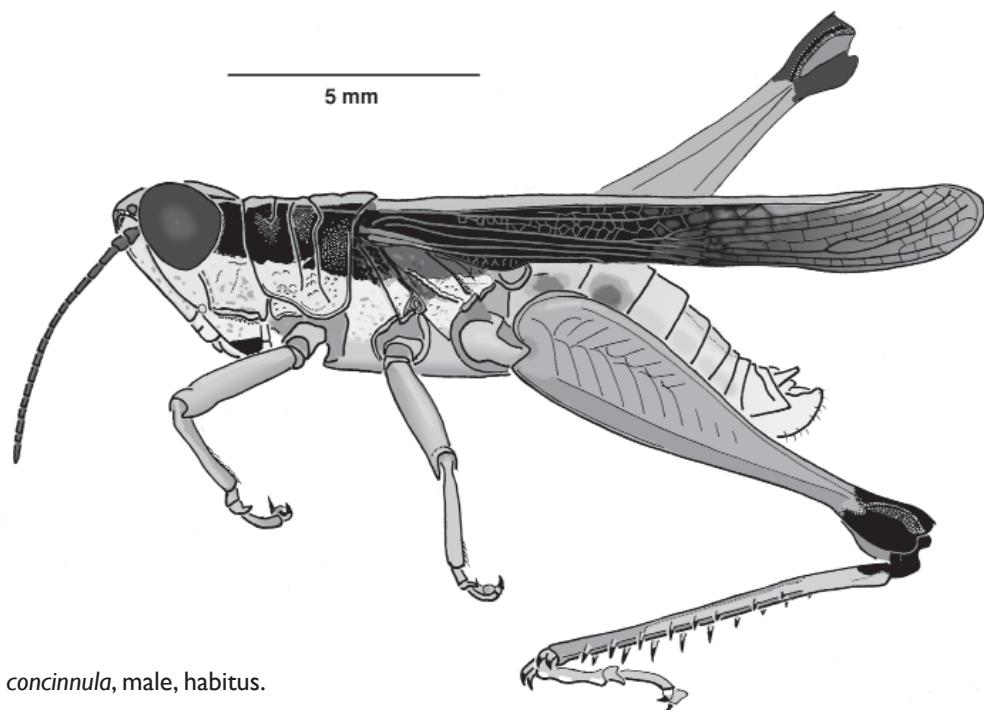


Fig. G27. *Orphulella concinnula*, male, habitus.

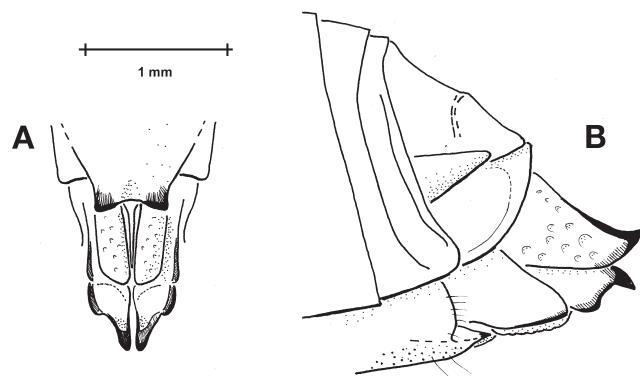


Fig. G28. *Orphulella concinnula*, female, terminalia. A ventral and B, lateral.

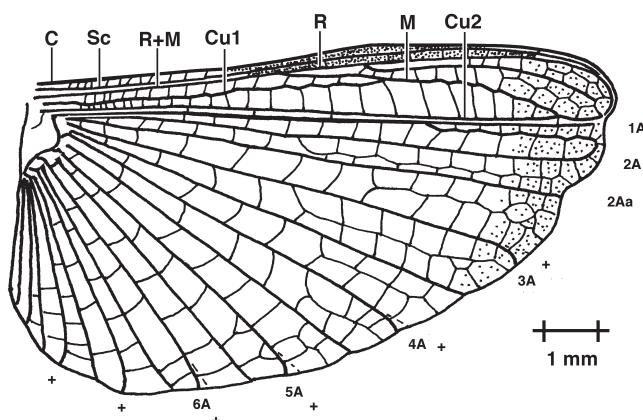


Fig. G29. *Orphulella concinnula*, male, wing.

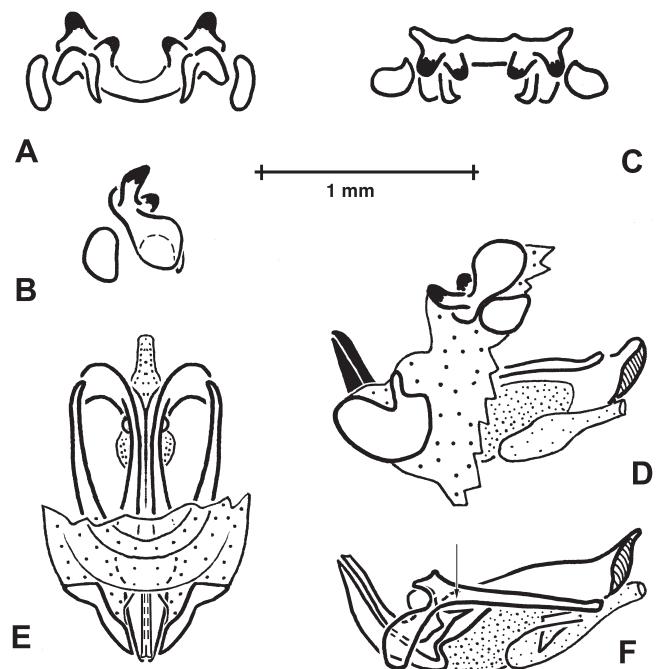


Fig. G30. *Orphulella concinnula*, phallic complex. A-C, epiphallus. D, phallic complex, lateral view. E, F, phallic complex minus epiphallus and ectophallic membrane, dorsal and lateral views.

2. *Orphulella concinnula* (Walker 1870)

Stenobothrus concinnulus Walker 1870: 759.

Type locality: BRAZIL: Para.

Location of type specimen: NHM London.

Etymology.

Latin *concinnus*, beautiful, striking, plus diminutive: “pretty little *Orphulella*”— a good description.

Subsequent literature.

- Kirby, W.F. 1910: 119. > Transfers to *Orphulina*.
- Uvarov, B.P. 1925: 265. > Transfers to *Orphulella*.
- Otte, D. 1979: 52. > Revision of genus.
- Otte, D. 1981: 97, 241.

Synonymy.

- = *Linoceratum australe* Bruner 1911, syn. with *O. boucardi* by Rehn 1916: 277, syn. with *O. concinnula* by Hebard 1933: 44.
- = *Linoceratum boucardi* Bruner 1904, transferred to *Orphulella* by Rehn 1916: 217, syn. with *O. concinnula* by Hebard 1933: 44.
- = *Orphulella chipmani* Bruner 1906, syn. with *O. boucardi* by Rehn 1916: 277, syn. with *O. concinnula* by Hebard 1933: 44.
- = *Orphulella peruna* Bruner 1911, syn. with *O. boucardi* by Hebard 1923: 204, syn. with *O. concinnula* by Hebard 1933: 44.
- = *Stenobothrus rugulosus* Walker 1870, syn. Otte 1979: 52.

Diagnosis.

(**Figs G27-G30, Plate G13**). Head nearly as long as pronotum in dorsal midline. Lateral carinae low and almost obsolete, especially in central part, cut by up to 3 sulci. Posterior margin of pronotum rounded (in *punctata* more angulate). Cells of medial area of male hind wing scarcely enlarged at all (**Fig. G29**). No stridulatory femoral pegs in either sex. F = 8.0 - 9.3 mm (males), 10.3 - 11.1 mm (females); 9 - (10, 11) outer and (10)-11 inner tibial spines, black tipped. Tibia black proximally, then pale, darkening distally. Elytra exceed abdomen and hind knees. Fastigium slightly longer than in *O. punctata* (**Fig. G25C**), but like that species slightly depressed centrally and with raised marginal carinae.

Phallic complex (**Fig. G30**) proportionately much smaller than in *O. punctata*; further, the ejaculatory and spermatophore sacs are relatively smaller than in the latter species. (Such differences in closely related species are usually signs of a different social structure or mating system.) Epiphallus with bilobed lophi, unlike *O. punctata*. Crest of endophallic plate terminates more bluntly and more posteriorly than in *O. punctata*.

Female subgenital plate (**Fig. G28A**) subrectangular distally, with sharply accentuated sclerotized corners flanking the egg guide, but lateral lobes poorly developed in comparison with *O. punctata*.

Sexual dimorphism in size = 0.79, similar to *O. punctata*.

Field characters.

Similar to *O. punctata*, but smaller, more slender, and

with the hind femora a clear golden brown, devoid of bands or spots, with a dark knee. The pale green of the face is continued as a band across the lower genae and the ventral lobes of the prothorax (in *punctata* the genae are dark, and the prothoracic lobes are of variable colour). The upper regions of the pronotal lobes and the lateral field of the tegmina are black in all males and some females. A pale dorsal stripe, usually green in Panama, runs from fastigium to the end of the tegmina. This “pretty”, contrasty coloration is the best field character. The species is green/brown polymorphic; a few individuals have the light green of the dorsal stripe, face and abdomen replaced by a light straw colour.

Distribution.

Peru, Bolivia, Brasil (Para, Amazonas, Mato Grosso do Sul), Suriname, the Guyanas, Ecuador, Venezuela, Trinidad, Colombia, Panama. A basically South American species which apparently reaches its northern limit in Western Panama. Not to date recorded from Costa Rica. **Map G8**.

Natural history.

Found in habitats similar to those of *O. punctata*, but usually where there is damp but short grass.

3. *Orphulella pernix* Otte 1979

Otte 1979: 64.

Type locality: COSTA RICA: Guanacaste Province, 8.9 mi S of La Cruz on Pan American Highway.

Location of type specimen: University of Michigan Museum of Zoology, holotype male.

Etymology.

Latin *pernix*, nimble, agile,

Subsequent literature.

- Otte 1981: 97 & 243.

Diagnosis.

(**Figs G31-34, Plate G14**). Small, body length of male 14.5 mm to end of abdomen, 17.5 mm to end of hind femur. F male = 9.13 mm, F female = 11.07 mm. Antennae filiform, 15 flagellar segments. Head 0.78 times length of pronotum in dorsal midline. Forewings shorter than head and pronotum combined, 1.60 times pronotum in length in both sexes (Otte gives 1.29 times). Frontal ridge with the merest suggestion of a shallow groove. Internal anterior margin of fastigium angular, subtriangular. Lateral carinae of pronotum strongly converging, cut by two (the second and third) sulci (**Fig. G34**); the most anterior sulcus is visible on both sides of the lateral carina, but does not incise it. Medial carina cut by only the posterior sulcus. Stridulatory file present in male, 54 teeth, reduced to <5

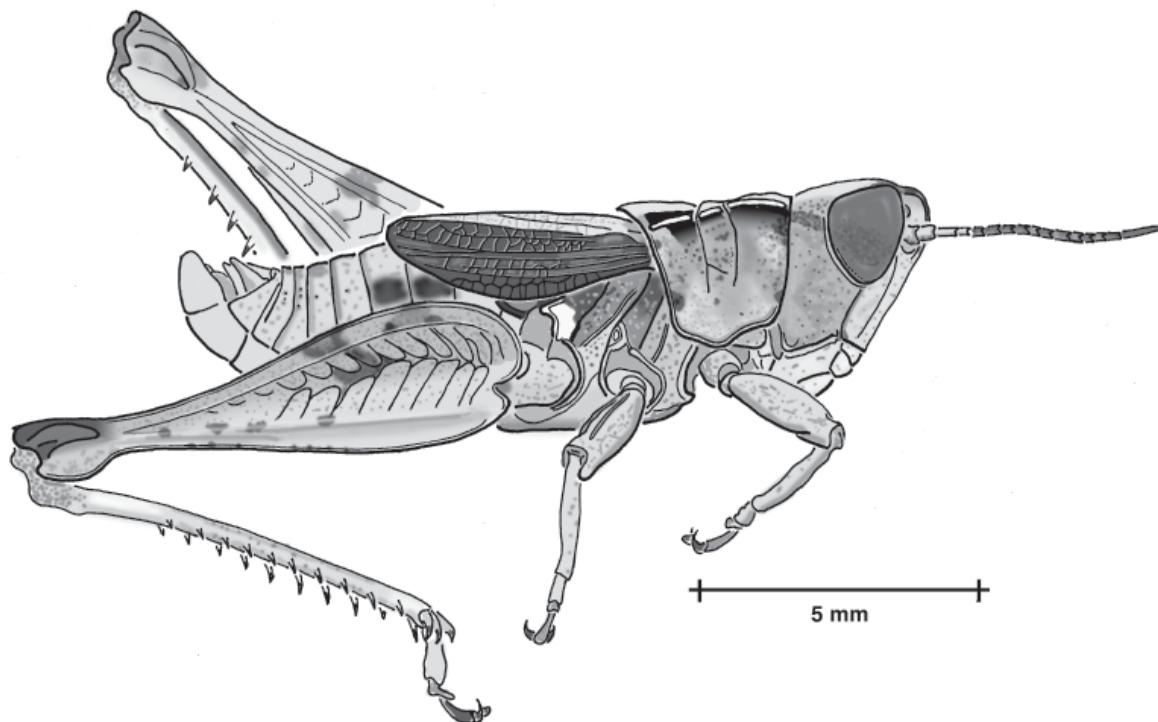


Fig. G31. *Orphulella pernix*, male, habitus.

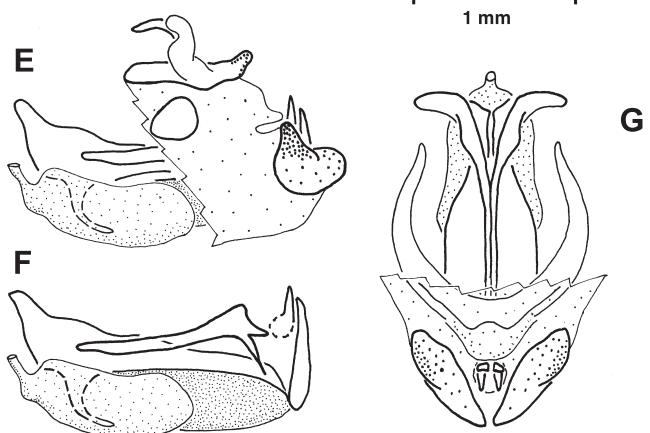
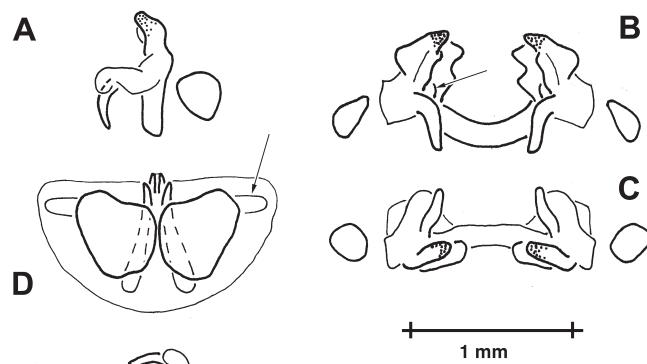


Fig. G32. *Orphulella pernix*. A-C, epiphallus. D, axial view of phallus from behind, epiphallus omitted. E, entire phallic complex, lateral view. F, G, the same, minus epiphallus and ectophallic membrane; lateral and dorsal views.

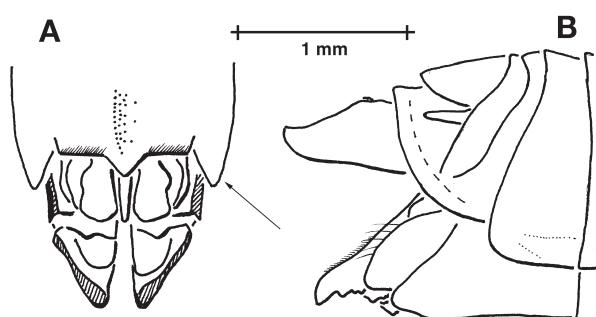


Fig. G33. *Orphulella pernix*, female terminalia. A, ventral. B, lateral.

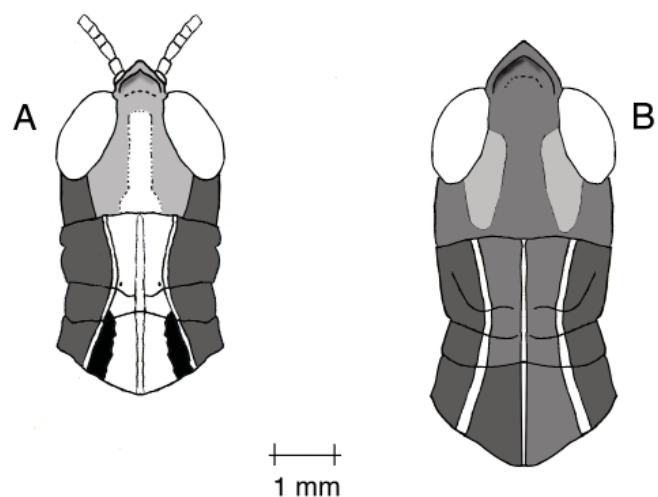


Fig. G34. *Orphulella pernix*. Pronotum, dorsal view. A, male. B, female.

teeth in female. Hind tibiae with 10 external and 10-11 internal spines. Male subgenital plate ends in a rounded point. Female SGP (**Fig. G33**) more similar to that of *O. punctata* than that of *O. concinna*, with well-developed lateral lobes (arrowed in **Fig. G33A**) and egg-guide flanked by straight sclerotized edges. Sexual dimorphism in size somewhat less than in the other two species, 0.82:1.

Side of head, lateral lobes of pronotum, sides of body pinkish brown, mottled with darker colour. Top of head green or light brown, apex of fastigium blackish. Face light pinkish brown, labrum paler. Side of head slightly darker behind eyes, continued forward and downward as a band over the eye. Disc of pronotum and dorsal field of tegmina light green or light brown, remainder of tegmen blackish brown. Lateral lobes of pronotum mostly pinkish brown, but with a black strip below lateral carinae. Disk green or light brown. Posterior FDI present, black. Lateral carinae pale, yellowish. Distal end of mesothoracic mesoepisternum white, proximal end nearly black, giving a conspicuous white lateral spot as in *O. punctata*. Sutures between epimeron and episternum T1 and 2 black. Hind femur pinkish brown, with two darker spots on upper marginal area. Upper carinula with a few tiny black lumps. Lower carinula with 3 black spots in distal half. Hind knees brown, area below semilunar process black. Abdomen with very large black markings on sides of tergites III and IV, remaining tergites brownish. Ovipositor valves rather short for the genus.

Male genitalia (**Fig. G32**) very similar to those of *O. punctata*, but smaller, and with more ornate lophi, which are partially bilobed, not flat or unitary, and clearly fenestrated basally (arrowed in **Fig. G32B**).

Field characters.

The only brachypterous species of the genus in our area. In the field, looks like a small *Silvitettix bolleyi*, but can be distinguished by the sharply constricted pronotal carinae, which give an hour-glass pattern in dorsal view (**Fig. G34**), and by the presence of a white spot on the lateral thorax (**Fig. G31**). Males are usually green dorsally, females usually brown.

Distribution.

Known only from northern Guanacaste Province, Costa Rica, but probably extends into southern Nicaragua. **Map G7**.

Natural history.

Known to date from very few specimens. I have found it in short grass under the shade of an *Enterolobium* tree in dry savanna grassland.

Orphulina Giglio-Tos 1894

Giglio-Tos 1894: 9

Type species: *O. pulchella* Giglio-Tos, by original designation.

Type locality: Paraguay: Provincia S. Pedro.

Location of type specimen: Museo del Instituto di Zoologia sistematica dell'Università de Torino.

Etymology.

Diminutive of *Orphula*, a genus of Acridinae.

Subsequent literature.

- Bruner, L. 1900-1910 (1902: 30; 1904: 74.
- Kirby, W.F. 1910: 118.
- Jago, N.D. 1971: 233.
- Amedegnato, C. 1974: 203.
- Otte D. 1979: 74.
- Otte, D. 1981: 100 & 228.

No. of described species.

Two. At least one occurs in our area, and the other has been reported once. The two however may well be synonymous; the distributions overlap, the reported differences are very small, and Rehn did not examine the type of Giglio-Tos' species before his description. A critical revision is necessary.

Range of genus.

Paraguay and Brasil to Colombia, but excluding Chile, Peru and Ecuador; Panama, Costa Rica, Honduras; Barbados; Curaçao.

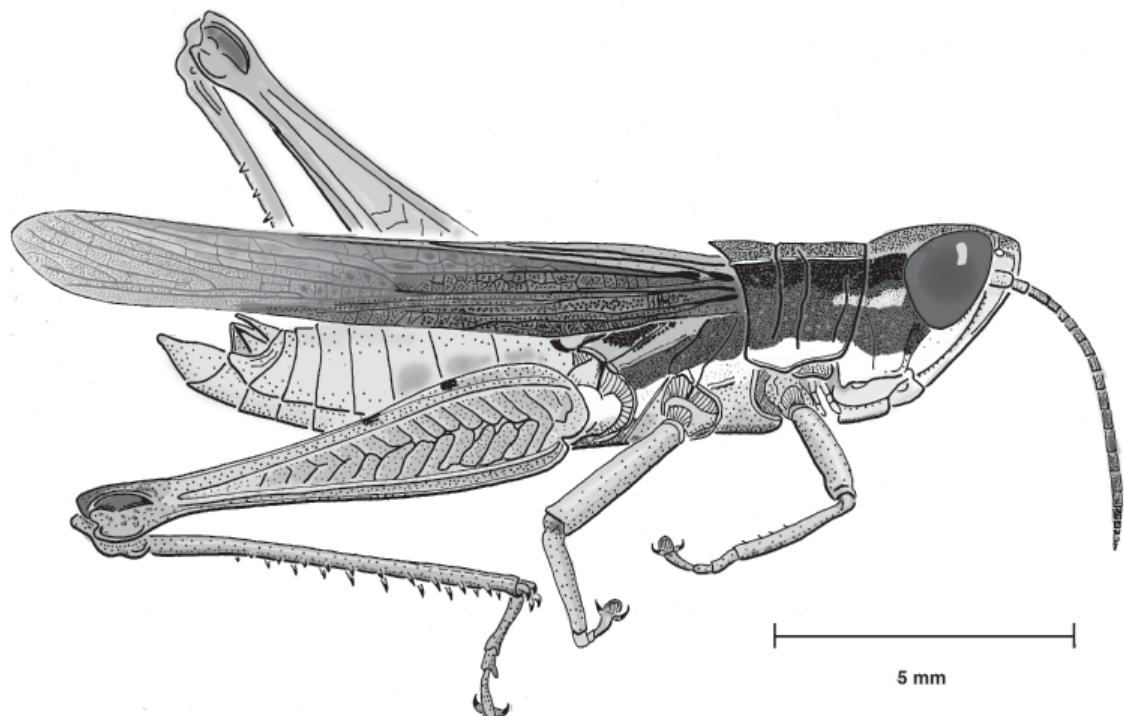


Fig. G35. *Orphulina balloui*, male. Habitus.

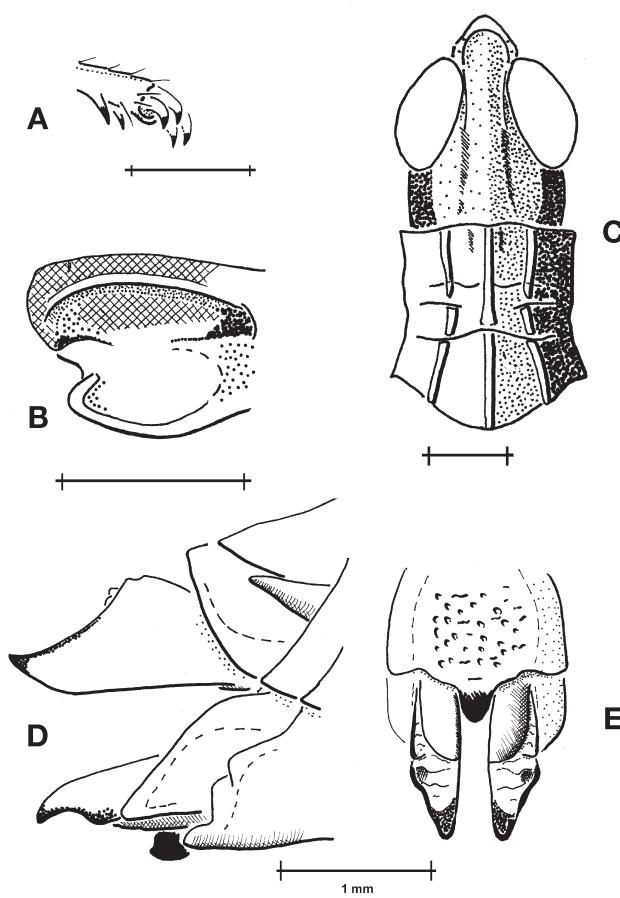


Fig. G36. *Orphulina balloui*. A, hind tibial spurs. B, hind knee. C, head and pronotum, dorsal view. D, E, female terminalia, lateral and ventral.

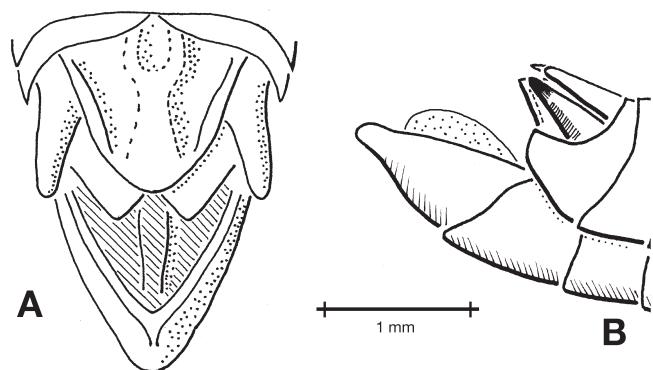


Fig. G37. *Orphulina balloui*, male terminalia. A, dorsal, B, lateral.

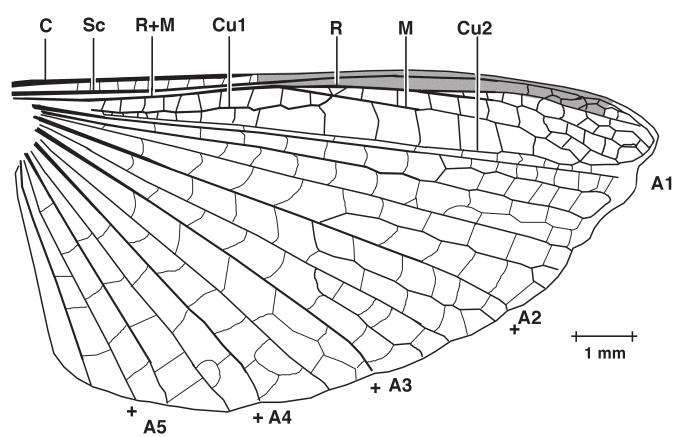


Fig. G38. *Orphulina balloui*, wing.

Diagnosis.

(**Figs G35-G39, Plate G15**). The external characters alone do not really warrant a generic distinction between *Orphulella* and *Orphulina*, as already noted by Jago (1971). The male aedeagus and the female subgenital plate are however significantly different from those of any *Orphulella* species, convincing me that the two genera should be maintained. In morphometric ratios and the shape of the head, *Orphulina* is closest to *Dichromorpha*, but shows less sexual dimorphism than that genus.

Overall length (frons to wing tip) ca 19 (male) or 22 (female) mm; wings exceed hind femora. Antennae flattened, slightly ensiform, 19-20 segments, narrowing abruptly after segment 13. Inner margin of fastigium rounded, almost semicircular (**Fig. G36C**). Head 0.98-1.03× the length of the pronotum in dorsal midline, rather pointed in side view, frons strongly receding. Pronotal disc crossed by three sulci, as in *Orphulella* but unlike *Dichromorpha*; posterior margin of pronotum rounded, not angulate (**Fig. G36C**). Male hind wing (**Fig. G38**) with moderately enlarged cells; the junction between Cu1 and M is more distal than in either *Orphulella* or *Dichromorpha*. Hind knee devoid of any medial spine, uniquely for members of this tribe (**Fig. G36B**). Hind tibia with 9-10 external spines, 11 internal. The tribal thickening of the male front femur is less pronounced than in *Orphulella* or *Dichromorpha*. Male paraprocts longer than supra-anal plate (**Fig. G37A**). Female subgenital plate with short lateral lobes and a short, blunt, sclerotized egg guide (**Fig. G36E**). Sexual dimorphism in size not very pronounced, significantly less than in *Orphulella*, various dimensions averaging male/female = 0.88.

(Otte [1979] writes that in *Orphulella* the ratio of the maximum length of pronotum (P) to height of pronotum (H) is always less than 1.2, whereas in *Orphulina* it is always greater. This however does not agree with my measurements of 21 specimens of *O. punctata*, where P/H varies from 1.14 - 1.37, mean 1.25 ± 0.05; my range of values for *Orphulina* male and female were 1.29 - 1.35 and 1.16 - 1.45 respectively).

Phallic complex (Fig. G39). Epiphallus with widely separated, weakly bilobed lophi, not fenestrated; oval sclerites present, small. Ventrolateral sclerites present. Cingulum with laterally flared apodemes and 2 posteriorly projecting knobs above zygoma. Endophallic apodemes widely splayed laterally; endophallic plate with a long thin horizontal dorsal process; flexure very short. Aedeagal valves straight, held vertically or even pointing slightly forward.

Female terminalia (Fig. G36D, E) in general typical for the tribe. Subgenital plate distinctive, pitted, broadly triangular at the posterior margin with a short, sclerotized egg-guide.

Field characters.

Orphulina is really very like *Orphulella*, especially *O. punctata*, and the two are difficult to distinguish unless seen

side by side. Both are green/brown polymorphic and variable in coloration. The pattern of carinae and sulci on the pronotal disc is identical. *Orphulina* has a proportionately longer and more pointed head and shorter pronotum and the hind femur is slightly more slender (maximum width/length = 0.22 in *O. balloui*, versus 0.25 in *O. punctata*). To make absolutely sure, measurement of head, prothorax and femur and the use of a microscope to examine the hind knee is advisable. Males of *Orphulina* usually have a prominent white or cream band across the lower part of the prothoracic lobe, which may be (but is not always!) continued anteriorly across the ventral genae and posteriorly across the ventral mesepisternum and hind coxa (as in **Fig. G35**); in *O. punctata* the lower part of the genae is usually brown. In females the subgenital plate is diagnostic (compare **Figs G25E & G36E**). The male subgenital plate is longer and slimmer than that of *O. punctata* (compare **Figs G25A & G37B**).

I. *Orphulina pulchella* Giglio Tos 1894

Giglio-Tos 1894, Boll. Mus. Univ. Torino 9: 8.

Type locality: PARAGUAY: Provincia S. Pedro.

Location of type specimen: Museo del Istituto di Zoologia sistematica dell'Università de Torino.

Etymology.

Latin *pulcher*, beautiful, plus diminutive.

Subsequent literature.

- Kirby, W.F. 1910: 118.
- Hebard, M. 1924: 94.
- Otte, D. 1979: 74.

Diagnosis.

According to Otte, differs only slightly in coloration from *O. balloui* (q.v.). The distinction appears to be minimal and needs to be re-examined (see above under generic description).

Distribution.

Paraguay (San Pedro, Paraguari, Guaira), Brasil (Rio de Janeiro, Espírito Santo, Mato Grosso, Bahia), Bolivia (Santa Cruz), French Guiana, Colombia (Vaupes, Meta, Amazonas), ?Panama (Darién).

The sole Panamanian record is from Giglio Tos, 1897, referring to material collected in Darién at Lago de la Pita. Hebard (1924: 94) considered this to be a misidentification of *O. balloui*, but apparently on geographical grounds, without examining the original material.

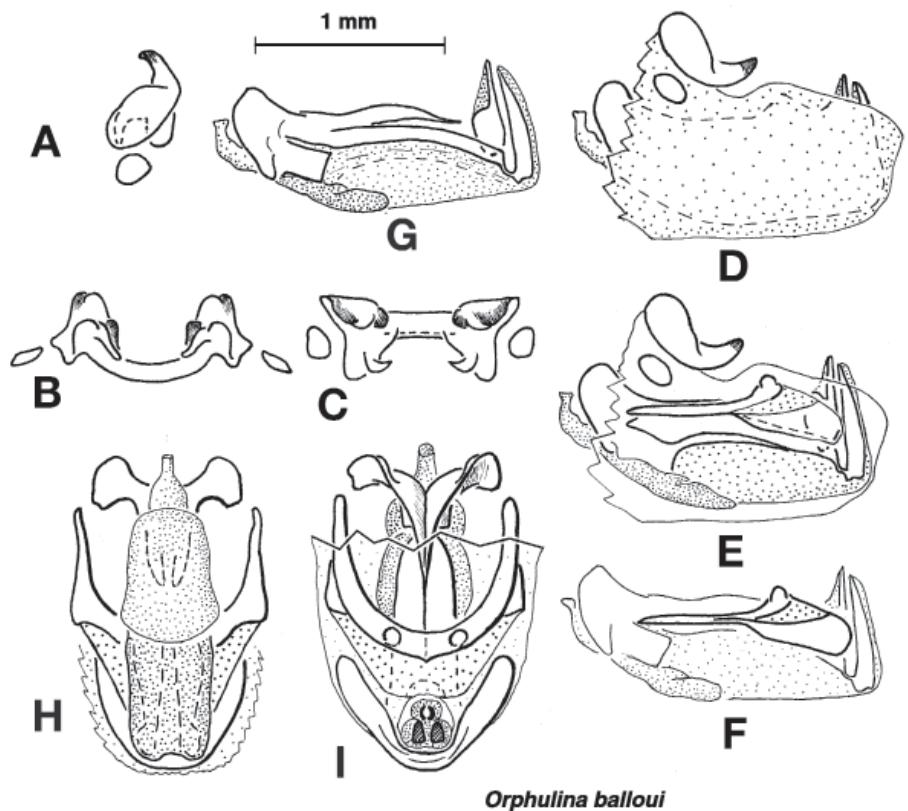


Fig. G39. *Orphulina balloui*. Phallic complex. A-C, epiphallus; lateral, axial and dorsal views. D, entire phallic complex, lateral view. E, as D, but ectophallic membrane deemed transparent, to show ecto- and endophalli within. F, minus epiphallus, showing cingulum and zygoma. G, endophallus and dorsal aedeagal valves. H, as F, ventral view. I, as F, dorsal view.



Map G7. Localities for *Orphulina balloui*, *Orphulella pernix* and *Dichromorpha prominula* in Costa Rica and Panama.

2. *Orphulina balloui* (Rehn 1905)

Orphulella balloui Rehn 1905: 178.

Type locality: BARBADOS: Bay Estate.

Location of type specimen: ANS Philadelphia.

Etymology.

Named for H.A. Ballou, Entomologist of the Imperial Department of Agriculture for the British West Indies in 1905.

Subsequent literature.

- Rehn, J.A.G. 1906: 21. > Transferred to *Orphulina*.
- Hebard, M. 1924: 94.
- Otte, D. 1979: 74.
- Otte, D. 1981: 100 & 244.

Synonymy.

=*Orphulina acuta* Rehn 1906b: 23, synon. Otte 1979: 74.

=*Orphulina veteratoria* Rehn 1906b: 21, synon. Otte 1979: 74.

Diagnosis.

Distinguished from *O. pulchella* only by having a pale streak behind the eye, a somewhat more interrupted white strip across the area between the rear of the pronotum and the socket of the hind coxa, and sometimes a pale stripe on the mesepisternum. The examined male specimens of *O. balloui* have 24-32 stridulatory teeth. Should the two species prove synonymous, *balloui* would be a junior synonym,

Distribution.

Barbados (Windward Islands), Curaçao (Dutch West Indies); Honduras, Costa Rica, Panama; Guyana, Venezuela (Bolívar), Colombia (Bolívar, Magdalena, Boyaca, Cundinamarca, Guajira, Córdoba), Bolivia (Beni), Brasil (Mato Grosso, Mato Grosso do Sul, Bahia, Goias, Rio de Janeiro, São Paulo).

Seemingly rare and local in Central America, but this may in part be due to it being taken for *Orphulella punctata*. In Costa Rica known only from a few specimens caught near the towns of Puntarenas and Limón, and from Boruca (southern Puntarenas Province). In Panama recorded only from the area around Panama City and Old Panama, and from the Caribbean coast at San-San, Prov. Bocas del Toro. Most known localities are coastal. See also above under *O. pulchella* for a possible occurrence in Darién.

Tribe Scyllinini
Carbonell 1995

Carbonell 1995: 91.

Diagnosis.

(After Carbonell.) Medial internal spur of hind femur very much longer than the other three (Fig. G40). Fastigium excavated dorsally; region of lateral foveolae usually visible from above, of variable distinctness (not however visible in species from our region); antennae generally filiform. Vertex and frons convex in lateral view; median carina of pronotum cut only by the main sulcus, lateral carinae present, continuous or discontinuous, generally curved mesad towards the middle; prozona and metazona subequal in length; femoral stridulatory file present, usually in both sexes. Tegmina with resonatory area well developed in costal, subcostal and radial areas; basal half of costal area (between C and Sc) usually convex, with cross veins obsolete, and coloured white or ivory.

No. included genera.

Fourteen, mostly S. American. In our area, one.

Tribal range.

Southern USA to Argentina and Chile.

Rhammatocerus
Saussure 1861

Type species: *Stenobothrus (Rhammatocerus) viatorius* Saussure 1861: 317, designated by Rehn 1940: 103.

Etymology.

Greek *rhamma*, thread; *keras*, horn. “thread-like antennae”.

Rhammatocerus was originally a group name (*Rhammatoceri*), used in Fieber 1852: 4, and in Fischer 1853: 315. Saussure (1861) was the first to use it in the singular as a subgenus, *Stenobothrus (Rhammatocerus)*, and this usage was repeated by Walker (1870: 756). The name then dropped from use, in favour of *Scyllina* Stål, until *Rhammatocerus* was restored to use by Rehn and *Scyllina* Synonymized with it by Jago (see below).

Subsequent literature.

- Rehn, J.A.G. 1906: 40. > As *Scyllina*.
- Kirby, W.F. 1910: 132. > As *Scyllina*.
- Rehn, J.A.G. 1940: 103, 105. > Redefines *Scyllina* and restores the name *Rhammatocerus*.
- Jago, N.D. 1971: 266, 296. > Synonymizes *Scyllina* sensu Rehn with *Rhammatocerus*.
- Amedegnato, C. 1974: 203.
- Otte, D. 1981: 120 & 229.

Orphulella concinnula

Map G8. Localities for *Orphulella concinnula* in Panama.

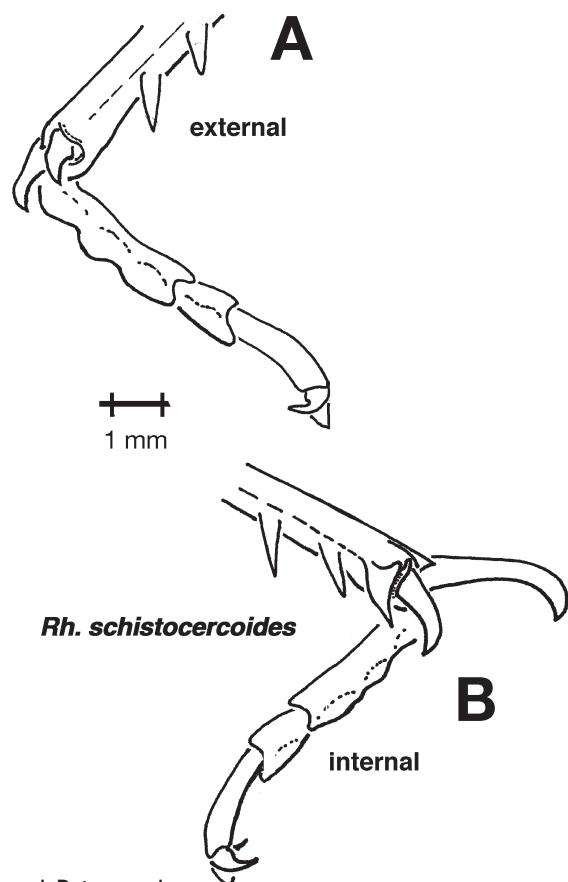


Fig. G40. *Rhammatocerus schistocercoides*, hind tibial spurs. A, external. B, internal.

- Carbonell, C.S. 1995: 87-152. > Allocates to Scyllinini.
- Assis-Pujol, C.V. 1998, : 2. > Redescription.

Synonymy.

=*Pseudostauronotus* Brunner de Wattenwyl 1893: 123, synon. with *Scyllina* by Rehn 1940: 105.
 =*Plectrophorus* McNeill 1897b: 251, synon. with *Scyllina* by Rehn 1940: 105.
 =*Plectrotettix* McNeill 1897a: 71 (replacement name for *Plectrophorus*), synon. with *Scyllina* by Rehn 1940: 105.
 =*Scyllina* Stål 1873: 94 & 112, synon. Jago 1971: 266.

(*Cauratettix* Roberts 1937, synon. with *Rhammatocerus* by Jago 1971: 266, was restored by Carbonell 1995: 114. It is exclusively S. American).

The genus is in great need of revision. Species boundaries and synonymy are currently not clear.

No. described species.

Seventeen, mostly South American.

Generic range.

Argentina to southern USA.

Diagnosis.

(Modified after Otte [1981] and Assis-Pujol [1998]).

Insects of medium or large size, greater than 20 mm (males) or 28 mm (females) in overall length. Head narrow: fastigium semicircular; lateral foveolae weak or (in our region) absent, frons inclined and convex; frontal ridge generally long and well marked, salient in the upper region, rounding gradually onto vertex; eyes large, distance between the anterior margin and the frontal ridge as large as or larger than that between the posterior margin of the eye and the prothorax; generally with a black stripe under the eye to the upper mandibular articulation; antennae filiform, usually slightly longer than head plus pronotum.

Anterior margin of the pronotum almost straight, posterior margin angular; lateral carinae cut by 3 sulci, indistinct between the first and third sulci; anterior portions parallel or slightly diverging towards the head, posterior portions strongly diverging towards the rear of the pronotum. Metazona usually much larger than prozona. Disc of pronotum with anterior and posterior *fascia dorsalis interior* (FDI); most species (in our region, all species) have a dark brown or black spot in the centre of the lateral lobe. Front and middle legs short and thin, posterior legs long and strong, hind femur with a species-specific colour pattern on the inner face (**Fig. G44**); hind tibiae with numerous long spines; median internal spur of hind femur much longer than the other three (**Fig. G40**). Tegmina (**Fig. G41**) well developed, generally extending past the hind knees, generally marked with alternating transverse bands in straw colour and dark brown or black, and in the majority of species there is a

band of vivid white or green in the anterior part of the costal area.

Abdomen compressed laterally, tectiform dorsally; tympana well developed. Male furcula obsolete or reduced to small sclerotized nodules; supra-anal plate triangular, with rounded tip; cerci longer than supra-anal plate, with rounded tips; subgenital plate entire with a sharp tip, which is directed obliquely upwards in lateral view.

Phallic complex: (**Fig. G42**). Epiphallus with a narrow bridge, about 5 times as long as its minimal width; lateral plates well developed with large ancorae; lophi rounded, dituberculate; oval sclerites large, subcircular, sclerotized dorsomedially; ventrolateral sclerites present, large. Apodemes of cingulum thin, divergent, not recurved towards the midline, the outer edges running smoothly into the rami, which are membranous in their central area (**Fig. G42,B**); zygoma simple and small. Dorsal sclerites of aedeagus straight and slender, about the same length as the ventral sclerites. Endophallic plates very deep in lateral view, apodemes large and sharply curved outwards, gonopore processes long and straight, extending halfway to the flexure. Flexure rather long and narrow, ventral aedeagal sclerites straight and slender, tapering to the tip, tilted upwards at about 45° and curved mesad at the tips; ejaculatory sac only moderately developed.

Female (**Fig. G43**) with the 10th tergite slightly curved with a U-shaped indentation in dorsal view; supra-anal plate elongate; cerci triangular, short, with rounded tips, reaching 3/4 the length of the paraprocts; valves of ovipositor smooth, subgenital plate (**Fig. G43,B**) elongate and semicylindrical, with the posterior border straight and lightly sclerotized, egg-guide triangular, about half as long as the ventral ovipositor valves. Ovipositor valves (**Fig. G43,B,C**) short and strongly sclerotized, ventral surface of lower valves provided with striations; valves are usually semiretracted except when engaged in copulation or oviposition. Spermatheca large, preapical diverticulum sac-like and apical diverticulum generally fine and pointed.

Field characters.

As it is the only genus of its tribe in our area, the enormously long inner medial spur of the hind tibia, a tribal character (**Fig. G40,B**), is diagnostic of the genus. Two of the three local species (i.e. all excepting *Rh. cyanipes*) are also unusually large for a gomphocerine. In the hand, the most useful specific character is the coloration of the inner face of the hind femur (**Fig. G44, Plate G16**).

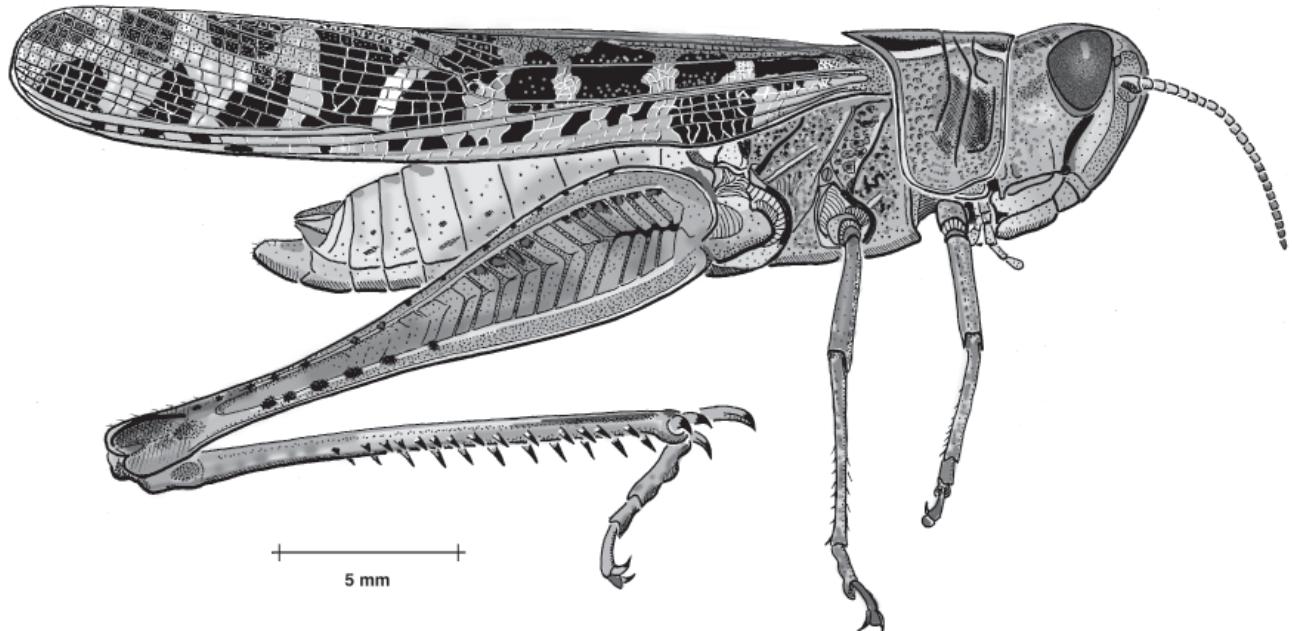


Fig. G41. *Rhammatocerus viatorius*, male habitus.

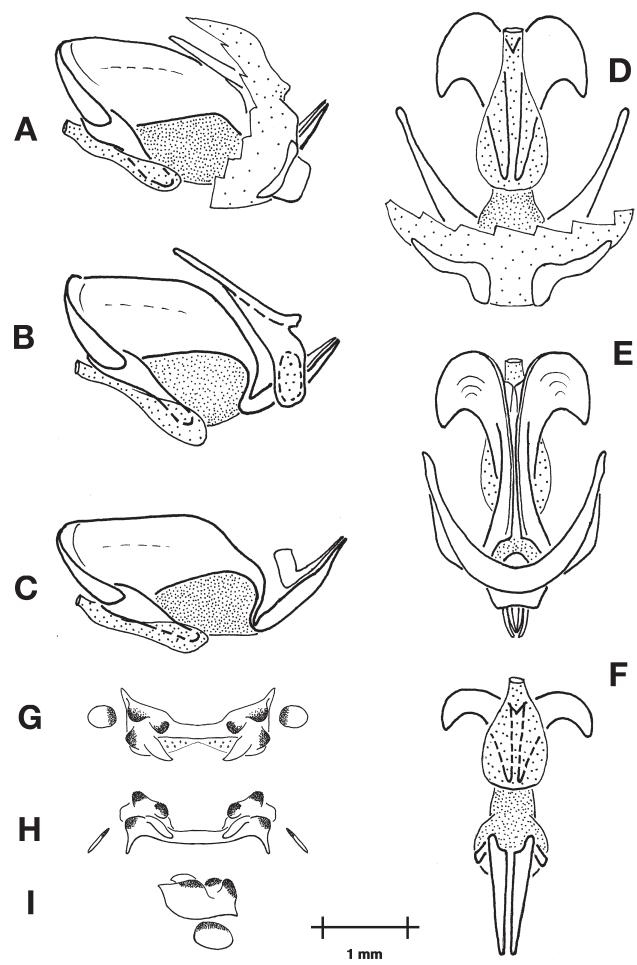


Fig. G42. *Rhammatocerus viatorius*. Phallic complex. A, minus epiphallus and much of ectophallus. B, endophallus, cingulum and dorsal aedeagal valves. C, endophallus, arch and dorsal valves. D, as A, dorsal view. E, as B, dorsal view. F, as C, ventral view. G-I, epiphallus in dorsal, axial and lateral views.

I. *Rhammatocerus cyanipes* (Fabricius 1775)

Gryllus cyanipes Fabricius 1775: 292.

Location of type specimen: holotype lost. Lectotype, designated Otte 1995: 221, ANSP.

Type locality: holotype: "America". Lectotype: PANAMA: Prov. Panamá, La Chorrera.

Etymology.

Greek *kyanos*, dark blue; Latin *pes*, foot, referring to the blue distal portion of the hind tibia, which however is not diagnostic of the species.

Subsequent literature.

- Scudder, S.H. 1868: 5. > As *Acrididium cyanipes*.
- Kirby, W.F. 1910: 132. > As *Scyllina cyanipes*.
- Bruner, L. 1920: 5-91. > As *Scyllina cyanipes*.
- Hebard, M. 1923: 211. > As *Scyllina cyanipes*.
- Hebard, M. 1924: 98. > As *Scyllina cyanipes*.
- Descamps, M. & Amedegnato, C. 1970: 865. > As ?*Rhammatocerus cyanipes*.
- Otte, D. 1981: 121, 247. > As *Rhammatocerus cyanipes*.
- Carbonell, C.S. 1995: 133. > As *Rhammatocerus cyanipes*.
- Assis-Pujol, C.V. 1999: I. > As *Rhammatocerus cyanipes*. Redescription.

Synonymy.

=*Stenobothrus gregarius* Saussure 1861: 318, syn. Hebard 1923:

211.

- Thomas, C. 1873: 206.
- Scudder, S.H. 1901: 303. > As *Stenobothrus (Rhammatocerus) gregarius*.
- Rehn, J.A.G. 1903: 133. > As *Plectrotettix gregarius*.
- Rehn, J.A.G. 1906: 45. > As *Scyllina gregaria*.
- Kirby, W.F. 1910: 133. > As *Scyllina gregaria*.
- Rehn, J.A.G. 1940: 101 (as *Scyllina gregaria*).
- Carbonell, C.S. 1995: 133. > As *Rhammatocerus gregarius*

?=?*Gomphocerus (Epacromia) peregrans* Stål 1861, syn. Hebard 1923: 211.

- Walker, F. 1870: 767. > As *Epacromia peregrans*.
- Stål, C. 1873: 112. > As *Scyllina peregrans*.
- Kirby, W.F. 1910: 133. > As *Scyllina peregrans*.
- Hebard, M. 1923: 211. > As *Scyllina cyanipes*.
- Rehn, J.A.G. 1940: 108. > As *Scyllina peregrans*.
- Jago, N.D. 1971: 267. > As *Rhammatocerus peregrans*.
- Carbonell, C.S. 1995: 133. > As *Rhammatocerus peregrans*.
- Assis-Pujol, C.V. 1999: I. > As *Rhammatocerus cyanipes*.

After examining new *peregrans* material Rehn (1940) reversed Hebard's 1923 synonymy of *peregrans* with *cyanipes* and reinstated *peregrans*; subsequent authors have treated the two species as separate, with the recent exception of Assis-Pujol (1999), who did not however examine material of *peregrans*. According to Rehn (1940), *Rh. peregrans* does not have the coloration of the hind femur and tibia which Assis-Pujol

describes as diagnostic for *cyanipes*, being all brown, with no blue or red.

Diagnosis.

Much smaller than our other 2 regional species: $F = 13.7\text{-}16.7$ mm (male), $18.8\text{-}23$ mm (female – the value of 23 mm is from Hebard 1923, 1924); from frons to wing tip up to 29 mm (males) or 38 mm (females) (Assis-Pujol 1999). Apart from size and the small differences in colour noted below, essentially a small replica of *Rh. viatorius*. The inner margin of the fastigium is slightly more triangular and less rounded than in *viatorius* or *schistocercoides* (see Rehn 1940, Figures 1 & 2 [p. 106]). According to Hebard (1923), also distinguished by a more prominent angle between fastigium and frontal ridge, and the presence of very weak rectangular lateral foveolae, but I do not find these differences convincing. Hind femur straw coloured, with three dark chestnut-brown spots on the external face; externoventral face blue in some but not all individuals. Knees dark brown. Internal face (**Fig. G44, Plate G17**) mostly dark, with pale patches in pregenicular, central, dorso-subbasal, basal and ventral areas. Tibia vermilion in proximal two thirds and blue in distal third, tibial spines white at base, dark at tip, usually 13 in number. Male stridulatory file with about 110 teeth, significantly more than in the other regional species. Sexual dimorphism 0.79:1, very slightly more pronounced than in *Rh. viatorius*.

Distribution.

Haiti, Rep. Dominicana, Virgin Islands, Puerto Rico, Curaçao, Aruba, Bonaire, French Guiana(?), NW. Colombia, Panama. In Panama to date recorded only from the Western half of the country, from the provinces of Chiriquí, Veraguas, Los Santos, Coclé, Colón and Panamá. Not so far recorded from Costa Rica, though there is a record from David, close to the border.

2. *Rhammatocerus viatorius* (Saussure 1861)

Stenobothrus viatorius Saussure 1861: 317.

Type locality: MEXICO: Veracruz, Orizaba.

Location of type specimen: MHN Genève (lectotype, selected by C. S. Carbonell, designated by Otte 1981: 247).

Etymology.

Latin *viator*, traveller.

Subsequent literature.

- Walker, F. 1870: 756. > As *Stenobothrus (Rhammatocerus) viatorius*.
- McNeill, J. 1897: 252. > Transferred to *Plectrophorus*.
- Bruner, L. 1900-1910 (1904: 101). > Transferred to *Plectrotettix*.

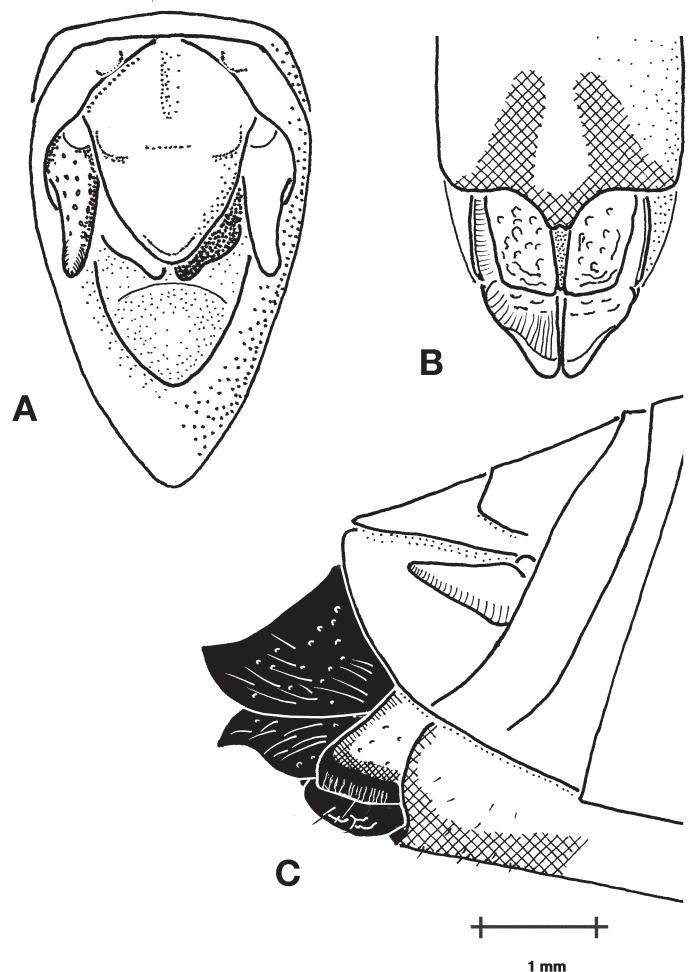


Fig. G43. *Rhammatocerus viatorius*. A, male terminalia, dorsal view. B, female terminalia, ventral view. C, female terminalia, lateral view.

- Rehn, J.A.G. 1906b: 48. > Transferred to *Scyllina*.
- Stål, C. 1873: 112. > As *Scyllina*.
- Kirby, W.F. 1910: 133. > As *Scyllina*.
- Hebard, M. 1923: 212. > As *Scyllina*, partim.
- Hebard, M. 1924: 159. > As *Scyllina*, partim.
- Rehn, J.A.G. 1940: 103. > As *Rhammatocerus*.
- Jago, N.D. 1971: 266. > As *Rhammatocerus*.
- Otte, D. 1981: 120 & 247.
- Carbonell, C.S. 1995: 135.
- Assis-Pujol 1998: 3. > Redescription.

Synonymy.

=*Stenobothrus nobilis* Walker 1871: 79, synon. Hebard 1924, Trans. Am. Ent. Soc. 50: 159.
 =*Plectrotettix patriae* Scudder 1901a: 95, synon. Hebard 1924: 159.
 =*Plectrotettix calidus* Bruner 1904: 102, synon. Hebard 1924: 159.
 =*Plectrotettix macneilli* Bruner 1904: 102, synon. Hebard 1924: 159.
 =*Plectrotettix excelsus* Bruner 1904: 102, synon. Hebard 1924: 159.
 =*Pseudostauronotus brunneri* Giglio-Tos 1894: 810; synon. Rehn 1940: 101.

Diagnosis.

Male habitus, **Fig. G41, Plate G16**. The largest gomphocerine found in our area: $F = 21.1 - 23.4$ mm (male), 25.8 - 27.3 mm (female); fastigium to wingtips up to 39.3 mm (males) or 48.5 mm (females). Antennae with 19-23 flagellar segments, light at base, darkening towards tip. Fastigium rounds imperceptibly into frontal ridge, facial-fastigial angle effectively nonexistent. Foveolae obsolete. Fastigial depression concave, semicircular. Green/brown polymorphic, affecting the colour of the light dorsal stripe which runs from the fastigium along head, pronotum and the dorsal field of the tegmina and the head and prothoracic lobes. Very conspicuous constricted lateral pronotal carinae, which are light coloured, contrasting with the darker lateral lobe and the more medial FDI, giving an hour-glass marking in dorsal view. Hind legs long, hind femora not quite surpassing the tips of the tegmina, with characteristic pattern of coloration on their inner face: light blue-grey basally, with two dark grey or black patches along the dorsal edge, shading to pale brown distally just proximal to the blackish knee (**Fig. G44, Plate G17**). Stridulatory ridge with about 70 teeth. Hind tibia orange, especially on the lower surface, with the terminal third lightly shaded blue or grey; 13-15 external tibial spines, 12-13 inner ones (exceptionally 10, according to Assis-Pujol), with white bases and black tips. Hind tarsi blueish dorsally, with the last tarsomere light brown. Sexual dimorphism relatively slight, on average 0.82:1.

Field characters.

In the wild, indistinguishable from *Rh. schistocercoides*. Both are of large size, have conspicuous hour-glass marking on pronotum, and darkly blotched elytra with a coloured dorsal area. In the hand distinguishable by the absence of dark blue colour

on the ventral surface of the hind femur, and the characteristic pattern of coloration on its inner face (see above).

Distribution.

Southern USA (Arizona) and Central America to Costa Rica; apparently very rare in or absent from Panama. Status in Colombia is uncertain. In Costa Rica characteristic of the savannas derived from dry forest surrounding the Gulf of Nicoya and in northern Guanacaste. Most southerly recorded locality, San Jose Prov., Monte Redondo. **Map G9**

3. *Rhammatocerus schistocercoides* (Rehn 1906)

Scyllina schistocercoides Rehn 1906: Proc. U.S. Nat. Mus. 30: 388. Type locality: BRAZIL: Mato Grosso, Chapada. Location of type specimen: USNM, Washington.

Etymology.

Greek -oides, similar to. Hence similar to *Schistocerca* (Cyrtacanthacridinae) (e.g. the Desert Locust).

Subsequent literature.

- Rehn, J.A.G. 1906: 48. > As *Scyllina*.
- Bruner, L. 1911: 36. > As *Scyllina*.
- Jago, N.D. 1971: 205-343, p 266.
- Guagliumi, P. 1958: 51-62.
- Guagliumi, P. 1959: 73-76.
- Carbonell, C.S. 1988: 17 pp. > Redescription, ecology.
- Carbonell, C.S. 1995: 134.
- Lecoq, M. & Assis-Pujol, C.V. 1998: 13-23.

Synonymy.

= *Rh. viatorius cyanomerus* Hebard, 1923: 212. **New synonym.**

This equivalence was previously noted by Lecoq & Assis-Pujol 1998, who did not however make a formal synonymy.

Diagnosis.

Very closely similar to *Rh. viatorius* and almost as large ($F = 25.5$ mm (female)). Green/brown polymorphic. Most easily distinguished from *viatorius* by the coloration of the hind femur and tibia (**Fig. G44 and Plate G17**): basal half of inner face of femur dark blue, a single blackish blotch superimposed on the blue towards the dorsal edge, distal areas and dorsal face orange; ventral faces (basal two-thirds) of femur also dark blue. Femoral stridulatory file with 68 teeth. Tibia orange in proximal three quarters, distal quarter dark blue; the division of the colours is much more definite than in *viatorius*. Tibial spines black tipped, in outer row whitish at their bases in the blue area. Tibial spurs orange, lined with dark blue. All tarsal segments blueish dorsally. Antennae less dark distally than in *viatorius*. Number of internal and external hind tarsal spines significantly smaller than in *viatorius*, usually nine.

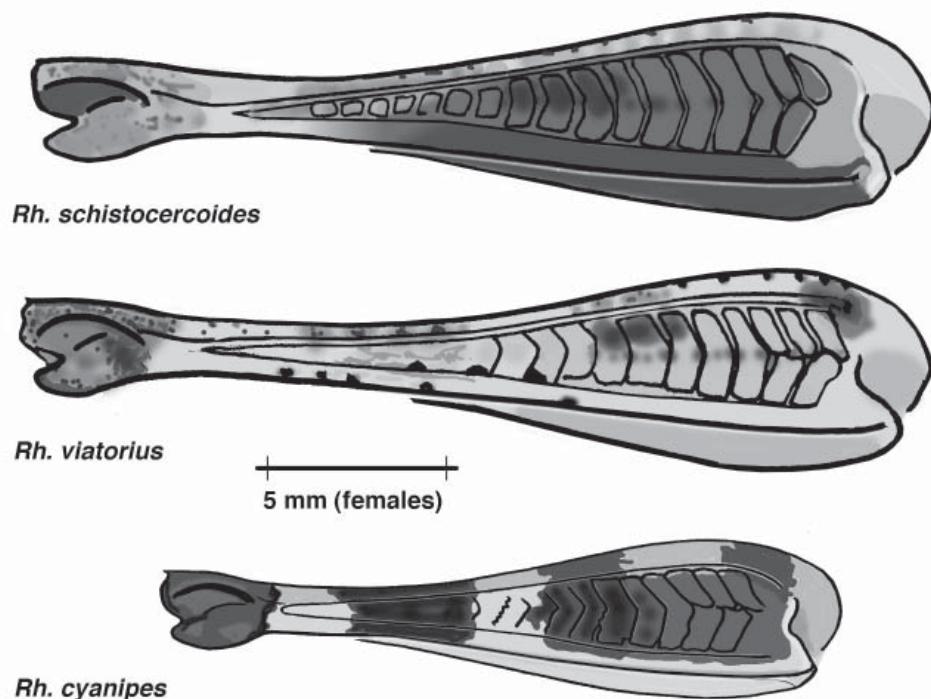
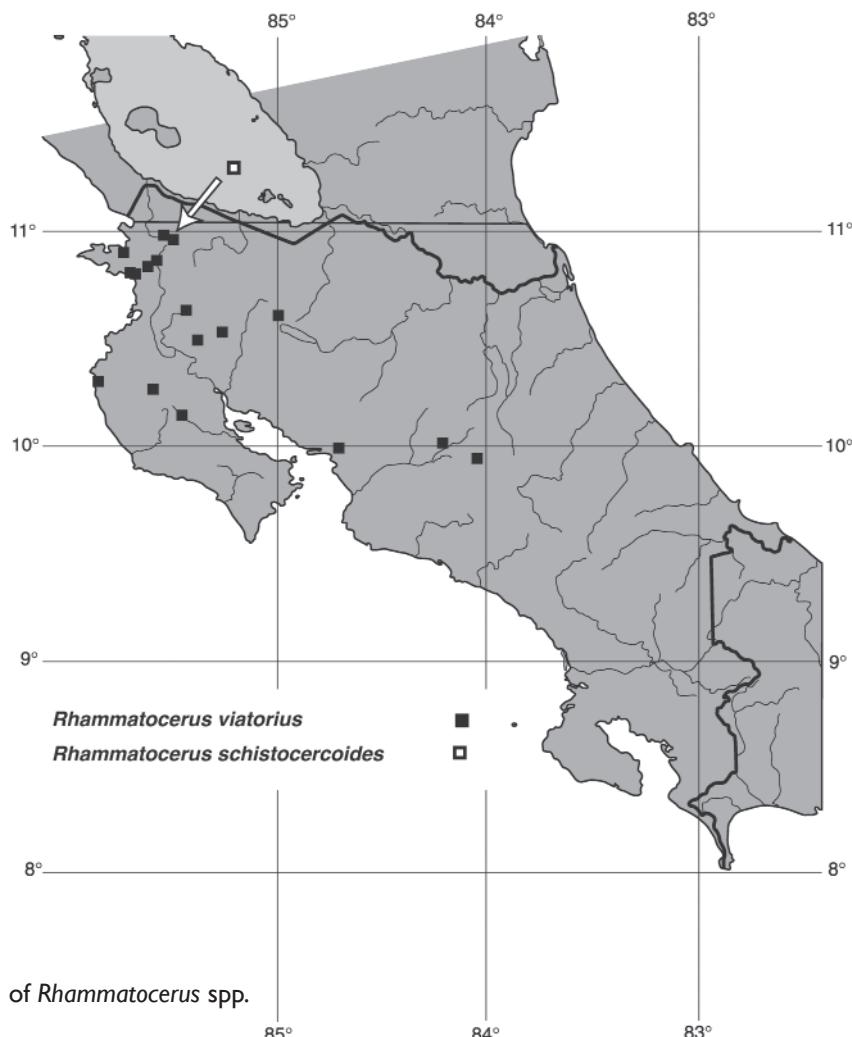


Fig. G44. Internal faces of the hind femora of three *Rhammatocerus* species, to show differences in patterning. See also **Plate G17**.



Map G9. Distribution of *Rhammatocerus* spp. in Costa Rica.

Field characters.

Essentially identical to *Rh. viatorius* in the field, can be distinguished only in the hand by the characters given above.

Distribution.

Brasil, Venezuela, Colombia, Costa Rica. In Costa Rica known in recent times only from Cerro El Hacha (northern Guanacaste Province). The paratypes of Hebard's *Rh. viatorius cyanomerus* (a synonym of *schistocercoides*) are also from Costa Rica (coll. M.A. Carriker) but unfortunately lack more precise locality data. Other Pacific slope collections by Carriker in Costa Rica are from Boruca and from Pozo Azul de Pirrís; but he also made at least one journey through Guanacaste province, as far as Liberia (M.R. Carriker 2001: 79); this would be the most likely source of his specimens.

Not as yet recorded from Panama.

Natural history.

In South America this species is liable to population outbreaks and in Venezuela to "locust-like" migrations (see Guaglumi 1958, 1959, Carbonell 1988, and Lecoq & Assis-Pujol, 1998), and is sometimes of commercial importance (whence the specific name). This behaviour has not so far been recorded in Central America.

[4. *Rhammatocerus pratensis* (Bruner 1904)]

This Brazilian species was shown as occurring in Panama in a distribution map published by Assis-Pujol (1998). This is an error (Assis-Pujol, pers. comm.). No specimens of *pratensis* are in fact known from our region.

Subfamily Leptysminae Brunner von Wattenwyl 1893

The Leptysminae are a rather small group (currently 21 genera and 81 valid spp.) of exclusively New World grasshoppers, most diverse in tropical South America, but extending north as far as the southern USA and south into Argentina. They were first recognized (as the Leptysmae) by Brunner von Wattenwyl, 1893, and first raised to subfamily status by Amedegnato 1974. Following the latter author, they are currently usually divided into three tribes, one of which (the monogeneric *Chloropseustini*, apterous and in other ways atypical of the subfamily) is exclusively Amazonian. (Roberts & Carbonell [1980] incorporated *Chloropseustes* into the *Tetrataeniini*, but Lhano's [2009] cladistic analysis found them to be a well-defined monophyletic group with high statistical support). The other two tribes (*Leptysmini* and *Tetrataeniini*) are both represented in our area. Lhano's analysis did not distinguish either of them as natural groups, however, and found the former to be included within the latter.

The Leptysminae appear to be most closely related to – perhaps inseparable from – the Ommatolampinae, with which group they share many morphological characters, especially in the male and female genitalia. Amedegnato (1977) considered the Syntomacrinini to be the most similar living Ommatolampines. The special features of the Leptysminae, and of their two main Tribes, seem to be related to their environmental and foodplant specialisations.

Diagnosis.

The Leptysminae are readily identifiable. Characteristically the male cercus has a wide base in lateral view and is upwardly hooked, with the distal extremity vertical or nearly so; this is true of all the Leptysmines occurring in our region. (Only one genus, *Xenismacris* [S. America only] has a straight, non-hooked, male cercus, and Roberts & Carbonell [1980] suggest it may in fact be an Ommatolampine). Further, in all genera the lower external lobe of the hind knee is angular, forming a right angle or a more acute point. The second tarsal joint of the hind foot is always very short, making up only about 10% of the total tarsal length. (This is true even of the arboreal *Gueteresia*).

A small black furcula is present in males. The male supra-anal plate is often decorated with melanized nodules. In some genera (*Stenacris*, *Cylindrotettix*) the male subgenital plate is produced into unusual elaborate shapes.

The majority of genera are long slim insects, and in our region all are tympanate and fully winged. Many species of the subfamily have the hind tibiae flattened and widened at the tip, and sometimes provided with a fringe of short stiff hairs, all presumed to facilitate swimming. The hind tibial spines are usually small and numerous, often 10 or more on each margin. The antennae

are filiform or ensiform, or exceptionally (*Guetaresia*) irregularly nodular (Fig. L12). The fastigium is often produced forward, and this, combined with the opistognath position of the mouthparts, produces a backwardly slanting face with a noticeable rostrum in many genera.

Natural history.

Leptysmines tend to fall into two ecological groups, corresponding to the two main tribes *Leptysmini* and *Tetrataeniini*. The first of these eats grasses and sedges (Poaceae and Cyperaceae), mostly in marshy habitats; these genera, like many other grammivores, are usually of slim and elongate body form. Many are considered actual or potential pests of rice. The second tribe is specialised on broad-leaved monocots, such as the Araceae, Pontederiaceae and Cannaceae, many of which again live in swampy habitats. Because of the aquatic weed status of these plants, members of this tribe are considered potentially beneficial insects. As expected of foodplant specialists, at least some Leptysmines (*Leptysma*, *Stenacris*, *Stenopola*, *Cornops*) have endophytic oviposition (de Zolessi 1956, Riek 1974, Hilliard 1982, Cordero 1979, Turk 1984); the habit is probably widespread in the subfamily (Braker 1989), and may well be universal, as the ovipositor is broadly similar in all leptysmine genera, apart from *Chloropseustes*. The female first bites a hole in the surface of the rhachis or stem, then inserts the toothed ovipositor to complete tunnelling. Some genera (e.g. *Cornops*, *Guetaresia*) are subsocial as larvae, feeding in aggregated groups.

The species and to some extent the genera of this subfamily are difficult to identify with certainty in the field, and this, together with their often inaccessible swamp habitat, has led to them being rather poorly known and badly represented in most collections. The revisionary papers of Roberts and Carbonell and of Roberts alone in the 1970s and '80s first clarified our knowledge of the group.

The Leptysminae show many parallels, presumably due to convergent evolution, with the Old World subfamily Oxyinae. They use much the same food plants in the same sub-aquatic and rain forest habitats and show similar morphological and behavioural trends, although in the Oxyinae oviposition is typically epiphytic rather than endophytic.

No. of genera world-wide.

Twenty one. Number in our area: seven: *Belosacris*, *Cylindrotettix*, *Leptysma*, *Stenacris*, *Cornops*, *Guetaresia*, and *Stenopola*. Further, *Tucuyaca* is currently thought to have a disjunct distribution including S. America and Northern Central America and may well be present in our region too, though not yet recorded.

Literature.

- Amedegnato, C. 1974: 196, 200. > Acrididae: Leptysminae stat. nov.
- Roberts, H.R. 1977: 29-34 > Leptysminae.
- Roberts, H.R., & Carbonell C.S. 1980: 132: 64-85. >

- Leptysminae (Orthoptera:Acrididae).
- Otte, D. 1995:53 > Acrididae: Leptysminae.
 - Lhano, M. 2009: 153.

Belosacris
Rehn & Eades 1961

Rehn and Eades 1961: 111.
Type species *B. aurantipes* Rehn & Eades 1961.

Subsequent literature.

- Roberts, H.R. 1978: 56.

Etymology.

Greek *belos*, *beleos*, arrow or dart, referring to the slender pointed form and perhaps the swift darting flight.

No. of described species.

Two. In our area, 1.

Generic range.

Mexico to Paraguay.

Diagnosis.

Habitus **Fig. L1, Plate L1**. Fastigium (**Fig L2A**) large, triangular, short and broad, similar to that of *Stenacris*. Antennae slightly ensiform. Dorsum of pronotum subcylindrical, lacking both medial and lateral carinae. Thoracic pleura and lateral lobes of pronotum with heavily punctate ornamentation. Male subgenital plate simple, with no lateral lobes, the rim produced posteriorly to form an elongated channel or gutter that is directed upwards at about 30° (**Fig L2B**). Epiphallus simple and shield shaped, rather quadrate in outline, unique within the subfamily. Ovipositor with evenly spaced teeth. Relatively large size (females up to 50 mm).

Tribe Leptysmini
Brunner von Wattenwyl 1893

Tribal Diagnosis.

All genera are macropterous and tympanate, elongate and rod-shaped in body form, green or brown in colour, frequently with a pale lateral stripe. Antennae ensiform or subensiform, interocular space very narrow. Prosternal process inclined backwards and, in some genera (*Cylindrotettix*, some *Leptysma* spp.), flattened laterally. Hind tibial spines of inner and outer rows of about the same length. Male supra-anal plate usually bearing melanized nodules, male cerci always with a wide base, the distal portion strongly upwardly curved. Male subgenital plate simple or complex (*Stenacris*, *Cylindrotettix*). Epiphallus weak, lacking ancorae; its lophi lie in the plane of the eiphallus and are never pigmented.

I. Belosacris coccineipes (Bruner 1920)

Bruner, L. 1920[1919]: 46, as *Arnilia coccineipes*.

Type locality: Paraguay, Sapucay.

Location of type: USNM Washington.

Etymology.

Latin *coccineus*, scarlet, berry-red, *pes*, *pedis*, foot, leg.

Synonymy.

= *aurantipes* Rehn & Eades, synonymized Roberts 1977: 56.

= *intermedia* Bruner, synonymized Roberts 1977: 56.

Diagnosis.

Very pointed head. Bright orange-red rear tibiae, no lateral white stripe, relatively large size. Unique shape of male subgenital plate (see above).

Note: the habitus illustration (**Fig. L1, Plate L1**) was made from a pinned dried Brasilian specimen; the colours shown are therefore somewhat speculative, as no living specimen or photograph of one was available to me.

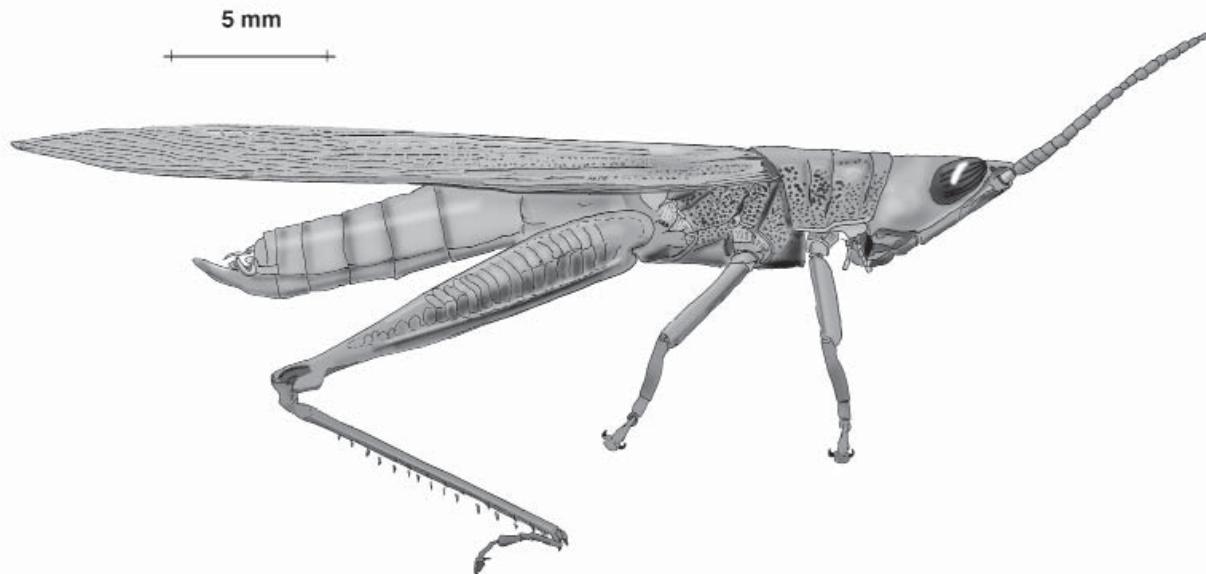


Fig. L1. *Belosacris coccineipes*, male habitus (see also **Plate L1**).

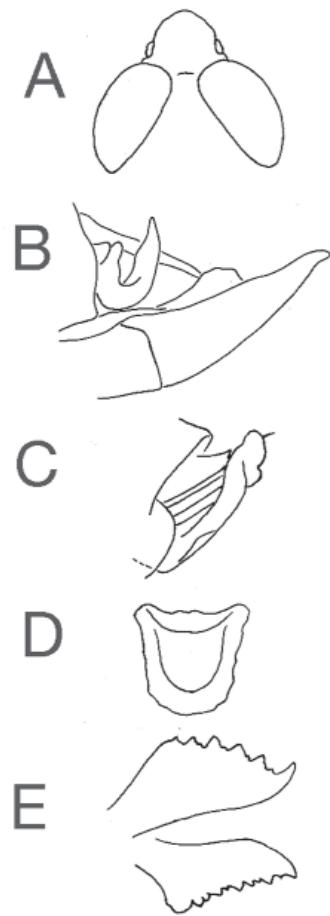


Fig. L2. *Belosacris coccineipes*. A, fastigium, dorsal view. B, male terminalia, lateral view. C, aedeagus, lateral view. D, epiphallus, dorsal view. E, ovipositor valves, lateral view. (From Roberts 1978).

Natural history.

"Generally found in tall grasses at the edge of marshes. A strong flyer and not easy to collect, which may account for its sporadic record of distribution" (Roberts 1978: 57). COPR (1982) records *Belosacris* as an occasional minor pest of rice in S. America.

Distribution.

According to Roberts (loc. cit.) recorded from Vera Cruz, Mexico; Panama; Venezuela; Trinidad; Guyana; Surinam; French Guiana; Brasil; Paraguay; Bolivia; Argentina. It is also found in Uruguay (Carbonell, pers.com.). The Panamanian specimen recorded by Roberts is from the Canal Zone; we have seen (but not captured!) specimens in Darién too. Not to date recorded from Costa Rica, but may very well occur there. **Map L1.**

one large proximal tooth. Between this and the apical tooth there may be 0 - 3 very small further teeth. The ventral valves have a pair of large proximal teeth and a single apical tooth, generally without intervening smaller teeth.

I. *Cylindrotettix insularis herbaceus* Bruner 1908

Bruner 1900-1910 (1908): 252

Type locality: COSTA RICA: Prov. Alajuela: San Mateo: Surubres. Location of type: ANSP.

Etymology.

Latin *insularis*, "of the island" – the nominate subspecies was described from Trinidad. Latin *herbaceus*, "of grass," the typical habitat of the genus.

Diagnosis.

Habitus, **Fig. L3, Plate L2.** In ventral view, end of male SGP is smoothly rounded, with no shoulders or lateral lobes (**Fig. L4C**). Lateral tubercles of pallial sclerite small, pointed, located posterior to end of subgenital plate sensu strictu in side view. Fastigium (**Fig. L4A**) about as long as the eyes; antennae slightly longer than head and pronotum together, weakly ensiform. Pronounced white or yellow lateral stripe. Lateral lobes of pronotum and thoracic pleura minutely punctate. Prosternal process short, inclined backwards with a subhemispherical tip. Outer ventral lobe of hind knee angularly pointed. Distal narrow portion of male SAP (**Fig. L4B**) shorter than basal portion; female may lack some or all small teeth on dorsal ovipositor valve.

Coloration: dorsum and elytra usually light brown, separated from the yellow-green ventral parts by a longitudinal yellow stripe. Eyes and antennae brown. Hind legs light green or brown, fore and mid legs green. Wings smoky red-brown, elytra with a prominent red-brown longitudinal venation.

Natural history.

Atypical within the subfamily in living in dry grasslands, not swamp. In our area confined to the drier areas of the Pacific slope. Rare in Costa Rica; recent records are restricted to the Osa peninsula and the lowlands of northern Puntarenas Province. Fairly common in grasslands around Panama City.

Diagnosis.

Form long and slender. Fastigium elongate, longer than half the length of the eye. Antennae ensiform, slightly longer than head and PN together. Dorsal apex of male subgenital plate elaborated into a complex structure called by Roberts (1975) a "pallial sclerite", which however, lies behind the pallium and has no connection with it. Apex of male cercus never tapering to a sharp point, more or less truncate. Females have a characteristic dentition of the ovipositor valves: the dorsal valves have each

Costa Rica, Panama, lowlands of Northern Colombia.

Map L2. A single specimen, now lost, was reported [Bruner 1900-1910 (1908)] from Honduras.

The very closely related subspecies *insularis* Bruner extends the range of the species through Venezuela and Trinidad to French Guiana.

Cylindrotettix Bruner 1906

Bruner 1906a:153.

Type species: *C. insularis insularis* Bruner 1900-1910 (1908), by original monotypy.

Etymology.

Latin *cylinder*, roll, cylinder; Greek *tettix*, *tettigos*, cicada, conventionally used for grasshopper. A reference to the body shape.

Subsequent literature.

- Amedegnato, C. 1975: 200. > Assigns to Leptysmini.
- Roberts, H.R. 1975: 30. > Revision of genus.
- Otte, D. 1995: 55.

No. of described species.

Ten. In our area: one.

Range.

Argentina to Costa Rica, possibly to Honduras.

Diagnosis.

Form long and slender. Fastigium elongate, longer than half the length of the eye. Antennae ensiform, slightly longer than head and PN together. Dorsal apex of male subgenital plate elaborated into a complex structure called by Roberts (1975) a "pallial sclerite", which however, lies behind the pallium and has no connection with it. Apex of male cercus never tapering to a sharp point, more or less truncate. Females have a characteristic dentition of the ovipositor valves: the dorsal valves have each

Belosacris coccineipes

Map L1. Localities of *Belosacris coccineipes* in Panama. (Not yet recorded from Costa Rica).

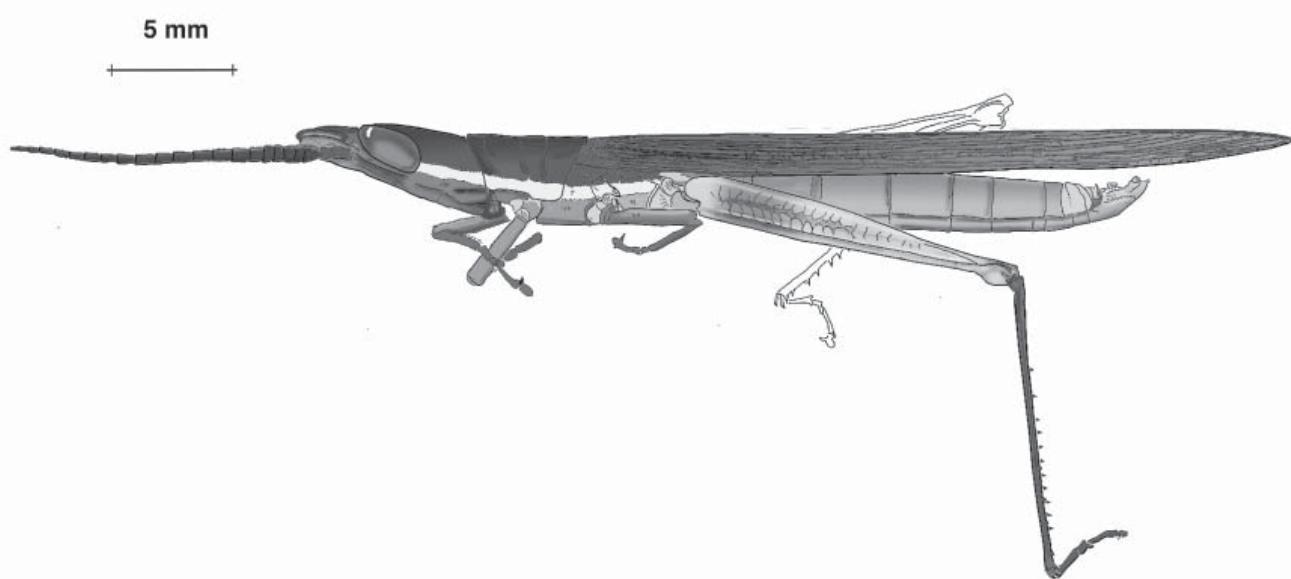


Fig. L3. *Cylindrotettix insularis herbaceus*, male habitus. (See also **Plate L2**).

Leptysma Stål 1873

Stål 1873: 42, 85.

Type species: *Opsomala marginicollis* Serville 1838.

Etymology.

Greek *leptos*, small, thin, delicate, referring to the slender body form.

Subsequent literature.

- Scudder, S.H. 1897:
- Rehn, J.A.G. 1904. > Designation of type species.
- Kirby, W.F. 1910: 410.
- Bruner, L. 1911: 71.
- Bruner, L. 1920(1919): 42.
- Hebard, M. 1934: 187.
- Rehn, J.A.G. & Eades, D.C. 1961: 82.
- Amedegnato, C. 1974: 200.
- Roberts, H.R. 1977: 39. > Revision of genus.
- Otte, D. 1995: 55.

Diagnosis.

The genus as currently understood is difficult to define, as it includes very diverse species (Roberts 1977). Fastigium always relatively large, but not necessarily elongate. Male subgenital plate simple, attenuate, never lobed. Male cercus more or less pointed, never broadly truncate. Aedeagus short, projecting but little beyond the cingulum. Both sexes of all species have a lateral white stripe (as do many other genera of the subfamily).

Distribution.

Southern USA to Argentina; Cuba and Trinidad.

No. of described species.

Six. In our area: 1.

***Leptysma marginicollis* (Serville 1838)**

Serville 1838: 591, as *Opshomala marginicollis*.

Type locality: "North America".

Location of type: lost, according to Roberts 1977.

Etymology.

Latin *margo, marginis*, brink, border, plus Latin *colo, cultus*, dwelling in, inhabiting, from *cola, inhabitant of*: "dwelling in the margins" (of bodies of water, understood). *Marginicola* would have been a more obvious formulation. A derivation from Latin *collum, collaris*, neck, is unlikely.

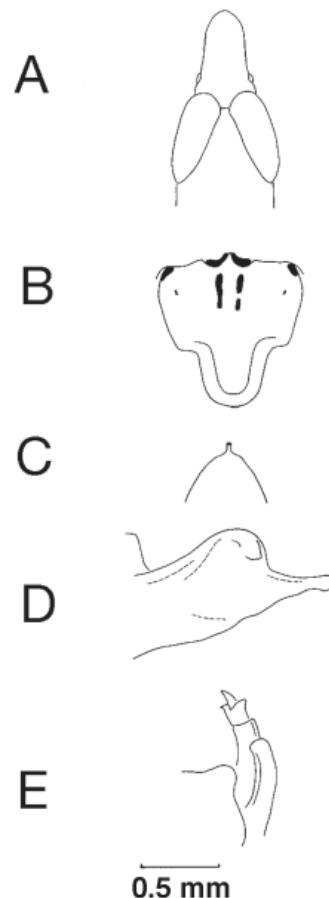
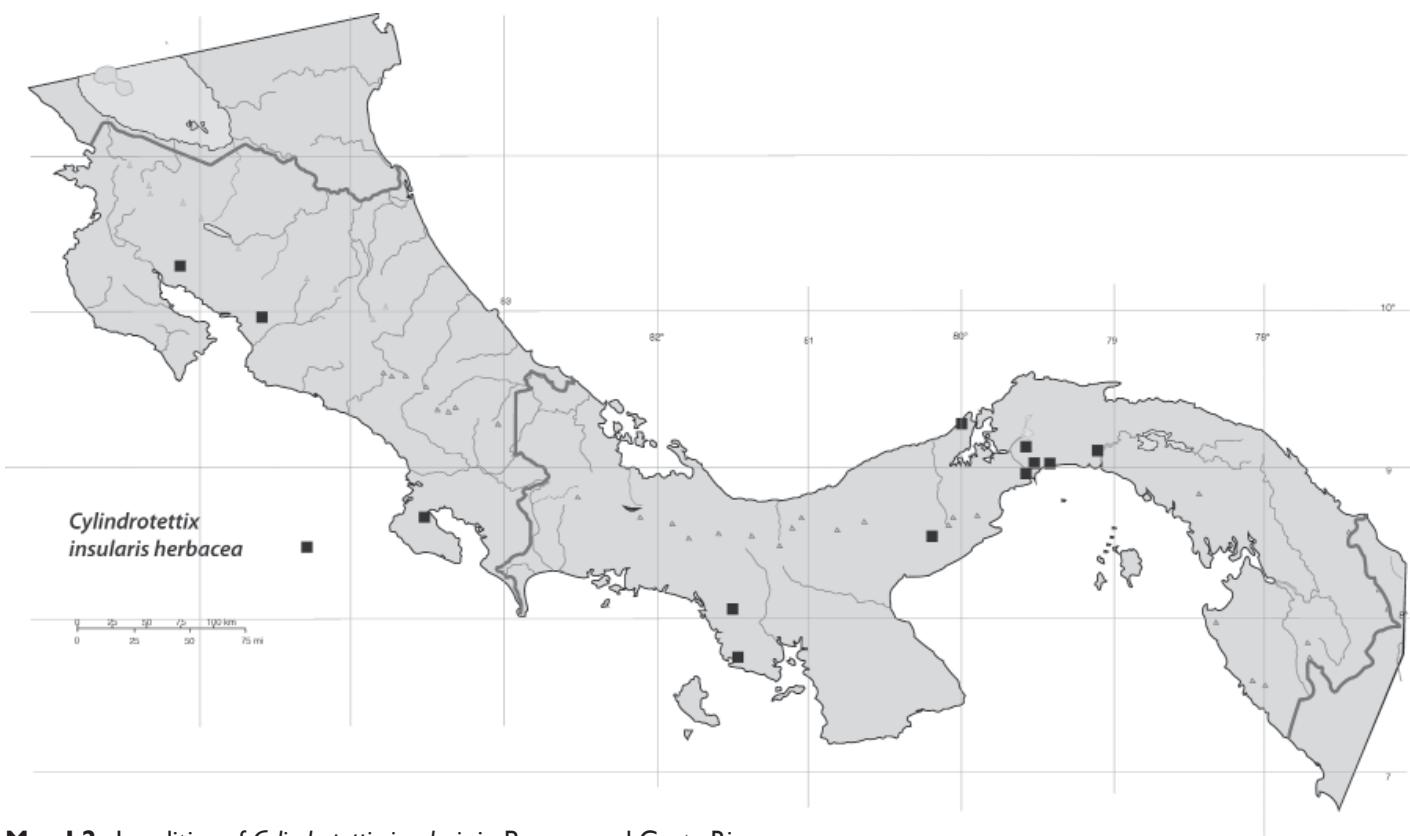


Fig. L4. *Cylindrotettix insularis herbaceus*. A, fastigium, dorsal view. B, male supra-anal plate, dorsal view. C, extremity of male subgenital plate, ventral view. D, male terminalia, lateral view. E, aedeagus, lateral view. (From Roberts 1975.)



Map L2. Localities of *Cylindrotettix insularis* in Panama and Costa Rica.

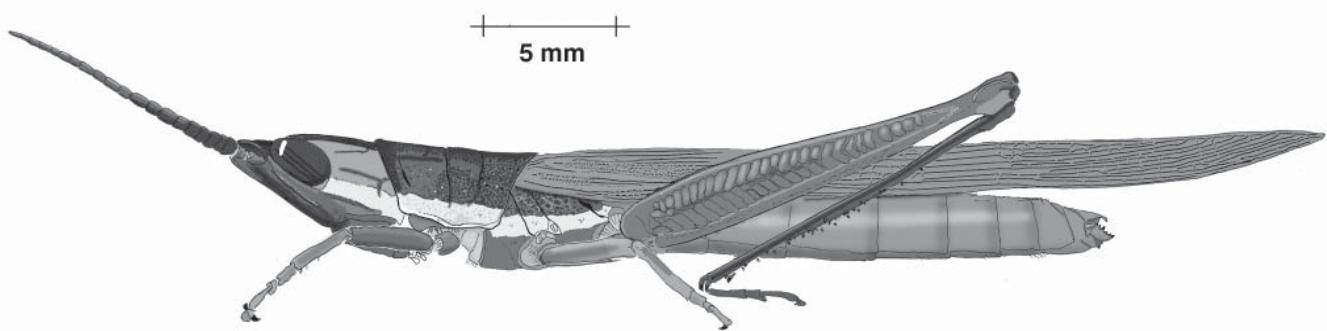


Fig. L5. *Leptysma marginicollis mexicana*. Female, habitus. (See also Plate L3).

The species has 3 subspecies, *L.m. marginicollis* (Serville, 1838), *L.m. mexicana* (Saussure, 1861) and *L.m. hebardi* (Rehn & Eades, 1961). All were originally described as full species, but were grouped and relegated to subspecific status by Roberts 1978. All three are very similar, but are allopatric in different parts of N. America. Only *L.m. mexicana* is found in our area. *Leptysma m. marginicollis* is the “cat-tail toothpick grasshopper” of N. American natural history writers.

Subsequent literature.

- Rehn, J.A.G. & Hebard, M. 1905: 39. > *Leptysma marginicollis*.
- Hebard, M. 1932b: 272.
- Hebard, M. 1934: 187. > *Leptysma marginicollis*.
- Roberts, H.R. 1977 [1978]: 39. > Generic revision.
- Hilliard, J.R. 1982: 153-180. > Oviposition strategies.
- Braker, H.E. 1989: 389-406. > Evolution and ecology of oviposition.
- Capinera, J.L., Scott, R.D. & Walker, T.J. 2004: 114, Plate 30. > *Leptysma marginicollis*.

Distribution.

Southern USA, Mexico, Guatemala, Honduras, Belize, Costa Rica.

The local subspecies is:

Leptysma marginicollis mexicana (Saussure 1861)

Saussure 1861, Revue et Magasin de Zoologie (2)13:161, as *Opomala mexicana*.

Type locality: “Mexico”.

Location of type specimen: Museum d’Histoire Naturelle, Geneva.

Subsequent literature.

- Bruner, L. 1900-1910 (1908): 253.
- Hebard, M. 1925b: 280.
- Rehn, J.A.G. & Eades, D.C. 1961: 108.
- Descamps, M. 1975a: 14, 60.
- Roberts, H.R. 1978: 142. > Subsp. of *marginicollis*.

Diagnosis.

Habitus, **Fig. L5, plate L4**. As the only species of the genus in our area the generic diagnosis applies. Green/brown polymorphic. In Costa Rica, most females are brown, most males green.

The fastigium (**Fig. L6-A**) is robust, triangular with a rounded tip, as broad as long (broader than in other species of the genus), and surrounded by a slight raised carina. Frontal ridge narrow, bordered by two parallel carinae which continue almost to the clypeal suture. The dorsal extremity of the frontal ridge is separated from the apex of the fastigium by a very short constriction; in other subspp. this constriction is much

longer. Antennae markedly ensiform, shorter than head and PN together. Pronotum devoid of carinae, but the midline is crossed by three rather faint sulci, and a fourth sulcus runs on the lateral lobes just behind the anterior lateral margin of the pronotum. Posterior margin of the pronotum somewhat produced, and gently rounded; anterior margin with a slight medial embayment; anterior and posterior ventral angles bluntly truncate. Prosternal process short, inclined slightly backwards, bluntly rounded at tip. Elytra greatly exceed abdomen and taper to a fine delicate point. The dorsal posterior margin of the attenuate male subgenital plate is produced into a short overhanging lip. Tip of male cerci pointed.

Field characters.

The thick ensiform antennae and the broad yellow stripe along the bottom of the lateral lobe of the pronotum are a rather distinctive combination.

Distribution.

Southern Mexico; Belize; Guatemala; Honduras; Costa Rica. Not as yet recorded from Panama. **Map L3.**

Natural history.

Inhabits reedy swamps. In Costa Rica abundant in swamps on the margins of the estuary of the Rio Tempisque, such as at Palo Verde. Also known from swamps near the southern shores of Lake Nicaragua. Green/brown polymorphic in coloration. As first recorded by Hilliard (1982), it lays its eggs endophytically in stems of grasses and sedges (see also Braker 1989b).

Stenacris Walker 1870

Walker, F. 1870: 651.

Type species: *Stenacris chlorizans* Walker, 1870 (= *vitreipennis* (Marschall, 1836)).

Type locality: USA, Florida, St. Johns Bluff.

Location of type specimen: BMNH London.

Etymology.

Greek *Stenos*, narrow; *acris*, conventionally used for grasshopper.

Synonymy.

= *Arnilia* Stål 1873, synonymized Roberts 1977. This synonymy had previously been pointed out by Rehn & Eades 1961a: 2.

Several species of the genus were erroneously described under or transferred to the generic name *Opshomala*, which is currently a valid Brasilian genus of the Copiocerinae. Rehn & Eades (1961a) explain the historical circumstances.

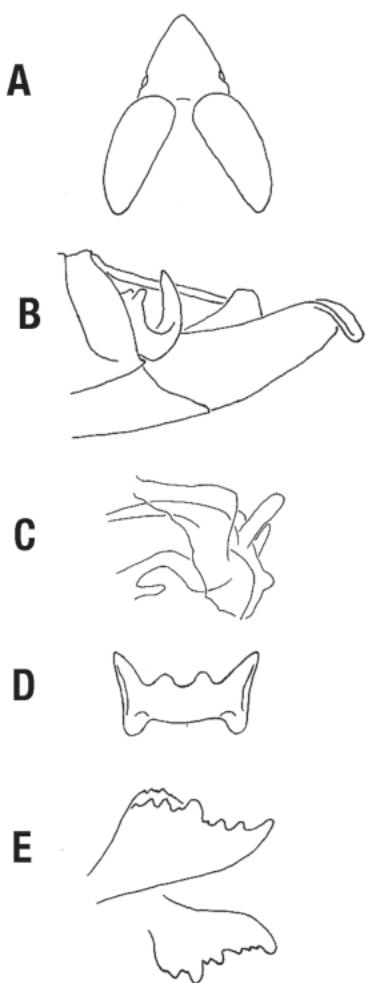


Fig. L6. *Leptysma marginocollis mexicana*. A, fastigium, dorsal view. B, male terminalia, lateral view. C, aedeagus, lateral view. D, epiphallus, dorsal view. E, ovipositor valves, lateral view (from Roberts 1978).

Subsequent literature.

- Kirby, W. 1910: 413. > *Stenacris*.
- Hebard, M. 1924: 116. > *Opshomala*.
- Rehn, J.A.G. & Eades, D. 1961a. : I. > Restores to *Stenacris*.
- Amedegnato, C. 1974: 200. > Leptysminae: Leptysmini.
- Hilliard, J.R. 1982: 153-180. > Oviposition strategies.
- Roberts, H.R. 1977[1978]: 57. > Revision of genus.
- Otte, D.C. 1995: 57. > As *Stenacris*; Leptysmini.

No. of described species.

Six. In our area: 4.

Diagnosis.

Fastigium (**Fig L8A**) short and broad, roughly triangular. Antennae filiform or subensiform. Prosternal process short and cylindrical, inclined to the rear, the tip rounded. Male subgenital plate with prominent lateral lobes and an elaborate dorsal posterior process. Hind tibiae flattened, often with a short dense row of hairs on the inner margin. Ovipositor teeth evenly spaced.

Field characters.

Stenacris individuals living in their characteristic wet swamp environment are largely green in colour. In somewhat drier habitats they are often darker, especially on the nota and the area dorsal to the white lateral stripe; under these conditions they can resemble *Stenopola*, which is typically dark dorsally. Dried pinned specimens darken and lose much of the original green and blue coloration, becoming brownish. Especially the pale blue-grey eye turns brown in dried specimens.

Our regional species are all very similar to each other, and can only be distinguished reliably by a close examination of the male or female terminalia. For this reason only one habitus picture (**Fig. L7, Plate L4**) is given, which can serve for all our species.

Distribution.

Southern USA to Argentina, though only one species (*vitreipennis*), extends north of Southern Mexico.

Natural history.

By far the commonest genus of the tribe in our area. Found in virtually every patch of swampy grassland. While it apparently mostly eats grasses and sedges, Hilliard (1982) reports it eating a variety of other swamp plants, both monocot and dicot, as well.

***Stenacris fissicauda* (Bruner, 1908)**

Bruner, L. 1900-1910 (1908): 258, as *Arnilia fissicauda*.

Etymology.

Latin *fissus*, cloven, *cauda*, tail, referring to the cleft in the end of the male subgenital plate.

Diagnosis.

All subspp. of *S. fissicauda* are distinguished by the long pointed male cercus, projecting well above the supra-anal plate (**Fig. L8B II**). The broad basal portion of the supra-anal plate is unusually thick with upturned lateral margins that are decorated internally with black ornamentation, the narrow distal portion is very narrow, almost rod-like, about 2/3 as long as the basal portion (**Fig. L9B**); the lateral lobes of the male SGP are large and incurved, sometimes meeting or crossing behind the SGP sensu stricto; the toothed margin of the ventral ovipositor valve is strongly arcuate in lateral view (**Fig. L8E**).

As defined by Roberts, 1978, the species is composed of three allopatric subspecies: *S.f. fissicauda* (northern S. America), *S.f. chocoensis* (Atrato Valley, Colombia, and thence south along the Pacific coast to Peru), and *S.f. goethalsi* in Costa Rica and Panama.

The local subspecies is:

***Stenacris fissicauda goethalsi* (Hebard 1924)**

Hebard 1924: 117 (as *Opshomala goethalsi*).

Type locality: Panamá, Canal Zone, Cristobal, France Field.

Location of type: ANSP Philadelphia.

Etymology.

Named for Lt. Col. G.W. Goethals, U.S.Army, (1858-1928), chief engineer of the Panama Canal.

Subsequent literature.

- Roberts, H.R. 1977 [1978]: 67. > Transfers to *Stenacris fissicauda goethalsi*.
- Nunes, A.L., Adis, J. & Mello, J. 1995: 349-374.

Diagnosis.

Habitus **Fig L7, Plate L4**. *S. f. goethalsi* is distinguished from the other subspp. by the much larger median terminal structure of its male SGP, and the smaller lateral lobes, the apices of which do not meet or overlap (**Fig. L9B**). The distal portion of the aedeagus (**Fig. L8C**) is also diagnostic in its shape. Antennae very slightly ensiform at their base. Usually the general colour is more green than brown. Both sexes have a lateral white stripe. Hind tibiae green, tarsi tinged with red. Processes of male SGP usually red or pink.

Distribution.

Costa Rica, principally on the Pacific slope, but also occurring in the northern Caribbean lowlands. Panama, from

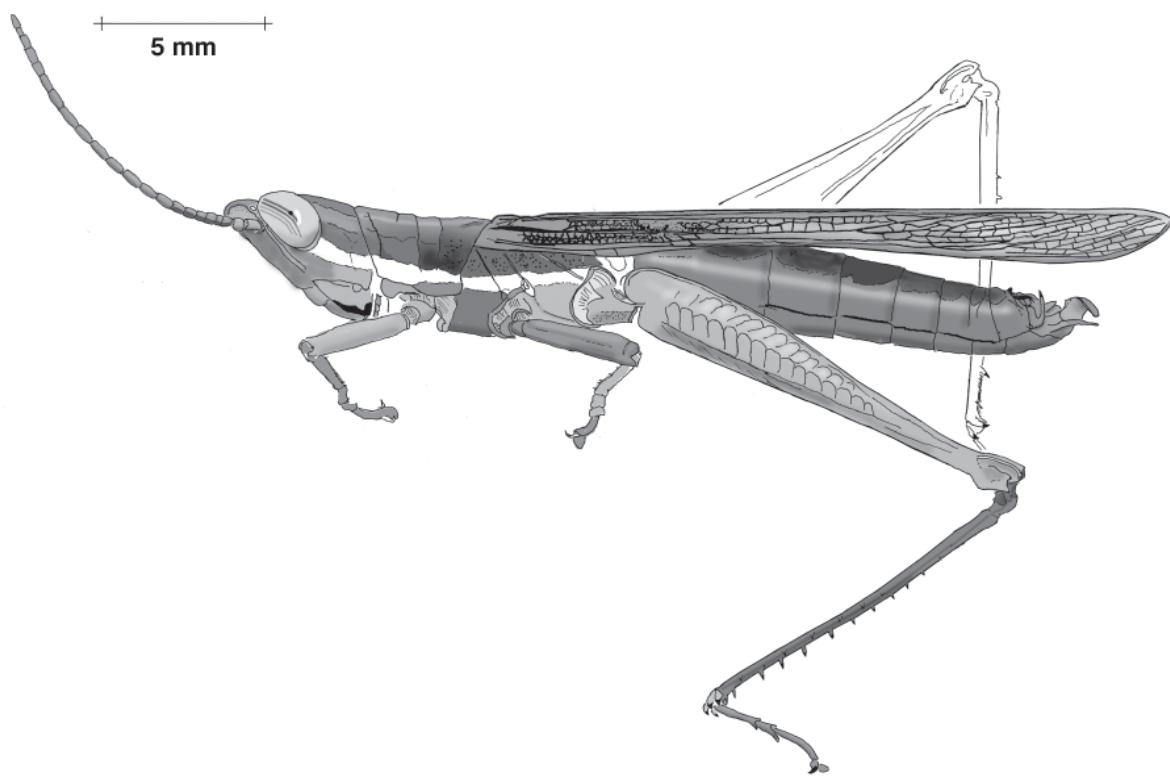


Fig. L7. *Stenacris fissicauda goethalsi*, male, habitus. (See also **Plate L4.**).

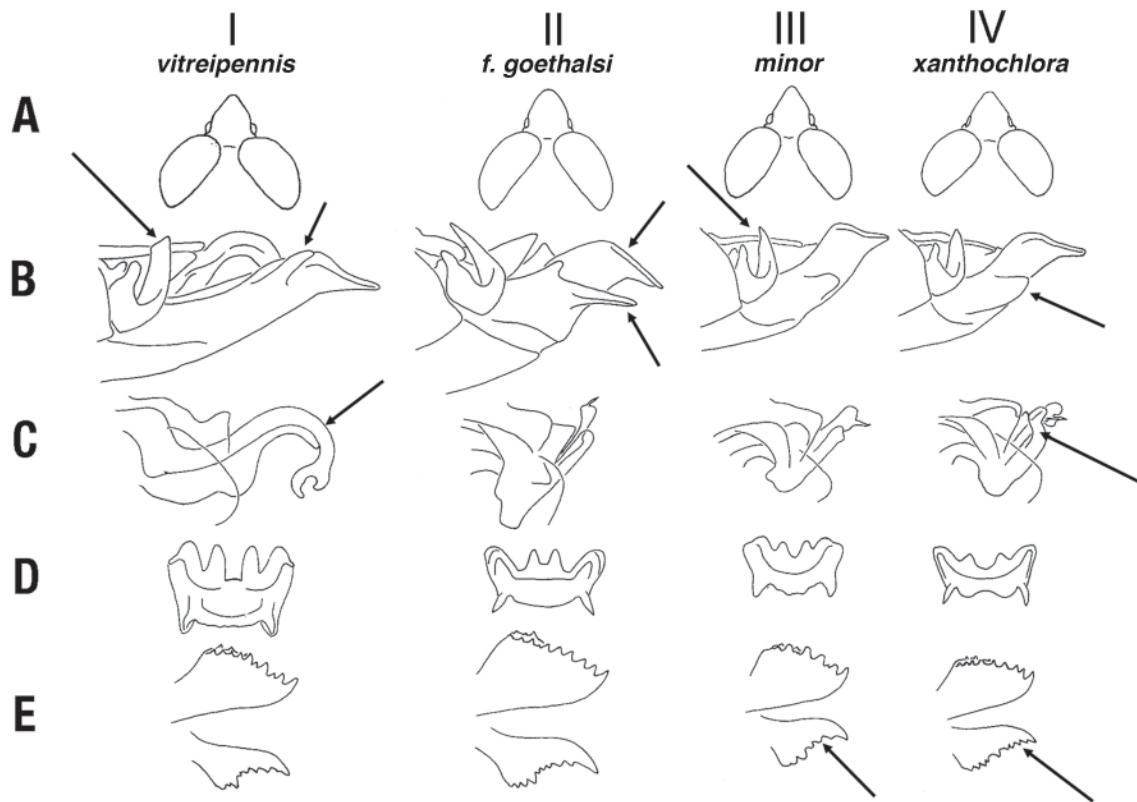


Fig. L8. Central American species of *Stenacris*. I, *vitreipennis*. II, *fissicauda goethalsi*. III, *minor*. IV, *xanthochlora*. A, fastigium, dorsal view. B, male terminalia, lateral view. C, aedeagus, lateral view. D, epiphallus, dorsal view. E, ovipositor valves, lateral view (After Roberts 1978). Arrows indicate major points of difference.

Chiriquí and Bocas del Toro through Veraguas to the Canal Zone (Provinces Colón and Panama). Not so far recorded from Darién. **Map L4** (p. 267).

Natural history.

Common in grasses growing in water, either running or stagnant. By analogy with *S. vitreipennis* assumed to oviposit endophytically in grass or sedge stalks. Often occurs sympatrically with *S. xanthochlora*.

2. *Stenacris minor* (Bruner 1906)

Bruner 1906b:11 (as *Arnilia minor*).

Type locality: Guatemala: San José (Pacific coast).

Location of type: ANSP.

Etymology.

Latin *minor*, smaller.

Diagnosis.

Differs from *S. fissicauda* in that the lateral lobules of the male subgenital plate are small and rounded and placed more ventrally than those of the other species (**Fig. L8-BIII**). Very similar to *S. xanthochlora*, and only distinguishable with difficulty from that species. As the name implies, it is on average somewhat smaller than *S. xanthochlora*. The cercus is more sharply pointed, and the epiphallus is less slender. The tip of the aedeagus is also slightly different (see **Figs L8C**). In the female, the dentition of the ovipositor valves is much coarser in minor than in *xanthochlora* (**Figs L8-E**). If both species are available for comparison, this is the easiest discriminating character. There is a prominent white lateral stripe in both sexes.

Distribution.

Mexico, Guatemala, El Salvador, Honduras, western Costa Rica. Probably also occurs in Nicaragua. **Map L4** (p. 267).

Natural history.

Found in grasses growing in still or running water, as usual in this genus. In Mexico occurs sympatrically with *S. vitreipennis*, but in its only known Costa Rican locality there were no congeners present.

3. *Stenacris vitreipennis* (Marschall 1836)

Marschall (1836): 214. As *Gryllus vitreipennis*.

Type locality: Georgia, USA.

Location of type: Vienna Museum.

Etymology.

Latin *vitrum*, glass; *penna*, wing: "glassy-winged".

Synonymy.

- = *Stenacris chlorizans* Walker 1870, synon. Roberts 1978: 58.
- = *Arnilia marschalli* Bruner 1900-1910 (1908), synon. Hebard 1932: 272 (as *Opshomala vitreipennis*).
- = *Arnilia propinqua* Bruner 1900-1910 (1908), synon. Descamps 1975: 63.

Subsequent literature.

- Hebard, M. 1932: 272. > Distribution (as *Opshomala*).
- Rehn, J.A.G. & Eades, D.C. 1961b: 120. > Transfers to *Stenacris*.
- Descamps, M. 1975: 63. > Ecology, distribution.
- Roberts, H.R. 1977[1978]: 58.
- Hilliard, J.R. 1982: 153-180. > Oviposition.
- COPR (Centre for Overseas Pest Research). 1982: 188. > Bionomics, biology.

Diagnosis.

Males distinguished from other species of the genus by the very broad, upturned arm of the cercus, with apex broadly truncate, the long finger-like lobes of the male subgenital plate, and the very long recurved aedeagus. The ovipositor is rather finely toothed. (**Fig. L8.**)

Distribution.

Atlantic coastal plain of southern USA, through Mexico and Honduras to Costa Rica. In Costa Rica, most records are from the NE of the country, on the Caribbean slope, from Juan Viñas to the Caribbean coast, but there is also one individual from Guanacaste on the Pacific slope. In general, less common than either *S. f. goethalsi* or *S. xanthochlora* in our area. Not as yet recorded from Panama, so apparently on the edge of its range in Costa Rica. **Map L4** (p. 267).

Natural history.

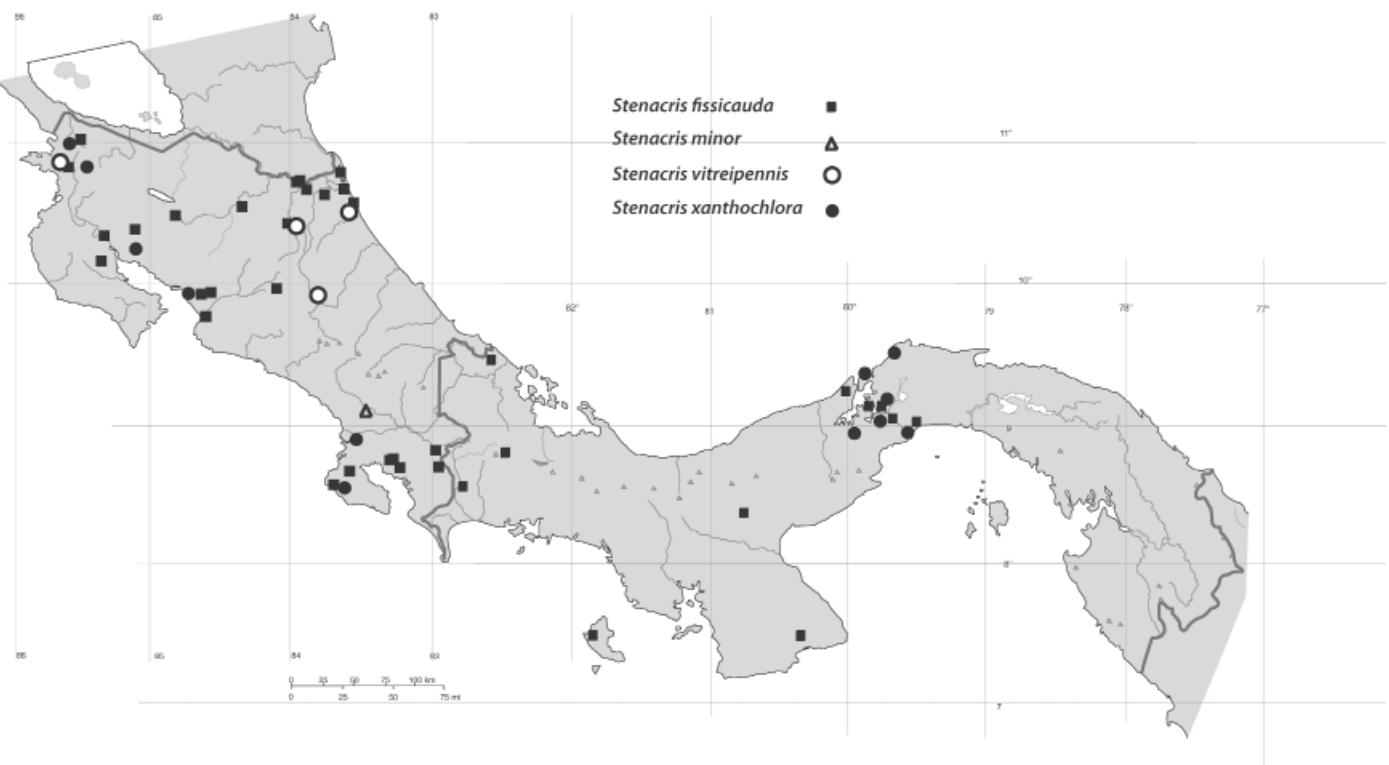
Hilliard (1982) documented the endophytic oviposition of this sp. in *Scirpus* and *Typha* spp. (Cyperaceae) in Texas. Each boring contained on average 14 eggs. In captivity it ate not only Cyperaceae and Poaceae, but also a variety of other marsh plants: *Sagittaria* (Alismataceae), *Eichornia* (Pontaderiaceae), *Polygonum* (Polygonaceae) and *Hydrocotyle* (Apiaceae) (See also note on *S. xanthochlora* below.). This author recorded two broods per year in E Texas.

4. *Stenacris xanthochlora* (Marschall 1836)

Marschall (1836): 215, (as *Gryllus xanthochlora*).

Type locality: Brasil (probably near Rio de Janeiro).

Location of type specimen: Vienna museum.



Map L4. Localities of *Stenacris* spp. in Panama and Costa Rica. Note that *S. xanthochlora* has a predominantly southern distribution, while *S. fissicauda* occurs equally in both countries.

Etymology.

Greek *xanthos*, yellow, *chloros*, green: greenish-yellow.

Synonymy.

- = *Opsomala cylindrodes* Stål 1860. Synon. Roberts 1978: 61.
- = *Stenacris concolor* Walker 1870. Synon. Roberts 1978: 61.
- = *Stenacris lanceolata* Walker 1870. Synon. Roberts 1978: 61.
- = *Stenacris cayennensis* Bruner 1920(1919). Synon. Roberts 1978: 61
- = *Stenacris reyesi* Descamps 1975. Synon. Roberts 1978: 61.
- = *Arnilia saussurei* Carl, 1916. Synon. Roberts 1978: 61.

Subsequent literature.

- Rehn, J.A.G. 1918: 170. > As *Oxyblepta*.
- Roberts, H.R. 1977[1978]: 61 > As *Stenacris xanthochlora*.
- Carbonell C.S., Cigliano, M.M. & Lange. 2006. > *Stenacris xanthochlora*.

Diagnosis.

Closely similar to *S. minor*; lateral lobes of male subgenital plate rounded and short. The males differ from that species in having a somewhat less sharply tapered cercus, and upwardly angled ventral aedeagal valves; the epiphallus is more slender. Females have a more finely toothed ovipositor (see Fig. L8). Hind tibiae green, hind tarsi tinged with red. Usually has a conspicuous white lateral stripe, but this is frequently absent in females and sometimes also in males (e.g. in Guanacaste), which are then a uniform yellow green. Antennae usually pink or red. Differs from *S. fissicauda* in its shorter, less pointed, cercus, the much shorter and smaller lateral lobes of the SGP and in the male SAP (Fig. L9-A) – this is wider, especially in its distal portion and has more black nodular markings.

Distribution.

Mexico, Guatemala, Costa Rica (Pacific slope only to date); Panama: Provinces Herrera, Panama, and Colón; Colombia, Venezuela, Trinidad, Suriname, French Guiana, Brasil, Paraguay, Bolivia, Argentina. Not recorded from Uruguay. Map L4 (p. 265).

Natural history.

Assumed to be similar to that of other members of the genus. Usually to be found on the stems of grasses in freshwater marshes; however, it has also been found in coastal mangrove at Punta Galeta, Colón, Panama, where it was eating seedlings of *Avicennia germinans* (black mangrove)! (W. Souza, pers. comm.). In Panama equally common as, and often sympatric with, *S. fissicauda goethalsi*.

Tribe Tetrataeniini

Brunner von Wattenwyl 1893

Alate and tympanate grasshoppers, often more brightly coloured than the Leptysmini. Antennae usually filiform (but not in *Guataresia*). Male supra-anal plate usually smooth, lacking black nodules, and male subgenital plate usually simple. The ancorae of the epiphallus are present, the lophi upturned and pigmented in black. Hind tibial spines of the inner row usually longer than those of the outer row.

In a cladistic analysis of morphological characters, Lhano (2009) was unable to show that the Tetrataeniini was a monophyletic group, casting doubt on the validity of this tribe. Some molecular data would be desirable.

Amedegnato (1977) divided this tribe into two subtribes, the Oxybleptae and the Tetrataeniae. Both are predominantly South American, and in our region each is represented by only one or two genera. The Oxybleptae resemble the Leptysmini in being generally elongate and slender in body form, whereas the Tetrataeniae are often shorter and more robust, even squat.

Lhano's (2009) cladistic analysis recovered both the Oxybleptae and the Tetrataeniae as natural groups within the Leptysminae.

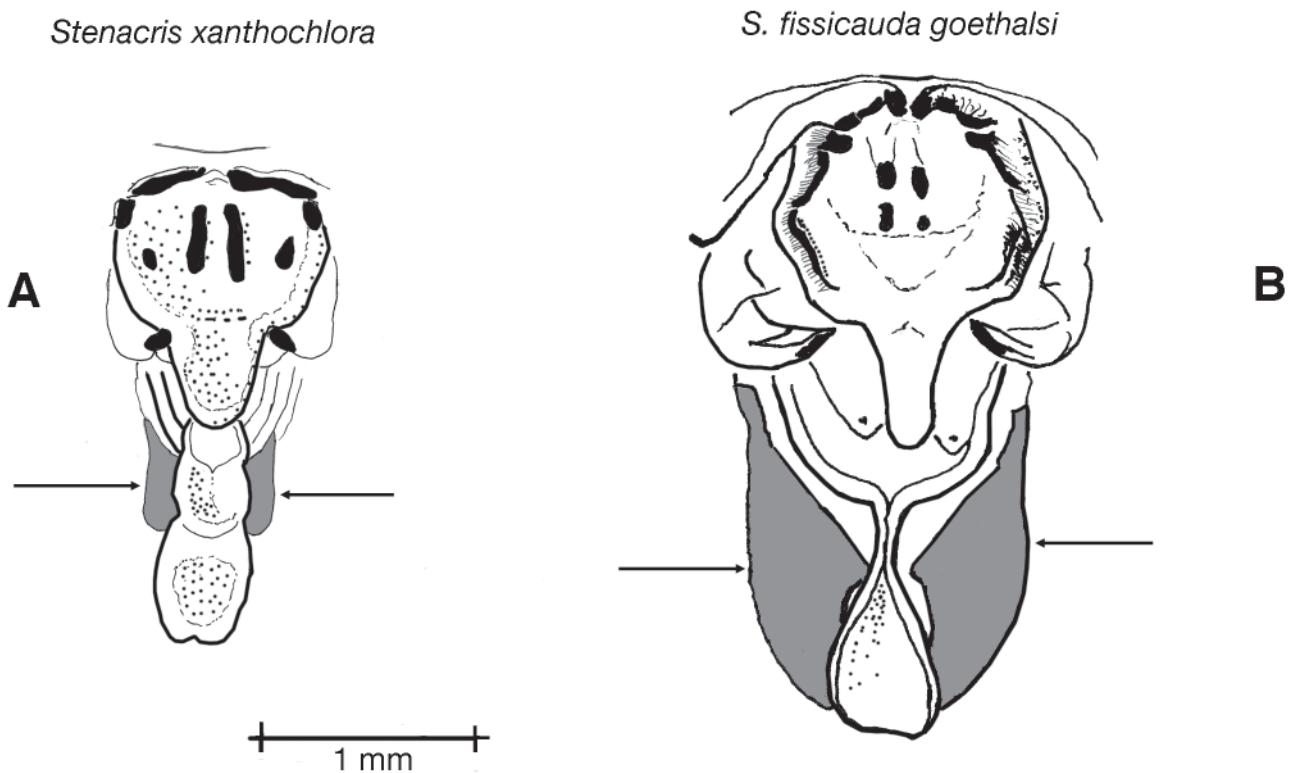


Fig. L9. *Stenacris*. Male supra-anal plate, and processes of subgenital plate, dorsal view. A, *S. xanthochlora*. B, *S. fissicauda goethalsi*. Lateral lobules of subgenital plate shaded grey and marked with arrows.

Subtribe Oxybleptae

Amedegnato 1977

Guetaresia

Rehn 1929

Rehn, J.A.G. 1929:32.

Type species: *G. lankesteri* Rehn 1929.

Etymology.

Named for the indigenous Guatares nation, who inhabited Central Costa Rica in Pre-Columbian and early historical times.

Subsequent literature.

- Roberts, H.R. 1973: 64.
- Amedegnato, C. 1974.: 201. > Leptysminae:Tetrataeniini.
- Amedegnato, C. 1977: 207. >Tetrataeniini: Oxybleptae.
- Roberts, H.R. & Carbonell, C.S. 1980: 77.
- Lhano, M. 2009: 153.

Diagnosis.

Habitus, **Fig.L10, Plate L5**. Frons markedly concave in profile, heavy dark “nodular” antennae (**Fig. L12**). Pronotum rugose, with blackish nodules on the disc, saddle shaped.

Fastigium (**Fig. L10-A**) long and slender, pointed. Prosternal process small, vertical, smoothly pointed. Elytra about as long as abdomen; costal area of elytron expanded. Dorsum of hind knee produced to the rear and tapers to a sharp point. Hind tibiae not flattened (corresponding to the non aquatic environment). Male furcula consists of two well separated small sharp melanized points. Male cercus of the usual upturned leptysmine type, but less sharply hooked than in e.g. *Stenacris*, and only the very tip is melanized (**Fig. L11-C**).

Distribution.

Known so far only from the Caribbean slope forests of Costa Rica and the immediately adjoining areas of Bocas del Toro, Panama.

No. of described species.

One. In our region: one.

Guetaresia lankesteri Rehn 1929.

Rehn, J.A.G. 1929: 32.

Type locality: COSTA RICA, Prov. Cartago, Turrialba, Peralta.
Location of type specimen: ANSP.

Etymology.

Named for Charles Lankester (1879-1969), a British manager of coffee plantations in the Cartago region of Costa Rica. He founded the Lankester Gardens near Paraíso to house his extensive orchid collection (gathered during deforestation for establishing coffee). An enthusiastic amateur naturalist, he collected with Rehn during the latter's visits to Costa Rica.

Subsequent literature.

- Amedegnato, C. 1974: 201. > Leptysminae:Tetrataeniini.
- Roberts, H.R. 1973: 64.
- Roberts, H.R. & Carbonell, C.S. 1980: 77.

Diagnosis.

Monospecific genus, the generic diagnosis applies.

Habitus, **Fig. L10, Plate L5**.

Field characters.

In adults and late larvae, the dark, irregularly nodular antennae (**Fig. L12**) and the coloration (pale leaf green) are distinctive. Larvae are pale leaf green with a purple-brown lozenge on the thoracic and proximal abdominal nota and are usually grouped together on their foodplant. Adults (**Fig. L10**) have a wide white stripe along the ventral part of the pronotal lobes, extending onto the thoracic pleura, and anteriorly as a narrow stripe slanting upwards to the bottom of the eye. Elytra about as long as abdomen, purplish brown.

Natural history.

A specialist on Araceous epiphytes (*Anthurium*, *Xanthosoma*) in lowland rain forest. Refuses other common epiphytic plants, such as orchids and bromeliads. Specimens are most often found as groups of larvae when such epiphytes, or the branches supporting them, fall to the ground. Roberts (1973) collected this species by insecticidal fogging of forest trees in Puerto Viejo de Sarapiquí, but did not find it in the Osa. Apparently subsocial as larvae, like *Cornops*. The characteristic adult markings and coloration develop slowly over some days following the final moult.

The unusual habitat, coupled with the conservative Araceous foodplant, suggests that the taxon is derived from swamp-dwelling Tetrataeniini and has subsequently lost the usual aquatic adaptations, such as the flattened hind tibiae. A similar evolutionary history is suggested for rain-forest Oxyinae in Central Africa (e.g. *Pterotiltus* [Rowell 2005]).

Distribution.

Known so far only from the Caribbean-slope forests of Costa Rica and the adjoining areas of Bocas del Toro, Panama. May well extend further along the Caribbean coast of Panama as well. **Map L5**.

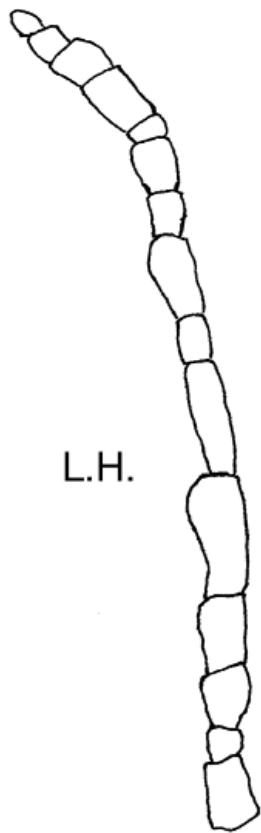


Fig. L12. *Guetaresia lankesteri*. Left hand side antenna, dorsal view.

Fig. L11. *Guetaresia lankesteri*. A, fastigium, dorsal view. B, male supra-anal plate, dorsal view. C, male cercus, lateral view. D, epiphallus, dorsal view. E, aedeagus, lateral view. F, ovipositor valves, lateral view (from Roberts 1978).

Stenopola
Stål 1873

Stål. 1873. Recencio Orthopterorum. Revue critique des Orthoptères décrits par Linné, De Geer et Thunberg. I. Acridiodes: 83.

Type species: *Truxalis dorsalis* Thunberg 1827, by original monotypy.

Etymology.

Greek *stenos*, narrow, Latin *polus*, rod, axis; a reference to the body form.

Subsequent literature.

- Brunner von Wattenwyl, K. 1893: 137 as *Stenopola*
- Roberts, H.R. & Carbonell, C.S. 1979: 106. > Revision of genus.
- Roberts, H.R. 1980: 3.
- Otte, D. 1995: 61. > *Stenopola*; Tetrataeniini.

Synonymy.

- = *Heniola* Uvarov, 1940, synonymized Roberts & Carbonell, 1979: 107.
- = *Inusia* Giglio-Tos, 1897, synonymized Roberts & Carbonell, 1979: 107.
- = *Oxyblepta* Stål, 1873, synonymized Stål 1878: 39.
- = *Pseudoxyblepta* Descamps & Amedegnato 1972, synonymized Roberts & Carbonell, 1979: 107.

Diagnosis.

Slender elongate Leptysmines, usually with a dark coloured dorsum and a black postocular stripe extending rearwards to the thoracic pleura (as also in *Cornops*). Often with a pale lateral longitudinal stripe below the dark dorsum. Some species (all of them S. American) are brightly marked with orange, yellow or red. Fastigium (**Fig. L14-A**) narrow and pointed, often with a weak medial carina at the tip. Antennae filiform or ensiform. Male supra-anal plate (**Fig. L14-B**) longer than broad, with black ornamentation only at the base, if at all. Male furcula small and melanized, the points usually well separated. Aedeagus slender and upwardly curled. Male cerci (**Fig. L14-C**) often with rounded tips, the extremities less vertical than in most other genera of the subfamily. Male subgenital plate simple. Ovipositor of the usual type for this subfamily, with prominent teeth and a pointed terminal "talon" (**Fig. L14-E**).

No. of described species.

Fourteen. In our area: 2.

I. *Stenopola dorsalis* (Thunberg 1827)

Thunberg 1827:80, as *Truxalis dorsalis*.

Type locality: Brasil.

Location of type: Upsala Museum.

Etymology.

Latin *dorsalis*, of the back, dorsum.

Synonymy.

- = *Inusia antillarum* Rehn, J.A.G., 1908, synon Roberts and Carbonell 1979: 111.
- = *Inusia bicolor* Bruner, L., 1900-1910 (1908), synon. Hebard 1924: 119.
- = *Inusia chipmani* Bruner, L., 1906c, synon Roberts and Carbonell 1979: 111.
- = *Opomala femoralis* Walker, F., 1870, synon Kirby 1910:415.
- = *Inusia flavipes* Burmeister, 1838, synon Roberts and Carbonell 1979: 111.
- = *Inusia gracilima* Giglio-Tos, 1897, synon Roberts and Carbonell 1979: 111.
- = *Inusia inornatipes* Bruner, L., 1908, synon Roberts and Carbonell 1979: 111.
- = *Inusia janeiresis* Bruner, L., 1908, synon Roberts and Carbonell 1979: 111.
- = *Inusia nana* Bruner, L., 1900-1910 (1908), synon. Hebard 1924: 119.

Subsequent literature.

- Roberts, H.R. & Carbonell C.S. 1979: 110.
- COPR (Centre for Overseas Pest Research). 1982. 189. > Bionomics, biology.
- Carbonell, C.S., Cigliano, M.M. & Lange, 2006. > *Stenopola dorsalis*.

Diagnosis.

Habitus **Fig. L13, Plate L6**. Somewhat larger than *S. puncticeps*, and with a much narrower white lateral stripe. No blue on wings or abdomen. Hind tibiae dull blue. Male cercus (**Fig. L14**) distinctive, the melanised area is confined to the anterior inner corner of the rather square tip. Upturned tips of the aedeagus shorter and less divergent than in *S. puncticeps*.

Field characters.

The very thin white lateral stripe is the most striking character. The dorsum is often very dark, almost black, darker than in most specimens of *puncticeps*. In the hand the absence of blue wings or abdomen is easily seen. The antennal flagellum is more brownish than red.

Hind knee tinged with pink or brown, hind tibiae greenish blue.

Natural history.

Usually found at edges of wet forests, or along forest paths or light gaps, but also in swamps. Less universal than *S. puncticeps*, but similarly associated with Araceae.

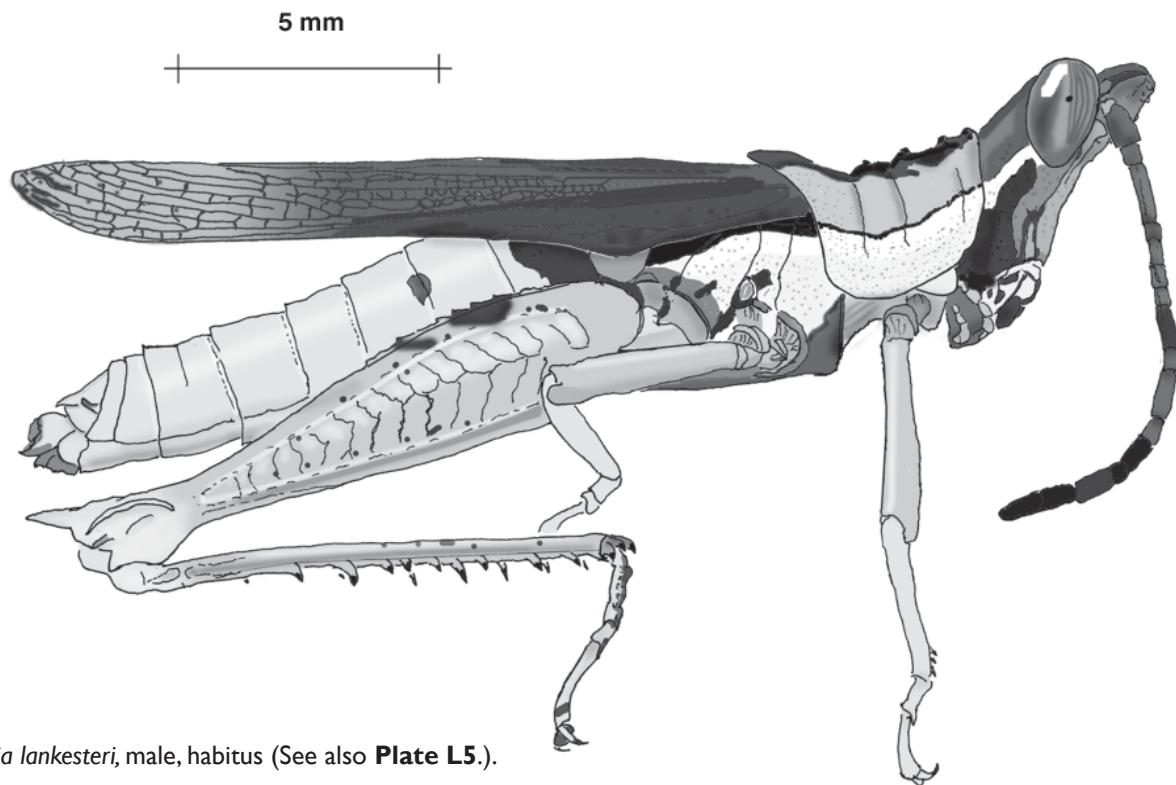


Fig. L10. *Guetaresia lankesteri*, male, habitus (See also Plate L5.).



Map L5. Localities of *Guetaresia lankesteri* in Panama and Costa Rica.

Distribution.

Mexico to Brasil, Paraguay and Bolivia, including Trinidad. In Costa Rica recorded from almost all parts of the country, except the extreme N.E.; in Panama from Bocas del Toro East to Panama and Colón. As it is also common in Colombia, it is likely to occur in Darién, but has not yet been recorded there. **Map L6** (p. 273).

2. *Stenopola puncticeps* (Stål 1873)

Stål 1861: 325, as *Opsomala puncticeps*.

Etymology.

Latin *puncticeps*, pointed head.

Subsequent literature.

- Brunner von Wattenwyl, K. 1893: 137. > As *Stenopola*.
- Giglio-Tos, E. 1897: 31. > As *Stenopola puncticeps*.
- Rehn, JAG 1905:38. > As *Stenopola puncticeps*.
- Rehn, JAG. 1913: 337.
- Bruner, L. 1920[1919]: 57. > As *Oxyblepta puncticeps*.
- Roberts, H.R. & Carbonell, C.S. 1979:117. > As *Stenopola puncticeps puncticeps*.
- Otte, D. 1995. Orthoptera Species File.5: 61. > As *Stenopola*, Tetrataeniini.
- Carbonell, C.S., Cigliano, M.M. & Lange, 2006. > As *Stenopola puncticeps puncticeps*.

Diagnosis.

Antennae filiform, usually reddish. Eyes protuberant, globose, dorsum of head and pronotum dark brown or green. Lateral pale stripe below postocular stripe present or absent. Proximal portion of wing, occasionally the costal margin of the elytrum, and (frequently) dorsa of the abdominal segments tinged with dark blue. Hind femur green, never with dark bands. Roberts and Carbonell (1979) recognize 5 subspecies, 4 of which are confined to S America.

The subspecies in our area is:

***Stenopola puncticeps limbatipennis* Stål 1861**

Stål 1861[1860]:325, as *Opsomala puncticeps*.

Type locality: Colombia: Antioquia, Remedios.

Location of type: Stockholm Museum.

Etymology.

Latin *puncticeps*, pointed head; *limbatipennis*, fringed wing.

Subsequent literature.

- Roberts, H.R. & Carbonell, C.S. 1979: 120. > *Stenopola puncticeps limbatipennis*.

Diagnosis.

Habitus, Fig L15, Plate L7. Dorsum of head and pronotum green or dark brown; broad white stripe below dark postocular stripe; furcula lobate, a small black tubercle on base of supra-anal plate lying outside the furcula. Upturned arm of male cercus relatively broad and short, tegmina extending well beyond hind knees. Hind knee tinged with black or dark blue; hind tibiae bright blue, hind tarsi blue-green (male) or pink (female). Antennal flagellum reddish, basal segments green. The distal end of ventral ovipositor valve less prolonged and talon-like than in *S. dorsalis*.

Field characters.

Much broader white lateral stripe than in *S. dorsalis*, our other species. In flight or in the hand the dark blue of wings and abdomen is noticeable. In some specimens, especially females, the dorsa of the abdomen are black or brown rather than blue, which may reflect a maturational change.

Distribution.

Recorded throughout Panama and Costa Rica, often very common in moist wooded areas with Araceous plants. **Map L7** (p. 275).

Natural history.

Our most widely distributed leptysmine in terms of ecological zone. Not confined to swamp, found in damp forest margins and indeed almost anywhere its Araceous foodplants grow, including domestic gardens. Has been found at a height of 50 m in forest trees, possibly following Araceous epiphytes (Cabra et al. 2011).

Apparently absent from Northern Costa Rica, where replaced by *S. dorsalis*.

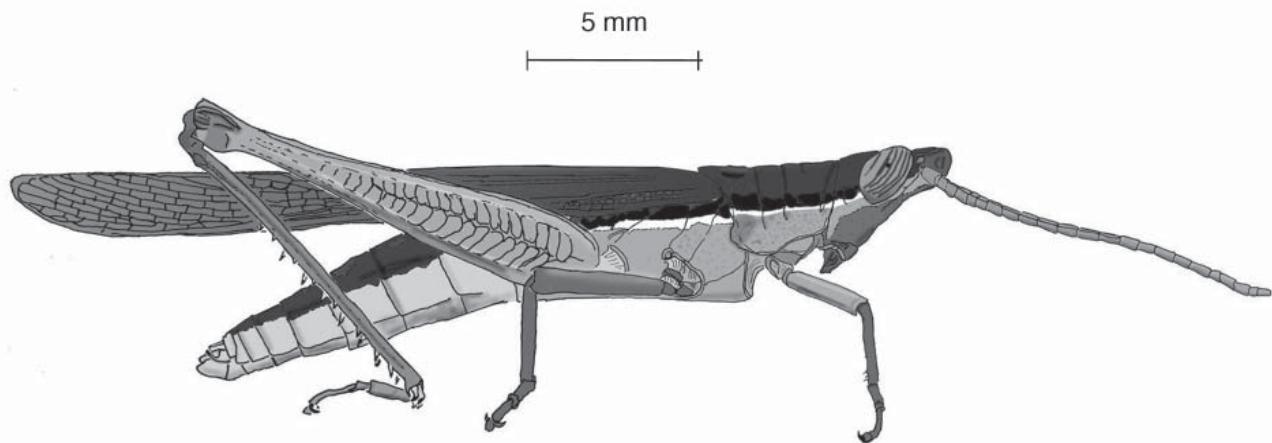
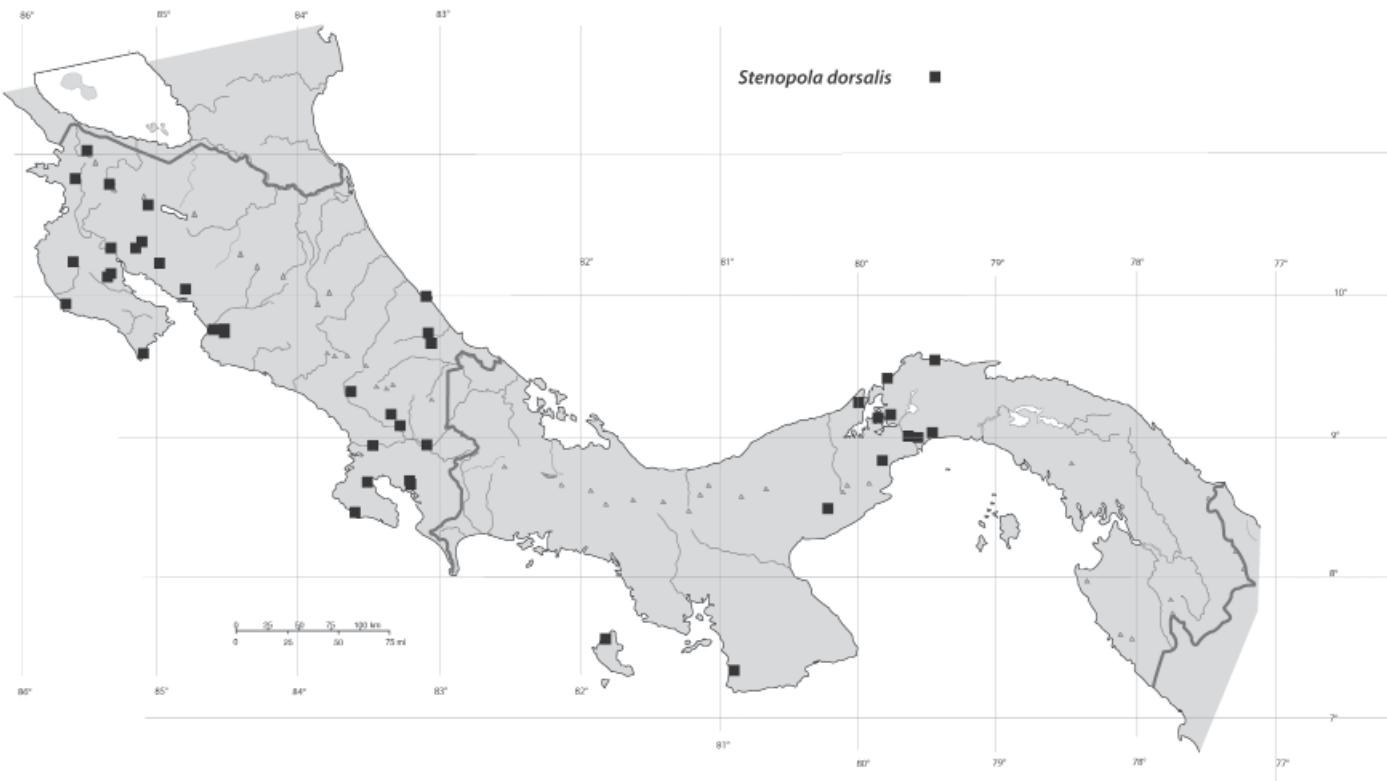


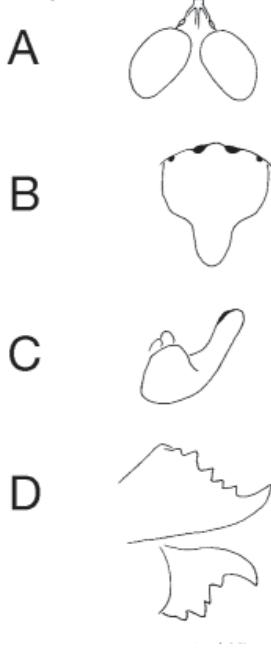
Fig. L13. *Stenopola dorsalis*, male, habitus. (See also Plate L6).



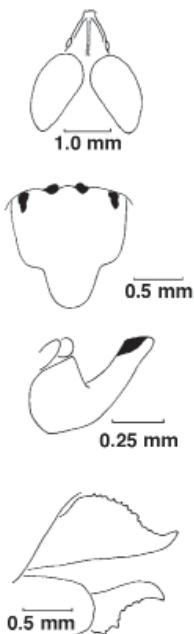
Map L6. Localities of *Stenopola dorsalis* in Panama and Costa Rica.

Subtribe Tetrataeniae Amedegnato 1977

Stenopola puncticeps
limbatipennis



Stenopola dorsalis



Lhano's (2009) cladistic analysis recovered both the Oxybleptae and the Tetrataeniae as natural groups within the Leptysminae.

Cornops Scudder 1875

Scudder, S.H. 1875. Proc. Boston Soc. Nat. Hist. 17:276.
Type species: *Cornops bivittatum* Scudder (= *C. frenatum*), by original monotypy.

Etymology.

Latin *cornus*, hard, horny, Greek *ops*, face.

No. of described species.

Six. In our area, one.

Range.

Mexico to Argentina, Trinidad. The genus is much less common in Central America than in Amazonia. In our area it is essentially confined to the swampy hinterland of the Caribbean coast.

Diagnosis.

Habitus, **Fig. L16, Plate L8**. Much less gracile and elongate than our other leptysmines, rather short and chunky in build, with a slightly convex frons. A broad black postocular stripe extends from the rear of the eye across the pronotum onto the thoracic pleura. Fastigium broad and less pointed than in other genera, the eyes less protuberant (**Fig. L17A**). Basal portion of male supra-anal plate much broader than the distal part, which is reduced to a short medial appendage (in our species, rather quadrate in shape, [**Fig. L17B**]). Furcula present in the male, and in our only species the basal part of the supra-anal plate is decorated with melanic ornament (**Fig. L17B**).

Fig. L14. *Stenopola dorsalis* and *S. puncticeps limbatipennis*.
A, fastigium, dorsal view. B, male supra-anal plate, dorsal view. C, male cercus, lateral view. D, ovipositor valves, lateral view (from Roberts & Carbonell 1979).

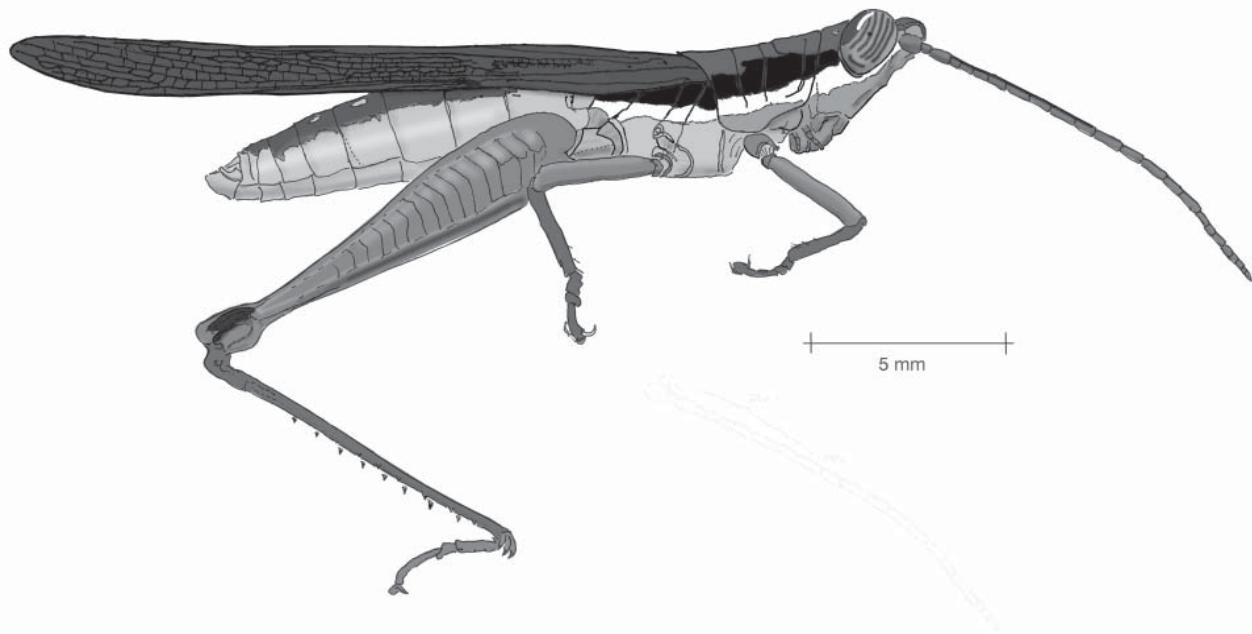
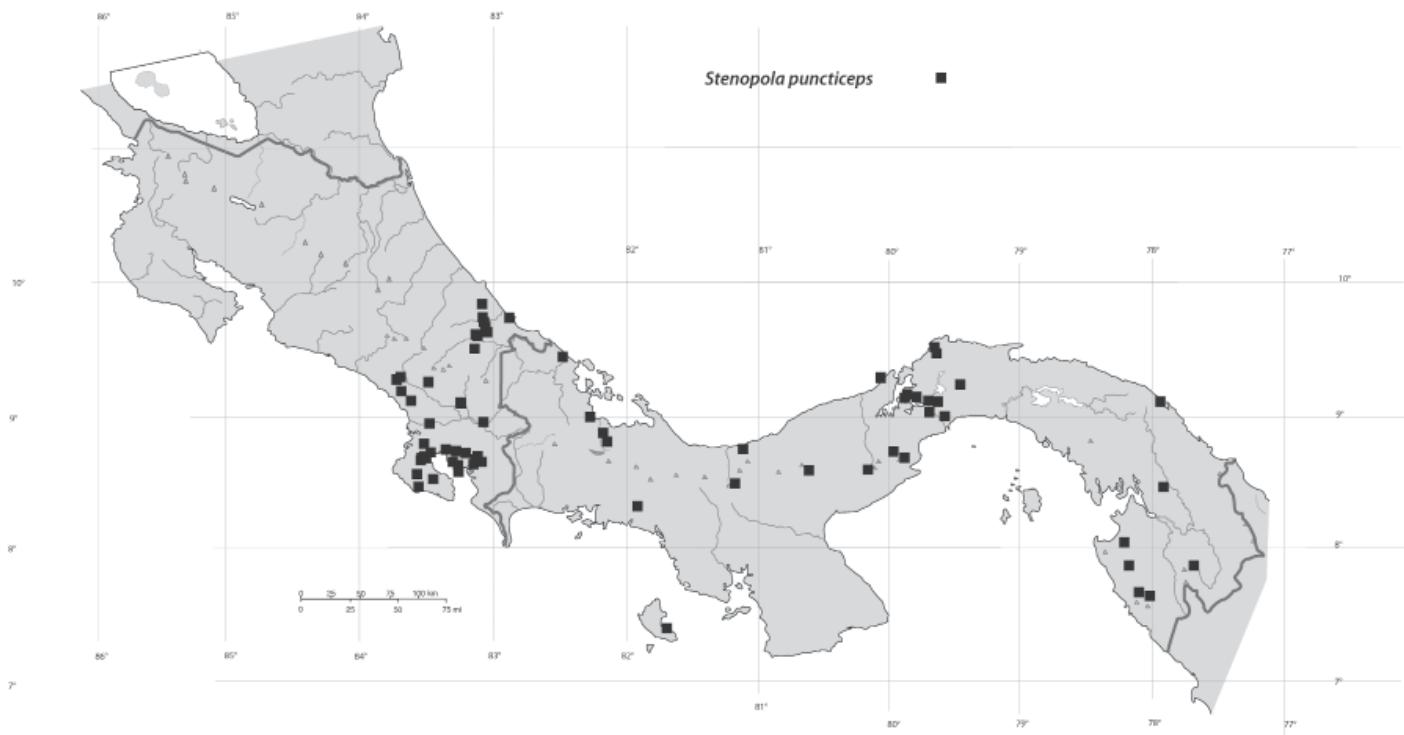


Fig. L15. *Stenopola puncticeps limbatipennis*, male, habitus. (See also **Plate L7.**)



Map L7. Localities of *Stenopola puncticeps* in Panama and Costa Rica. Note the predominantly southern distribution.

***Cornops aquaticum* Bruner 1906.**

Bruner, L. 1906a: 663. As *Paracornops aquaticum*.
Type locality: Paraguay, San Bernardino.
Location of type: USNM Washington.

Etymology.

Latin *aquaticum*, of water, aqua.

Synonymy.

- =*pelagicum* Bruner, L., 1920 (1919), synonymized Roberts & Carbonell 1979:127.
- =*politum* (Bruner, L., 1906a), synonymized Roberts & Carbonell 1979:127.
- = *scudderi* Bruner, L., 1906,b synonymized Roberts & Carbonell 1979:127.

Subsequent literature.

- de Zolessi, L.C. 1956: 3-28. > *Cornops aquaticum*. Oviposition strategy.
- Bennett. 1970: 10-13, as *Cornops aquaticum*.
- Bennett, F.D. 1973: 63-71. > As *Cornops aquaticum*.
- Bennett, F.D. 1974: 224-236. >As *Cornops aquaticum*.
- Bennett, F.D & Zwolfer, H. 1968: 832-835. >As *Cornops aquaticum*.
- Guido, A.S. & Perkins, B.D. 1975: 400-404. >As *Cornops aquaticum*.
- Gangwere, S. & Ronderos, R.A. 1975:173-194. >As *Cornops aquaticum*.
- Roberts, H.R. & Carbonell, C.S. 1979: 127. > Generic revision.
- Carbonell, C.S. 1981: 92-99.
- COPR (Centre for Overseas Pest Research). 1982: 183. > Bionomics, biology.
- Braker, H.E. 1989: 389-406 > Evolution and ecology of oviposition.
- Adis, J. & Junk, W.J. 1990. > *Cornops aquaticum*.
- Adis, J.U., Lhano, M.G, Hill, M.P., Junk, W.J., Marques, M.I. & Oberholzer, H. 2004: 127-132.
- Bentos-Pereira, A. & Lorier, E. 1991: 631-653. > *Cornops aquaticum*.
- Cilliers, C.J. 1991.: 207-217. > *Cornops aquaticum*.
- Sperber, C.F & Lopes, F.S. 1995: 21-20. > Feeding habits, *Cornops aquaticum*.
- Lhano, M.G., Adis, J.U. & Penteado, C.H.S. 1998:118. > Distribution. *Cornops aquaticum*.
- dos Santos,A.C. & Vieira, M. De F. 1999: 37-40. > Life cycle, *Cornops aquaticum*.
- Hill, M.P. & Cilliers, C.J. 1999.:103-112. > *Cornops aquaticum*.
- Hill, M.P. & Oberholzer, H. 2000: 349-356. >*Cornops aquaticum*.
- Marques, M.I., Adis, G.B., dos Santos, M.C. & Lhano, M.G. 2002: 6-7. > Ecology in the Pantanal floodplains. *Cornops aquaticum*.
- Adis, J. & Junk, W.J. 2003. : 245-249. > *Cornops aquaticum*.

Impact on *Eichornia*.

- Vieira, M. DE F. & dos Santos, A.C. 2003: 711. > Feeding habits, *Cornops aquaticum*.
- Carbonell, C.S., Cigliano, M.M. & Lange. 2006. CD ROM. *Cornops aquaticum*.
- Adis, J. et al. 2007 : I 1-24. >Distribution of genus.

Diagnosis.

As the only species of the genus occurring in our area, the generic diagnosis applies.

The various (and confusingly similar!) species of *Cornops* are most readily distinguished by the pattern of the melanic ornaments on the male supra-anal plate. In *C. aquaticum* these consist of two thin parallel bars on the medial basal part of the plate, flanked by a single pair of black dots, one on either side of the small and weak medial furcula (**Fig. L17-B**).

C. frenatum, which occurs in Colombia and might yet be found in Panama, usually has an additional pair of black dots, located posterior to the parallel bars (**Fig. L17-B**). The species differ also in the dentition of the ovipositor valves (**Fig. L17-D**). Head and body, below lateral black stripe, greenish yellow, above stripe either bright green or light reddish brown.

According to Roberts & Carbonell's 1979 review, *C. frenatum* does not occur in Panama. In the collection of the California Academy of Sciences, however, there are specimens from the Canal Zone identified as *C. frenatum* by Roberts in 1974. Presumably the later work is more likely to be correct, in which case these specimens are in fact *C. aquaticum*. Costa Rican male specimens are ambivalent in Carbonell & Roberts' (1979) key (they have the fastigial and the supra-anal plate characters of *aquaticum* but the hind knee characters of *frenatum*), but Costa Rican females are assigned unambiguously to *aquaticum* by the dentition of the ovipositor valves.

Natural history.

Cornops is a specialist on various broadleaved aquatic monocots, such as *Eichornia* (Water hyacinth, Pontaderiaceae) and *Canna*. The eggs are deposited endophytically (de Zolessi, 1956). *C. aquaticum* uses principally *Eichornia crassipes*. As *Eichornia* is now a serious pan-tropical weed *Cornops* has been extensively debated (see references above) as a possible biocontrol agent, and *C. aquaticum* has been released for this purpose in S.Africa (Hill & Cilliers 1999). The genus is noteworthy for the remarkable subsocial habit of its larvae, which feed together in well-aligned groups of individuals. In Brasilian Amazonia larval development lasts 40-50 days and includes 5-6 instars; longevity is 3.2 months for males and 5.8 months for females, and average development from oviposition to adult takes 70-80 days (Adis & Junk 2003).

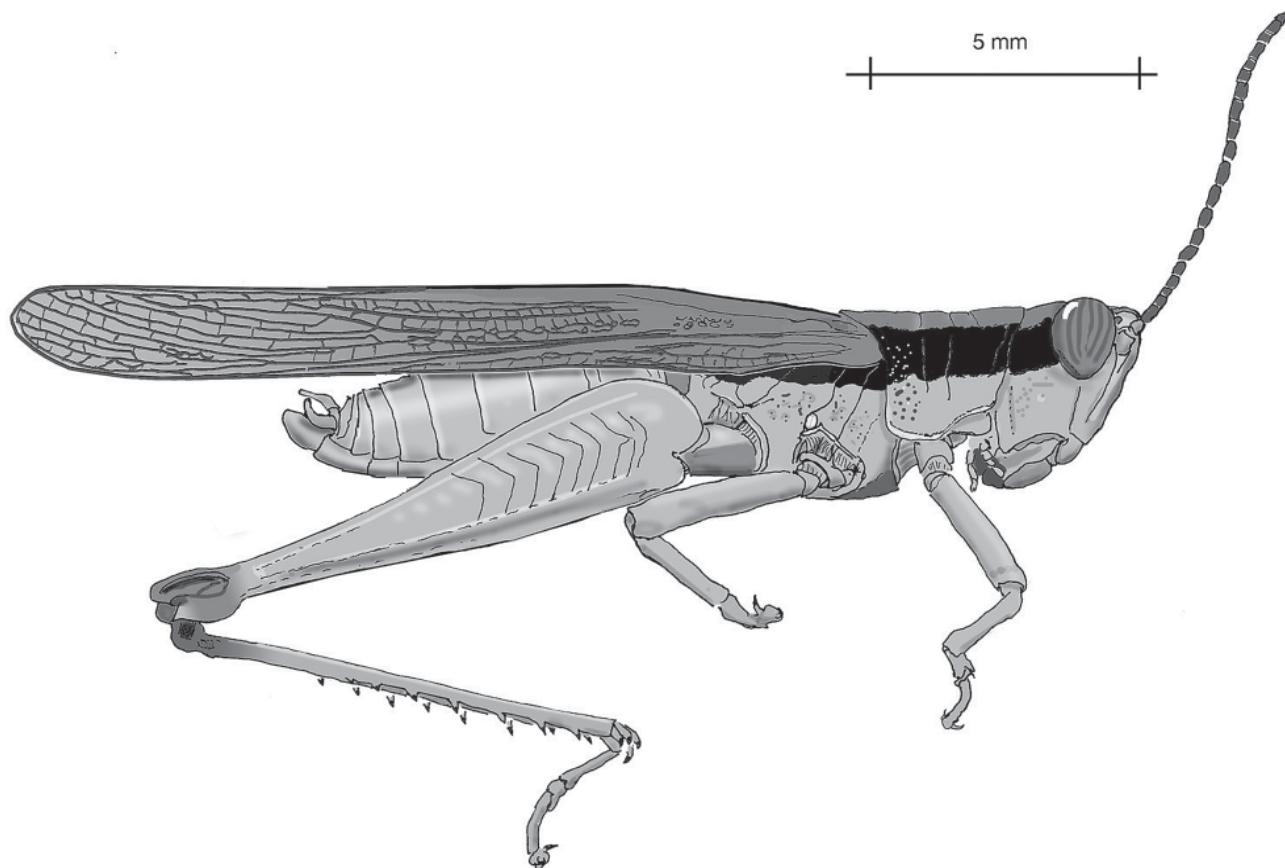


Fig. L16. *Cornops aquaticum*, male, habitus (see also Plate L7.).

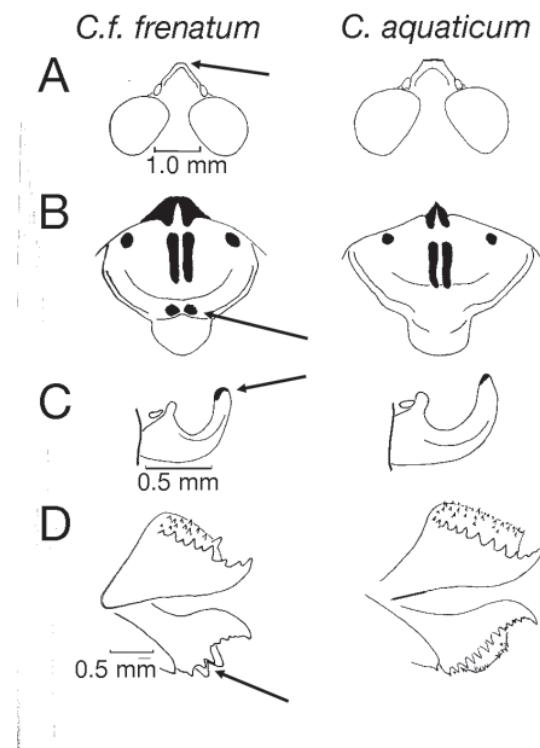
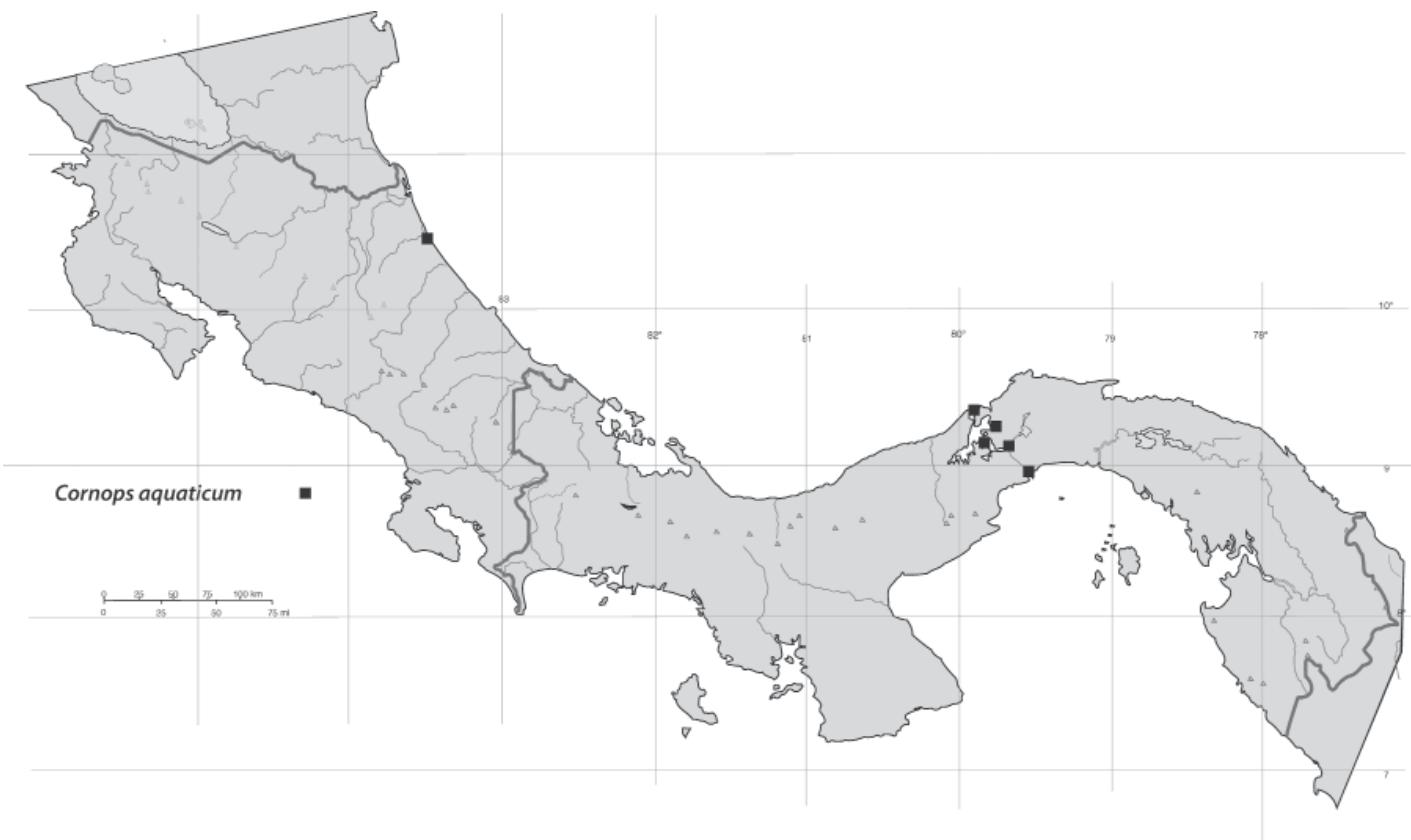


Fig. L17. *Cornops aquaticum* and *frenatum*. A, fastigium, dorsal view. B, male supra-anal plate, dorsal view. C, male cercus, lateral view. D, ovipositor valves, lateral view (from Roberts & Carbonell 1979). Arrows indicate major discriminating characters.

Distribution.

S. Mexico to Argentina and Uruguay, including Trinidad. Common in Amazonia. In Colombia extends SW into the Chocó but apparently does not continue into Ecuador. In our region, found in the swamps of the Caribbean coastal regions of both Costa Rica (e.g. Tortuguero) and Panama (e.g. the northern Canal Zone). **Map L8** (p. 279, opposite).



Map L8. Localities of *Cornops aquaticum* in Panama and Costa Rica.

Subfamily Melanoplinae

Scudder 1897

The Melanoplinae are a large group (129 genera, and nearly 900 spp.) of predominantly Holarctic grasshoppers, but with an important additional radiation in South America. The group Melanoplini was formally recognized by Scudder (1897) and first used at subfamily rank by Uvarov (1966). The subfamily is currently divided into 7 tribes: Conalcaeini, Dactylotini, Dichroplini, Jivarini, Melanoplini, Podismini, and Prumnini, of which the most important numerically and the best studied are the predominantly North American Melanoplini, the predominantly Eurasian Podismini, and the predominantly S. American Dichroplini. They are usually thought to be an originally Holarctic subfamily that has colonised S. America secondarily (e.g. Carbonell 1977). However, the South American tribe Jivarini, differing in many ways from the rest of the subfamily, but linked to them by both morphological and molecular systematics, have an estimated divergence date of approximately 50 million years ago and seem to be the most basal branch of the clade (Amedegnato, Chapco & Litzenberger [2003], Rowell & Flook [2004]) – their current distribution, restricted to Andean South America, may therefore be secondary. Alternatively, this may be an indication that the subfamily in fact had its origin in South America, as has been argued by Amedegnato et al.

Most Melanoplinae are of small to moderate size and live in grasslands, but eat dicotyledons either exclusively or in combination with grasses. They can be important competitors with grazing mammalian livestock and of considerable economic importance (e.g. the N. American genus *Melanoplus*, the South American *Dichroplus*). Many are foodplant specialists, and correspondingly some have epiphytic or endophytic oviposition (e.g. the S. American *Scotussa cliens*, a specialist on the Apiaceous genus *Eryngium*).

Melanoplines are very prominent in the Mexican fauna, but much less diverse in tropical Central America.

Number of genera world-wide.

129.

Number in our area.

Two.

Diagnosis.

The Melanoplinae are characterized by an inflated, cup-shaped male subgenital plate, a thick and often coriaceous or wrinkled pallium, and often complex male cerci and aedeagi. The anterior apodemes of the endophallus are flattened laterally, and the endophallic sclerites clearly fractured. The females have a long, tubular, preapical diverticulum of the spermatheca – in all these characters they resemble the Proctolabinae. The profile of the face is convex in lateral view, and runs smoothly into the fastigium, with no pronounced fastigio-facial angle (except in the S. American Jivarini). The antennae are filiform. The second

hind tarsal segment is short (<20% of foot – differentiates from Proctolabinae). They have a prosternal spine or tubercle, always lack a stridulatory apparatus but are usually tympanate. In our region the pronotum is always devoid of lateral carinae. Many taxa have a red or otherwise brightly coloured inner hind femur, which is displayed during courtship, and some Mexican genera are brilliantly coloured. Many Melanoplines are brachypterous, especially the numerous alpine forms.

Aidemona

Brunner von Wattenwyl 1893

Brunner de Wattenwyl 1893: 145.

Type species: *Platypyma aztecum* Saussure 1861, subsequently designated by Rehn 1904: 536. (Brunner von Wattenwyl specified no type).

Subsequent literature.

- Scudder, S.H. 1897: 44.
- Rehn, J.A.G. 1904: 536.
- Kirby, W.F. 1910: 497.
- Roberts, H.R. 1947: 208. > Revision of genus.
- Rehn, J.A.G & Randell, R.L. 1963: 11.
- Amedegnato, C. 1974: 199.
- Cigliano, M.M. & Otte, D. 2003: 316. > Revision of genus.
- Amedegnato, C., Chapco, W. & Litzenberger, G. 2003: 115-119. > Molecular systematics.

Number of species in genus.

Five.

Generic range.

USA (Texas to Arizona) to Colombia. Most species are Mexican.

No. of species in our area.

One.

Diagnosis.

(Condensed from Cigliano & Otte [2003]). Macropterous (except in *A. scarlata*, Mexico), small insects (L = 14-25 mm). Body colour brown, spotted with dark brown on lateral field of forewings, with a pale spot on the metathoracic epimeron. Lateral pronotal lobes dark above and lighter below. Hind femur with two transverse darker bands on dorsal area, ventral marginal area and inner face red-orange, hind tibiae blue (or red in *A. scarlata*). Head small with prominent eyes, interocular area narrow, fastigium with slight lateral carinae. Disc of pronotum flat, caudal margin angular. Distal end of male abdomen not inflated. Male cerci conical, male furculae reduced.

The primary generic characters are genital. As pointed out by Rehn & Randell (1963) and more recently by Cigliano & Otte (2003), the phallic structure of this genus is unlike that of any other known melanopline, which makes it difficult to assign to any of the normal tribes. Rehn & Randell placed it in the Melanoplini, but one suspects on purely geographical grounds. Differs from most other Melanoplini in having a broad flat pronotal disc and a relatively uninflated male genital region.

Amedegnato *et al.* (2003) found *Aidemona* to be basal (i.e. probably primitive) in the molecular phylogeny of the North American melanoplines they sampled.

***Aidemona azteca* (Saussure 1861)**

Platypyma aztecum Saussure 1861: 162.

Type locality: "Temperate Mexico".

Location of (lecto)type specimen: MHN Geneva.

Subsequent literature.

- Walker, T.J. 1870: 716.
- Stål, C. 1878: 10. > Transfers to *Pezotettix* (synonym of *Platypyma*).
- Brunner von Wattenwyl, K. 1893: 145. > Transfers to *Aidemona*, n.g.
- Scudder, S.H. 1897a: 204.
- Scudder, S.H. 1897b: 45.
- Rehn, J.A.G. 1902: 15.
- Bruner, L. 1900-1910 (1907): 313.
- Kirby, W.F. 1910: 497.
- Hebard, M. 1917: 264.
- Hebard, M. 1932b: 286.
- Roberts, H.R. 1947: 209, 229. > Designation of lectotype, illustration of male genitalia.
- Cigliano, M.M. & Otte, D. 2003: 317. > Revision of genus.

Distribution.

Southern USA (Texas, New Mexico & Arizona, but not California) south through Mexico and Central America to Colombia. A very common grasshopper of secondary vegetation of the entire Pacific slope of both Costa Rica and Panama. In Costa Rica it is rarely found in the Atlantic drainage; there is a persistent colony immediately south of Cartago, in the area Navarro/Cangrejo, and it is common in plantation areas of the Valle de la Estrella, but only occasional elsewhere. In Panama, *Aidemona* reaches the Atlantic coast around the city of Colón, and in Bocas del Toro. **Map M1**, p. 290.

Diagnosis.

Habitus, **Fig. M1 & Plate M1**. Elytra exceeding hind knees in length. Hind femora brown with 2 weak transverse dark bands on outer and dorsal surfaces, red on inner surface. Hind tibiae bluish in their central part. The hind wing of *Aidemona* is clear basally, clouded grey distally. The elytra are grey brown, with faint brown spotting and brown or black venation. Nine external

and eleven internal hind tibial spines. Male cerci flattened at base, tapering to a slender tip and directed somewhat inward towards the midline. Male furcula consists only of two small rounded lobes near the midline. Supra-anal plate subtriangular with a rounded tip, sulcate in the basal midline, but not divided transversely (**Fig. M2**).

Very variable between individuals in both size and depth of coloration. The main specific characters within the genus are genital; see figures in Cigliano & Otte (2003).

Field characters.

Adults readily recognized by combination of dull brown or blackish colour, squat form with short head, darkly banded hind femora with red colour on their inner faces, and prominent small white spot on the metathoracic epimeron above the base of the hind leg (superficially similar to that of male *Orphulella punctata*, which however does not share the other characters). *Abracris dilecta* is about the same size and also has banded femora; it is paler in colour, slimmer and more active, and lacks the white spot and red coloration.

The larvae of *Aidemona* are strikingly coloured in patches of black, yellow and white, changing in detail with each moult.

Natural history.

In general a good indicator species of what was once seasonally moist forest. The foodplants have not been studied, but it seems to eat numerous dicotyledenous herbs, and like many melanoplines is especially fond of the flowering heads. COPR (1982) considered the evidence for pest status in El Salvador to be negligible, contra Bates (1942).

Baeacris

Rowell & Carbonell 1977

Rowell & Carbonell 1977: 56.

Type species: *Baeacris talamanicensis* Rowell & Carbonell 1977: 58.

Subsequent literature.

- Ronderos, R.A. & Cigliano, M.M. 1991. > Enlarges genus by inclusion of *punctulatus* group of *Dichroplus*.

Etymology.

Greek *baeos*, small; *acris*, conventionally used for grasshopper.

No. of species in genus.

Nine. The genus was erected for *Baeacris talamanicensis* Rowell & Carbonell, 1977. Subsequently Ronderos and Cigliano

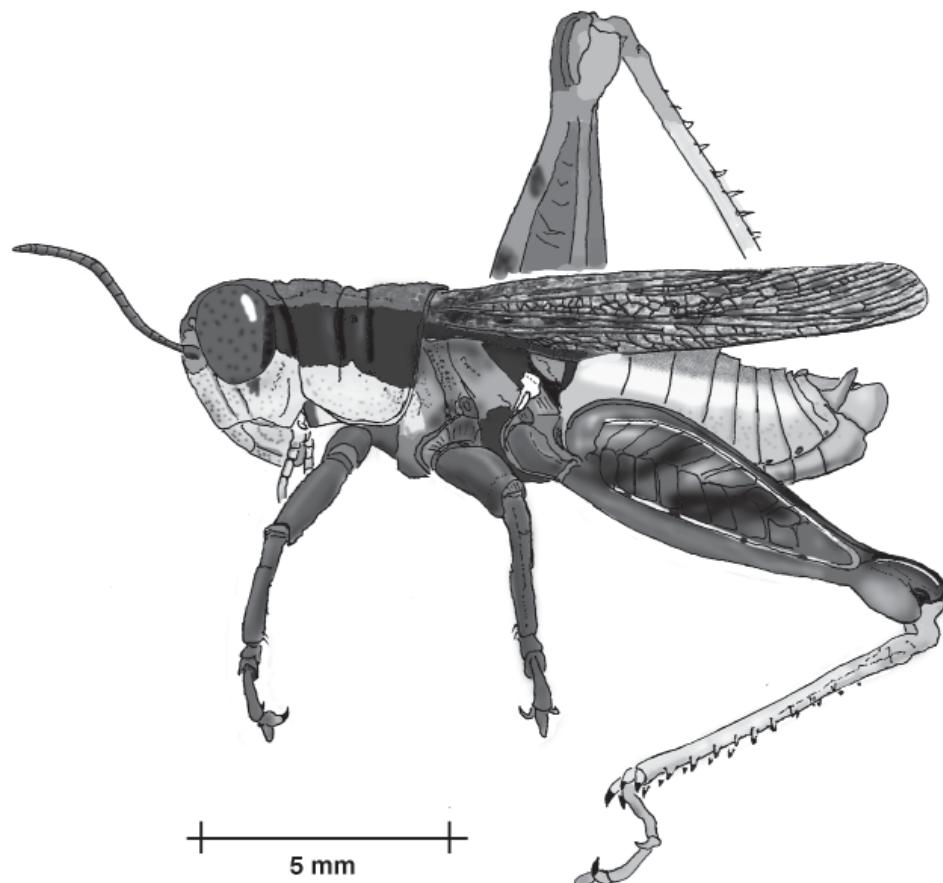


Fig. M1. *Aidemona azteca*, male habitus.

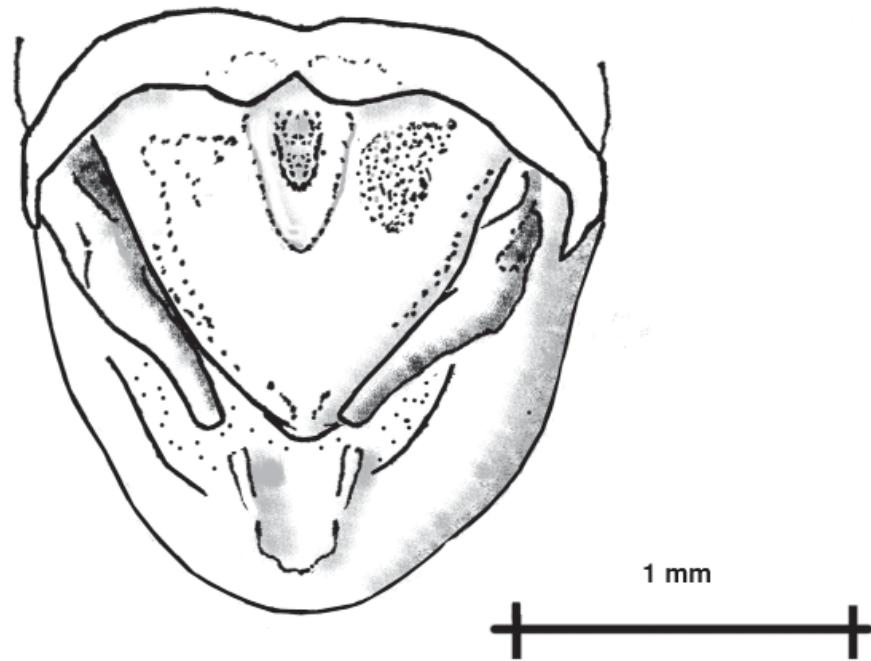


Fig. M2. *Aidemona azteca*, male terminalia, dorsal view. Note undivided supra-anal plate.

(1991) transferred a group of mostly South American species (the punctulatus group) from *Dichroplus* to this genus. (The punctulatus group was established by Carbonell & Ronderos [1973] and consists of 6 species which are all essentially identical in their external morphology, but clearly different in their male genitalia). Unfortunately Ronderos and Cigliano did not redefine the genus after this fusion, nor did they alter the specific names to reflect the feminine gender of the new generic name.

No. of species in our area.

Two.

Generic diagnosis.

(Condensed from Carbonell & Ronderos [1973], & Rowell & Carbonell 1977). Generally of small size (relative to members of the genus *Dichroplus* s.str.), the males being more gracile.

Head in dorsal view scarcely wider than the anterior part of the prothorax, globose, widest at genae, vertex slightly elevated above pronotal disc; eyes relatively large, moderately protuberant, interocular space wide; scape of antenna flattened, almost as wide as the interocular space, antennal flagellum with 17-20 segments. Fastigium slightly excavated in its mid line dorsally, running smoothly into the frons in lateral view. Upper part of frontal ridge slightly grooved, narrowing slightly downwards towards the clypeal suture. Facial carinae raised, subparallel with the frontal ridge.

Pronotum slightly constricted at the principal transverse sulcus, then somewhat expanded in the metazona. Pro- and metazona about equal in length. Medial pronotal carina absent in the prozona, weak in the metazona. Lateral pronotal carinae absent, but a clearly defined angle between the disc and lateral lobes is seen, especially in the metazona. Transverse sulci well defined, the most posterior sulcus being the deepest, always cutting the median carina. The anterior sulci may or may not do so. Anterior margin of the pronotal disc slightly convex, often somewhat embayed in the midline; posterior margin produced rearwards, angulate, right-angular or slightly obtuse angled. Lateral lobes narrowing downwards, proepisternum large and triangular, prosternal tubercle strong, wide at its base, subconical, blunt at its tip. Mesosternal interspace wider than long; metasternal lobes contiguous. Fore and middle legs rather gracile, the femora of the latter with a slight dorsal carina. Hind femora strong, with well marked dorsal carinae; hind tibiae with 9-10 internal spines and 8-9 external ones, no external apical spine. Wings and elytra fully developed, exceeding the hind knees in length (except in *B. talamancensis*, which is brachypterous).

Male cerci wide basally, slightly upwards curving in their basal two thirds, the apical third somewhat compressed and expanded, curving downwards and ending in a point. Furcula small or completely absent; supra-anal plate subrhombic with a rounded tip, often divided at mid length by a transverse ridge (**Fig. M4**). Ovipositor valves robust, curved and pointed at their tips.

I. Baeacris morosa (Rehn 1905)

Rehn 1905a: 442, *Dichroplus morosus*.

Type locality: COSTA RICA: Prov. S. José, Monte Redondo.

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *morosus*, miserable, presumably a reference to the drab colours or perhaps the cool foggy environment! Rehn remarks that the coloration is much duller than that of *Dichroplus punctulatus* (now *Baeacris punctulata*).

Subsequent literature.

- Rehn, J.A.G. 1905b: 285. > As *Dichroplus morosus*.
- Kirby, W.F. 1910: 489. > As *Trigonophymus morosus*.
- Hebard, M. 1923: 285. > Synonymizes with *Dichroplus punctulatus* (Thunberg).
- Carbonell, C.S. & Ronderos, R.A. 1973: 374. > As *Dichroplus morosus*, restored from synonymy.
- King, A.B.S. & Saunders, J.L. 1982: 95. Bionomics, biology, chemical control.
- Ronderos, R.A. & Cigliano, M.M. 1991: 176. > Transfers to *Baeacris*, together with rest of the punctulatus group of *Dichroplus*.

Diagnosis.

Habitus **Fig. M3, Plate M2**. As generic diagnosis. Furcula absent. Quite small; (L-male [frons-subgenital plate]) = 15.4 mm, F = 9.44 mm).

Field characters.

Prominent red hind tibia and feet, rest of animal cryptically coloured, mottled brown and pale grey-yellow. Lower inner surface of hind femur red. Rather short antennae.

Distribution.

Costa Rica, extreme Western Panama. In Costa Rica found in the Cordillera de Tilarán, the Cordillera Central and the hills surrounding the Meseta Central, and along the southwest foothills of the Talamanca range. In Panama known only from the highlands of Chiriquí Province adjoining Costa Rica. **Map M2**.

Natural history.

Sporadic in cattle pasture derived from montane forest at around 1100 m altitude, but never very common. King and Saunders (1982) describe it as an occasional pest of beans and maize within its area of distribution.

COPR (1982) cites the *D. punctulatus* group in general (as defined by Carbonell & Ronderos [1973]) as being of actual or potential pest status in Argentina, Brazil and Uruguay, mostly in pasture lands.

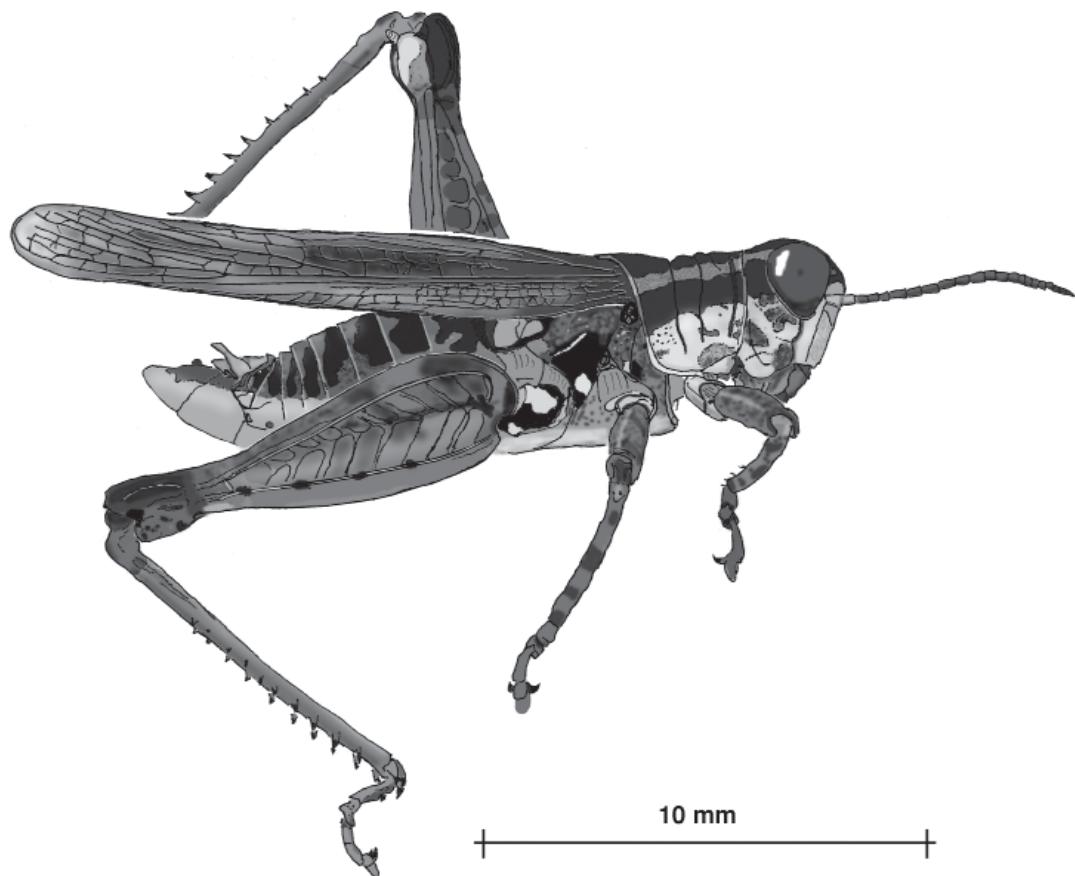


Fig. M3. *Baeacris morosa*. Male habitus.

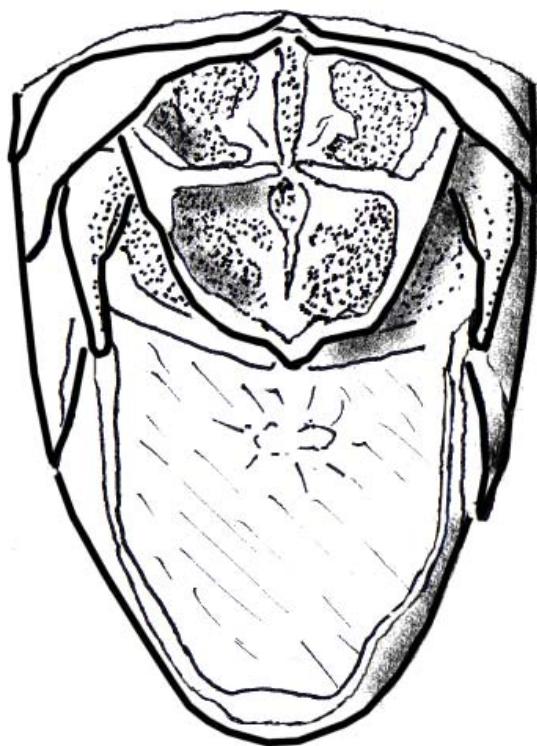


Fig. M4. *Baeacris morosa*. Male terminalia, dorsal view. Note transverse ridge dividing the supra-anal plate, and the extensive pallium.

2. *Baeacris talamanicensis* Rowell & Carbonell 1977

Rowell & Carbonell 1977: 58.

Type locality: COSTA RICA: Prov. S. José, Cerro de la Muerte, 3490 m.

Location of type specimen: ANS Philadelphia.

Etymology.

From the type locality, the Talamanca range of southern Costa Rica.

Diagnosis.

Habitus **Fig. M5, Plate M3.** The only brachypterous member of the genus, tegmina reaching almost to the middle of the abdomen (posterior margin of 3rd or 4th abdominal segment). Frontal ridge separated from fastigium by a small transverse ridge, prominent between the eyes, widening gradually to the medial ocellus, then more markedly to the clypeal suture. Fastigium with a marked longitudinal excavation from interocular space to the anterior transverse ridge at boundary with frons, bounded laterally by two raised carinae that converge slightly to the rear. Furculae vestigial or absent, paraprocts large and conspicuous, cerci typical for the genus. Pallium dark reddish brown. Hind tibiae brownish basally, orange red distally.

Field characters.

Small (L_{male} = 13.2 mm, F_{male} = 7.8 mm). Very cryptic in the mixture of coarse rocky soil, lichen and dry vegetation which it inhabits, being blotched brown, blackish grey and greenish yellow. It has reddish inner surfaces to the hind femora, like many other melanoplines. Can be agile in hot sunshine, but more usually quiescent in its often cold foggy environment, and then very difficult to find.

Distribution.

High mountains of Costa Rica. The only acridid grasshopper found in its high Alpine habitat, on dry paramó above 3000 m, sometimes quite commonly. Recorded from the Cerro de la Muerte and from Chirripo Grande, and probably occurs on other high peaks in the Talamanca range.

Map M2.**Natural history.**

Apparently geophilous. Has been seen to eat both grass and lichens; otherwise nothing is known of the life of this species. Unlike most Costa Rican grasshoppers, it seems to be most common in the dry season of January to March, and copulations are to date recorded only from this period.

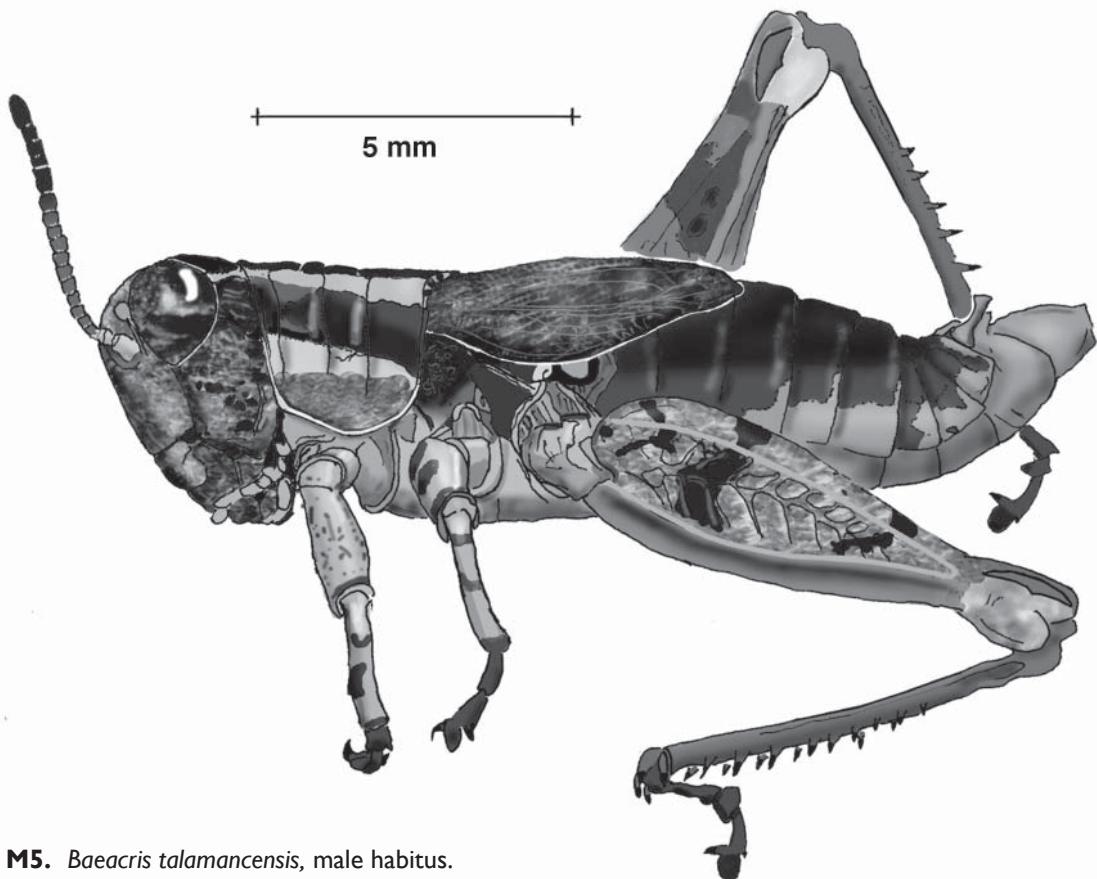


Fig. M5. *Baeacris talamancensis*, male habitus.

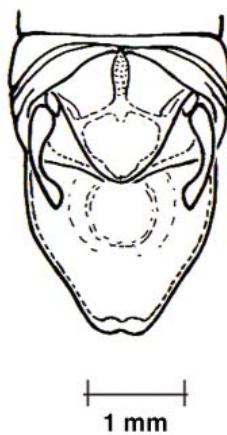
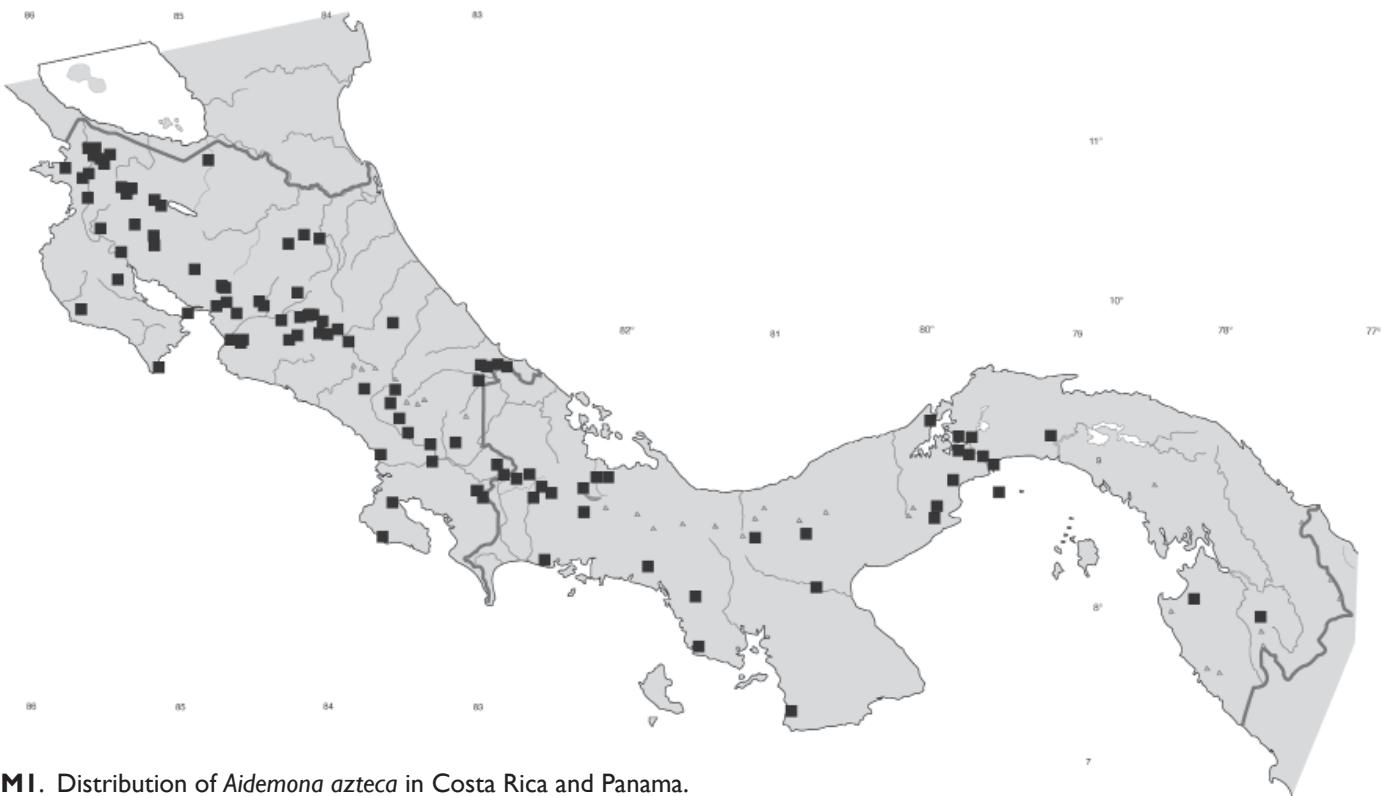
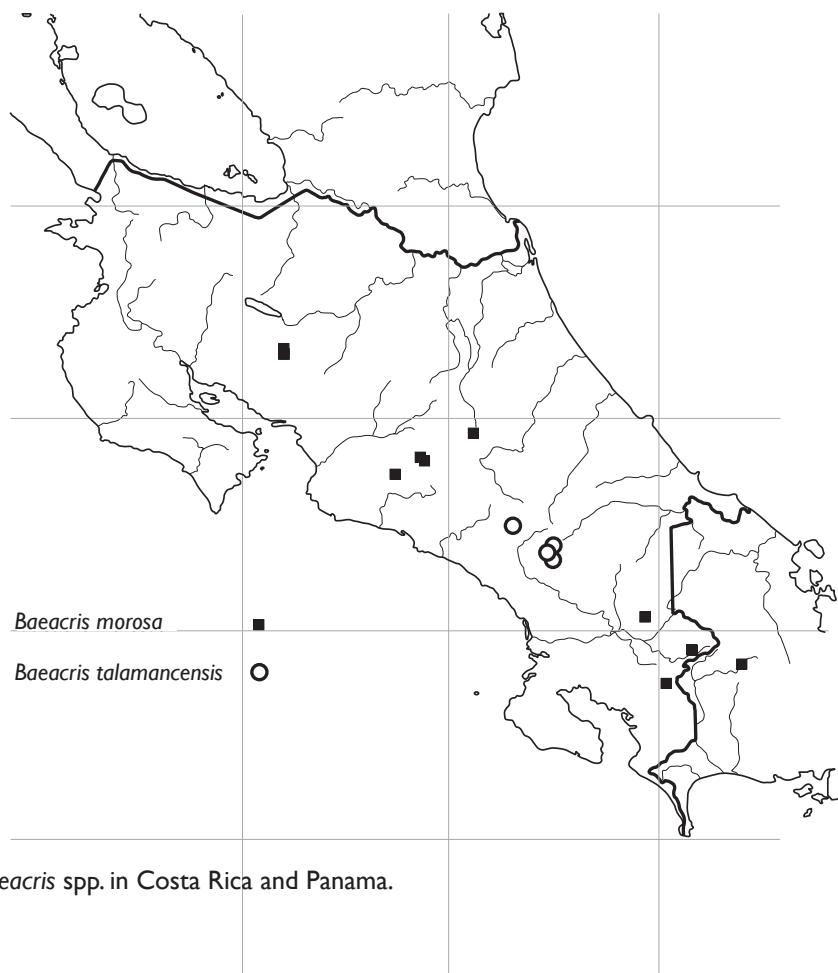


Fig. M6. *Baeacris talamancensis*. Male terminalia, dorsal view (from Rowell & Carbonell 1977).



Map M1. Distribution of *Aidemona azteca* in Costa Rica and Panama.



Map M2. Distribution of *Baeacris* spp. in Costa Rica and Panama.

Subfamily Oedipodinae

Walker 1871

Type genus: *Oedipoda* Latreille 1829. (The oldest genus in the subfamily is actually *Locusta* Linn 1758, but this name and its derivate Locustinae have been so confusingly employed in the older literature that *Oedipoda* is now used as the type instead).

Subsequent literature.

- Walker, F. 1871.
- Saussure, H. de 1884: 1-256.
- Slifer, E.H. 1939: 437-470. > Female genitalia.
- Dirsh, V.M. 1956.
- Dirsh, V.M. 1961.
- Uvarov, B.P. 1966: 415.
- Dirsh, V.M. 1975: 152.
- Otte, D. 1983.

The Oedipodinae are a large subfamily (currently 122 genera, 841 spp.) of almost world-wide distribution, especially diverse and common in the warmer parts of the Old World but also very well developed in North America. Considered as a whole, they are a diverse group, including not only the well-known geophilous “band-wings” of mostly dry habitats but also, especially in the Old World, a variety of slim, swamp dwelling forms (such as *Aiolopus*, *Paracinema* or *Mecostethus*). The subfamily also contains the notorious locust species *Locusta migratoria* and *Locustana pardulina* and other grasshoppers of agricultural importance, such as the *Oedaleus* spp. of West Africa or *Astroicetes* spp. of Australia. Most oedipodines are found in habitats in which grasses are either dominant or at least well represented, and many eat grasses either solely or as part of their diet. The geophilous forms are well known for their developmental ability to match in colour the background on which they live (homochromy), a process experimentally studied in e.g. the African taxa *Locustana* (Fauré 1923) and *Gastrimargus* (Rowell 1970, 1971). As a consequence, they are very variably and usually cryptically coloured, except for the hind wings and the hind tibiae, which are often invariably and diagnostically patterned and thus important in identification.

Diagnosis.

Morphologically, the Oedipodinae comprise the third acridid subfamily in our area (the other two being the Acridinae and the Gomphocerinae) that is devoid of a prosternal spine or tubercle. They also resemble these two subfamilies in the general form of the male phallic complex, at least of its sclerotized elements; Eades (2000) however notes that the membranous ventral fold of the phallus is uniquely formed in the Oedipodinae, and may be an apomorphy of the subfamily. Some molecular systematic analyses (see e.g. Rowell & Flook 1998) suggest however that the three subfamilies are not closely related, in which case the morphological resemblances are convergent; these analyses also suggest that the Oedipodinae are a very early branch of the acridid grasshoppers (see also Gaunt & Miles 2002, Rowell & Flook 2006). The classical defining feature of the Oedipodinae is their stridulatory

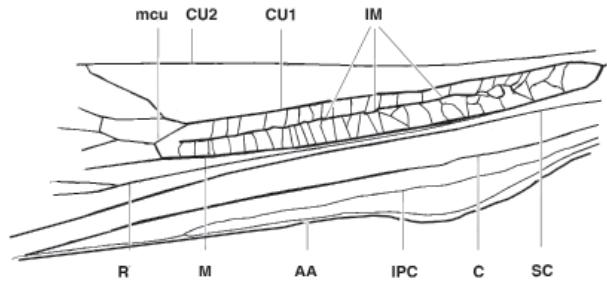


Fig. Oe1. The intercalary vein of the medial area in Oedipodinae. Side view of proximal ventral margin of the folded elytron in *Chortophaga*. The lowest line represents the leading edge of the wing. The wing base is to the right, the wing tip to the left. The main longitudinal veins are indicated and named according to the scheme of Ragge (1955). The intercalary vein of the medial area (**IM**) is seen as a local specialisation of the archedictyon, or network of small cross-veins, that covers the wing. Abbreviations: **R**, radius; **M**, media; **AA**, anterior ambient vein; **IPC**, intercalary vein of precostal area; **C**, costa; **SC**, subcosta; **CU1**, **CU2**, first and second branches of the cubitus; **mcu**, cross-vein between cubitus and media, closing the cell of the medial area. In the Oedipodinae IM is usually present and often serrated, functioning as a stridulatory organ.

apparatus, consisting of a more or less serrated intercalary vein lying in the cell formed between the media and 1st cubitus veins of the elytron (Fig. Oe1), that is contacted by a sharpened ridge on the inner surface of the hind femur. Unfortunately for taxonomists, this structure, like the diagnostic femoral stridulatory file of the Gomphocerinae (q.v.), is sometimes lost. One of our local genera, *Heliastus*, is a case in point.

In most species the frons is more or less vertical and often slightly convex, and the hind femur is powerfully developed and wide dorsoventrally (hence the name *Oedipoda*, literally “thick leg”), though thin laterally. The hind wings are frequently brightly coloured, often with a darker peripheral band. The rim of the abdominal tympanum is usually thickened, forming a funnel-shaped cuticular meatus.

Other important taxonomic characters are often taken to be the profile of the pronotum and the details of the fastigial foveolae. Most Oedipodines, and all those occurring in our region, are fully winged.

In the Neotropics the Oedipodinae are very poorly represented. In our area there are only 4 genera, each represented by only a single species, and these are easily separated by obvious differences in coloration. Three of them are of the “band-wing” type, cryptically coloured geophilous grasshoppers with coloured hind wings, characteristic of dry areas with little or only patchy vegetation, such as river banks, beaches, land-slip areas, unsurfaced roads, or overgrazed dry pasture. The other one, *Chortophaga viridifasciata*, is found at high altitude in wet montane meadows and swampy areas.

Tribe Chortophagini Otte 1995

Otte, D. 1995, OSF Vol 5: 334.
Otte, D. 1983: 68 (as Chortophaga genus group).

Diagnosis.

(After Otte 1984). Hindwings (**Fig. Oe3**) lack dark coloration or a distinctly defined dark band; leading edge of hindwing has a dark thickened region; forewings have 1-3 distinctive dark bands along the leading edge (but indistinct in *C. viridifasciata* and *C. mendocino*); hind tibia mostly blue (but not in *C. viridifasciata*).

No. included genera.

Four, all basically North American. In our area, 1.

Tribal range.

S. Canada to Costa Rica.

Chortophaga Saussure 1884

Saussure 1884: 72.

Type species: *Acridium viridifasciatum* DeGeer, 1773, by monotypy.

Subsequent literature.

- Scudder, S.H. 1897: 33.
- Kirby W.F. 1910: 198.
- Amedegnato, C. 1974: 202.
- Otte, D. 1984: 70, 308.
- Otte, D. 1995: 335.
- Brust, M.L., Hoback, W.W. & Wright, R.L. 2008: 101.

Synonymy.

=*Tragocephala* Harris (name preoccupied by *Tragocephala* Dupont), synon. Scudder 1875c: 80.

Etymology.

Greek *chortos*, grass; *phagein*, to eat: "grass eater".

The generic names *Tragocephala* and *Chimarocephala*, previously applied to this genus, both translate as "goat head"; the basis for these names eludes me.

Diagnosis.

(After Otte 1983). Fastigium strongly triangulate and flat. Distance between frons and front edge of eyes relatively large. Forewings scarcely banded. Frontal ridge deeply grooved. Median carina of pronotum present, cut shallowly or deeply by sulcus.

No. of known species.

Four. In our area, one.

Generic range.

S. Canada to Costa Rica, Cuba.

Chortophaga viridifasciata (DeGeer 1773).

Acridium viridifasciatum DeGeer 1773, Mem. Ins. 3: 498.

Type locality: USA, Pennsylvania.

Location of type specimen: Naturhistoriska Riksmuseet, Stockholm, holotype female.

Subsequent literature.

- Goeze 1778: 115. > Transfers to *Gryllus*.
- Harris, T.W. 1835: 56. > Transfers to *Locusta (Tragocephala)*.
- Scudder, S.H. 1862: 461. > Transfers to *Tragocephala*.
- Walker, F. 1870: 786.
- Thomas, J.G. 1873: 103
- Scudder, S.H. 1876: 508. > Transfers to *Chimarocephala*.
- Saussure, H. de 1884: 73. > Transfers to *Chortophaga*.
- Kirby, W.F. 1910: 199.
- Capinera & Sechrist 1982: 83.
- Otte, D. 1984: 72 & 315.
- Pfadt 1994. > Feeding habits, general biology, development.
- Otte, D. 1995: 334.
- Capinera, J.L., Scott, R.D. & Walker, T.J. 2004: 82, Plate 10.

Synonymy.

=*Acridium marginatum* Olivier 1791: 229, synon. Thomas 1873: 103.

=*Acridium hemipterum* Beauvois 1805-1820: 145, synon. Thomas 1873: 103.

=*Gryllus virginianus* Fabricius 1793: 57, synon. Thomas 1873: 103.

=*Gryllus chrysomelas* Gmelin 1788: 2086, synon. Thomas 1873: 103.

=*Tomonotus zimmermanni* Saussure 1861: 159, synon. Saussure 1884: 73.

=*Locusta (Tragocephala) infuscata* Harris 1841: 148, synon. Scudder 1875: 80.

=*C. meridionalis* Bruner 1900-1910 (1905): 136, synon. Otte 1984: 315.

Etymology.

Latin *viridis*, green; *fascia*, stripe or zone: green striped.

Diagnosis.

(After Otte 1983). Habitus **Fig. Oe2, Plate Oe1**.

Posterior margin of pronotal disc strongly acute-angulate. Lateral field of elytron without a strong dark marking directly above base of hind femur. Upper face of hind femur not strongly banded, and without a strong triangular dark mark in central part. Frontal ridge not concave at level of antenna. Hind tibiae usually brown.

These characters principally distinguish *viridifasciata* from other species of its genus, which, however, are not present in our area.

Ten external and nine internal tibia spines.

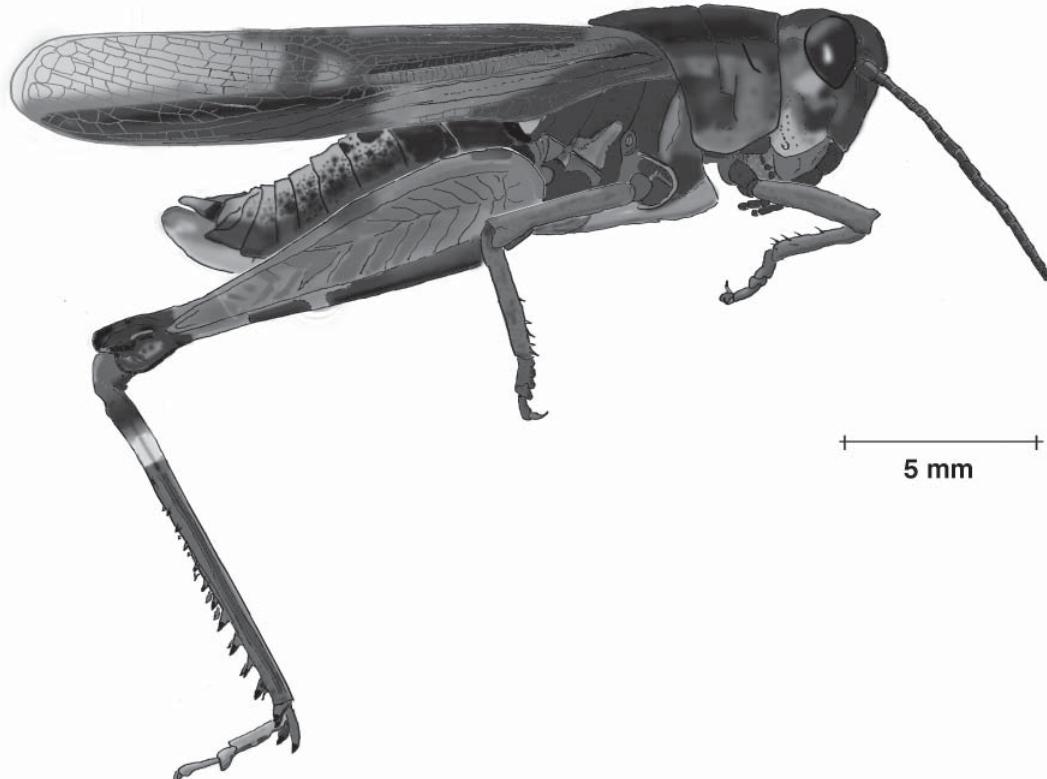
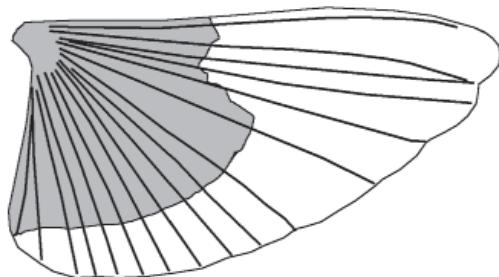


Fig. Oe2. *Chortophaga viridifasciata*, male habitus..



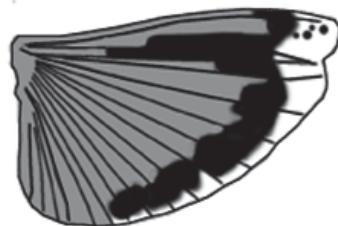
Heliaustus sumichrasti



Lactista straminea



Chortophaga viridifasciata



Leuronotina orizibae

Fig. Oe3. The gross colour pattern of the hind wings of Central American oedipodines. Grey areas correspond to red or pink in life, black to black, and white to clear or (in *Lactista* and *Chortophaga*) very pale yellow. The large “black” area shown for *Chortophaga* is actually only a pale translucent grey, the wing is not banded with black in this taxon..

Coloration.

Green/brown polymorphic; in the highlands of Costa Rica the green form predominates among females, whereas most males are brown. Inside of hind femur with dark brown bands on especially the lower part of the internal face, extending across internal and external ventral faces, but leaving the pregenicular area clear; hind tibia brown, with a diffuse post-genicular pale ring. Hind wing pale yellowish green at base, grey-brown in centre, clearing towards the edge; no well-defined peripheral dark band (**Fig. Oe3**).

Field characters.

The only oedipodine found in the high montane region of Costa Rica. The prominent medial pronotal carina and sharply angular posterior margin of the pronotum are distinctive.

Distribution.

South-eastern Canada; Central and Eastern USA, excluding Florida; Eastern Mexico; highland Guatemala; highland Costa Rica. Not yet recorded from Panama, but may be present in the highlands of the extreme West. In Costa Rica, occurs in moist grassy places above 2000 m on both the Northern and Southern margins of the Meseta Central. **Map Oe1.**

Natural history.

Throughout its large geographical range associated with short moist grass. Will eat forbs, but principally a grass feeder in the USA (Capinera & Sechrist 1982, and references therein). Often abundant in cattle pasture on the higher southern slopes of the volcanoes of the Costa Rican Cordillera Central. Also occurs in pasture and along mown road verges on the north end of the Talamanca range, and in the natural *Blechnum/Puya* swamps of that area. Confined to the cloud forest zone where the climate is damp, cool and misty.

Tribe Hippiscini

Hebard 1928

Hebard 1928: 236 (as group Hippisci).

Otte 1984: 92. As Hippiscus genus group. Adds the genera *Heliastus* and *Hadrotettix*.

Otte 1995: 348 (as Hippiscini).

No. of included genera.

Ten. In our area, one.

Diagnosis.

None given by author.

Tribal range.

Alaska and Canada to Chile and Brazil. Only *Heliastus*

is Neotropical, the remaining genera of the group are North American.

Heliastus

Saussure 1884

Saussure 1884: 212.

Type species: *Heliastus sumichrasti* (Saussure), designated by Rehn 1904b.

Etymology.

Probably from Greek *helios*, sun and *-aster*, astrum, a Latin diminutive suffix; “little sun”, possibly referring to the bright colour of the hind wings? (in the Mexican type specimens, these are golden yellow).

Subsequent literature.

- Bruner, L. 1905: 188.
- Amedegnato, C. 1974: 202.
- Otte, D. 1984: 128 & 309.
- Otte, D. 1995: 351.

Diagnosis.

Intercalary vein of elytron absent. Fastigium narrow and smooth; pronotal disc smooth. Hind tibiae banded successively with ivory, black, and red, reading from proximal to distal end. Posterior margin of pronotum obtusely angulate, the tip slightly rounded.

No. of species.

Nine. In our area, one.

Generic Range.

USA to Colombia and Venezuela, possibly to Chile and Brazil.

***Heliastus sumichrasti* (Saussure 1861).**

Oedipoda sumichrasti Saussure 1861: 324.

Type locality: Mexico.

Of neotype (designated by Otte 1984: 321): MEXICO:, Tamaulipas, Tampico.

Location of type specimen: Syntypes in MHN Geneva. Of neotype: ANS Philadelphia.

Etymology.

Named for F. Sumichrast (1828-1882), a Swiss naturalist and collector who accompanied H. de Saussure as his scientific assistant on his collecting trip to Mexico 1854-56. He made his subsequent home in Chiapas, Mexico, and worked principally on reptiles and birds (Hollier & Hollier 2012).

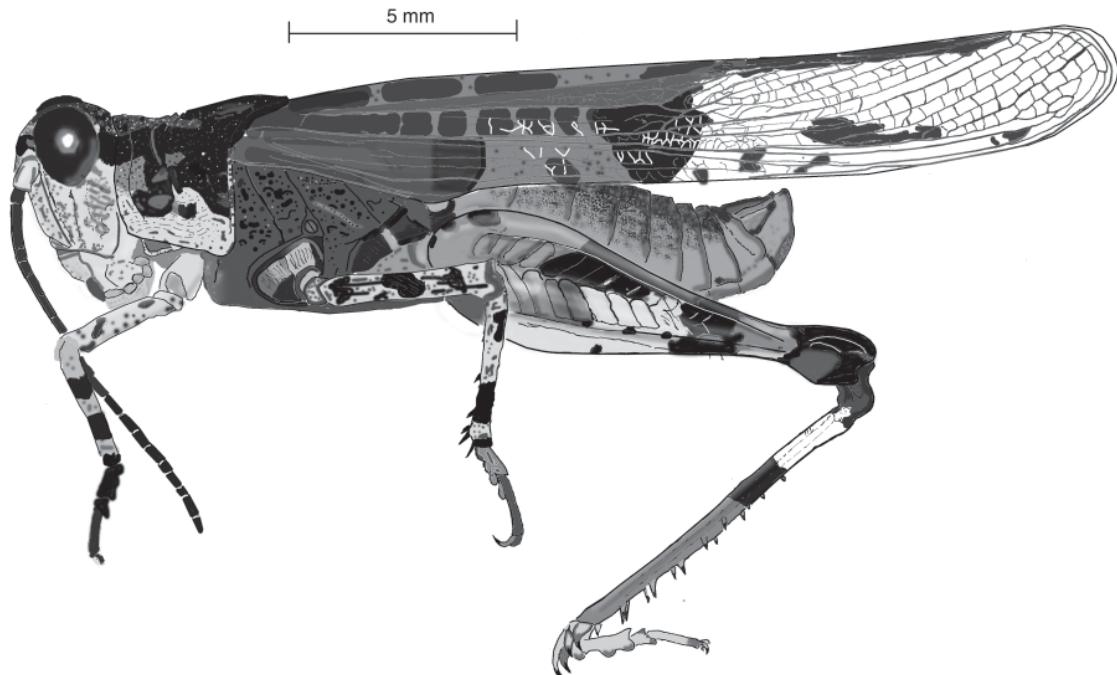


Fig. Oe. 4. *Heliastus* habitus. See also **Plate Oe2**.

Subsequent literature.

- Walker, F. 1870: 733.
- Thomas, J.G. 1873: 214.
- Saussure, H. de 1884: 28. > transfers to *Heliastus*.
- Bruner, L. 1900-1910 (1905): 188.
- Kirby, W.F. 1910: 270.
- Hebard, M. 1924a: 99 (as *H. venezuelae*).
- Otte, D. 1984: 131 & 321.
- Otte, D. 1995: 351.

Synonymy.

- =*Oedipoda speciosa* Walker 1870: 735, syn. Kirby 1910: 270.
- =*Oedipoda tentatrix* Walker 1871: 74, syn. Kirby 1910: 270.
- =*H. costaricensis* Rehn 1905: 402, synon. Otte 1984: 322.
- =*H. venezuelae* Saussure 1884: 213, synon. Otte 1984: 322.
- =*H. guatemalae* Saussure 1888: 91, synon. Otte 1984: 322.

Diagnosis.

Habitus **Fig. Oe4, Plate Oe2**. As the only species of the genus in our area, the generic diagnosis applies. Very prone to background homochromy, ground colour varies from greyish white (on sand) to black or dark red brown (on appropriate soils). The only local oedipodine with red hind wings and red hind tibiae. The hind wings are coloured only proximally, the distal areas are clear, with no dark peripheral band (**Fig. Oe3**).

Field characters.

The basally red hind wings are conspicuous in flight. Outside of our area this species is more variable in coloration, with hind wings yellow or orange as well as red. Internal face of hind femur with two prominent dark bands and a black knee.

Distribution.

USA (Texas), Mexico, all the Central American countries, Colombia, Venezuela. In Costa Rica and Panama found in suitable places, especially on sandy shores, throughout both countries. Does not occur much above about 1000 m. (**Map Oe2**). Commoner on the Pacific watershed, probably due to the drier climate and higher human population density, both of which tend to produce bare ground.

Natural history.

The commonest and most widely distributed oedipodine in our area. Found on bare earth, such as dry river beds, sandy shores, unsurfaced roads and paths, cultivated fields or overgrazed pasture. For remarks on sexual behaviour see Otte 1984.

Tribe Arphiini Otte 1995

Otte 1984: 28, as *Arphia* genus group.
Otte 1995: 322.

Diagnosis.

(After Otte 1984). Transverse groove of fastigum located posteriorly. Pronotal crest cut by one sulcus. Body brown to blackish. Forewings with or without dark cross-bands, sometimes uniformly brown or grey. Male epiphallus with posterior lobes more or less unilobate. Hind tibiae rarely orange or red, mostly bluish, sometimes brown or black, often banded with black.

No. of included genera.

Four. In our area, two.

Tribal range.

Alaska to northern South America. Most taxa are found in the USA and Mexico.

Lactista
Saussure 1884

Saussure 1884: 142.

Type species: *Oedipoda punctata* Stål 1873: 130 (designated Rehn 1904).

Type locality: Mexico (no further data).

Location of type specimen: Stockholm Museum.

Subsequent literature.

- Rehn, J.A.G. 1904: 562. > designation of type species.
- Amedegnato, C. 1974: 202.
- Otte, D. 1984: 60, 309.
- Ortega & Marquez, M.C. 1987: 45. > Key to species.
- Otte, D. 1995: 326.

Synonymy.

=*Platylactista* Hebard 1932: 201, synon. Otte 1984: 309.

Etymology.

Greek *laktistes*, a kicker (NB, a masculine noun).

Diagnosis.

Filiform antennae. Medial carina of pronotum low and flat. Frontal ridge smooth, not grooved. Forewings banded with blackish. Hindwings with characteristic black patterning (see

Fig. Oe3) with a clear tip. Hind femur tapering smoothly distally to the knee (contrasts with *Leuronotina*).

No. of species.

Nine. In our region, one or possibly two.

Generic range.

USA to Costa Rica, Venezuela, Dutch Antilles.

I. Lactista pellepidus Saussure 1884

Saussure 1884: 144.

Type locality: MEXICO: Yucatán, Valladolid (of lectotype male, selected by C.S. Carbonell, designated by Otte 1984: 323).

Location of type specimen (lectotype): MHN Geneva.

Subsequent literature.

- Bruner, L. 1900-1910 (1905): 169.
- Kirby W.F. 1910: 327.
- Otte, D. 1984: 64 & 323. > Designates lectotype.
- Otte, D. 1995: 326.

Etymology.

Greek *pellos*, dusky; *podus*, possibly a corruption of the latin *pes*, *pedis*, foot?

Diagnosis.

(After Otte 1984). Distinguished from the otherwise identical *L. stramineus* by colour of hind tibiae and of hind wings; in *pellepidus* hind tibiae are pale blue throughout most of their length, in *stramineus* (see below) they are grey grading into yellowish, with ivory and black bands. Hind wings of *pellepidus* are noticeably yellow in basal area; in *stramineus* they are clear or very pale greenish or yellowish.

Comment - potential synonymy.

Otte (1984: 60) considers it possible that *pellepidus* is conspecific with *stramineus*. The differences (above) are indeed very small and only in coloration. In this case the name *pellepidus* would be a junior synonym.

Field characters.

Not distinguishable in the field from *L. stramineus*, q.v., unless the colour of the hind tibiae can be seen.

Distribution.

Mexico (Yucatán), El Salvador. Possibly Costa Rica? The evidence for its occurrence in our region is the existence of two specimens in the collection of the ANSP with what appear to be Costa Rican labels, but without further data. It has not otherwise been seen in our region.

Natural history.

Unknown.

2. Lactista stramineus (Erichson 1848)

Oedipoda straminea Erichson 1848: 582.

Type locality: GUYANA, no other details.

Location of type specimen: syntypes in ZMB, Berlin..

Subsequent literature.

- Saussure, H. de 1884: 28. > As *Trimerotropis pallidipennis*.
- Kirby, W.F. 1910: 258. > As *Pseudotrimerotropis pallidipennis*.
- Caudell, A.N. 1911: 158. > As *Trimerotropis pallidipennis*.
- Rehn, J.A.G. 1939: 401. > Transfers to *Lactista*.
- Otte, D. 1984: 64 & 32

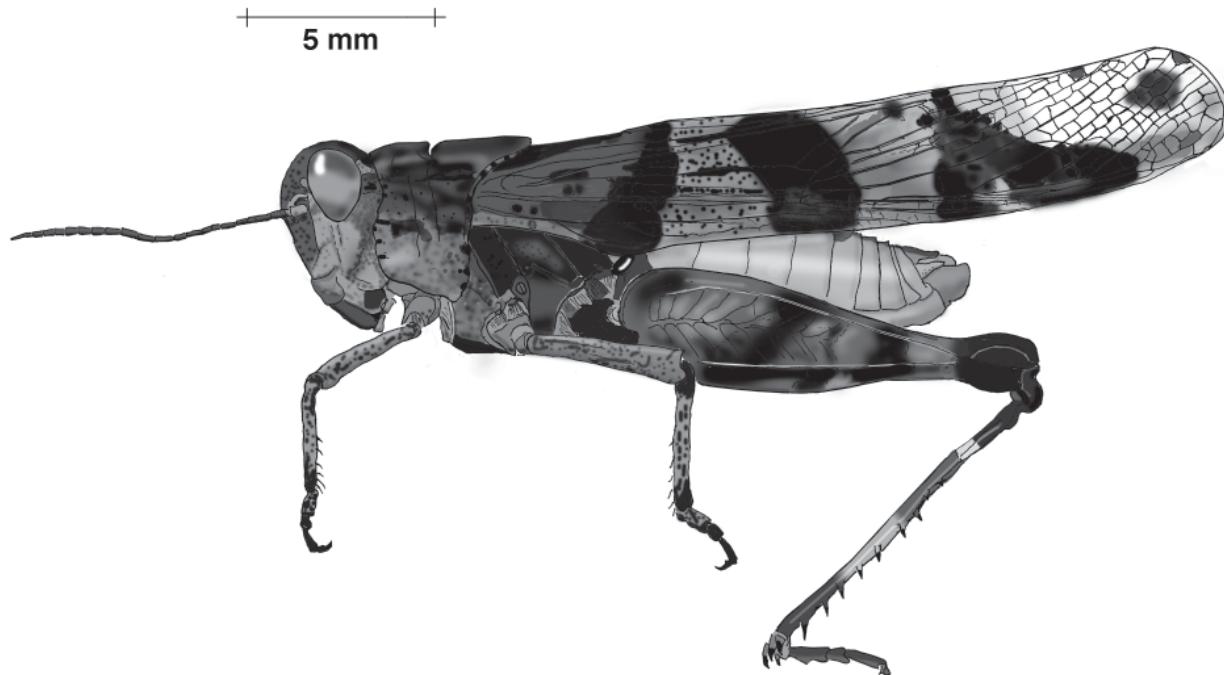


Fig. Oe5. *Lactista stramineus*, male habitus.

Synonymy.

=*L. pulchripennis* Saussure 1884: 144, synon. Rehn 1940: 401.
=*L. australis* Bruner 1913: 457 (synon. with *L. pulchripennis* by
Hebard 1923), synon. Otte 1984: 323.
=*L. punctatus* (Stål) of Rehn 1905: 402 (misidentification).

Etymology.

Latin *stramineus*, of straw.

Diagnosis.

Habitus **Fig. Oe5, Plate Oe3**. Pronotal lobe with a small tooth at the posterior ventral corner and a somewhat sinuous ventral margin. Basal area of hind wing very pale green or yellow; for dark patterning of wing, see **Fig. Oe3**. Hind tibia dark grey below the knee, banded proximally with black, then ivory, then black, then yellowish or greenish, then blackish distally. Inner face of hind femur black, crossed by two pale bands and with a pale patch dorsally and proximally.

Field characters.

Very pale yellow hind wings, visible in flight. Forewings clearly banded with black, especially in proximal half. Both sexes, but especially the males, noticeably more slender than those of *Helastus*.

Distribution.

Mexico (Yucatan, Quintana Roo and Vera Cruz), Honduras, Costa Rica, Panama, Colombia (Magdalena, Cundinamarca), Venezuela (Bolívar), Aruba (Dutch West Indies), Guyana, Suriname.

In Costa Rica (**Map Oe3**) the species has a curiously disjunct distribution. It is common in the Pacific lowlands of Guanacaste and northern Puntarenas, extending up on to the southern and western parts of the Meseta Central as far East as S. José and as far south as Monte Redondo. It also occurs in the extreme south of the Caribbean watershed in the valleys of the Estrella and Sixaola. Apparently absent from the rest of the Caribbean watershed, and from the southwestern part of the Pacific slope.

In Panama the species appears to be rather local, and is much less widely distributed than *Helastus*, the only other Panamanian oedipodine. It has been recorded from the West of the country as far East as the Canal.

Natural history.

Usually found in stony or rocky places; where both species occur, *Helastus* is more likely to be on soil, *Lactista* on rocks. For courtship behaviour, see Otte (1979).

Leuronotina
Hebard 1932

Hebard 1932: 256.

Type species: *Oedipoda orizibae* Saussure, by original designation.

Subsequent literature.

- Hebard, M. 1932: 201.
- Amedegnato, C. 1974: 202.
- Otte, D. 1984: 53 & 309.

Etymology.

Greek *leuros*, smooth; *nitos*, back; Latin *-ina*, diminutive or feminine suffix. Possibly refers to the almost uninterrupted median carina of the pronotum.

Diagnosis.

(Otte 1983.) Disc of pronotum forms a concave depression immediately behind the principal sulcus. Fore wings spotted or rather dark, sometimes with cross bands. Hindwings pink or orange in basal area. Dark band on hindwings near the periphery with a long spur directed towards the base of the wing (**Fig. Oe3**). Hind femora bluish on inner face. Lower ridge on hind femora becomes suddenly narrower near the centre (**Fig. Oe6**); this character is especially useful in determining larval specimens, where wing characters are unavailable.

No. of included species.

Four. In our area, one.

Generic range.

USA to Costa Rica.

Leuronotina orizibae (Saussure 1884)

Oedipoda orizibae Saussure 1884: 97.

Type locality: MEXICO, Tescutlan, .

Location of type specimen: MHN Geneva.

Etymology.

Coming from Orizaba, Vera Cruz, Mexico.

Subsequent literature.

- Saussure, H. de 1884: 98. > Transfers to *Tomonotus*.
- Bruner, L. 1905: 170.
- Kirby, W.F. 1910: 237.
- Hebard, M. 1932: 256. > Transfers to *Leuronotina*.
- Otte, D. 1984: 55 & 324.

Diagnosis.

Habitus **Fig. Oe6**, **Plate Oe4**. As the only species of the genus in our region, the generic diagnosis applies.

Distinguished from other species of the genus by having fastigium wider than long; hind wings deep pink (or rarely colourless) with characteristic black patterning (**Fig. Oe3**); hind tibiae with a broad distal black band.

Overall colour light to dark grey-brown, heavily speckled with darker pigment. Frontal ridge never deeply grooved, sometimes quite flat, foveolate at junction with fastigium. Fastigium wider than long and with an undulating surface, including a low median carinula in the anterior part.

Pronotum: medial carina low, cut only by the principal sulcus. Disc of prozona strongly raised relative to concave anterior part of metazona. Lateral carinae deeply cut by transverse sulci. Disk rough with many tubercles; posterior margin acutely angular (i.e. less than 90°). Forewings usually with 2 or 3 dark crossbands. Hind femora with two indistinct dark bands in central two thirds, sometimes darker on upper face; lower carina becoming suddenly narrower between the second and last third; inner surface blue. Hind tibiae banded with black. Abdomen light brown, straw yellow or ivory yellow.

Field characters.

Distinguished from *Helastus* by pink, rather than red, hind wing, and the different black pattern, with a pink or transparent terminal patch (**Fig. Oe3**). In the hand the blue inner face of the hind femora, and its constricted lower edge, are distinctive. No red on hind tibiae.

Distribution.

Mexico (Vera Cruz, Jalisco, Michoacán), Guatemala, Nicaragua, Honduras, Costa Rica.

Rare and local in Costa Rica. Recorded from the southern edge of the Meseta Central at the start of the 20th century (Prov. S. José: Monte Redondo, Tablazo; Prov. Alajuela: Atenas), but in modern times only from over-grazed savannas in northern Guanacaste. Not recorded from Panama. **Map Oe4**.

Natural history.

Unknown.

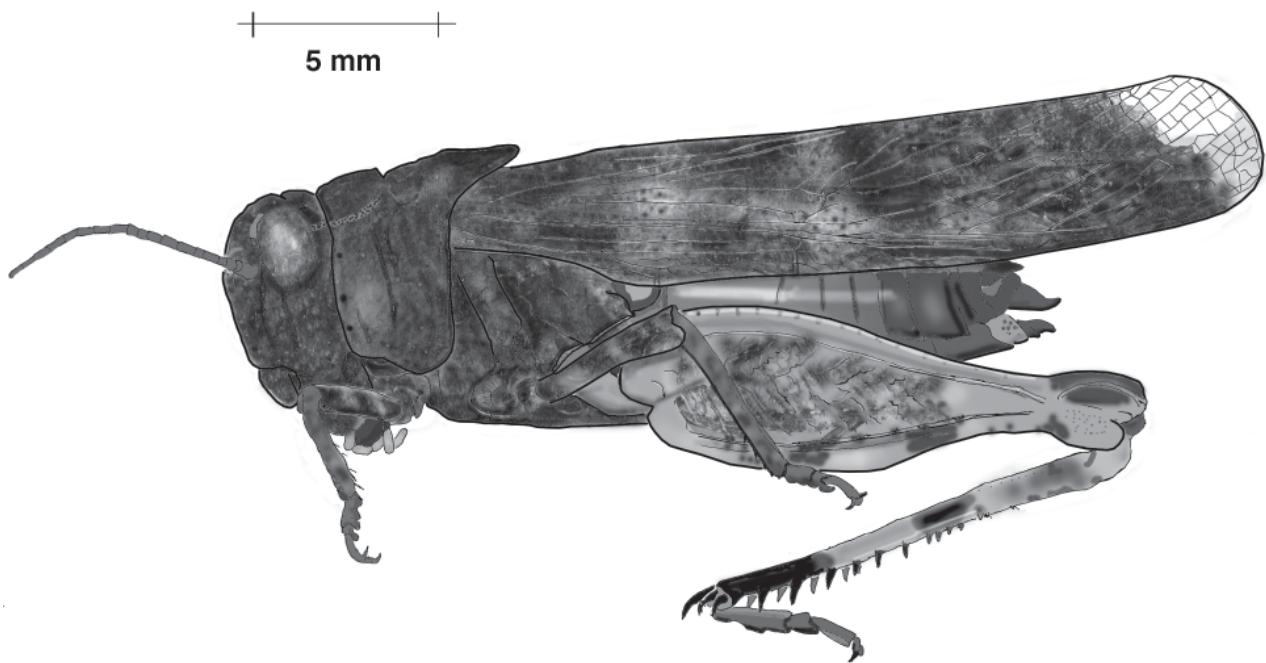
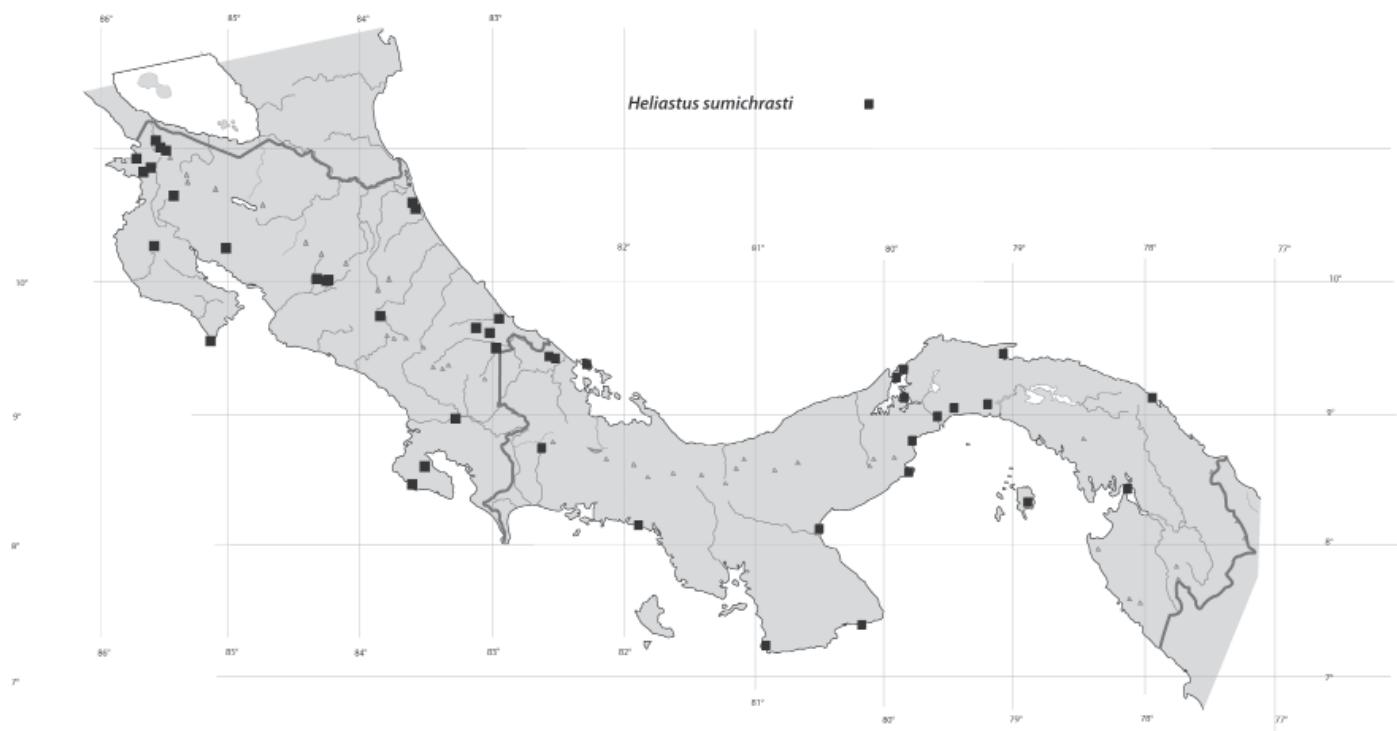


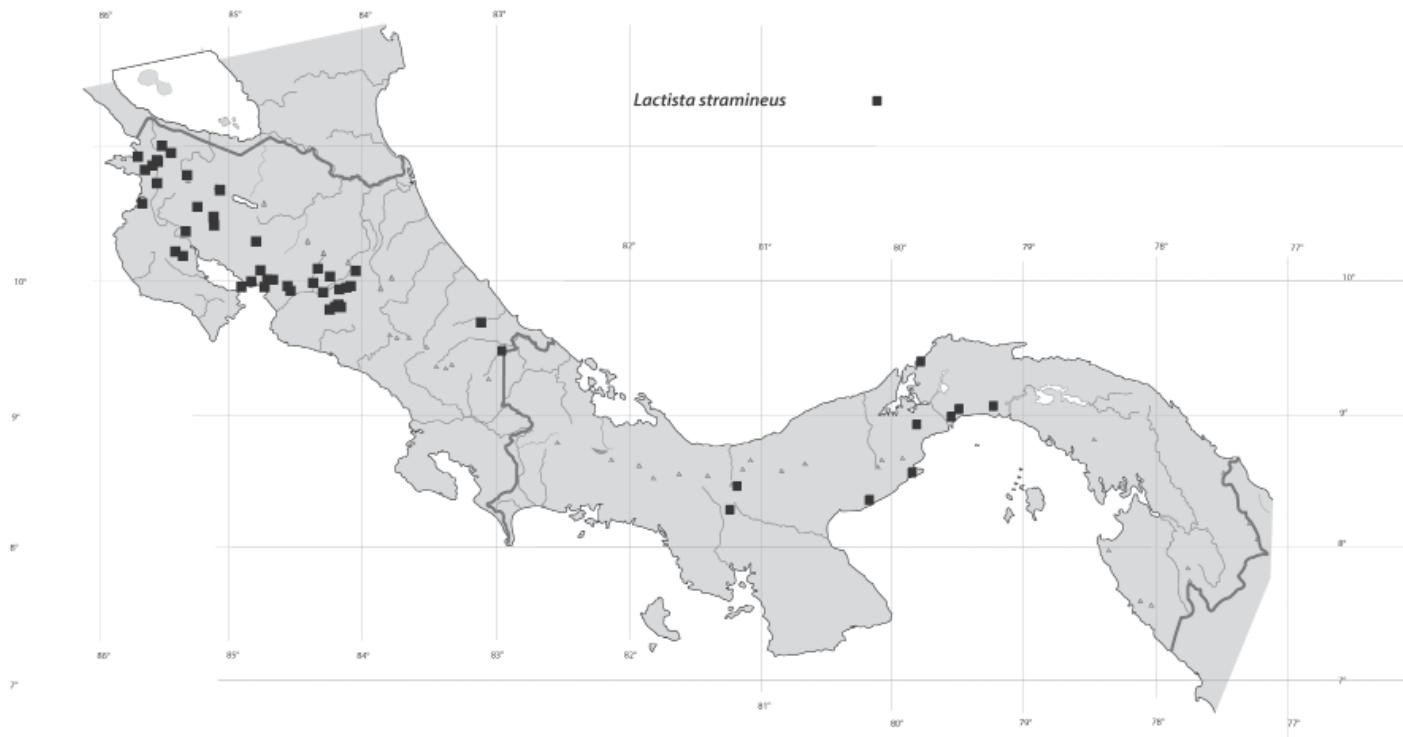
Fig. Oe 6. *Leuronotina* female habitus.



Map Oe1. Distribution of *Chortophaga viridifasciata* in Costa Rica.



Map Oe2. Distribution of *Heliastus sumichrasti* in Costa Rica and Panama..



Map Oe3. Distribution of *Lactista stramineus* in Costa Rica and Panama.



Map Oe4. Distribution of *Leuronotina orizibae* in Costa Rica.

Subfamily Ommatolampinae

Brunner von Wattenwyl 1893

Type genus *Ommatolampis* Burmeister 1838.

The Ommatolampinae are a large subfamily of the Acrididae, confined to South and Central America, with Mexico and the Greater Antilles, and were first raised to subfamily status by Amedegnato (1974, 1977). Currently about 100 genera are placed in this group. The subfamily is divided into seven tribes, four of which have Central American representatives, showing various amounts of differentiation from the South American forms.

Diagnosis.

The subfamily is only provisionally defined, and partly by negative characters. In essence, it comprises all Neotropical Acrididae which a) possess a prosternal spine or tubercle, b) have a simple spermatheca, usually with a small to medium-sized preapical diverticulum and c) do not have the defining features of the Rhytidochrotinae (short pronotum, reduced aedeagus) or the Leptysminae (vertically hooked male cerci, flattened and expanded hind femora).

Defined in this way the subfamily contains several well-characterised tribes; it is however uncertain how and to what extent these are related to each other. There are also a number of problematic genera (especially in the Antilles) that do not easily fit into the established tribes. It remains to be seen whether or not the Ommatolampinae as currently understood will prove to be a monophyletic group. Amedegnato's original treatment of the subfamily (1977) implies that it is paraphyletic with respect to at least the Rhytidochrotinae and the Leptysminae, which she sees as derivatives of primitive Ommatolampine stock, perhaps of the (exclusively S. American) tribe Aspidophymini (see also Amedegnato & Poulain 1998).

The subfamily is represented in our region by the following taxa:

OMMATOLAMPINI: VILERNAE

Cryptacris Descamps & Rowell 1978.
Leptomerinthoprora Rehn 1905.
Nicarchus Stål 1878.
Vilerna Stål 1873.

SYNTOMACRINI: CALOSCIRTAE

Ateliacris Descamps & Rowell 1978.
Microtylopteryx Rehn 1905.
Pseudanniceris Descamps 1977.

ABRACRINI

Abracris Walker 1870.
Omalotettix Bruner 1906.
Rhachicreagra Rehn 1905.

PAURACRINI

Christenacris Decamps & Rowell 1984.
Pauracris Descamps & Amedegnato 1972.

These genera are examined in more detail below.

Tribe Ommatolampini

Brunner von Wattenwyl 1893

- Brunner von Wattenwyl 1893: 139. (Also appears as Ommatolampidinae in the same work).
- Amedegnato 1974: 201.
- Amedegnato 1977: 143 et seq.
-

The Ommatolampini are the largest tribe of the subfamily, comprising about 50 genera. It was erected by Amedegnato (1974) and split by her (1977) into three subtribes: the Ommatolampae (revised by Carbonell & Descamps 1978), Oulenotacrae (revised by Descamps, 1979) and the Vilernae. Only the Vilernae are represented in Central America.

Diagnosis.

Because of its diversity the tribe is difficult to diagnose. The most characteristic external features are in the male abdominal terminalia. The margin of the 10th abdominal tergite is thickened, melanized and decorated with black projections, sometimes forming a furcula; the supra-anal plate is triangular and decorated with black callosities; the cercus usually has a black basal internal process, used during copulation to hold down the supra-anal plate. These characters also apply to many of the tribe Syntomacrini, but not to any of them found in Central America. The lateral carinae of the frontal ridge in the Ommatolampini are well-marked, but are weak in the Syntomacrini. The other distinctions between the two tribes are based on the internal genitalia.

Subtribe Vilernae

Brunner von Wattenwyl 1893

- Brunner von Wattenwyl 1893: 139.
- Amedegnato 1977: 143.
- Descamps & Amedegnato 1989a: 17 (footnote).

Diagnosis.

(* = applies in our area, but not necessarily elsewhere).

Usually rather squat shape*; fully winged to apterous; head strongly opistognath*; fastigium more or less produced as a rostrum; eyes protuberant, interocular space about half the width of the antennal scape; antennae rather short (except male *Cryptacris*), somewhat ensiform and with irregular segments (except *Leptomerinthoprora* and *Cryptacris*, where they

are filiform); lateral margins of frontal ridge prominent; medial carina of pronotum present, often well developed. Prosternal process low and wide with a small apical tubercle, or spiniform (*Nicarchus*); tympanum present*; posterior border of male 10th abdominal tergite decorated with melanic processes and/or a toothed furcula; supra-anal plate of male more or less triangular, decorated with melanic bosses; cerci conical, usually (but not in *Cryptacris*) with a well developed, sclerotized internal process. Hind tibia with 5-7 external spines, 7-9 internal ones.

Male genitalia: Lateroventral sclerites present, melanized apically, often terminating in a hook (but not in *Nicarchus* or *Cryptacris*); epiphallus large, with a narrow bridge and small lateral plates, posterior processes very well developed; ancorae well defined, pointed and sclerotized; lophi melanized; ectophallic sheath of aedeagus complex and extensively folded at the tip, often with a nodular projection behind the arch and before the terminal folds; endophallic apodemes laterally compressed, small; gonopore process digitiform, with no ventral expansion; middle part of endophallus long and narrow; flexure tending to be very fine; ventral sclerites sometimes bifid, usually combining with the ectophallic sheath to form a gutter around the dorsal aedeagal sclerites.

Female genitalia: Bursa copulatrix often with a semicircular sclerite near its base. The bursa itself is in two parts, the posterior part wide and membranous, the anterior narrower and thick walled, conical and curving laterally or posteriorly before giving rise to the rather short spermatophore duct; spermatheca sometimes with a preapical diverticulum (but not in *Vilerna*, *Leptomerinthoprora* or *Nicarchus*). Postvaginal sclerites with an irregular oblique row of small columellae (*Vilerna* and *Leptomerinthoprora*, **Figs Om4, Om11**) or none at all (*Nicarchus*, *Cryptacris*).

No. included genera.

Nineteen. In our area, four.

Subtribal range.

Mexico to Northern Argentina.

Natural history.

A diverse group of mostly forbivorous grasshoppers, but including other ways of life too. The four genera in our region differ ecologically; *Leptomerinthoprora* is forbivorous in light gaps in wet forests, *Vilerna* is geophilous at the edges of seasonally dry forests, whereas *Nicarchus* and *Cryptacris* live on mossy tree trunks or canopy branches in montane forest and are correspondingly camouflaged.

Cryptacris

Descamps & Rowell 1984

Type species: *Cryptacris costaricensis* Descamps & Rowell 1984: 146.

Subsequent literature.

- Descamps, M. & Amedegnato, C. 1989: 17. > Footnote.
- Rowell, C.H.F. 2008, 62. Redescription, including male allotype.

Etymology.

Greek *kryptos*, hidden, secret; *acris*, conventionally used for grasshopper. Refers to the cryptic coloration.

Diagnosis.

Small insects (L= 12-15 mm), male slender and hump-backed (**Fig. Om1**), female fusiform. Apterous. Tegument mostly smooth, some rugose areas on lobes of metazona of pronotum, mesothoracic epimeron, metathoracic episternum, and in the female on the expanded terga of the metathorax and 1st abdominal segment. Head rather short, rostrum present but not as developed as in many *Vilernae*, eyes globular and protuberant; interocular space narrower than antennal scape. Frontal ridge wider than interocular space, almost flat, obsolete below median ocellus. Frons concave in lateral view, tapering downwards in front view; lateral carinae of the face practically absent. Fastigium subtriangular, truncated at the tip; antennae filiform, short and thin in female, in male longer than head and pronotum together, thickening distally, 18-20 segments. Tips of palps flattened, darkly coloured.

Pronotum slightly saddle shaped in profile; without lateral carinae, but with a pair of lateral protuberances between the second and third sulcus, weak in the male; moderately incised in midline posteriorly; anterior ventral angle of lobe of pronotum sharp and outwardly reflexed, posterior angle bluntly rounded; prosternal process low, with an obtuse blunt point, vertical. Thoracic sterna wide, inner edges of mesosternal lobes diverging sharply; metasternal interspace of female transverse. Tympanum present, large and circular. Carinae of hind femora smooth, except dorsal medial carina minutely serrate, corresponding to insertion of hairs, and ending in a short sharp point at the knee. Five external and eight internal spines on posterior tibia, tibial spines long and thin. Hind foot long (43% of femur) with a very long third tarsus.

Posterior margin of 10th abdominal terga of male melanized, with irregular projections, but not forming a well-defined furcula. Supra-anal plate of male triangular, slightly ligulate at tip, with a pair of large transverse black bosses near the tip, and two weak longitudinal rows of small black spots proximally. Male cercus short, conical, tips slim and melanized, slightly incurved at half length, internal basal apophysis absent or subobsolete, probably represented by a small black disc on inner surface of cercus. Subgenital plate short, smoothly rounded at apex.

Female supra-anal plate triangular, with a deeply concave transverse furrow dividing it into posterior and anterior halves; lateral margins of anterior portion lightly sclerotized, a proximal depression medially. Cerci simple, conical. Ovipositor valves robust, the ventral one inflected upwards distally; outer edges melanized but smooth, no crenulations or teeth. Female subgenital plate ends in a long slim medial point.

Male internal genitalia (figured in Rowell 2008)..

Epiphallus layer. Epiphallus a narrow bridge, ancorae lightly melanized, lateral plates with prominent posterior processes, oval sclerites present, long and thin. Lophi black, digitiform, simple. Lateroventral lobes well developed, melanized at posterior margin, not hooked.

Ectophallus layer. Cingular apodemes straight, slim, flattened dorsoventrally, tips slightly incurved and upcurved. Zygoma large, with a central membranous window. Rami large, sloping backwards, encircling, with a melanized, laterally directed pointed process protruding from the ectophallus membrane inside the ventrolateral lobes (apomorphy of genus?). Aedeagal sclerites swathed in ectophallus membrane. Arch large, overlapping ventrally the basal parts of the ventral aedeagal valves.

Endophallus layer. Anterior apodemes laterally compressed, elongate, rounded. Gonopore processes digitiform, tapering, no ventral process. Ejaculatory sac fairly large, spermatophore sac small. Flexure narrow. Ventral aedeagal sclerites with a ventral, inwardly directed flange, short, continued dorsally and distally by curved plates of ectophallus membrane. Dorsal aedeagal valves short and straight.

Female internal genitalia. Egg guide long, thin, straight, pointed, angled upwards at about 30°, arising anterior to apex of subgenital plate; columellae of postvaginal sclerite absent. Spermatheca in two parts, with the duct arising from the asymmetrical anterior portion. No semicircular sclerite. Spermatophore duct fairly short; apical diverticulum long and cylindrical, doubly bent back on itself; preapical diverticulum present, fairly large for the tribe.

No. of known species.

One.

Range.

Costa Rica, Panama.

***Cryptacris costaricensis* Descamps & Rowell 1984**

Descamps & Rowell 1984: 146.

Type locality: COSTA RICA, Sarapiquí, La Virgen del Socorro.

Location of type specimens: MNHN Paris (female holotype).

ANS Philadelphia (male allotype).

Subsequent literature.

- Rowell, C.H.F. 2008: 64. > Redescription, description of allotype male.

Diagnosis.

Monospecific genus, the generic diagnosis applies.

P_{male} = 2.26 mm, P_{female} = 2.50 mm; F_{male} = 9.18 mm, F_{female} = 10.00 mm; L_{male} = 12.54 mm, L_{female} = 15.45 mm. Foot formula 29:14:57, foot 0.43× as long as femur. Sexual dimorphism (P_{male}/P_{female}) = 0.90. Proportionately, the males have longer antennae and a much narrower interocular space.

Field characters.

Small insects. The very short pronotum suggests a rhytidochrotine. Apterous, but the contrasting red-brown meso- and metathoracic terga at first sight give the impression of short wings. Intensely cryptic, resembling alga-coated bark. General colour in life grey-green, with brown and black speckling, eyes yellowish in female, blue-green in male. Palps greenish, darkening towards their tips. Antennae black at the base, otherwise reddish brown, with 4-5 yellow rings in the female, but unringed in the male. Legs greenish or blue-grey, with multiple dark bands on all femora. The white lower face of both sexes and the white fastigium of the male are the only conspicuous markings.

Distribution.

Costa Rica and Panama. Very rare in montane forests (ca 1000 m altitude) of the Costa Rican Cordillera Central and on Volcan Tenorio; possibly on other peaks of the Cordillera del Norte. In Panama recorded only from the highlands of Prov. Bocas del Toro. To date known from only 4 individuals. Map OmI.

Natural history.

Found in the canopies of low trees, such as *Blakea gracilis* (Melastomaceae). Nothing is known of its diet or reproductive biology. The elongate foot suggests an adaptation to arboreal life, and the coloration suggests that it rests on bark.

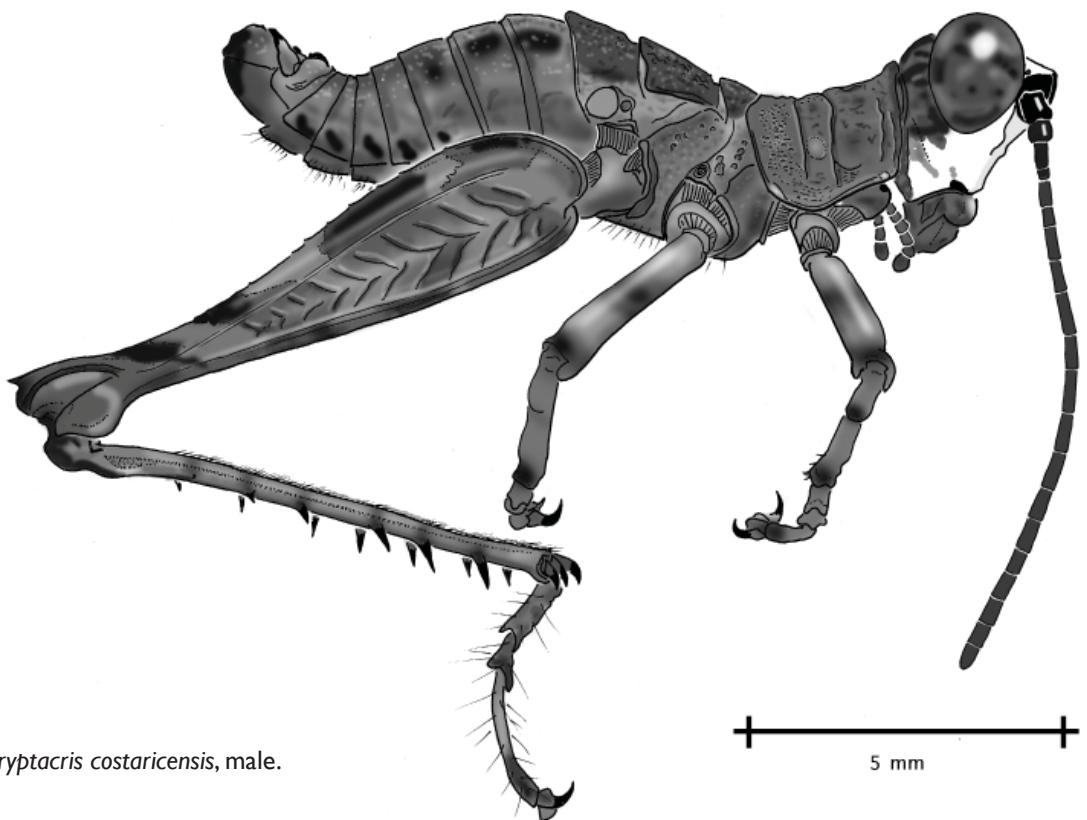
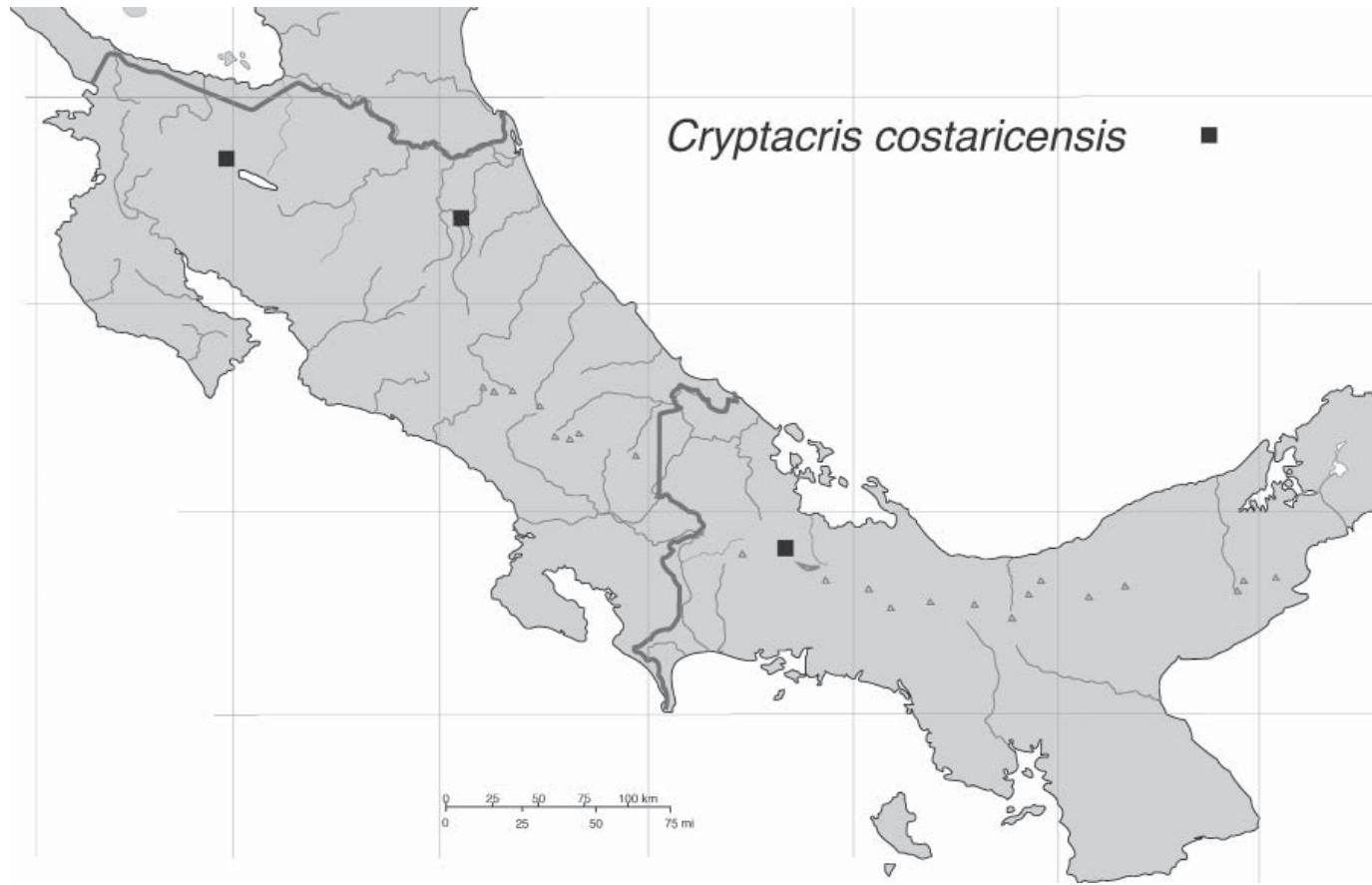


Fig. Om1. *Cryptacris costaricensis*, male.



Map Om1. Localities of *Cryptacris costaricensis*, in Costa Rica and Panama.

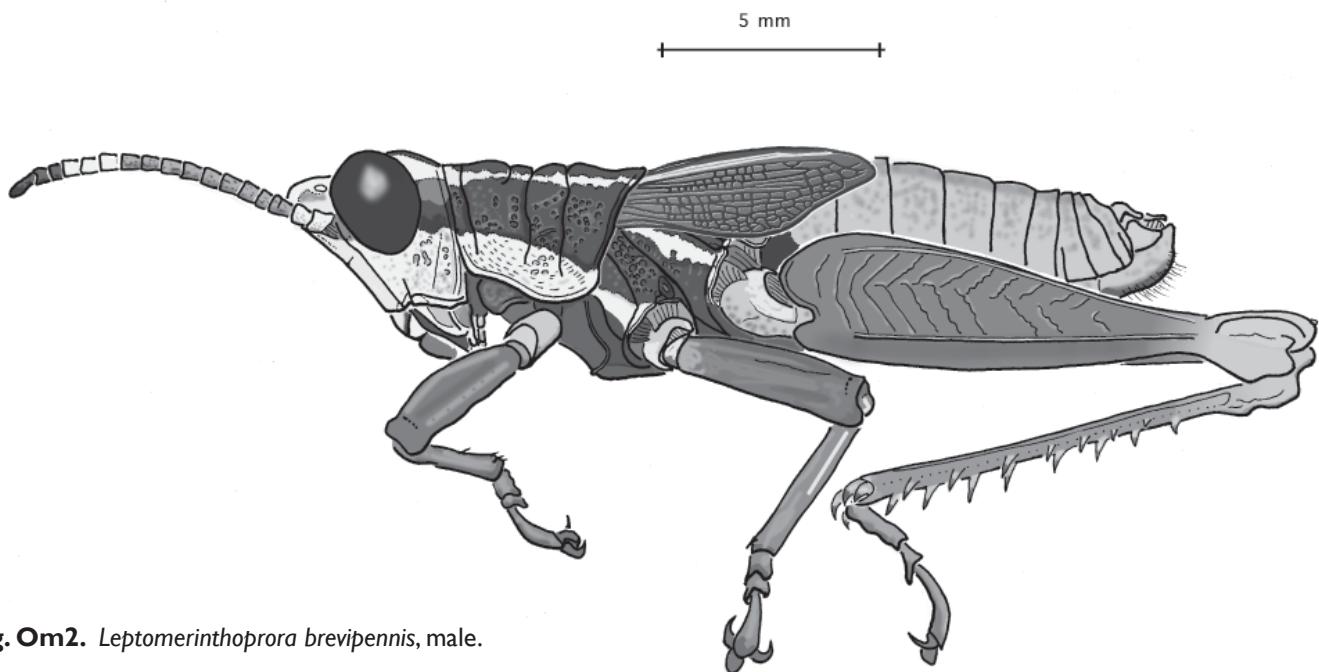
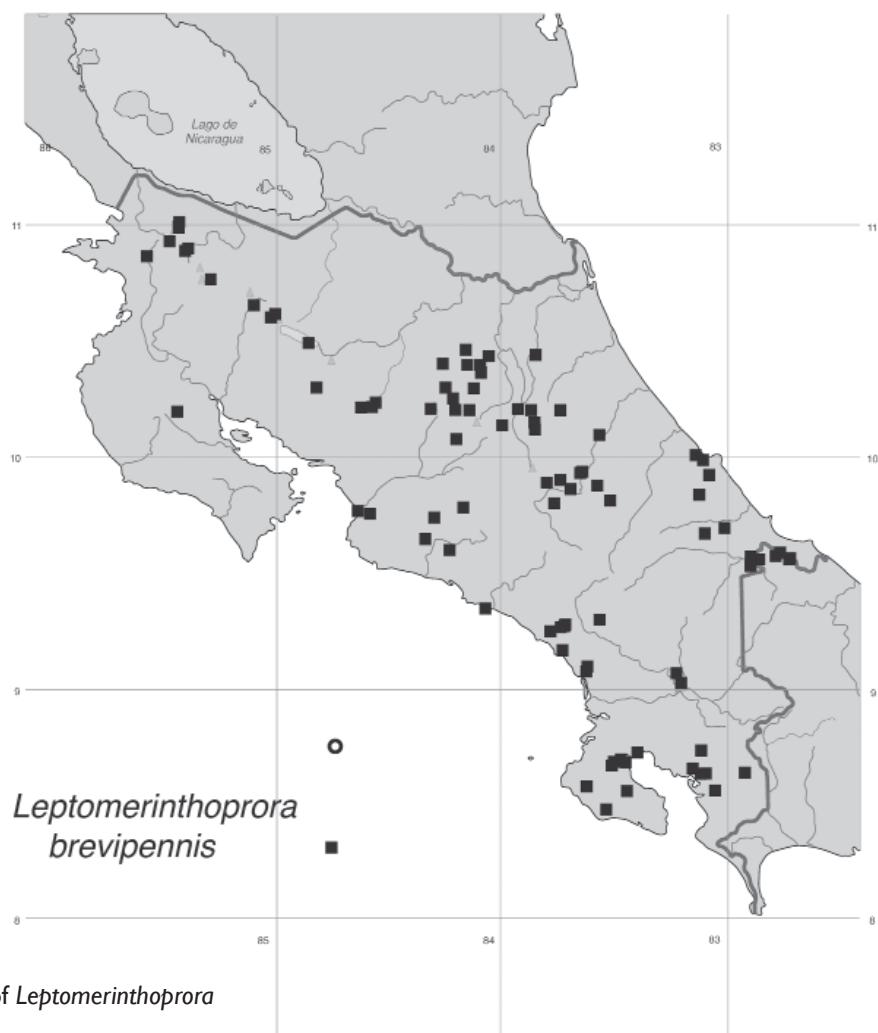


Fig. Om2. *Leptomerinthoprora brevipennis*, male.



Map Om2. Localities of *Leptomerinthoprora brevipennis* in Costa Rica.

Leptomerinthoprora
Rehn 1905

Rehn 1905: 436.

Type species: *Leptomerinthoprora brevipennis* Rehn 1905: 437.

Subsequent literature.

- Amedegnato, C. 1974: 201.
- Rowell, C.H.F. 1983: 179-200. > Revision of genus.

Etymology.

Greek *leptos*, narrow, slender; *merinthos*, line, cord; *prora*, prow, face; referring to the longitudinal stripes of the anterior part of the body? Or to the sulcate frontal ridge?

Diagnosis.

Differs externally from *Vilerna* (q.v.) in having filiform, not ensiform, antennae, and in the smoother integument. All known species are brachypterous [Rowell (1983) gives internal genital characters distinguishing the two genera]. Frons concave to almost straight; fastigium rounded at tip. Medial pronotal carina thickened and melanized, cut by three sulci; lateral carinae absent. Posterior margin of pronotum rounded or (in Panamanian specimens) bluntly angulate. Pronotal process vertical or slightly inclined backwards, usually sharply pointed and slender; in some specimens transversely compressed, more chisel-shaped than pointed. Dorsal carina of hind femur lightly serrate. Male furcula with 2-4 pairs of small black teeth, sometimes with an additional medial tooth. Male supra-anal plate almost quadrangular, with thickened, raised edges, and a triangular terminal process, rounded at the tip; bears up to 6 paired melanic spots, plus 1-3 medial distal spots. Thorax of all species chocolate brown, longitudinally striped in yellow or light brown.

Epiphallus with melanized, bar-shaped lophi; ventrolateral sclerites well developed, with melanized, inwardly curving dorsal tips. Ventral aedeagal valves laterally flattened, enveloped in an elaborate ectophallic membranous sheath, obscuring the ventral valves in lateral view.

Ovipositor robust, toothed. Bursa large, with paired sclerites at its entrance, bent sharply ventrally at its distal extremity. Apical diverticulum of spermatheca long and tubular, with no lateral diverticulum.

Larvae of both our species are dark brown, with a noticeable white fastigium and anterior part of the vertex, and mottled green and brown hind femora.

Number of known species.

Four. In our area, three (one here synonymized).

Generic range.

Guatemala, Honduras, Nicaragua, Costa Rica, Panama. Forbivorous insects of forest edge and light gaps.

Key to males of species of *Leptomerinthoprora* in Costa Rica and Panama.

I Larger insects, 16-22 mm from fastigium to tip of abdomen. Frons concave in profile, making an angle of 45° with the horizontal, rostrum noticeable. Antennae light brown, usually with a distal yellow annulus and black tip. Tegmina extending into 4th abdominal segment. Legs usually bright green, sometimes brown or olive, or green weakly banded with brown (widely distributed in Costa Rica and Western Panama)

..... *L. brevipennis* Rehn.

IA Smaller insects, 12-15.5 mm from fastigium to tip of abdomen. Frons almost straight in profile, making a 60° angle with the horizontal, rostrum short. Antennae plain reddish brown. Tegmina reaching at least the posterior part of the 3rd abdominal segment. Legs brownish or yellow, but never green (SW Panama, SW Costa Rica).

..... *L. corticina* (Hebard).

Females are best identified by their associated males; Rowell (1983) distinguished them on characters of the subgenital plate, ovipositor valves and supra-anal plate. They are duller in coloration than the males.

I. *Leptomerinthoprora brevipennis* Rehn 1905

Rehn 1905: 436.

Type locality: COSTA RICA, Prov. San José, Pozo Azul de Pirris. Location of type specimen: ANS Philadelphia.

Synonymy.

=*L. smaragdipes* Bruner Bruner, L. 1900-1910 (1908) :188.
1908, synon. Rowell 1983: 287.

Rehn & Hebard 1912: 120 (designation of lectotype).

=*L. modesta* Bruner 1900-1910 (1908), synon. Rowell 1983: 288.

Rehn & Hebard 1912: 120 (designation of lectotype).

=*L. flavovittata* Bruner 1900-1910 (1908), synon. Rowell 1983: 288.

Rehn & Hebard 1912: 120 (designation of lectotype).

= *L. occidentalis* Rowell 1983 (**New synonym**).

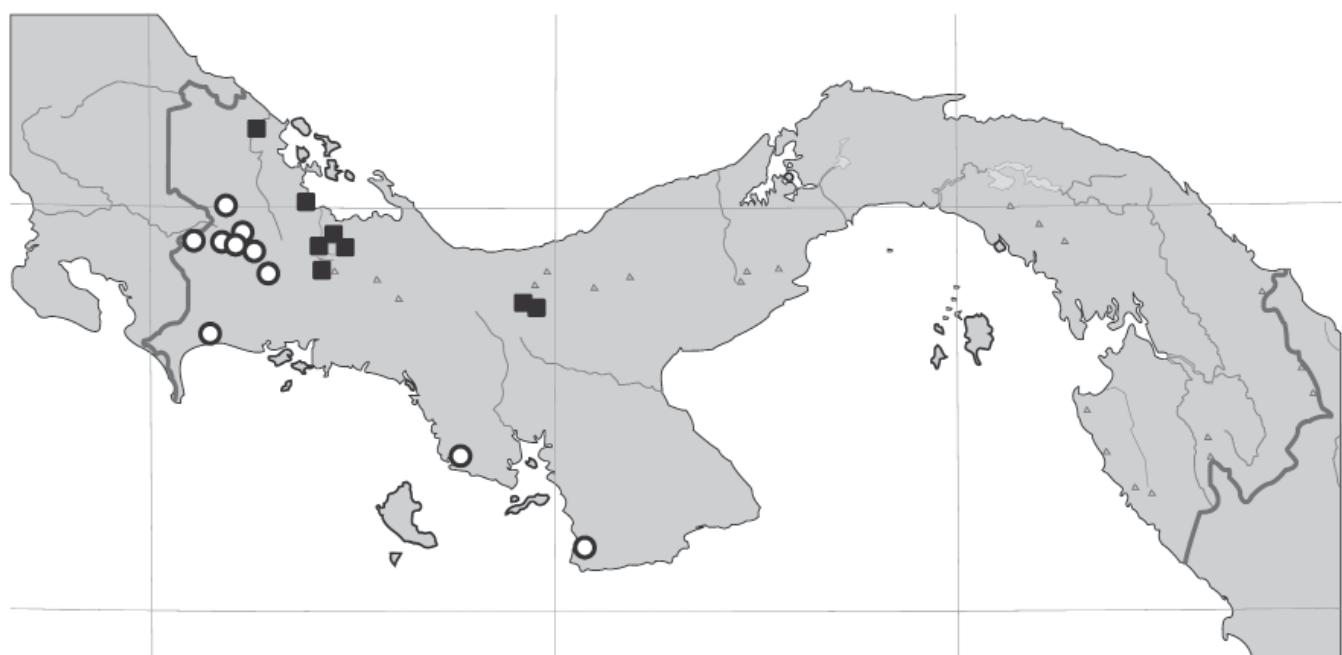
L. occidentalis Rowell 1983 was described from a small sample of individuals collected from what was then (early 1970s) a very isolated locality on the Western margin of the Osa Peninsula. Since then the area has been opened up and extensively deforested, and a much larger sample is now available; I no longer believe that *occidentalis* is specifically distinct: it seems to fall within the range of variation of the local *brevipennis*, which is very variable around the Golfo Dulce, much more so than on the Caribbean coast. It is possible that one or more hybrid zones between *brevipennis* and *corticina* occur in SW Costa Rica, and that *occidentalis* and other puzzling forms, such as that noted in Rowell (1983) from Quisarrá, are actually hybrids.



Map Om3. Localities of *Leptomerinthoprora corticina* in Costa Rica.

Leptomerinthoprora brevipennis ■

L. corticina ○



Map Om4. Localities of *Leptomerinthoprora* spp. in Panama.

Etymology.

Latin *brevis*, short; *penna*, wing, hence *brevipennis*, short winged; Latin *smaragdus*, emerald, *pes*, foot; Latin *modestus*, unassuming, modest; Latin *flavus*, yellow, *vitta*, stripe or band, *flavovittata*, having yellow stripes; Latin *occidentalis*, Western.

Diagnosis.

$P_{male} = 4.24$ (3.94-4.51), $P_{female} = 5.68$ (5.43 - 5.98) mm; $F_{male} = 10.83$ (10.33 - 11.55), $F_{female} = 13.94$ (12.86 - 14.85) mm; $L_{male} = 18.21$ (17.33 - 19.52), $L_{female} = 24.51$ (22.40 - 26.02) mm.

Tends to be smaller at higher elevations. Sexual dimorphism (P_m/P_f) = 0.75; proportions of male and female identical, except males have slightly longer hind femora. Foot formula 38:14:48, hind foot 32% as long as femur. For other characters see key above.

Habitus, Fig. Om2 & Plate Om2. The male internal genitalia were figured by Rowell (1983). The male terminalia are shown in **Fig. Om3**.

The female genitalia, which have not been figured previously, are shown in **Fig. Om4**. Subgenital plate tapering in a bisinuate manner, with a short rectangular apex. Egg guide short, straight and rounded at the end in lateral view, inflected upwards at about 50°. Spermatheca with a single U-shaped apical diverticulum. Postvaginal sclerites with an irregular oblique row of small, weakly developed columellae.

Field characters.

The typical Caribbean slope form of this taxon is brightly coloured and conspicuous, with head, thorax and elytra longitudinally striped in yellow and dark brown, a slanting yellow mark on the metathoracic epimeron, bright green abdomen and legs, and pale reddish hind knees. Underside dark blue-green in life, fading when dried. The species is, however, rather variable in coloration, and much more sombre forms occur, especially in females, and are common on the Pacific slope. Some of these individuals have the femora transversely banded with dark brown.

Early larval instars are quite differently coloured, being dark brown with a white patch on the fastigium and vertex.

Distribution.

Southeastern Nicaragua, Costa Rica, midwestern Panama (Prov. Bocas del Toro & Veraguas). Primarily a wet forest species, much commoner on the Caribbean slope, but occurring near sea level on the Pacific slope of Costa Rica in the humid forests of Carara, Quépos, UVita, the Golfo Dulce and Osa Peninsula. **Maps Om2 & 4.**

Natural history.

Often abundant in clearings in wet forest or along forest margins, from near sea level up to 1200 m on V. Cacao.

A wide-range oligophage, it eats principally ferns (especially *Hypolepis hostilis*) and Urticaceae (especially *Urera baccifera*), but also eats from a wide range of other plants, including *Piper* spp. (Marquis & Braker 1987). Appears to mate diurnally, unlike many Central American grasshoppers, and is very frequently found in copula.

2. *Leptomerinthoprora corticina* (Hebard 1924)

Vilerna corticina Hebard 1924: 132.

Type locality: PANAMA, Prov. Chiriquí, Boquete. Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Rowell, C.H.F. 1983: 193. > Transfers to *Leptomerinthoprora*; description of neallotype male.

Etymology.

corticatus, covered in bark; presumably referring to the cryptic coloration of the female (the original description was of the female only).

Diagnosis.

$P_{male} = 4.06$ (3.85 - 4.27), $P_{female} = 5.02$ (4.49 - 6.17) mm; $F_{male} = (8.76 - 10.50)$, $F_{female} = 11.34$ (10.27-13.52) mm; $L_{male} = 17.09$ (15.05 - 19.00), $L_{female} = 21.89$ (20.10 - 28.38) mm. Sexual dimorphism (P_m/P_f) = 0.81; proportions identical. Foot formula 38:13:49, foot 31% as long as femur.

Habitus Fig. Om 5, Plate Om3. See Key to Species above. Also, the antennae and hind femora are relatively shorter than in *L. brevipennis*.

The female internal genitalia (**Fig. Om6**) are similar to those of *L. brevipennis* (**Fig. Om4**), except for the apical diverticulum of the spermatheca, which is long, thin, twice folded back on itself and the whole spirally twisted a half turn.

Field characters.

Similar to *L. brevipennis*, but much smaller, and more dullly coloured, especially the females. Hind femora and abdomen are light olive brown, not green, and the longitudinal striping of the female is much less contrasty. Underside yellow-brown, not blue-green as in *brevipennis*.

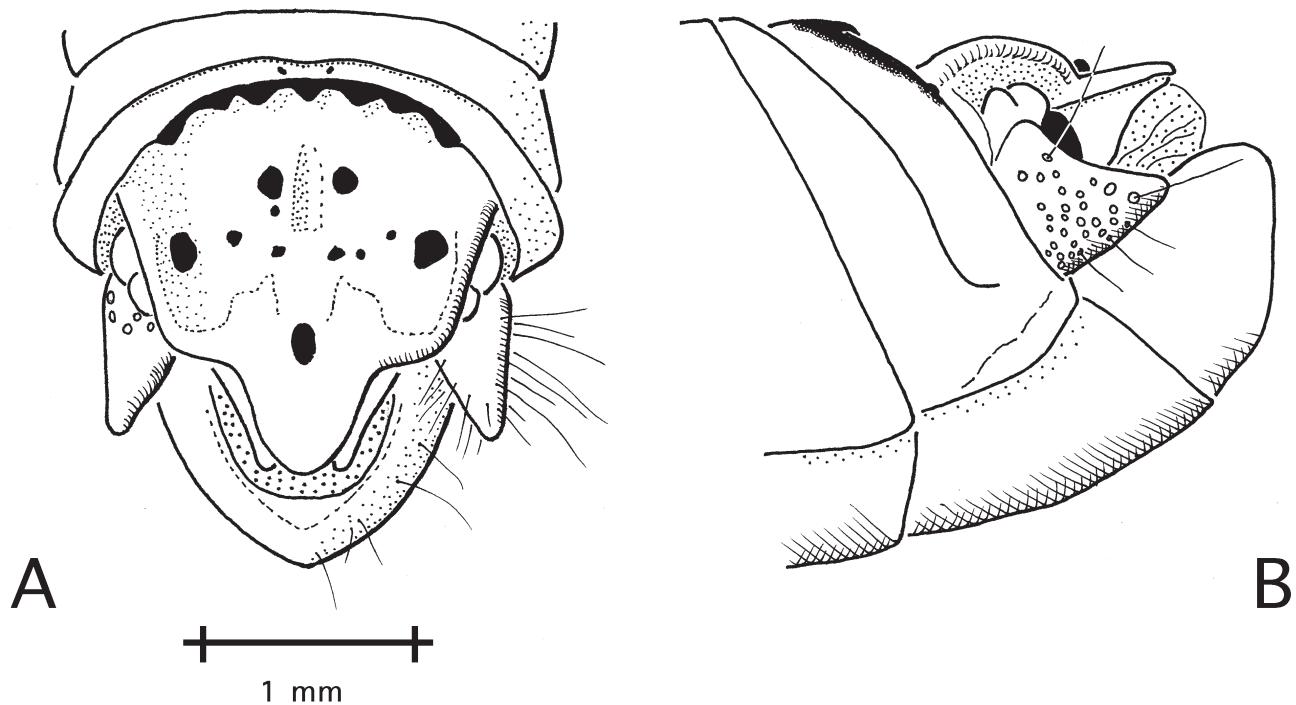


Fig. Om3. *Leptomerinthoprora brevipennis*, male terminalia. A, dorsal and B, lateral view.

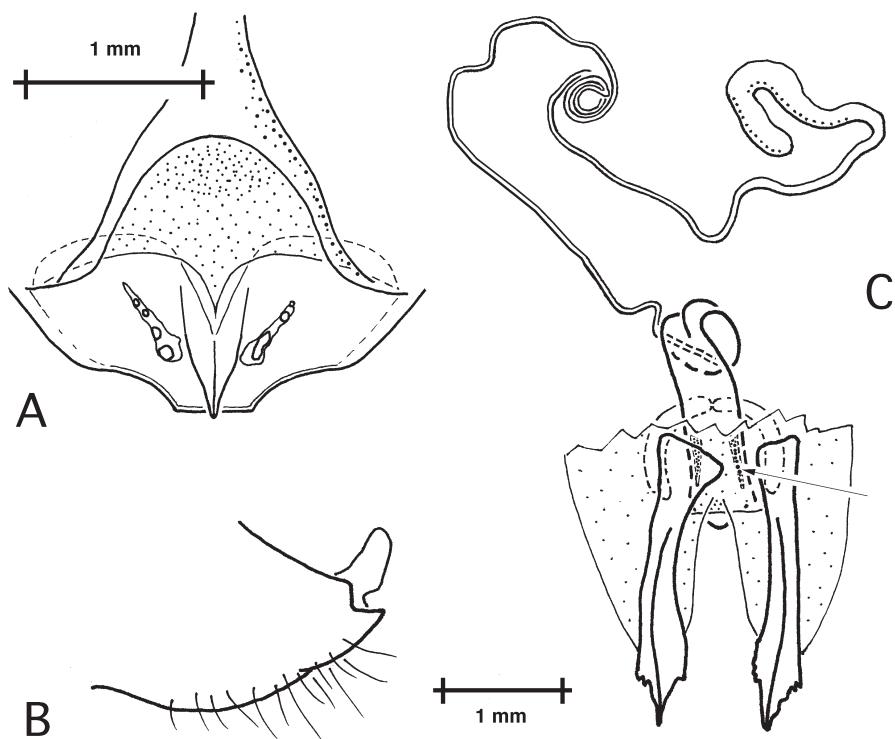


Fig. Om4. *Leptomerinthoprora brevipennis*, female genitalia. A & B, subgenital plate in dorsal and lateral views. C, spermatheca and bursa copulatrix. Scale bars 1 mm.

Distribution.

Pacific slopes of SW Costa Rica and SW Panama, from sea level to 1750 m, but usually above 1000 m. In Costa Rica, apart from an occurrence in Carara, it is confined to the western slopes of the Talamancas from S. Isidro de El General southwards, and to the Fila Costeña del Sur. In Panama, known in the highlands of Chiriquí Province from the Costa Rican frontier to Boquete and on the Pacific shore at Bahía Honda, and in Veraguas Province from the Pacific shore of the Azuero Peninsula. **Maps Om3 & 4.**

Natural history.

Sometimes abundant in clearings and along edges and paths in wet montane forest, more often rather uncommon. Food plants not well known, but has been seen feeding on ferns, together with *Homeomastax acrita* and *Hylopedetes nigrithorax*.

Nicarchus
Stål 1878

Stål 1878: 34, 78.

Type species: *Nicarchus erinaceus* Stål 1878.

Subsequent literature.

- Giglio-Tos, E. 1898: 48
- Bruner, L. 1900-1910 (1908): 289.
- Kirby, W.F. 1910: 433.
- Amedegnato, C. 1974: 201.
- Descamps, M. 1976: 511.
- Rowell, C.H.F. 2008: 57. > Synonymy of the species.

Etymology.

“Nicarchus or Nicarch was a Greek poet and writer of the 1st century AD, best known for his epigrams, of which forty-two survive under his name in the Greek Anthology, and his satirical poetry. He was a contemporary of, and influence on, the better-known Latin writer Martial. A large proportion of his epigrams are directed against doctors.” (Wikipedia: <http://en.wikipedia.org/wiki/Nicarchus>). Many of Stål's generic names are characters from the classics, and their relevance to specific genera is obscure. Possibly he selected Nicharchus for this genus because of the prickly, spiny nature of his satirical works.

No. species known.

One.

Distribution.

Panama and Costa Rica.

Diagnosis.

The genus is remarkable for the spiny processes which decorate the fastigium, pronotum and the hind femora; these,

together with the coloration, make the insects resemble pieces of bark encrusted with lichen and alga. Antennae nodular, with alternating expanded and non-expanded segments, not longer than head and pronotum together, 13-14 flagellar segments. Fastigium subtriangular, elongate, truncate and notched at tip, with paired dorsal marginal processes. Medial carina of pronotum extended into four vertical processes; posterior margin of pronotal disc sharply angulate, terminating in a fifth medial process or tooth. Lateral pronotal carinae extended into 5 paired spines (**Fig. Om7**). Prosternal process spiniform. Thorax wide, mesosternal interspace transverse. Brachypterous, elytra not extending much further than the middle of the abdomen. Tympanum present. All 3 dorsal carinae of hind femur provided with prominent teeth. Dorsal terminal spine of hind knee very long. Seven external and 9 internal spines on hind tibia.

Male: 10th abdominal tergite decorated with 5 melanized points (**Fig. Om8**), but no furcula per se. Supra-anal plate triangular, the point somewhat produced, with a thickened margin and irregular melanized tubercles (**Fig. Om8**). Subgenital plate short, rounded in dorsal view, bluntly pointed in lateral view (**Fig. Om8**). Phallic complex (Rowell 2008, Fig. 5) typical of the subtribe; lophi of epiphallus melanized and divergent in axial view, ventrolateral sclerites present but weakly developed.

Female: supra-anal plate triangular, tip rounded; divided transversely into two halves by a furrow with a somewhat sclerified anterior wall; both halves with symmetrical raised ornamentation. Cerci short, conical, simple. Subgenital plate simple, smoothly pointed posterior margin, with a membranous fringe that may be either smooth (Panama) or irregular (Costa Rica). Egg guide pointed, arising anterior to tip of plate, pointed obliquely upwards. Ovipositor valves (Rowell 2008, Fig. 6A) robust, outer edges melanized, crenulated. Bursa copulatrix bipartite, wide and thin-walled proximally, with a semicircular sclerite near the opening, thinner, asymmetrical, curved to the RHS distally, leading to a thin duct (Rowell 2008, Fig 7A, B). No columellae on the postvaginal sclerites. Spermatheca: apical diverticulum long, slender, subcylindrical, twice folded back on itself; preapical diverticulum absent.

***Nicarchus erinaceus* Stål 1878**

Stål 1878a: 34, 78.

Type locality: “Panama”; no further data.

Location of type specimen: Vienna, holotype male.

Etymology.

Latin *Erinaceus*, the hedgehog, a spiny insectivorous mammal.

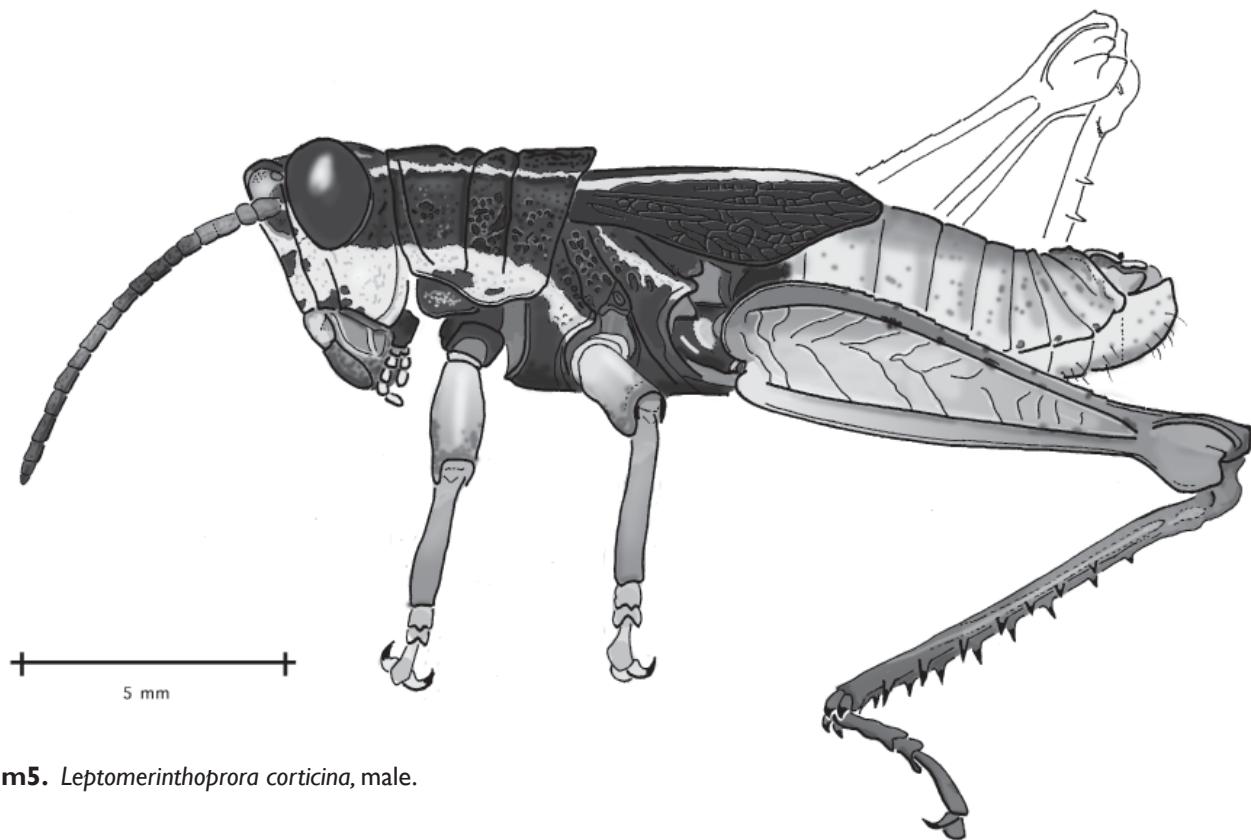


Fig. Om5. *Leptomerinthoprora corticina*, male.

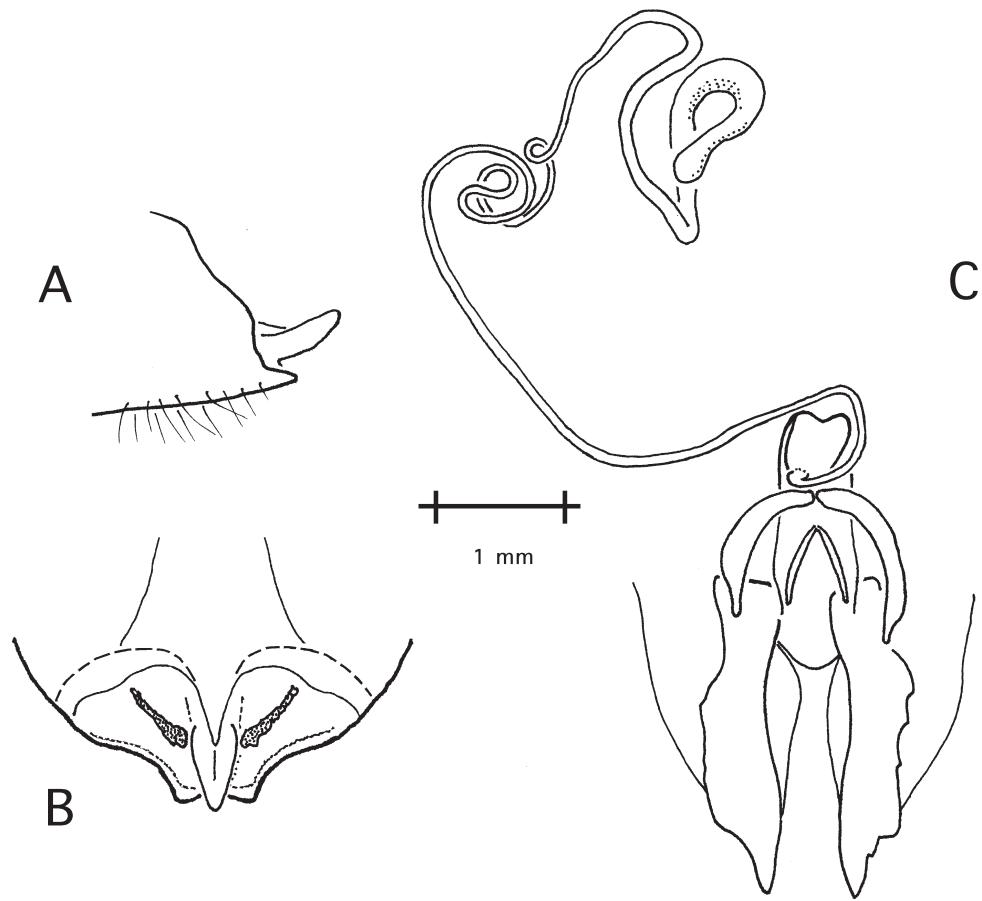


Fig. Om6. *Leptomerinthoprora corticina*, female. A & B, subgenital plate in lateral and dorsal views. C, spermatheca.

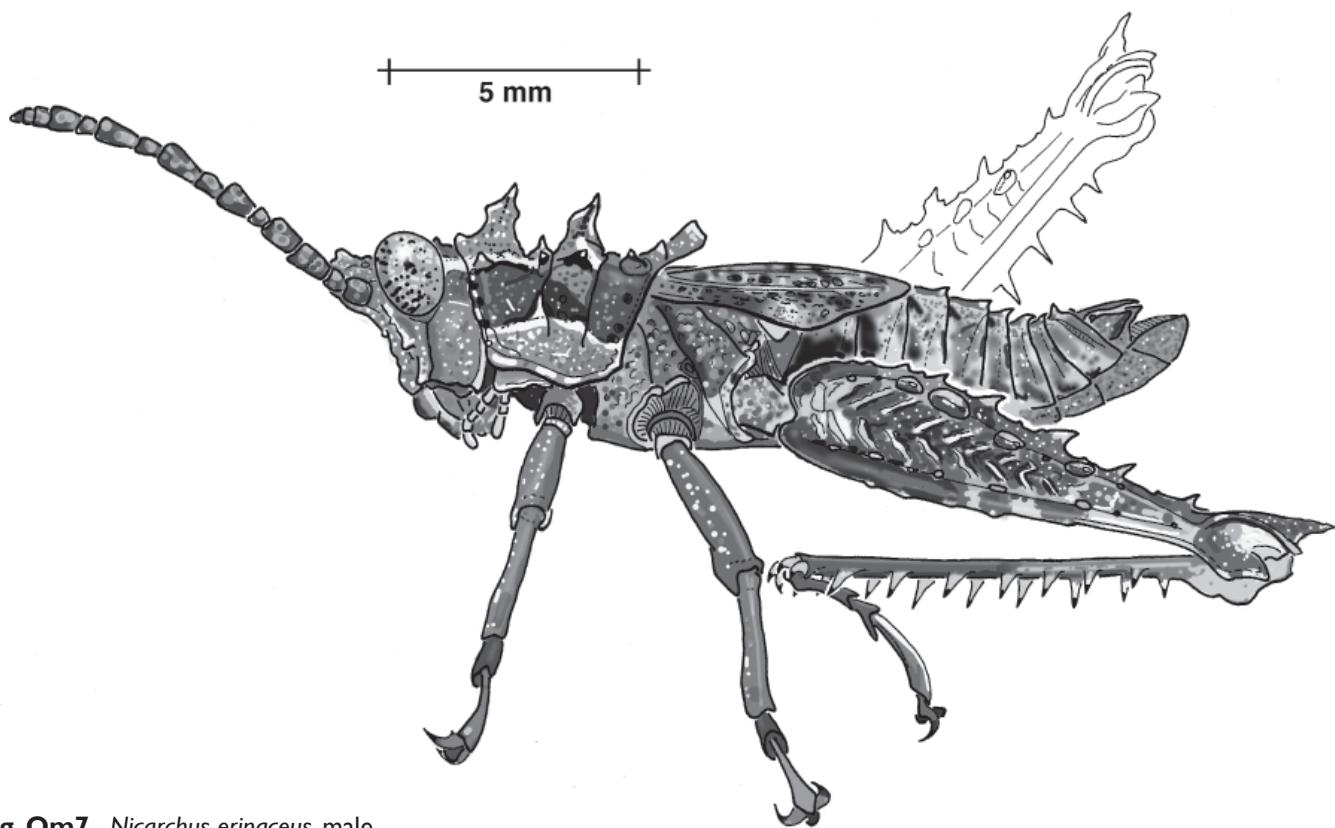


Fig. Om7. *Nicarchus erinaceus*, male.

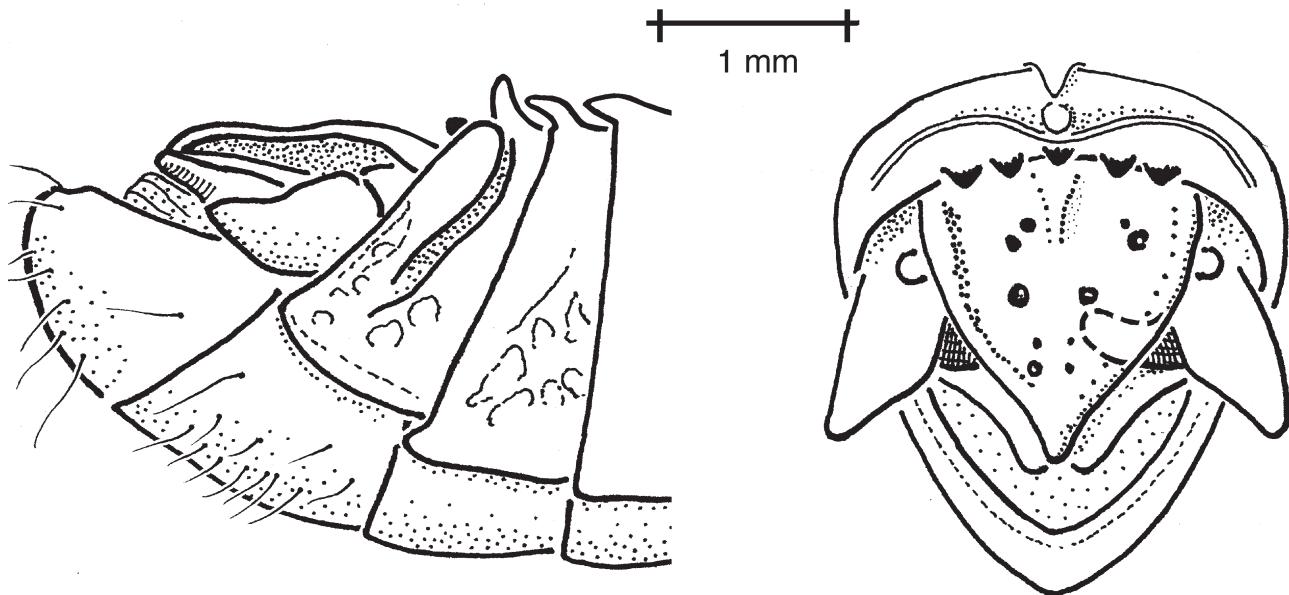
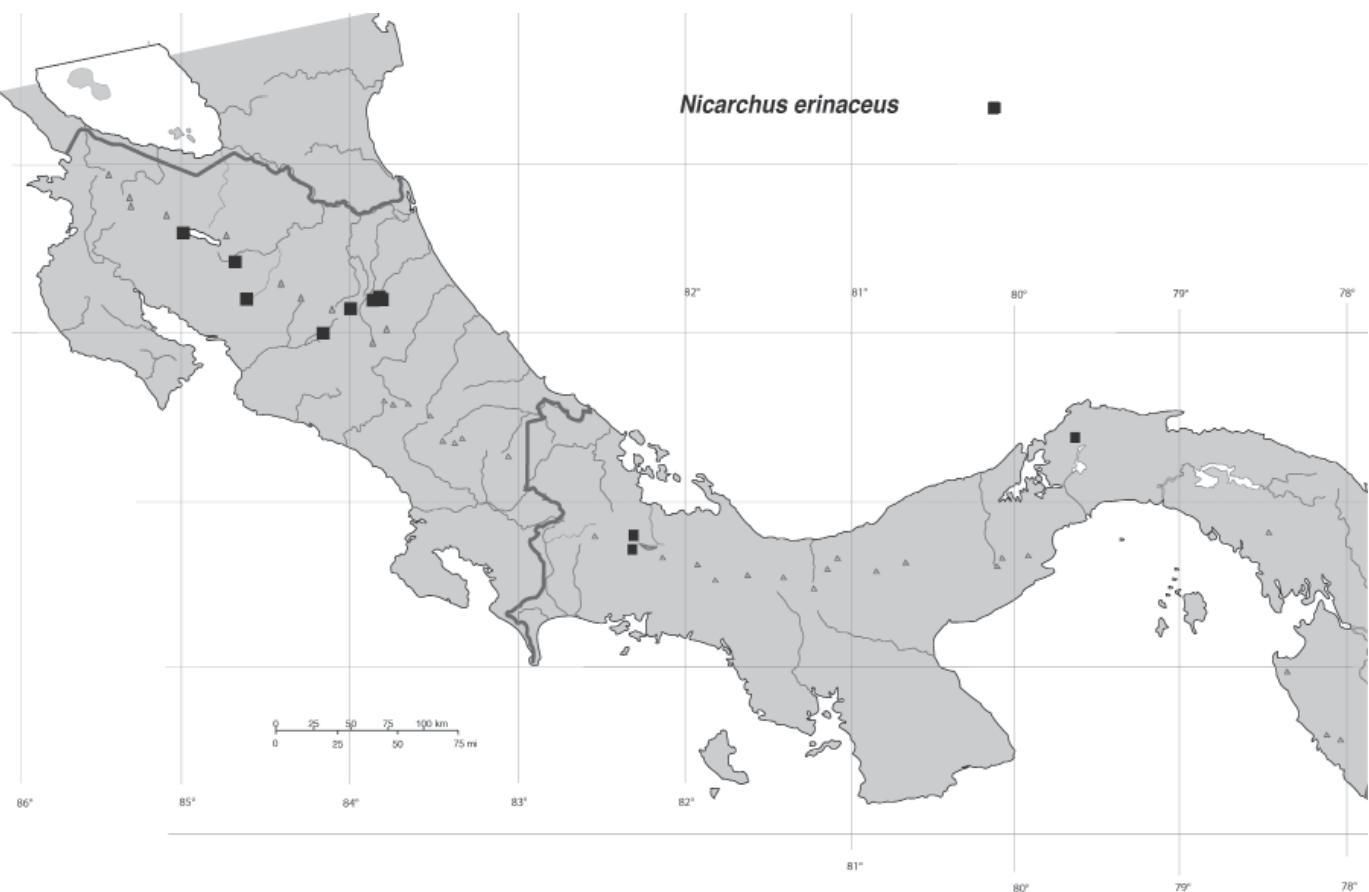
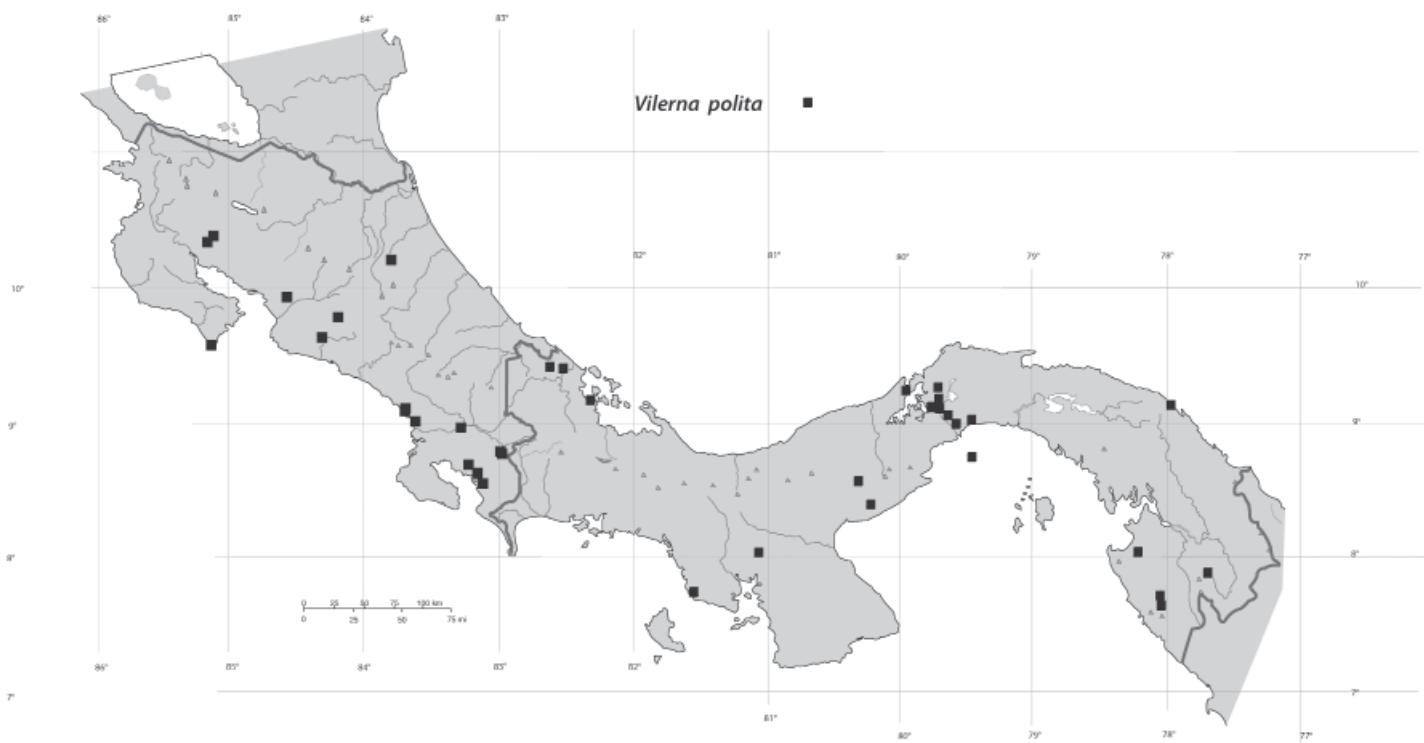


Fig. Om8. *Nicarchus erinaceus*, male terminalia, lateral and dorsal aspects,



Map Om5. Localities of *Nicarchus erinaceus* in Costa Rica and Panama.



Map Om6. Localities of *Vilerna polita* in Costa Rica and Panama.

Subsequent literature.

- Bruner, L. 1908: 289.
- Kirby, W.F. 1910: 433.
- Rehn, J.A.G. 1929: 37, plate I, Fig. 7-8.
- Rowell, C.H.F. 2008: 57-62, Figs 1-7, Plate 3. > Synonymy. Male and female internal genitalia.

Synonymy.

= *Nicarchus enyalius* Rehn, syn. Rowell 2008: 60.

Diagnosis.

Habitus **Fig. Om7, Plate Om4.** Monospecific genus, the generic diagnosis applies. $P_{male} = 5.13$, $P_{female} = 7.55$ mm; $F_{male} = 11.33$, $F_{female} = 14.22$ mm; $L_{male} = 17.36$, $L_{female} = 23.64$ mm. Sexual dimorphism (P_m/P_f) = 0.68; proportions identical. Foot formula 33:13:54, foot 34% as long as femur.

Distribution.

Lower montane forest of the Caribbean slope, so far only recorded from the northern half of Costa Rica and from Prov. Bocas del Toro and Panamá in Panama, but actual distribution may well be larger. **Map Om 5.**

Natural history.

Exceedingly cryptic and, probably for this reason rather than actual rarity, seldom seen or captured. Unmistakable if seen, but usually overlooked unless it moves. Both sexes are green, marbled with pinkish brown. The basal internal surface, and to a much smaller extent the basal external surface, of the hind femur and the distal portion of hind tibia vivid coral red. Early larvae unknown, late larvae similar to adult.

The species is known from only about a dozen specimens in all. Not only does it resemble and live in moss on fallen tree trunks, it also eats it, as shown by observation and faecal analysis; though common in the Tetrigoidea, this habit is rare in Acridoidea. Individuals appear to communicate by slow movements of the hind femur, exposing the red inner surface.

Vilerna

Stål 1873

Stål 1873: 38, 71.

Type species: *Acrydium aeneo-oculatum* DeGeer 1773: 502.

Type locality: SURINAME.

Location of type specimen: Stockholm Museum.

Subsequent literature.

- Kirby, W.F. 1910: 429.
- Amedegnato, C. 1974: 201.
- Descamps, M. & Amedegnato, C. 1989: 20. > Review of genus.

Etymology.

Obscure. Vilerna is a Lithuanian family name.

Diagnosis.

Geophilous insects, cryptically coloured; internal face of hind femur, red. Integument more or less rugose. Macropterous to brachypterous. Fastigium short, margins angular, extremity rounded in dorsal view. Frons concave in profile. Antennae ensiform. Pronotal medial carina present, thin, straight; lateral carinae absent. Prosternal process subcylindrical to subconical, vertical. Dorsal carina of hind femur smooth. Upper and lower lateral lobes of knee (**Fig. Om9**) rounded, terminal medial spine reduced to a short blunt process. Male cerci short, triangular in profile, with a large internal apophysis. Posterior margin of male 10th abdominal tergite decorated with black teeth (**Fig. Om10**). Male supra-anal plate triangular, with raised black spots. Male subgenital plate about twice as long as the cerci, curving to a blunt point in lateral view. Ventral surface of abdomen not marked with black (distinguishes from *Locheuma* and *Pseudovilerna*, both S American). Ovipositor valves robust, bluntly toothed (but often worn almost smooth in older specimens).

No. known species.

Seven. In our area, one.

Range of genus.

Mexico, Guatemala & Honduras; Costa Rica and Panama; South America south to Brazil, Northern Argentina and Paraguay. Not apparently recorded to date from Belize, El Salvador or Nicaragua, nor from Ecuador or British Guyana.

***I. Vilerna polita* Descamps & Amedegnato 1989**

Descamps & Amedegnato 1989: 26.

Type locality: COLOMBIA: Cordoba, Montería.

Location of type specimen: MNHN Paris.

Etymology.

Greek *polites*, citizen. Perhaps an allusion to the dull and unassuming coloration.

Diagnosis.

$P_{male} = 4.04$ (3.91 - 4.44), $P_{female} = 4.13$ (4.01 - 4.26) mm; $F_{male} = 10.08$ (9.62 - 11.37), $F_{female} = 11.48$ (10.71 - 11.85) mm; $L_{male} = 20$ (16.45 - 16.77), $L_{female} = 22.19$ (19.9 - 23.13) mm. Descamps and Amedegnato (1989) give slightly but significantly smaller dimensions for a primarily Colombian sample. Sexual dimorphism (P_m/P_f) = 0.80. Foot formula 43:15:42 in both sexes, foot 29% as long as femur.

Habitus, **Fig. Om9, Plate Om5.** Integument of thorax heavily pitted, covered with shallow cupular depressions, but pronotal disc devoid of wrinkles and tubercles, thus exceptionally



Map Om7. Localities of *Pauracris brachyptera* in Costa Rica.

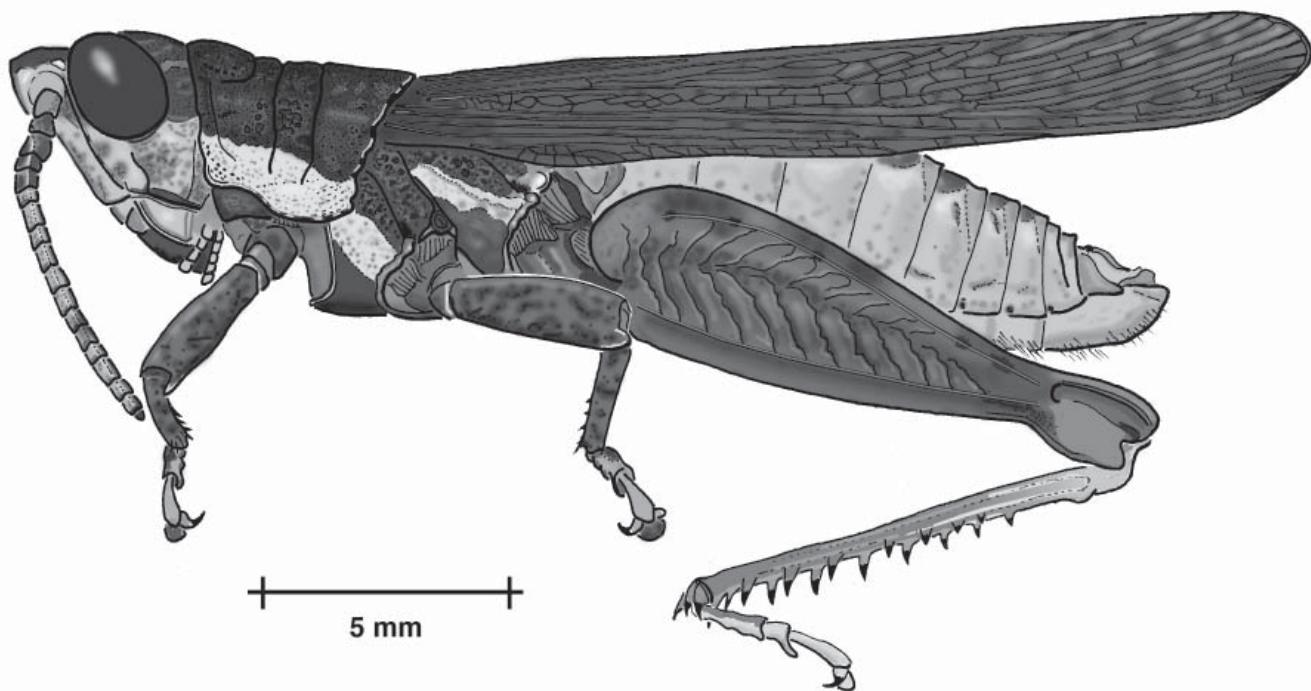


Fig. Om9. *Vilerna polita*, male habitus.

smooth for the genus. Macropterous, elytra longer than hind femora, E/F 1.71 (1.60 - 1.79). Slimmer than the otherwise similar *V. rugulosa* of S America, and with differences in the aedeagal sheath (see Figs 29 & 30 and 32 & 33 of Descamps & Amedegnato 1989a: 23). Fastigium concave distally, with low paired knobs towards the base.

General coloration, dull chestnut brown. Lower frons and genae are pale yellow, and this colour is continued as a band along the ventral edge of the pronotal lobe and onto the mesothoracic episternum. A small yellow mark decorates the metathoracic episternum as well. The dorsal surface of the hind femur bears indistinct black bands, usually not continued onto the outer face. Wings yellow basally, distally clear with blackish venation. Pattern of black knobs on margin of male 10th abdominal tergite and supra-anal plate as in **Fig. Om10**.

Male internal genitalia are figured by Descamps & Amedegnato 1989: 23, Figs 32 & 33.

Female internal genitalia (**Fig. Om11**) in general typical of subtribe (see above) but the spermatheca has no preapical diverticulum and there is no accessory sclerite at the mouth of the bursa. Mesosternal interspace of female subrectangular, wider than long.

Field characters.

In size, agility, and dark-banded hind legs similar to the often sympatric *Abracris dilecta*. Can be distinguished from that species by the red internal face of the hind femur, the more chestnut ground colour, the pale bands laterally along the genae and ventral part of the pronotal lobes and dorsally from fastigium along the pronotum and the trailing edge of the elytra, and by a preference for a more forested habitat. Active and swift in flight.

The early instar larvae have remarkable nodular antennae, in which alternate segments differ markedly in size; these are lost in the adult.

Distribution.

Northwestern Colombia, Panama, Costa Rica. In Costa Rica confined to the Pacific slope, but in Panama found on both sides of the continental divide. **Map Om6**.

Natural history.

Typical of edges of seasonally humid lowland forest, absent or infrequent in wetter forest types. Often associated with the vine *Sabicea panamensis* (Rubiaceae) which it will also eat. However, it is probably polyphagous, and in captivity will eat various Asteraceae.

Comment.

V. polita was split by its authors from the previously recognised species *V. aenio-oculata* (De Geer) and some earlier literature on that species refers in part to what is now *V. polita*.

Tribe Pauracrini Amedegnato 1974

Amedegnato 1974: 201.

Rowell 2008: 69.

Diagnosis.

Male supra-anal plate with 2 small black spots. Male cerci simple, conical, lacking an internal apophysis. Integument smooth. Head only slightly opistognath. Fastigium short, more or less rounded. Interocular space very narrow, less than half the diameter of the antennal scape.

Lateroventral sclerites large, sometimes hooked at tip, but not sclerified. Epiphallus with well-developed ancorae, lophi sclerotized, flattened. Arch of cingulum small. Dorsal aedeagal valves straight, simple. Ectophallic sheath of aedeagus simple (differentiates from Ommatolampini). Endophallic apodemes laterally compressed, flexure wide. Ventral aedeagal valves shorter than dorsal ones.

No. of genera included.

Two. Both occur in our area.

Tribal Range.

Western Colombia, Panama, Costa Rica.

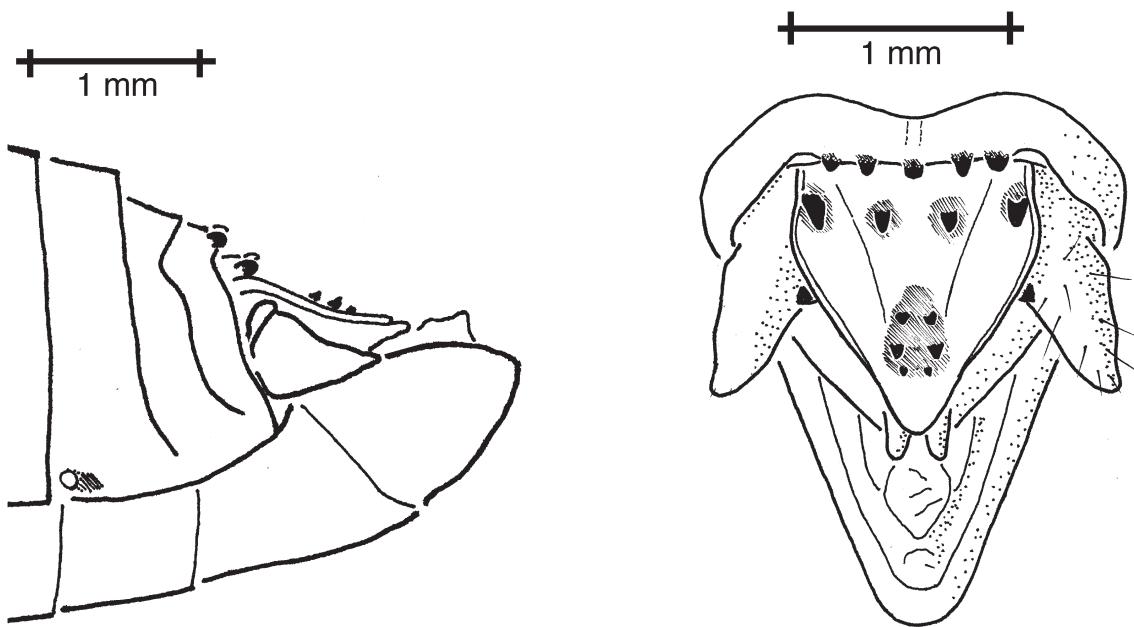


Fig. Om10. *Vilerna polita*, male terminalia. Lateral and dorsal views

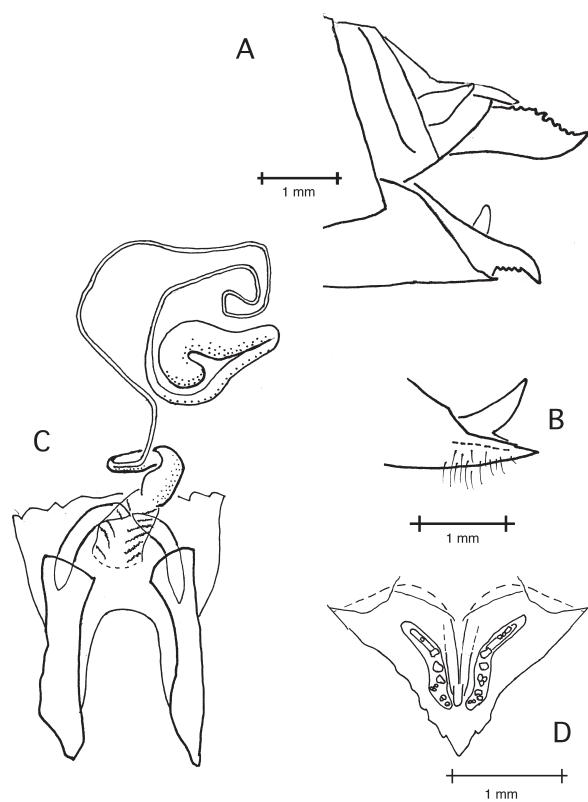


Fig. Om11. *Vilerna polita*, female genitalia. A, tip of abdomen, lateral view. B & D, subgenital plate, lateral and dorsal view. C, Bursa copulatrix and spermatheca. Scale bars, 1 mm. Note numerous columellae on the postvaginal sclerites in D..

Pauracris
Descamps & Amedegnato 1972

Descamps & Amedegnato 1972: 518.

Type species: *Pauracris tenera* Descamps & Amedegnato 1972: 519.

Type locality: COLOMBIA: El Valle, Anchicaya, 300m.

Location of type specimen: MNHN Paris.

Subsequent literature.

- Amedegnato, C. 1974: 201.
- Rowell, C.H.F. 2008: 67.

Etymology.

Greek *pauros*, little; *acris*, conventionally used for grasshopper.

Diagnosis.

Posterior margin of 10th abdominal tergite of male completely black. Male supra-anal plate with 2 small black spots. Male cerci simple, conical, lacking an internal apophysis. Integument smooth. Head only slightly opisthognath. Fastigium short, more or less rounded. Interocular space very narrow, less than half the diameter of the antennal scape. Phallic lateroventral sclerites large, hooked at tip, but not sclerified. Epiphallus large, with a wide bridge, well-developed ancorae, lophi sclerotized, flattened, broad, weakly bifid, extending close to the midline. Arch of cingulum small. Dorsal aedeagal valves straight, simple. Ectophallic sheath of aedeagus simple (differentiates from Ommatolampini). Endophallic apodemes laterally compressed, flexure wide. Ventral aedeagal valves shorter than dorsal ones.

Distribution.

Colombia and Costa Rica. Not as yet recorded from Panama.

Number of known species.

Two. In our area, one.

***Pauracris brachyptera* Rowell 2008**

Rowell 2008: 67.

Type locality: COSTA RICA, Prov. Heredia, Puerto Viejo, Finca La Selva.

Location of type specimen: ANS Philadelphia (holotype male, allotype female).

Etymology.

Greek *brachys* short; *pteron*, wing.

Diagnosis.

$P(\text{ronotum})_{\text{male}} = 3.14$, $P_{\text{female}} = 4.28$ mm; (Hind) $F(\text{emur})_{\text{male}} = 9.53$, $F_{\text{female}} = 12.47$ mm; (Body) $L(\text{ength})_{\text{male}} = 15.14$, $L_{\text{female}} = 19.24$ mm. Sexual dimorphism (P_m/P_f) = 0.73;

bodily proportions are similar in the two sexes, in the male the interocular space is comparatively much narrower and the hind foot slightly longer. Foot formula 32:16:51, foot length 36% of femur.

Male: Habitus **Fig. Om12, Plate Om6.** Antenna with 18 flagellar segments, the terminal ones being somewhat wider than the more proximal ones. Head and thorax similar to those of *P. tenera*. Frons concave, frontal ridge briefly and intermittently sulcate, at median ocellus and again above and below the ocellus (**Fig. Om13A**). Fastigium short, downward sloping, rounded. Pronotum rounded in section, lateral carinae absent; prozona much longer than metazona; the metazona has traces of a very weak medial carina, its posterior margin is smoothly convex. The midline of the prozona is crossed by only the most posterior two or three of the four very weak sulci. Elytra extend only to the junction of 4th and 5th abdominal segments, entirely covering the tympanum. Pro- and mesothoracic tibia each with 4 pairs of small black spines. Metathoracic tibia with 6 external spines and 8 internal ones. Supra-anal plate with no medial black spots (unlike *P. tenera*) but with a single pair of marginal melanized bosses, halfway down the lateral margins (**Fig. Om13C**). Cerci conical, the tips curved slightly outwards (**Fig. Om13C**). Apex of subgenital plate bluntly rounded in side view (**Fig. Om13D**). Phallic structures similar to those of *P. tenera*. Ancorae of epiphallus sharp and hooked; lophi of epiphallus tilted forward, rather than posteriorly as in *P. tenera*.

Coloration. Similar to that of *P. tenera*. General colour yellow-green. Antennae blackish brown, intersegmental areas in proximal two-thirds of flagellum whitish. Tips of palps dark green. Diffuse dark green postocular stripe. Two pairs of longitudinal dark green stripes on pronotum and elytra, plus a weak medial stripe on the metazona. Hind knees edged with dark blue; hind tibia and the distal parts of all terminal tarsal segments dark blue.

Female: Similar to *P. tenera*. Coloration similar to that of male, but antennae lack the white rings, the longitudinal stripes are less apparent, and the hind tibiae and tarsi are red, not dark blue. The tympanum is partly exposed under the edge of the elytron. External genitalia, see **Fig. Om14**. The spermatheca of *P. tenera* was figured by Amedegnato (1977, Fig. 196).

Field characters.

The only regional acridid other than *Leioscapheus* which has the elytra longitudinally striped; distinguished from that genus by the shorter wings, more robust build, and shorter antennae. *Taeniophora* spp. also have striped elytra, but can be readily distinguished by their small size and romaleid characters. Colour of hind tibia is sexually dimorphic – red in females, dark blue in males.

Distribution.

Caribbean plain of NE Costa Rica, from sea level up to 700 m on V. Orosí.

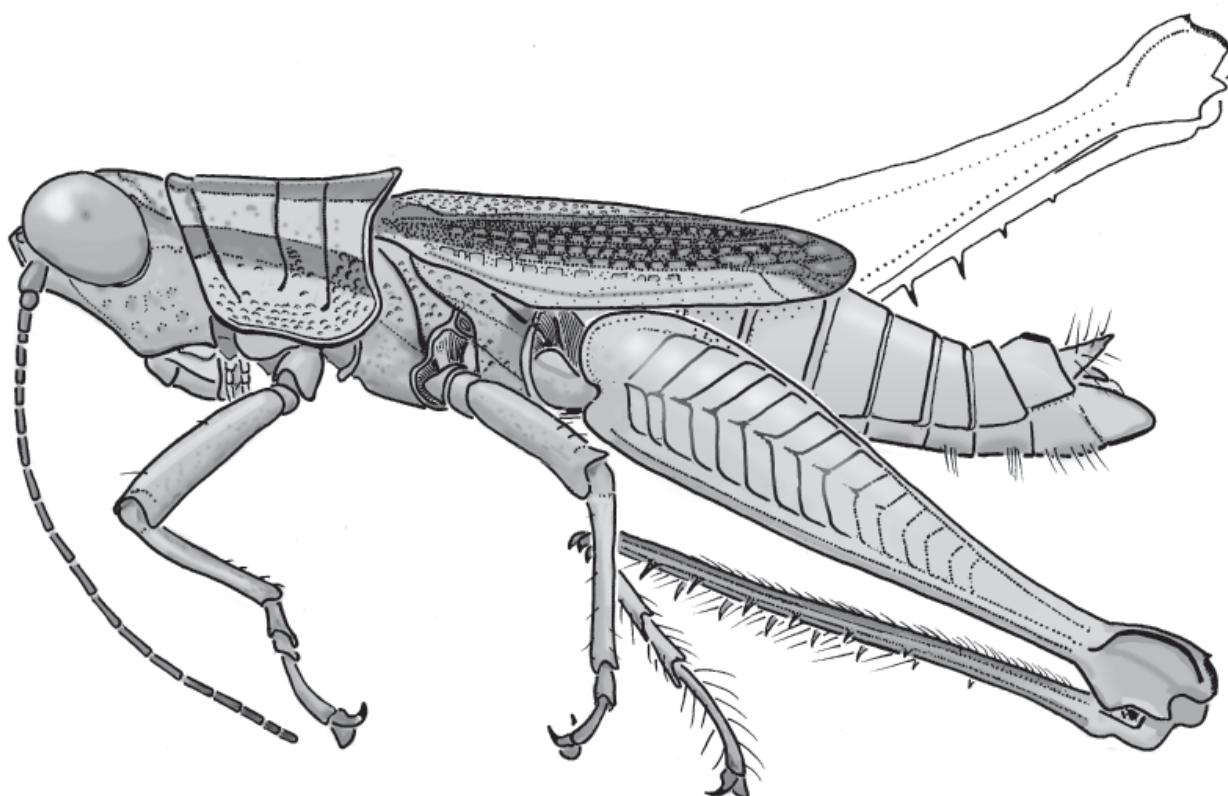


Fig. Om12. *Pauracris brachyptera*, male habitus.

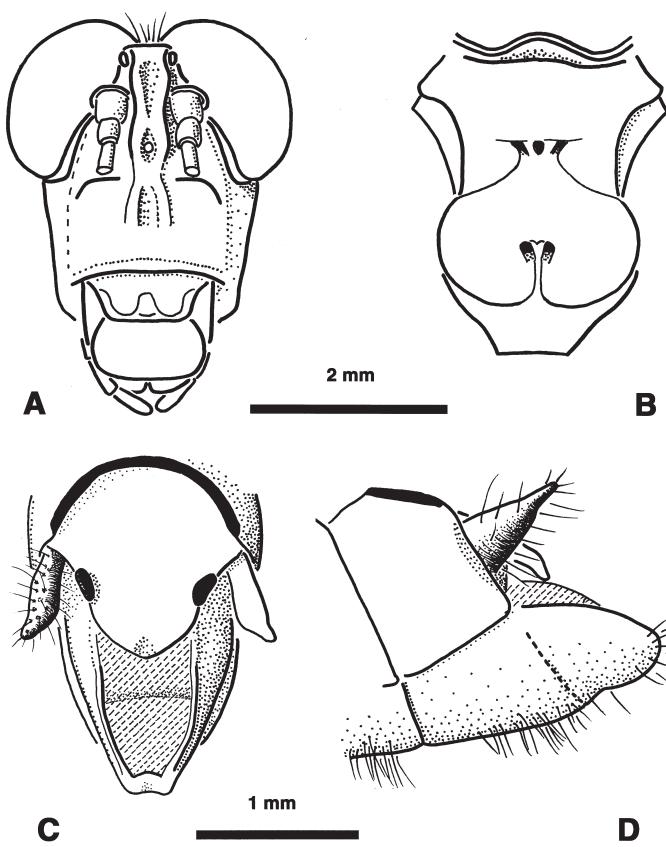


Fig. Om13. *Pauracris brachyptera*, male. A, Face. B, Pterothoracic sterna. C & D, terminalia.

Natural history.

Unknown. A rare inhabitant of the forest understorey, possibly associated with Melostomaceae.

Christenacris
Descamps & Rowell 1984

Descamps & Rowell 1984: 143.

Type species: *Christenacris sanguilenta* Descamps & Rowell 1984: 144.

Subsequent literature.

- Rowell, C.H.F. 2008: 69. > Transfers to Pauracini.

Etymology.

Named for Christen Hyde, who captured the holotype of *C. sanguilenta*.

Diagnosis.

Small size, $F_{\text{male}} = 9.5$ mm. Integument more or less smooth; fastigium subhexagonal, somewhat depressed longitudinally, gently sloping; interocular space about equal to diameter of antennal flagellum. Profile of face subrectangular, sloping towards the rear, frontal ridge practically flat above the medial ocellus, obsolete beneath it. Eyes large, elongated dorsoventrally. Antennae filiform, 20 segments. Disc of pronotum traversed by three wide sulci, the 2nd and 3rd reaching almost to the ventral margin of the lobe. Medial carina weak, visible only in front of the first sulcus and behind the third one; lateral carinae absent, anterior and posterior margins slightly excurred, with a small medial sinuosity. Prosternal process with a small mucroniform protuberance; mesosternal space very wide; metasternal lobes subcontiguous. Fore and mid feet slender. Hind femora with smooth carinae; 6-7 regularly spaced, external tibial spines. Hind tarsus nearly half as long as tibia, third tarsal segment longer than the other two together, 2nd tarsal segment short, only 16% of foot. Micropterous, the elytra reach the posterior margin of the 1st abdominal tergite. Tympanum present, large; hind margin of last abdominal tergite slightly incurved in male, but no furcula. Male supra-anal plate short, triangular, with 2 black spots. Male cerci conical and sharply pointed, lacking an internal apophysis. Subgenital plate short, subconical in lateral view. Epiphallus crescent shaped, with straight, pointed, sclerotized lophi; ancorae small; endophallic apodemes laterally compressed; aedeagal sclerites short.

No. of known species.

One.

Comment.

Originally placed tentatively in the Ommatolampini, but appears to fit better into the Pauracini (Rowell 2008: 69). The female internal genitalia, which would be informative, are unknown.

Christenacris sanguilenta Descamps & Rowell 1984

Descamps & Rowell 1984: 144.

Type locality: COSTA RICA: Prov. Puntarenas: San Vito de Jaba: Finca Las Cruces, 1000 m.
Location of type specimen: MNHN Paris.

Etymology.

Latin *sanguis*, blood; *lens*, lentil, spot. Refers to the prominent patch of red colour at the base of the hind femur.

Diagnosis.

$P_{\text{male}} = 3.0$ mm, $F_{\text{male}} = 9.5$ mm, $L_{\text{male}} = 12.64$ mm, foot formula 28:16:56, foot 43% as long as femur.

Habitus, Fig. Om15, Plate Om7. Monospecific genus: the generic diagnosis applies.

Coloration. Antennae, head, thorax, tegmina and first abdominal segment, black with light blue markings; posterior part of abdomen, front and mid legs, green. Hind femur basally bright red, remainder blue-green, knee black; hind tarsus basally black, then blue-green, shading to dark brown distally, tarsi greenish.

Field characters.

Small size and brilliant black and light blue and red coloration; unmistakeable within our fauna.

Distribution.

Known only from the type specimen, a male found in the flower of a *Costus* (Zingiberaceae) in montane forest of the Fila Costeña del Sur, South West Costa Rica. **Map Om8.**

Natural history.

Unknown. The fauna of the type locality is well known, and the failure to find further examples probably indicates that the normal habitat is the canopy. This hypothesis is weakly supported by the long hind foot, similarly proportioned to but relatively longer than that of *Pauracris*.

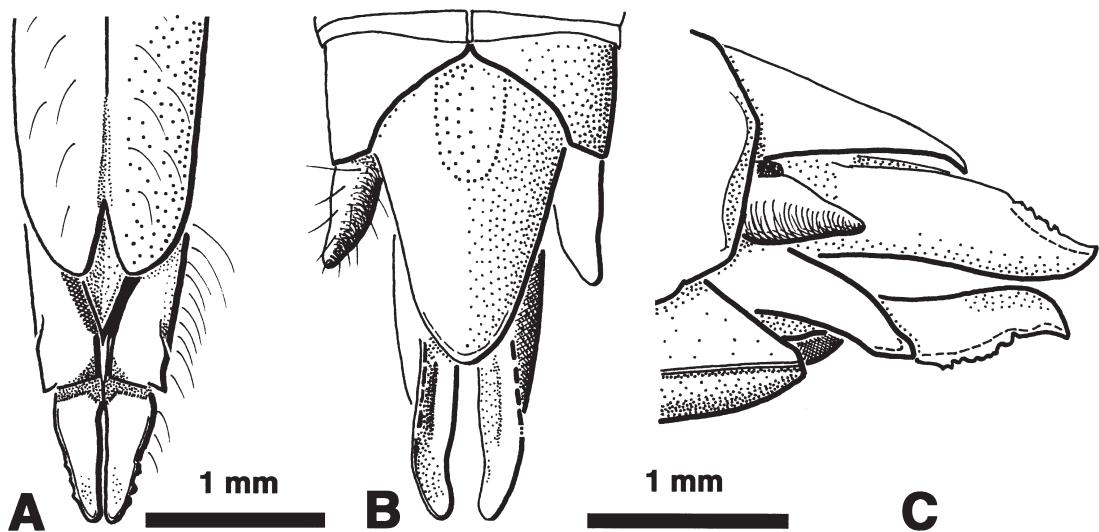


Fig. Om14. *Pauracris brachyptera*, female. A, B &C, terminalia, viewed from ventral, dorsal and lateral aspects.

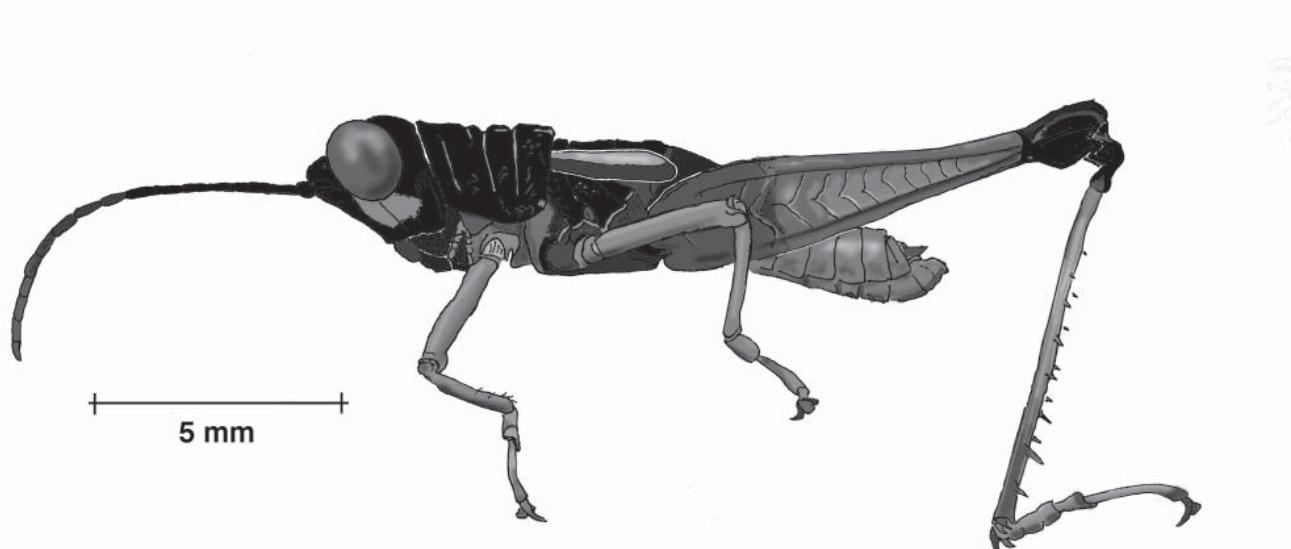
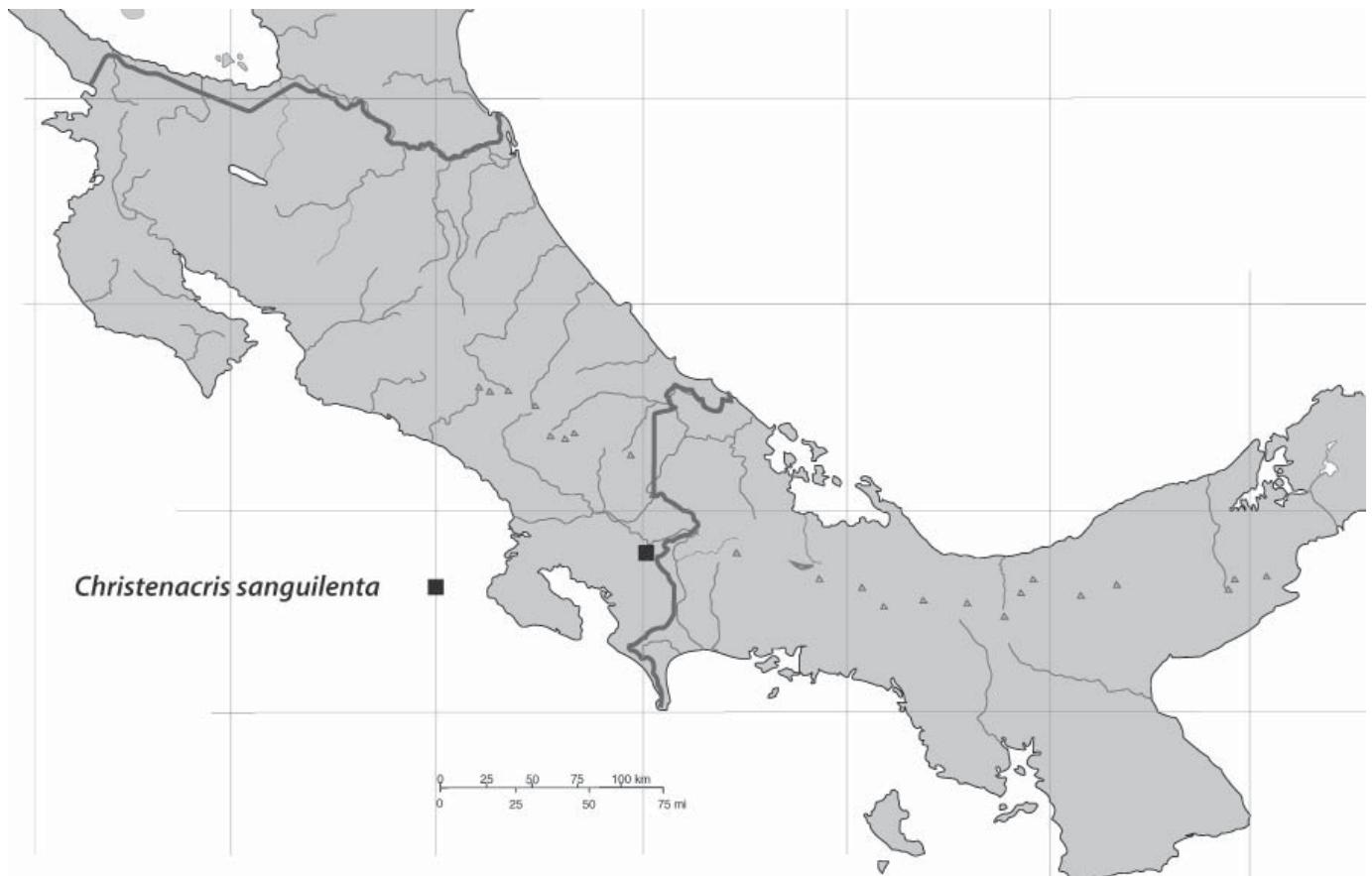


Fig. Om15. *Christenacris sanguilenta*, male habitus.



Map Om8. The unique Costa Rican locality of *Christenacris sanguilenta*.

Tribe Syntomacriini Amedegnato 1974

Subtribe Caloscirtae

The Syntomacriini, a predominantly South American tribe, were split by Amedegnato (1977) into 2 groups, the relatively well-defined Syntomacrae, confined to South America, and the remainder, which make up the rather incoherent Caloscirtae. The caloscirtan genera found in our area, moreover, are atypical for the group as a whole.

Diagnosis.

(Modified from Amedegnato 1977). Fully winged, brachypterous, micropterous or subapterous. Head opistognath with a short or mid-sized fastigium, gently rounded in the Caloscirtae. Face somewhat concave, frontal ridge indistinct or absent. Lateral carinae of the face parallel. Eyes large, globose, interocular space very small, equal or less than half the thickness of the antennal scape (except in *Microtylopteryx*). Antennae filiform to ensiform, long (except in *Microtylopteryx*).

Pronotum rounded without lateral carinae (except *Ortalacris*) or a well-marked median carina (except *Microtylopteryx*). Disc crossed by three shallow sulci.

Tympanum present (except in *Pseudannicerus*).

Posterior margin of male 10th tergite with a black furcula. Supra-anal plate with black spots (except *Microtylopteryx*). Male cercus with a sclerotized internal basal apophysis, which appears to migrate towards the extremity of the cercus in some genera (*Microtylopteryx*, *Pseudannicerus*) and at the same time the latter becomes upwardly curved. In *Microtylopteryx* a tendency for the tip of the cercus to disappear, the upwardly curved structure which is left is thus the apophysis. Ovipositor valves are rather slender in the Caloscirtae (with smooth edges in *Caloscirtus* and *Eugenacris*, edges cutting and serrated in *Pseudanniceris*).

Lateroventral sclerites well-developed, oval, sclerified. Lophi of epiphallus generally digitiform; in *Microtylopteryx* compressed onto the bridge. Ancorae very membranous. Arch of the cingulum well developed, voluminous in many species. Rami slightly upcurved posteriorly. Ectophallic membrane sclerified at the level of the dorsal aedeagal valve, and frequently integrated into the ventral valve.

Endophallic apodemes flattened dorsoventrally. Middle part of endophallus also dorsoventrally flattened in its dorsal region, extending laterally over the walls of the spermatophore sac. Flexure very narrow. Gonopore process with a well-developed rectangular ventral expansion.

Dorsal aedeagal sclerites usually much longer than the ventral ones, overlapping them at their base. Aedeagal sclerites sometimes very long and thin (some *Caloscirtus* spp.) or alternatively regressed, as in other *Caloscirtus* spp., *Microtylopteryx* and *Pseudanniceris*.

Postvaginal sclerites with only a single columella in the *Caloscirtae*, as opposed to many columellae in the *Syntomacrae*. Bursa copulatrix well developed, or regressive and thin. Spermatheca with a preapical diverticulum.

No. of known genera.

Fourteen. In our area, three

Subtribal range.

Mexico to Brazil.

Ateliacris Descamps & Rowell 1978

Descamps & Rowell 1978: 353.

Type species: *Ommatolampis annulicornis* Bruner 1908: 290.

Etymology.

Greek *ateles*, imperfect, ineffective; *acris*, conventionally used for grasshopper. The name was coined by Descamps, and its derivation is obscure to me, unless he had the almost completely reduced wings in mind.

Diagnosis.

(Modified after Descamps & Rowell 1978).

Male: Antennae filiform, longer than the hind femur, about 80% as long as body, black, a prominent white ring on segments 11-12, a less prominent one on segments 7-8. Profile of the face slightly concave, with a rounded rostrum; fastigium subtriangular, with a longitudinal depression continuous with the medial groove of the frontal ridge. Frontal ridge parallel sided and sulcate above medial ocellus, obsolete or reduced beneath it: lateral carinulae of the face thin, sometimes obsolete in subocular part. Eyes protuberant; interocular space narrow, about as wide as the antennal flagellum. Last segment of the maxillary palps spatulate, wide, flattened, that of the labial palp normal; ultimate and penultimate segments of both palps greenish white.

Pronotum rugose, devoid of carinae; disc crossed by four very indistinct sulci, the anterior margin variably bisinuate, the posterior margin straight, usually with a median notch; metazona much shorter than prozona, less than the space between the 3rd and 4th sulci. Prosternal process broad and low,

with a sharp vertical spine towards the rear; mesosternal space transverse. Subapterous; vestiges of the elytra represented by small lobes pressed against the tergum. Tympanum large. Superior carina of the hind femur slightly rugose, ends at knee in a minute spine. Upper and lower external lobes of hind knee smoothly rounded. Six external and eight internal tibial spines. Hind foot 33% as long as hind femur, second tarsal segment very short (12-13% of foot), third segment very long (54% of foot).

Posterior margin of the last abdominal tergite forming a furcula with 2, 3 or 4 points; supra-anal plate with or without melanized thickenings at the distal edge and a medial spot). Cercus with a strong internal apophysis implanted basally on the inferior cercal margin.

Lophi slightly twisted, not bifid. Ventrolateral sclerites small. Cingulum with flattened, almost parallel, apodemes; rami long, oriented towards the rear. Endophallic sclerites flexured, the apodemes laterally compressed; gonopore process large, without a ventral expansion. Aedeagus sheathed; inferior sclerites surround slightly the bases of the superior ones; arch of cingulum strongly developed, superior sclerites of aedeagus curved, convex dorsally.

Female: Antennae much shorter than in the male, and the more proximal pale bands much more clearly defined. Pronotal disc slightly tectiform and with lateral edges diverging towards the rear, but not forming true lateral carinae; disc crossed by 2-3 very indistinct sulci. Supra-anal plate simple, divided transversely, the posterior part a flat triangle rounded at the tip. Subgenital plate semicylindrical, polished, with a simple triangular tip; cerci simple and conical, with long thin tapering points. Dorsal ovipositor valves concave dorsally, sharply hooked, with 4-5 coarse teeth on the proximal outer margin, the tips slender, smooth edged, and squared off at the end; ventral ovipositor valves simple and smooth edged. Spermatheca with a long hooked tubular ampulla and a rather similar lateral diverticulum.

No. of known spp.

One.

Range.

Western Costa Rica, Western Panama.

Ateliacris annulicornis (Bruner 1908)

Ommatolampis annulicornis Bruner 1900-1910 (1908): 290.

Type locality (holotype female): COSTA RICA, Prov. San José, Pozo Azul de Pirris; (of neallotype male: Costa Rica, Prov. Puntarenas, S. Vito de Jaba, Finca Las Cruces).

Location of holotype: ANS Philadelphia; of neallotype male: MNHN Paris.

Subsequent literature.

- Kirby, W.F. 1910: 434.
- Rehn, J.A.G. & Hebard, M. 1912: 120. > Designation of lectotype.
- Descamps, M. & Rowell, C.H.F. 1978: 354. > Transfer to *Ateliacris*, description of allotype male.

Etymology.

Latin *annulus*, ring; *cornus*, horn; referring to the white banded antennae.

Diagnosis.

Monospecific genus, the generic diagnosis applies. $P_{male} = 3.04$ (2.82 - 3.32), $P_{female} = 4.57$ (4.31 - 4.85) mm; $F_{male} = 11.51$ (10.85 - 12.37), $F_{female} = 15.53$ (13.53-16.53) mm; $L_{male} = 17.16$ (16.26 - 18.20), $L_{female} = 25.46$ (23.74 - 28.16) mm. Sexual dimorphism (P_m/P_f) = 0.67; males have relative to their length a hind femur 10% longer than the female, and much (60%) longer antennae. Foot formula 34:13:53, foot 31% as long as femur.

Habitus **Fig. Om16, Plate Om8.** Small-medium (male) to medium (female) grasshoppers. Male is plain black dorsally, grey-brown laterally and ventrally. Clypeus and labrum, light brown.

Field characters.

The combination of aptery, white-banded dark antennae, and spatulate white maxillary palps is unique in our area. (The sympatric *Silvitettix* also has conspicuous white palps, but they are not flattened, and [in our area] it is always brachypterous, never apterous). Female *Ateliacris* are a uniform dull brown, except for palps and antennae, fusiform, much larger and more robust than the males.

Distribution.

SW Costa Rica, extreme SW Panama. Has much the same area of distribution as *Leptomerinthoprora corticina*, from the Río Pirris down the western flanks of the Talamancas and into Chiriquí Province, Panama, at least as far as Boquete. **Map Om9.**

Natural history.

One of the few truly shade-tolerant grasshoppers in our area. Found on leaf litter on the montane or submontane forest floor, or on understorey shrubs. Occasional in light gaps and tree-fall clearings, but not confined to them. In captivity accepts preferentially *Sanicula* (Apiaceae) and *Dichorozandra* (Commelinaceae), both common in the habitat, but there are no observations in the wild. Starved animals will eat a wider range of plants. The white-ringed antennae and the expanded white palps are very prominent in the shade of the forest floor, where the dark brown animals themselves are almost invisible; these appendages are constantly in motion when two animals meet and probably have signal function. Caged but invisible females do not attract males, suggesting that pheromones are unimportant in

mate finding, and that, as in most forest grasshoppers, vision plays the major role.

Key to subspecies of *Ateliacris annulicornis* (males).

I Upper surface uniformly sooty black, rest of body light yellowish brown. *A.a. annulicornis* (Bruner).

IA Upper surface black with a row of orange or yellow medial markings from fastigium to middle of abdomen. Clypeus, labrum and underside black. Lower frons, genae, and lower lateral lobes of pronotum, yellow.

..... *A.a. pulchra* Rowell 2008

***Ateliacris a. pulchra* Rowell 2008**

Rowell 2008: 70.

Etymology.

Latin *pulcher*, pretty, referring to the coloration of the male, which contrasts with the sombre male of *A. annulicornis*.

Diagnosis.

$P_{male} = 2.9$ (2.7 - 3.1) mm; $F_{male} = 11.3$ (10.8 - 12.4) mm; $L_{male} = 16.4$ (15.5 - 17.5, mm; foot formula 34:13:53, foot 31% as long as femur.

Morphologically very similar to *A. annulicornis*, but strikingly different in coloration of the male. Slightly smaller and with a somewhat longer femur. The head is about 10% smaller, and shorter dorsoventrally, than in *annulicornis*. The frons is more concave, resulting in a more prominent rostrum. The eye is narrower in its lower half. The frontal ridge is completely obsolete ventral to the medial ocellus and the lateral carinulae of the face are obsolete below the eyes. Fastigium and frontal ridge are less deeply grooved. The furcula of the male usually has an additional medial pair of projections, often fused into a single medial process, and the supra-anal plate is almost always decorated with a black medial spot.

Coloration. Male: Upper surface black, with a medial row of irregular orange-yellow lozenges from pronotum to the terminal abdominal segments, becoming more diffuse and darker posteriorly; (**Fig. Om18, Plate Om9**). Fastigium and vertex yellow. Underside black (fawn in *annulicornis*). Head and mouthparts black, except for vertex and fastigium, upper part of frontal ridge, and the lower frons and genae below the eyes, yellow (**Fig. Om17**).

Distribution.

Costa Rica. Known to date only from the upper reaches of two Talamancan valleys (R. Peñas Blancas, R. Unión) draining into the upper part of the Rio del General. **Map Om9.**

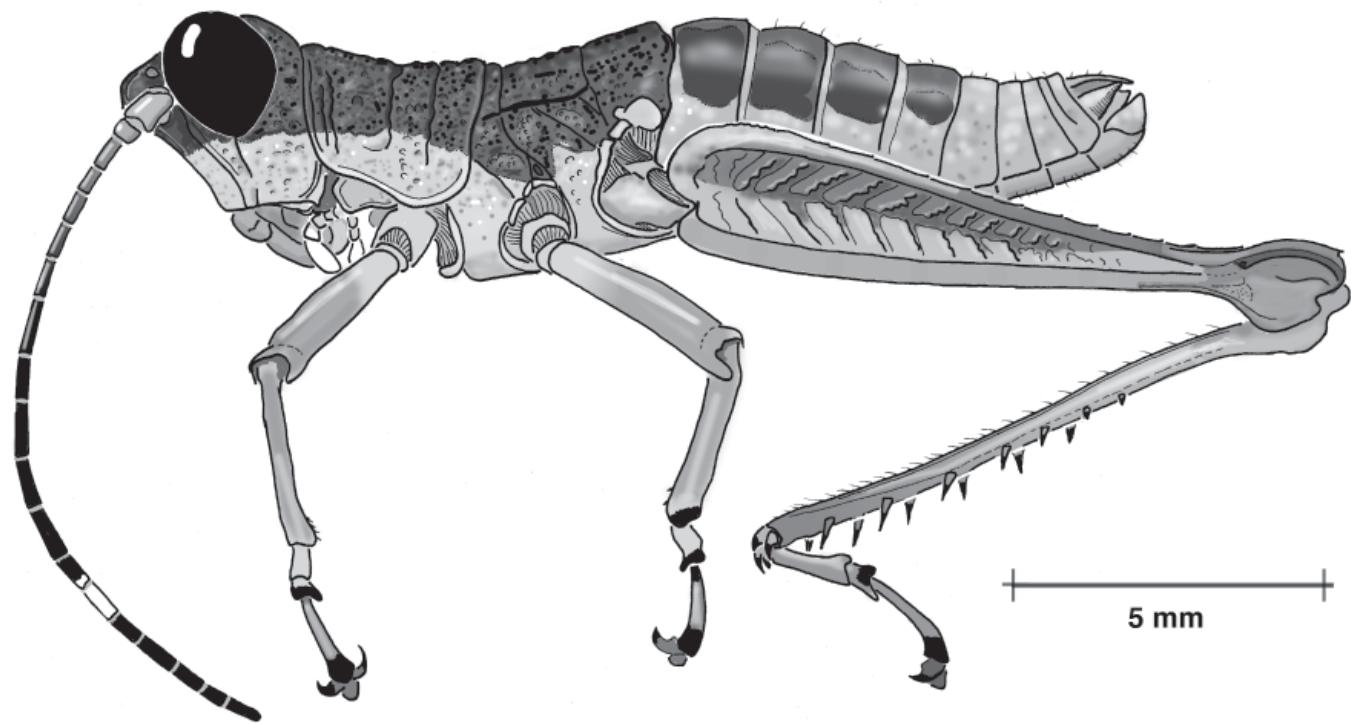


Fig. Om16. *Ateliacris annulicornis annulicornis*.

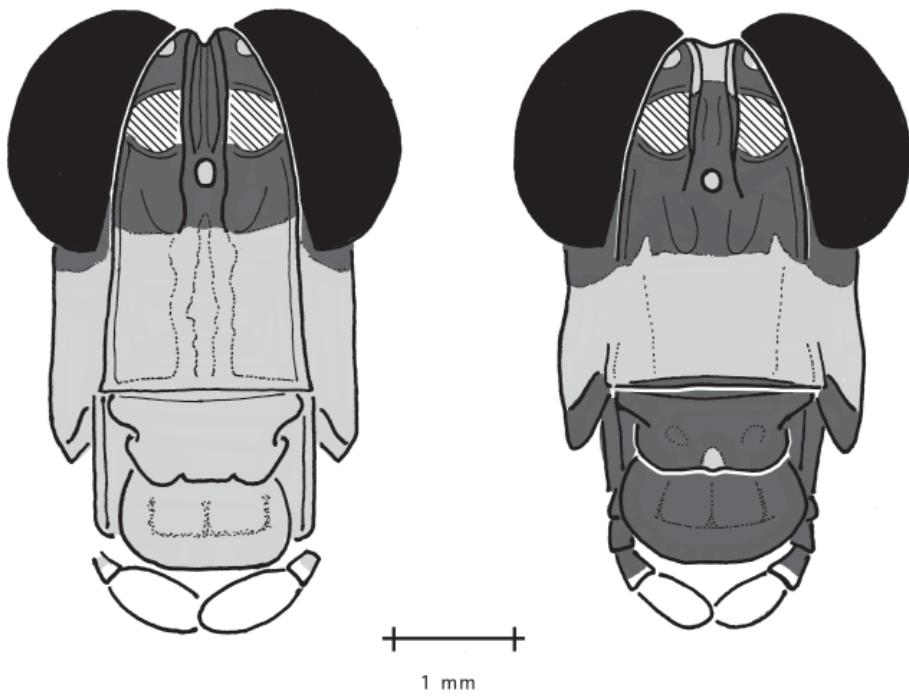


Fig. Om17. *Ateliacris annulicornis annulicornis*, (left) and *A. a. pulchra* (right), face to show differences in markings.

Natural history.

To date appears identical to that of *A. annulicornis*.

Females are unusually difficult to find, to date no adult female has been captured. The last instar larval females are indistinguishable from those of *annulicornis*.

Comment.

The type locality of *A. a. annulicornis* is the most northerly known locality known for this species, and the holotype is a female. These two facts raise the possibility that the holotype could in fact be a member of the taxon here called *A. a. pulchra*, which is also northerly (See distribution Map Om9), and that the more southerly populations, including the allotype male, have been wrongly attributed to *A. a. annulicornis*. A male from the area around the Río Pirris and an adult female of *A. a. pulchra* will be necessary to resolve this.

by two shallow sulci, which may or may not incise the medial carina. Anterior margin of pronotum convex, often slightly emarginate in midline. Posterior margin of lateral lobe bisinuate. Brachypterous; elytron extends maximally into 2nd abdominal segment, but can be shorter. Hind femur with dorsal external face well developed, pitted, and coloured a metallic gold; lateral external face smoothly polished, black. Dorsal medial carina of hind femur well developed, minutely serrate in lateral view in its central region, terminating in a small medial tooth at the knee. Lateral lobes of hind knee smoothly rounded. Six-7 external and 8-9 internal hind tibial spines, the most proximal in both rows often rudimentary or absent.

Male furcula weakly developed, melanized. Supra-anal plate grooved medially in proximal region, rounded or oblong in outline, but terminating in a rounded tongue-like posterior process; anterior parts of lateral margins somewhat melanized. Male cercus short and deep in lateral view, at the tip sometimes bifurcate: the outer process always very short, often completely obsolete, the inner long, with a melanized chisel-shaped tip, and inflected upwards and inwards by up to 90° giving a hook-like structure reminiscent of the cercus of a leptysmine. (Amedegnato [1977] interprets this as being the modified internal apophysis of the cercus, the rest of which has disappeared). Basally and dorsally, two other short melanised processes. Subgenital plate laterally compressed, rounded in lateral view, with a sulcus bounded by two ridges medially on the dorsal edge.

Female supra-anal plate elongate, lozenge-shaped with a rounded tip, tectate proximally, distally fringed with dense hair. Cerci extremely short and blunt. Ovipositor valves short and strongly hooked, laterally compressed, retractable; dorsal valve with interior dorsal edge much higher than exterior, ventral valve with a long concave space between the first and subsequent teeth. Subgenital plate simple, with subrectangular shoulders flanking a thin, transparent, upwardly inflected and acutely pointed egg-guide which exceeds in length the lower ovipositor valves, curling upwards behind their tips. The entire female genital complex is densely haired (omitted for clarity in the Figures presented here).

Internal genitalia. Male: lophi of epiphallus reduced to convex, melanized, plate-like thickenings of the bridge. Ancorae weakly sclerified, large, pointed. Oval sclerites very small, in some specimens apparently absent. Membrane posterior to epiphallus sometimes thickened and more or less melanized. Lateroventral sclerites small, forming weakly sclerified, vertical flaps on either side of the aedeagus. Cingular apodemes and zygoma reduced to thin rodlike structures, somewhat wavy, arranged orthogonally; rami well developed, encircling the aedeagus almost completely, with a large sheet-like membranous apodeme inserted ventrally and running anteriorly. Arch sclerite well developed, dorsal aedeagal sclerites short, upwardly slanted. Partially sclerified ectophallic membrane integrated into both ventral and dorsal aedeagal valves and is their main component.

***Microtylopteryx* Rehn 1905**

Rehn 1905: 448.

Type species: *Microtylopteryx hebardii* Rehn 1905.

Subsequent literature.

- Kirby, W.F. 1910: 544.
- Hebard, M. 1924: 137.
- Amedegnato, C. 1974: 202.
- Rowell, C.H.F. 2003: I. > Revision of genus.
-

Etymology.

Greek *micros*, small; *tyle*, *tylos*, pad, knob, lump; *pteryx*, wing; “having wings like small pads”.

No. of known species.

Two.

Diagnosis.

Small to medium grasshoppers, adult body lengths 13-17 mm (male), 14-26 mm (female). Integument in general polished, pitted on thorax and head. Antennae filiform, 15-21 segments, the 12th antennal segment usually strikingly paler than the rest. Fastigium short to moderately long, triangular, often notched at the anterior end by the continuation of the deeply incised frontal ridge, horizontal or downward sloping. Face straight or slightly concave in profile. Frontal ridge well developed above medial ocellus, deeply grooved medially, the groove sometimes continued onto fastigium. Eyes globose, interocular space large, at least twice as wide as antennal scape. Pronotum without lateral carinae but with a well-marked median carina. Posterior extremity of medial carina usually elevated into a prominent melanized tooth; metanotum, proximal segment of the abdomen and in a lesser degree the succeeding segments of the abdomen with similar, but usually smaller, teeth. Disc of pronotum crossed

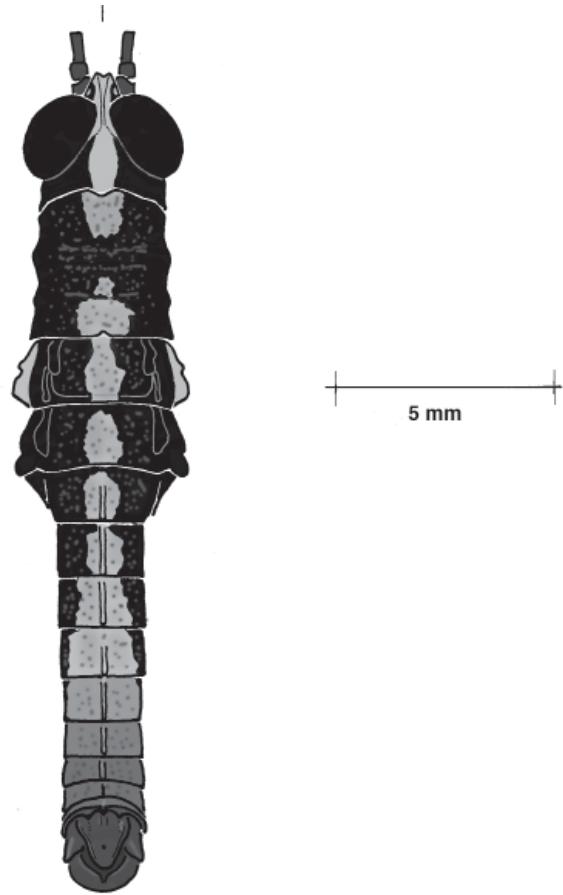
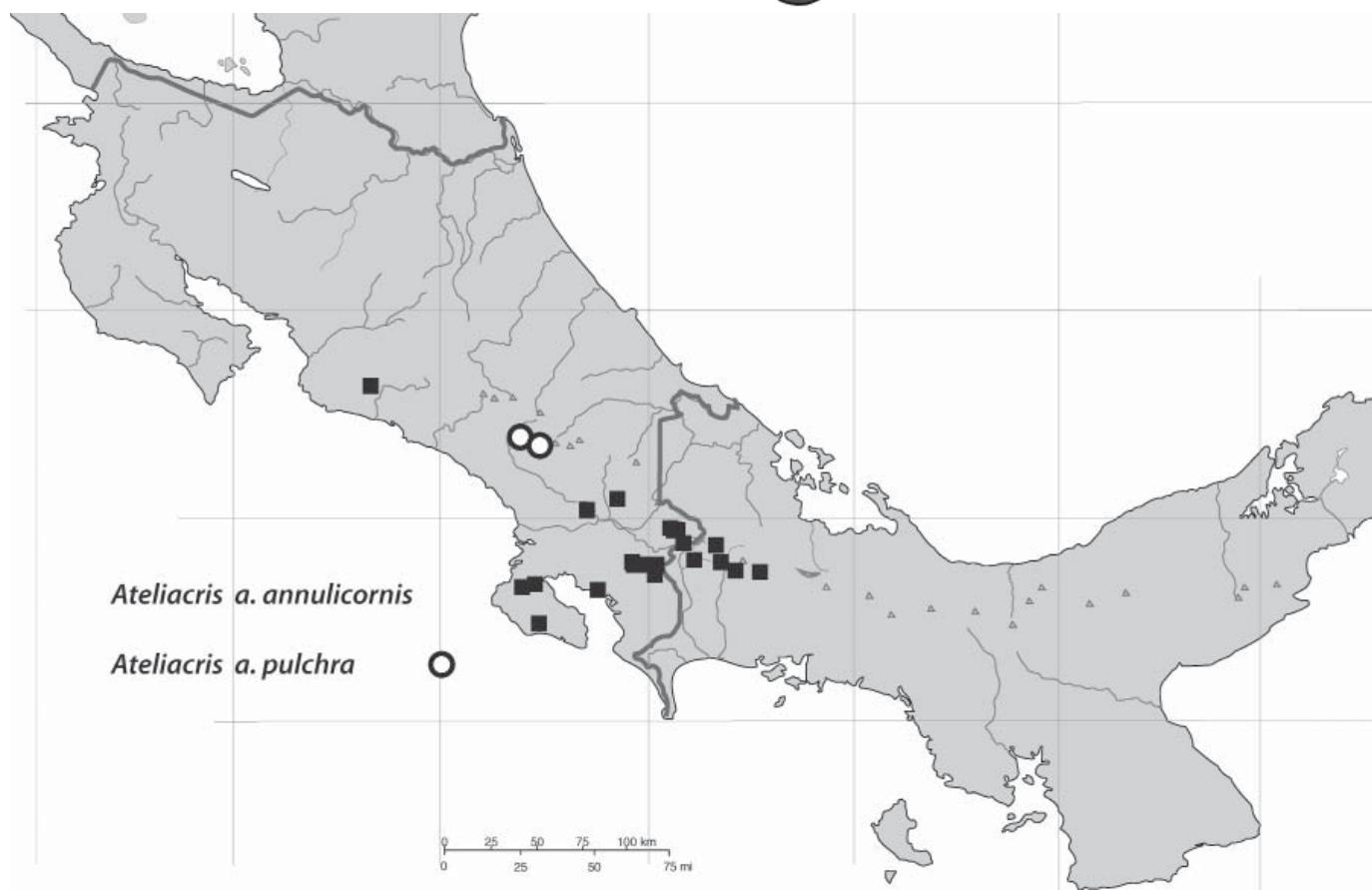


Fig. Om18. *Ateliacris annulicornis pulchra*, dorsal view to show tergal markings.



Map Om9. Localities of *Ateliacris annulicornis* in Costa Rica and Panama.

Endophallic apodemes flattened dorsoventrally and widely separated at their tips. Middle part of endophallus also dorsoventrally flattened in its dorsal region, extending laterally over the walls of the spermatophore sac. Flexure very short, completely fractured. Gonopore process with a well developed rectangular ventral expansion running the length of the ejaculatory sac. Ventral aedeagal sclerite rudimentary, with a short membranous continuation, usually shorter than the dorsal sclerite.

Female: postvaginal sclerites without columellae. Bursa copulatrix simple, a short thin-walled ampulla; duct long and thin, widening distally towards the spermatheca; lateral diverticulum of spermatheca very short, apical diverticulum long and sausage-shaped, bent back on its self towards its tip.

Field characters.

The combination of dark brown, black and vivid white or gold markings with dark, pale-ringed antennae, in a medium sized, flightless grasshopper, is diagnostic of *Microtylopteryx* in our area. Found in moist to wet forest environments, absent from dry forest.

Range.

Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Western Panama. Not as yet recorded from Belize or El Salvador, nor from Colombia or elsewhere in S. America.

1. Microtylopteryx fusiformis Rehn 1905

Rehn 1905:451.

Type locality: COSTA RICA, Prov. S. José, Carrillo.
Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Rowell, C.H.F. 2003, I. > Revision of genus.

Synonymy.

=*M. talamancae* Rehn 1929, syn. Rowell 2003.

=*M. tristani* Rehn 1929, syn. Rowell 2003.

Rehn 1929 further recognized two subspecies of *M. fusiformis*: *M.f. fusiformis* Rehn 1929: 49 (from Carrillo), and *M. f. lamprus* Rehn 1929: 51 (based on a single specimen from Monte Redondo, in the drainage of the Rio Grande de Candelaria, Costa Rica, and an "atypical" male from S. José). Statistical analysis does not show any significant morphological differences between these populations, now all synonymized (Rowell 2003).

Etymology.

Latin *fusus*, spindle; *fusiformis*, spindle-shaped. Latin *lamprus*, shining, referring to the glossy sheen of the integument

in this genus. Latin *talamancae*, of Talamanca, referring to the range of mountains running medially from NW to SE through Southern Costa Rica. The Valle de la Estrella, the type locality of *M. talamancae*, is watered by rivers arising in this range, but is itself almost at sea level and not at all mountainous; the specific name is thus misleading. The Valle de Talamanca is a name applied to the upper reaches of the nearby Rio Sixaola, towards Telire.

Diagnosis.

Medium-small, L = 13.2 - 14.6 mm, F = 8.7 - 9 mm (males). Foot formula 39:13:48. Antennae short, 16 flagellar segments, the widest being nos 12-15.

Habitus Fig. Om19, Plate Om10. Fastigium horizontal, triangular, flat or convex dorsally, at the tip often but not always incised by the groove of the frontal ridge. Vertex with or without a medial raised ridge. Tegmina spatulate, about 35% as wide as long, usually covering the tympanum and often extending briefly into A2. Posterior angle of prothoracic lobe not of a contrasting colour. Posterior margin of pronotum not deeply incised in midline. Hind femur relatively short, F/P = 2.58 - 2.65. Dorsal medial carina of hind femur irregularly granular or slightly serrate. Male supra-anal plate with proximal margins turned somewhat upwards and melanized, posterior to cercus tip edges simple, densely haired (hairs not shown in Fig. Om20). Male subgenital plate laterally compressed, rounded in lateral view, with a sulcus bounded by two ridges medially on the dorsal edge.

Female subgenital plate not much longer than the preceding sternite, smoothly polished, posterior margin bisinuate, with a rectangular lobe either side of the triangular medial egg guide. Ovipositor valves sharply toothed, the upper valve with a chisel-shaped tip. The valves can be facultatively retracted into the abdomen, in which case the egg-guide projects beyond them and forms the most posterior part of the abdomen.

Coloration varies from nearly completely black to a pale brown with conspicuous black, dark brown and gold markings. Internal face of hind femur usually brown with transverse black bands, but can be completely black or completely brown. There is also great variation between populations in size (high altitude specimens are smaller), in the length of the fastigium and tegmen, and the development of the toothed median crests of head, pronotum and abdominal segments.

Larval coloration. Very young larvae (I and II) are dark brown with black abdomen and hind legs; all of face (except eyes) and antennae creamy white; hind femur with white bands and/or spots. Later larvae (III or IV) blackish; abdominal tergites begin to show adult pattern; face and hind leg marking duller than before; antennae longer, brown with white band as in adult. All stages have a white postgenicular ring around the upper hind tibia.

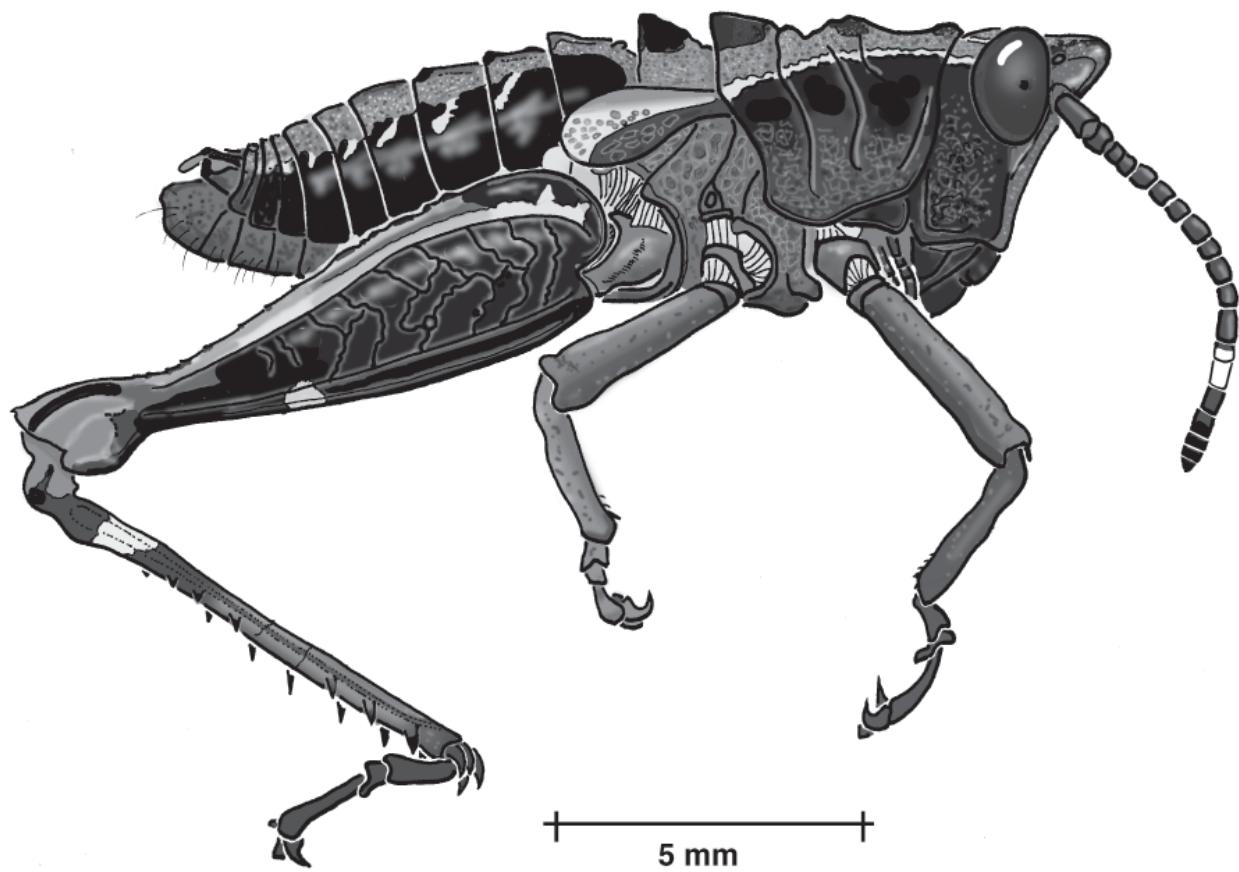


Fig. Om19. *Microtylopteryx fusiformis fastigiata*, male habitus. The more widely distributed subspecies *M. fusiformis fusiformis* is identical, except for a less pronounced rostrum and weaker midline processes.

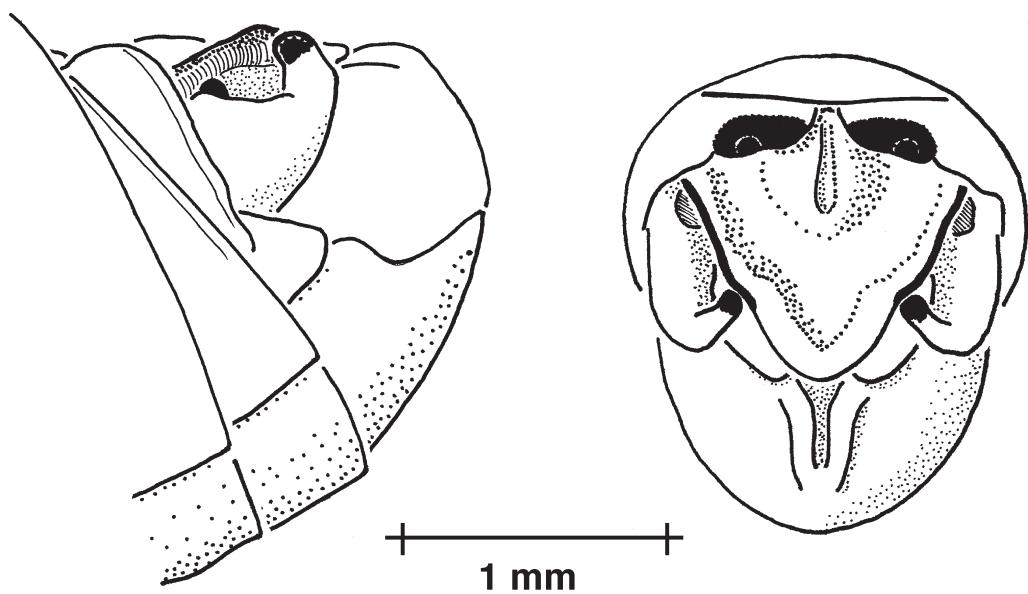


Fig. Om20. *Microtylopteryx fusiformis fusiformis*, male terminalia.

Field characters.

M. fusiformis can be distinguished from *M. hebardii*/*nigrigena* by the relatively narrower head and shorter hind legs, more fusiform and less elongate build, conspicuous white band on the antenna of both sexes (not just of the male), pale blotches at the base of the hind femora (these are actually caused by a basal expansion of the pale coloured dorsal external face of the femur, and are most pronounced in lowland populations), and the pattern of gold chevrons on the abdominal tergites; in *fusiformis* these are similar in all segments, and are wide posteriorly, narrow anteriorly.

Distribution.

Mexico, Guatemala (*M.f. chiapensis*); Honduras (*M.f. worthi*); Nicaragua, Costa Rica and Western Panama. Widely distributed in wet forest from sea level to 2500 m. Commoner on the Caribbean side of the watershed, but in Costa Rica occurs on all the peaks of the Cordillera del Norte and on the SW slopes of the Talamancas and on the Fila Costeña, and in the Pacific lowlands wherever there is appropriate forest (e.g. Candelaria, Carara, Quépos, Golfo Dulce, Osa). In Panama known to date from Bocas del Toro and Chiriquí east to Santa Fé (highlands of Prov. Veraguas). (In the highlands of Bocas del Toro *M. f. fastigiata* is found). Not to date recorded from Central Panama or further East. **Map Om10.**

Natural history.

Often common on leaf litter and understorey plants of wet forest. Selectively polyphagous. Plants fed on in the wild include *Liabum bourgeau* (Asteraceae), *Alloplectus* sp. (Gesneriaceae), *Pila* sp. and *Urera baccifera* (Urticaceae), *Ruellia* sp. and *Blechum brownei* (Acanthaceae), and a commelinaceous plant. Though commoner in light gaps, this species can also be found in closed forest. It is often found on leaf litter in dark forest environments, where the white bands on the antennae are very conspicuous and often the only part of the insect which is visible (cf. *Ateliacris*). Larvae are solitary, not gregarious, unlike those of *M. hebardii*. The similarity of the ovipositor to that of *M. hebardii*, and the known endophytic oviposition of the latter (see below), suggest that *M. fusiformis* too may lay its eggs endophytically. The sharp teeth and edges of its valves, however, suggest that these are used to cut into the plant tissue, whereas *M. hebardii* first bites a hole for this purpose. The host plant is unknown.

Comment.

This is a widely distributed and variable species with a large altitudinal range. The local populations of this genus show considerable inter- and intrapopulation variation in size, shape of fastigium and pronotum, coloration and length of elytra, and relative proportions of the femora. As a consequence, most populations can be characterized only on a statistical basis. Some populations show statistically significant differences, e.g. in the Valle de la Estrella the tegmen is on average shorter than in more northerly populations. A population in upland Bocas del Toro, Panama (*M. f. fastigiata* Rowell 2004) has a very long fastigium and prominently toothed dorsal profile (**Fig. Om 19**);

even individual members of this population can be distinguished from all other populations. There is no genitalic differentiation between any of these populations.

2. *Microtylopteryx hebardi* Rehn 1905

Rehn 1905:448.

Type locality: COSTA RICA, Prov. S. José, Carrillo.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Hebard, M. 1924a: 137. > Designation of type specimen.
- Rehn, J.A.G. 1929: 58.
- Rehn, J.A.G. 1955: 123.
- Braker, H.E. 1989.
- Braker, H.E. 1991.
- Braker, H.E. & Chazdon, R.L. 1993.
- Rowell, C.H.F. 2004. > Revision of genus.

Synonymy.

=*Microtylopteryx nigrigena* Hebard 1924: 137 (type locality: PANAMA: Prov. Colón, Gatún), reduced to subspecific rank as *M.h. nigrigena* by Rowell (2004).

Rehn 1955: 123 recognized 2 subspecies, *M.h. hebardi* of the lowlands, and *M.h. caligo* (La Palma, Costa Rica, 4900-5000' [= 1505-1536 m]), both synonymized by Rowell 2004.

Etymology.

hebardi, named for Rehn's colleague Morgan Hebard, Philadelphian orthopterist of the first half of the 20th century. *Nigrigena*, from Latin *niger*, black; *gena*, cheek, referring to the coloration of the male.

Diagnosis.

M.h. hebardi:

$L_{male} = 15.6$ mm, $F_{male} = 12.34$ mm. $P_{male} = 3.5$ mm;
 $L_{female} = 23.7$ mm, $F_{female} = 15.87$ mm. $P_{female} = 5.03$ mm;
 $L_{male}/L_{female} = 0.71$. Foot formula 35:10:55.

Habitus Fig. Om22, Plate Om11. Antennae 18-21 segments, relatively speaking nearly twice as long in males as in females. Fastigium short, 0.45× as long as wide at the base, sloping steeply downwards, concave, grooved distally in the midline. Posterior margin of prothorax broadly incised medially, anterior margin usually entire. Tegmina narrow and strap-like, not more than 15% as wide as long, covering only the upper edge of the tympanum, and of variable length. Posterior angle of prothoracic lobe contrastingly coloured with gold. Dorsal medial carina of hind femur well developed, minutely serrate in lateral view in its central region, terminating in a small medial tooth at the knee. Hind femur relatively long, $F/P = 3.17$ (females) - 3.47

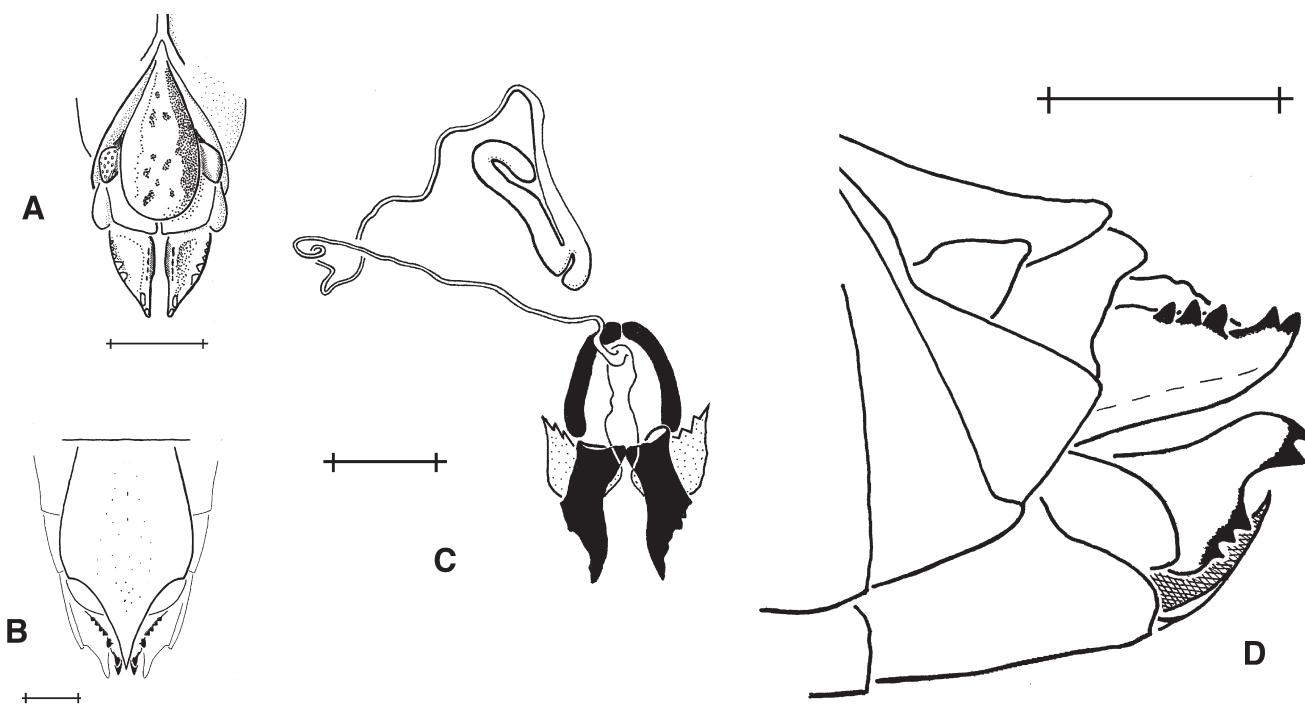
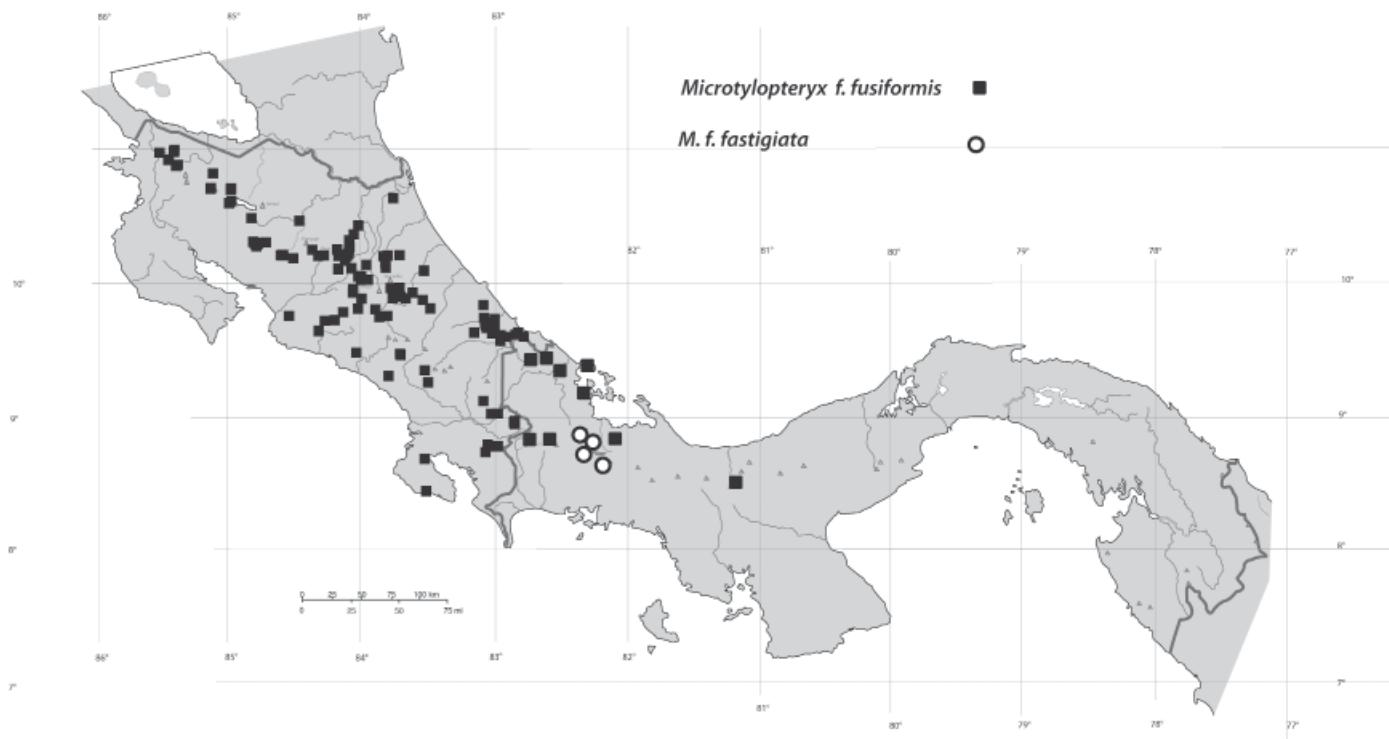


Fig. Om21. *Microtylopteryx fusiformis fusiformis*, female terminalia. A, dorsal view. B, ventral view. C, bursa copulatrix and spermatheca. D, Terminalia, lateral view: compare with **Fig. Om24**. All scale bars 1 mm.



Map Om10. Localities for *Microtylopteryx fusiformis* in Costa Rica and Panama.

(males), and relatively slender, $4.7 \times$ as long as deep. Internal face of hind femur dark brown distally, blackish proximally, with no pale bands. Abdominal segments 3 and 4 with prominent paired gold spots laterally. Male SGP pointed with a straight dorsal border. Female SGP boat-shaped, nearly twice as long as the preceding sternite, posterior margin tapering smoothly to a pointed egg-guide. Ovipositor valves with blunt, squared-off teeth – this is related to the oviposition habit (see Natural history below).

M.h. nigrigena:

About 12-15% smaller than *M. h. hebardi* ($L_{male} = 13.95$, $L_{female} = 14.28$ mm; $F_{male} = 10.66$, $F_{female} = 14.04$ mm). Other differences are in coloration (Fig. Om23, Plate Om12).

In the males, the face and genae are solid dark brown (as in the females of both *hebardi* and *nigrigena*), and not yellow or cream as in *hebardi*; most of sides of meso- and metathorax black, rather than brown. The hind tibia has a small pale post genicular band. Antennae of both sexes with 18 segments, predominantly white, with a short black band proximal to the distal white 13/14th segments, and black segments beyond that point. The gold marks of *M. hebardi* are replaced by white or cream in *nigrigena*, and the undersides of the tarsal pads and the arolia are also white. Inner face of hind femur pale proximally, darkening distally.

Field characters.

Adults and late larval instars are readily distinguished from *M. fusiformis* by the larger size, elongate, tapering, cylindrical shape, proportionately wider head, the longer slimmer hind femora which have no pale patch at their base, and the twin lateral gold spots on the abdomen which fuse mediad with the dorsal gold stripe. The bright yellow genae of the male (but not the female, which are black) are also distinctive. The black hind femora have a bottle-green sheen when alive, especially proximally and ventrally. The gold lines along the dorsal surface of all femora and the margins of the pronotal disc are much brighter and better defined in this species than in *M. fusiformis*. The typical white band on the antenna is absent in the female.

The species is also usually indicated by its typical situation on the leaf of a large monocotyledonous plant at 1-2 m height (see "Natural history" below), rather than on the forest floor or low herbage, as in the case of *M. fusiformis*.

Young larvae, which occur grouped on their foodplant (see "Natural history") have a quite different coloration. Antennae, head, mouthparts, prothorax, all entirely black except a) eyes are dark brown and b) posterior ventral angle of pronotum is pinkish yellow. Fore and mid legs, dull pale green with brown banding; coxae yellow mottled pink-brown. Terga of T2 & 3,A 1-3, leaf green dorsally, distal segments olive brown mottle. Abdominal terga laterally black, A4 & 5 bearing showy paired yellow spots by instar III. Thoracic epimera and episterna pale brown with yellow marks. Cerci thick at base, abruptly constricted to long fine yellowish points. Hind femur, lateral and

ventral external faces black, dorsal external face olive brown. Tarsi and feet blackish brown, tibial spines black. Knee brown above, ventral lobe black.

Distribution.

Nicaragua, Costa Rica, and Panama. Similar habitat to that of *M. fusiformis*, with which it co-occurs, but only up to 1100 m. elevation (highest records on V. Tenorio and in the drainage of the Rio San Lorenzo). In Costa Rica and Nicaragua effectively confined to the Caribbean slope and the volcanoes of the Cordillera del Norte: one record from the anomalous wet forest of Cerro el Hacha at 300 m in Guanacaste Curiously, it is absent from apparently suitable habitat in the southern half of Costa Rica (Map Om11).

M. h. hebardi is not so far recorded from Panama. Further East in Central Panama it is replaced by *M. h. nigrigena*. The latter is known only from the type series and two females from near the same locality, (Gatún) and a single pair from Cerro Copé, Prov. Coclé. As these are some of the best collected areas in Panamá, the subspecies must be very infrequent there.

Natural history.

One of the best known of neotropical grasshoppers in respect to food plant selection and oviposition, due to the work of H.E. Braker (see references above). Ecologically very different from the sympatric and congeneric *M. fusiformis*. *M. h. hebardi* is an oligophage on broad-leaved monocots (Araceae, Marantaceae, Heliconiaceae). The eggs are laid endophytically in the rhachis of the leaf; the female first bites a hole in the outer wall of the rhachis, then inserts the abdomen into this hole. This presumably explains the relative regression of the teeth of the ovipositor valves (compare Figs Om24, Om21).

The distinctively coloured larvae (see above) are subsocial and remain grouped throughout their larval history, often on a single leaf, which can be severely damaged by the end of their development.

In undisturbed forest especially associated with the understorey palms such as *Geonoma cuniata*, *G. congesta*, *Asterogyne martiana*, *Chamaedoria exorrhiza* and *Synechanthus warscewitziana*. In disturbed or wetter areas *Heliconia* or *Calathea* or *Maranta* spp. are used instead. Adults are occasionally seen feeding (but not ovipositing!) on a variety of other plants, such as *Vriessia* (Bromeliaceae) or domestic banana (*Musa*, Musaceae). There are no field observations on *M.h. nigrigena*, but its natural history is probably identical.

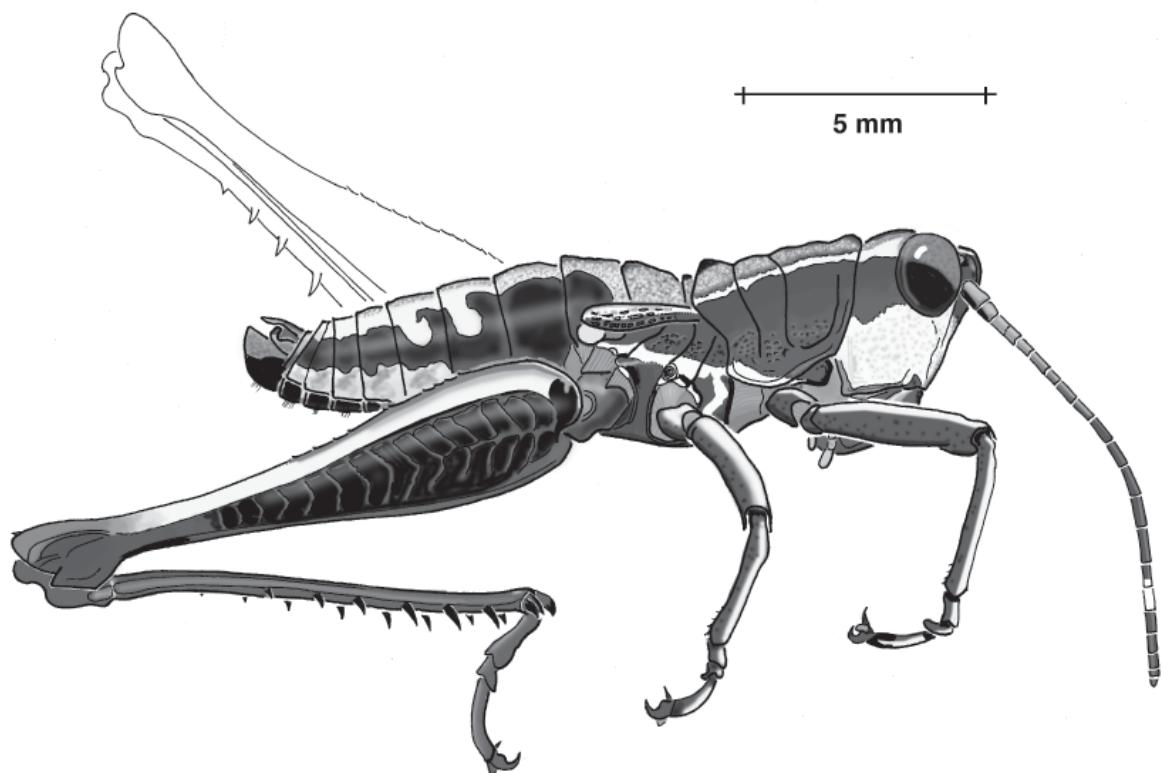


Fig Om22. *Microtylopteryx hebardi hebardi*, male.

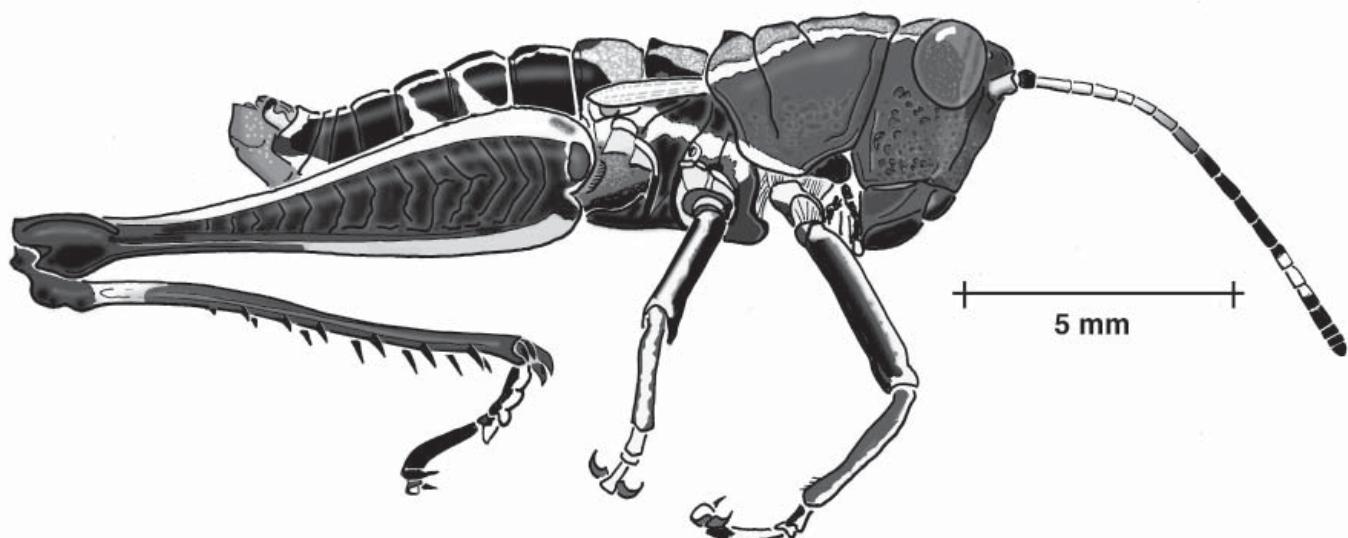


Fig. Om23. *Microtylopteryx hebardi nigrigena*, male habitus.

Pseudanniceris
Descamps 1977

Descamps 1977a: 72. (Includes key to spp.)
Type species: *Anniceris nigrinervis* Stål 1878.

Subsequent literature.

- Descamps 1977b.: 222.

Etymology.

Greek *pseudes*, false; resembling but different from *Anniceris* Stål 1878 (Syntomacrini Syntomacrae), the original genus. (*Anniceris* is currently a monospecific genus, confined to Peru. A medley of unrelated grasshoppers, also including species of *Jodacris* [Ommatolampinae Abracrini] and of *Ampelophilus* and *Tela* [Proctolabinae], were originally included in this genus by the early authors.). “*Anniceris* of Cyrene was an ancient Greek, said to have bought Plato from slavery and given him freedom” (Carbonell 2000, Metalepta 20 [2]: 9).

Diagnosis.

(Modified from Descamps 1977a). Small insects. (L = 12 [males]-16 mm [females]). Brachypterous; elytra extend into A4. Fastigium short, rounded distally, with a thin raised rim. Frontal ridge well developed dorsal to medial ocellus, obsolete below it. Eyes large, globose, interocular space small, less than half the thickness of the antennal scape. Antennae filiform, flagellum with 18 segments.

Pronotal and thoracic integument finely rugose. Pronotum rounded, lateral carinae absent, median carina obsolete between sulci, weakly developed at anterior and posterior extremities. Disc crossed by three shallow sulci. Anterior margin of pronotum emarginate medially, posterior margin obtusely angulate. Prosternal process short, sharply pointed. Mesosternal space transverse, the metasternal lobes touching each other. Tympanum greatly reduced, probably non functional. Hind femur with well-developed dorsal carina, smooth. Knee with a short medial spine, dorsal lobes of knee smoothly rounded, lower lobe pointed. Seven external and 9 internal hind tibial spines. First hind tarsal joint laterally expanded.

Male: (Figs Om25, Om26). Tenth tergite with a small black furcula. Supra-anal plate simple, triangular, with paired and medial black spots. Male cercus in lateral view thick at the base, then abruptly upturned and narrowed; in dorsal view bifurcate, the longer, outer fork curving upwards, the shorter, inner, fork projecting horizontally mediad; both forks are melanized at their tips. (Amedegnato [1978] interprets the inner fork as being the internal basal apophysis of the cercus, which has migrated distally). Subgenital plate short, pointed, upturned.

Lateroventral sclerites present, oval, sclerified. Lophi of epiphallus melanized, simple. Ancorae membranous. Oval sclerites minute, at posterior corners of epiphallus. Cingular

apodemes straight, parallel, the zygoma reduced to a narrow transverse bar joining the two halves. Rami large, convex. Arch well developed, dorsal aedeagal valves short, straight, horizontal. Endophallic apodemes markedly flattened and expanded dorsoventrally. Middle part of endophallus also dorsoventrally flattened in its dorsal region extending laterally over the walls of the spermatophore sac. Gonopore process with a well developed rectangular ventral expansion. Flexure very narrow. Ventral aedeagal sclerites reduced to short horizontal rods, subequal in length to dorsal aedeagal sclerites.

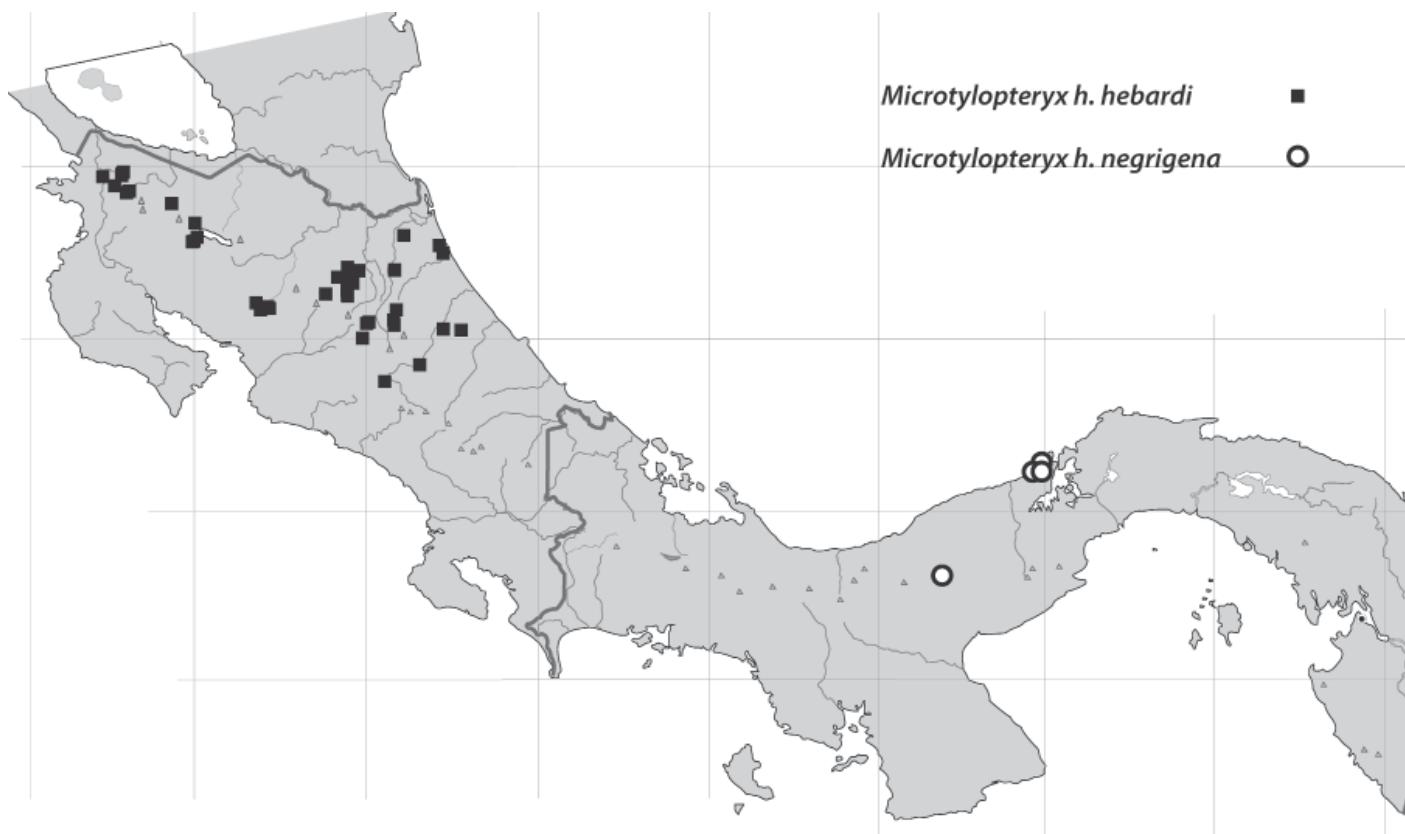
Female: Supra-anal plate simple, rounded at tip. Cerci very short, triangular in lateral view, pointed. Ovipositor valves short, laterally compressed, with sharp serrated edges appropriate for endophytic oviposition. Subgenital plate smooth, simple, subtriangular, tapering smoothly to the apex; egg guide short, pointed, slanted upwards at 30°. Postvaginal sclerites with a single, poorly developed columella. Bursa copulatrix small and thin-walled; spermatheca with a smaller preapical diverticulum and a larger cylindrical apical diverticulum, reflexed 180° on itself.

No. of known spp.

Three. In our region, one.

Generic range.

Guyana; Ecuador; Colombia, Panama, Costa Rica, Mexico. The three species are highly disjunct, one in Guyana, one in the upper Amazon, and one in Western Colombia, Central America, and Mexico.



Map Om11. Localities for *Microtylopteryx hebardi* in Costa Rica and Panama.

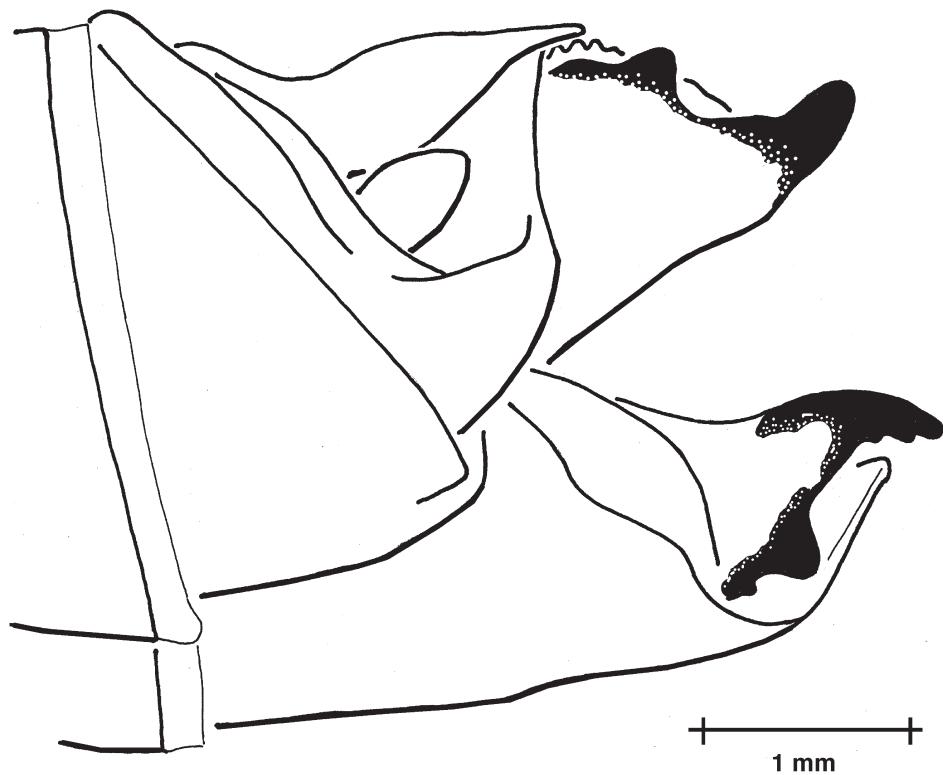


Fig. Om24. *Microtylopteryx hebardi nigrigena*, ovipositor. Compare with **Fig. Om21.**

Pseudanniceris nigrinervis (Stål 1878)

Anniceris nigrinervis Stål 1878: 83.

Type locality: Nueva Grenada (= Colombia).

Location of type specimen: Stockholm Museum.

Etymology.

Latin *nigrinervis*, black-veined. Stål was presumably referring to the blackish coloration of the bases of the radial and medial veins of the green elytra.

Subsequent literature.

- Rehn, J.A.G. 1905: 430. > As *Jodacris* (?) *costaricensis*.
- Bruner, L. 1908: 283. > As *Chrysopacris* *costaricensis*.
- Kirby, W.F. 1910: 429. > As *Chrysopacris* *costaricensis*.
- Hebard, M. 1923: 252. > As *Anniceris* *costaricensis*.
- Hebard, M. 1924: 126. > As *Anniceris* *costaricensis*.
- Descamps, M. 1977: 74. > Transfers to *Pseudanniceris*.

Synonymy.

=*Jodacris* (?) *costaricensis* Rehn 1905: 430, synon. Descamps 1977: 74.

=*Chrysopacris* *costaricensis* Bruner 1908: 283, synon. Descamps 1977: 74.

=*Anniceris* *costaricensis* Hebard 1923: 252; 1924: 125, synon.

Descamps 1977: 74.

Diagnosis.

$P_{male} = 3.01$ (2.88 - 3.13), $P_{female} = 4.07$ (3.68 - 4.33) mm; $F_{male} = 7.88$ (7.50 - 8.18), $F_{female} = 9.77$ (9.01 - 10.70) mm; $L_{male} = 12.30$ (11.63 - 12.81), $L_{female} = 15.71$ (14.52 - 16.85) mm. Sexual dimorphism (P_m/P_f) = 0.74; males have proportionately slightly longer hind femora and feet. Foot formula 3I:17:5I in both sexes.

Habitus **Fig. Om25, Plate Om13.** Brachypterous; coloration dull green or green-blue, hind femora with orange-red bases (in Costa Rica, but not in Panama) and ochre knees, blue hind tibiae, and (in male only) bright blue eyes. Male cercus two pronged in dorsal view, sharply upturned in lateral view (**Fig. Om26A, C**).

The male internal genitalia of *P. amazonicus* were figured by Descamps (1977a) and Amedegnato (1978); those of *P. nigrinervis* are very similar.

Field characters.

Males are much smaller and much more brightly coloured than the females, and very distinctive with their bright blue eyes (when alive – the colour fades rapidly on death). Male larvae also have bright blue wing buds, and the hind knees are green, not orange-brown as in the adult. The females are duller, olive or bronze in ground colour, and lack the blue eyes. As previously noted by Descamps (1977a), the species varies in coloration and in the length of the elytra, both between populations and within them. Especially, the East and Central

Panamanian forms lack the orange bases to the hind femora seen in Costa Rica. Coincidentally (? - there seems to be no reason to postulate mimicry), this is also true of *Ampelophilus olivaceus* (Proctolabinae), which often occurs sympatrically.

Individuals of these two species (*A. olivaceus* and *Ps. nigrinervis*) can readily be confused where they are sympatric on the Pacific slope of Costa Rica and Panama; similar in size and form, both are also brachypterous, green in ground colour, blueish around the eyes and (in Costa Rica) with reddish bases to the hind femora. Even the males of both species seem to confuse the two except at very close range! *Pseudannicerus* can be distinguished in the field by the relatively much shorter antennae and the angulate posterior margin of the pronotum. In the hand, there are numerous differences, e.g. in the male cerci and supra-anal plates.

Distribution.

Colombia, Panama, Costa Rica, Mexico. Not so far recorded from the intervening Central American countries, but probably occurs there. In our area extends from Darién to the Nicaraguan border. Found on both Atlantic and Pacific slopes, wherever there is suitable habitat. Much more frequent below 300 m, but reaches 700 m in the Cordillera del Norte of Costa Rica. **Map Om12.**

Natural history.

A typical and sometimes common resident of tree-fall clearings, forest edges, and areas of secondary forest succession. Certainly oligophagous, possibly monophagous: a specialist on the thorny vine *Bytneria aculeata* (Sterculiaceae), which is common in these habitats. It is usually found upon this plant. As befits a specialist, the eggs are laid in the pithy stem, similar to the situation in *Microtylopteryx hebardi* (q.v.).

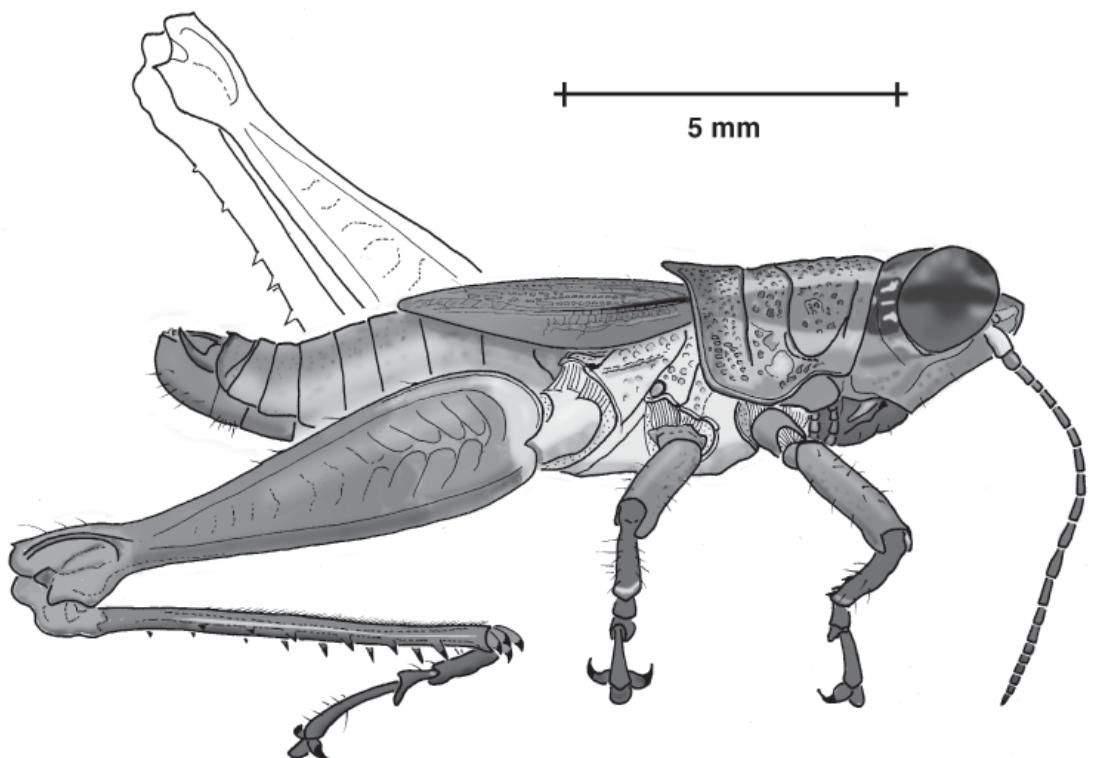


Fig. Om25. *Pseudanniceris nigrinervis*.

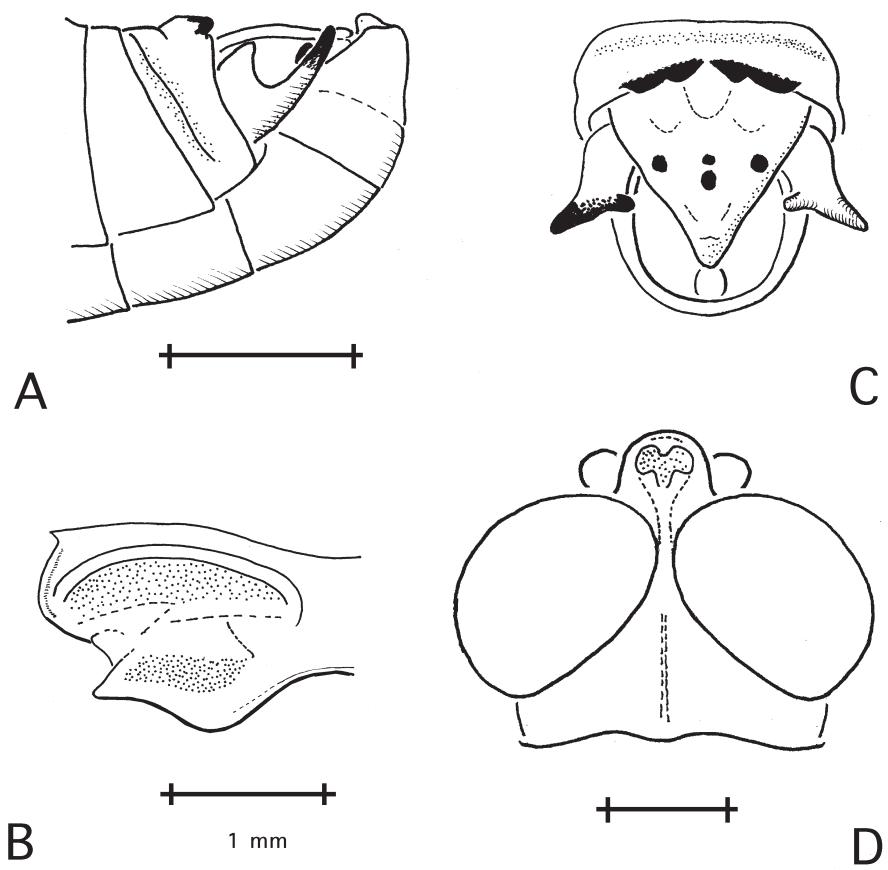


Fig. Om26. *Pseudanniceris nigrinervis*, male. A & C, terminalia. B, hind knee. D, vertex and fastigium.

Tribe Abracrini

Amedegnato 1974

Diagnosis.

(From Amedegnato, 1977: 151, modified). Insects of small to medium size, generally squat in form and with a marked tendency to apterism: 7 of 16 current genera are micropterous or apterous, the others are macropterous. Coloration generally brown or blackish with yellow spots, rarely green. Cuticle most often smooth, never very rugose (except in some *Rhachicreagra*).

Head slightly opistognath with a short fastigium. Frons straight in profile. Lateral carinae of the face diverging not at all or very little. Eyes generally less protuberant than in the other ommatolampine tribes. Interocular space of male narrow, equal or less than the diameter of the antennal scape. Antennae normally filiform (but ensiform in *Xiphioala*).

Prosternum with a low process bearing a small sharp tubercle (except in *Eujivarus* – tubercle bilobed – and some *Sitalces*). Disc of pronotum rounded in section, lacking lateral carinae (except *Xiphioala*, disc flattened, and *Rhachicreagra*, sharply crestate). Medial carina poorly developed or absent (except in *Rhachicreagra*). Disc crossed by three rather shallow sulci.

Tympanum present. Margin of male 10th abdominal tergite with or without furcula, but never melanized. Supra-anal plate generally triangular and smooth, lacking black calluses.

Male subgenital plate short, with the pallium barely or not at all visible (except in *Rhachicreagra* and *Teinophaus*). Male cercus (Figs 246-249) often forked at the extremity, long, broad, massive; or long, thin and twisting; or again short, conical, with sporadically a small black protuberance in place of the internal apophysis of other tribes (*Xiphioala*, *Sitalces*).
Hind tibia with 7-8 external spines.

The male genitalia are diagnostic of the Tribe.

a. Epiphallus layer:

Epiphallus large, with well-sclerotized ancorae. Lophi digitiform, bifid, or formed into a lobe, always flattened and never black (except slightly in *Eujivarus*). Postepiphallus sclerites (Carbonell et al. 1980) usually present, paired or medially fused, sometimes embedded in a thickened fold of membrane overhanging the ecto- and endophallus posteriorly. Ventrolateral sclerites present and well developed (e.g. *Rhachicreagra*) or absent (e.g. *Abracris*).

b. Ectophallus layer:

Cingulum normal. Sheath well developed, enveloping laterally the superior sclerites of the aedeagus. Ectophallus membrane sclerotized at the level of the dorsal sclerites of the aedeagus, but often remains membranous at the tip. Ectophallus membrane in the region of the cingular rami prolonged and secondarily thickened to a variable extent, forming what appear superficially to be posterior processes of the rami, integrated to

a greater or lesser degree into the dorsal aedeagal valves. There is considerable variation in this feature between the genera, and the morphologically simplest form, from which the others can most readily be derived conceptually, is found in *Agesander* (Colombia).

c. Endophallus layer:

Endophallus apodemes flattened dorsoventrally. The central part of the endophallus slightly compressed dorsoventrally, stretched over the spermatophore sac laterally. Flexure very ligamentous. Gonopore process with a rectangular or lobiform ventral expansion. Inferior and superior sclerites of aedeagus of the same length, or the superior sclerite slightly longer, generally rather simple.

Female genitalia. Postvaginal sclerites without columella (e.g. *Agesander*, *Abracris*) or with one single columella (*Jodacris*). Bursa copulatrix usually very large, much more voluminous than the aedeagus (e.g. *Jodacris*, *Agesander*, *Xiphioala*, *Teinophaus*, *Abracris*).

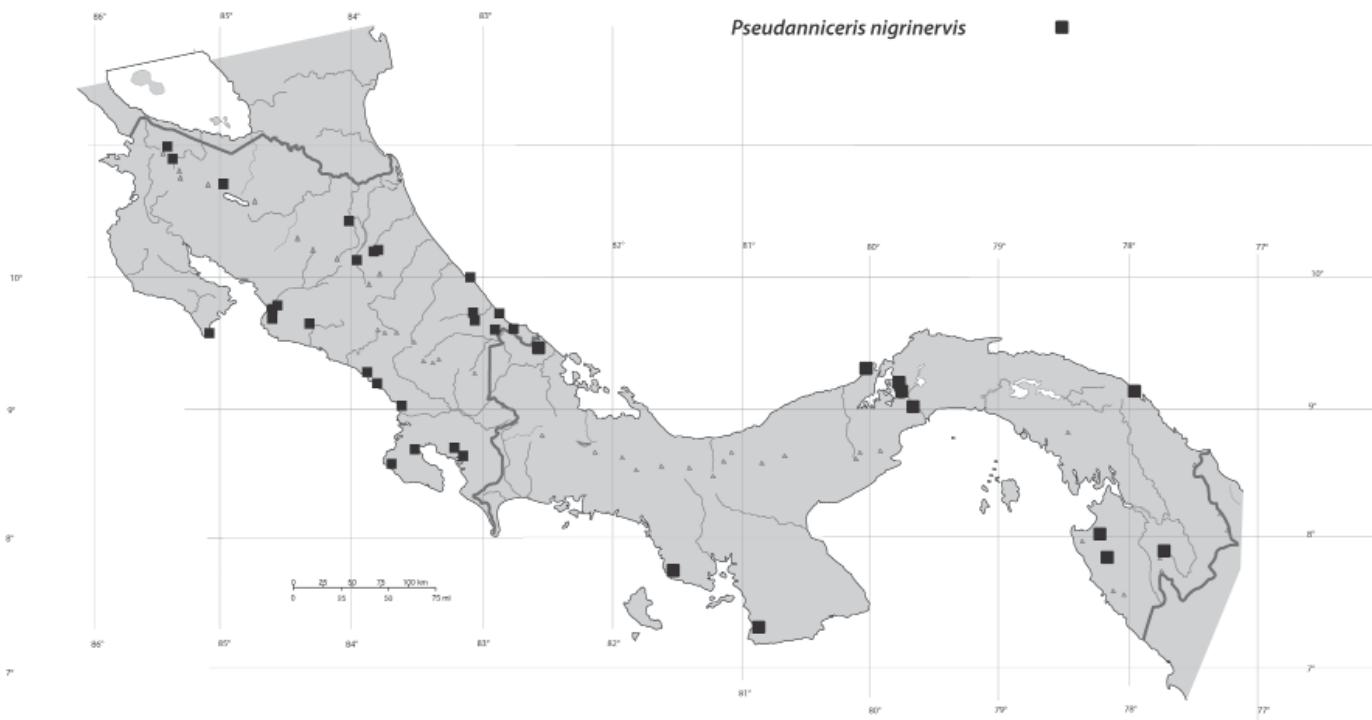
Spermatheca with a small preapical diverticulum and a long apical diverticulum, reflexed back on itself (e.g. *Abracris*). Ovipositor valves robust, simple, unmodified.

Number of included genera.

Sixteen. In our area, three.

Tribal distribution.

Mexico, Central America, Colombia and South America East of the Andes, South to mid-Argentina. *Abracris* is present in some of the Antilles too.



Map Om12. Localities for *Pseudanniceris nigrinervis* in Costa Rica and Panama.

Abracris Walker 1870

Type species: *Abracris dilecta* Walker 1870: 642 (q.v.), by monotypy.

Subsequent literature.

- Kirby, W.F. 1910: 428.
- Hebard, M. 1924: 131. > As *Osmilia*.
- Walker, F. 1870: 642. > *Abracris*.
- Amedegnato, C. 1974: 202. > Ommatolampinae: Abracrini
- Carbonell, Mesa & Conduzza 1980: 279. > Comparison with *Omalotettix*.
- Roberts, H.R. & Carbonell, C.S. 1981: 3: 2. > Revision of genus.
- Otte, D. 1995: 67. > Abracrini, *Abracris*

Synonymy.

=*Osmilia* Stål 1873: 68, synon. Roberts & Carbonell 1981: 2.

Etymology.

Obscure. Conceivably from Latin *abruptus*, steep, with reference to the profile of the frons?

Diagnosis.

Small to medium size. Predominantly brown coloration, with an oblique yellowish or light brown line running along the metathoracic epimeron. Antennae filiform, with 19-21 segments. Alate, the wings comfortably exceeding both hind knees and the abdomen. Frontal ridge rather weakly developed in dorsal view. Anterior margin of pronotum straight, sometimes with slight medial notch; posterior margin convex. Lateral pronotal carinae absent, dorsal pronotal carina weak, cut by three transverse

sulci. Prosternal spine conical and more or less pointed. Upper and lower lateral lobes of knee (Fig. Om28) rounded, terminal medial spine absent. Seven-8 external hind tibial spines, 9-10 internal; inner hind femoral spurs conspicuously longer than outer ones.

Male genitalia (see also Roberts & Carbonell 1981). Cercus simple, or forked at tip. Furcula almost absent. Supra-anal plate elongate triangular, rounded at tip. Subgenital plate pointed, short or slightly elongate.

Internal genitalia. Epiphallus with large erect oblong lophi, ancorae slender and sharply pointed, oval sclerites present. Ventrolateral sclerites absent. Postepiphallus sclerites present, either medially fused or paired. Cingular apodemes slender, straight, scarcely or not at all diverging. Membranes of cingular rami expanded and sclerotized towards the posterior; dorsal aedeagal sclerites laterally compressed. Arch and dorsal aedeagal valves well developed. Endophallus with fractured flexure, anterior apodemes dorsoventrally flattened, diverging. Endophallic ventral aedeagal valves robust, concave on their medial surface, partially surrounding the smaller dorsal valves.

Female genitalia. There are no significant differences between the female genitalia of our two species. Ovipositor valves robust, weakly toothed, typical of soil-ovipositing species. Bursa copulatrix very long, robust, with a spiral ornamentation; spermatheca typical of the tribe, with a long folded apical diverticulum and a small preapical diverticulum. Subgenital plate with small rectangular processes either side of the short pointed egg guide, which is inflected upwards at about 20°. Postvaginal sclerites lacking a columella.

Number of known species.

Three; in our area, 2. Our species, *A. flavolineata* and *A. dilecta*, are very widely distributed; the third species, *A. bromeliae* Roberts & Carbonell, is confined to a small area of northern Argentina.

Generic range.

Mexico, Central America, South America east of the Andes, and south to mid-Argentina.

***1. Abracris flavolineata* (DeGeer 1773)**

Acridium flavo-lineatum De Geer 1773: 497.

Type locality: SURINAME, no other details.

Location of type specimen: lost.

Etymology.

Latin *flavus*, yellow; *linea*, linen thread, line.

Subsequent literature.

- Burmeister, H. 1838: 634.
- Walker, F. 1870: 640. > Transfers to *Calacris*.
- Stål, C. 1873: 68. > Transfers to *Osmilia*.
- Giglio-Tos, E. 1897: 5. > As *O. violacea*.
- Rehn, J.A.G. 1905: 443. > As *O. tolteca*.
- Bruner, L. 1900-1910 (1908): 330. > As *Osmilia*.
- Kirby, W.F. 1910: 539. > As *Osmilia*.
- Rehn, J.A.G. 1916: 295. > As *Osmilia*.
- Hebard, M. 1924a: 131. > As *Osmilia*.
- Hebard, M. 1924b: 189. > As *Osmilia*.
- Rowell, C.H.F. 1983: 772. > As *Osmilia*.
- Roberts, H.R. & Carbonell, C.S. 1981: 3. > Transfer to *Abracris*.

Synonymy.

- =*Acridium coelestre* Burmeister 1839: 634, synon. Kirby 1910: 539.
- =*Acridium obliquum* Walker 1870, synon. Kirby 1910: 539.
- =*Osmilia coelestis* Bruner 1908, synon. Kirby 1910: 539.
- =*Osmilia tolteca* Saussure 1861: 163, synon. Hebard 1923: 265.
- =*Gryllus violaceus* Thunberg 1824: 413, synon. Hebard 1923: 265; Roberts and Carbonell 1981: 4.
- =*Acridium (Osmilia) saussurei* Scudder 1875: 274, synon. Hebard 1924: 189.
- =*Acridium labratum* Scudder 1869: 634, synon. Hebard 1924: 189.

Diagnosis.

P_{male} = 4.69 (4.69 - 6.13), P_{female} = 6.85 (6.35 - 7.55) mm; F_{male} = 14.09 (13.07 - 15.97), F_{female} = 18.62 (17.81 - 19.73) mm; L_{male} = 24.30 (22.34 - 28.44), L_{female} = 32.87 (29.93 - 35.14) mm. Sexual dimorphism (P_m/P_f) = 0.75; proportions identical, except males have slightly longer elytra. Foot formula 42:13:45, foot 27% as long as femur.

Habitus Fig. Om27, Plate Om14. Anterior margin of pronotum straight, posterior margin obtusely angulate, subpolygonal (see **Fig. Om28**). Prosternal spine sharply pointed. Male cerci (**Fig. Om28**) simple, long, slightly inwardly curved, pointed. Supra-anal plate (**Fig. Om28**) with proximolateral ridges, absent in *A. dilecta*, but without a thickened rim. Dorsolateral and ventrolateral faces of hind femur predominantly yellow. In our area and Northern S. America the hind wings are pale yellow, but are pale blue in Belize (pers. obs.) and in Amazonia and more southerly S. America (Roberts & Carbonell 1981) – hence the synonymous specific names *coelestre*, *coelestis* and *violaceus*.

The distinctive male internal genitalia are figured by Roberts & Carbonell 1981: 8. In their drawing the postepiphalllic sclerites are fused medially; in Costa Rican material they are always separate.

Field characters.

Best identified by the oblique yellow stripe on the thoracic pleura plus the longitudinal yellow lines on the hind femur. The larvae, which are bright green when young and green/brown polymorphic from instar III onwards, are easily confused with those of *Schistocerca*, but can be distinguished by their flatter face and shorter antennae. Distinguished from *A. dilecta* by the much larger size, the nonbanded hind femora marked longitudinally with yellow, and the brown (not blue-grey) hind tibiae.

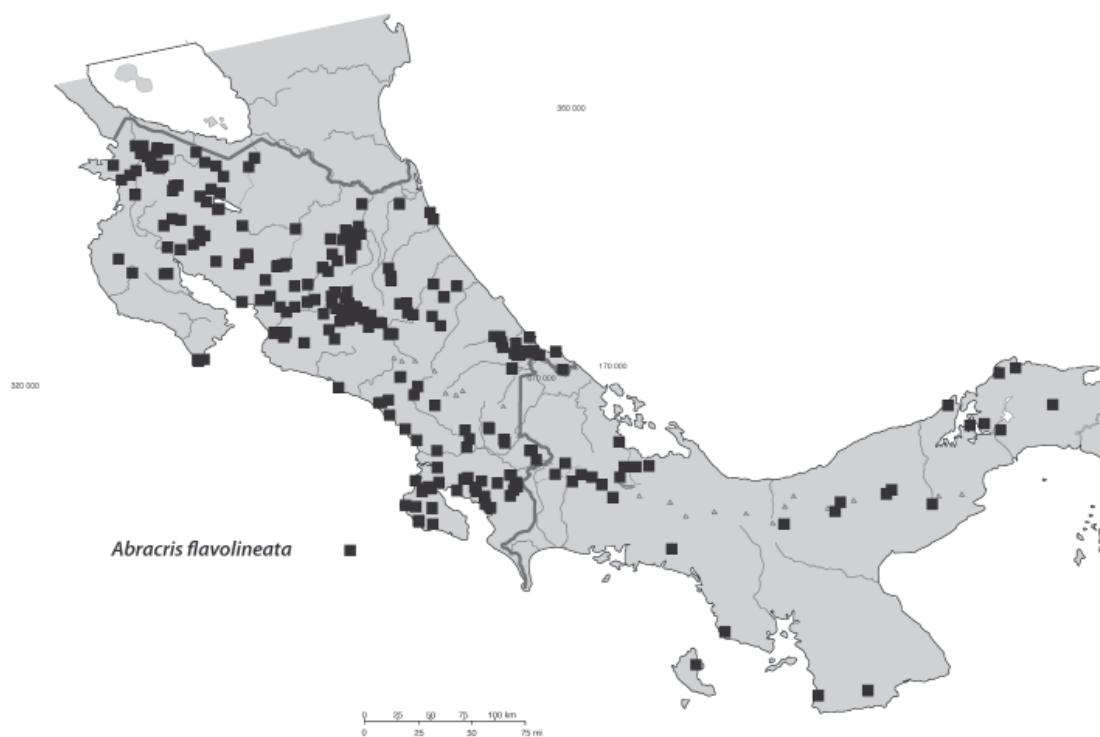
The adults are somewhat variable in ground colour, especially the females, varying from red-brown (as illustrated) to dark grey; females often have darker patterning along the leading edge of the elytron.

Distribution.

Mexico, all of Central America, Jamaica, South America East of the Andes to mid-Argentina. **Map Om13.**

Natural history.

One of the commonest Central American grasshoppers, found where ever there is large scale secondary succession or disturbed land in the forest zones. It is not however a typical inhabitant of treefall clearings in primary forest, though often abundant at forest edges. Occurs from sea level to a least 1800 m, on both Caribbean and Pacific slopes. Markedly polyphagous, but with a strong preference for Asteraceae; often eats chiefly *Wedelia trilobata* where this is available. Agile and rapid fliers, especially the males, but make only short flights. Their abundance and conspicuous behaviour leads them to dominate collections of grasshoppers made by non-orthopterists.



Map Om13. Localities for *Abracris flavolineata* in Costa Rica and Panama.



Map Om14. Localities for *Abracris dilecta* in Costa Rica and Panama.

2. Abracris dilecta Walker 1870

Walker 1870: 642.

Type locality: BRAZIL, Santarém.

Location of type specimen: BMNH London.

Subsequent literature.

- Kirby, W.F. 1910: 428.
- Rehn, J.A.G. 1916: 294.
- Carbonell, C.S., Mesa, A. & Condutta, V.L. 1980: 280. > Comparison with *Omalotettix*, karyotype.
- Roberts, H.R. & Carbonell, C.S. 1981: 2.
- Sperber, C.F. 1996: 127. > Diet in Brasil.

Synonymy.

=*Osmilia meridionalis* Bruner 1900-1910 (1908): 281, synon. Rehn 1916: 294.

=*Osmilia signatipes* Bruner 1906: 673, synon. Kirby 1910: 428.

=*Omalotettix conspersipennis* Bruner 1908: 281, synon. Roberts & Carbonell 1981: 3.

Etymology.

Latin *dilectus*, beloved. Significance obscure.

Diagnosis.

$P_{male} = 3.15$ (3.06 - 3.23), $P_{female} = 4.13$ (4.01 - 4.26) mm; $F_{male} = 9.01$ (8.96 - 9.06), $F_{female} = 11.48$ (10.71 - 11.85) mm; $L_{male} = 16.61$ (16.45 - 16.77), $L_{female} = 22.19$ (19.9 - 23.13) mm. Sexual dimorphism (P_m/P_f) = 0.76; males have proportionately slightly longer elytra, hind femora and feet. Foot formula 41:13:46 in both sexes, foot 28% as long as femur.

Habitus **Fig. Om29, Plate Om15**. Prosternal spine rather short and blunt. Anterior margin of pronotum straight, posterior margin smoothly convex, not subpolygonal as in *A. flavolineata*. The male cercus is long, inwardly curved and pointed, and seen in dorsal view obviously forked at the tip, the inner branch being spatulate, the outer pointed (**Fig. Om30 A,B**). Wings smoky brown, darker than the semitransparent elytra and responsible for the dark colour of the folded complex.

The male internal genitalia are figured by Carbonell, Mesa & Condutta 1980: 282 and by Roberts & Carbonell 1981: 8.

Field characters.

Much smaller (66%) and relatively more slender than *A. flavolineata*, and often paler in colour; the outer faces of the hind femora are pinkish brown or grey, conspicuously banded in black, the inner and lower faces are predominantly light olive green with black banding. Hind tibia with a postgenicular pale straw ring, then blue grey, shading to brown at the tip. The larva is greyish green with a fine white speckle and pink feet; it tends to hold the antennae close together, straight in front of it.

Almost indistinguishable from *Omalotettix chapadensis* (Bruner) without genital examination. According to Roberts &

Carbonell 1981, however, most individuals of *Omalotettix* have the underside of the hind coxae coloured black.

Distribution.

Mexico, Central America, South America East of the Andes to Uruguay. In our area found exclusively on the Pacific slope, with the exception of a single record from near Colon, Panama. **Map Om14**.

Natural history.

Occurs in open dry forest or savanna, sometimes on foreshores or along dry road edges. Rarely overlaps with *A. flavovittata*. Usually found in association with weedy Asteraceae or Lamiaceae. Sperber (1996) analysed the diet of the species in a dry Brasilian forest: at least 14 Angiosperm species in 10 families were taken, the most important being *Elephantopus mollis* (Asteraceae) and *Hyptis suaveolens* (Lamiaceae), which together made up 50% of all food. Grasses (Poaceae) were found in only about 10% of individuals.

Omalotettix Bruner 1906

Bruner 1906: 613-694.

Type species: *Jodacris(?) nebulosa* Bruner 1900.

Subsequent literature.

- Carbonell, C.S., Mesa, A. & Condutta, V.L. 1980. > Karyotype, restores genus.
- Roberts, H.R. & Carbonell, C.S. 1981. Review of genus.

Etymology.

Greek *homalos*, even, unremarkable, from *homos*, one and the same; *tettix*, Greek for cicada, conventionally used for grasshopper genera. A reference to the undistinctive appearance of the genus.

Diagnosis.

(From Roberts & Carbonell 1981). Habitus **Fig Om31, Plate Om16**. Similar in appearance to *Abracris*, especially A.

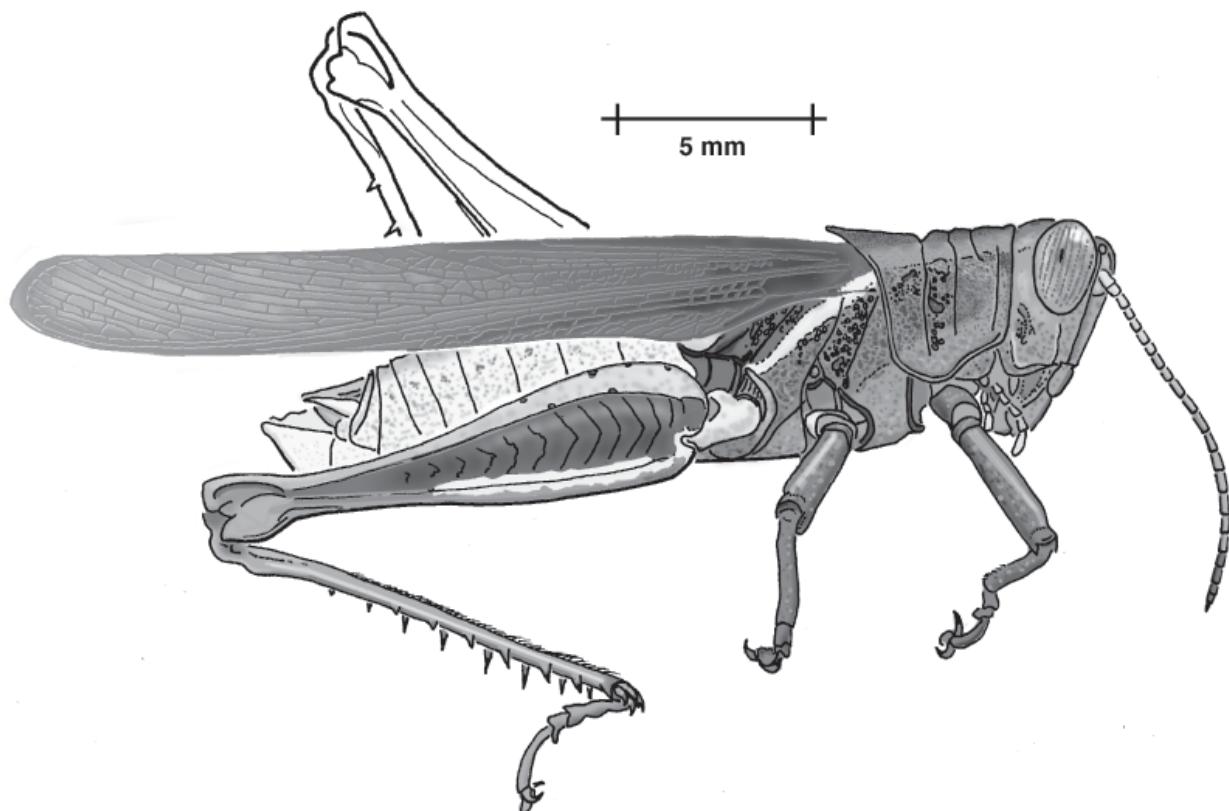


Fig. Om27. *Abracris flavolineata*, male habitus.

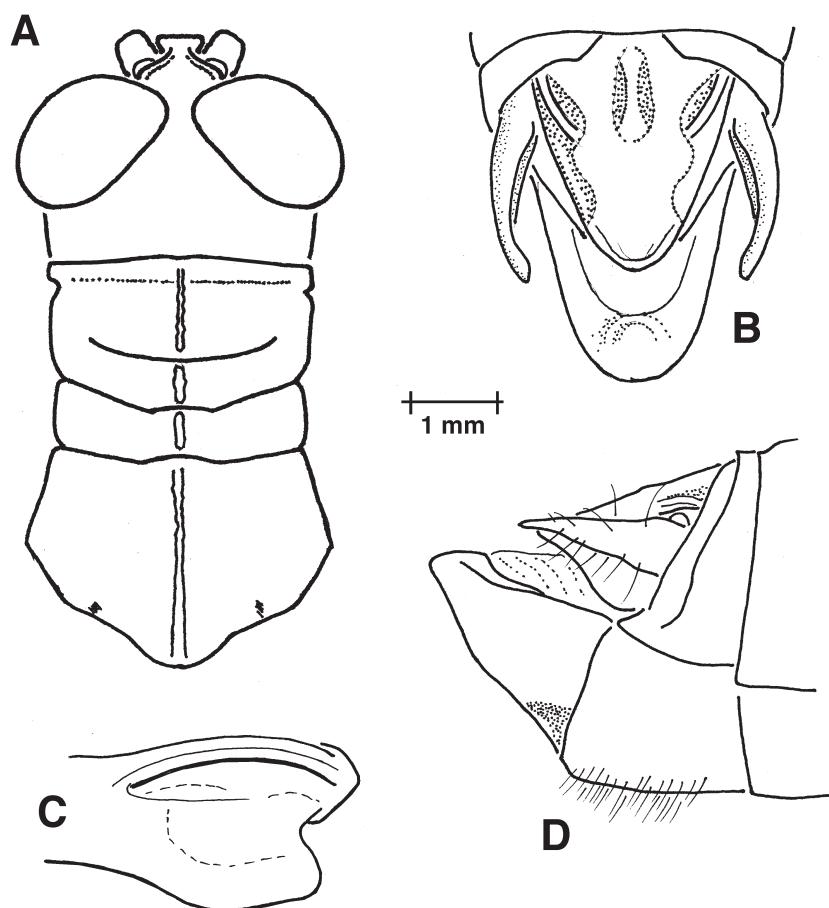


Fig. Om28. *Abracris flavolineata*, male. A, vertex and pronotum, dorsal view. B & D, terminalia. C, hind knee.

dilecta, differing externally only in minor characters, but very different in phallic structure. Ventral surface of hind coxa and outer ventral surface of hind femur marked with black pigment. Fastigium slightly more protuberant than in *Abracris*, adjoining frontal ridge narrower, about 2/3 or less of the distance between the lateral ocelli. End of male subgenital plate pinched in at posterior end to form a point. Angle formed by posterior margin of female subgenital plate in ventral view more obtuse than in *Abracris*. Pale diagonal stripe on thorax, and dark or black banding on hind femora usually present, at least on inner face.

The male genitalia are distinctive: the ejaculatory sac is reduced to a very small size. The postepiphallie sclerites, characteristic of the tribe, are very well developed and fused into a single medial structure; the upper and lower apical aedeagal valves are fused.

No. of known species.

Two. Within our area, one.

Generic range.

Mexico, Panama, possibly other Central American countries. Colombia, French Guiana, Brazil, Argentina.

Omalotettix chapadensis Bruner 1908

Bruner 1900-1910 (1908): 282.

Lectotype locality: BRAZIL: Mato Grosso, Chapada dos Guimarães.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *homalos*, equal, undistinguished, unremarkable; *tettix*, cicada, but conventionally used for grasshopper.

Subsequent literature.

- Roberts, H.R. & Carbonell, C.S. 1981: 10. > Designation of lectotype, genital structures.

Diagnosis.

$P_{male} = 3.47$ mm, $F_{male} = 9.56$ mm, $L_{male} = 16.37$ mm.
Foot formula 42:13:45, foot 27% as long as femur.

Field characters.

At a distance indistinguishable from *Abracris dilecta*. In the hand distinguished by the black pigment on the underside of the hind coxa. Additionally the tip of the male subgenital plate is narrowed to a point. The tip of the male cercus of Mexican specimens, as figured by Robert and Carbonell (their Fig 4), is oblique, flattened laterally and only slightly notched. That of the sole Panamanian male specimen (**Fig. Om30**) is more deeply forked, with the upper and inner branch slightly longer than the lower and outer one (the reverse of the situation in *A. dilecta*, **Fig. Om28**).

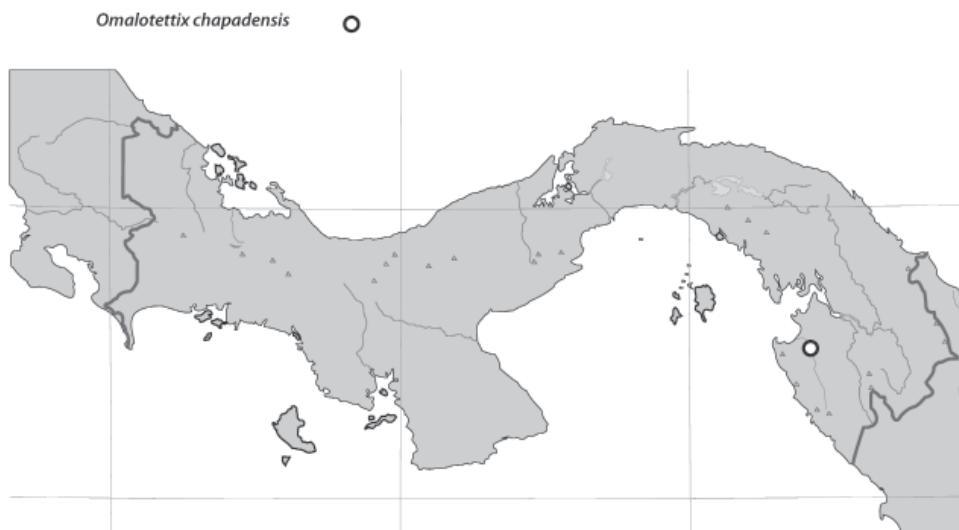
Distribution.

Mexico, Panama; Brazil. The occurrence in Panama was not previously known, and raises the possibility that the species actually occurs in other C. American countries too.

Natural history.

Certainly known from our area only from a single male captured on a trail through wet forest with oil-palm in Puerto Indio, Comarca Embera, Darién.

In Central America *A. dilecta* is associated with much drier habitats than this.



Map Om15. The unique locality of *Omalotettix chapadensis* in Panama.

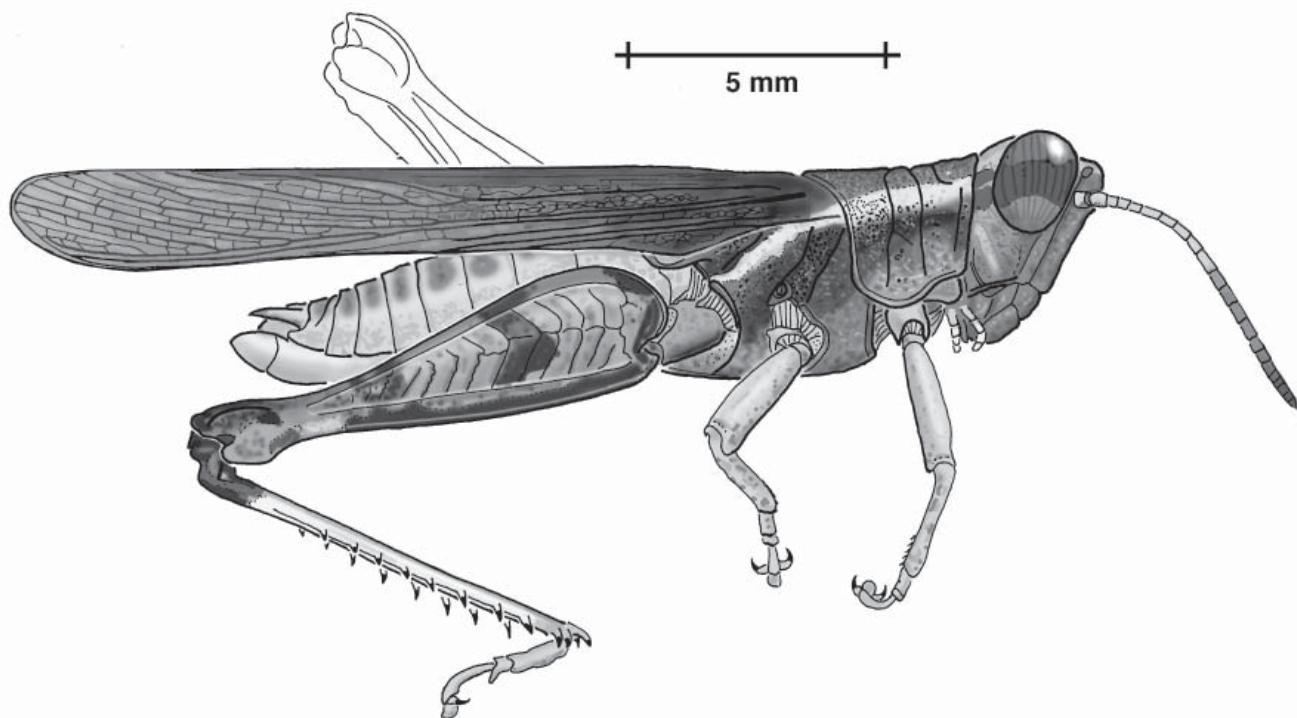


Fig. Om29. *Abracris dilecta*, male.

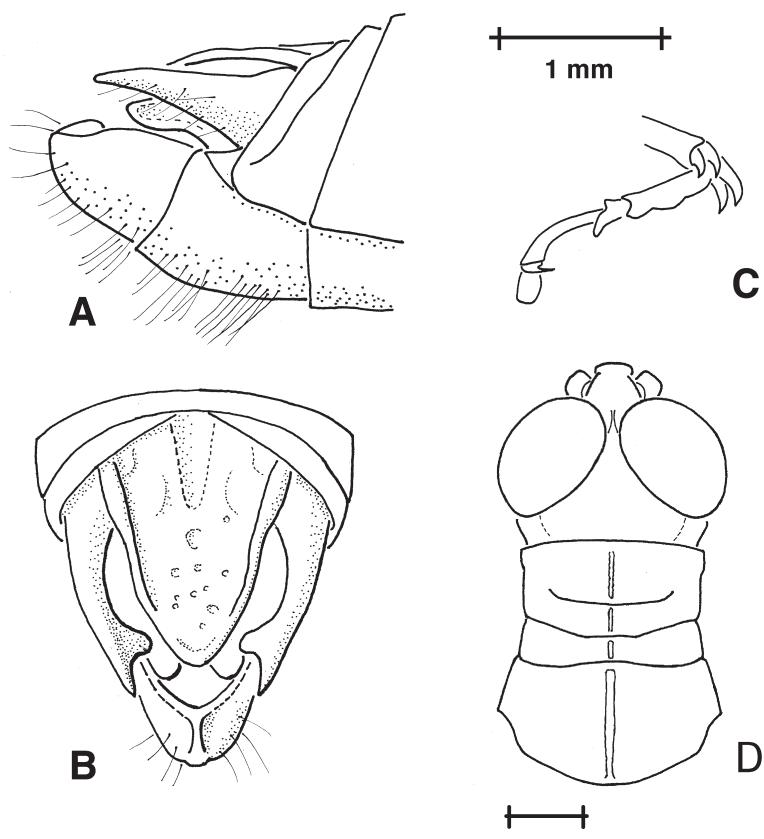


Fig. Om30. *Abracris dilecta*, male. A & B, terminalia. C, hind foot, lateral view. D, head and pronotum, dorsal view. Scale bars, 1 mm.

Rhachicreagra
Rehn 1905

Rehn 1905: 444.

Type species: *Rhachicregra nothra* Rehn, by original designation.

Type locality: Carrillo, Prov. S. José, Costa Rica (lectotype designated by Jago & Rowell 1981: 212).

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *rhachis*, spine, backbone, ridge; *kreagra*, meathook; “crooked-back”. The generic name refers to the profile of thoracic and first abdominal terga, which in some species have midline protuberances.

Subsequent literature.

- Kirby, W.F. 1910: 544.
- Hebard, M. 1932. > *Rh. mexicana*.
- Amedegnato, C. 1974: 202.
- Descamps, M. 1975. > *Rh. mexicana*.
- Jago, N.D. & Rowell, C.H.F. 1981: 181. > Revision of genus, new species.
- Rowell, C.H.F. 1985: 87-98, 99-107. > Ecology.
- Rowell, C.H.F. & Amedegnato, C. 2000: 390. > New species, genitalic characters.
- Rowell, C.H.F. 2008: 57-81. > New species.

Diagnosis.

(Condensed from Jago & Rowell 1981.) Micropterous.

Male cerci inwardly curved, forked at tip in lateral view, the lower lobe usually longer than the upper. Male phallic characters very important (see below). Male subgenital plate simple, globular, with or without a pair of tubercles on its posterior median rim. Cuticle of head, pronotum, meso- and metathorax dorsally and laterally, and anterior part of abdomen rugose and wrinkled. Median dorsal pronotal carina sharp, lateral carinae absent. Posterior margin of pronotum angularly emarginate. Antennae relatively long, reaching back to middle of hind femora. Frontal ridge parallel-sided, produced forward between antennal bases, sulcate throughout its length but flush with surface of frons in lower half. Eyes globular, interocular space less than width of antennal scape. Prosternal process conical, pointed, directed slightly forward. Tympanum present but weak. Male tergite IX massive, forming a capsule; tergite X undivided, without a furcula. Fore and mid femora somewhat thickened and inflated. Hind femur usually with slightly serrulate dorsal and ventral medial carinae, especially basally, smoother distally. Posterior tibiae with 8 outer and 9 inner spines; external apical spine absent.

Female subgenital plate carinate medially and acute-angulate at tip. Lower margin of lower ovipositor valve smooth; upper margin of upper valve finely toothed. Cerci simple, conical, slightly compressed laterally. Supra-anal plate diamond-ovoid with median sulcus along entire length. All abdominal segments carinulate.

No. of known species.

Twenty-four. Within our area, seventeen.

Generic range.

Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama.

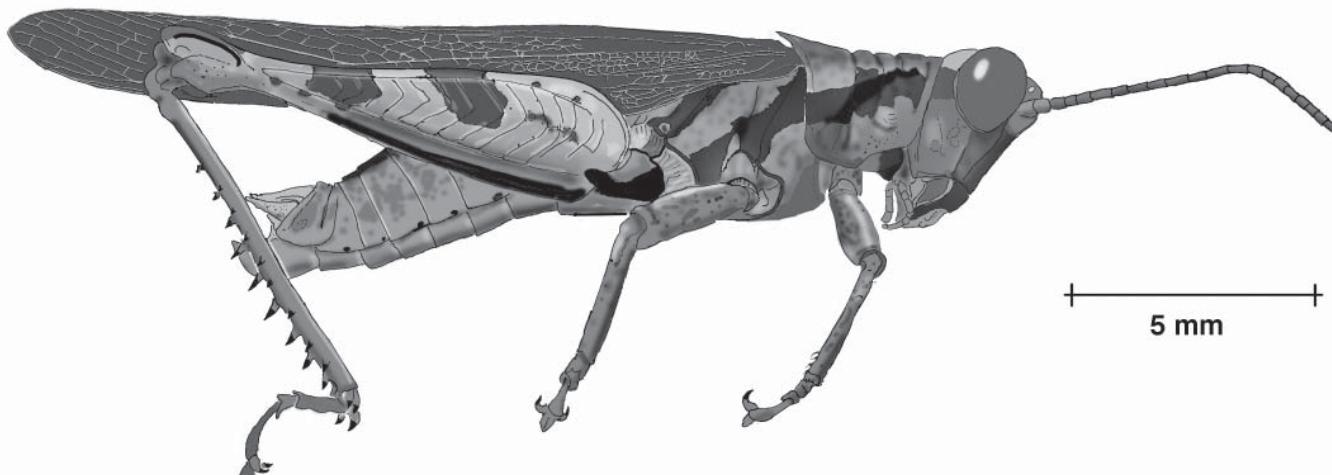


Fig. Om31. *Omalotettix chapadensis*, male habitus.

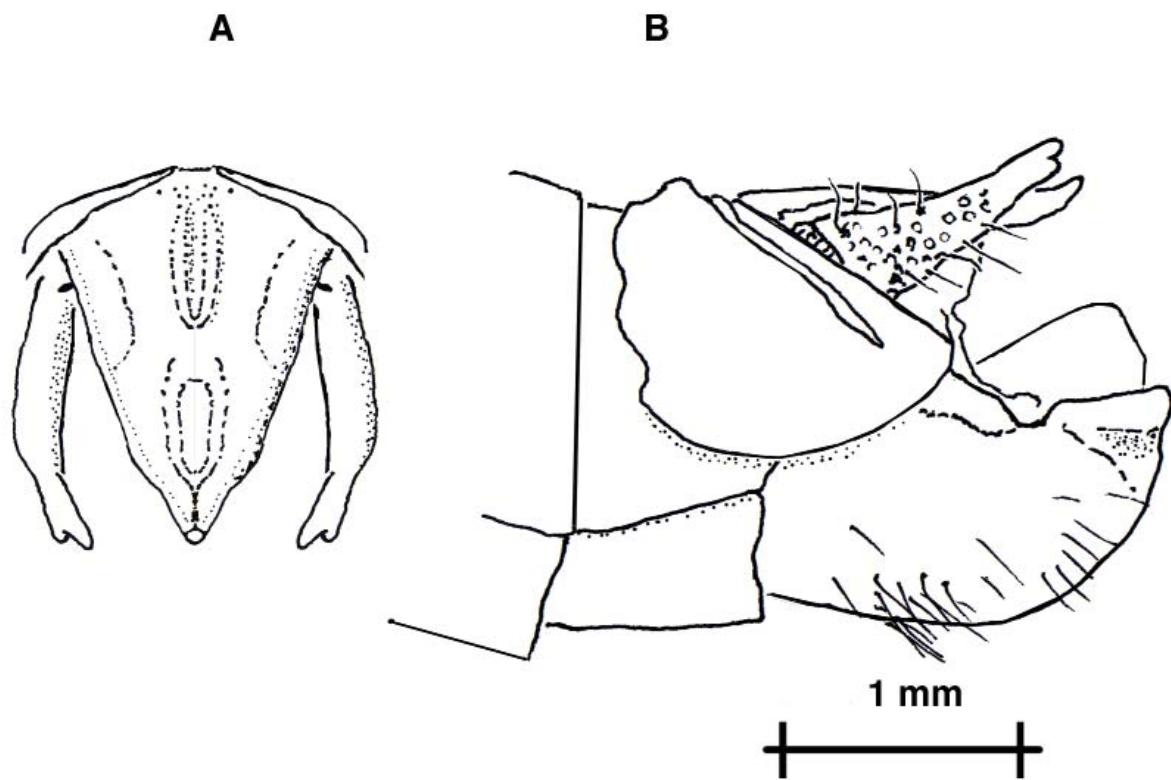


Fig. Om32. *Omalotettix chapadensis*, male terminalia. A, supra-anal plate and cerci. B, Lateral view.

Comments.

Rhachicreagra is the only genus of the tribe which is truly endemic to Central America, though *Teinophaus* is endemic to southern Mexico. Its species inhabit light gaps in wet forests, mostly on the Caribbean slope, and are wide-range oligophages, eating an eclectic assortment of plants from several unrelated families. The commonest and probably the original specialisation is on some genera of Asteraceae (*Neurolaena*, *Clibadium*, *Galinsoga*, *Dahlia* i.a.); some *Rhachicreagra* species commonly supplement or replace these with a single genus of Urticaceae (*Urera*), and at least one species (*Rh. obsidian*) is normally confined to *Iresine* (Amaranthaceae), a plant which is also eaten by other species with less specialised habits. Other species take *Phytolacca* (Phytolaccaceae), *Loasa* (Loasaceae) or *Hydrocotyle* (Apiaceae).

The genus is remarkable both for the large number of its species, often with very restricted ranges and markedly different male colorations, and for the bizarre structure of the internal male genitalia (Jago & Rowell 1981). The membranous extensions of the cingular rami are highly elaborated and integrated into the aedeagal valves. The left hand valves of the aedeagus tend to be reduced and in some species may be non-functional, whereas the right hand valves are highly elaborated and often twisted into strange shapes. Both valves are rotated outwards along their longitudinal axis for up to 90°, relative to their position in other genera (Rowell & Amedegnato 2000).

In contrast to the distinctively coloured males, the females of the various species are homogenous in structure and colour, usually differing only in size and minor details of coloration, especially of the antennae, palps and hind femora. They are barrel-shaped, widest at the junction of the metathoracic and first abdominal segments, larger than the males, and typically dull brown in colour (see e.g. **Fig. Om44, Plate Om29**). Green/brown polymorphism, especially in the colour of the abdomen and hind legs, is common among larvae and to some extent among adult females, but rarer in males.

The numerous species of *Rhachicreagra* can be grouped on the basis of their male genital morphology into four groups, which are also geographically coherent (Rowell & Amedegnato 2000):

- 1) *Rh. khayachrosa*, *haematodes* and *dierythra* have the least asymmetrical aedeagal structures, and are therefore assumed to be the most primitive. They are confined to montane forest of the Pacific slope of SW Costa Rica and W. Panama. They also share unique chromatic characters.
- 2) The *nothra* species-group, inhabiting the lowlands and lower montane forest of Caribbean Costa Rica and Western Panama, comprising the species *nothra*, *gracilis*, *jagoi*, *astytophallus*, *achrosta* and *magnifica*.
- 3) The central montane species-group of Costa Rica, comprising (from North to South) the species *melanota*, *chrysonota*, *drymocnemensis*, *anchidiphala*, *taurusflavus*, *sphagicerca*, *brachysphagicerca*, *obsidian* and *apopsis*.

4) The northern species-group, inhabiting the Caribbean slope and mountains of Nicaragua, Honduras, Guatemala, Belize and Mexico, comprising the species *himantocerca*, *pomatiophallus*, *maya*, *ocotei*, *chiapensis*, *mexicana* and *olmeca*. This northern group may be derived from the *nothra* species-group.

Of these four groups, the first three occur exclusively within our area.

Patterns of distribution within our area.

Rhachicreagra are almost ubiquitous in the wet forests of Costa Rica, but extend only a little way over the border into Panama, reaching as far east as Sta. Fe (Veraguas province). The lowland areas of Costa Rica are occupied by a few widely distributed species: the N.W savannahs (principally Provincia Guanacaste) have no *Rhachicreagra* species, but the S.W. lowlands are occupied by *Rh. obsidian*. On the Caribbean slope, the North and East are occupied by *Rh. nothra*, which extends from the Nicaraguan border to south of Limon city at the Rio Banano. South of this river, *Rh. astytophallus* occupies the S.E. lowlands and its closely related congener *Rh. achrosta* continues the distribution a little way into Bocas del Toro, Panama.

Superimposed on this lowland distribution are numerous very local species, mostly located in the central mountain ranges of Costa Rica and Western Panama. Both *nothra* and *obsidian* extend up the river valleys somewhat into the mountains, but most montane *Rhachicreagra* are local species of very limited and often disjunct distribution. *Rh. jagoi* and *Rh. achrosta* are exceptional in being local species in the lowlands.

Key to males of *Rhachicreagra* species occurring in Costa Rica and Panama.

This key is based principally on the coloration of hind femur, hind knee, pronotal spots and face in life, and is suitable for use with living or freshly killed specimens. For museum specimens the keys to be found in Jago and Rowell (1981) and Rowell and Amedegnato (2000) are to be preferred, as these emphasise morphological characters, especially the shapes of the tegmina and male cerci and subgenital plate, and because the colours mentioned there are based on faded museum specimens. In most cases an identification of the species can be obtained from its locality data, as members of this genus are very rarely sympatric.

Females are best identified by the co-occurring males, though Jago & Rowell (1981) give a key that includes most species.

1	Hind femur predominantly black in colour.	..... 2
1A	Hind femur of another colour.	..... 7
2.	Femora of all legs black.	..... 3
2A	Femora of only the hind legs black.	..... 5

3	Tibiae of fore and mid legs green. Large black and white insects with a green abdomen. <i>magnifica</i>	12A	Hind knee only partially black. 15
3A	Tibiae of all legs black. 4	13	Entire pronotum and thorax jet black, with no pale spots of any sort. <i>melanota</i> .
4	Lower hind knee lobes blue. Eyes black or dark brown; pronotal spots yellow, separated; face yellow with black spots. <i>obsidian</i>	13A	Pronotal disc speckled gold and black, spots yellow. 14
4A	Lower hind knee lobes black. Eyes orange; pronotal spots white, with a small intermediate spot between the two main ones. <i>taurusflavus</i>	14	Pronotal spots widely separated. <i>c. chrysonota</i> .
		14A	Pronotal spots almost confluent. <i>c. salazari</i> .
5	Fore and mid legs bright yellow. Antennae yellow at base, salmon coloured distally. Face yellow. Pronotal spots yellow, separated. Usually predominantly dark green insects, sometimes dark brown or pale beige. <i>astytophallus</i>	15	Femur becoming sooty distally, upper knee black, lower knee lobe dark sooty green. Pronotum mainly light brown, pronotal spots pale ochre, separated. <i>achrosta</i>
5A	Not as above 6	15A	Not as above. 16
6	Fore and mid legs light brown. Pronotal spots white, confluent. Hind femur with a pale basal patch dorsally. <i>nothra</i> , brown morph.	16	Upper knee black, lower lobe dark blue. Pronotal spots white, almost but not quite touching. <i>anchydiphalara</i> .
6A	Fore and mid legs dull yellow with red mottle. Head, pronotum and anterior abdominal nota red with black mottle. Small insects with greenish distal abdomen. <i>khayachrosa</i> .	16A	Upper knee black, lower lobe green. 17
7	Hind femur ochre with prominent black "herring-bone" pattern. Fore and mid femora red, pronotum dull yellow with red marginal spots. Small insects. <i>haematodes</i> .	17	Pronotal spots white, confluent. Hind femur with a pale dorsal patch at its base. <i>nothra</i> , green morph
7A	Hind femur predominantly green in colour, hind knee yellowish. 8	17A	Pronotal spots separated. 18
8.	Hind knee yellowish, lunules red or brown. Face white, speckled dark blue. Pronotal spots clear white, confluent or narrowly separated. Small insects. <i>gracilis</i> .	18	Pronotal spots yellow, separated. Face yellow with black speckles. <i>apopsis</i> .
8A	Hind knee yellowish, lunules brown. Vertex, fastigium, pronotum and thorax brown. Frons, genae and confluent pronotal spots yellow. <i>jagoi</i> . Not as above. 9	18A	Pronotal spots pure white, very widely separated. Face black and white with dark blue speckle. <i>drymocnemensis</i> .
9	Hind knee green. Hind femur dark green with outer dorsal face olive or yellowish. Large brown insect with red pronotal spots and a green abdomen (drying brown). <i>dierythra</i> .	19	Pronotum mainly black, though pronotal disc and occiput with ochraceous speckle. Pronotal marginal spots white, separated. All three thoracic episterna weakly marked with white. Elytra terminate near middle of metathoracic tergum. Genae and face white. Frons and fastigium white with black speckle. Distal abdomen and all legs green. Hind knee light red-brown, the ventral lobe shading to yellow or greenish yellow, lunules not contrastingly coloured. Lower fork of cercus long and blade-like, 4 times the length of the upper fork (Fig. Om37). <i>sphagicerca</i> .
9A	Not as above 10	19A	As in 19, but lower fork of cercus less prolonged, not more than 3 times as long as upper fork (Fig. Om37). <i>brachysphagicerca</i> .
10.	Hind femur yellow at base, shading to dusky green at knee. Fore and mid femora yellow or beige. <i>astytophallus</i> , Margarita population		
10A	Not as above. 11		
11	Hind knee at least partially black. 12		
11A	Hind knee pale chestnut brown. 19		
12	Hind knee completely black. 13		

I. Rhachicreagra achrosta Jago & Rowell 1981

Jago & Rowell 1981: 197.

Type locality: PANAMA: Prov. Bocas del Toro: Changuinola Distr., plantations of United Fruit Company.

Location of type specimen: UMMZ Ann Arbor.

Etymology.

Greek *achrostos*, uncoloured. Refers to the relatively dull coloration.

Subsequent literature.

- Rowell, C.H.F. & Amedegnato, C. 2000: 405. >
Redescription.

Diagnosis.

Habitus **Fig. Om33, Plate Om17**. Differs from all other members of the genus apart from the closely related (and geographically adjoining) *astytophallus* in that the male cerci have equal upper and lower apical forks. Distinguished from that sp. by the generally dull coloration: eyes red-brown, pronotum light brown with blue-green marbling, light marginal spots pale ochraceous, separated, fore and middle legs olive green, hind femur ochraceous green with sooty knee; in *astytophallus* the pronotum is dark green, brown or light beige, fore and middle legs are yellow, and the hind femur is either all black or yellow proximally shading to green distally.

Distribution.

Known only from the valleys of the Ríos Teribé & Changuinola in extreme NW Panama.

Natural history.

Unknown.

2. Rhachicreagra anchidiphala Jago & Rowell 1981

Jago & Rowell 1981: 197.

Type locality: COSTA RICA, Prov. Alajuela, R. Balsa, 15 km. N of Angeles Norte on road to S. Lorenzo, 750m.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *anchi-*, near; *dis*, double; *phalaros*, white-spotted, referring to the closely-spaced spots on the lobe of the pronotum.

Subsequent literature.

- Rowell, C.H.F. 1985 a & b: 87 et seq. > Foodplants.

Diagnosis.

Habitus **Fig. Om34, Plate 18**. Frons and genae creamy white with a few black or dark-green spots. Lateral pronotal spots white, nearly touching. Tegminal apices level with back edge of metathoracic tergite. Fore and mid femora light green. Hind femora dark shining green, shading to light green basally; genicular lunules black, lower lobe of knee dark blue. Posterior tibiae light green. Cercus apex rather broad and weakly incurved.

Distribution.

Patchily distributed along the northern slopes of the Cordillera Central at 700-1500 m in the montane forest belt. In most localities occurs at a higher altitude than *Rh. nothra*, the range of which it adjoins. **Map Om17**.

Natural history.

Eats predominantly Asteraceae (*Galinsoga*, *Erechtites*, *Neurolaena*) but also takes *Hydrocotyle* (Apiaceae) in the wild.

3. Rhachicreagra apopsis Rowell 2000

Rowell & Amedegnato, 2000: 391.

Type locality: COSTA RICA: Prov. Puntarenas: Altamira, above Finca Colorado, 1385 m.

Location of type specimen: ANS Philadelphia (holotype male, allotype female).

Etymology.

Greek *apopsis*, a lofty spot or eminence giving a commanding view; from the Spanish place-name Altamira, the type locality.

Diagnosis.

Male: Habitus **Fig. Om35, Plate Om19**. Tegmen extending to junction of metathoracic and first abdominal terga. Upper lobe of cercus less than 1/3 as long as lower lobe, both lobes with slender, smoothly rounded tips. Medial rim of subgenital plate with two small tubercles.

Coloration. Antennae black. Face yellow with black speckle. Eyes black (turning brown when dried). Postocular stripe glossy black, continuing rearwards over pronotum. Fastigium and vertex yellow with black (brownish when dried) and blue-green mottle. Clypeus and labrum mostly black. Palps green.

Thorax. Disk of pronotum yellow, speckled heavily with dark brown, this coloration being narrow anteriorly, extending colour of vertex rearwards, but widening posteriorly to base of elytra. Lateral lobes of pronotum glossy black. Between the lateral black and the dorsal yellow/brown zones are patches of glossy blue-green. Ventral margin of pronotal lobe decorated with two large yellow spots, narrowly separated. Prothoracic episternum yellow, especially posteriorly. Medial carina produced into a blunt black tooth at posterior edge of pronotum. Posterior edge of pronotum further decorated dorsally with three pairs of black spots. Tegmen brown, extending to posterior edge of metathoracic tergum. Meso- and metathoracic episterna black shading to olive green ventrally, each with a yellow spot. Legs green. Upper lobes of hind knee, distal end of hind tibia, all tarsal spines, pulvilli and undersides of tarsal segments, black.

Coloration of pronotum replicated on tergum of 1st

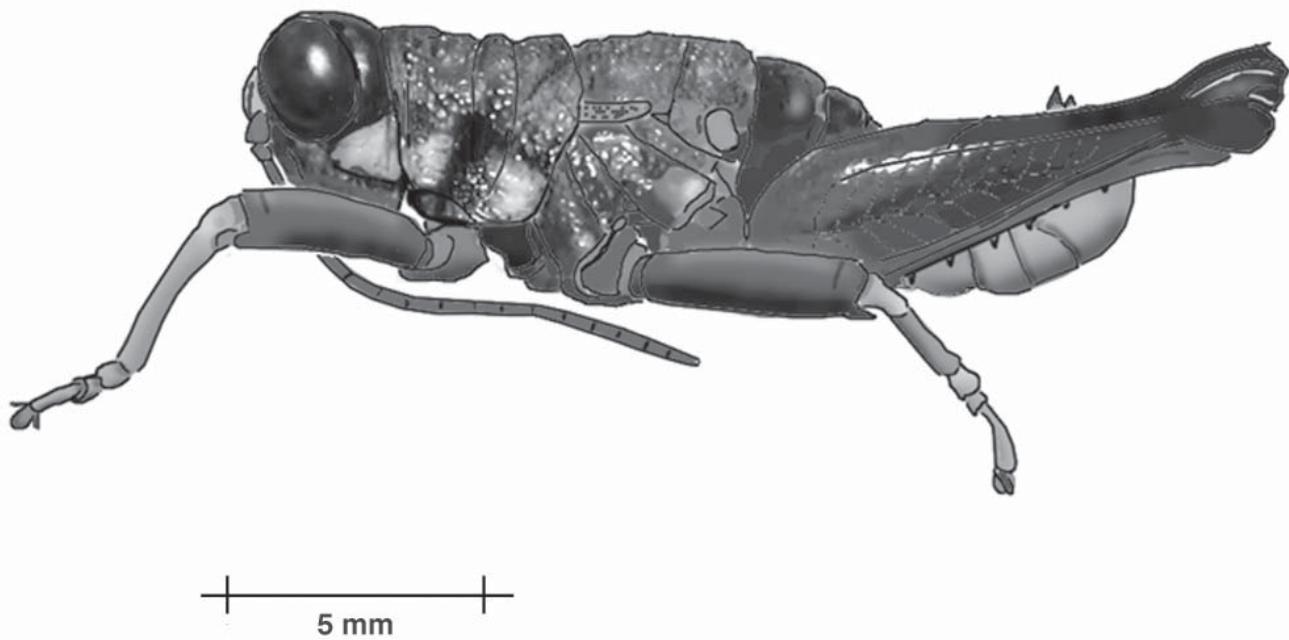


Fig. Om33. *Rhachicreagra achrosta*, male habitus.

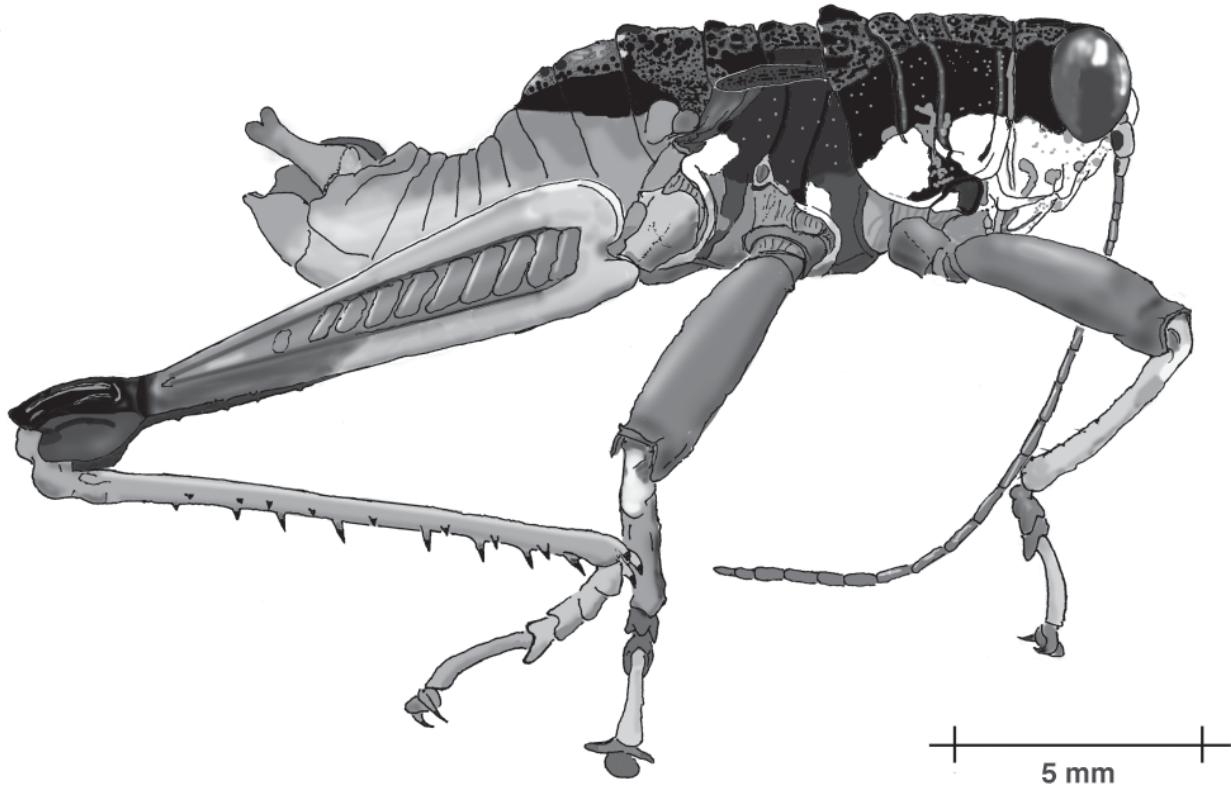


Fig. Om34. *Rhachicreagra anchidiphala*, male habitus.

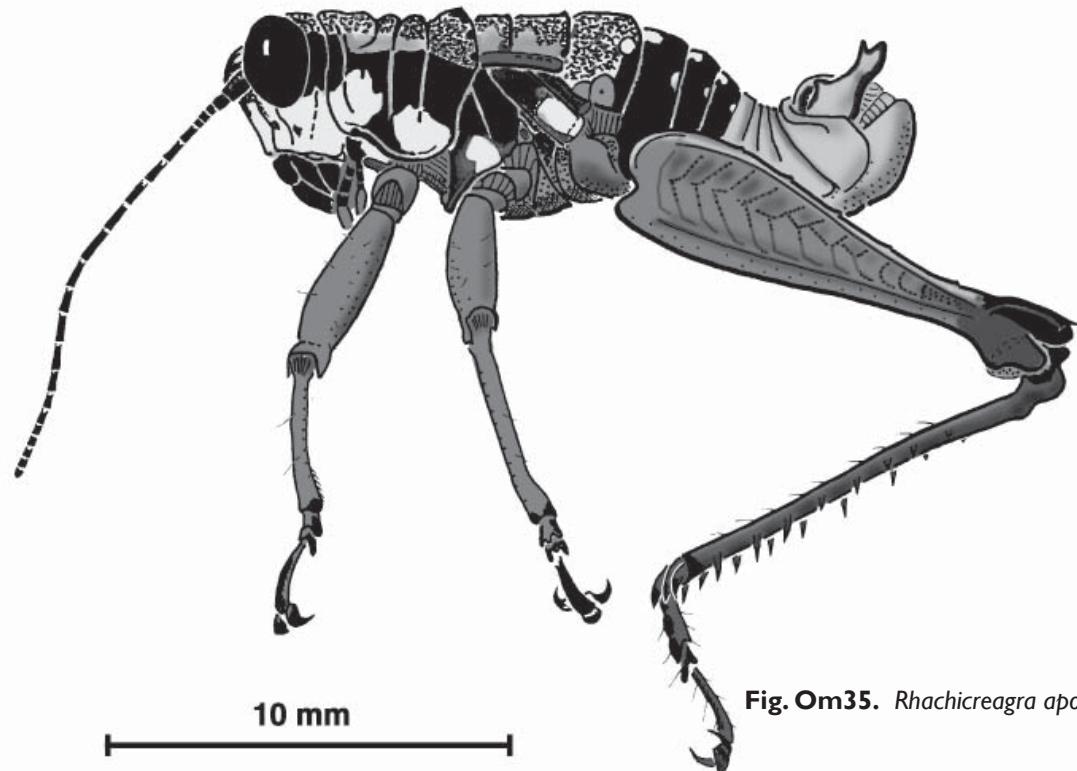


Fig. Om35. *Rhachicreagra apopsis*, male habitus.

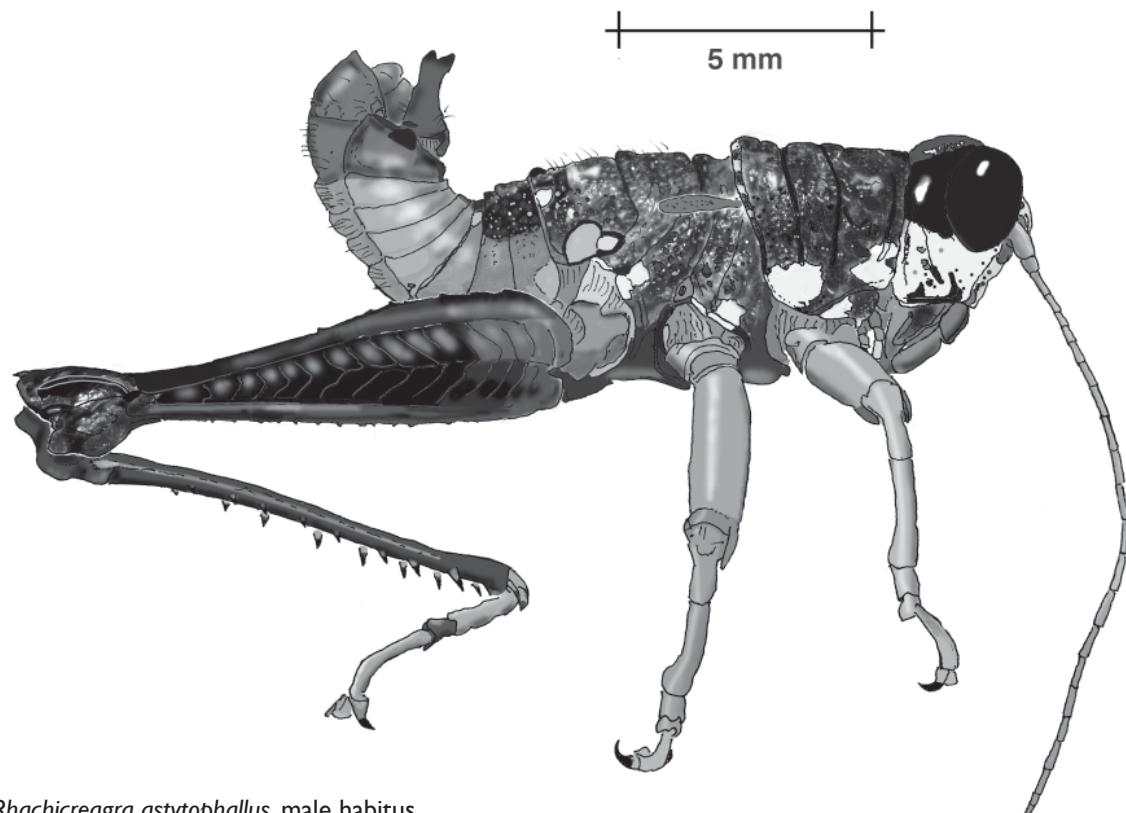
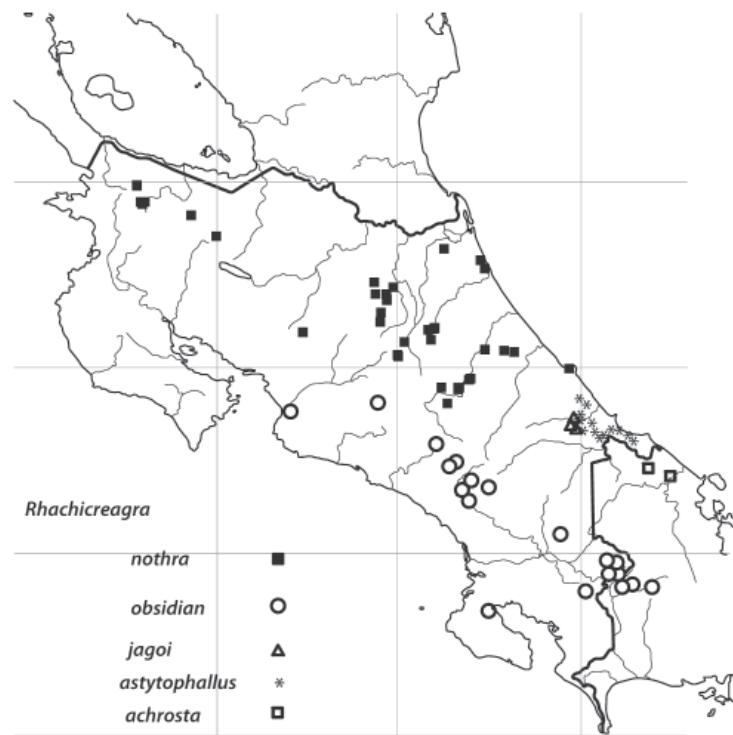
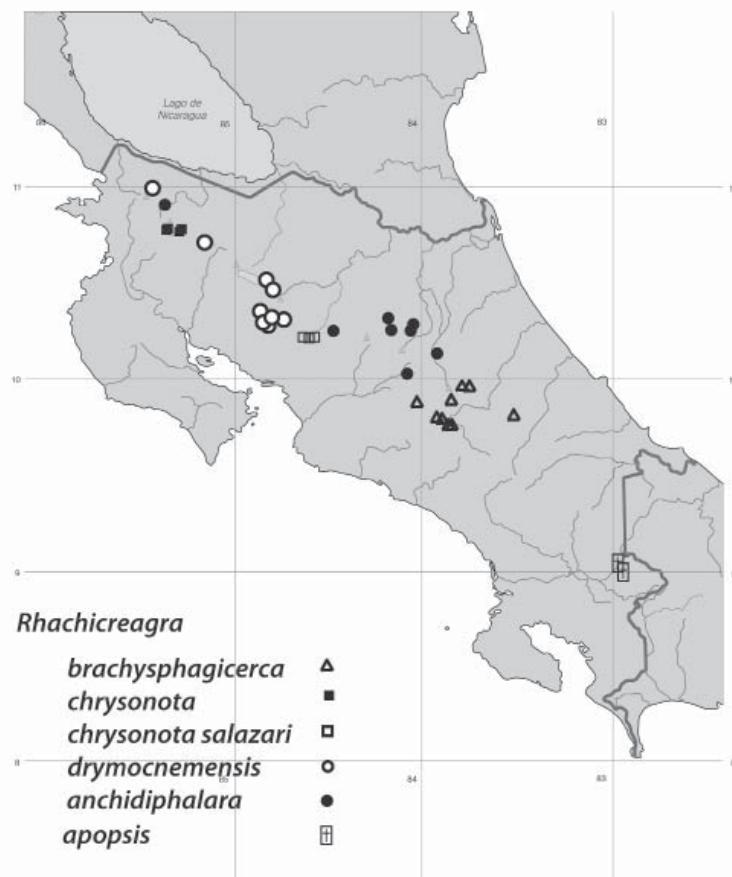


Fig. Om36. *Rhachicreagra astytophallus*, male habitus.



Map Om16. Distribution of the lowland species of *Rhachicreagra* in Costa Rica and Panama. Note that *astytophallus* and *achrosta* are very closely related.



Map Om17. Distribution of some highland *Rhachicreagra* species in Costa Rica.

abdominal segment. Terga of abdominal segments 2-4 black, decorated with yellow spots medially and at their posterior edges. Remainder of abdomen, underside, green. Cerci edged in black.

Field characters.

A medium-sized montane forest species from the Pacific slope of southern Costa Rica, the males having green legs, black hind knees and yellow thoracic spots. The pronotum is yellow/brown speckled dorsally, and glossy black with yellow spots laterally, with a narrow band of glossy blue-green between the two zones.

Distribution, natural history.

The species is known only from a small area on the Pacific slope of the Talamanca Mountains lying beneath Cerro Pittier. Further along this mountain range, both to the NW and the SE, it appears to be replaced by *Rh. obsidian*, which has a much wider distribution. Food plants unknown. **Map Om17.**

4. *Rhachicreagra astytophallus* Jago & Rowell 1981

Jago & Rowell 1981: 198.

Type locality: COSTA RICA, Prov. Limón, Valle de la Estrella, N. end of Suretka trail on Río Duruy, 50 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *astytos*, incapable of erection, impotent; *phallos*, penis, referring to the reduced nature of the left aedeagal valves (which however is not a species specific character, being common in this genus).

Subsequent literature.

- Rowell, C.H.F. & Amedegnato, C. 2000: 404.

Diagnosis.

Habitus **Fig. Om36, Plate Om20.** Cerci with large apical forks of equal size (only found otherwise in *Rh. achrosta*). Subgenital plate with a pair of tiny papillae apically.

Occurs in two regionally distinct colour forms. The first (and most widely distributed) is a very dark green (or in some populations dark brown) insect with blackish hind femora and eyes, and bright yellow face, palps, fore and middle legs. Antennae yellow at the base but salmon red in the distal two thirds. Pronotal lobes dark green or brown with two widely separated yellow spots. Hind tibiae dark green, hind tarsi light green; cerci dark green with blackish tips.

In the second form the dark green of the thorax and first abdominal segments is replaced by light brown or beige; the yellow coloration of head, palps and thoracic spots is replaced by white or cream, often including the vertex and occiput. The

hind femur usually remains black, but in the Margarita population it is yellow proximally, shading to green distally with the knee blackish. This form occurs in diagonally opposite parts of the species range: at the N.W. end of the Estrella basin, up the valley of the Río Suruy and north to the R. Banano, and then again in a particularly light-coloured race in the S.E. on the Fila Margarita above the estuary of the Río Sixaola.

The female is of the usual shades of brown, but the antennae are crimson except at the base, the palps bright yellow, and the underside of the tarsi pink.

Field characters.

The males of both colour variants are striking insects; the first one is dark green and yellow with black femora, the second beige and cream with black or yellow-green hind femora. Neither can readily be confused with any other species of the genus, even though the two forms are very different from each other in appearance.

Distribution.

Southeastern lowland Caribbean Costa Rica, from the Rio Banano (south of Limón Town) to the Rio Sixaola. To the north replaced by *Rh. nothra*, to the south by *Rh. achrosta*.

Map Om16.

Natural history.

Usually found on *Urera caracasana* (Urticaceae), but also on *Neuroleena trilobata* (Asteraceae) and occasionally on *Phytolacca*. It will eat *Iresine* (Amaranthaceae) in captivity but has never been seen on it in the wild.

5. *Rhachicreagra brachysphagicerca* Jago & Rowell 1981

Jago & Rowell 1981: 200.

Type locality: COSTA RICA, Prov. Cartago, between Cervantes and Pacayas, 1450-1500 m.

Location of type specimen: ANS Philadelphia.

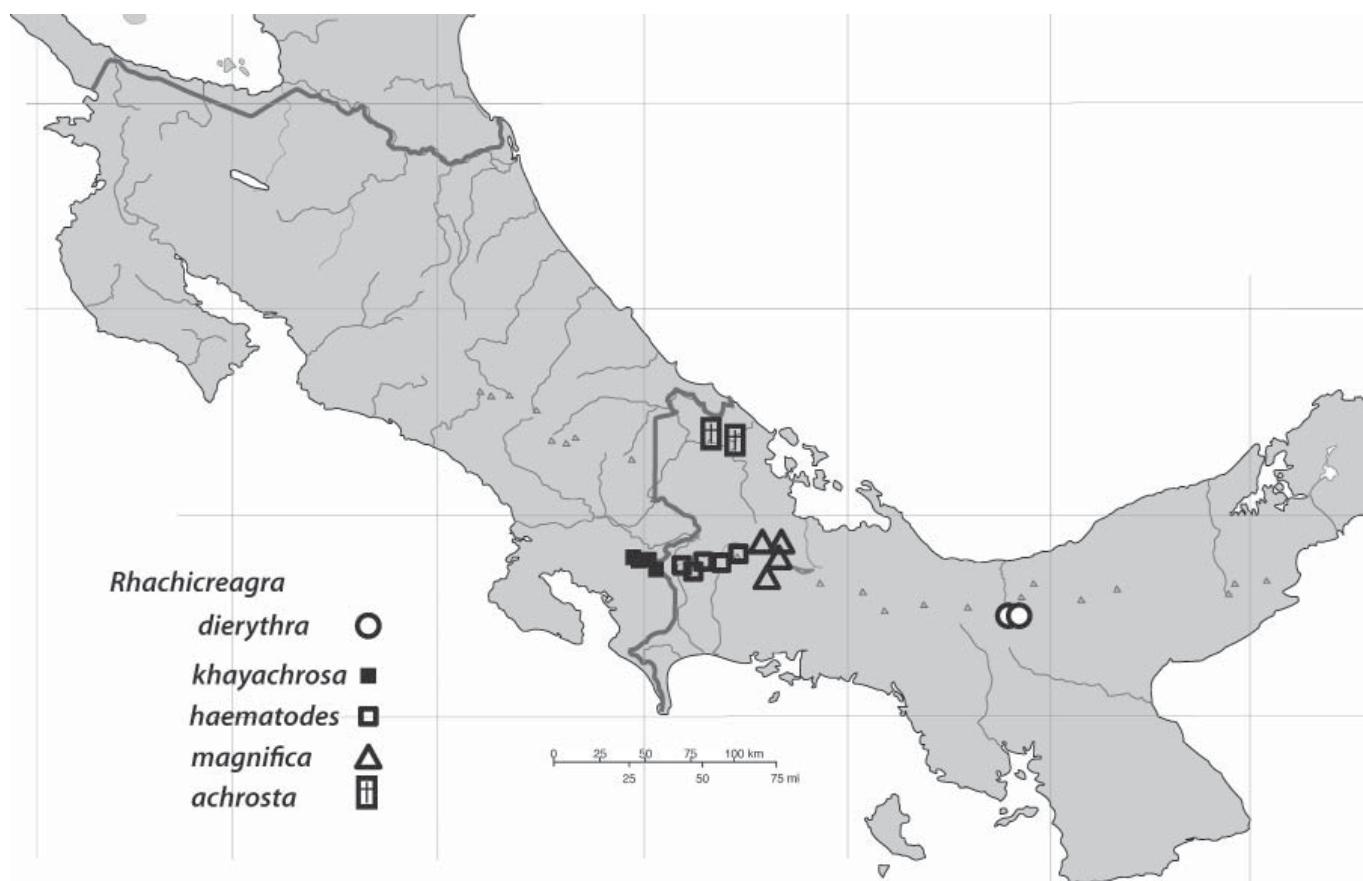
Etymology.

Greek *brachys*, short; *sphagis*, knife; *kerkos*, tail; here, cercus.

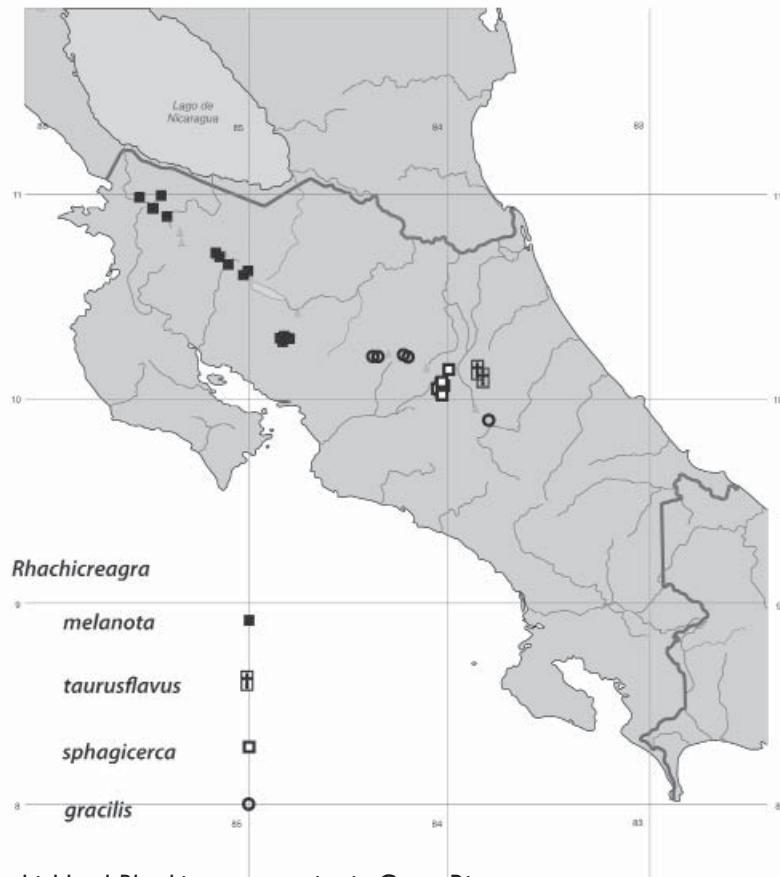
Diagnosis.

Outwardly almost identical to *Rh. sphagicerca* (**Fig. Om50, Plate Om33**). Differs from that species only in the shape of the cercus. Cercus short and robust; lower fork of cercus not more than 3x as long as upper (much shorter than in *sphagicerca*, hence the specific name: see **Fig. Om37**). Tip of tegmen reaches to at least the middle of the metanotum, sometimes (but not always) attaining its posterior margin.

Frons white with black spots. Pronotum black, white spots on margin of lobe of pronotum well separated. All thoracic



Map Om18. Distribution of *Rhachicreagra* species in Panama. Note that *haematodes* and *khayachrosa* are closely related, and possibly conspecific.



Map Om19. Distribution of more highland *Rhachicreagra* species in Costa Rica.

episterna marked with white. Hind femora green with darker green carinae, knees pale red-brown, ventral lobe paler.

Appears to form a species pair with *Rh. sphagicerca*, from which it is separated geographically by a watershed. The phallic structures are different, but externally the differently shaped cercus (**Fig. Om37**) is the only good differentiating character.

Distribution.

Caribbean slope of Central Costa Rica. Confined to the upper basin of the Río Reventazón and its tributaries, as far as the Cerro La Carpintera above Tres Ríos, the valley of the Rio Macho, and the mid-elevation slopes of Volcan Turrialba. All known localities are in the Province of Cartago.

Natural history.

At different localities, seems to feed mainly on *Dahlia imperialis* (Asteraceae) or *Hydrocotyle* (Apiaceae). In captivity will eat *Iresine* (Amaranthaceae) and *Vernonia brachiata* (Asteraceae), but has not been seen on either in the wild.

6. *Rhachicreagra chrysonota* Rowell 2000

Rowell & Amedegnato, 2000: 394.

Type locality: COSTA RICA: Prov. Guanacaste: P. N. Rincón de la Vieja: road to Colonia Blanca, near summit of pass, 820 m
Location of type specimen: ANS Philadelphia (holotype male, allotype female).

Subsequent literature.

- Rowell, C.H.F. 2008: 79. > Description of new subspecies, *Rh. chr. salazari*.

Etymology.

Greek “*chrysos*” golden, *noton*, back, describing the most obvious feature of the male coloration.

Diagnosis.

Male: (**Fig. Om38, Plate Om21**). Tegmen not quite reaching posterior edge of metathoracic tergum. Upper lobe of cercus about half the length of lower lobe, but both lobes very short and with blunt rounded tips. Paired tubercles of median rim of subgenital plate large (as in *Rh. melanota*).

Coloration.

Frons and genae yellow, speckled with black; palps yellow. Antennal flagellum dark red brown. Vertex, disc of pronotum, meso- and metathoracic terga and tergum of first abdominal segment golden yellow, speckled coarsely with black. Pronotal spots yellow, rather small, widely separated. Distal abdomen, all legs, deep leaf green; hind knees solid black, tarsi tinged with red. The black areas of hind knee and pronotal lobes have a blue sheen.

Note: *Rh. ch. salazari* is superficially very similar in

coloration, but the yellow pronotal spots are large, very close together, almost confluent. The golden colour of the thoracic nota is more densely speckled with black, giving a duller appearance.

Field characters.

Large size and striking yellow-gold coloration.

Distribution.

Confined to the upper montane forest of Volcán Rincón de la Vieja in the Northern Cordillera of Costa Rica. On the adjoining volcanoes (Miravalles and Tenorio to the S.E, Cacao and Orosí to the N.W.) it is replaced by *Rh. melanota*; the less colourful subspecies *Rh. ch. salazari* is known only from around S. Ramón in the valleys of the Rio San Lorenzo and the Rio San Lorencito.

Natural history.

Associated with Asteraceae.

7. *Rhachicreagra dierythra* Rowell 2000

Rowell & Amedegnato, 2000: 401.

Type locality: PANAMA: Prov. Veraguas: Alto de Piedra, 800 m.
Location of type specimen: ANS Philadelphia (holotype male, allotype female).

Subsequent literature.

- Rowell, C.H.F. 2008: 79. > Coloration in life.

Etymology.

Greek *dierythros*, spotted or decorated with red.

Diagnosis.

Male: (**Fig. Om39, Plate Om22**). Sulci deeply incised in medial carina. Tegmen just reaching posterior margin of metathoracic notum. Lower cercal fork (Figs. 37, 38) much longer than the upper. Posterior apical rim of subgenital plate with a low subrectangular projection (**Fig. Om39**). Supra-anal plate (**Fig. Om37**) of normal type for genus, tip smoothly rounded with no medial projection. Animal very sparsely haired, almost glabrous.

Coloration. Antenna, scape and pedicel greenish, flagellum yellow, the distal 5 segments pale chocolate brown. Eyes black (drying brown). Head, mouthparts, palps, light brown, with no spotting on the frons; postocular stripe pale blue-green. Pronotum: pale greenish brown; anterior and posterior margins decorated with 4 pairs of red spots, two dorsolateral, two ventral. Pterothorax and 1st abdominal segment, same pale brown colour as pronotum and head; red marks on metathoracic episterna, and paired dorsolaterally on the metathoracic (very small) and 1st abdominal tergites (large). Tegmen pale brown. Other abdominal segments dark green. Front and middle legs: coxae and femora green, tibiae and tarsae yellow-green. Hind femora dark green, external dorsal face olivaceous or yellow; knees dark green. Tibiae and tarsi yellow-green; all spines, spurs and claws tipped with black.

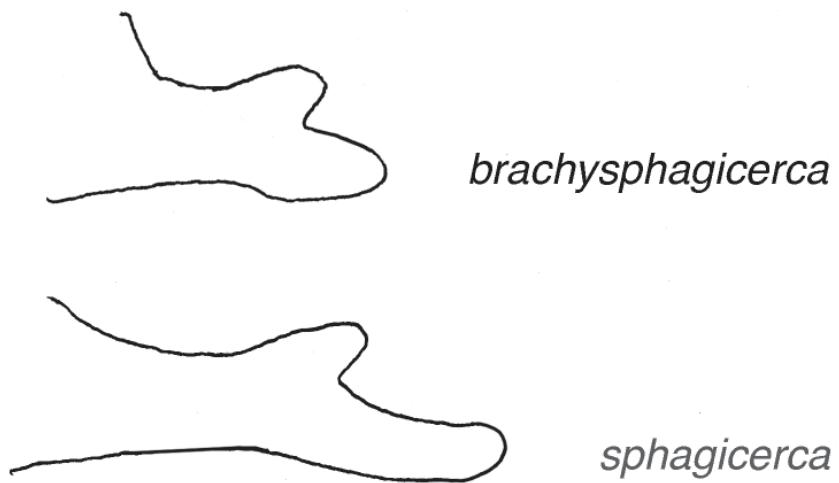


Fig. Om37. *Rhachicreagra brachysphagicerca* and *sphagicerca*, male cerci compared.

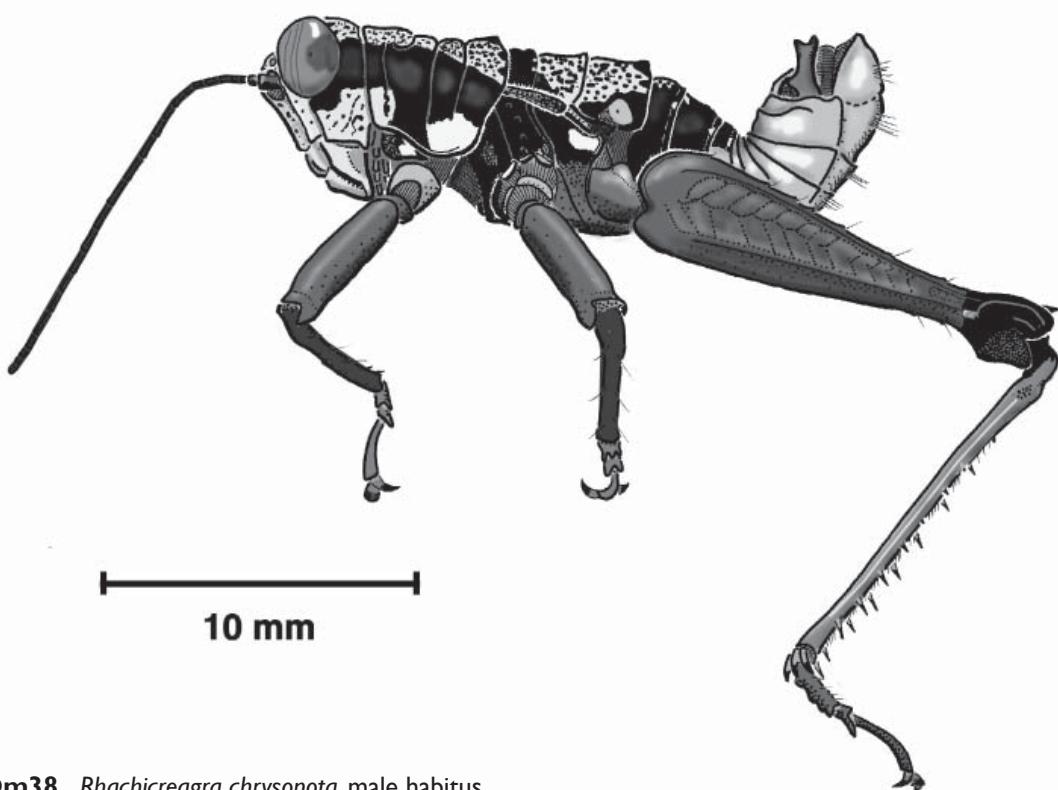


Fig. Om38. *Rhachicreagra chrysonota*, male habitus.

Field characters.

The only large brown *Rhachicreagra* with red spots on the pronotum, bright yellow antennae and yellow and green legs.

Distribution.

Panama. Wet montane forest near the watershed between the Caribbean and Pacific slopes at 800 m in mid-Western Panama. To date the most south-easterly species known.

Natural history.

Apparently associated with composites. In captivity will accept *Neurolaena*. Adults appear in November.

8. *Rhachicreagra drymocnemensis* Jago & Rowell 1981

Jago & Rowell 1981: 202.

Type locality: COSTA RICA: Prov. Puntarenas: Monteverde. 1400-1500 m.

Location of type specimen:ANS Philadelphia (holotype male, allotype female).

Etymology.

Greek *drymos*, oak-coppice, forest, wood; *knemos*, shoulder of mountain, hill; “from oak-clad hills”.

Subsequent literature.

- Rowell, C.H.F. 2008: 79. > Extension of range.

Diagnosis.

Habitus **Fig. Om40, Plate Om23.** Tegmen reaches 3/4 of way into metanotum, but does not quite attain its posterior edge. Cerci with upper lobe rounded, lower lobe tapered and pointed, 3x as long as upper lobe, both lobes black or brown tipped.

Antennae brown, basal segments dark green. Frons white with heavy black and light blue mottle, eyes (in life) grey-pink with brown flecks. Pronotum, epimera and episterna black, with brown and dark blue mottle. Spots on pronotal lobes pure white, and separated by a black interval wider than the anterior spot. Abdomen and all legs light green, hind femora with prominent darker green carinae and black knees with a blackish green lower lobe.

Distribution.

The dominant species of the genus in the Tilarán uplands on the Pacific slope of north-central Costa Rica, and the shores of Lago Tilarán. It also occurs in isolated populations on Volcan Miravalles.

Natural history.

Clearings in and edges of montane forest. Seems to feed

mainly on *Hydrocotyle* (Apiaceae) in its natural habitat. Unlike most species of the genus, it does not accept *Iresine* (Amaranthaceae) in captivity.

9. *Rhachicreagra gracilis* Bruner 1908

Bruner 1900-1910 (1908): 340,341.

Type locality: COSTA RICA, Prov. Cartago, Juan Viñas, 1200 m. Location of type specimen:ANS Philadelphia.

Subsequent literature.

- Rehn, J.A.G. & Hebard, M. 1912: 122. > Designation of lectotype.
- Jago, N.D. & Rowell, C.H.F. 1981: 204.
- Rowell, C.H.F., 2008: 72.

Etymology.

Latin *gracilis*, slender or delicate, referring to the relatively small size.

Diagnosis.

The following is based on both Bruner's type material and modern material from the upper valleys of the Rios Sarapiquí and Toro. The major differences between the old and the modern samples, are the following:

- The tegmen of the modern specimens is shorter than in the type series, where it usually reaches to the post-margin of T3 tergite. In the modern specimens the tegmen usually ends within the third thoracic tergite, without reaching its posterior edge.
- The paired pale spots on the pronotal lobes of the type series are partially confluent; in the modern material they are narrowly divided by a patch of dark pigment.

As the genus is especially prone to local geographical variation, and the old and new populations are separated by a minimum of 55 km, these differences are not surprising.

Phallic structures, and both the male and female terminalia, are identical in the old and the new specimens. Allowing for colour deterioration of museum specimens, all other aspects of coloration are identical too.

Habitus **Fig. Om41, Plate Om24.** Terminal medial process of notum of first abdominal segment smoothly rounded, not inflected.

Male cerci spatulate at tip, upper fork much shorter than lower, SGP rim slightly squared off at tip,with a suggestion of papillae.

Coloration. Male: Antennae dull red. Eyes dark brown. Palps white, labrum and clypeus tinged reddish brown. Frons and genae white, speckled with cobalt blue (turning brown in ancient

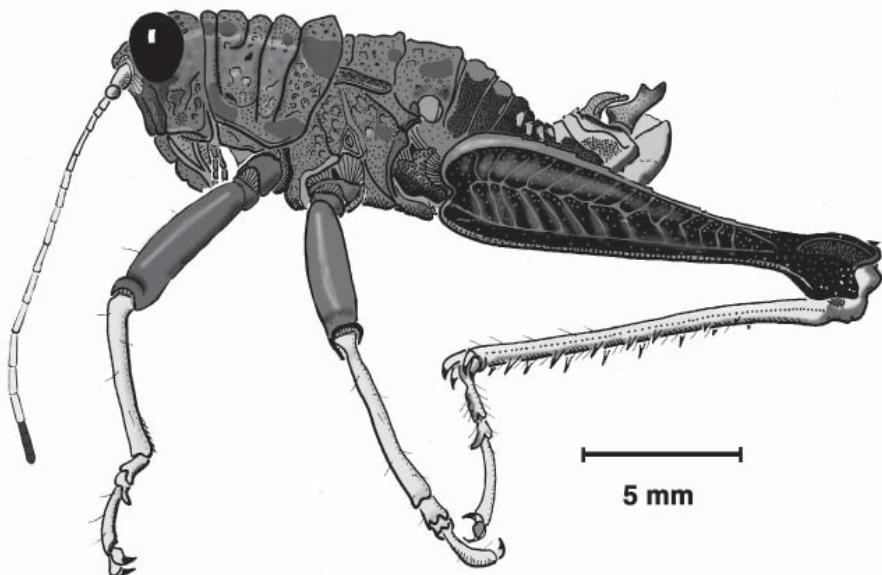


Fig. Om39. *Rhachicreagra dierythra*, male habitus.

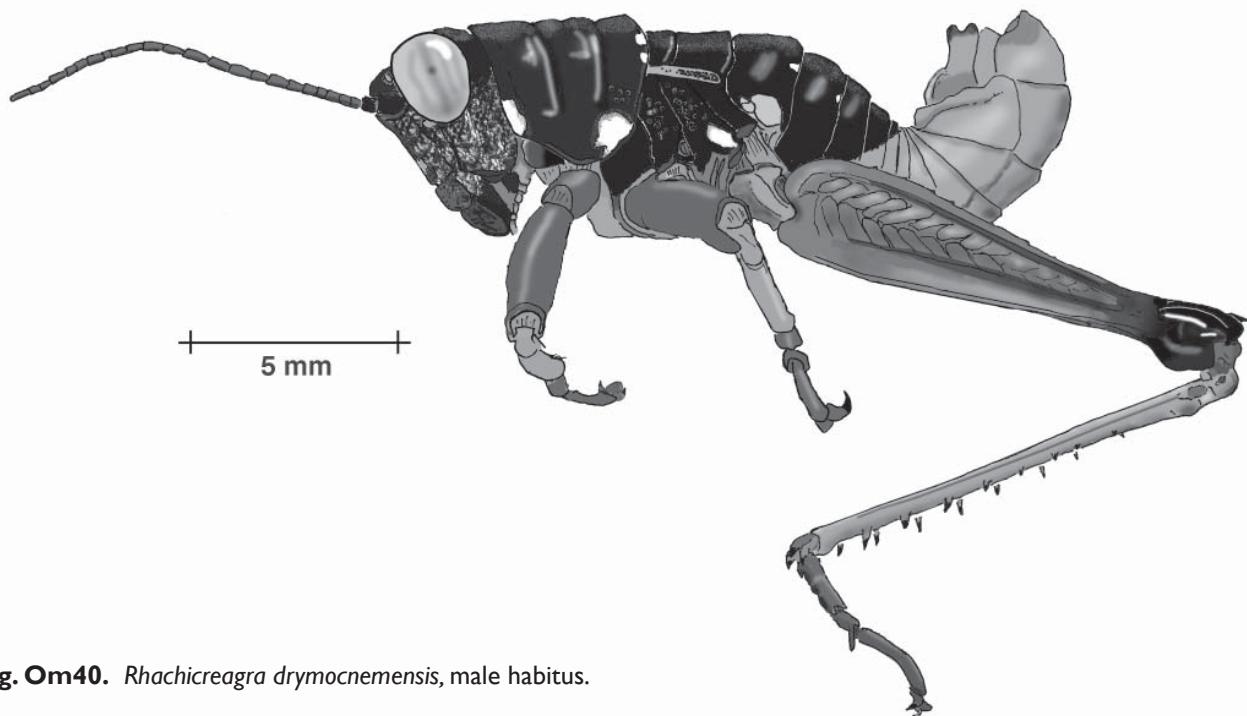


Fig. Om40. *Rhachicreagra drymocnemensis*, male habitus.

specimens). Spots on ventral margin of pronotal lobe white, narrowly separated with black. Prothoracic epimeron white posteriorly, black or grey anteriorly. Postocular stripe, lateral lobe of pronotum, and meso- and metathoracic epimera and episterna, shiny black, with a green sheen; white spots on mesothoracic and metathoracic episterna. Dorsal surface of fastigium, vertex, disc of pronotum, thoracic and first abdominal tergites, white ground colour thickly pitted and blotched with black, giving a greyish appearance. Elytron white, often with black tip, usually extending to about 70% of T3. Tympanal membrane pinkish white. Abdominal terga 2-4 black dorsally, with white spots on their posterior margins. Remainder of abdomen bright green, cerci and supra-anal plate edged with light red-brown. Cerci mainly bright green, only tips of their forks reddish. All legs emerald green. All feet reddish. Hind knees and first part of hind tibia yellowish, genicular lunules and the inner "elbow" surface of tibia pale red brown. Under surface olivaceous green.

Female (brown form): antennae dull red. Most of animal dull mid-brown, abdominal segments somewhat tinged green, esp. distally (green colour lost in dried specimens). Frons, genae and lower part of pronotal lobes dull ochre. Eyes dark brown, some vertical darker barring. Faint dark postocular stripe, continued obliquely over pronotal lobes between brown and ochre areas, ending on mesothoracic epimeron. Patches of slightly lighter brown occur on the lower pronotal lobes between the 1st and 2nd sulci, and on the meso- and metathoracic episterna. Black spots on post-margin of first abdominal tergum, and post-border of tympanum. External dorsal face of hind femur chestnut, including the knee. Outer face of femur blackish green above, pale ochre below. Inner face dark olive green. Rest of knee olive, tibia olive brown; all feet dark brown. Underside bright green.

A minority of females are green forms, with coloration essentially the same as the male, though slightly less brilliant, especially the face.

Field characters.

Small size. Green femora with yellow knees with brown lunules. Pronotal spots, genae and face pure white.

Distribution.

Known in recent years from only two widely separated localities on the Caribbean slope of Costa Rica: one in Sarapiquí near Cinchona, 1475 m, and the other at 800 m in the valley of the Rio Toro. In the first decade of the 20th century it was also recorded several times from Juan Viñas in the upper valley of the Reventazón. **Map Om19.**

Natural history.

Eats *Hydrocotyle* (Apiaceae), *Iresine* (Amaranthaceae) and the virulently stinging plant *Loasa* (Loasaceae) in the wild.

10. *Rhachicreagra haematodes* Jago & Rowell 1981

Jago & Rowell 1981: 205.

Type locality: PANAMA: Prov. Chiriquí: Rio Gariche.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *haimatodes*, blood-red, referring to the facial and pronotal markings.

Diagnosis.

Habitus **Fig. Om42, Plate Om25.** Small size for the genus (F male = 10.35 mm). Tegmen long and straplike, extending onto or across tympanic membrane.

Coloration. Frons and genae, red with black mottling. Pronotum dull yellow with black spots laterally. Pronotal lobes with twin marginal patches of red. Meso and metathorax same colour (dull yellow) as pronotum, with red marking at base of middle leg. Tegmen black or dark brown. Abdominal segments with lateral red spots, segments 2 and 3 black laterally. Hind femora ochre with external lateral area occupied by a black herring-bone pattern; hind knees black, lower lobes red. Hind tibiae dull yellow. Fore and mid femora red.

Distribution.

Known from a few localities between the town of Volcán and the Río Colorado to its west, and from nearby Volcan Barú, at elevation 1500-1800 m. There is little natural habitat left in this area, other than on V. Barú, and the species may be threatened. **Map Om18.**

Natural history.

Largely unknown. Associated with Asteraceae. First adults appear around October.

11. *Rhachicreagra jagoi* Rowell 2008

Rowell & Amedegnato 2008: 76.

Type locality: COSTA RICA: Prov. Limón: Valle de la Estrella: Concepción, 5 km S. along Rio Cerere.

Location of type specimen: ANS Philadelphia.

Etymology.

Named for N.D. Jago, British orthopterist who first revised this genus and discovered and described its remarkable phallic structures.

Comment.

This taxon was erected recently to accommodate a Valle de la Estrella population erroneously placed under *gracilis* by Jago and Rowell (1981).

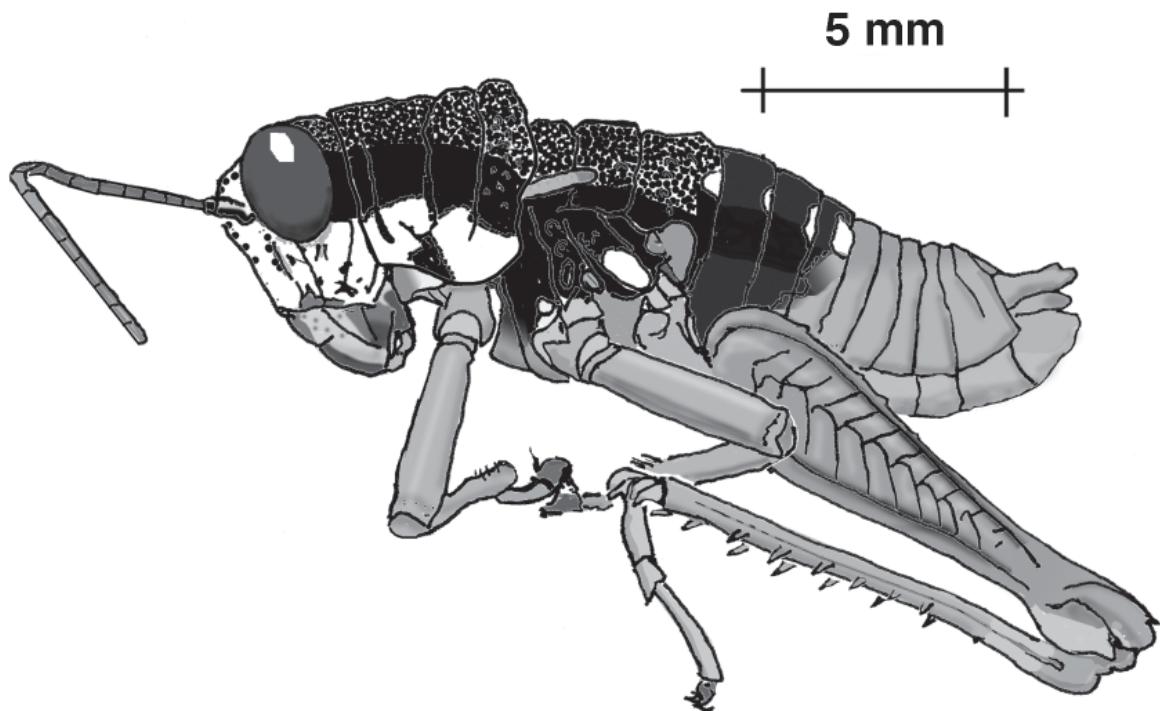


Fig. Om41. *Rhachicreagra gracilis*, male habitus.

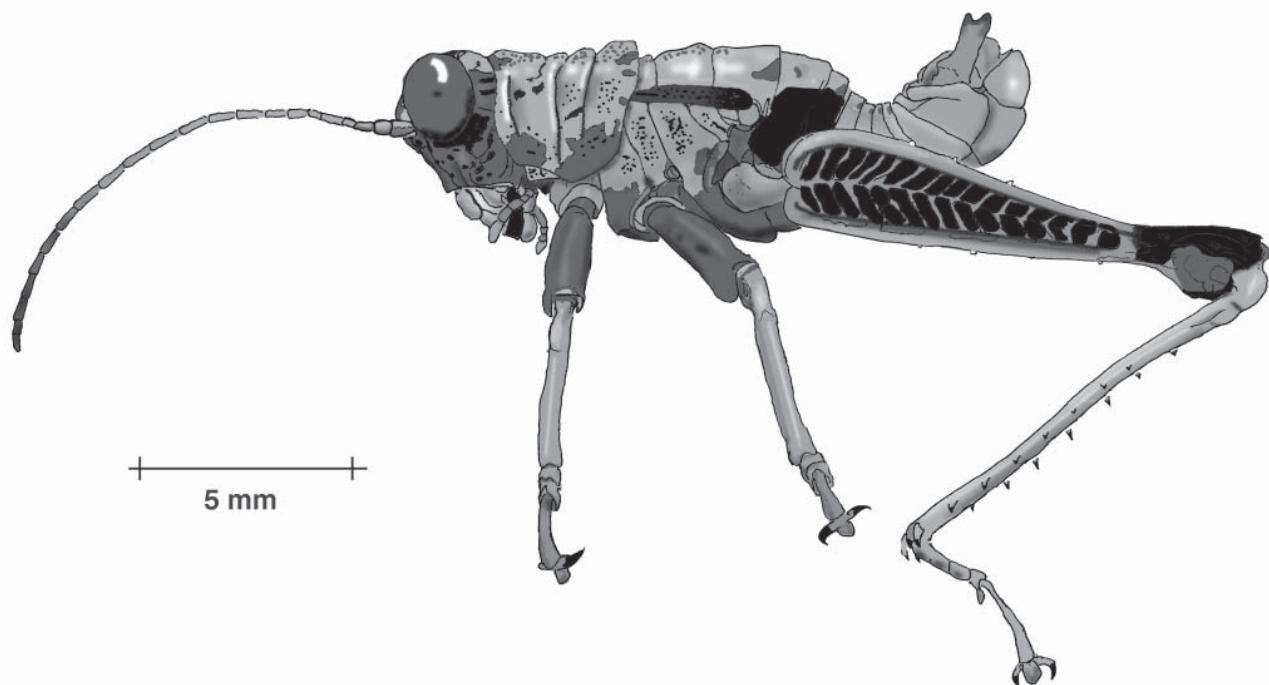


Fig. Om42. *Rhachicreagra haematodes*, male habitus.

Diagnosis.

Coloration (in life). Male: (**Fig. Om43, Plate Om26**) antennae reddish brown. Frons and genae yellow, vertex and fastigium brown. Thorax and prothorax brown, lateral lobes of prothorax brown, marginal spots yellow and confluent, with a dark green area above the yellow, shading to brown dorsally. Fine yellow supraocular stripe extends obliquely across pronotum, ends as yellow dot on the metathoracic episternum at base of hind leg. Abdomen and all legs green. Underside green. All brown areas finely stippled with yellow.

Female: general colour dull brown. Antennae brown banded with black. Same distribution of yellow on thorax as in male, plus an additional yellow patch on outer face of hind femur.

Sexual dimorphism in linear dimensions approx. 0.85.

Male cerci, narrow, pointed rather straight, with a small upper fork (**Fig. Om27**). Figs 68 and 69 of Jago and Rowell, 1981, labelled *Rhachicreagra gracilis*, actually refer to *Rh. jagoi*. No tubercles on rim of subgenital plate.

Although the two species *jagoi* and *gracilis* are very similar in size and shape, they cannot be confused if fresh material is available, as the former has the thoracic region coloured brown and yellow, the latter black and white. In discoloured dried specimens the male cercus serves to distinguish the two. The phallic complexes are also significantly different in the two species (see Rowell & Amedegnato 2008 for details).

Distribution.

Known only from the central part of the Valle de la Estrella, around the village of Concepción and along the banks of the Rio Cerere. **Map Om16**.

Natural history.

Unknown.

12. *Rhachicreagra khayachrosa* Jago & Rowell 1981

Jago & Rowell 1981: 207.

Type locality: COSTA RICA, Prov. Puntarenas, S.Vito de Jaba, Finca Las Cruces, 1100 m.

Location of type specimen: ANS Philadelphia.

Comment.

Rh. haematodes and *khayachrosa* are very similar and geographically adjoining species. A paucity of male specimens of *haematodes* prevents me from re-examining their statuses as separate species. Jago and Rowell (1981) found no significant genital differences, but distinguished them primarily on the basis of their coloration; however, they had few specimens at their

disposal, and the male holotype of *khayachrosa* now seems to me rather atypical. Females of *haematodes* have more red markings and a more contrasty hind femur than those of *khayachrosa*, whereas the opposite seems true of the males, but these differences could well represent merely the extremes of a cline.

Etymology.

From *Khaya*, the generic name of an African mahogany tree, and Greek *chros*, colour of the skin: "mahogany coloured".

Diagnosis.

Somewhat larger than *Rh. haematodes*, but still a very small species (F male = 11.85 mm). Habitus **Fig. Om44, Plate Om27**.

Coloration. Antennal scape and pedicel yellow-green, flagellum grey-blue shading apically to black. Tegmen black, long and strap-like, extending to but not across the tympanic membrane. Frons, genae, pronotum and first 2 abdominal terga red, mottled with black spots. The ventral marginal spots on the pronotal lobes, when visible, are red, but they usually merge with the ground colour; red spots also on thoracic episterna and on the abdomen. Fore- and mid femora predominantly red. Hind femur: internal dorsal face ochre with a row of black markings, external dorsal face ochre, sometimes marked with red basally, external lateral face black, knees black with ventral lobes greenish. All tibiae and tarsi, yellow-green, often marked with red. Distal abdomen and terminalia yellow green, cerci suffused blueish at their tips.

Distribution.

Known only from the Fila Cruces, near S.Vito de Jaba, SW. Costa Rica, and from around the nearby town of Cañas Gordas on the Panamanian border. **Map Om18**.

Natural history.

Montane forest edges and clearings, on Asteraceae (*Clibadium* spp and *Erechtites* spp). Obviously closely related to the geographically adjacent species *H. haematodes*, possibly even conspecific (see Comment above). Sympatric throughout its range with *Rh. obsidian*, which however is a specialist on *Iresine* (Amaranthaceae) and thus ecologically separated from *khayachrosa*.

13. *Rhachicreagra magnifica* Rowell 2000

Rowell & Amedegnato, 2000: 398.

Type locality: PANAMA: Prov. Bocas del Toro: Quebrada Felix, 2 km NW of summit of rd. to Chiriquí Grande, 900 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *magnificus*, splendid, referring to the large size and striking coloration of the male.

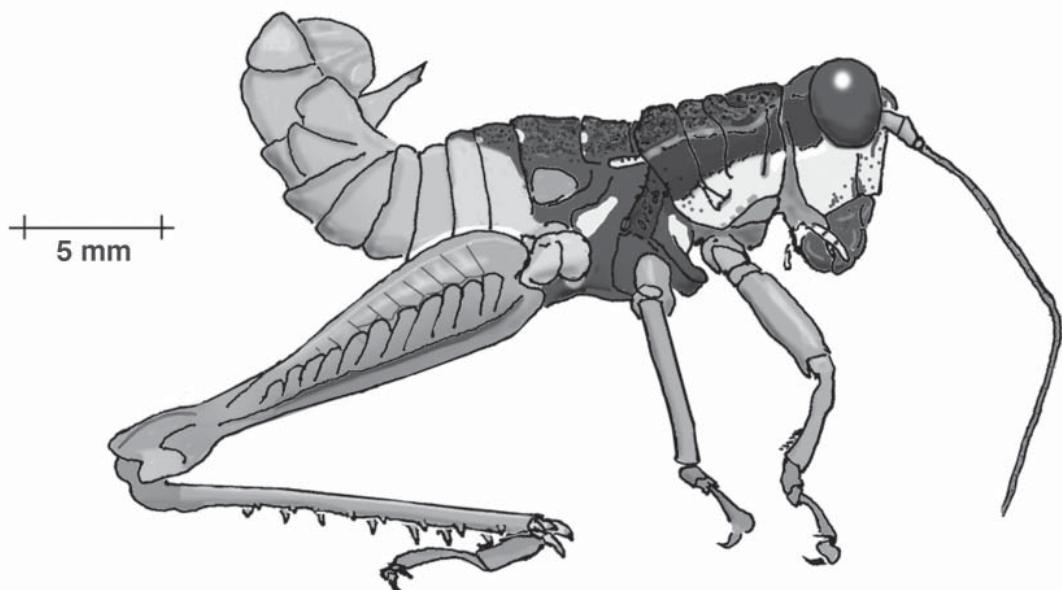


Fig. Om43. *Rhachicreagra jagoi*, male habitus.

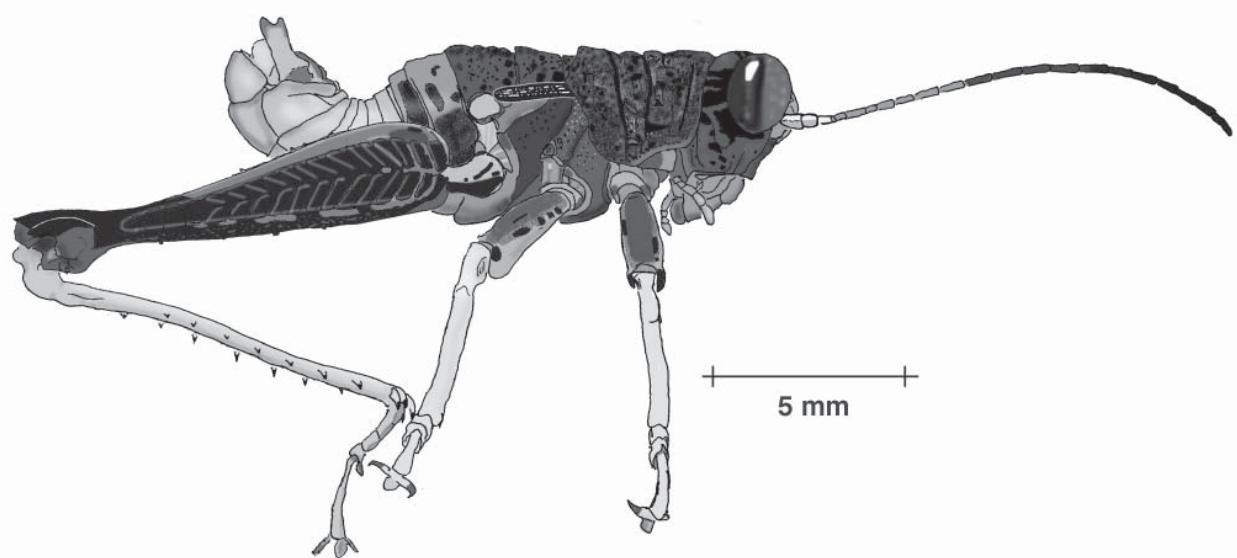


Fig. Om44. *Rhachicreagra khayachrosa*, male habitus.

Diagnosis.

Male: (**Fig. Om45, Plate Om28**) Tegmen long, extending beyond the metathoracic/first abdominal suture and partially overlapping the tympanum. Cerci with upper lobe much shorter than lower lobe; lower lobe laterally compressed, spatulate, obliquely truncate at tip, very long, the two cerci almost touching in the midline; medial rim of subgenital plate smooth, devoid of tubercles.

Coloration. Antennae red. Eyes, head and body black, except all tibiae and tarsi, green, and distal 2/3 of abdomen, dark green. White frons and genae, and a pair of large white spots on vertex behind eyes, confluent with those on the pronotum. Four pair white spots on pronotum, two pair ventral, two pair dorsolateral. White spots on meso- and metathoracic episterna, the latter being larger. One pair large white spots on the black tergum of the first abdominal segment, and a pair of small ones at the posterior margin of the second abdominal tergum. All femora black tinged with dark maroon. Hind knee black, lower lobe dark green. Tarsal segments blackish ventrally, tarsal claws and pulvilli black tipped.

In dried specimens, much of the black coloration becomes tinged with maroon, not just the hind femora.

Female habitus **Fig. Om46, Plate Om29.**

Field characters.

Males unmistakable. A very large black and white Panamanian montane species, differing from all other known *Rhachicreagra* except *Rh. dierythra* in having a double rather than a single row of pale spots on the pronotum.

Distribution.

Rh. magnifica is found in the upper montane forest of the Caribbean slope of Western Panama above Chiriquí Grande. In the vicinity of Fortuna it extends a few kilometres over the watershed onto the Pacific side. **Map Om18.**

Natural history.

Feeds on Asteraceae and Urticaceae, especially *Urera* spp. Mature females contain between 22 and 28 ripe eggs.

14. *Rhachicreagra melanota* Jago & Rowell 1981

Jago & Rowell 1981: 209.

Type locality: COSTA RICA, Río Peñas Blancas, Finca Vargas, 1400-1500 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *mela*, black; *noton*, back; "black-backed", referring to the coloration of the male.

Diagnosis.

Coloration unique – the only *Rhachicreagra* species with no contrasting spots on the male pronotum.

Habitus **Fig. Om47, Plate Om30.**

Field characters.

Very distinctive. Males have a blue and black mottled face, jet black pronotum with no light spots, and bright green legs and abdomen; hind femora green with darker green carinae, black knee. Both sexes have striking orange-red eyes and reddish antennae. The female has a yellow stripe on ventral face of T3 femur and a yellow pronotal spot.

Distribution.

Occurs on some but not all of the peaks of the Cordillera del Norte: Tilarán (but only on the Caribbean slope, replaced by *Rh. drymocnemensis* on the Pacific slope); Volcan Tenorio; Volcan Miravalles; Volcan Cacao. Absent from Volcán Rincón de la Vieja, where it is replaced by *Rh. chrysonota*. Specimens from the northern volcanoes are considerably larger than those from Tilarán. **Map Om19.**

Natural history.

Gaps and edges in montane forest, usually 1000-1400 m, but has been recorded down to 500 m. on V. Tenorio. Normal food plants unknown, probably asteraceous; in captivity will accept *Neurolaena* (Asteraceae) *Phenax* (Urticaceae), and *Iresine* (Amaranthaceae).

15. *Rhachicreagra nothra* Rehn 1905

Rehn 1905: 444; lectotype designated by Jago and Rowell 1981: 212.

Type locality: COSTA RICA, Prov. S. José, Carrillo, (lectotype). Location of type specimen: ANS Philadelphia.

Synonymy.

= *R. pallipes* Bruner 1908: 340, synon. Jago & Rowell 1981: 212.
= *R. aeruginosa* Bruner 1908: 340, synon. Jago & Rowell 1981: 212.

Subsequent literature.

- Rehn, J.A.G. & Hebard, M. 1912: 122. > Designation of lectotype.
- Rowell, C.H.F. 1985 a & b.: 87 et seq. > Foodplants.

Etymology.

Greek *nothris*, sluggish, inactive. In my experience a serious misnomer!

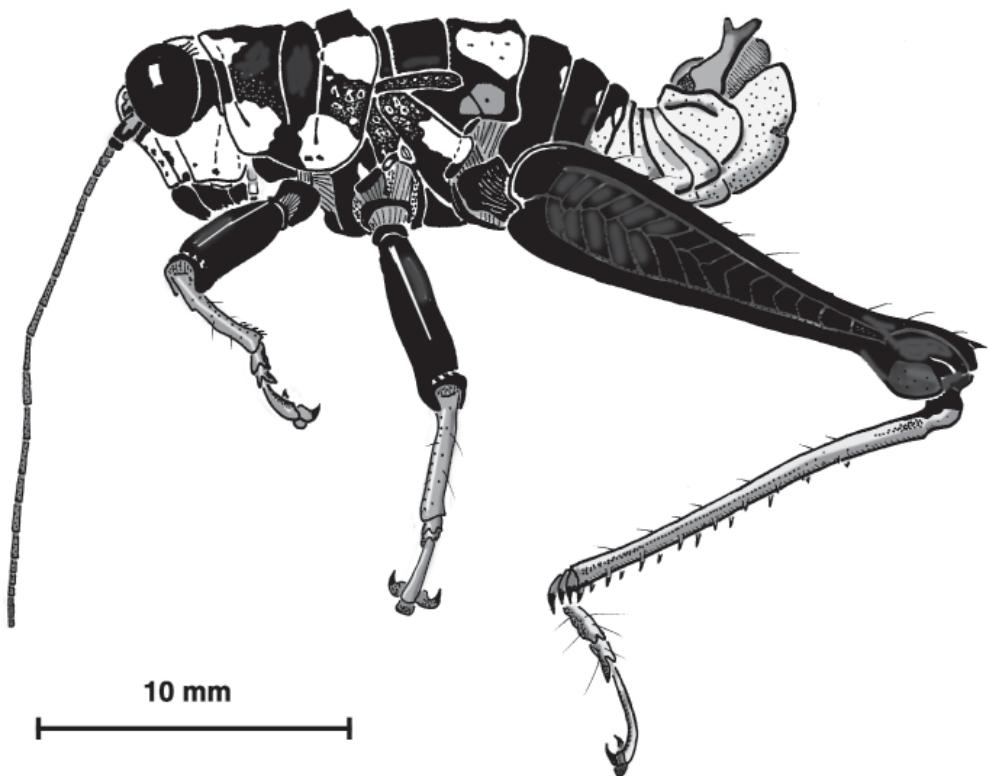


Fig. Om45. *Rhachicreagra magnifica*, male habitus.

10 mm

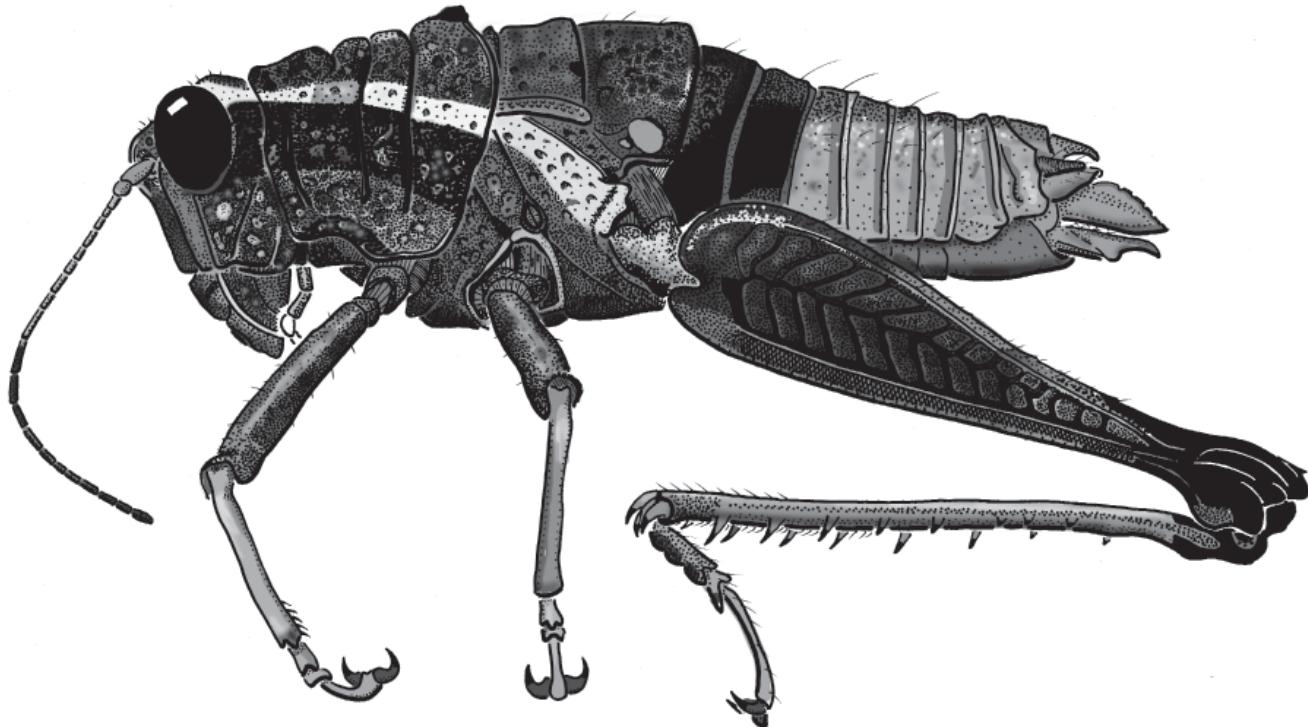


Fig. Om46. *Rhachicreagra magnifica* female habitus.

Diagnosis.

Habitus, **Fig. Om48, Plate Om31.** Males are predominantly black on the pronotum and vertex, slightly speckled with brown or yellow.

The pronotal spots are white and broadly confluent along the lower edge of the pronotal lobes. Face and lower genae white, with a few small brown speckles. Antennae light brown. Tegmina short, extending only to half the width of the metathorax. Cercus prominently forked, the lower fork being clearly longer than the upper one. The species is green/brown polymorphic; most males have green legs (with black hind knees) and abdominal segments, but some have brown instead of green. In these the hind femur is mostly black. The pale patch at the base of the hind femur (see Field Characters below) is diagnostic and visible in all colour forms, and sometimes even in females.

Field characters.

Easily separated on sight from all other species of the genus by the pale whitish-yellow patch on the dorsal surfaces of the base of the hind femora (**Fig. Om48**). This is evident in both sexes and both green and brown colour morphs; the actual colour of the patch varies between individuals but is always lighter than its surroundings (hence Bruner's name *pallipes*). The white pronotal spots are confluent. Frons and genae white.

Distribution.

Caribbean plain of Costa Rica from the Río Banano (S. of Limón town) north to the Barra de Colorado. To the south of the Río Banano it is replaced by *Rh. astytophallus*. *Rh. nothra* extends up river valleys into the surrounding mountains to various extents, reaching 1100 m in valley of the Río Sucio and 1200 m at Juan Viñas in the Reventazón, but only 600 m in the Río Toro Amarillo. Not reported from Nicaragua to date. This is the commonest and most widely distributed species of the genus on the Caribbean slope of Costa Rica. **Map Om16.**

Natural history.

Variably common in treefall clearings in wet forest. Perhaps the most catholic of the genus in its food habits, having been found in the wild eating *Iresine* (Amaranthaceae), *Phytolacca* and *Trichospermum* (Phytolaccaceae), *Urera* (Urticaceae), and a variety of Asteraceae, including especially *Neurolaena* and *Clibadium*. It refuses, however, other closely related plants from these families, such as *Myriocarpa* (Urticaceae) or *Cyathula* (Amaranthaceae).

16. Rhachicreagra obsidian Jago & Rowell 1981

Jago & Rowell 1981: 214.

Type locality: COSTA RICA, Prov. Puntarenas, S. Vito de Jaba, Finca Las Cruces, S. 1100 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *obsidianus*, from Obsius, discoverer of volcanic glass. Refers to the glossy black femora.

Diagnosis.

Habitus **Fig. Om49, Plate Om32.**

Field characters.

The male is a handsome dark blue-black insect with creamy white or yellow thoracic spots and glossy black femora with a blue or blue-green sheen.

Distribution.

Mid-altitude (700-1700 m) forest of the Pacific slope of SW Costa Rica, from the Río Grande de Tárcoles south to the Panamanian border, and of extreme SW Panama (Prov. Chiriquí, the area West of Volcán). Rarely recorded at lower altitudes; apart from the Tárcoles specimen, there is a record from 520 m in the Valle de El General and a dubious one (female specimen only) from the Osa Peninsula, 100 m. **Map Om16.**

Natural history.

Almost invariably associated with *Iresine celosia* (Amaranthaceae), on which it appears to be a specialist. Larvae are often found on this plant in groups of even-aged individuals, probably corresponding to a single egg-pod, and remain aggregated by means of visual attraction to each other. The adults are solitary. Occasionally (Panama) also found on *Wedelia* and *Clibadium* (Asteraceae). In captivity, will also eat *Hydrocotyle* (Apiaceae). In different parts of its range it is sympatric with or adjoins *Rh. apopsis*, *Rh. haematodes* and *Rh. khayachrosa*.

17. Rhachicreagra sphagicerca Jago & Rowell 1981

Jago & Rowell 1981: 218.

Type locality: COSTA RICA, Prov. S. José, Carrillo.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *sphagis*, knife; *kerkos*, tail, here cercus.

Diagnosis.

Habitus **Fig. Om50, Plate Om33.** Very closely similar to *Rh. brachysphagicerca*, but slightly larger and with a much longer lower lobe to the male cercus (**Fig. Om35**). Tip of elytron usually does not reach hind margin of metanotum. There are convincing differences between the two species in their phallic structure, but the chromatic differentiating characters given in Jago and Rowell (1981) are not reliable in a larger sample.

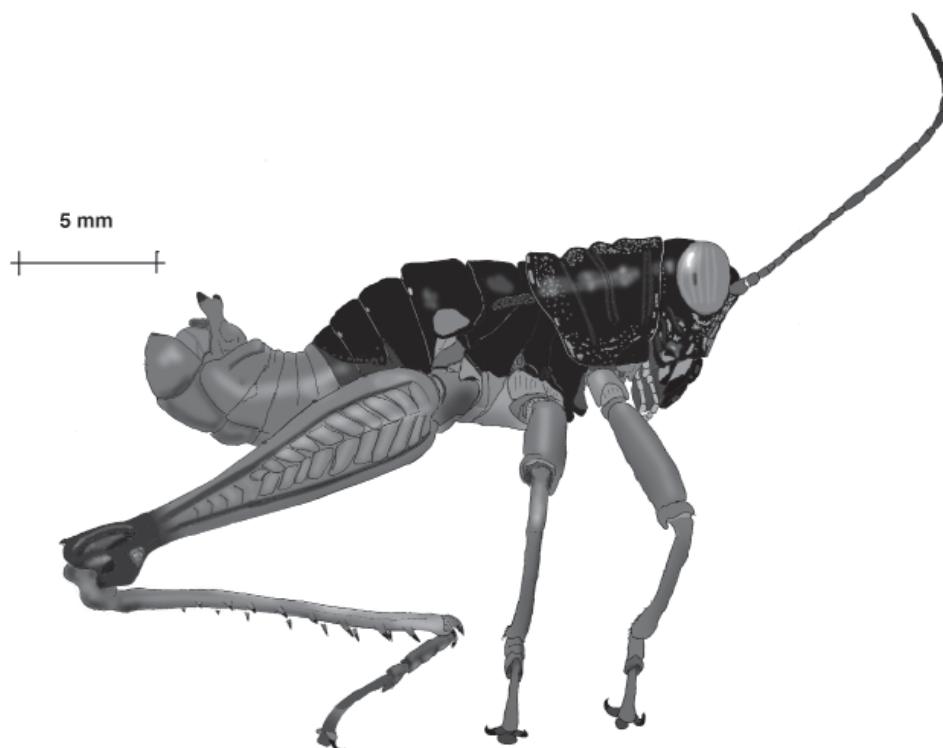


Fig. Om47. *Rhachicreagra melanota*, male habitus.

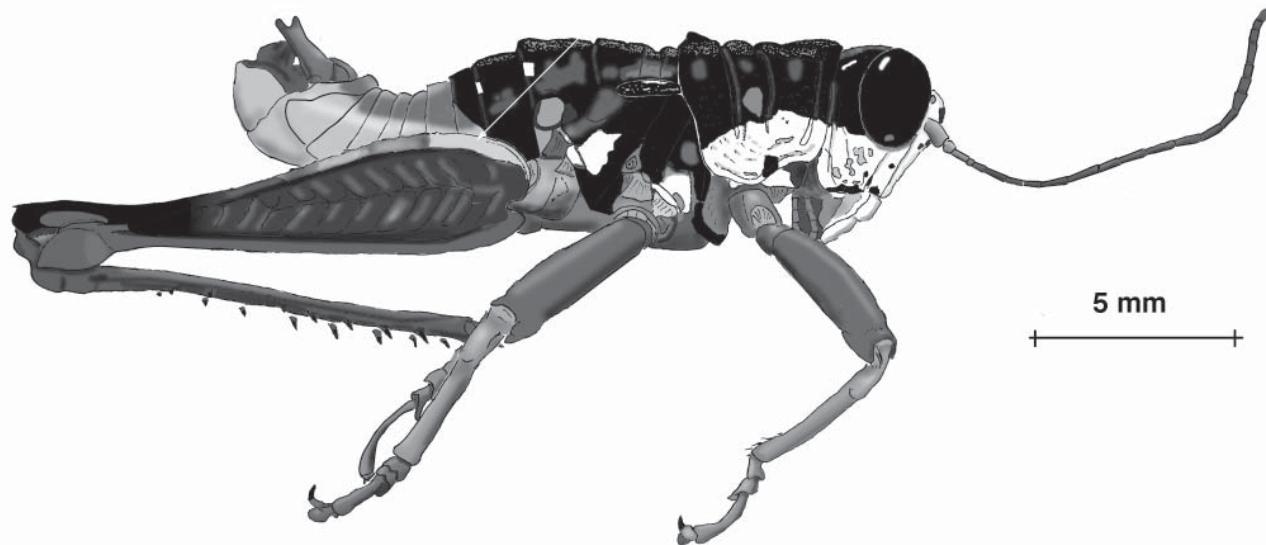


Fig. Om48. *Rhachicreagra nothra*, male habitus. The white arrow indicates the diagnostic pale patch on the dorsal edge of the hind femur.

Field characters.

Legs green, hind knee pale red-brown, lunules not contrastingly coloured. Pronotum and thoracic pleura black, with white marginal and episternal spots. Antennae pale red.

Distribution.

Upper Caribbean slope of a short section of the Cordillera Central, between Cerro Zurquí and Alto la Palma, reaching 1700 m and descending as far as Carrillo (850 m). **Map Om19.**

Natural history.

Unknown.

18. *Rhachicreagra taurusflavus* Rowell 2000

Rowell & Amedegnato, 2000, Ann. Soc. Entomol. Fr. 36: 396.

Type locality: COSTA RICA: Prov. Limón: Río Toro Amarillo, 10 km S of Guápiles; S of Quebrada Grande on trail to S. Valentino, 650 m.

Location of type specimen: ANS Philadelphia (holotype male, allotype female).

Etymology.

Latin *taurus* bull, *flavus* yellow, from the Spanish place-name of the type locality, Río Toro Amarillo.

Diagnosis.

Male (**Fig. Om51, Plate Om36**). Tegmen short, extending only about 2/3 of the way to the posterior edge of the metathorax. Cercus with a short upper lobe and a long slender pointed lower one; posterior median rim of subgenital plate with a pair of small tubercles which are joined medially, resulting in a squared-off tip to the abdomen. The species differs from most members of the genus in following details: head rather large in relation to body; angle between fastigium and frontal ridge less rounded, more angular; medial carina of pronotum ending in a more pronounced dorsally-directed protuberance; a similarly large protuberance at the posterior edge of the first abdominal segment.

Coloration. Antennae brown, grading distally to red. Frons dull yellow, speckled black; genae and tips of palps white. Eyes reddish brown, postocular stripe black, continued posteriorly onto the lobes of the pronotum. Fastigium and vertex of head, thoracic terga and those of 1st and 2nd abdominal segments yellow brown with black speckle. All thoracic spots white. Spots of pronotal lobe clearly disjunct, but linked by

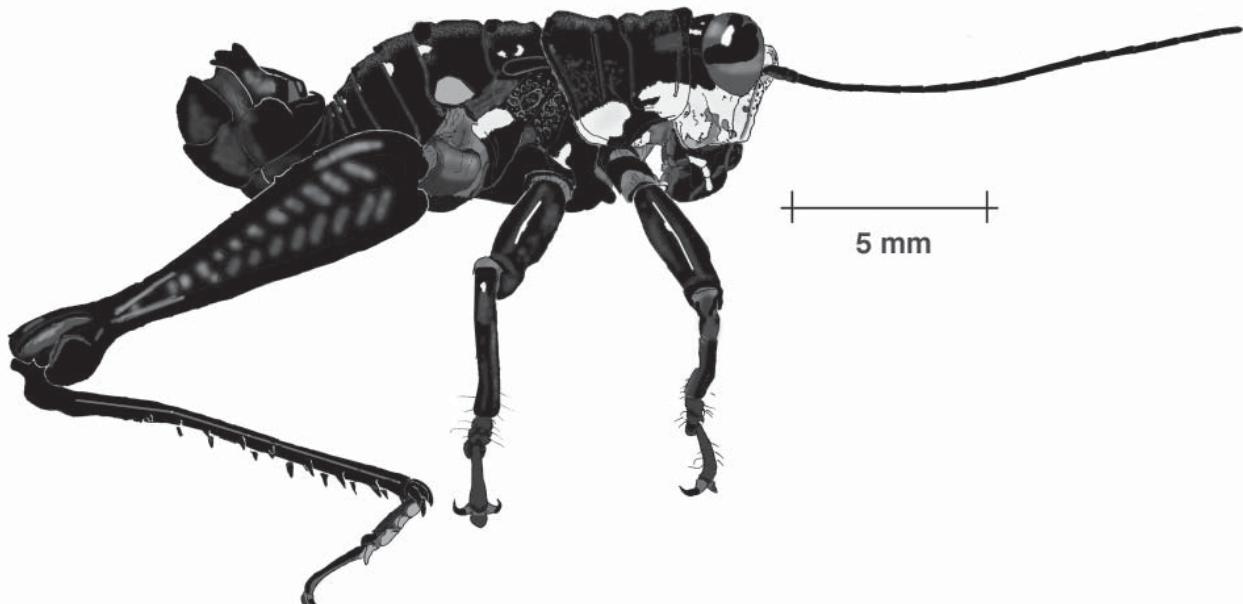


Fig. Om49. *Rhachicreagra obsidian*, male habitus.

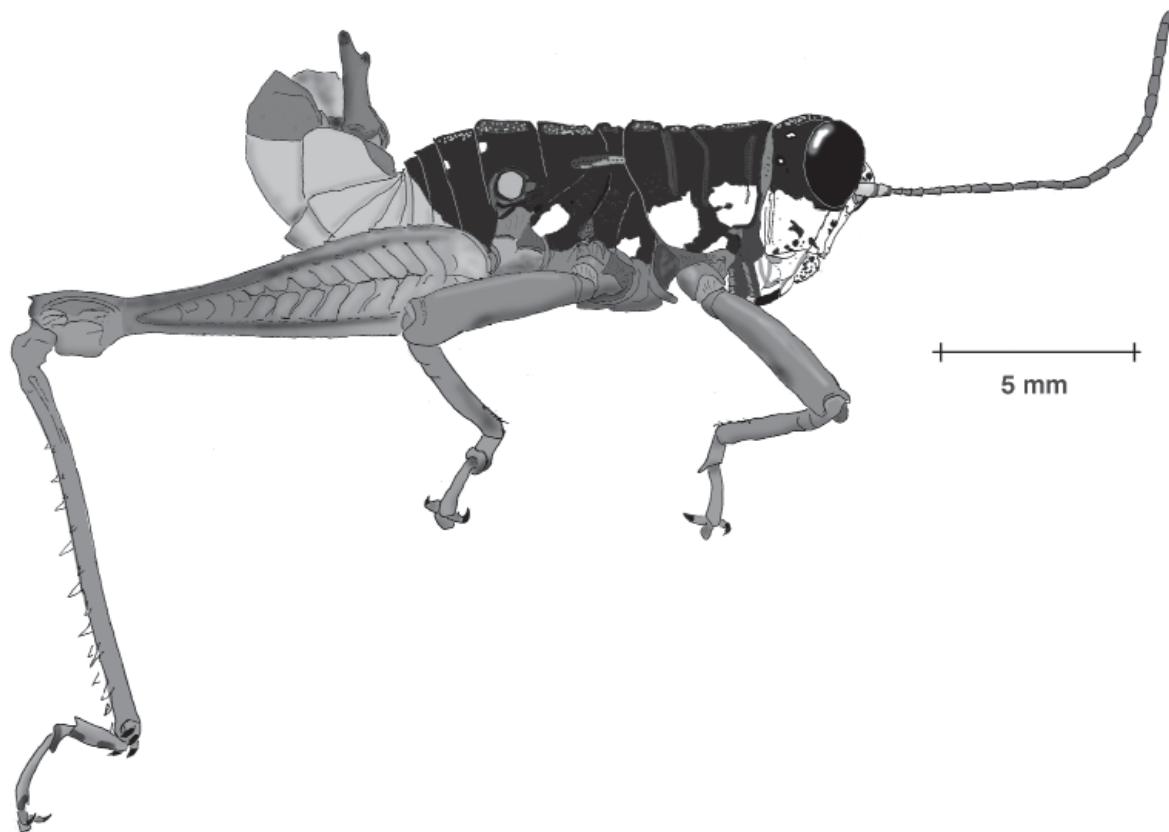


Fig. Om50. *Rhachicreagra sphagicerca*, male habitus. Note that *Rh. brachysphagicerca* is identically coloured, differing only in the shape of the cerci (see Fig. Om35).

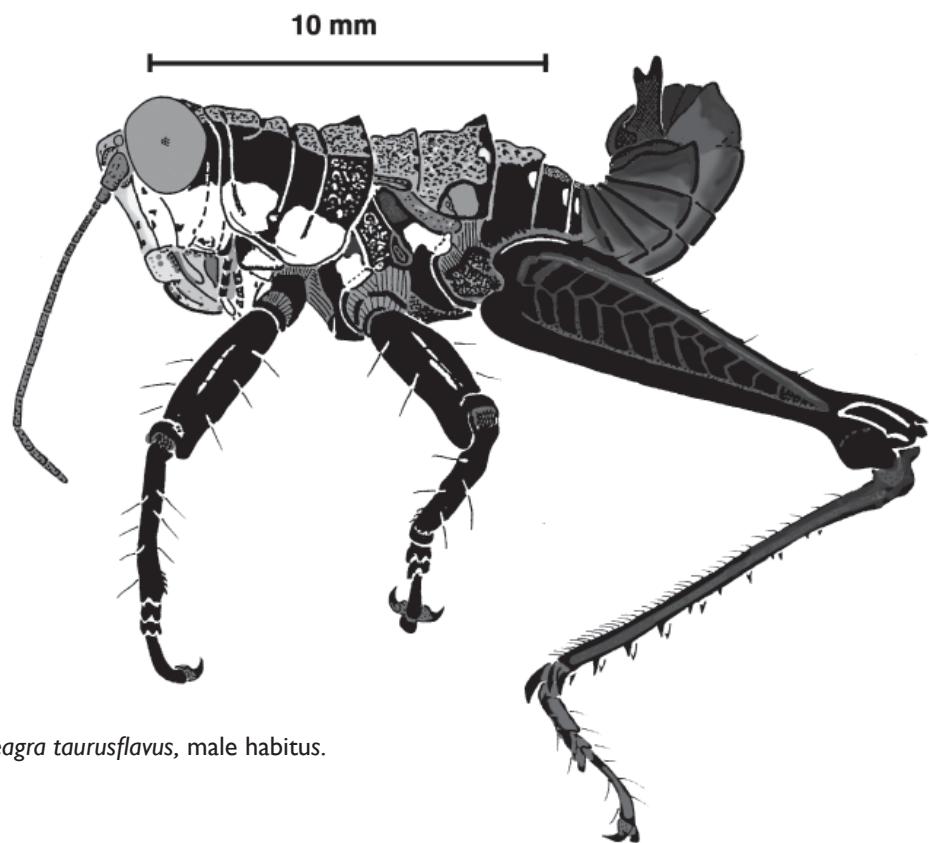


Fig. Om51. *Rhachicreagra taurusflavus*, male habitus.

a small intermediate spot. Posterior dorsal protuberance of medial carina of pronotum black; tympanum and posterior edge of 1st abdominal segment edged in black. Terga of 2nd - 4th abdominal segments black, marked with white spots on posterior margin. Abdomen otherwise blackish green. Entire genital region, including velum and membranes of aedeagus, dull black. Thoracic sterna brown. Front and middle legs glossy black. Hind femora black, faintly tinged with green; tibia greenish black, turning pure black distally.

Field characters.

A distinctive small montane species from the Caribbean slope of north-central Costa Rica, the male with all-black legs, reddish-brown eyes and white thoracic spots.

Distribution.

Cordillera Central above Guápiles, apparently confined to the upper valley of the Río Toro Amarillo above its conluent, the Quebrada Grande, and the valley of the Río Honduras, above (South) of Carrillo. It can be expected in the intervening valleys, those of the Ríos Corinto, Costa Rica and Blanco, and possibly those of rivers to the East of the Toro Amarillo as well. To the North (below about 500 m.) it is replaced by *Rh. nothra*; on the East bank of the Toro Amarillo the two species are separated only by the stream bed of the Quebrada Grande, a distance of not more than 50 metres. To the South (above 1500 m.) it is replaced by *Rh. sphagicerca*. **Map Om19**

Natural history.

This species has been most often found on *Urera caracasana* (Urticaceae).

Subfamily Pauliniinae

Hebard 1923

This subfamily currently contains only a single monospecific genus, the predominantly aquatic swamp-dwelling *Paulinia* Blanchard 1843. This odd small grasshopper lives in and on floating aquatic vegetation, especially the ferns *Salvinia* and *Azolla* and the araceous plant *Pistia*, and is commonly found in the swamps of Eastern S. America, from Argentina to Colombia. It extends north through Panama as far as northern Costa Rica, but has not yet been found beyond that point.

Previously the taxon was often allotted familial rank and then included another S. American aquatic acridid, *Marellia remipes* (Uvarov 1929). However, the common features of these two taxa, and their differences from other acridid groups, seem to be due merely to convergent adaptations to an aquatic life style, and they differ markedly in other ways, e.g. their phallic structures. They do not form an obvious clade in molecular systematic phylogenies (Rowell & Flook 1998). Carbonell (2000) formally removed *Marellia* from the Pauliniidae and demoted the taxon to subfamilial rank. His paper gives full details of the complicated taxonomic history of the group (which is therefore omitted from the references given below). (*Marellia* was left *incerta sedis* by Carbonell, but is certainly an acridid. Some earlier authors saw in it resemblances to the Oedipodinae).

Paulinia

Blanchard 1843

Type species, *Paulinia muscosa* Blanchard 1843.

Generic range.

Eastern S. and Central America, from Argentina to Costa Rica. Occurs on the Pacific coast in the Chocó, Colombia.

No. of included species.

One.

Synonymy.

=*Coelopterna* Stål 1873, synon. Willemse 1948
=*Epacromia* Walker 1871 (preoccupied).

Subsequent literature (heavily selected).

- Giglio-Tos, E. 1897. > Occurrence in Darién.
- Hebard, M. 1924. > Distribution in Canal Zone, Panama.
- Carbonell, C.S. 1964.
- Andres, L.A. & Bennett, F.D. 1975. > Use as biological control agent of aquatic ferns.
- Carbonell, C.S. 2000. > Phallic anatomy, systematics.

Paulinia shows numerous adaptations to its aquatic lifestyle, both in morphology (e.g. the hind legs modified for

swimming, the placement of the eyes at the top of the head) and in behaviour (oviposition on aquatic plants, diving for refuge when startled). As its preferred foodplants *Salvinia* and *Azolla* have become pantropical weeds of freshwaters reservoirs, *Paulinia* has aroused interest among economic entomologists as a potential biological control agent (reviewed by Andres & Bennett, 1975), analogous to the situation with the grasshopper *Cornops* (Leptysminae) and the aquatic weed *Eichornia*. *Paulinia* has therefore been introduced experimentally into regions of Africa, India and Sri Lanka.

Paulinia acuminata (De Geer 1773)

De Geer 1773:51 (as *Acrydium acuminatum*).

Type locality: SURINAME, no other details

Location of type specimen: NHRS Stockholm.

Synonymy:

- = *brevipennis* (Giglio-Tos, 1894), synon. Bruner 1906.
- = *muscosa* Blanchard 1843, synon. Liebermann 1939.
- = *selecta* (Walker 1871), synon. Kirby 1910.
- = *stalii* (Scudder 1875), synon. Giglio-Tos 1894.

Etymology.

Latin *acuminatus*, sharpened to a point, presumably referring to the tip of the brachypterous elytron (see below and Fig. Pau2).

Diagnosis.

Habitus, Fig. Pau1, Plate Pau1. Small grasshoppers, but variable in size: L males = 10 - 13 mm, L females = 15 - 18 mm. Antennae filiform, slightly thickened towards their tip, with blunt rounded ends, 18-21 flagellar segments and varying in length between individuals. Head small, eyes protuberant and placed anteriorly and dorsally, interocular space wide, two or more times the width of the antennal scape. Fastigium very short, blunt and subrectangular, the lateral ocelli adjoining the outer anterior edges. Frons almost straight in profile, frontal ridge narrow and deeply sulcate between the antennae, more or less obsolete below the medial ocellus. Pronotum dorsally flattened, metazona twice as long as prozona; lateral carinae absent, medial carina present only in metazona. Posterior margin of pronotum produced, excurved, with a blunt rounded tip (Fig. Pau2); anterior margin straight. Mesosternal interspace wider than long, narrowing toward the front. Metasternal interspace smaller, subquadrate. Prosternal process absent, replaced by a thickened anterior rim to the sclerite. Tympanum present. Brachypterous or fully alate; in brachypterous individuals the elytra extend to the posterior margin of the 1st (male) or 3rd (female) abdominal segment, and are produced to a tapering point (hence the name *acuminata*), in the macropterous form they comfortably exceed both the abdomen and the hind knees in length, and have rounded tips (Fig. Pau1). Cerci simple, short, tapering to a slender rounded point, very slightly incurved,

the inner surface decorated with weak vertical ridges. Supra-anal plate simple and triangular, in the male longer and entirely covering the pallium, with a slight medial carina basally. Male furcula consists of two small rounded melanised lobes. Dorsal margins of male subgenital plate produced into two low vertical fins bordering the pallium. Ovipositor valves short, smooth, devoid of toothed edges, the upper valves slender and grooved dorsally. Fore and middle legs slender, with prominently spined tibiae. Hind femora robust, dorsal and ventral carinae completely smooth, knee devoid of, or showing only the weakest of traces of, an apical spine. Hind tibiae flattened and markedly expanded distally, and the tibial spurs are also enlarged and expanded to increase the propulsive surface area. (**Fig. Pau3**)

Coloration. Basically a pale leaf green with black or dark brown pronotal disc and basal elytra, and often darkly banded hind femora. The distal elytra and the wings of macropterous individuals are transparent or slightly infumate. Typically coloured specimens are very cryptic on their foodplants. Individuals are however variable in both the patterning and intensity of dark pigmentation, and some females are entirely green, in others the dorsum of the dark metazona is marked with a green or white patch. Males are usually darker than females, sometimes almost completely blackish brown.

Natural history.

Found exclusively in swamps with floating vegetation and some open water. The macropterous forms fly readily at night and are attracted to light. The brachypterous forms are probably dispersed mainly by rafting on floating vegetation (Carbonell 2000). The factors governing the degree of development of the wings are not certainly known, but are presumably environmental, and Carbonell (1964) suggested that temperature may be an important determinant, as brachypterous forms are commoner in the more temperate parts of the range (e.g. in Uruguay), and relatively rare in, e.g. Central Amazonia. The egg pods are attached to the underside of the leaves of the floating foodplant, and are permanently submerged.

Distribution.

The only recorded Costa Rican specimen is a macropterous male taken at light near Puerto Viejo de Sarapiqui. A likely origin for it would be in the nearby lower reaches of the Río San Juan, and similar apparently favorable conditions are found all along the course of the pericoastal canal as far south as Matina. The species is however probably uncommon in this area, for collections made by InBio personnel in both Tortuguero and Barra del Colorado have failed to include it. In Panama *Paulinia* has been recorded from Darién (Lago Pita) (Giglio-Tos 1897), Gatún, La Chorrera and the Río Trinidad (Hebard 1924). It is not, however, commonly observed at light in the Canal Zone, as would be expected were it frequent there.

For recent introductions to the Old World tropics see previous page.

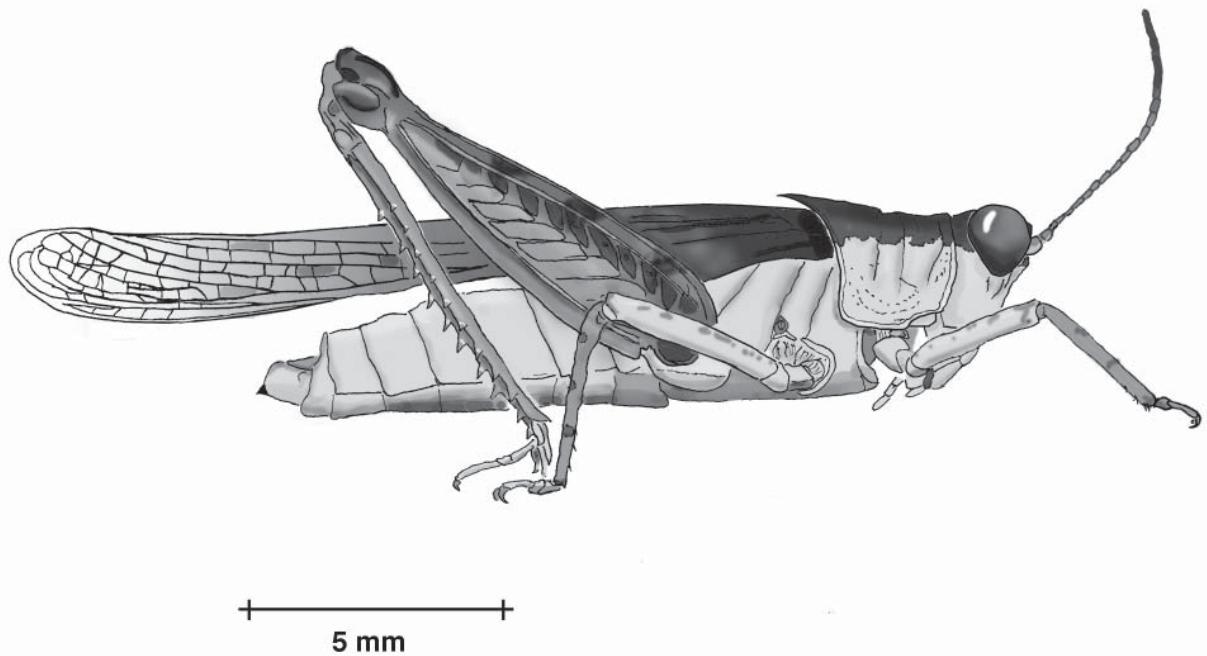


Fig. Pau1. *Paulinia acuminata*, macropterous male.

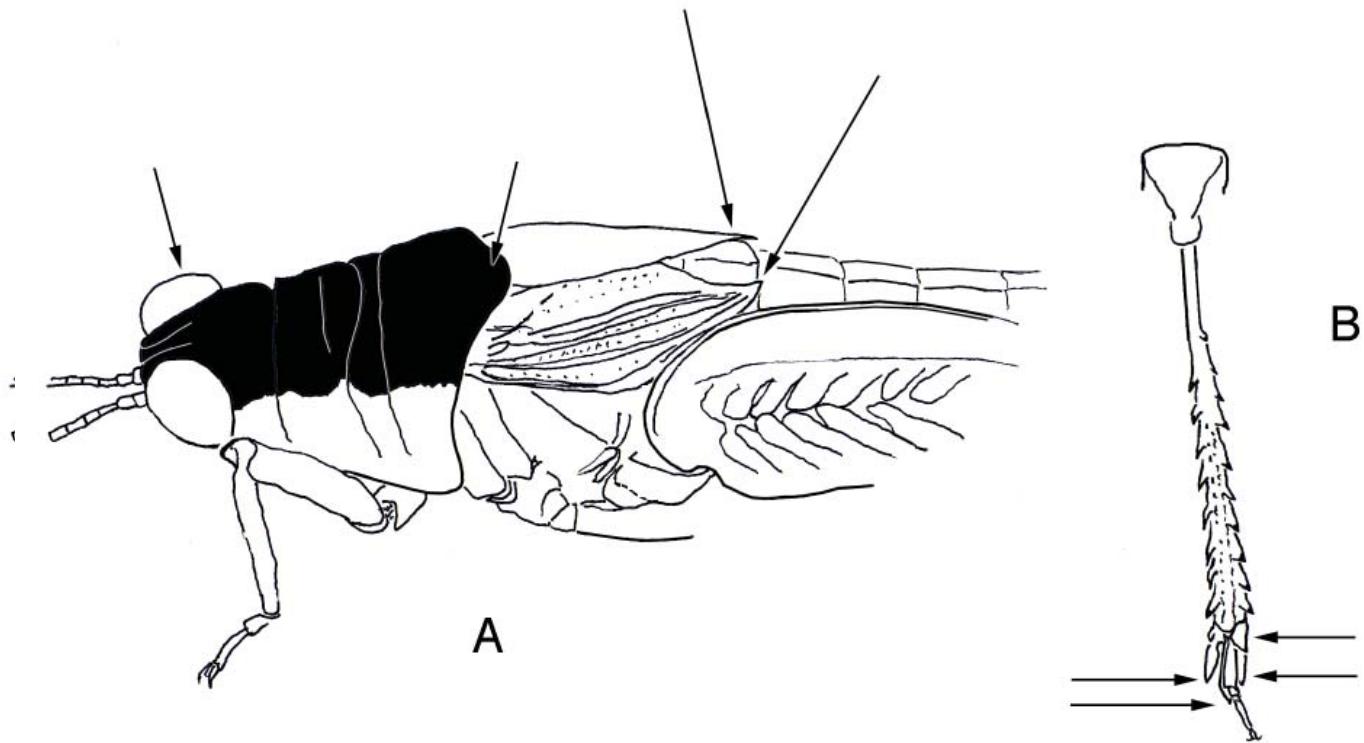
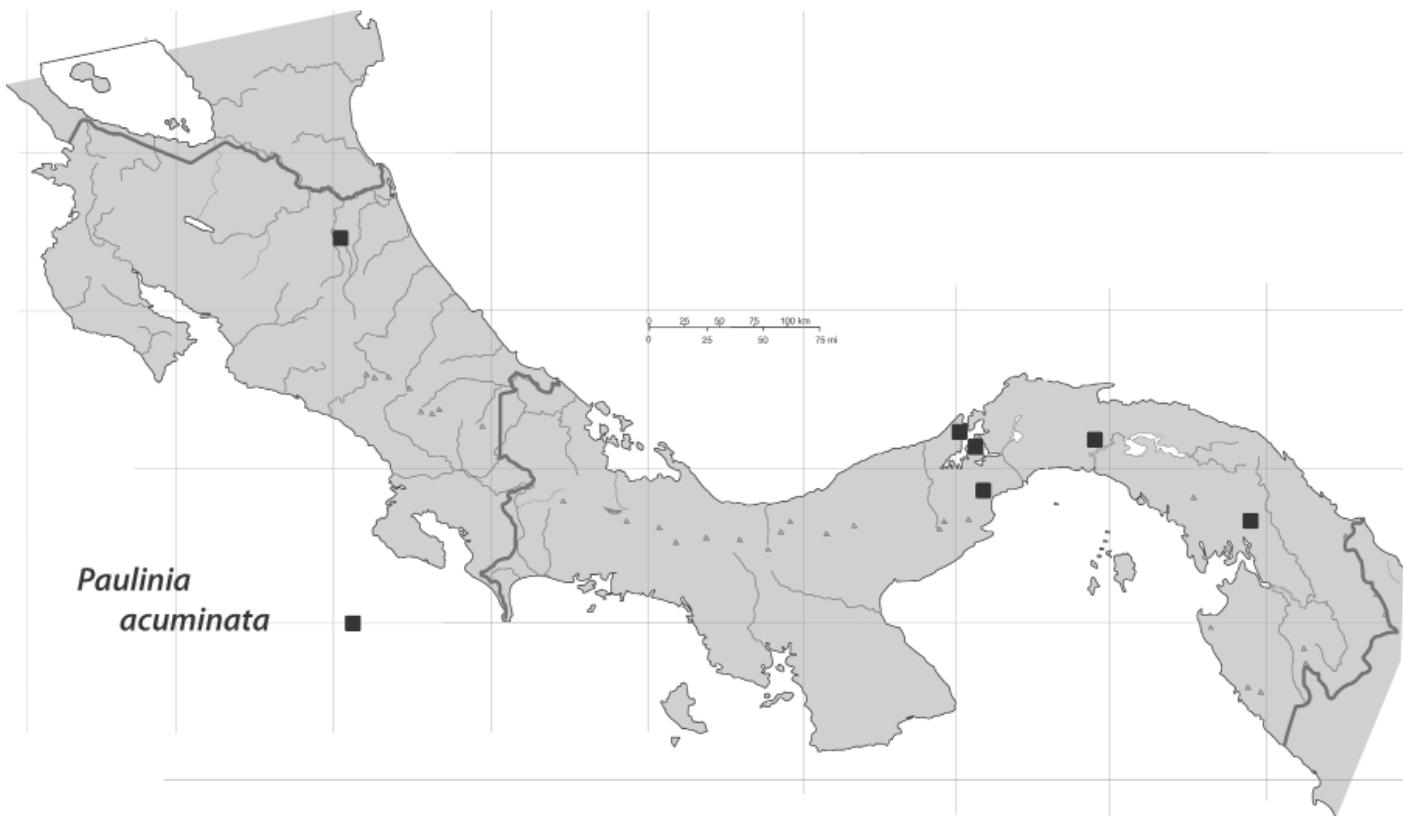


Fig. Pau2. *Paulinia acuminata*, brachypterous male. A, oblique view to show the acuminate tips of the elytra (long arrows), and the rounded posterior margin of the pronotum and the protuberent eyes (short arrows). B, dorsal view of left hind tibia. Note enlarged and flattened spurs (arrows), and expanded lower half of tibia.,



Map Paul. Recorded localities of *Paulinia acuminata* in Costa Rica and Panama.

Subfamily Proctolabinae

Amedegnato 1974

The Proctolabinae are a distinctive subfamily of endemic neotropical Acridids. They were first raised to subfamily status by Amedegnato (1974) and further classified, principally on the basis of their male genitalia, by Amedegnato (1977), Descamps (1976, 1980a, 1980b), Descamps and Rowell (1978, 1984), Amedegnato and Poulain (1987) and Rowell (2000). The subfamily currently contains 29 genera and 200 described species.

The Proctolabinae range from southern Mexico to northern Paraguay and southern Brasil, and almost all live in wet forest, up to about 2500 m elevation. Ecologically, the majority fall into one of two categories. The members of the first category are fully winged and mostly arboreal; they occur in both primary and secondary forest throughout the range of the subfamily, but are most diverse in South America. This ecological category includes the tribe Coscineutini and three of the four subtribes of the tribe Proctolabini (the Proctolabae, the Eucephalacrae and the Saltonacrae) and accounts for the majority of the genera and species. The second category consists mostly of brachypterous or micropterous genera found on woody forbs, shrubs or colonizing tree species in secondary successional areas within the forest, such as in light-gaps or at forest edges. This category corresponds roughly to the fourth subtribe of the Proctolabini, the Lithoscirtae, one that is confined to Central America. Occasionally, otherwise flightless genera of the Lithoscirtae contain fully winged species convergent with the Proctolabae, such as *Ampelophilus coeruleus* and all species of the genus *Leioscapheus*. Conversely, *Proctolabus*, a Mexican genus of the Proctolabae, is ecologically convergent with the Lithoscirtae and some of its species are brachypterous. The same appears to be true of the little-known Colombian *Azotocerus*.

In all, thirteen genera of this subfamily are currently known from our area.

Diagnosis.

The principal characters of the Proctolabinae are genital (long vermiform preapical diverticulum of the spermatheca (e.g. Fig. P20E); anterior sclerites of endophallus compressed laterally, with reduction of the apodemes and the elaboration of secondary replacement structures; hypertrophy and fusion of the lateroventral sclerites of the ectophallus to form a ring surrounding the phallus laterally and anteriorly). Externally, they are characterized by a thickened transverse ridge which forms the apex of the fastigium and separates it from the frontal ridge (Fig. P1). The pronotum is rounded in cross-section, with no lateral carinae and only a weak medial carina, usually crossed by three sulci. Wings and elytra are frequently cycloid, brachypterous or micropterous (but fully developed in some genera, including the Central American

Coscineuta, *Zosperamerus*, *Adelotettix*, *Balachowskyacris* and *Poecilocloeus*), but are never totally absent; male subgenital plate inflated, cup-like, open dorsally; pallium thick and wrinkled and often protuberant; male cerci frequently of complex shape, simple and conical only in *Coscineuta*. Furcula present or absent. Ventral lobe of hind knee usually bluntly pointed. There is no external apical spine on the hind tibia. Ovipositor valves (especially in the Lithoscirtae) often modified to spatulate or rod-like forms. Many Proctolabines have the long hind feet (Fig. P2), protuberant eyes and bright coloration characteristic of most canopy grasshoppers.

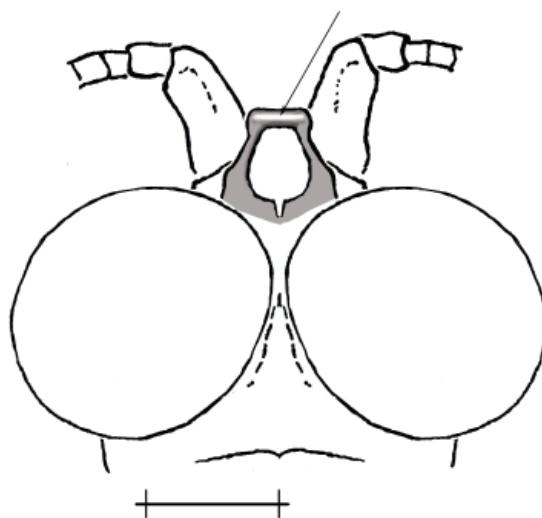


Fig. P1. *Zosperamerus planus*. Dorsal view of head, to show the ridge (arrowed) bounding the tip of the fastigium in the Proctolabinae. Scale bar 1 mm.

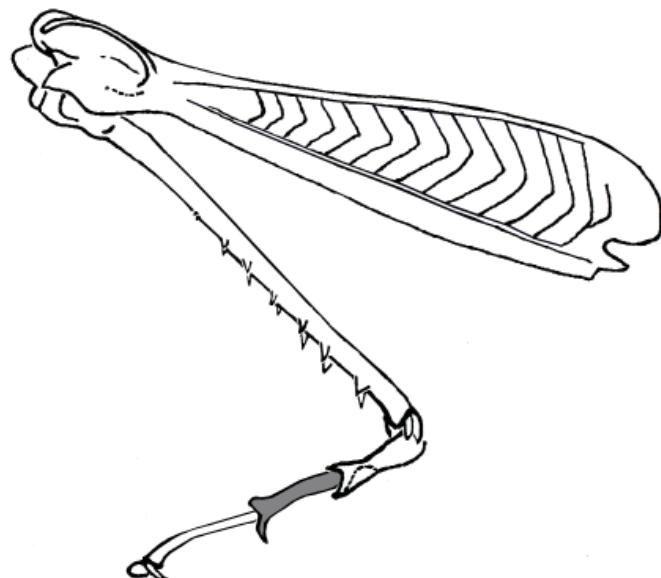


Fig. P2. *Poecilocloeus septentrionalis*, hind leg, showing the relatively long hind foot and elongated second tarsal segment (shaded) seen in most Proctolabines.

Tribe Coscineutini Brunner von Wattenwyl 1893

Brunner's group Coscineutae was raised to tribal status by Amedegnato 1974.

- Amedegnato 1974: 200.
- Amedegnato & Poulain. 198 :400.
- Rowell & Flook. 2004: 36, Molecular systematics.

The tribe contains only a single genus.

Coscineuta Stål 1873

Stål 1873: 33.

Type species: *Acridium coxale* Serville 1839.

- Amedegnato 1974: 200.
- Descamps 1976: 71.
- Descamps 1980: 21

Etymology.

Probably from Greek *koskinon*, a sieve, suggested by the deeply pitted cuticle of the thorax.

No. known species.

Eight. In our area: one.

Range.

Northern Amazonia (of Peru, Brasil and the Guyanas), Venezuela, Ecuador, Colombia and Panama; Trinidad and St.Barthelemy (Windward Islands). The record from Uruguay given by Popov et al. (1994, J. Orth. Res. 2: 48-59) is erroneous (C.S. Carbonell, pers.comm.).

On the basis of genital and cercal structure, both Descamps (1976) and Amedegnato & Poulain (1987) considered *Coscineuta* the most primitive living proctolabine taxon. Molecular systematics (Rowell & Flook 2004) support this conclusion.

Diagnosis.

Fully alate. Cuticle of pronotum and thoracic pleura rugose and deeply pitted. Male cerci simple, conical. Pallium not protuberant, male supra-anal plate divided transversely, triangular. Ovipositor valves normal, rather wide and strong; female subgenital plate simple.

Natural history.

Often very common in seasonal wet forest, occasionally in outbreak proportions. Polyphagous on many species of trees and shrubs. In Trinidad *C. virens* has occasionally been declared officially a pest of forest trees. Individuals of several species, including the Central American *C. coxalis*, are known to form

aggregations of individuals at certain fixed points, which can persist for months. Neither the cause nor the function of this behaviour is known.

I. *Coscineuta coxalis* (Serville 1839)

Acridium coxale Serville 1839: 672.

Type locality: New Grenada (Colombia).

Location of type specimen: MNHN Paris (holotype female).

Subsequent literature.

- Stål, C. 1873: 33. > Transfers to *Coscineuta*.
- Hebard, M. 1923: 254.
- Hebard, M. 1924: 128.
- Hebard, M. 1933: 130.
- Descamps, M. 1976: 73.
- Descamps, M. 1980: 21.
- Carbonell, C.S., Rowell, C.H.F., Bentos-Pereira, A. & Porras, M.F. 2007: 50.

Diagnosis.

Male habitus **Fig. P3, Plate PI.** Readily identified by the red coxae and orange compound eyes, the abdomen segmentally ringed in light-blue and black, and the yellow male subgenital plate or ovipositor valves, all contrasting strongly with the dark green body, legs and elytra. Hind wings blue, the tips infumate. Late larvae are also distinctively coloured in black, orange and yellow. Markedly dimorphic in size, the males are only about half as big as the females.

Field characters.

The distinctive coloration is unique in our area. Males are extremely agile and swift fliers, hard to catch. Females are sluggish, and hence predominate in most collections.

Distribution.

Colombia (Antioquia, Choco, Cordoba); Panama, from the Colombian border up to and including the Canal Zone. Not recorded from Western Panama or from Costa Rica. **Map PI.**

Natural history.

Lowland forest edges and light gaps, where they are polyphagous on a large variety of forest trees and shrubs, eating preferentially the flowers and fruits. Often very common. Sometimes forms large persistent aggregations (see generic description above). The coloration, and the behaviour of especially females when roughly handled – lying passive, with the conspicuously coloured abdomen curled ventrally into full view – strongly suggests chemical defence and aposematic coloration, but there are no experimental data; however, aggregated individuals are readily eaten by both pigs and domestic fowl. Adults are present from August to at least January.

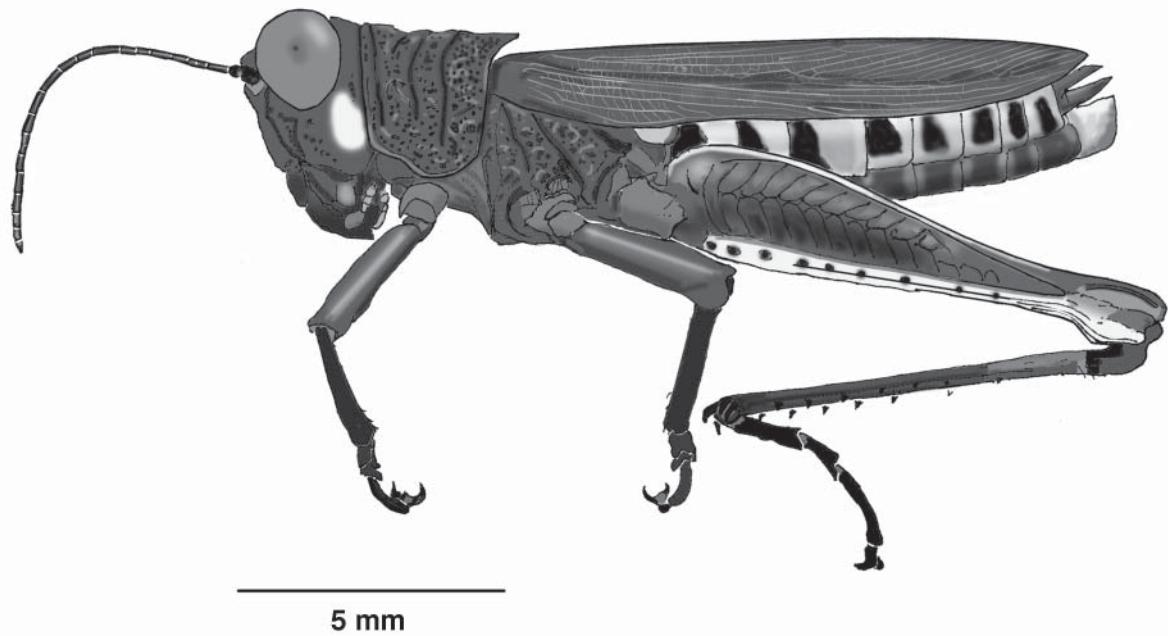
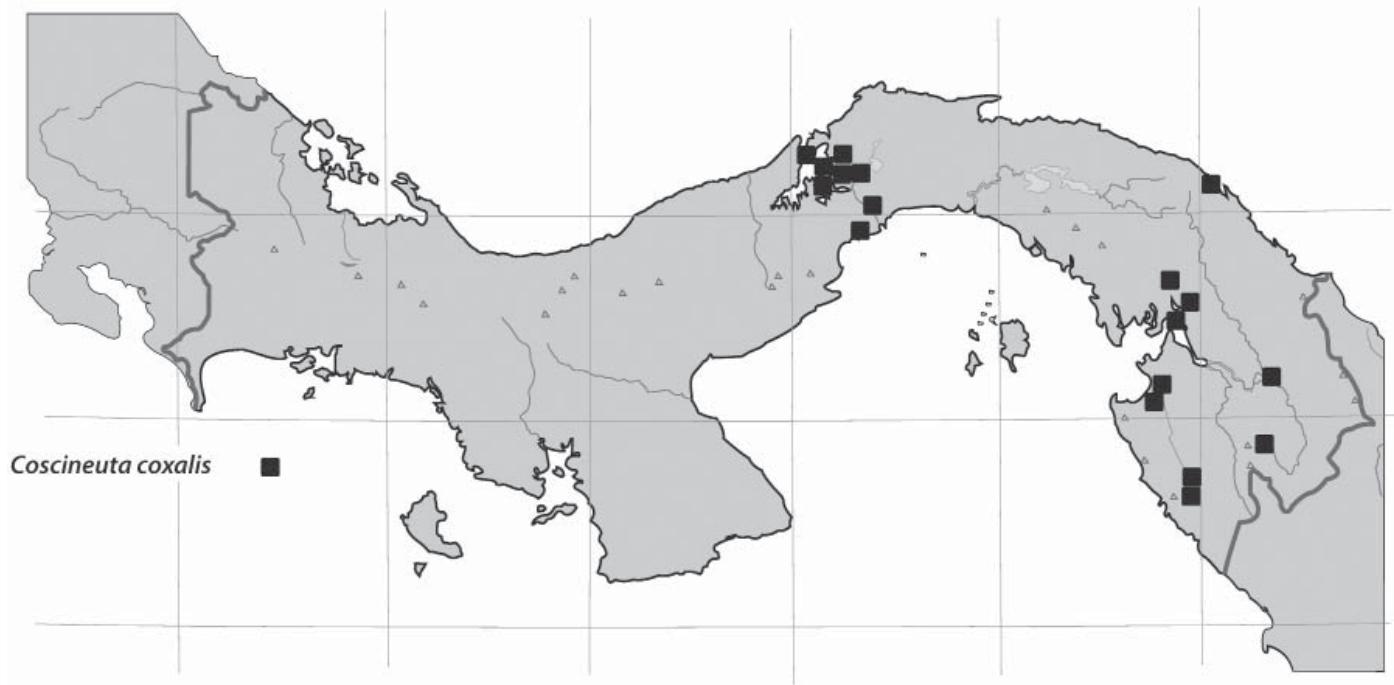


Fig. P3. *Coscineuta coxalis*, male habitus.



Map PI. Distribution of *Coscineuta coxalis* in Panama.

Tribe Proctolabini Amedegnato 1974

Diagnosis.

Alate or brachypterous or micropterous. Cuticle usually smooth. Male cerci of varied shape, but never simple or styliform. Pallium frequently protuberant. Male supra-anal plate triangular or subquadangular. Ovipositor of varied form, sometimes simple (*Adelotettix*), sometimes highly modified (Lithoscirtae); female subgenital plate simple (Lithoscirtae) or quadrilobate (Proctolabae).

Only two of the four included subtribes are represented in our area, the Lithoscirtae and the Proctolabae.

Subtribe Lithoscirtae Amedegnato 1974

A homogenous group of light-gap and canopy dwelling grasshoppers from Central American wet forest. The Lithoscirtae are notable ecologically for two features: they are oligophagous or even monophagous, and the individual genera are composed of geographically separated but ecologically similar species, often with very restricted ranges, usually all eating the same or closely related plants (Rowell 1978, 1983; unpubl. obs.). The different genera, on the other hand, as well as some isolated species, sometimes eat very different plants. This suggests that past food-plant shifts may have been associated with taxon generation. The commonest (and probably the original [Rowell & Flook 2004]) food-plants of the subtribe are the Asteraceae and the Solanaceae. Associated with their oligophagy, the Lithoscirtae have changed their oviposition habits from the plesiomorphic soil-depositing type to epi- or possibly even endophyllous oviposition, with correspondingly profound changes in the structure of the ovipositor. Copulation and moulting usually occur at night, and the latter is extremely rapid, a matter of a few minutes, probably as an adaptation against predation by ants.

Lithoscirtae are usually both brightly coloured and predominantly visual in their social behaviour. They are attracted to conspecifics visually and often form groups, sometimes involving more than one species, and sometimes (*A. olivaceus*, *D. nigrescens*) including similarly coloured sympatric species of the rhytidochrotine genus *Hylopedetes*.

No. of included genera.

Seven. All are represented in our area.

Tribal range.

Extreme W. Colombia (Chocó, Nariño, El Valle); Panama; Costa Rica; Nicaragua; Honduras; Guatemala; southern Mexico. To be expected from Belize, but not recorded to date.

Diagnosis.

All the Lithoscirtae have a flat, shield-shaped epiphallus devoid of ancorae and with small lophi and a characteristic phallic structure, in which the ventral aedeagal valves are elongated but usually relatively simple (though branched in some species of *Ampelophilus*). The prosternal process is reduced to a broad smooth swelling, devoid of a point, spine or cylindrical peg (except in *Tela* and *Paratela*). The male supra-anal plate is triangular and not transversely divided, and often is ornamented with hairs, thickened margins or melanic processes, and near the tip bears a process or fin which often extends beyond the end of the plate (the “granule apical saillant”) of Amedegnato (1977), here termed the preterminal process. The male cerci characteristically have complex shapes. Females have simple subgenital plates and the ovipositor valves are modified from the plesiomorphic soil-digging type (see above). The antennae are finely filiform and very long, especially in males; the flagellum usually has 21 segments. The majority of species and genera are brachypterous or micropterous; only *Ampelophilus coeruleus* and all species of *Leioscapheus* are fully winged. Early larvae of all genera have a characteristic black coloration with orange head and/or pronotum and a dorsal yellow or white stripe, with only small interspecific differences (Descamps and Rowell 1978). Adults are mostly brilliantly coloured in species-specific patterns. Most species are noticeably sexually dimorphic; the males are slender with inflated genital capsules, the females fusiform and larger, and often somewhat differently patterned. In all genera except *Leioscapheus* there is a fairly common bronze-coloured morph of the female, as well as one more nearly resembling the male in coloration

Both morphological (Descamps 1976) and molecular systematic data (Rowell & Flook 2004) group the seven genera in three clades: *Ampelophilus/Leioscapheus*; *Tela/Paratela*; *Lithoscirtus/Drymophilacris/Drymacris*. They are treated in this order below.

Key to genera of Lithoscirtae.

- | | |
|-----------|--|
| I | Posterior margin of pronotum usually convex (but see 4A). Elytra attain at least the first abdominal segment and are usually longer than that. Ventral ovipositor valves either reduced to smooth rods, or slender, pointed and finely toothed. 2 |
| IA | Posterior margin of pronotum straight or emarginate; usually micropterous, elytra rarely attain the tympanum. Dorsal ovipositor valves dorsoventrally flattened, spatulate, diverging. Ventral ovipositor valves rodlike. 5 |
| 2 | Prosternal process greatly reduced, forming a smooth swelling with no point or tubercle 3 |
| 2A | Prosternal process pointed. Dorsal ovipositor valves dorsoventrally flattened, with more or less pointed tips, not diverging. Ventral ovipositor valves rodlike. 4 |

- 3 Wings and elytra functional, attaining the hind knees or beyond. Elytra usually longitudinally striped in blue-green and black. Upper and lower ovipositor valves reduced to smooth subcylindrical rods. Male SAP with a dark depressed tip and a more or less prominent subterminal process. Male cerci incurving, and often of complex form. Antennae very long and slender. Coloration predominantly blue-green, often with red or orange markings on the thoracic pleura. *Leioscapheus*
- 3A Wings and elytra squamate, extending at least into 2nd abdominal tergum, or (*A. coeruleus*) only slightly brachypterous, extending as far as the cerci. Male cerci elongate at the tip, upwardly and inwardly curved, weakly toothed on the ventral edge. Male SAP triangular with prominent lateral shoulders, and the subterminal process forms a small medial fin near the tip. Ovipositor valves long, slender, laterally compressed and finely toothed. Coloration predominantly green, with iridescent blue markings on the head. Terminalia often red or orange-brown. *Ampelophilus*
- 4 Brachypterous, elytra extending into 4th or 5th abdominal terga, dark brown in colour. (Outside of our region, micropterous with squamate elytra, usually green). Male cerci bifid and fishtail-shaped at their tip in lateral view. (**Fig. P16**). *Tela*
- 4A Micropterous, elytra extending only into first abdominal segment and partially occluding the tympana; elytra longitudinally striped in black and yellow or black and light blue-green. Posterior margin of pronotum often straight or even slightly incurved. Male cerci bifid and fishtail-shaped at their tip in lateral view (**Fig. P18**) *Paratela*
- 5 Elytra cycloid, extending into 2nd abdominal segment and partially covering tympana. Male cerci long, only slightly incurved, with an abrupt embayment in the ventral edge at 2/3 of the length, tip laterally flattened and symmetrically rounded. (**Fig. P21**). Dorsal ovipositor valves slightly excavated on dorsal surface, with raised internal edge. Female subgenital plate flat (**Fig. P20**). *Drymacris*
- 5A Male cerci of various forms (**Figs P19 & P20**), but not as above. Elytra squamiform, extending maximally into metanotum. Dorsal ovipositor valves flattened, spatulate. Female cerci long and straight, with fine sharp points (**Figs. P26, P31**). Female subgenital plate domed or with paired swellings at anterior margin. 6
- 6 Male cerci abruptly flexed inwards by some 70° at about half length, completely or almost completely melanized; furcula absent (**Fig. P34**). Female subgenital plate smoothly domed in anterior region. *Lithoscirtus*
- 6A Male cerci curved smoothly inwards, forceps-like, usually only the distal region melanized; furcula absent or present

(**Figs P22 & 23**). Female subgenital plate with paired ventral or ventrolateral swellings near anterior margin

..... *Drymophilacris*

A. The *Leioscapheus* genus group.

Ampelophilus and *Leioscapheus* are at first sight rather dissimilar genera, but on close examination share several features. They have similar male supra-anal plates, with lateral shoulders and a complexly decorated tip, their prosternal processes are reduced almost to nothing, and they include the only fully winged members of the subtribe.

Ampelophilus Hebard 1924

Hebard 1924a: 127.

Type species: *Anniceris meridionalis* Bruner 1908: 271.

Subsequent literature.

- Hebard, M. 1932: 99.
- Amedegnato, C. 1974: 200.
- Descamps, M. 1976: 87-90.
- Descamps, M. & Rowell, C.H.F. 1978: 36.
- Descamps, M. & Rowell, C.H.F. 1984: 151.
- Amedegnato, C. & Poulain, S. 1987: 400.
- Rowell, C.H.F. & Flook, P.K. 2004 > Molecular systematics.

Etymology.

Greek *ampelos*, vine, *philia*, affection. “vine loving”.

Vines in the broad sense are indeed characteristic of wet forest light-gaps and edges, where the species of the genus are mostly found, but none are known to serve as a foodplant or to be especially associated with *Ampelophilus*, so the name is not very apt.

Diagnosis.

Rather small, but robustly built. Brachypterous or fully winged. Posterior margin of pronotum convex. Cuticle of thoracic nota and pleura densely and finely punctate. Antennae black, with pale annuli at the joints, tipped with white in males only. Male cerci melanised and upturned at the tip and variously provided with processes on the ventral margin – those of the various species differ only slightly (see Descamps 1976, Figs 61-66). Male supra-anal plate subtriangular, rather short, with prominent lateral shoulders at approximately midlength; the rounded tip bears a small vertical fin. Ovipositor valves long, laterally compressed, with serrate edges and sharply hooked tips (**Fig. P6**).

No. of known species.

Four. All occur in our area. The three older species were all originally described under the genus name *Anniceris* Stål, now considered a South American Ommatolampine taxon.

Generic range.

Pacific slope of Panama and Costa Rica, from northern Darién north and west to the Cordillera de Tilarán, principally but not exclusively in montane forest. Not to date recorded from Southern Darien or Colombia.

Natural history.

In the wild all members of the genus appear to be oligophagous on Asteraceae and/or Solanaceae. The structure of the ovipositor (**Fig. P6**) suggests that oviposition might be endophytic, perhaps within the pithy stems of the food plants, but no wild observations are available. Dr.W. Hickler (pers. comm.) found however that captive females of *A. olivaceus* oviposited in soil, and in culture the resultant larvae accepted various European plants as food, including *Rubus* (Rosaceae) and *Taraxacum* (Asteraceae), a surprising observation.

Key to species of *Ampelophilus*.

- | | | |
|----|--|------------------------------|
| I | Wings functional, elytra nearly as long as abdomen, dark green. Head of male brilliantly blue. Hind femora red brown, hind tibiae blue. Highlands of Central Costa Rica only | <i>A. coeruleus</i> |
| IA | Wings micropterous, squamate | 2 |
| = | | |
| 2 | Hind knees dorsally black, ventrally blue. Hind tibiae blue, lower edge of pronotal lobes yellow, remainder of body green. In male, tip of abdomen reddish brown. Costa Rica only | <i>A. truncatus</i> |
| 2A | Hind knees dorsally red brown, ventrally green; hind tibiae blue-green, lower pronotal lobes yellow dorsally, green ventrally. Posterior parts of head iridescent blue. Eyes dark blue when alive. Costa Rica only. | <i>A. meridionalis</i> |
| 2B | Hind knee at least partially red, hind tibae pale brown, shading to blackish distally; pronotal lobes green. Basal part of hind femora, and underside of abdomen and thorax, red or green, depending on race. Genae and posterior parts of head iridescent blue. Remainder of body, green. Costa Rica & Panama | <i>A. olivaceus</i> |

The three brachypterus species also differ markedly in the shape of the tip of the ventral valves of the aedeagus: that of *A. truncatus* is short and simple, that of *A. olivaceus* is elongate and bifid, with rather long prongs; that of *A. meridionalis* is trifid, with very short prongs (see Descamps 1976, Figs 68-74). This would be an appropriate criterion for use with faded museum specimens.

I. *Ampelophilus olivaceus* (Giglio-Tos 1897)

Anniceris olivaceus Giglio-Tos 1897: 4.

Type locality: PANAMA: Prov. Darién: Punta de Sabana.

Location of type specimen: MRSN Torino, Museo Regionale di Scienze Naturali di Torino.

Subsequent literature.

- Bruner, L. 1900-1910 (1908): 270.
- Kirby, W.F. 1910: 422.
- Hebard, M. 1924: 127. > Transfers to *Ampelophilus*.
- Hebard, M. 1933: 130.
- Descamps, M. 1976: 89.

Etymology.

Latin *oliva*, olive tree; a reference to the uniform olive green colour of the East Panamanian race of this species.

Diagnosis.

Occurs in two races (**Figs P4 & P5**).

The nominate race (**Plate P2**) is a uniform pale olive green (thus explaining Giglio-Tos' specific name), apart from a dark postocular stripe, blueish genae and vertex, and light reddish brown hind knees. In the living animal there are usually small flecks of red coloration on the tarsal segments and the terminalia too. It extends from Darién west to Veraguas province in midwestern Panama.

The more brightly coloured northern race (**Plate P3**), in which the hind knees, basal part of the hind femora and often the entire underside and the tip of the male abdomen are all bright red, occurs on Isla Coiba and in Chiriquí Province of Panama and throughout the Costa Rican part of the species range. In general, the further north and west the locality, the more red pigment is present.

There are no genitalic differences between the two races. In both, the black antennae are minutely but obviously ringed with white at the intersegmental membranes.

Distribution.

Pacific slope of Panama and southern Costa Rica, from Western Darién west and north to the head of the valley of Río El General, Costa Rica. Not so far recorded from Eastern Darien or Colombia. **Maps P2 & P3.**

Natural history.

A specialist on Solanaceae and Asteraceae. *Solanum quitoense* (an introduced semidomesticated plant), *S. ochraceoferrugineum*, *Witheringia solanacea* and *Verbesina* species (e.g. *V. brachiata*) are especially favored, but many others are eaten too. See also note under generic natural history above. Can reach very high densities under favourable conditions. Ascends to at least 1800 m on Volcan Barú.

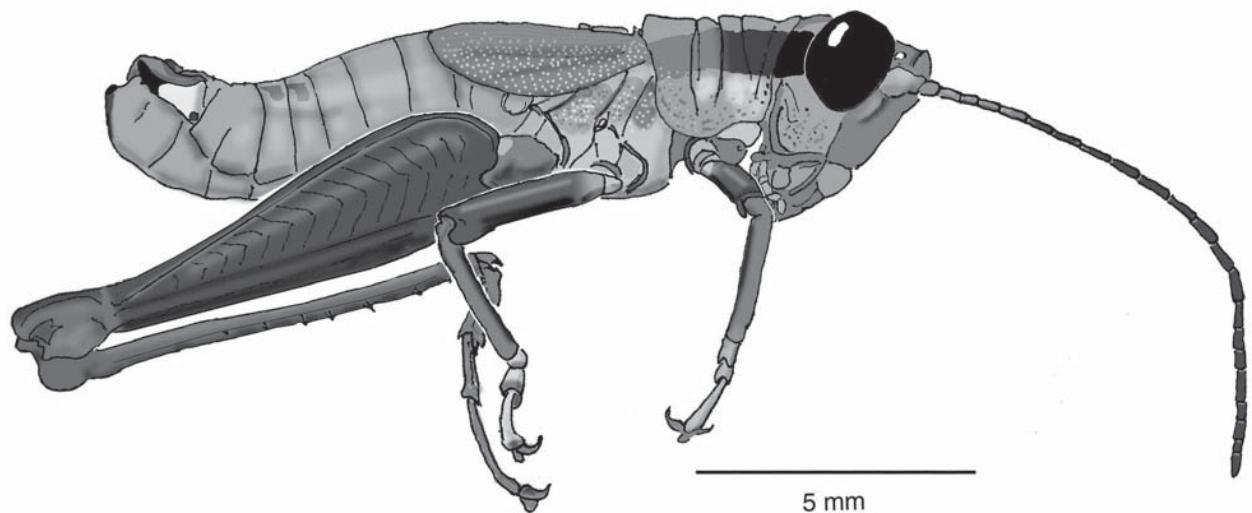


Fig. P4. *Ampelophilus olivaceus* (E. Panamanian race).

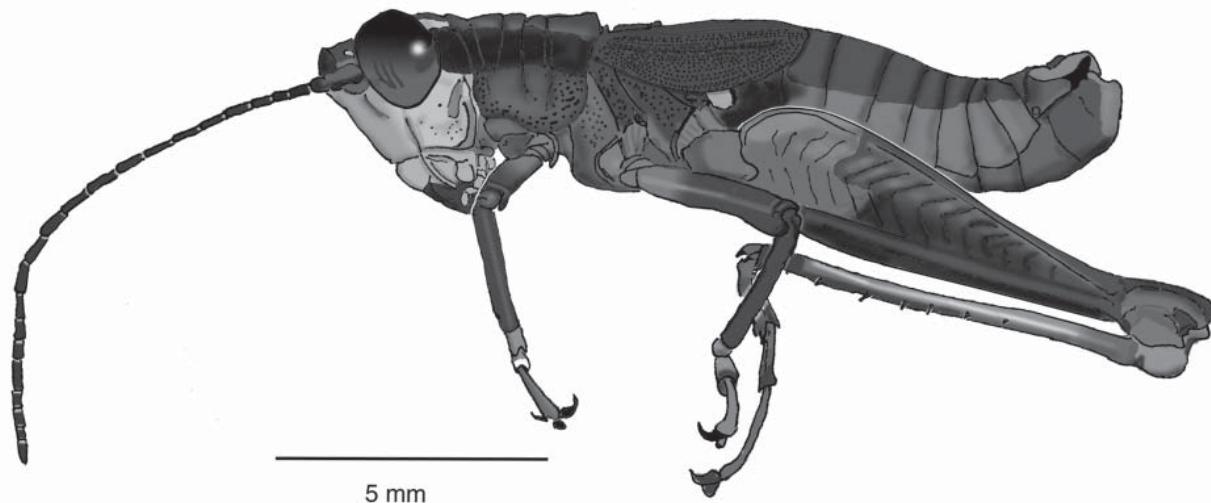


Fig. P5. *Ampelophilus olivaceus* (W. Panamanian and Costa Rican race).

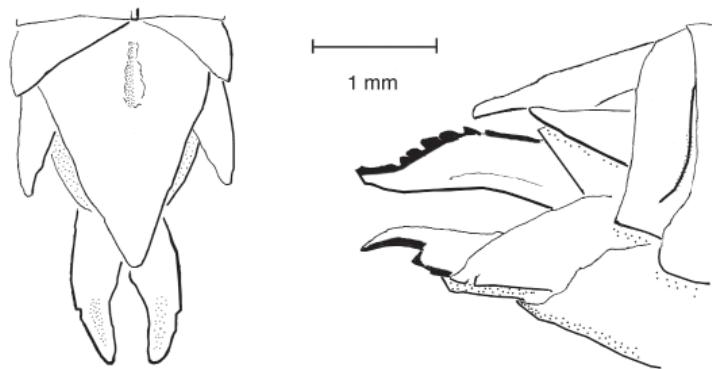


Fig. P6. *Ampelophilus olivaceus*, female, ovipositor and other terminalia.

In Costa Rica the bright green and red coloration, especially of males, is superficially similar to that of both *Pseudannicerus nigrinervis* (Ommatolampinae) and *Hylopedetes nigrithorax* (Rhytidochrotinae), and mixed groups of *A. olivaceus* with members of either of these two species are sometimes found, presumably indicating visual species recognition in both.

2. *Ampelophilus truncatus* (Rehn 1905)

Annicerus truncatus Rehn 1905: 421.

Type locality: COSTA RICA: Prov. S. José: Tarbaca.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Bruner, L. 1900-1910 (1908): 270.
- Kirby, W.F. 1910: 422.
- Rehn, J.A.G. & Hebard, M. 1912: 120. > Designation of lectotype.
- Hebard, M. 1924: 127. > Transfers to *Ampelophilus*.
- Descamps, M. 1976: 88.

Synonymy.

=*Anniceris apicalis* Bruner 1908: 271 (type locality S. José de Costa Rica), synon. Descamps 1976: 88.

Etymology.

Latin *truncatus*, shortened by being cut off. Rehn's original description speaks of the fastigium as having a truncate apex: this may be the character that led to his choice of name.

Diagnosis.

Habitus **Fig. P7, Plate P4.** Wings brachypterous, squamate, reaching 3rd abdominal tergum. General colour green, but postocular stripe black, and genae and vertex of head blue. Dorsal regions of lateral pronotal lobes, adjacent to postocular stripe, yellow. Hind knees black dorsally, hind tibiae blue. Terminal segments of abdomen red-brown.

Distribution.

Costa Rica. Montane forest of Pacific drainage of the Meseta Central, including the city of S. José and its surroundings. This is the only species of the genus that extends over the the watershed to the Caribbean slope of Costa Rica; it reaches East to Cartago and beyond as far as Chitaría. From the Meseta Central, the distribution extends northwest to Tilarán. Reaches 1800 m on the Altos de Escazú, but apparently absent from the Cordillera Central. **Map P2.**

Natural history.

Similar to that of *A. olivaceus*. Often found on the Solanaceous hedge-row tree *Acnistus*.

3. *Ampelophilus meridionalis* (Bruner 1908)

Anniceris meridionalis Bruner, L. 1900-1910 (1908): 271.

Type locality: COSTA RICA: Prov. S. José: Pozo Azul de Pirris.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Kirby, W.F. 1910: 422.
- Rehn, J.A.G. & Hebard, M. 1912: 120. > Designation of lectotype.
- Hebard, M. 1924: 127. > Transfers to *Ampelophilus*.
- Descamps, M. 1976: 90.

Etymology.

Latin *meridionalis*, of the south, southern. Presumably refers to the distribution relative to that of the previously named *A. truncatus*. At that time (1908) *A. olivaceus*, which has a yet more southerly distribution, was not known to occur in Costa Rica.

Diagnosis.

Habitus **Fig. P8, Plate P5.** Wings brachypterous, squamate, reaching 3rd abdominal tergum. In general uniformly green, but postocular stripe black, and genae and vertex of head blue. Eyes (in living or fresh specimens) dark blue. Antennae black with narrow light blue annuli. Upper part of hind knees light brown, but no red pigment anywhere. Hind tibiae green.

Field characters.

Best distinguished from *A. olivaceus* and *A. truncatus* by the complete absence of bright contrasting colours on hind legs or abdomen.

Distribution.

Confined to a small segment of the Pacific watershed of Costa Rica, from Fila Diamante (1100 m, SW of Ciudad Colón) in the north, to the Rio Barú in the south, where it descends almost to sea level. Common in the P.N. Carara. This species inhabits a belt between *truncatus* to the north and *olivaceus* to the south.

Natural history.

A specialist on various Asteraceae species.

4. *Ampelophilus caeruleus* Descamps & Rowell 1984

Ampelophilus caeruleus Descamps & Rowell 1984: 151.

Type locality: COSTA RICA: Prov. S. José: Hortensia, near S. Isidro de el General; valley of Rio Payner, 1530 m.

Location of type specimen: MNHN Paris.

Etymology.

Latin *caeruleus*, sky blue, a reference to the colour of the head.

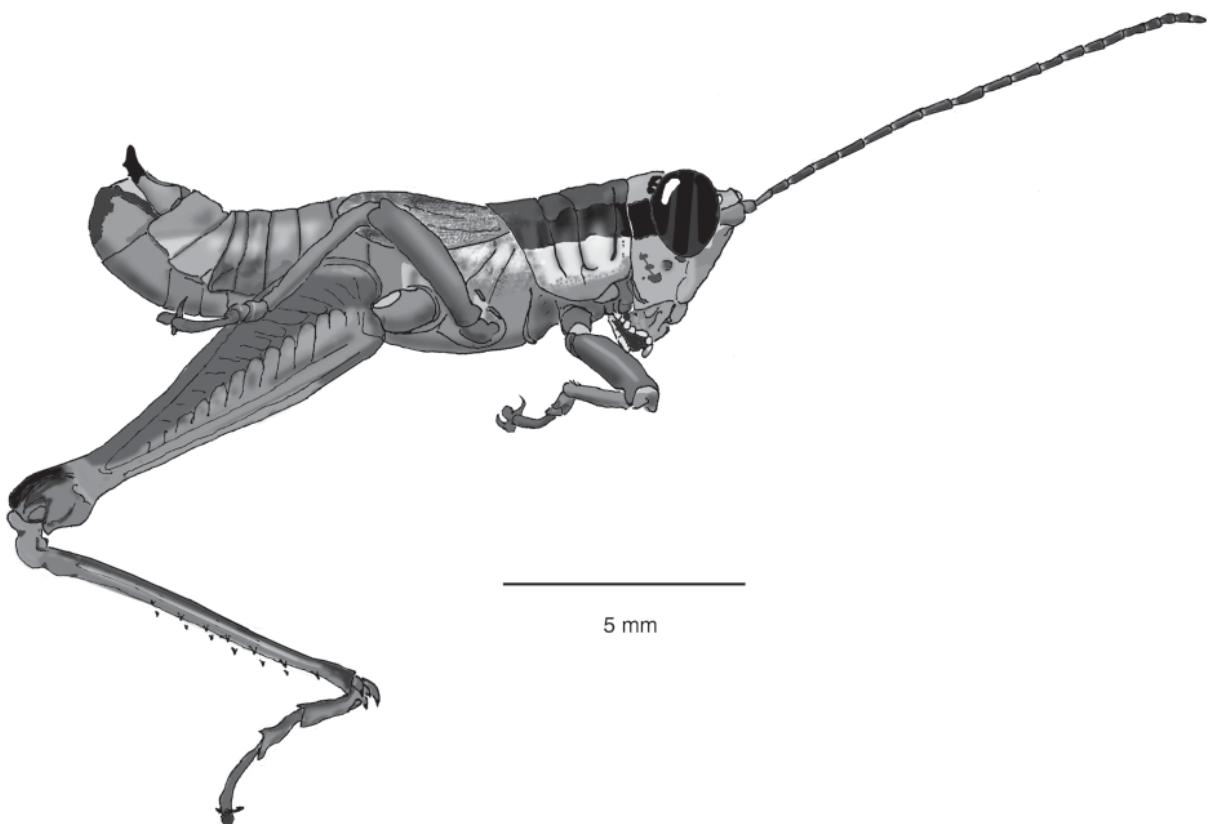


Fig. P7. *Ampelophilus truncatus*, male habitus.

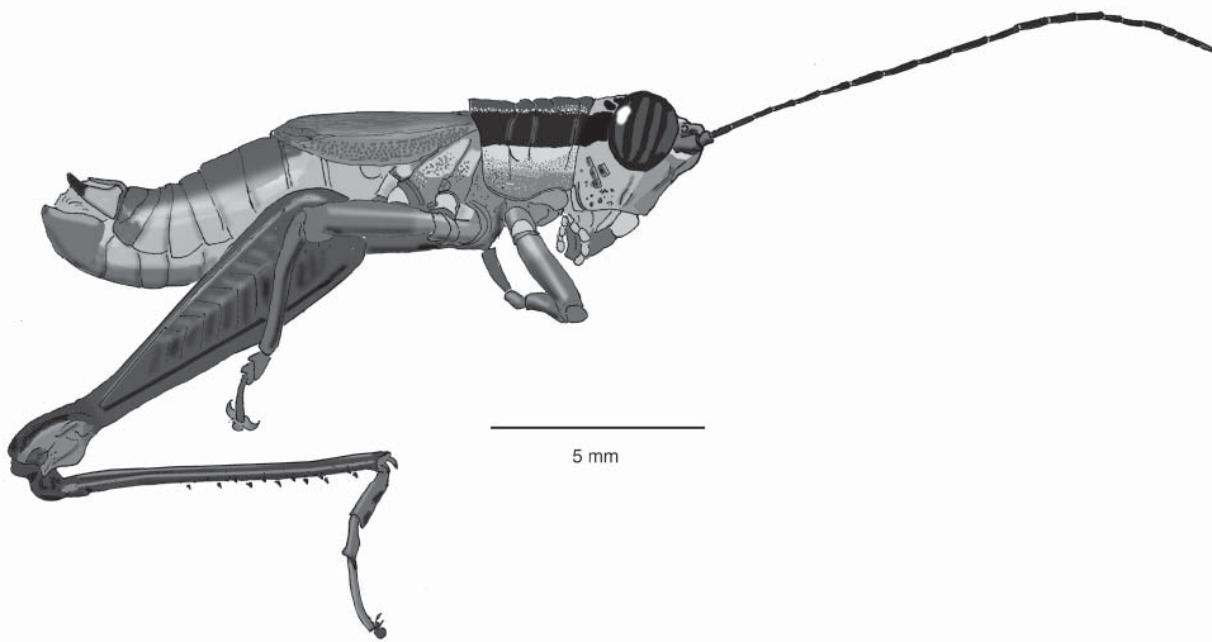


Fig. P8. *Ampelophilus meridionalis*, male habitus.

Diagnosis.

Habitus, **Fig. P9, Plate P6**. The only fully winged member of the genus, elytra extend almost to the end of abdomen in both sexes. Also recognizable by the brilliantly iridescent blue coloration of the entire head in life, contrasting with the dark green and orange body.

The larvae are unusually coloured, speckled black and white.

Coloration. Male: Antennae long, 22 flagellar segments, slightly flattened dorsoventrally and ribbon shaped. Antennal segments black, articulations white, ventral surface of apical 6 segments paler and reddish. Eyes black. Palps white, tinged orange. Postocular stripe and occipital markings black. Head otherwise bright blue.

Pronotum metallic green, the transverse sulci marked in black. Posterior metazona pitted, the rest more or less smooth in texture. Dark postocular stripe continued faintly on lateral lobes of pronotum, but does not extend past the third sulcus. Meso- and metathoracic epimera and episterna yellow green dorsally, orange brown ventrally. Ventral surface of pterothorax orange brown. Elytra green, wings smoky grey. Abdomen yellow. Cerci and supra-anal plate tinged with blackish, broad black vertical stripe at apex of subgenital plate.

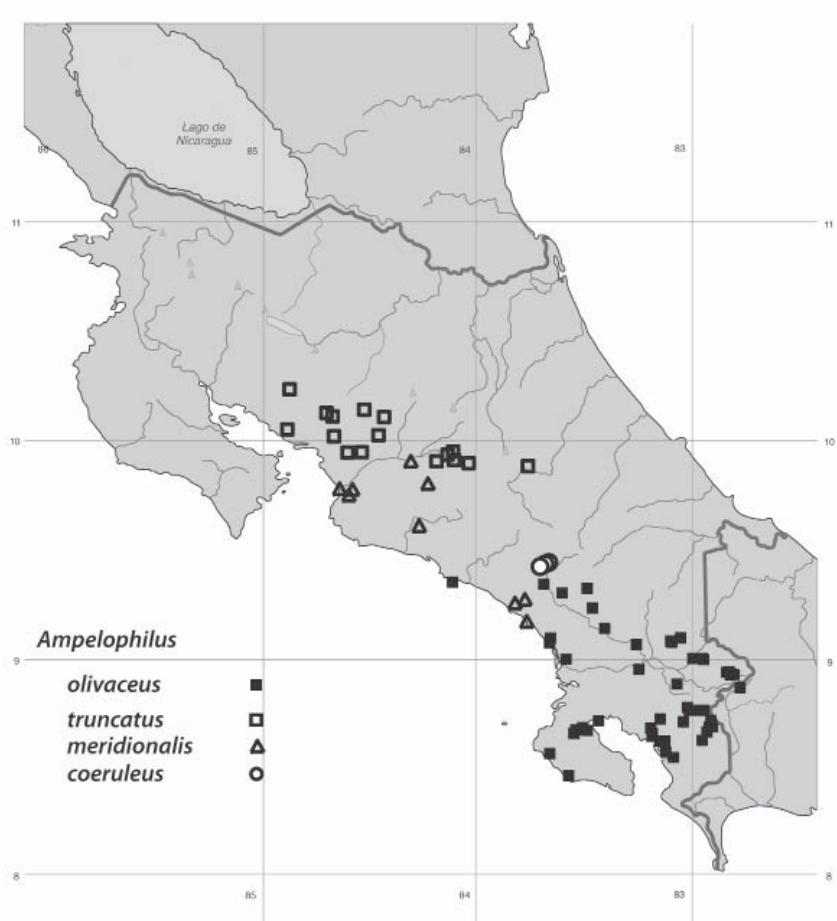
Pro and mesothoracic legs: coxae and basal part of femora orange brown, distal femur, tibia, green, tarsus brown. Metathoracic leg: coxa, femur, knee, orange brown, extreme proximal part of tibia, dark green; rest of tibia and tarsus, blue grey.

Distribution.

Costa Rica. Known only from a small area of montane forest above San Isidro de el General at 1500-2000 m on the Pacific slope of the Talamanca mountains.

Natural history.

A specialist on various Asteraceae species, at forest edges, roadsides and light gaps in wet montane forest. Has not so far been observed on any solanaceous plant.



Map P2. Distribution of *Ampelophilus* spp. in Costa Rica.

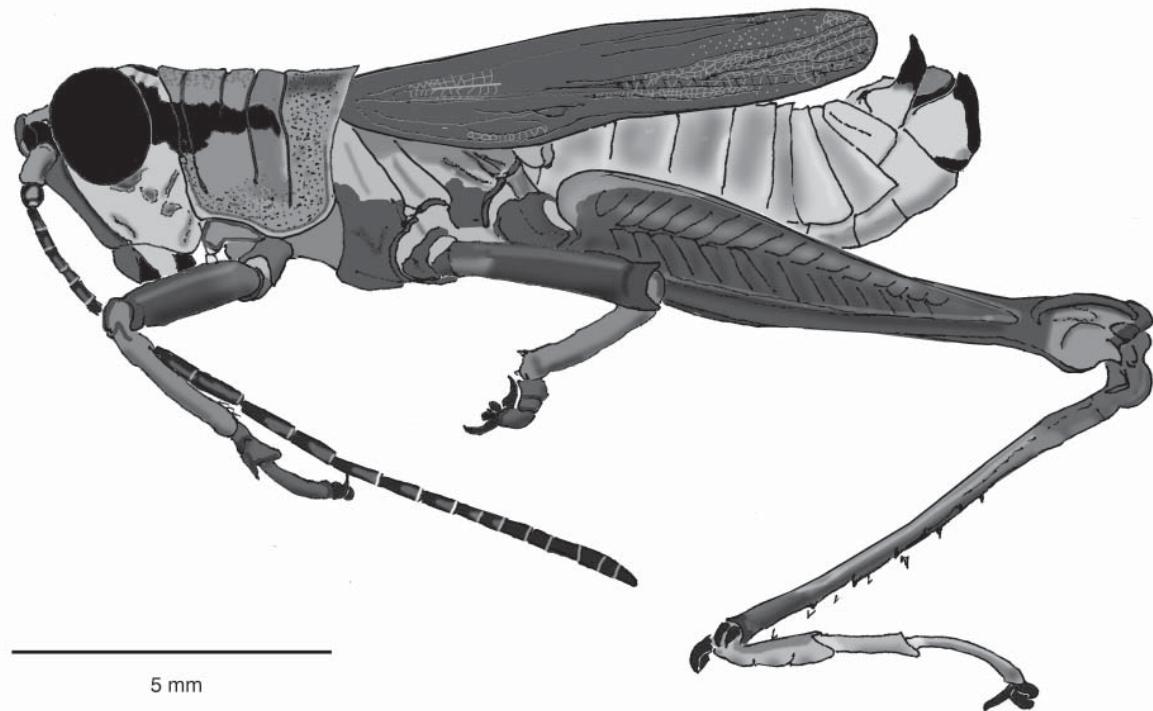
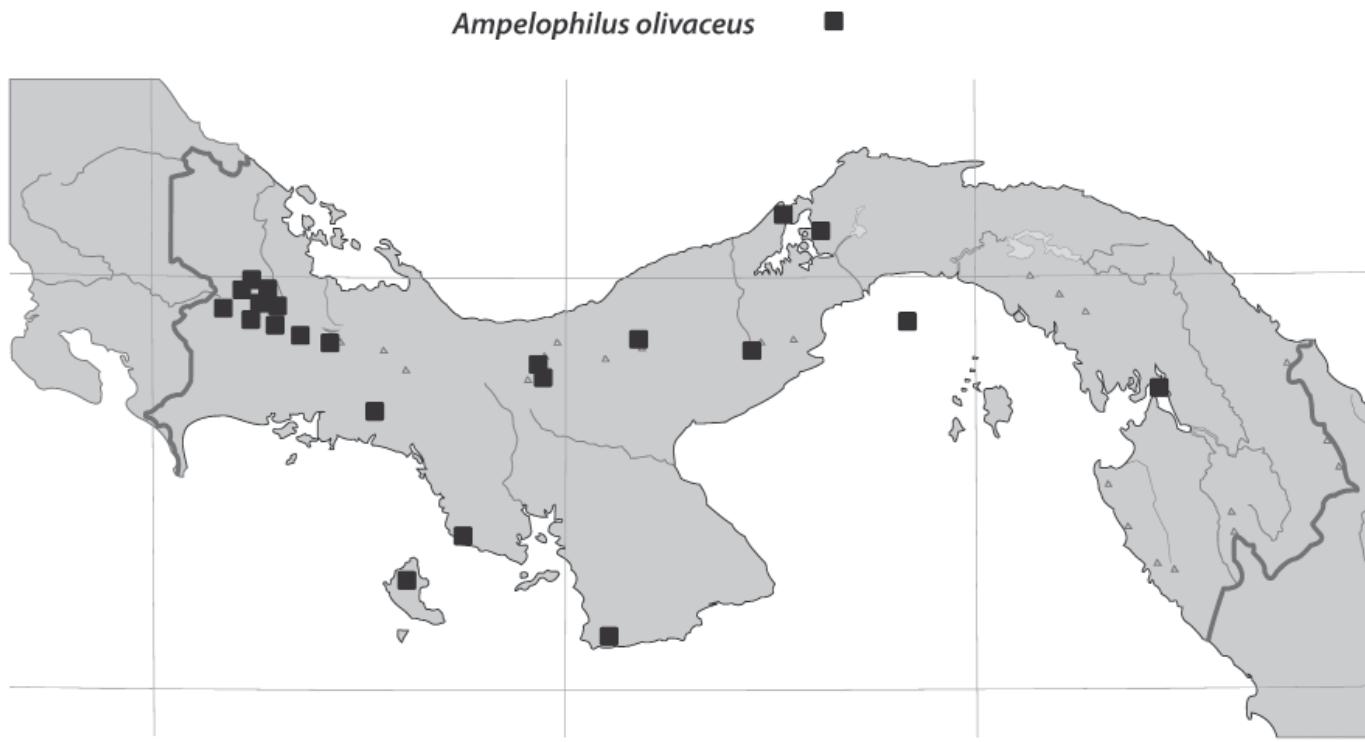


Fig. P9. *Ampelophilus coeruleus*, male habitus.



Map P3. Distribution of *Ampelophilus olivaceus* in Panama.

Leioscapheus
Bruner 1907

Bruner 1907: 214, 267.

Type species: *Leioscapheus gracilicornis* Bruner, L. 1900-1910 (1907): 267.

Subsequent literature.

- Kirby, W.F. 1910: 422.
- Roberts, H.R. 1973: 61. > Occurrence in canopy, description of new spp.
- Amedegnato, C. 1974: 200.
- Descamps, M. 1976: 82. > Description of new species, key to spp.
- Amedegnato, C. & Poulain, S. 1987: 400.
- Rowell, C.H.F. & Flook, P.K. 2004. > Molecular systematics.

Etymology.

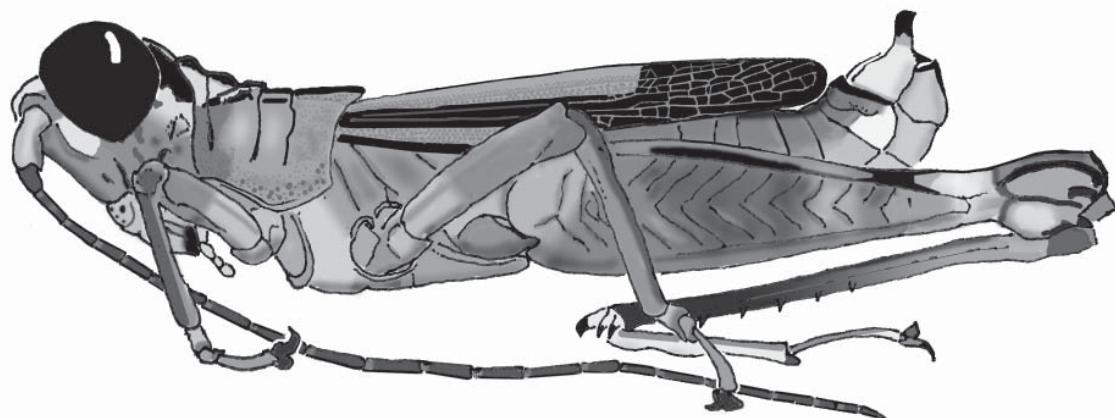
Greek *leios*, smooth; *scapheos*, boat or trough; probably a reference to the shape and coloration of the elytra. Bruner gives no indication of the inspiration of his name, but the contrasting longitudinal stripes on the elytra are reminiscent of the planking on a boat's hull.

Diagnosis.

All species are small, slender and fully winged, and active fliers. Elytra extending almost to the tip of the abdomen,

coloured a striking metallic blue or blue-green; in most species (all, in our region) each elytron is longitudinally striped with 3 black lines. Hind wings cycloid, pale blue with a dark grey border. Antennae very long and thin, in males nearly as long as the body. Pronotal sulci narrow, but deeply incised. Prozona longer than metazona. Posterior margin of metazona bluntly rounded, with a suspicion of a medial carina. The prosternal tubercle is almost completely absent. Male furcula present or absent. Male SAP subtriangular, with prominent lateral shoulders at about 1/3 of its length; subterminally, a small raised medial ridge arises just before the rounded tip, though in most species it is much less prominent than the similar structure in *Ampelophilus*. This structure is often lightly melanised, and can project upwards at an angle or horizontally as a lingulate process beyond the posterior edge of the SAP (e.g. **Figs P11 & 13**). To either side of it, the surface of the tip of the SAP is depressed and darkly pigmented. Male cercus wide at base, laterally compressed, always curved inwards to some degree, the tip melanised, either simply pointed or complexly toothed. Ovipositor valves reduced to long thin subcylindrical rods, devoid of teeth, the upper pair longer than the lower (**Fig. P12**); this correlates with the epiphylloous oviposition habits (see Natural history below). The adults and larvae of most species have a prominent pale pregenicular ring on the hind femur.

An easily recognised and rather speciose genus, very homogenous in morphology and appearance. Species identification is based mostly on the male terminalia and the



5 mm

Fig. P10. *Leioscapheus tremae* n. sp. Male habitus.

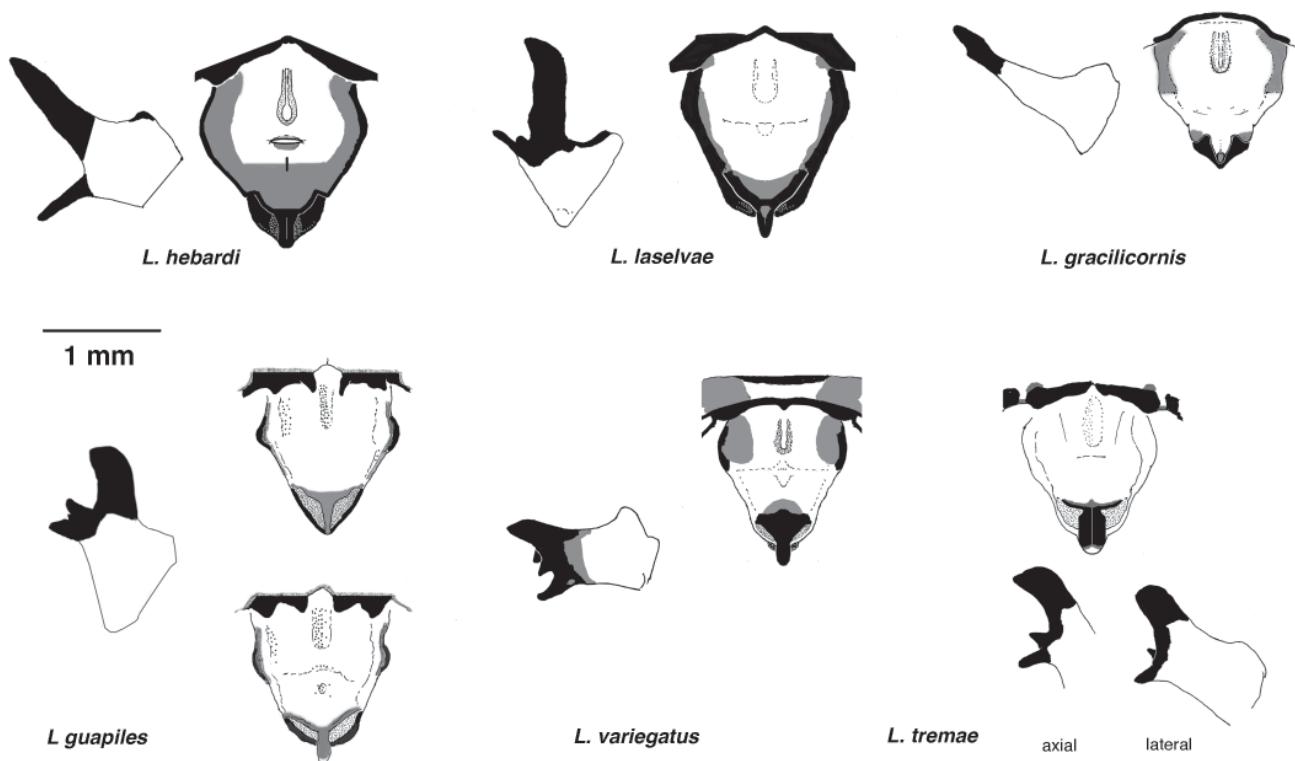
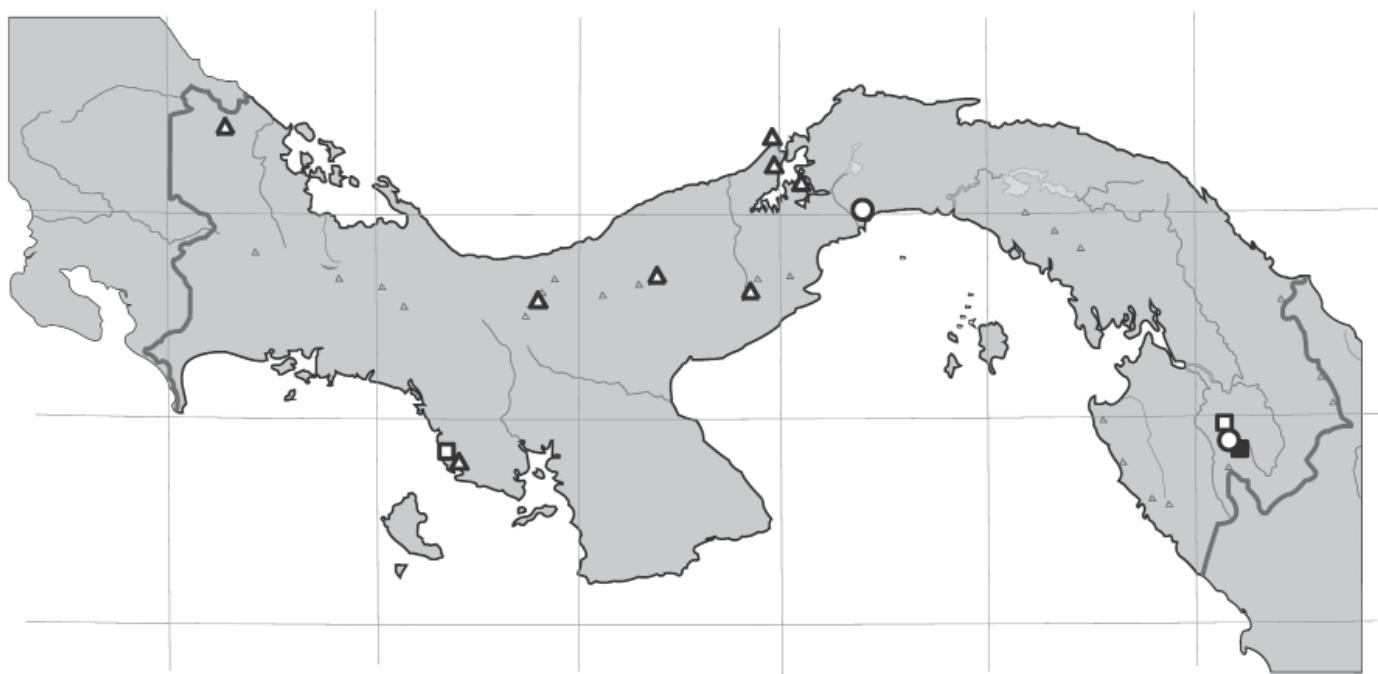


Fig. P11. *Leioscapheus* spp. Male supra-anal plates, furculae and cerci (in lateral view) of local spp.

Leioscapheus spp.

- | | |
|----------------------|---|
| <i>gracilicornis</i> | ■ |
| <i>hebardi</i> | △ |
| <i>tremae</i> | ○ |
| <i>variegatus</i> | □ |



Map P5. Distribution of *Leioscapheus* spp. in Panama.

coloration of the antennal flagellum, and is not simple; females are really only reliably determined when in copulation with a male. Size and coloration, especially the amount of red or orange on hind legs and thorax, is variable within each species. No *Leioscapheus* species, except possibly the typically coloured form of *L. tremae*, can be recognized to species in the field, determination almost always requires microscopic examination of a male specimen.

Distribution.

Southern Mexico to north western Colombia; not yet recorded from Belize or El Salvador. The genus is not yet well known; quite possibly there are further local species awaiting description. Sympatry is common, and the geographical boundaries of the known species are unclear.

No. of described species.

Eight. In our area, at least six, seven if *L. colombae* is indeed in Panama. See text below.

Natural history.

All *Leioscapheus* spp. are found in wet lowland or low montane forest. Some (e.g. *L. laselvae*) appear to be confined to the canopy, others (e.g. *L. guapiles*, *L. gracilicornis*) also visit light gaps. The sympatric occurrence of up to 3 species suggests they are ecologically separated. They are most commonly found on the secondary successional tree *Trema* (Ulmaceae), on which several species appear to be exclusive specialists, but at least *L. guapiles* and *L. gracilicornis* sometimes eat Solanaceae as well. Oviposition is epiphyllous. The eggs are laid in a foam sheet, 5-7 at a time, sandwiched between leaves of the foodplant. Egg development to hatching takes more than 35 days.

Key to local species of *Leioscapheus* (males).

Use in conjunction with Fig. P11.

- I Cercus simple, elongate, tapering to a rounded point, twice as long as it is wide at its base (Fig. P11, P13). Antennae black with fine white annuli. Coloration predominantly yellow, green and blue, with little or no orange or red markings. *L. gracilicornis*
- IA Cercus as above, but less than twice as long as its basal width. Thorax, and all femora, extensively coloured with orange or red. *L. colombiae*
- Cercus not as above. 2
- 2 Cercus bifurcate at its tip, the longer dorsal branch pointing upwards at about 45°, the ventral branch shorter and more slender. Furcula absent. Antennae pale brown basally, blackish distally, with weak pale annuli. *L. hebardi*
- 2A Cercus with multiple terminal processes. 3
- 3 Cercus with 4 terminal processes, the two medial ones short, the dorsal and ventral ones longer and more pointed. Furcula poorly developed, but a small pointed

process in the midline is present. Antenna red brown, without pale annuli. *L. variegatus*

Cercus with less than 4 terminal processes. 4

4 Cercus with three processes, the lower two short, closely set, and subparallel; the dorsal lobe large and nearly vertical, with a blunt end. Furcula well developed, consisting of two pointed processes each side of the midline. Coloration usually with little or no orange or red. Antennae black or brown with pale annuli. *L. guapiles*

- Cercus with three processes. The lower two processes short and closely set, the upper of the two curved in towards the midline. The most dorsal process large and bluntly pointed. Furcula consists merely of a thickened bar either side of the midline. Thorax and hind femora largely orange or red. *L. tremae n.sp.*

- Cercus not as above. 5

5 Cercus with one large dorsal branch, subvertical with a curved pointed tip. Ventrally one or two short branches, with rounded tips. Antennae brown with paler annuli. *L. laselvae*

1. Leioscapheus gracilicornis Bruner 1908

Leioscapheus gracilicornis Bruner 1900-1910 (1908): 267.

Type locality: COSTA RICA: Prov. S. José: Pozo Azul de Pirris.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Kirby, W.F. 1910: 422.
- Rehn, J.A.G. & Hebard, M. 1912: 120. > Designation of lectotype.
- Hebard, M. 1924: 125.
- Hebard, M. 1933: 130.
- Roberts, H.R. 1973: 63.
- Descamps, M. 1976: 83.

Etymology.

Latin *gracilis*, thin, gracile, slender; *cornu*, horn. Refers to the very long thin antennae, which however are a generic rather than a specific characteristic.

Synonymy.

=*L. annulicornis* Bruner 1900-1910(1908). (Type locality S. Isidro, Guatemala).

- Kirby, W.F. 1910: 422.
- Hebard, M. 1932: 99, 122. > Transfers to *Tela*.
- Roberts, H.R. 1973: 63. > Synonym of *L. gracilicornis*.
-

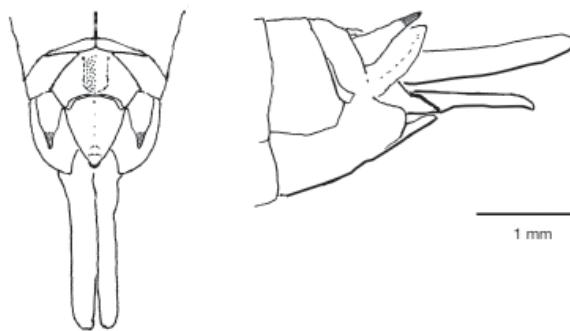


Fig. P12. *Leioscapheus variegatus*. Ovipositor, dorsal and lateral views.

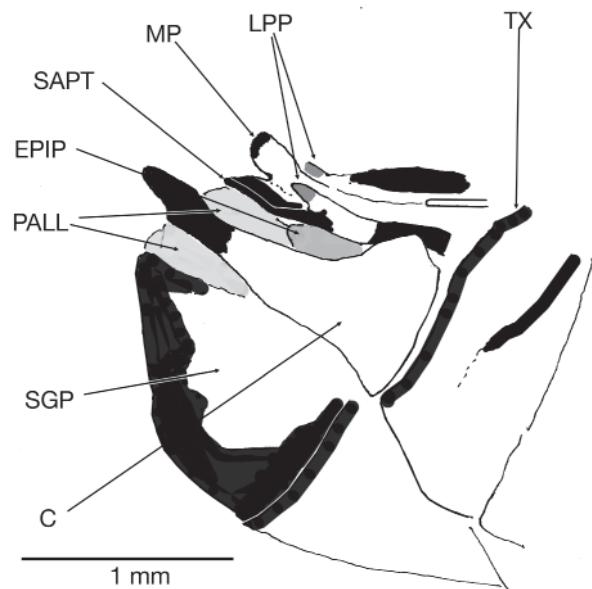
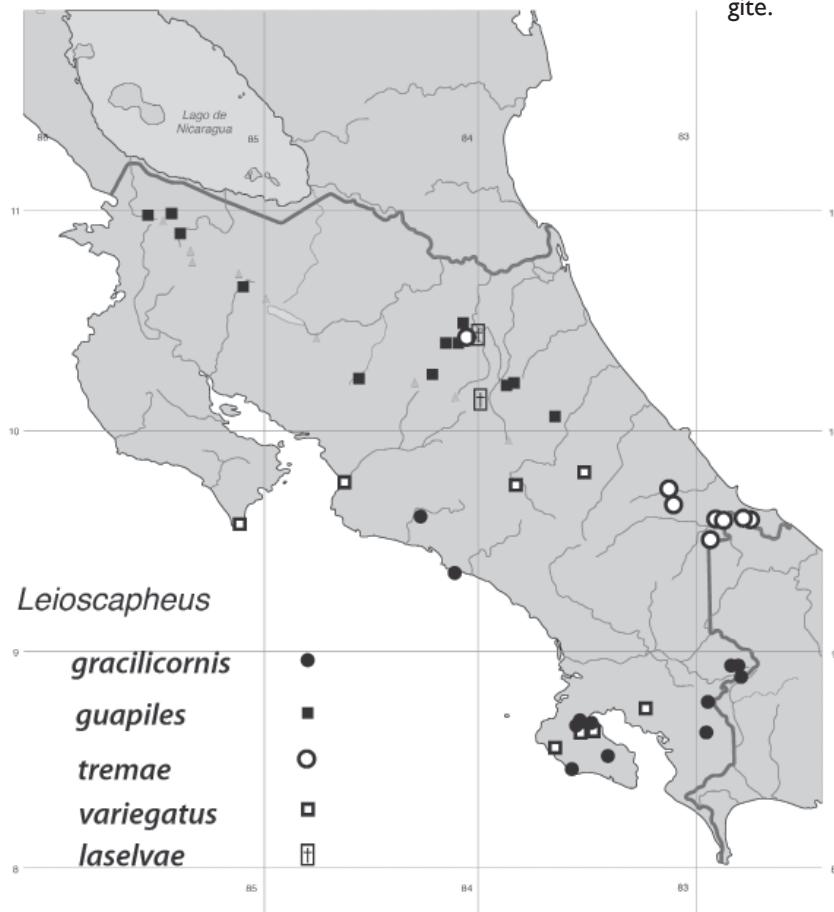


Fig. P13. Oblique lateral view of male terminalia in *L. gracilicornis*. C, cercus; SGP, sub-genital plate; PALL, pallium; EPIP, epiproct; SAPT, tip of supra-anal plate. MP, LPP medial and lateral process of supra-anal plate; TX, margin of tenth abdominal tergite.



Map P4. Distribution of *Leioscapheus* spp. in Costa Rica.

Diagnosis.

The only species of the genus in our area with a simple male cercus, tapering to a single rounded point, usually with a slight embayment on the ventral edge of the tip (**Fig. P11, P13**). (*L. columbae*, which may occur in E. Panama, has a similar but much shorter cercus: see Figs 46 and 47 of Descamps [1976]). That species however has much more orange coloration than is usual in *gracilicornis*). Male furcula absent, and there is no medial projection in the midline from the posterior edge of the tenth abdominal tergite. The preterminal process of the male SAP is laterally compressed at its tip and cocked upwards at about 30°, and flanked laterally by two smaller flatter projections (**Fig. P13**, MP and LPP). As in *L. variegatus*, the anterior medial portion of the SAP is decorated with a raised ridge, rather than the usual weak depression (**Fig. P11**).

The upper surfaces of the dorsal ovipositor valves are slightly grooved longitudinally in this species, and not at all or only very slightly in other species of the genus.

Antennal flagellum black with fine white annuli at the joints.

Natural history.

Strongly associated with the tree *Trema interigissima* (Ulmaceae), and eats it voraciously. Sometimes also found on Solanaceae (*Witheringia*, *Acnistus*) and can be induced to eat these in captivity. Like *L. guapiles*, it is often found in light gaps or at forest edges.

Distribution.

Guatemala, Costa Rica, Panama. All modern records from our area are from SW Costa Rica, from Quépos southwards, plus a probable record from Darién, Panama. Hebard (1925) cites records from the Canal Zone in the early 20th century, but Roberts (1973) showed that these are in fact misidentified specimens of *L. hebardi*. Ascends to at least 1600 m on Cerro Irkibi, Costa Rica.

2. *Leioscapheus guapiles* Roberts 1973

Leioscapheus guapiles Roberts 1973: 62.

Type locality: COSTA RICA: Prov. Limón: Guápiles, Río Toro Amarillo.

Location of type specimen: Michigan University Museum of Zoology.

Subsequent literature.

Descamps 1976: 85.

Etymology.

Name derived from the type locality.

Diagnosis.

Male furcula consisting of twin peaked processes, the inner one usually longer and more slender (**Fig. P11**). Male cercus ends in three processes, a large dorsal one with a rounded tip, and two small, closely set, pointed ventral ones (**Fig. P11**). The preterminal process of the SAP extends beyond the tip of the plate. Hind wing pale blue with a smoky grey border. Usually devoid of orange or red coloration, especially in males, but some individuals have orange markings on the pronotal lobes, thoracic pleura and outer and inner faces of the hind femora, and can then be confused with *L. tremae*. Hind femur with a dark pregenicular ring followed by a more distal pale one. Antennal flagellum black or very dark brown with narrow pale annuli at the joints.

Natural history.

The most accessible species of the genus, often occurring in light gaps or at forest edges. Roberts (1973) did not find it in the canopy. Food-plant uncertain: frequently found on Solanaceae (*S. umbellatum*, *rugosum*, *siparunoides*, *Markia*) and eats them in captivity, but there are also several records of it on *Trema* and preferring it to *Solanum* in captivity. I can detect no morphological differences between insects from the two sorts of foodplant.

Distribution.

Caribbean lowlands of Costa Rica N of the Rio Reventazón, to 1200 m. Absent south of 10° N latitude. Extends a little westward over the watershed of the Cordillera Central onto the Pacific slope in association with wet forest outliers (e.g. Rio Naranjo, Cerro El Hacha), and is probably to be found in SE Nicaragua too. **Map P4**.

3. *Leioscapheus laselvae* Roberts 1973

Roberts 1973: 62.

Type locality: COSTA RICA: Prov. Heredia: Sarapiquí, Puerto Viejo, Finca La Selva.

Location of type specimen: ANS Philadelphia.

Etymology.

Name derived from the type locality.

Diagnosis.

The male cercus has one major branch, more or less vertical, with a rounded tip. Ventrally there are one or two small processes, almost horizontally arranged. The SAP is completely bordered with shiny black cuticle, the preterminal lingual process extends beyond the tip of the plate. There is almost no furcula, just two slight thickenings of the rim of the 10th abdominal tergite level with the margins of the SAP (**Fig. P11**).

Antennae brown, with very indistinct pale annuli at the joints.

Natural history.

Usually obtained from the canopy by insecticide fogging or tree felling, rarely found elsewhere. Food plant unknown.

Distribution.

Caribbean lowlands of northern Costa Rica and southern Nicaragua, to 1000 m on Cerro Zurquí.

4. *Leioscapheus variegatus* Bruner 1908

Bruner 1900-1910 (1908): 268.

Type locality: MEXICO: Yucatán: Valladolid.
Location of type specimen: BMNH London.

Subsequent literature.

- Kirby, W.F. 1910: 422.
- Roberts, H.R. 1983: 62.
- Descamps, M. 1976: 85.

Etymology.

Latin *variegatus*, of different colours.

Diagnosis.

Commonly (but not invariably) has a patch of orange colour on the lateral lobe and/or disc of the pronotum, and sometimes on the hind femur too, especially in females. In some individuals the dorsal part of hind femur is transversely banded with black or red. This is the origin of Bruner's name.

Differs from all other species of the genus in having 4 processes on the end of the male cercus. The arrangement is similar to that seen in *L. guapiles* and *L. tremae*, which have 3 processes, but there is also a fourth ventral process below, long and thin and inclined downwards (Fig. P11). The dorsal rim of the male subgenital plate is produced into a rounded thickened melanistic structure in the midline, very obvious in dorsal view. The preterminal process of the male SAP extends beyond the margin of the plate.

The male furcula (Fig. P11) consists merely of a melanized posterior rim to the 10th abdominal tergite, somewhat thickened bilaterally at the outer margins of the SAP, and with a small unpaired point in the midline. The anterior medial portion of the SAP is decorated with a raised ridge, unlike the usual weak depression (Fig.).

Antennae red-brown, without prominent annuli.

Natural history.

Unknown.

Distribution.

Mexico; Honduras; Costa Rica south of 10° N, widely distributed on both sides of the continental divide, commonest in the SW and in the upper valley of the R. Reventazón; Panama

(Darién and Pacific coastal Veraguas). Individuals from the northern part of the range are considerably larger than those from our region.

5. *Leioscapheus hebardi* Roberts 1973

Roberts 1973: 63.

Type locality: PANAMA: Canal Zone: Barro Colorado Island.
Location of type specimen: ANS Philadelphia.

Etymology.

Named for the Philadelphian orthopterist Morgan Hebard (1887 – 1946), who had misidentified the type series as *L. gracilicornis*.

Diagnosis.

The male cercus is very distinctive, bifurcate at its tip, with two long slender processes arranged at approximately 90° to each other. The dorsal process is the longer, and is almost vertical. In my experience, *L. hebardi* never has red or orange coloration on thorax or legs.

The SAP is completely bordered with black, and the preterminal process projects to or slightly beyond the tip of the plate. Just a suggestion of a furcula (Fig. P9), the rim of the 10th tergite is thickened at the outer margins of the SAP (similar to the situation in *L. laselvae* and *L. variegatus*).

Antennae pale brown basally, blackish distally, with weak pale annuli.

Natural history.

The species is poorly known to date. It does not seem to be associated with the tree *Trema*, unlike other species.

Distribution.

Central Panama, including Panama, Coclé and Veraguas provinces westward to Bocas del Toro. Ascends to at least 800 m on Cerro Copé. Not so far recorded from Costa Rica. This is to date the most widely collected species of the genus in Panama.

6. *Leioscapheus tremae* n.sp Rowell 2013

Rowell, this publication.

Type locality: COSTA RICA: Prov. Limón: Río Sixaola.
Location of type specimen: ANSP.

Etymology.

Named for its apparently exclusive food plant, *Trema* (Ulmaceae).

Diagnosis.

Habitus **Fig. P10, Plate P7.** Structurally very similar to *L. guapiles*, from which it can be best distinguished by the furcula, which is a more or less linear bar lacking the twin peaks seen in *guapiles*. (**Fig. P11.**)

The cercus has three processes, as in *L. guapiles*, but the upper of the twin ventral processes is pointed sharply in towards the midline, and does not run in the same plane as the most ventral process. All specimens so far examined are strongly marked with orange coloration on the lateral pronotum, thoracic pleura and hind femora. Hind femur with a wide, diffuse darker band at mid length, followed by a pale pregenicular ring. Antennae dark brown, with paler annuli.

Natural history.

Very strongly associated with the tree *Trema*, and eats its leaves both in captivity and in the wild.

Distribution.

To date collected only in the Sixaola/Estrella region of S.E. Costa Rica, plus isolated examples from Puerto Viejo de Sarapiquí and a possible record from Darien.

7. *Leioscapheus colombiae* Descamps 1976

Descamps 1976: 84.

Type locality: COLOMBIA: Nariño: between El Diviso and Barbacoa.

Location of type specimen: MNHN, Paris.

Etymology.

Named for the country of the type locality.

Diagnosis.

Male cercus (Descamps 1976, Fig.47) of the same general shape as that of *L. gracilicornis*, but proportionately shorter in relation to its basal width. Coloration similar to that of *L. tremae*, with extensive areas of orange on thorax and hind femora; in addition the proximal parts of the fore and mid femora are also orange.

Natural history.

Unknown.

Distribution.

Known with certainty only from Colombia. Possibly

extends into Panama: females which could belong to this species have been collected in Darién, but a male specimen is required for certainty.

B. The *Tela* genus group.

Tela and *Paratela* share with the *Lithoscirtus* genus group the short-winged condition and the flattened spatulate dorsal valves of the ovipositor. These latter however are parallel and not divergent as in the *Lithoscirtus* group, and the elytra, while shortened, are not reduced to tiny rudiments. Posterior margin of pronotum convex or straight, rarely slightly incurved (*Paratela*). In body form they are rather squat and robust, resembling *Ampelophilus*. Male supra-anal plates similar to those of the *Leioscapheus* group, with lateral shoulders, but the subterminal process is less developed.

Tela

Hebard 1932

Hebard 1932: 99.

Type species: *Tela chlorosoma* Hebard 1932: 100.

Type locality: HONDURAS: Atlantida: Lancetilla, near Tela.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Amedegnato, C. 1974: 200.
- Descamps, M. 1976: 91-93.
- Amedegnato, C. & Poulain, S. 1987: 400.

Etymology.

Named for Tela, a city in North East Honduras, near the type locality of *T. chlorosoma*.

Generic Range.

Mexico; Honduras; Costa Rica.

No. of known species.

Four. In our area, one.

Diagnosis.

Brachypterous but not micropterous insects. Posterior margin of pronotum rounded and convex. The extremity of the male cercus is broadly bifid (fish-tail like) in lateral view, and often has further small processes on its inner face (**Fig. P16**). Male furcula very weak. Dorsal ovipositor valves spatulate, pointed and parallel (**Fig. P15A**); the lower valves subcylindrical, rodlike (**Fig. P15B**), resembling those of *Leioscapheus*.

Natural history.

Typical light gap and forest edge genus. The Mexican

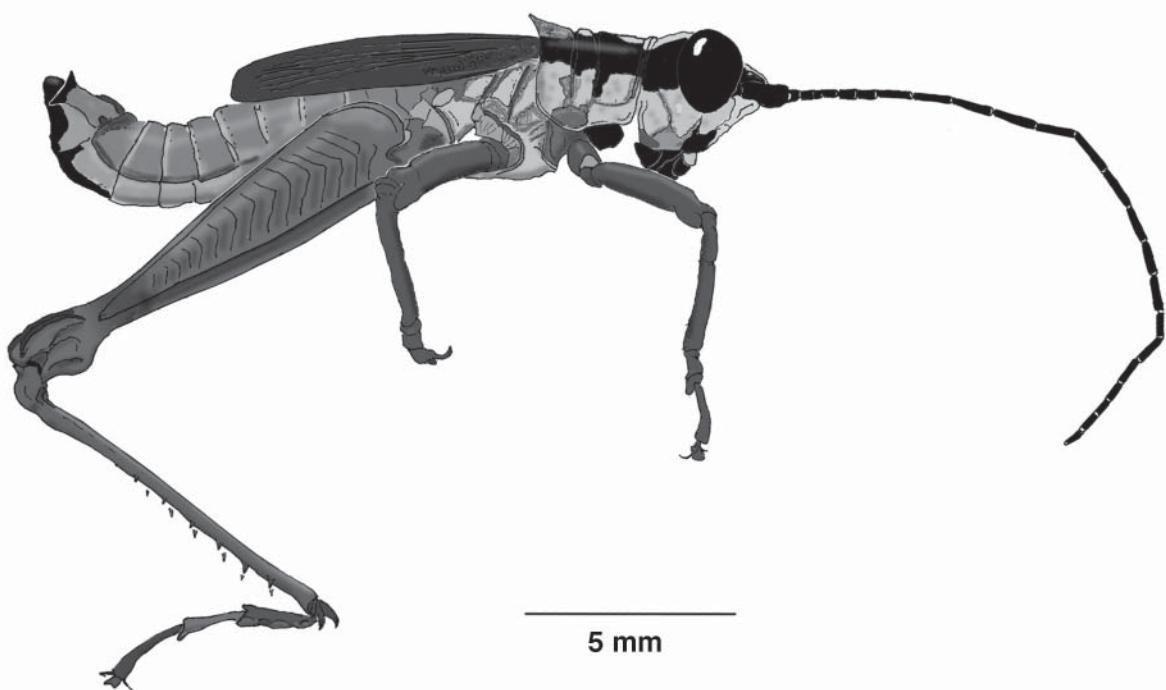


Fig. P14. *Tela neeavora*, male habitus.

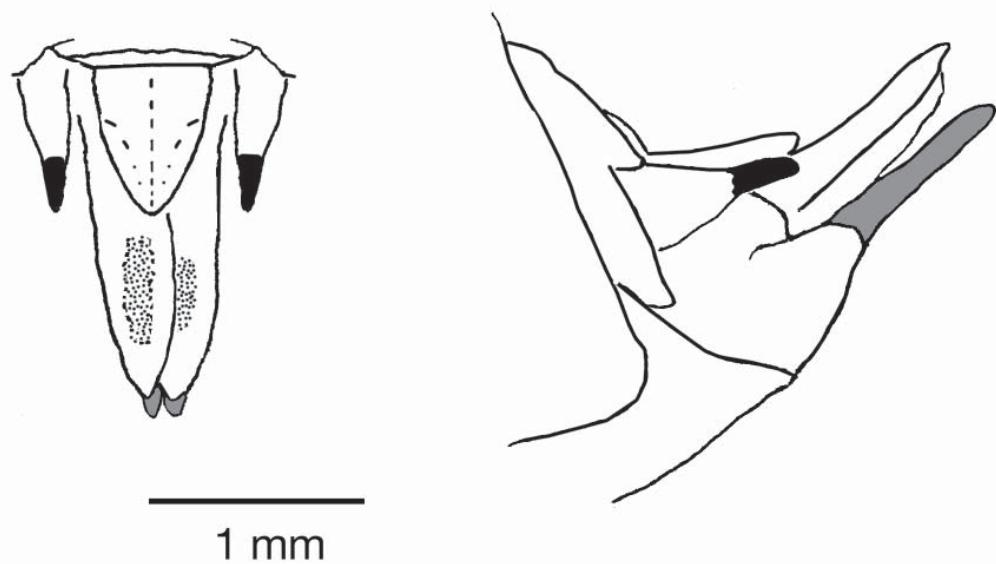


Fig. P15. Ovipositor of *Tela neeavora*, dorsal and lateral views. Lower valves shaded.

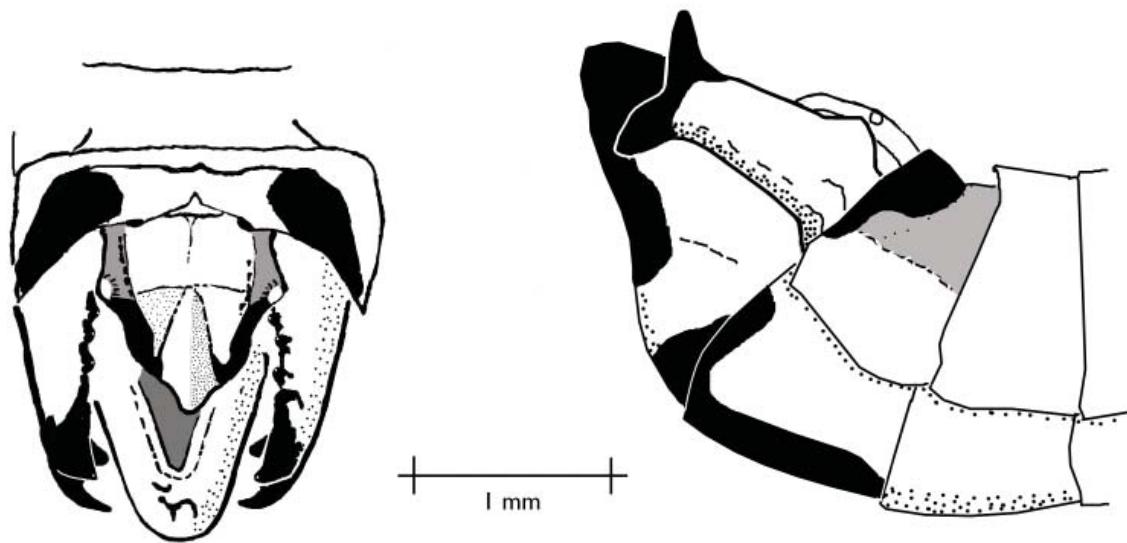


Fig. P16. *Tela neeavora*, male terminalia, dorsal and lateral aspects.



Map P6. Distribution of *Tela neeavora* in Costa Rica.

spp. (*T. viridula* and *bolivari*) appear to be associated with *Solanum* spp. (Amedegnato, pers. comm.), unlike the Costa Rican *neavora*.

I. *Tela neavora* Descamps & Rowell 1978

Descamps & Rowell 1978: 364.

Type locality: COSTA RICA: Prov. Heredia: Sarapiquí, Puerto Viejo, Finca La Selva.

Location of type specimen: MNHN Paris.

Etymology.

Neea, a woody genus of the Nyctaginaceae; Latin *vorare*, to devour. Refers to the exclusive food plant.

Diagnosis.

Habitus **Fig. P14, Plate P8.** The relatively large elytron (extending to the 6th abdominal tergite) distinguishes it from all other local members of the subtribe except *Ampelophilus coeruleus*, which is totally different in coloration and habitat. The fish-tailed male cercus has an additional small pointed process on the internal face (**Fig. P16**), and its dorsal inner edge is ornamented with small black teeth. There is a very weak male furcula, consisting of two minute, widely-spaced, points. The male subgenital plate terminates in an upturned subcylindrical process. Ovipositor (**Fig. P15**) typical of the genus.

Field characters.

Black, green and gold head and thorax, elytra extending half way down the abdomen and of a rich dark brown. Antennae very long and black, with white tips in some females only. Found almost exclusively on the underside of young leaves of *Neea laetivirens*.

The early larvae are of the usual Lithoscirtan type, black with orange-red pronotum and head, with a white dorsal stripe; the eyes are black with a prominent vertical white line, the legs are green. Descamps and Rowell (1978) give more details.

Natural history.

Apparently monophagous on the secondary succession tree *Neea laetivirens* (Nyctaginaceae), in captivity refuses the foliage of other sympatric *Neea* species. This tree is typical of the edges of larger light gaps. A rather sluggish insect, apparently active only at night. Rarely found off its foodplant, of which it seems to eat only the younger leaves. Flightless, despite the relatively well developed wings.

Distribution.

Costa Rica only. Recorded from the Sarapiquí, from near Guápiles, and from Dos Ríos de Alajuela, spanning an altitudinal range of nearly 1000m. Appears to be patchy, as not found at all sites where the foodplant is present. Probably widely distributed over the Caribbean plain and the surrounding

foothills. There is a single record from the upper drainage of the Rio Grande de Candelaria, draining to the Pacific. **Map P6.**

Paratela Descamps & Rowell 1978

Descamps & Rowell 1978: 365.

Type species: *Paratela ovatipennis* Descamps & Rowell 1978 (=*Dellia ovatipennis* Rehn 1905).

Subsequent literature.

- Descamps, M. & Rowell, C.H.F. 1984: 156.
- Amedegnato, C. & Poulain, S. 1987: 400.

Etymology.

Greek *para*, near: *Tela*, a closely related genus of proctolabine grasshopper.

Distribution.

Costa Rica.

No. of known species.

One.

Diagnosis.

Habitus **Fig P17, Plate P9.** Very similar to *Tela*, but differs as follows (Descamps & Rowell 1978): micropterous, rather than brachypterous, elytra extending into the first abdominal segment and partly covering the tympana; posterior margin of pronotal disc straight or slightly concave rather than convex; a small but definite male furcula is present, its points lying inside the margins of the base of the supra-anal plate (**Fig. P18**); fastigium separated from frontal ridge by a weak depression.

In molecular systematic analyses (Rowell & Flook 2004), this genus falls into a clade with *Tela* species. This suggests that *Tela* is paraphyletic with respect to *Paratela*, and thus that the separate generic status of the latter is unnecessary. The morphological characters separating the two are indeed minor. The phallic complexes and the male cerci (**Figs P16 & P18**) do not differ significantly.

I. *Paratela ovatipennis* (Rehn 1905)

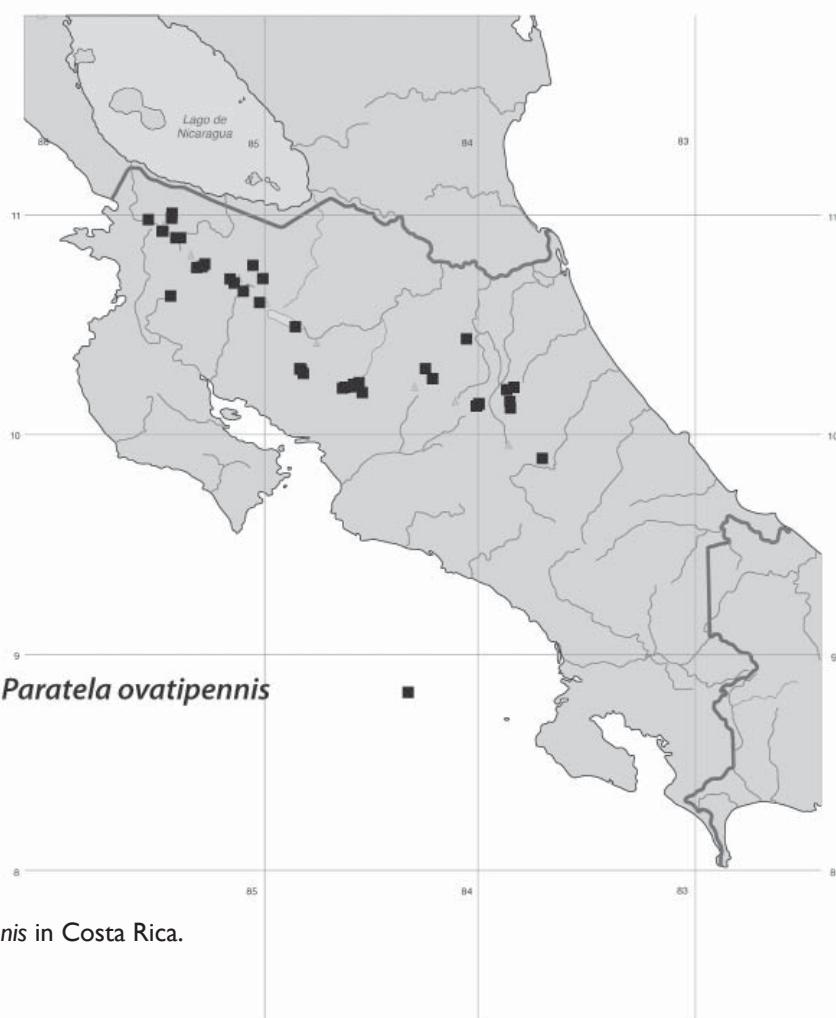
Dellia ovatipennis Rehn 1905: 428.

Type locality: COSTA RICA: Prov. S. José: Carrillo.

Location of type specimen: ANS Philadelphia (holotype female).

Subsequent literature.

- Rehn, J.A.G. 1929: 31. > Transfers to *Lithoscirtus*.
- Descamps, M. 1976: 82. > Transfers to *Drymophilacris*(?).
- Descamps, M. & Rowell, C.H.F. 1978: 365. > Description of neallotype male. Erects *Paratela* to accommodate it.
- Descamps, M. & Rowell, C.H.F. 1984: 156. > Synonymises



Map P7. Distribution of *Paratela ovatipennis* in Costa Rica.

Paratela ovatipennis Descamps & Rowell 1978 with *Dellia ovatipennis* Rehn 1905.

- Rowell, C.H.F. & Flook, P.K. 2004. > Molecular systematics.

Etymology.

Latin *ovatus*, egg-shaped, *penna*, wing or feather. Refers to shape of elytron.

Synonymy.

= *Dellia ovatipennis* Rehn 1905, synon. Descamps & Rowell 1984.

Diagnosis.

(Fig. P17) Monospecific genus, the generic description applies. Distinctive coloration (see Field characters below). The margins of the male supra-anal plate are ornamented with two black upright horn-like processes. (Fig. P18).

Field characters.

The striped black and gold (or black and light blue-green) squamoid elytron is distinctive and noticeable against the green body. The male subgenital plate is mostly black, but ornamented with a pair of gold or light green patches on either side of its tip. Legs and palps green, hind feet pink, antennae black. The hind knee is black, with a pale green or yellow

pregenicular ring. In life, the black eyes are conspicuously marbled with pale blue, which disappears at death. Habitus Plate P9.

Distribution.

Cordilleras Central and del Norte, Costa Rica. Normally montane, found between 300 and 1500 m asl, though there is one record from 50 m in the Sarapiquí. Occurs on both sides of the Continental Divide. The furthest south record is near Turrialba. Not known from Southern Costa Rica or Panama.

Map P7.

Natural history.

A specialist on Asteraceae, especially *Vernonia* and *Verbesina* spp. Often found on the foodplant in mixed groups of adults and larvae. Fairly common at the edges of montane forest, or in charral.

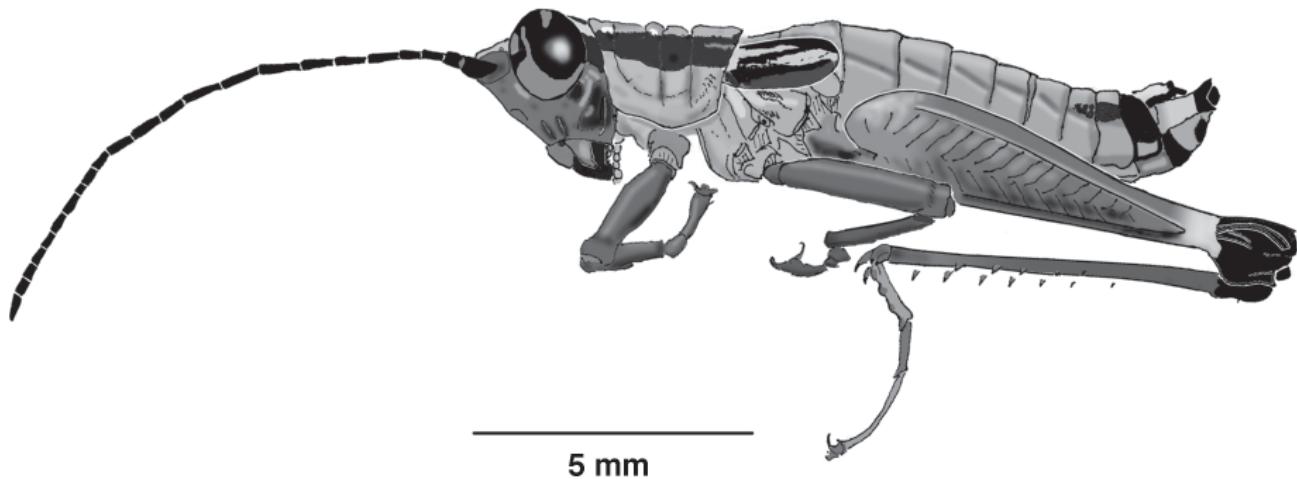


Fig. P17. *Paratela ovatipennis*, male habitus.



Fig. P18. *Paratela ovatipennis*, male terminalia, dorsal and lateral aspects,

C. The Lithoscirtus genus group.

The genera of this group (*Drymacris*, *Drymophilacris* and *Lithoscirtus*) are separated from other genera of the subtribe by the incurved posterior edge to the pronotum and by extreme microptery (except for *Drymacris nebulicola*) (Descamps, 1976); also by the fact that the upper ovipositor valves are to a greater or lesser extent dorsoventrally flattened into spatula-like organs, which diverge distally (Fig. P26A) (unlike the situation in *Tela* and *Paratela*, where the valves are also spatulate, but parallel). Both morphology (the less modified structure of the ovipositor, Fig. P20) and molecular systematics (Rowell & Flook 2004) suggest that *Drymacris* is the most basal member of this clade. *Drymophilacris* and *Lithoscirtus* are closely related sister genera, very similar in both morphology and ecology, but differing markedly in the structure of the male internal genitalia, and slightly in the shape of the female subgenital plate (Rowell 2000).

Key to genera (external characters only).

Males.

- I Cerci long, only slightly incurved, with an abrupt embayment in the ventral edge at 2/3 length, tip laterally flattened and symmetrically rounded (Fig. P21). Elytra cycloid, extending onto 2nd or 3rd abdominal segment and partially covering tympana. Costa Rica: usually at 2000 m or above.
..... *Drymacris* Descamps & Rowell
- IA Cerci of various forms, but not as above. Elytra squamiform, extending maximally onto metanotum.
..... 2
- 2 Cerci abruptly flexed inwards by some 70° at about half length, completely or almost completely melanized; furcula absent (Fig. P34). *Lithoscirtus* Bruner
- 2A Cerci curved smoothly inwards, forceps-like, usually only the distal region melanized; furcula absent or present (Figs P22 & P23).
..... *Drymophilacris* Descamps

Females

- I Elytra cycloid, extending into 2nd abdominal segment and partially covering tympana. Cerci short, with blunt rounded tips (Fig. P20A, C). Dorsal ovipositor valves slightly excavated on dorsal surface, with raised internal edge, only very slightly divergent (Fig. P20A). Subgenital plate flat (Fig. P20C).
..... *Drymacris* Descamps & Rowell
- IA Elytra squamiform, extending maximally into metanotum. Dorsal ovipositor valves flattened, spatulate. Cerci long and straight, with fine sharp points (Figs. P26, P31). Subgenital plate either domed or with paired swellings at its anterior margin
..... 2
- 2 Subgenital plate smoothly domed in anterior region *Lithoscirtus* Bruner

- 2A Subgenital plate with paired ventral or ventrolateral swellings near anterior margin (Figs P26, P31)
 - *Drymophilacris* Descamps

Drymacris

Descamps & Rowell 1978

Descamps & Rowell 1978: 361.

Type species: *Lithoscirtus nebulicola* Rehn 1929: 26.

Subsequent literature.

- Descamps, M. 1976: 81. > Transfers to *Drymophilacris*.
- Descamps, M. & Rowell, C.H.F. 1978: 361. > Transfers to *Drymacris*.
- Amedegnato, C. & Poulain, S. 1987: 400.
- Rowell, C.H.F. 2000: 830. > Redescription.
- Rowell, C.H.F. & Flook, P.K. 2004. > Molecular systematics.

Etymology.

Greek *drymos*, oak forest, wood or coppice; *acris*, conventionally used for grasshopper.

Distribution.

Costa Rica.

No. of included species.

One.

Diagnosis.

Habitus Fig. P19. Plate P10. Posterior margin of pronotum in midline straight or very slightly emarginate. Elytra cycloid, widely separated in the midline, extending into the second, occasionally third, abdominal segment and partially covering tympanum. Male cerci (Fig. P21) abruptly notched on the ventral margin towards the tip. Female cerci (Fig. P20A, C) short, bluntly rounded at the tip, unlike the sharp points of *Drymophilacris* or *Lithoscirtus*. Upper ovipositor valves (Fig. P20A, C) relatively unmodified, less flattened dorsoventrally and much less divergent than in *Drymophilacris* or *Lithoscirtus*, slightly excavated dorsally, with a raised, minutely toothed, internal edge. Subgenital plate (Fig. P20B, C) of female flat, neither domed (*Lithoscirtus*) nor provided with paired anterior swellings (*Drymophilacris*); terminal process ("egg-guide") very short.

The phallic complex is very similar to that of *Drymophilacris* which is therefore presumably the most closely related genus. The original description of the genus *Drymacris* included the species *panamae* and *ovatipennis*, then known from only single-sex collections. When male material became available, these were transferred to *Drymophilacris* and *Paratela* respectively.

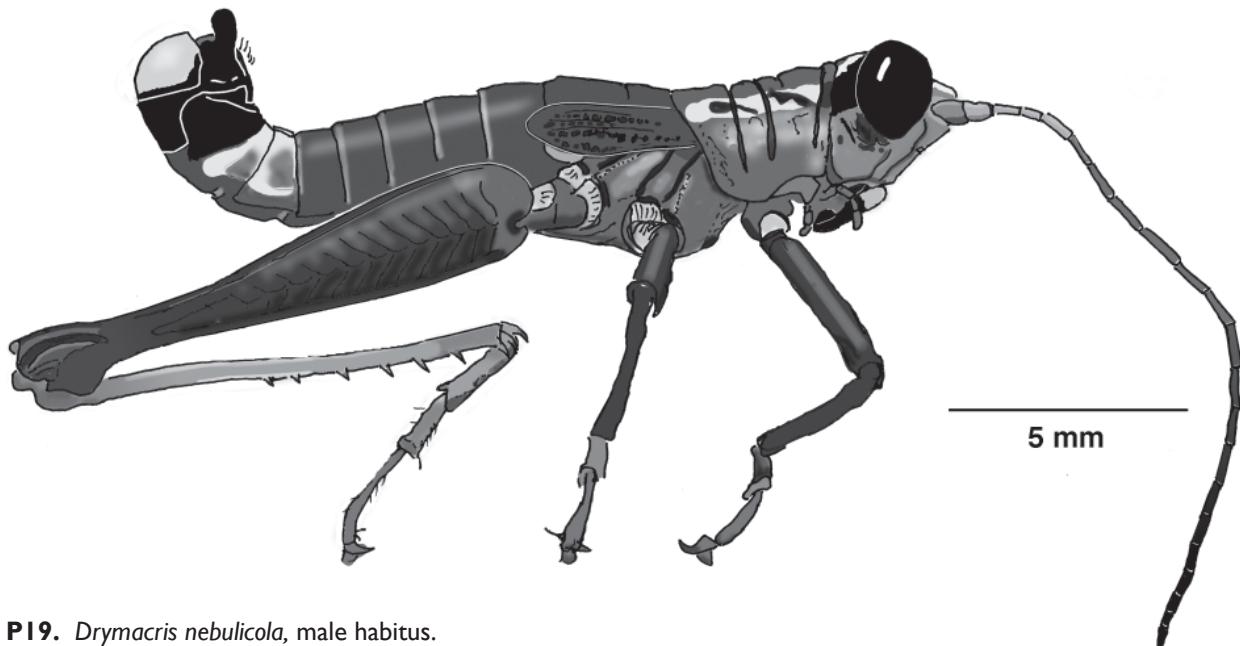


Fig. P19. *Drymacris nebulicola*, male habitus.

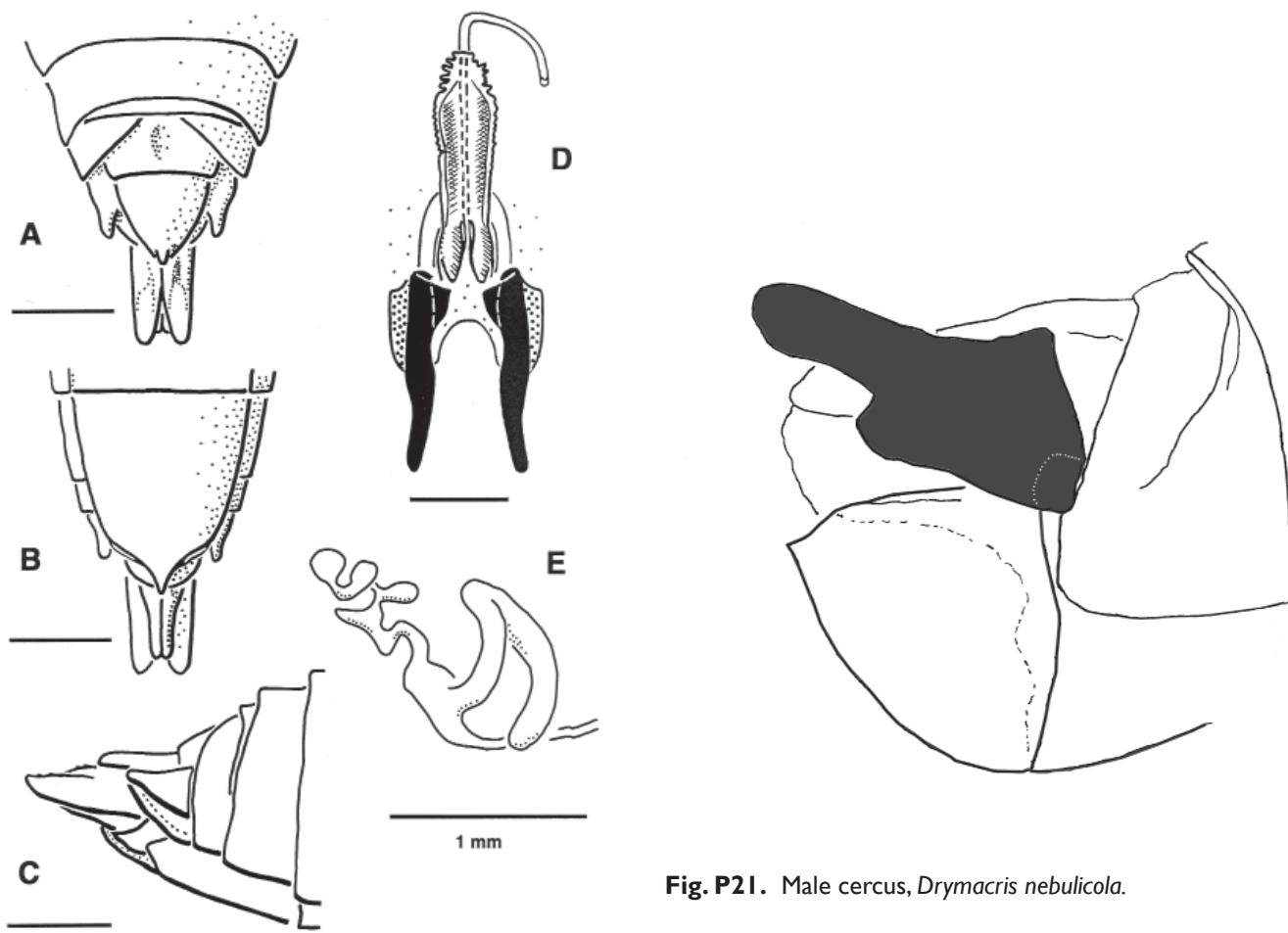


Fig. P20. *Drymacris nebulicola*, female genitalia. A, terminalia, dorsal view. B, terminalia, ventral view. C, terminalia, lateral view. D, bursa copulatrix. E, spermatheca. All scale bars, 1 mm.

Fig. P21. Male cercus, *Drymacris nebulicola*.

***Drymacris nebulicola* (Rehn 1929)**

Lithoscirtus nebulicola Rehn 1929: 26.

Type locality: COSTA RICA: Prov. S. José: La Palma, between Volcan Barba & Volcan Irazú, 4960-5100 feet.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Descamps, M. 1976: 81. > Transfers to *Drymophilacris*.
- Descamps, M. & Rowell, C.H.F. 1978: 361. > Transfers to *Drymacris*.
- Rowell, C.H.F. 2000: 833.

Etymology.

Latin *nebula*, cloud, mist, smoke; *cola*, inhabitant. Refers to the montane or alpine habitat, frequently cloud covered.

Diagnosis.

Habitus. **Fig. P19.** The generic diagnosis applies (monospecific genus).

Coloration.

General colour dark green, with small yellow markings on head and pronotum. Male terminalia black, with a single medial undivided light blue patch (drying white in pinned specimens) on the subgenital plate; the mostly black terminalia are separated from the green abdomen by a clear lemon-yellow ring. Femora green; dorsal part of hind knee reddish brown. The internal ventral face of the hind femur is light blue in fresh

specimens, and articular membranes are blueish grey. Hind femur green proximally, shading to blue grey distally. All tarsi either blue grey or (more commonly) reddish brown, depending on locality and maybe on age. Fastigium and most of vertex yellow. Eyes black, drying brown. Male antennae green basally, black distally, with no pale tip.

Females are commonly but not invariably of the bronze morph, and have reddish antennae with paler tips.

Field characters.

Readily distinguished from most *Solanum* lithoscirtines by the coloration of the tip of the male abdomen – terminalia black, separated from the green abdomen by a clear lemon-yellow ring. The male subgenital plate is a conspicuous light blue.

In the hand the relatively large elytra are easily seen.

Natural history.

A characteristic upper montane species. A specialist on *Solanum* species at higher altitudes, at lower edges of its range overlapping with and eventually replaced by one of several *Drymophilacris* spp. Males are commonly seen displaying to groups of females on *Solanum* leaves. The mode of egg deposition is unknown; in view of the incomplete transformation of the ovipositor valves it would be interesting to know whether oviposition is epiphyllous, as in *Drymophilacris*, or not.



Map P8. Distribution of *Drymacris nebulicola* in Costa Rica.

Distribution.

Widely distributed in and above the higher montane forest zone (1600-2500 m) of Costa Rica on both Atlantic and Pacific watersheds, from near Arenal in the north to Tres Colinas, Potrero Grande, in the south. Not recorded from Panama.

Drymophilacris Descamps 1976

Descamps 1976: 80.

Type species: *Dellia bimaculata* Rehn 1905: 426.

Subsequent literature.

- Amedegnato, C. 1977: 256.
- Descamps, M. & Rowell, C.H.F. 1978: 358.
- Amedegnato, C. & Poulain, S. 1987: 400.
- Rowell, C.H.F. 2000: 805.

Range.

Northern Costa Rica to Central Panama, Caribbean slope.

No. of known species.

Eight. All of them occur in our area.

Diagnosis.

Medium-small (>10, <20 mm) to medium (>20, <30 mm) sized grasshoppers: body length 14 - 19 mm (males), 17 - 22 mm (females). Interocular space narrow but somewhat wider than that of *Lithoscirtus*, 0.48 - 0.52 times (males), 0.69 - 0.82 times (females) as wide as antennal pedicel. Antennae 3.7 - 4.8 times (males), 2.5 - 3.5 times (females) as long as pronotum, thus tending to be slightly shorter than those of *Lithoscirtus*.

Micropterous, elytra do not exceed posterior border of metanotum in *D. panamae*, and are still smaller in all other spp.

Male characters. Cerci long, gradually curving inwards, forceps-like, nearly straight or somewhat sigmoid in lateral view, with tips of variable shape. Rim of subgenital plate pinched together at apex and prolonged medially, like the lip of a jug. Endophallus has large regularly oval anterior processes, with doubly flanged entire margins, sharply differentiating the genus from *Lithoscirtus*. Ventral aedeagal sclerites thin and tapering in both lateral and ventral view, ending in one or more sets of recurved hooks. Epiphallus usually relatively broader than that of *Lithoscirtus*, nearer square than rectangular in dorsal view, less narrowed anteriorly, lophi less erect.

Female characters. Cerci long and slender at tip, acutely pointed, similar to those of *Lithoscirtus*. Upper ovipositor valve flattened dorsoventrally, divergent, upper face flat and pointed at the tip (as in *Lithoscirtus*). Subgenital plate simple, triangular,

posterior edges almost straight, with 2 more or less prominent swellings near the anterior margin; in some species these form large laterally projecting bulges visible from above. Apex of subgenital plate ("egg-guide") of variable length, from short in *D. bimaculata* to equaling the ventral ovipositor valves in *D. rubripes* and *D. nigrescens*; tip upturned, straight or downturned in lateral view. Spermatheca similar to that of *Lithoscirtus*, but with a more complex appendage of the lateral diverticulum, usually provided with pouches and small diverticula (but simple in *D. bimaculata*).

The genus as originally erected contained only 4 species, two of which have since been transferred to other genera. Most of the current species have been discovered only recently.

Natural history.

All species of the genus have a similar life style, being specialists on various Solanaceous plants, sometimes extending to some Asteraceae as well. The characteristic ovipositor is used to deposit the eggs in small batches embedded in foam sandwiched between leaves of the foodplant. Most species are found in clearings in montane forest.

Key to species of *Drymophilacris* (adult males).

Use in conjunction with Figs P22 & P23 (pg. 405)

I	Subgenital plate black with a pair of yellow or yellow-green spots. Hind knees wholly or partly reddish brown, supra-anal plate yellow.	2
IA	Not as above.	4
2	Clypeus, labrum, frontal ridge, frons, genae: yellow, lightly mottled with small black markings. Antenna in dorsal view black, minutely ringed with white at joints, terminal segment white in both sexes. Furcula absent (Caribbean Costa Rica).	<i>D. bimaculata</i> (Rehn, 1905).
2A	Face not as above; at least clypeus, labrum and antennal sockets black. Furcula present.	3
3	Frontal ridge, frons and ventral part of genae entirely black; terminal two segments of antennae white; furcula well-developed (Fig. P23) (Coclé Prov., Panama).	<i>D. melanopsis</i> Rowell 2000a
3A	Frontal ridge black only in dorsal region; remainder of frons and genae, metallic yellow-green or bluish-green; antennae black; spots of subgenital plate relatively small, covering only about half of total area, and in fresh specimens tending to blueish grey medially; furcula small (Fig. P23) (Veraguas Prov., Panama).	<i>D. veraguensis</i> Rowell 2000a
4	Cercus with ventral distal extremity angled obliquely inwards and shorter than dorsal extremity.	5
4A	Cercus not as above.	6
5	Subgenital plate black with broadly confluent green spots; supra-anal plate yellow-green; hind knees	

- red; antennae black with indistinct pale annulations proximally; furcula absent (**Fig. P22**) (highlands of Central Costa Rica).
..... *D. glyphocerca* Rowell 2000a.
- 5A Subgenital plate entirely pale blue, supra-anal plate yellow brown; all femora light reddish brown; furcula present but minute (**Fig. P22**) (highlands of SW Costa Rica and Chiriquí Province, Panama).
..... *D. panamae* Descamps, 1976.
- 6 Cercus long and nearly parallel-sided in lateral view, almost completely black; subgenital plate entirely turquoise, supra-anal plate emerald green in life, yellow green when dried; furcula absent (Cordillera del Norte, Costa Rica).
..... *D. monteverdensis* Descamps & Rowell, 1978.
- 64A Cercus not as above; subgenital plate with confluent or narrowly separated blue-grey spots; furcula small but present 7
- 7 Supra-anal plate blue-grey; femora of middle and fore legs red basally, blue-green distally; pronotum mostly green (lowlands, Bocas del Toro, Panama).
D. rubripes Descamps & Rowell, 1984.
- 7A Supra-anal plate yellow; femora of middle legs yellow basally, green distally; pronotum mostly black (highlands, Bocas del Toro, Panama).
D. nigrescens Rowell 2000a.

***Drymophilacris bimaculata* (Rehn, 1905)**

Dellia bimaculata Rehn 1905: 426.

Type locality: COSTA RICA: Prov. S. José: Carrillo.

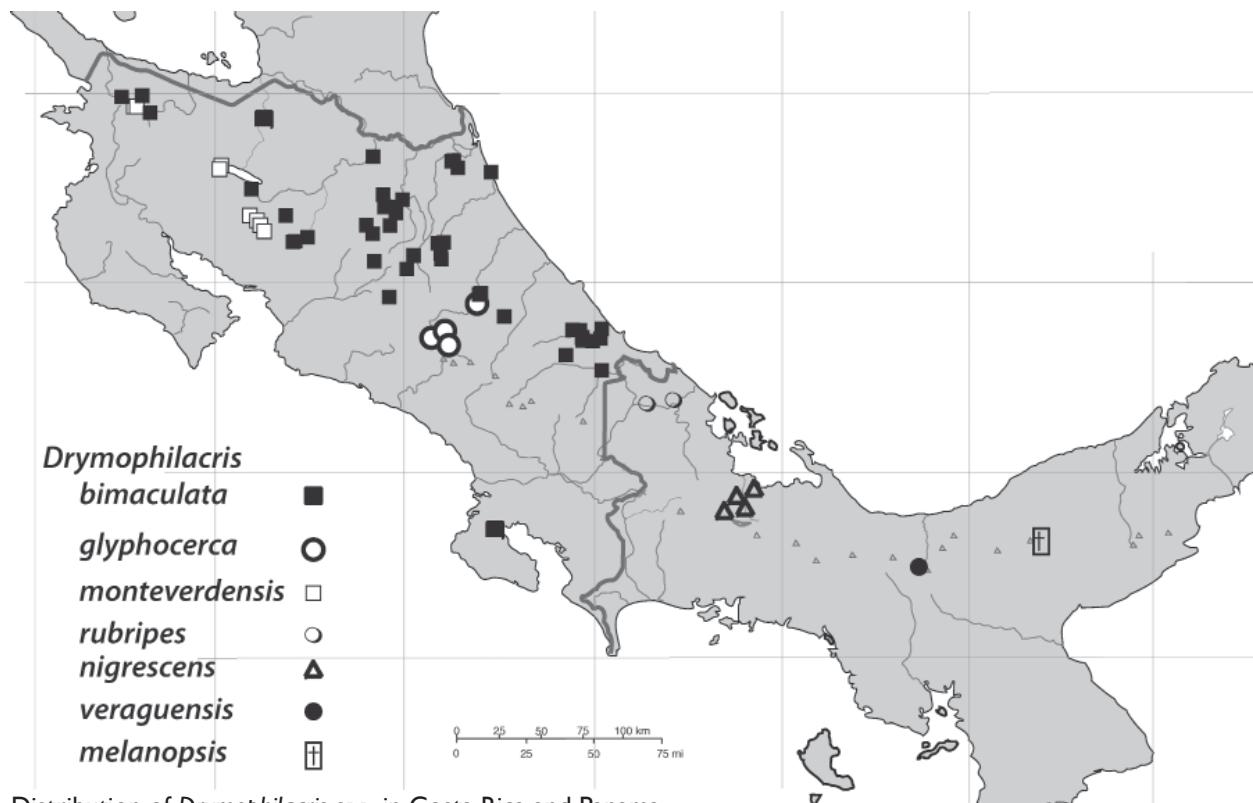
Location of type specimen: ANS Philadelphia.

Subsequent literature.

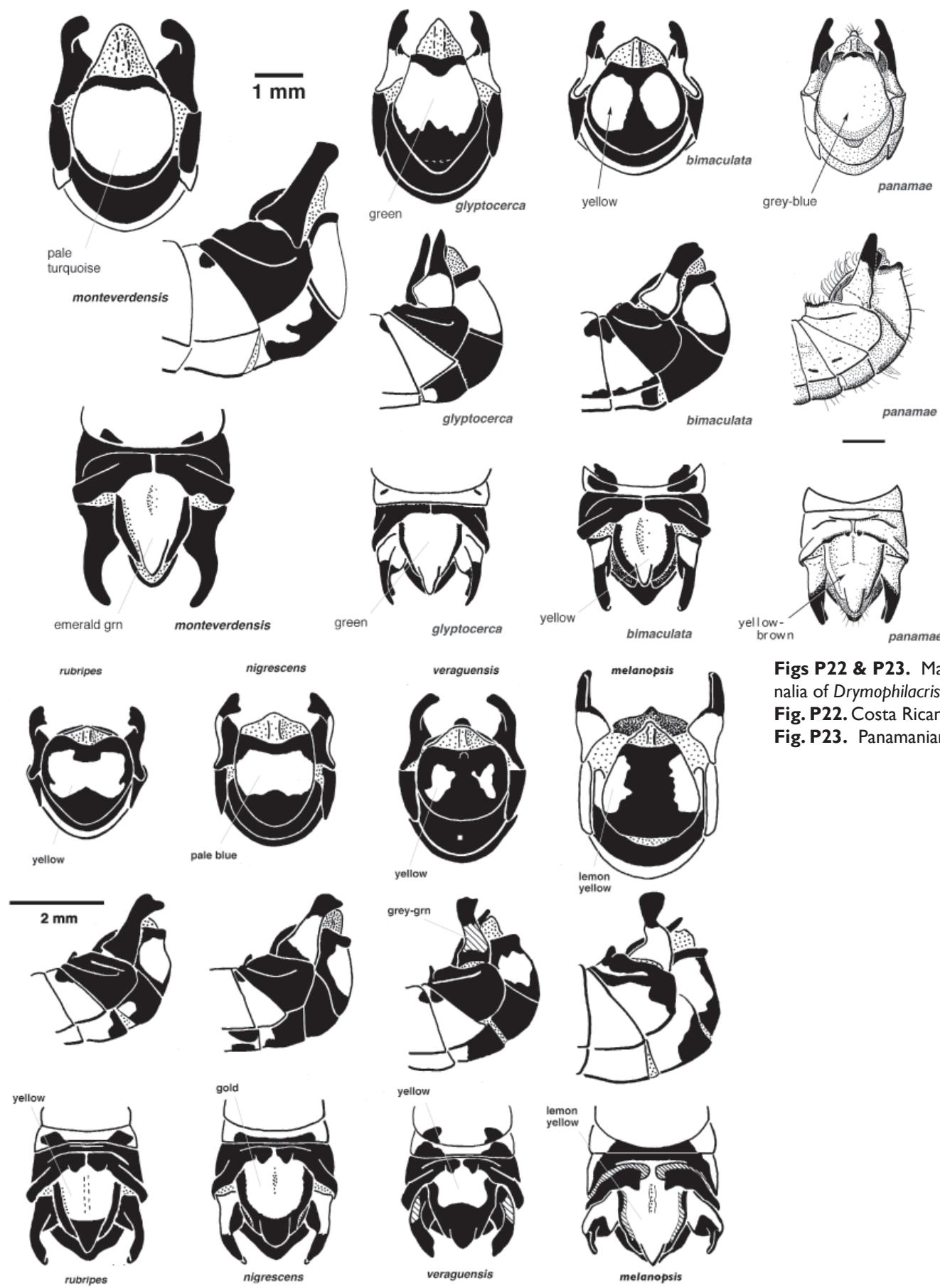
- Bruner, L. 1900-1910 (1908) : 272.
- Rehn, J.A.G. 1929: 26. > Transfers to *Lithoscirtus*, designation of male lectotype.
- Descamps, M. 1976: 81. > Transfers to *Drymophilacris*
- Amedegnato, C. 1977: 256 > Fig. 346.
- Descamps, M. & Rowell, C.H.F. 1978: 359.
- Rowell, C.H.F. 1983: 714. > Natural history.
- Rowell, C.H.F. 2000a: 807.

Diagnosis.

Habitus **Fig. P24, Plate P11**. Elytra do not extend past the posterior margin of the mesonotum. Male cerci bar-like and slightly sigmoid in lateral view, with the tip somewhat down curved and very slightly bifurcate; only the distal half is melanised. Subgenital plate black with two discrete yellow spots apically. Supra-anal plate yellow, bordered with black; furcula absent (**Fig. P22**). Legs and abdomen green, hind knees reddish brown; head, pronotum and thoracic pleura black and yellow. Antennae black, terminal segment white. Differs from all other species of the genus in having a noticeably upturned tip of the dorsal aedeagal valve (see Descamps 1976, Fig. 37). Egg guide of female very short.



Map P9. Distribution of *Drymophilacris* spp. in Costa Rica and Panama.



Field characters.

The only lowland species of the genus in Costa Rica, and the only one with twin golden spots on a black subgenital plate in the male. Has a predominantly green and gold appearance.

Natural history.

A specialist on species of *Solanum* and *Witheringia* (Solanaceae). A typical light-gap and forest edge species. Unlike some other species of the genus (see e.g. *D. panamae* below) it appears to breed continuously, as all life stages are present at all times of the year.

Distribution.

Widely distributed and sometimes fairly common on the Caribbean slope of Costa Rica, from sea level to over 1000 m. It does not however seem to extend much south of the Valle de la Estrella; though recorded from Puerto Viejo on the coast, it is rare in the valley of the R. Sixaola (one specimen from Amubri) and in the adjoining area of Caribbean Panama is replaced by *D. rubripes*. Possibly occurs in the lowlands of Nicaragua, but is undocumented. Apparently absent from Pacific slope. There is one specimen, the identification of which I have confirmed, recorded from the Osa peninsula (ANSP). It is possible that the specimen is mislabelled. The collector (H.R. Roberts) had just previously visited Sarapiquí where the species is common. No other occurrence on the Pacific slope has ever been recorded.

2. *Drymophilacris panamae* Descamps 1976

Drymophilacris panamae Descamps 1976: 82

Type locality: PANAMA: Prov. Chiriquí: El Volcán: Cerro Punta, 5600 feet.

Note: Descamps omitted the locality Cerro Punta from the original description, but it is recorded on the specimen label. Location of type specimen: ANS Philadelphia, holotype male.

Subsequent literature.

- Descamps, M. & Rowell, C.H.F. 1978: 361. > Transfer to *Drymacris*.
- Rowell, C.H.F. 2000a: 810. > Redescription, description of female, restoration to *Drymophilacris*.

Diagnosis.

Small for genus, and with relatively short antennae.

Male (Habitus, Fig. P25, Plate P12): Elytra squamiform, reaching posterior edge of metathoracic notum. Furcula present, in form of two minute melanized projections. Supra-anal plate (Fig. P22) 1.48× as long as broad, with a medial proximal depression; having a somewhat up-rolled, thickened margin, and ending in a bluntly pointed cylindrical process. Apical lip of subgenital rim rather long. Cercus (Fig. P22) longer than supra-anal plate, curving gently inwards, tapering smoothly to a

rounded tip; lower edge bearing a ventrally and inwardly directed lobe 3/4 of the way to the tip.

Female: Elytron squamiform, extending to posterior margin of metanotum. Cerci short, but abruptly narrowed to thin points. Female subgenital plate (Fig. P26B) flat posteriorly, somewhat concave medially; proximally two paired swellings, easily visible in profile in side view of the abdomen (Fig. P26C); distal margin subtriangular, ending in an thick straight "egg guide" nearly equal in length to the ventral ovipositor valves; outer lobes densely haired.

Coloration. Male: Antennae, black. Eyes, black (brown when dried). Mandibles blackish distally. Postocular stripe, marks on genae and V-mark on vertex dark green. Remainder of head metallic pale green with golden sheen (drying to dull light green).

Nota of pterothorax and disc of pronotum olive green, pronotal lobes shading to olive brown. Metallic green marks dorsolaterally at anterior rim of pronotum and anterior to each pronotal sulcus (vanish in dried specimens). Elytra olive green.

Front and middle legs pale reddish brown proximally shading to olive green at knee. Tibia and tarsi olive green. Tarsal spines and tarsal claws tipped black, pulvilli blackish. Basal 3/4 of hind femur, reddish brown, distally green, upper part of knee tinged brown. Hind tibia blue-green, shading to reddish brown distally, spurs brown; tarsal spines (6/7) blue-green, tipped brown. Hind tarsi pink, claws brown.

First 8 abdominal segments olive green, paired darker green blotches dorsolaterally on each tergum. Segment 8 with metallic iridescence in life, lost at death. Segments 9-10 reddish brown, furcula and rim of 10th tergum blackish. Cerci pale blue-green basally, black distally. Supra-anal plate pale yellow-brown proximally, dark brown distally; it lacks the striking colours seen in other species of the genus. Subgenital plate a conspicuous light blue in life, medium dark grey-blue when dried, undivided by black medially; rim and pallium blackish. Underside purplish grey, darker medially. Sternum of 9th abdominal segment blackish.

Female: All adult and late larval females seen to date were of the bronze morph frequently found in this genus group; if there is a form coloured like the males, it is not common.

Antennae. Scape and pedicel yellow, flagellar segments 1-10 red, 11-20 black, 21 white. Eyes light purple-grey, with black pseudopupil (brown when dried). Labrum and clypeus, yellow brown. Palps greenish, blackish at base. Frons and anterior portion of genae, pinkish bronze. Posterior genae iridescent green (dries pale yellow brown) with a few black spots. Postocular stripe black. Vertex and fastigium brown, V-shaped mark on vertex green.

Dorsal surface of thorax, pinkish bronze. Postocular stripe continued onto upper lobe of pronotum as an irregular

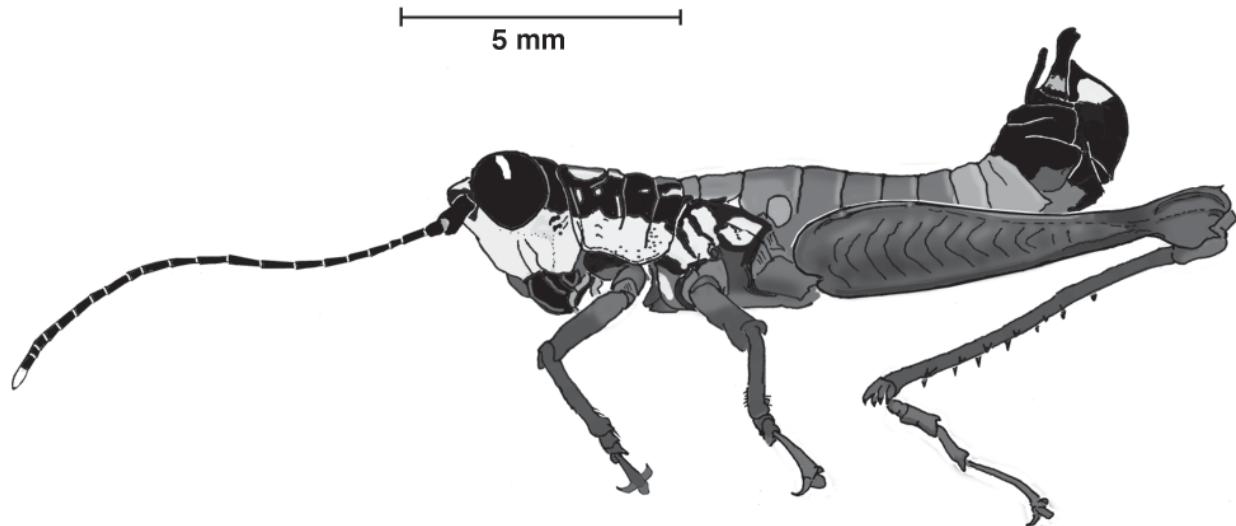


Fig. P24. *Drymophilacris bimaculata*, male habitus.

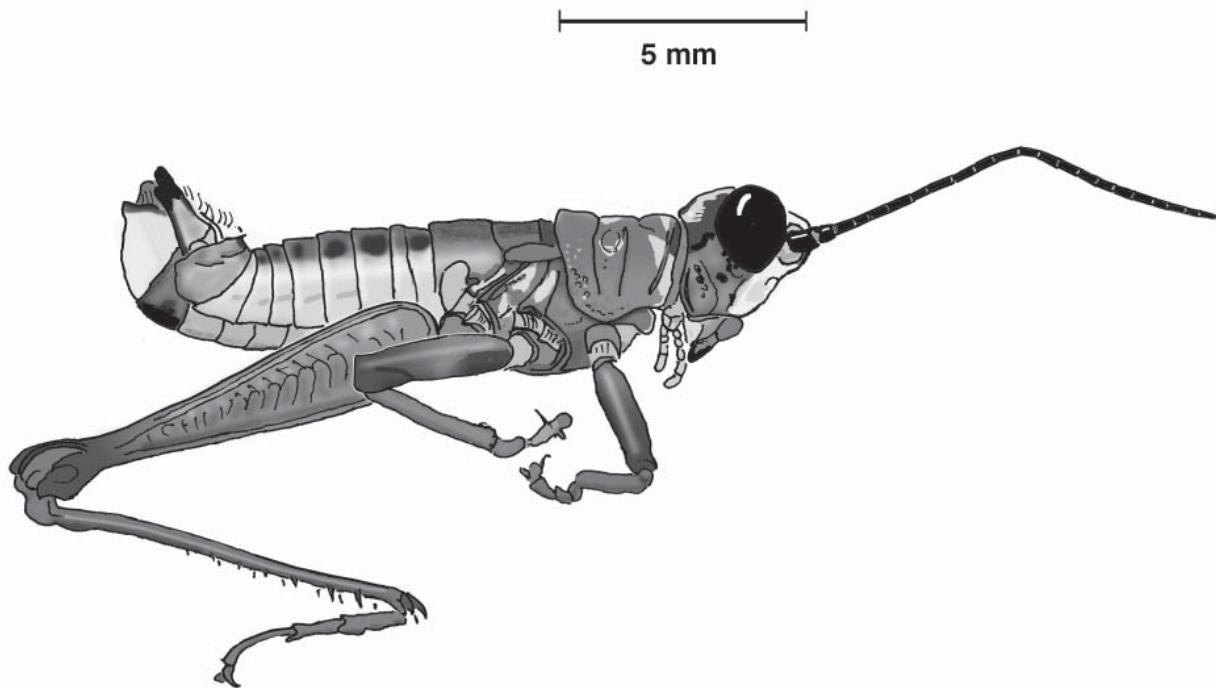


Fig. P25. *Drymophilacris panamae*, male habitus.

black stripe, bordered ventrally with iridescent green. Metathoracic epimeron and episternum metallic blue-green dorsally, shading to olive green ventrally. Elytron blackish brown.

Front and middle legs green; tibiae blackish distally, tarsi and pulvilli blackish brown. Hind femur and tibia green, upper part of knee tinged brown. Tarsi pink. Spines and spurs minutely tipped black.

Dorsal surface of abdomen, including supra-anal plate, pinkish bronze; all segments with grayish posterior border. Conspicuous black spot on the side of each notum of abdominal segments 2-4, each containing an ill-defined yellow blotch posteriorly. Abdomen widest at level of segment 7, thereafter narrowing abruptly to genital region. Tips of cerci, dorsal surface of superior ovipositor valves and tips of ventral valves blackish brown.

Underside of abdomen and thorax dark green laterally, in each segment shading to dark blue medially and posteriorly.

Dried specimens lose almost all the colour described above and become a uniform pale rufous brown with green legs and some black markings. The antennae retain their colours.

Distribution.

Known from Volcán Barú, Chiriquí Prov., Panama, the nearby area of Cerro Punta, and from a single older specimen from near S.Vito de Jaba in SW Costa Rica. Probably it originally occupied all the montane forest above 1500-1800 m between these points. The type locality, Cerro Punta, is now a centre of intensive vegetable horticulture with very heavy insecticide application, little natural vegetation and few living insects.

Natural history.

On Volcán Barú *D. panamae* lives on *Solanum* bushes at the forest edge, sharing them with a very large population of *Ampelophilus olivaceus* (Giglio-Tos), another lithoscirtan. In September the majority of individuals of *D. panamae* are still larvae; probably there is only one generation per year, the adults commencing around October.

3. *Drymophilacris monteverdensis* Descamps & Rowell 1978

Drymophilacris monteverdensis Descamps & Rowell 1978: 358.
Type locality: COSTA RICA: Prov. Puntarenas: Monteverde. 1400 m.
Location of type specimen: MNHN Paris.

Subsequent literature.

- Rowell, C.H.F. 2000a: 807.

Diagnosis.

(Habitus Fig. P27, Plate P13.) Much the largest member of the genus. Hind femur 12.05 mm (males) to 13.0 mm (females), overall length 19.26 mm (males) to 21.9 mm (females). Fastigium scarcely or not at all furrowed, the terminal transverse carinula weak. Male cercus strong and incurved, the posterior ventral angle of the tip not elongated as in *D. bimaculata*. Male subgenital plate entirely light coloured except for the extreme posterior margin. The female has three distinct colour morphs, described by Descamps and Rowell (1978: 359).

Field characters.

Large size. Mottled green and black, with a conspicuous egg-shell blue subgenital plate in the male. Antennae long and entirely black. Face pale blue-green, bounded above and below by the black eyes and mouthparts. Male supra-anal plate a conspicuous light colour, yellow or pale green, contrasting with the otherwise black terminalia. Legs dark green, palps pale blue-green.

Natural history.

A specialist on species of *Solanum* (e.g. *S. siperuroides* and *S. hispidum*) and the vine *Lycianthes synanthera* (Solanaceae). The 3rd and 4th instar larvae are atypically coloured (brown and yellow longitudinal stripes) and aggregate together on the food plant.

Distribution.

Northern Costa Rica. Of scattered occurrence in montane forest in the Cordillera del Norte, from Tilarán to the Nicaraguan border. The different populations vary considerably in size, those from the north being much the larger.

4. *Drymophilacris rubripes* Descamps & Rowell 1984

Descamps & Rowell, 1984: 154.

Type locality: PANAMA: Prov. Bocas del Toro; Changuinola District, United Fruit Co. Plantation.
Location of type specimen: UMMZ, Ann Arbor, Michigan.

Etymology.

Latin *ruber*, red *pes*, foot. Refers to the red femora of the fore and mid legs.

Subsequent literature.

- Rowell, C.H.F. 2000a, 807. > Redescription.

Diagnosis.

(Habitus Fig. P28, Plate P14)

Male: General colour, dark green. Antennae, black; 21 flagellar segments. Eyes, black (brown when dried). Frons and genae blueish-white, with a black band running from eyes

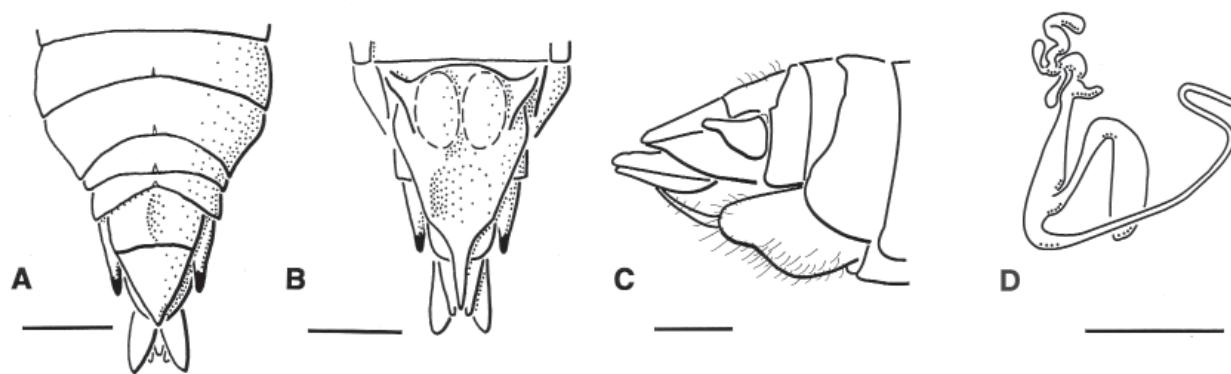


Fig. P26. *Drymophilacris panamae*, female terminalia. A, B, C, dorsal, ventral and lateral views. D, spermatheca. Scale bars, 1 mm.

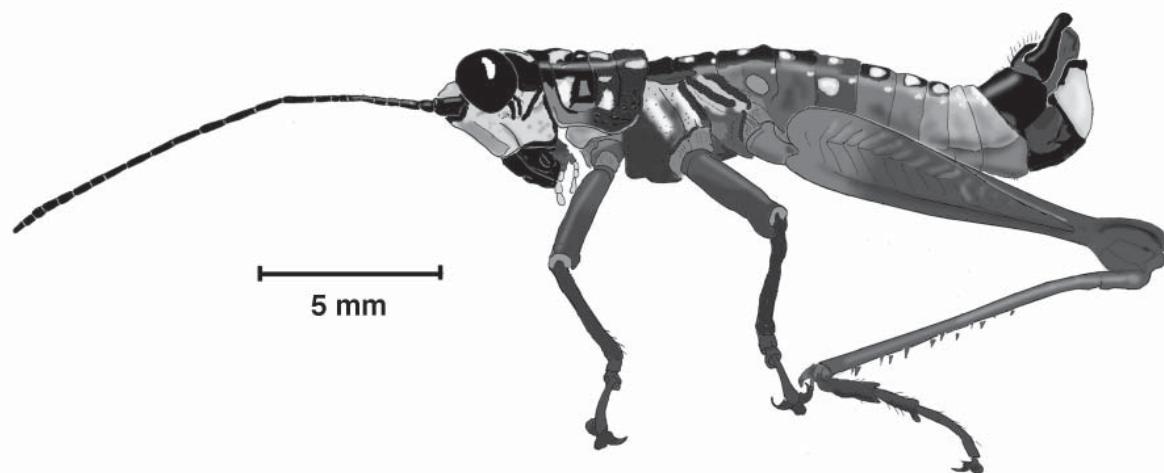


Fig. P27. *Drymophilacris monteverdensis*, male habitus.

through antennal sockets and including the rostrum; lower edge of frons and genae edged black. Mouthparts black, palps white. Postocular stripe and vertex, black. Fastigium and inverted V-marking on vertex, blue grey. Pronotum green, with black postocular stripe produced over lateral lobes to posterior border, where the black band is punctuated by a single green spot; sulci black. Pterothorax and abdomen, green. Preterminal abdominal segments pale yellow ventrolaterally, genital region black. Spots on subgenital plate, supra-anal plate and outer face of cerci, blue-grey. Fore and middle legs distal to midfemur, blue; proximal femur red, coxa yellow. Hind femora dark green, hind knee and hind tibia darker, suffused with blueish; hind feet brownish.

Female: generally similar to male. Metathoracic and abdominal segments 1-7 with an interrupted lateral yellow stripe, flanked dorsally and ventrally with diffuse black. Black stripes on pronotum bordered dorsally by a thin yellow stripe. Supra-anal plate yellow green. Hind femora paler green proximally.

Field characters.

Unmistakable in colour. The only predominantly dark green species with red fore and middle femora and blue grey spots on the male subgenital plate. The whitish face with black dorsal band is also distinctive. The red markings on the legs are reminiscent of *Lithoscirtus minatus* and *L. viceitas*, but the ground colour is quite different.

Distribution.

The lowland valleys of the Rios Changuinola and Teribé, Prov. Bocas del Toro, Panama.

Natural history.

The species is poorly known, but ecologically it seems to be a southern replacement of *D. bimaculata* of the Caribbean coast of Costa Rica. Morphologically it is close to *D. nigrescens* which occurs close by but at higher altitude.

5. *Drymophilacris glyphocerca* Rowell 2000

Rowell, 2000a: 815.

Type locality: COSTA RICA: Prov. Cartago: P.N. Tapantí: Rancho Negro, 1735 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *glyphis*, penknife, and *kerkos*, tail, referring to the form of the male cercus.

Subsequent literature.

- Rowell, C.H.F. 2000b: 31-35. > Mermithid parasitism and resultant modification of secondary sexual characters.

Diagnosis.

(Habitus Fig. P29, Plate P15.)

Male. Elytra rounded, squamiform, reaching to first 1/3 of metathoracic notum. Furcula barely perceptible. Supra-anal plate 1.33× as long as broad, in form like that of *D. panamae*. Lip of rim of subgenital plate shorter than in *D. panamae*. Sheathed aedeagus very large, projects above and beyond cerci. Cerci very similar to those of *D. panamae*, ventral lobe somewhat smaller and more angular at extremity. Antennal flagellum with 20 segments.

Coloration. Antennae black, proximally annulated in grey. Eyes black (brown when dried). Frons, clypeus, entire frontal ridge, genae, blue green. Labrum and mandibles, black distally, brownish proximally. Palps dark at base, tipped green. Fastigium green-gold; vertex greenish blue. Postocular stripe and some pitting on adjacent parts of gena, black.

Pronotum blue-green, its margins, sulci and continuations of postocular stripe, black. Meso- and metathoracic epimera and episterna, blue-green, sutures black. Elytron brown, central area green. Thoracic and abdominal nota blue-green with paired black chevrons, each bearing a gold mark. The black area diminishes in the later abdominal segments. Underside blueish green, medial area black.

Legs pale olive green, pulvilli and claws black. All feet red-brown. Hind knees, red brown. Hind tibiae green proximally, shading to red-brown distally; spines red-brown. Genital area, black. Supra-anal plate metallic green-gold. Cerci black at tip, yellow-grey on outer face proximally. Subgenital plate gold-green, undivided in adult, medially divided into two spots in late larva.

In dried specimens the blue, gold and some black elements fade, leaving predominantly shades of green. The black of the antennae, mouthparts and genital area is however unaffected.

Female: elytra rounded, squamiform, reaching onto middle of metathoracic notum. Cerci abruptly narrowed to long thin points. Subgenital plate flat or slightly concave posteriorly; proximally two paired swellings, which are produced anteriorly onto the next abdominal sternum; distal margin subtriangular, ending in an “egg guide” equal to 2/3 the length of the ventral ovipositor valves and markedly curved upwards at the tip; outer lobes densely haired. Antennal flagellum with 19-20 segments, median 20.

Coloration. Highly polymorphic in colour, with at least 4 variants – green like male, though with less black on pronotum; bronze; dull brown; and almost black. The first two forms can additionally have either red or green legs.

Antennae always red proximally, blue-black distally, with a white tip separated from the blue area by a thin red band.

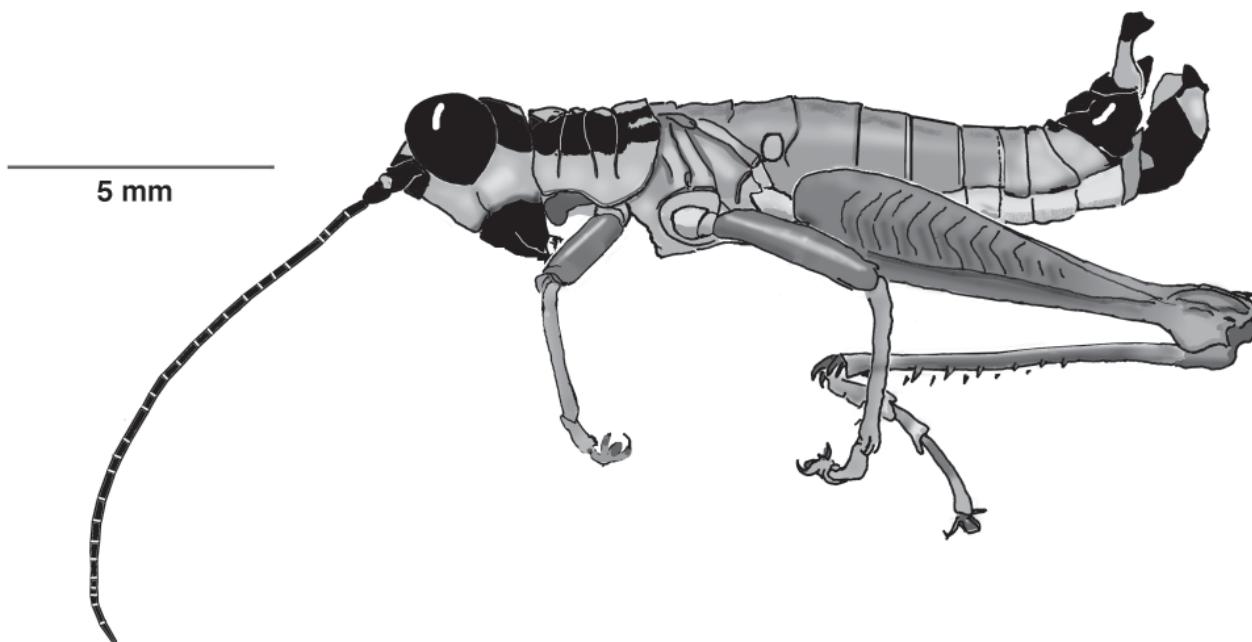


Fig. P28. *Drymophilacris rubripes*, male habitus.

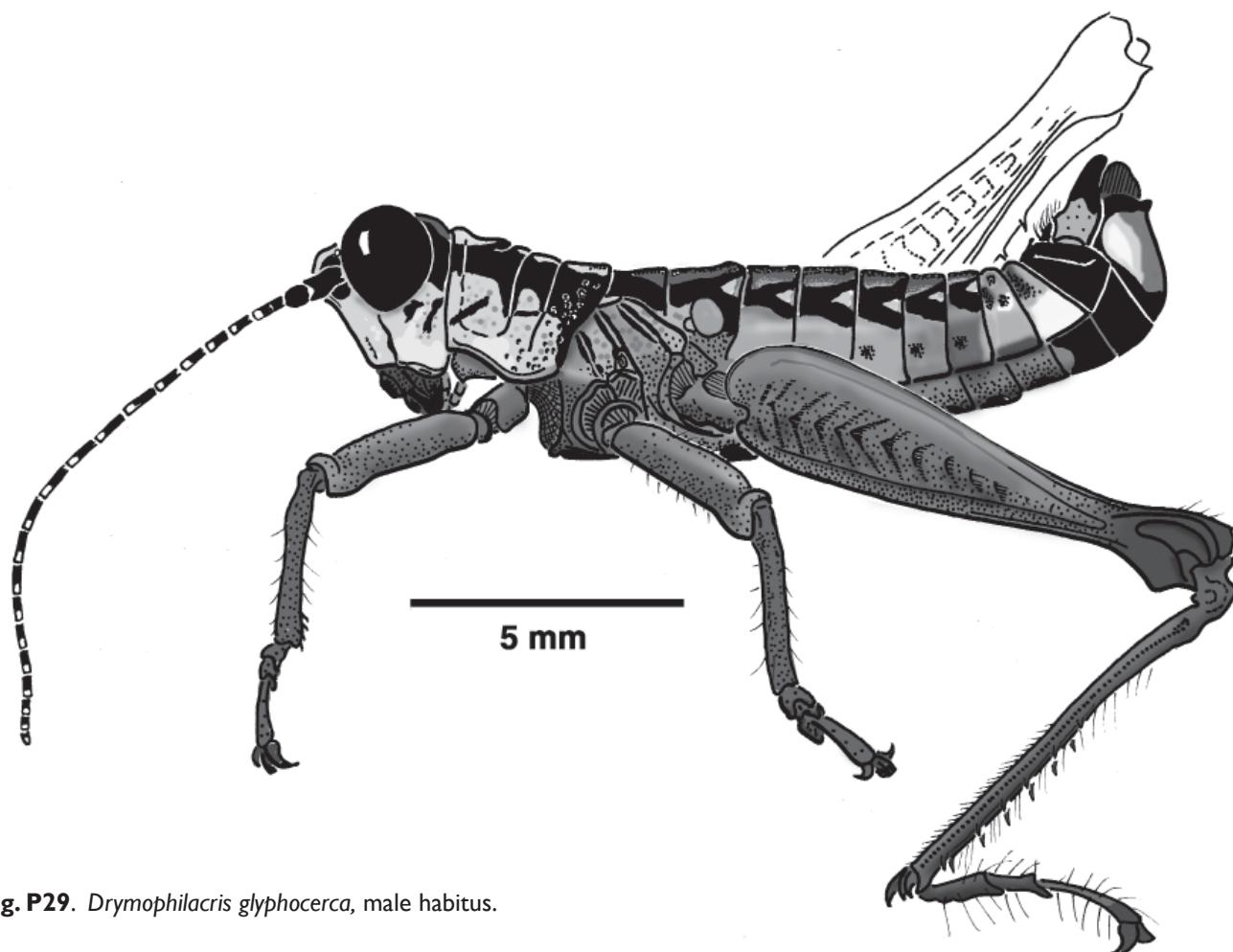


Fig. P29. *Drymophilacris glyphocerca*, male habitus.

Relationships.

This species seems close both ecologically and morphologically to *D. panamae*; both are alpine, small, have shorter antennae than usual in the genus, similar flanged male cerci, minute furculae, and similar male phallic structures.

Natural history.

Occurs commonly at the type locality on low-growing *Solanum* spp. in wet montane forest. At high altitude (>2000 m) it is sympatric with *Drymacris nebulicola*, below 1600 m it is replaced by *Lithoscirtus daedalus*. Of the 28 specimens of the type series, three were parasitised by mermithid nematodes and had abnormalities of the genitalia (Rowell 2000b).

Distribution.

Above 1600 m in the upper drainage of the Río Grande de Orosi and its tributary, the Río Macho, both draining the north-eastern Talamanca mountains of Costa Rica into the R. Reventazón.

6. *Drymophilacris nigrescens* Rowell 2000

Rowell, 2000a: 818.

Type locality. PANAMA: Prov. Bocas del Toro: 1-3 km past watershed on road Fortuna-Chiriquí Grande, 1035-850 m.

Etymology.

Latin *nigrescens*, dusky, blackish.

Diagnosis.

Male: (Habitus **Fig. P30, Plate P16**) Elytron extending over 50% to 90% of mesonotum, not reaching the posterior margin of the tergum. Furcula small but distinct. Tip of cercus with rounded obtuse upper and acute angular ventral corners. Supra-anal plate (**Fig. P23**) 1.18× as long as broad, tapering to a rounded tip, largely without the appendage seen in *panamae* and *glyphocerca*. Subgenital plate with a short medial lip.

Coloration. Antennae black. Eyes black (red-brown when dried). Lateral ocelli, yellow. Palps black basally, green at tip. Mandibles, labrum, clypeus, ventral rim of genae, black. Antennal socket, black. Postocular stripe and most of genae, black. Frons and anterior central part of genae, grey-green or grey-blue, variably suffused with black. Frontal ridge in upper part always black, below medial ocellus variably so. Fastigium and vertex, dull yellow-green or blue-grey; V-marking on vertex black.

Pronotum mainly black. Anterior ventral angle green, a pair of green marks dorsolaterally at posterior margin, just anterior to elytra. In some individuals a variable amount of dark green marking medially on pronotal disc. Meso- and metathorax, black laterally and ventrally, dark green dorsally and medially,

variously suffused black; a pair of poorly defined yellow dots dorsolaterally and posteriorly, in the black area of each segment. Elytra brown, traces of wings visible in some individuals.

Front and middle legs yellow proximally, dark green in distal femur and from thence distally. Pulvilli and claws blackish. Hind femur pale green proximally, dark green or blue-green distally, ventral surface light blue. Ventral lobes of knee light blue. Tibiae mainly blue, but green proximally and black distally; spines 6/7, blue, tipped red brown, spurs brown. Tarsi pinkish brown, claws and pulvilli blackish.

Terga of abdominal segments 1-6 repeat pattern of meso- and metathorax; segments 7-9 are lighter. Sides of segments yellow, underside blackish, with blue posterior margins and yellow-brown anterior margins. Genital area mostly black. Furcula black. Tip of cercus with rounded dorsal and angular ventral corners, black, proximal part of outer face grey-blue or grey-green. Paired confluent spots of subgenital plate grey-blue. Supra-anal plate with black rim and distal half, proximal central part yellow; distal half with long dense hairs.

Female: elytra extend to posterior margin of mesonotum. Cerci typical of genus, but slightly downturned at tip in lateral view (**Fig. P31C**). Subgenital plate flat or concave distally, ending in an egg guide (**Fig. P31D**) that equals or exceeds the length of the ventral valves, downwardly hooked at the tip; anteriorly provided with two large laterally directed swellings, clearly visible as lateral projections from above or below (**Figs P31A, B**).

Coloration. Females are dimorphic in coloration.

Green form: coloration as male, except for antennae (distal 2 segments white), hind tarsi (grey) and genital area. Cerci yellow-green basally, black distally. Proximal half of supra-anal plate green, terminal half blackish. Ovipositor valves light brown, blackish on dorsal face of superior valve. Subgenital plate brown laterally, blue grey medially; basal swellings, blackish.

Bronze form: entire body except legs reddish brown, with metallic sheen in life, lost after death; distal half of antenna black with white tip, postocular stripe darker brown. Yellow spots of the green form represented by light brown flecks. Front and middle legs green, tarsi and tibiae tinged brown. Hind femur green, knee area reddish brown, underside blue. Hind tibia reddish brown, ventral surface blue, blackish at distal extremity. Tarsi light brown. Claws, spurs and pulvilli dark brown.

Relationships.

Morphologically similar to the geographically adjacent *D. rubripes*, especially in the form of the female subgenital plate, but differing in the ventrally hooked egg guide (**Fig. P31D**). It also differs in its larger size and slightly longer fastigium, and markedly in coloration.

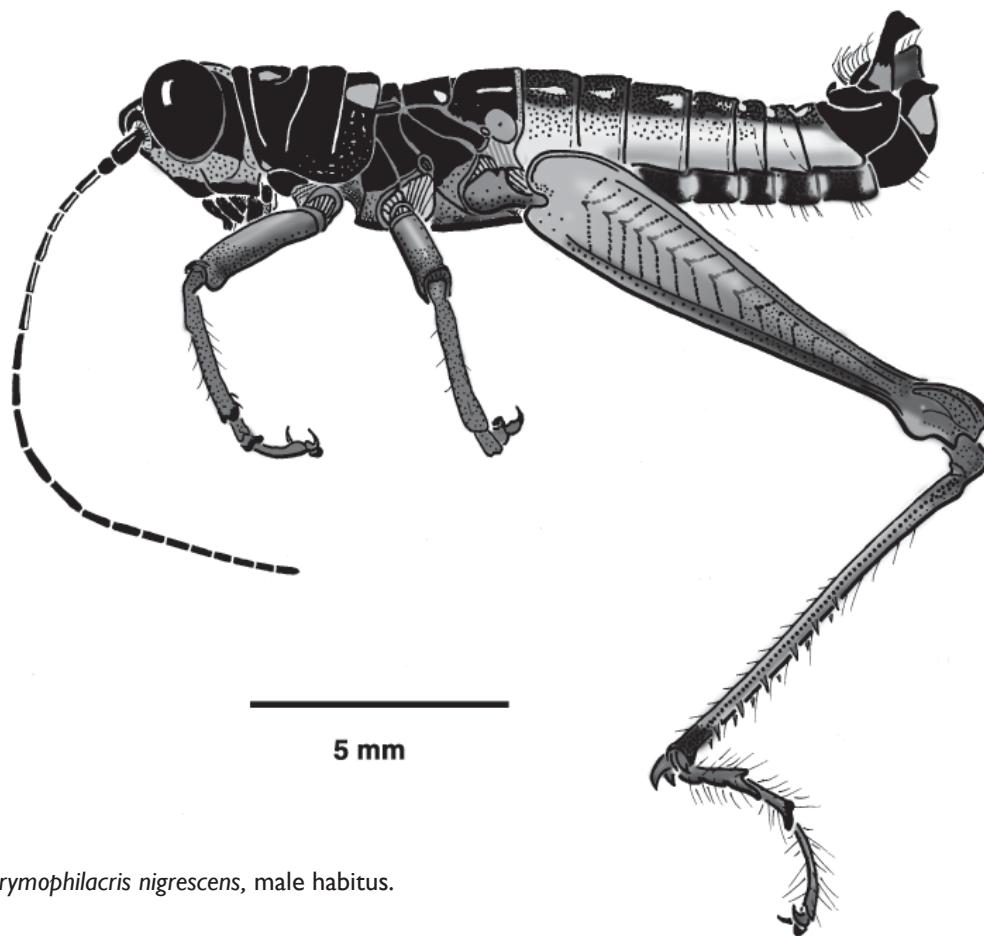


Fig. P30. *Drymophilacris nigrescens*, male habitus.

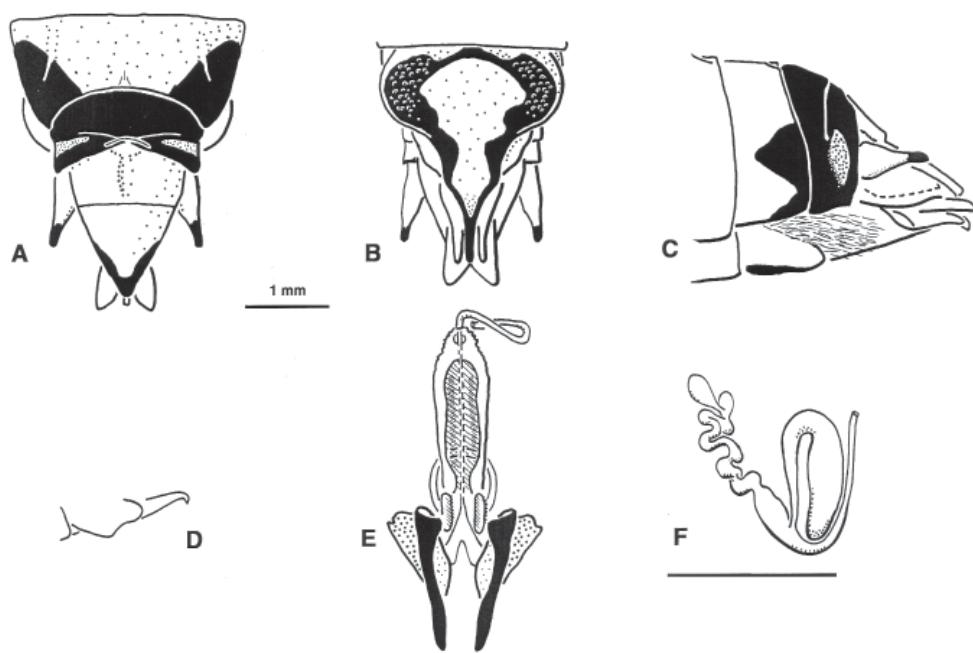


Fig. P31. *Drymophilacris nigrescens*, female genitalia. A, terminalia, dorsal view. B, terminalia, ventral view. C, terminalia, lateral view. D, subgenital plate and egg guide, lateral view. E, bursa copulatrix. F, spermatheca. Scale bars, 1 mm.

Field characters.

The only predominantly black proctolabine in Panama. The black and green males with twin yellow patches on the posterior edge of the pronotum are strongly reminiscent of the Costa Rican *Lithoscirtus daedalus*, but differ in the bright yellow supra-anal plate and the blue spots of the subgenital plate.

However, the species is remarkably similar in general coloration to *Hylopedetes fuliginosus* Rowell & Bentos-Pereira 1995, with which it is sympatric. Especially green females of *D. nigrescens*, lacking the characteristic markings of the male genital region, can readily be confused with this rhytidochrotine; the best field character under these circumstances is the length of the antennae, which in *Hylopedetes* are much shorter.

Distribution.

Currently known only from the type locality and adjoining areas, in the mountains of N.W Panama. Found to date solely on the Caribbean side of the watershed.

Natural history.

On Solanaceae (mostly *Solanum* spp., esp. *S. ochraceo-ferrugineum*, but also *Witheringia solanacea*) and sometimes on *Vernonia* (Asteraceae) in clearings in montane forest, up to 1200 m (the highest available point). Not recorded below 550 m. Adults and all stages of larvae present in September. Mature females contain 2-6 eggs.

7. *Drymophilacris veraguensis* Rowell 2000.

Rowell, 2000a: 824.

Type locality: PANAMA: Veraguas Prov.: Santa Fé: Alto la Piedra, 900 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *veraguensis*, coming from (the Province of) Veraguas.

Diagnosis.

Male: Habitus **Fig. P32, Plate P17**. Elytron minute, falling well short of posterior margin of the mesonotum; wing absent. Furcula (**Fig. P23**) quite well developed. Cerci incurving rounded at the dorsal tip, angular at the ventral tip, similar to those of *D. nigrescens*. Supra-anal plate 1.23× as long as wide, and tip blunter and more rounded, most similar to that of *D. nigrescens*.

Coloration. Antennae black (but flagellar segments distal to no. 16 missing in both specimens). Eyes black (brown when dried). Clypeus, labrum and mandibles black, palps yellow. Remainder of head yellow, except for black antennal sockets, black mark on upper part of frontal ridge between the two antennal sockets, black postocular stripe, small black fleck in

centre of fastigium, and inverted black V on vertex.

Pronotum yellow, with one medial and two lateral black stripes continuing the markings of the vertex and the postocular stripe posteriorly; these stripes continue as far as the first abdominal segment. Pronotal epimeron black. Elytron brown. Meso- and metathoracic epimera and episterna yellow with longitudinal black marks. Fore and mid legs, yellow. Hind femora green, upper lobe of knee tinged red-brown. Hind tibia green; 6 external and 7 internal tibial spines, tipped red-brown, tarsal spurs tipped black. Tarsi yellow, claws tipped black.

Abdominal segments greenish-yellow. Dorsa of segments 6-8 bright yellow medially. Genital region (see **Fig. P23**) mostly black; central area of supra-anal plate, spots on subgenital plate, bright yellow. Cerci black, with a grey-green region on the central part of the outer surface of the shaft.

Female unknown.

Distribution.

Known only from the type locality on the Caribbean/Pacific watershed in mid-Western Panama.

Natural history.

Found on *Solanum* plants at forest edges.

8. *Drymophilacris melanopsis* Rowell 2000.

Rowell, 2000a: 827.

Type locality: PANAMA: Prov. Coclé: Cerro Copé: 830 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *melanopsis*, black face.

Diagnosis.

Male: Habitus **Fig. P33, Plate P18**. Elytron rather large for the genus, reaching clearly into the metathoracic notum. Furcula well developed, with widely separated points directed obliquely upwards (**Fig. P23**). Supra-anal plate almost glabrous anteriorly, 1.37× as long as broad, with a prominent appendage terminally; cerci somewhat sigmoid and narrowly waisted behind tip in lateral view, tip broad and spatulate, dorsal corner rounded, ventral corner more acute. The male aedeagus differs from that of all other members of the genus, suggesting that this species is isolated and divergent (Rowell 2000).

Female: elytron extends on to metathoracic notum. Cerci typical of genus. Subgenital plate flat, with low, laterally spreading, paired swellings with rugose cuticle anteriorly, triangular posteriorly, terminating in a straight, pointed, upward slanting egg guide, 0.7× as long as the ventral ovipositor valves.

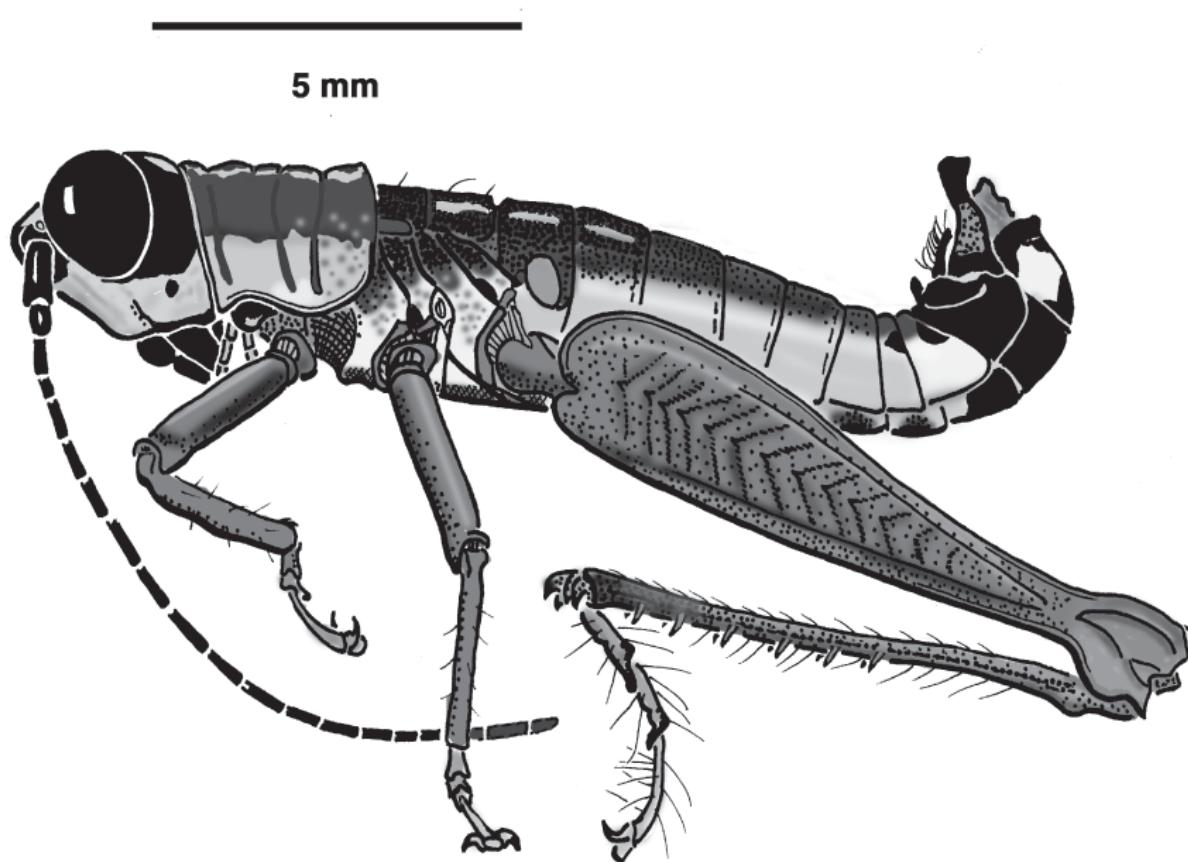


Fig. P32. *Drymophilacris veraguensis*, male habitus.

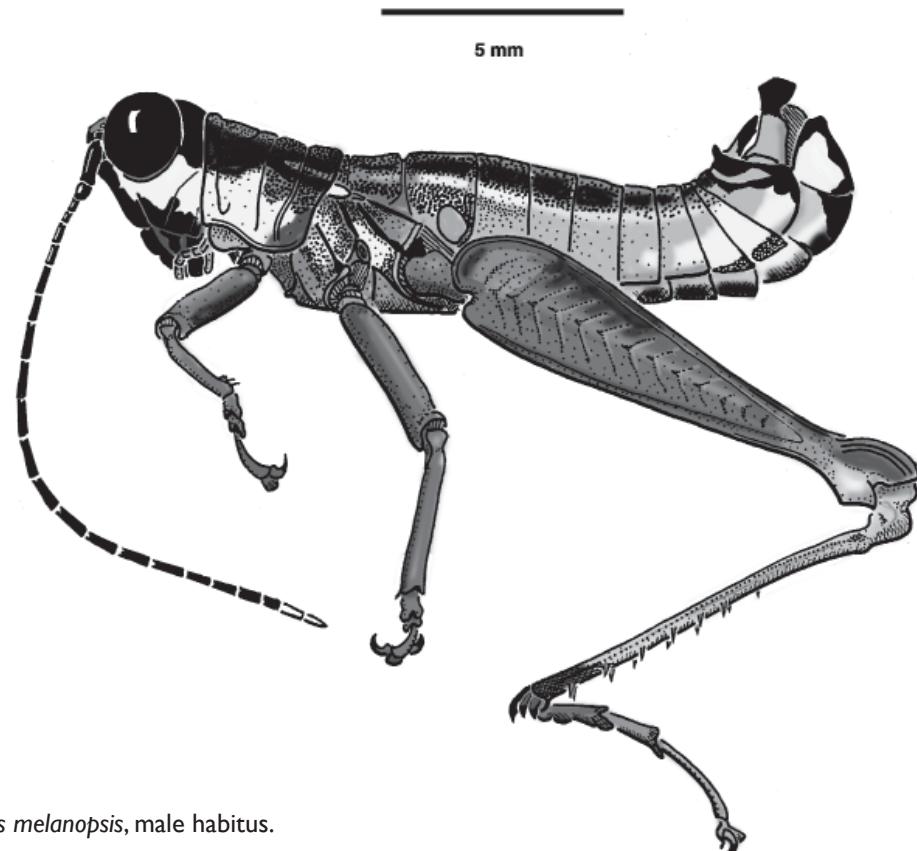


Fig. P33. *Drymophilacris melanopsis*, male habitus.

Coloration. Male: Antennae black, terminal 2 segments white (almost uniquely for males of the genus, only *D. bimaculata* is similar); 21 flagellar segments. Eyes black (red-brown when dried). Palps green. Mandibles, labrum, clypeus, frons, antennal sockets, postocular stripe, lower edge of genae, glossy black. Upper part of genae, lemon yellow. Fastigium and vertex, lemon yellow; inverted V-marking on vertex, black.

Pronotum green dorsally, with darker dorsolateral stripes continuing line of postocular stripes. Ventral half of lateral lobes lemon-yellow, continuing line of genae. Two short yellow stripes dorsolaterally posterior to hind sulcus, continuing the line of the elytra. Pronotal epimeron, green. Meso- and metasternal interspace, blackish. Elytron, yellow. Fore and middle legs green, pulvilli black. Hind femur green, knee reddish brown. Hind tarsus green, blackish-brown distally, spurs and tibial spines (6/7) blackish brown. Tarsi blackish brown, pale olive dorsally, claws and pulvilli tipped black.

Abdominal segments green dorsally, blackish brown ventrally. A pair of longitudinal yellow lines run dorsolaterally from the metathoracic notum to the genital region. Genital region (see Fig. P20). Tergum 9 black, tergum 10 (with furcula) brown anteriorly, black posteriorly. Supra-anal plate entirely yellow with a thin black/red-brown rim. Cerci green proximally, black distally. Paired spots of subgenital plate lemon yellow.

Female: coloration. As in male, except for genital region and white tips of antennae incorporating the 3 terminal segments. Supra-anal plate, mottled olive green, tip tinged brown. Cerci olive brown, darker at tips. Ovipositor valves brown, dorsal valves black distally. Subgenital plate predominantly blackish in colour.

Field characters.

Gives a general impression of alternate dark green and lemon yellow longitudinal stripes. The black frons is distinctive. Only Panamanian species of the genus to have white tipped antennae in the male.

Distribution.

To date known only from the type locality in Central Panama, on both sides of the Pacific/Caribbean watershed. Map P9.

Natural history.

The insect is found on species of *Solanum* and *Witheringia* along paths and in treefall clearings in montane forest.

Lithoscirtus

Bruner 1908*

Bruner 1900-1910 (1908): 273.

Type species: *Dellia miniatula* Rehn 1905: 423.

(*Although the name *Lithoscirtus* was used in passing by Bruner 1908: 273 in connection with what is now *L. miniatulus*, it was first correctly applied as a generic name by Rehn 1929).

Subsequent literature.

- Rehn, J.A.G. 1929: 14.
- Amedegnato, C. 1974: 200.
- Descamps, M. 1976: 77-80 (revision of genus).
- Amedegnato, C. & Poulain, S. 1987: 400.
- Rowell, C.H.F. 2000a: 796. > Review: key to spp.

Etymology.

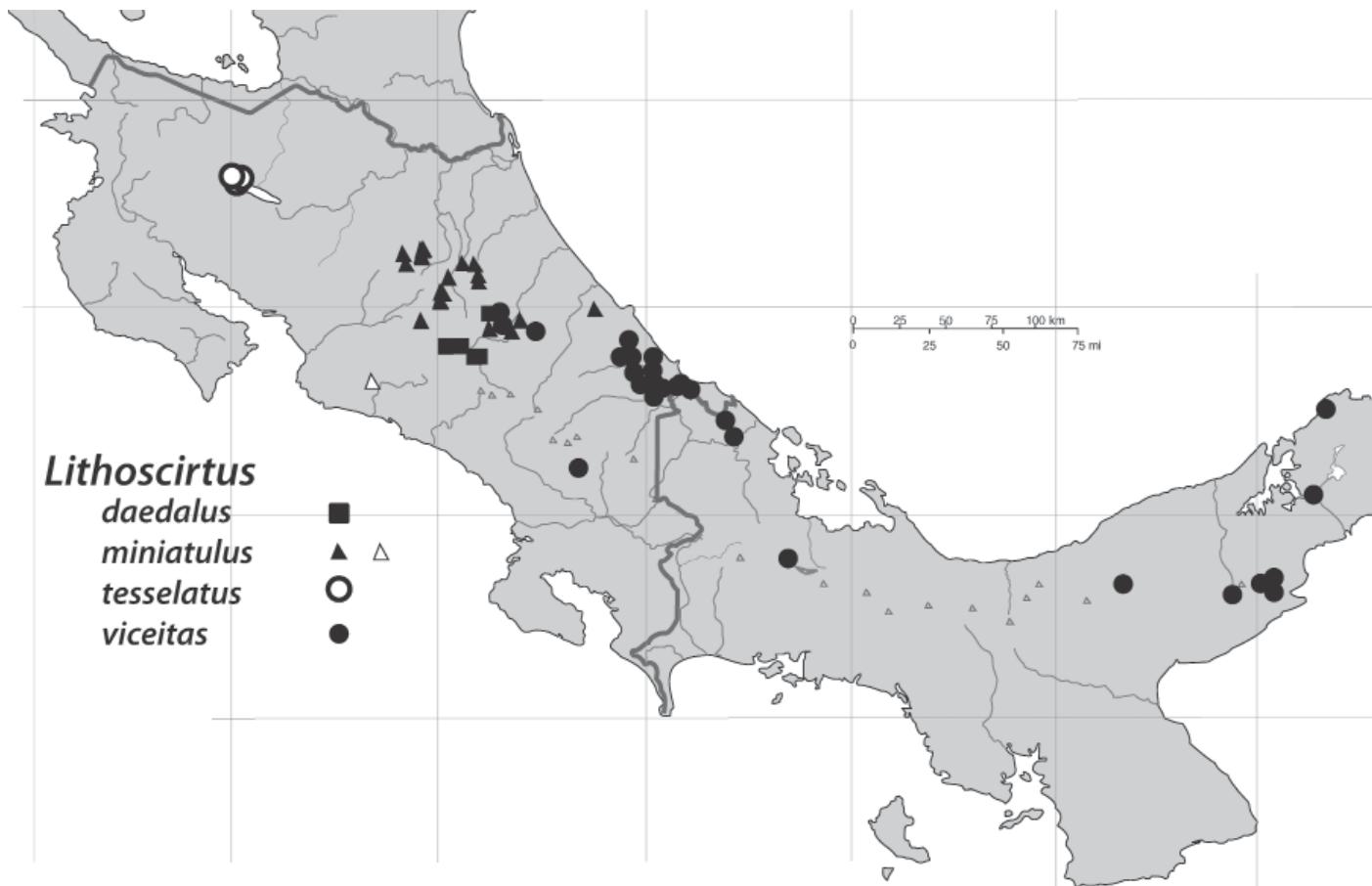
Greek *lithos*, stone, gem, *skitao*, leap, bound. Bruner stresses the gem-like appearance of these beautiful insects.

Diagnosis.

Medium-small grasshoppers (>9.9, <20 mm in length); body size 14 - 17 mm (males), 17 - 19 mm (females). Interocular space narrow. Antennae long and filiform, 4.5 - 4.9 (males), 3.3 - 3.7× (females) as long as pronotum. Micropterous: elytra extend maximally to the anterior part of the metanotum. The thickened transverse ridge typically separating the fastigium from the frontal ridge in the Proctolabinae is obsolete in this genus (Descamps 1976). Posterior margin of pronotum concave in the midline (as in *Drymophilacris*).

Male cerci short, thick, sharply inwardly flexed towards their tip, typically heavily melanized throughout (that of *L. tessellatus* sp. n. has however a green outer face proximally). The anterior processes of the endophallic sclerites are remarkable and diagnostic of the genus, being large thin irregular crumpled sheets of chitin, resembling miniature cabbage leaves (see Fig. 2B-D of Rowell 2000a). They clearly separate *Lithoscirtus* from *Drymophilacris*, which are otherwise very similar morphologically.

Female cerci straight, tapering to a fine point (as in *Drymophilacris*). Female subgenital plate simple, triangular, but with concave posterior edges; the anterior region smooth and domed, without the paired swellings seen in *Drymophilacris*. Posterior extremity of subgenital plate ("egg-guide") short, straight, laterally compressed and bluntly pointed in lateral view, about half as long as the visible portion of the ventral valves of ovipositor.



Map P10. Distribution of *Lithoscirtus* spp. in Costa Rica and Panama. The most western locality for *L.miniatulus*, marked with an open triangle on the Rio Pirris, has been repeatedly questioned by previous authors, and may be an error.

Key to species of *Lithoscirtus* (males).Use in conjunction with **Fig. P34**

x

Males of this genus are traditionally separated on the complex shapes of the cerci (see Figs in Rehn 1929, Descamps 1976, and Rowell 2000a; also **Fig. P34**), which is undoubtedly the best method when dealing with museum specimens, but requires a microscope. The key given below is based on the colour differences of living animals, which are unambiguous for all except the two very similar species *miniatulus* and *viceitas*. These latter however are nowhere sympatric and when alive differ markedly in ground colour (though not when dried). Females are best identified by association with their males, to which they are similarly coloured; all females and no males have white-tipped antennae. A rarer bronze-coloured female morph exists in all species.

- | | | |
|----|--|---|
| I | Apex of subgenital plate entirely black without other markings. Body generally black, but with dark green iridescence in life; paired dorsolateral spots at posterior margin of pronotum whitish yellow (not green, as in other spp.). All legs green. Cercus in side view vertically truncate at tip. | <i>L. daedalus</i> Rehn 1929
southern (nominate) race. |
| IA | Not as above. | 2 |
| 2. | Apex of subgenital plate with paired coloured spots. Elytron extends into metanotum. | 3 |
| 2A | Apex of subgenital plate with an undivided pale blue medial patch (or a pair of medially confluent ones); basal femora of mesothoracic legs red, other legs green. Elytron does not reach posterior border of mesonotum. | 4 |
| 3 | Apex of subgenital plate with paired pale blue patches. Fastigium and vertex markings, metallic blue green; basal femora of mesothoracic legs, red. Cercus in side view vertically truncate at tip. | <i>L. daedalus</i> Rehn, 1929, northern race
(cf. Descamps & Rowell, 1984) |
| 3A | Apex of subgenital plate with paired dull green patches (Fig. P34). Legs all green. Cercus in side view tapering to a blunt, upwardly inflected tip, with a grey-green area near the base. Antennae black proximally and in distal half, but pale green in segments 2-7 (Fig. P39). | <i>L. tesselatus</i> Rowell 2000 |
| 4 | Colour in life principally metallic green. Cercus (Fig. P34) in side view obliquely truncate at tip (N.E. Costa Rica) | <i>L. miniatulus</i> (Rehn, 1905). |
| 4A | Colour in life principally metallic blue. Cercus (Fig. P34) in side view tapering to a point (S.E. Costa Rica, N. Panama) | <i>L. viceitas</i> Rehn, 1929 |

I. *Lithoscirtus miniatulus* (Rehn 1905)*Dellia miniatula* Rehn 1905: 423.

Type locality: COSTA RICA: Prov. S. José: Carrillo.

Location of type specimen: ANS Philadelphia.

Dellia Stål 1878 was erected for *D. insulana* of Cuba. The genus is now known to be speciose in the Northern Antilles, and has been variously assigned to the Copiocerinae or the Ommatolampiniae. Rehn's 1905 use of the genus for *D. miniatulus* was a misapplication of Stål's name. He corrected it in his 1929 publication.

Etymology.

Latin *miniatus*, bright red, plus diminutive. Presumably a reference to the striking areas of red on the mesothoracic femora.

Subsequent literature.

- Kirby, W.F. 1910: 423.
- Bruner, L. 1908: 273. > Invalid use of name *Lithoscirtus*.
- Rehn, J.A.G. 1929: 19. > Transfers to *Lithoscirtus*, n. gen.
- Descamps, M. 1976: 77.
- Rowell, C.H.F. 2000a: 797.

Diagnosis.

(**Fig. P31, Plate P19**). The coloration is unique in our area. Especially the red femora of the middle legs distinguish it from all other species except *Drymophilacris rubripes*, which is confined to a small area of NE Panama. ,

Field characters.

In its area of distribution the only metallic green proctolabine with red middle femora and medial blue patch on the male subgenital plate.

Distribution.

NE Caribbean slope of Costa Rica from at least 1700 m down to about 300 m altitude. The species is typical of montane forest and does not occur in true lowland rain forest, where it is replaced ecologically by *Drymophilacris bimaculata*. As noted by Rehn (1929), Bruner's locality of Pozo Azul de Pirris (on the Pacific slope) is almost certainly false. (**Map P10**)

Natural history.

This species is usually found on selected species of *Solanum* and *Witheringia*, but also occurs on *Datura* and (more rarely) on *Verbesina* and *Vernonia* spp. (Asteraceae). Often occurs in groups of mixed ages, suggesting visual attraction between individuals.

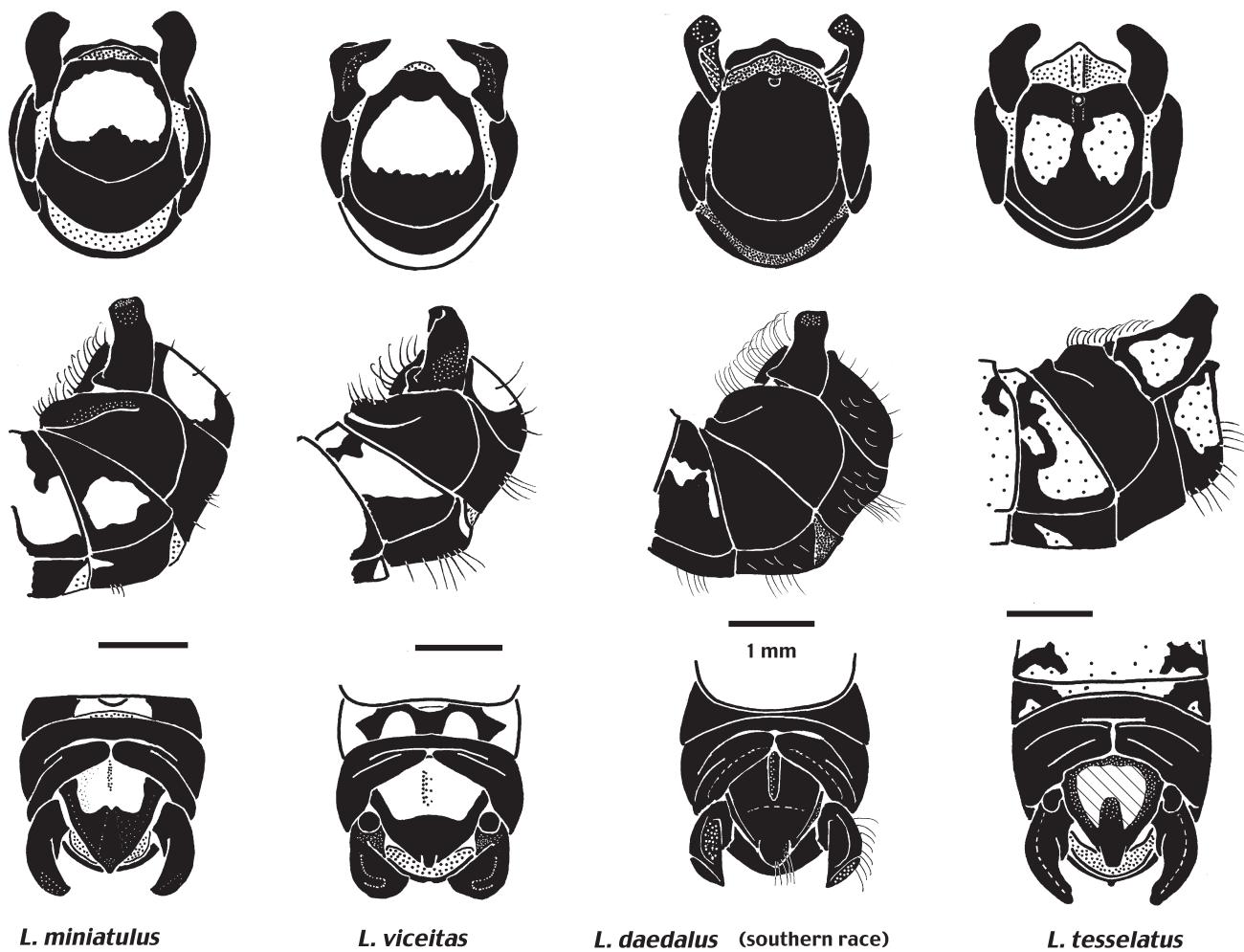


Fig. P34. Male terminalia of *Lithoscirtus* spp. From top to bottom: axial, lateral and dorsal views.

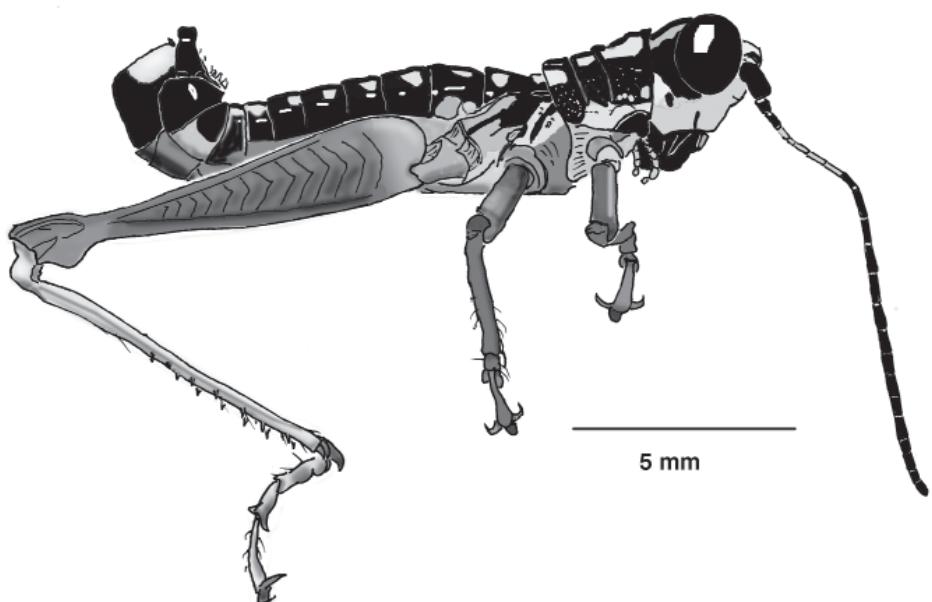


Fig. P35. *Lithoscirtus miniatulus*, male habitus.

2. *Lithoscirtus daedalus* Rehn 1929

Lithoscirtus daedalus Rehn 1929: 22.

Type locality: COSTA RICA: Prov. Cartago: Navarro. 3800-3950 feet (=1140-1185m).

Location of type specimen: ANS Philadelphia.

Etymology:

Greek *daidalos*, artful “in relation to the ability of the species to dodge and jump” (Rehn 1929: 22).

Subsequent literature.

- Descamps, M. 1976: 77.
- Descamps, M. & Rowell, C.H.F. 1984: 155. > Description of a northern race of different coloration.
- Rowell, C.H.F. 2000a: 799.

Diagnosis.

See key to species above, with **Fig. P34. Habitus Figs**

P36 & P37, Plates P20 & P21. This Costa Rican species occurs in two distinct colour forms which are geographically separated. There is no genitalic difference between the two races (Descamps & Rowell, 1984).

Distribution.

The species is apparently confined to the upper reaches (above 1000 m altitude) of the Río Reventazón and its tributaries. The Southern form is found in the region around Orosi and the P.N. Tapanti. The northern form is found around Santa Cruz and the Rio Aquiares on the southern slopes Volcan Turrialba.

Natural history.

A strict specialist on a few species of Solanaceae, sometimes including the hedgerow tree *Acnistus*.

3. *Lithoscirtus viceitas* Rehn 1929

Lithoscirtus viceitas Rehn 1929: 20.

Type locality: COSTA RICA: Prov. Limón: Valle de la Estrella: Suretka Trail on R. Duroy, . 100-150 feet (=33-50 m.).

Location of type specimen: ANS Philadelphia.

Etymology.

Named for the indigenous Viceitas nation of the Talamancas.

Subsequent literature.

- Descamps, M. 1976: 77.
- Rowell, C.H.F. 2000a: 798.

Diagnosis.

(Habitus **Fig. P38, Plate P22**). Apart from the ground colour when alive (see Key above) and the form of the male cerci (**Fig. P34**), almost indistinguishable from *L. miniatulus*. The pregenicular part of the hind femur is thicker in *viceitas*, as noted by Rehn (1929), but the difference is only 0.05 mm and requires simultaneous comparison of the two species to be seen.

Distribution.

Mid-elevation (1100 m) and lowland forest of the Caribbean slope, from the city of Turrialba and the Rio Pacuare (Costa Rica) south and east to at least Portobelo in Panama. The most widely distributed species of the genus, in many areas sympatric with one of several species of *Drymophilacris*.

Natural history.

A strict specialist on a few species of Solanaceae.

The ranges of the three preceding species (*L. viceitas*, *daedalus*, and *miniatulus*) adjoin each other in the neighbourhood of Turrialba, Prov. Cartago, on the Río Reventazón. Nowhere are they known to be truly sympatric.

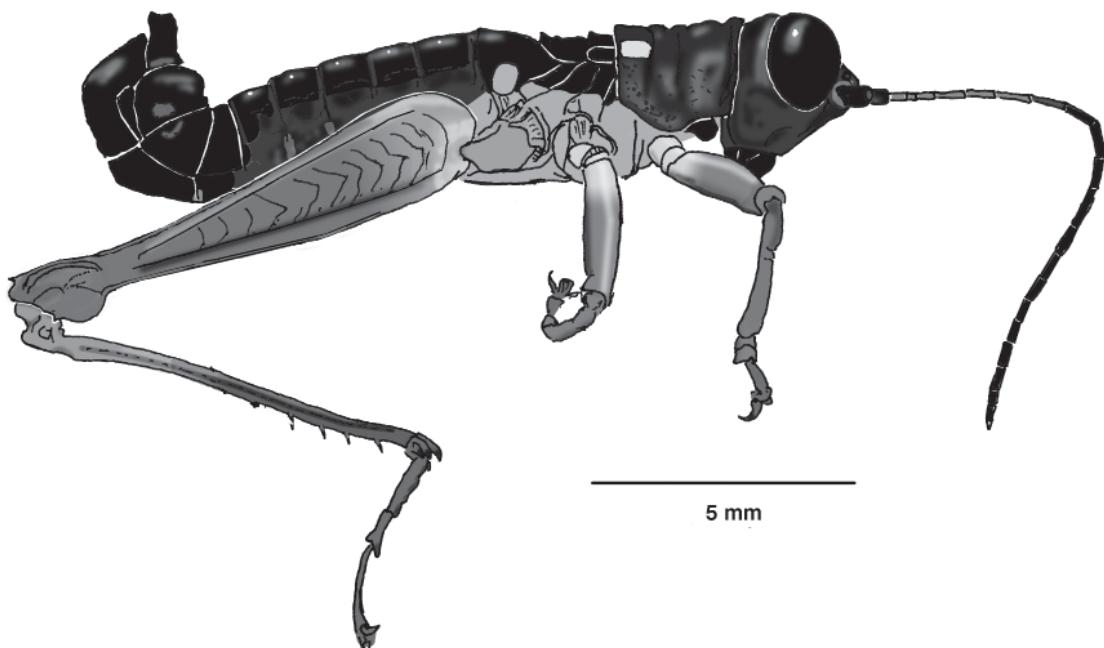


Fig. P36. *Lithoscirtus daedalus*, southern race; male habitus.

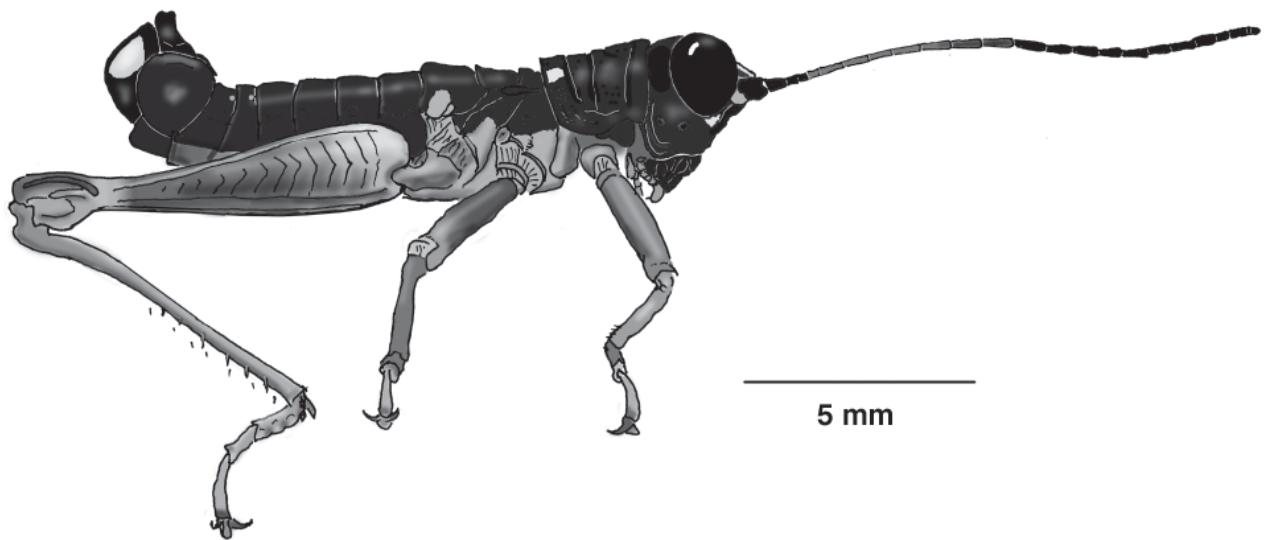


Fig. P37. *Lithoscirtus daedalus*, northern race; male habitus.

4. *Lithoscirtus tesselatus* Rowell 2000

Rowell, 2000a: 803.

Type locality: COSTA RICA: Guanacaste Prov.:Volcan Tenorio: nr summit of rd from Tierras Morenas to Bajo Los Cartagos. 1040 m.

Location of type specimen:ANS Philadelphia.

Etymology.

Latin *tesselatus*, inlaid with square mosaic stones, referring to the pattern of green and black markings.

Diagnosis.

Habitus **Fig. P39, Plate P23.** Elytron squamiform, large for the genus, reaching to anterior margin of metanotum. Wing absent. Cerci (**Fig. P34**) short, bent abruptly inwards halfway to tip at 45°; tip rounded, concavely excavated on ventral edge. Subgenital plate with a short round tubercle medially and apically, at the junction of the plate and the pallium. Furcula absent. Supra-anal plate longer than wide, ending in a blunt-tipped medial process.

Coloration. Male: antennae: scape, pedicel and first flagellar segment, glossy black; flagellar segments 2-7, pale green, 8 - 21 (tip), dull black. Eyes black (brown when dried). Palps green; mandibles, labrum and clypeus, glossy black. Rest of head basically green; inverted V on vertex, postocular stripe, ventral rim of frons, ventral and posterior rim of genae, antennal sockets, rostrum, and an hourglass-shaped mark on frontal ridge, with narrowest point ventral to the medial ocellus: glossy black.

Disc of pronotum, glossy black. A pair of dorsolateral green spots in front of each sulcus, and a pair of yellow spots behind the third sulcus, reaching the hind margin. Lateral lobes glossy black, blotched with green ventrally, proepimeron black. Mesonotum black. Elytron, black, dorsal margin green-brown. Mesonotum black with central green blotch and paired yellow spots dorsolaterally at hind margin. Meso- and meta epimera and episterna black dorsally, green ventrally.

Front and middle legs yellow proximally, shading to green by the middle of the femur, each with 4 brown tibial spines. Claws and pulvilli black. Hind femur green, hind tarsus green proximally, blue-green distally, tibial spines (7 externally, 8 internally) and spurs brown, tipped black. Tarsi green, claws and pulvillus brown, tipped black.

Abdominal segments with same pattern as metanotum, but with paired medial green marks, increasing in relative size towards the distal segments. Underside black, with a pale posterior rim to each segment. Genital region black. Supra-anal plate (**Fig. P34**) lemon yellow, bordered black, covered thinly with long white hairs. Cerci (**(Fig. P34)** mostly black but greenish proximally on outer surface. Subgenital plate (**Fig. P34**) black, with paired green spots.

Female: elytron squamiform, overlapping anterior margin of metanotum. Supra-anal plate triangular, longer than wide, tip rounded, almost as long as dorsal ovipositor valves, transversely divided, with a shallow medial depression proximally. Subgenital plate melanized in medial region, smoothly domed anteriorly, with paired patches of long hairs (in the position of the swellings of *Drymophilacris*), flat posteriorly, with a central semimembranous area, posterior edges concave, apex ("egg-guide") short, not more than half the length of the ventral valves in ventral view; lateral lobes densely hairy.

Coloration other than in antennal and genital regions as in male, but markings somewhat less clearly defined and colours less brilliant. Antennae black, terminal 2 segments white, the preceding one reddish.

Distribution.

Known only from the type locality in the Tilarán area of north-central Costa Rica. The most northerly known species of the genus.

Field characters.

At first sight looks like a small example of *Drymophilacris monteverdensis*, which has a very similar chequered black and green coloration and which occurs geographically close by. Males are however readily distinguished by the subgenital plate with its twin small green spots, that of *D. monteverdensis* being entirely pale turquoise blue. The pale proximal third of the male antenna is also distinctive; those of *D. monteverdensis* are entirely black.

Natural history.

On solanaceous plants at the edge of montane forest.

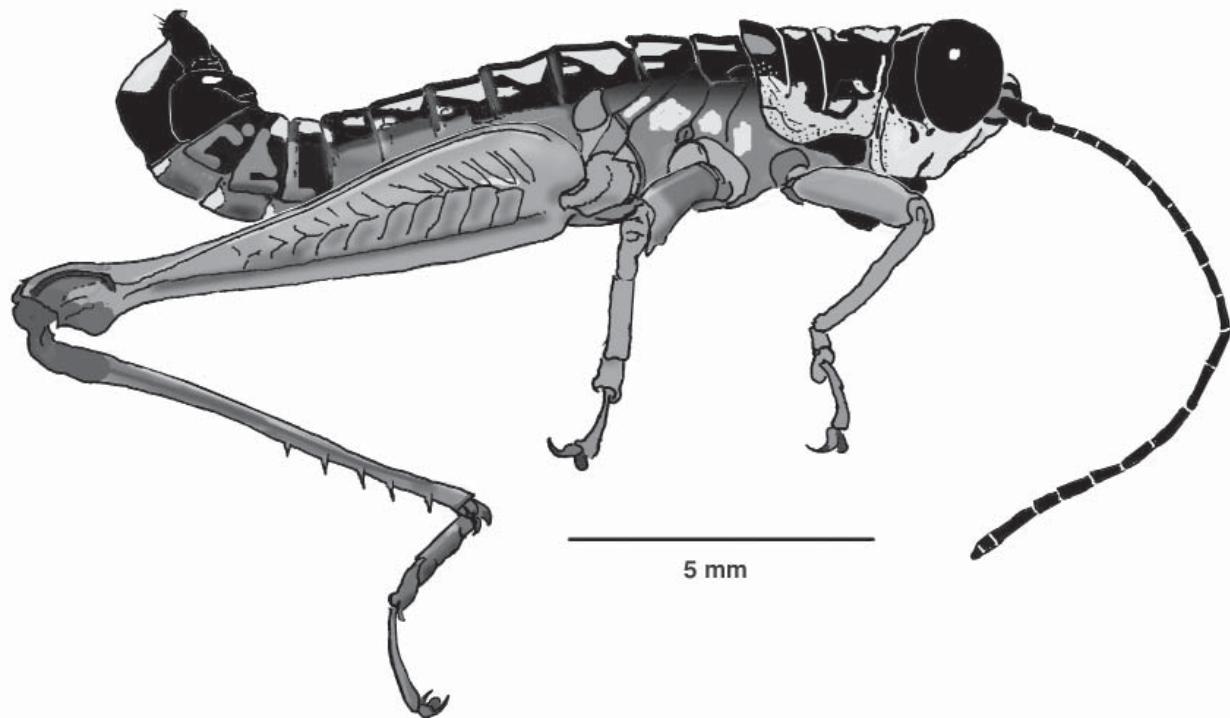


Fig. P38. *Lithoscirtus viceitas*, male habitus.

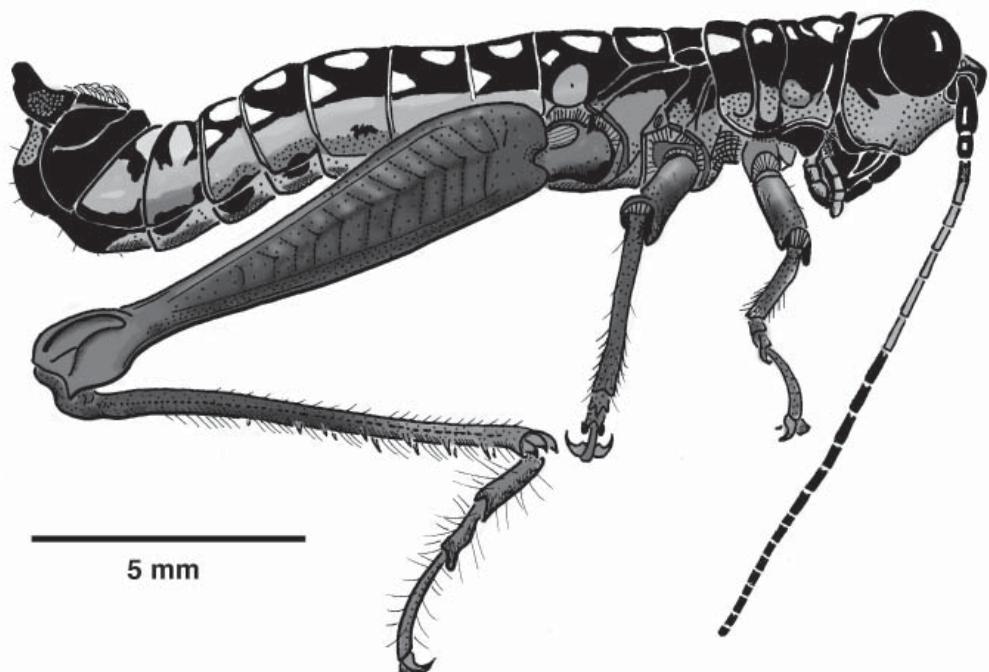


Fig. P39. *Lithoscirtus tessellatus*, male habitus.

Tribe Proctolabini

Amedegnato 1974

Subtribe Proctolabae

Amedegnato 1974

The Proctolabae make up the largest group in the subfamily, with 14 genera, but are rather poorly represented in our area, by only 5 genera. Of the remainder, *Proctolabus* is known only from Mexico and El Salvador and the rest are all South American. At least some genera are oligophagous on species of forest trees (Amedegnato 1997).

Diagnosis.

Prosternal process well developed, never virtually smooth as in most Lithoscirtae. In the male: supra-anal plate usually hairless or nearly so, and lacking a terminal or preterminal process; epiphallus with well-developed ancorae; in some genera, a tendency to develop very long and complexly shaped ventral aedeagal valves, commencing with a simple elongation in *Zosperamerus*, and progressing to increasingly bizarre forms in *Kritacris* (in part), *Poecilocloeus* and *Balachowskyacris*. In the female: the posterior margin of the subgenital plate is divided into three or four lobes, never simply pointed as in the Lithoscirtae. The ovipositor valves are usually of the unmodified, soil-laying type. Most genera and species are fully winged and flighted, though in many the wings are cycloid.

Adelotettix

Bruner 1910

Bruner 1910: 476 (Not all of the original description is actually included in this article, due to a printers' error. The missing section is printed as a footnote in Bruner 1913: 484-486).

Type species: *Abila(?) collaris* Bruner 1908: 275; 1910: 476; designated by Bruner 1911: 97.

Type locality: MEXICO: Yucatan: Valladolid. The location of holotype female was unknown to Descamp (1976) who then designated a neallotype: male from El Vergel, Chiapas, Mexico, location MNHN Paris.

Etymology.

Greek *adelos*, secret, unknown; *tettix*, cicada, conventionally used for grasshopper.

Subsequent literature.

- Amedegnato, C. 1974: 200.
- Descamps, M. 1976: 117-123. > Revision of genus.
- Descamps, M. 1980: 33.
- Amedegnato, C. & Poulain, S. 1987: 400, 413.

Synonymy.

=*Rhopsacris* Descamps & Amedegnato 1972: 550, synon.
Amedegnato 1974: 200 (in footnote).

Diagnosis.

The only member of the tribe with completely unmodified wings. A powerful flier. Elytra comfortably exceed both the tip of the abdomen and the hind knees (**Fig. P40**). Prosternal process subconical, broadly rounded at its tip; posterior margin of pronotum excurved (convex). Male supra-anal plate pentagonal; male cerci wide at their base, falciform with a rough upper margin, the tips are rodlike, melanized and slanted upwards in an almost vertical position; male subgenital plate convex and rounded at its tip (**Fig. P41**).

The species of this genus are rather difficult to distinguish, and each is known from relatively few specimens.

No. of known spp.

Nine. In our area, two.

Generic range.

Brazil, Peru, French Guiana, Colombia, Panama, Costa Rica, Mexico. Probably occurs in the intervening Central American countries as well.

I. *Adelotettix gigas* Descamps & Rowell 1978

Descamps & Rowell 1978: 367.

Type locality: COSTA RICA: Prov. Heredia: Sarapiquí, Puerto Viejo, Finca La Selva (holotype female). Allotype male: MEXICO: Veracruz: Los Tuxtlas.

Location of type specimens: MNHN Paris.

Etymology.

Greek *gigas*, giant. The largest known member of the genus.

Subsequent literature.

- Amedegnato, C. & Poulain, S. 1987: 414. > Description of allotype male.

Diagnosis.

Habitus **Fig. P40, Plate P24**. Anterior edge of pronotum forming a black collar; an additional black band runs transversely across the pronotum along the third pronotal sulcus and extends to the ventral margins of the pronotal lobes. Membrane of elytron blue-black, venation yellow-green. Hind wings blue basally, infuscate at tip and along posterior edge. Terga of second and third abdominal segments (below the wings) blue. Hind knees black, internal face of hind femur dark purple. Hind tibiae dark green, their ventral face black. Eight external hind tibial spines. Fastigium relatively short and wide, a least in females; some males have a longer, thinner version (see next species, *A. ombrophilus*, below).

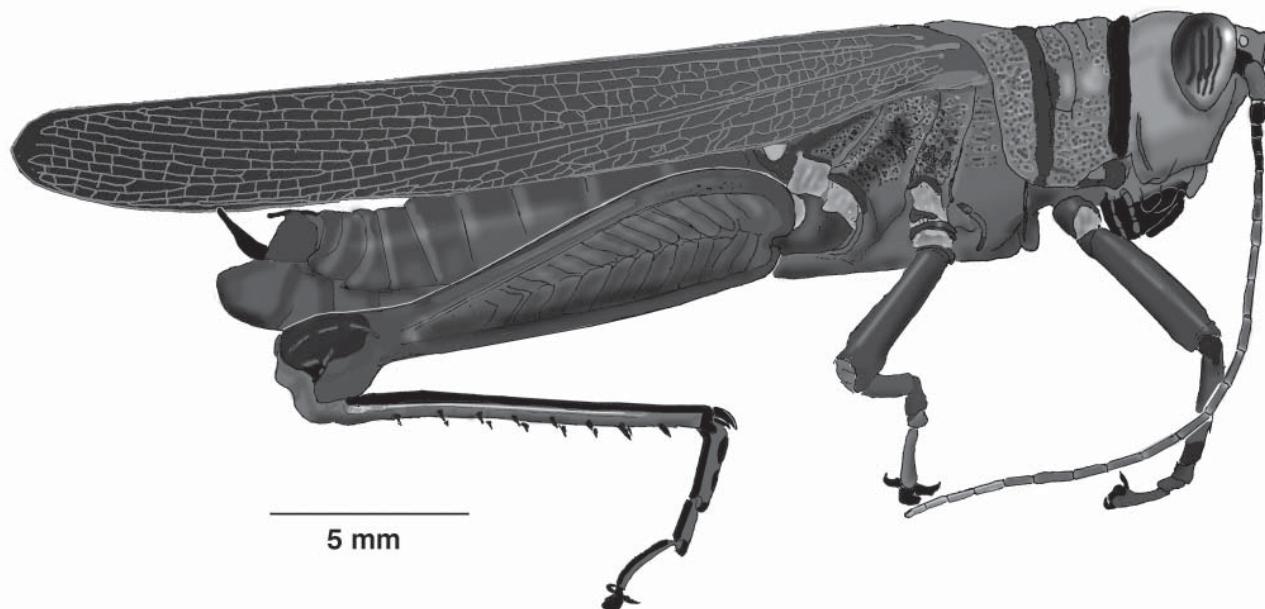


Fig. P40. *Adelotettix gigas*, male habitus.

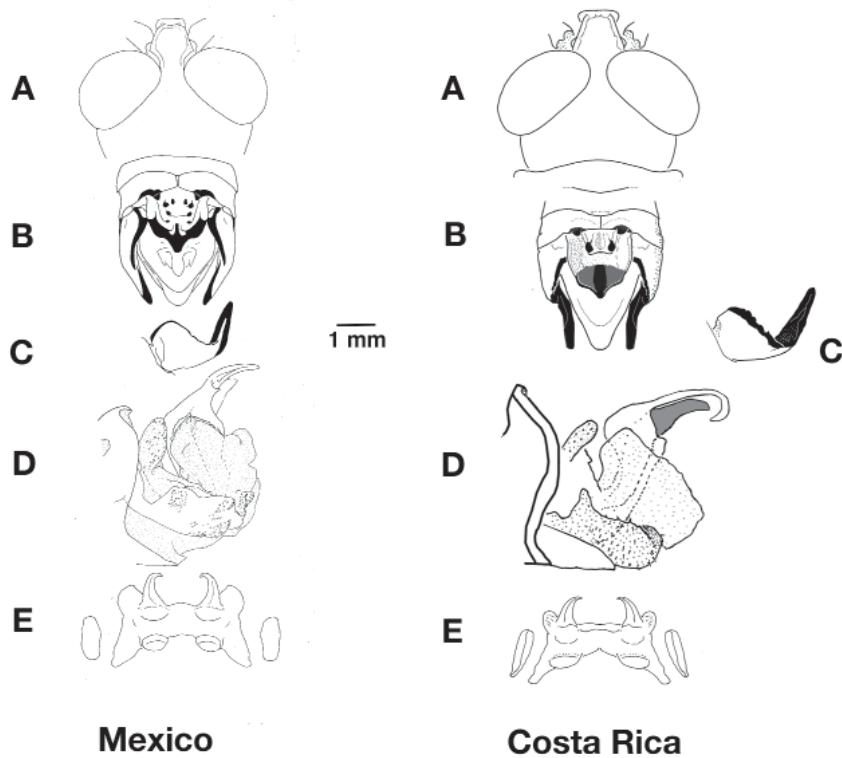
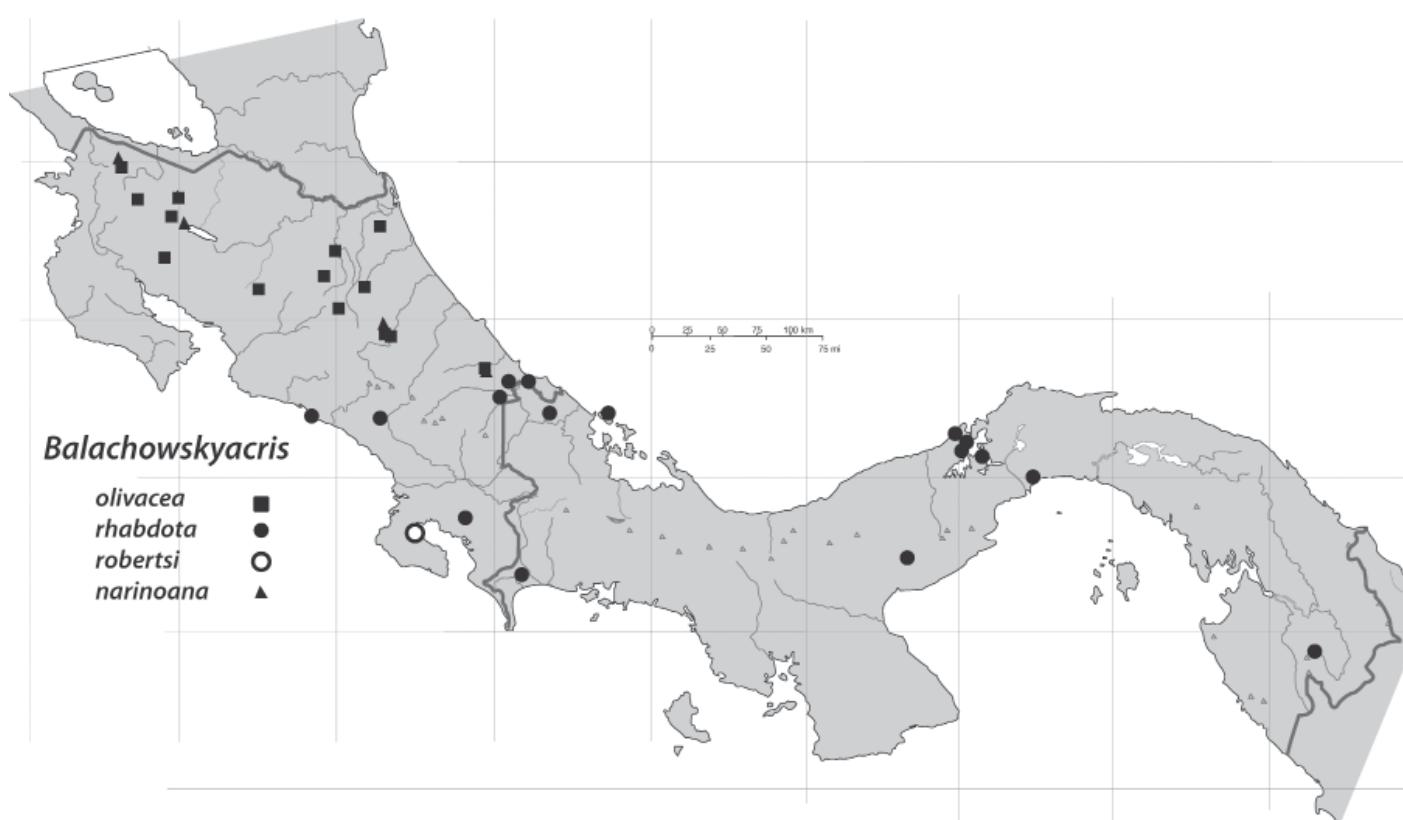
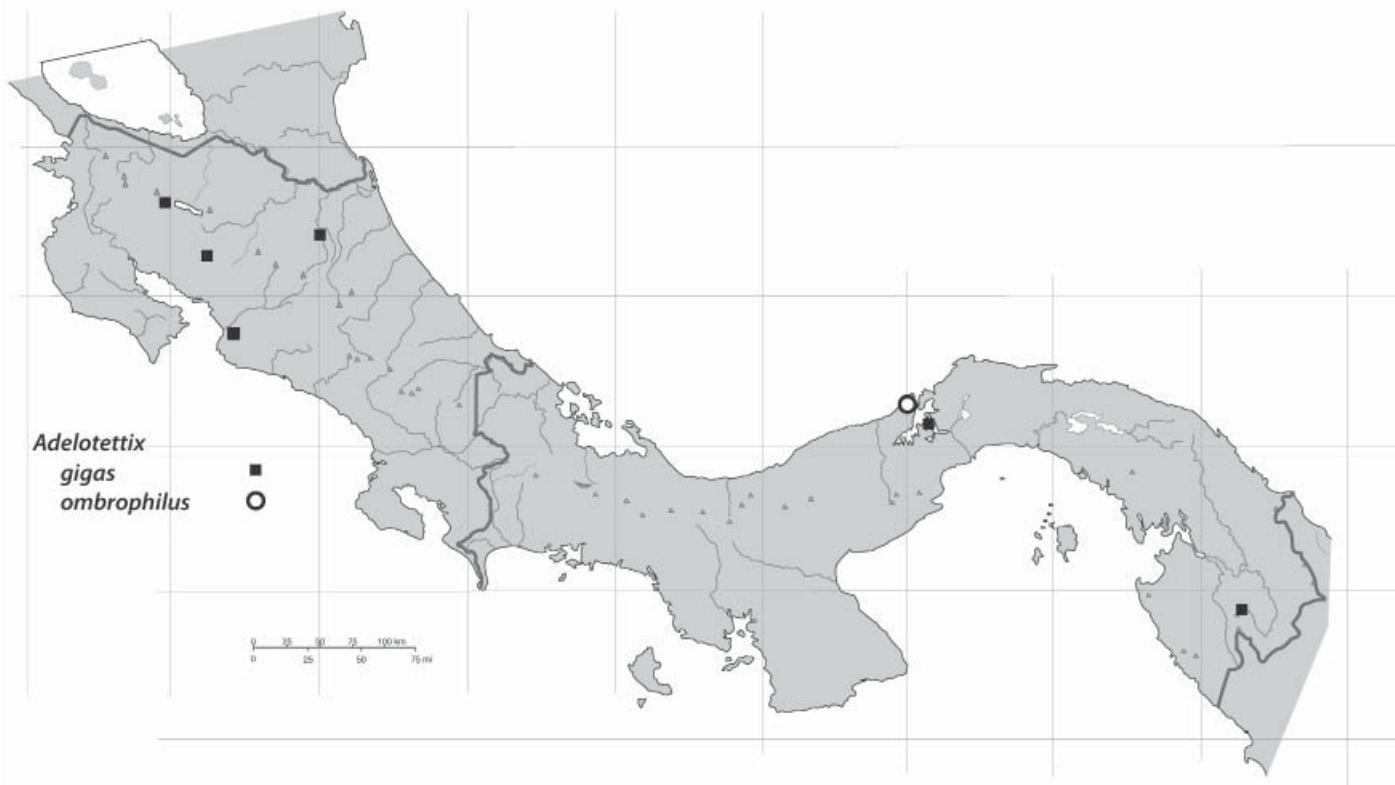


Fig. P41. *Adelotettix gigas*. Comparison between the alleged allotype male from Mexico and a male from the type locality in Costa Rica. A, head. B, terminalia, dorsal view. C, cercus, lateral view. D, aedeagus. E, epiphallus. The Mexican figures are from Amedegnato & Poulain 1987. The scale bar (1 mm) applies to Figs A, B & C from Costa Rica only.



Map P12. Distribution of *Balachowskyacris* spp. in Costa Rica and Panama.



Map P13. Distribution of *Kritacris* spp. in Costa Rica. The open triangle at Amubri has not been determined to species; it is likely to be *arboricola* or *licrophallus* from geography. The record of *arboricola* at Cañas, Guanacaste, is anomalous and may be an error.



Map P14. Distribution of *Poecilocloeus septentrionalis* in Costa Rica.

The late larva is pale green, and in the male larva the cercus is straight rather than upwardly slanted as in the adult.

The Mexican allotype male differs from males caught in Costa Rica (in e.g. the shape of the tips of the ventral aedeagal valves, the fastigium, and the ornamentation of the male supra-anal plate and cercus, see **Fig. P41**). If it is indeed conspecific, it shows that there is considerable geographical variation within the species, and it is probably in fact a different and undescribed Mexican species.

Field characters.

Readily identified by the large size (females exceed 40 mm overall length from fastigium to folded wing tip), uniform dark olive green coloration, black antennae with conspicuous orange tips, and the black bands on the pronotum.

Distribution.

Panama, Costa Rica; doubtfully Mexico. In Panama recorded to date only from Darién and the Canal Zone. In Costa Rica widely distributed in the wet forest zone, on both coasts and up to at least 1500 m. **Map P11.**

Natural history.

Unknown. Sometimes comes to light at night.

2. *Adelotettix ombrophilus* Descamps & Amedegnato 1972

Descamps & Amedegnato 1972: 552.

Type locality: COLOMBIA: Nariño: Espriella.

Location of type specimen: MNHN Paris.

Diagnosis.

Very similar to *A. gigas*, but somewhat smaller and distinguished by having a thin yellow line anterior to the dark collar on the anterior edge of the pronotum, and the fore and middle feet are ochre or reddish in colour, instead of olive green. Hind tibia reddish. The fastigium is longer and narrower than in *A. gigas*, and there are only 7 external hind tibial spines.

Distribution.

Colombia, Panama. In our area known from a single pair from Fort Sherman, Colón Province, Panama. **Map P11.**

Natural history.

Unknown.

Balachowskyacris

Descamps & Amedegnato 1972

Descamps & Amedegnato 1972: 545.

Type species: *Balachowskyacris cerciata* Descamps & Amedegnato 1972: 547.

Subsequent literature:

- Amedegnato, C. 1974: 200.
- Descamps, M. 1976: 147-153. > Revision of genus.
- Amedegnato, C. & Poulain, S. 1987: 400.

Etymology.

Named for the Parisian entomologist Alfred Balachowsky (1901-1983).

Diagnosis.

(After Descamps & Amedegnato 1972.) Insects of medium size. Integument pitted on the head and thorax. Fastigium short, sloping gently downwards, trapezoidal in shape, a little shorter than wide at its base, the dorsal face having a weak longitudinal depression, the tip bearing a well-marked transverse carina. Interocular space subequal in width to the antennal pedicel. Profile of the face receding; frontal ridge protruding between the antennae, obsolete below the medial ocellus; lateral facial carinae obtuse. Eyes large, protruding; the infraocular distance less than the width of the eye. Antennae filiform, about twice as long as the head and pronotum together, with up to 23 flagellar segments.

Pronotum: a weak medial carina is discernable on the metazona; lateral carinae absent; disc of pronotum barely convex, crossed by three sulci, the anterior margin is curved outward, overhanging the occiput, somewhat incurved in the midline; metazona shorter than the prozona, the posterior margin exurved; lateral lobes somewhat longer than wide, the lower margin sinuate. Prosternal process subtrapezoidal with a small posterior conical tubercle. Mesosternal space trapezoidal, metasternal lobes subcontiguous. Macropterous, elytra rough, with a dense reticulation, narrowing somewhat posteriorly, the tips extending a little beyond the hind knees. Femora of the fore and middle legs thick. Hind femora, thick, with smooth carinae. Seven external and eight internal tibial spines. Hind foot almost half as long as the tibia, the second tarsal segment only slightly shorter than the first.

Male: posterior margin of the last abdominal tergite with a shallow median depression, limited laterally by two small projections. Supra-anal plate subpentagonal, scarcely longer than wide, provided with bosses on its anterior part, strongly concave on its posterior part. Cerci more than twice as long as they are wide at their base, somewhat incurved, sometimes with a subapical projection on the interior margin. Subgenital plate short, strongly convex.

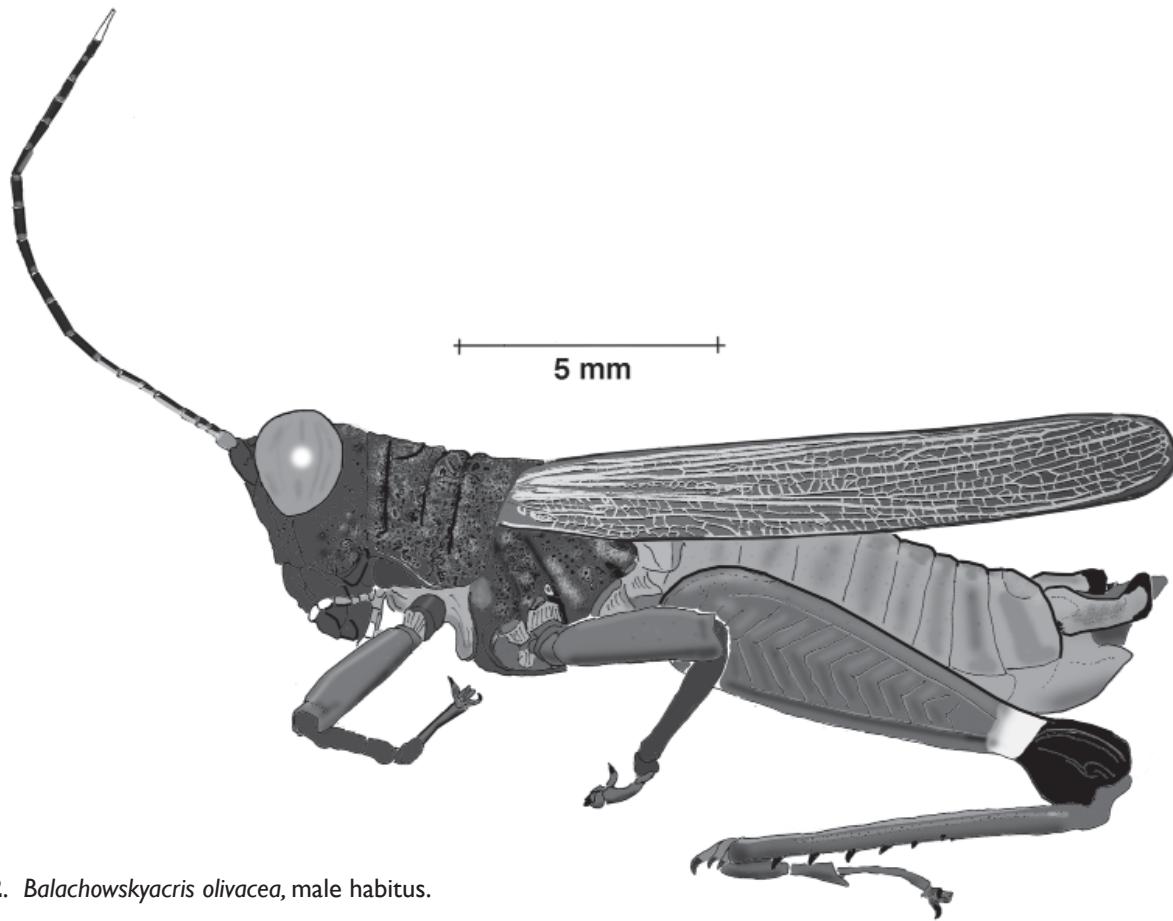


Fig. P42. *Balachowskyacris olivacea*, male habitus.

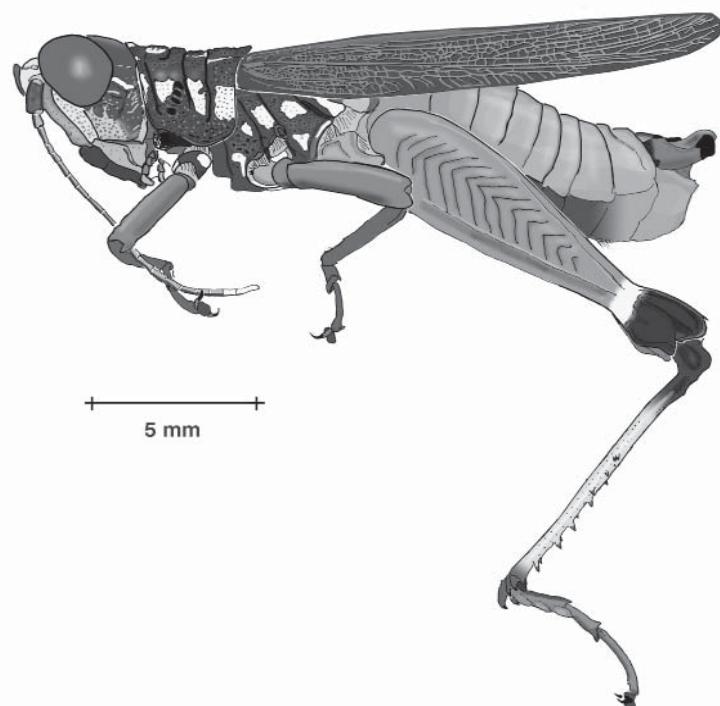


Fig. P43. *Balachowskyacris rhabdota*, male habitus.

Epiphallus with well-developed ancorae and digitiform lophi. Ectophallic membrane with a roof-like posterior sclerification joining laterally to the lateroventral sclerites, which are themselves joined to the rami of the cingulum on their internal faces.

Lateroventral sclerites strongly oblique towards the front, fused ventrally; the cingular rami are directed towards the rear, and are also fused below. Dorsal aedeagal valves complex. Ventral aedeagal valves with their basal part very enlarged; distally, they are at first thick, with an internal spine, enclosing the dorsal valves, then very fine, threadlike and spiralling apically. The sheathing pallium is large and protuberant.

Female: antennae shorter, about 1.5× head and pronotum together. Mesosternal space transverse, metasternal lobes widely separated. Wings shorter, reaching just to the ends of the hind knees. Cerci short and conical. Ovipositor valves strong; lower valves strongly curved, with smooth margins; upper valves have a rough external edge. Subgenital plate with 4 terminal lobes (plus a medial egg guide).

Very similar and closely related to the genus *Poeciloeus* (see p. 434 below). For distinguishing characters see under that genus. In general, *Balachowskyacris* species have a bar-shaped male cercus without an upwardly hooked tip, and many have coloured hind wings.

Generic range.

Ecuador; Western Colombia; Panama; Costa Rica; Nicaragua.

No. of known species.

Six. In our area, four.

1. *Balachowskyacris olivacea* (Bruner 1908)

Coscineuta olivacea Bruner 1900-1910 (1908): 274.

Type locality: NICARAGUA: Chontales.

Location of type specimen: BMNH London.

Subsequent literature

- Hebard, M. 1924: 123.
- Roberts, H.R. 1973: 64.
- Descamps, M. 1976: 151. > Transfers to *Balachowskyacris*.

Diagnosis.

Male habitus, **Fig. P42, Plate P25**. Differs from other species of the genus in having no projection on the internal face of the male cercus. The cerci are rather sharply incurved. The filamentous extremity of the inferior aedeagal valve is branched at midlength. In the female the inner pair of the lobes of the subgenital plate are short and have an irregular posterior margin.

Otherwise defined largely by differences in coloration (see below).

Field characters.

Readily identifiable by the yellow pregenicular ring on the hind femur, dove grey eye, and pink hind wings. Remainder of body dark green.

Natural history.

Apparently a specialist on the vine *Plukenetia* (Euphorbiaceae), which occurs both in light gaps and in the canopy.

Distribution.

Nicaragua and Costa Rica. In Costa Rica widely distributed in wet forest on the Caribbean slope, from the Sixaola to the San Juan, and on the volcanoes of the Cordillera del Norte. There is one record from near Cañas, near the Pacific shoreline. Not yet recorded from Panama. **Map P12.**

2. *Balachowskyacris rhabdota* (Hebard 1924)

Poecilocloeus rhabdotus Hebard 1924: 123.

Type locality: PANAMA, Canal Zone, Gatún.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Descamps, M. 1976: 153. > Transfers to *Balachowskyacris*.

Diagnosis.

Male habitus **Fig. P43, Plate P26**. Inner lobes of the female subgenital plate shorter than the outer lobes, as in *B. olivacea*, but with smooth, entire posterior margins. Coloration is distinctive (see Field Characters below).

Field characters.

Unique spotty brown and yellow appearance of the thorax, with plain brown elytra. The head, abdomen and legs are green. There is a yellow pregenicular ring before the brown hind knee. The wings are infumate grey brown. The two sexes are similarly coloured.

Distribution.

Panama and Southern Costa Rica, including both watersheds. **Map P12.**

Natural history.

In light gaps and at forest edges, otherwise unknown.

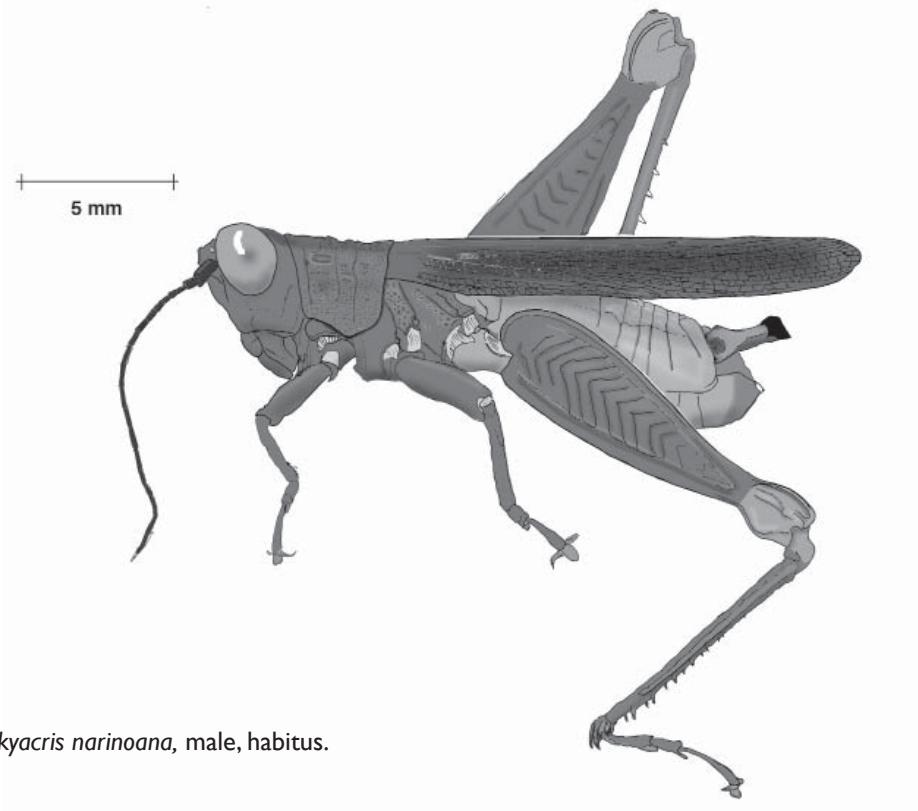


Fig. P44. *Balachowskyacris narinoana*, male, habitus.

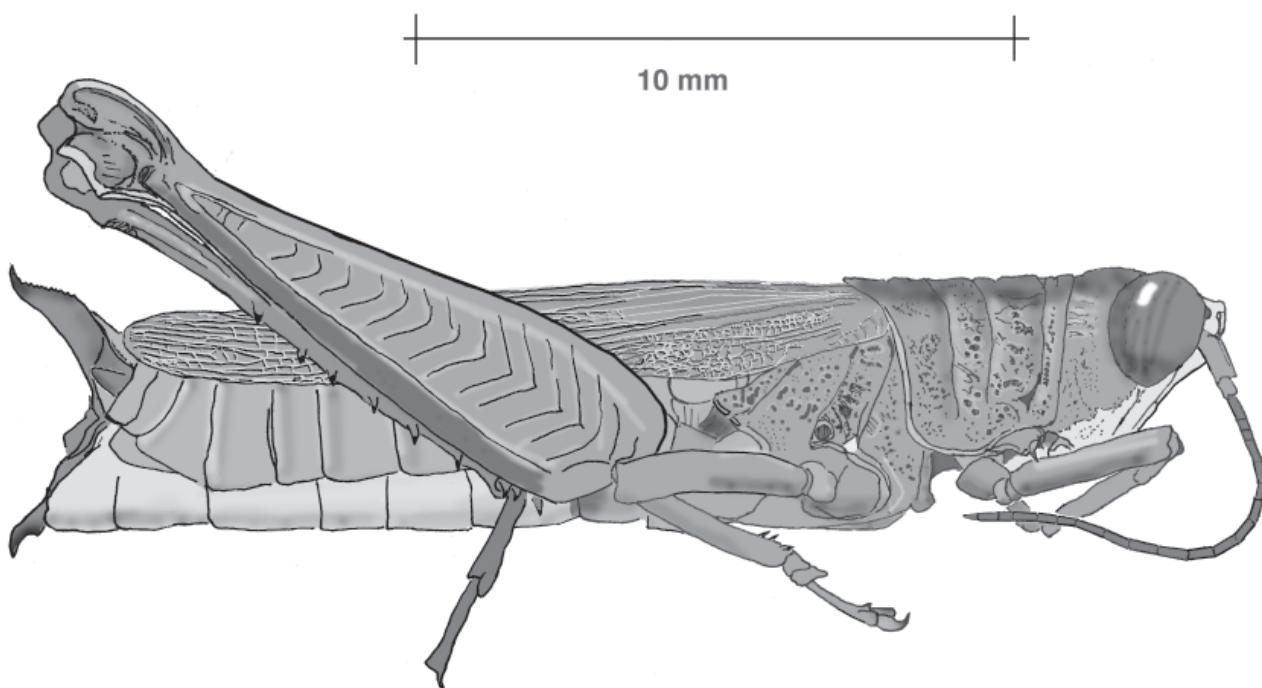


Fig. P45. *Balachowskyacris(?) robertsi*, female holotype.

3. *Balachowskyacris narinoana* Descamps & Amedegnato 1972

Descamps and Amedegnato 1972: Ann. Soc. ent. Fr. Nouvelle série 8:549.

Type locality: COLOMBIA: Prov. Narinoa: Tumaco, Espriella.

Location of type specimen: MNHN

Diagnosis.

Male habitus **Fig. P44, Plate P27.** Male cerci with sharply, almost vertically truncated tips. The tip of the supra-anal plate is flanked by two black marks. The threadlike extremity of the ventral aedeagal valve is shorter than in other species of the genus.

Note pronounced sexual dimorphism. The male is small and green, the female large and brown.

Field characters.

The female is decidedly robust, dark brown, with distinctive transversely barred hind femora, that are usually brown but sometimes olive green. The male is much more slender, dark green, with red hind tibiae, superficially resembling *Poecilocloeus septentrionalis*. Both sexes have orange hind wings.

Distribution:

Colombia; rare on the forested Caribbean slope of Costa Rica; not so far recorded from Panama, but to be expected. **Map P12.**

Natural history.

Unknown.

4. *Balachowskyacris(?) robertsi* Descamps 1976

Descamps 1976: 153.

Type locality: COSTA RICA, Prov. Puntarenas, 3-10 mi S. of Rincón de Osa.

Location of type specimen: ANS Philadelphia (holotype female).

Diagnosis.

Female habitus **Fig. P45, Plate P28.** The median lobes of the female subgenital plate are longer than the external lobes, and are smoothly rounded at their tips.

The general colour is dark green, with paler abdominal terga; the face, genae and palps are white, the antennae red, and the hind wings a dusky brown, like those of *B. rhabdotus*. Descamps (1976: 153) expressed doubts as to whether the glued-on hindleg of the type specimen actually belongs to it, though I personally see no grounds for doubt. It is green with a red tibia.

Known only from the holotype female. In the absence of a male, this species may possibly be incorrectly assigned to *Balachowskyacris*. A new genus, or another species of *Poecilocloeus*, may be represented here.

Field characters.

In form and coloration very similar to *Poecilocloeus septentrionalis*, but may be distinguished at once by the white face.

The coloration given above and in **Plate P28** is based on the present appearance of the type specimen and on the original description of Descamps, who saw it shortly after its collection. The white face he describes is now (late 2012) pale yellowish brown, due to discoloration over time.

Kritacris
Descamps 1976

Descamps 1976: 113.

Type species: *Kritacris arboricola* Descamps 1976: 115 (q.v.).

Subsequent literature.

- Amedegnato & Poulain 1987: 400.
- Rowell 2007b: 158. New species, redescription of genus

Etymology.

Obscure.

Distribution.

Costa Rica (and probably Western Panama, though not yet recorded there).

Diagnosis.

Fastigium longer than wide, especially in the males, with a raised terminal carina. Interocular space very narrow, equal to or smaller than the diameter of the antennal flagellum. Antennae filiform, and long, especially in the male, longer than head and pronotum combined. Frons in profile straight or slightly concave, receding. Eyes protuberant, globular. Prosternal process conical, blunt, mounted on a subquadrate pedestal. Mesosternal space subquadrate, wider than long. Pronotum with 4 sulci, three of which cross the midline. Medial pronotal carina present, but weak. Lateral carinae absent. Anterior margin of pronotum slightly incurved in midline. Posterior margin of pronotum entire, somewhat produced, rounded or very obtuse angulate. Elytra usually attain the base of the hind knees but do not project beyond the ends of the knees, and are covered with a heavy reticulate venation. Dorsal carina of hind femur ends in a small spine at the knee. Upper lateral lobe of knee rounded, lower lobe short and roundly pointed. Seven external hind tibial spines, 8 internal ones. Hind feet long, nearly half as long as the hind femur. Second tarsal joint of hind foot slightly longer than the first one: foot formula 28:30:42.

Male: posterior margin of 10th tergite usually with the suspicion of a small weak furcula. Male supra-anal plate (**Fig. P49**) characteristic, roughly oblong, longer than wide,

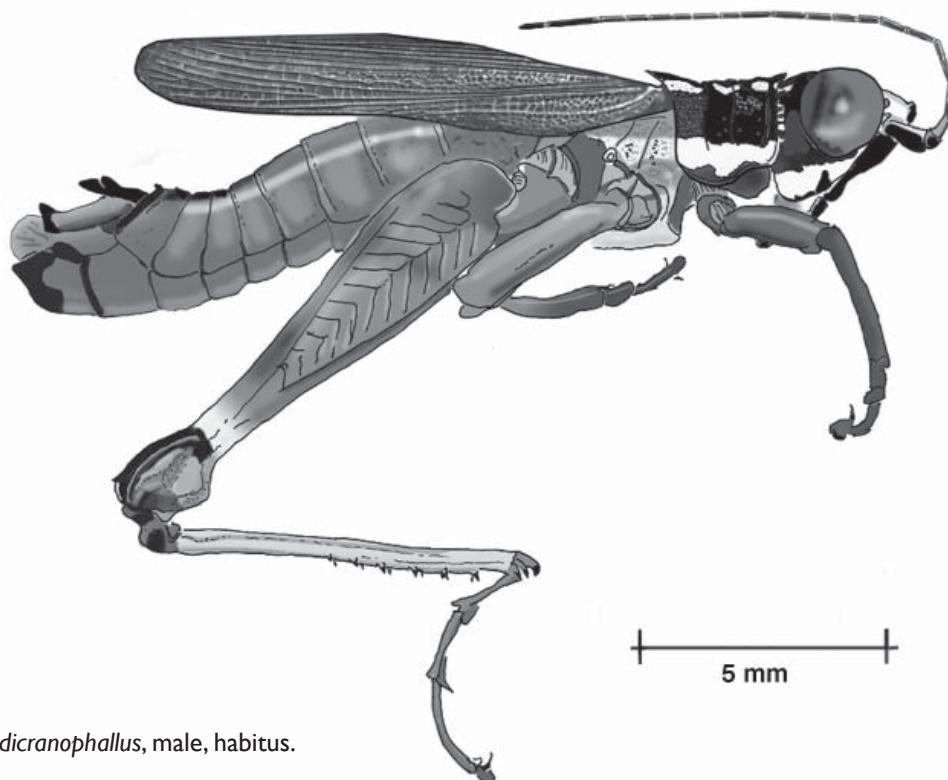


Fig. P46. *Kritacris dicranophallus*, male, habitus.

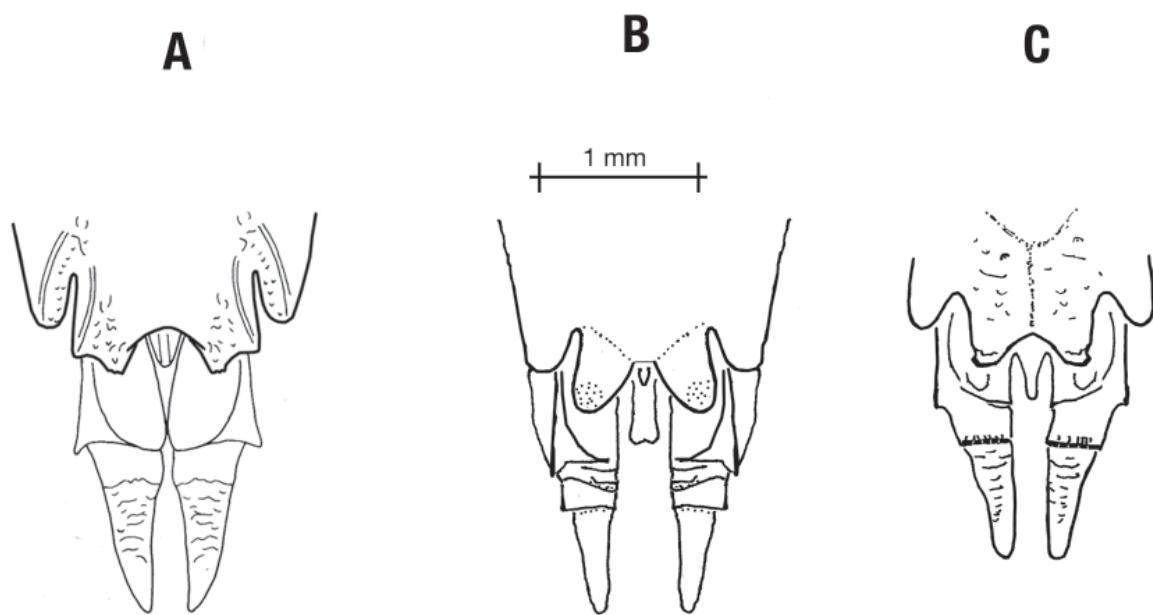


Fig. P47. Subgenital plates of female *Kritacris* spp. (from Rowell, 2007). A, *K. arboricola*. B, *K. licrophallus*. C, *K. dicranophallus*.

with a triangular distal termination. The posterior corners of the oblong are produced upward and backwards as two small hornlike structures, and most of the supra-anal plate is melanized; only the proximal medial area is light coloured, and somewhat concave (**Fig. P49iE**). Subgenital plate terminates in a pronounced triangular beak, and there are small membranous patches near the upper margin of the subgenital plate on each side. The pallium is coarse and thick and forms a cylindrical condom-like sheath containing the projecting aedeagal valves (**Fig. P49iA**). Paraprocts large, terminating in rounded cylindrical tips.

Phallic complex typical of the subtribe, with well-developed lateroventral sclerites that encircle it completely. Epiphallus bridge-shaped, with plate-like lophi and sharp curving ancorae. Cingular apodemes short and wide. Dorsal aedeagal sclerites fused into a medial valve along almost their entire length, only the very tips are free; form of valve variable. The ectophallic membrane forms two tubular membranous projections flanking the base of the dorsal aedeagal valve; similar structures are seen in other members of this subtribe, e.g. *Adelotettix* (**Fig. P38D**). Endophallic plates laterally flattened and devoid of anterior apodemes. Flexure present, slender; ventral aedeagal valves massive basally, their distal extremities simple (*K. arboricola*) or complex (*K. licrophallus*, *K. dicranophallus*).

Female: The subgenital plate is 4-lobed, the inner lobes having species-specific shapes (**Fig. P43**). Ovipositor valves strong and rather short, the upper valves with projecting

rugosities visible in lateral view, the lower ones with a pronounced subterminal diastoma. Cerci short, conical, rounded at the tip and laterally compressed. Supra-anal plate short and triangular, rounded at the tip, medially excavated at its base, and crossed by a prominent melanised transverse carina. Spermatheca characteristic of the subfamily, with a hooked terminal vesicle and long vermiform preapical diverticulum.

All species known to date have a closely similar coloration. The extent of light patterning on the mostly dark pronotum and frontal ridge differs slightly between the species (**Fig. P48**).

All three species are essentially identical in size and shape. Sexual dimorphism (M:F) of linear dimensions is about 0.85.

Field characters.

Very similar in size and shape to *Zosperamerus*, but differently coloured. The head and pronotum are marked in gold and black, and the elytra and wings are dark blue. The three known species are externally very similar, and only certainly distinguished by their phallic anatomy.

Natural history.

Kritacris is similar in its habits to *Zosperamerus*, but is found somewhat more frequently in the lower strata of the forest. Like *Zosperamerus*, it is associated with *Trema* (Ulmaceae).

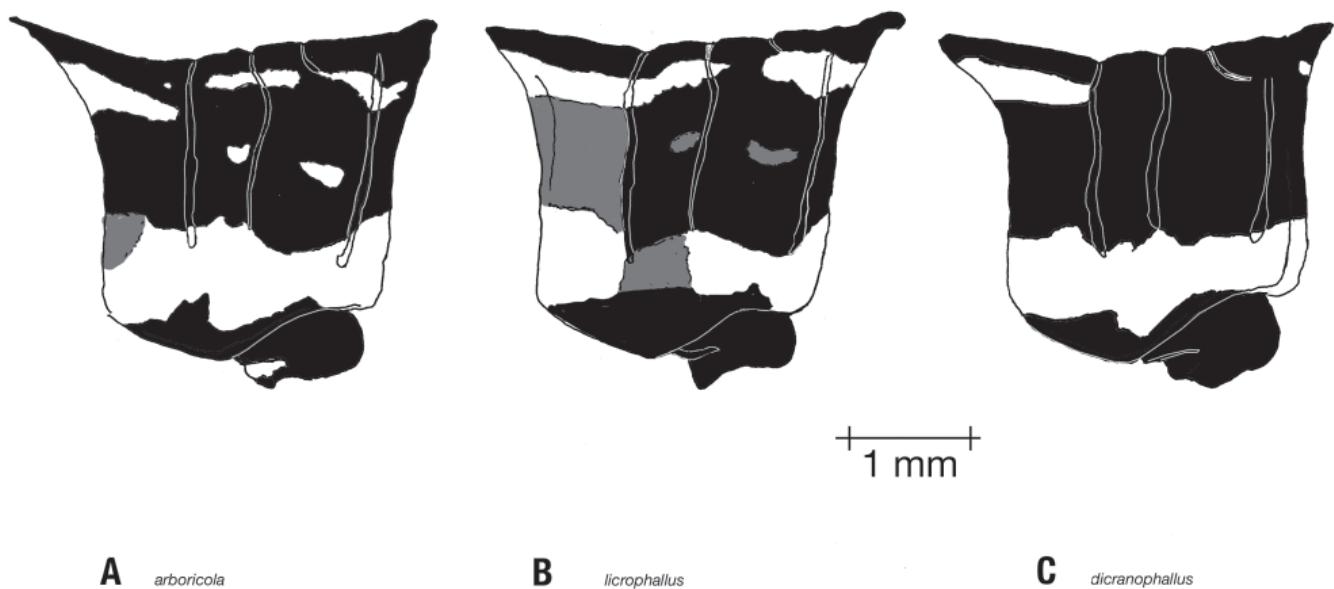


Fig. P48. Pronotal patterns of female *Kritacris* spp. (from Rowell 2007b). A, *K. arboricola*. B, *K. licrophallus*. C, *K. dicranophallus*.

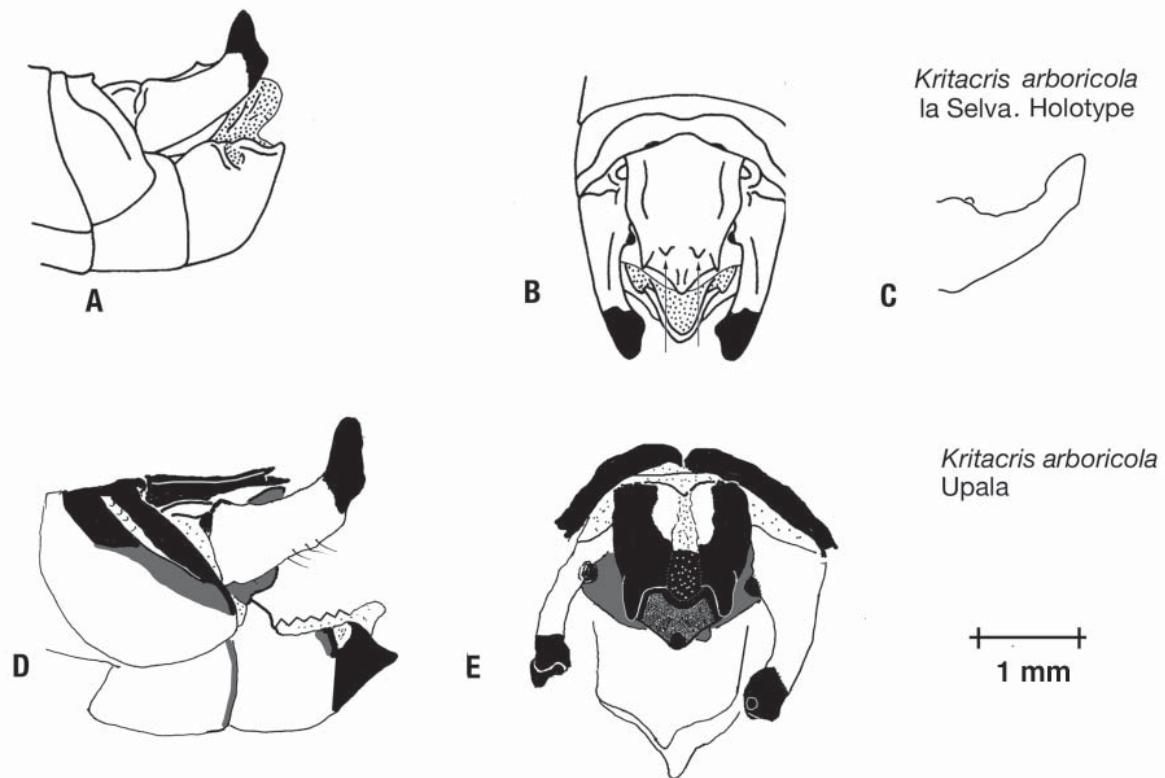


Fig. P49i. *Kritacris* spp. Male terminalia in lateral and dorsal views. A-E, *K. arboricola*. Figs A & B are from Descamps 1978, Fig 158 -159. Fig. C is from Roberts 1971, Fig.8 (same specimen as A & B). D & E are from Rowell 2007b.

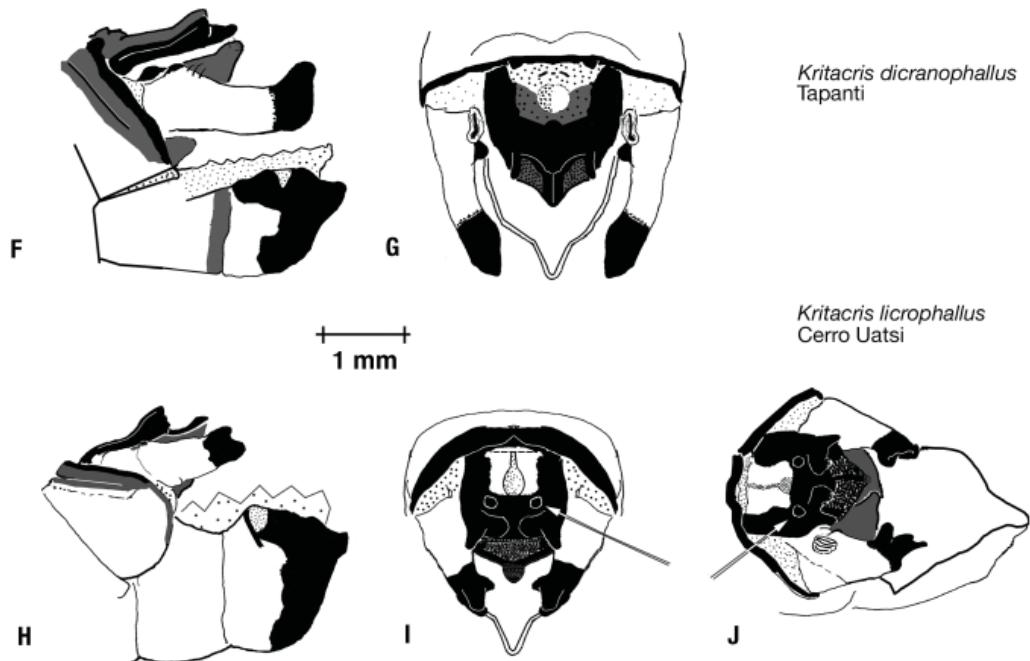


Fig. P49ii. *Kritacris* spp. Male terminalia in lateral and dorsal views (from Rowell 2007b). F-G, *K. dicranophallus*. H-J, *K. licrophallus*. Arrows in I & J mark species-characteristic projections on the supra-anal plate. J is an oblique dorsal view.

1. *Kritacris arboricola* Descamps 1976

Descamps 1976: 115.

Type locality: COSTA RICA, Prov. Heredia, Puerto Viejo, Finca La Selva.

Location of type specimen: ANS Philadelphia.

Other literature.

- Roberts, H.R. 1973: 63. > Original description of holotype male, but without providing a name.
- Descamps, M. & Rowell, C.H.F. 1984: 154. > Description of topotypic neallotype female.
- Rowell, C.H.F. 2007b: 159.

Etymology.

Latin *arbor*, tree; *cola*, inhabitant. “tree dwelling”.

Diagnosis.

The generic description applies. Distinguished from other species of the genus by the simple unbranched nature of the ventral aedeagal valve (Rowell 2007, Fig 4 I), the male terminalia (**Fig. P49i A-E**), the pronotal markings (**Fig. P48A**), and the female subgenital plate (**Fig. P47A**).

Distribution.

Known from almost the entire Caribbean slope of Costa Rica to 500 m, from Upala to the Valle de la Estrella. Not so far recorded from Panama or Nicaragua, nor from the Pacific slope forests of Costa Rica. **Map P13.**

2. *Kritacris dicranophallus* Rowell 2007

Rowell 2007b: 164

Type locality: COSTA RICA: Prov. Cartago: P.N. Tapantí.

Location of type specimen: ANS Philadelphia.

Etymology.

Greek *dikranon*, a two-pronged pitchfork, *phallos*, penis, alluding to the form of the ventral aedeagal valve.

Diagnosis.

Male habitus, **Fig P46, Plate P29**. Differs from other species of the genus in having the extreme tip of the ventral aedeagal valve bifid, with two short pointed subequal arms (Rowell 2007, Fig. 4O). Also distinguishable by the male terminalia (**Fig. P49F & G**), the female subgenital plate (**Fig. P47C**) and the reduced pronotal markings (**Fig. P48C**).

Distribution.

Known only from the type locality, in montane forest on the Eastern flanks of the Talamanca range of Costa Rica. **Map P13.**

3. *Kritacris licrophallus* Rowell 2007

Rowell 2007b: 164

Type locality: COSTA RICA: Prov. Limón: Cerro Uatsi, above Bri-brí.

Location of type specimen: ANSP.

Etymology.

Greek *likros*, antler, *phallos*, penis, alluding to the form of the ventral aedeagal valve.

Diagnosis.

Differs from other species of the genus in having the distal portion of the ventral aedeagal valve branched at its base, the ventral branch being much shorter than the dorsal one (Rowell 2007, Fig. 4 U). Also distinguishable by the male terminalia (**Fig. P49F & G**), the female subgenital plate (**Fig. P47C**), and the pronotal markings (**Fig. P48B**).

Distribution.

Known only from the valley of the Río Sixaola, S.E. Costa Rica. **Map P13.**

***Poecilocloeus*
Bruner 1910**

Bruner 1910: 11.

Type species *P. ornatus* Bruner.

Type locality: Peru.

Location of type specimen: Moscow.

- Amedegnato, C. 1974: 200.
- Descamps, M. 1976: 64, 70, 128-129. > Key.
- Descamps, M. 1980: 161. > Revision of genus.
- Mariño & Marquez. 1985: 350. > New Peruvian sp.
- Amedegnato, C. & Poulain, S. 1987: 419. > Classification, ecology, new spp., key.
- Otte, D. 1995: 450.
- Rowell, C.H.F. & Flook, P.K. 2004: 36. > Molecular phylogenetics.
- Rowell, C.H.F. 2007a.: 151-156. > New Central American sp.

Etymology.

Greek *poikilos*, varicoloured, mottled; *kloios*, collar. The type species has contrasting orange marks on the dark green pronotum, which might have inspired the name.

Diagnosis.

A rather homogenous and very speciose genus of medium-sized fully winged grasshoppers, usually of dark green

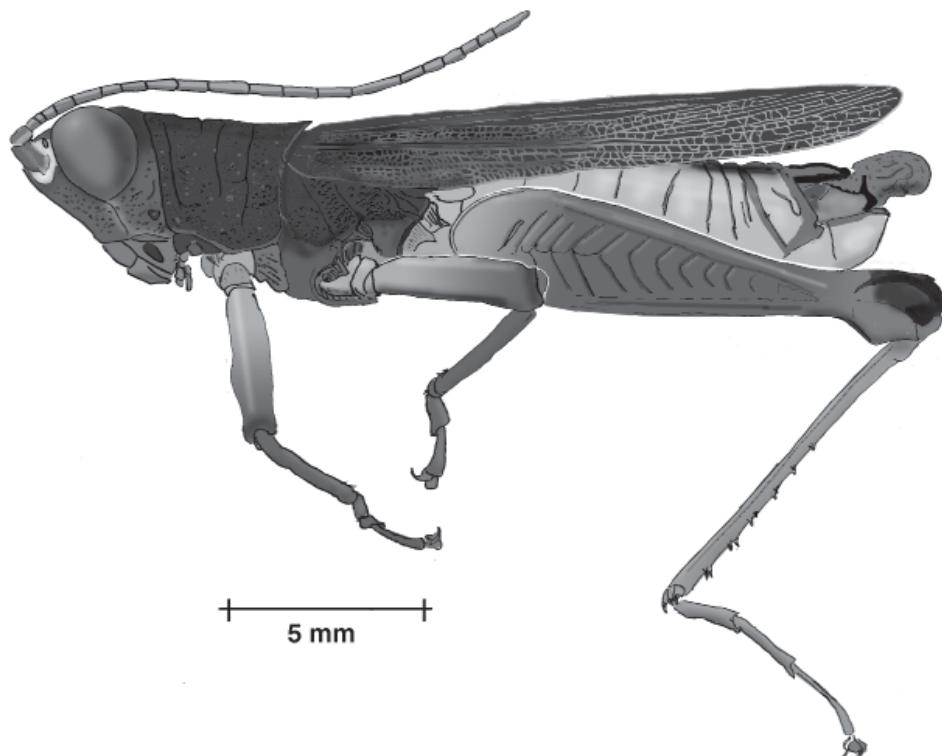


Fig. P50. *Poecilocloeus septentrionalis*, male habitus.

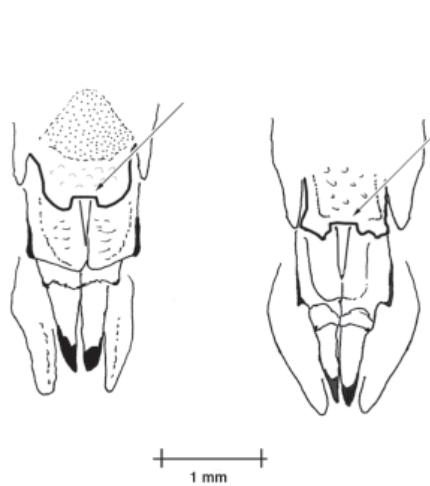


Fig. P51. *Poecilocloeus septentrionalis*, female subgenital plate in 2 different individuals. The characteristic medial oblong excision is arrowed. From Rowell 2007b.

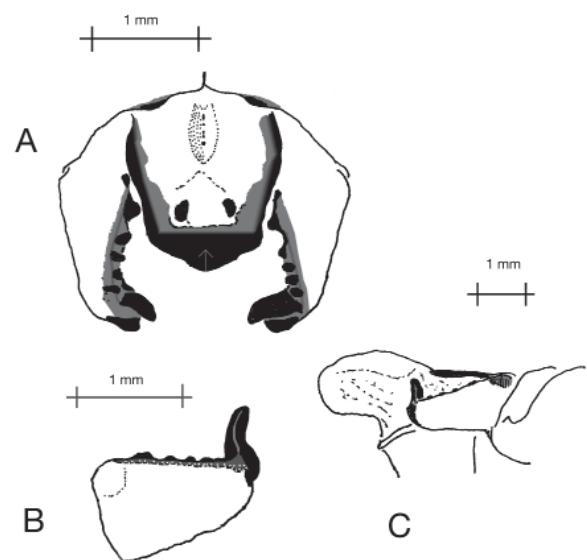


Fig. P52. *Poecilocloeus septentrionalis*, male terminalia. A, supralanal plate and cerci, dorsal view. B, cercus, lateral view. C, cercus and pallium, lateral view. From Rowell 2007b.

coloration, sometimes ornamented with yellow or orange pronotal spots and frequently having red hind tibiae and antennae. One Peruvian group of species has striking blue elytra, reminiscent of those of the closely related *Kritacris*. Male cercus almost always curved dorsally at its tip; hind wings infumate but not colored; inferior aedeagal valves very elongate, but not wrapped around the upper valve. Dorsal surface of superior valve of the ovipositor lacking a projecting inner border at its base. (These characters serve primarily to distinguish the genus from the very similar and closely related *Balachowskyacris*, q.v.; see Rowell 2007b for more details). The elongated aedeagus leads to a markedly protuberant pallium (see Fig. P50, 52C).

Number of described species.

Fifty-one, divided by Amedegnato and Poulain (1987) into nine species groups. In our area, one.

Generic range.

Brazil, Peru, Bolivia, Guyana; Costa Rica.

Natural history.

Little is known of their biology, but at least one species (*P. hamatus* Descamps, 1980) is associated with Solanaceae. The great majority of species is from Amazonia, where the genus is associated with secondary forest (Descamps 1976).

I. *Poecilocloeus septentrionalis* Rowell 2007

Rowell. 2007a 151.

Type locality: COSTA RICA: Guanacaste Prov.: Volcán Tenorio, nr Bajo Los Cartagos.

Location of type specimen: ANSP.

Etymology.

Latin *septentrionalis*, northern, referring to its outlying geographic placement relative to the other species of the genus.

Diagnosis.

Male habitus, Fig. P50, Plate P30.

Coloration. General color, dark green, tending to blackish on vertex of head. The abdominal segments are lighter in hue, as are the coxae and proximal areas of the femora of all the legs. Eyes olive brown. Clypeus, dorsal surface of antennal stipe, lower central area of prothoracic episternum, and outer surface of cercus, brownish. Hind knee brown proximally and ventrally, blackish brown dorsally. Antennal flagellum rose pink with a blackish line dorsally; hind tibiae and tarsus scarlet. Tibial spines scarlet with black tips. The dorsal surface of the terminal abdominal segments is marked with dark olive brown or black.

Female: similar to male in coloration and appearance, but of heavier build and having relatively much shorter, darker, antennae and slightly shorter hind feet. The legs of females tend to be a more uniform dark green than in the males. The posterior margin of the subgenital plate is roughly four lobed;

the internal lobes are longer, but of rather variable shape, but are always separated by a conspicuous oblong excision (arrowed in Fig. P51). Ovipositor of the normal type for this genus.

Distribution.

Known to date from only nine specimens from various forest localities on the Caribbean slope of Costa Rica, ranging from near sea level to 1000 m altitude. Map P14.

Natural history.

Nothing is known. One specimen was taken at light at night, all others were on undergrowth in primary forest.

Zosperamerus Bruner 1908

Bruner 1900-1910 (1908): 274.

Type species: *Zosperamerus zonatus* Bruner 1908: 274.

Type locality: NICARAGUA: Chontales.

Location of type specimen: BMNH London.

Kirby, W.F. 1910: 274.

Roberts, H.R. 1973: 60.

Amedegnato, C. 1974: 200.

Descamps, M. 1976: 110-113.

Amedegnato, C. & Poulain, S. 1987: 400.

Etymology.

Bruner (1908) is explicit: "As the name implies, the legs and especially the femora, are alternately pale and dark banded". Presumably he derived the name from Greek *zoster*, belt or girdle, and *meros*, *meris*: part or member. His specific name *zonatus* refers (this time in Latin) to the same feature.

Diagnosis.

(Male habitus, Fig. P53, Plate P31). Slim medium sized Proctolabines, similar in form to *Kritacris*, fully alate; elytron attains the base of the hind knee. Antennae and hind feet are long, the eyes globular and protruding. Interocular space narrow, about the width of the antennal flagellum. Frontal ridge narrow, with its margins concave between the antennae. The ridge separating the fastigium from the frontal ridge is pronounced in *Z. planus* and *Z. virgatus* (Fig. P1), less so in *Z. limonensis*. The facial carinae are well developed. The terminal segments of the palps are flattened. Prosternal process short and broadly rounded at its tip. Mesosternal space longer than broad in the male, the reverse in the female. Male supra-anal plate concave, subrectangular, rimmed in black, with a triangular tip. Male subgenital plate subglobular, short, with a marked terminal beak. Male cerci curving inwards towards the midline.

The phallic complex is distinctive, the epiphallus having robust saucer-shaped lophi, the concave surfaces facing forwards, and large incurving blade-shaped ancorae. The zygoma of the

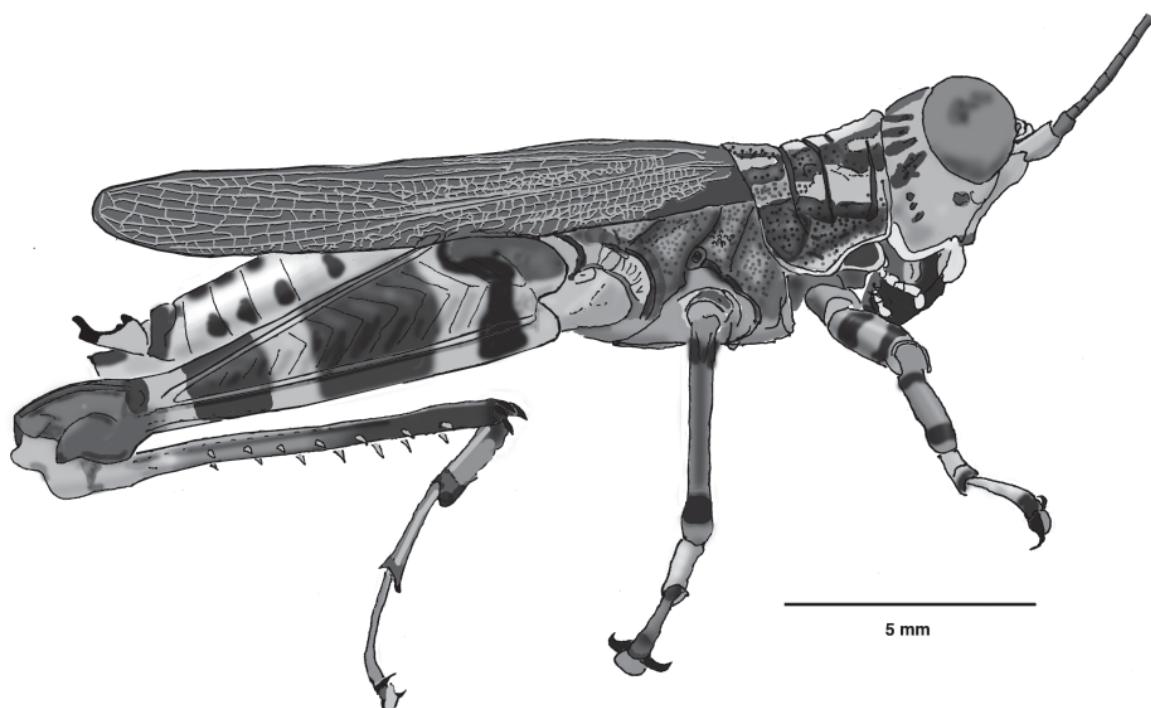


Fig. P53. *Zosperamerus virgatus* male, habitus.

Z. virgatus

Z. planus

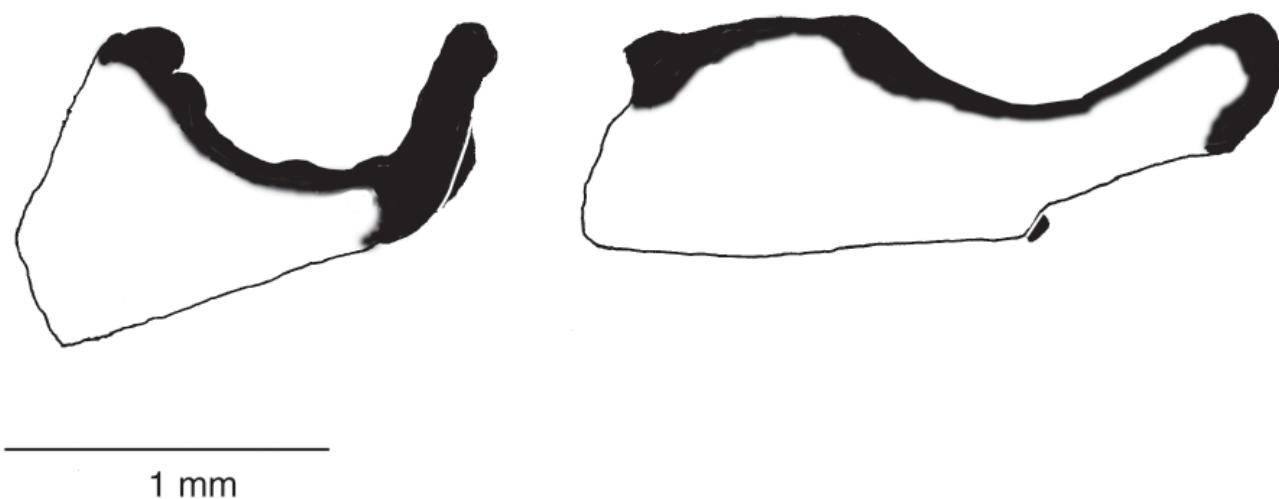


Fig. P54. *Zosperamerus* spp., male left cerci in lateral view. (The male of *Z. limonensis* is unknown).

ectophallus is produced into a downward pointing keeled beak overhanging the aedeagus. The fused upper valve of the aedeagus is short, the lower ones elongated, thin and pointed, but not produced into filaments as in *Balachowskyacris*, *Poecilocloeus* or some spp. of *Kritacris*.

Coloration. In life *Zosperamerus* spp. are brightly coloured, in shades of green and blue-black, with black and yellow markings on the pronotum; dried specimens become predominantly brown with yellowish lighter markings. As Bruner noted, the femora, especially the hind ones, are prominently banded with darker colour. The base of the hind femur is sometimes coloured reddish brown. This striking coloration occurs in all but the first instar (which have the characteristic proctolabine early larval coloration, black with orange head). Perhaps no other local genus is so badly represented by preserved specimens – these rapidly lose almost all the original colours, which is why they are usually and misleadingly described as “brown” in their formal descriptions.

No. of described species.

Seven. Of these, *Z. albopictus* Bruner, 1910 (from Peru) is actually not a *Zosperamerus*, according to Descamps 1976:111, but its true genus is uncertain; similarly, *Z. vittatus* Bruner 1922 (from Bolivia) is thought by Descamps (1976) to be a misplaced ommatolampine. *Z. colombiae* Descamps 1976 comes from Nariño. As the male of the type species, the Nicaraguan *Z. zonatipes*, is unknown, it is impossible to say whether or not one of the other Central American species is its synonym, though this is very probable, as already noted by Roberts (1973).

The remaining 3 spp. (*Z. virgatus*, *planus* and *limonensis*) are all found in our area.

Generic range.

Nicaragua; Costa Rica; Panama; Colombia. They may well extend further north in Central America. Panamanian specimens of the genus have come from the Central and Eastern parts of the country, especially the Canal Zone and Darién. **Map P15.**

Natural history.

Zosperamerus species are fully winged canopy insects, which are rather rarely caught at ground level, and then it is normally the egg-laying females which are found. Males are rarely taken, which greatly hampers the systematics of the genus, though they are sometimes taken at light, by insecticide fogging of the canopy, or by tree climbing. The species of this genus are often associated with the tree *Trema*, the leaves of which they also eat, but it is not yet known how specialised they truly are.

Of our 3 very similar species, *Z. limonensis* is easily recognizable by its size, much bigger than the other two species. These latter, however, are only separable by the male cerci (**Fig. P54**); the females are to date indistinguishable.

Key to species of *Zosperamerus*.

- | | |
|----|---|
| I | Medium sized insects ($L_{\text{female}} = 26 \text{ mm}$). Hind tibiae predominantly rose pink.
..... <i>limonensis</i> Descamps & Rowell.
(Male unknown). |
| IA | Smaller insects ($L_{\text{female}} = 21 \text{ mm}$, $L_{\text{male}} = 18 \text{ mm}$). Hind tibiae suffused blackish or dark green. 2 |
| 2 | (See Fig. P54 .) Male cercus with an elongate spatulate tip.
..... <i>planus</i> Roberts |
| 2A | Male cercus with a rod like tip, sharply inflected upwards.
..... <i>virgatus</i> Roberts |

I. *Zosperamerus planus* Roberts 1973

Roberts 1973: 61.

Type locality: COSTA RICA, Prov. Puntarenas, 9 km S. of Rincón de Osa.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Bruner, L. 1908: 274.
- Kirby, W.F. 1910: 424.
- Descamps, M. 1976: 112.

Etymology.

Latin *planus*, flat. Refers to the shape of the distal part of the male cercus.

Diagnosis.

Extremely similar to *Z. virgatus* (**Fig. P53, Plate P31**), only the males can be reliably distinguished (by the form of the cerci). Cerci laterally flattened, very wide at the base, narrower distally. The dorsal and terminal edges of the cercus are melanized. The tip is straight and spatulate in side view, embayed on its lower margin and slightly curved inwards towards the midline, and there is a small internal point on the ventral inner surface (**Fig. P54**). Supra-anal plate roughly rectangular, rounded distally, somewhat pointed at the tip, with a black border. Paraprocts large and pointed, protruding slightly in the midline behind the edge of the supra-anal plate. Rim of male subgenital plate produced into a small beak in the dorsal midline. Two small melanized thickenings on the posterior margin of the male 10th tergite are probably homologous with a furcula. Elytron extending to the base of the hind knee, its membrane blueish grey, overlaid by a dense reticulum of veins which are yellow green in life, but reddish brown in dried specimens. Hind wings cycloid, pale blue, with infumate margins. Base of hind femur reddish dorsally on outer face. Antennae dark brown, with a lighter tip. For other details of coloration, see generic diagnosis.

Distribution.

Costa Rica and Panama. Has been found almost wherever there is wet forest in Costa Rica, from north to south and on both Pacific and Atlantic slopes, up to 700 m. This appears to be the commonest species of the genus in Costa Rica, and the only male of the genus so far recorded from Panama also belongs to it. **Map P15.**

Natural history.

Little known. A canopy resident, associated with the tree *Trema*. Females appear to oviposit in the ground, as the ovipositor valves are frequently clogged with earth. Males occasionally come to light.

2. *Zosperamerus virgatus* Roberts 1973

Roberts 1973: 61.

Type locality: COSTA RICA, Prov. Puntarenas, 8 km S. of Rincón de Osa.

Location of type specimen: ANS Philadelphia.

Subsequent literature.

- Descamps, M. 1976: 112. > Specific name misspelt as *variegatus*.

Etymology.

Latin *virga*, rod or branch, hence *virgatus*, rod-like. Refers to the shape of the distal part of the male cercus (**Fig. P54**).

Diagnosis.

(**Fig. P48**). Male habitus, **Fig. P53, Plate P31**.

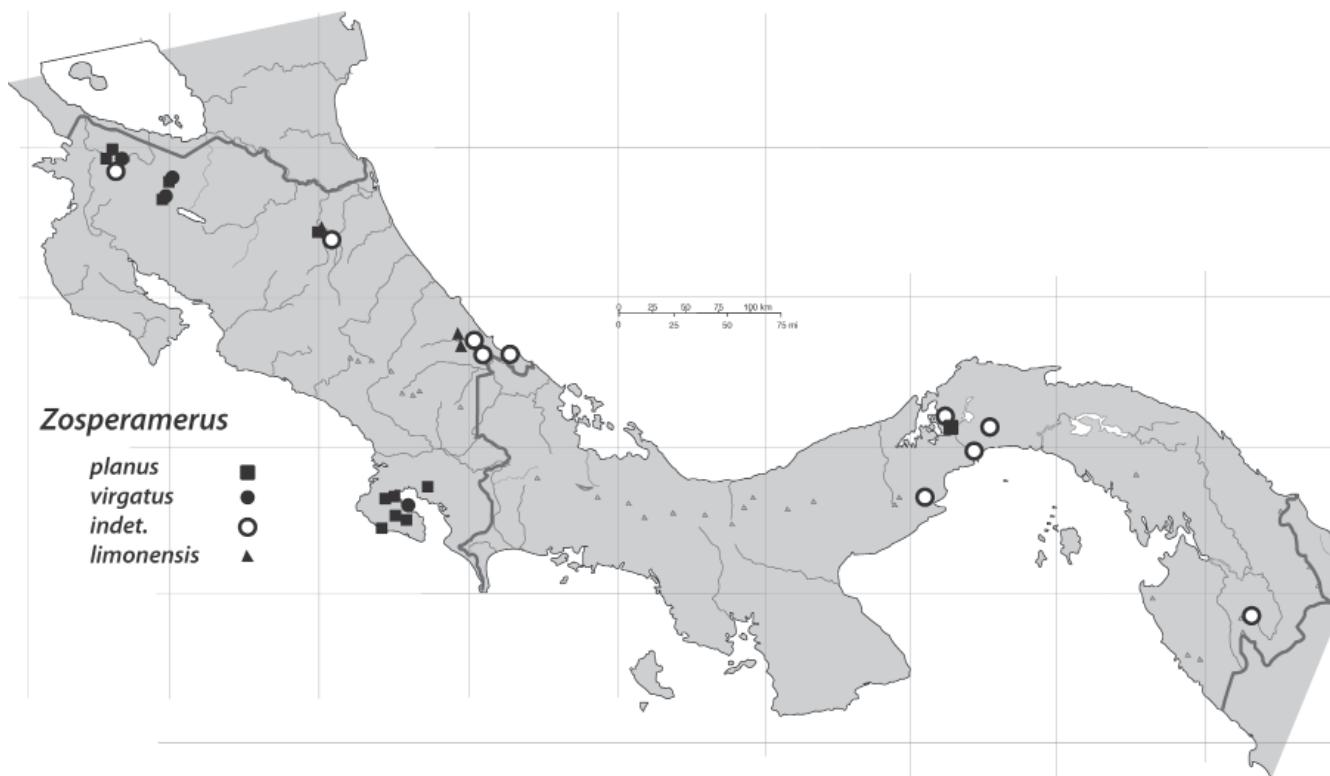
Extremely similar to *Z. planus*, only the males can be reliably distinguished (by the form of the cerci). Cerci wide at base, narrowing to a fine rodlike (hence specific name) terminal process, which is curved inwards and upwards (**Fig. P54**).

Distribution.

Known with certainty (i.e. from adult male specimens) only from Costa Rica; the Osa Peninsula, the lower Sarapiquí valley, and from the Cordillera del Norte in Guanacaste. These localities, however, delimit opposite extremes of the wet forest zone in Costa Rica, so the species probably occurs throughout this zone. Apparently sympatric with *Z. planus* over all of this range. Not so far recorded with certainty from Panama. **Map P15.**

Natural history.

Little known. No ecological separation from *Z. planus* is obvious..



Map P15. Distribution of *Zosperamerus* spp. in Costa Rica and Panama. Open circles indicate female specimens of either *planus* or *virgatus*, which cannot be distinguished.

3. *Zosperamerus limonensis* Descamps & Rowell 1984

Descamps & Rowell 1984: 157.

Type locality: COSTA RICA: Prov. Limón, Valle de Estrella, Progresso, Finca Cantón.

Location of type specimen (female holotype): MNHN Paris. Male unknown.

Etymology.

Name derived from the type locality.

Diagnosis.

Very large size for the genus (F female = 15 mm, in other species less than 12 mm). The valves of the ovipositor are relatively shorter and deeper in lateral view than in the other species, and the ventral valves are more slender in ventral view. The hind tibiae are pink, like the tarsi, and not blue or black, as in our other two local species.

Field characters.

Very large size for the genus, but with the typical *Zosperamerus* coloration and shape.

Distribution.

To date known from only three Costa Rican female specimens, two from the Valle de la Estrella, one other from Sarapiquí. This suggests a wide distribution over the Caribbean slope of Costa Rica. Apparently very uncommon, at least at ground level.

(Nomen nudum)**"*Proctolabus pulchripennis*" Rehn 1908**

Rehn 1908b: 396).

In his description of the Peruvian *Proctolabus bullatus* (now *Poecilocloeus bullatus*) Rehn (1908) refers to "the Costa Rican *Proctolabus pulchripennis*". No taxon of this name has been published, however, and no species of *Proctolabus* (a Mexican and Salvadorian genus as now understood) has ever been recorded from our region. Rehn's subsequent works do not mention this name again. Note that at the time of Rehn's writing, the known members of what are now *Poecilocloeus* and *Balachowskyacris* were assigned to *Proctolabus*, a genus that has since been greatly restricted. It is unlikely that Rehn meant the Costa Rican *Poecilocloeus septentrionalis*, as this does not have "pretty (i.e. coloured?) wings", *pulchripennis*. A Costa Rican *Balachowskyacris* sp. with coloured wings would be a more probable candidate. In his first collecting trip to Costa Rica (in 1903) Rehn almost certainly encountered *B. olivacea*, common in the region he visited, and may well have intended to describe it under this name, but was forestalled by Bruner's 1908 description.

Subfamily Rhytidochrotinae Brunner von Wattenwyl 1893

Last globally reviewed by Descamps & Amedegnato (1972b), the small Neotropical group Rhytidochrotae (Brunner von Wattenwyl 1893) was elevated to subfamily status by Amedegnato (1975). It currently includes 20 genera and 46 species (Descamps & Amedegnato 1972b; Descamps & Rowell 1978, 1984; Rowell 1995; Rowell & Bentos-Pereira 2005). (*Loepacris*, until recently considered a member of this subfamily, has now been transferred to the Ommatolampinae Aspidophymini (Amedegnato & Poulin 1998).

The greatest number of genera and species is found in Colombia. With a few exceptions (*Paropaon*, *Lathacris* and *Oedalacris*, that all live in lowland forest), the rhytidochrotines are insects of montane forest (roughly 1000 m to 2500 m in altitude) and are patchily distributed. They are often brilliantly coloured, especially the males, sometimes in unusual shades of red, orange or even bright blue. Most are small in size, but a few, including the Panamanian *Piezops*, are quite large (females up to 40 mm long). Some genera (*Exerythracris*, *Hylopedetes*, *Rhytidochrota*) are behaviourally specialised to eat ferns (Rowell et al. 1984; Schmidt, pers. comm.), and all that have been studied seem to be at least oligophagous, on ferns, Asteraceae, Urticaceae or Piperaceae.

Diagnosis.

The formal morphological characteristics of the subfamily were listed by Descamps & Amedegnato (1972b) and Amedegnato (1977). All genera but one (*Driphilacris* Descamps & Amedegnato, 1972a, from S. America) are completely apterous, and in our region (though not in S. America) most are also atympanate. In our region the antennae are always filiform, except in *Piezops*, which has long and wide ensiform antennae. The fastigium is subtriangular, typically inclined forward and downwards, its end not clearly separated from the frontal ridge. The frontal ridge itself is usually absent or indistinct ventral to the medial ocellus. Lateral carinae of the face (suborbital ridges) absent or subobsolete. Eyes protuberant, especially in males, little elongated. Interocular space narrow, but usually as wide as or wider than the antennal scape (but narrower in *Liparacris*, *Exerythracris*, *Brakeracris* and *Hylopedetes*). Occiput vaulted. The pronotum is characteristically very short, exposing the entire meso- and metanota, and is traversed dorsally by three sulci; the first of these is short with its ends curved anteriorly, almost joining a further sulcus that runs just behind the anterior margin of pronotum, but which is obsolete dorsally (*Lathacris* Descamps & Amedegnato, 1972a, has only 2 transverse sulci). Dorsolateral area between the 2nd and 3rd sulci often but not always inflated into a prominent bulge, often bearing a matte-surfaced oval depression. Males have a "furcula" (a notched and usually toothed posterior margin of the 10th abdominal tergite). The male supra-anal plate is sometimes decorated with

black ornamentation, which if present is often genus-specific in form. Similar pronota and furculae are however seen in several Ommatolampine genera, e.g. *Thamnacris* Descamps & Amedegnato, 1972a.

The male genitalia are characteristic and very homogenous; the aedeagus is extremely short and completely sheathed, with reduced inferior sclerites and very short or obsolete superior ones, which arise from a massive arch sclerite. The only part of the male genitalia that is at all useful in distinguishing genera is the epiphallus (especially the shape and orientation of the lophi).

Similarly, the female spermathecae are all very homogenous. The receptaculum seminalis is without a well-defined copulatory bursa; instead the duct of the spermatheca is merely somewhat widened at its base, its opening into the genital chamber usually reinforced by a V-shaped or semicircular sclerite. A preapical diverticulum is present, typically short or of medium size. Apical diverticulum little or not at all recurved towards the exterior. The ventral ovipositor valves are typically slender distally and along their dorsal edge and lie largely between the dorsal valves. In the Central American genera both lower and upper valves are prominently toothed on their outer edges. Female rhytidochrotines tend to be fusiform in shape, males are characteristically much smaller and more slender.

Of all the groups of grasshoppers treated in this book, the rhytidochrotines are those in which specific identification can be most successfully approached by considering the colour pattern, much as one would for butterflies. This is partly a consequence of their characteristically bright and varied patterning, but also of the relative homogeneity of their morphology, which does not provide as many differentiating characters as it does in most other groups.

Systematic positions.

It is formally very difficult to distinguish the Rhytidochrotinae from some of Ommatolampinae (e.g. from the tribe Aspidophymini) and their separation has not been demonstrated cladistically. It seems likely that the two are closely related.

Distribution.

To date, rhytidochrotines are known only from the northern half of South America and from the southern part of Central America (specifically, from Brasil to Costa Rica). The first rhytidochrotine genera described from Central America were *Piezops* Hebard, 1923 (erected for *Rhytidochrota ensicornis* Stål 1878 from Panama) and *Hylopedetes* Rehn, 1929 from central Costa Rica. *Scirtopaon* and *Micropaon*, also from Costa Rica, were added by Descamps & Rowell (1984). Since then three new genera have been described from the uplands of Costa Rica (Rowell 1995), and a further new genus from Panama, where the originally Colombian genus *Oedalacris* and the originally Costa Rican genus *Hylopedetes* have also both been recognized

recently (Rowell & Bentos-Pereira 2005). No rhytidochrotines have yet been described from countries north of Costa Rica, but it seems quite likely that they may in fact occur, e.g. on the mountains of Nicaragua.

Alphabetic list of genera present in our area.

1. *Brakeracris* Rowell 1995
2. *Chiriquacris* Rowell & Bentos-Pereira 2005
3. *Exythracris* Rowell 1995
4. *Hylopedetes* Rehn 1929
5. *Micropaon* Descamps & Rowell 1984
6. *Oedalacris* Descamps & Amedegnato 1972
7. *Piezops* Hebard 1923
8. *Scirtopaon* Descamps & Rowell 1984
9. *Talamancacris* Rowell 1995

Brakeracris

Rowell 1995

Type species: *Brakeracris varablanensis* Rowell 1995, by original designation.

No. of described species.

One.

Etymology.

Named for Dr. H.E. Braker, the first collector.

Diagnosis.

Male: Habitus **Fig. Rh1, Plate Rh1**. Size small to medium. Integument polished except on head, the integument of which is matte. Dorsal surfaces of occiput, pro-, meso- and metanota and 1st abdominal tergum heavily pitted. Legs, frons and remaining abdominal segments smooth. Integument with numerous white hairs, especially on hind tibiae, genital area and distal underside of abdomen, but also sparsely on the dorsal surface.

Fastigium subhorizontal, triangular, bearing a pair of prominent longitudinal ridges proximally, truncate anteriorly, distally grooved, the groove reaching the anterior margin of fastigium. Frontal ridge slightly narrower ($0.8\times$) than interocular space, straight and almost parallel sided, slightly tapering ventrally, irregularly pitted in midline, ending above medial ocellus. Medial and ventral arms of subantennal suture short and deeply incised, dorsal arms thin and curved. Frons concave, upper part of frontal ridge forming a blunt rostrum. Preocular ridges well marked. Eyes globose. Interocular space narrower ($0.7\times$) than maximum width of antennal pedicel. Antennae of medium length ($3.57\times$ length of pronotum), slightly flattened dorsoventrally and rather thick, 17 segments in flagellum of adult.

Thorax. Medial carina present on pronotum anterior to 1st sulcus and posterior to 3rd sulcus, but absent between 1st - 2nd and 2nd - 3rd sulci. Dorsolateral projections present between 2nd and 3rd sulci, but less well developed than in some other genera of the subfamily, e.g. *Exythracris* or *Talamancacris*. Posterior ventral angle of lateral lobe of pronotum rounded, posterior margin of pronotum slightly concave. Anterior ventral angle of lateral lobe with a small anteriorly directed projection. Posterior margins of pronotum slightly concave in midline, anterior margin straight or slightly notched. Prosternal process short, abruptly conical, vertical. Medial carina absent on meso- and metanotum. Apterous.

Hind femur relatively long, 4.1 - 4.2× as long as pronotum. Dorsal carina of femur minutely toothed proximally, smooth distally, ending in a spine which is shorter than lateral lobes of knee. Ventral carina smooth, lateral carinulae absent or very slight, outer face of hind femur rounded. Seven non-terminal spines on the dorsal external margin of hind tibia, 8 on the dorsal internal. Hind foot long, 0.34× as long as femur; 3rd

tarsal segment relatively short, 1.26× as long as 1st and 2nd tarsal segments together.

Tympanum absent. Medial carina absent from 1st abdominal segment, present on 2nd-6th segments. Posterior margin of last abdominal tergite with a central notch and short lateral sclerotised teeth. Supra-anal plate triangular, without sclerotised melanic markings, with a short longitudinal medial furrow at its base. Cerci short, conical, simple. Subgenital plate bluntly pointed in lateral view, terminating in a short medial furrow in dorsal view. Internal genitalia of the usual type for subfamily.

Female. The female is so far known only from several last instar larvae. Comparison of these with similarly aged larvae of other rhytidochrotine genera for which the female is known indicates that the adult female is likely to be of conventional form for the group, larger and more fusiform than the male.

Systematic position.

Brakeracris seems to be related to the Costa Rican *Scirtopaon* (**Fig. Rh15**). It shares with this genus the presence of a weak medial carina on the anterior and posterior sections of the pronotum and also on the posterior abdominal segments; it shares the slight anterior projection of the anterior ventral angle of the pronotum and the size and shape of the terminal spine of the hind knee). It differs from *Scirtopaon* as follows: frontal ridge with subparallel margins, and not with a double constriction as in *Scirtopaon*; medial and ventral antennal sutures strongly excavated (medial and dorsal in *Scirtopaon*); shorter and thicker antennae; more prominent rostrum; differs in the detail of the rugosities of the pronotum; in the less well-developed teeth of the furcula; in the shape of the lophi – in *Scirtopaon* these have a prominent lateral ridge which is absent in *Brakeracris*, and are not tilted caudally as in *Brakeracris*. *B. varablancensis* shows no extreme values in the morphometric ratios, but has a rather larger rostrum than most other taxa and the relatively thickest antennae of all rhytidochrotines other than *Talamancacris*.

I. Brakeracris varablancensis Rowell 1995

Rowell 1995: 566.

Type locality: COSTA RICA: Prov. Heredia, 3 km. E. of S. Rafael de Vara Blanca, 1800-2100 m.

Location of type specimen: ANSP.

Etymology.

Named for the type locality.

No. described species.

One.

Diagnosis.

(See habitus: **Fig. RhI, Plate RhI**) Most readily recognized by its distinctive coloration. A small, predominantly green and black insect with bright yellow markings and green legs. Antennae black; eyes, black; palps, green; suborbital band on frons and genae, yellow; remainder of head, black. Pronotum black with a striking yellow border all around its periphery; thoracic and abdominal tergites olive green with yellow markings. Metathoracic episternum yellow. Posterior margin of metanotum with 1 - 2 yellow marks. Terga of abdominal segments 1 - 8 each bear a pair of yellow chevrons in the midline and paired yellow spots laterally. Legs dark green, hind knee reddish brown, 3rd tarsal segments largely black.

Distribution, natural history.

B. varablancensis is known to date only from around S. Rafael de Vara Blanca, on the northern scarp of the Cordillera Central of Costa Rica, in the headwaters of the Río Sarapiquí, altitude 1900 to 2200 m. In March 1986 it was found commonly in regenerating scrub at the forest edge above the farmhouse (now situated in the Parque Nacional Braulio-Carrillo) and also on landslip areas bordering two stream beds traversing dense montane wet forest 1 - 2 km north of the farmhouse. Most individuals seen were mid or late larval instars; only two adult males were found, and no adult females, despite intensive search. There was no obvious association between *B. varablancensis* and any particular plant species. In captivity it nibbled at a variety of plants from the habitat, but ate well from none of those tested, which included several species of ferns. In the same localities were found the acridids *Drymacris nebulicola* (Proctolabinae) on Solanaceous plants and *Silvitettix communis* (Gomphocerinae) on grasses.

Intensive search of the same areas under fine weather conditions in July 1991 produced only a single 3rd instar larva and no adults. This may indicate marked seasonality, or might be due to the extensive vegetational change, corresponding to 5 years of secondary succession. This larva ate various *Senecio* spp. from other parts of Costa Rica in the following days, suggesting that *B. varablancensis*, like its relative *Talamancacris palustris* (see below), may prefer Asteraceae.

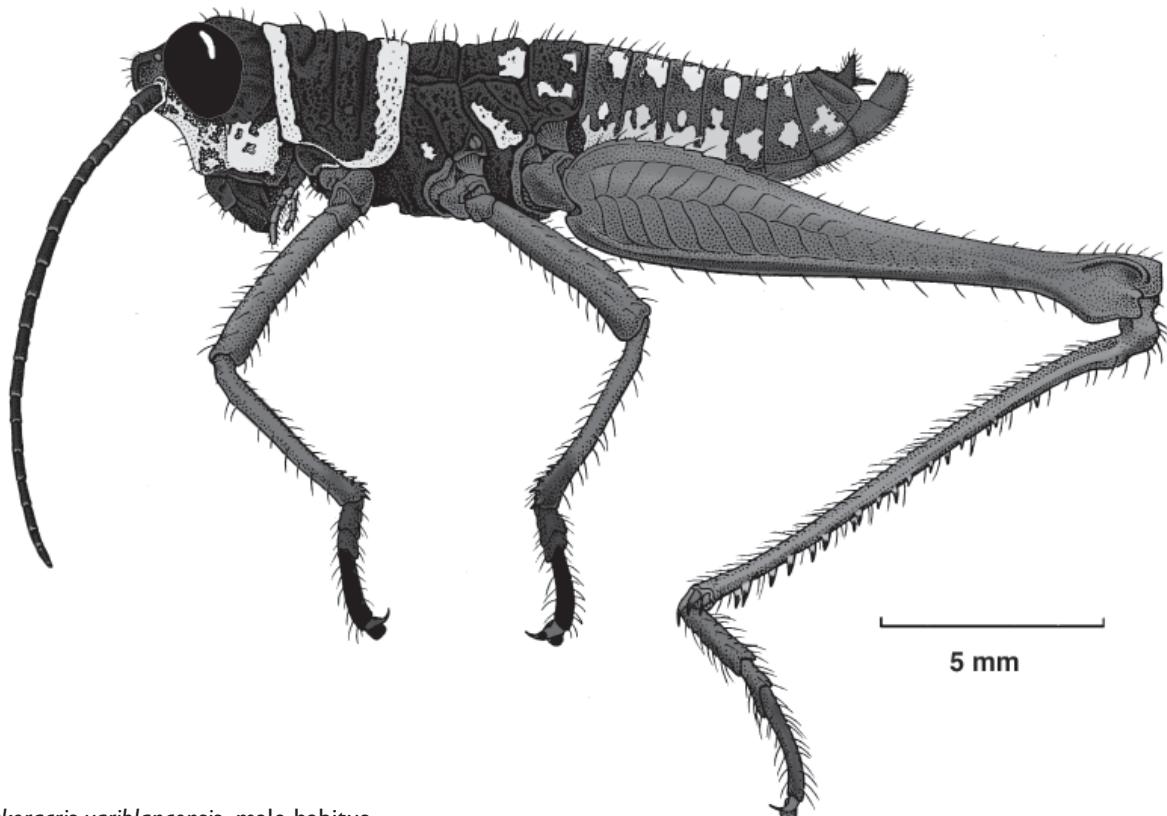


Fig. Rh1. *Brakeracris variblancensis*, male habitus.



Map Rh1. *Brakeracris variblancensis*.

Chiriquacris
Rowell & Bentos-Pereira 2005

Type species: *Chiriquacris quadrimaculata* Rowell & Bentos-Pereira 2005.

Etymology.

Derived from the town of Chiriquí Grande, relatively near to the type locality.

Diagnosis.

As a monospecific genus, the specific diagnosis applies.

At first sight this genus evokes the Costa Rican *Brakeracris*, (Rowell 1995) to which it may be nearly related. It resembles that genus in having 6-7 external and 8-9 internal tibial spines, a markedly concave frons and a pitted cuticle, but it lacks the medial carinae on the pronotum and the lateral projections between pronotal sulci 2 and 3. The adult female is much larger than expected of *Brakeracris* and the female supra-anal plate is of a different form, with a long thin lingulate tip. The antennae are not at all flattened. For further characters, see the species description below.

No. of described species.

One.

I. *Chiriquacris quadrimaculata* Rowell & Bentos-Pereira 2005

Rowell & Bentos-Pereira 2005:75.

Type locality: PANAMA: Bocas del Toro: Quebrada Felix, 1.5 km E of summit of road to Chiriquí Grande, 940 m.

Location of type specimen: ANSP.

Etymology.

Latin *quadrimaculata*, four spotted, referring to the pale yellow markings on abdominal terga 2 and 3.

Diagnosis.

Male: (**Fig. Rh2. Plate Rh2**) small, body length 15 mm. Apterous and atympanate. Cuticle weakly pitted on dorsal surfaces. Eyes globular and protruding, forming widest point of body. Fastigium triangular, with a shallow medial groove, truncate at tip in dorsal view, slanting downward and forward. Frons markedly concave, end of rostrum blunt in lateral view. Frontal ridge parallel sided, flat, obsolete below medial ocellus.

Antenna filiform, with 15 flagellar segments. Pronotum devoid of medial or lateral carinae. Three sulci cross its dorsal midline. No dorsolateral processes between sulci 2 and 3. Posterior margin of pronotal disc slightly incised medially, anterior margin somewhat excurved medially, anterior angle of pronotal lobe obtusely angular, posterior angle rounded. Prosternal process conical, pointed, vertical or inclined slightly forward. Mesosternal interspace narrow, transverse,

metasternal interspace longitudinal, narrow, almost closed. Cerci short, conical and straight; in lateral view wide at the base, narrowing abruptly at half length to the tip. Supra-anal plate triangular, weakly divided transversely at half-length, the proximal half with a medial depression, tip acutely pointed. Furcula small, consisting of two closely spaced obtuse triangular points. Male SGP short, conical, rounded at tip. Hind femora nearly twice as long as abdomen. Dorsal carina of hind femur with a few hair-bearing irregularities basally, smooth distally, terminating in a small spine at the knee. Six external tibial spines, eight or nine internal ones. The hind foot is 35% as long as the hind femur, the foot formula is 28:15:57.

Coloration: Antennae black, head and eyes, black.

Lower frons and genae, shining white; mouthparts, pale greenish blue. Dorsal surface of fastigium with two indistinct yellow streaks, which darken and disappear in dried specimens. Thorax, abdomen and legs green, tinged with olive brown on the pronotum. One pair large pale yellow spots on notum of 2nd abdominal segment and a smaller, less distinct pair on that of the 3rd abdominal. Distal third of hind femur, hind knee, proximal half of hind tibia, blackish blue. Proximal part of hind femur with prominent herring-bone pattern in blackish blue-green on both outer and inner faces. Distal extremities of fore and middle femora and tibiae, blackish blue. Feet and tibiae, blue.

Female: fusiform in shape and much larger than the male (body length 25 mm, 1.65× that of male). Similar to male, but eyes less prominent, body widest in first segment of abdomen, and the abdomen is more than 2/3 as long as the hind femora. Coloration as in male, but sides of abdominal pleura 2,3 and 4, below the dorsal pale spots, glossy black.

Cuticle of thorax and abdominal dorsa heavily pitted, the floor of the pits being of a darker green colour than the rest of the cuticle. Ovipositor valves robust, with serrated outer margins. Posterior margins of subgenital plate triangular, the edges concavely incurved, egg guide short and upcurved, not extending dorsally beyond the upper surface of the lower valves. Supra-anal plate triangular, weakly divided transversely at half-length, the proximal half with a strong medial depression, the distal half narrow, lingulate, tip obtusely pointed. Cerci short, conical, bluntly pointed. Hind femur with 6 or 7 external spines and 9 internal ones.

Field characters.

Among several similarly sized green and black taxa, all sympatric at this locality (*Hylopedetes nigrithorax*, *H. fuliginosus*, *Drymophilacris nigrescens*), *Chiriquacris* can readily be distinguished by the combination of its shining white lower face and the 4 yellow spots on the abdominal terga.

Distribution.

Known only from a few localities near the summit (ca. 900 m) of the road from Gualada and Fortuna to Chiriquí Grande. All are on the Caribbean side of the watershed.

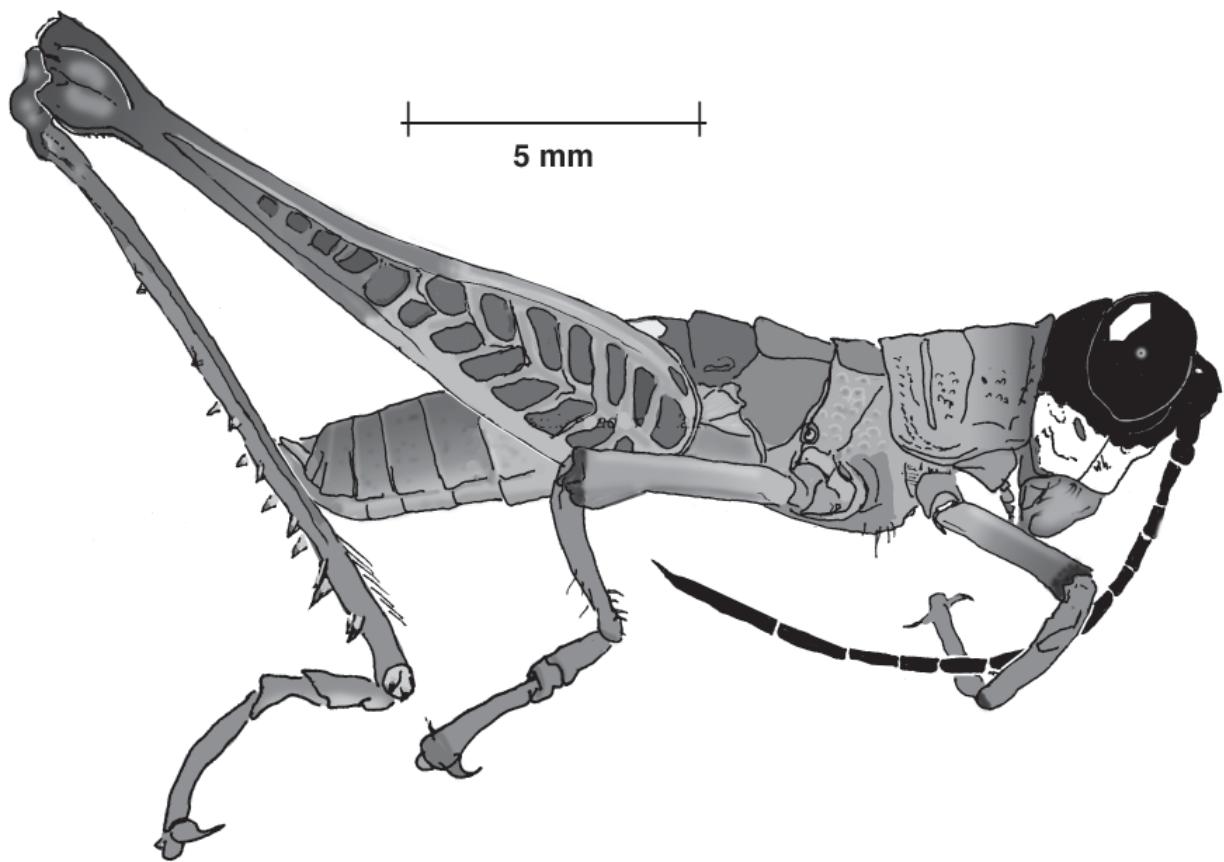


Fig. Rh2. *Chiriquacris quadrimaculatus*. Male habitus.



Map Rh2. *Chiriquacris quadrimaculatus*.

Natural history.

This species has been found only rarely, in forest-edge situations on a variety of plants, including ferns. Its normal food plant is unknown.

The reasons for the remarkable convergence in appearance of *Chiriquacris* to unrelated sympatric species at the type locality is unknown. None of them is known to be distasteful or belongs to a chemically protected clade, making mimicry an unlikely explanation.

Exerythracris Rowell 1995

Type species: *Exerythracris volcanica* Rowell 1995: 559.

Location of type specimen: ANSP.

Etymology.

Greek "everythros", very red, referring to the coloration of the type species.

No. of described species.

One.

Male: (Fig. Rh3, Plate Rh3). Size small-medium ($10\text{mm} < \text{body length} < 20\text{ mm}$). General form cylindrical, slender, long legged. Integument polished; dorsal surfaces of thorax, occiput, hind femora, and to a lesser extent of abdomen, heavily pitted.

Morphology. Fastigium steeply inclined forwards, tapering, bearing a pair of low longitudinal ridges proximally, distally shallowly grooved medially, the groove not reaching the anterior margin of the fastigium. Frontal ridge narrow, not wider than interocular space, narrow at top and bottom, slightly wider opposite the upper margin of the antennal foramen, ending and diverging slightly above the very small medial ocellus. Profile of frons markedly concave, the frontal ridge forming a rounded rostrum. Subantennal sutures thin and rather indistinct, the ventral sutures short and projecting laterally; ventral margin of frons at frontoclypeal suture distinctly concave. Preocular ridges of frons present. Eyes large and globose; interocular space narrow, 0.6 - 0.8 times as wide as greatest width of antennal scape. Antennae long, filiform, slender, round in cross section, 17 segments in flagellum of adult, end of terminal segment obliquely pointed.

Prothorax without medial carina. Transverse sulci deep. Dorsolateral area between 2nd and 3rd sulci inflated into a prominent bulge, bearing a matte-surfaced oval depression. Posterior ventral angle of lateral lobe of pronotum rounded, posterior margin above the ventral angle straight. Anterior ventral angle of lateral lobe of pronotum obtusely rounded. Both anterior and posterior margins of pronotum slightly notched in midline. Prosternal process short, abruptly conical, vertical or slightly

angled forwards. Apterous. Posterior margins of meso- and metanotum somewhat raised, giving a saw-tooth dorsal profile to thorax in lateral view.

Hind femora very long ($4.3 \times$ as long as pronotum) and slender; outer face of femur rounded. Dorsal carina of femur terminating in a short spine. Seven spines on the dorsal external margin of hind tibia, eight on the dorsal internal. Hind tarsi long, 0.34 times as long as hind femur and 1.45 times as long as pronotum. Third tarsal segment 1.5 times as long as the first and second segments together. Claws long and widely separated.

Tympanum absent. Posterior margin of 10th abdominal tergite with a central notch and short lateral sclerotised teeth. Supra-anal plate triangular, without sclerotised melanic markings, slightly rounded at apex and with a slight medial furrow at its base. Cerci short, conical, simple. Subgenital plate smoothly rounded, in dorsal view terminating in a short medial furrow. Internal genitalia of the type typical for the subfamily.

Female: Size, medium ($20\text{mm} < \text{body length} < 30\text{ mm}$), 1.3 - 1.4 \times as long as the male.

Morphology.

Differs from male as follows: Integument less polished, more extensively pitted than in male. Interocular space slightly wider than in male, 0.9 \times as wide as antennal pedicel. Antennae slightly flattened dorsoventrally and relatively shorter than in male ($3.1 \times$ pronotum). Fusiform in shape, posterior margin of pronotum, meso and metathorax, and the anterior segments of abdomen being relatively wider than in male. Pronotum with the merest suggestion of a median carina, defined more by local absence of pitting than by a raised ridge. Hind tarsus and femur relatively shorter than in male, the femur 3.9 \times as long as pronotum. Third segment of hind tarsus 1.4 \times length of 1st and 2nd segments together. Genitalia typical for the subfamily. Spermatheca not examined.

Diagnosis.

Like most rhytidochrotines in our area, *Exerythracris* is most readily recognised by its colour pattern, at least in the male. This is the only predominantly red species of grasshopper in our fauna. Females are often of the same striking color, but also occur in a dull olive brown form.

Exerythracris has one of the proportionately longest hind femora ($4.3 \times$ pronotum) and both the longest last tarsal segment (approx. 1.5 \times the 1st and 2nd segments together) and the longest rostrum of all our rhytidochrotines. The genus is superficially very similar to *Hylopedetes* and shares with it a very elongate third tarsal segment; the two are probably sister genera. It differs from *Hylopedetes* in numerous details: lophi of epiphallus not convergent towards the midline as in all species of *Hylopedetes*; proportionately longer and more slender legs and antennae; more pronounced rostrum; deep anterior pronotal sulcus (rather weak in *Hylopedetes*); presence of well-developed dorsolateral processes between 2nd and 3rd pronotal sulci (barely

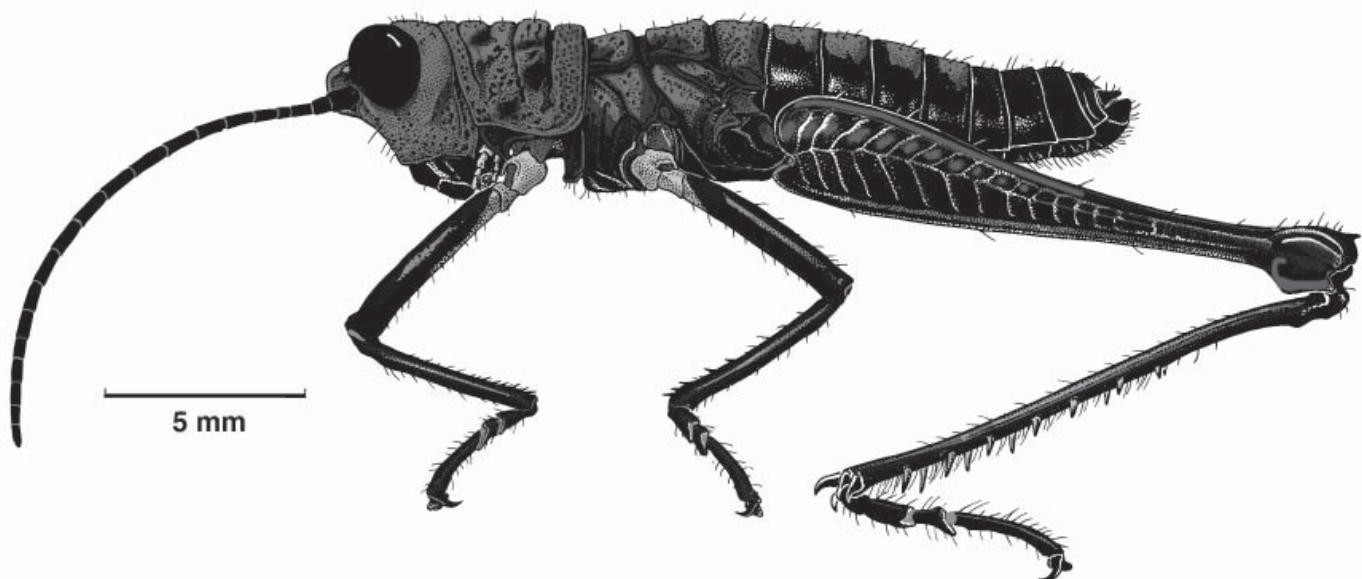
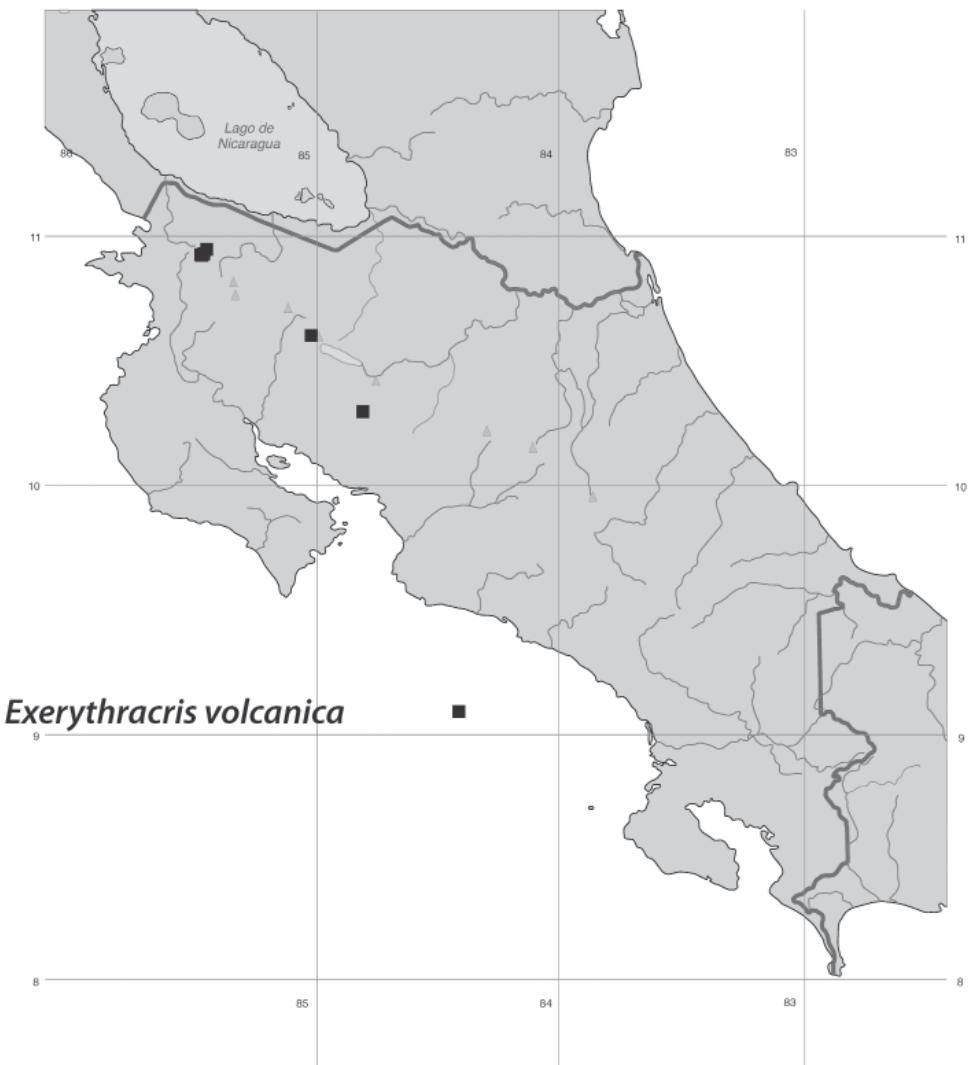


Fig. Rh3. *Exythracris volcanica*, male habitus.



Map Rh3. *Exythracris volcanica*, localities in Costa Rica.

discernible in *Hylopedetes*); anterior ventral angle of pronotum obtusely rounded, and not with a ventrally directed projection as in *Hylopedetes*; relatively well-developed dorsal spine on hind knee (minute in *Hylopedetes*); furcula with relatively shorter teeth than in *Hylopedetes*.

***Exerythracris volcanica* Rowell 1995**

Rowell 1995: 559.

Type locality: COSTA RICA, Prov. Guanacaste, P.N. Guanacaste, Volcán Cacao, 1300 m.

Location of type specimen: ANSP.

Etymology.

Latin “of volcano” an illusion to both the type locality and the red coloration of the male.

Coloration.

The live male (**Fig. Rh3, Plate Rh3**) is bright red with shining jet-black eyes, legs, antennae and underside. In dried specimens (described below) the colours become more dilute.

Antennae, blackish purple. Eyes black, drying beige to brown in pinned specimens. Labrum and mandibles, dark purplish black. Palps green, suffused with black. Rest of head carmine red. Pro-, meso- and metanota, thoracic episterna and epimera, carmine red. Thoracic sulci blackish. First 6 abdominal tergites with a medial carmine spot, decreasing in size on the more posterior segments. Abdomen and thorax otherwise purplish black. All legs and feet purplish black. Coxa, trochanter, and basal part of femur of fore and mid legs yellowish green, especially on ventral surfaces. Spines of hind tibia greenish yellow tipped with black.

Female: Coloration. Two forms exist: one is identical to the male. In the other form, the general olive brown coloration is marbled with yellow in life, a band across the frons, genae and pronotal lobes is bright cream, and the abdominal segments are green laterally. Distal abdominal segments (5th onwards) are also green dorsally. Basal segments of all legs are green; the black hind femur has a greenish cast. Antennae dark brown. In pinned specimens (described below) the colours change.

Antennae purplish black. Eyes brown. Head olive brown, a paler stripe extending across genae and frons and continuing posteriorly on the lobes of the pronotum. Labrum and mandibles blackish purple. Palps green. Pronotum generally olive brown; anterior and posterior margins and anterior ventral part of lateral lobes olive green. Thorax and abdomen olive brown, tinged green on sides of abdominal segments 2-5. Ovipositor valves purplish brown.

Fore leg: as in male. Mid leg: coxa, trochanter, basal part of femur light brown; distal femur black; tibia greenish proximally, purplish distally; tarsus purple. Hind leg: femur olive brown dorsally, inner and outer faces black; knee, tibia and tarsus purple; spines of tarsus green tipped with black. Claws black.

Distribution.

Occurs on two of the northern volcanoes (Cacao and Tenorio) and uncommonly around Monteverde in Tilarán. To date is a Costa Rican endemic, but might exist on the mountains of Southern Nicaragua.

Natural history.

Edges and clearings in montane forest, occasional in forest understorey. Usually sympatric with *Hylopedetes surdus*, and the male makes numerous copulation attempts on females of that species. A fern specialist, eats *Hypolepis* and *Thelypteris* spp., like *H. surdus*.

***Hylopedetes* Rehn 1929**

Rehn 1929: 59.

Type species: *Hylopedetes mirandus* Rehn 1929: 62

Location of type specimen: ANSP.

Etymology.

Greek “*hallomai*”, leaping, springing, Greek “*pedetes*”, leaper or jumper.

No. of described species.

Seven; all occur in our area.

Hylopedetes is both the commonest and the most speciose genus of Rhytidochrotinae in our area. They are typically small, brightly coloured and agile grasshoppers of montane forest, usually found on ferns. The females, as is usual for the group, are larger, duller, fusiform in shape, and less eye catching. They are perhaps commonest in forest edge or light-gap situations, but can also be found on ferns in deeply shaded closed forest – there seems to be interspecific variation in their preference for this habitat. As far as is currently known, they are confined to Costa Rica and Western Panama. Morphologically they are a uniform genus, and the generic diagnosis given below applies to all our species. The different species are most easily recognized by their chromatic differences, which are marked. The different species are frequently sympatric, suggesting they are well isolated from each other genetically.

Generic diagnosis.

Small in size, cuticle smooth and shiny but pitted on the thorax. Fastigium short, subhorizontal or slanting downwards, rounded at the tip. Interocular space narrow, subequal to the antennal pedicel. Vertex only slightly inflated. Profile of the face somewhat concave at the level of the median ocellus. Frontal ridge narrow and flat above the medial ocellus, absent or subobsolete below it. Lateral carinae of the face thick and little projecting. Eyes strongly protruding. Antennae filiform, less than 2× as long as head and pronotum together, flagellum of 15-16 segments. The four sulci of the pronotum are deep, but

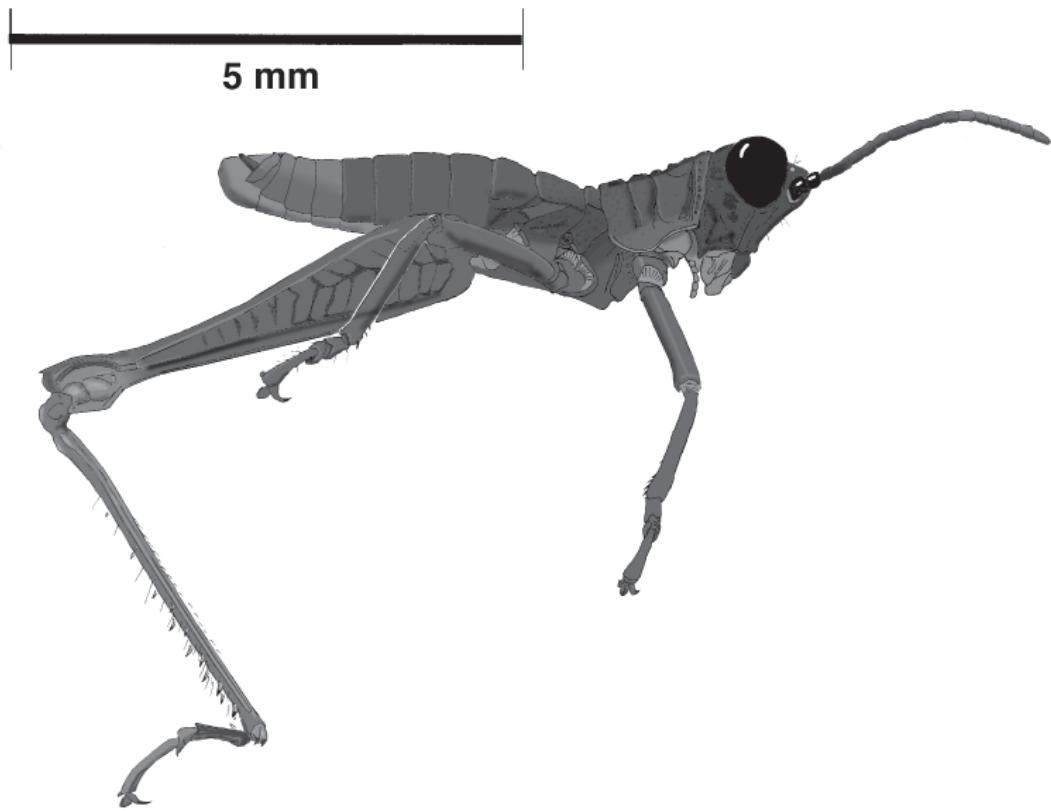


Fig. Rh4. *Hylopedetes cruentus*, male habitus.

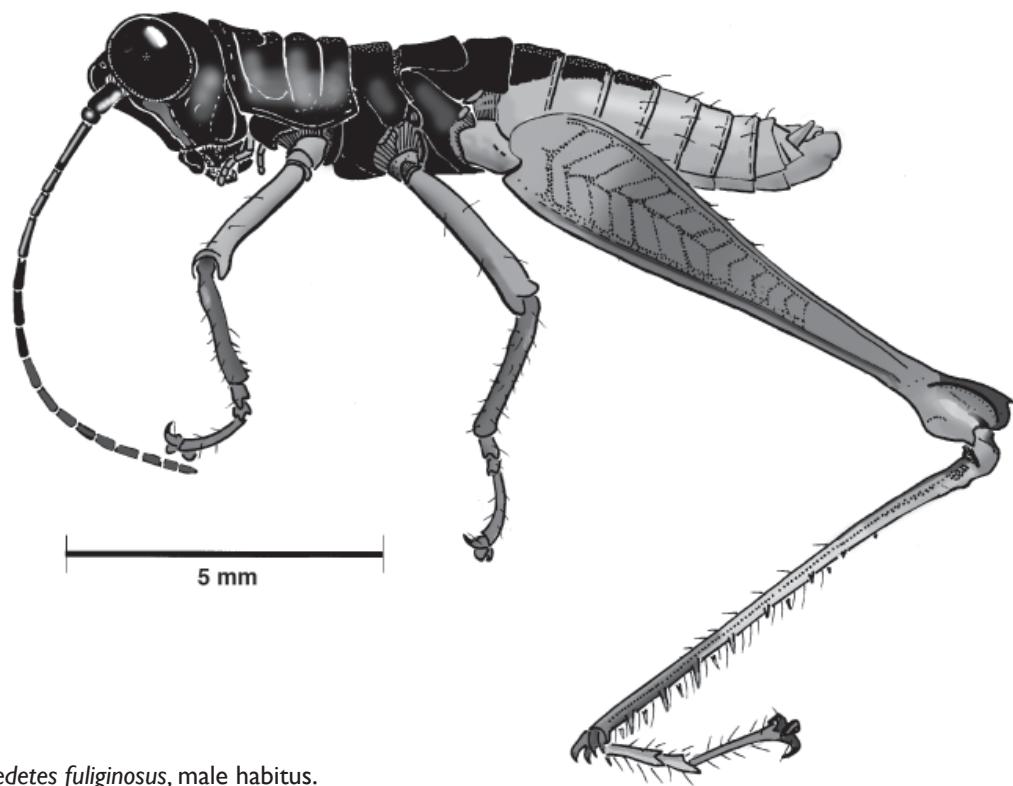


Fig. Rh5. *Hylopedetes fuliginosus*, male habitus.

the first one is obsolete in the midline, not cutting the midline of the pronotum. The upper edge of the pronotum is more or less rectangular (in lateral view). Posterior margin of pronotal disc sinuous or truncated; anterior margin excurred in the middle. Prosternal process a conical tubercle, sharply pointed and sometimes inclined forwards. Mesonotum and metanotum without posterior-medial projections. Abdominal tympanum absent. Hind femora with smooth carinae; the dorsomedial carina terminates in an indistinct process or a short spine. Posterior tibiae with seven external spines and nine internal ones. Third tarsal segment longer than the other two combined.

Male: Posterior margin of the last tergite with a small furcula, the tips being obtuse and melanized. Supra-anal plate triangular, a little longer than wide at its base, lacking the black granules seen in many genera of this subfamily, weakly divided transversely by a furrow at mid length. The dorsal rim of the apex of the genital capsule is notched or grooved medially in all species, and in some the groove is provided with raised lips which continue for a little way onto the posterior face of the capsule.

Phallic complex typical of the subfamily. Epiphallus with large conical black lophi, posterior processes large and diverging, ancorae weak, ventrolateral sclerites subcircular, well developed, set rather far back on the phallus. Ventral aedeagal valves completely sheathed, cingular arch large and robust, but usually devoid of valves.

Female: Subfusiform in shape. The ovipositor valves have toothed external margins and are somewhat hooked at the tip. The spermatheca is typical of the subfamily, tubular, with a small apical diverticulum and a large cylindrical subapical diverticulum. The duct arises directly from the genital chamber with no bursa, and the opening is supported in most species by a v-shaped sclerite. Most species lack columellae on the internal surface of the subgenital plate. If present (e.g., *H. surdus*), there is only a single pair. The subgenital plate terminates in a short triangular egg guide with a rounded tip.

In several but not all species there is a small ventrally directed process at the anterior angle of the pronotum. *Hylopedetes* has the smallest relative interocular distance of any of the Central American rhytidochrotine genera and (together with *Talamancacris* Rowell 1995) the relatively shortest antennae. The pattern of the antennal sutures is similar to that of the closely related *Everythracris* Rowell 1995, with which it also shares a proportionately very long last segment of the hind tarsus (50-60% of foot). *Hylopedetes* is a difficult genus to diagnose with discrete positive characters, but very characteristic and readily recognizable once seen. The different species form a homogenous group morphologically and ecologically, differing principally in coloration, which is often vivid. Typically the males have a slightly different colour pattern from the females.

Key to species of *Hylopedetes*.

(Colour images of all species have been deposited in the OSF2 (<http://osf2x.orthoptera.org/>).

- | | | |
|-----|---|---|
| I | Some red coloration present. | 2 |
| IA. | No red coloration anywhere. | 7 |
| 2 | At least some red coloration present on terga or pleura of thorax. | 3 |
| 2A | No red colour on terga or pleura of thorax.. | 5 |
| 3 | Antennae entirely black, rest of body mostly green.
Thoracic pleura and sometimes rear of pronotum with bright red marks. Conspicuous yellow patches on lateral nota of proximal abdominal segments (see Plate Rh6) (Costa Rica & Panama). | <i>H. gemmeus</i> |
| 3A | Not as above, antennae not entirely black. | 4 |
| 4 | Antennae black basally but the terminal 6-7 segments yellow-brown. Red colour mostly confined to thoracic pleura and sterna. Frons and genae yellow. Hind knees yellow-brown. (Costa Rica). | <i>H. mirandus</i> |
| 4A | Antennae brown or red. Head, thorax, and much of abdomen dark purplish red; legs green, hind knees light brown, male cerci red. (Costa Rica). | <i>H. cruentus</i> |
| 5 | Hind knees red
- | |
| | Tip of abdomen (both sexes) and hind knees red, general colour dark blackish-green. Dorsa of thorax and anterior abdominal segments with paired white or yellow dots of variable intensity. (Costa Rica). | <i>H. punctatus</i> |
| 5A | Hind knees, underside and, in male, sides of abdomen red. Male thorax black with bluish iridescence. (Costa Rica & Panama). | 6 |
| 6 | Antennae red. Tip of adult male abdomen red on dorsal surface (Costa Rica). | <i>H. nigrithorax nigrithorax</i> |
| 6A | Antennae black, brown at the tip. Tip of adult male abdomen green on dorsal surface (Panama). | <i>H. nigrithorax panamensis</i> |
| 7 | No red coloration at all. | 8 |
| 8 | Frons entirely black. Antenna black basally, terminal 3-5 segments yellowish white. Female with lower genae and ventral edge of pronotal lateral lobes cream or greenish white. Male with head and pronotum entirely black (Panama). | <i>H. fuliginosus</i> |
| 8A | Antennae black with brown tips. General colour orange-brown and green. Frons and ventral margin of lateral lobes yellow. Hind knees green or (on V. Tenorio and further north) yellow (Costa Rica). | <i>H. surdus</i> |

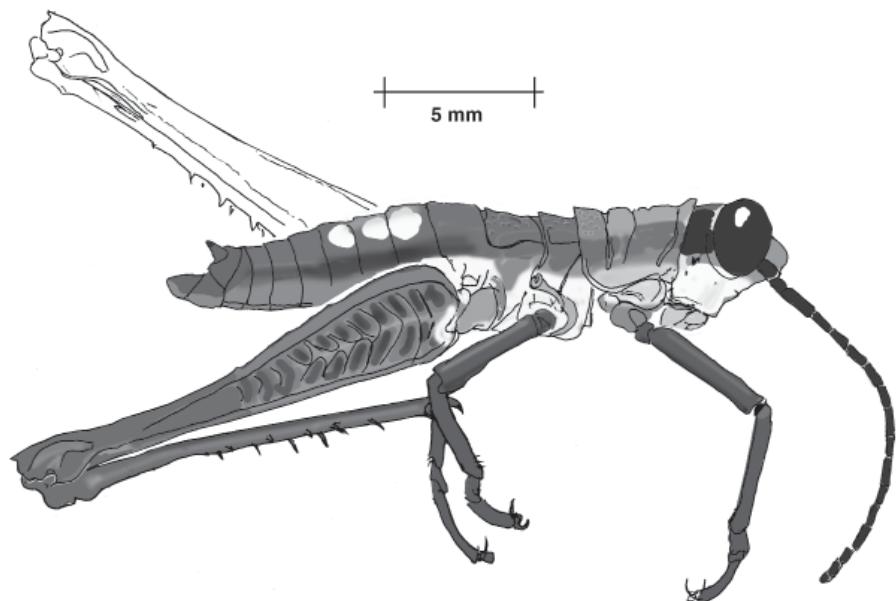


Fig. Rh6. *Hylopedetes gemmeus*, male habitus.

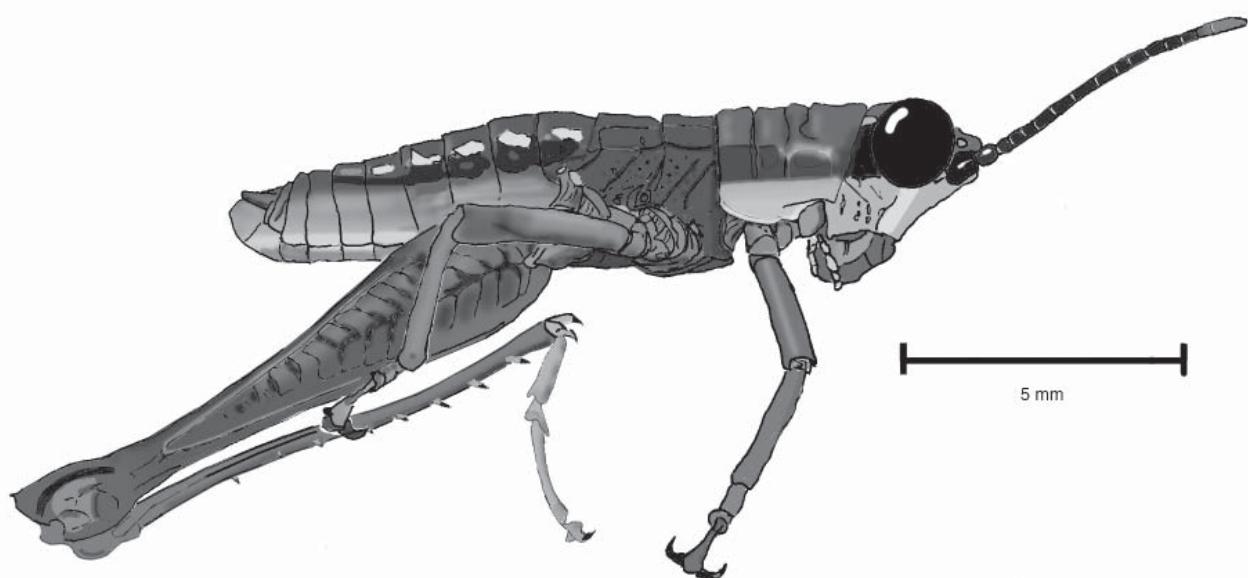


Fig. Rh7. *Hylopedetes mirandus*, male habitus.

1. *Hylopedetes cruentus* Rehn 1929

Rehn 1929: 66

Descamps & Amedegnato 1972: 1063.

Type locality: COSTA RICA, Cartago Prov., Navarro, 3800 feet

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *cruentus*, bloody, an allusion to the dark reddish purple coloration.

Diagnosis.

Male habitus **Fig. Rh4, Plate Rh4.**

Field characters.

Unmistakable: a small apterous insect, dark reddish purple in colour except for leaf-green legs. The antennae are brown or red, the hind knees brownish. The sexes are similarly coloured, but the female has a broad green dorsal medial stripe extending over the abdomen, pronotum and the vertex of the head, areas which are mostly purple in the male. Occasional specimens are more red-brown than purple.

Distribution.

H. cruentus seems to be largely confined to the upper headwaters of the Rio Reventazón, where it is locally abundant at forest edges or in light gaps. It is especially numerous in the lower areas of Tapantí National Park and around the area of Orosí, both close to the type locality, on the lowest slopes of the Talamanca massif. It is also found around Turrialba, including at Grano de Oro, and in the neighbourhood of Cartago. Its most remote occurrence is on the N. face of Cerro Zurquí, N. of the city of San José.

Natural history.

Like its congeners, *H. cruentus* is frequently found on ferns, especially *Hypolepis hostilis*, which it will eat in captivity, but is by no means confined to them, and shows less association with them than any other species of the genus. It can be found on a large variety of forbs, including *Piper* and *Impatiens* spp., both of which it eats in the wild.

2. *Hylopedetes fuliginosus* Rowell & Bentos-Pereira 2005

Rowell & Bentos-Pereira 2005: 70.

Type locality: PANAMA: Bocas del Toro: Quebrada Felix, 1.5 km E of summit of road to Chiriquí Grande, 940 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *fuliginosus*, sooty.

Diagnosis.

Male habitus **Fig. Rh45, Plate Rh5.**

Field characters.

Male is predominantly sooty black, with a pale green distal abdomen and legs. The female is similar, but has the ventral margins of the genae shining white, and a strip of pale green runs along the lower margin of the lateral lobes of the pronotum. Remainder of head and thorax black or very dark blue green. Legs and abdomen green, as in male. Antennae and eyes, black in both sexes.

Distribution.

To date known only from the area around the type locality, in the mountains of extreme Western Panama. Not to date recorded from Costa Rica.

3. *Hylopedetes gemmeus* Rehn 1929

Rehn 1929: 71.

Type locality: COSTA RICA, Prov. Cartago, Navarro, 3800 feet.

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *gemma*, precious stone, bud. An allusion to the brilliant colours of the male.

Diagnosis.

Male habitus **Fig. Rh6, Plate Rh6.**

Field characters.

A dark green insect with vivid flecks of red and yellow on the thoracic and abdominal terga. Antennae entirely black.

Distribution.

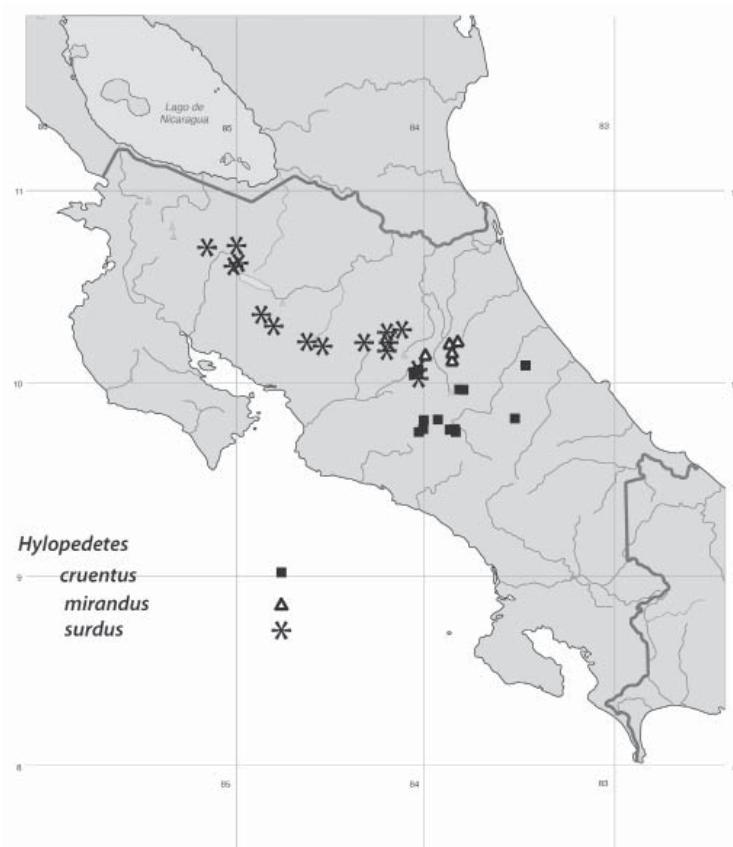
Found in both Costa Rica and Panama, but in a disjunct fashion. Costa Rica: *H. gemmeus* occurs on the Cordillera de Tilarán in the north (common at Monteverde) and from there south and east along the north slope of the Cordillera Central at least as far as the Río Frío. The type locality (the same as that of *H. cruentus*) lies to the south of this, in the northern Talamanca foothills at Navarro in the central part of the country, but the species has not been seen there since the original collection, presumably a consequence of the general forest degradation in that area (Rowell 1995). It has not been recorded in Costa Rica south of this point.

Panama: Occurs commonly in the mountains of Western Panama (Bocas del Toro and Chiriquí Provinces) and less commonly further East, at Cerro Copé (Coclé Province). It has not yet been found E. of the Panama Canal.

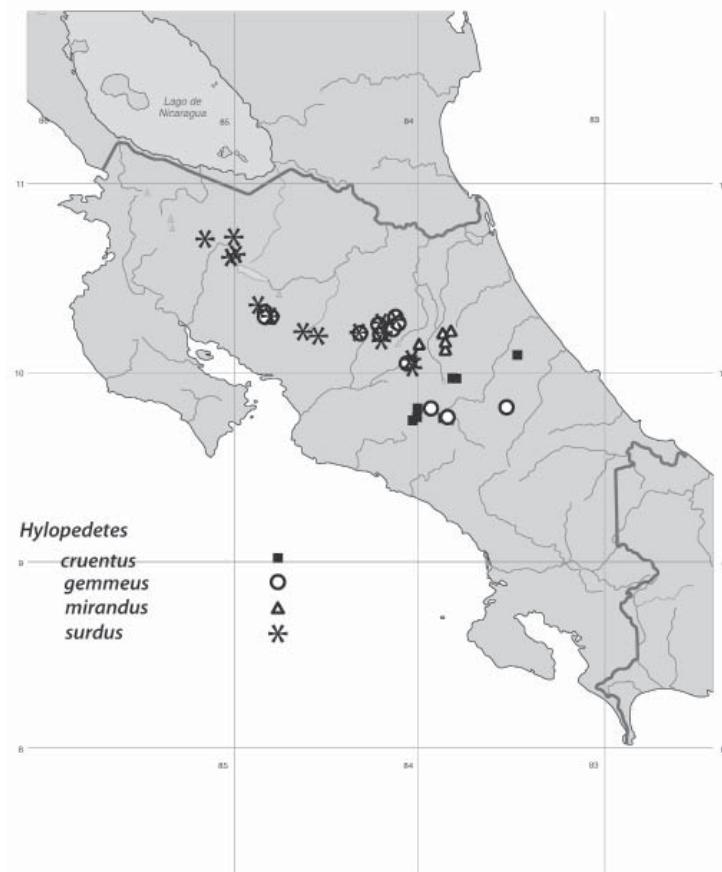
The Panamanian insects are slightly larger but show no other significant difference from the Costa Rican population.

Natural history.

This is the *Hylopedetes* species most likely to be found in thick forest at low light intensities. It is usually found on ferns,



Map. Rh4. *Hylopedetes* spp. in Costa Rica, excluding *H. gemmeus*. Note lack of overlap.



Map. Rh5. *Hylopedetes* spp. in Northern Costa Rica (as in **Map Rh4**) plus *H. gemmeus*. Note overlap! Discussion in the text.

in Costa Rica especially on members of the genera *Dryopteris* and *Pteris*, but also on other plants, such as *Costus* and *Anthurium*. It is less likely than other members of the genus to be found in sunny situations at forest edges or in light gaps, though this does occur. As shown in the comparison of **Maps Rh4** and **Rh5**, the other *Hylopedetes* spp. of northern Costa Rica are more or less geographically separated, with little overlap. However, all of them are extensively overlapped by *H. gemmeus*. I believe this is due to the different habitat preferences of *H. gemmeus*. The remaining species are all very similar in life style, preferring *Hypolepis* ferns growing in sunny forest edges and light gaps; *H. gemmeus* lives equally happily on shaded ferns in closed forest, and so does not compete.

4. *Hylopedetes mirandus* Rehn 1929

Rehn 1929: 62

Type locality: COSTA RICA: Prov. Limón, Guápiles, La Emilia, 1000 ft

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *mirandus*, wonderful, strange, presumably referring to the bright and varied coloration.

Diagnosis.

Male habitus **Fig. Rh7, Plate Rh7.**

Field characters.

The first impression is of a green grasshopper with golden lateral stripes and golden hind knees. On second glance, one notices the black eyes and postocular stripe and the black antennae with yellow brown tips, and a patch of bright red on the thoracic pleura. In the hand, the bright red underside is striking, as is the clear yellow frons and genae. Individuals vary greatly in the amount of golden coloration. In some it is very conspicuous, in others barely noticeable.

Distribution.

H. mirandus is a Costa Rican endemic, known only from a restricted area of the foothills of the northern slope of the Cordillera Central, from the region around the town of Guápiles (**Map Rh4**). It is found in forest light gaps, almost always in groups on *Hypolepis* ferns.

5. *Hylopedetes nigrithorax* Descamps & Rowell 1978

Descamps & Rowell 1978: 356.

Type locality: COSTA RICA: Prov. Puntarenas, Coto Brus, San Vito de Jaba, Finca Las Cruces, 1100 m.

Location of type specimen: MNHN Paris.

Etymology.

Latin, "black thorax".

Subsequent literature

Rowell et al. 1983 (food plant specialisation, ecology).

Diagnosis.

Male habitus **Fig. Rh8, Plates Rh8 & Rh9.**

Distribution.

Known from both Costa Rica and Panama, with a disjunct distribution. In Costa Rica *H. nigrithorax* is an insect of the forests of the SW highlands, specifically of the Fila Cruces, the last ridge of high ground before the Pacific coastal plain. It does not seem to continue East into the adjoining and very similar country of Chiriquí province in SW Panama, but stops more or less at the international border. However, it is found again on the other side of the continental divide, on the upper Atlantic slopes of Prov. Bocas del Toro, in N.W. Panama, about 75 km to the East (**Map Rh7**). This disjunct distribution could be an artifact of the modern deforestation of Chiriquí, but the morphological differences between the two forms (below) suggest that they have been separated for some time.

Field characters.

The general impression of the Costa Rican male (**Plate Rh9**) is of a small blue-black insect with bright red abdomen and antennae, and green hind legs with red knees. Females have a medial dorsal green stripe from fastigium to tip of abdomen, and the black and red is thereby confined to lateral areas.

The Panamanian form (**Plate Rh8**) is larger by about 30%, and differs a little in coloration and in the details of the male genitalia. Rowell & Bentos-Pereira (2005) recognized it as a separate subsp., *H. n. panamensis*. Externally it differs most obviously in that the dorsal surface of the tip of the male abdomen is green and not bright red, and the antennae are brown and not bright red.

Natural history.

The Costa Rican subspecies of *H. nigrithorax* is the only member of the genus whose natural history has been studied (Rowell et al. 1983). It is usually found in groups on the fronds of a few species of fern, typically preferring fronds that are exposed to the sun for some part of the day. Sexually mature males are territorial and maintain a frond, or a portion of a frond, free of other males, and solicit entering females. Intruding males are attacked and bitten, and may even be killed by biting into the top of the head. These colonies are semi-permanent, and may last in the same place for several years, usually until the favoured fronds die or are destroyed by e.g. falling branches. The animals feed on the home fronds, and over time cause them considerable damage. It has been shown experimentally that they have strong dietary preferences for some species of fern over others. The most palatable are *Hypolepis* and *Dryopteris*. Fronds of *Pteris*, being more robust, seem to offer better basking and territorial sites. In S.W. Costa Rica *H. nigrithorax* is sympatric with the proctolabine *Ampelophilus olivaceus*, which is slightly larger in size but of similar habit and red and green and black coloration. It is of interest

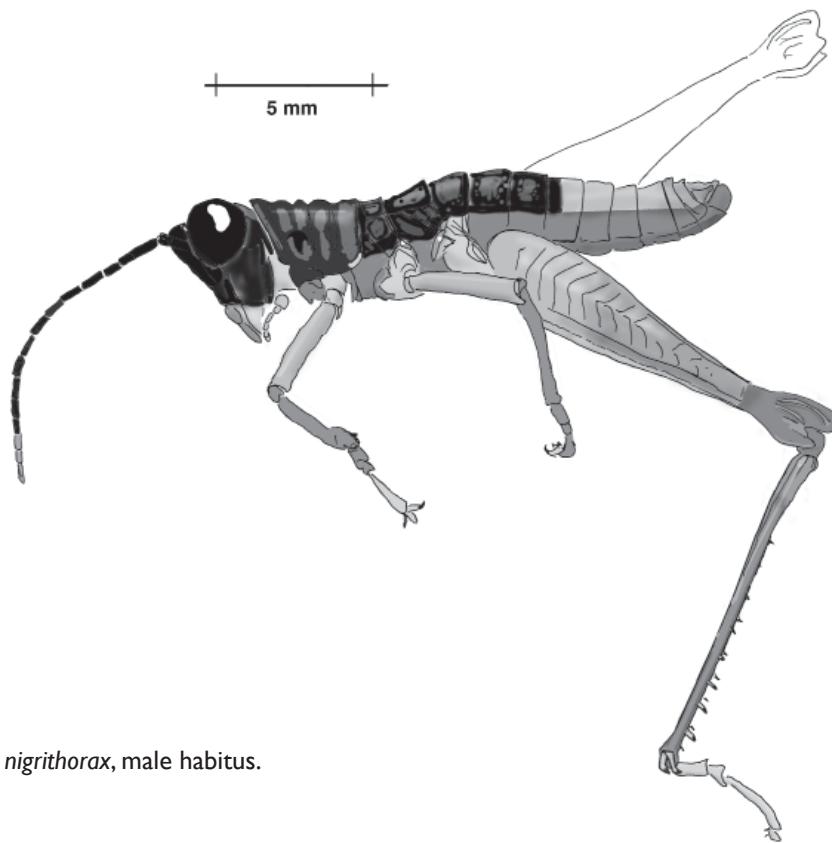


Fig. Rh8. *Hylopedetes n. nigrithorax*, male habitus.

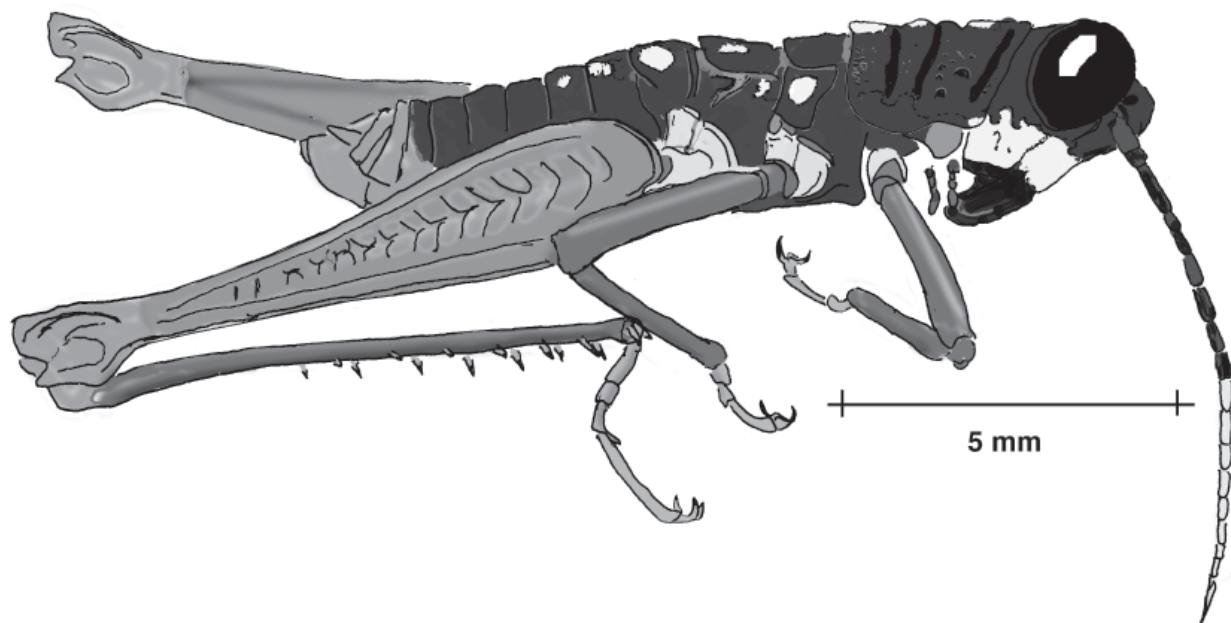


Fig. Rh9. *Hylopedetes punctatus*, male habitus.

that territorial male *nigrithorax* react at first to *Ampelophilus* intruders as if they were conspecifics, indicating that coloration and visual aspect are used for species recognition at a distance.

The Panamanian form has not been studied in the same way, but appears to be similar in life style. It too is usually found on ferns at montane forest edge or within light gaps. *H. nigrithorax* is strongly associated with forest ferns in undisturbed localities, but is not necessarily confined to them; flourishing colonies have been found on Asteraceae in recently deforested countryside.

6. *Hylopedetes punctatus* Rowell & Bentos-Pereira 2005

Rowell and Bentos-Pereira 1995: 72.

Type locality: COSTA RICA: Prov. S. José: Sa. Elena: Fila above Los Nubes, valley of R. Peñas Blancas, 1350–1550 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Lat. *punctum*, small hole, dot, spot, point, referring to the small pale spots on the generally dark integument.

Diagnosis.

Male habitus **Fig. Rh9, Plate Rh10.**

Field characters.

Coloration (both sexes): General colour dark greenish black. In males almost the entire thorax and pronotum is black. Eyes and proximal segments of antennae shining black. The terminal nine antennal flagellar segments ochraceous, yellowish or white. Lower part of frons and genae white or yellow; in females, but not in males, this colour extends backwards along the ventral edges of the pronotal lobes. Three pairs of white or yellow or golden spots on the dorsal surface of the pronotum, and one pair on each of the meso- and metathoracic and first and second abdominal terga. Other pale spots occur on the meso and metathoracic epimera. These spots, especially those on the terga, vary in distinctness and are nearly absent in some individuals, very conspicuous in others. Legs green, the hind femora being the lightest in colour, the hind tibiae the darkest, almost black. Hind tibial spines ochre, with black tips. Feet, ochre or green (especially in females). Genital region and hind knees vermillion.

Distribution.

This is again a very local species, known only from the densely forested upper reaches of two small mountain streams (R. Union, R. Peñas Blancas) on the Pacific slope of the Talamanca mountains. Like *H. gemmeus*, it can be found on deeply shaded ferns inside the forest, but also at forest edges, where it too favours *Hypolepis hostilis*.

7. *Hylopedetes surdus* Descamps & Rowell 1978

Descamps & Rowell 1978: 357.

Type locality: COSTA RICA: Prov. Alajuela: R. Balsa, 1 km N. of S Ramón, on ferns at forest edge.

Location of type specimen: MNHN Paris

Etymology.

Latin *surdus*, deaf, mute, presumably a reference to the lack of tympanum (which is true of all the genus, not just this species!).

Diagnosis.

Male habitus **Fig. Rh10, Plate Rh11.**

Field characters.

A light orange-brown apterous insect with a green vertex and green abdominal tip. All legs are green, the tarsi reddish brown. The antennae are black with brown tips, the eye and postocular stripe black, frons and ventral margins of lateral lobes of the pronotum yellow. The mouthparts are green. As in several other species of the genus, the female but not the male has a dorsal medial green stripe. In the extreme North and West of its range *H. surdus* has orange-brown hind knees, whereas elsewhere the hind leg is entirely green. No other morphological difference can be discerned between these colour forms. Faded museum specimens of the northern form of *H. surdus* can at first be confused with *H. mirandus*, which also has pale knees and a yellow frons. In life the true colours are distinctive and the two species cannot be confused, due to the golden abdominal markings and red thoracic pleura and sterna of *mirandus*.

Distribution.

In Costa Rica *H. surdus* has the largest range of any *Hylopedetes* sp. and is also the commonest. In the Cordillera Central it is sympatric with *H. gemmeus* over almost the entire range of the latter and extends further north along the Cordillera de Guanacaste, at least as far as Volcán Tenorio, where it is sympatric with *Exerythrachis volcanica*, and to V. Miravalle. (**Maps Rh4-6**). *H. surdus* has not yet been found outside of Costa Rica.

A single pair of specimens in the Geneva Museum is labelled as being from Pozo Azul de Pirrís, near the town of Parrita on the Pacific seaboard (not shown on **Maps Rh4-6**). If this can be believed (Rehn's Costa Rican collections in the ANSP include several species with apparently erroneous localities, suggesting problems in the labelling process there at that time), it indicates that the species had a considerably wider range before modern deforestation. The specimens are not dated, but might derive from Rehn and Lankester's collection at this locality on 21.8.1927. Nowadays the species is absent from surviving forests in this area (e.g. P. N. Carrera), and must be considered locally extinct, if it were indeed ever present, which I personally doubt.

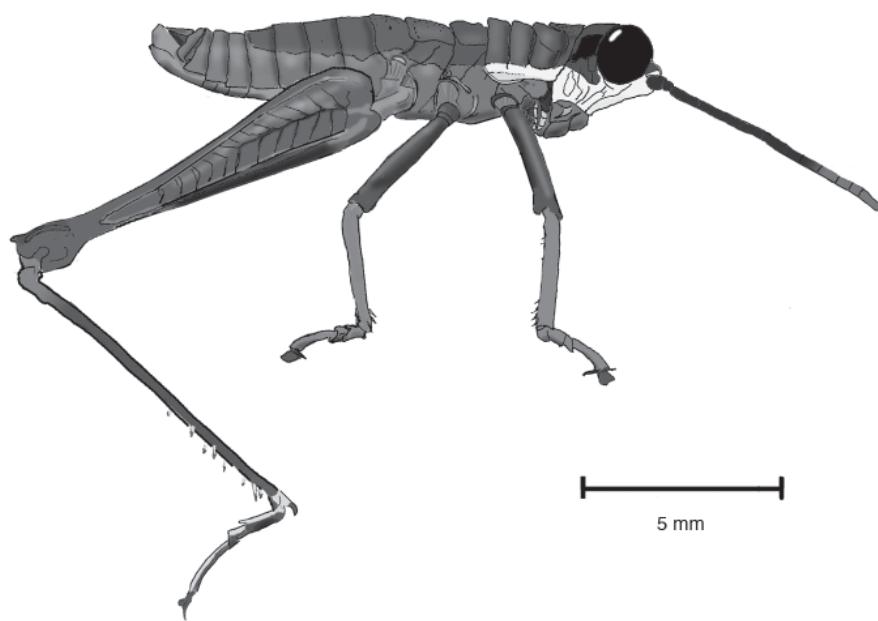


Fig. Rh10. *Hylopedetes surdus*, male habitus.

Natural history.

H. surdus appears to be less shade tolerant than *gemmeus*, but like the latter, *H. surdus* is found on a variety of ferns, including *Hypolepis*. It is not however an exclusive fern eater. It has been seen on several occasions eating *Bocconia* (Papaveraceae) in the wild.

***Micropaon lucens* Descamps & Rowell 1984**

Descamps & Rowell 1984:149.

Type locality: COSTA RICA: Prov. S. Jose, S. Isidro de El General, Hortensia, Valley of R. Payner, 1530 m., marshy valley in woodland.

Location of type specimen: MNHN Paris.

Etymology.

Latin *lucens*, shining, an allusion to the bright iridescent colours.

Diagnosis.

Habitus **Fig. Rh11, Plate Rh12.**

Field characters.

Micropaon is similar in size and form to *Hylopedetes*, but in its coloration (see **Plate Rh12**) is quite distinct from any species of that genus. General coloration black with bright iridescent blue sheen, the proximal abdominal tergites marked with patches of yellow (female) or pale blue-green (male). In the male the lower frons and genae are a striking dark blue. Legs green, with paler femoral bases and coxal segments. The hind knee is yellow brown, the hind tarsus black, and the base of the hind femur is pink and red. Underside of thorax, black; feet pinkish.

When dead and dried most of the above colours fade, and the darker areas turn black.

Distribution.

Another Costa Rican endemic. Known only from various upland localities on the Pacific slope of the Talamanca massif, from Hortensia and Santa Eduviges in the North to Tres Colinas above Potrero Grande and Cerro Pittier in the South. (**Map Rh7**).

Natural history.

This species is typically found in somewhat marshy places in montane woodland, often resting on leaves of *Persicaria* sp., which, however, it does not eat. It appears to be a specialist on Urticaceae, eating especially *Urera* spp. in the wild. In captivity, wild-caught larvae have been reared through several instars to maturity on the European stinging nettle, *Urtica dioica*.

Micropaon

Descamps & Rowell 1984

Type species: *Micropaon lucens* Descamps & Rowell 1984:149

Location of type specimen: MNHN Paris.

Etymology.

Greek *mikros*, small; “-paon” from *Opaon* Kirby 1902, a well-known Colombian genus of this subfamily.

No. of described species.

One.

Diagnosis.

Differs from *Hylopedetes* in the following characters:

Coloration (see below under Field characters).

Profile of face concave, with an appreciable blunt rostrum projecting between the antennae in lateral view. In *Hylopedetes* the facial profile is almost straight.

Fastigium more abruptly inclined downwards.

Points of furcula more widely spaced.

Sulci of pronotum unusually deep and wide, forming prominent grooves.

Posterior margins of meso and metanotum (metanotum only in female) strongly thickened.

The male supra-anal plate has a single black tubercle in its centre, just posterior to the transverse furrow.

Like *Hylopedetes*, *Micropaon* has 7 external and 9 internal tibial spines, and no tympanum. Eighteen antennal segments.

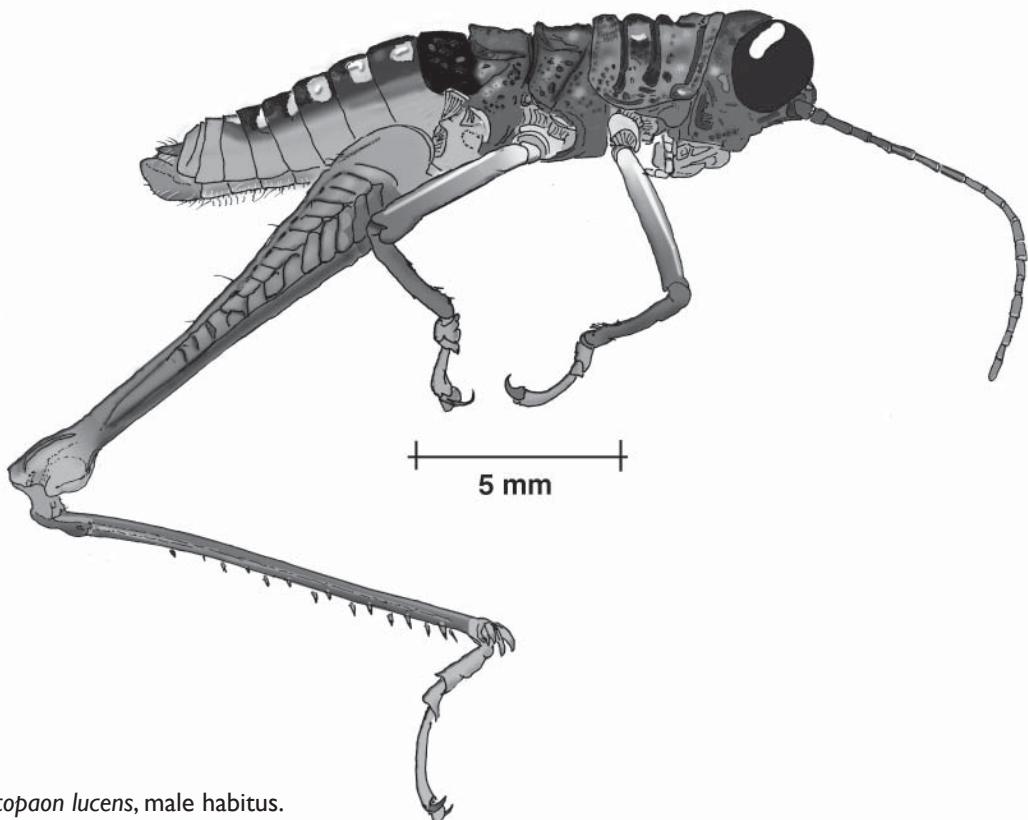


Fig. Rh11. *Micopaon lucens*, male habitus.



Map. Rh7. *Micopaon lucens*, localities.

Oedalacris**Descamps & Amedegnato 1972: 539**

Type species: *Oedalacris cordobae* Descamps & Amedegnato 1972: 541

Location of type specimen: MNHN Paris.

Etymology.

Greek *oedaleos*, swollen; *akris*, grasshopper; locust. Presumably refers to the rather plump form of the females of this genus.

No. of described species.

Four; two in our area, the other 2 in Colombia.

The genus differs from most other Central American rhytidochrotines in that it is found in lowland, rather than montane, forest, and in having a well-developed tympanum. It is also unusual in having eight, rather than the usual seven external spines on the hind tibia, no protuberances on the meso or metathoracic terga, and the dorsal carina of the hind femur is minutely toothed, not perfectly smooth.

1. *Oedalacris cambrai* Rowell & Bentos-Pereira 2005

Rowell & Bentos-Pereira 2005: 82.

Type locality: PANAMA: Prov. Darién: P.N. Darién: Pirre: Estación Rancho Frio.

Location of type specimens: ANS Philadelphia.

Etymology.

Named for the first collector, Prof. R. Cambra, University of Panama.

Diagnosis.

Very similar to the Colombian *O. cordobae* Descamps & Amedegnato 1972, but more brightly coloured and bearing more pale spots. (**Fig. Rh12, Plate Rh13**). Pronotal process short and obliquely truncated in lateral view. Posterior margin of female subgenital plate smoothly triangular, terminating in an irregularly pointed egg guide.

Field characters.

O. cambrai is a dark chocolate-brown species with leaf-green fore and middle legs and distal abdomen. Head and thorax are richly ornamented with golden, yellow or white spots; the hind femora are brown with blackish knees. Antenna red brown basally, shading through red to pale yellow distally.

Distribution.

Relatively common in the forests of Eastern Panama. To date all records are from the Province of Darien, but it is not excluded that it occurs elsewhere. Not known from the former Canal Zone or from Western Panama. Similar to the Colombian *Oedalacris cordobae* Descamps & Amedegnato 1972, conceivably a local Panamanian form of that species.

Natural history.

Found on forbs in lowland forest light gaps or along forest paths. Seems to have a marked preference for *Piper* spp. (Piperaceae), which it also eats.

2. *Oedalacris lesbiae* Rowell & Bentos-Pereira 2005

Rowell & Bentos-Pereira 2005: 84.

Type locality: PANAMA: Comarca Kuna Yala: Ustupo. Terre firme, on *Piper peltatum*.

Location of type specimens: ANS Philadelphia.

Etymology.

Named for Lesbia De Gracia, University of Panama, the first collector.

Diagnosis.

Habitus **Fig. Rh13, Plate Rh14**.

Field characters.

Somewhat larger than *O. cambrai*, and differing in coloration: the dark maroon hind femora and the unspotted body are distinctive.

Differs from all other species of the genus in having no pale spots on the dark head and thorax. Prosternal process short, obtusely conical, ending in a small bead-like point. The furcula of the male is minute but clearly defined. Cerci black tipped. Supra-anal plate triangular, transversely divided, the proximal portion with a medial hollow. Posterior margin of female subgenital plate smoothly triangular; terminating in a small pointed egg guide inflected upwards at about 30°. Ventral ovipositor valves smooth, edges devoid of teeth.

Coloration. Head, eyes, palps, antennae, thorax and first two abdominal segments: dark purple-black or blackish brown. Abdomen ochraceous grey, with darker rings around the distal part of each segment. Fore and middle legs, green. Hind femora, dark maroon, knee black; hind tibia olive green, tibial spines white tipped with black; hind feet, yellow-grey.

Distribution.

To date known only from the type specimens, collected at sea level on the North (Caribbean) coast of Eastern Panama. This area, the land of the Kuna nation, is separated from the known distributional area of *O. cambrai* in the Darien by a ridge of mountains parallel to the Caribbean coast, the Serranía de San Blas and the Serranía de Darien. Further collecting is required to delimit the areas occupied by two species.

Natural history.

Largely unknown. Like its congener *O. cambrai*, it seems to feed on *Piper* spp.

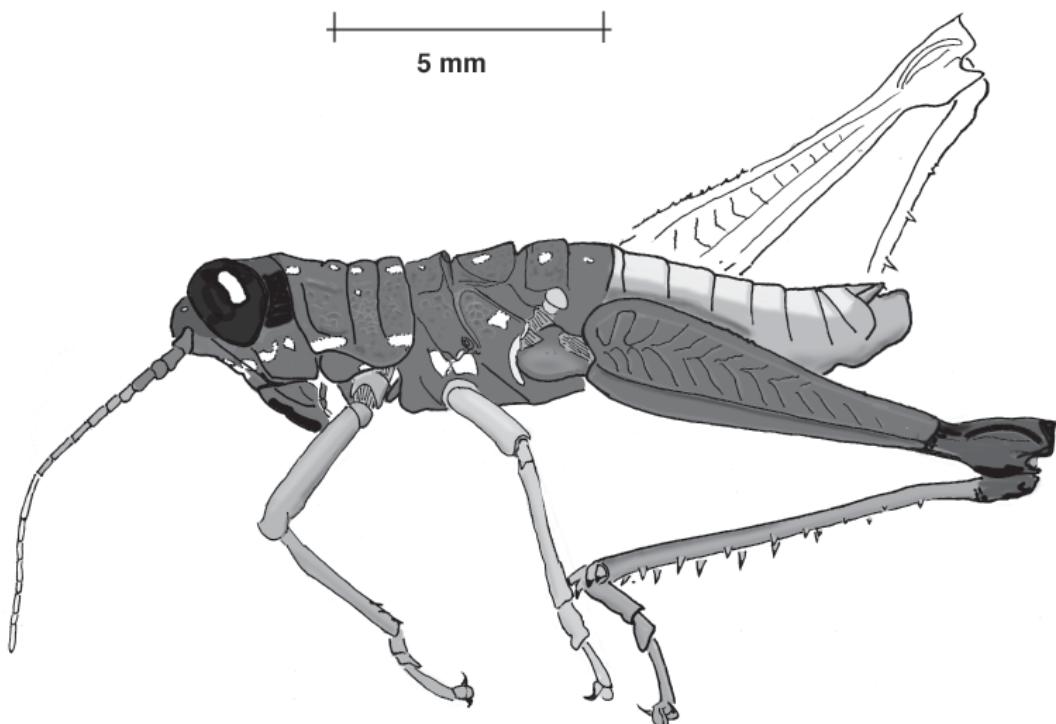


Fig. Rh12. *Oedalacris cambrai*, male habitus.

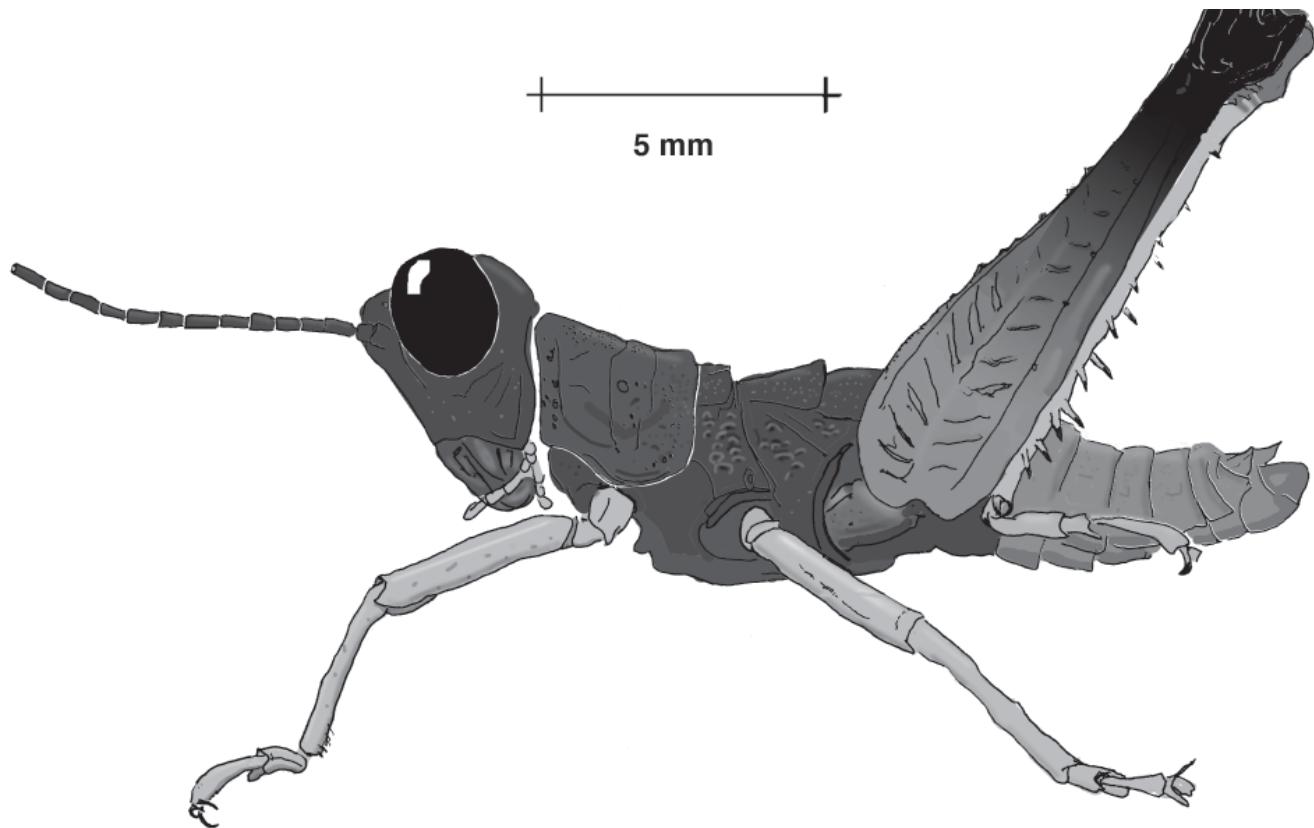


Fig. Rh13. *Oedalacris lesbiae*, male habitus.

Piezops
Hebard 1923

Hebard 1923: 296.

Type species: *Rhytidochrota ensicornis* Stål 1878: 76.

Etymology.

Greek *piezo*, press; *ops*, face, “flattened face”. Presumably refers to the way the frons is depressed relative to the rostrum.

No. of described species.

One.

Subsequent literature.

- Hebard, M. 1924: 136.
- Descamps, M. & Amedegnato, C. 1972: 1087.
- Amedegnato, C. 1974: 201.
- Rowell, C.H.F. & Bentos-Pereira, A. 2005: 77. > Description of female, distribution.

Generic diagnosis.

(See also Fig. Rh14.) Of large size, body length from 25mm (males) to 40 mm (females.) Integument rough and granular. Fastigium of the vertex slanting downward and triangular, the tip often deeply incised by the sulcus of the frontal ridge. Profile of the face strongly concave. Frontal ridge obsolete below the medial ocellus, and deeply grooved above it. Lateral carinulae of the face interrupted below the eyes. The infra-ocular distance is equal to or a little less than the length of the eye. Antennae strongly ensiform, the segments at the base of the flagellum wider than the interocular space, and longer than head and pronotum together, about as long as the hind femur; in males they can be as long as the entire body. Flagellum with 17 segments.

Pronotum very rough with narrow sulci. Metazona with a strong medial process. The anterior margin is excurred and bisinuate in the midline, projecting over the occiput. Posterior margin almost straight. Prosternal process short and conical. The disc has a strong, bluntly spinous lateral process between sulci 2 and 3. Meso- and metanotum very rough and granulate and with elevated posterior medial processes. The upper part of the mesothoracic epimeron is strongly inflated into a rough, bluntly spinous projection. Similar, somewhat weaker, projections are found on the mesothoracic episternum and the metathoracic epimeron.

Hind femora with rough carinae, and rather stronger spines on internal dorsal and ventral carinae. The chevron markings of the outer femoral face are rugose, and the dorsal surfaces of the femora are densely set with pointed tubercles. The dorso-medial carina of the hind femur terminates in a relatively strong spine. Hind tibiae with 7 external and 9 internal spines, which are long and sharp, and those of the internal margin are somewhat curved upwards dorsally. Foot formula 35:14:51, the foot is 30% as long as the hind femur.

A large abdominal tympanum is present. Posterior

margin of the last tergite in the male notched or incurved but the furcula is poorly developed.

***Piezops ensicornis* (Stål 1878)**

Rhytidochrota ensicornis Stål 1878: 76.

Type locality: “Panama”, no other details

Location of type specimen: Vienna Museum.

Diagnosis.

The generic diagnosis applies. Habitus Fig. Rh14, Plate Rh15.

Field characters.

Piezops is a striking and conspicuous animal, large, blackish or very dark brown or very rarely dark green in colour, with orange lateral patches on the proximal abdomen, orange fore and middle legs and hind tibiae, and very long black ensiform antennae. The genital area of the male is commonly a dark greenish brown, somewhat lighter than the rest of the body.

Natural history.

Piezops is typically found in groups, often including adults and larvae, or composed only of adults, either a single female and several males, or a group of males only. The range of ages and sexes seen in the groups suggests that they form from mutual attraction between individuals, and not necessarily from the progeny of a single egg pod. It prefers open sunny localities at the edge of dense montane forest. It has been seen eating three quite unrelated plants: *Bocconia* (Papaveraceae), *Clibadium* (Asteraceae) and *Hyptis* (Labiatae). Although *Clibadium* (locally used as a fish poison) is eaten by several Neotropical acridooids (including *Rhachicreagra* (Ommatolampinae) and *Munatia* (Romaleinae), the other two genera are rarely if ever eaten by grasshoppers other than rhytidochrotines. We have never found an association of *Piezops* with ferns, in contrast to some other Central American rhytidochrotine genera (e.g. *Hylopedetes*, *Exerythracris*).

Larvae. Very young larvae of *Piezops* are entirely black. In the second instar they gain yellow-green legs; in the adults this yellow turns to orange, and the males also develop orange lateral patches at the base of the abdomen, absent in the larvae. Occasionally specimens are seen in which the orange colour is replaced by red.

Distribution.

A Panamanian endemic. Recorded from virtually all highland areas between the western end of the Serranía de San Blás in the East, to the western end of the Cordillera Central at its junction with the Cordillera de Talamanca in the West, near the Panamanian/Costa Rican boundary. The lack of collections from the mountains of Eastern Panama leaves open the possibility of a still wider range. All localities are highland,

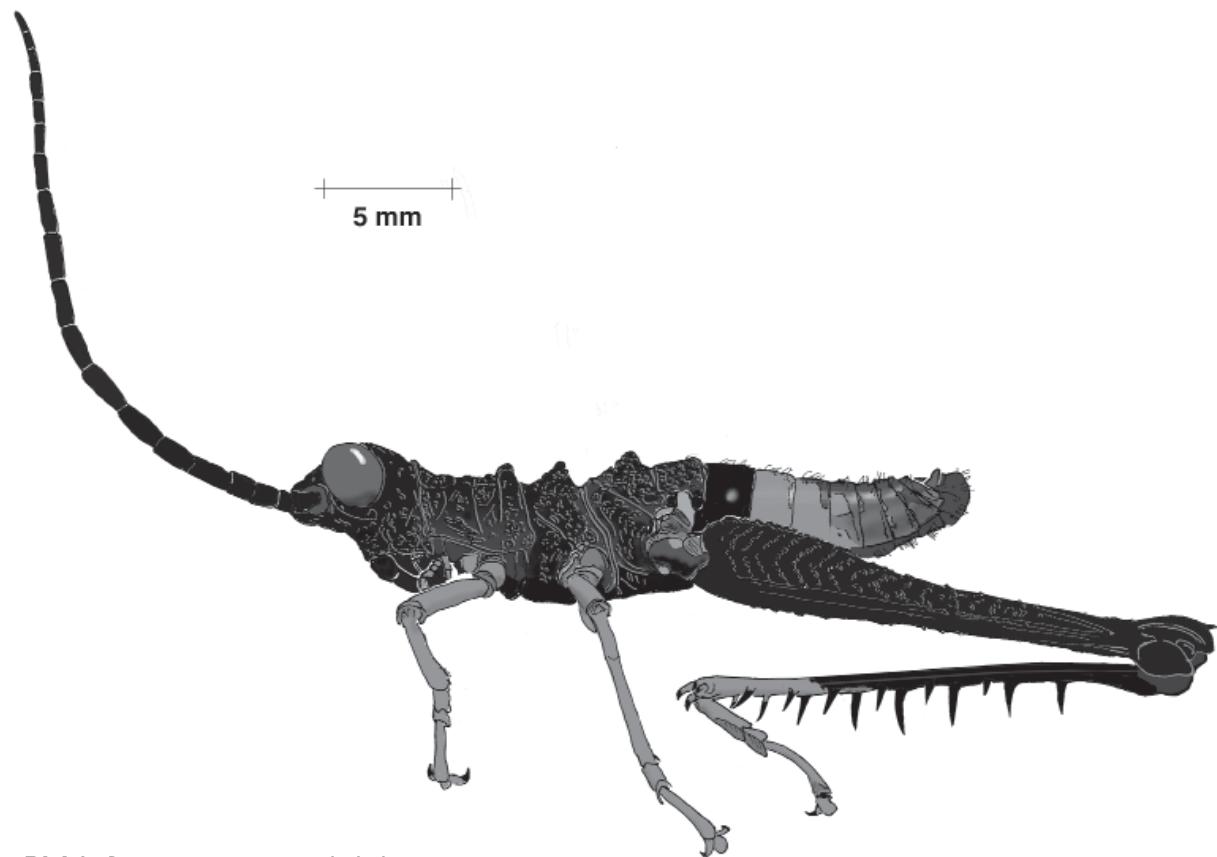
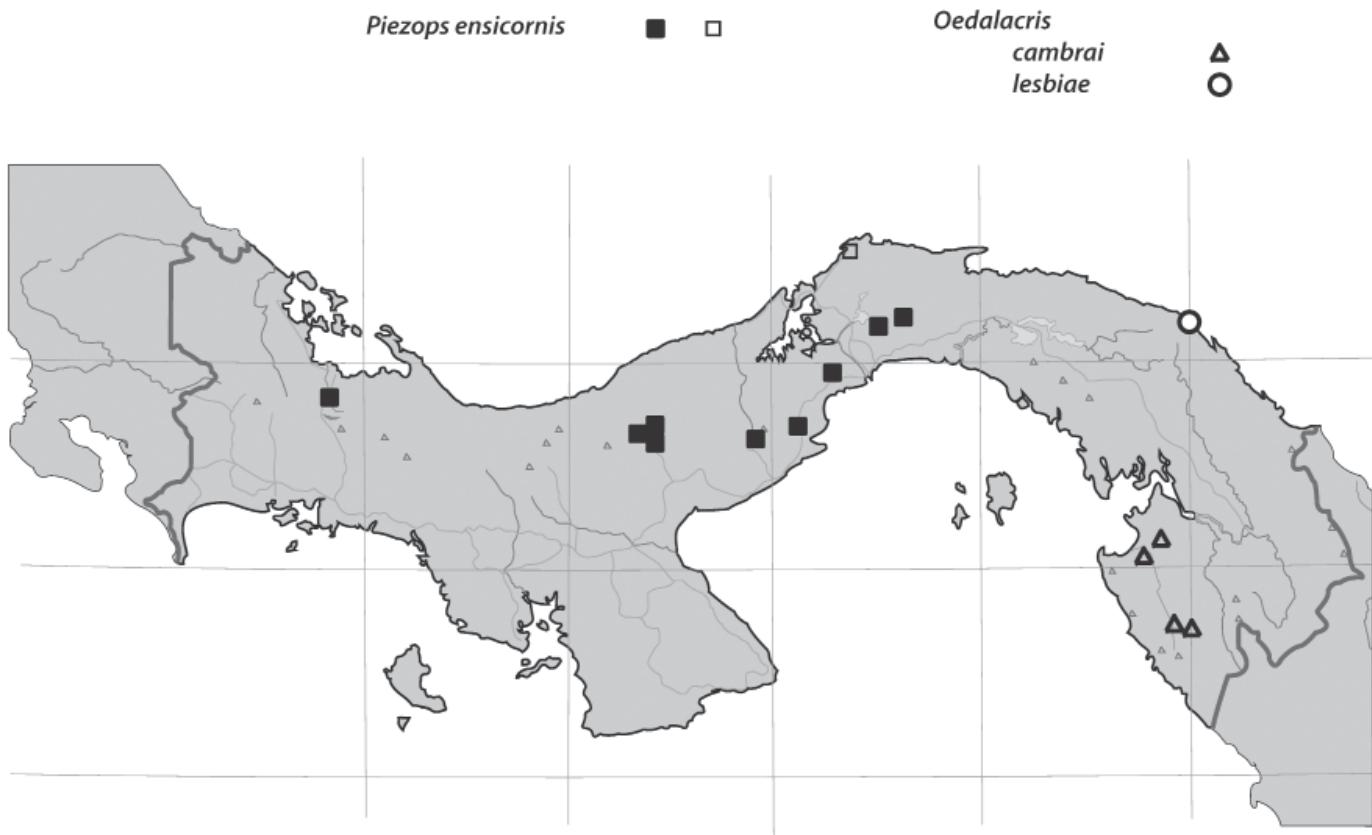


Fig. Rh14. *Piezops ensicornis*, male habitus.



Map Rh8. *Oedalacris* spp. and *Piezops*. The locality indicated by an open square for *Piezops* is very dubious – see text.

between 750 and 1200 m in altitude. Hebard (1924:137) records ANSP specimens collected by the lepidopterist A. Busck in 1911 and 1912 in Portobelo, which is at sea level; but there is higher country close behind this settlement and the specimens may have come from such areas. We have not found it in the Portobelo area proper, despite search. Other allegedly Portobelan specimens collected by Busck are likely in fact to have come from Cerro Campana (see note under *Homeomastax cerciata*, p. 36), and the same may well be true of his specimens of *Piezops*.

Scirtopaon **Descamps & Rowell 1984**

Type species: *Scirtopaon dorsatus* Descamps & Rowell 1984:151
Location of type specimen: MNHN Paris.

Etymology.

Greek *skirtao*, bound or leap; *-paon* from *Opaon* Kirby 1902, a well-known Colombian genus of this subfamily.

No. of described species.

One.

Generic diagnosis.

Similar in size and form to *Hylopedetes*, but very different in appearance.

Readily distinguished from other genera by the combination of blunt rostrum, incomplete pronotal medial carina, and long, thin, filiform antennae, by the pattern of the antennal sutures, the very rugose, sculptured cuticle, especially that of the female, and the distinctive coloration.

Fastigium slanting downwards, slightly longer than wide, truncate at its tip. Frontal ridge about as wide as the antennal pedicel, and obsolete below the medial ocellus. Pronotum has 4 deep sulci, lined with darker pigment; posterior margin of the disc slightly incurved. Prosternal process pointed, spine shaped and inclined towards the rear. Posterior margin of the metanotum thickened in the male. Tympanum absent. Hind tibiae with 7 external spines; male supra-anal plate devoid of black ornamentation. Male furcula consists of two small weakly melanised points on the posterior margin of the 10th abdominal tergite, each placed about midway between the mid line and the cercus.

***Scirtopaon dorsatus* Descamps & Rowell 1984w**

Descamps & Rowell 1984:151.

Type locality: COSTA RICA: Puntarenas: Tilarán: Monteverde, Ventana trail.

Location of type specimens: MNHN Paris.

Etymology.

Dorsatus from Latin *dorsum*, back, probably an allusion to the brightly coloured tergites of the male.

Diagnosis.

The generic diagnosis applies. Habitus **Fig. Rh14-15.**

Plate Rh16.

Field characters.

In life the brilliant yellow or copper and purplish black coloration of the male is unmistakable. The antennae are bright purple. The female is duller, browner and less conspicuous, and the integument is more heavily pitted and rugose than in the male.

Distribution, natural history.

Originally described from Monteverde in the Cordillera de Tilarán, S. *dorsatus* is now known to be widely distributed throughout montane forest zones in the Costa Rican Cordillera Central, including the upper Sarapiquí valley and the valleys of the Ríos La Paz and Toro, in the Cacho Negro area above Quesada and in the R.B. San Ramón. Patchy, never common, and rather cryptic (despite the bright colours of the male), the species is easy to overlook. It is not a fern or grass eater in the wild, but is associated with a variety of montane dicots. It is most often seen eating *Rubus* (Rosaceae) leaves, but also eats *Saurauia* (Actinidiaceae) and *Impatiens* (Balsaminaceae). It has been reared to adulthood through several larval stages on a mixed diet of *Rubus* and *Hypolepis*. Not to date recorded from Panama.

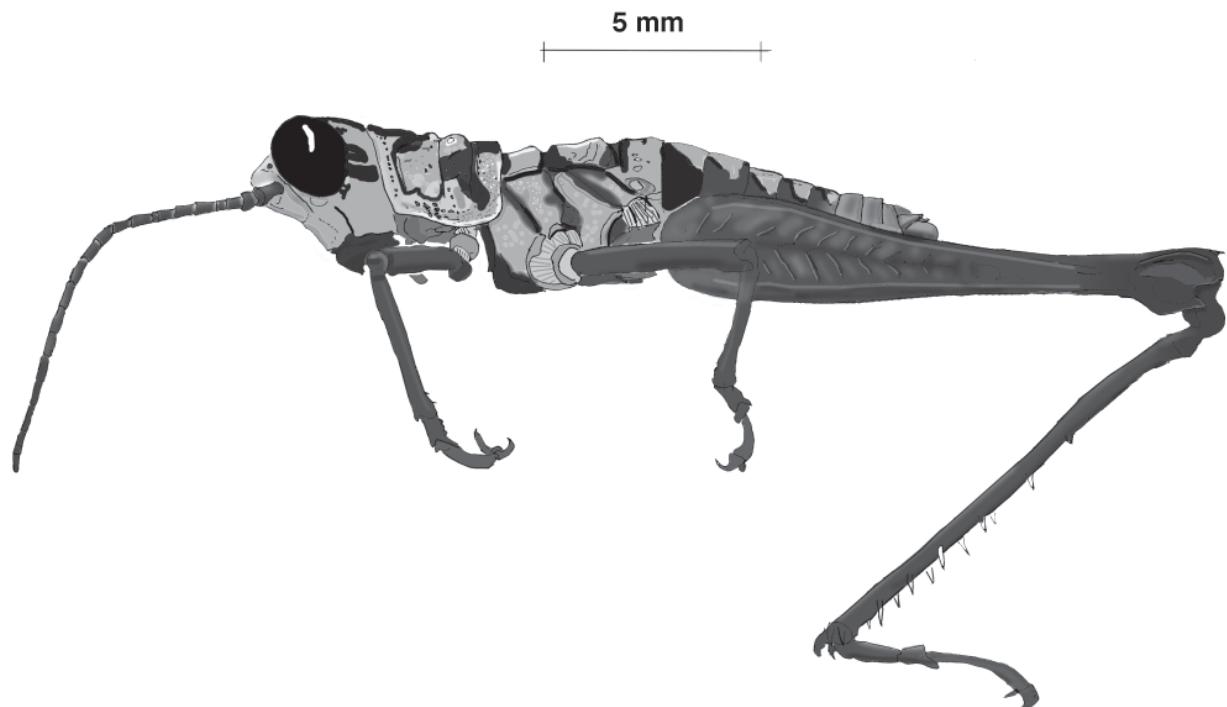


Fig. Rh15. *Scirtopaon dorsatus*, male habitus.



Map Rh9. *Scirtopaon dorsatus*.

Talamancacris
Rowell 1995

Rowell 1995: 568.

Type species. *Talamancacris palustris* Rowell 1995: 572.

Etymology.

"*Talamanca*", the range of mountains in South Central Costa Rica where this genus is found; Greek *akris*, grasshopper, locust.

No. of described species.

One.

Diagnosis. Male. (Fig. Rh16, Plate Rh17).

Size small-medium. Integument highly polished except on head, which is matte. Frons, genae, dorsal surfaces of occiput, and of pronotal disc posterior to the last transverse sulcus, lightly pitted; remaining areas smooth and glossy, as though clear-varnished. Integument with numerous white hairs, especially on the tibiae, proximal hind femora, genital area and meso- and metathoracic sterna, and also bilateral tufts dorsolaterally near anterior margin of each abdominal segment.

Fastigium inclined, triangular, truncate anteriorly, with two low longitudinal ridges proximally, shallowly grooved distally, lateral margins straight or slightly concave. Frontal ridge at its widest point narrower (0.6 times) than interocular space, subparallel sided, somewhat narrower at dorsal and ventral extremities, extending to lower rim of antennal foramen, slightly divergent above medial ocellus; shallowly grooved medially for a short distance dorsal to medial ocellus, lightly pitted between this point and fastigium. Medial ocellus barely visible. Medial and ventral arms of subantennal suture short and rather deeply incised, dorsal arms thin and indistinct. Profile of frons concave, upper part of frontal ridge forming a short, vertically-ended rostrum. Preocular ridges present. Eyes globose. Interocular space slightly wider (1.1 times) than width of antennal pedicel. Antennae filiform, somewhat flattened dorsoventrally, short (2.8 times as long as pronotum) and thick, 17 segments in flagellum of adult.

Pronotum slightly inflated in midline anterior to 1st sulcus, but no medial carina present. Sulci deep; well-developed dorsolateral bulges present between the 2nd and 3rd sulci. Posterior ventral angle of lateral lobe of pronotum rounded, somewhat lobate, projecting ventrally and posteriorly. Anterior ventral angle rounded. Posterior margins of pronotum slightly concave in midline; anterior margin convex and minutely notched. Prosternal process short, abruptly conical, vertical. Medial carina absent from meso- and metanotum. Apterous.

Hind femur relatively short, 3.57× as long as pronotum. Dorsal carinae of femur well marked over most of its length, slightly toothed, obsolete immediately before the knee, terminating there in a sharp spine which exceeds in length the

outer lateral lobes of the knee. Ventral carina strongly developed, smooth, lateral carinulae absent or very slight, outer face of hind femur rounded in cross section. Seven spines on external dorsal margin of hind tibia, 8 on internal dorsal margin. Hind tarsus long in relation to femur (0.32 times), but smaller than in the other Costa Rican genera in relation to the pronotum (1.13 times); 3rd tarsal segment of hind leg slightly (1.28 times) longer than 1st and 2nd tarsal segments together.

Tympanum absent. Medial carina absent from 1st but present on 2nd-6th abdominal segments. Posterior margin of last abdominal tergite with a central notch and short lateral sclerotised teeth. Supra-anal plate triangular, without sclerotised melanic markings, with a short longitudinal medial furrow at its base. Cerci short, conical, simple. Subgenital plate bluntly pointed in lateral view, terminating in a short medial furrow behind the tip of the supra-anal plate, glabrous in ventral and apical midline, pilose laterally. Internal genitalia of the usual type for the subfamily. Epiphallus distinctive.

Female: Size, small to medium. Differs from male in following morphological characters: larger (1.38 times in overall length) and more fusiform, wider in posterior thorax and anterior abdominal segments. Ovipositor valves long, projecting 1.12 mm beyond end of the subgenital plate. Both upper and lower ovipositor valves heavily toothed on exterior outer margins, smooth on inner margins. Lower valves narrow, normally held between upper valves, with a shoulder proximally on lateral ventral edge. Subgenital plate with concave posterior edges, forming a medial point. Spermatheca not examined.

Talamancacris differs from all other Costa Rican rhytidochrotines in that a) the terminal spine of the hind knee projects well beyond the lateral knee lobes, b) the interocular space exceeds the maximum width of the antennal scape and c) in the shape of the male epiphallus. It is also much more hirsute than the other genera. *Talamancacris* has the highest number of extreme morphometric ratios of any of the rhytidochrotine taxa studied: the shortest overall length relative to the pronotum, the widest interocular space, the shortest hind tarsus relative to the pronotum, and the relatively shortest and thickest antennae. *Talamancacris* gives a first impression of a small, short legged version of *Brakeracris*; especially the profile of the head and the form of the frontal ridge and the antennal sutures are very alike in the two genera. The abdomen, legs and antennae are however much shorter (relative to pronotum), the antennae are relatively thicker, the pronotum has no medial carina, its anterior ventral angle lacks projections, and the integument is glossy and smooth. Further, of course, the coloration is different, *Talamancacris* lacking the striking yellow-bordered pronotum of *Brakeracris*.

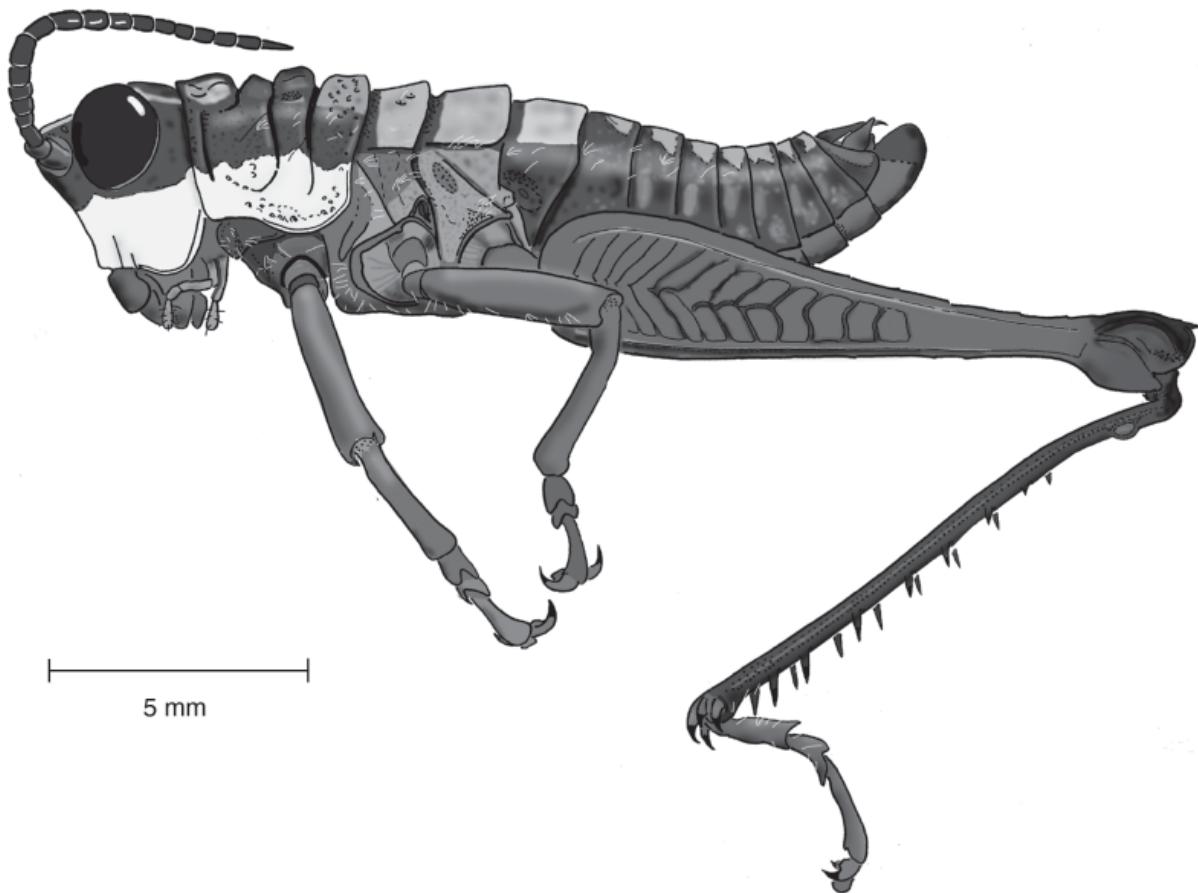


Fig. Rh16. *Talamancacris palustris*, male habitus.



Map Rh10. *Talamancacris palustris*, localities.

I. *Talamancacris palustris* Rowell 1995

Rowell 1995:572.

Type locality: COSTA RICA, Prov. Cartago, Turbera "La Chonta", 2.7km SSE of El Empalme, 2'380 m.

Location of type specimen: ANS Philadelphia.

Etymology.

Latin *palustris*, of swamps, after the habitat of the species.

Diagnosis.

Monospecific genus, the generic diagnosis applies.

Field characters.

Alive, both sexes are dark metallic bluish green, with black antennae and eyes, a shining white facial and pronotal band, paired lighter green chevrons on each abdominal tergum, and reddish hind knees. The striking blue-green colour fades to brownish an hour or two after death and is probably structural in origin.

Distribution.

T. palustris is known only from a few high-altitude bogs lying between 2300 and 2600 m altitude near the watershed of the Talamanca range of Costa Rica. All these localities have a very characteristic vegetation dominated at the ground layer by *Sphagnum* moss and the rush-like *Xyris* (Xyridaceae); the main emergents are the large fern *Blechnum* and the terrestrial Bromeliad *Puya*. This characteristic plant assemblage, otherwise known only from the Andes, is confined to certain areas of restricted drainage which appear to date from after the end of the last glaciation (G.Vargas, pers. comm.). The only other acridoid found in or near any of these sphagnum bogs is the Oedipodine *Chortophaga viridifasciata* (De Geer, 1773). The southernmost localities of *Talamacacris* in Costa Rica lie very close to the Panamanian border, and the species may well occur in that country too. There is apparently suitable habitat on the East slope of Cerro Echandi.

Natural history.

Phenology. Larvae have been found in January, July, August and September, but not in April; adults have been found in July, August and September. A third-instar female larva captured 20th September and maintained in captivity became adult on 5th November. These data are compatible with the hypothesis that there is one generation per year and that eggs are laid at the end of the year or in the first months of the following year, as is common among Costa Rican acridids, but do not exclude the possibility that breeding takes place year round.

Foodplants. *T. palustris* is not obviously associated with any particular plant species in its habitat. It is found on the vegetation covering the bog surface, and not in the emergent shrubs, bromeliads or ferns. Consistent with this observation, in captivity it refuses *Puya*, *Blechnum* and the Ericaceous shrub

Pernettya. It also refuses *Sphagnum* and *Xyris* and a variety of other plants growing with them. The only plant from the native habitat which *Talamancacris* has accepted in captivity is *Hieracium stanleyi* (Asteraceae). In captivity it refuses all monocots and most exotic dicots, but accepts a variety of cultivated Asteraceae, including *Doronicum* and *Dahlia*, especially the latter. (*Dahlia imperialis* is indigenous to Costa Rica and grows within some kilometres of the more northerly bogs inhabited by *T. palustris*, but is not present within them). Some but not all individuals accept in captivity the fern *Hypolepis hostilis* (the commonest food of two other Costa Rican rhytidochrotine genera, *Hylopedetes* and *Exythracris*) or *Rubus* nr *glaucus* (eaten in the wild by the Costa Rican rhytidochrotine *Scirtopaon dorsatus*) but do not eat either of them in quantity. Neither plant is present in the natural habitat. These observations suggest a specialisation of *Talamancacris* on Asteraceae, perhaps normally *H. stanleyi*.

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Note: Bruner's chapter "Acrididae" in the *Biologia Centrali Americana* was published in many parts over a period of some ten years. These parts were not separately titled, and here the total work is listed simply as "BRUNER, L. 1900-1910. Acrididae. In: *Biologia Centrali Americana. Insecta, Orthoptera*, 2: 1-342." However, the species described in the "Biologia" are always attributed to Bruner in the year in which their description first appeared: thus, for example, in the present book *Silvitettix bolleyi* (Bruner 1904) is referenced as "Bruner 1900-1910 (1904): 57, as *Leuconotus bolleyi*."

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Country check lists.

The Tables on the following pages list all the grasshopper species currently known to occur, or at least to have been collected once, in Costa Rica and Panama. Note that in both countries the species list is a work in progress. Probably the majority of species occurring in Costa Rica has been recorded by now, but even there I know of at least three further species for which there are insufficient materials available to make a description possible, and hence are not included in this book. In Panama there are doubtless numerous species still to be recorded, as seen in the apparently shorter list for that country (total 144 species) compared to Costa Rica (198 species). Costa Rica has considerably more highland forest than Panama, and this is a rich habitat; but Panama is in direct contact with the very rich and diverse fauna of Colombia, and the southern half of the country has been very poorly surveyed. So probably the final list for Panama will be at least as long as that for Costa Rica. The two countries are contiguous and not severely different in climate, so it is not surprising that there is much faunal overlap; of the 144 species recorded from Panama to date, 86 (60%) are also recorded from Costa Rica, leaving only 58 unique to Panama. Some of these 58 are also to be found in Colombia, and belong to characteristically S. American taxa such as the Romaleinae, Bactrophorinae, Copiocerinae, Rhytidochrotinae and Proscopiidae. However, there is also a significant number of local Panamanian species of typical Central American genera such as *Homeomastax*, *Hylopedetes* and *Rhachicreagra*, that also have developed numerous unique species in Costa Rica, showing that immigration from the south is not the only source of endemic Panamanian forms.

The lists include the known species of Tridactyloidea and Tetrigoidea, otherwise ignored in this book. The tridactylids are derived from the catalogue of Dr. K.K. Günther (1980), who was also kind enough to examine a large collection of unidentified Costa Rican Tridactyloids for me and confirm that all were included in his published list. The list of Tetrigids is derived from the works of Hebard (1924) and K. Günther (1939); tellingly, there seem to be no more modern publications on this group from our area.

In a few cases, entries in the Table are asterisked. This implies some doubt as to the real occurrence of the species, and the interested reader should refer to the entry for that species in the main text for further information.

An alert orthopterist might perhaps note the absence from these lists of two species previously reported in the literature. These have been synonymised in the present work:

Silvitettix thalassinus Jago 1971 = *S. bolleyi* Bruner 1904, **n. syn.**
Leptomerinthoprora occidentalis Rowell 1983 = *L. brevipennis* Rehn 1905, **n. syn.**

The reasons for these synonymies are presented in the main text.

I. Species list for Costa Rica, as of December 2012.

	Genus	species	Author
TRIDACTYLOIDEA			
1	<i>Ellipes</i>	<i>minutus</i>	Scudder 1862.
2	<i>Ellipes</i>	<i>minutus histrionica</i>	Saussure 1896.
3	<i>Ellipes</i>	<i>rostratus</i>	(Hebard 1928).
4	<i>Neotridactylus</i>	<i>apicialis</i>	(Say 1825).
5	<i>Ripipteryx</i>	<i>bolleyi</i>	Saussure 1896.
6	<i>Ripipteryx</i>	<i>bruneri</i>	Chopard 1920.
7	<i>Ripipteryx</i>	<i>capotensis</i>	Günther 1970.
8	<i>Ripipteryx</i>	<i>carbonaria</i>	Saussure 1896.
9	<i>Ripipteryx</i>	<i>hydrodoma</i>	Saussure 1896.
10	<i>Ripipteryx</i>	<i>insignis</i>	Chopard 1927.
11	<i>Ripipteryx</i>	<i>limbata</i>	Burmeister 1838.
12	<i>Ripipteryx</i>	<i>nodicornis</i>	Hebard 1924.
13	<i>Ripipteryx</i>	<i>ornata</i>	Chopard 1927.
14	<i>Ripipteryx</i>	<i>saltator</i>	Saussure 1896.
15	<i>Mirhipipteryx</i>	<i>biloba</i>	Hebard 1928.
16	<i>Mirhipipteryx</i>	<i>biloba incurvata</i>	Günther 1989.
17	<i>Mirhipipteryx</i>	<i>hondurica</i>	Günther, 1969.
18	<i>Mirhipipteryx</i>	<i>lineata</i>	Günther, 1989.
19	<i>Mirhipipteryx</i>	<i>pulicaria</i>	Saussure, 1896.
20	<i>Mirhipipteryx</i>	<i>variabilis</i>	Günther, 1969.
TETRIGOIDEA			
21	<i>Allotettix</i>	<i>peruvianus</i>	Bolívar, 1887.
22	<i>Chiriquia</i>	<i>serrata</i>	Morse, 1900.
23	<i>Crimisus</i>	<i>costaricensis</i>	Günter, 1939.
24	<i>Ochetotettix</i>	<i>barretti</i>	Hancock, 1899.
25	<i>Otumba</i>	<i>dentata</i>	Hancock, 1906.
26	<i>Paratettix</i>	<i>aztecus</i>	Saussure, 1861.
27	<i>Paratettix</i>	<i>toltecus</i>	Saussure, 1861.
28	<i>Tettigidea</i>	<i>nicaraguae</i>	Bruner, 1895.
EUMASTACOIDEA			
29	<i>Episactus</i>	<i>tristani</i>	Rehn & Rehn 1934.
30	<i>Homeomastax</i>	<i>acrita</i>	Rowell & Bentos-Pereira 2002.
31	<i>Homeomastax</i>	<i>bustum</i>	Rowell & Bentos-Pereira 2002.
32	<i>Homeomastax</i>	<i>dentata</i>	(Saussure 1903).
33	<i>Homeomastax</i>	<i>kressi</i>	(Rehn 1929).
34	<i>Homeomastax</i>	<i>pluvialis</i>	Rowell & Bentos-Pereira 2002.
35	<i>Homeomastax</i>	<i>robertsi</i>	(Descamps 1971).

36	<i>Homeomastax</i>	<i>silvicola</i>	(Rehn 1929).
37	<i>Homeomastax</i>	<i>strigla</i>	Rowell & Bentos-Pereira 2002.
38	<i>Homeomastax</i>	<i>surda</i>	Burr 1898.
39	<i>Homeomastax</i>	<i>tenoriensis</i>	Rowell & Bentos-Pereira 2002.

PROSCOPIOIDEA

40	<i>Pseudoproscoptia</i>	<i>septentrionalis</i>	(Bruner 1905).
41	<i>Pseudoproscoptia</i>	<i>sp. indet.</i>	Bentos-Pereira & Rowell 1999.

PYRGOMORPHOIDEA

42	<i>Prophena</i>	<i>scudderii</i>	Bolívar 1884.
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**ACRIDOIDEA, Romaleidae,
Bactrophorinae**

43	<i>Bactrophora</i>	<i>mirabilis</i>	(Bruner 1905).
44	<i>Caenolampis</i>	<i>osae</i>	(Roberts 1973).
45	<i>Caenolampis</i>	<i>robertsi</i>	Descamps 1978.
46	<i>Inbiolampis</i>	<i>herediensis</i>	Rowell 2012.
47	<i>Lagarolampis</i>	<i>cararensis</i>	Rowell 1999.
48	<i>Lagarolampis</i>	<i>maculata</i>	Rowell 1999.
49	<i>Mezentia</i>	<i>proracerca</i>	Rowell 2012.
50	<i>Mezentia</i>	<i>prymnocerca</i>	Rowell 2012.
51	<i>Nautia</i>	<i>conspersipes</i>	Bruner 1907.
52	<i>Nautia</i>	<i>costaricensis</i>	Descamps 1978.
53	<i>Nautia</i>	<i>crassipes</i>	Descamps 1978.
54	<i>Nautia</i>	<i>flavosignata</i>	Stål 1878.
55	<i>Rhincoderma</i>	<i>humile</i>	Rehn 1905.
56	<i>Rhincoderma</i>	<i>olivaceum</i>	Gerstaecker 1889.
57	<i>Parahicnoderma</i>	<i>cacaoensis</i>	Rowell 2012.
58	<i>Parahicnoderma</i>	<i>janzeni</i>	Rowell 2012.
59	<i>Parahicnoderma</i>	<i>laselvae</i>	Rowell 2012.
60	<i>Parahicnoderma</i>	<i>uatsiensis</i>	Rowell 2012.
61	<i>Taeniophora</i>	<i>femorata</i>	Bruner 1908.
62	<i>Taeniophora</i>	<i>panamae</i>	Hebard 1924.
63	<i>Taeniophora</i>	<i>rubrosignata</i>	Descamps & Rowell 1984.
64	<i>Zoumolampis</i>	<i>bradleyi</i>	(Rehn 1929).

ACRIDOIDEA**Romaleidae, Romaleinae**

65	<i>Agriacris</i>	<i>tricristata</i>	(Serville 1839).
66	<i>Chromacris</i>	<i>colorata</i>	(Serville 1839).
67	<i>Chromacris</i>	<i>psittacus</i>	(Gerstaecker 1873).
68	<i>Chromacris</i>	<i>trogon</i>	(Gerstaecker 1873).
69	<i>Cibopteryx</i>	<i>variegata</i>	Rehn 1905.
70	<i>Cloephoracris</i>	<i>caesia</i>	Rowell 1999.

71	<i>Cloephoracris</i>	<i>disrupta</i>	Rowell 1999.
72	<i>Colpolopha</i>	<i>bruneri</i>	Rehn 1905.
73			
dubious!*	<i>Colpolopha</i>	<i>rehni</i>	Hebard 1923.
74	<i>Costarica</i>	<i>costaricensis</i>	(Carbonell 2000).
75	<i>Legua</i>	<i>crenulata</i>	(Stoll 1813).
76	<i>Munatia</i>	<i>bolleyi</i>	Carl 1916.
77	<i>Munatia</i>	<i>punctata</i>	Stål 1875.
78	<i>Phaeoparia</i>	<i>depressicornis</i>	(Bruner 1908).
79	<i>Phaeoparia</i>	<i>phrygana</i>	Jago 1980.
80	<i>Procolpia</i>	<i>lankesteri</i>	Rehn 1955.
81	<i>Taeniopoda</i>	<i>reticulata</i>	(Fabricius 1781).
82	<i>Taeniopoda</i>	<i>variipennis</i>	Rehn 1905.
83	<i>Titanacris</i>	<i>ornatifemur</i>	Descamps & Carbonell 1985.
84	<i>Titanacris</i>	<i>velasquezi</i>	(Nieto 1857).
85	<i>Tropidacris</i>	<i>cristata</i>	(Linn 1758).
86	<i>Xyleus</i>	<i>discoideus mexicanus</i>	Bruner 1906.
87	<i>Xyleus</i>	<i>discoideus rosulentus</i>	Stål 1878.

ACRIDOIDEA**Acrididae, Acridinae**

88	<i>Metaleptea</i>	<i>adspersa</i>	(Blanchard 1846).
89	<i>Metaleptea</i>	<i>brevicornis</i>	(Linn 1753).
90	<i>Orphula</i>	<i>azteca</i>	Saussure 1861.

ACRIDOIDEA**Acrididae, Copiocerinae**

91	<i>Copiocera</i>	<i>specularis</i>	Gerstaecker 1889.
92	<i>Copiocera</i>	<i>harroweri</i>	Hebard 1924.
93	<i>Copiotettix</i>	<i>venezuelae</i>	Descamps 1984.

ACRIDOIDEA**Acrididae, Cyrtacanthacridinae**

94	<i>Schistocerca</i>	<i>centralis</i>	Dirsh 1974.
95	<i>Schistocerca</i>	<i>nitens</i>	(Thunberg 1815).
96	<i>Schistocerca</i>	<i>pallens</i>	(Thunberg 1815).
97	<i>Schistocerca</i>	<i>piceifrons</i>	(Walker 1870).

ACRIDOIDEA**Acrididae, Gomphocerinae**

98	<i>Achurum</i>	<i>sumichrasti</i>	(Saussure 1861)
99	<i>Amblytropidia</i>	<i>mysteca</i>	(Saussure 1861).
100	<i>Amblytropidia</i>	<i>trinitatis</i>	Bruner 1904.
101	<i>Orphulella</i>	<i>pernix</i>	Otte 1979.
102	<i>Orphulella</i>	<i>punctata</i>	(De Geer 1773).
103	<i>Orphulina</i>	<i>baloui</i>	(Rehn 1905).
104	<i>Rhammatocerus</i>	<i>schistocercoides</i>	(Rehn 1906).
105	<i>Rhammatocerus</i>	<i>viatorius</i>	(Saussure 1861).

106	<i>Silvitettix</i>	<i>bolleyi</i>	(Bruner 1904).
107	<i>Silvitettix</i>	<i>communis</i>	(Bruner 1904).
108	<i>Silvitettix</i>	<i>maculatus</i>	Otte & Jago 1979.
109	<i>Syrbula</i>	<i>festina</i>	Otte 1979.

ACRIDOIDEA**Acrididae, Leptysminae**

110	<i>Cornops</i>	<i>aquaticum</i>	(Bruner 1906).
111	<i>Cylindrotettix</i>	<i>insularis herbaceus</i>	(Bruner 1908).
112	<i>Guetaresia</i>	<i>lankesteri</i>	Rehn 1929.
113	<i>Leptysma</i>	<i>marginocollis mexicana</i>	(Saussure 1861).
114	<i>Stenacris</i>	<i>fissicauda goethalsi</i>	(Hebard 1924).
115	<i>Stenacris</i>	<i>minor</i>	(Bruner 1906).
116	<i>Stenacris</i>	<i>vitreipennis</i>	(Marschall 1836).
117	<i>Stenacris</i>	<i>xanthochlora</i>	(Marschall 1836).
118	<i>Stenopola</i>	<i>dorsalis</i>	(Thunberg 1827).
119	<i>Stenopola</i>	<i>puncticeps</i>	(Stål 1860).

ACRIDOIDEA**Acrididae, Melanoplinae**

120	<i>Aidemona</i>	<i>azteca</i>	(Saussure 1861).
121	<i>Baeacris</i>	<i>morosa</i>	(Rehn 1905).
122	<i>Baeacris</i>	<i>alamancensis</i>	Rowell & Carbonell 1977.

ACRIDOIDEA**Acrididae, Oedipodinae**

123	<i>Chortophaga</i>	<i>viridifasciata</i>	(DeGeer 1773).
124	<i>Heliastrus</i>	<i>sumichrasti</i>	(Saussure 1861).
125	<i>Lactista</i>	<i>pellipidus</i>	Saussure 1884.
126	<i>Lactista</i>	<i>stramineus</i>	(Erichson 1848).
127	<i>Leuronotina</i>	<i>orizibae</i>	(Saussure 1884).

ACRIDOIDEA**Acrididae, Ommatolampinae**

128	<i>Abracris</i>	<i>directa</i>	Walker 1870.
129	<i>Abracris</i>	<i>flavolineata</i>	(DeGeer 1773).
130	<i>Ateliacris</i>	<i>annulicornis</i>	Bruner 1908.
131	<i>Ateliacris</i>	<i>annulicornis pulchra</i>	Rowell 2008.
132	<i>Christenacris</i>	<i>sanguilenta</i>	Descamps & Rowell 1984.
133	<i>Cryptacris</i>	<i>costaricensis</i>	Descamps & Rowell 1984.
134	<i>Leptomerinthoprora</i>	<i>brevipennis</i>	Rehn 1905.
135	<i>Leptomerinthoprora</i>	<i>corticina</i>	(Hebard 1924).
136	<i>Microtylopteryx</i>	<i>fusiformis</i>	Rehn 1905.
137	<i>Microtylopteryx</i>	<i>hebardi</i>	Rehn 1905.
138	<i>Nicarchus</i>	<i>erinaceus</i>	Stål 1878.
139	<i>Pauracris</i>	<i>brachyptera</i>	Rowell 2008.
140	<i>Pseudanniceris</i>	<i>nigrinervis</i>	(Stål 1878).

141	Rhachicreagra	<i>anchidiphalara</i>	Jago & Rowell 1981.
142	Rhachicreagra	<i>abopsis</i>	Rowell 2000.
143	Rhachicreagra	<i>astytophallus</i>	Jago & Rowell 1981
144	Rhachicreagra	<i>brachysphagicerca</i>	Jago & Rowell 1981.
145	Rhachicreagra	<i>chrysonota chrysonota</i>	Rowell 2000.
146	Rhachicreagra	<i>chrysonota salazari</i>	Rowell 2008.
147	Rhachicreagra	<i>drymocnemensis</i>	Jago & Rowell 1981
148	Rhachicreagra	<i>gracilis</i>	Jago & Rowell 1981.
149	Rhachicreagra	<i>jagoi</i>	Rowell 2008.
150	Rhachicreagra	<i>khayachrosa</i>	Jago & Rowell 1981.
151	Rhachicreagra	<i>melanota</i>	Jago & Rowell 1981.
152	Rhachicreagra	<i>nothra</i>	Rehn 1905.
153	Rhachicreagra	<i>obsidian</i>	Jago & Rowell 1981.
154	Rhachicreagra	<i>sphagicerca</i>	Jago & Rowell 1981.
155	Rhachicregra	<i>taurusflavus</i>	Rowell 2000.
156	Vilerna	<i>polita</i>	Descamps & Amedegnato 1989.

ACRIDOIDEA**Acrididae, Pauliniinae**

157	Paulinia	<i>acuminata</i>	(DeGeer 1773).
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ACRIDOIDEA**Acrididae, Proctolabinae**

158	Adelotettix	<i>gigas</i>	Descamps & Rowell 1978.
159	Ampelophilus	<i>coeruleus</i>	Descamps & Rowell 1984.
160	Ampelophilus	<i>meridionalis</i>	(Bruner 1908).
161	Ampelophilus	<i>olivaceus</i>	(Giglio-Tos 1897).
162	Ampelophilus	<i>truncatus</i>	(Rehn 1905).
163	Balachowskyacris	<i>olivacea</i>	(Bruner 1908).
164	Balachowskyacris	<i>rhabdotus</i>	(Hebard 1924).
165	Balachowskyacris	<i>narinoana</i>	Descamps & Amedegnato 1972
166	Balachowskyacris?	<i>robertsi</i>	Descamps 1976.
167	Drymacris	<i>nebulicola</i>	(Rehn 1929).
168	Drymophilacris	<i>bimaculata</i>	(Rehn 1905).
169	Drymophilacris	<i>glyphocerca</i>	Rowell 2000.
170	Drymophilacris	<i>monteverdensis</i>	Descamps & Rowell 1978.
171	Drymophilacris	<i>panamae</i>	Descamps 1976.
172	Kritacris	<i>arboricola</i>	Descamps 1976.
173	Kritacris	<i>dicranophallus</i>	Rowell 2007.
174	Kritacris	<i>licrophallus</i>	Rowell 2007.
175	Leioscapheus	<i>gracilicornis</i>	Bruner 1908.
176	Leioscapheus	<i>guapiles</i>	Roberts 1973
177	Leioscapheus	<i>laselvae</i>	Roberts 1973.
178	Leioscapheus	<i>variegatus</i>	Bruner 1908.
179	Leioscapheus	<i>tremae</i>	n.sp.
180	Lithoscirtus	<i>daedalus</i>	Rehn 1929.

181	<i>Lithoscirtus</i>	<i>miniatulus</i>	(Rehn 1905).
182	<i>Lithoscirtus</i>	<i>tesselatus</i>	Rowell 2000.
183	<i>Lithoscirtus</i>	<i>viceitas</i>	Rehn 1929.
184	<i>Paratela</i>	<i>ovatipennis</i>	(Rehn 1905).
185	<i>Poecilocloeus</i>	<i>septentrionalis</i>	Rowell 2007.
186	<i>Tela</i>	<i>neavora</i>	Descamps & Rowell 1978.
187	<i>Zosperamerus</i>	<i>limonensis</i>	Descamps & Rowell 1978.
188	<i>Zosperamerus</i>	<i>planus</i>	Roberts 1973.
189	<i>Zosperamerus</i>	<i>virgatus</i>	Roberts 1973.

ACRIDOIDEA**Acrididae, Rhytidochrotinae**

190	<i>Brakeracris</i>	<i>varablancae</i>	Rowell 1995.
191	<i>Exerythracris</i>	<i>volcanica</i>	Rowell 1995.
192	<i>Hylopedetes</i>	<i>cruentus</i>	Rehn 1929.
193	<i>Hylopedetes</i>	<i>gemmeus</i>	Rehn 1929.
194	<i>Hylopedetes</i>	<i>mirandus</i>	Rehn 1929.
195	<i>Hylopedetes</i>	<i>nigrithorax</i>	Descamps & Rowell 1978.
196	<i>Hylopedetes</i>	<i>punctatus</i>	Rowell & Bentos-Pereira 2005.
197	<i>Hylopedetes</i>	<i>surdus</i>	Descamps & Rowell 1978.
198	<i>Micropaon</i>	<i>lucens</i>	Descamps & Rowell 1984.
199	<i>Talamancacris</i>	<i>palustris</i>	Rowell 1995.

ACRIDOIDEA**Acrididae, incerta sedis: Eucopiocerae**

200	<i>Leptalacris</i>	<i>fastigiata</i>	Descamps & Rowell 1978.
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2. Species list for Panama, as of December 2012.

	Genus	species	Author
TRIDACTYLOIDEA			
1	<i>Ellipes</i>	<i>minutus</i>	Scudder 1862.
2	<i>Ellipes</i>	<i>wagneri</i>	(Chopard 1920).
3	<i>Rhipipteryx</i>	<i>bolleyi</i>	Saussure 1896.
4	<i>Rhipipteryx</i>	<i>bruneri</i>	Chopard 1920.
5	<i>Rhipipteryx</i>	<i>carbonaria</i>	Saussure 1896.
6	<i>Rhipipteryx</i>	<i>hydrodoma</i>	Saussure 1896.
7	<i>Rhipipteryx</i>	<i>limbata</i>	Burmeister 1838.
8	<i>Rhipipteryx</i>	<i>nodicornis</i>	Hebard 1924.
9	<i>Rhipipteryx</i>	<i>ornata</i>	Chopard 1927.
10	<i>Rhipipteryx</i>	<i>rivularia</i>	Saussure 1896.
11	<i>Mirhipipteryx</i>	<i>biloba</i>	Hebard 1928.
12	<i>Mirhipipteryx</i>	<i>hondurica</i>	Günther, 1969.
13	<i>Mirhipipteryx</i>	<i>panamica</i>	Günther 1969.
14	<i>Mirhipipteryx</i>	<i>pulicaria</i>	(Saussure, 1896).
TETRIGOIDEA			
15	<i>Allotettix</i>	<i>peruvianus</i>	(Bolívar, 1887).
16	<i>Chiriquia</i>	<i>serrata</i>	Morse, 1900.
17	<i>Otumba</i>	<i>aciculata</i>	Hebard 1924.
18	<i>Ochetotettix</i>	<i>barretti</i>	(Hancock, 1899).
19	<i>Paratettix</i>	<i>aztecus</i>	(Saussure, 1861).
20	<i>Paratettix</i>	<i>toltecus</i>	(Saussure, 1861).
21	<i>Paratettix</i>	<i>antennatus</i>	Hebard 1923.
22	<i>Paratettix</i>	<i>frey-gesneri</i>	Bolívar 1888.
23	<i>Tettigidea</i>	<i>nicaraguae</i>	Bruner, 1895.
24	<i>Paurotarsus</i>	<i>insolitus</i>	Rehn 1916.
25	<i>Scaria</i>	<i>fasciata</i>	Hancock 1907.
EUMASTACOIDEA			
26	<i>Homeomastax</i>	<i>kressi</i>	(Rehn 1929).
27	<i>Homeomastax</i>	<i>brachyptera</i>	Rowell & Bentos-Pereira 2002.
28	<i>Homeomastax</i>	<i>cerciata</i>	(Hebard 1924).
29	<i>Homeomastax</i>	<i>quinteroi</i>	Rowell & Bentos-Pereira 2002.
30	<i>Homeomastax</i>	<i>veraguae</i>	Hebard 1933.
31	<i>Helicomastax</i>	<i>mnioides</i>	Rowell & Bentos-Pereira 2002.
32	<i>Helicomastax</i>	<i>copensis</i>	Rowell & Bentos-Pereira 2002.

PROSCOPIOIDEA

33	<i>Pseudoprosopia</i>	<i>septentrionalis</i>	(Bruner 1905).
34	<i>Pseudoprosopia</i>	<i>sp. indet.</i>	Bentos-Pereira & Rowell 1999.
35	<i>Pseudoprosopia</i>	<i>panamensis</i>	Bentos-Pereira & Rowell 1999.

ACRIDOIDEA,**Romaleidae, Bactrophorinae**

36	<i>Caenolampis</i>	<i>robertsi</i>	Descamps 1978.
37	<i>Caenolampis</i>	<i>copensis</i>	Rowell 2012.
38	<i>Lagarolampis</i>	<i>gamboensis</i>	Rowell 1999.
39	<i>Mezentia</i>	<i>gibbera</i>	Stål 1878.
40	<i>Megacheilacris</i>	<i>megacephala</i>	(Bruner 1907).
41	<i>Nautia</i>	<i>crassipes</i>	Descamps 1978.
42	<i>Nautia</i>	<i>flavosignata</i>	Stål 1878.
43	<i>Nautia</i>	<i>panamae</i>	Descamps 1978.
44	<i>Nautia</i>	<i>atrata</i>	Rowell 2012.
45	<i>Rhicnoderma</i>	<i>olivaceum</i>	Gerstaecker 1889.
46	<i>Panamacris</i>	<i>magnifica</i>	(Hebard 1924).
47	<i>Taeniophora</i>	<i>femorata</i>	Bruner 1908.
48	<i>Taeniophora</i>	<i>panamae</i>	Hebard 1924.
49	<i>Taeniophora</i>	<i>choocoensis</i>	Hebard 1924.
50	<i>Taeniophora</i>	<i>pirrensis</i>	Rowell 2012.
51	<i>Taeniophora</i>	<i>santosi</i>	Rowell 2012.
52	<i>Zoumolampis</i>	<i>bradleyi</i>	(Rehn 1929).

ACRIDOIDEA,**Romaleidae, Romaleinae**

53	<i>Agriacris</i>	<i>tricristata</i>	(Serville 1839).
54	<i>Chromacris</i>	<i>psittacus</i>	(Gerstaecker 1873).
55	<i>Cibotopteryx</i>	<i>sp.</i>	not described.
56	<i>Cloephoracris</i>	<i>caesia</i>	Rowell 1999.
57	<i>Cloephoracris</i>	<i>festae</i>	(Giglio-Tos 1897).
58	<i>Colpolopha</i>	<i>bruneri</i>	Rehn 1905.
59	<i>Colpolopha</i>	<i>rehni</i>	Hebard 1923.
60	<i>Legua</i>	<i>crenulata</i>	(Stoll 1813).
61	<i>Maculiparia</i>	<i>rotundata</i>	(Stål 1875).
62	<i>Maculiparia</i>	<i>embera</i>	Rowell 2006.
63	<i>Maculiparia</i>	<i>coibensis</i>	Rowell 2006.
64	<i>Munatia</i>	<i>bolleyi</i>	Carl 1916.
65	<i>Munatia</i>	<i>punctata</i>	Stål 1875.
66	<i>Phaeoparia</i>	<i>depressicornis</i>	(Bruner 1908).
67	<i>Phaeoparia</i>	<i>phrygana</i>	Jago 1980.
68	<i>Procolpia</i>	<i>lankesteri</i>	Rehn 1955.
69	<i>Taeniopoda</i>	<i>reticulata</i>	(Fabricius 1781).
70	<i>Taeniopoda</i>	<i>variopennis</i>	Rehn 1905.

71	<i>Titanacris</i>	<i>gloriosa</i>	(Hebard 1924).
72	<i>Titanacris</i>	<i>ornatifemur</i>	Descamps & Carbonell 1985.
73	<i>Tropidacris</i>	<i>cristata</i>	(Linn 1758).
74	<i>Xyleus</i>	<i>discoideus rosulentus</i>	(Stål 1878).

ACRIDOIDEA,
Acrididae, Acridinae

75	<i>Metalepta</i>	<i>adspersa</i>	(Blanchard 1846).
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ACRIDOIDEA,
Acrididae, Copiocerinae

76	<i>Copiocera</i>	<i>harroweri</i>	Hebard 1924.
77	<i>Copiocera</i>	<i>specularis</i>	(Gerstaeker 1889).
78	<i>Copiocera</i>	<i>austera</i>	(Gerstaeker 1889).
79	<i>Copiotettix</i>	<i>megacephala</i>	Descamps 1984.

ACRIDOIDEA,
Acrididae, Cyrtacanthacridinae

80	<i>Schistocerca</i>	<i>centralis</i>	Dirsh 1974.
81	<i>Schistocerca</i>	<i>nitens</i>	(Thunberg 1815).
82	<i>Schistocerca</i>	<i>pallens</i>	(Thunberg 1815).
83	<i>Schistocerca</i>	<i>piceifrons</i>	(Walker 1870).

ACRIDOIDEA,
Acrididae, Gomphocerinae

84	<i>Achurum</i>	<i>sumichrasti</i>	(Saussure 1861).
85	<i>Amblytropidia</i>	<i>trinitatis</i>	Bruner 1904.
86	<i>Dichromorpha</i>	<i>viridis</i>	Scudder 1862.
87	<i>Orphulella</i>	<i>punctata</i>	(De Geer 1773).
88	<i>Orphulella</i>	<i>concinnula</i>	(Walker 1870).
89	<i>Rhammatocerus</i>	<i>cyanipes</i>	(Fabricius 1775).
90	<i>Silvitettix</i>	<i>communis</i>	(Bruner 1904).
91	<i>Silvitettix</i>	<i>gorgasi</i>	Hebard 1924.
92	<i>Silvitettix</i>	<i>centralis</i>	n.sp.

ACRIDOIDEA,
Acrididae, Leptysminae

93	<i>Belosacris</i>	<i>coccineipes</i>	(Bruner 1906).
94	<i>Cornops</i>	<i>aquaticum</i>	(Bruner 1906).
95	<i>Cylindrotettix</i>	<i>insularis</i>	Bruner 1908.
96	<i>Guetaresia</i>	<i>lankesteri</i>	Rehn 1929.
97	<i>Stenacris</i>	<i>fissicauda</i>	Bruner 1908.
98	<i>Stenacris</i>	<i>xanthochlora</i>	(Marschall 1836).
99	<i>Stenopola</i>	<i>dorsalis</i>	(Thunberg 1827).
100	<i>Stenopola</i>	<i>puncticeps</i>	(Stål 1860).

ACRIDOIDEA,**Acrididae, Melanoplinae**

- I01** *Aidemonia* *azteca* (Saussure 1861).
I02 *Baeacris* *morosa* (Rehn 1905).

ACRIDOIDEA,**Acrididae, Oedipodinae**

- I03** *Heliastus* *sumichrasti* (Saussure 1861).
I04 *Lactista* *stramineus* (Erichson 1848).

ACRIDOIDEA,**Acrididae, Ommatolampinae**

- | | | |
|--------------------------------------|------------------------------|-----------------------------|
| I05 <i>Abracris</i> | <i>dilecta</i> | Walker 1870. |
| I06 <i>Abracris</i> | <i>flavolineata</i> | (DeGeer 1773). |
| I07 <i>Ateliacris</i> | <i>annulicornis</i> | Bruner 1908. |
| I08 <i>Cryptacris</i> | <i>costaricensis</i> | Descamps & Rowell 1984. |
| I09 <i>Leptomerinthoprora</i> | <i>brevipennis</i> | Rehn 1905. |
| I10 <i>Leptomerinthoprora</i> | <i>corticina</i> | (Hebard 1924). |
| I11 <i>Microtylopteryx</i> | <i>fusiformis fusiformis</i> | Rehn 1905. |
| I12 <i>Microtylopteryx</i> | <i>fusiformis fastigiata</i> | Rowell 2003 |
| I13 <i>Microtylopteryx</i> | <i>hebardi nigrigena</i> | Hebard 1924). |
| I14 <i>Nicarchus</i> | <i>erinaceus</i> | Stål 1878. |
| I15 <i>Omalotettix</i> | <i>chapardensis</i> | Bruner 1908. |
| I16 <i>Pseudanniceris</i> | <i>nigrinervis</i> | (Stål 1878). |
| I17 <i>Rhachicreagra</i> | <i>obsidian</i> | Jago & Rowell 1981. |
| I18 <i>Rhachicreagra</i> | <i>achrosta</i> | Jago & Rowell 1981. |
| I19 <i>Rhachicreagra</i> | <i>dierythra</i> | Rowell 2000. |
| I21 <i>Rhachicreagra</i> | <i>magnifica</i> | Rowell 2000. |
| I22 <i>Vilerna</i> | <i>polita</i> | Descamps & Amedegnato 1989. |

ACRIDOIDEA,**Acrididae, Pauliniinae**

- I23** *Paulinia* *acuminata* (DeGeer 1773).

ACRIDOIDEA,**Acrididae, Proctolabinae**

- | | | |
|------------------------------------|----------------------|-----------------------------|
| I24 <i>Adelotettix</i> | <i>gigas</i> | Descamps & Rowell 1978. |
| I25 <i>Adelotettix</i> | <i>ombrophilus</i> | Descamps & Amedegnato 1972. |
| I26 <i>Ampelophilus</i> | <i>olivaceus</i> | (Giglio-Tos 1897). |
| I27 <i>Balachowskyacris</i> | <i>rhabdotus</i> | (Hebard 1924). |
| I28 <i>Coscineuta</i> | <i>coxalis</i> | Serville 1839). |
| I29 <i>Drymophilacris</i> | <i>panamae</i> | Descamps 1976. |
| I30 <i>Drymophilacris</i> | <i>rubripes</i> | Descamps & Rowell 1984. |
| I31 <i>Drymophilacris</i> | <i>nigrescens</i> | Rowell 2000. |
| I32 <i>Drymophilacris</i> | <i>veraguae</i> | Rowell 2000. |
| I33 <i>Drymophilacris</i> | <i>melanopsis</i> | Rowell 2000. |
| I34 <i>Leioscapheus</i> | <i>gracilicornis</i> | Bruner 1908. |

I35	<i>Leioscapheus</i>	<i>hebardi</i>	Roberts 1973.
I36	<i>Lithoscirtus</i>	<i>viceitas</i>	Rehn 1929.
I37	<i>Zosperamerus</i>	<i>planus</i>	Roberts 1973.

ACRIDOIDEA,**Acrididae, Rhytidochrotinae**

I38	<i>Chiriquacris</i>	<i>quadrimaculata</i>	Rowell & Bentos-Pereira 2005.
I39	<i>Hylopedetes</i>	<i>fuliginosus</i>	Rowell & Bentos-Pereira 2005.
I40	<i>Hylopedetes</i>	<i>gemmeus</i>	Rehn 1929.
I41	<i>Hylopedetes</i>	<i>nigrithorax panamensis</i>	Rowell & Bentos-Pereira 2005.
I42	<i>Oedalacris</i>	<i>cambrai</i>	Rowell & Bentos-Pereira 2005.
I43	<i>Oedalacris</i>	<i>lesbiae</i>	Rowell & Bentos-Pereira 2005.K
I44	<i>Piezops</i>	<i>ensicornis</i>	(Stål 1878).

3. Species list for Costa Rica and Panama combined, as of December 2012.

In this final table, all species for both countries are combined. The second and third columns show the occurrence or otherwise in each of the two countries (CR & P).

ACRIDOIDEA, Acrididae, Acridinae

	CR	P	Genus	species	Author
TRIDACTYLOIDEA					
1	CR	P	<i>Ellipes</i>	<i>minutus</i>	Scudder 1862.
2	CR		<i>Ellipes</i>	<i>minutus histriónica</i>	Saussure 1896.
3	CR		<i>Ellipes</i>	<i>rostratus</i>	(Hebard 1928).
4		P	<i>Ellipes</i>	<i>wagneri</i>	(Chopard 1920).
5	CR		<i>Neotridactylus</i>	<i>apicalis</i>	(Say 1825).
6	CR	P	<i>Rhipipteryx</i>	<i>bolleyi</i>	Saussure 1896.
7	CR	P	<i>Rhipipteryx</i>	<i>bruneri</i>	Chopard 1920.
8	CR		<i>Rhipipteryx</i>	<i>capotensis</i>	Günther 1970.
9	CR	P	<i>Rhipipteryx</i>	<i>carbonaria</i>	Saussure 1896.
10	CR	P	<i>Rhipipteryx</i>	<i>hydrodoma</i>	Saussure 1896.
11	CR		<i>Rhipipteryx</i>	<i>insignis</i>	Chopard 1927.
12	CR	P	<i>Rhipipteryx</i>	<i>limbata</i>	Burmeister 1838.
13	CR	P	<i>Rhipipteryx</i>	<i>nodicornis</i>	Hebard 1924.
14	CR	P	<i>Rhipipteryx</i>	<i>ornata</i>	Chopard 1927.
15	CR		<i>Rhipipteryx</i>	<i>saltator</i>	Saussure 1896.
16		P	<i>Rhipipteryx</i>	<i>rivularia</i>	Saussure 1896.
17	CR		<i>Mirhipipteryx</i>	<i>biloba</i>	Hebard 1928.
18	CR	P	<i>Mirhipipteryx</i>	<i>biloba incurvata</i>	Günther 1989.
19	CR	P	<i>Mirhipipteryx</i>	<i>hondurica</i>	Günther, 1969.
20	CR		<i>Mirhipipteryx</i>	<i>lineata</i>	Günther, 1989.
21		P	<i>Mirhipipteryx</i>	<i>panamica</i>	Günther 1969.
22	CR	P	<i>Mirhipipteryx</i>	<i>pulicaria</i>	(Saussure, 1896).
23	CR		<i>Mirhipipteryx</i>	<i>variabilis</i>	Günther, 1969.
TETRIGOIDEA					
24	CR	P	<i>Allotettix</i>	<i>peruvianus</i>	(Bolívar, 1887).
25	CR	P	<i>Chiriquia</i>	<i>serrata</i>	Morse, 1900.
26	CR		<i>Crimisus</i>	<i>costaricensis</i>	Gunter, 1939.
27		P	<i>Otumba</i>	<i>aciculata</i>	Hebard 1924.
28	CR		<i>Otumba</i>	<i>dentata</i>	Hancock, 1906.
29	CR	P	<i>Ochetotettix</i>	<i>barretti</i>	(Hancock, 1899).
30	CR	P	<i>Paratettix</i>	<i>aztecus</i>	(Saussure, 1861).
31	CR	P	<i>Paratettix</i>	<i>toltecus</i>	(Saussure, 1861).
32		P?	<i>Paratettix</i>	<i>antennatus</i>	Hebard 1923.
33		P	<i>Paratettix</i>	<i>frey-gesneri</i>	Bolívar 1888.
34	CR	P	<i>Tettigidea</i>	<i>nicaraguae</i>	Bruner, 1895.

35	P	<i>Paurotarsus</i>	<i>insolitus</i>	Rehn 1916.
36	P	<i>Scaria</i>	<i>fasciata</i>	Hancock 1907.

EUMASTACOIDEA

37	CR	<i>Episactus</i>	<i>tristani</i>	Rehn & Rehn 1934.
38	CR	<i>Homeomastax</i>	<i>acrita</i>	Rowell & Bentos-Pereira 2002.
39	CR	<i>Homeomastax</i>	<i>bustum</i>	Rowell & Bentos-Pereira 2002.
40	CR	<i>Homeomastax</i>	<i>dentata</i>	(Saussure 1903).
41	CR P	<i>Homeomastax</i>	<i>kressi</i>	(Rehn 1929).
42	CR	<i>Homeomastax</i>	<i>pluvialis</i>	Rowell & Bentos-Pereira 2002.
43	CR	<i>Homeomastax</i>	<i>robertsi</i>	(Descamps 1971).
44	CR	<i>Homeomastax</i>	<i>silvicola</i>	(Rehn 1929).
45	CR	<i>Homeomastax</i>	<i>strigla</i>	Rowell & Bentos-Pereira 2002.
46	CR	<i>Homeomastax</i>	<i>surda</i>	Burr 1898.
47	CR	<i>Homeomastax</i>	<i>tenoriensis</i>	Rowell & Bentos-Pereira 2002.
48	P	<i>Homeomastax</i>	<i>brachyptera</i>	Rowell & Bentos-Pereira 2002.
49	P	<i>Homeomastax</i>	<i>cerciata</i>	(Hebard 1924).
50	P	<i>Homeomastax</i>	<i>quinteroi</i>	Rowell & Bentos-Pereira 2002.
51	P	<i>Homeomastax</i>	<i>veraguae</i>	Hebard 1933.
52	P	<i>Helicomastax</i>	<i>mnioides</i>	Rowell & Bentos-Pereira 2002.
53	P	<i>Helicomastax</i>	<i>copensis</i>	Rowell & Bentos-Pereira 2002.

PROSCOPIOIDEA

54	CR P	<i>Pseudoproscoptia</i>	<i>septentrionalis</i>	(Bruner 1905).
55	CR P	<i>Pseudoproscoptia</i>	<i>sp. indet.</i>	Bentos-Pereira & Rowell 1999.
56	P	<i>Pseudoproscoptia</i>	<i>panamensis</i>	Bentos-Pereira & Rowell 1999.

PYRGOMORPHOIDEA

57	CR	<i>Proshprena</i>	<i>scudderii</i>	Bolívar 1884.
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ACRIDOIDEA,**Romaleidae, Bactrophorinae**

58	CR	<i>Bactrophora</i>	<i>mirabilis</i>	(Bruner 1905).
59	CR	<i>Caenolampis</i>	<i>osae</i>	(Roberts 1973).
60	CR P	<i>Caenolampis</i>	<i>robertsi</i>	Descamps 1978.
61	P	<i>Caenolampis</i>	<i>copensis</i>	Rowell 2012.
62	CR	<i>Inbiolampis</i>	<i>herediensis</i>	Rowell 2012.
63	CR	<i>Lagarolampis</i>	<i>cararensis</i>	Rowell 1999.
64	CR	<i>Lagarolampis</i>	<i>maculata</i>	Rowell 1999.
65	P	<i>Lagarolampis</i>	<i>gamboensis</i>	Rowell 1999.
66	P	<i>Mezentia</i>	<i>gibbera</i>	Stål 1878.
67	CR	<i>Mezentia</i>	<i>proracerca</i>	Rowell 2012.
68	CR	<i>Mezentia</i>	<i>pyrmnocerca</i>	Rowell 2012.
69	P	<i>Megacheilacris</i>	<i>megacephala</i>	(Bruner 1907).
70	CR	<i>Nautia</i>	<i>conspersipes</i>	Bruner 1907.

71	CR	<i>Nautia</i>	<i>costaricensis</i>	Descamps 1978.
72	CR P	<i>Nautia</i>	<i>crassipes</i>	Descamps 1978.
73	CR P	<i>Nautia</i>	<i>flavosignata</i>	Stål 1878.
74	P	<i>Nautia</i>	<i>panamae</i>	Descamps 1978.
75	P	<i>Nautia</i>	<i>atrata</i>	Rowell 2012.
76	CR	<i>Rhicnoderma</i>	<i>humile</i>	Rehn 1905.
77	CR P	<i>Rhicnoderma</i>	<i>olivaceum</i>	Gerstaecker 1889.
78	CR	<i>Parahicnoderma</i>	<i>cacaoensis</i>	Rowell 2012.
79	CR	<i>Parahicnoderma</i>	<i>janzeni</i>	Rowell 2012.
80	CR	<i>Parahicnoderma</i>	<i>laselvae</i>	Rowell 2012.
81	CR	<i>Parahicnoderma</i>	<i>uatsiensis</i>	Rowell 2012.
82	P	<i>Panamacris</i>	<i>magnifica</i>	(Hebard 1924).
83	CR P?	<i>Taeniophora</i>	<i>femorata</i>	Bruner 1908.
84	CR P	<i>Taeniophora</i>	<i>panamae</i>	Hebard 1924.
85	CR	<i>Taeniophora</i>	<i>rubrosignata</i>	Descamps & Rowell 1984.
86	P	<i>Taeniophora</i>	<i>chocoensis</i>	Hebard 1924.
87	P	<i>Taeniophora</i>	<i>pirrensis</i>	Rowell 2012.
88	P	<i>Taeniophora</i>	<i>santosi</i>	Rowell 2012.
89	CR P	<i>Zoumolampis</i>	<i>bradleyi</i>	(Rehn 1929).

ACRIDOIDEA, Romaleidae, Romaleinae

90	CR P	<i>Agriacris</i>	<i>tricristata</i>	(Serville 1839).
91	CR	<i>Chromacris</i>	<i>colorata</i>	(Serville 1839).
92	CR P	<i>Chromacris</i>	<i>psittacus</i>	(Gerstaecker 1873).
93	CR	<i>Chromacris</i>	<i>trogon</i>	(Gerstaecker 1873).
94	P	<i>Cibopteryx</i>	<i>sp.</i>	not determined.
95	CR	<i>Cibopteryx</i>	<i>variegata</i>	Rehn 1905.
96	CR	<i>Cloephoracris</i>	<i>caesia</i>	Rowell 1999.
97	CR	<i>Cloephoracris</i>	<i>disrupta</i>	Rowell 1999.
98	P	<i>Cloephoracris</i>	<i>festae</i>	(Giglio-Tos 1897).
99	CR P	<i>Colpolopha</i>	<i>bruneri</i>	Rehn 1905.
100	CR P	<i>Colpolopha</i>	<i>rehni</i>	Hebard 1923.
101	CR	<i>Costarica</i>	<i>costaricensis</i>	(Carbonell 2000).
102	CR P	<i>Legua</i>	<i>crenulata</i>	(Stoll 1813).
103	P	<i>Maculiparia</i>	<i>rotundata</i>	Stål 1878.
104	P	<i>Maculiparia</i>	<i>embera</i>	Rowell 2006.
105	P	<i>Maculiparia</i>	<i>coibensis</i>	Rowell 2006.
106	CR P	<i>Munatia</i>	<i>bolleyi</i>	Carl 1916.
107	CR P	<i>Munatia</i>	<i>punctata</i>	Stål 1875.
108	CR P	<i>Phaeoparia</i>	<i>depressicornis</i>	(Bruner 1908).
109	CR P	<i>Phaeoparia</i>	<i>phrygana</i>	Jago 1980.
110	CR P	<i>Procolpia</i>	<i>lankesteri</i>	Rehn 1955.
111	CR P	<i>Taeniopoda</i>	<i>reticulata</i>	(Fabricius 1781).
112	CR P	<i>Taeniopoda</i>	<i>variopennis</i>	Rehn 1905.
113	P	<i>Titanacris</i>	<i>glopirosa</i>	(Hebard 1924).

I14	CR	P	<i>Titanacris</i>	<i>ornatifemur</i>	Descamps & Carbonell 1985.
I15	CR		<i>Titanacris</i>	<i>velasquezi</i>	(Nieto 1857).
I16	CR	P	<i>Tropidacris</i>	<i>cristata cristata</i>	(Linn 1758).
I17	CR		<i>Xyleus</i>	<i>discoideus mexicanus</i>	(Bruner 1906).

ACRIDOIDEA,**Acrididae, Acridinae**

I18	CR	P	<i>Xyleus</i>	<i>discoideus rosulentus</i>	(Stål 1878).
I19	CR	P	<i>Metaleptea</i>	<i>adspersa</i>	(Blanchard 1846).
I20	CR		<i>Metaleptea</i>	<i>brevicornis</i>	(Linn 1753).
I21	CR		<i>Orphula</i>	<i>azteca</i>	Saussure 1861.

ACRIDOIDEA,**Acrididae, Copiocerinae**

I22	CR		<i>Copiocera</i>	<i>specularis</i>	Gerstaecker 1889.
I23	CR	P	<i>Copiocera</i>	<i>harroweri</i>	Hebard 1924.
I24		P	<i>Copiocera</i>	<i>austera</i>	(Gerstaecker 1889).
I25		P	<i>Copiotettix</i>	<i>megacephala</i>	Descamps 1984.
I26	CR		<i>Copiotettix</i>	<i>venezuelae</i>	Descamps 1984.

ACRIDOIDEA,**Acrididae, Cyrtacanthacridinae**

I27	CR	P	<i>Schistocerca</i>	<i>centralis</i>	Dirsh 1974.
I28	CR	P	<i>Schistocerca</i>	<i>nitens</i>	(Thunberg 1815).
I29	CR	P	<i>Schistocerca</i>	<i>pallens</i>	(Thunberg 1815).
I30	CR	P	<i>Schistocerca</i>	<i>piceifrons</i>	(Walker 1870).

ACRIDOIDEA,**Acrididae, Gomphocerinae**

I31	CR	P	<i>Achurum</i>	<i>sumichrasti</i>	(Sauvage 1861).
I32	CR		<i>Amblytropidia</i>	<i>mysteca</i>	(Sauvage 1861).
I33	CR	P	<i>Amblytropidia</i>	<i>trinitatis</i>	Bruner 1904.
I34	CR	P	<i>Dichromorpha</i>	<i>viridis</i>	Scudder 1862.
I35	CR		<i>Orphulella</i>	<i>pernix</i>	Otte 1979.
I36	CR	P	<i>Orphulella</i>	<i>punctata</i>	(De Geer 1773).
I37		P	<i>Orphulella</i>	<i>concinnula</i>	(Walker 1870).
I38	CR		<i>Orphulina</i>	<i>balloui</i>	(Rehn 1905).
I39	CR		<i>Rhammatocerus</i>	<i>schistocercoides</i>	(Rehn 1906).
I40	CR		<i>Rhammatocerus</i>	<i>viatorius</i>	(Sauvage 1861).
I41		P	<i>Rhammatocerus</i>	<i>cyanipes</i>	(Fabricius 1775).
I42	CR		<i>Silvitettix</i>	<i>biolleyi</i>	(Bruner 1904).
I43	CR	P	<i>Silvitettix</i>	<i>communis</i>	(Bruner 1904).
I44	CR		<i>Silvitettix</i>	<i>maculatus</i>	Otte & Jago 1979.
I45		P	<i>Silvitettix</i>	<i>gorgasi</i>	Hebard 1924.
I46		P	<i>Silvitettix</i>	<i>centralis</i>	n.sp.
I47	CR		<i>Syrbula</i>	<i>festina</i>	Otte 1979.

ACRIDOIDEA,**Acrididae, Leptysminae**

148	P	<i>Belosacris</i>	<i>coccineipes</i>	(Bruner 1906).
149	CR P	<i>Cornops</i>	<i>aquaticum</i>	(Bruner 1906).
150	CR P	<i>Cylindrotettix</i>	<i>insularis</i>	Bruner 1908.
151	CR P	<i>Guetaresia</i>	<i>lankesteri</i>	Rehn 1929.
152	CR	<i>Leptysma</i>	<i>marginocollis</i>	(Serville 1839).
153	CR P	<i>Stenacris</i>	<i>fissicauda</i>	Bruner 1908.
154	CR	<i>Stenacris</i>	<i>minor</i>	(Bruner 1906).
155	CR	<i>Stenacris</i>	<i>vitreipennis</i>	(Marschall 1836).
156	CR P	<i>Stenacris</i>	<i>xanthochlora</i>	(Marschall 1836).
157	CR P	<i>Stenopola</i>	<i>dorsalis</i>	(Thunberg 1827).
158	CR P	<i>Stenopola</i>	<i>puncticeps</i>	(Stål 1860).

ACRIDOIDEA,**Acrididae, Melanoplinae**

159	CR P	<i>Aidemona</i>	<i>azteca</i>	(Saussure 1861).
160	CR P	<i>Baeacris</i>	<i>morosa</i>	(Rehn 1905).
161	CR	<i>Baeacris</i>	<i>talamancensis</i>	Rowell & Carbonell 1977.

ACRIDOIDEA,**Acrididae, Oedipodinae**

162	CR	<i>Chortophaga</i>	<i>viridifasciata</i>	(DeGeer 1773).
163	CR P	<i>Heliastus</i>	<i>sumichrasti</i>	(Saussure 1861).
164	CR	<i>Lactista</i>	<i>pellipidus</i>	Saussure 1884.
165	CR P	<i>Lactista</i>	<i>stramineus</i>	(Erichson 1848).
166	CR	<i>Leuronotina</i>	<i>orizibae</i>	(Saussure 1884).

ACRIDOIDEA,**Acrididae, Ommatolampinae**

167	CR P	<i>Abracris</i>	<i>dilecta</i>	Walker 1870.
168	CR P	<i>Abracris</i>	<i>flavolineata</i>	(DeGeer 1773).
169	CR P	<i>Ateliacris</i>	<i>ann. annulicornis</i>	Bruner 1908.
170	CR	<i>Ateliacris</i>	<i>annulicornis pulchra</i>	Rowell 2008.
171	CR	<i>Christenacris</i>	<i>sanguilenta</i>	Descamps & Rowell 1984.
172	CR P	<i>Cryptacris</i>	<i>costaricensis</i>	Descamps & Rowell 1984.
173	CR P	<i>Leptomerinthoprora</i>	<i>brevipennis</i>	Rehn 1905.
174	CR P	<i>Leptomerinthoprora</i>	<i>corticina</i>	(Hebard 1924).
175	CR P	<i>Microtylopteryx</i>	<i>fusiformis</i>	Rehn 1905.
176		<i>Microtylopteryx</i>	<i>fus. fastigiata</i>	Rowell 2003.
177	CR P	<i>Microtylopteryx</i>	<i>hebardi hebardi</i>	Rehn 1905.
178	P	<i>Microtylopteryx</i>	<i>hebardi nigrigena</i>	(Hebard 1924).
179	CR P	<i>Nicarchus</i>	<i>erinaceus</i>	Stål 1878.
180	P	<i>Omalotettix</i>	<i>chapadensis</i>	Bruner 1908.
181	CR	<i>Pauracris</i>	<i>brachyptera</i>	Rowell 2008.
182	CR P	<i>Pseudanniceris</i>	<i>nigrinervis</i>	(Stål 1878).
183	CR	<i>Rhachicreagra</i>	<i>anchidiphalara</i>	Jago & Rowell 1981.
184	CR	<i>Rhachicreagra</i>	<i>apopsis</i>	Rowell 2000.
185	CR	<i>Rhachicreagra</i>	<i>astytophallus</i>	Jago & Rowell 1981.

186	CR	Rhachicreagra	<i>brachysphagicerca</i>	Jago & Rowell 1981.
187	CR	Rhachicreagra	<i>chrysonota</i>	Rowell 2000.
188	CR	Rhachicreagra	<i>chrysonota salazari</i>	Rowell 2008.
189	CR	Rhachicreagra	<i>drymocnemensis</i>	Jago & Rowell 1981.
190	CR	Rhachicreagra	<i>gracilis</i>	Jago & Rowell 1981.
191	CR	Rhachicreagra	<i>jagoi</i>	Rowell 2008.
192	CR	Rhachicreagra	<i>khayachrosa</i>	Jago & Rowell 1981.
193	CR	Rhachicreagra	<i>melanota</i>	Jago & Rowell 1981.
194	CR	Rhachicreagra	<i>nothra</i>	Rehn 1905.
195	CR P	Rhachicreagra	<i>obsidian</i>	Jago & Rowell 1981.
196	CR	Rhachicreagra	<i>sphagicerca</i>	Jago & Rowell 1981.
197	CR	Rhachicreagra	<i>taurusflavus</i>	Rowell 2000.
198	P	Rhachicreagra	<i>achrosta</i>	Jago & Rowell 1981.
199	P	Rhachicreagra	<i>dierythra</i>	Rowell 2000.
200	P	Rhachicreagra	<i>magnifica</i>	Rowell 2000.
201	CR P	Vilerna	<i>politae</i>	Descamps & Amedegnato 1989.

ACRIDOIDEA,
Acrididae, Pauliniinae

202	CR P	Paulinia	<i>acuminata</i>	(DeGeer 1773).
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ACRIDOIDEA,
Acrididae, Proctolabinae

203	CR P	Adelotettix	<i>gigas</i>	Descamps & Rowell 1978.
204	P	Adelotettix	<i>ombrophilus</i>	Descamps & Amedegnato 1972.
205	CR	Ampelophilus	<i>coeruleus</i>	Descamps & Rowell 1984.
206	CR	Ampelophilus	<i>meridionalis</i>	(Bruner 1908).
207	CR P	Ampelophilus	<i>olivaceus</i>	(Giglio-Tos 1897).
208	CR	Ampelophilus	<i>truncatus</i>	(Rehn 1905).
209	CR	Balachowskyacris	<i>olivacea</i>	(Bruner 1908).
210	CR P	Balachowskyacris	<i>rhabdotus</i>	(Hebard 1924).
211	CR	Balachowskyacris	<i>narinoana</i>	Descamps & Amedegnato 1972
212	CR	Balachowskyacris?	<i>robertsi</i>	Descamps 1976.
213	P	Coscineuta	<i>coxalis</i>	Serville 1839).
214	CR	Drymacris	<i>nebulicola</i>	(Rehn 1929).
215	CR	Drymophilacris	<i>bimaculata</i>	(Rehn 1905).
216	CR	Drymophilacris	<i>glyphocerca</i>	Rowell 2000.
217	CR	Drymophilacris	<i>monteverdensis</i>	Descamps & Rowell 1978.
218	CR P	Drymophilacris	<i>panamae</i>	Descamps 1976.
219	P	Drymophilacris	<i>rubripes</i>	Descamps & Rowell 1984.
220	P	Drymophilacris	<i>nigrescens</i>	Rowell 2000.
221	P	Drymophilacris	<i>veraguae</i>	Rowell 2000.
222	P	Drymophilacris	<i>melanopsis</i>	Rowell 2000.
223	CR	Kritacris	<i>arboricola</i>	Descamps 1976.
224	CR	Kritacris	<i>dicranophallus</i>	Rowell 2007.
225	CR	Kritacris	<i>licrophallus</i>	Rowell 2007.
226	CR P	Leioscapheus	<i>gracilicornis</i>	Bruner 1908.
227	CR	Leioscapheus	<i>guapiles</i>	Roberts 1973.
228	CR	Leioscapheus	<i>laselvae</i>	Roberts 1973.

229	CR	<i>Leioscapheus</i>	<i>variegatus</i>	Bruner 1908.
230	CR	<i>Leioscapheus</i>	<i>tremae</i>	n.sp.
231	P	<i>Leioscapheus</i>	<i>hebardi</i>	Roberts 1973.
232	CR	<i>Lithoscirtus</i>	<i>daedalus</i>	Rehn 1929.
233	CR	<i>Lithoscirtus</i>	<i>miniatulus</i>	(Rehn 1905).
234	CR	<i>Lithoscirtus</i>	<i>tesselatus</i>	Rowell 2000.
235	CR P	<i>Lithoscirtus</i>	<i>viceitas</i>	Rehn 1929.
236	CR	<i>Paratela</i>	<i>ovatipennis</i>	(Rehn 1905).
237	CR	<i>Poecilocloeus</i>	<i>septentrionalis</i>	Rowell 2007.
238	CR	<i>Tela</i>	<i>neavora</i>	Descamps & Rowell 1978.
239	CR	<i>Zosperamerus</i>	<i>limonensis</i>	Descamps & Rowell 1978.
240	CR P	<i>Zosperamerus</i>	<i>planus</i>	Roberts 1973.
241	CR	<i>Zosperamerus</i>	<i>virgatus</i>	Roberts 1973.

ACRIDOIDEA,**Acrididae, Rhytidochrotinae**

242	CR	<i>Brakeracris</i>	<i>varablancae</i>	Rowell 1995.
243	P	<i>Chiriquacris</i>	<i>quadrimaculata</i>	Rowell & Bentos-Pereira 2005.
244	CR	<i>Exerythracris</i>	<i>volcanica</i>	Rowell 1995.
245	CR	<i>Hylopedetes</i>	<i>cruentus</i>	Rehn 1929.
246	P	<i>Hylopedetes</i>	<i>fuliginosus</i>	Rowell & Bentos-Pereira 2005.
247	CR P	<i>Hylopedetes</i>	<i>gemmeus</i>	Rehn 1929.
248	CR	<i>Hylopedetes</i>	<i>mirandus</i>	Rehn 1929.
249	CR	<i>Hylopedetes</i>	<i>nigrithorax</i>	Descamps & Rowell 1978.
250	P	<i>Hylopedetes</i>	<i>nigrithorax panamensis</i>	Rowell & Bentos-Pereira 2005.
251	CR	<i>Hylopedetes</i>	<i>punctatus</i>	Rowell & Bentos-Pereira 2005.
252	CR	<i>Hylopedetes</i>	<i>surdus</i>	Descamps & Rowell 1978.
253	CR	<i>Micropaon</i>	<i>lucens</i>	Descamps & Rowell 1984.
254	P	<i>Oedalacris</i>	<i>cambrai</i>	Rowell & Bentos-Pereira 2005.
255	P	<i>Oedalacris</i>	<i>lesbiae</i>	Rowell & Bentos-Pereira 2005.
256	P	<i>Piezops</i>	<i>ensicornis</i>	(Stål 1878).
257	CR	<i>Talamancacris</i>	<i>palustris</i>	Rowell 1995.

ACRIDOIDEA,**Acrididae, Incerta Sedis: Eucopiocerae**

258	CR	<i>Leptalacris</i>	<i>fastigiata</i>	Descamps & Rowell 1978.
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About the colour plates.

The colour plates are normally the most used part of any field guide. I have therefore given them a lot of thought and effort. Though good photographs of living animals can be very informative, no photograph can show the morphological detail possible with a good drawing. Photographs of pinned museum specimens can show morphological detail, but invariably give a poor impression of the living animal, because grasshopper pigments and colours change after death, often very markedly. I have therefore chosen to make coloured drawings of all the species in this book. These have been made using a microscope, with drawing tube, from pinned specimens. The coloration is as nearly true to life as possible, based on my field notes and colour photos of living animals.

Note that individual grasshoppers of any one species can vary greatly in colour. In fact, it would be difficult to find two individuals of any one species that were precisely the same. Genetic variation plays a part in this, and there are also numerous environmental influences. For example, the degree of humidity during development often controls whether the ground colour of a grasshopper is green or brown, and this polymorphism is often better expressed in the larval stages, e.g. in the genera *Schistocerca* and *Abracris*. *Schistocerca* is also one of the few genera that exhibit a socialising effect upon contact with numerous conspecifics – which in turn brings about endocrine changes that affect all aspects of the animal's physiology, including its coloration. So-called “gregarious” locusts are often brightly marked in yellow and black, or pink and black, and look very different from their “solitarious” conspecifics. Some grasshoppers show the phenomenon known as “background homochromy”: as a result of visual input, their pigmentation changes over time to match their habitual background. This change in colour can be striking, and it is particularly common in geophilous taxa, such as many “band-wing” oedipodines. Such species as *Heliastus sumichrasti* can thus vary from black to grey or reddish-brown, or be a pale, speckled sandy colour, depending on the soil colour of their habitat, and of course, whether or not the ground had been recently burnt. In homochromic species, there are usually some chromatic characters which are more or less invariant, such as the colour of the hind wings or of the hind tibiae. These “invariable” characters can however be subject to genetic variation; thus, *H. sumichrasti* normally has red hind wings in our area, but in other populations they are orange or yellow. In some genera, old mature adults are coloured differently from newly moulted immature adults, males can be differently patterned from females (as in many proctolabines and rhytidochrotines), and larval patterns are often quite unlike the adult ones. In general, it requires some experience to become familiar with the range of variation in colour and pattern likely to be shown by a grasshopper species, it is not as easy as dealing with butterflies or birds! This is one of the reasons why the morphological diagnosis of a species can be vitally important for a correct identification.

Note also that the various drawings are not to the same scale: it is important to look at the 5 or 10 mm scalebars to get an idea of relative size. In this connection, remember that male grasshoppers are always considerably (5-40%) smaller than their females.

Where the various species of a genus do not differ appreciably in their habitus, I have provided only one drawing (e.g. in the genera *Homeomastax*, *Stenacris*, *Kritacris*, *Leioscapheus*, *Titanacris*, and *Zosperamerus*). In such cases the different species are clearly differentiated in the text; often the distinctions are based on such details as the form of the male cercus. The colour plates in these cases serve primarily to identify a specimen to genus, the specific identification needs the keys and descriptions found in the text.

As in the rest of this book the plates of the various genera are grouped by subfamily, and this is indicated at the top of all the pages of plates and as a prefix to the number of each plate.

Eumastacinae

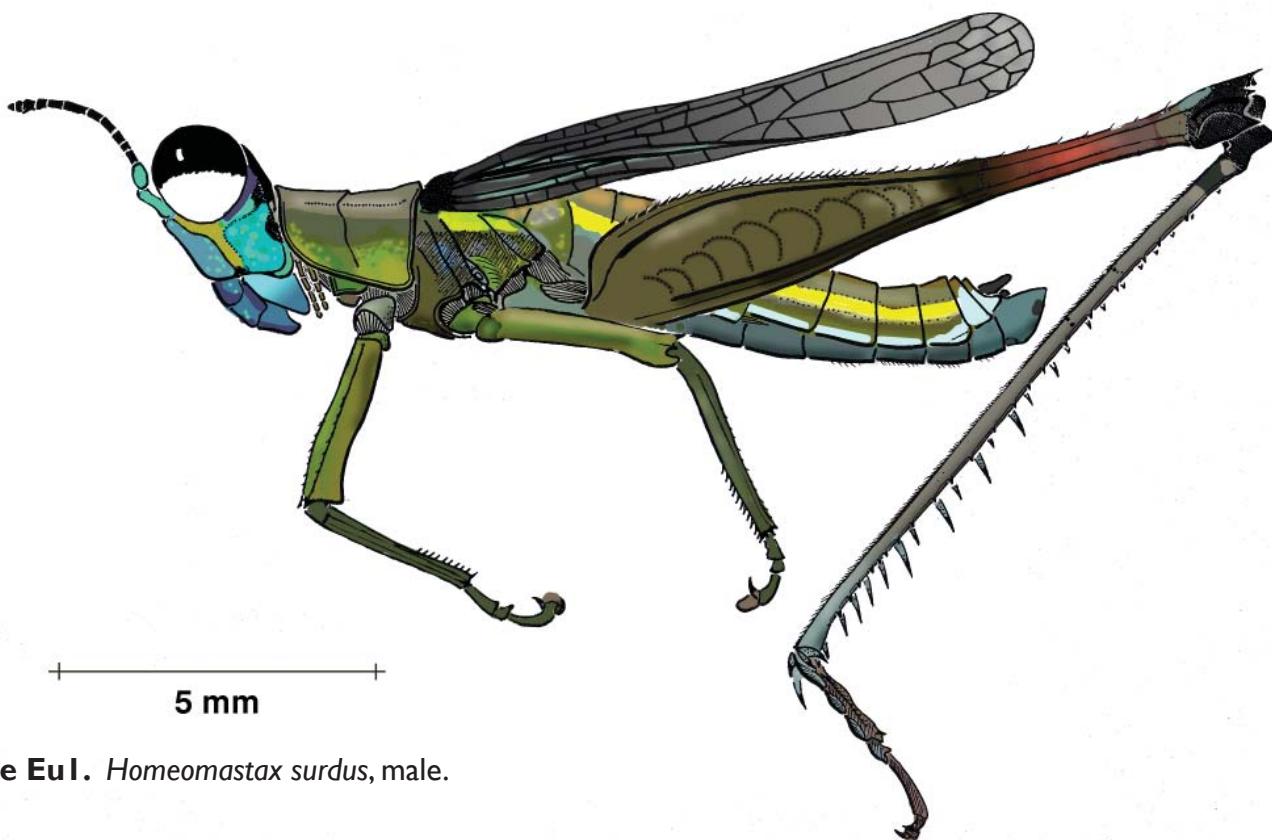


Plate Eu1. *Homeomastax surdus*, male.

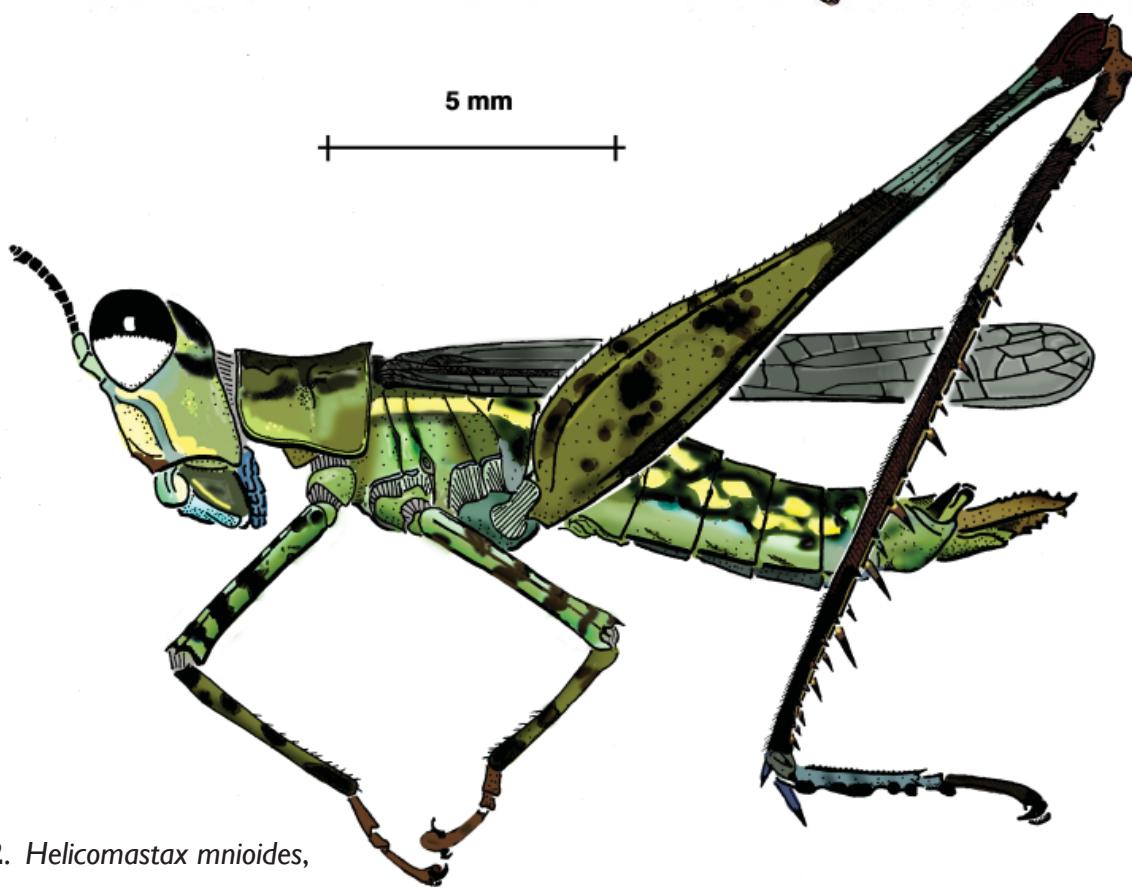


Plate Eu2. *Helicomastax mnioides*, female.

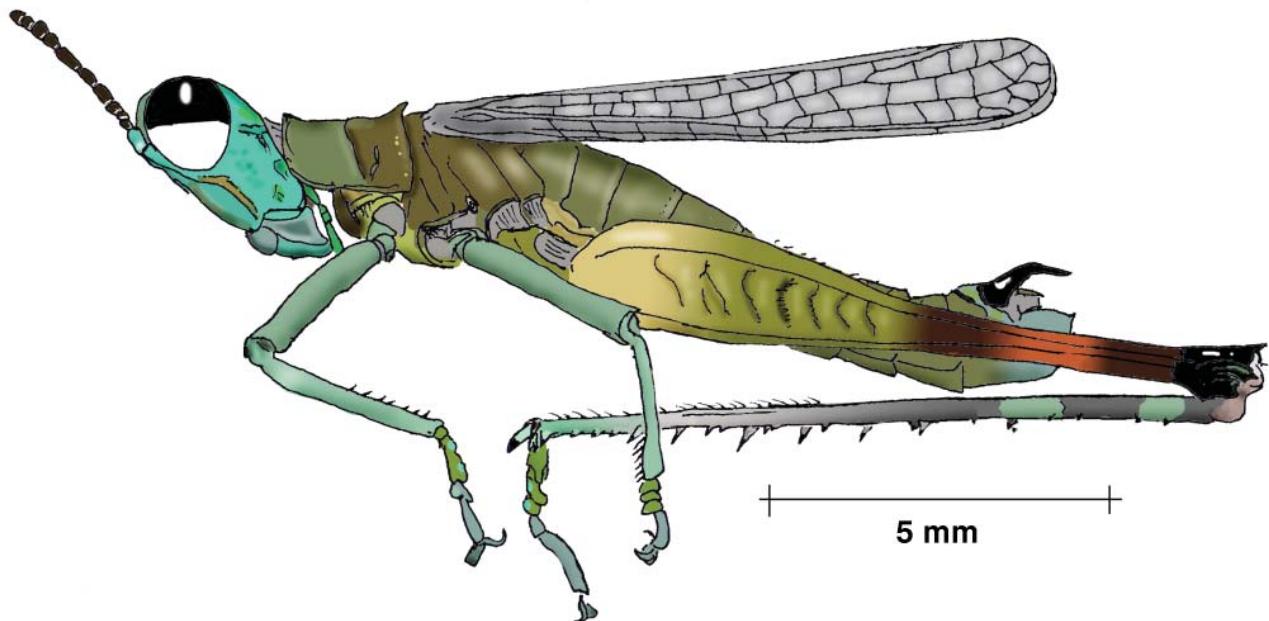


Plate Eu3. *Helicomastax copensis*, male.

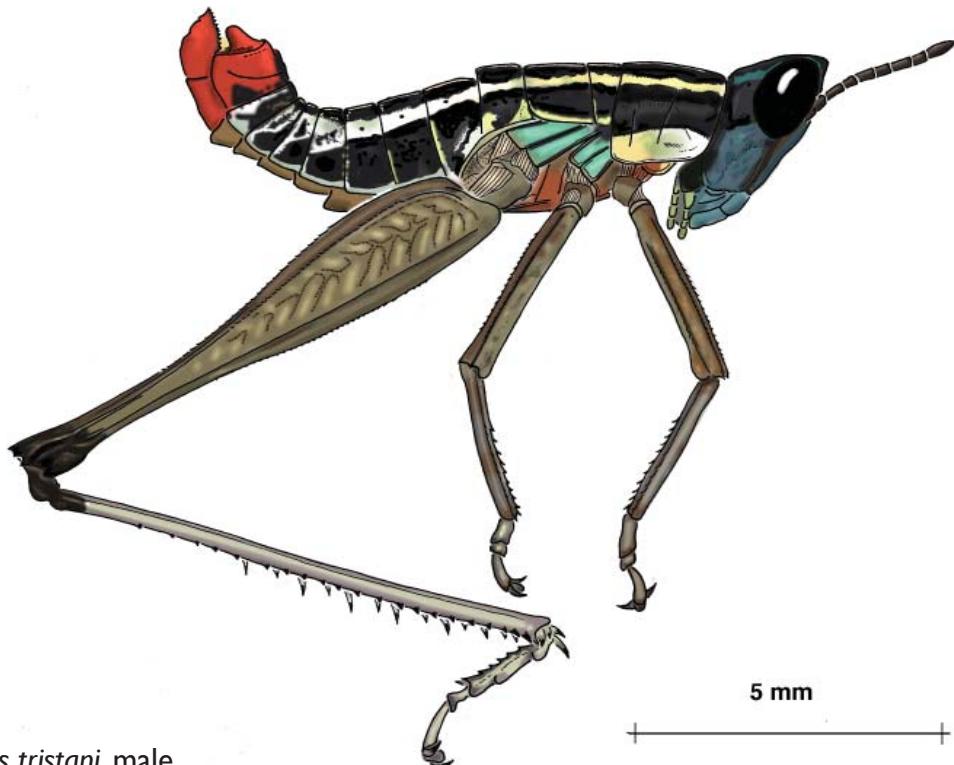


Plate Ep1. *Episactus tristani*, male.

Proscopiidae
Pyrgomorphidae



Plate Prosc I. *Pseudoproscopia septentrionalis*, male.

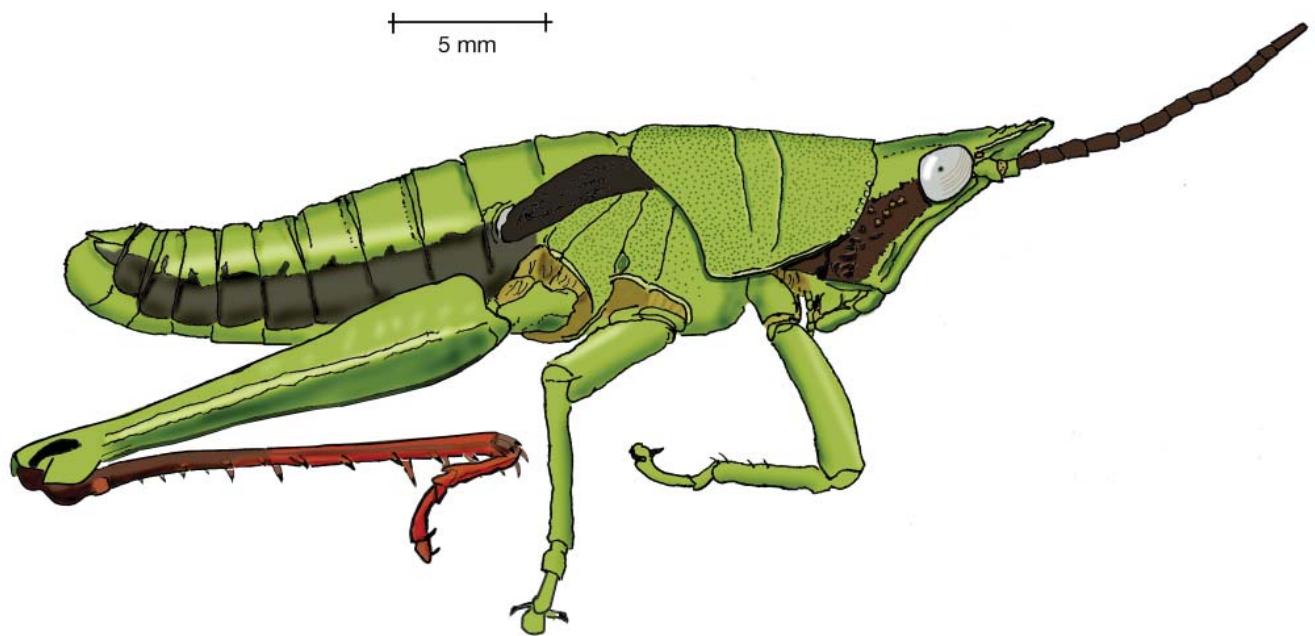


Plate Pyr I. *Parasphepha scudderri*, male.

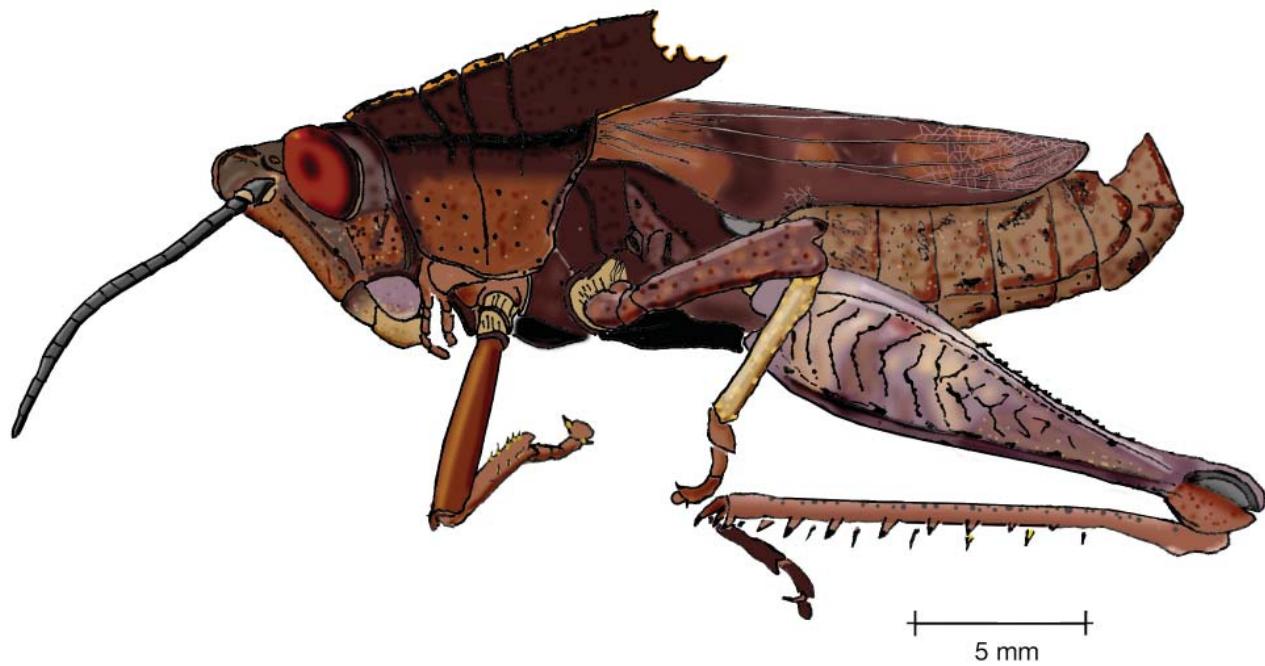


Plate R1. *Colpolopha bruneri*, male.

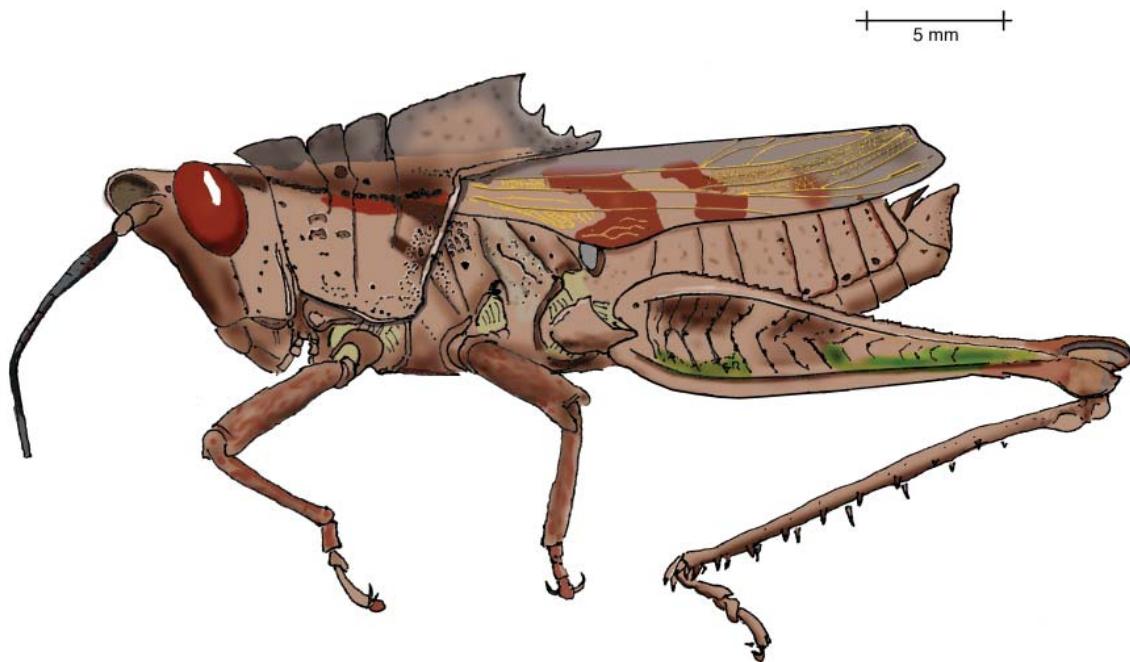


Plate R2. *Colpolopha rehni*, male.

Romaleinae

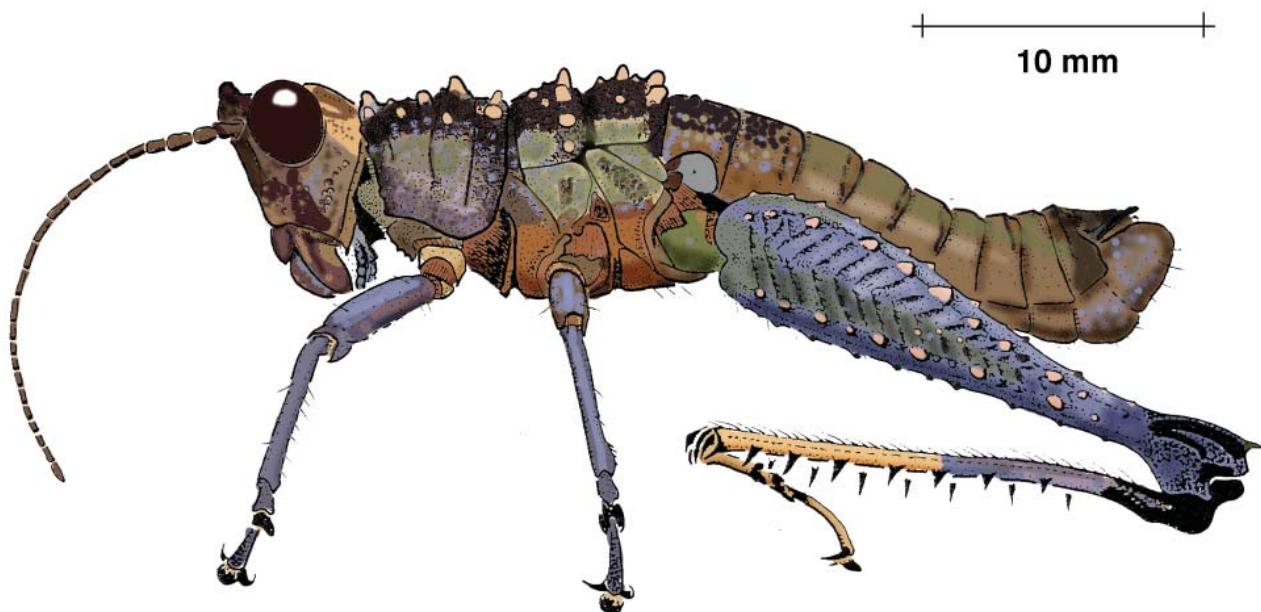


Plate R3. *Cloephoracris caesia*, male.

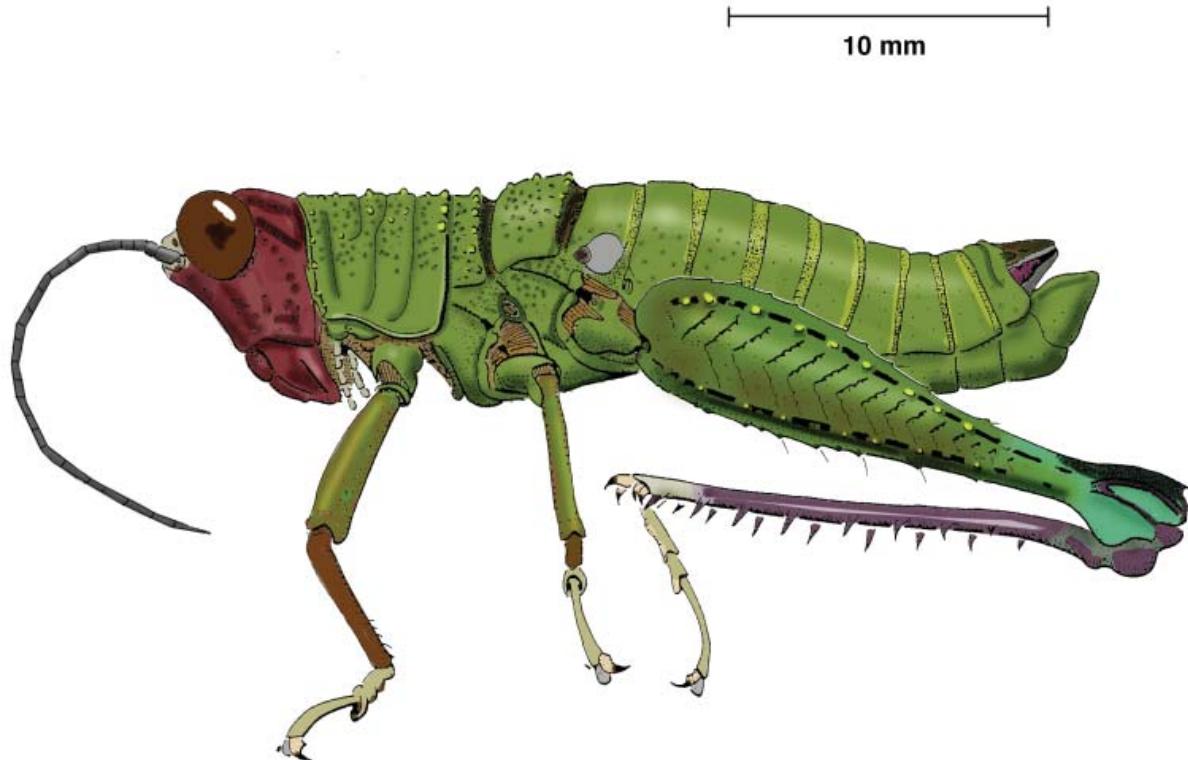


Plate R4. *Cloephoracris disrupta*, male.

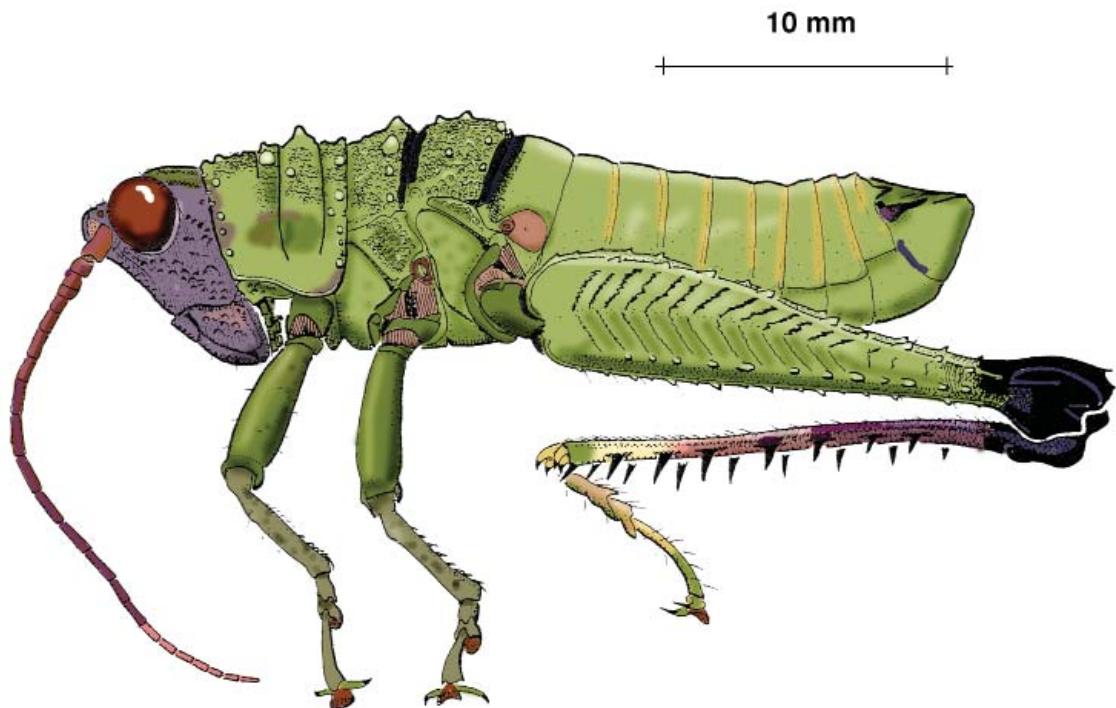


Plate R5. *Cloephoracris festae*, male.

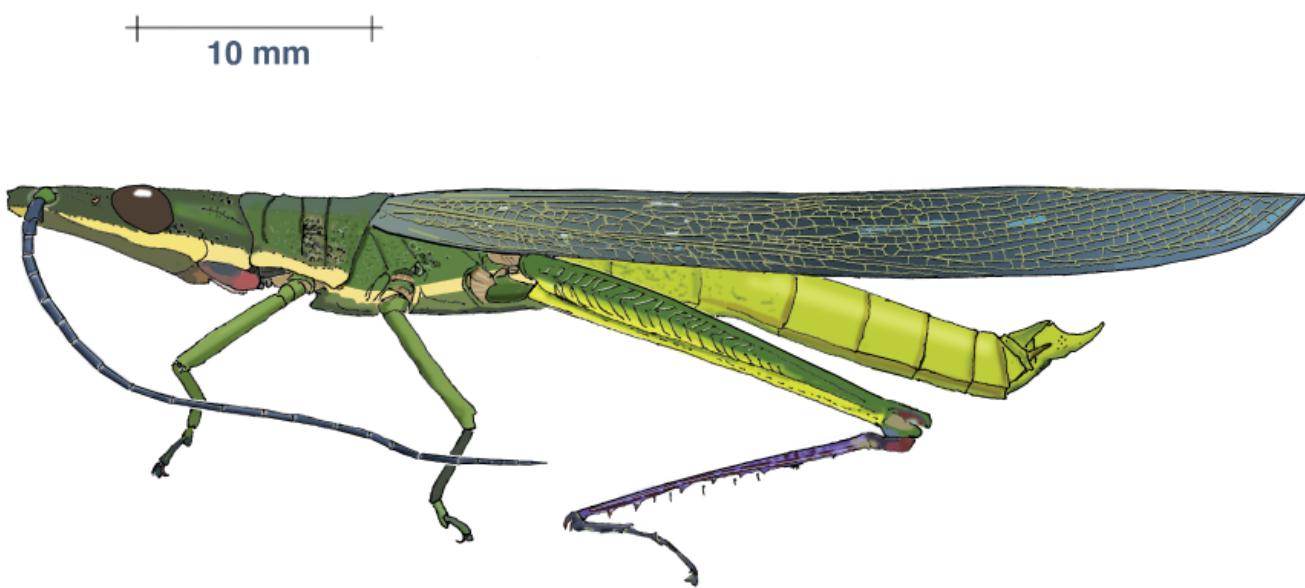


Plate R6. *Legua crenulata*, male.

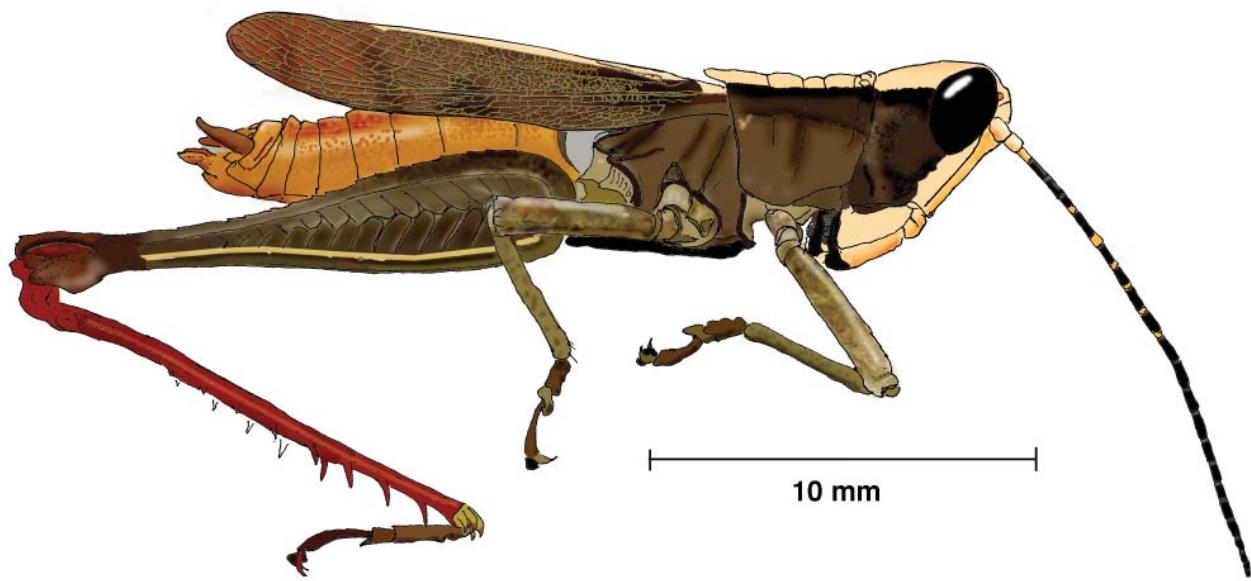


Plate R7. *Maculiparia rotundata*, male.

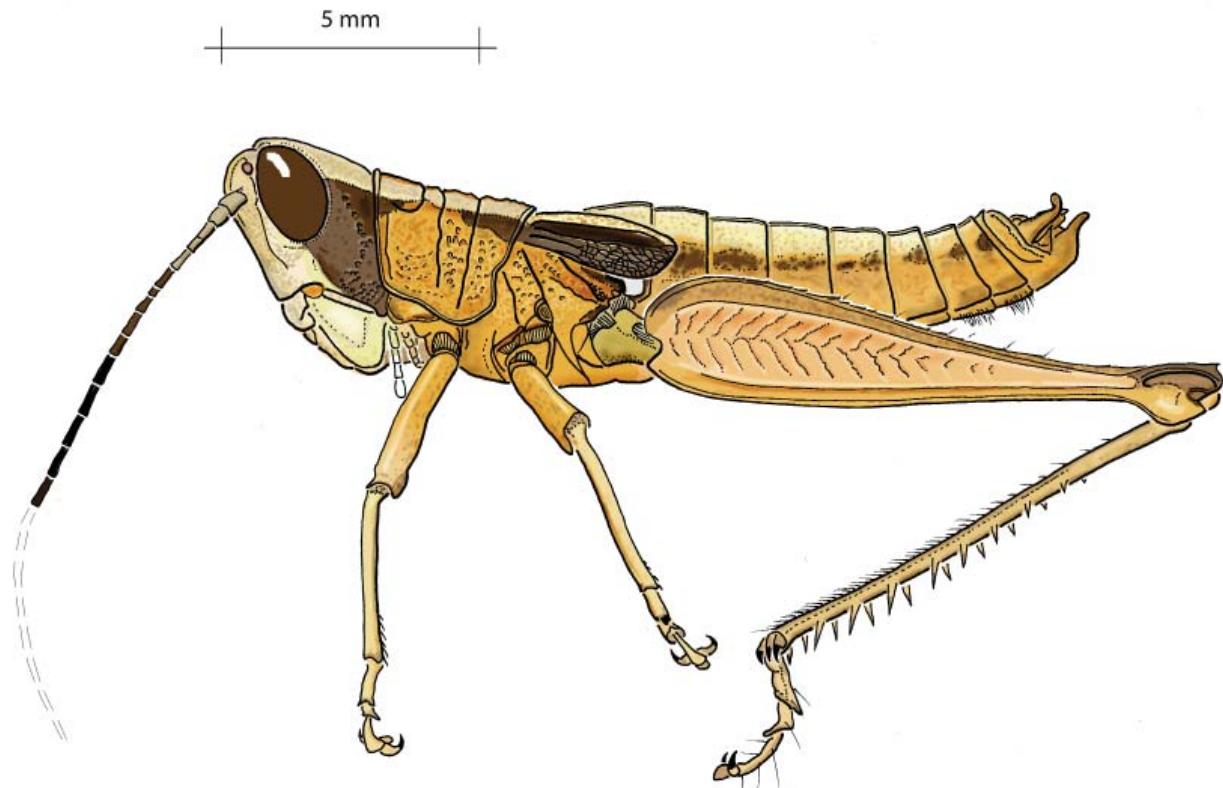


Plate R8. *Maculiparia coibensis*, male.

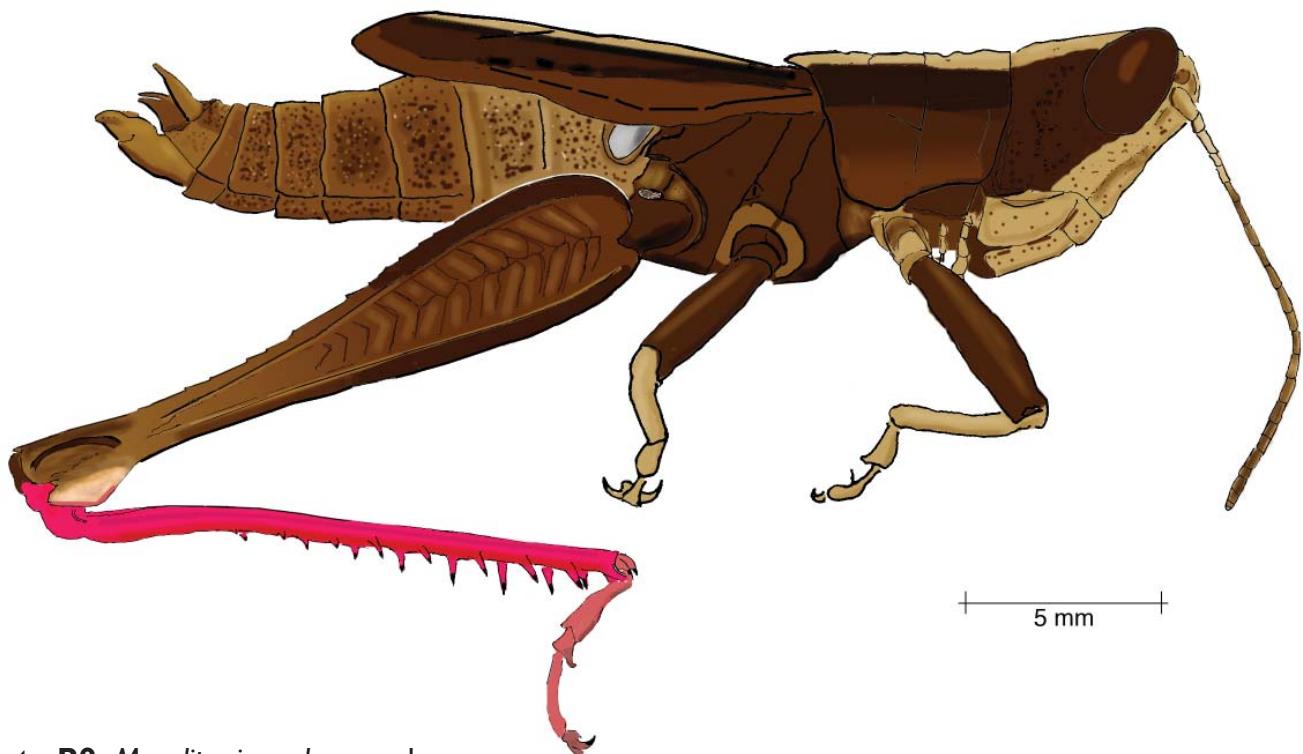


Plate R9. *Maculiparia embera*, male.

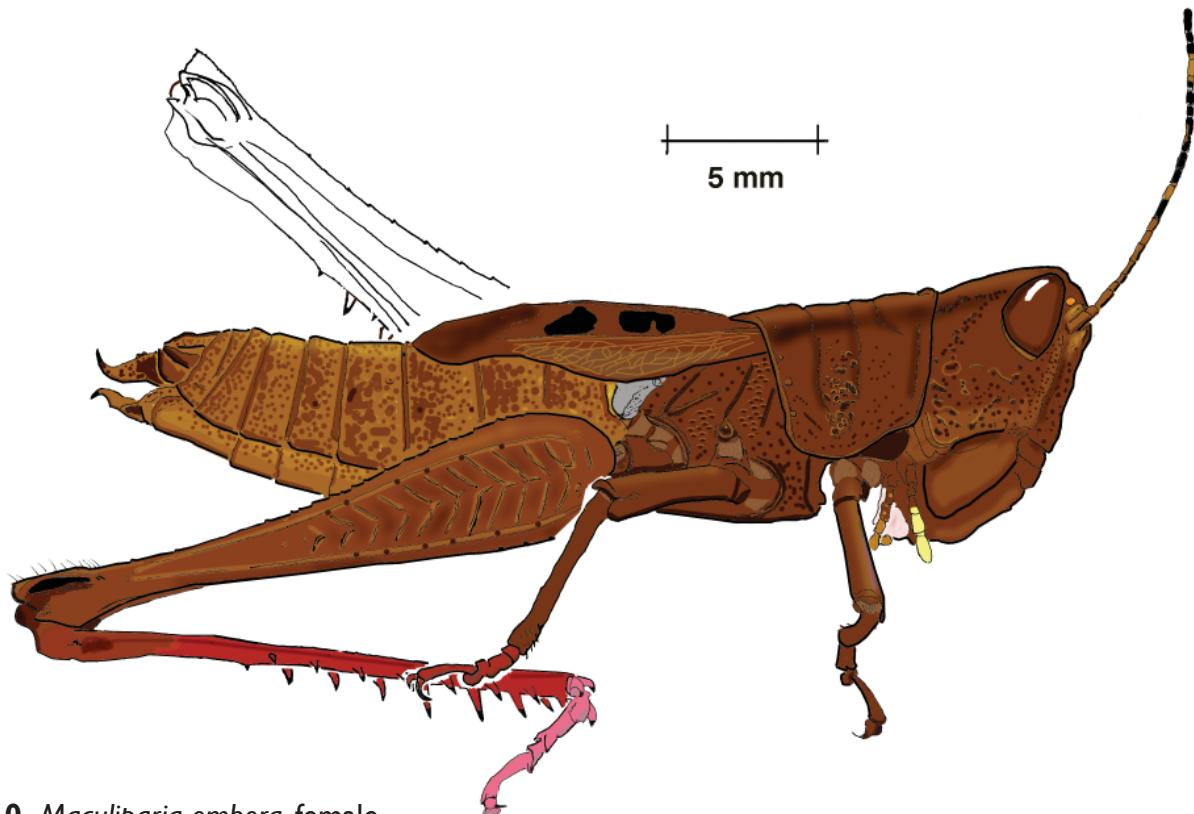


Plate R10. *Maculiparia embera*, female.

Romaleinae

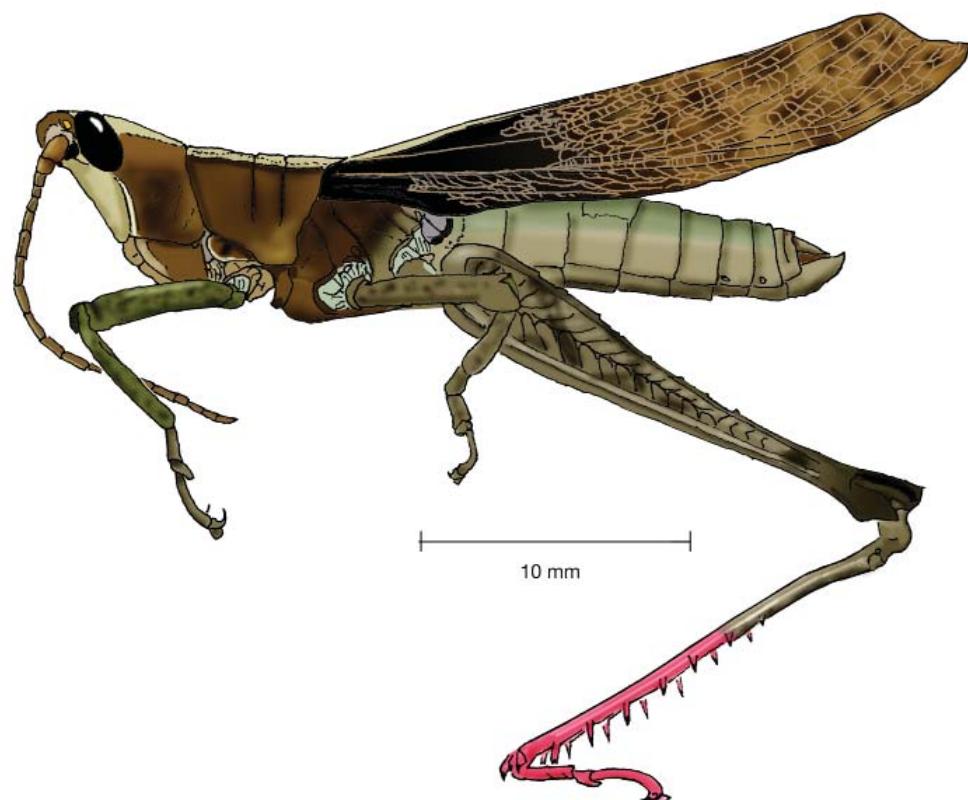


Plate R11. *Phaeoparia depressicornis*, male.

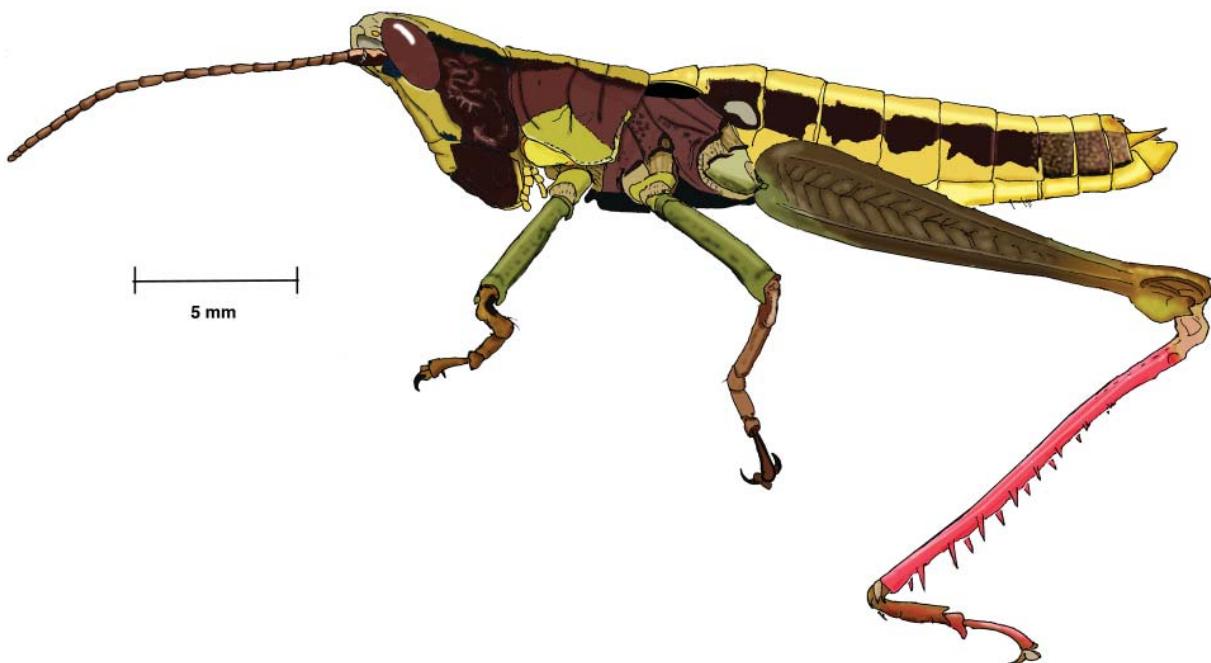


Plate R12. *Phaeoparia phrygana*, male.



Plate R13. *Costarica costaricensis*, male.

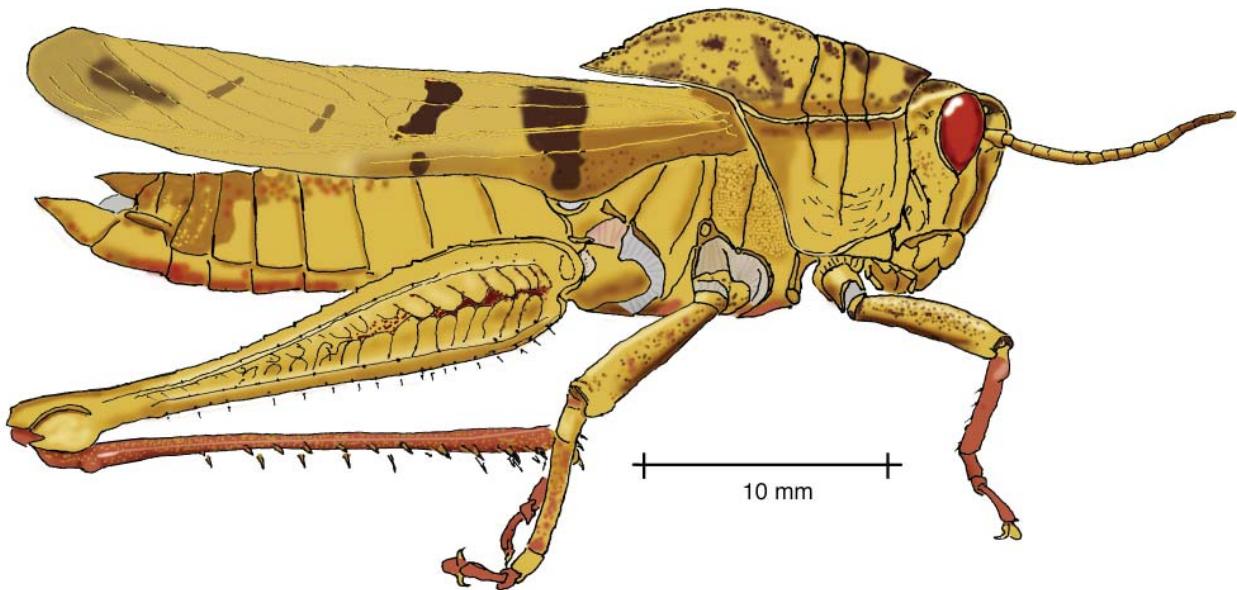


Plate R14. *Xyleus discoideus mexicanus*, male.

Romaleinae

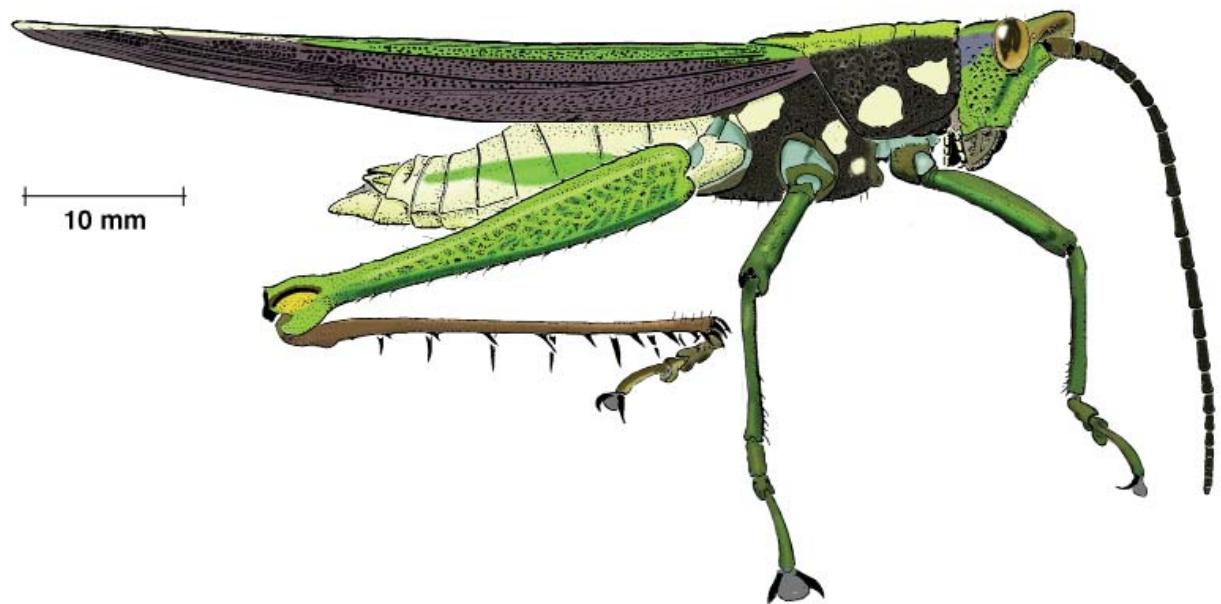


Plate R15. *Munatia punctata*, male.

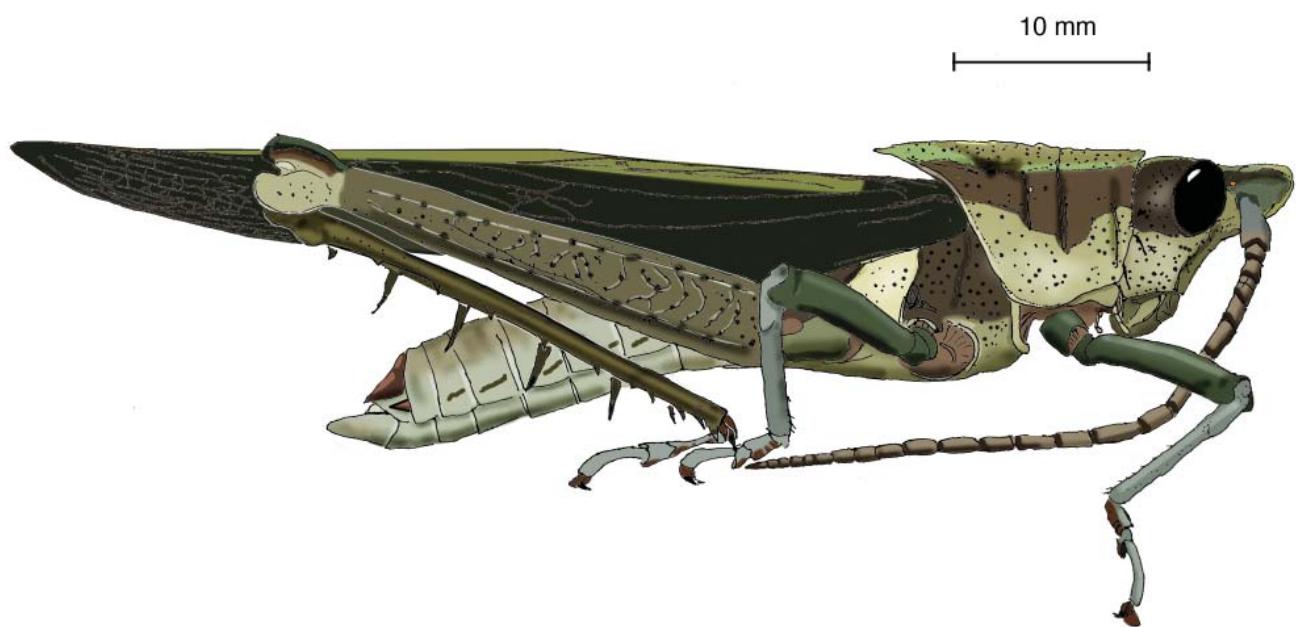


Plate R16. *Munatia bolleyi*, male.

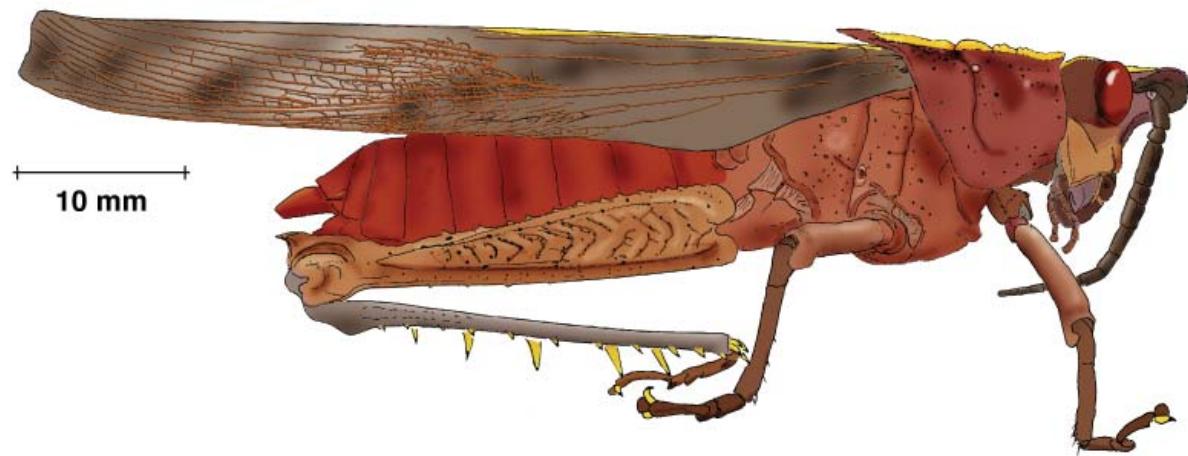


Plate R17. *Procolpia lankesteri*, male.

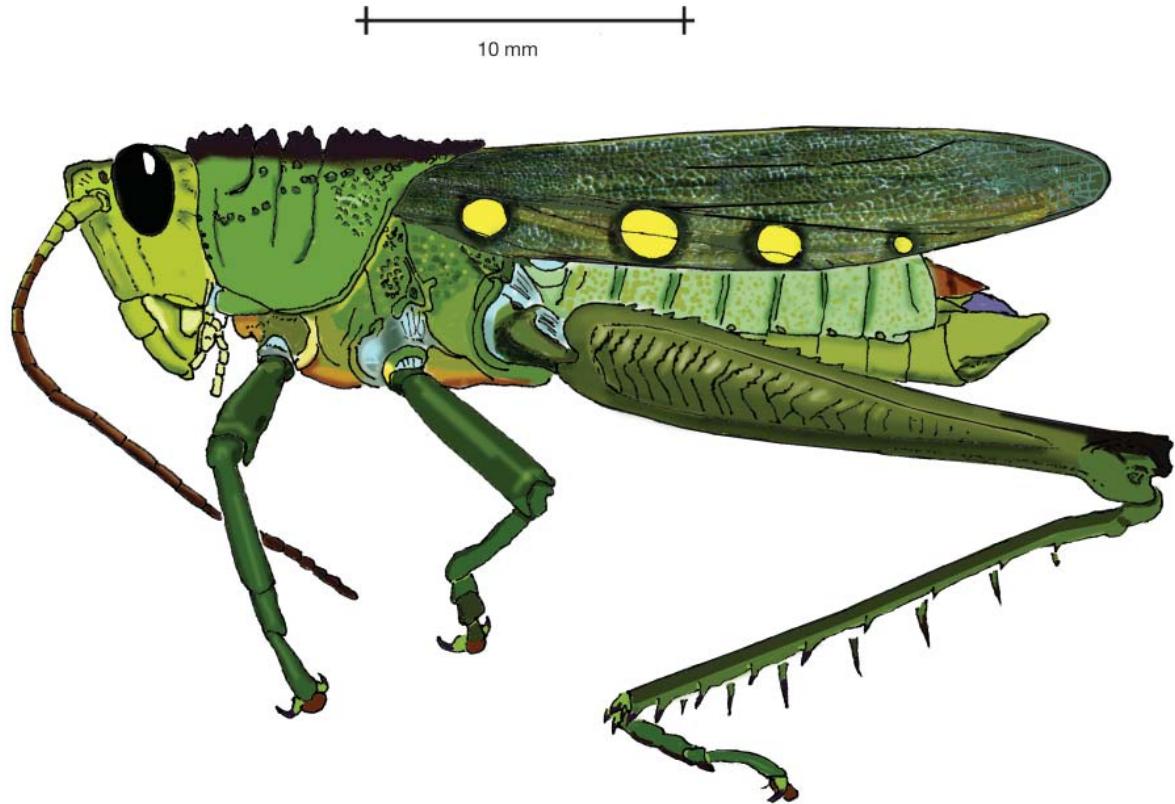


Plate R18. *Agriacris tricristata*, male.

Romaleinae

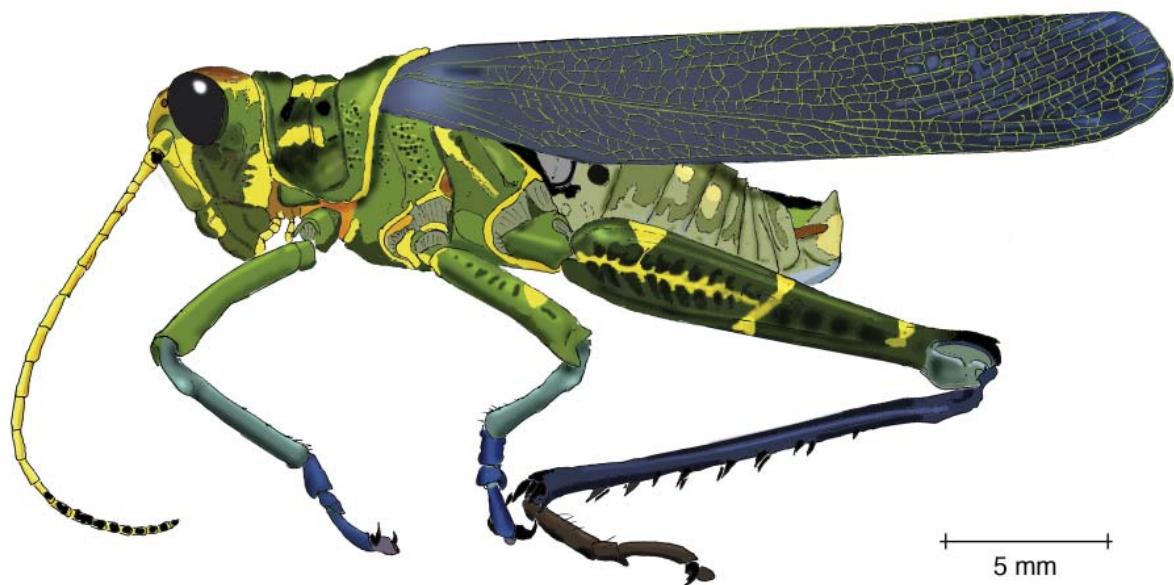


Plate R19. *Chromacris colorata*, male.

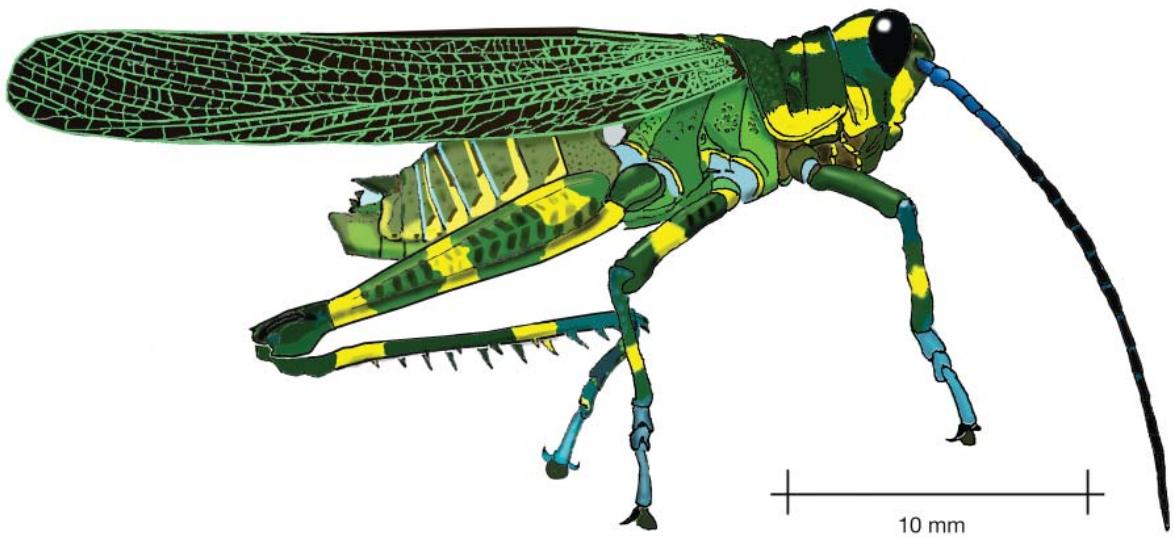


Plate R20. *Chromacris psittacus*, male.

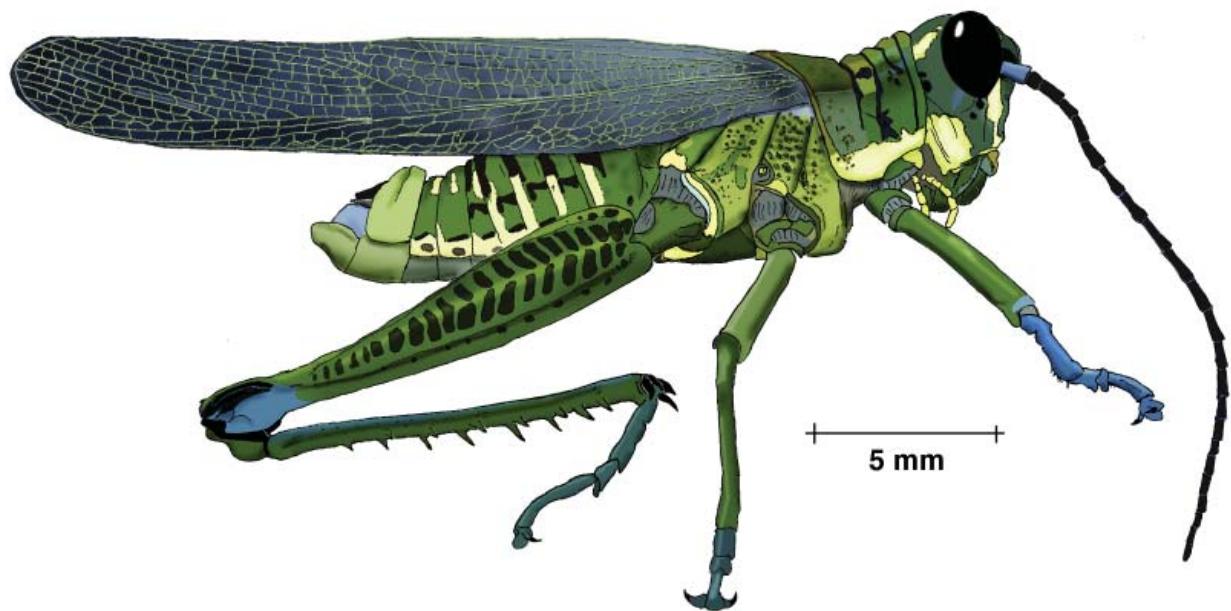


Plate R21. *Chromacris trogon*, male.

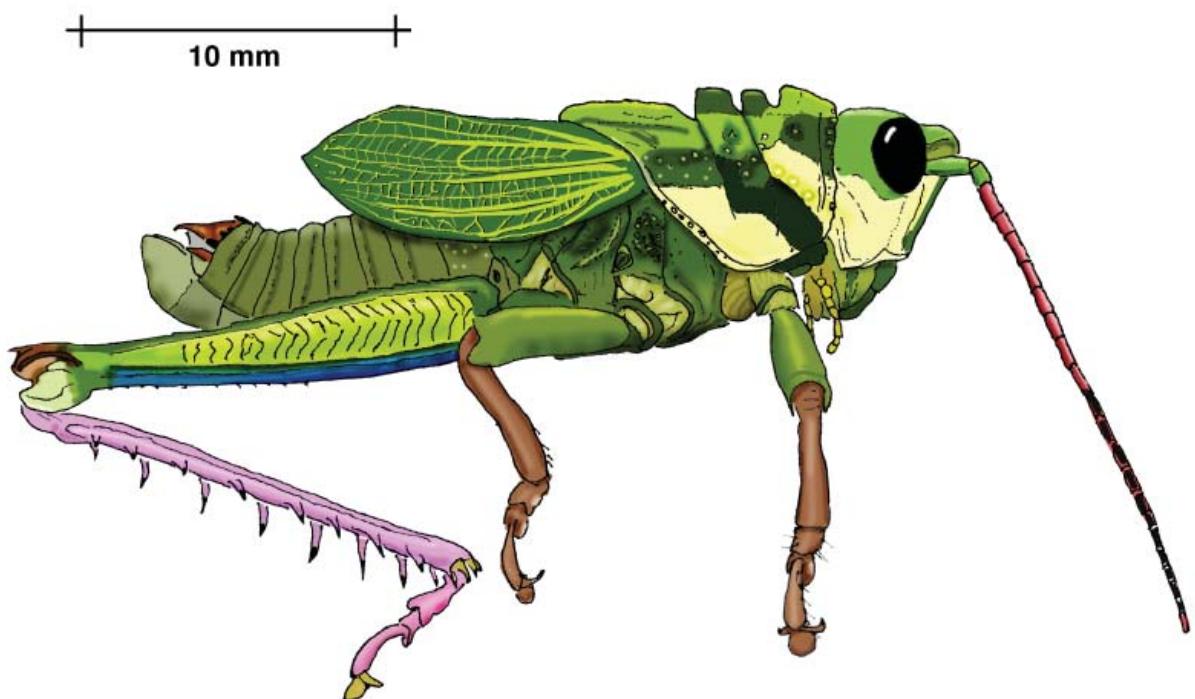


Plate R22. *Cibotopteryx variegata*, male.

Romaleinae

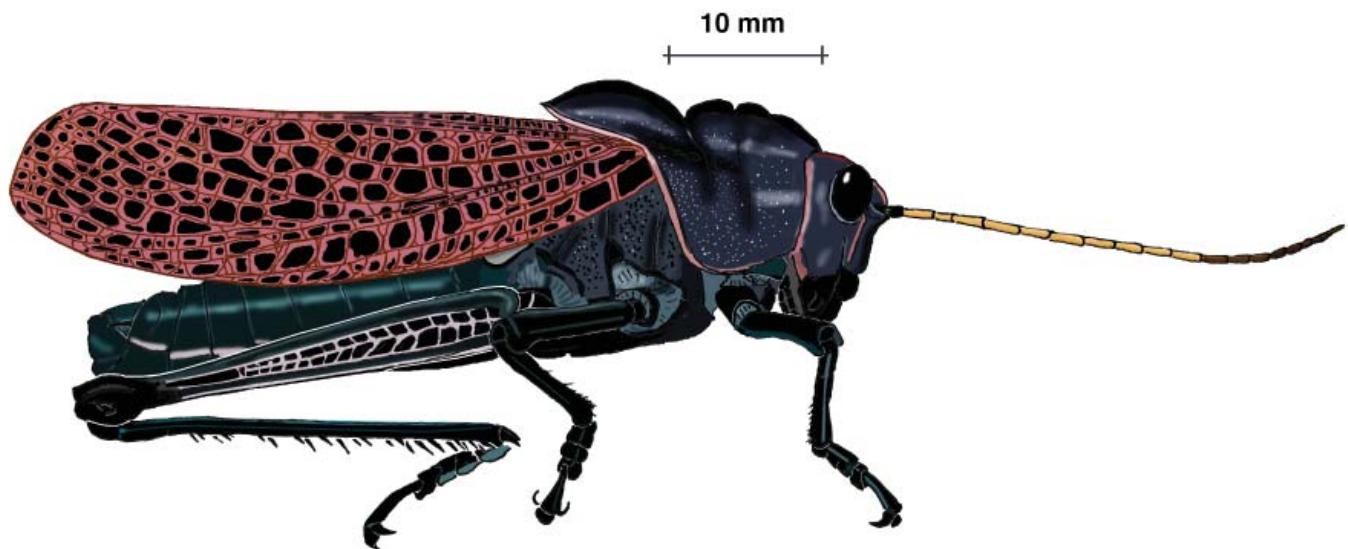


Plate R23. *Taeniopoda reticulata*, male.

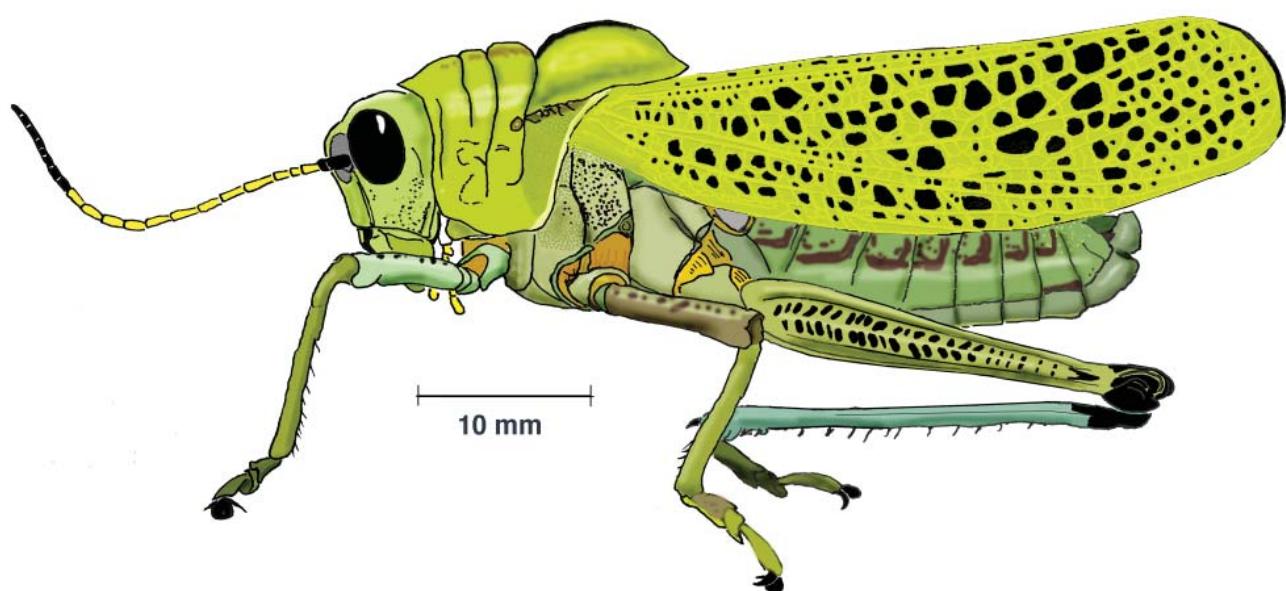


Plate R24. *Taeniopoda varipennis*, male.

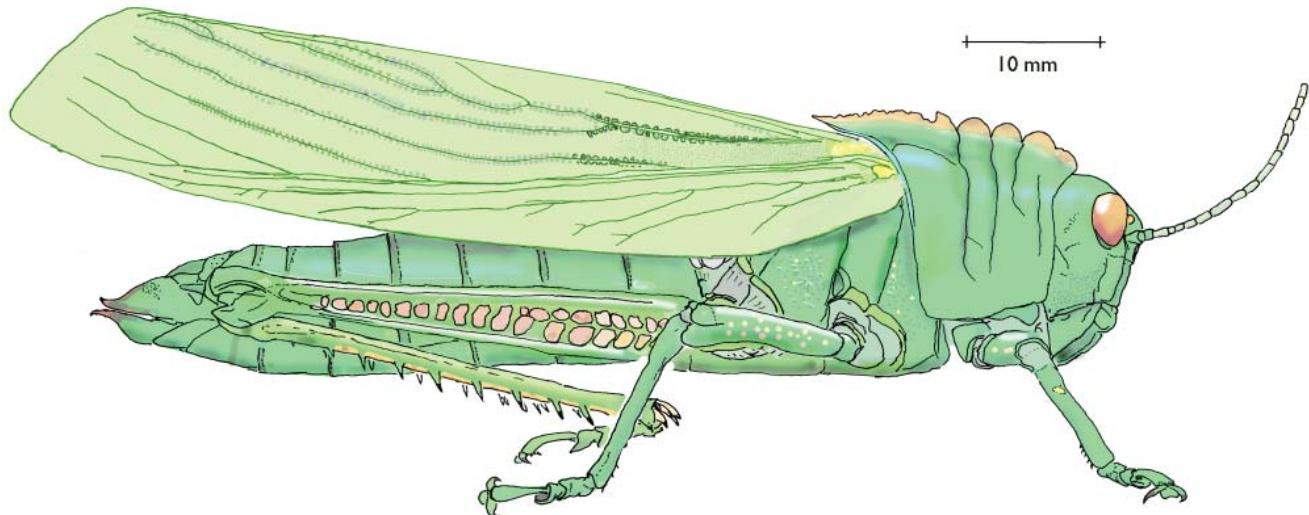


Plate R25. *Titanacris velasquezi*, male.



Plate R26. *Tropidacris cristata*, male.

Romaleinae
Bactrophorinae



Plate R27. *Tropidacris cristata*, female larva V.

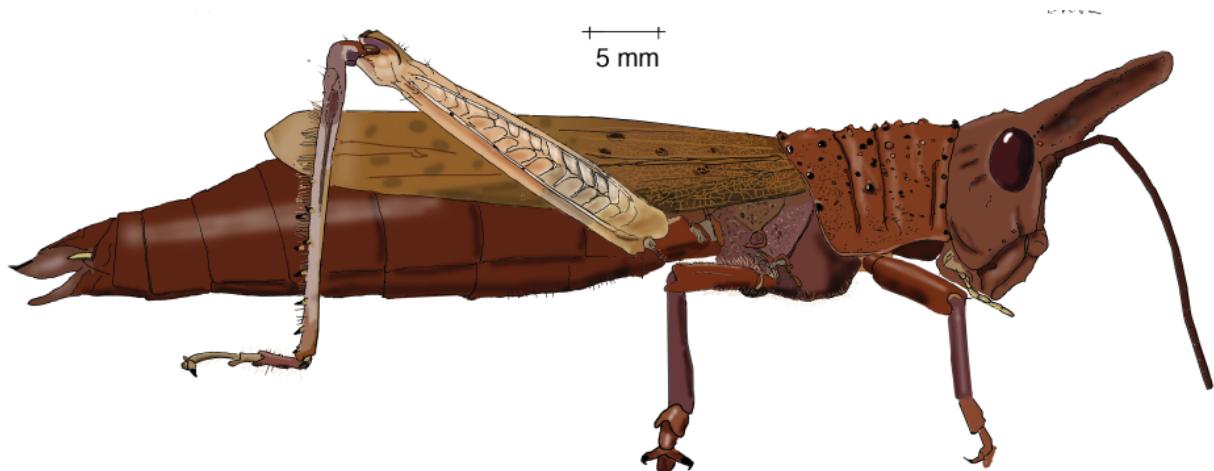


Plate B1. *Bactrophora mirabilis*, female.

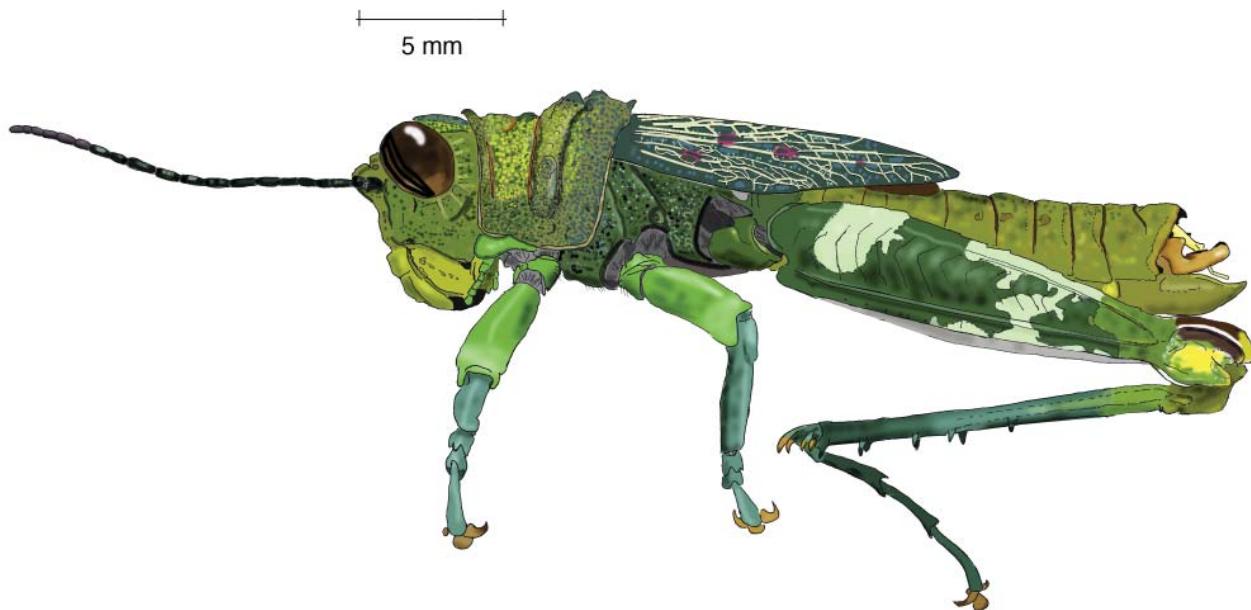


Plate B2. *Mezentia proracerca*, male.



Plate B3. *Panamacris magnifica*, male.

Bactrophorinae

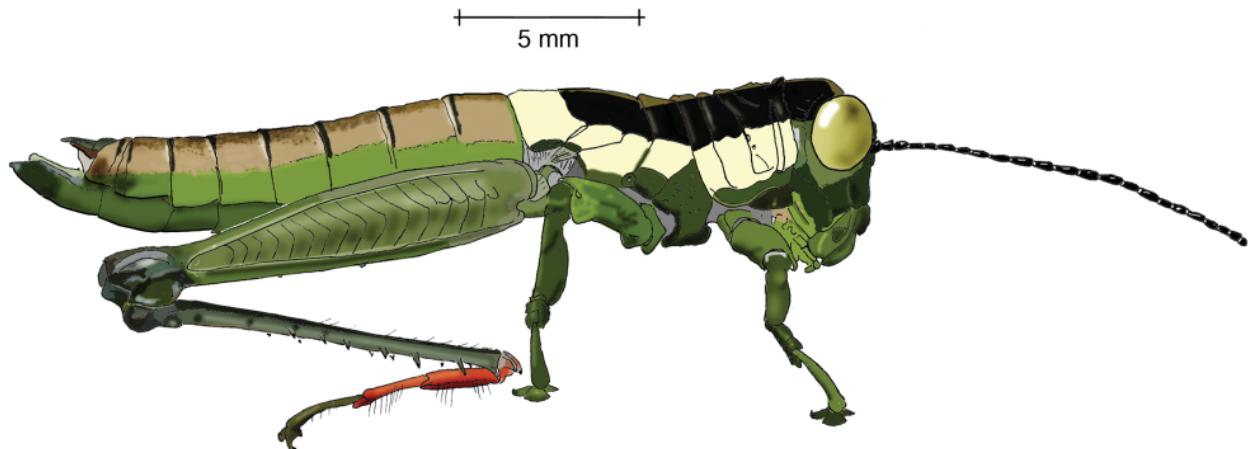


Plate B4. *Pararhicnoderma cacaoensis*, male.

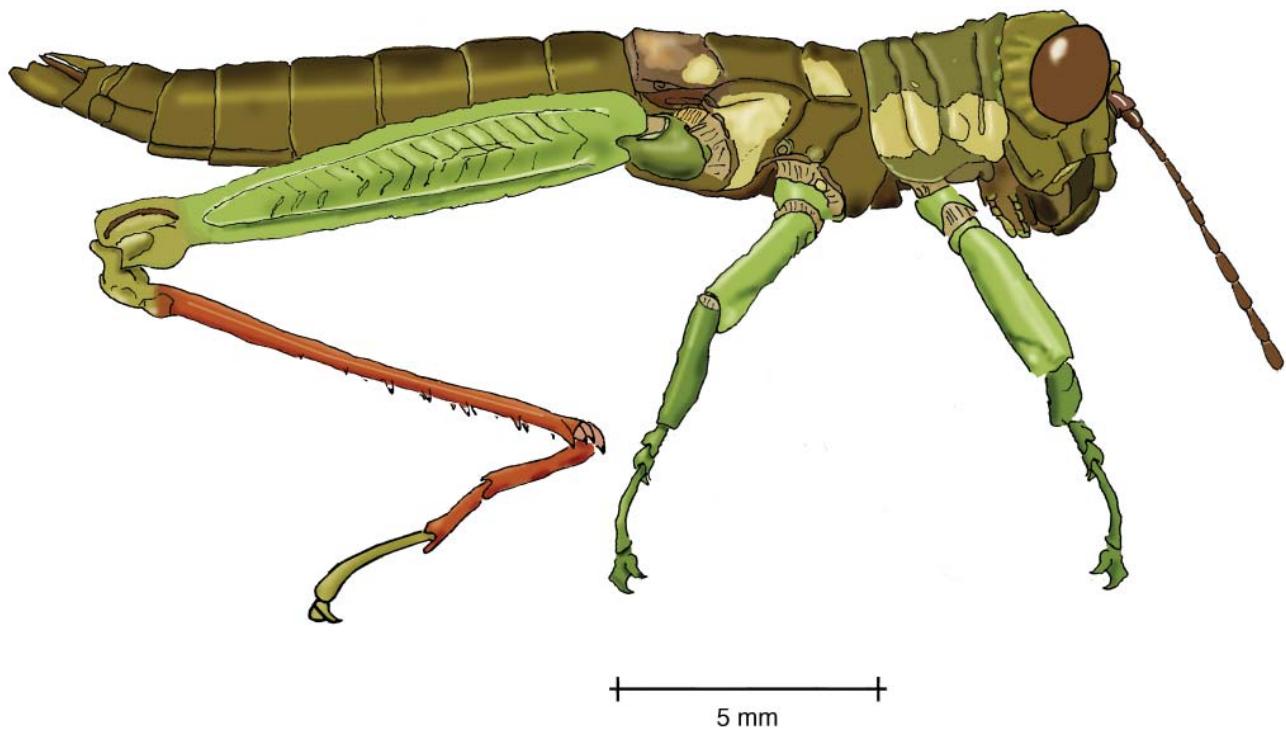


Plate B5. *Pararhicnoderma janzeni*, male.

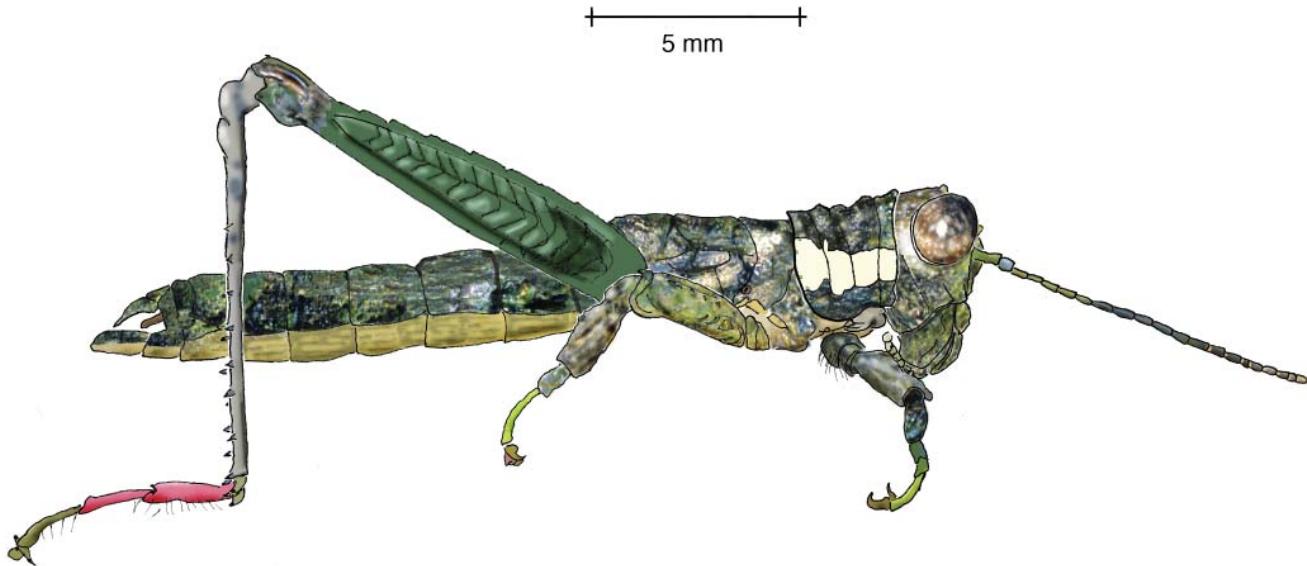


Plate B6. *Pararhicnoderma laselvae*, male.

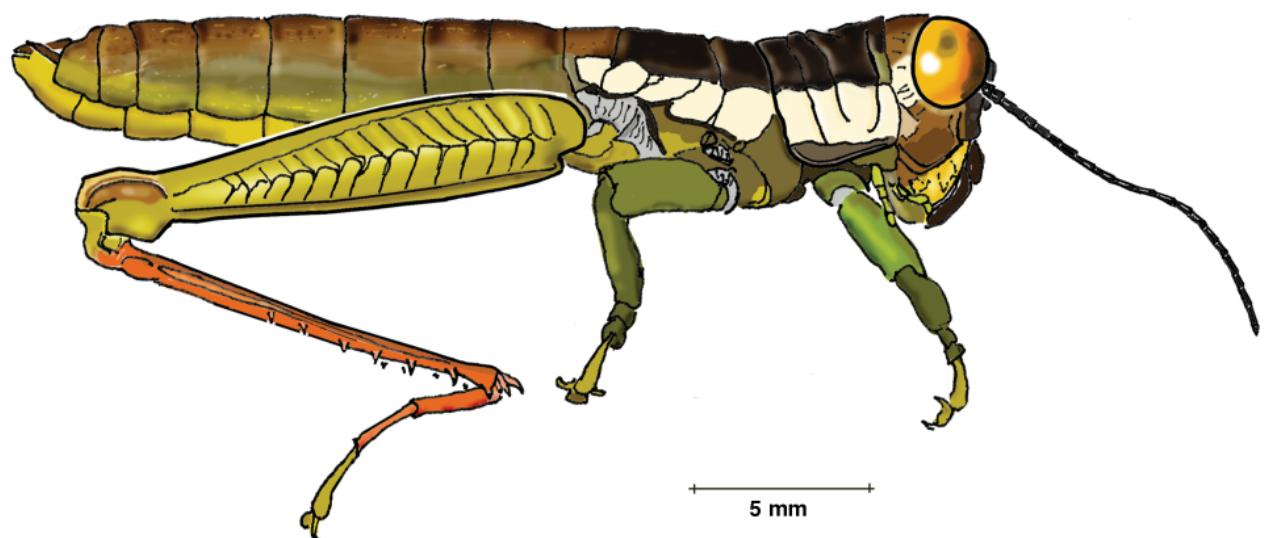


Plate B7. *Pararhicnoderma uatsiensis*, male.

Bactrophorinae

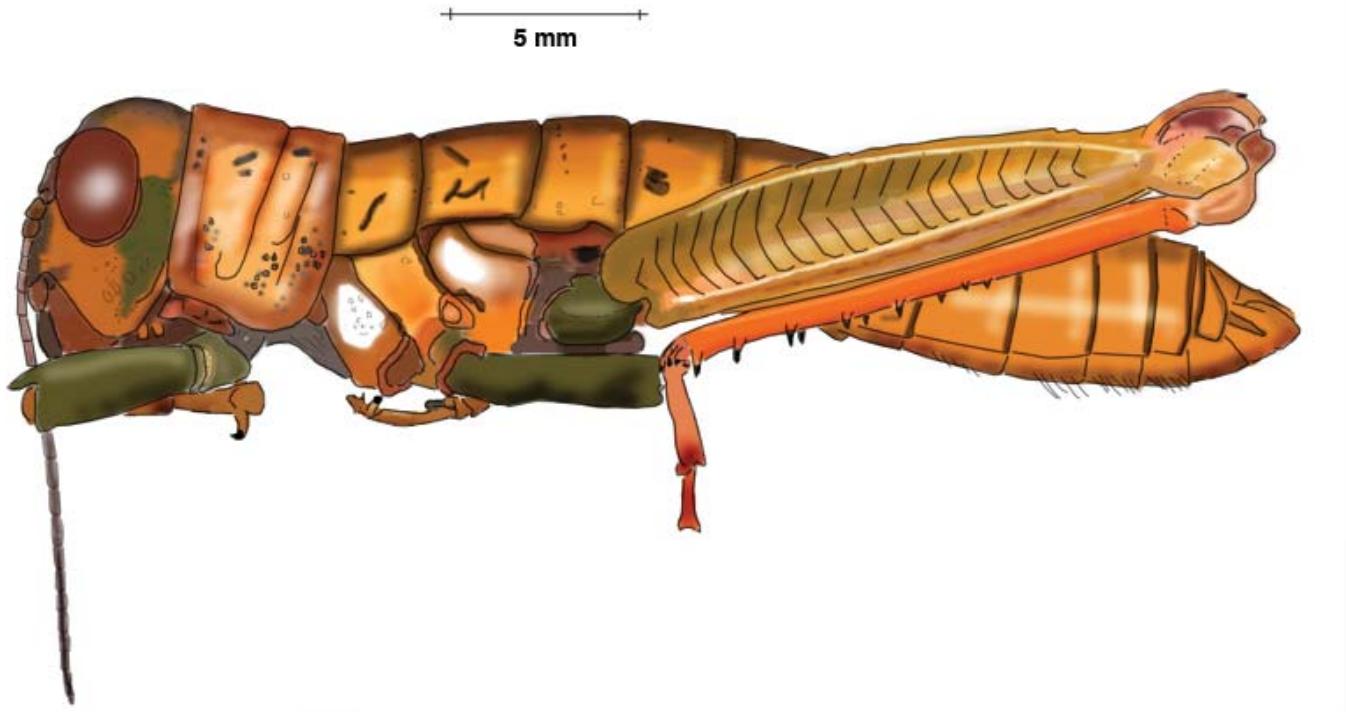


Plate B8. *Rhicnoderma olivaceus*, male.

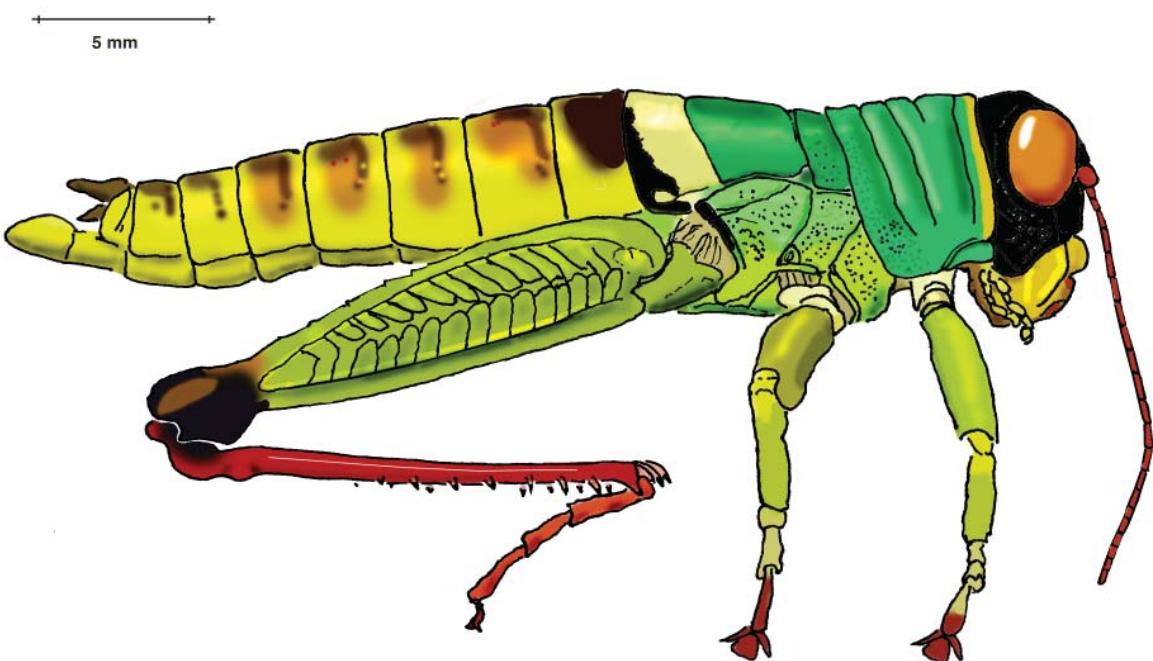


Plate B9. *Rhicnoderma humilis*, male.

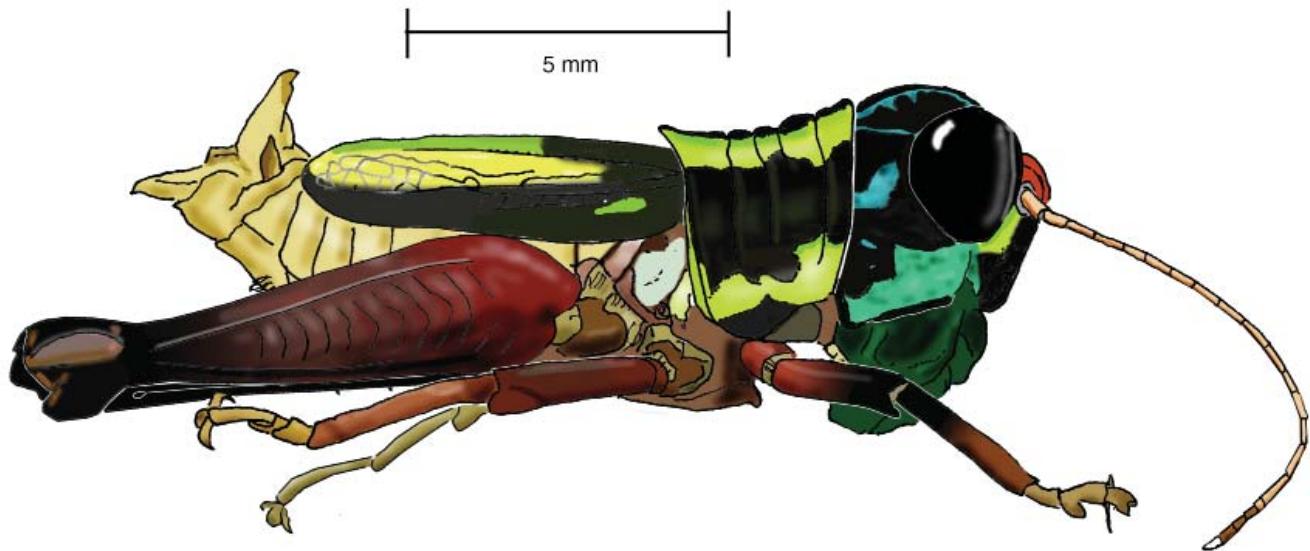


Plate B10. *Megacheilacris megacephala*, female.

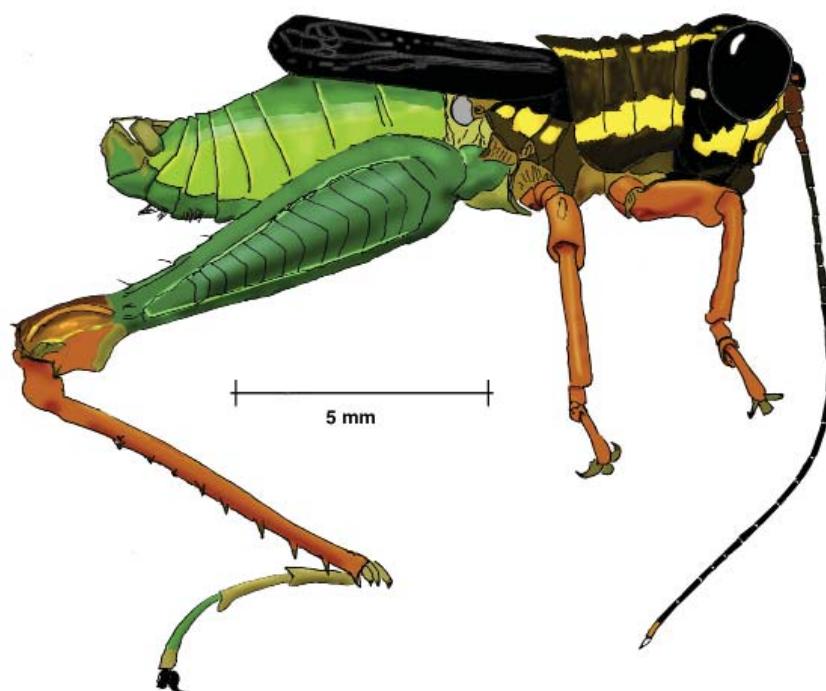


Plate B11. *Taeniophora choocoensis*, male.

Bactrophorinae

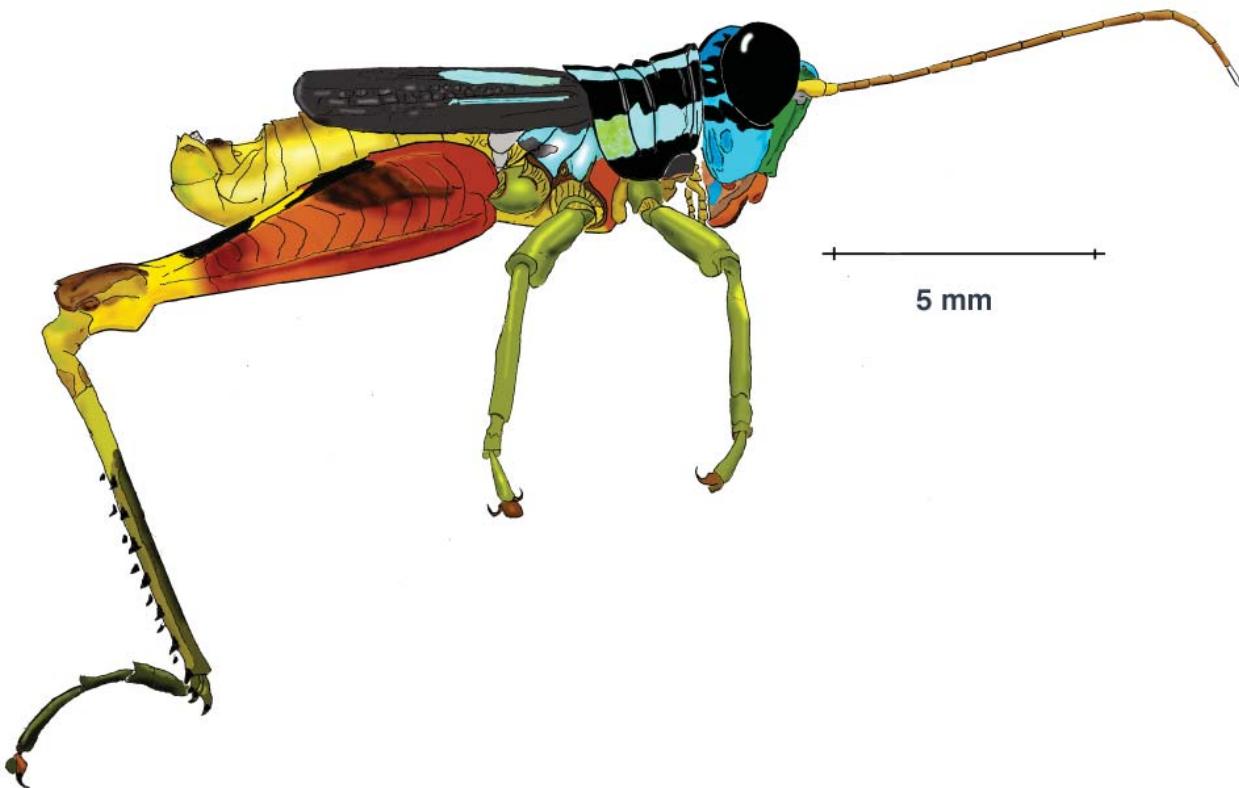


Plate B12. *Taeniophora femorata*, male.

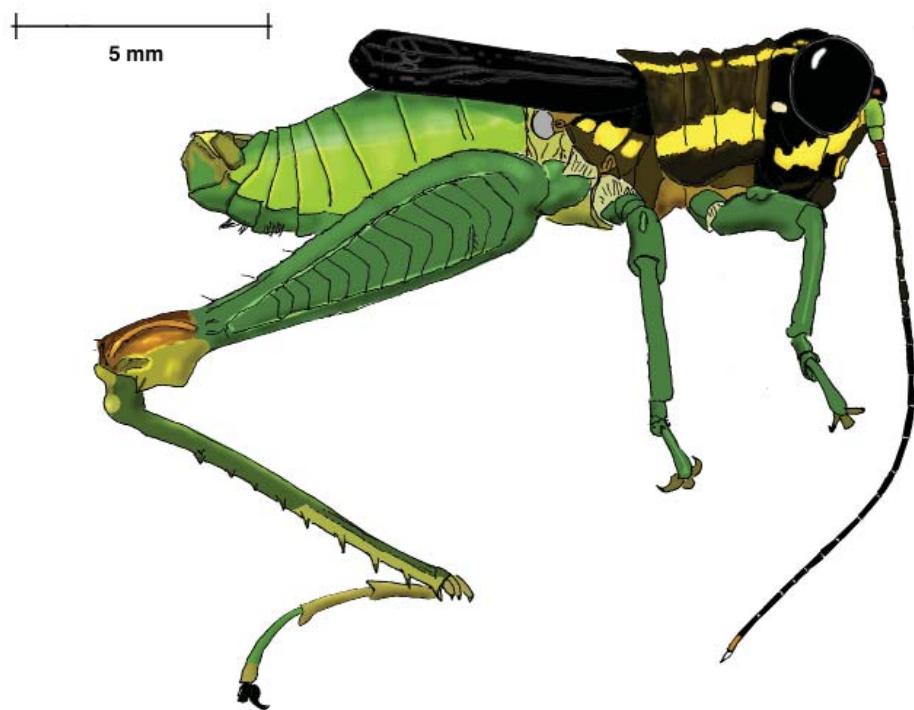


Plate B13. *Taeniophora panamensis*, male.

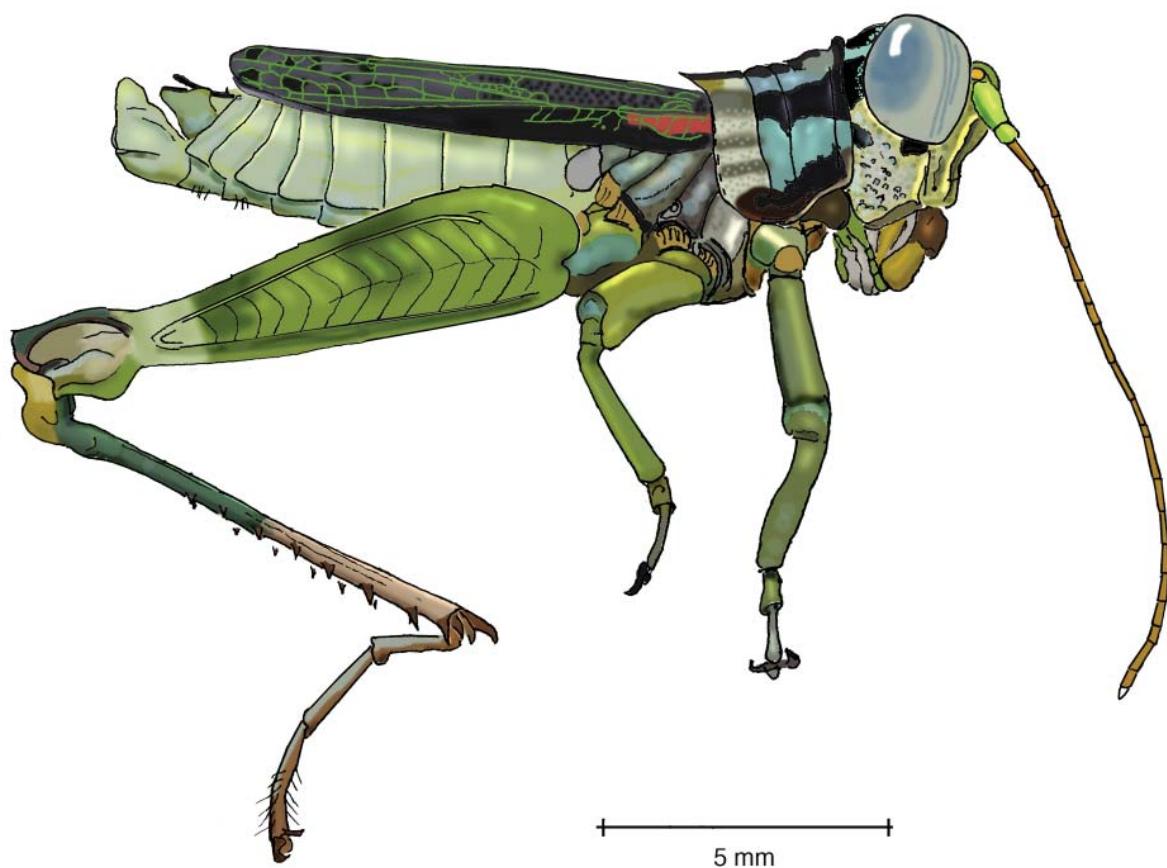


Plate B14. *Taeniophora rubrosignata*, male.

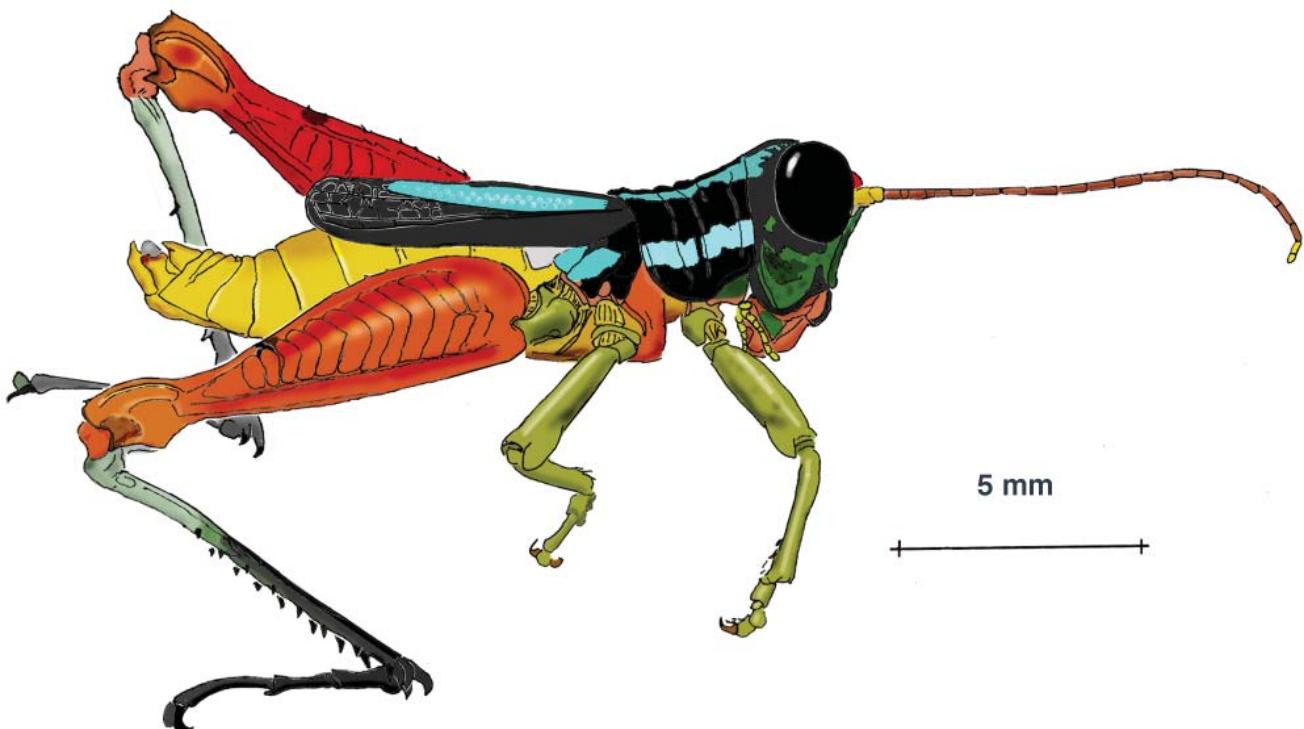


Plate B15. *Taeniophora pirrensis*, male.

Bactrophorinae

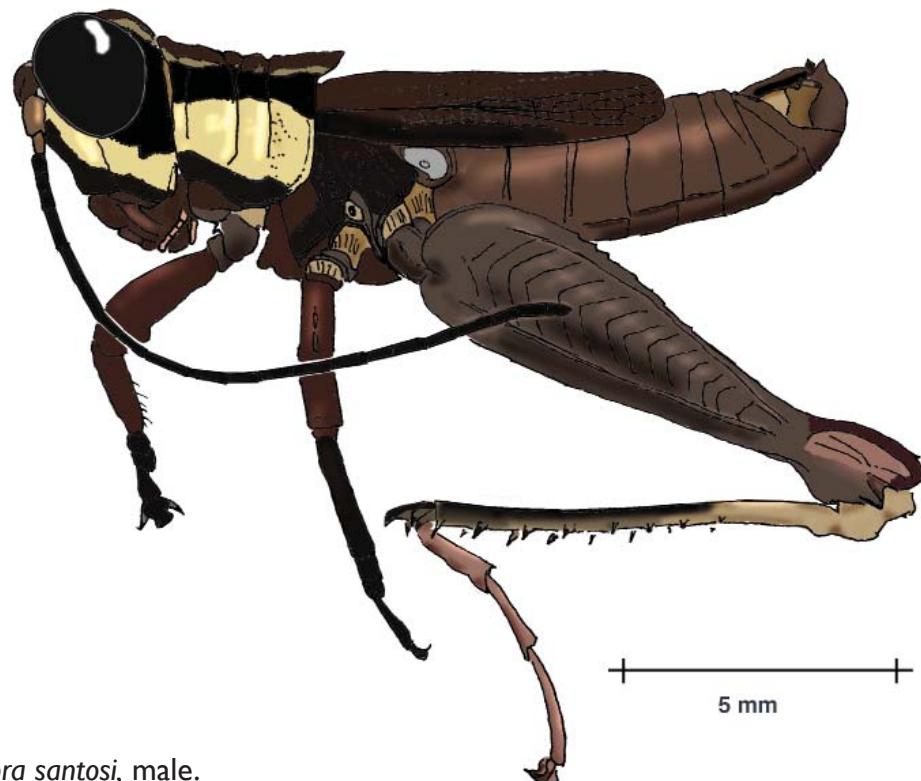


Plate B16. *Taeniophora santosi*, male.

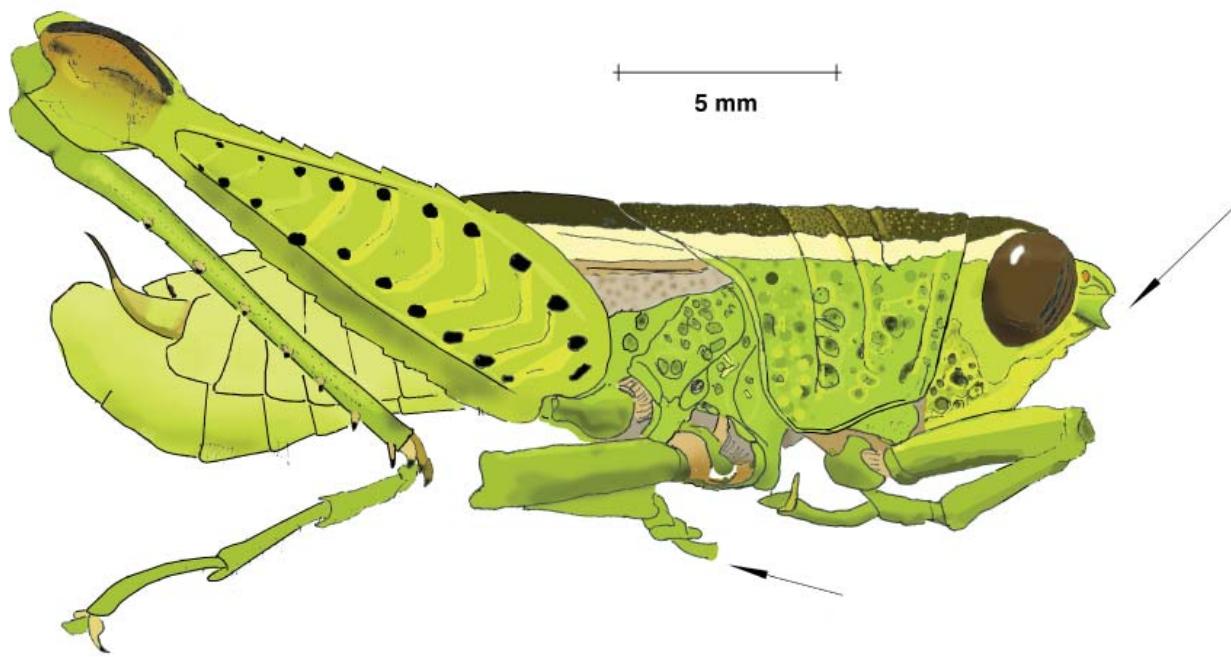


Plate B17. *Caenolampis osae*, male holotype. The specimen is faded, the live animal is probably more vividly coloured than shown here. Arrows indicate missing portions of limbs. Note the uniformly green face with no pale stripe.

5 mm



Plate B18. *Caenolampis robertsi*, male.

5 mm

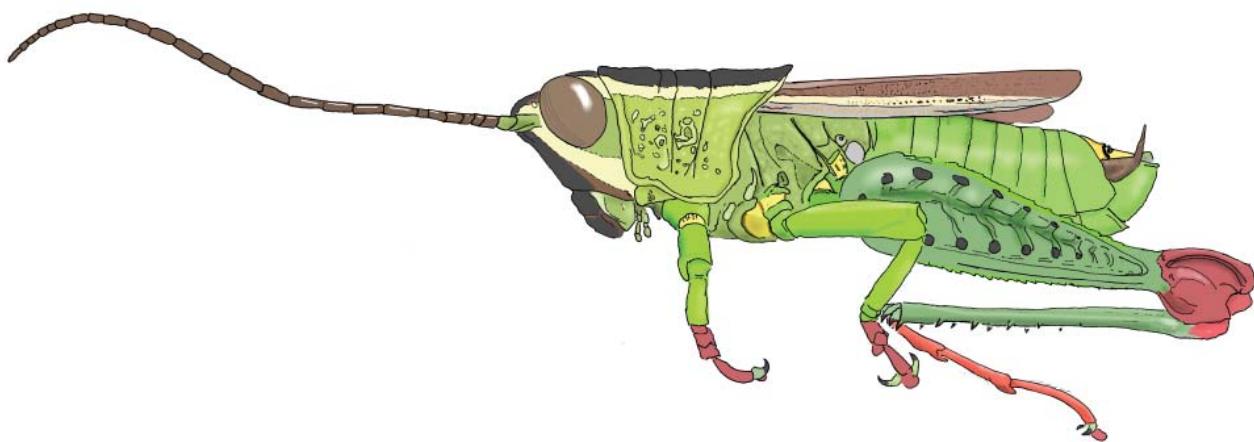


Plate B19. *Caenolampis copensis*, male.

Bactrophorinae

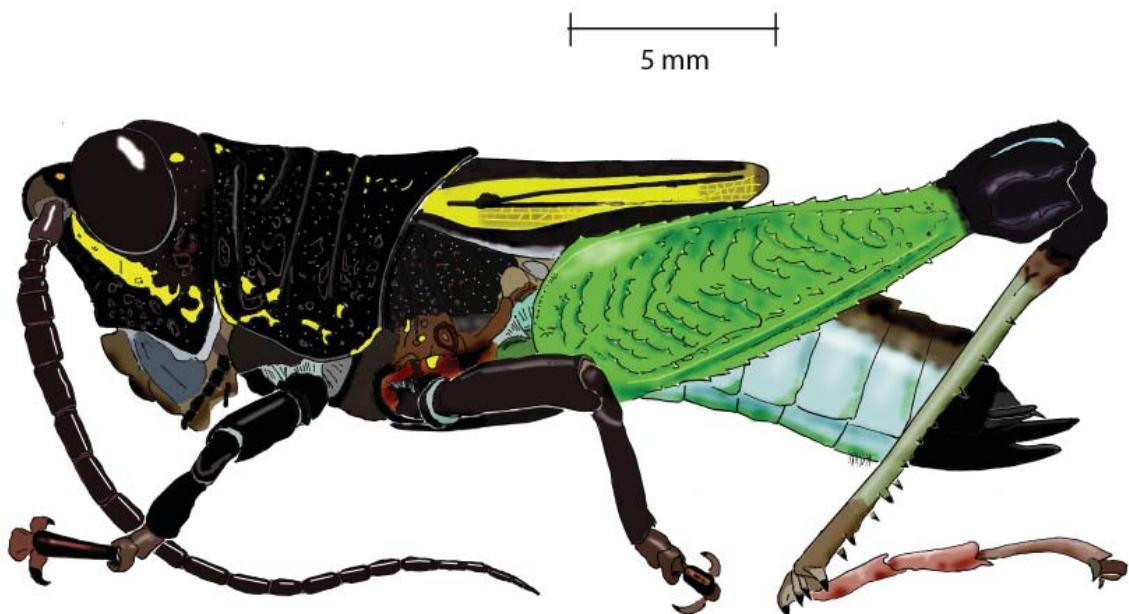


Plate B20. *Nautia atrata*, female.

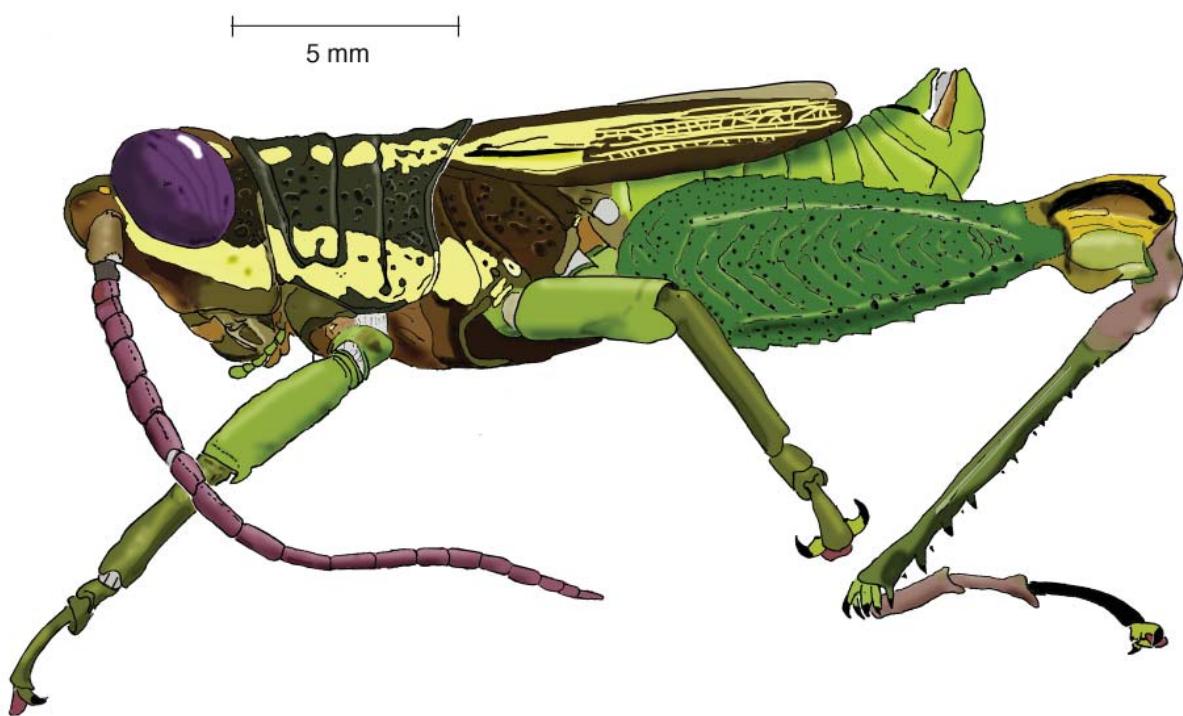


Plate B21. *Nautia conspersipes*, male.

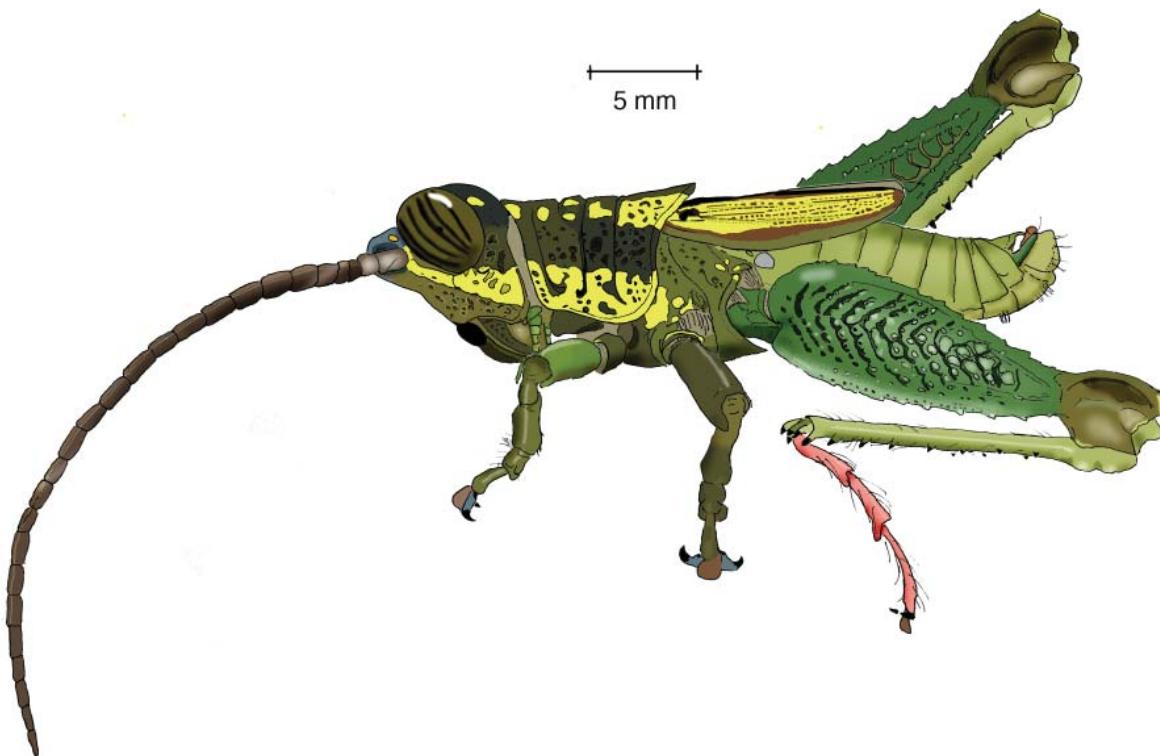


Plate B22. *Nautia costaricensis*, male.

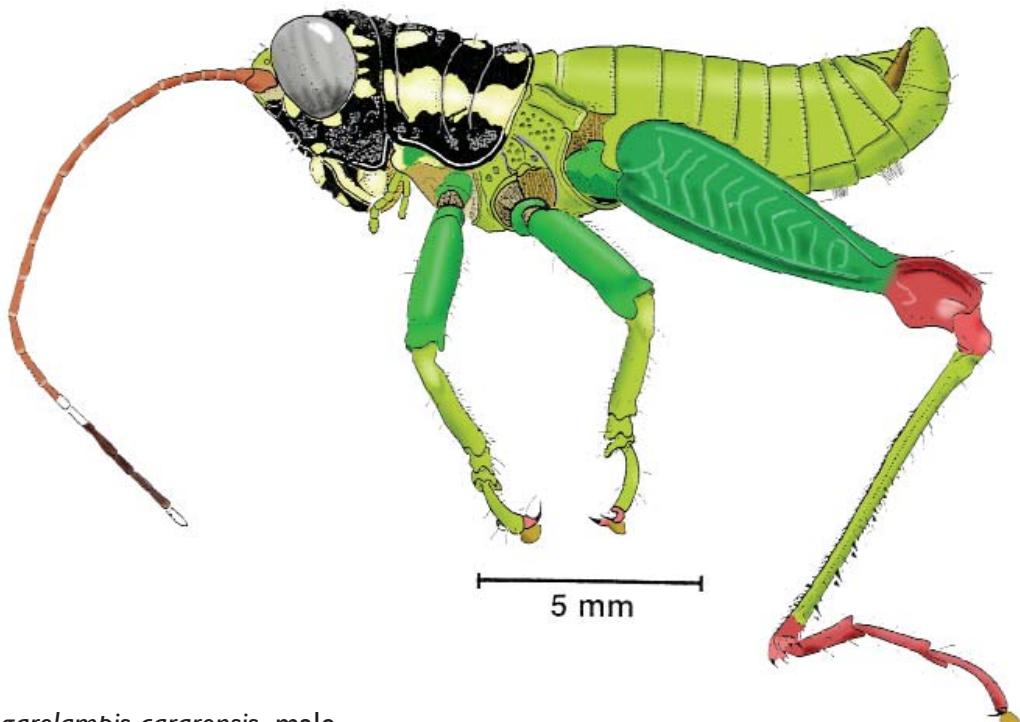


Plate B23. *Lagarolampis cararensis*, male.

Bactrophorinae

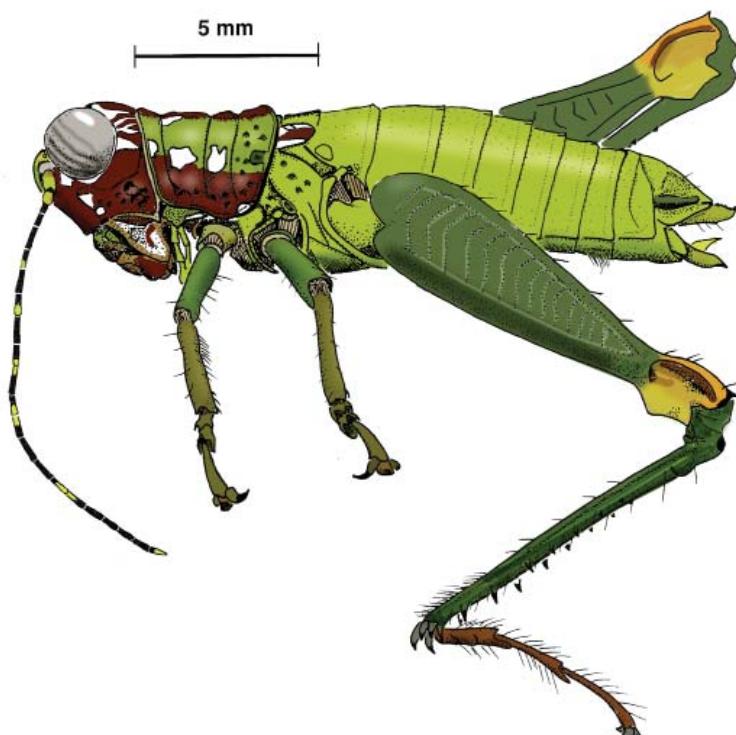


Plate B24. *Lagarolampis gamboensis*, male.



Plate B25. *Lagarolampis maculatus*, male.

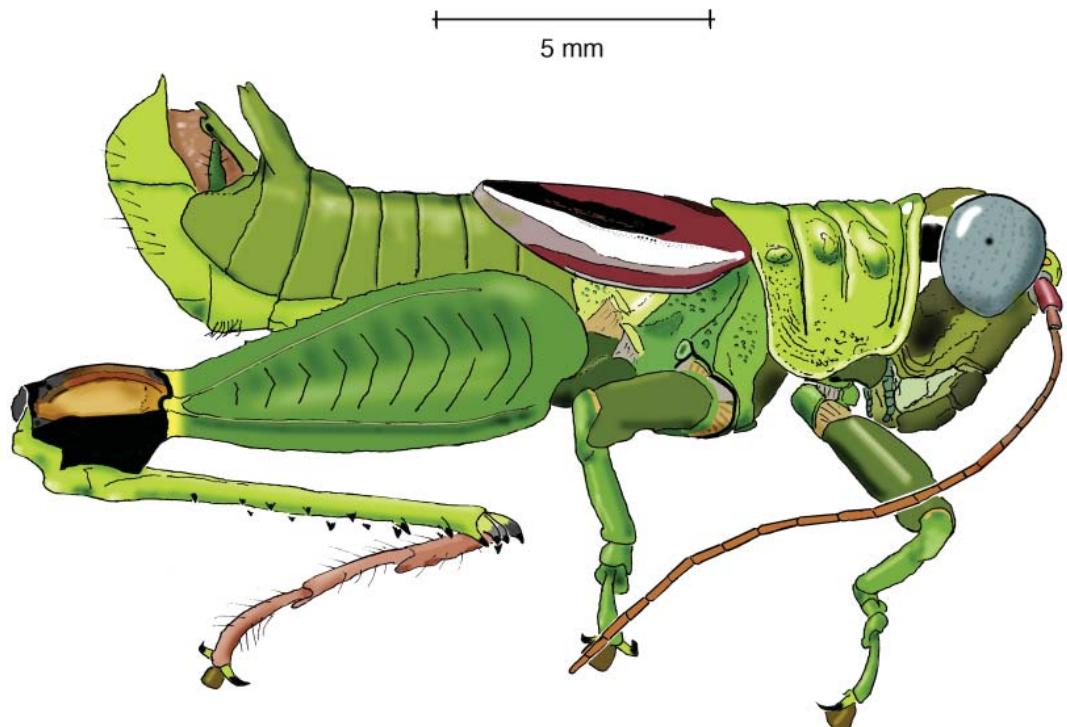


Plate B26. *Zoumolampis bradleyi*, male.

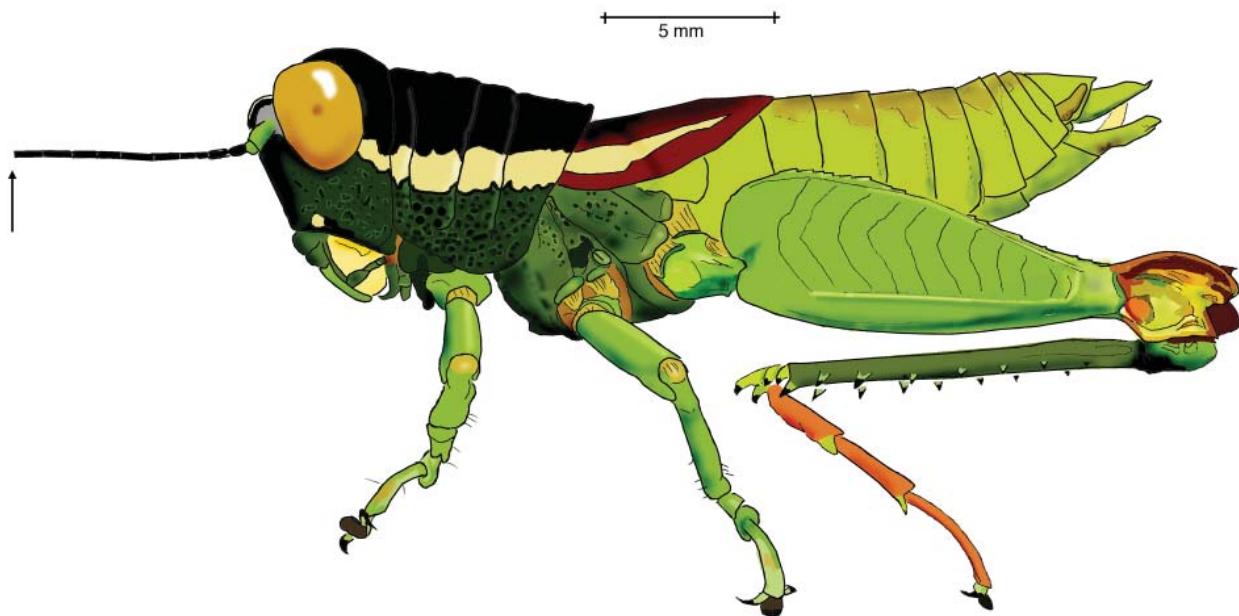


Plate B27. *Inbiolampis herediensis*, female.

Acridinae

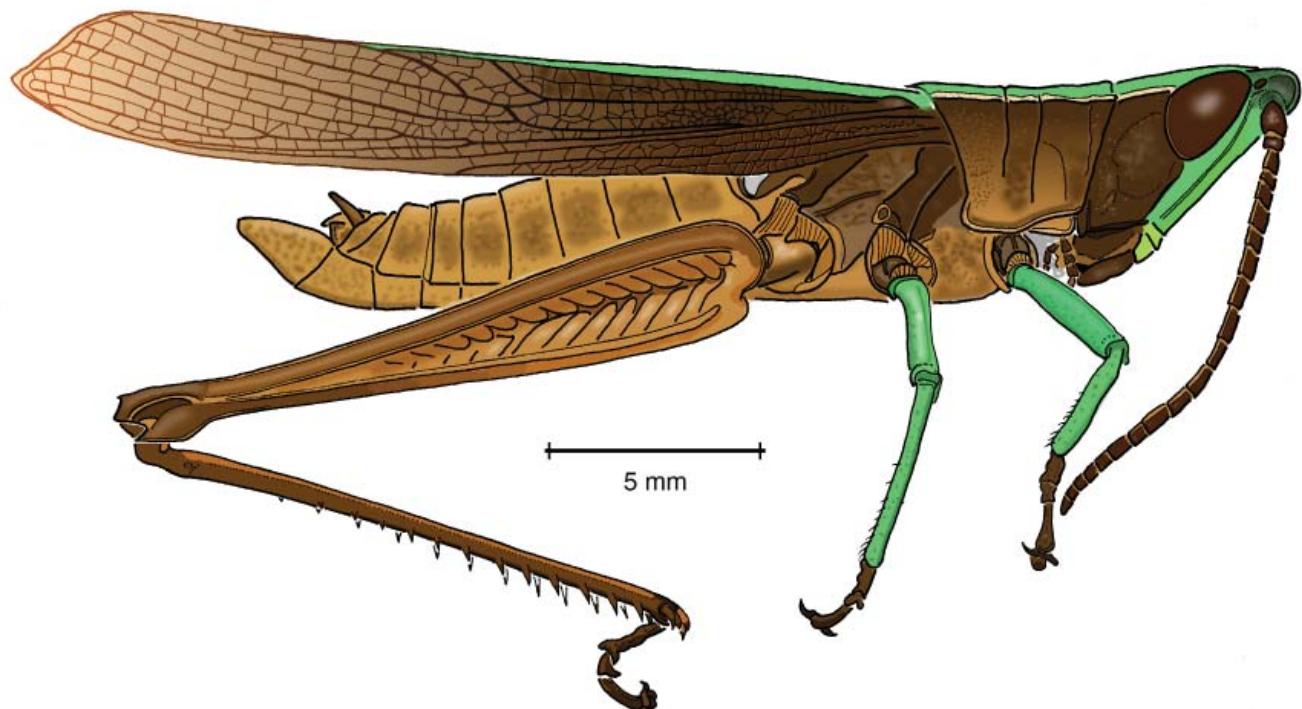


Plate A1. *Metaleptea adspersa*, male.

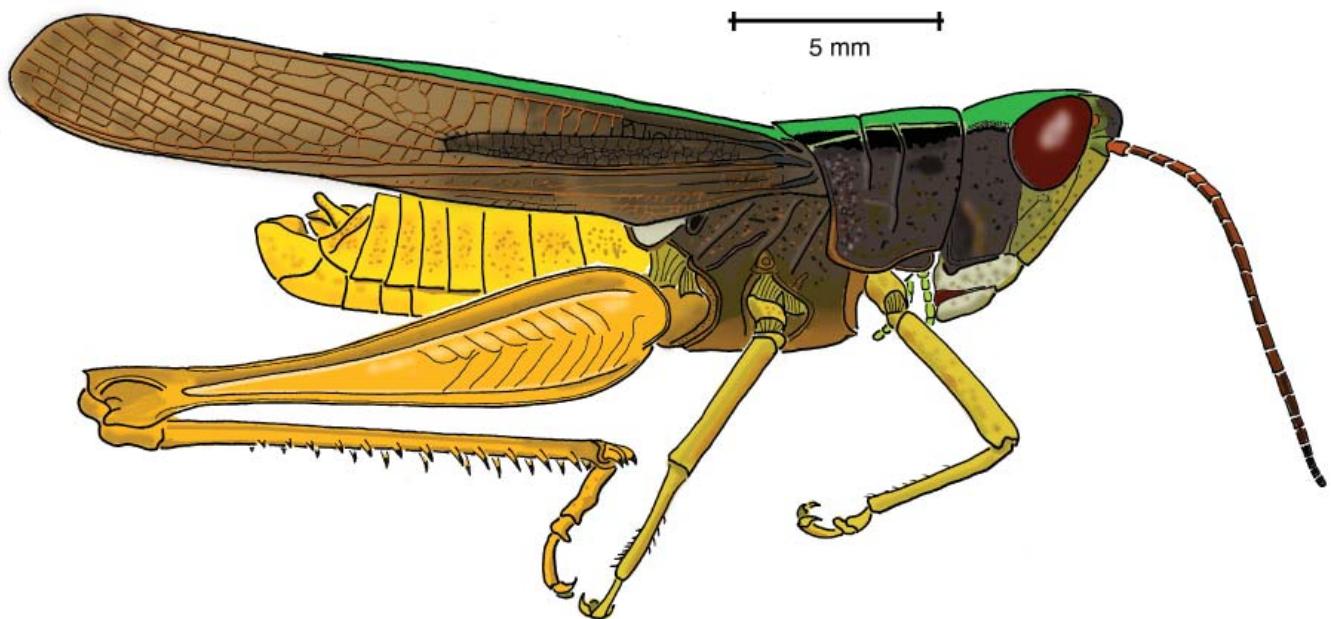


Plate A2. *Orphula azteca*, male.

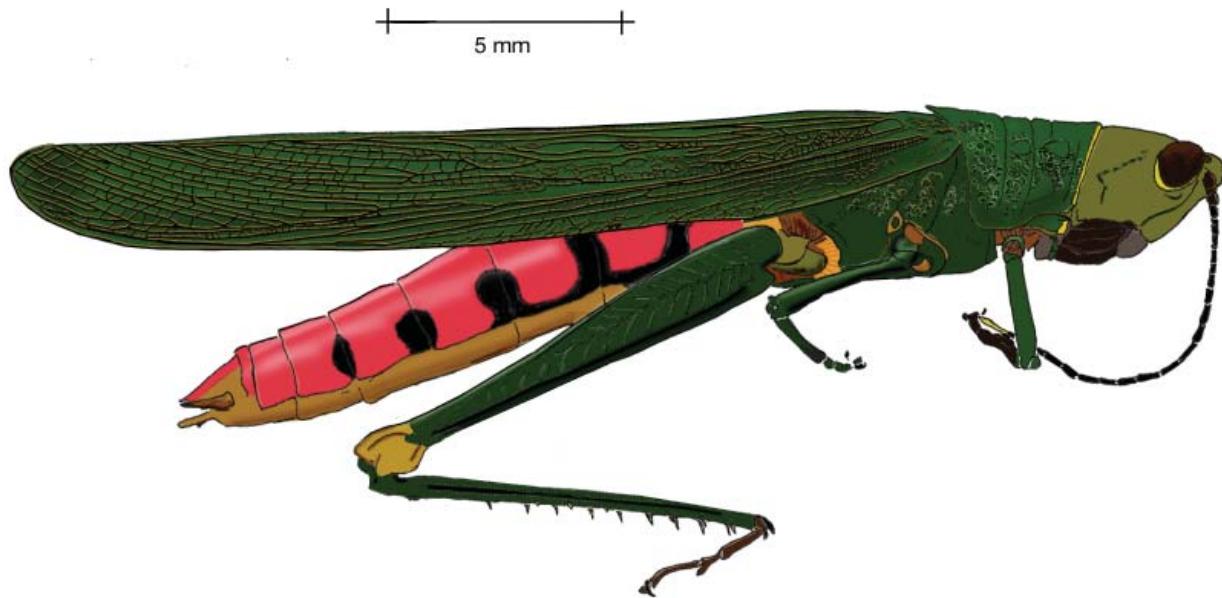


Plate Co1. *Copiocera specularis*, male.

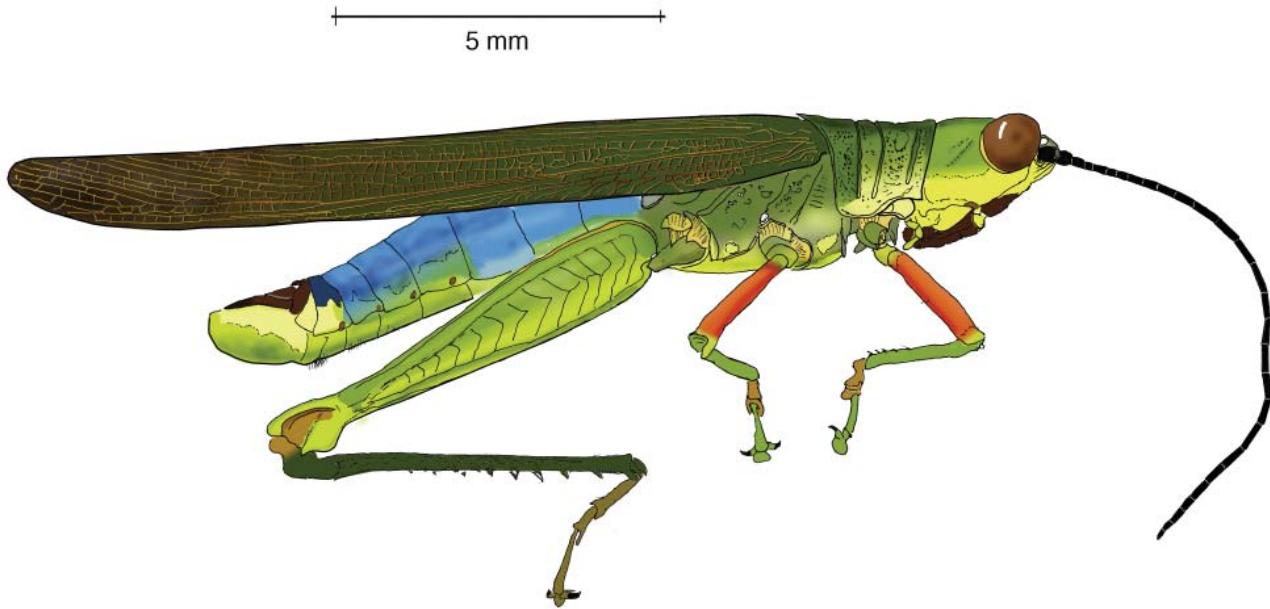


Plate Co2. *Copiotettix venezuelae*, male.

Eucopiocerae
Cyrtacanthacridinae

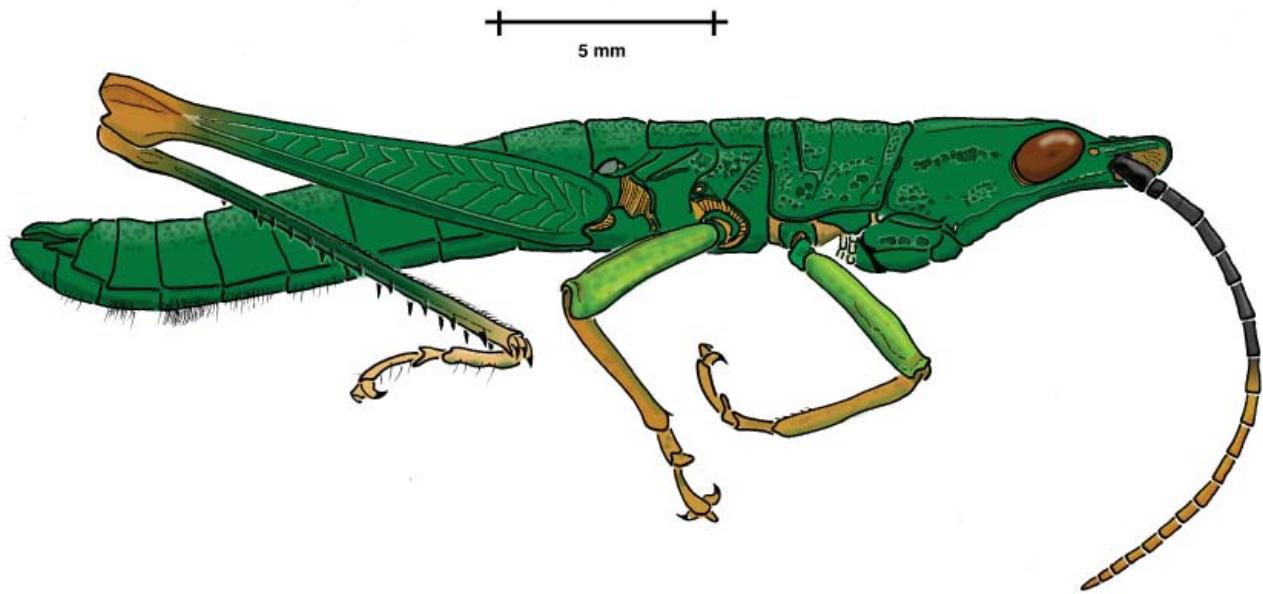


Plate EucopI. *Leptalacris fastigiata*, male.

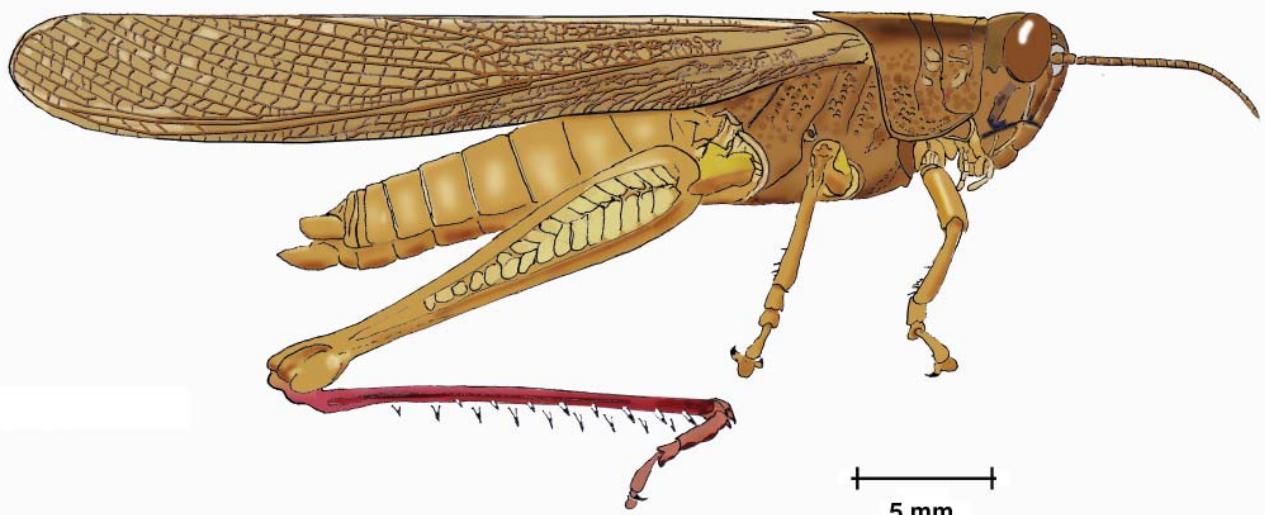


Plate CyrtI. *Schistocerca centralis*, male.

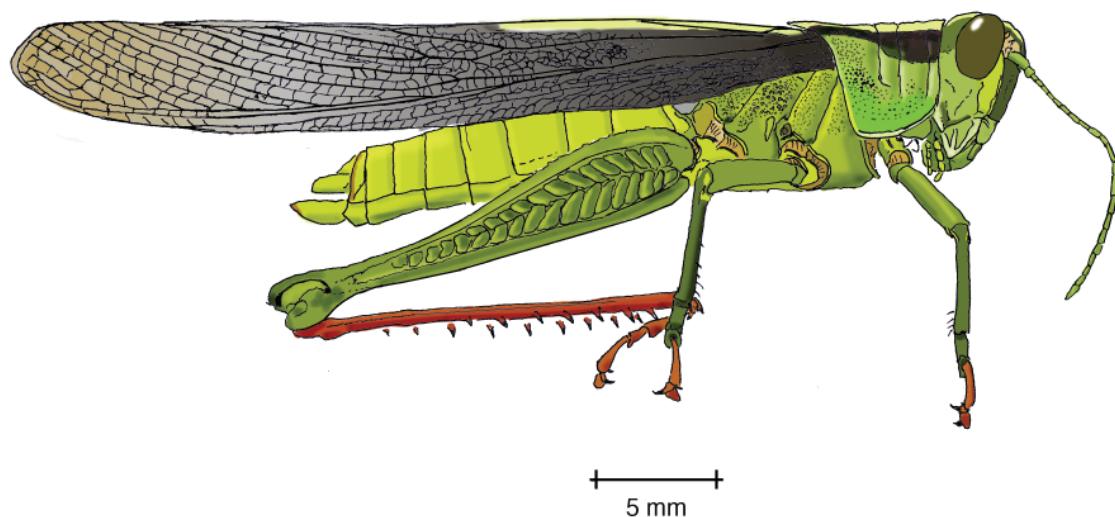


Plate Cyrt2. *Schistocerca nitens*, male.

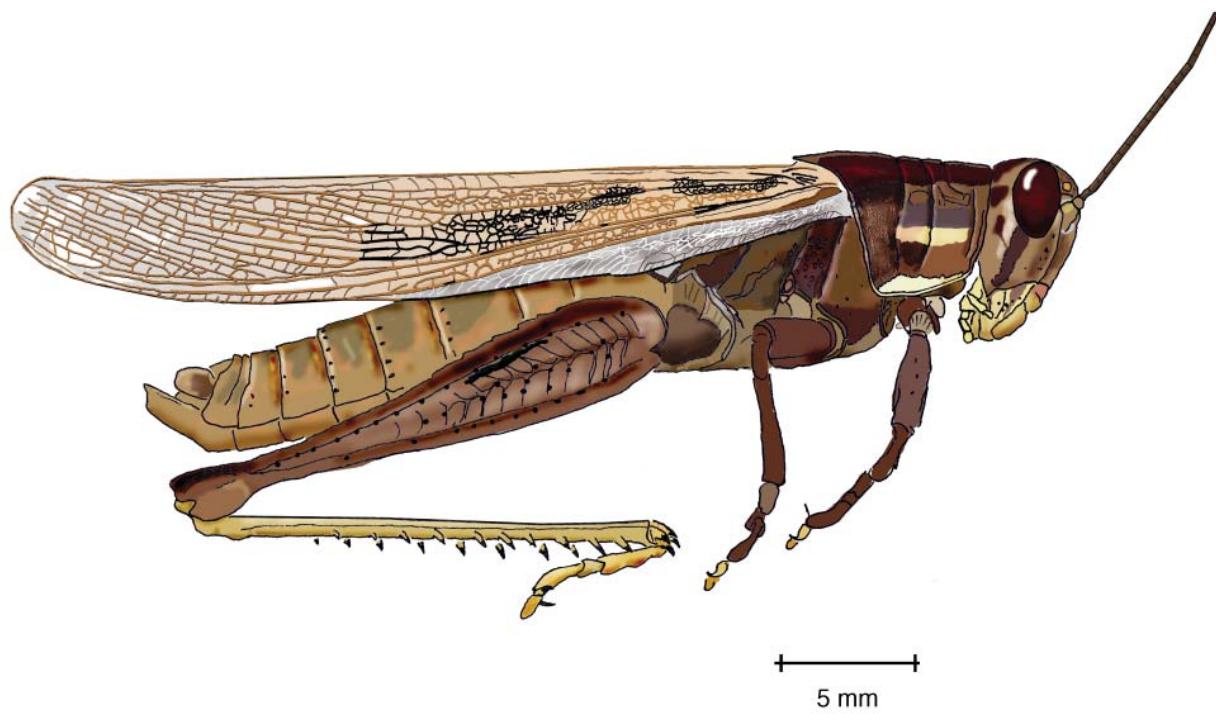
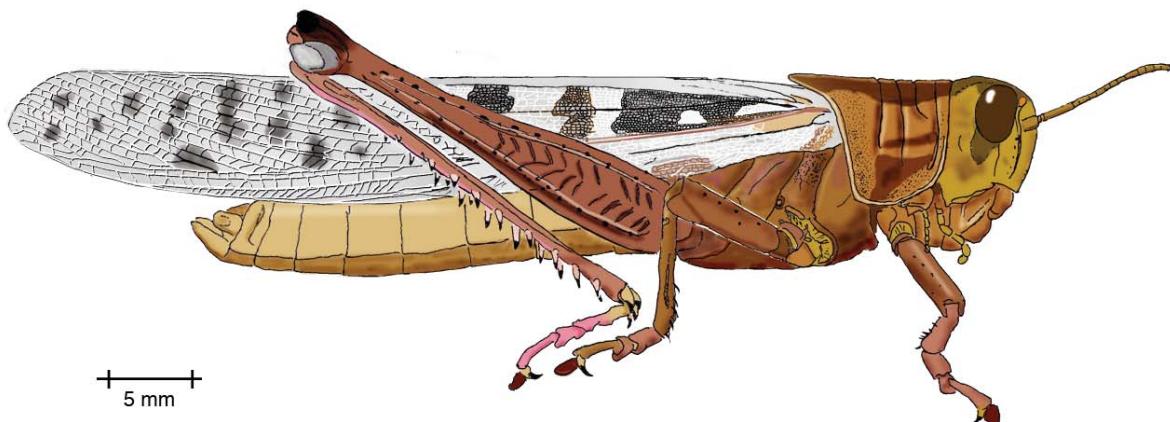
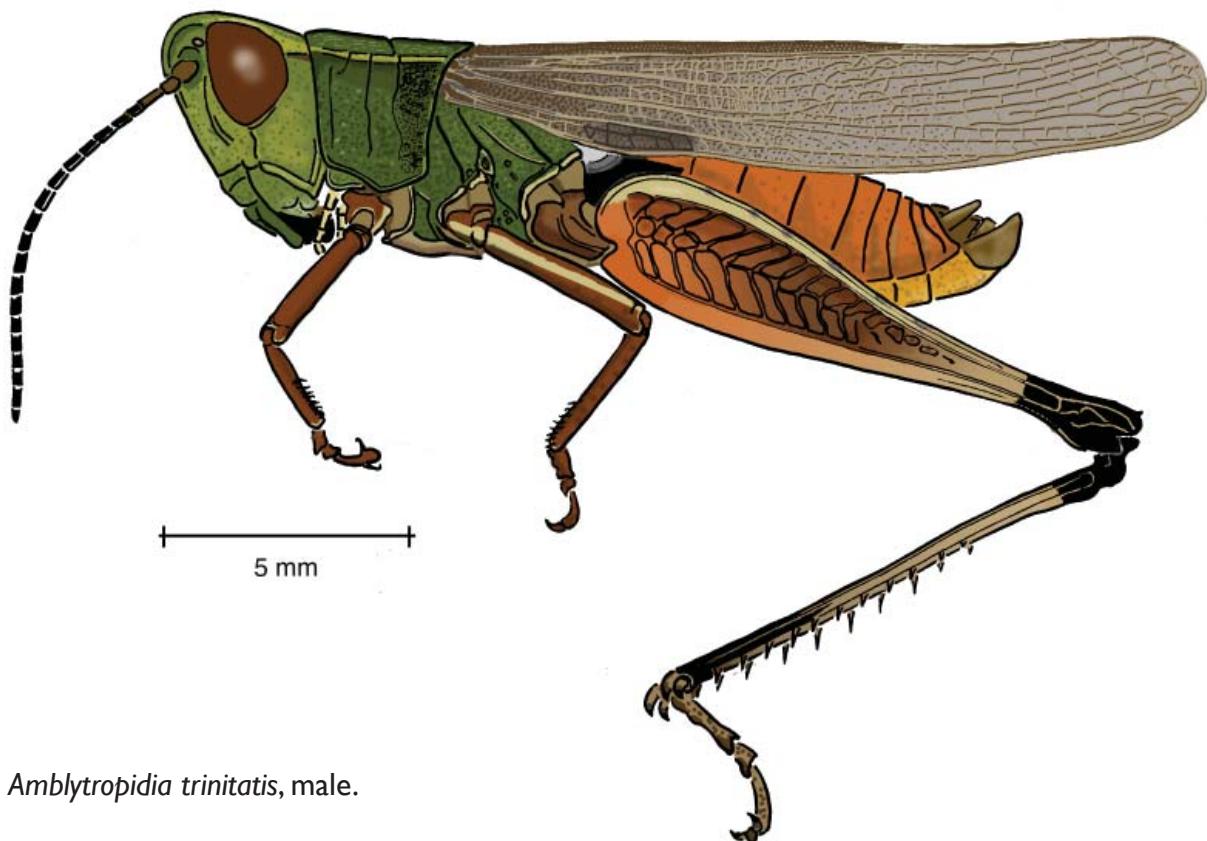


Plate Cyrt3. *Schistocerca pallens*, male.

Cyrtacanthacridinae
GomphocerinaePlate Cyrt4. *Schistocerca piceifrons*, male.Plate GI. *Amblytropidia trinitatis*, male.

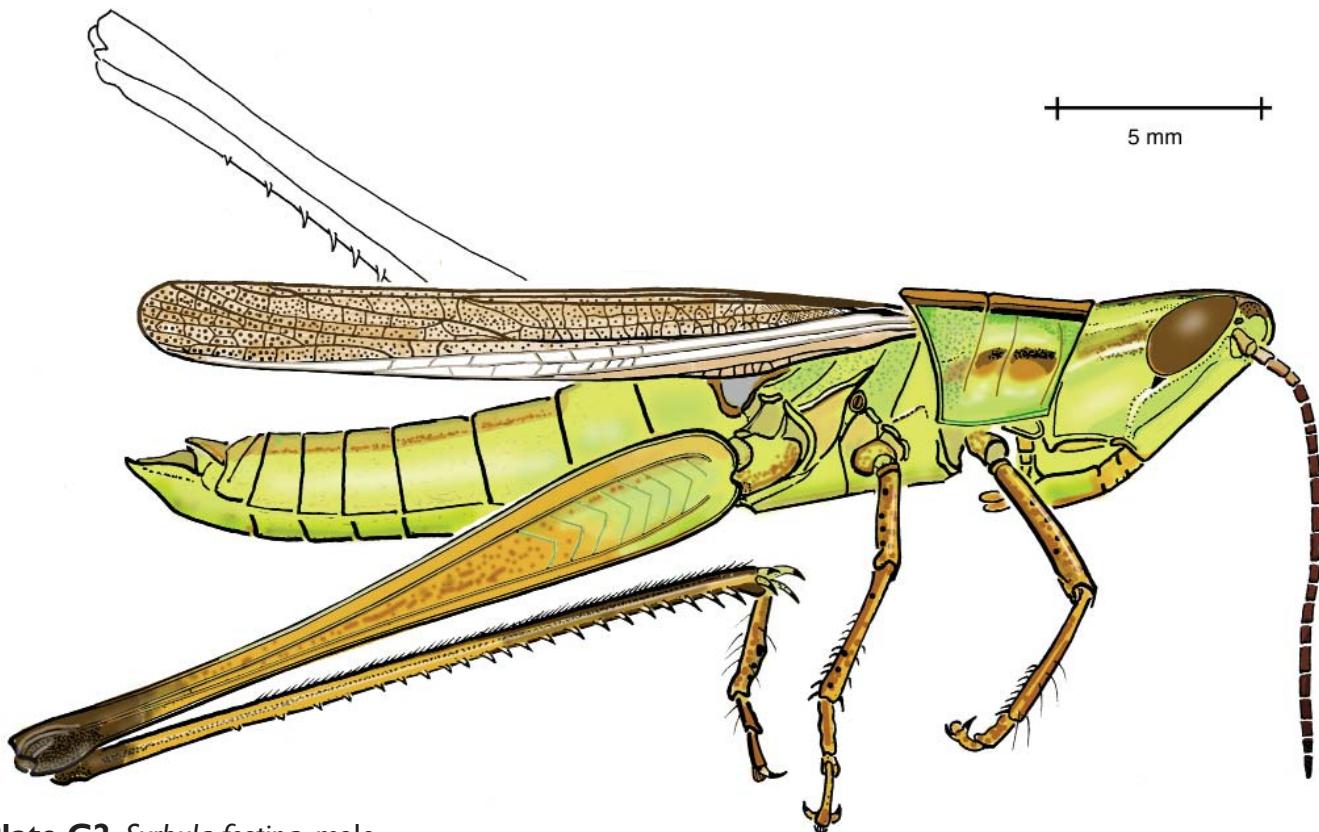


Plate G2. *Syrbula festina*, male.

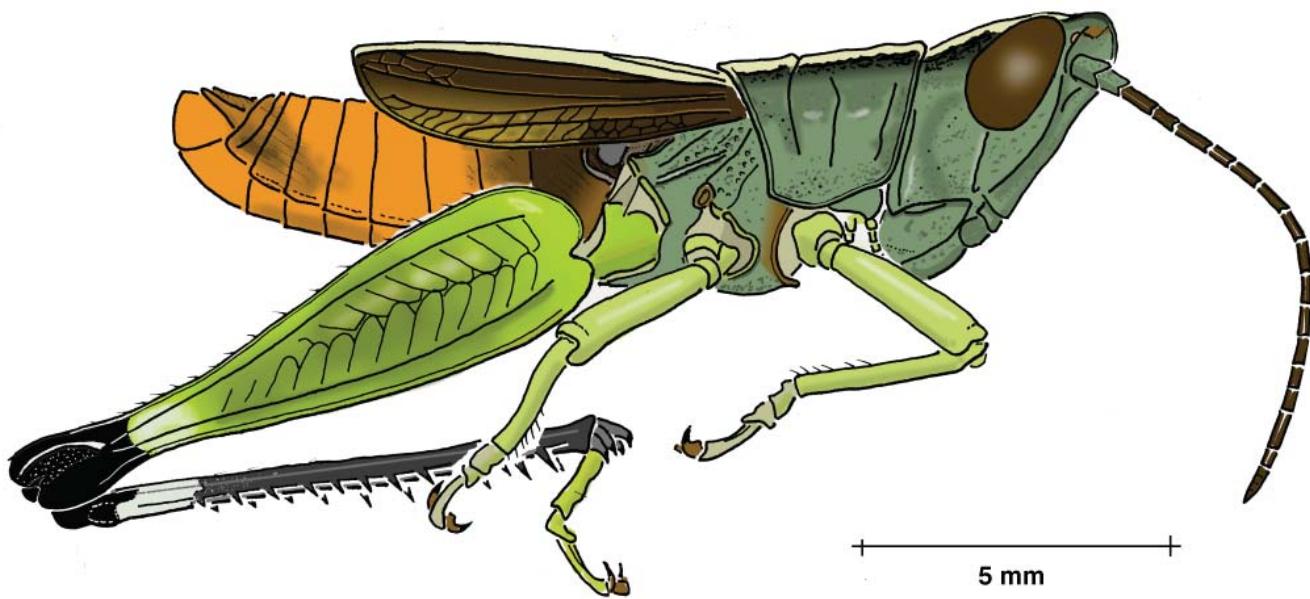
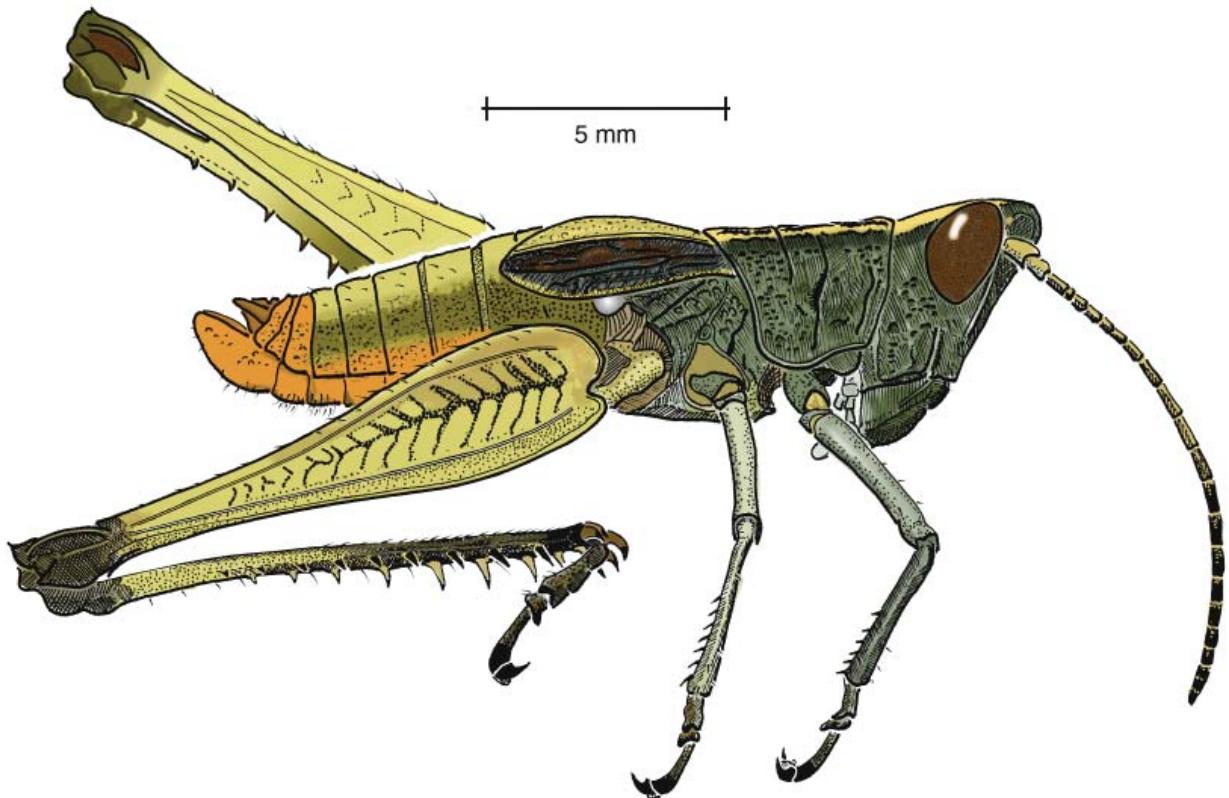
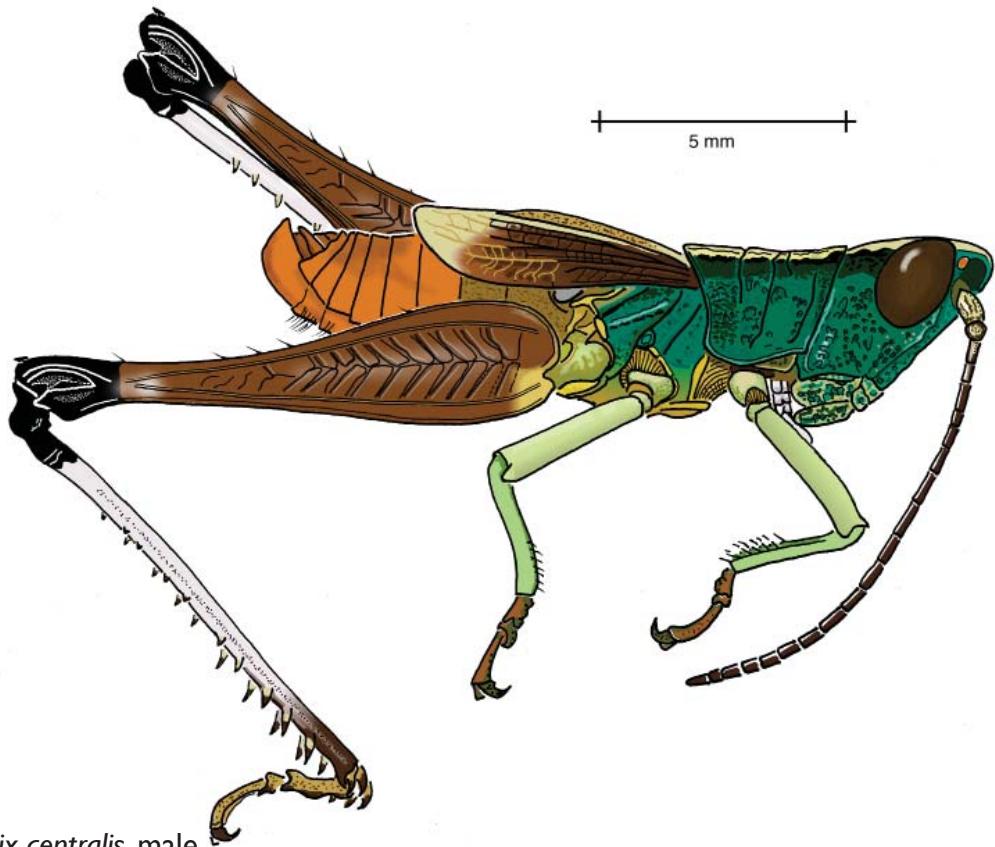


Plate G3. *Silvitettix biolleyi*, male.

Gomphocerinae

Plate G4. *Silvitettix maculatus*, male.Plate G5. *Silvitettix centralis*, male.

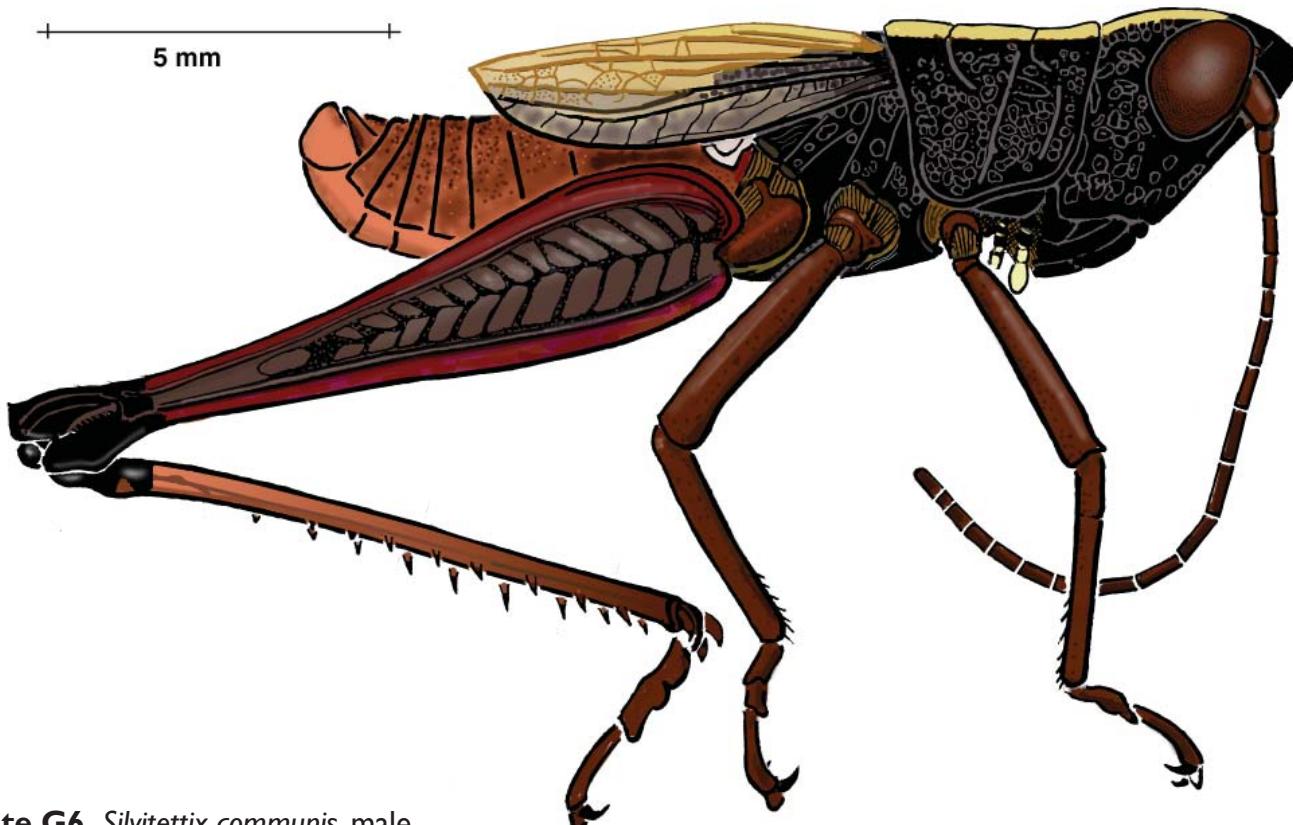


Plate G6. *Silvitettix communis*, male.

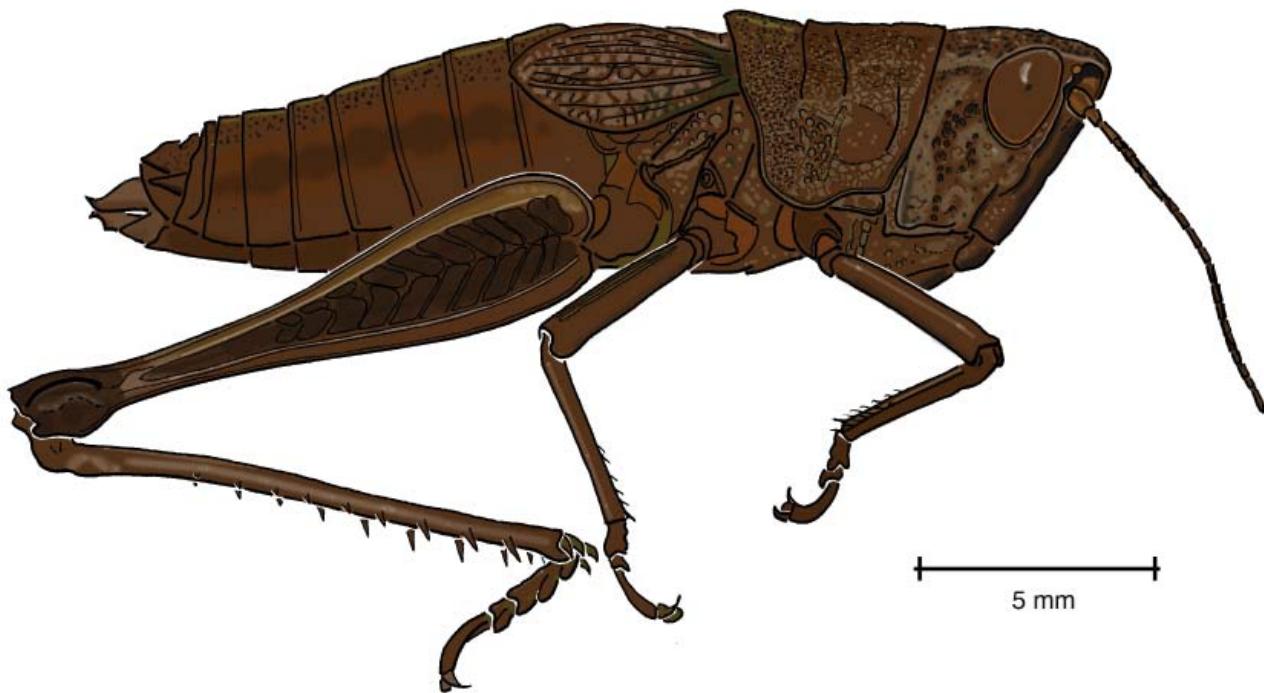


Plate G7. *Silvitettix communis*, female.

Gomphocerinae

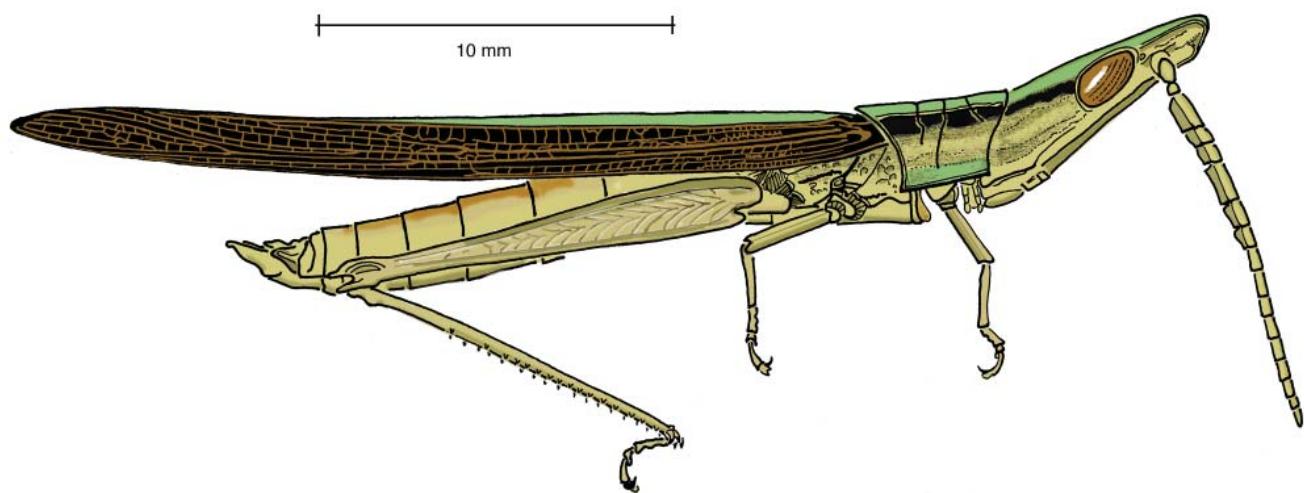


Plate G8. *Achurum sumichrasti*, male.

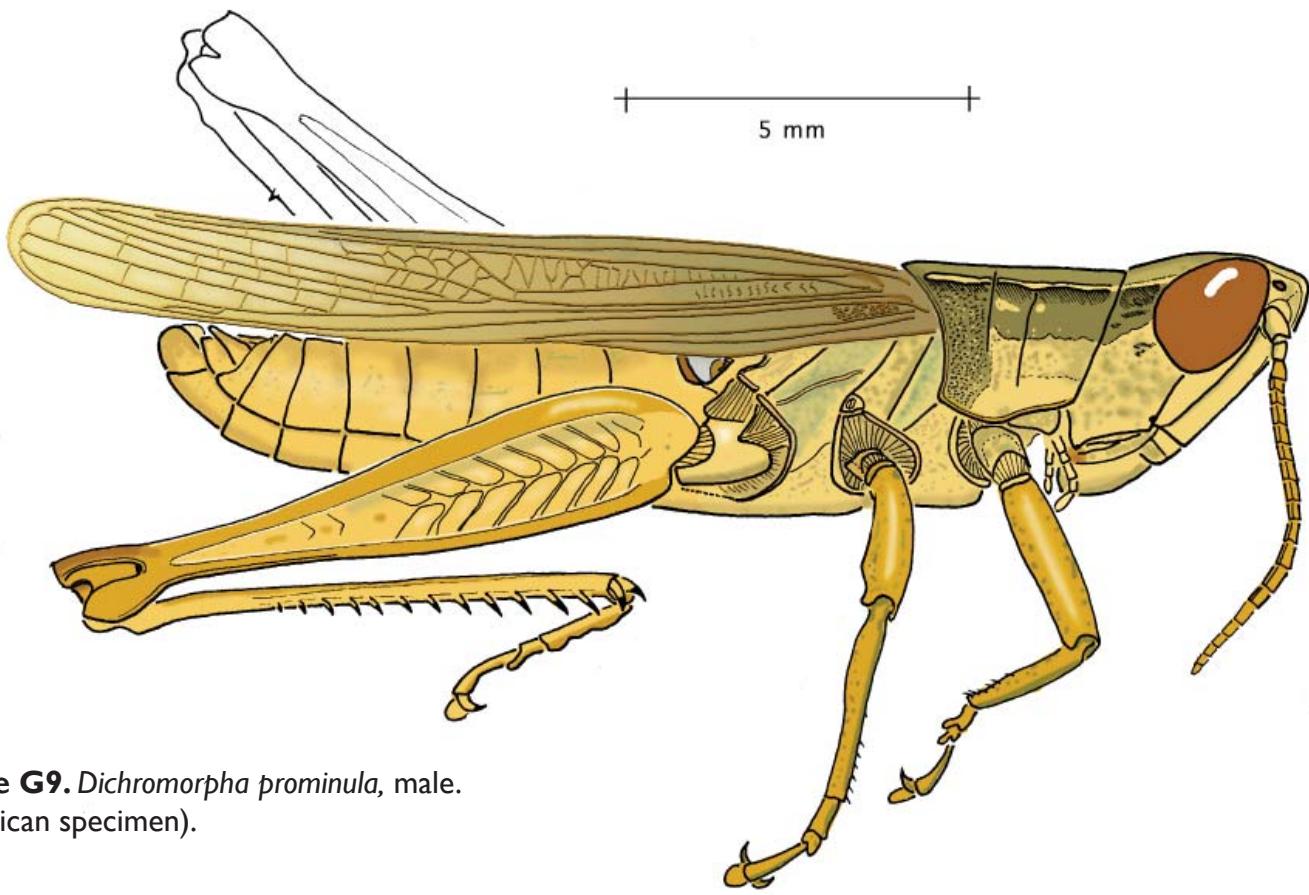


Plate G9. *Dichromorpha prominula*, male.
(Mexican specimen).

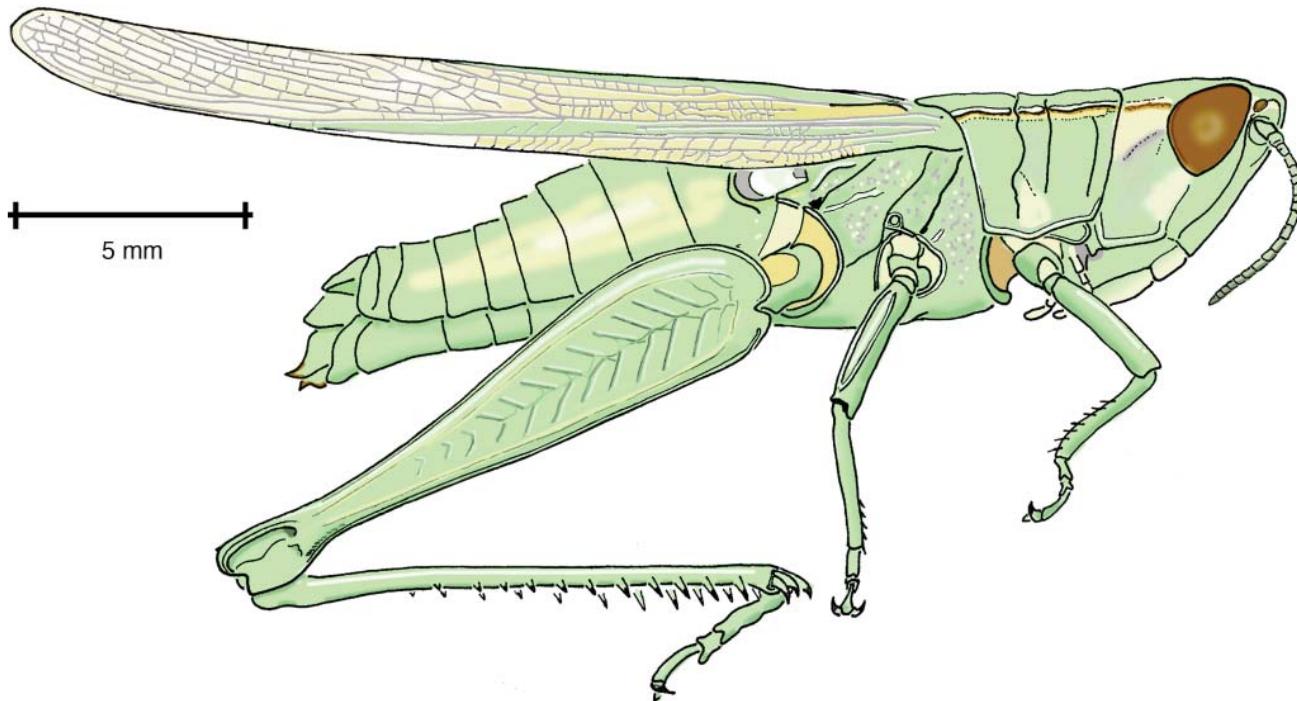


Plate G10. *Dichromorpha prominula*, female.
(Costa Rican specimen).

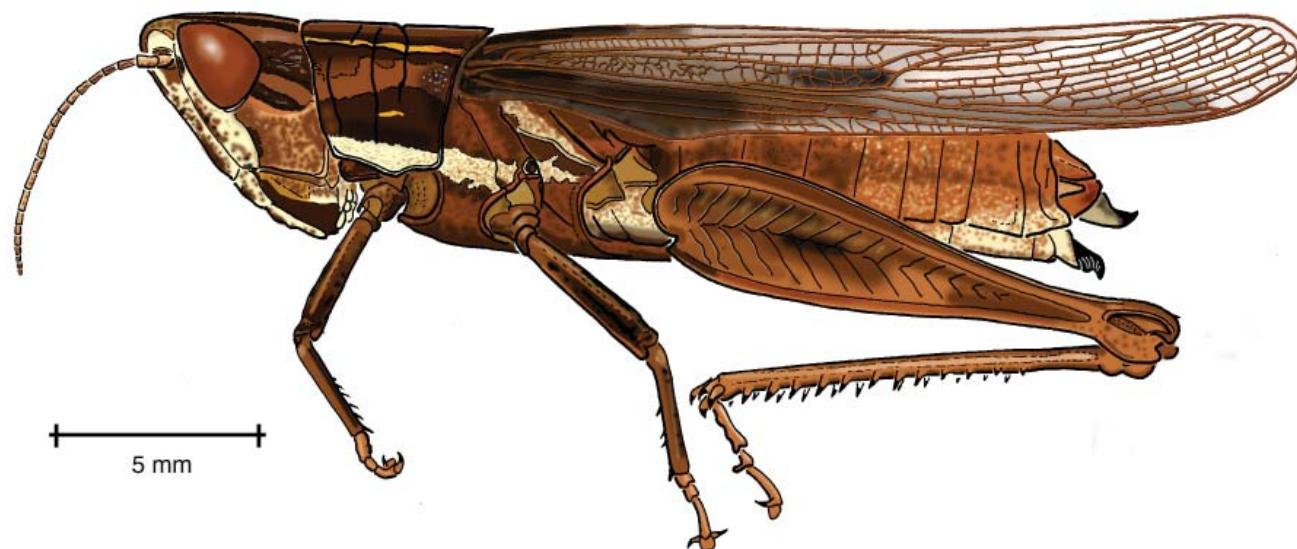


Plate G11. *Dichromorpha prominula*, female.
(Panamanian specimen).

Gomphocerinae

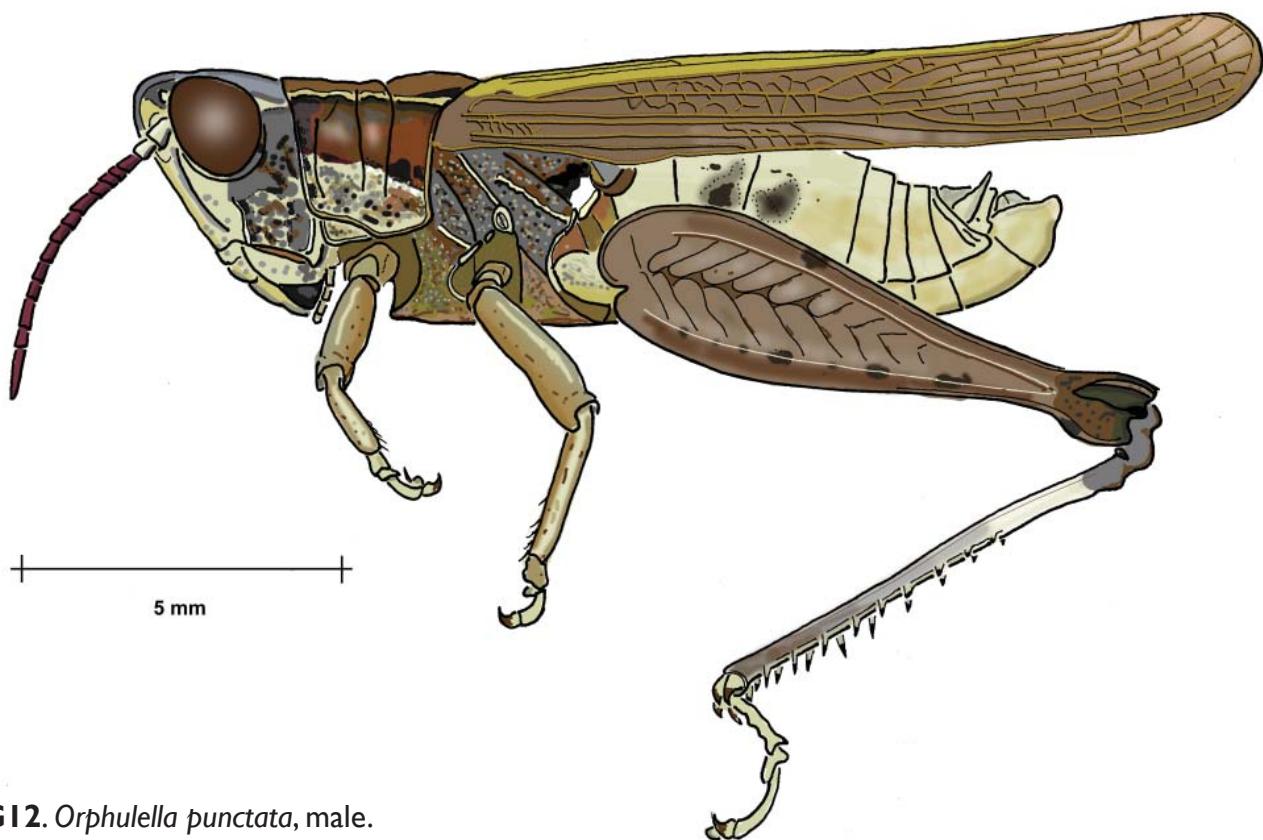


Plate G12. *Orphulella punctata*, male.

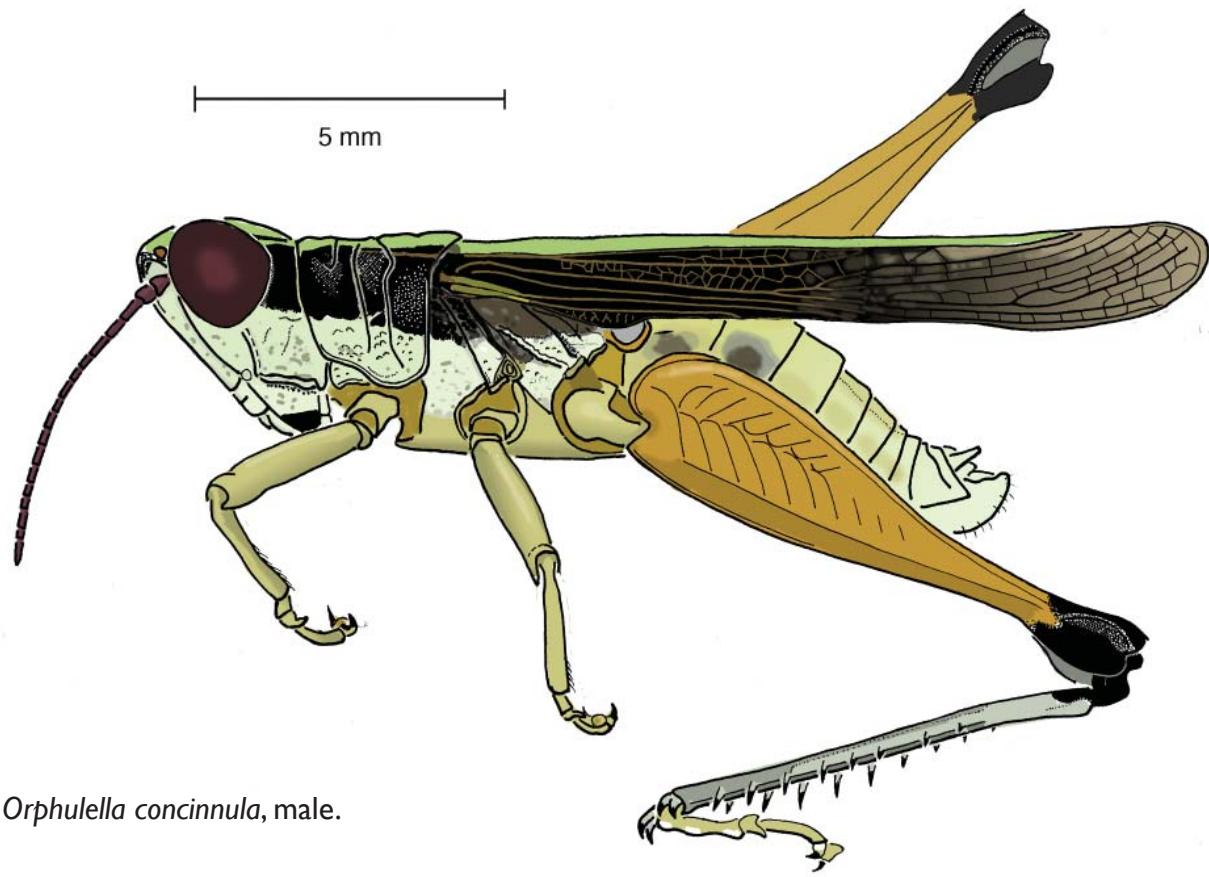


Plate G13. *Orphulella concinnula*, male.

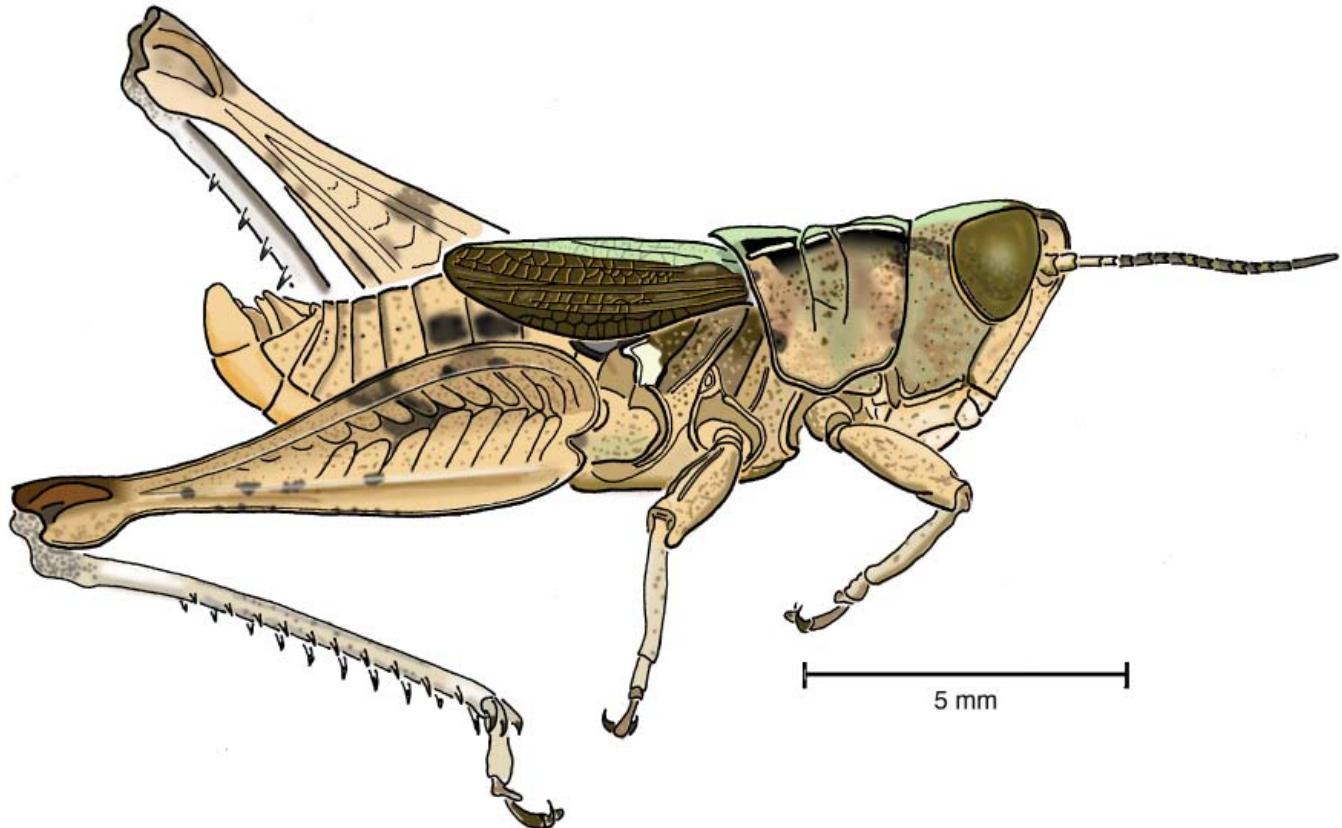


Plate G14. *Orphulella pernix*, male.

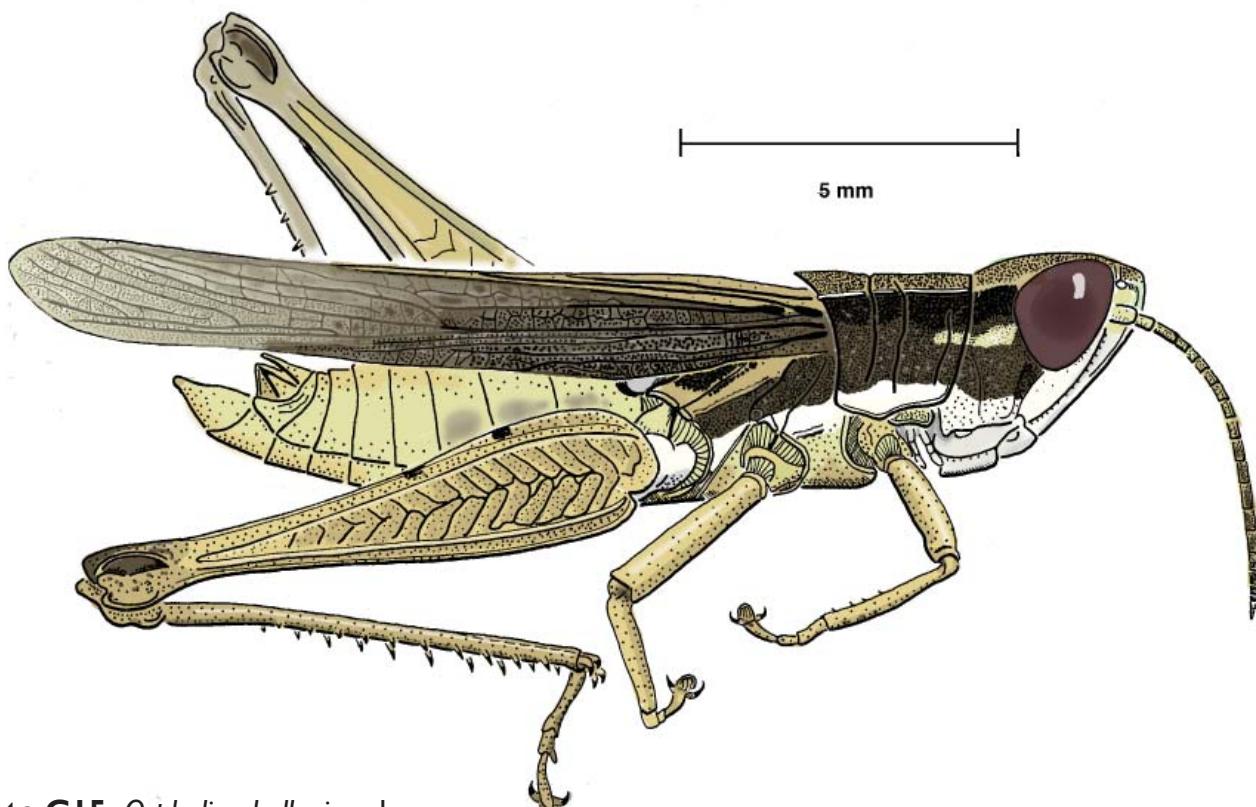


Plate G15. *Orphulina balloui*, male.

Gomphocerinae

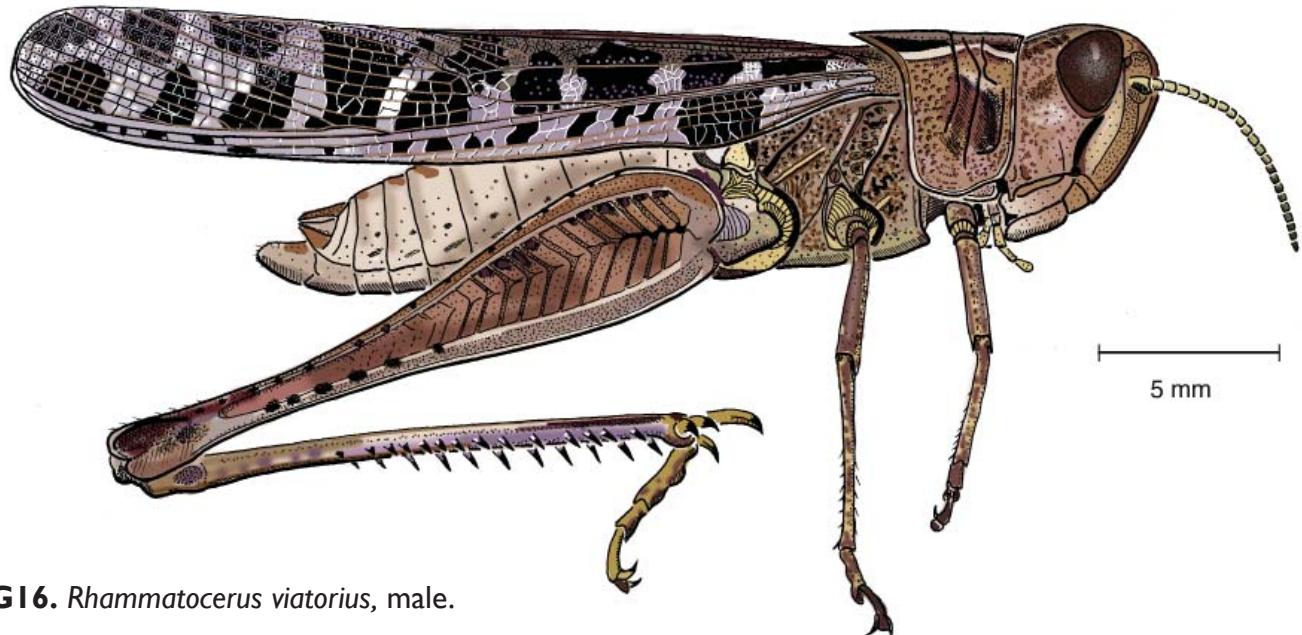


Plate G16. *Rhammatocerus viatorius*, male.

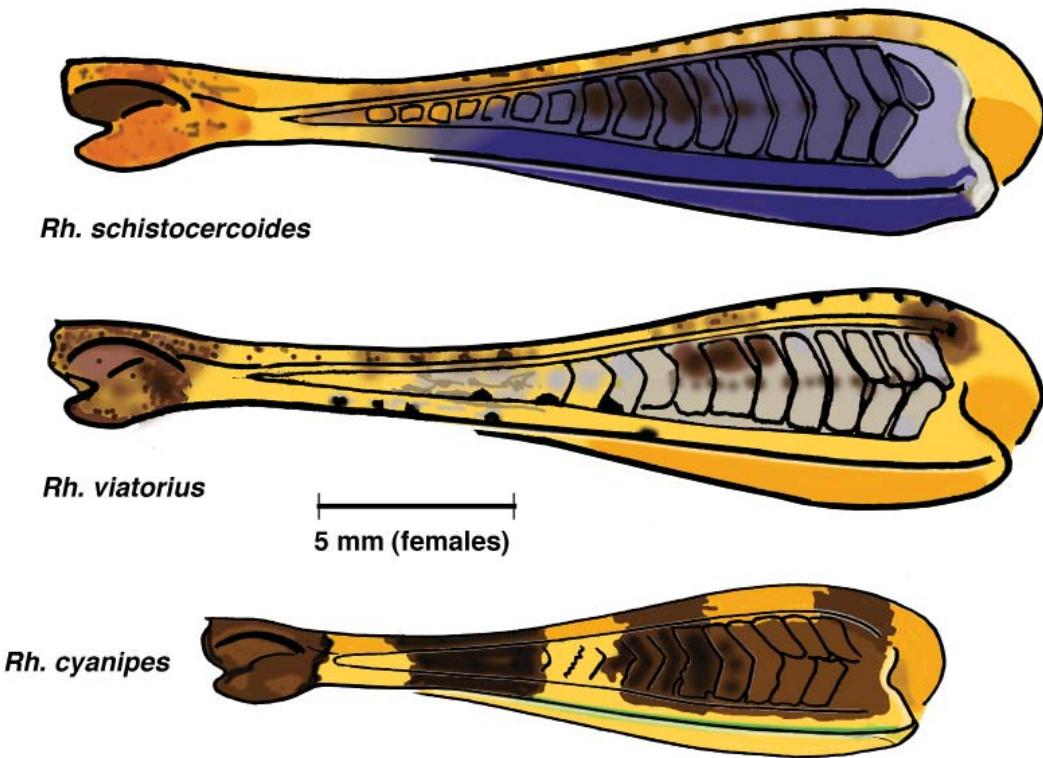


Plate G17. *Rhammatocerus* spp., inner face of hind femora.

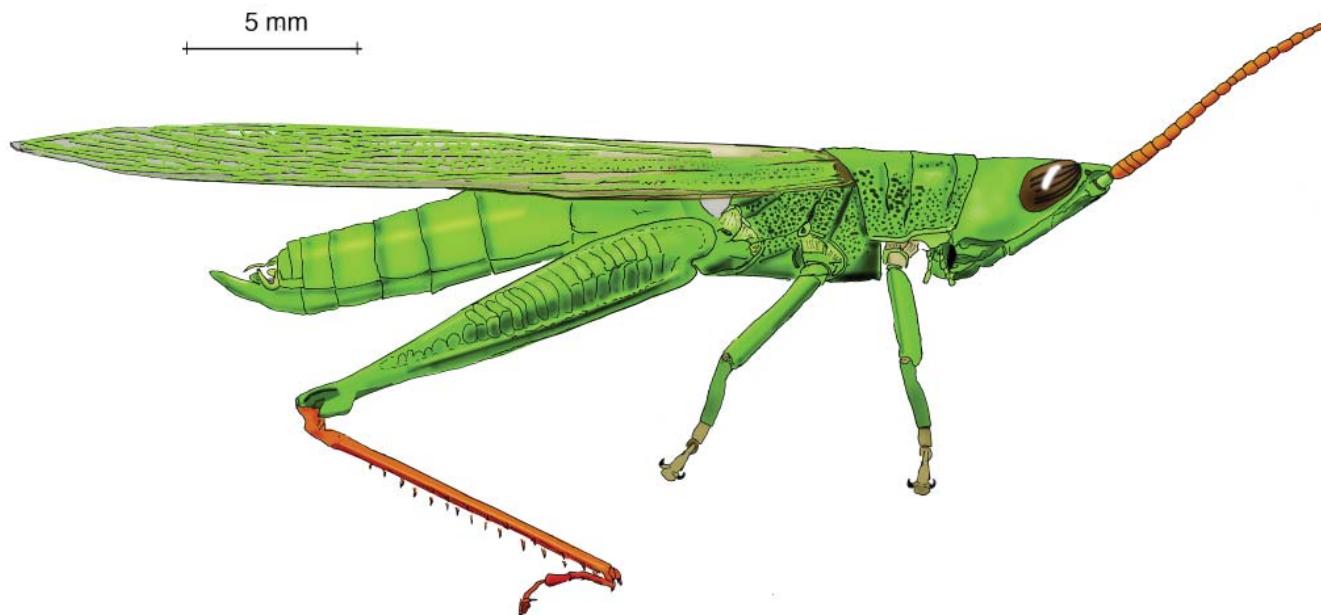


Plate L1. *Belosacris coccineipes*, male.

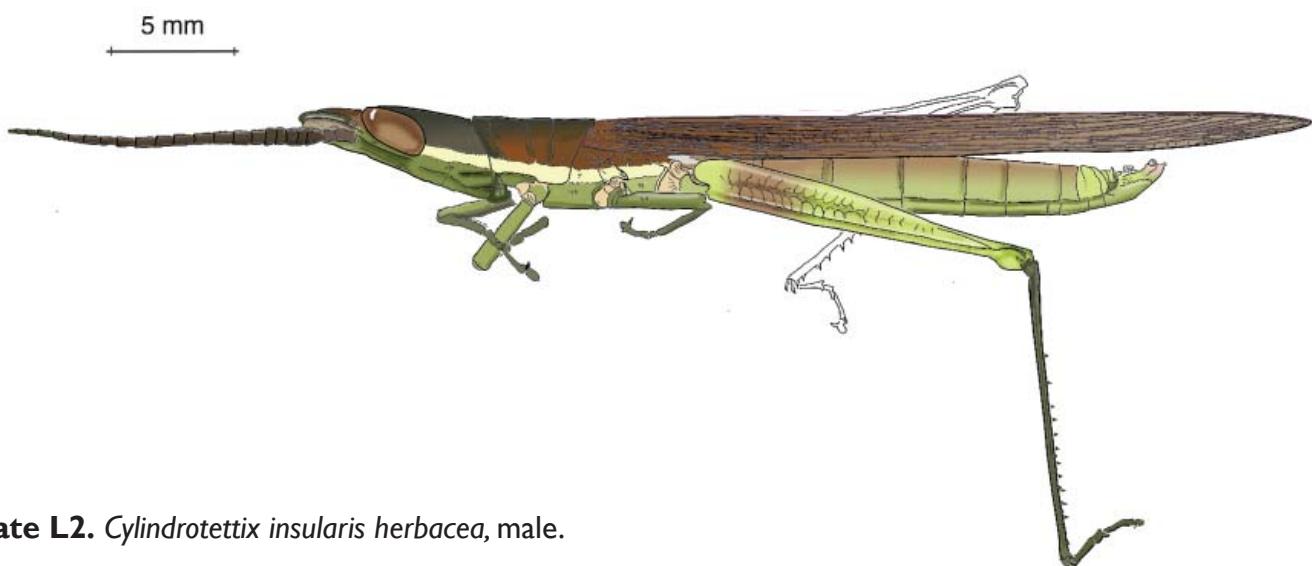


Plate L2. *Cylindrotettix insularis herbacea*, male.

Leptysminae

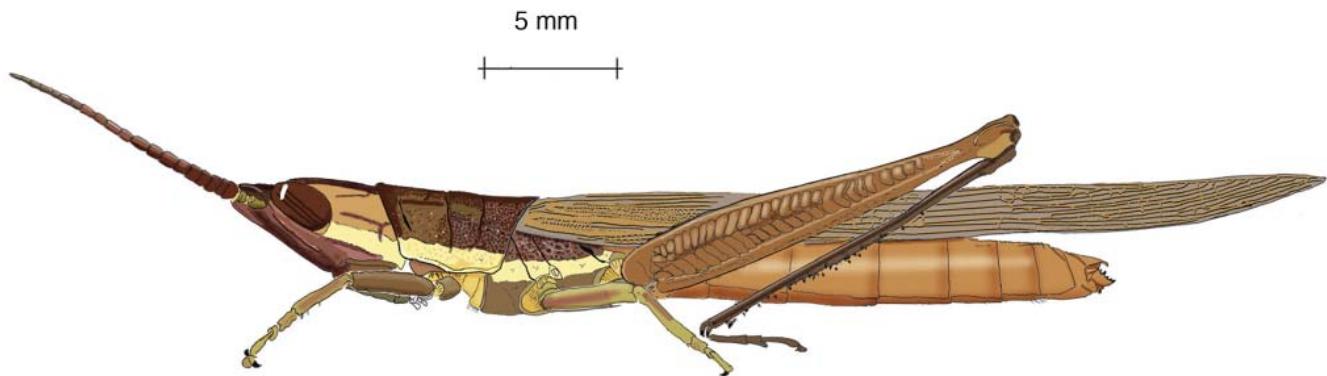


Plate L3. *Leptysma marginicollis*, female.

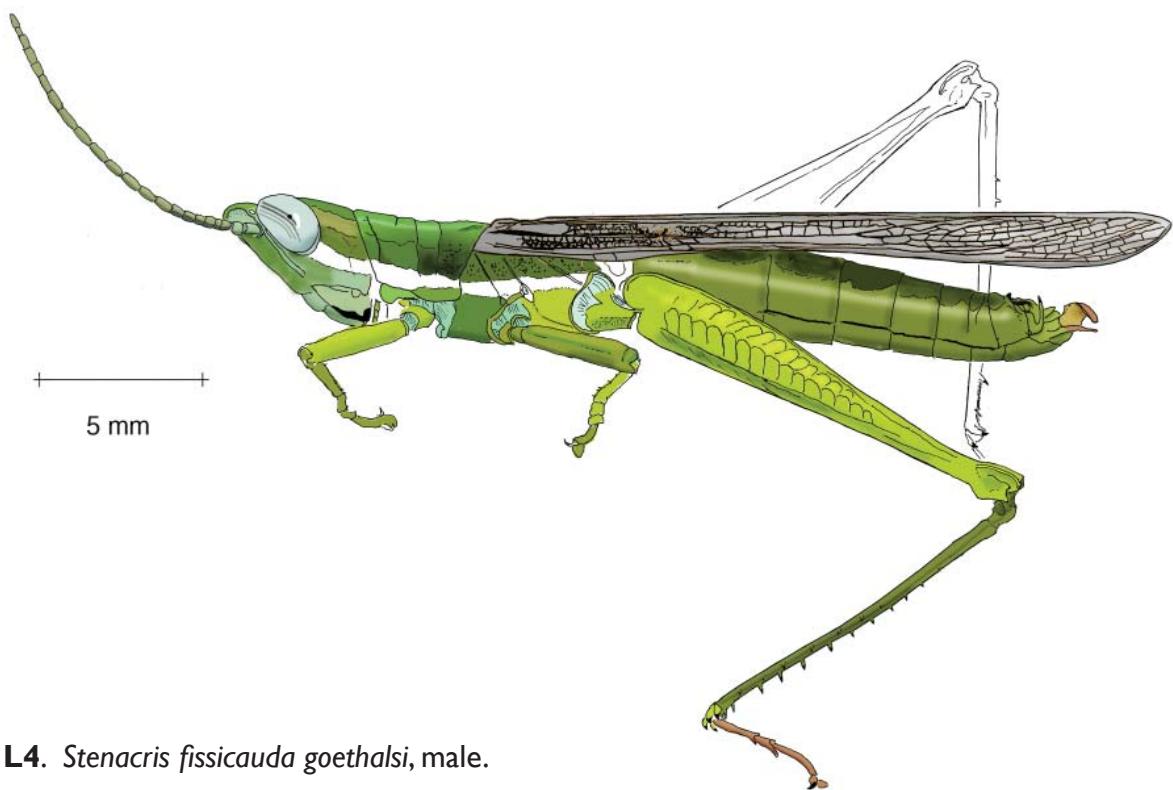


Plate L4. *Stenacris fissicauda goethalsi*, male.

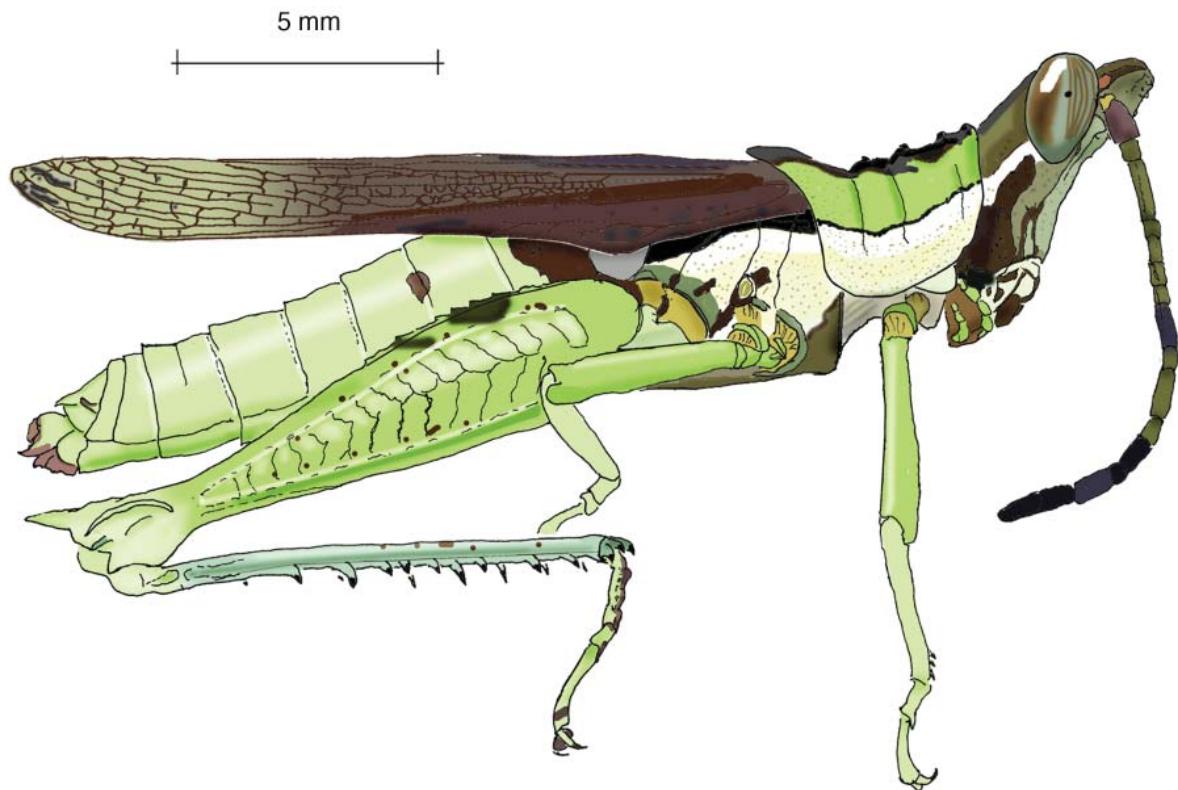


Plate L5. *Guetaresia lankesteri*, female.

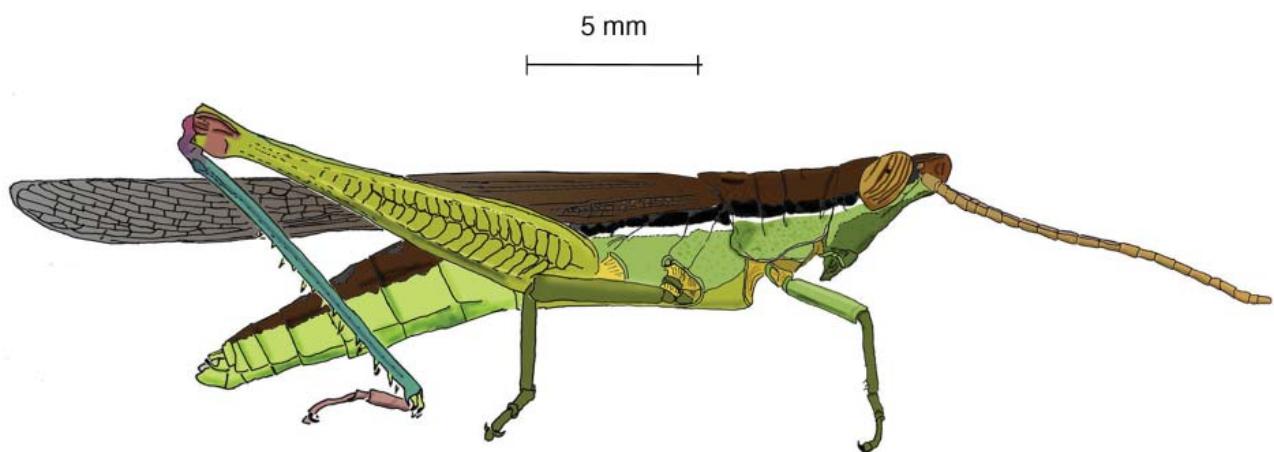


Plate L6. *Stenopola dorsalis*, male.

Leptysminae

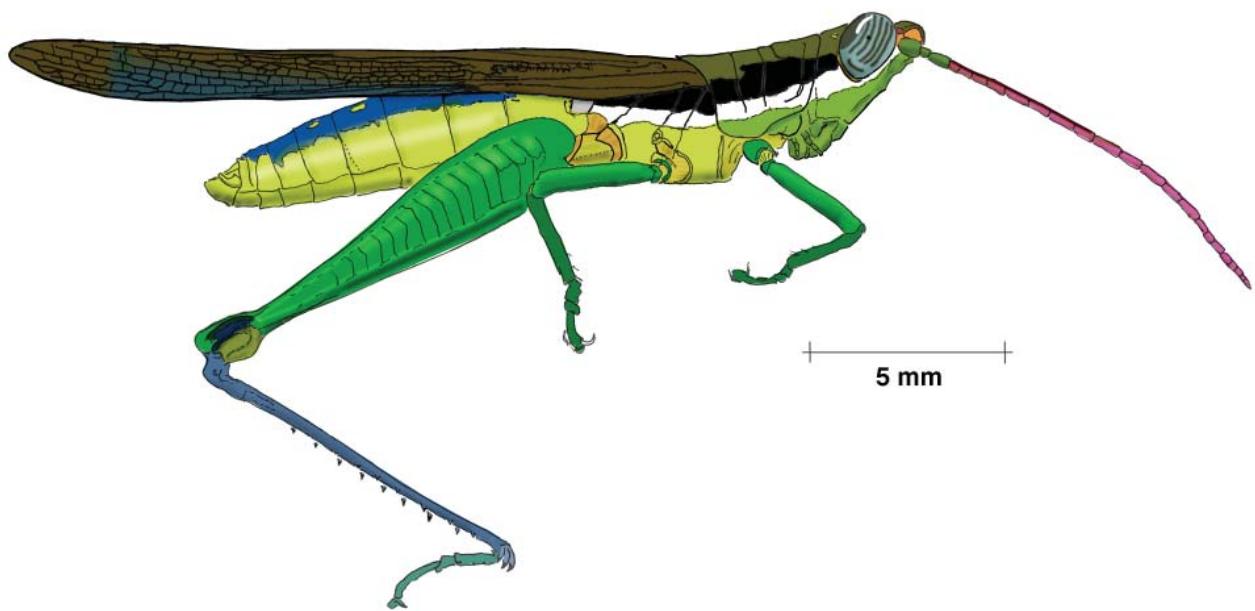


Plate L7. *Stenopola puncticeps limabtipennis*, male.

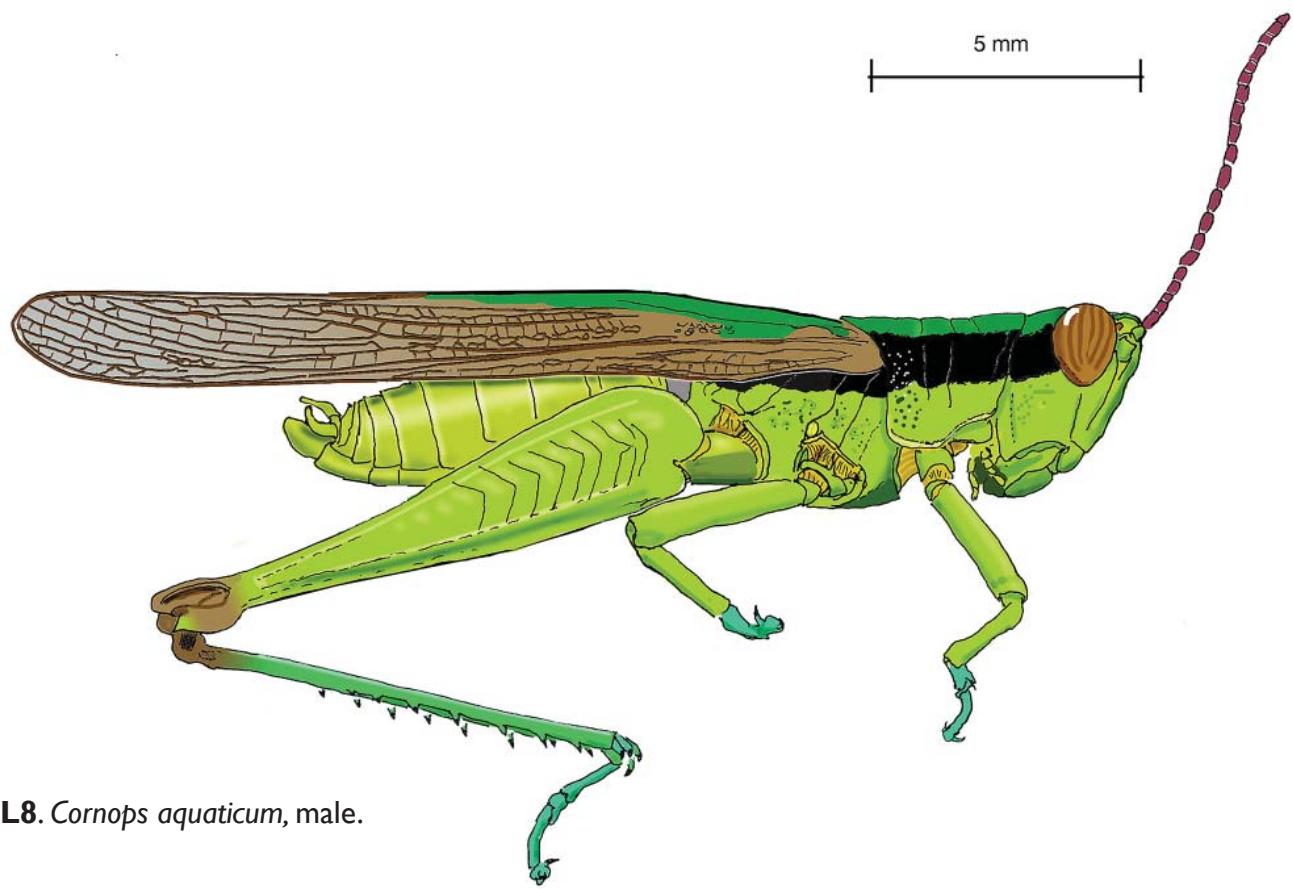


Plate L8. *Cornops aquaticum*, male.

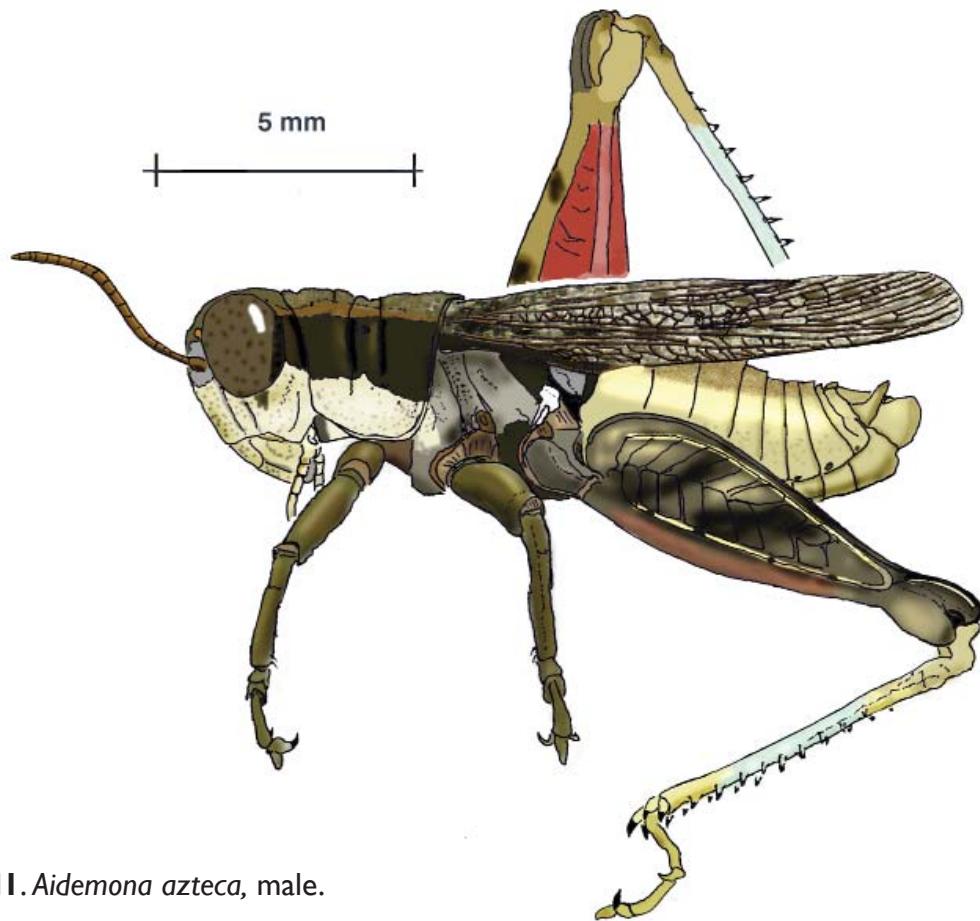


Plate M1. *Aidemona azteca*, male.

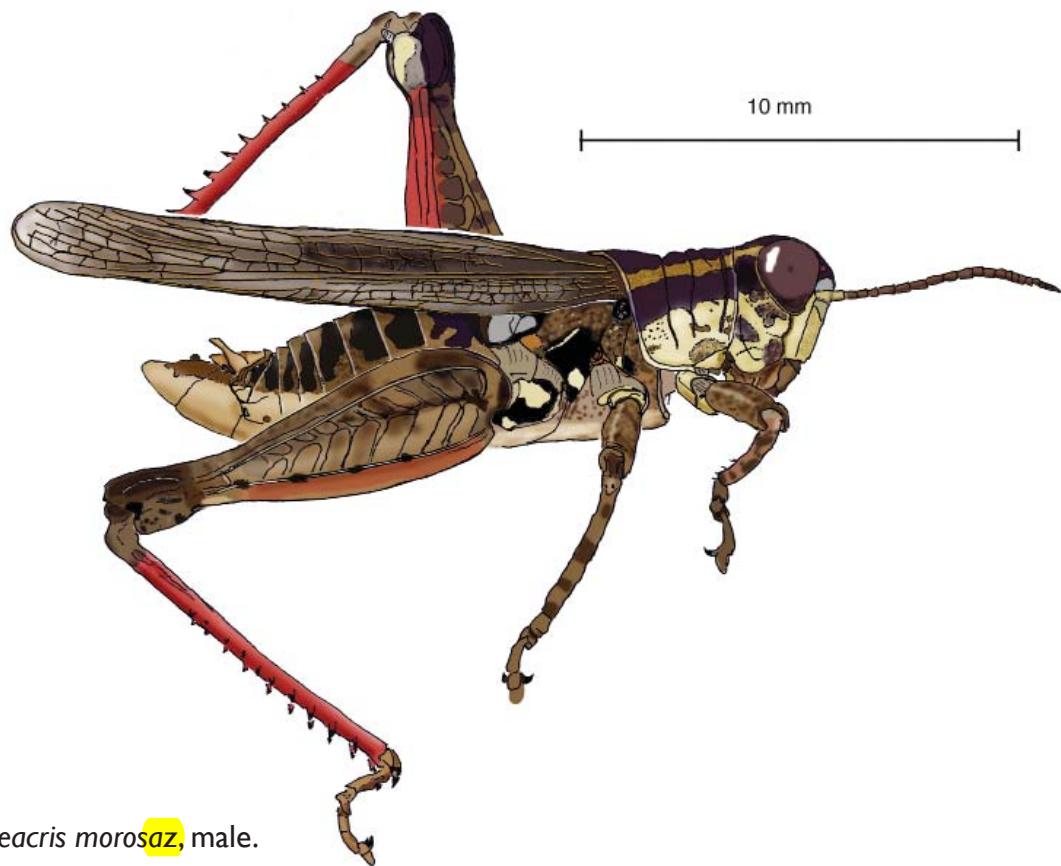
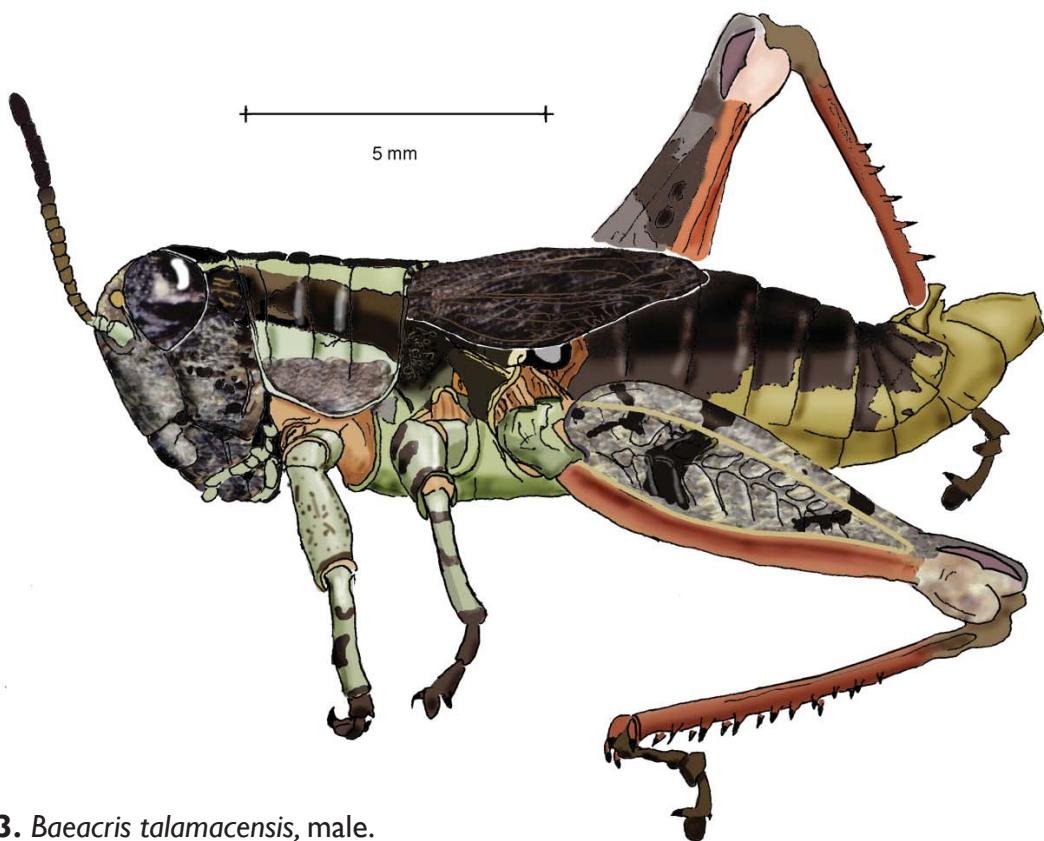
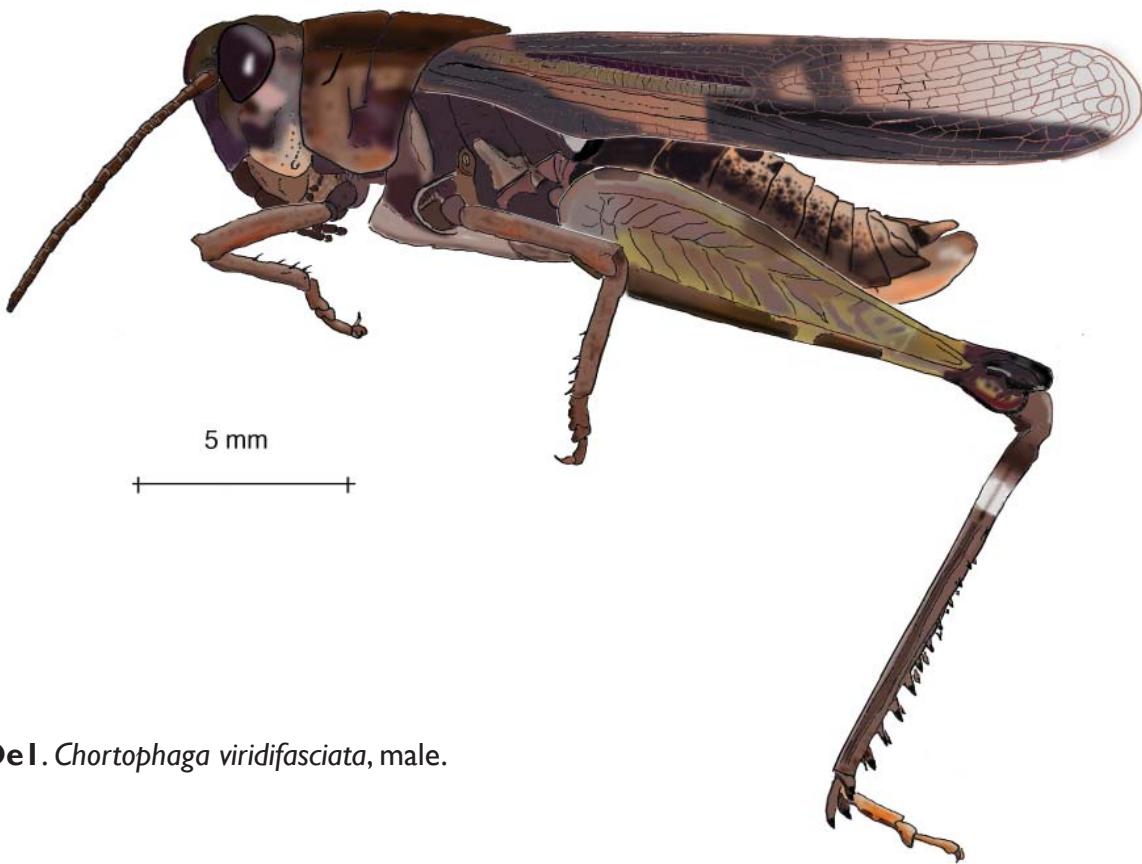


Plate M2. *Baeacris morosaz*, male.

Melanoplinae
OedipodinaePlate M3. *Baeacris talamacensis*, male.Plate Oe1. *Chortophaga viridifasciata*, male.

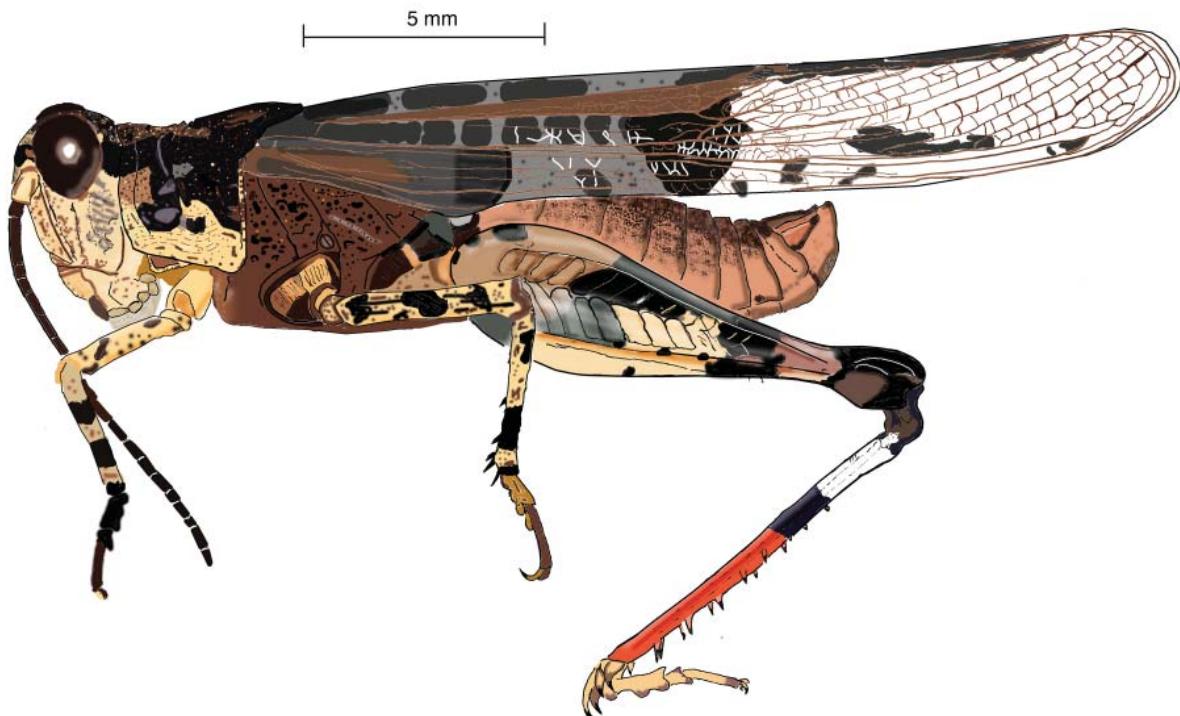


Plate Oe2. *Heliastus sumichrasti*, male.

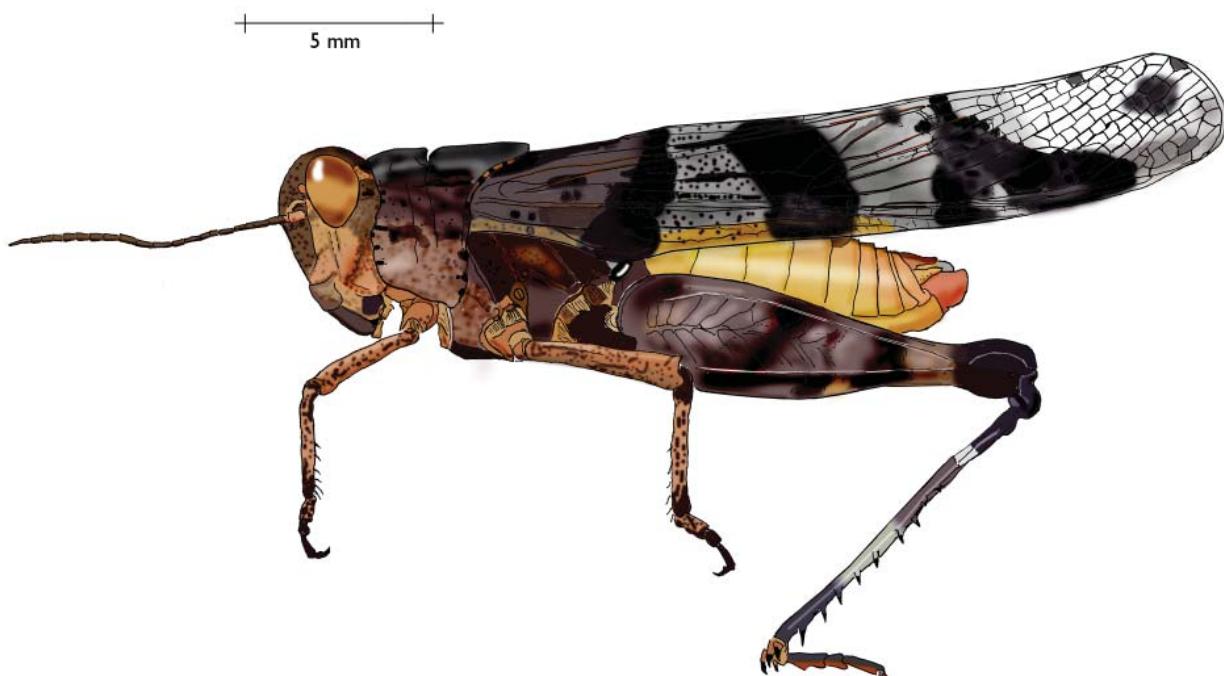


Plate Oe3. *Lactista stramineus*, male.

Oedipodinae
Pauliniinae

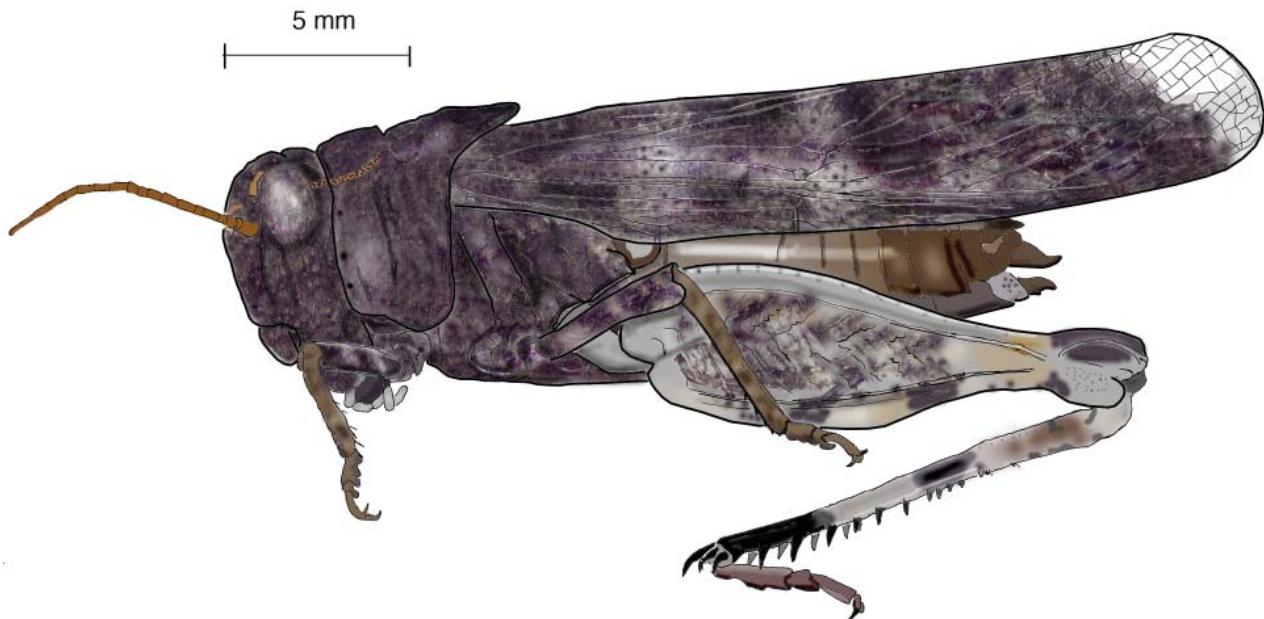


Plate Oe4. *Leuronotina orizibae*, male.

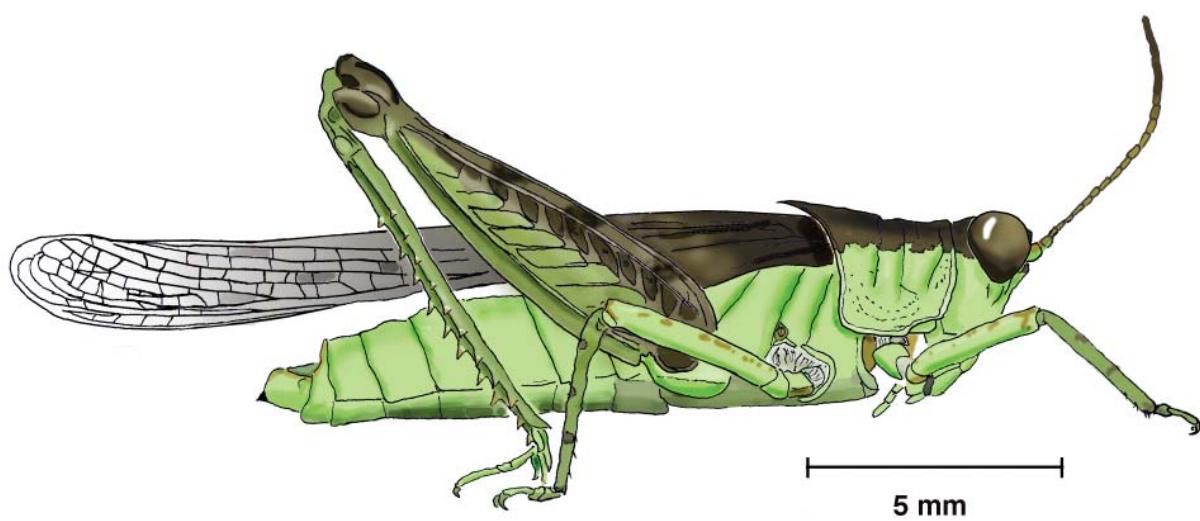


Plate Paul. *Paulinia acuminata*, fully alate form. Male.

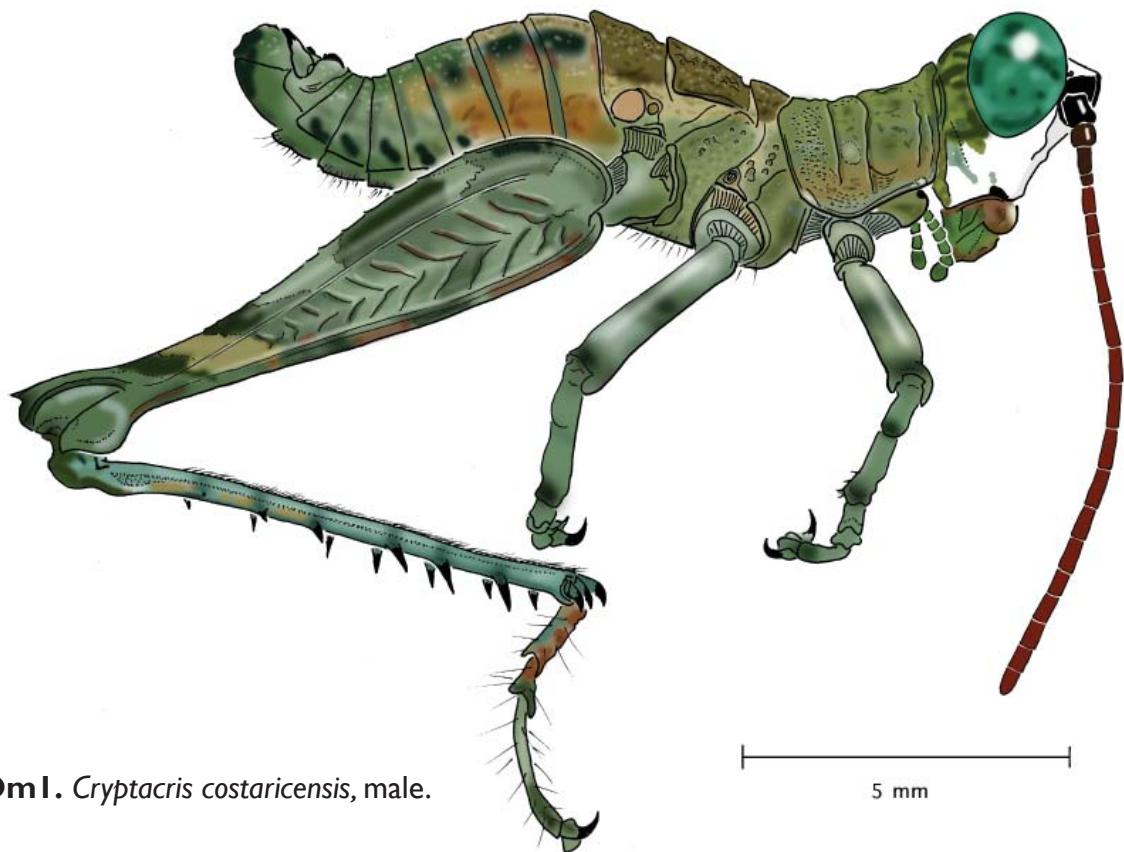


Plate Om1. *Cryptacris costaricensis*, male.

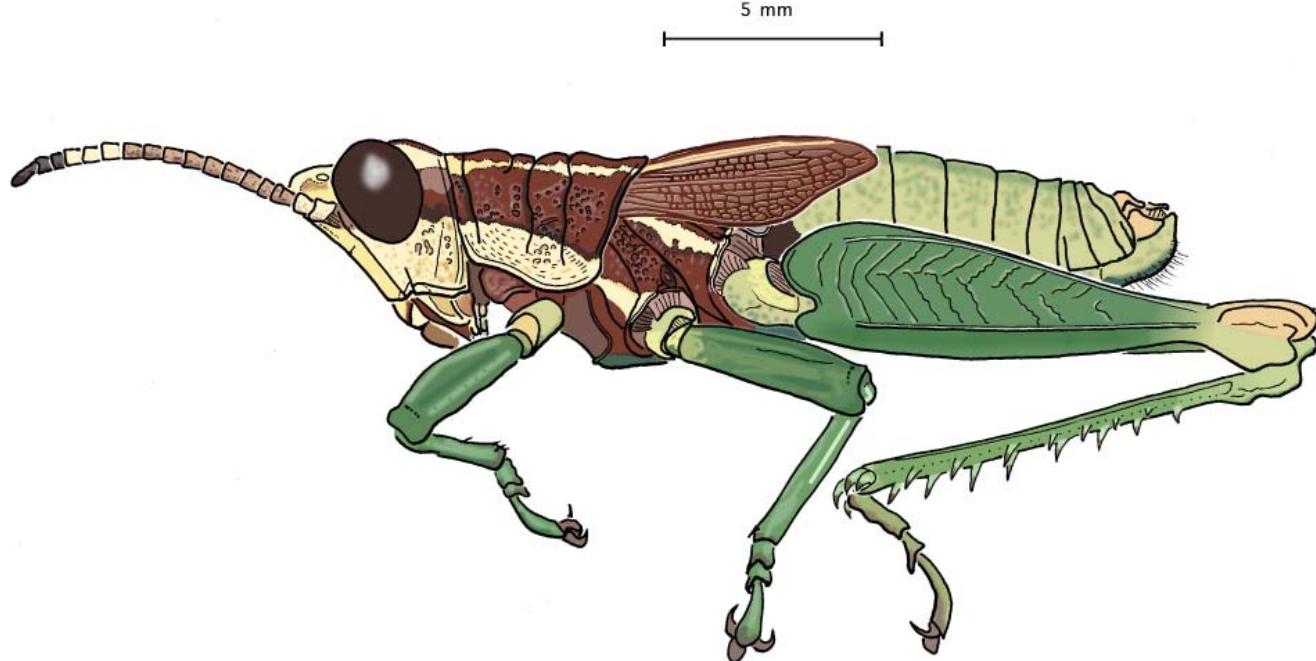


Plate Om2. *Leptomerinthoprora brevipennis*, male.

Ommatolampinae

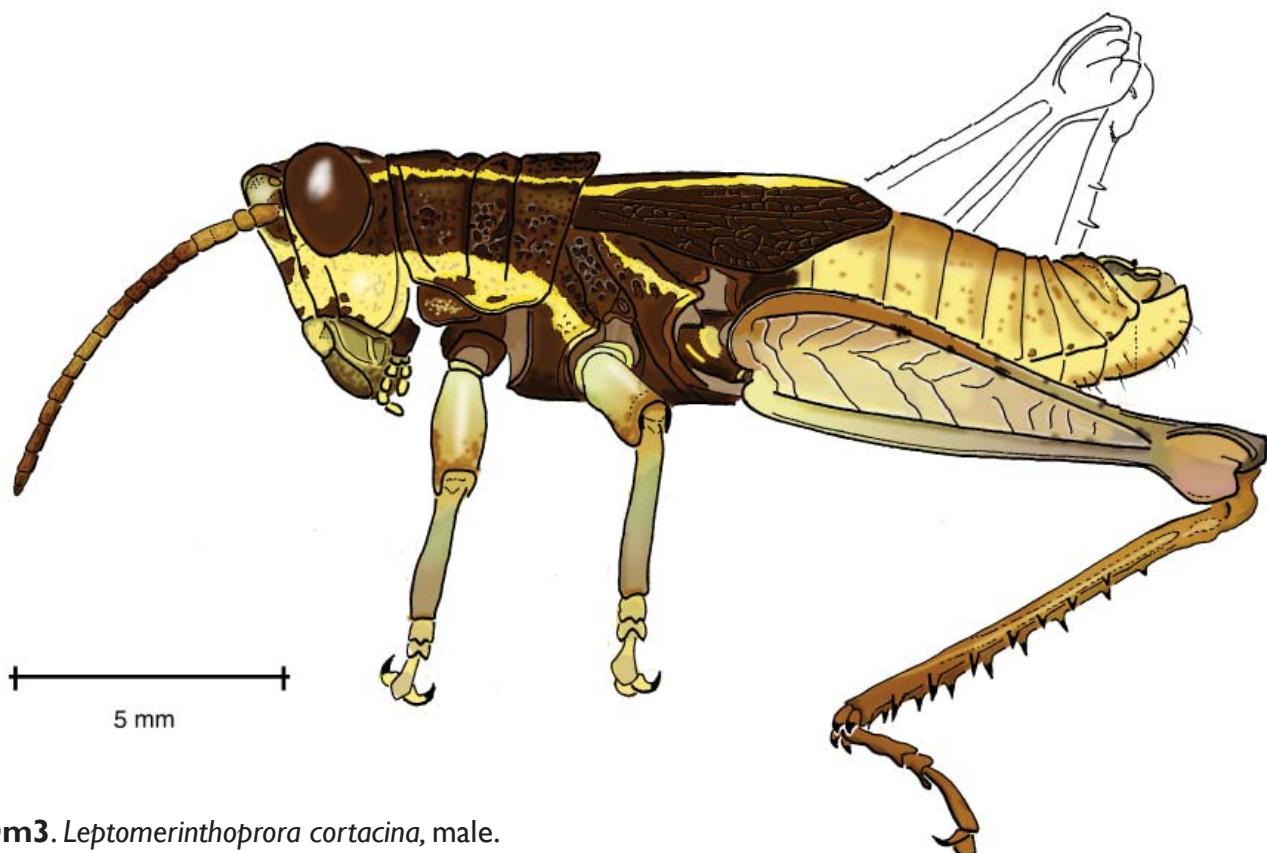


Plate Om3. *Leptomerinthoprora corticina*, male.

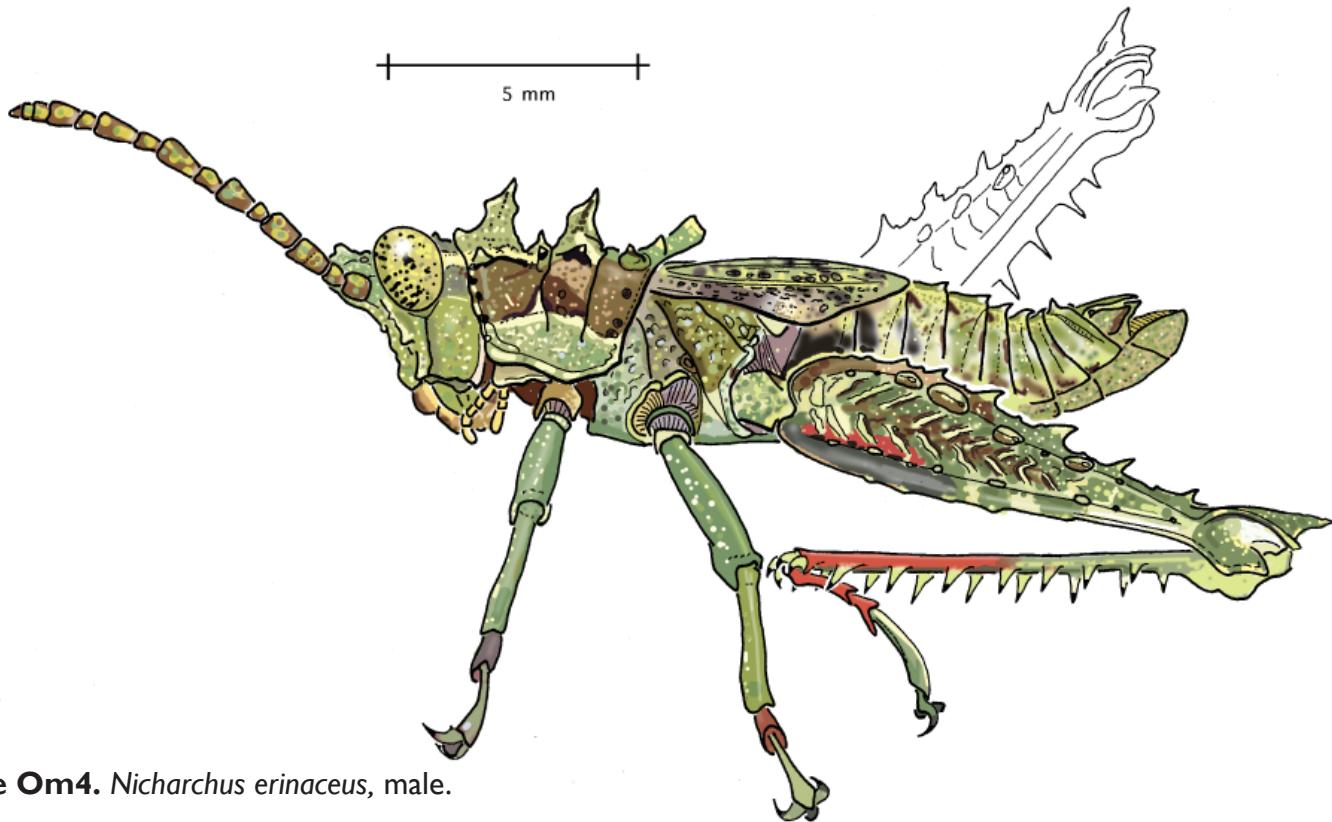


Plate Om4. *Nicharchus erinaceus*, male.

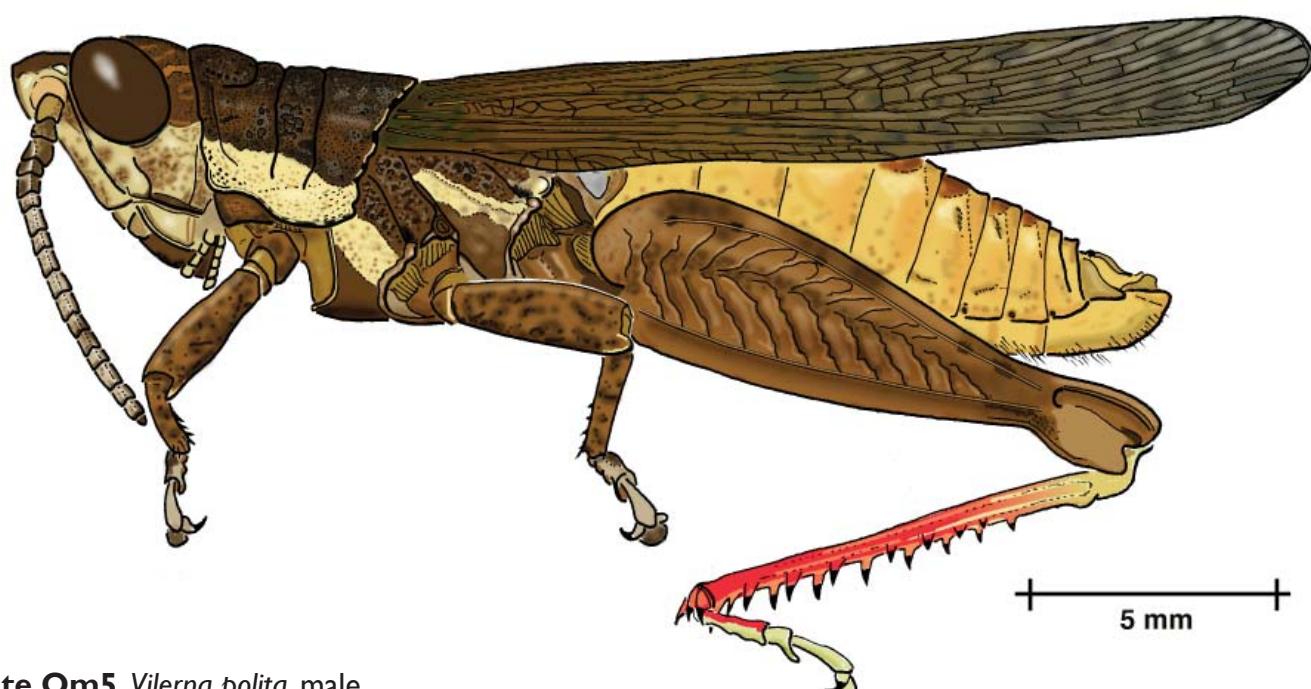


Plate Om5. *Vilerna polita*, male.

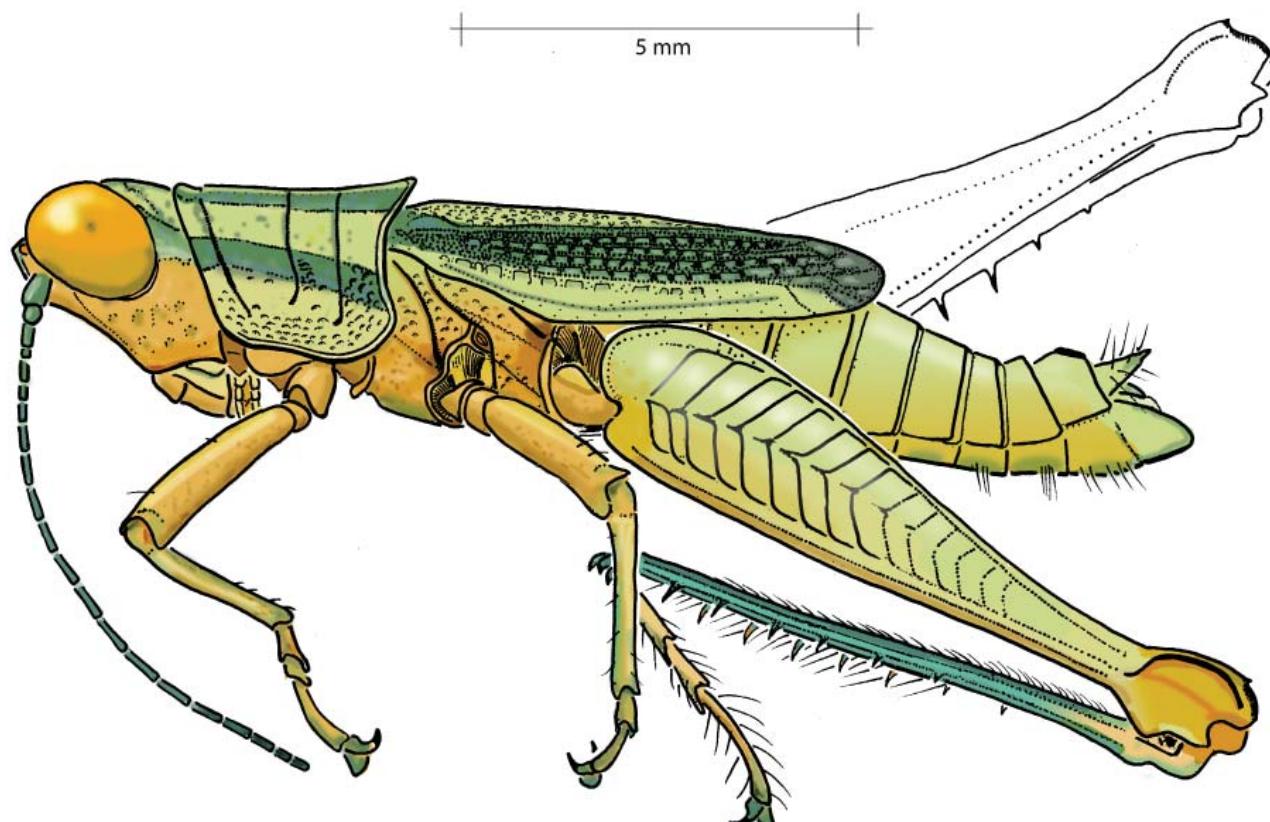


Plate Om6. *Pauracris brachyptera*, male.

Ommatolampinae

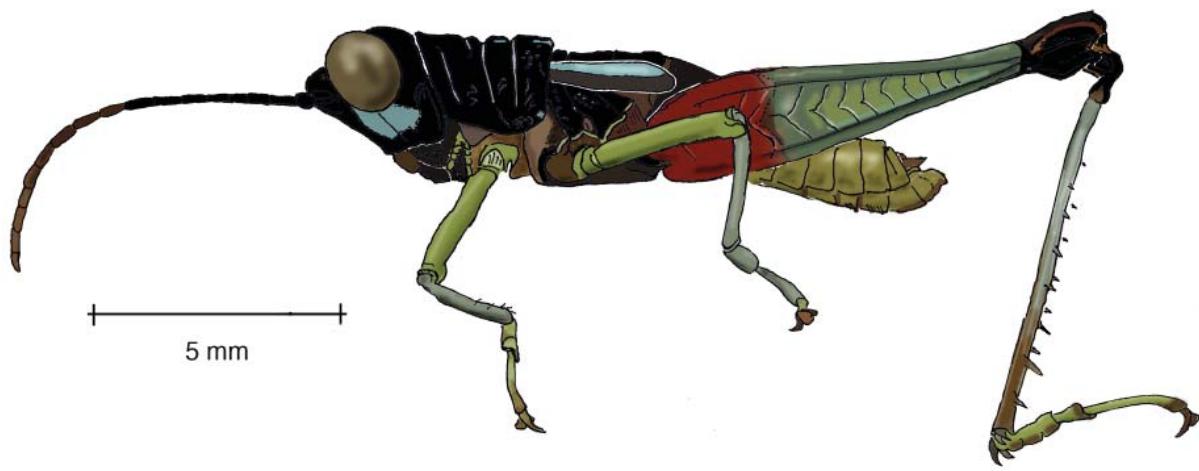


Plate Om7. *Christenacris sanguilenta*, male.

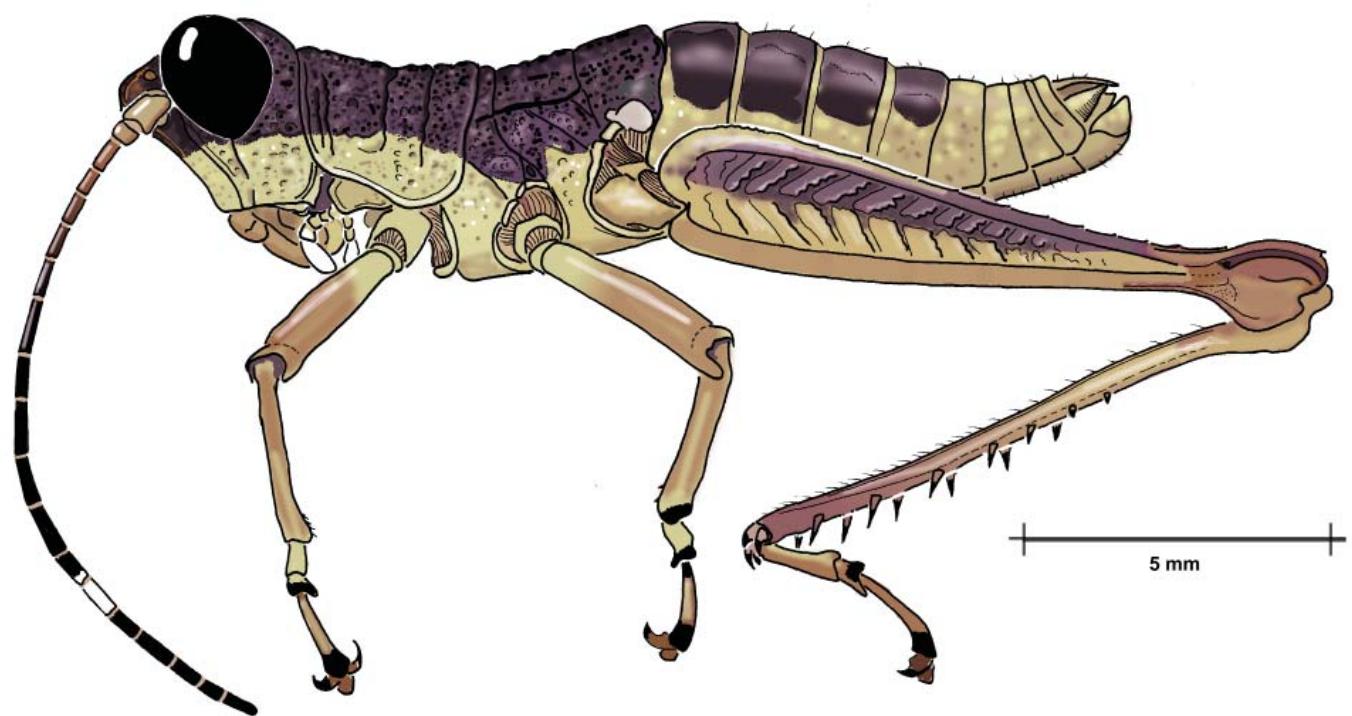


Plate Om8. *Ateliacris a. annulicornis*, male.

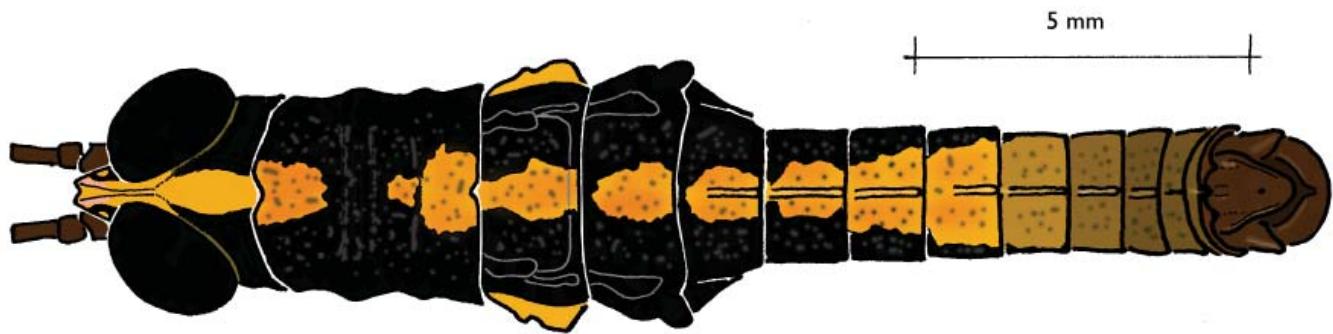


Plate Om9. *Ateliacris annulicornis pulchra*, male, dorsal view.

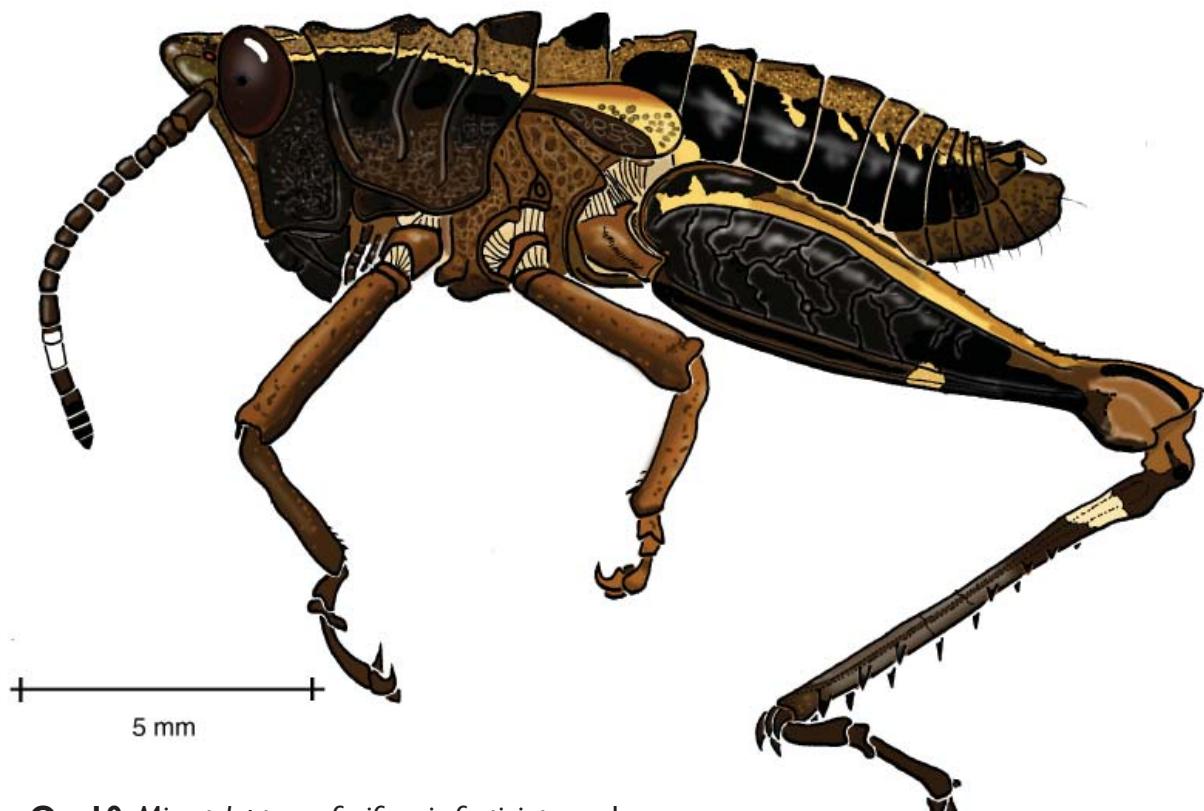


Plate Om10. *Microtylopteryx fusiformis fastigiata*, male.

Ommatolampinae

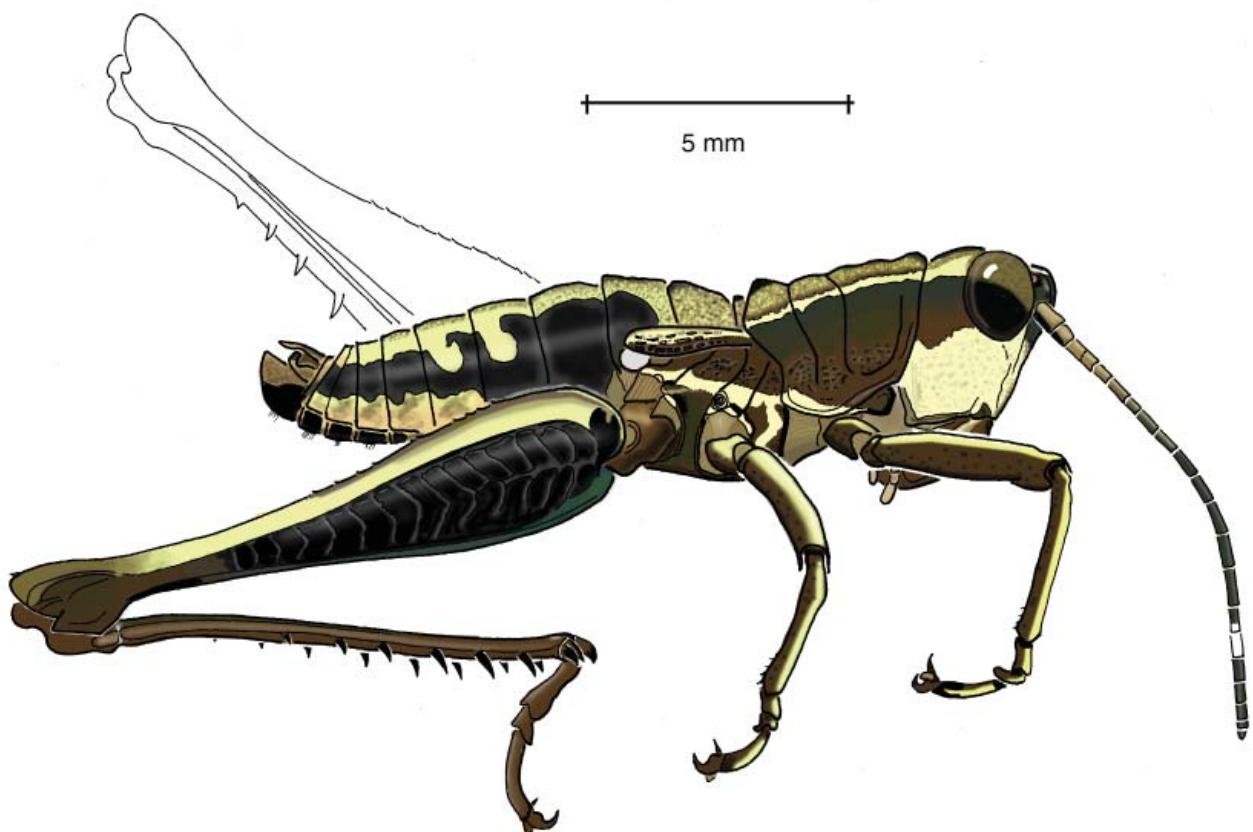


Plate Om11. *Microtylopteryx h. hebardi*, male.

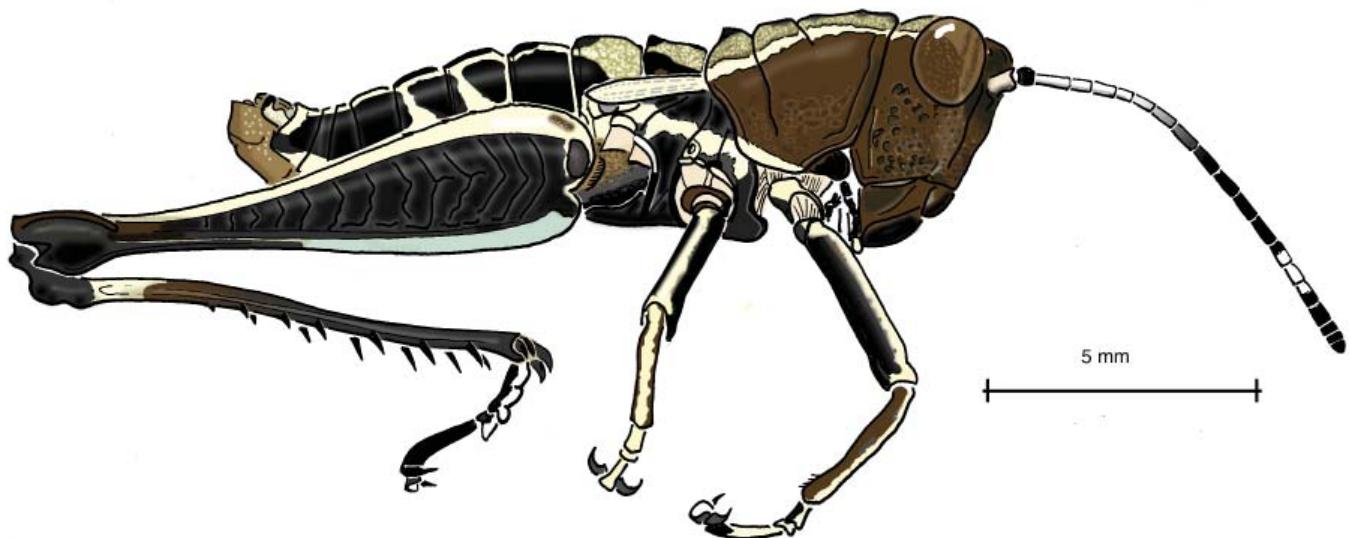


Plate Om12. *Microtylopteryx hebardi nigrigena*, male.

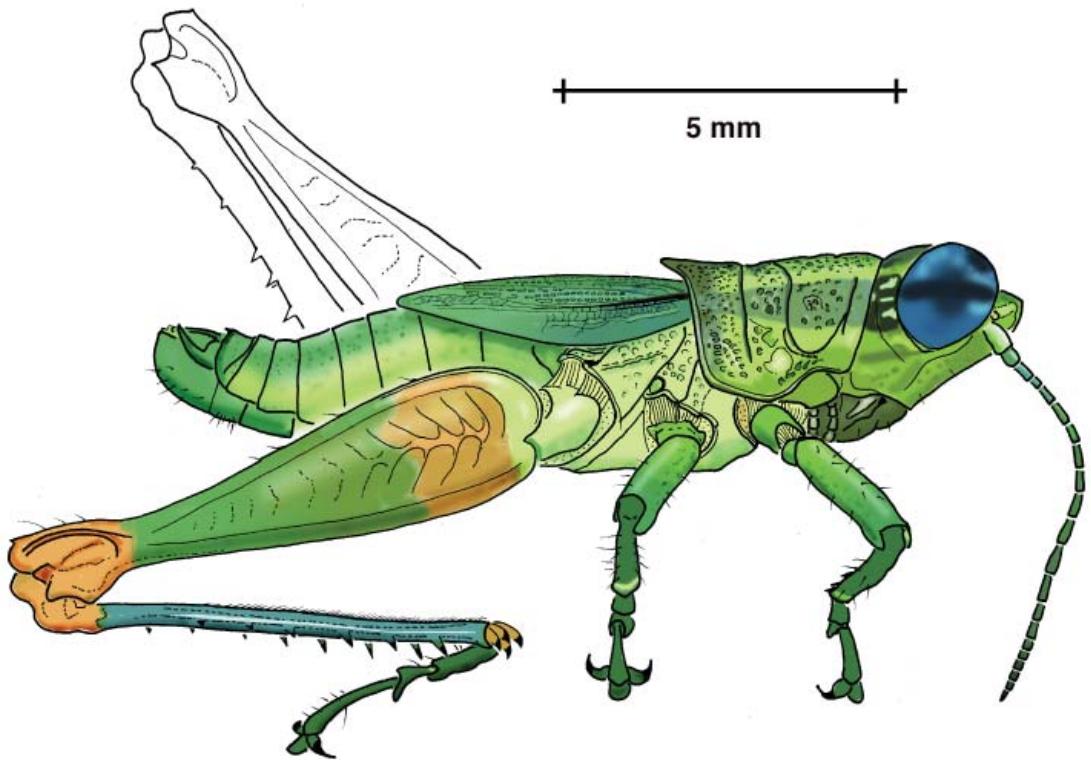


Plate Om 13. *Pseudannicerus nigrinervis*, male.

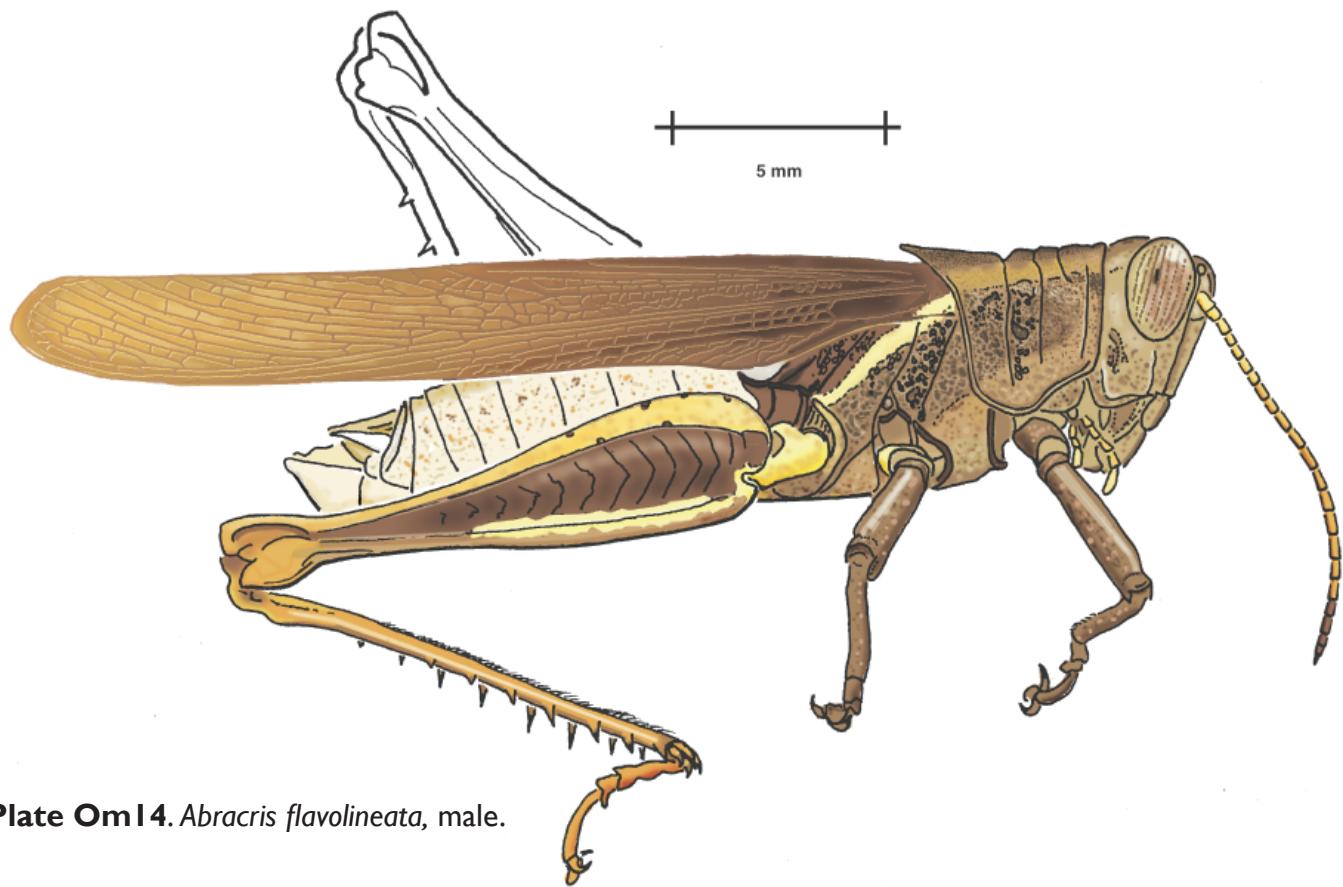


Plate Om 14. *Abracris flavolineata*, male.

Ommatolampinae

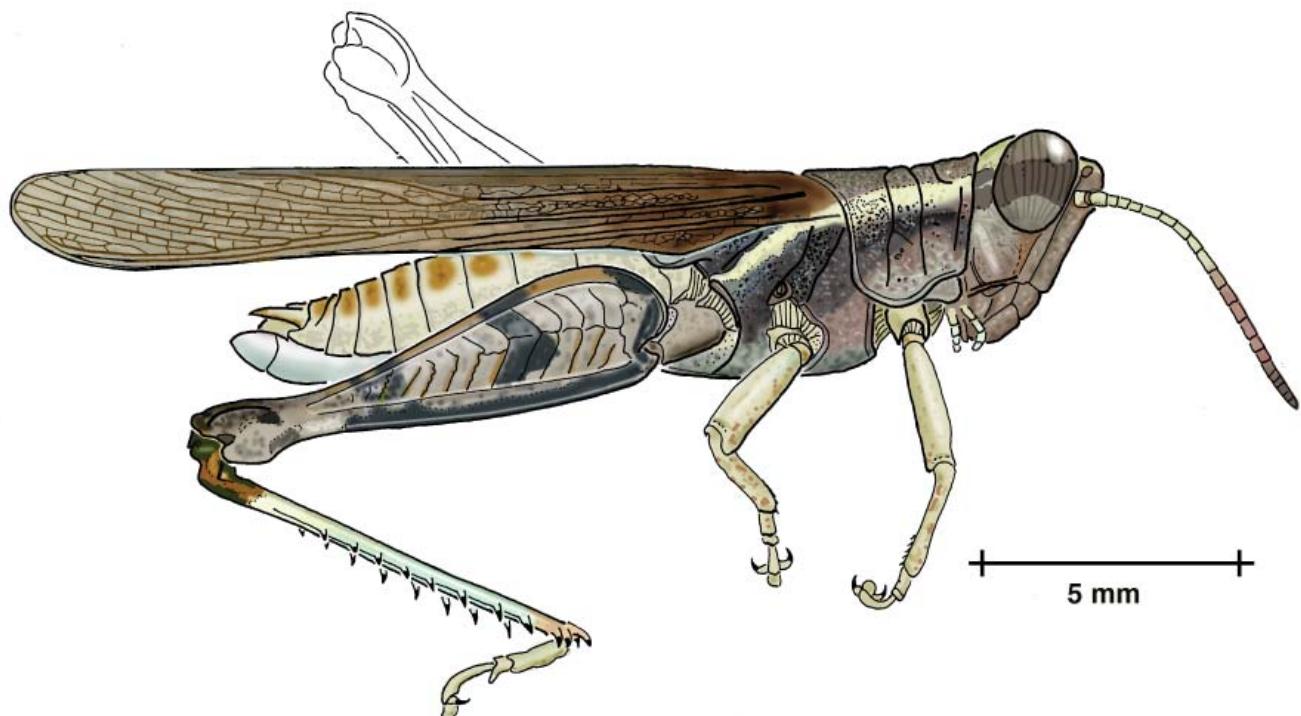


Plate Om15. *Abracris dilecta*, male.



Plate Om16. *Omalotettix chapadensis*, male.

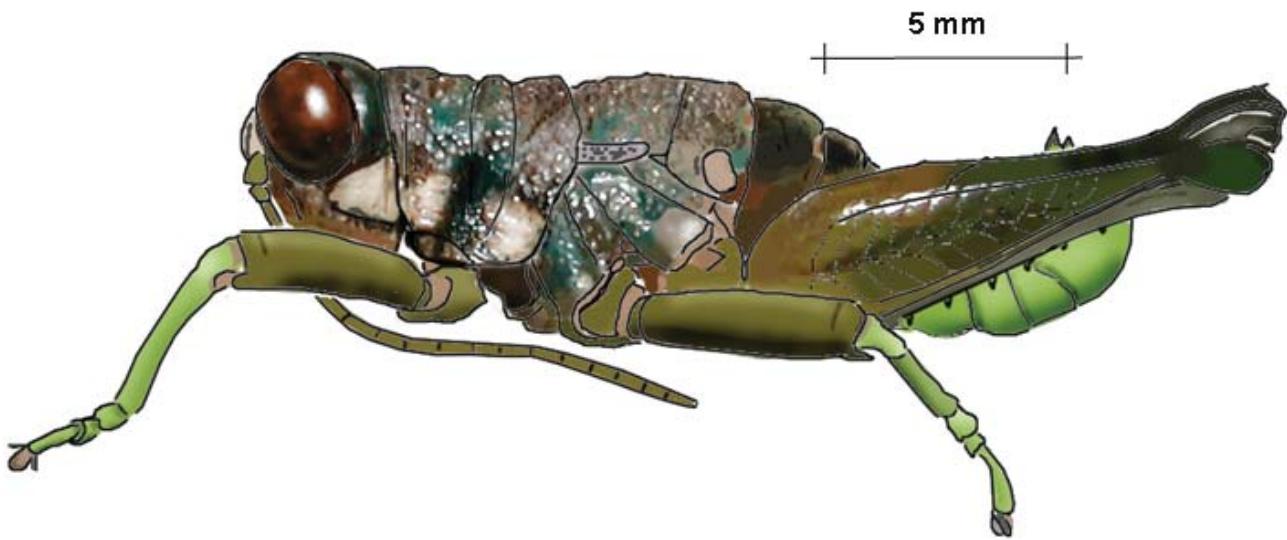


Plate Om17. *Rhachicreagra achrosta*, male.

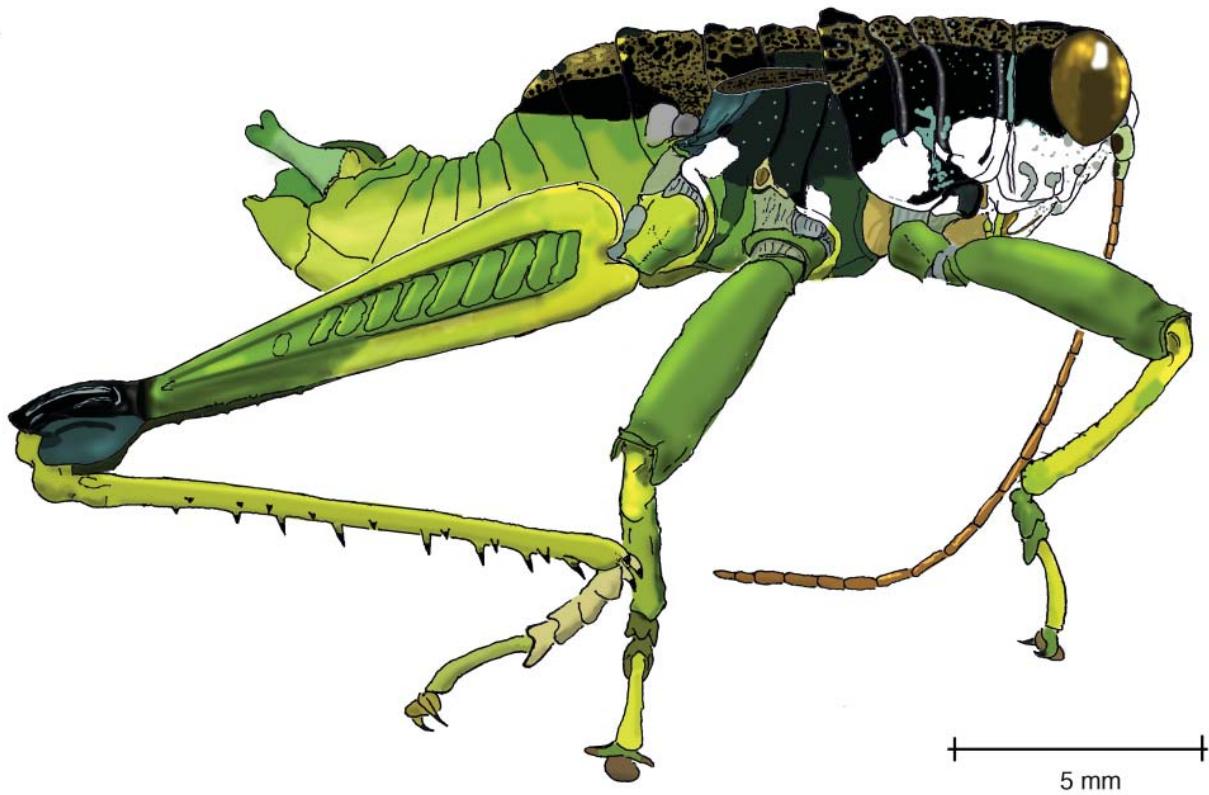


Plate Om18. *Rhachicreagra anchidiphala*, male.

Ommatolampinae

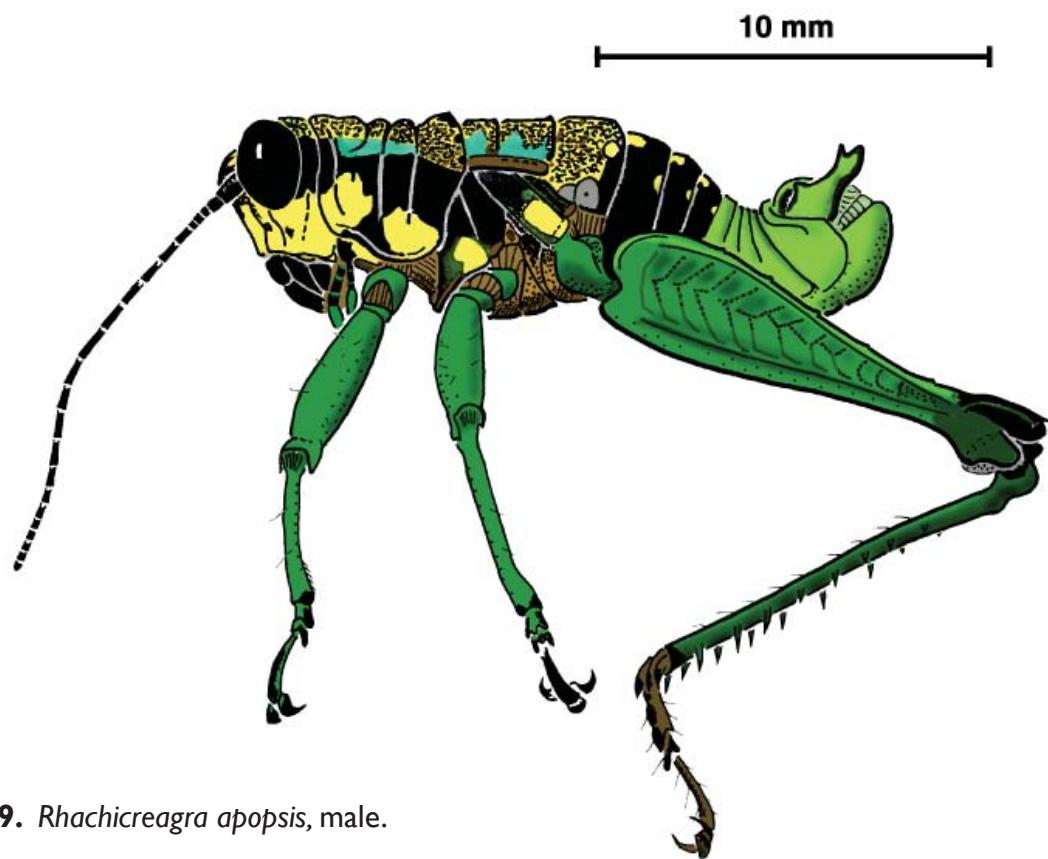


Plate Om19. *Rhachicreagra apopsis*, male.

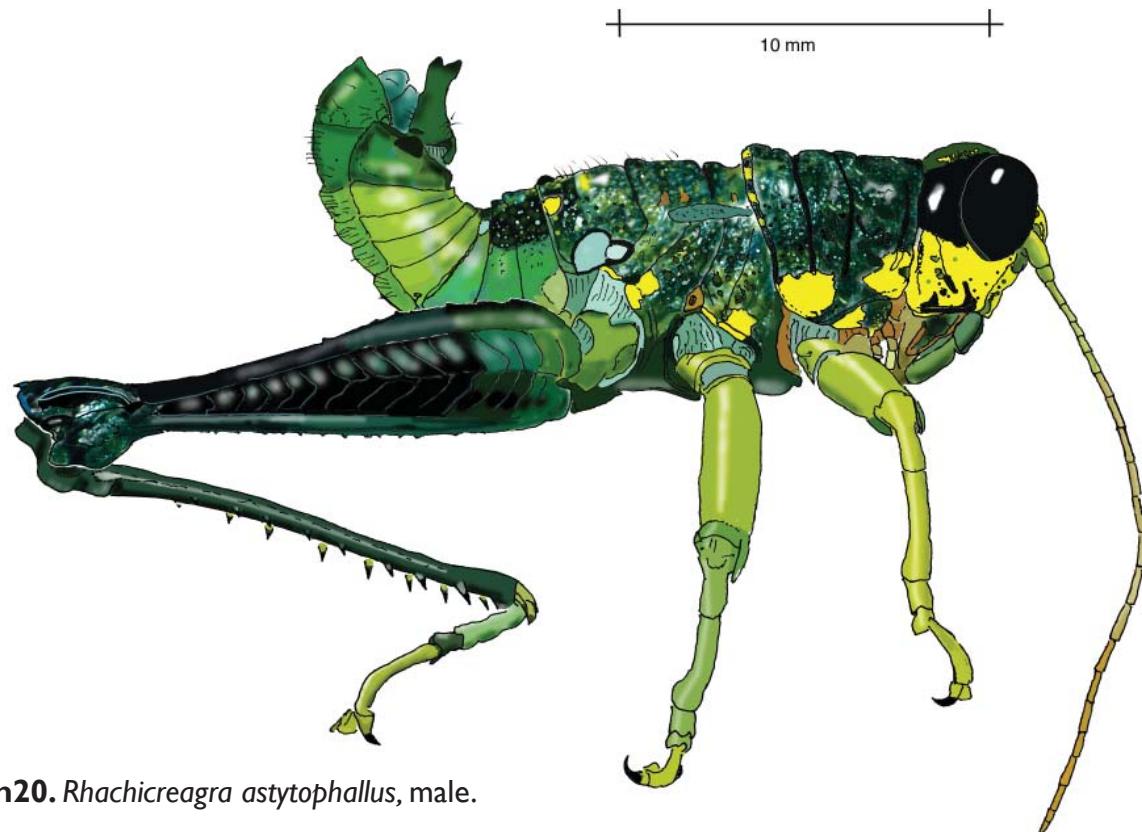


Plate Om20. *Rhachicreagra astytophallus*, male.

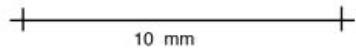
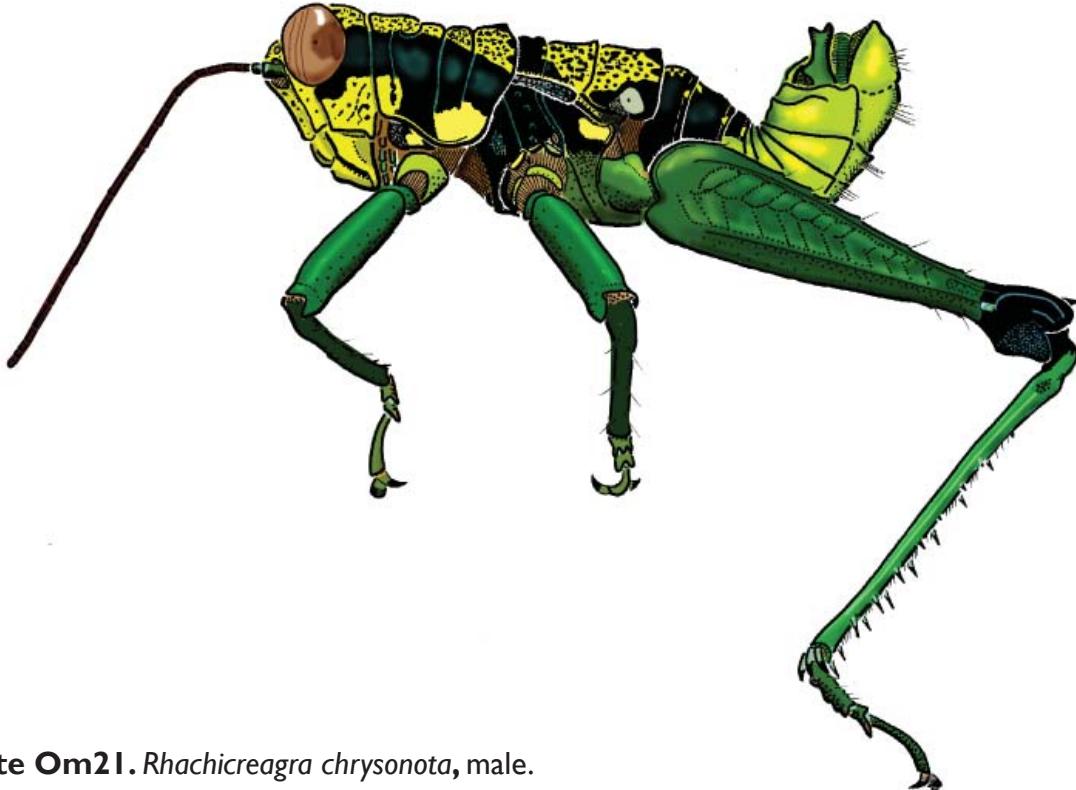
A horizontal scale bar with a central tick mark and the text "10 mm" below it.

Plate Om21. *Rhachicreagra chrysonota*, male.

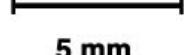
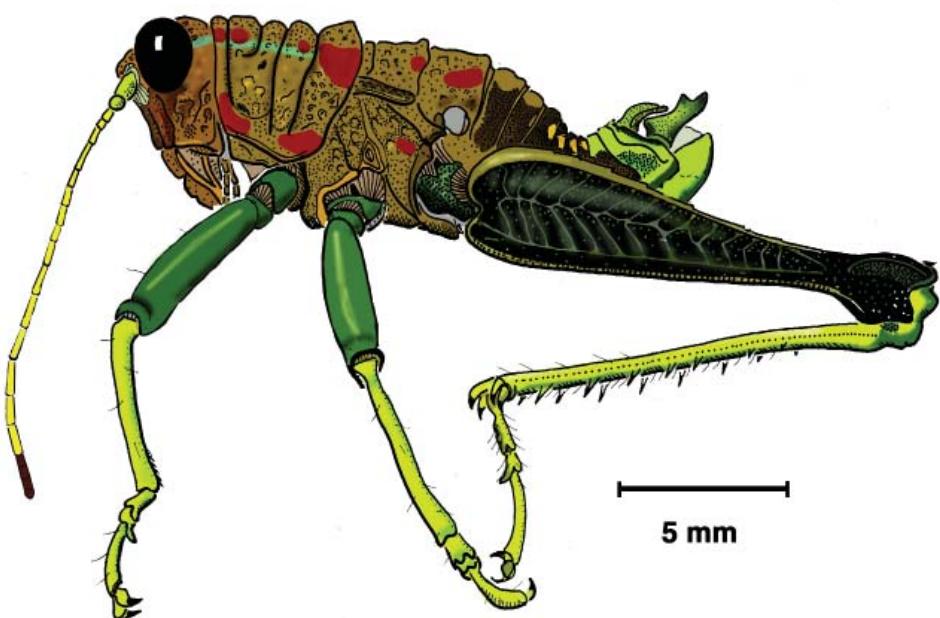
A horizontal scale bar with a central tick mark and the text "5 mm" below it.

Plate Om22. *Rhachicreagra dierythra*, male.

Ommatolampinae

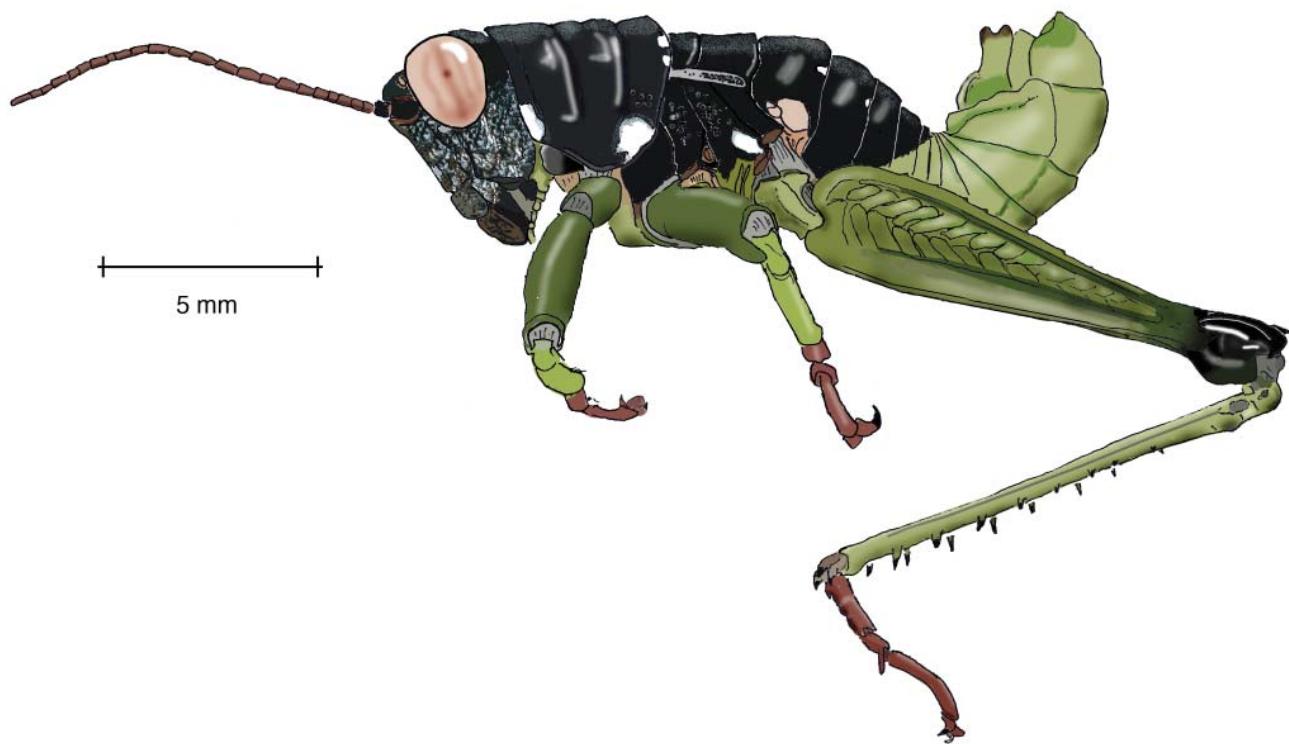


Plate Om23. *Rhachicreagra drymocnemensis*, male.

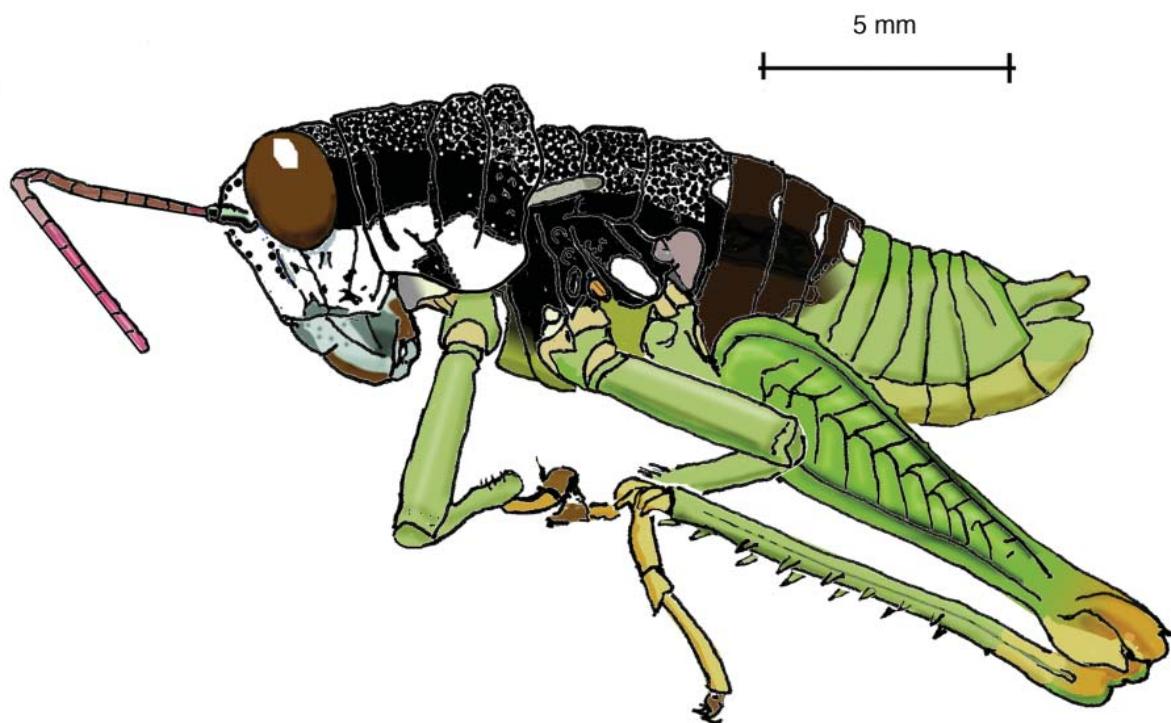


Plate Om24. *Rhachicreagra gracilis*, male.

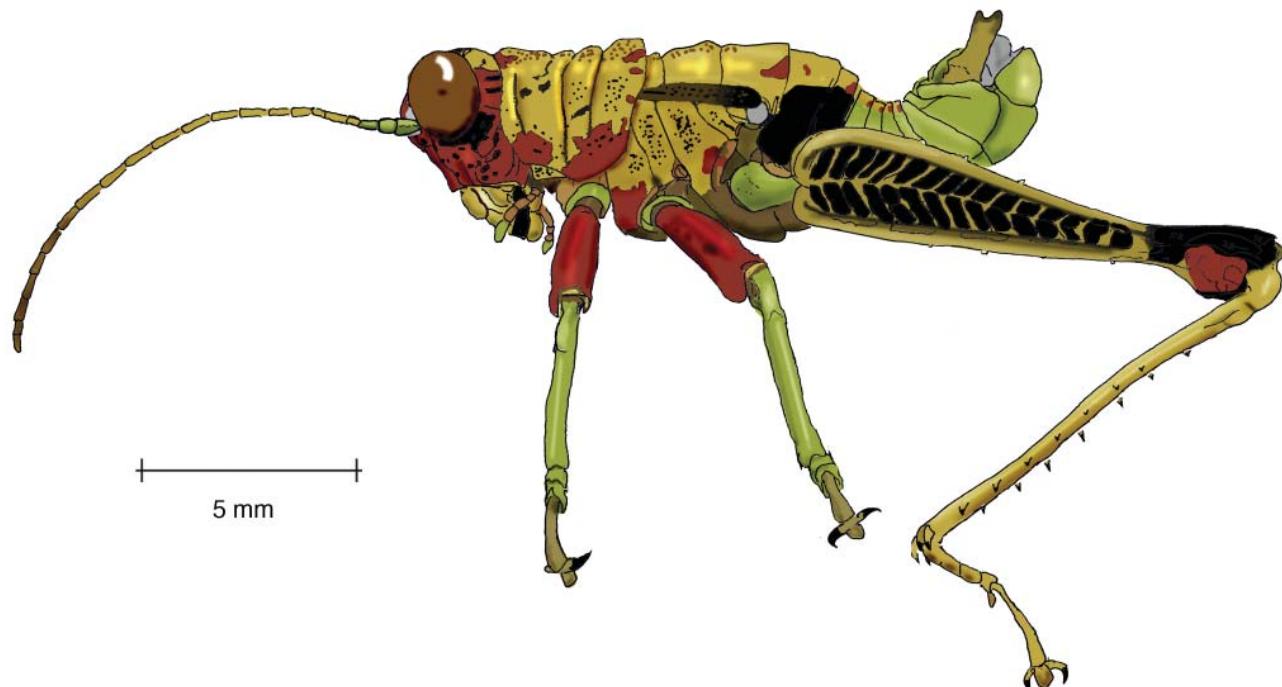


Plate Om25. *Rhachicreagra haematodes*, male.

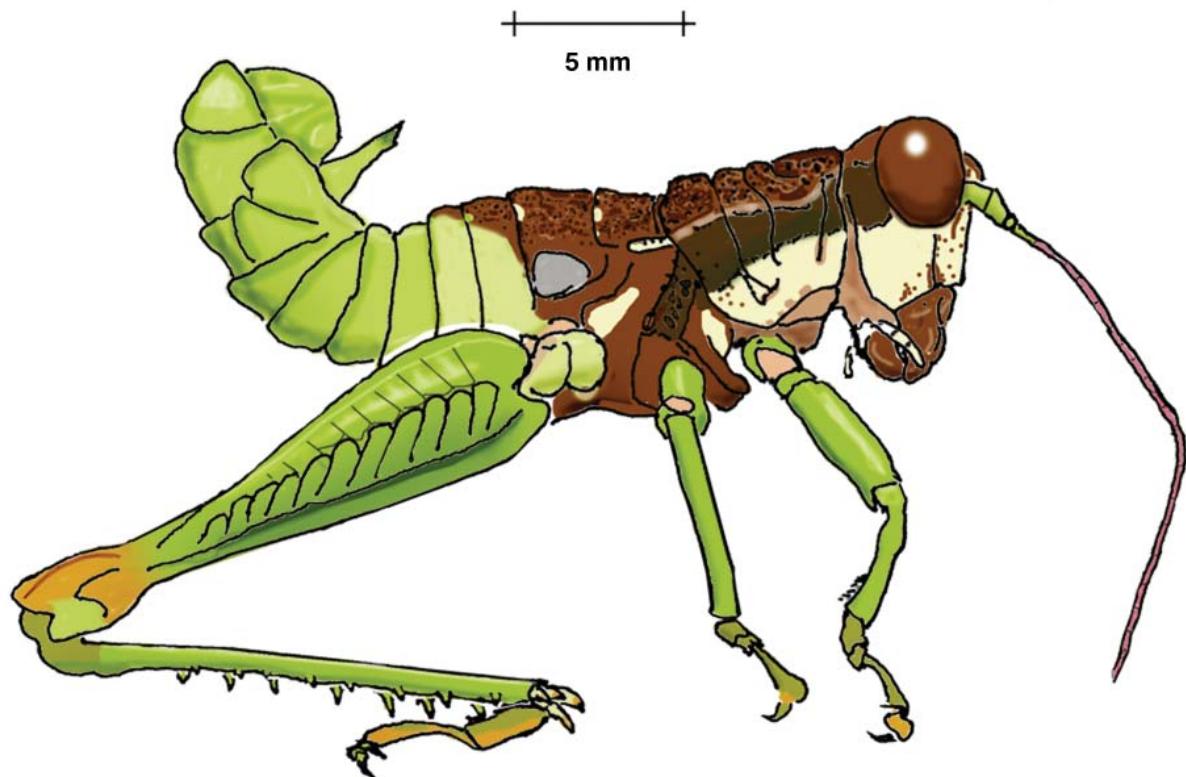


Plate Om26. *Rhachicreagra jagoi*, male.

Ommatolampinae

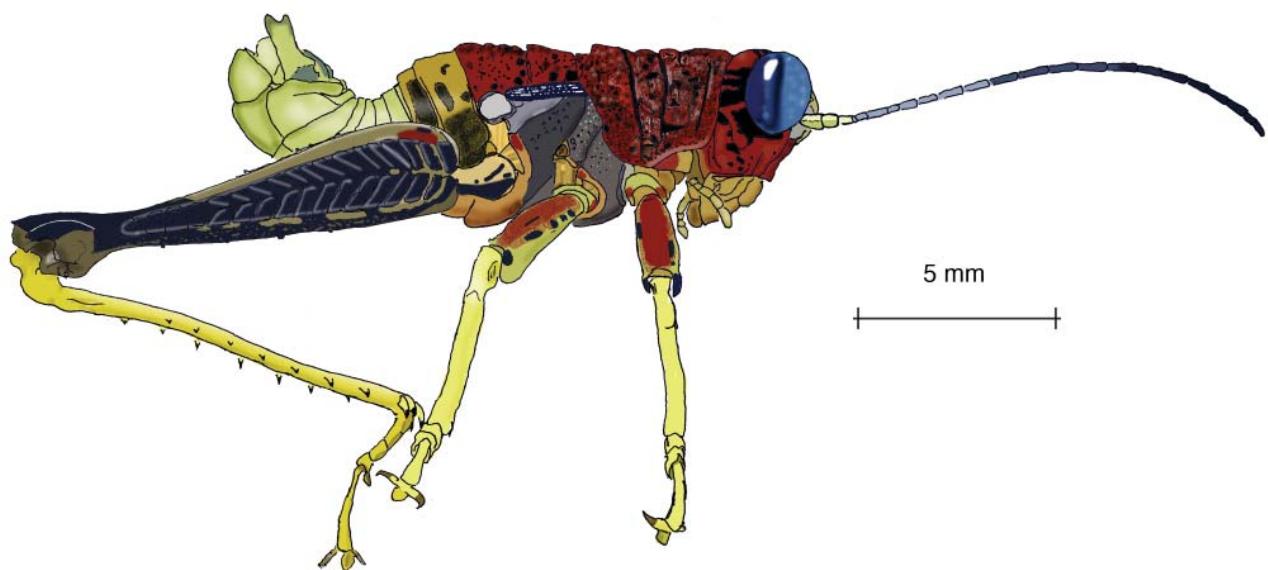


Plate Om27. *Rhachicreagra khayachrosa*, male.

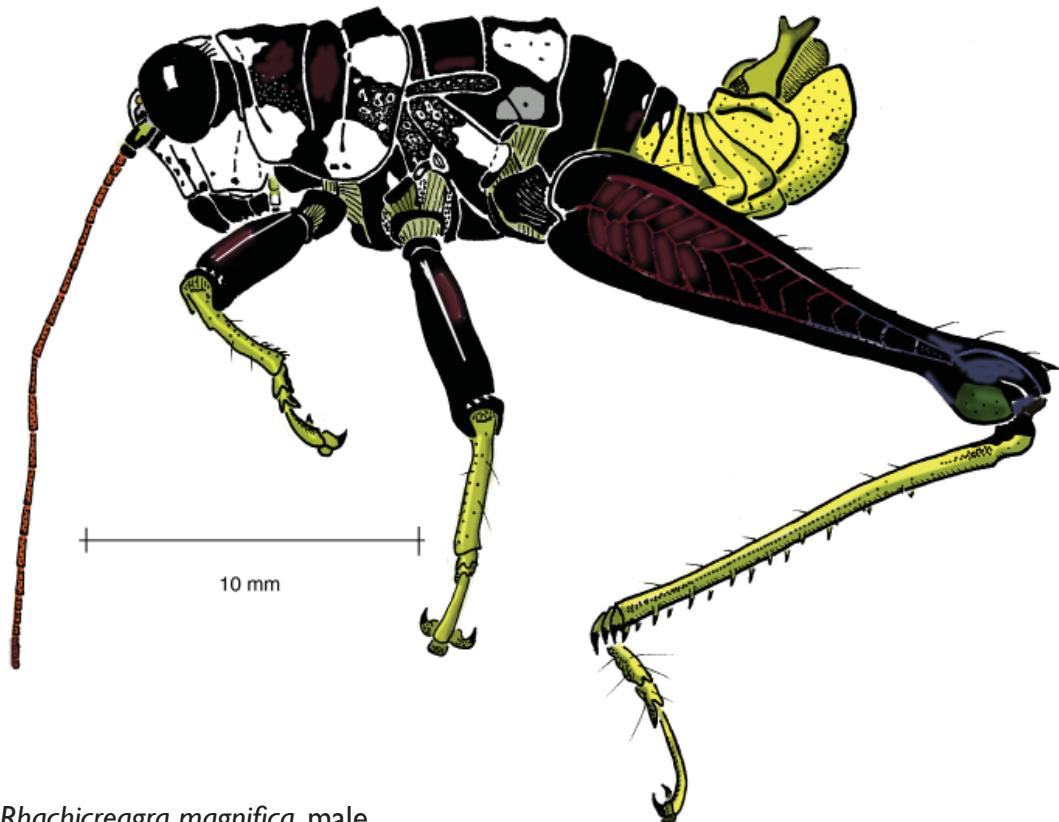


Plate Om28. *Rhachicreagra magnifica*, male.

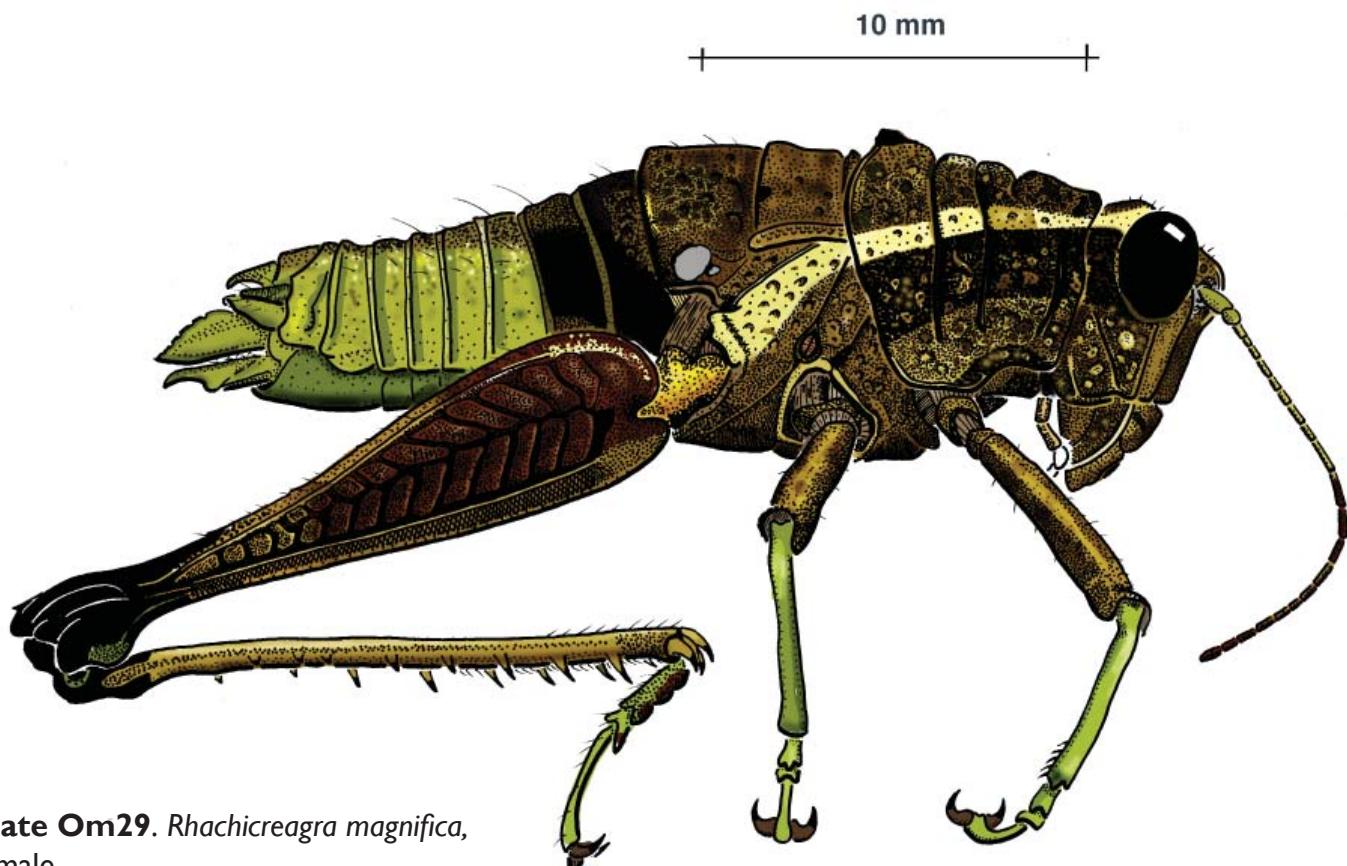


Plate Om29. *Rhachicreagra magnifica*,
female.

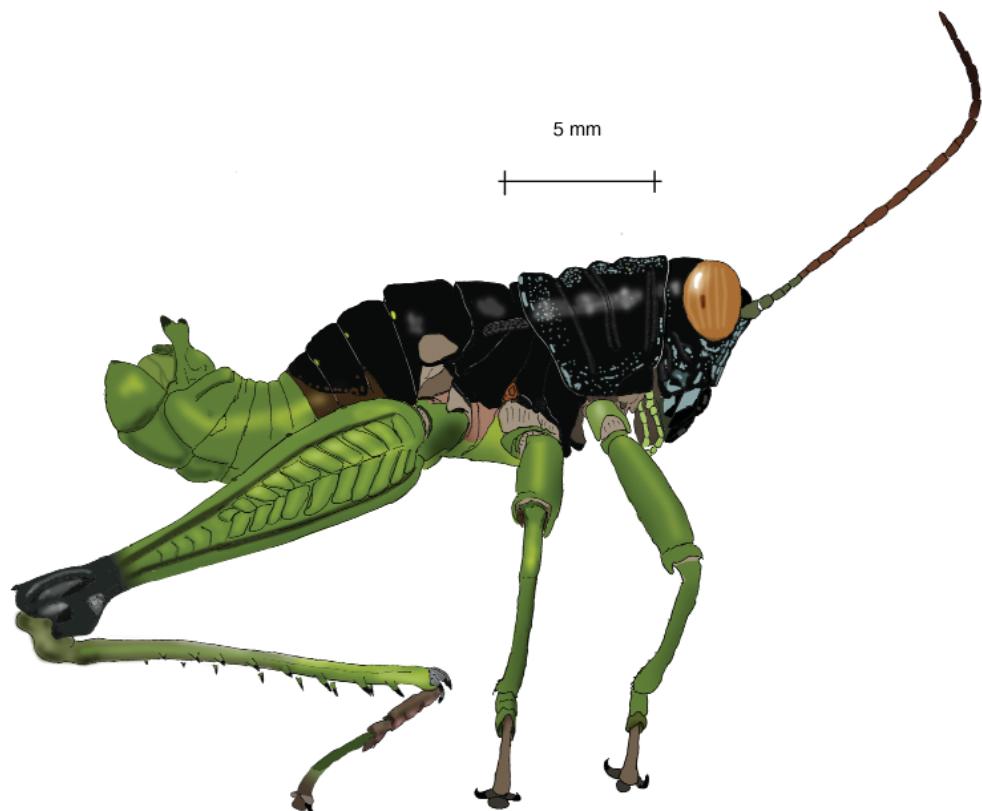


Plate Om30. *Rhachicreagra melanota*, male.

Ommatolampinae

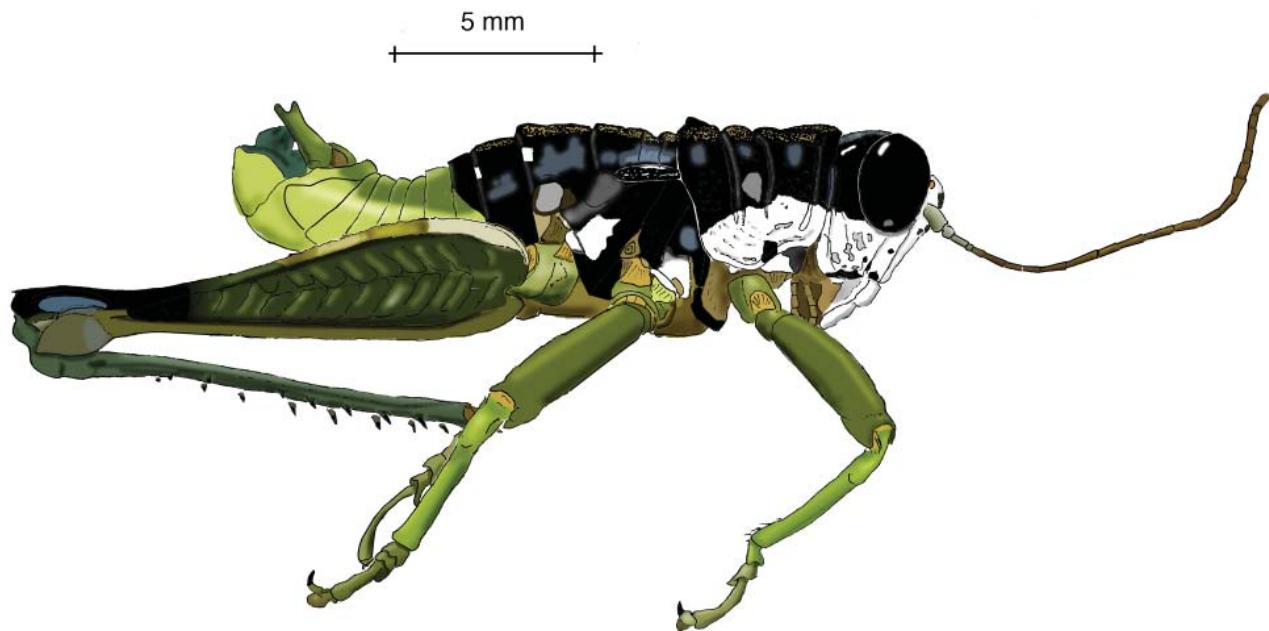


Plate Om31. *Rhachicreagra nothra*, male.

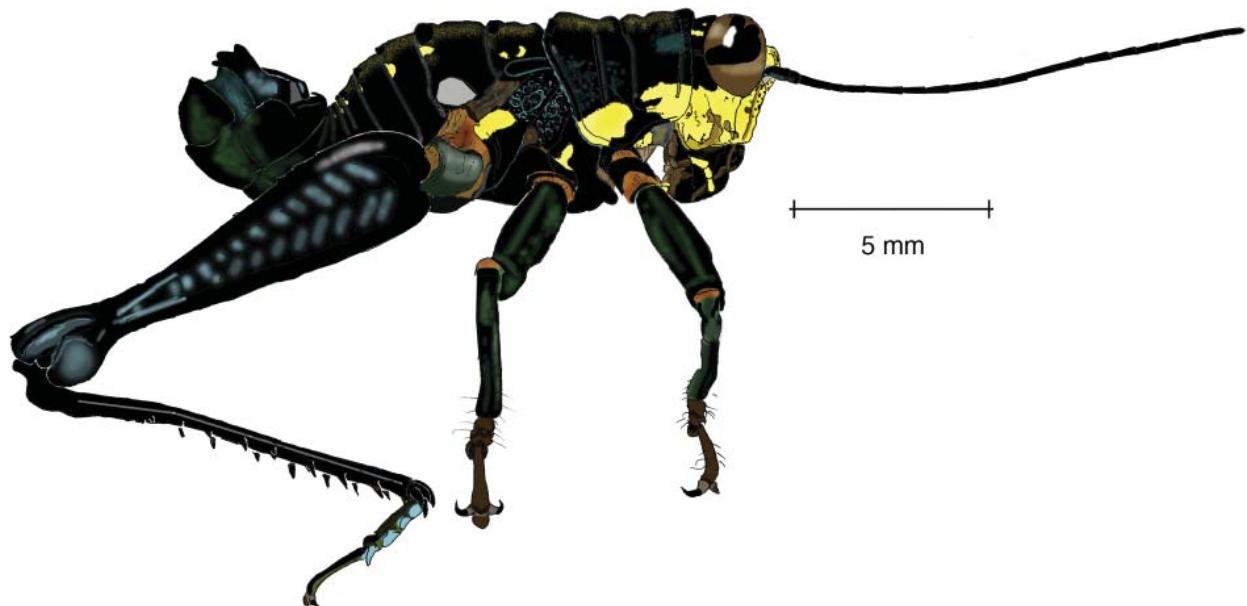


Plate Om32. *Rhachicreagra obsidian*, male.

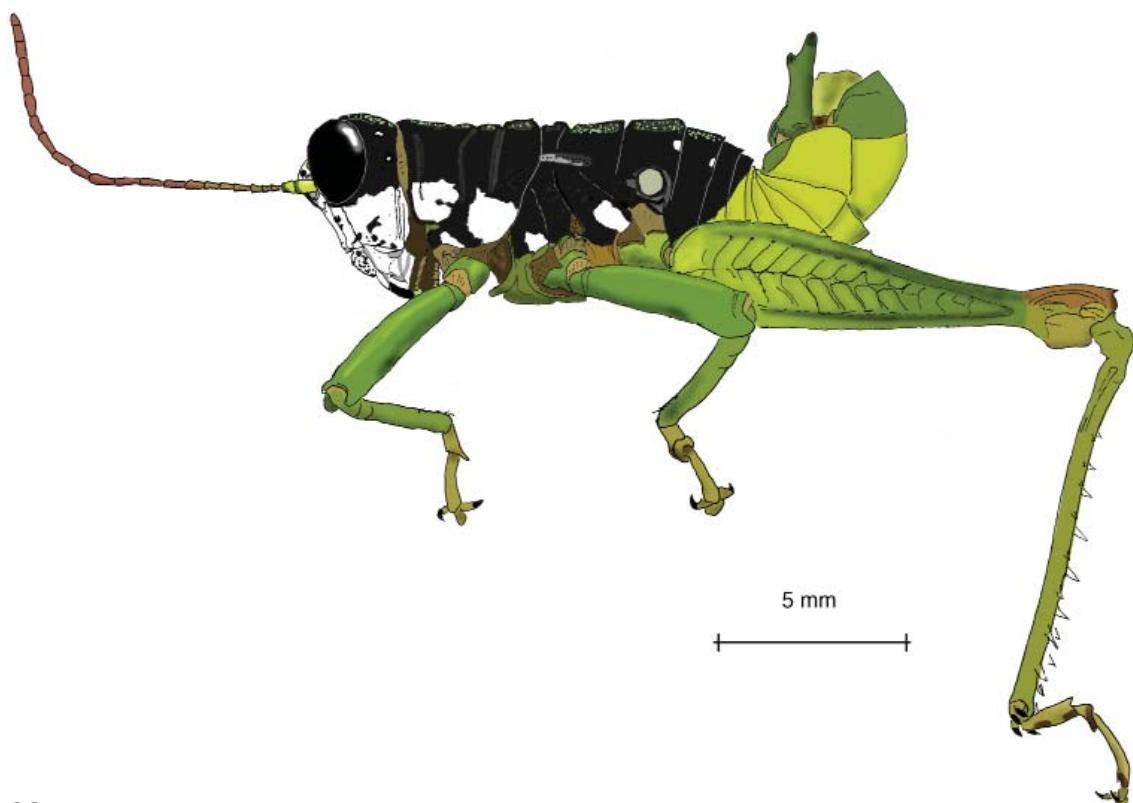


Plate Om33. *Rhachicreagra sphagicerca*, male.

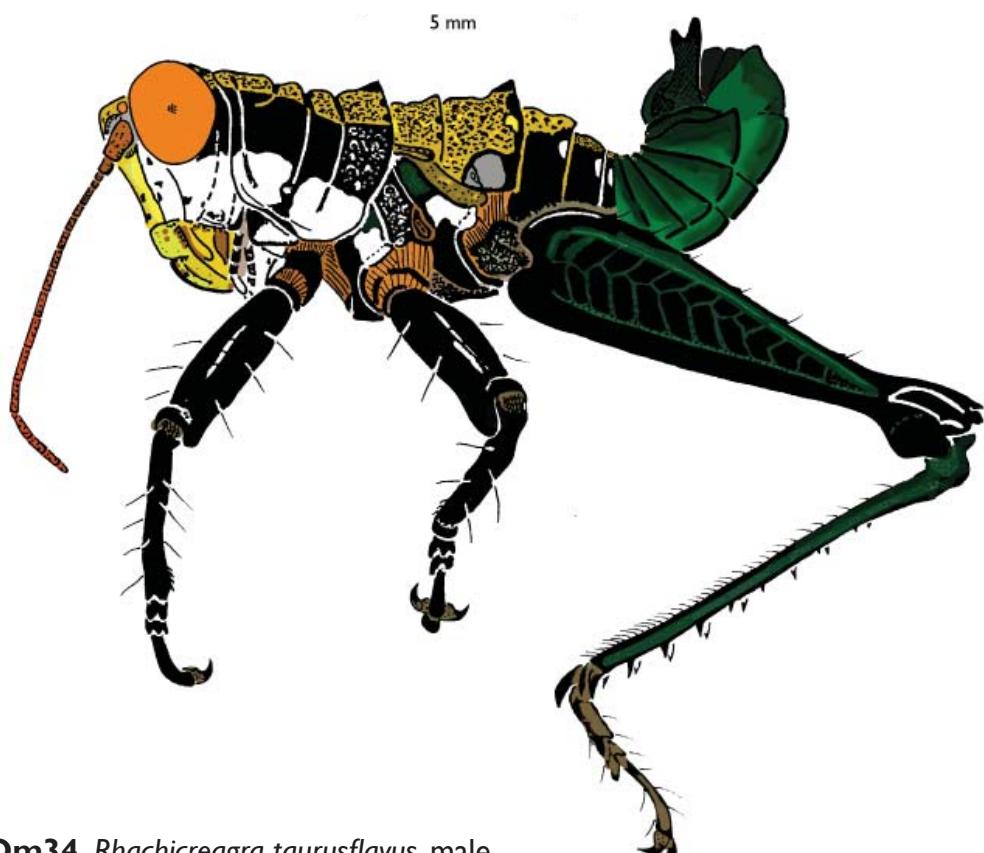


Plate Om34. *Rhachicreagra taurusflavus*, male.

Proctolabinae

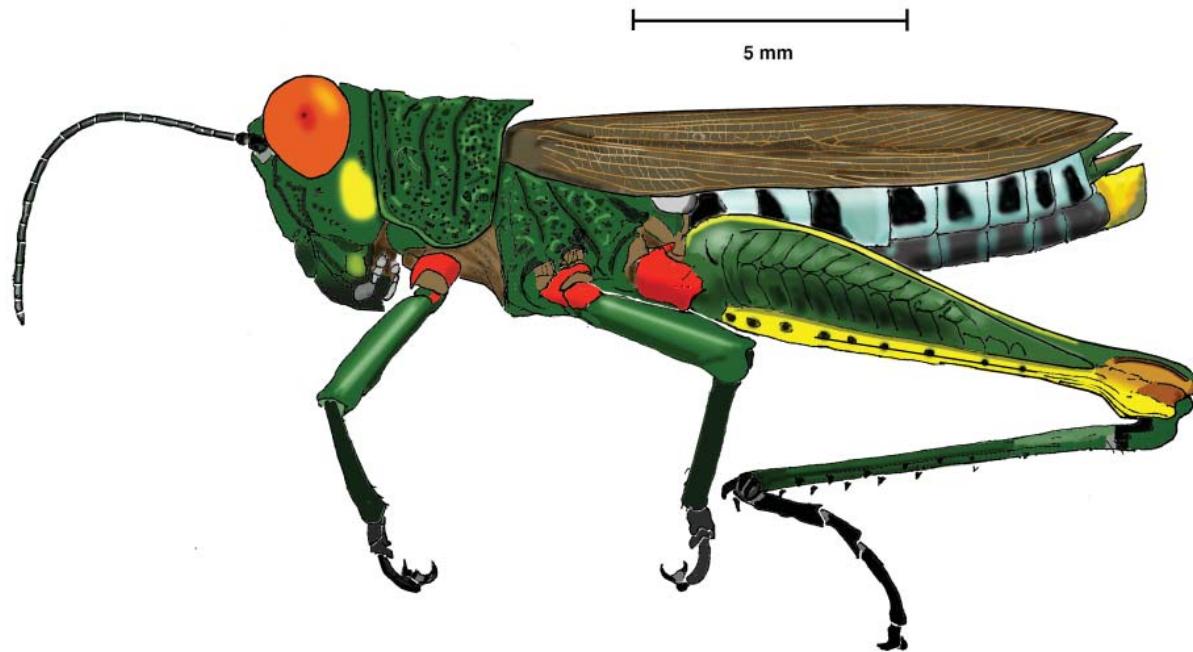


Plate P1. *Coscineuta coxalis*, male.

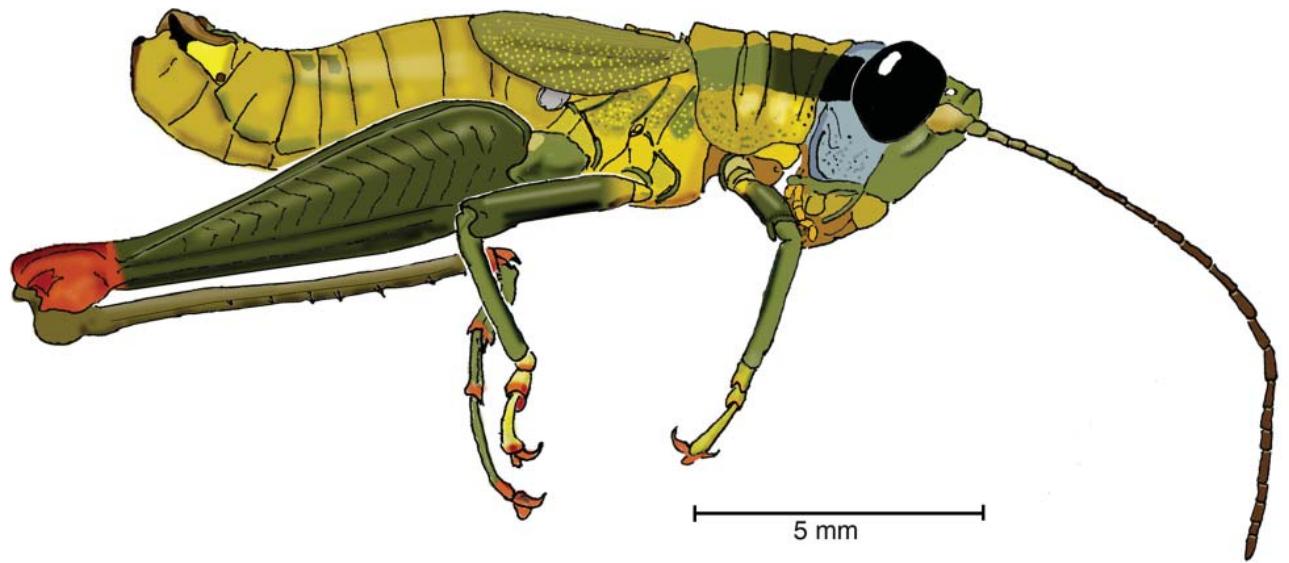


Plate P2. *Ampelophilus olivaceus* (E. Panamanian form). Male.

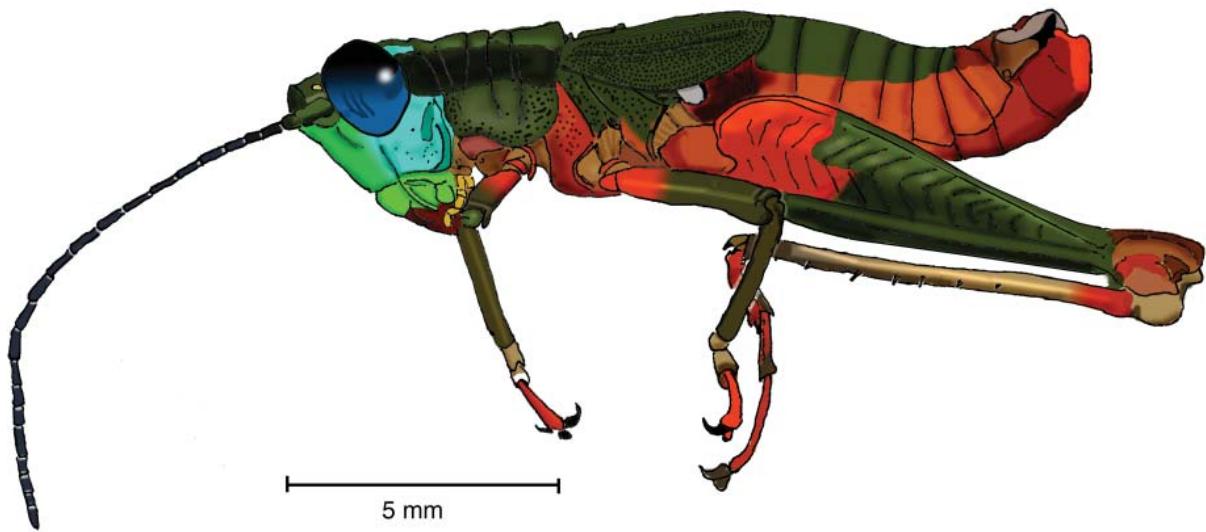


Plate P3. *Ampelophilus olivaceus* (W. Panamanian and Costa Rican form). Male.

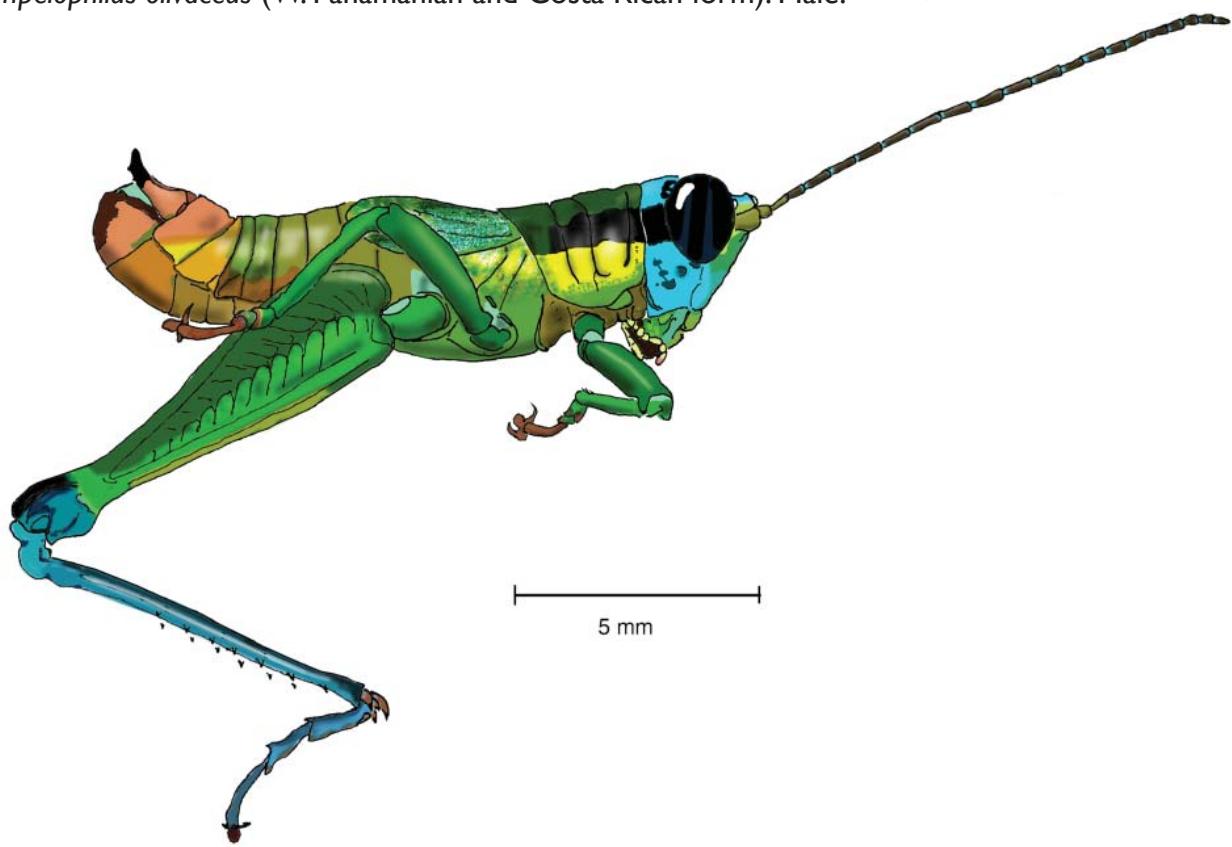


Plate P4. *Ampelophilus truncatus*, male.

Proctolabinae

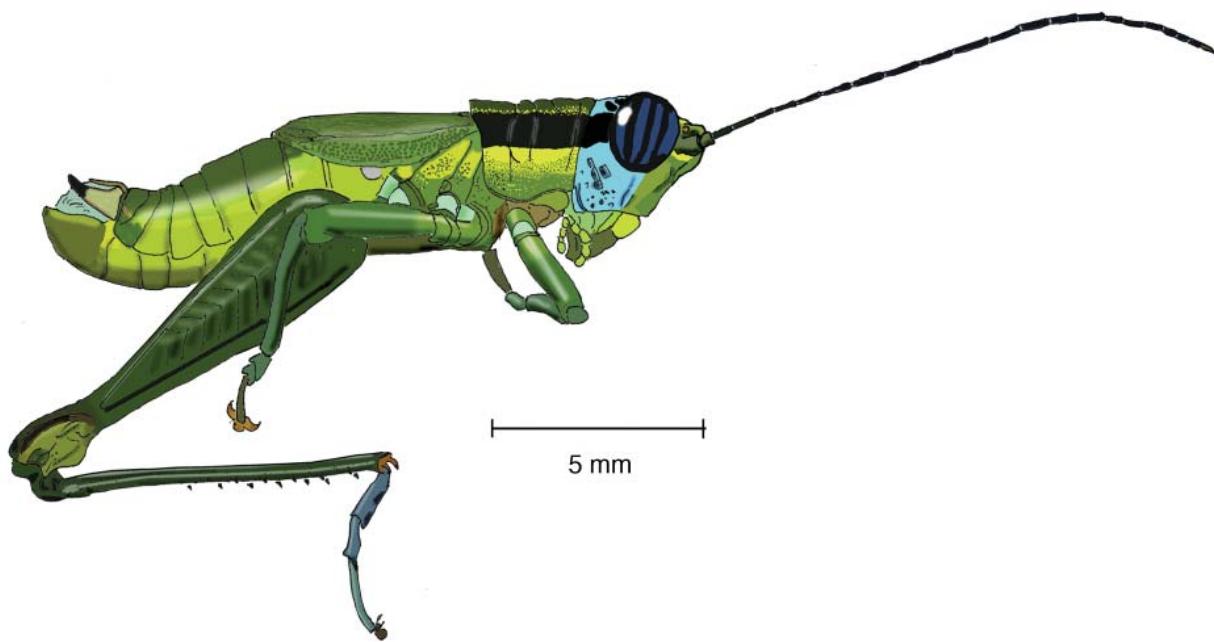


Plate P5. *Ampelophilus meridionalis*, male.

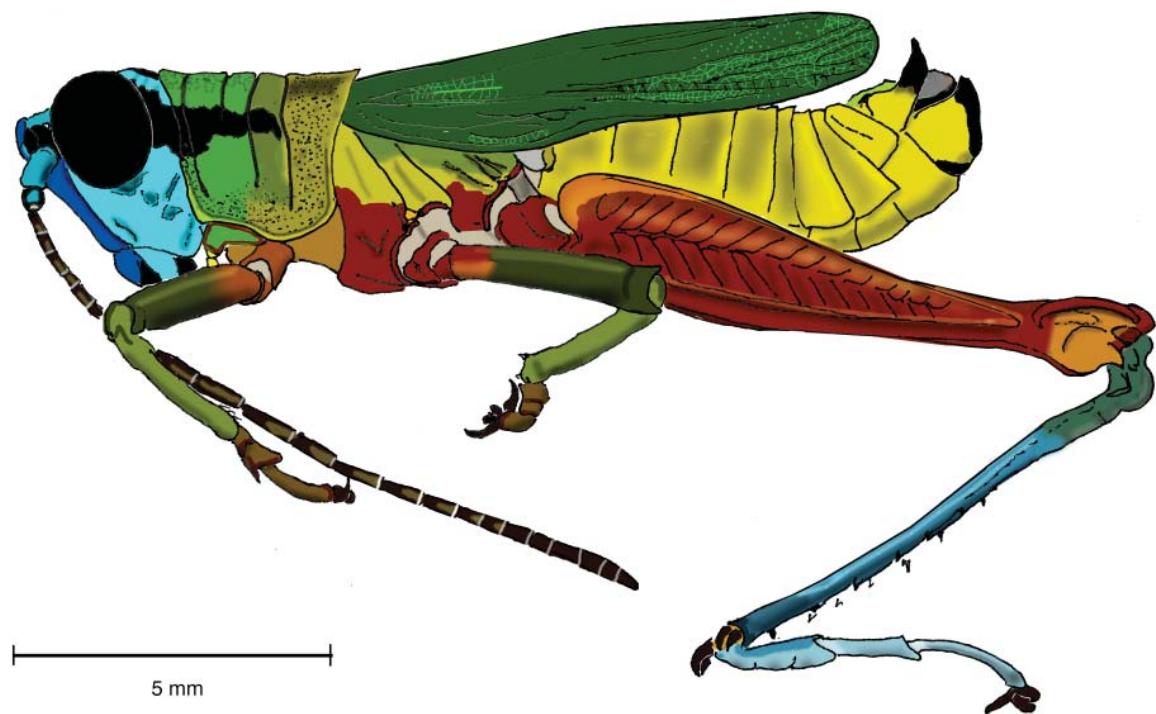


Plate P6. *Ampelophilus coeruleus*, male.

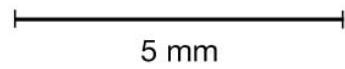


Plate P7. *Leioscapheus tremae*, male.

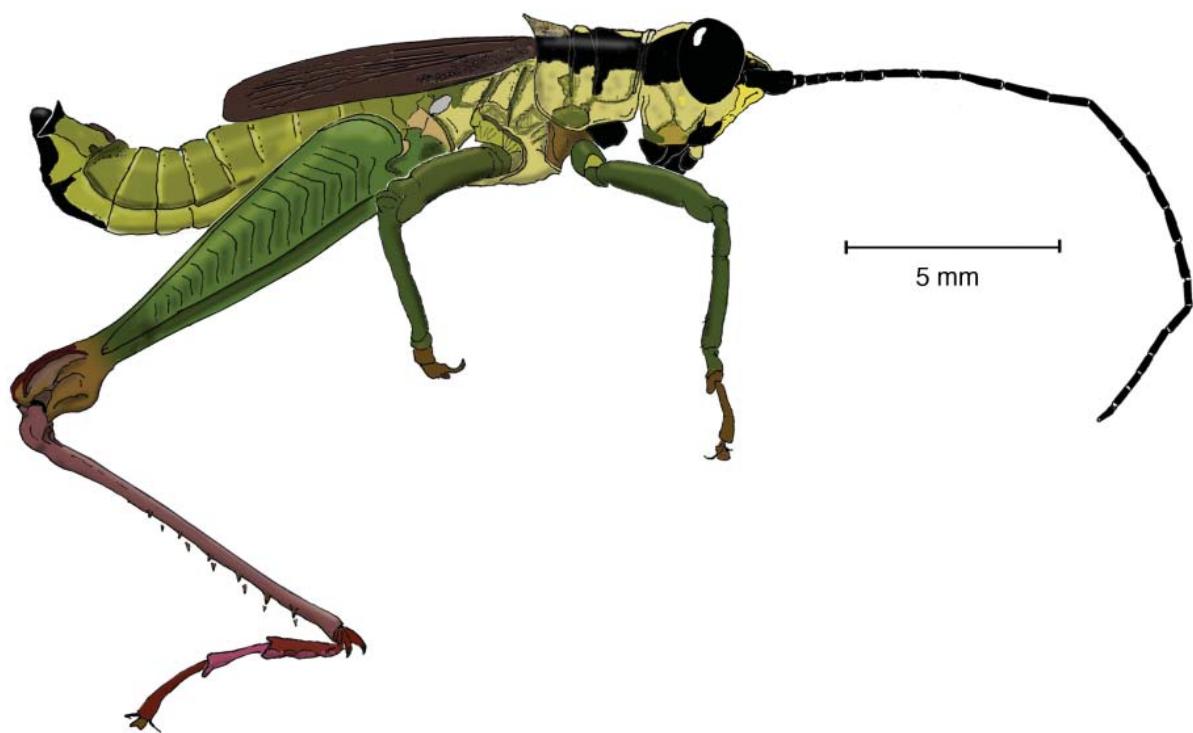


Plate P8. *Tela neeavora*, male.

Proctolabinae

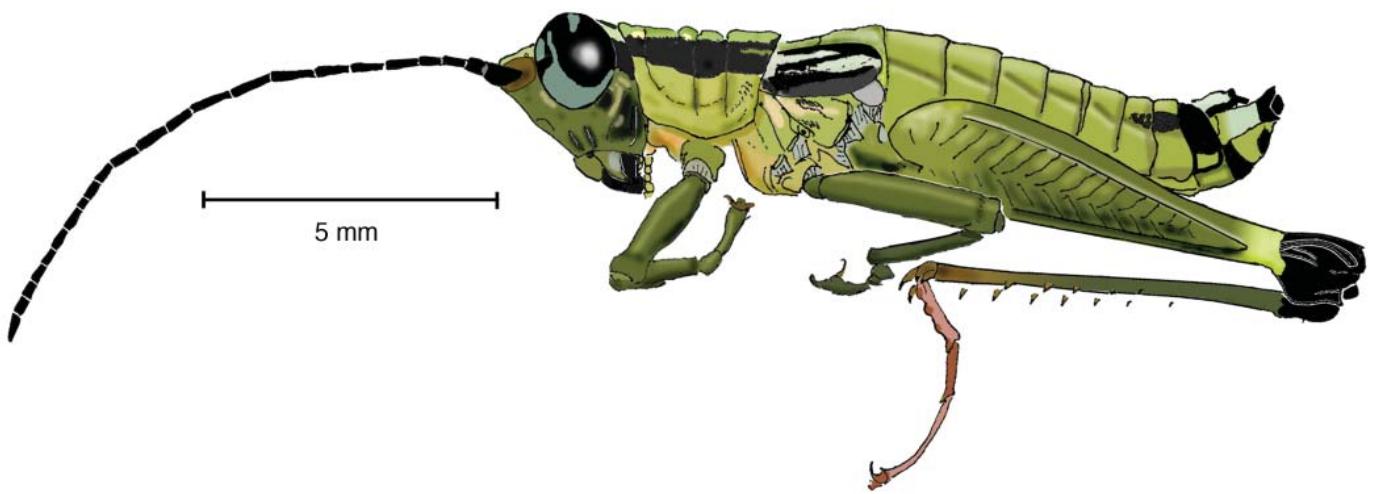


Plate P9. *Paratela ovatipennis*, male.

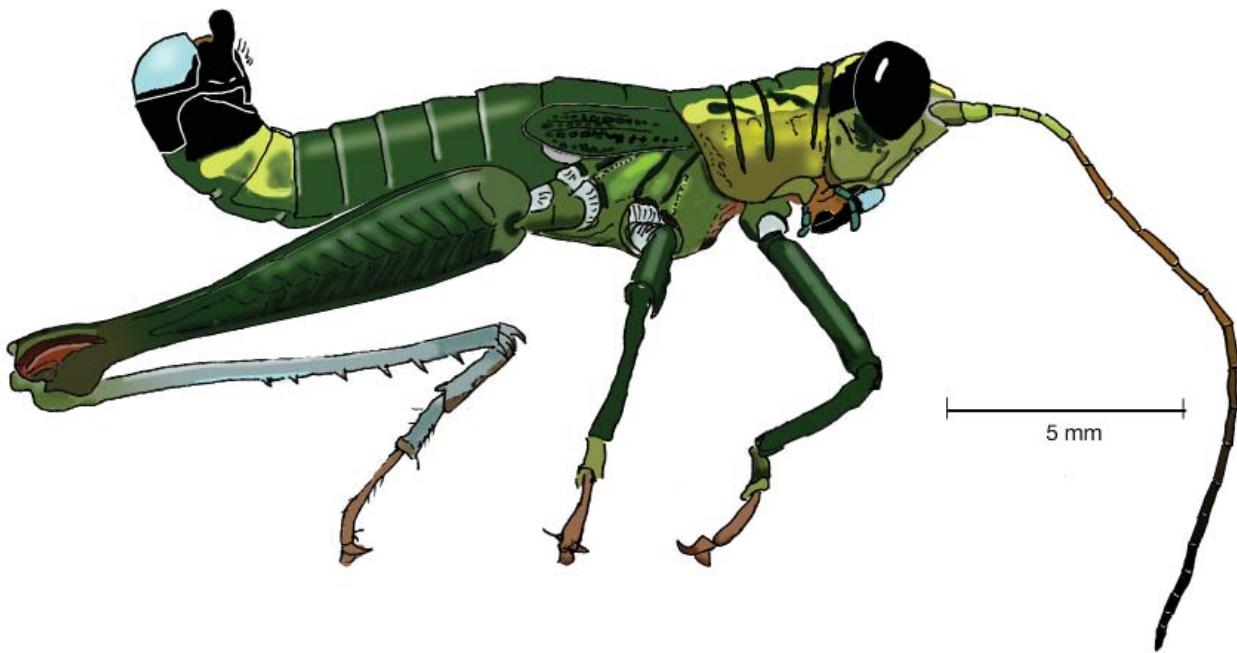


Plate P10. *Drymacris nebulicola*, male.

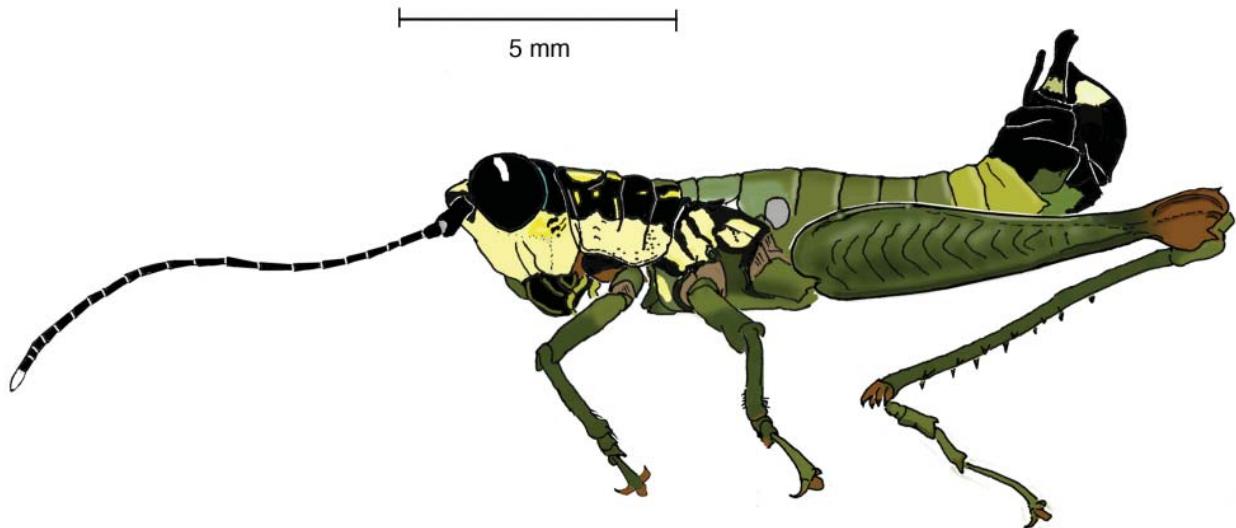


Plate P11. *Drymophilacris bimaculata*, male.

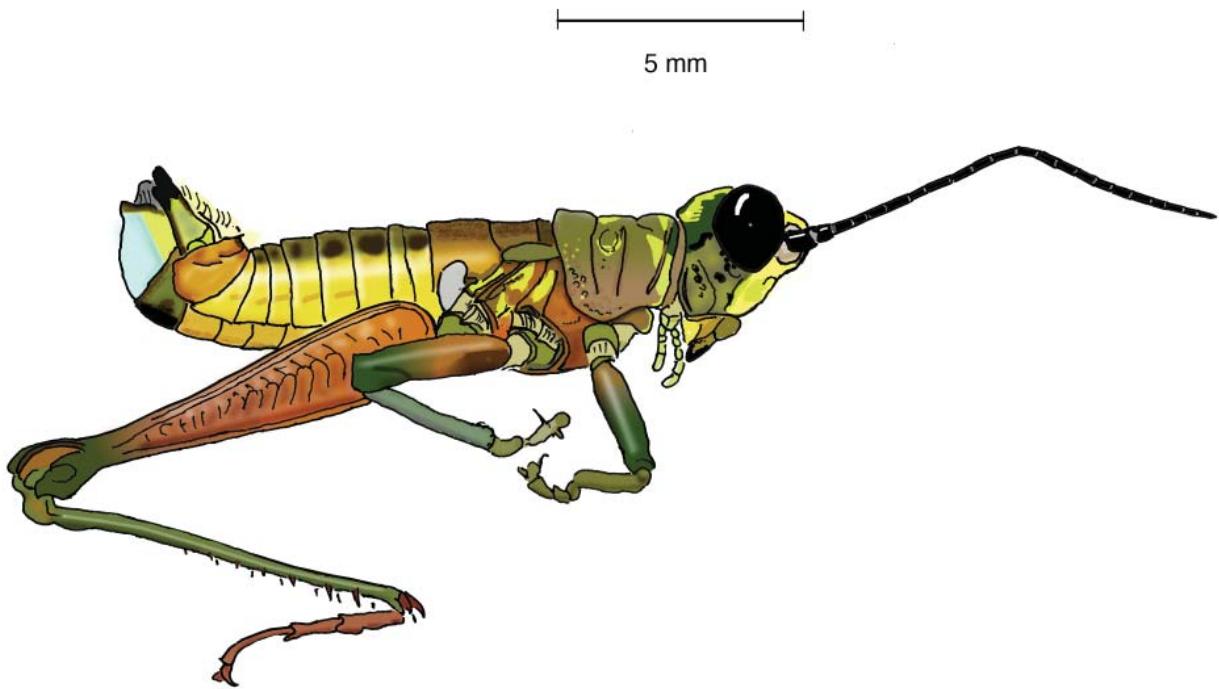


Plate P12. *Drymophilacris panamae*, male.

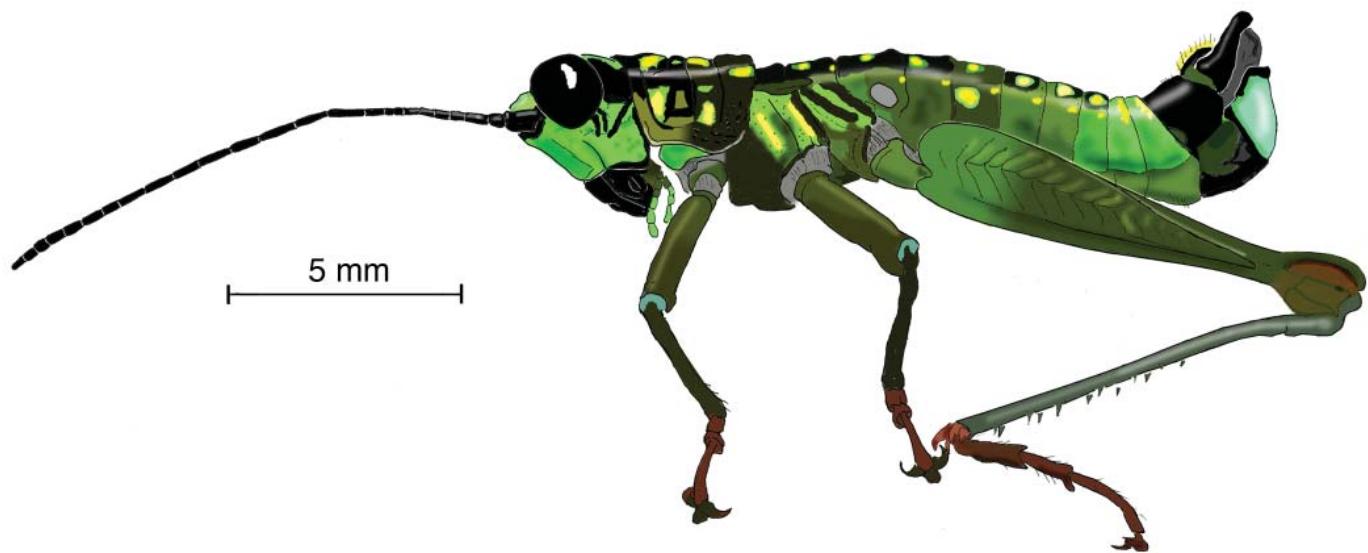


Plate P13. *Drymophilacris monteverdensis*, male.

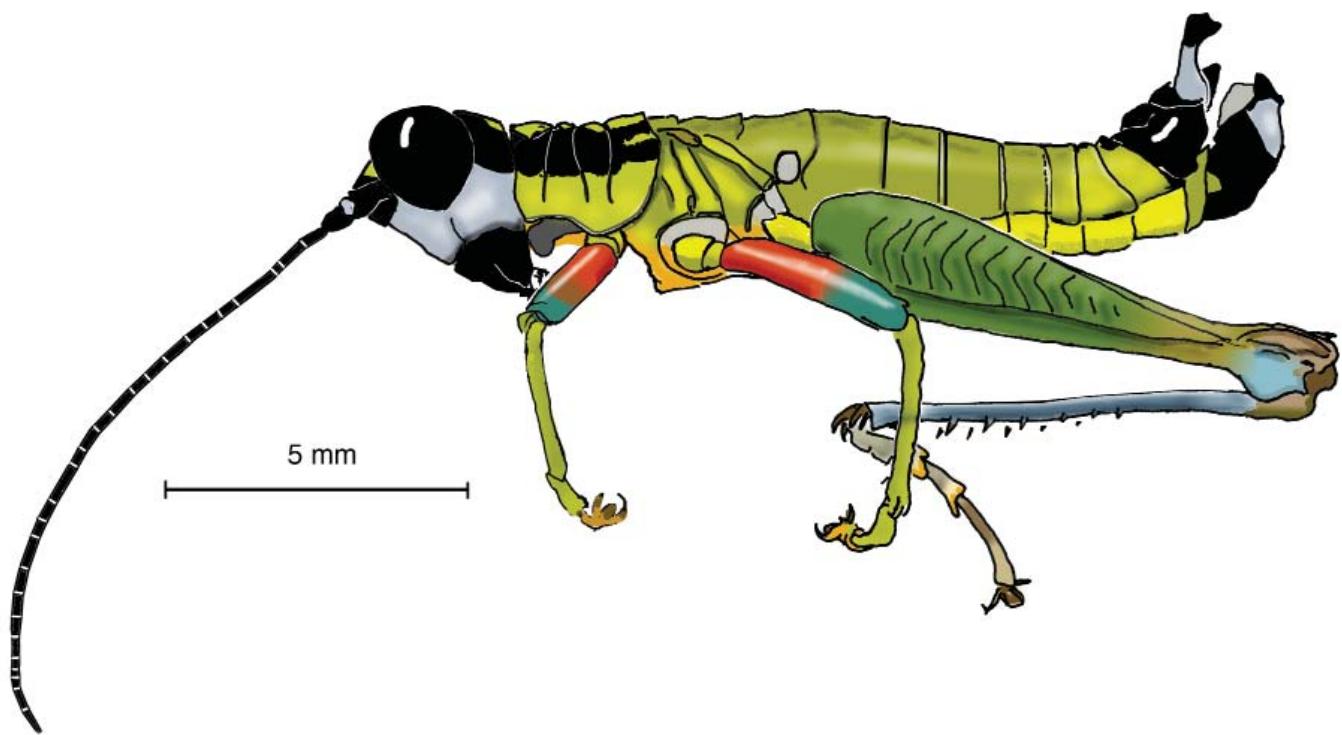


Plate P14. *Drymophilacris rubripes*, male.

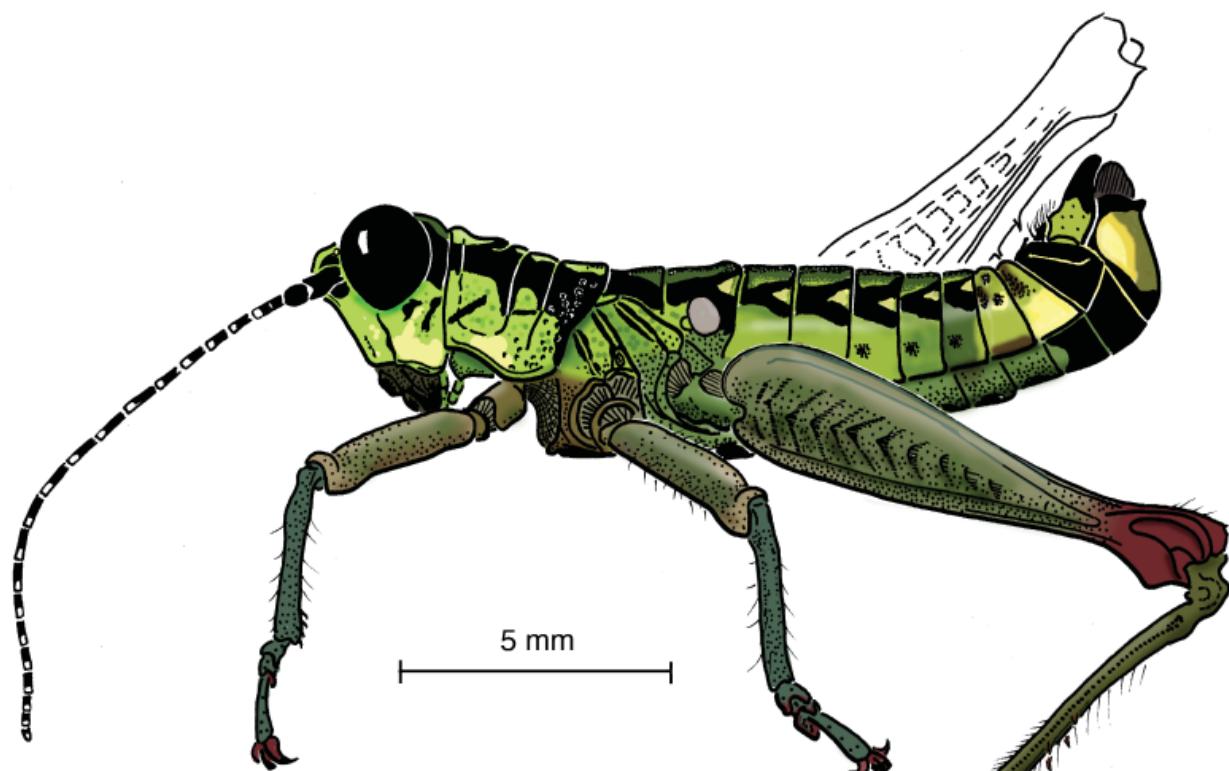


Plate P15. *Drymophilacris glyhocerca*, male.

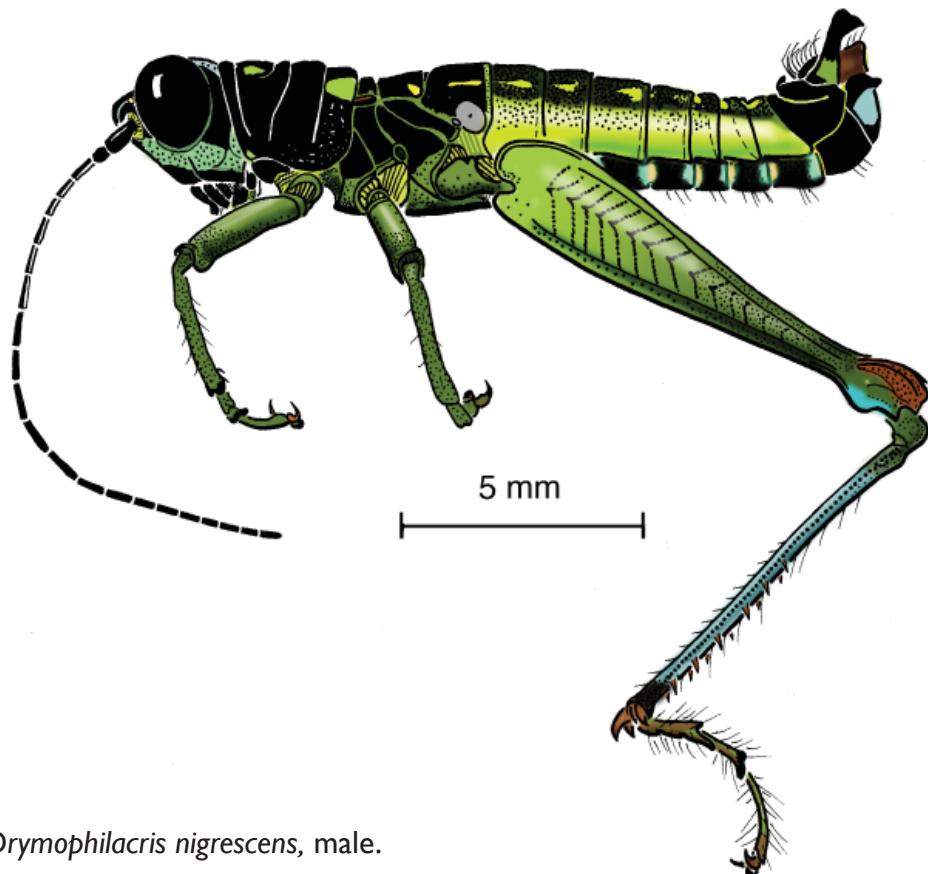


Plate P16. *Drymophilacris nigrescens*, male.

Proctolabinae

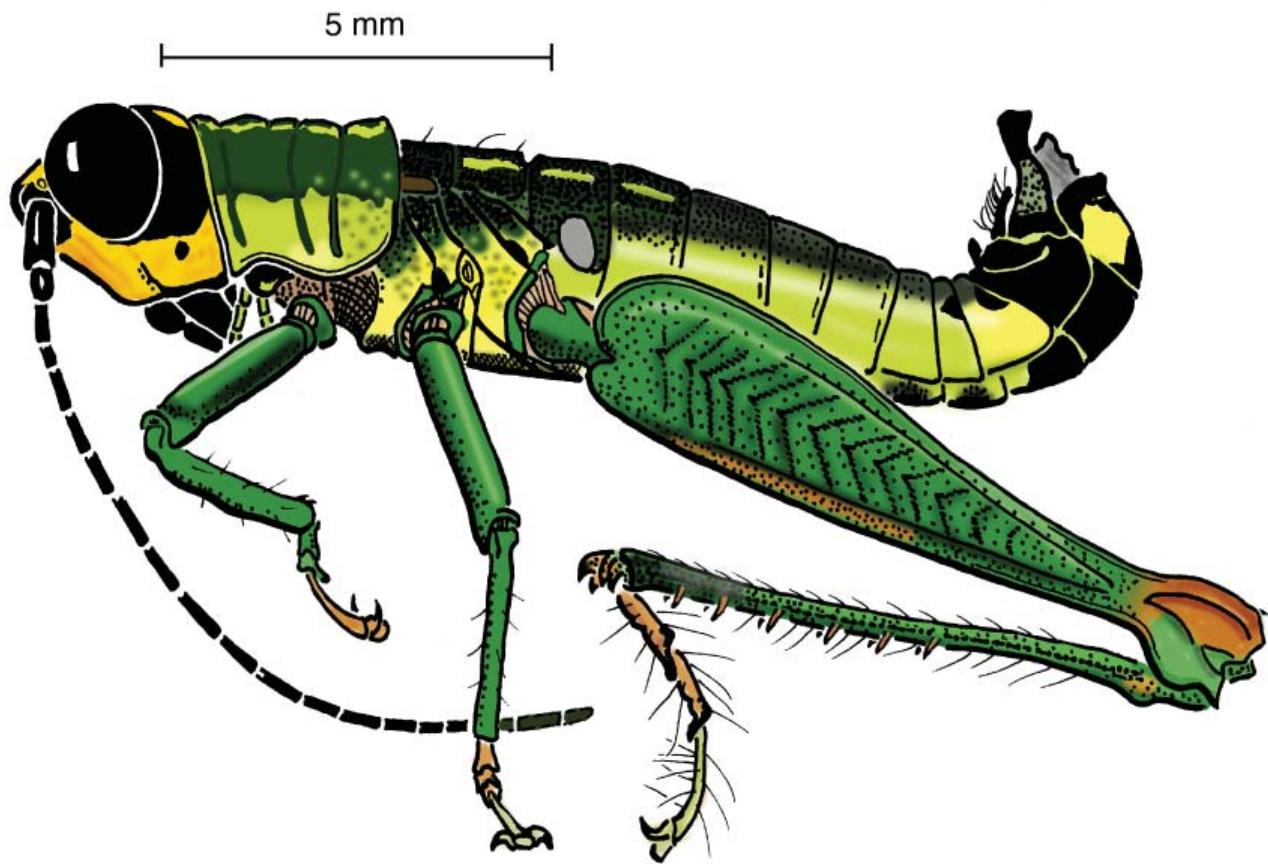


Plate P17. *Drymophilacris veraguensis*, male.

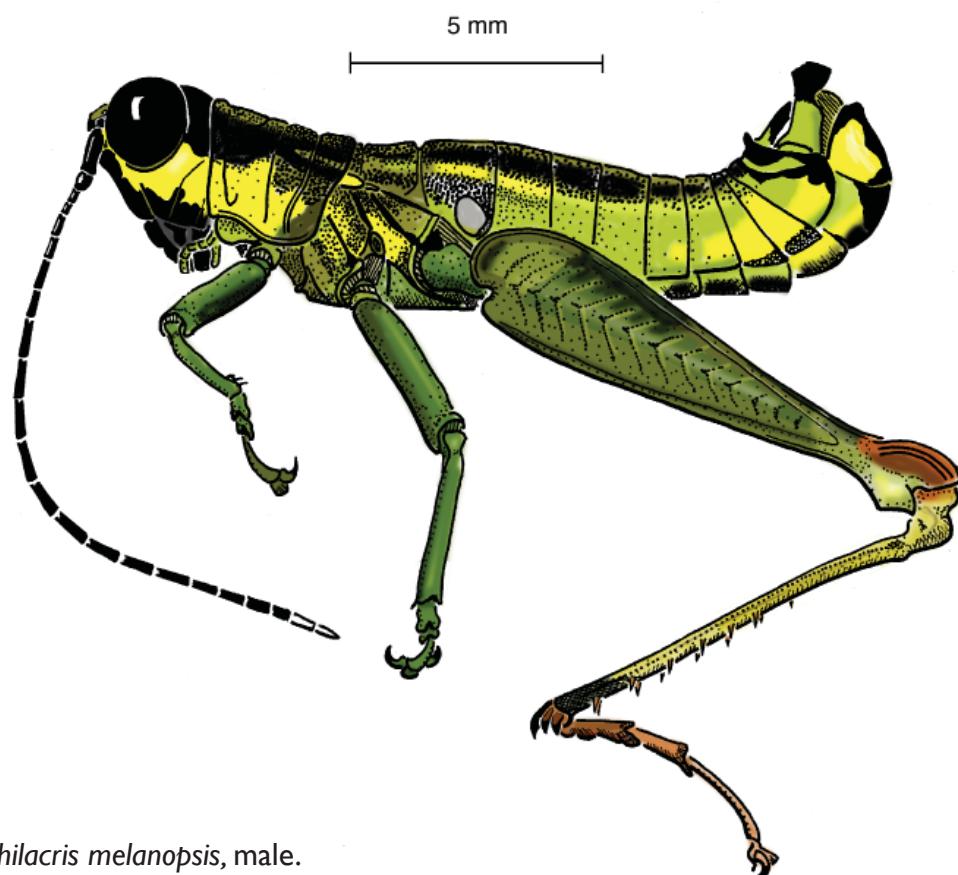


Plate P18. *Drymophilacris melanopsis*, male.

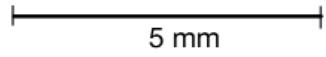
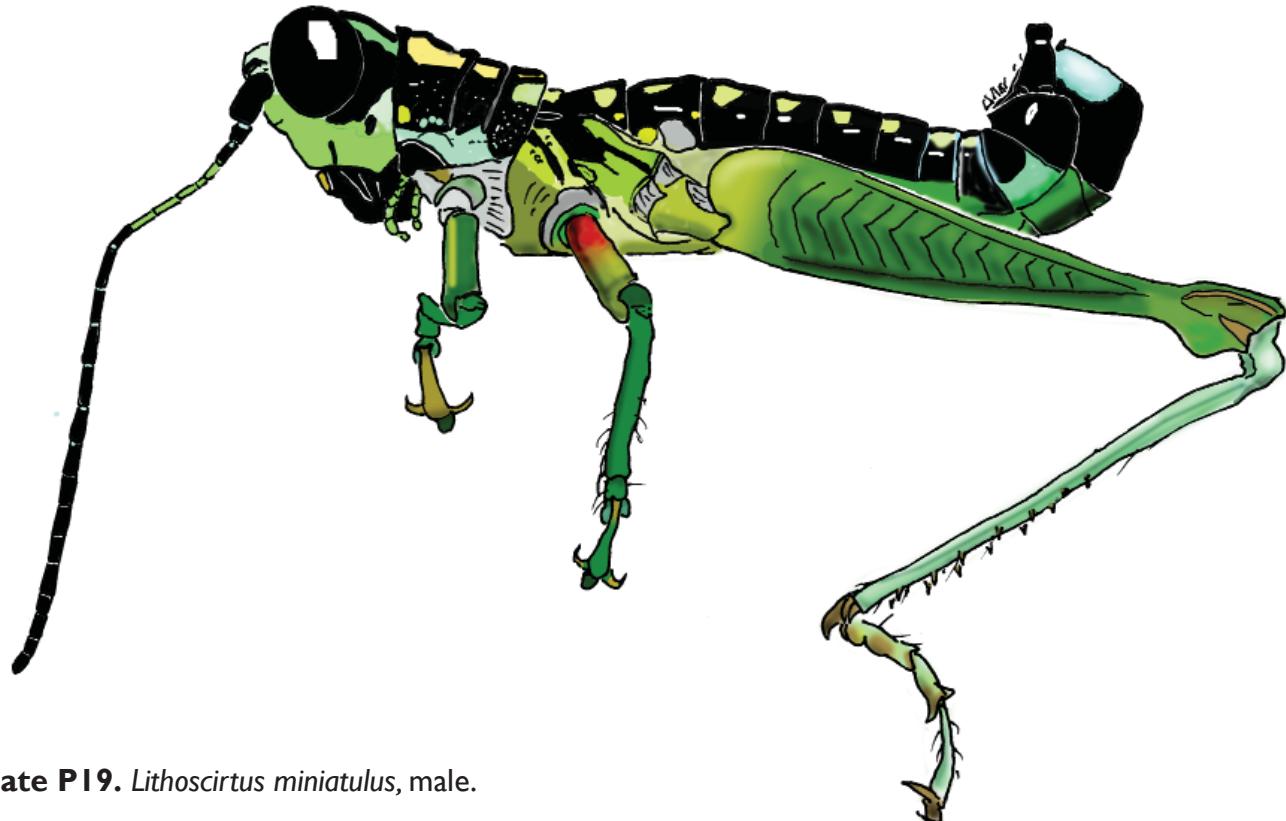
A horizontal scale bar with the text "5 mm" written below it.

Plate P19. *Lithoscirtus miniatulus*, male.

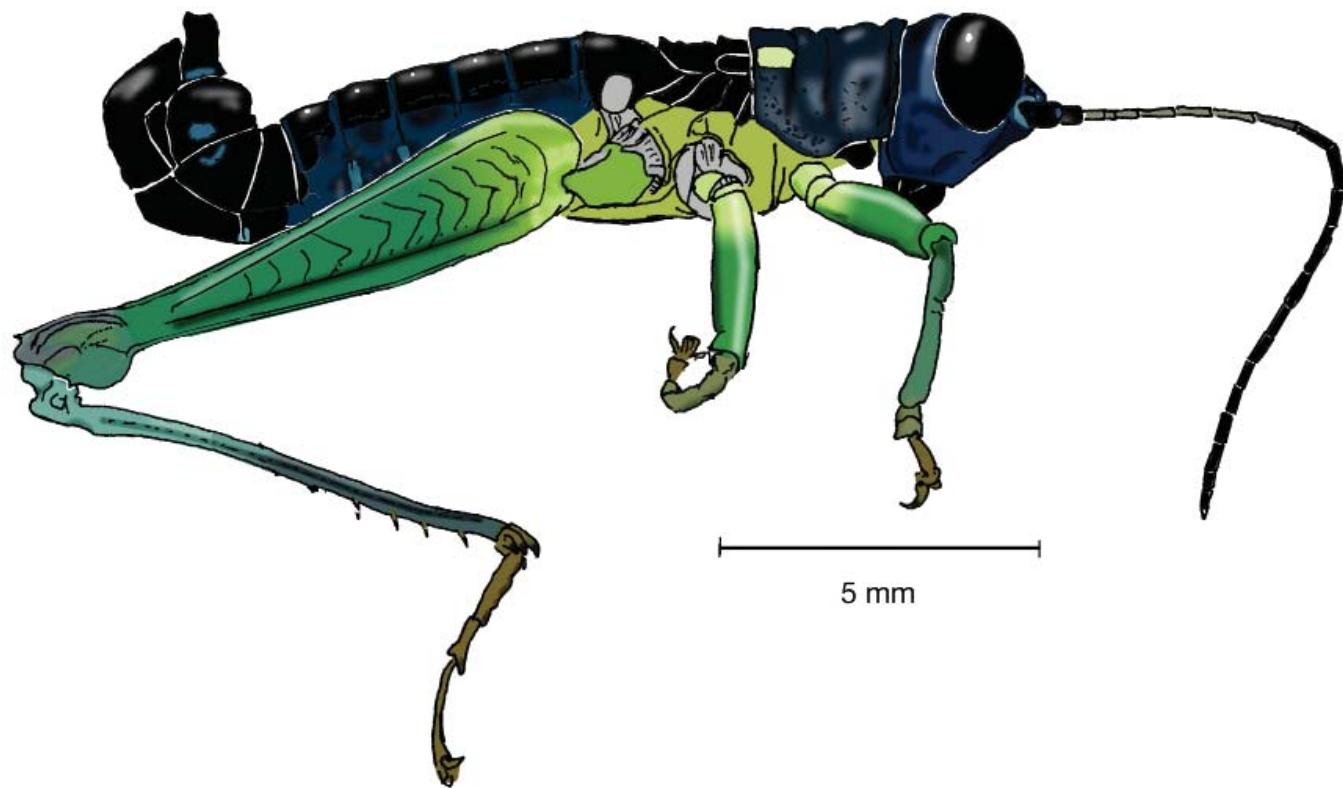


Plate P20. *Lithoscirtus daedalus*, southern form. Male.

Proctolabinae

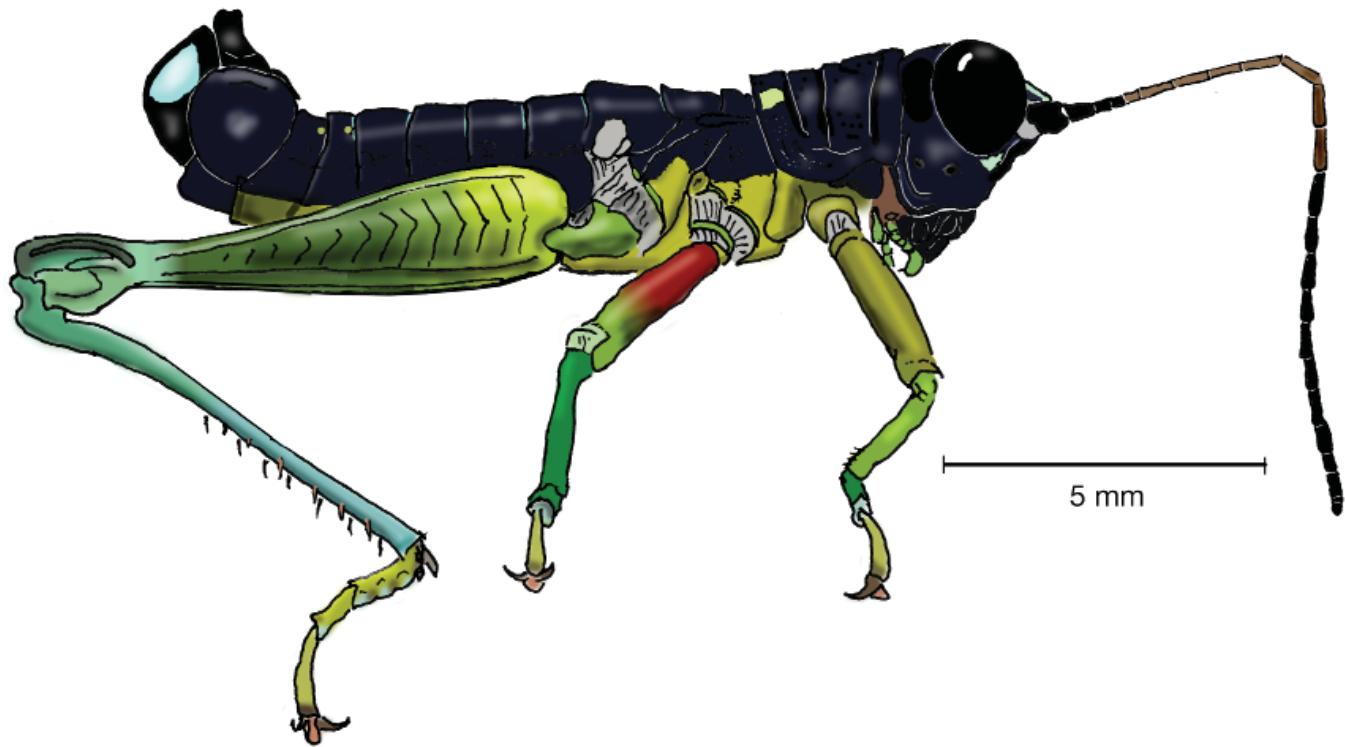


Plate P21. *Lithoscirtus daedalus*, northern form. Male.

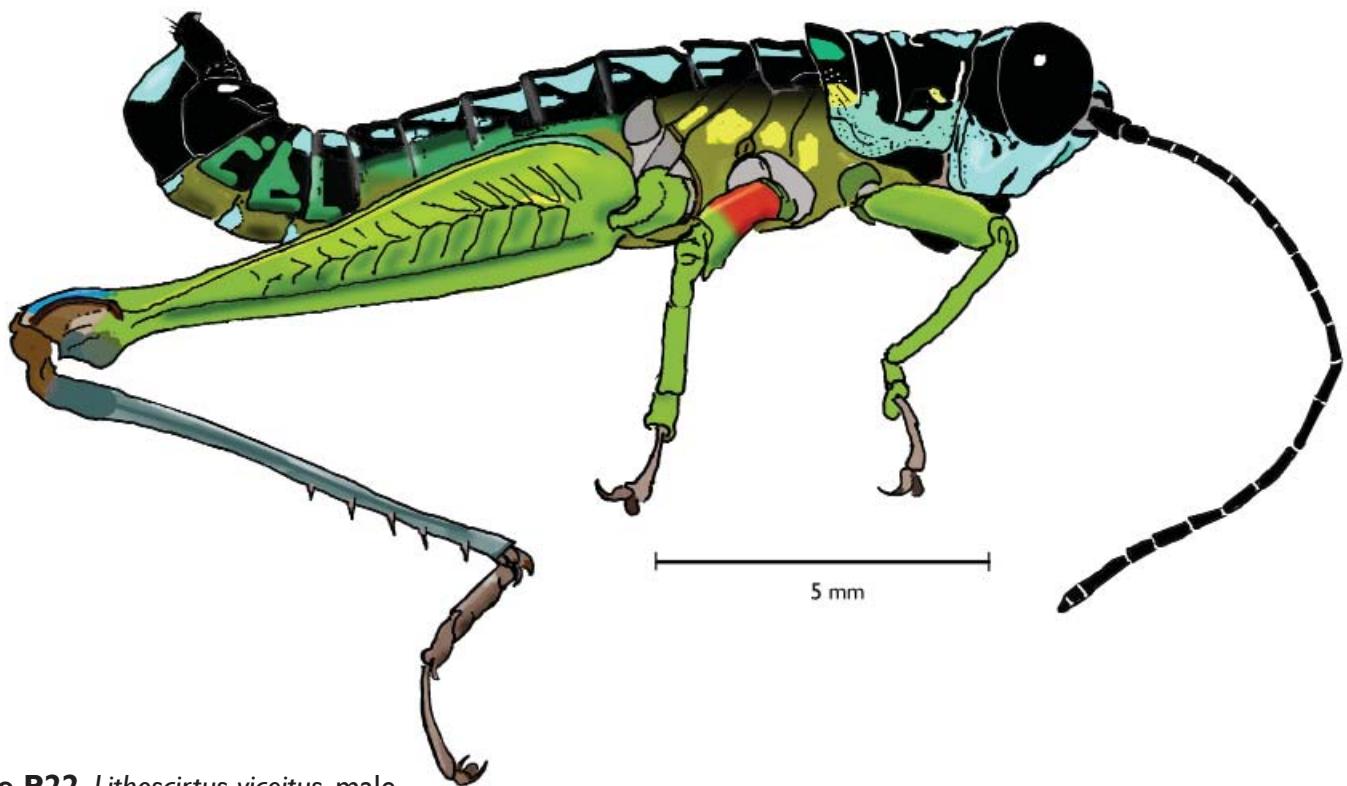


Plate P22. *Lithoscirtus viceitus*, male.

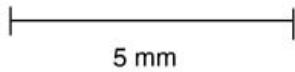
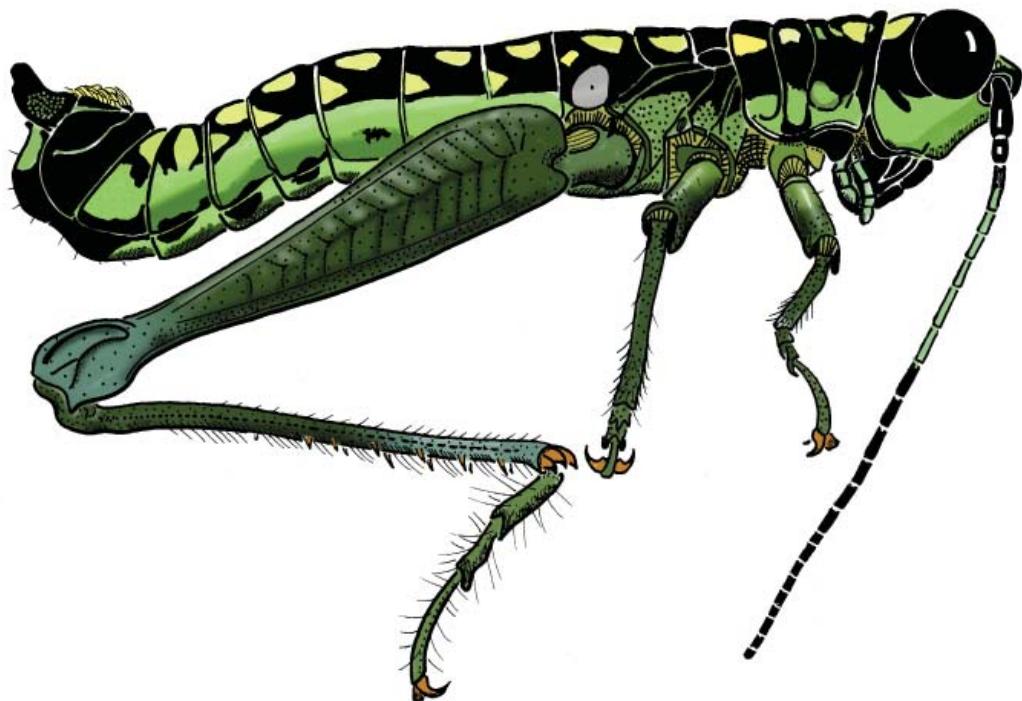
A horizontal scale bar consisting of two vertical lines with a short horizontal line connecting them in the middle, labeled "5 mm".

Plate P23. *Lithoscirtus tessellatus*, male.

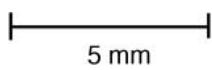
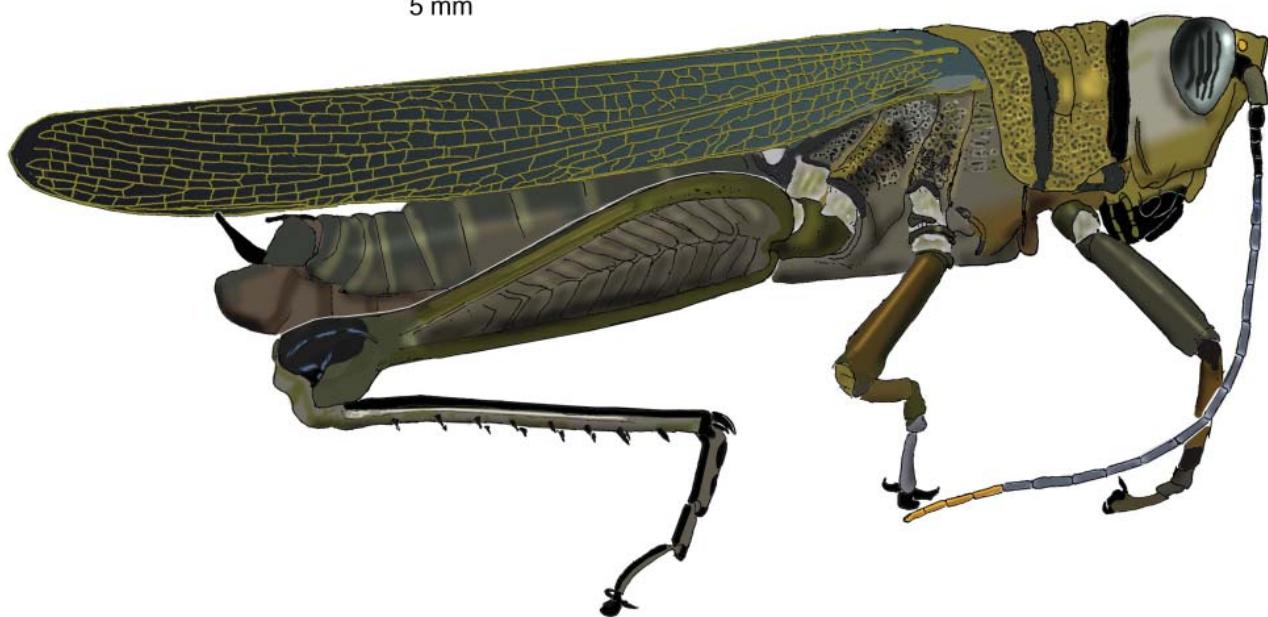
A horizontal scale bar consisting of two vertical lines with a short horizontal line connecting them in the middle, labeled "5 mm".

Plate P24. *Adelotettix gigas*, male.

Proctolabinae

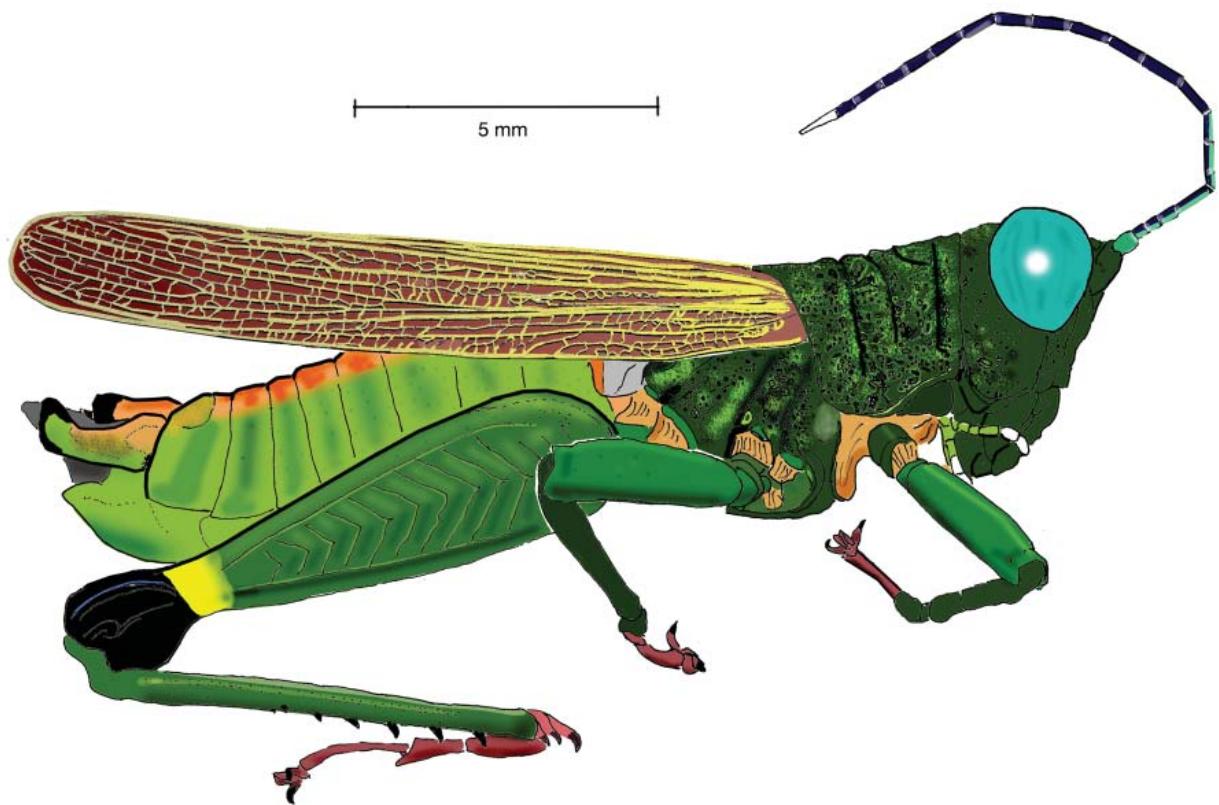


Plate P25. *Balachowskyacris olivacea*, male.

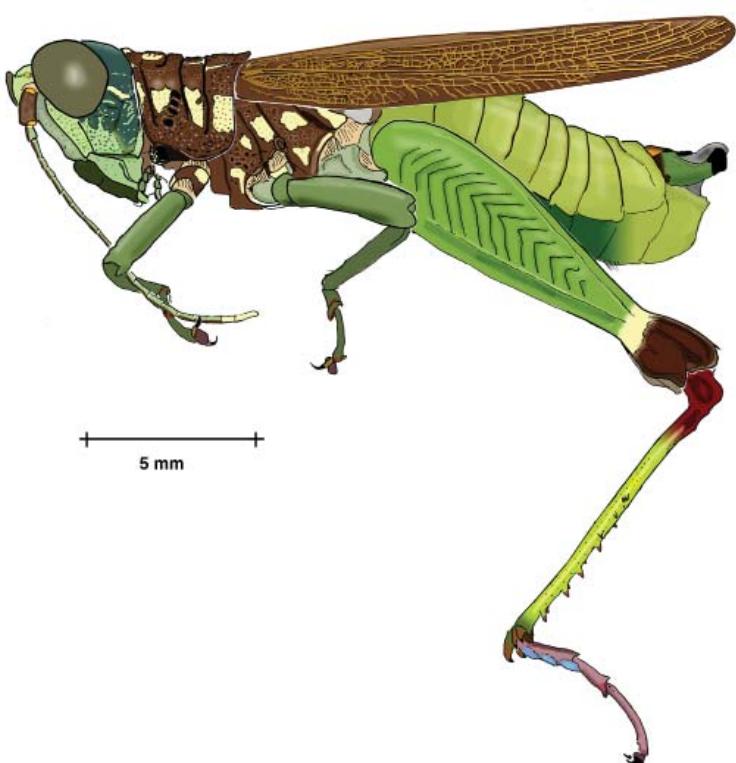


Plate P26. *Balachowskyacris rhabdota*, male.

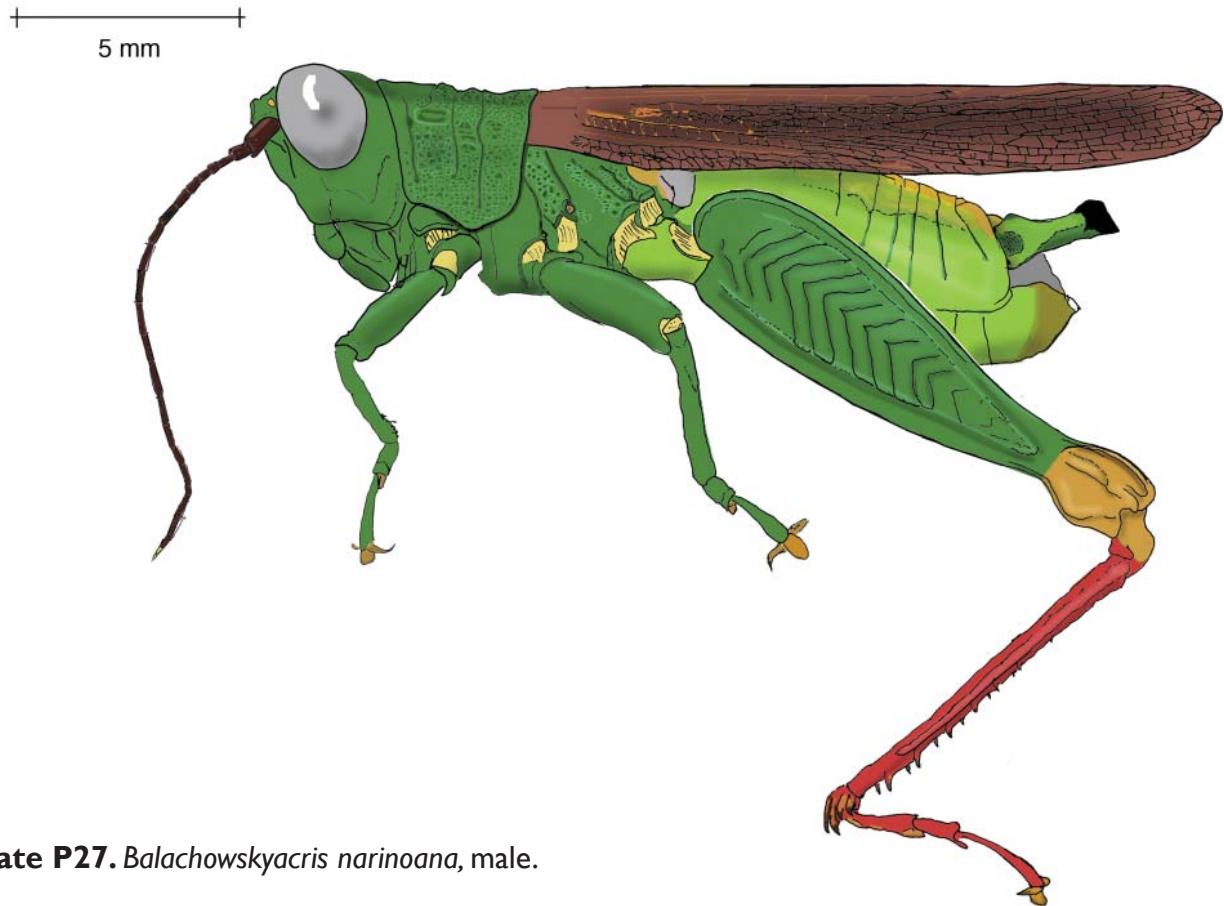


Plate P27. *Balachowskyacris narinoana*, male.

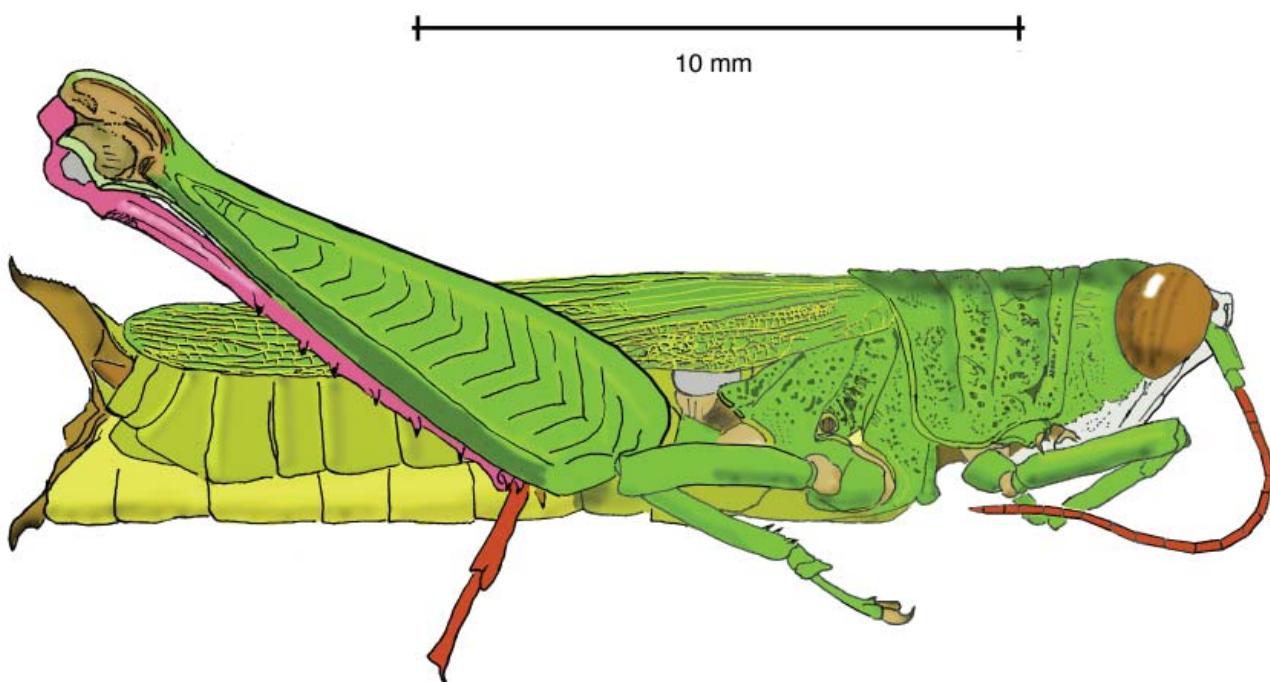


Plate P28. *Balachowskyacris robertsi*, female.

Proctolabinae

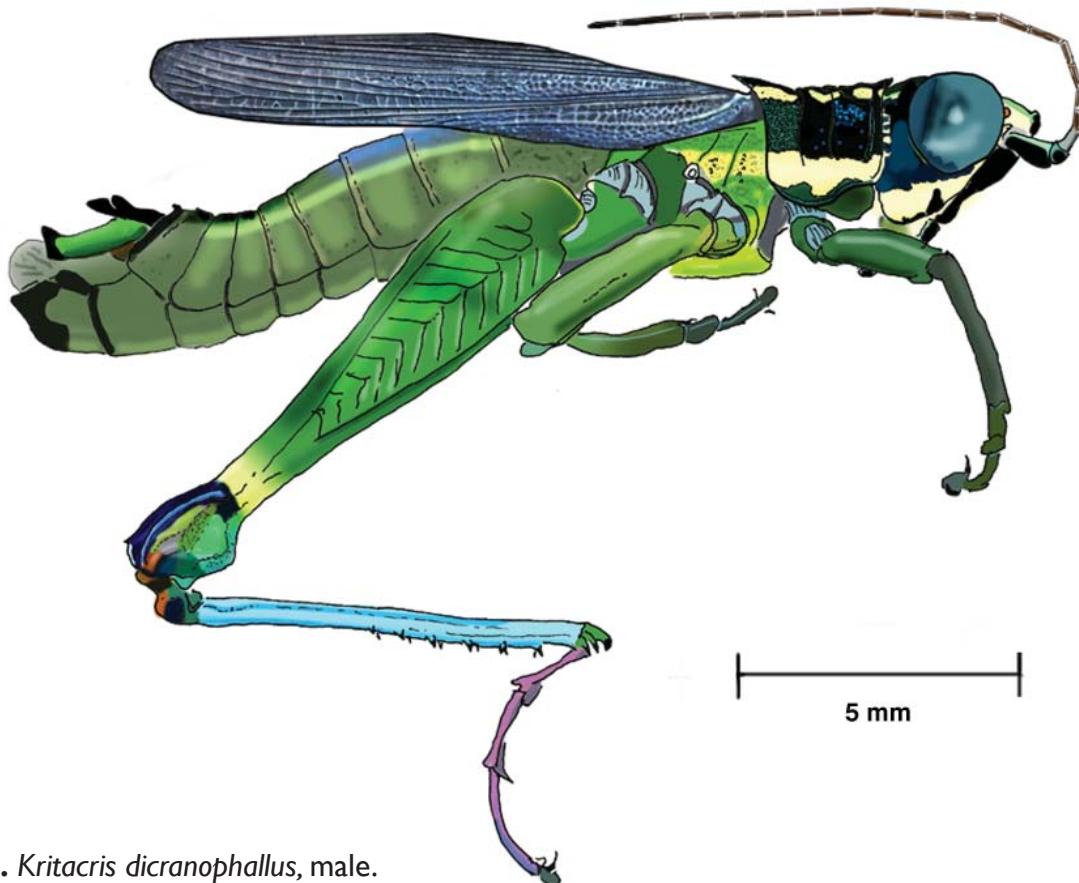


Plate P29. *Kritacris dicranophallus*, male.

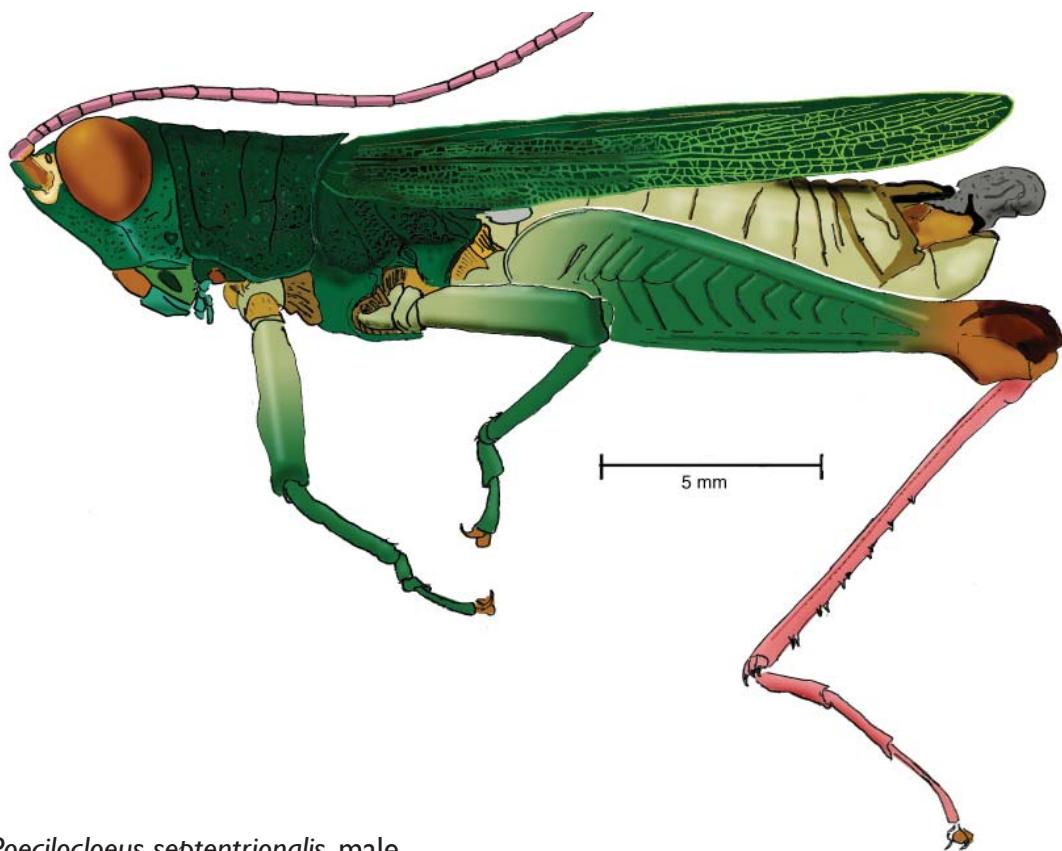


Plate P30. *Poecilocloeus septentrionalis*, male.

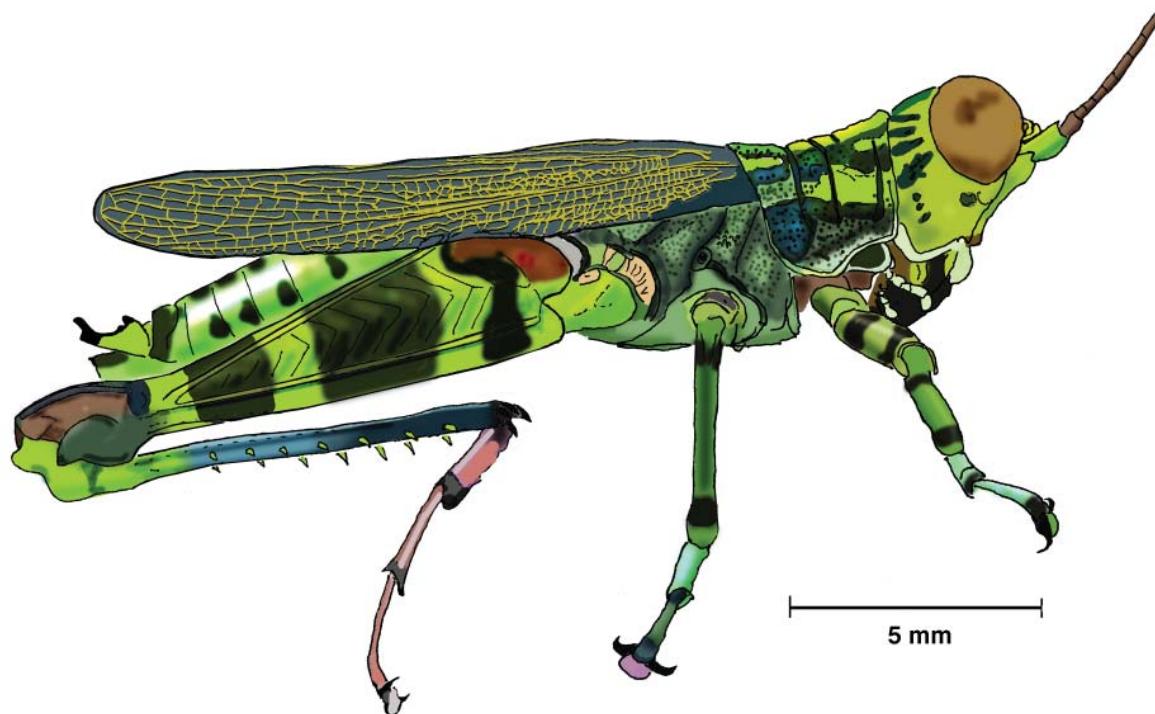


Plate P31. *Zosperamerus virgatus*, male.

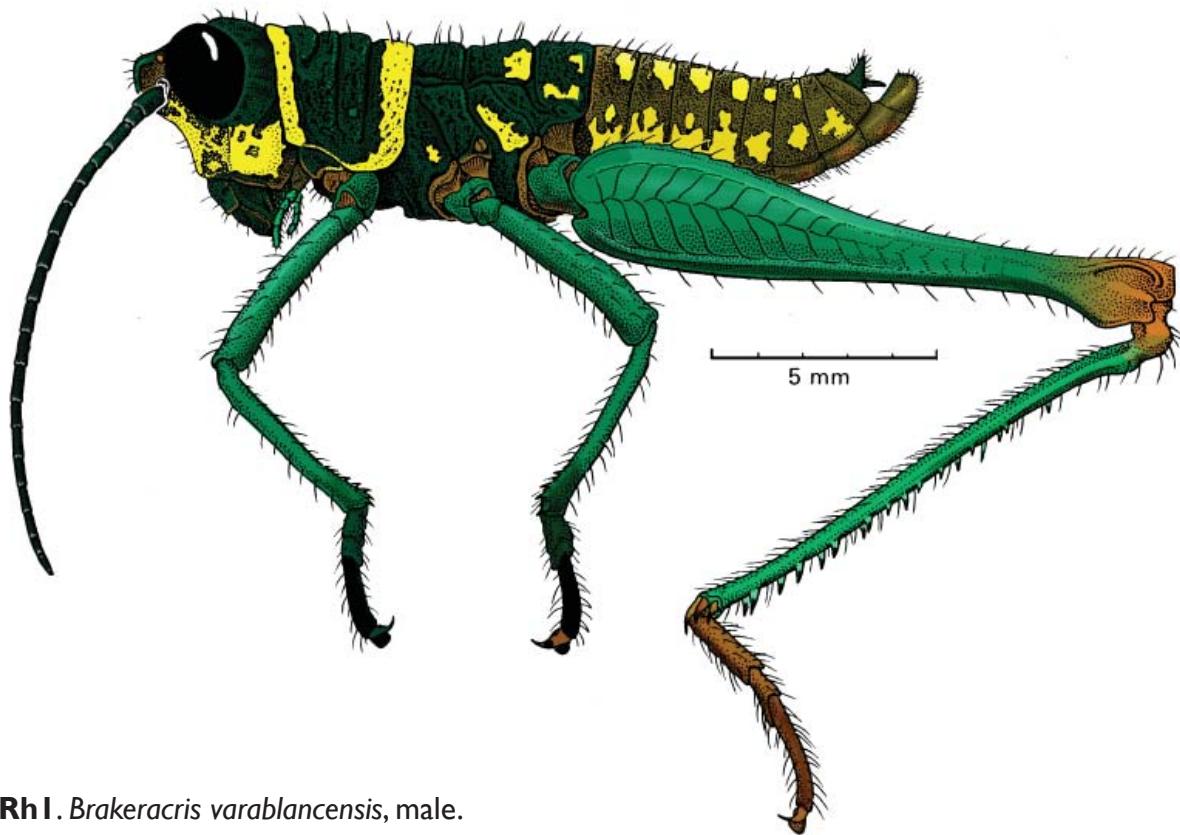


Plate Rh1. *Brakeracris varablancensis*, male.

Rhytidochrotinae

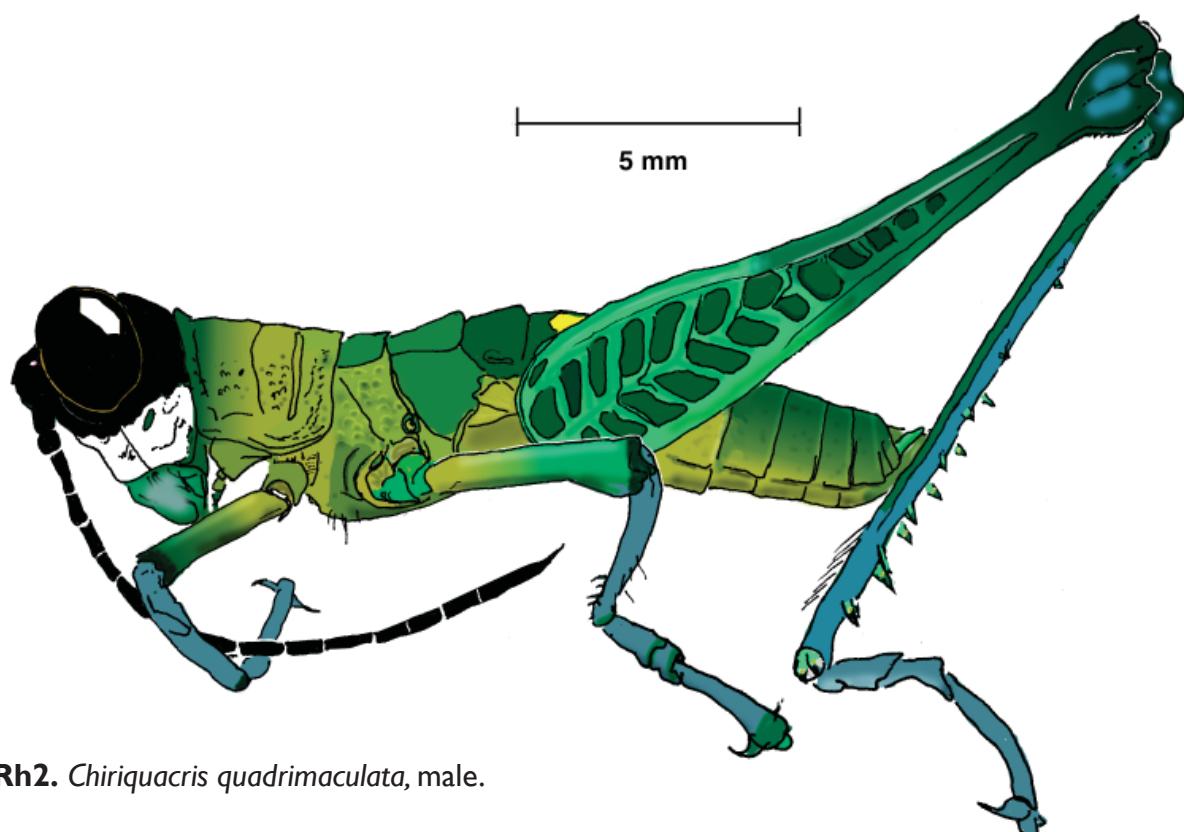


Plate Rh2. *Chiriquacris quadrimaculata*, male.

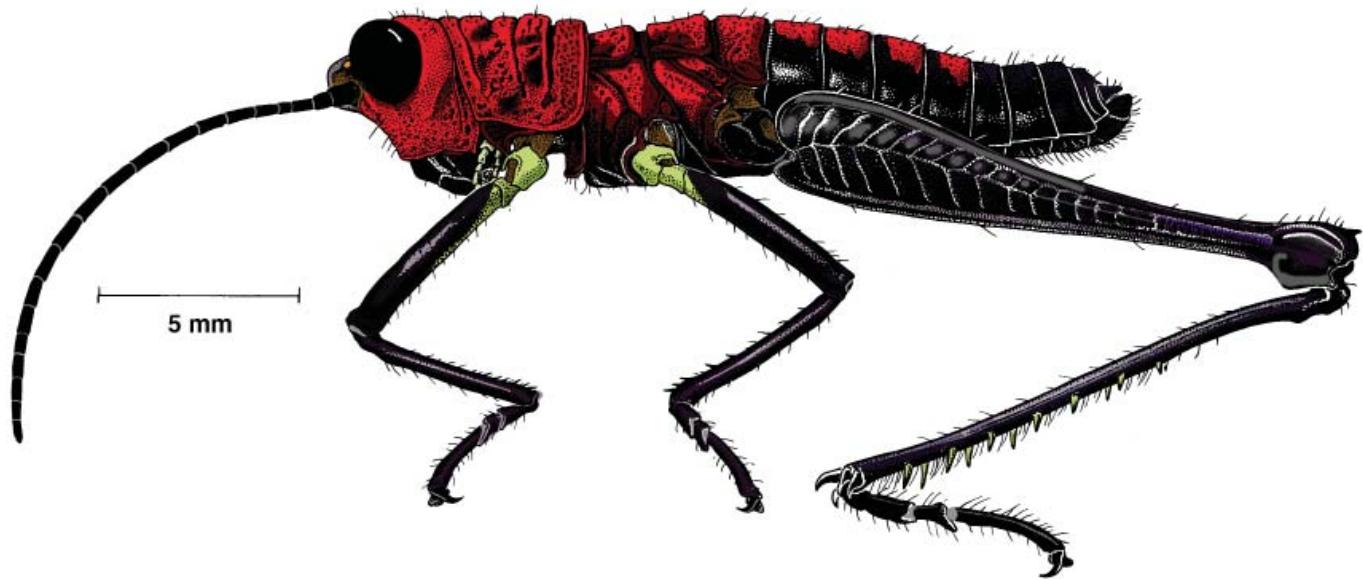


Plate Rh3. *Exythracris volcanica*, male.

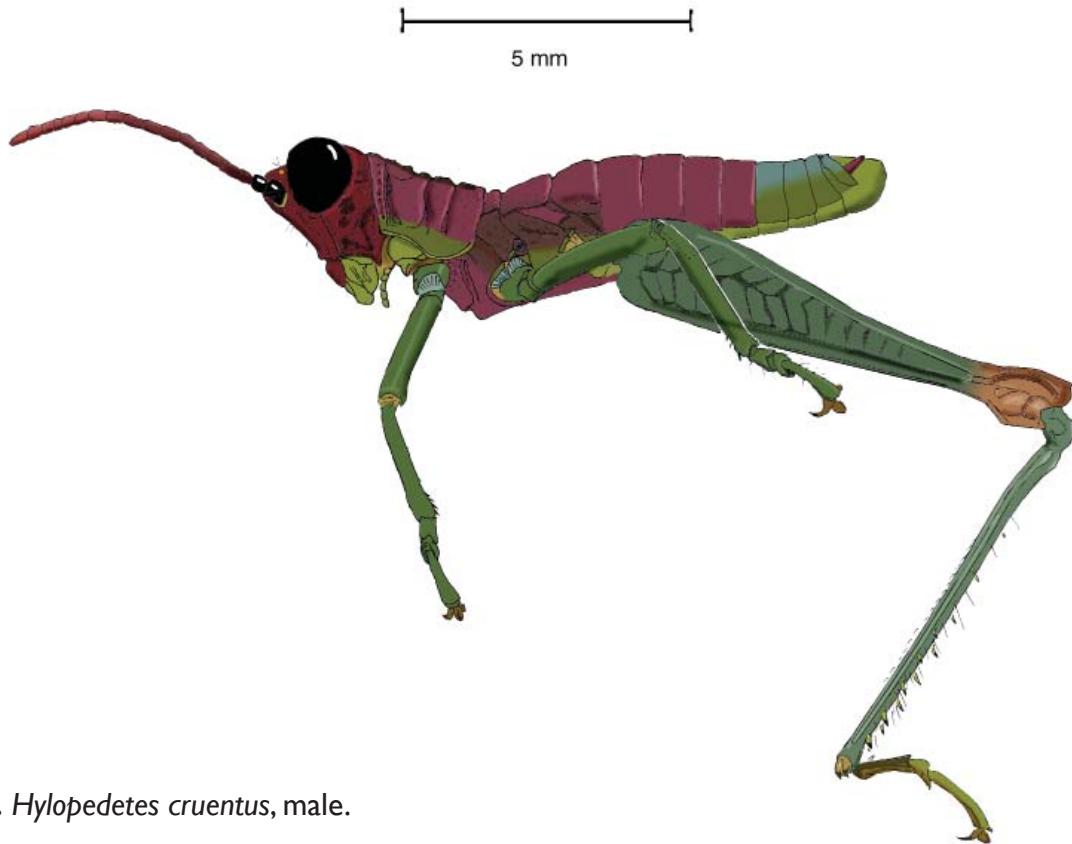


Plate Rh4. *Hylopedetes cruentus*, male.

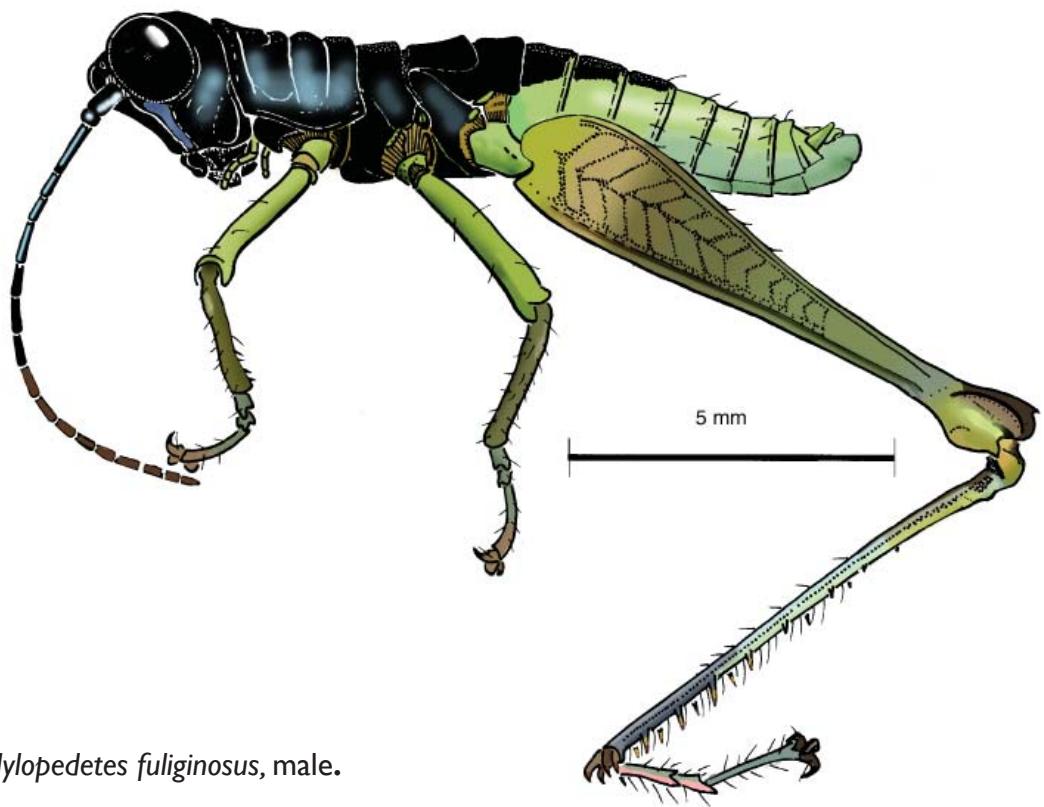


Plate Rh5. *Hylopedetes fuliginosus*, male.

Rhytidochrotinae

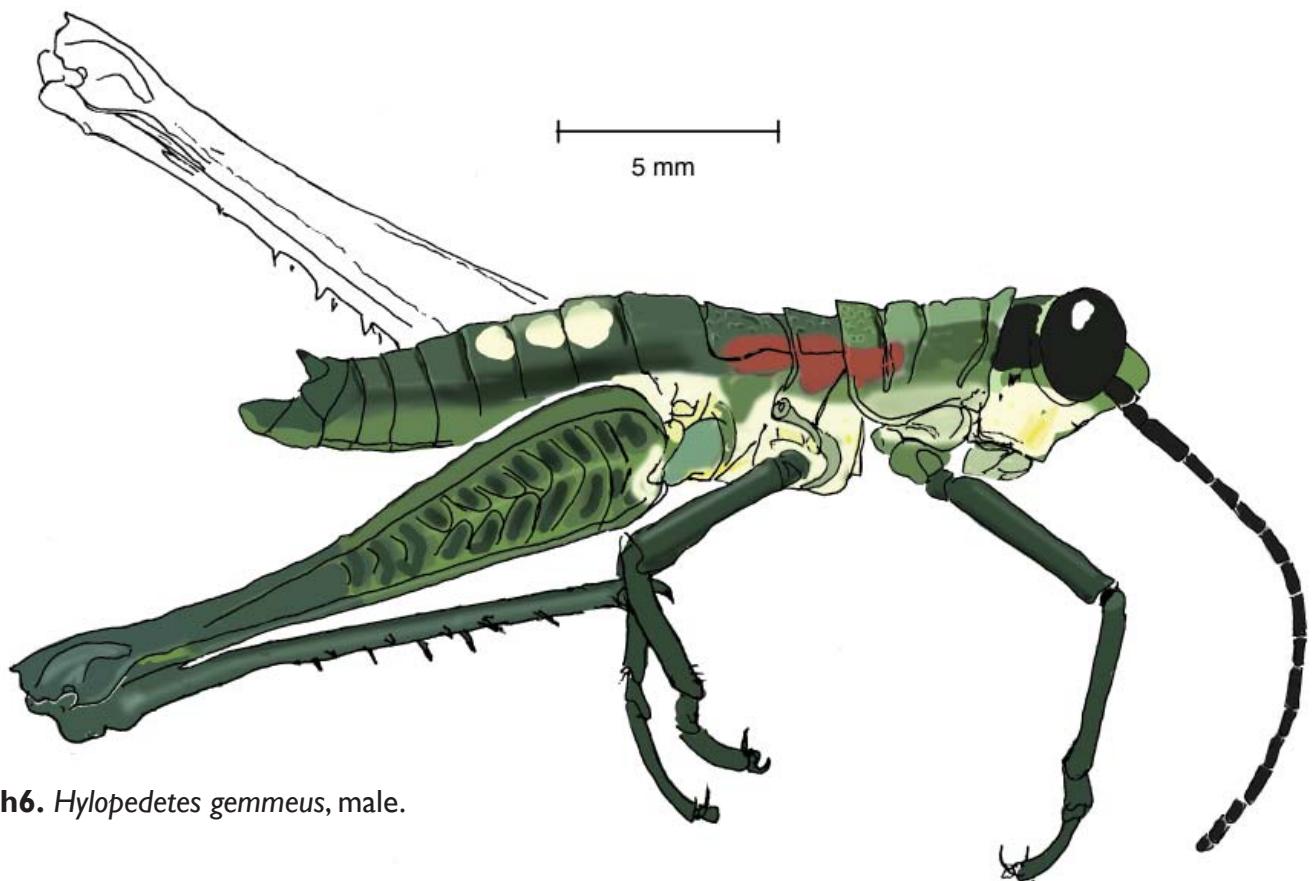


Plate Rh6. *Hylopedetes gemmeus*, male.

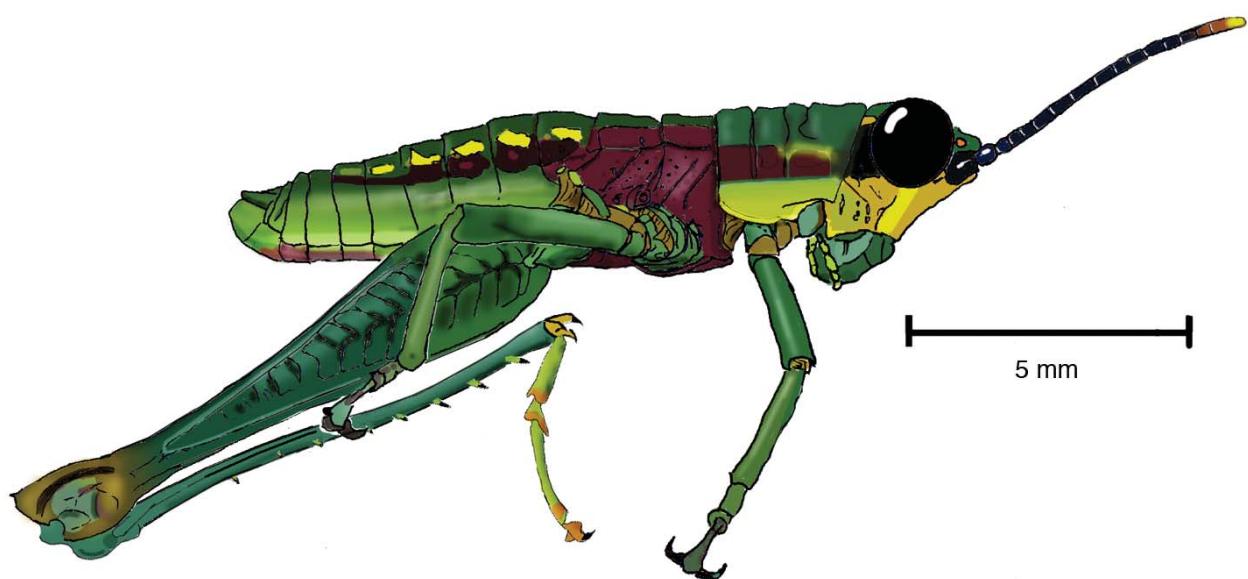


Plate Rh7. *Hylopedetes mirandus*, male.

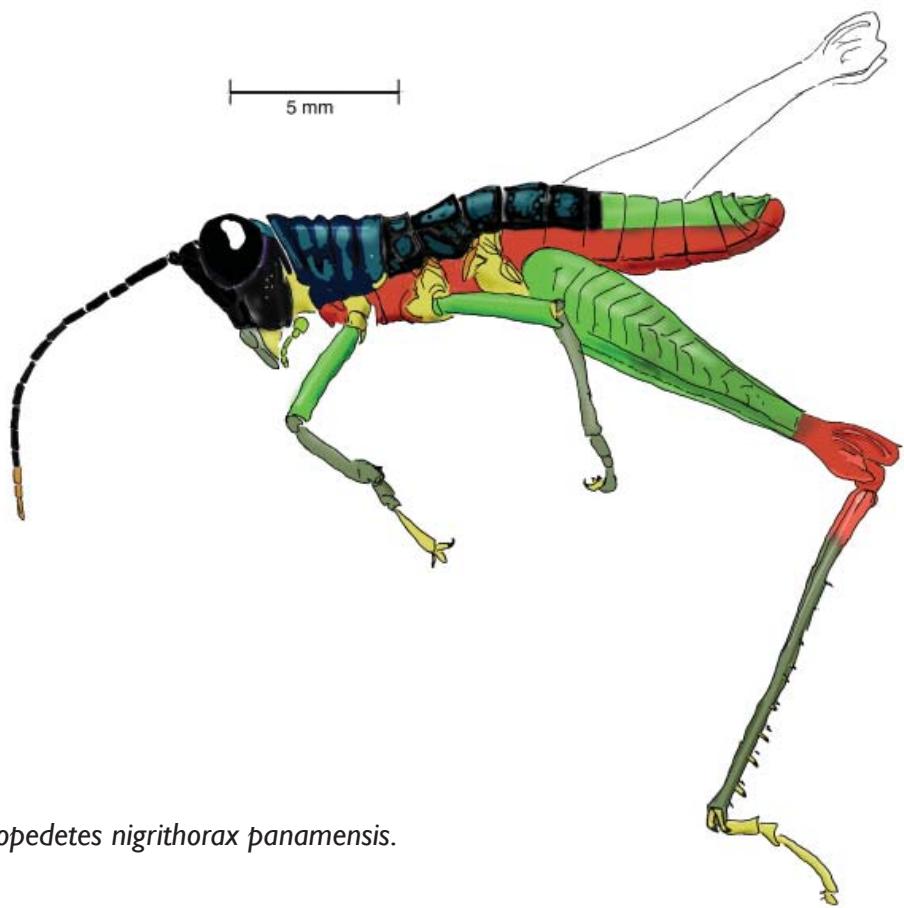


Plate Rh8. *Hylopedetes nigrithorax panamensis.*

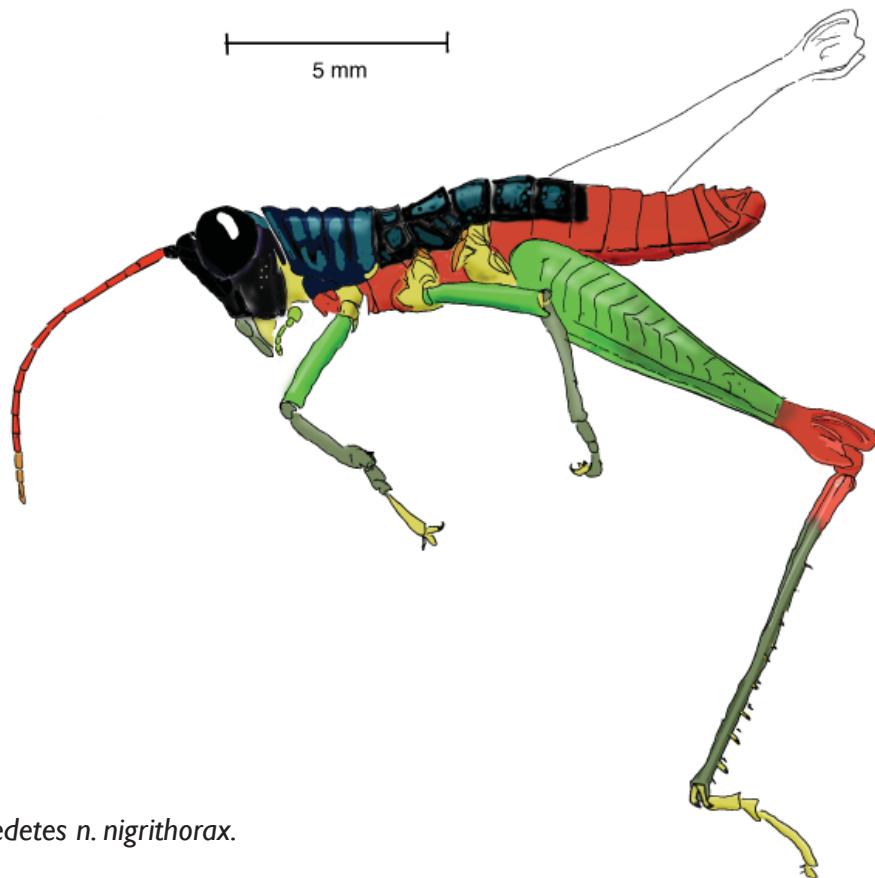


Plate Rh9. *Hylopedetes n. nigrithorax.*

Rhytidochrotinae

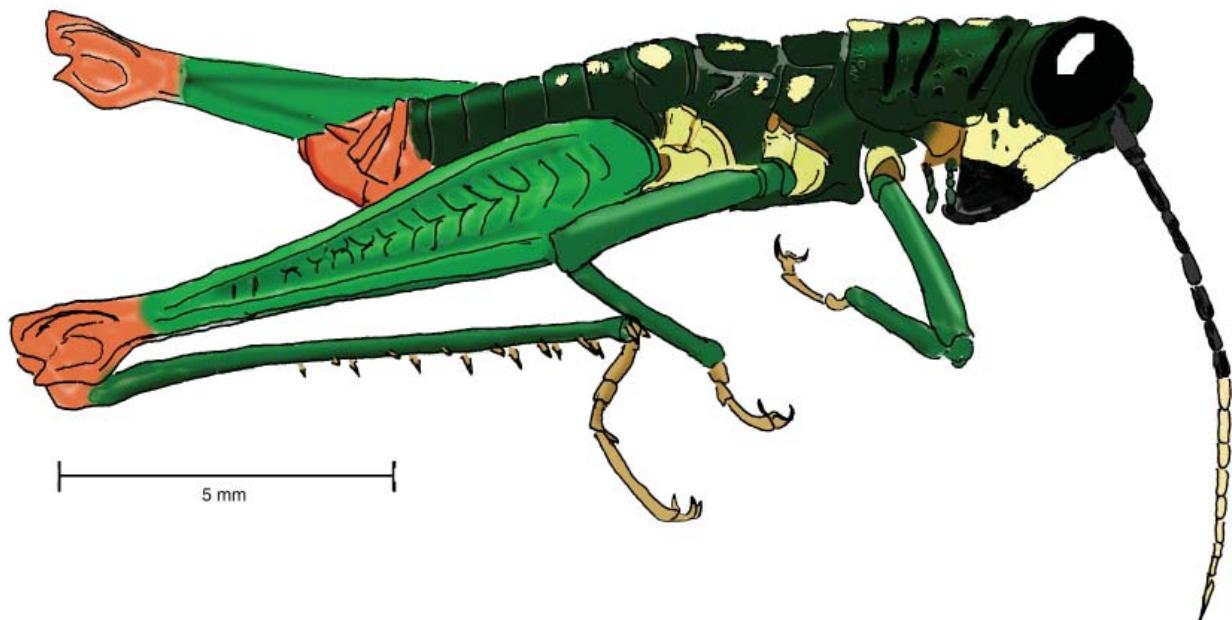


Plate Rh10. *Hylopedetes punctatus*, male.

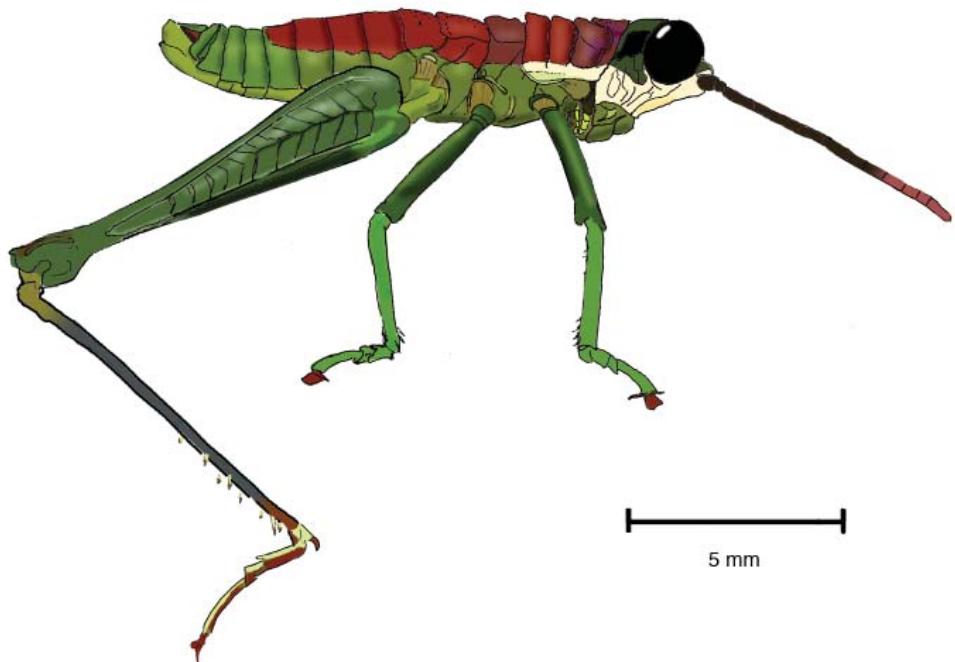


Plate Rh11. *Hylopedetes surdus*, male.

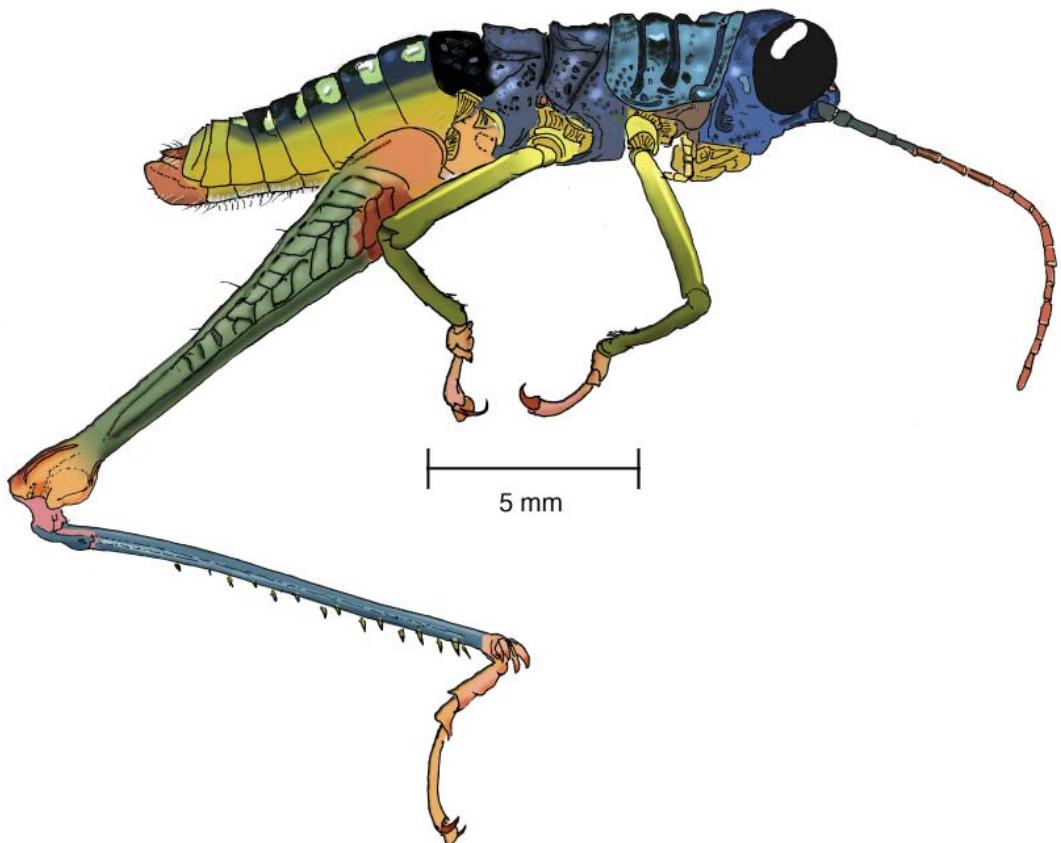


Plate Rh12. *Micropaon lucens*, male.

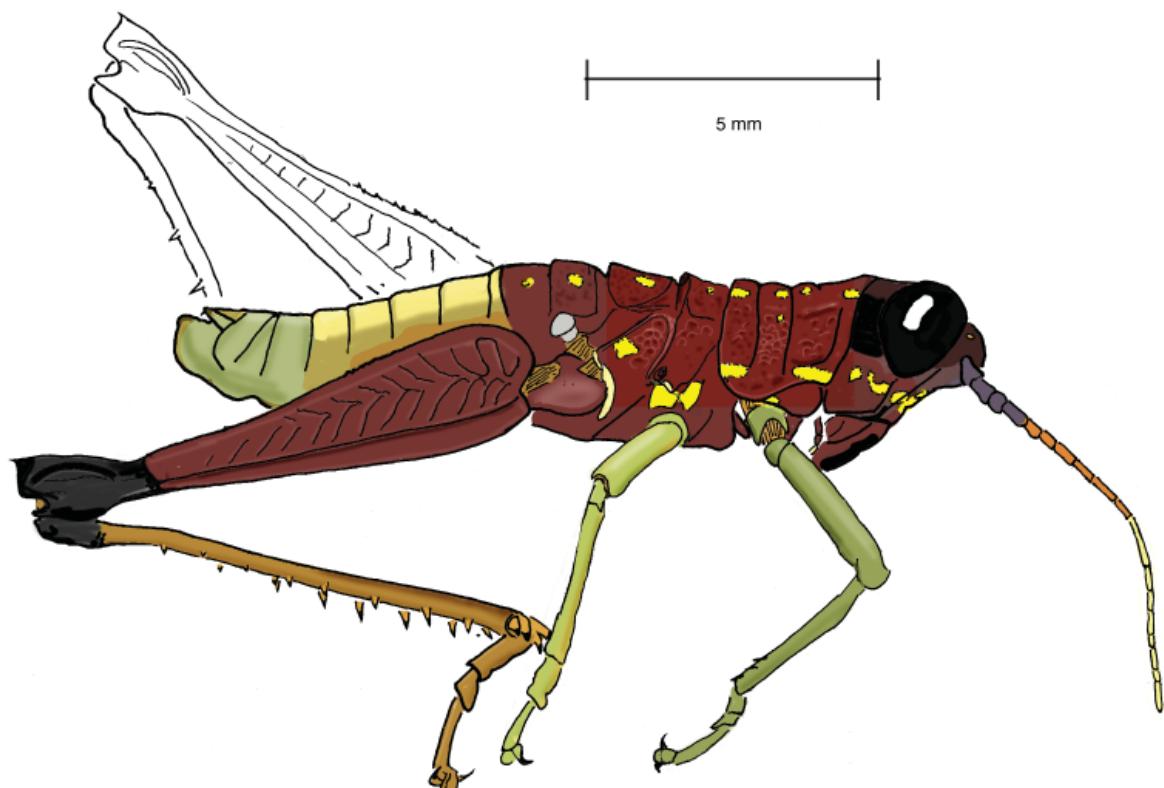


Plate Rh13. *Oedalacris cambrai*, male.

Rhytidochrotinae

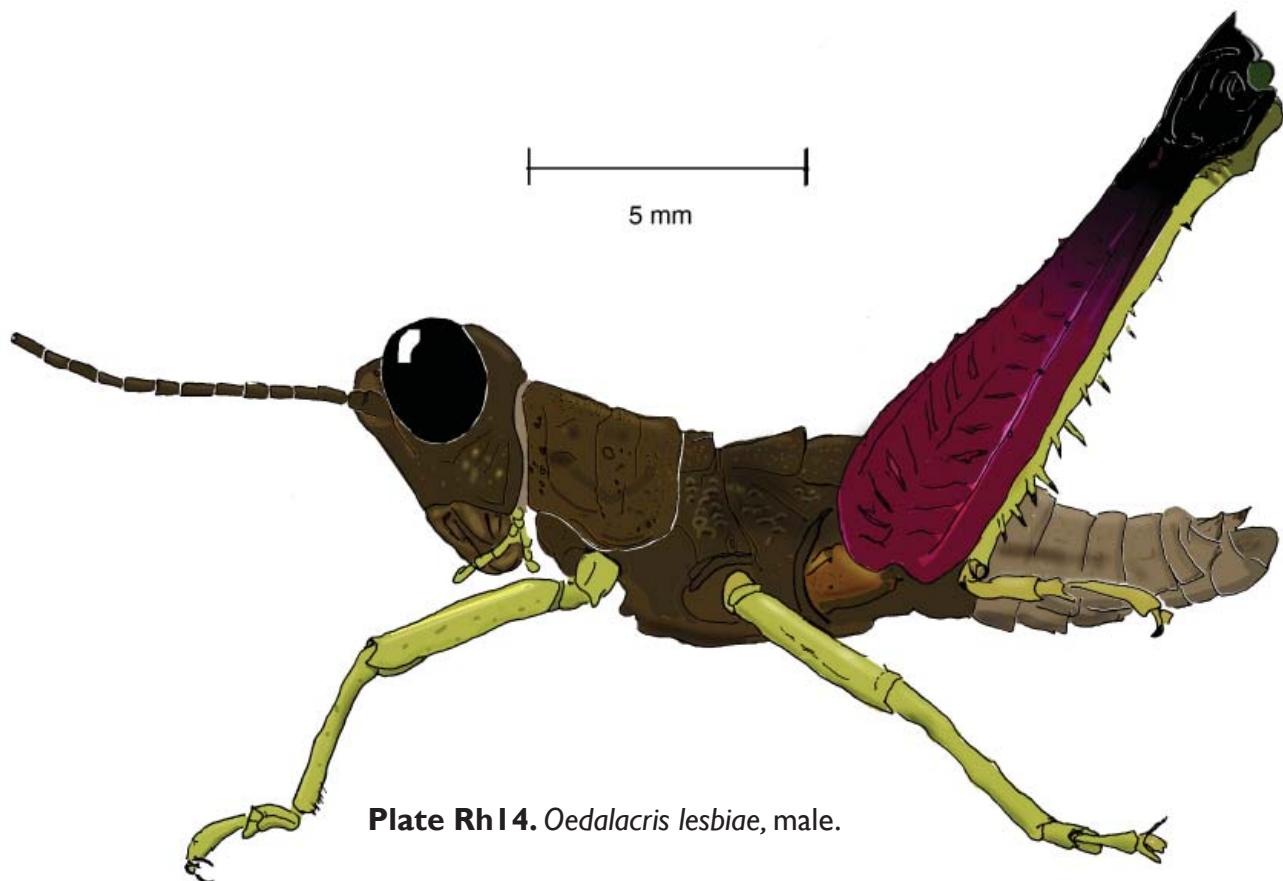


Plate Rh14. *Oedalacris lesbiae*, male.

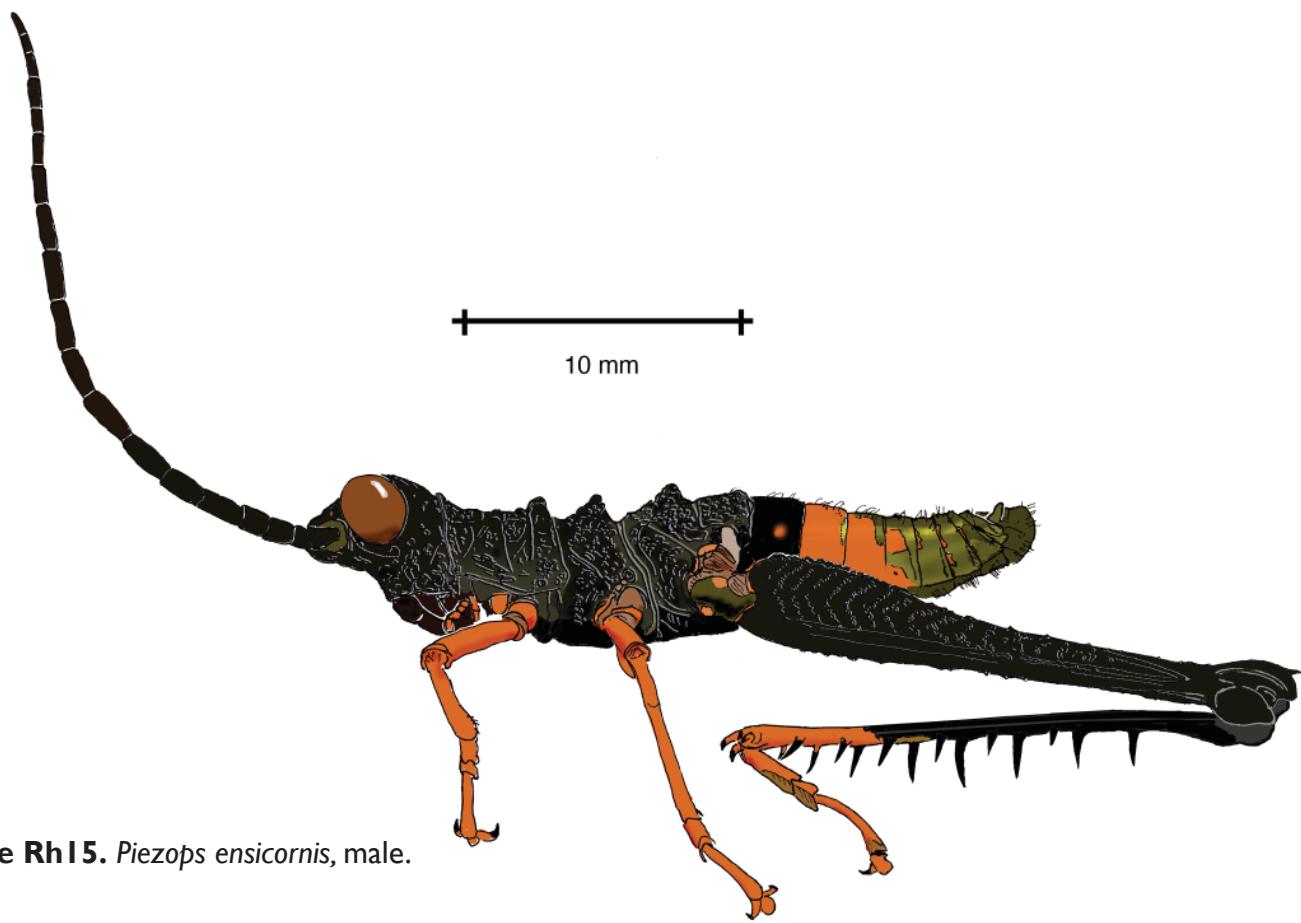


Plate Rh15. *Piezops ensicornis*, male.

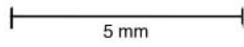


Plate Rh16. *Scirtopaon dorsatus*, male.

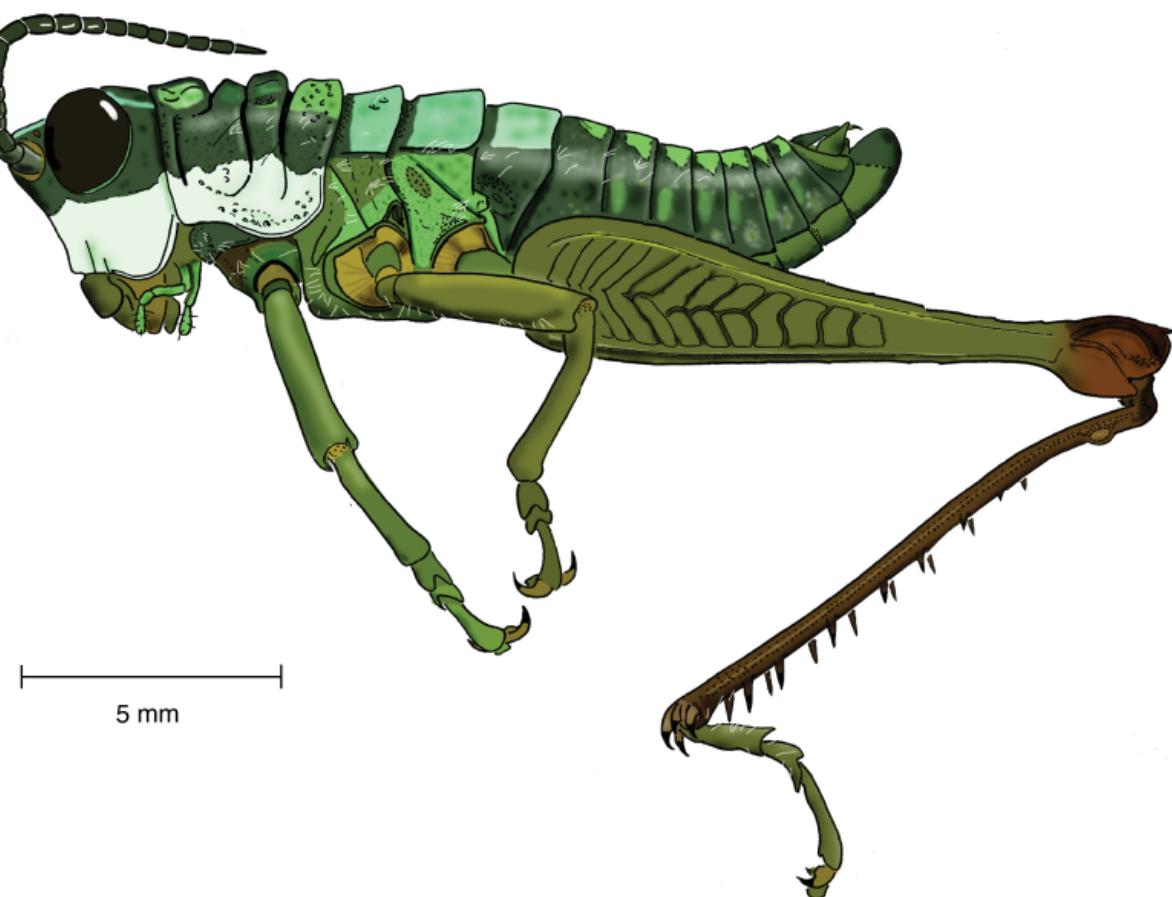


Plate Rh17. *Talamancacris palustris*, male.

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Names in **bold type** refer to currently valid taxa found in Costa Rica and/or Panama. Names in regular type are either junior synonyms or refer to taxa from outside our area. Page numbers of 500 or above represent colour plates. Note that specific names are not listed separately.

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Taxonomic changes made in this book.

New species:

Lioscapheus tremae n.sp. (Pg. 393).

Silvitettix centralis n. sp. (Pg. 226).

New synonymies:

Silvitettix thalassinus Jago 1971 = *S. bolleyi* (Bruner 1904) n.syn.
(Pg. 220).

Leptomerinthoprora occidentalis Rowell 1983 = *L. brevipennis* Rehn
1905 n. syn. (Pg. 308, 310).

Rhammatocerus viatorius cyanomerus Hebard, 1923 =
Rhammatocerus schistocercoides (Rehn 1906) n. syn. (Pg.
252).

