THE FULGORIDAE (HEMIPTERA, FULGOROMORPHA) OF GUATEMALA

GEERT GOEMANS*

RESUMEN

Se discuten mitos, leyendas y estrategias de defensa de los fulgóridos. Se incluyen experiencias de colecta así como información y sugerencias pertinentes. Desde la publicación de la *Biologia Centrali-Americana* sólo existen seis publicaciones en un espacio de tiempo de 99 años, en las cuales se incluyen descripciones de nuevas especies o nuevos registros de Guatemala. Esas seis publicaciones elevaron el número de especies conocidas de Guatemala de 14 a 23. El presente trabajo proporciona 6 nuevos registros para el país, dando un total de 29 especies conocidas. Para este estudio se examinaron 200 espécimenes usando trampas de luz, trampas malaise y colecta activa. Comparada con otros países de Centroamérica, la diversidad de fulgóridos de Guatemala es alta. Guatemala tiene 29 especies descritas mientras que México tiene 47 y Costa Rica 31. Al presente tenemos en mano 10 especies nuevas para la ciencia (colectadas en Guatemala) para un total de 39 especies, aunque desafortunadamente 5 de ellas son especimenes únicos.

ABSTRACT

Myths, legends and defense strategies of fulgorids are discussed. Collecting experiences, tips, and suggestions are given. Since the publication of the *Biologia Centrali-Americana,* there have been six publications over a timespan of 99 years, with descriptions of new species or with new records for Guatemala. These 6 publications brought the amount of known species for Guatemala from 14 to 23 species. The present work gives 6 new records for the country, bringing the total to 29 known species. For this study, 200 specimens collected using light and malaise traps and by active searching, were examined. Compared to other Central American countries, the fulgorid biodiversity in Guatemala is high. Guatemala has 29 described species; Mexico and Costa Rica have respectively 47 and 31 described species. At present we still have 10 species new to science (collected in Guatemala) on hand, for a total of 39 species; unfortunately 5 of these are single specimens.

INTRODUCTION

Fulgoridae are brightly colored, fairly large (20-105 mm) tropical insects that mostly sit and feed on trees. At present about 600 species of the family Fulgoridae are described worldwide. The richest fulgorid fauna is present in the New World, which accounts for about 260 described species in 66 genera. The fulgorid fauna from Australia and Asia is composed of 202 described species in 30 genera, catalogued by Nagai & Porion (1996, 2002). The African fulgorid fauna was composed of 102 species spread over 20 genera when revised by Lallemand (1959, 1963). Fulgoridae are absent in the Palaearctic, except for a few species that occur in the northern part of China (Nast 1972).

For Guatemala there are 29 described species cited, including the new records from this paper, additionally we have at this moment 10 more undescribed species from Guatemala, which brings the total to 39 species, or 15 % of the at present described New World Fulgoridae fauna. Three other species are both present north and south of Guatemala, but have not yet been collected in Guatemala.

DIAGNOSIS

Fulgoridae belong to the suborder Fulgoromorpha which are easily recognised by the presence of tegulae on the mesothorax, by the pedicel of antenna enlarged, often bulbous and bearing some enlarged placoid sensilla and a particular sensory organ, by relatively elongate midcoxae whose bases are widely separated. Fulgoridae are characterized (and easily separated from the other Fulgoromorpha families) by the combination of 1) the presence of a row of apical spines on the second segment of the hind tarsi, 2) both the apical and anal area of the hind wings having many cross-veins (fig.1). The latter characteristic mostly allows a rapid identification of a fulgorid with the naked eye, especially in the New World where there are no Eurybrachidae (some of the species of the Eurybrachidae also have these cross veins).

Figure 1. Fulgorid hind wing with the typical crossveins in the apical and anal area (after O'Brien, 1988)

NATURAL HISTORY, LEGENDS AND MYTHS

Although Fulgoridae are very colorful and relatively large insects, still very little is known about their distribution and ecology. The main reason is probably due to the difficulties in collecting specimens. Not all species come to light traps, and if they do come they mostly arrive quite late at night (after 11 p.m.). The best way to search for fulgorids is by scanning the trunks of trees for

*Collaborator at Royal Belgian Institute of Natural Sciences
Entomology Department, rue Vautier 29, B-1000 Brussels, Belgium
Or: Potstraat 30, 3300 Tienen
Geert.Goemans@inbo.be

a fulgorid silhouette (fig. 2). Once one has spotted one, the next difficulty will be to catch it. Fulgoridae are very hard to catch with a net, they mostly jump away from the net very fast. One's best chance to catch one is with a clear vial, holding it by the sides being sure you do not cover the bottom, and approaching the specimen very, very slowly from the top. When you are almost there it will mostly jump to the end of the vial thinking of it as the escape route. If you do not succeed the first time.... you do get a second chance since Fulgoridae tend to stay on the same 'fulgorid tree' for several weeks and come back year after year. Students in Belize could make maps of the 'fulgorid trees', which they observed year after year (Lois O'Brien, personal communication). In the garden of Dan Janzen in Costa Rica there have been *Fulgora* adults and several egg masses on the trunk of the same tree for at least 30 years (Lois O'Brien, personal communication). In French Guiana I saw four specimens of *Enhydria longicornuta* Lallemand on the trunk of a tree; managed to catch two. The same night (at 01:00 hrs) we went back but they were not (yet) back on the tree. When we went back the next day, the two remaining specimens from the previous day were again on the same tree ... we did not manage to catch them though! In Bolivia I observed that at dusk Fulgoridae tend to jump around and fly from one spot on a tree to another spot on that same tree.

Figure 2. Typical fulgorid silhoutte, in this case *Enchophora sanguinea* Distant. Ó Photo: Piotr Naskrecki

Without doubt, the most famous Fulgoridae are the species from the genus *Fulgora* (fig. 3), the so-called lantern fly or peanut bug. From above, the head looks like a peanut. But if one looks at the side view of *Fulgora* (*F. laternaria* in this case, figure 3), one can clearly see the resemblance to an alligator, including the false eyes, breathing holes and teeth. *Fulgora* is regionally known under very many names: machaca, cabeza de manía, vívora cuco, chicharra machacui, jitiranabóia, jitirana, cobra-de-asa ... many of these names referring to the resemblance with snakes, for example.

Equivalent to the number of different names that exist for *Fulgora*, many myths exist about the effect of

Figure 3. *Fulgora laternaria* Linneaus sitting on a tree at the Biotopo del Manatí, Izabal. Photo: José Monzón

Fulgora on mankind. To me the most amazing story about *Fulgora* is one from Costa Rica. Peasants believe that the huge, peanut shaped head is full of poison. They believe that if someone is bitten by the insect, he or she must have sexual intercourse within 24 hours (urgency of treatment varies, some people even stated that the antidote was needed within 15 minutes). If not, he or she will die (Ross 1994). Personally, I am very curious to know how many males/females have tried this out and how many were saved, or how many died? I guess it is not without reason that in Colombia the expression 'picado por la machaca' is applied to a person who has a great sexual appetite (Anzola 2001). College students (males) from Mexico to Argentina asked Dr. Lois O'Brien if this last legend was true. She replied that if they could find 9 volunteers, 6 to be bitten (the ones to be saved, of course, had to be chosen randomly to make the experiment valid) and 3 to rescue the others, then they would have a scientific experiment and know. They did not bother her again with the question (O'Brien 2002)!

The first recorded legend about *Fulgora* was probably in the year 1705 when the German artist-naturalist Maria Sybilla Merian published her book '*Metamorphosis Insectorum Surinamensis*'. For whom it might concern, her stepfather was a Flemish flower painter and one of Merian's first teachers! In her beautifully illustrated book she wrote that the head of the lantern-fly lit up at night when there were males and females present, and it was bright enough to read by, hence the common name lantern-fly. Since then scientists all over the world have questioned the possibility of *Fulgora* emitting light. In 1983 Ridout in a thesis at the University of London tested all the bioluminescent processes known. He did not get a response to any of them. Possibly Merian confused it with a beetle from the genus *Pyrophorus* (Coleoptera: Elateridae).

That (indigenous) people are afraid of *Fulgora* becomes very clear in the ethnoentomological study by

Costa-Neto and Pacheco (2003) of *Fulgora laternaria* Linneaus in the small Brazilian village: Pedra Branca (400 inhabitants). They consulted 45 men and 41 women, whose ages ranged from 13 to 108 years old, through open-ended interviews and their actions were observed in order to document wisdom, beliefs, feelings, and behaviors related to the lantern-fly. They saw clearly that the insect inspires feelings of fear and aversion, and people think that these fearsome insects should be exterminated whenever they are found because they make 'deadly attacks' on plants and human beings.

This fear probably has something to do with the resemblance that observers, both scientifically-trained and native people, see with a snake (cf. vívora cuco, cobra-de-asa) or a cayman (cf. *Fulgora crocodilia* Brailowsky & Beutelspacher). *Fulgora* species have been compared by scientists with arboreal pit vipers of the genus *Bothrops* (Hogue 1984), a winged dragon (Cascudo 1972, fide Costa-Neto & Pacheco 2003), and an arboreal lizard (Hogue 1993).

The reason for these strange cephalic protuberances might well be a defense strategy, like for example the extraordinary head process of the species from the genus *Phrictus*, meaning frightening (fig. 4). Another defense strategy is seen by species of the genus *Odontoptera.* They have false eyespots at the end of their fore wings and their head actually looks like a tail. To predators it probably looks as if their head is the place where the false eyespots are situated. Most of the collected specimens I have seen had bite marks at the rear end of their wings, where the false eyespots are situated, proving the effectiveness of this strategy (fig. 5). In the genera *Fulgora* and *Cathedra*, there are large false eyespots on the hind wings, probably to scare off possible predators by suddenly spreading their wings. Saturnid moths of the genus *Automeris* use false eyespots on their hind wings in the same way to scare off predators.

Very little is known about the possible hosts of fulgorids. Rarely there has been seen actual feeding on trees, although the results of a very interesting study by Johnson and Foster (1986), about associations of homopterans and trees, were that fulgorids can be highly selective of tree species even in a diverse forest, where the low probability of encountering a given kind of tree might be thought to select against host tree specialization. During one month in the midst of the rainy season, they surveyed 4203 tree trunks in an area of 26.72 ha of semideciduous lowland forest in Panama. Of the 63 specimens of *Enchophora longirostris* Distant encountered, 71 % were found on 26 of the 82 *Simarouba amara* (Simaroubaceae) trees. This was a strikingly non-random arrangement. From *Phrictus quinquepartitus* Distant, 19 specimens were encountered, 16 of them being aggregated on 2 *Terminalia oblonga* (Combretaceae) trees, the 3 remaining were found on 2 other trees. The binomial probability that *T. oblonga*, rare in the surveyed area, would be chosen at least two out of four times by *P. quinquepartitus* was P = 0.0001.

Figure 4. Lateral view of the head of the "frightening" *Phrictus tripartitus.*

Figure 5. Lateral view of *Odontoptera carrenoi* with bite marks near the false eye-spots.

These results indicate that at least some species of Fulgoridae might be monophagous in contrast with the idea that tropical sap-feeding insects ought to be polyphagous (Eastop 1972) or monophagous on common plants (Dethier 1970).

In September 2003 hundreds of *Cerogenes auricoma* Burmeister (fig. 6a) were observed on *Quercus* sp. by J. Cruz, in the Parque San José Obrero in Esquipulas, Chiquimula. Twenty-one of them were collected and are stored in the arthropod collection of the Universidad del Valle in Guatemala City (UVGC). In February 2004, hundreds of nymphs of *C. auricoma* (fig. 6b) were observed at the same locality. They looked like little frogs leaping around on the ground (A. C. Bailey & J. Monzón, personal communication). Eleven of these were collected and are stored both in my own collection (GGCB) and in the UVGC. These findings are almost equal to the report by Hogue *et al*. (1989), who found large aggregations of adults in September at several locations in Mexico resting on trunks of *Quercus reticulata* Humboldt & Bonpland. Nymphs were also collected in February. The only difference is that the nymphs they found were first instar, and the ones that were found in Guatemala are at least second instar nymphs because of the presence of 3 divisions in the hind tarsomeres.

Figure 6. *Cerogenes auricoma* adult and instars collected on *Quercus* sp. in Esquipulas, Chiquimula.

ECONOMIC IMPORTANCE

Fulgorids are of no significant economic importance. In the New World only one species is known as a pest, *Phrictus diadema* (Linneaus) on cacao (*Theobroma cacao* L.). This low economic importance might be one of the reasons why so little is known about their biology. But since they lay eggs and live on the same trees year after year, they can be shown to ecotourists, once discovered.

HISTORY

Little or no taxonomic work on Fulgoridae had been done in Guatemala or Central America until the end of the 19th century when the Homopterous part of the *Biologia Centrali-Americana* started being published, in 1881 (Distant 1881-1905). Interestingly the largest number of Central American localities (128 of 340) was from Guatemala (Selander & Vaurie 1962). The last volume of the Homopterous part was published in 1905; by then 14 species of Fulgoridae were cited from Guatemala. Oman (1936), Metcalf (1938) and Nast (1951) have since each described one new species from Guatemala.

In 1988 O'Brien did a monograph on the Fulgoridae with elongate head-processes (17 of the 66 New World genera), adding one more species to the list. Porion (1994) published an illustrated catalogue for the New World, adding four more records to Guatemala. A new genus with one new species from Guatemala has just been described by Goemans & O'Brien (in press). The present work gives 6 new records for Guatemala and 3 species that are both found north and south of Guatemala so are expected to also appear in Guatemala. We have 10 new species on hand which will be described in the near future. Goemans and O'Brien are preparing a paper on the fulgorid fauna from Guatemala with a key to the genera and species, redescriptions of several known species and with descriptions of new species. Since 5 of these new species are represented by single specimens, and another one by only 2 females, we kindly request to bring or send unidentified material to either Jack Schuster, Enio Cano, or myself, this way it will be possible for us to make a sounder description of these new species.

In figure 7 we give a graphical presentation of the accumulation in Guatemala for the number of species per publication year. In figure 7a we plot the number of known species for Guatemala per consequent publication, in figure 7b we plot it on a real time scale. One can clearly note the exponential increase in number of recorded species in the last couple of years, mainly due to the intense collecting done by myself in 1999-2000 and the recent contributions to the arthropod collection of the Universidad del Valle, both by students and researchers.

METHODOLOGY

Specimens were collected both by light trap (mercury vapor light, 175 Watt + UV, 20 Watt), using a power generator of 750 Watt, and by scanning the surfaces of tree trunks, two specimens were collected with a malaise trap. Jack Schuster and Enio Cano were so kind to let me borrow the specimens from the arthropod collection of the Universidad del Valle, which were collected over the years, the oldest being collected in 1973. Furthermore, José Monzón provided me with several known and new species from his personal collection. Specimens were killed either in a killing jar with ethyl acetate or were injected with ethyl acetate or ammonia. Some specimens were preserved in alcohol, hence the decoloration of some specimens. Specimens were pinned, dried and provided with a label with the complete field data. For most of the specimens which were collected by myself, I registered, in addition to the regular collecting data, the time of arrival at the light trap and the moon-phase at the time of collecting to get a better idea of the optimal collecting time/period. Some specimens, which were collected during the day, have an extra label with the host plant they were found on.

A first method of identifying species was done by using Porion's catalogue of the American species (Porion 1994) and for the ones with elongate head processes, species were identified using O'Brien's paper (O'Brien

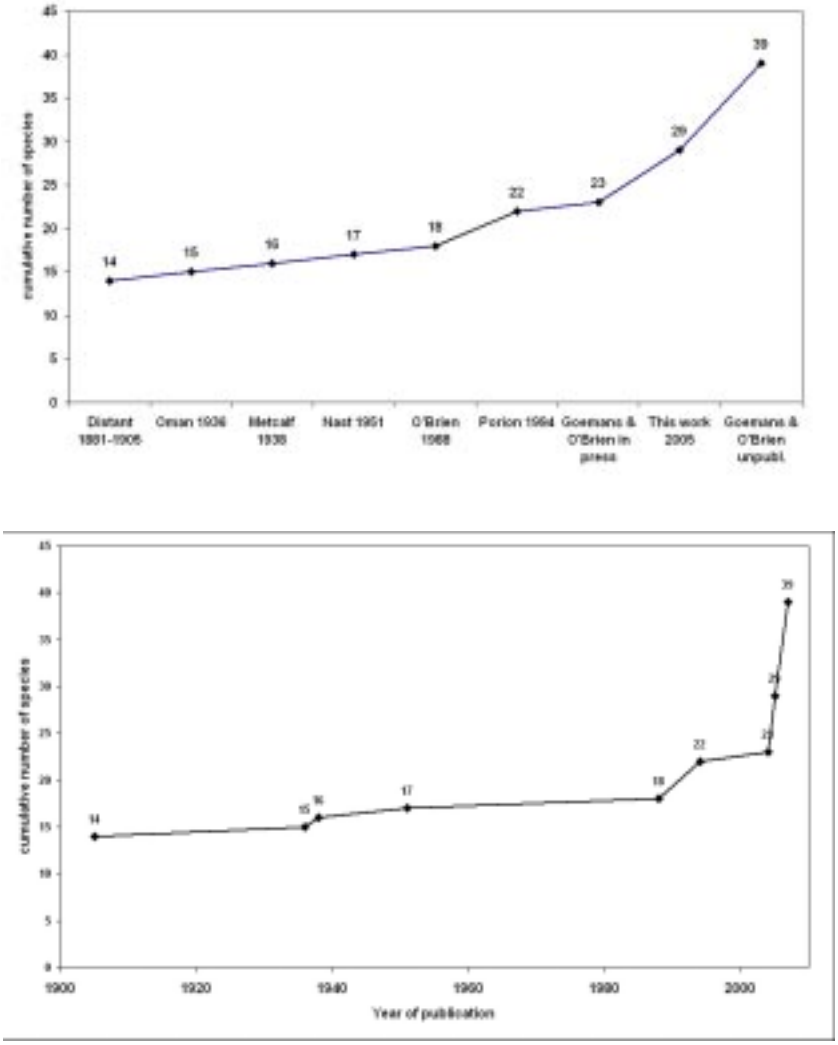

Figure 7. Accumulation of species/ publication year in Guatemala. 7a: per consequent publication; 7b: on a time scale. The results here presented **do not include** the 3 species which are not reported for Guatemala itself, but which are present both north and south of Guatemala.

1988). Consequently I visited the collection of Dr. Lois O'Brien in Tallahassee, Florida (which will soon move to Arizona), since she has most New World species compared with the primary types, and has several primary types in her collection. The Royal Belgian Institute for Natural Sciences in Brussels, Belgium, the collections zoologiques, Zoologie générale et faunistique, Faculté de Sciences in Gembloux, Belgium and the collection of the Museum für Naturkunde der Humboldt Universität in Berlin, Germany were also visited and types were studied.

All together 200 Guatemalan specimens from 30 species were examined.

RESULTS AND DISCUSSION

At present we know of 29 described Fulgoridae species from Guatemala, not including 3 additional species which are not (yet) reported from Guatemala but are known from both north and south of Guatemala. These 3 species are all reported from Mexico; the countries south of Guatemala where they have been collected are El Salvador (*Amycle sodalis* Stal), Honduras (*Cyrpoptus belfragei* Stal) and Nicaragua (*Itzalana submaculata* Schmidt). The absence of these species might be because of the reasonably little collecting that has been done on the Pacific side of Guatemala. In due time it is expected that these 3 species will be also reported from Guatemala. Together with the 10 new species we have on hand from Guate-

mala, (5 of these new species were collected in the department of Santa Rosa, 4 in Guatemala City (!)), we end up with 39 fulgorid species reported from Guatemala. This represents 15 % of the known species from the New World, considering that Guatemala is only a very small part of the New World, this is a vast amount and is a first indication of the high biodiversity present in Guatemala. If we compare the diversity with other Central American countries we clearly see that the fulgorid fauna from Guatemala is very rich. Mexico, which is 18 times the size of Guatemala, has (only) 47 reported species (O'Brien 1996 and Goemans & O'Brien in press). Costa Rica, collected very intensely in the framework of INBio, has 31 reported species (O'Brien 1988, Porion 1994 and Goemans and O'Brien in press). On the other hand we have to be very careful in comparing these data due to the absence of information and collecting data. To make a statement on endemic species for Guatemala is even harder because of this same reason; maybe after revising all of the American museums and collections one may make a precautious prediction. A second problem is the far from complete revision of the tribes, genera and species. Several genera are clearly not monophyletic but few or no people have the chance to work on this, much less be paid for it.

A frightening sign is that several of the species reported and/or described in the *Biologia Centrali-Americana* by Distant (1801-1905), have never been collected in Guatemala since. Whether this is due to the relatively little collecting since the "*Biologia*" or to the disappearance of habitats is not very clear. Since it might be the case that at least some species are monophagous on relatively rare tree species (see introduction), disappearance of these trees would mean a simultaneous disappearance of their guest species.

There is one thing we can be sure of if we want to see, describe and maybe even study all the remaining species before they become extinct; we will have to be very quick and will need all the help we can get to do this.

CONCLUSIONS AND PERSPECTIVES

Compared to other Central American countries, the biodiversity in Guatemala is high. This is most probably due to the wide range of habitats in this reasonably small country. Habitats range from lowland desserts, tropical rain forests and pine-oak forests to high altitude cloud forests. When we look at the overlap between, for example, Guatemala and Costa Rica we see that it is only 20 %. This might suggest a possible geographical separation in between these two countries.

We clearly noticed the effect of focused research (and collecting) for a specific group on our concepts of the biodiversity in a specific region. In the last couple of years, the same number of new records for Guatemala has been noted as there has been in the previous 99 years. A key to the genera and species from Guatemala, with redescriptions of several known species and descriptions of new species, is in preparation by Goemans & O'Brien. Since 5 of these new species are single specimens, we would like to strongly encourage people to bring or send unidentified material to either Jack Schuster, Enio Cano or myself. This way it will be possible for us to make a sounder description of the new species and to get a better idea of the distribution of the different species.

We also would like to stimulate students as well as researchers to collect and list as much data of the collecting as possible, *e.g.* collecting method, host plant, habitat type. We think it is especially important for students and researchers living in 'the tropics' to take advantage of the chances they have, go out in the field and make observations at several times during the year. Most researchers not living in 'the tropics' will never get the chance to do these observations.

By visiting a 'fulgorid tree' at different times during the year we might be able to link host plants, egg cases, nymphs and adults of a specific species and get a better insight of their biology, ecology and probably of their phylogeny. When putting up light traps at the same location at different times during the year we might get a better idea of the life span fulgorids have. Personally I collected two specimens of one of the new species in November; all the other specimens ever collected were collected from May through August.

The complete *Biologia Centrali-Americana* has been digitalized and placed 'on-line' by the Smithsonian Institution Libraries Washington, D.C. This incredible work gives most people the opportunity to access the descriptions of the species and the beautiful color plates. This kind of digitalizations are extremely important for so called "third world countries", since researchers working here mostly have not got the possibilities of seeing/studying primary types. These types were/are mostly deposited in European or North American museums. When all people visiting museums to study types would try to digitalize the types they studied and put them online (preferably on a centralized location), this would make doing proper research a lot easier for the "less advantaged" but not necessarily less competent or even gifted.

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APPENDIX. SPECIES LIST OF GUATEMALAN FULGORIDAE.

Species	Departamento
Acmonia trivia (Distant)	Quetzaltenango; Sacatepéquez
Acraephia perspicillata Fabricius	Baja Verapaz
Alaruasa illustrata Nast	Chimaltenango
Alaruasa lepida (Spinola)	Alta Verapaz; Baja Verapaz
Alaruasa pallidoconspersa (Distant)	Guatemala; Quetzaltenango
Alaruasa violacea (Distant)	Alta Verapaz; Baja Verapaz
Alaruasa walkeri Oman	Unknown
Alaruasa? n.sp.	Guatemala; Huehuetenango
Amycle amabilis (Westwood)	Guatemala; Sacatepéquez
Amycle sodalis Stal	El Salvador & Mexico
Calyptoproctus confusus Distant	Escuintla; Izabal; Petén; Retalhuleu; Santa Rosa; Suchitepéquez
Calyptoproctus stigma (Fabricius)	Izabal
Cerogenes auricoma Burmeister	Chiquimula; Escuintla; Santa Rosa
Copidocephala guttata (White)	El Progreso; Izabal; Suchitepéquez; Zacapa
Copidocephala viridiguttata Stal	Izabal; Petén
Cyrpoptus belfragei Stal	Honduras & Mexico
Cyrpoptus dubius Kramer	El Progreso
Cyrpoptus nubeculosus Stal	El Progreso
Cyrpoptus suavis Stal	El Progreso; Izabal
Diareusa imitatrix Ossianilsson	Alta Verapaz; Izabal; Zacapa
Enchophora sanguinea Distant	Unknown
Enchophora stillifera (Stal)	Baja Verapaz; Zacapa
Flatolystra n.sp.	Izabal
Fulgora castresii Guerin-Meneville	Jutiapa; Suchitepéquez
Fulgora laternaria (Linnaeus)	Izabal; Petén
genus? n.sp.1	Baja Verapaz; Guatemala; Huehuetenango; Sololá
genus? n.sp.2	Chiquimula
genus? n.sp.3	Santa Rosa
Hypaepa illuminata Distant	Baja Verapaz; Escuintla
Hypaepa zapotensis Distant	Escuintla
Itzalana submaculata Schmidt	Nicaragua & Mexico new
genus n.sp.	Santa Rosa
Obia tenebrosa Distant	Zacapa
Odontoptera carrenoi Signoret	Alta Verapaz; Izabal; Petén
Phrictus tripartitus Metcalf	Escuintla; Izabal; Petén
Scaralis n.sp. Goemans, in prep.	Baja Verapaz; Chiquimula; Guatemala; Huehuetenango; Sacatapéquez; San Marcos; Santa Rosa; Zacapa
Scaralis neotropicalis (Distant)	Guatemala; Izabal; Petén; Santa Rosa
Scaralis? n.sp.	Quiché
Sinuala stali O'Brien	Guatemala; Izabal; Zacapa
Villala canoi Goemans	Alta Verapaz; Izabal
Zeunasa n.sp. Goemans, in prep.	Guatemala; Izabal; Santa Rosa
Zeunasa? n.sp.	San Marcos; Santa Rosa

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