

**ORTHOPTERA OF FRASER'S HILL,  
PENINSULAR MALAYSIA**



**Ming Kai Tan and Khairul Nizam Kamaruddin**

Lee Kong Chian Natural History Museum  
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Cover photograph of male (top) and female (bottom) *Tauchira polychroa* (Stål) © Tan Ming Kai

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This book is dedicated to Tan Ming Kai's mother, Madam Toh Siew Tin, for her unwavering support in the pursuit of his scientific dreams.



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## INTRODUCTION

Fraser’s Hill or Bukit Fraser is a highland area north-east of Kuala Lumpur bisected by the border between the states of Pahang and Selangor, Peninsular Malaysia (Perumal et al., 2001; Azima et al., 2012) (Fig. 1). With a mean altitude of 1,200 m asl (above sea level), Fraser’s Hill forms part of the Titiwangsa Range (formerly known as the Main Range) that runs approximately north–south through the interior of the Malay Peninsula (Fig. 2). Fraser’s Hill is mainly covered by tropical lower montane forest, dominated by trees of the families Fagaceae (oak family) and Lauraceae (cinnamon family). There are usually no distinct seasons in Fraser’s Hill, although the months of Nov. to Jan. are marked by more frequent and intense rainfall owing to the north-east monsoon (Malaysian Meteorological Department, 2014). The average annual rainfall is about 3,200 mm while the mean daily temperature ranges from 17–25°C (Malaysian Meteorological Department, 2014). Discovered by Englishman James Louis Fraser, the area was governed and developed by the then British colonial government since the 1900s (Scrienor, 1931). Following the Second World War and Malaya’s independence on 31 Aug.1957, many of the colonial buildings still remain today. The rich natural and historical heritage make Fraser’s Hill a special site. It has an area of about 2,000 ha and was gazetted as the Fraser’s Hill Wildlife Reserve (2,978 hectares gazetted in 1922 within the state of Selangor) while forests on the Pahang side forms part of the Hutan Simpan Ulu Tranum and Hutan Simpan Batu Talam.

Fraser’s Hill is renowned for its diverse flora and fauna. As many as 247 bird and 67 reptile and amphibian species have been recorded from Fraser’s Hill (Strange, 2004; Norhayati et al., 2011). However, Southeast Asian biodiversity—particularly those found in tropical montane cloud forests in—are gravely threatened (Sodhi et al., 2010). In Malaysia, 23% of the original tropical cloud montane forests have been lost or degraded and only 9% of the remainder of such forests protected (Sodhi & Brook, 2006). These cloud forests are subjected to various anthropogenic activities such as agricultural expansion, commercial logging, and infrastructural and tourism development (Peh et al., 2011). Additionally, montane forests are also very vulnerable to global warming and biological invasion (Peh et al., 2011). These can lead to loss of pristine habitats and extinction of endemic species. Species that are confined to montane habitats inherently occupy small areas, and their populations tend to be fragmented by the topography so making them even more vulnerable (Bubb et al., 2004). The forests in Fraser’s Hill are also considered tropical lower montane rainforest, and are not exempted from the threats similarly faced by other areas of montane forest (Perumal et al., 2001). Of the biodiversity found on Fraser’s Hill, the Orthoptera is one of the understudied taxonomic groups.

The Orthoptera is an order of insects consisting of the grasshoppers, crickets, and katydid. This order forms a major component of terrestrial ecosystems with important ecological niches (Quinn et al., 1993; Lockwood, 1996; Samways, 1997; Armstrong & van Hensbergen, 1999). Many orthopterans





Fig. 1. The view of the terrain surrounding Fraser's Hill from the Smoke House along Semantan Road/Jeriau Road.

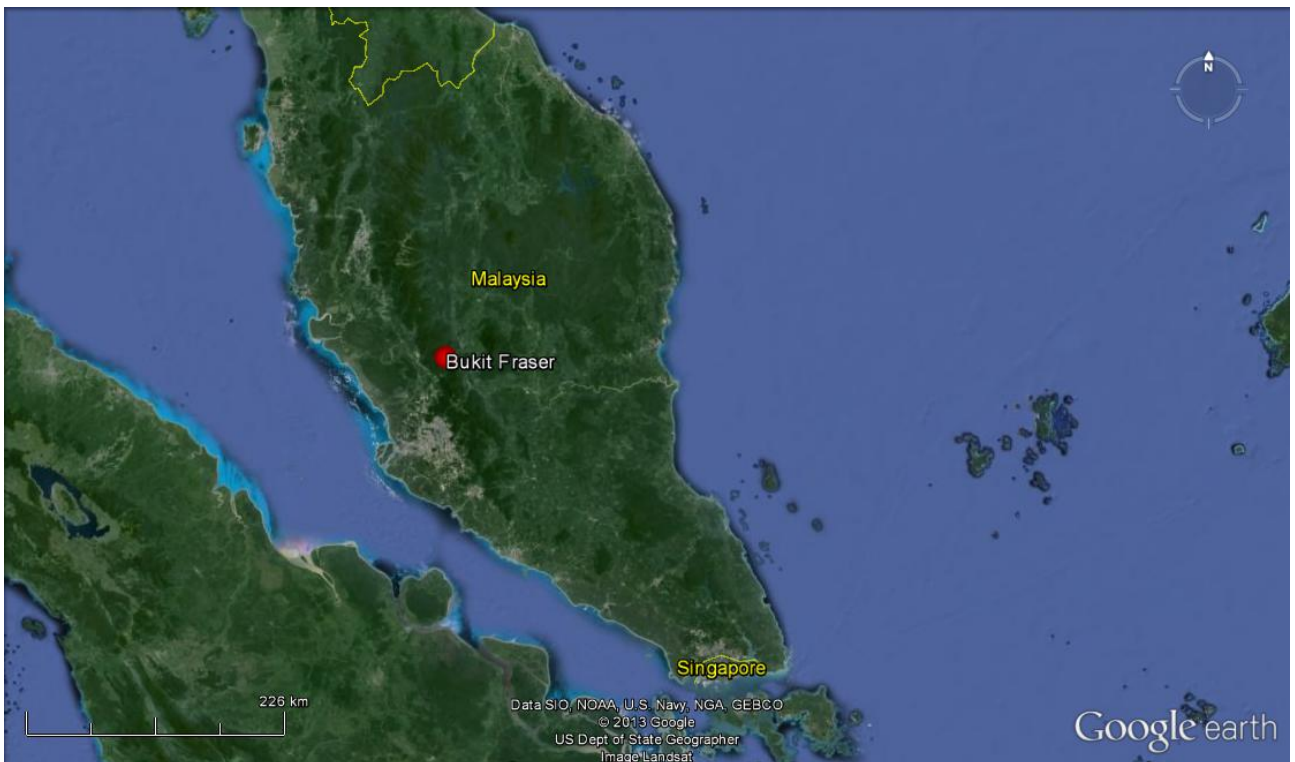


Fig. 2. Map of Peninsular Malaysia, with the location of Fraser's Hill (Bukit Fraser) (Google, 2013).

## Orthoptera of Fraser's Hill

are prey to larger animals such as birds while others are predators of smaller insects (Samways, 1997; Rentz, 2010). Some are known to be keystone species while others may serve as good indicators of ecosystem health (Samways, 1997). However, the orthopteran species of Fraser's Hill are still poorly known. Although species new to science have previously been described from Fraser's Hill, there are hitherto no comprehensive studies or reports of the Orthoptera from Fraser's Hill, or from other highland localities in Peninsular Malaysia. Information on the Orthoptera species in Fraser's Hill will allow a better understanding of the overall biodiversity in this highland area.

This electronic book aims to be the first publication on the orthopterans recorded from Fraser's Hill. It includes an identification key for the systematic examination and identification of orthopterans, both in the museum and in the field. There are also habitus photographs, in-situ and ex-situ, of all species recorded from Fraser's Hill encountered during the surveys to showcase species which are elusive as well as common.

### MATERIAL AND METHODS

Many orthopterans are active during the day but many more can be found at night. Orthopterans can be found in a wide variety of habitats, ranging from pristine montane forest to grassy and herbaceous areas and even along roadsides (Fig. 3). The map indicates the localities of the surveys, four of them within Selangor and 13 within Pahang (Fig. 4). The sites surveyed range from about 1,250–1,300 m altitude around the main settlements, down to 960 m at Jeriau Waterfall and up to 1,340 m on Kindersley Trail. Habitats along the 8-km access road from The Gap to Fraser's Hill, and along the trail to Pine Tree Hill were not surveyed for orthopterans.

A major part of Fraser's Hill was combed for orthopterans during the wet (December) and dry (May) seasons in 2012 and 2013. Three collection trips were conducted: 19–31 Dec.2012; 13–21 May 2013; and 5–9 Dec.2013. Opportunistic collections involved searching through plants, the ground, and fallen trees; raking through leaf litter; sweeping vegetation; breaking off branches and examining the interior of the plant's crown; searching burrows; and locating calls. At times, sweep netting was employed. There are also numerous species which could be heard calling from the forest canopy. Unfortunately, without appropriate equipment, it was not possible to survey the orthopterans in the upper canopy consisting of the crowns of the taller trees, which are known to be vertically isolated from those living on or close to the ground (Paarmann & Stork, 1987). Whenever possible, in-situ photographs of the Orthoptera were taken using a Canon EOS500D digital SLR camera with compact-macro lens EF 50 mm at f/2.5. and the sounds produced by males were recorded with a digital sound recorder (Cenix VR-W240J).

While in Fraser's Hill, the collected specimens were first euthanized in a freezer. Ex-situ photographs of the habitus were taken to capture live colouration, especially for species for which in-situ shots were unavailable. After that, the specimens were kept in air-tight boxes with silica gel to prevent moulding. This not only saves time for more collections and observations in the field, but also saves space.

Preparation and examination of specimens were carried out after returning to the laboratory. The dried specimens were relaxed by placing them on a polystyrene board and kept inside a container with Mama Lemon dishwashing detergent (S. Ingrisch, in lit.) This is so that they could be mounted again properly in a standardised manner. Dissection could only be done when the specimens were relaxed. Thereafter, the specimens were pinned and dried. Dissected genitalia that were useful for identification were stored in 100% glycerine after examination. Subsequently, the set specimens and the preparations of genitalia were deposited in the Zoological Reference Collection, Lee Kong Chian Natural History Museum, National University of Singapore (ZRC). This included new



species discovered and described by Tan & Nizam (2013a, b, c), Tan & Ingrisch (2014) and Tan (2014b).

The general morphology of an orthopteran is illustrated as in Fig. 5. The venation of the wings is sometimes important for species identification and the general venation of the tegmen is illustrated in Fig. 6.



Fig. 3. Habitats in which orthopterans may be found: A, forest trails such as Hemmant Trail; and B, Bishop Trail; C, Grassy and/or shrubby areas such as this along Semantan Road.



## Orthoptera of Fraser's Hill



Fig. 4. Map of Fraser's Hill (Google, 2013).

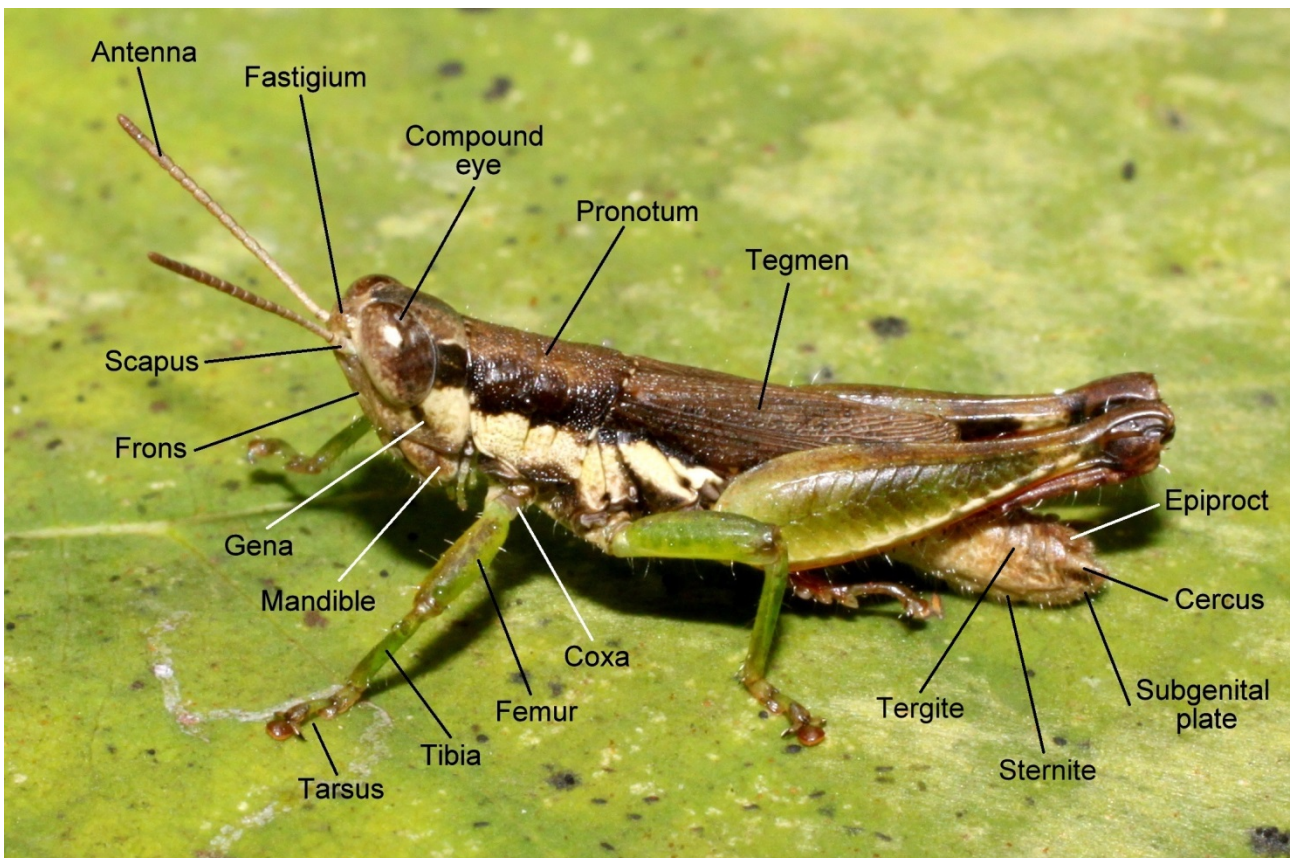


Fig. 5. The morphology of a typical orthopteran, as illustrated here by *Pseudoxya diminuta* (Walker).



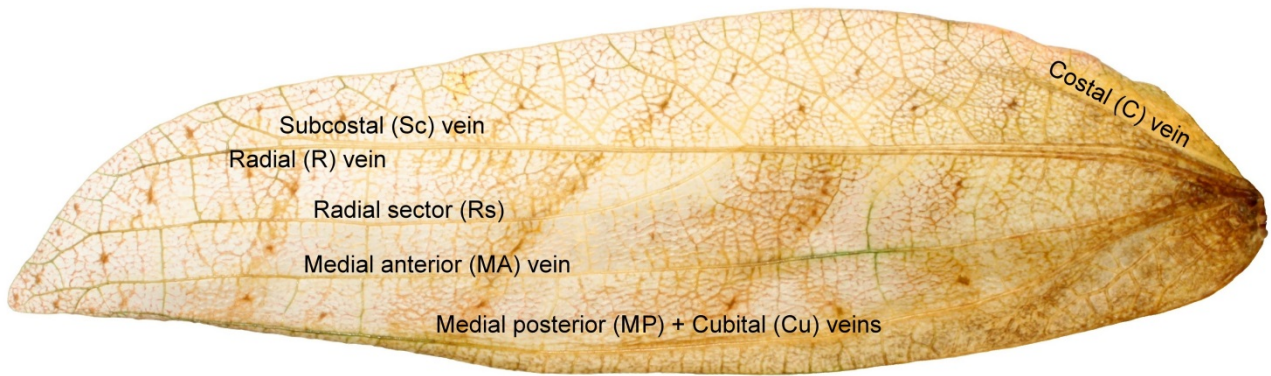


Fig. 6. Tegminal venation of *Promeca* cf. *perakana* Beier.

### IDENTIFICATION KEYS

These keys may be useful to identify a specimen in hand but may not apply to some specimens as there are potentially more species to be discovered from Fraser’s Hill that have not yet been included in this book. Moreover, some taxa have only been tentatively identified, thus only keys to the higher taxonomic levels are provided. It should also be mentioned that while some characteristics are applicable to orthopterans from other parts of Peninsular Malaysia, the keys provided here are most applicable to the Orthoptera from Fraser’s Hill. These keys also apply only to the adults. The nymphs are excluded because they are difficult to identify and were rarely collected. Whenever possible, characteristics of both sexes were included. In composing the keys, references and modifications were made to keys by: Willemse (1930), Murphy (1973), Otte & Alexander (1983), Ingrisch (1998a, b, c, 2006), Willemse (2001), Rentz et al. (2003), Mahmood (2007a, b), Rentz (2010), Zhou et al. (2010), and Tan (2012a).

Table 1. Differences between the suborders Caelifera and Ensifera of order Orthoptera.

S/No.	Characteristic	Caelifera	Ensifera
1.	Antennae	Less than 30 segments, usually shorter than body	More than 30 segments, usually longer than body
2.	Tympana (hearing organ)	on first abdominal tergite	on fore tibiae
3.	Female ovipositor	not elongated	usually elongated

#### Key to the Families of Caelifera

1. Pronotum produced backwards, reaching or extending beyond the abdominal apex. .... **Family Tetrigidae (with key to genera)**
1. Pronotum not produced backwards. .... **2**
2. Antenna shorter than the fore femur. Tegmen and hind wing, when folded, separated from the dorsum of the abdomen. .... **Family Chorotypidae**
2. Antenna longer than the fore femora. Tegmen and hind wing, when folded, covering at least part of the dorsum of the abdomen. .... **3**
3. Head, in profile, generally vertical, or slightly oblique. Fastigium and vertex without medial groove dorsally. .... **Family Acrididae (with key to subfamilies)**
3. Head, in profile, generally cone-shaped. Fastigium and vertex with medial groove dorsally. ... **4**
4. Antennae distinctively dilated basally and narrowed near the middle. Tegmina very broad and large, length about 2 times the width. .... **Family Trigonopterygidae**
4. Antennae regularly flattened. Tegmina narrow, length more than 2 times the width. .... **Family Pyrgomorphidae**



**Key to the Genera of Tetrigidae**

1. Lateral lobe of pronotum with posterior angle laminate outwards ..... 2
1. Lateral lobe of pronotum with posterior angle not laminate outwards ..... **3 (Subfamily Tetriginae)**
2. Lateral lobe of pronotum with posterior angle truncated, never spine-like ..... **Macromotettix (Subfamily Metrordorinae)**
2. Lateral lobe of pronotum with posterior angle acute, often spine-like ..... **Criotettix (Scelimeninae)**
3. Antenna with apical segments foliaceous, compressed and dilated..... **Phaesticus**
3. Antenna filliform, segments not as above..... **Coptotettix**

**Key to the Subfamilies of Acrididae**

1. Prosternal process present. .... 2
1. Prosternal process absent..... 4
2. Lower external lobe of hind knee with apex acute or spine-like. Hind tibia, in ventral view, with apical half laminately expanded. .... **Subfamily Oxyinae**
2. Lower external lobe of hind knee with apex obtuse. Hind tibia, in ventral view, rounded..... 3
3. Mesosternal lobes rectangular, with inner margins straight or substraight. .... **Subfamily Cyrtacanthacridinae**
3. Mesosternal lobes not rectangular, with inner margins curved or angulated. .... **Subfamily Catantopinae**
4. Head, in profile, oblique; fastigium verticis and frontis meet at an acute angle. Antenna slightly dilated, more distinct at the base. .... **Subfamily Acridinae**
4. Head, in profile, vertical; fastigium verticis and frontis meet at an obtuse angle. Antenna not dilated. .... **Subfamily Oedipodinae**

**Key to Families of Ensifera**

1. Male tegmen, if present, usually with stridulatory apparatus..... 2
1. Male tegmen, if present, usually without stridulatory apparatus..... 5
2. Habitus usually dorso-ventrally compressed. Right tegmen usually overlaps left tegmen. Tarsus generally with three segments. Ovipositor usually cylindrical and slender. .... 3
2. Habitus usually laterally compressed or cylindrical. Left tegmen usually overlaps right tegmen. Tarsus with four segments. Ovipositor varied, but not cylindrical and slender ..... **Family Tettigoniidae (with key to subfamilies)**
3. Foreleg highly modified, enlarged and shovel-like..... **Family Gryllotalpidae**
3. Foreleg not modified, similar to the middle legs..... 4
4. Body covered with fine scales. Female wingless; male usually with wings modified as the stridulatory apparatus. .... **Family Mogoplistidae**
4. Body not covered with fine scales. Male and female usually winged..... **Family Gryllidae (with key to subfamilies)**
5. Highly arched body. Wingless. .... **Family Rhaphidophoridae**
5. Body typical. Usually winged. .... **Family Gryllacrididae**

**Key to the Subfamilies of Tettigoniidae**

1. Prosternum unarmed. Fore tibia in section square. Hind wing surpassing tegmen; usually hyaline with apex non-hyaline. Ovipositor usually sickle-shaped. .... **Phaneropterinae**
1. Not as the above combination. .... **2**
2. Habitus usually larger and robust; mostly green or brown. .... **3**
2. Habitus usually smaller and less robust or delicate; some green or brown, others of varied colouration. .... **4**
3. Habitus usually more laterally compressed. Fastigium broadly rounded in dorsal view. Fore tibia with tympanal cover open. .... **Mecopodinae**
3. Habitus usually more dorso-laterally compressed. Fastigium narrow and tapering in dorsal view. Fore tibia with tympanal cover conchiform. .... **Pseudophyllinae**
4. Habitus of varied colouration. Fastigium protruding; conical or spinose. Prosternum armed or unarmed. .... **Conocephalinae**
4. Habitus usually green or yellow green. Fastigium not protruding. Prosternum unarmed. .... **Meconematinae**

**Key to the Subfamilies of Gryllidae**

1. Habitus delicate, usually with long slender legs. Head prognathous. Tarsal claw bifurcate. .... **Oecanthinae**
1. Habitus from delicate to stout, rarely with long slender legs. Head usually not prognathous, rounded. Tarsal claw not bifurcate. .... **2**
2. Hind tibia with spines between spurs. .... **3**
2. Hind tibia without spines between spurs. .... **8**
3. Tegmen longer, reaching or surpassing the abdominal apex. Hind wing often surpassing the tegmen. .... **4**
3. Tegmen shorter and often truncated, not reaching the abdominal apex. Hind wing not surpassing the tegmen. .... **Landrevinae**
4. Male tegmen mostly with a stridulatory apparatus; different from the female tegmen. Ovipositor blade-shaped or cylindrical with apex modified, but not tapering to a subacute apex. .... **5**
4. Male tegmen without a stridulatory apparatus; similar from the female tegmen (venation may differ). Ovipositor tapers to a subacute apex. .... **Euscyrтинаe**
5. Ovipositor blade-shaped, laterally compressed and slightly curved upwards. .... **Pteroplistinae**
5. Ovipositor not blade-shaped, usually cylindrical with apex modified as an ovipositing apparatus. .... **6**
6. Male tegmen modified with a stridulatory apparatus and enlarged; tegminal dorsal field in the male often distinctively wider than the abdomen width, compared to that of the female. .... **7**
6. Male tegmen modified with a stridulatory apparatus but not enlarged; tegminal dorsal field in the male not distinctively wider than the abdomen width, similar to that of the female. .... **Podoscirtinae**
7. Legs generally longer and more slender; hind tibia with long spurs. .... **Phalorinae**
7. Legs generally shorter and more stout; hind tibia with short spurs. .... **Itarinae**
8. Habitus smaller, with the body length generally ca. 5 mm. Head with dorsal bristles. Hind tibia with 2–4 dorsal, subapical spurs on each side. Ovipositor sword-shaped. .... **9**
8. Habitus larger, with body length generally larger than 10 mm. Head without dorsal bristles. Hind tibia with  $\geq 4$  dorsal subapical spurs on each side. Ovipositor cylindrical and slender. .... **Gryllinae**
9. Second tarsal segment ventrally with adhesive pad. Hind tibia with two inner and two outer dorsal apical spurs. .... **Trigonidiinae**
9. Second tarsal segment ventrally without adhesive pad. Hind tibia with three inner and three outer dorsal apical spurs. .... **Nemobiinae**

**RESULTS**

Based on the collections in Dec.2012, May 2013, and Dec.2013, 72 species from 52 genera of Orthoptera were collected and examined, of which 19 species were grasshoppers (suborder Caelifera) and 53 species were crickets and katydids (suborder Ensifera). The Caelifera is represented by four families, of which the Acrididae and Tetrigidae are the most specious (eight species recorded each; Fig. 7a). The Ensifera is represented by six families, of which the Gryllidae and Tettigoniidae are the most specious (20 species recorded each; Fig. 7b). Appendix 1 provides information on the material from the collections in 2012 and 2013. Note that the material listed in Appendix 1 does not provide any indication of the relative abundance of each species of Orthoptera.

In total, 45 species were compiled from historical records. Thirty-seven species recorded historically were not collected during the surveys but on the other hand, 64 species collected during the surveys were not found in the historical records. Of the 109 species recorded, at least 26 species were described from Fraser's Hill as the type locality.

Fig. 7 summarises the species richness according to families, based on both the collections and historical records.

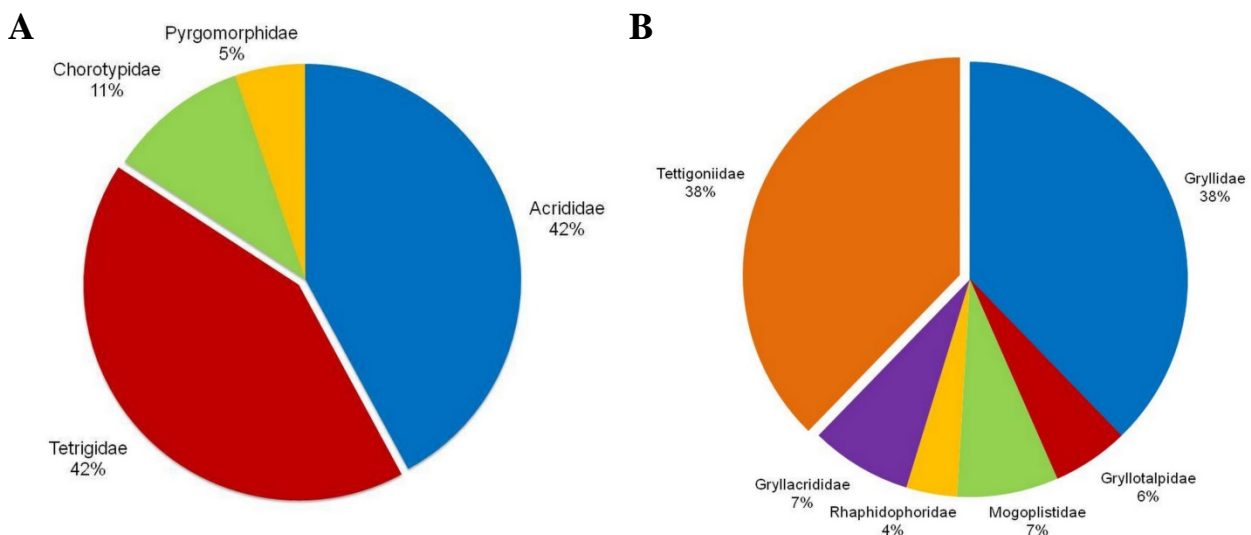


Fig. 7. Pie charts showing the species richness of the families of: A, Caelifera; and B, Ensifera, based on the collections in 2012 and 2013. Total species recorded: 19 Caelifera and 53 Ensifera.

Order **Orthoptera** (109 species)

Suborder **Caelifera** (32 species)

Superfamily group **Acridomorpha**

Family **Acrididae** (17 species)

Family **Chorotypidae** (5 species)

Family **Pyrgomorphidae** (1 species)

Family **Trigonopterygidae** (1 species)

Superfamily **Tetrigoidea**

Family **Tetrigidae** (8 species)

- Suborder **Ensifera** (77 species)  
 Superfamily **Grylloidea**  
 Family **Gryllidae** (31 species)  
 Family **Gryllotalpidae** (3 species)  
 Family **Mogoplistidae** (5 species)  
 Superfamily **Rhaphidophoroidea**  
 Family **Rhaphidophoridae** (9 species)  
 Superfamily **Stenopelmatoidea**  
 Family **Gryllacrididae** (4 species)  
 Superfamily **Tettigonioidea**  
 Family **Tettigoniidae** (25 species)

## CHECKLIST OF THE ORTHOPTERA OF FRASER'S HILL

Table 2 is the checklist of the Orthoptera of Fraser's Hill. In addition to the material collected in 2012–2013 by us, the species compiled from historical records and the recent literatures are also listed here. Based on historical records and the recent literatures, as many as 30 more species were added to the checklist based on the collection and many of these were new species. This checklist is not exhaustive. Given the vast area and the fragmentary exploration of the orthopterans, it is certain that not all parts of Fraser's Hill could have been covered equally well. There are likely to be other species not yet collected by us or previous workers. New records and previously unknown species are to be expected as the faunal exploration is continued or intensified.

Numerous species listed in Table 2 could only be identified to generic level. The identification of some species was also tentative, as noted by 'cf.' or '(?)'. This is especially for many of the diverse and taxonomically difficult groups, even if some of these species may be fairly common and abundant in Fraser's Hill. These species may require more materials for examination and comparison with known types and some of them may also represent undescribed species.

The classification system adopted here is based on the Orthoptera Species File Online Version 5.0/5.0 (Eades et al., 2013). The families, subfamilies, and genera are arranged alphabetically for ease of reference.

Table 2. A checklist on the Orthoptera in Fraser's Hill, Peninsular Malaysia. \* represents a species with type the locality as Fraser's Hill; Coll. represents material collected by us; HR represents a historical record. For more information on the species compiled from historical records, refer to: Chopard (1931, 1969), Miller (1934), Ingrisch (1998a; 2006), Mahmood et al. (2007a, 2008), and Gorochov (2011a–e, 2012b).

	Taxon	Coll.	HR
<b>SUBORDER CAELIFERA</b>			
<b>FAMILY ACRIDIDAE</b>			
Subfamily <b>Acridinae</b>			
1.	<i>Phlaeoba antennata</i> Brunner von Wattenwyl	+	+
2.	<i>Phlaeoba infumata</i> Brunner von Wattenwyl		+
Subfamily <b>Catantopinae</b>			
3.	<i>Anacranae nuda</i> Miller *		+
4.	<i>Eritrichius</i> cf. <i>modigliani</i> Bolívar	+	
5.	<i>Lucretilis bolivari</i> Miller *		+
6.	<i>Meltripata antennata</i> (Miller) *	+	+
7.	<i>Stenocatantops splendens</i> (Thunberg)	+	

## Orthoptera of Fraser's Hill

	Taxon	Coll.	HR
8.	<i>Tauchira polychroa</i> (Stål)	+	+
9.	<i>Tauchira rufotibialis</i> Willemse		+
10.	<i>Utanaeris flavifrons</i> Miller *		+
11.	<i>Willemseella bicolor</i> Miller	+	+
Subfamily <b>Cyrtacanthacridinae</b>			
12.	<i>Valanga nigricornis</i> (Burmeister)		+
Subfamily <b>Oedipodinae</b>			
13.	<i>Aiolopus thalassinus tamulus</i> (Fabricius)		+
14.	<i>Pternoscirta caliginosa</i> (De Haan)		+
15.	<i>Trilophidia annulata</i> (Thunberg)	+	+
Subfamily <b>Oxyinae</b>			
16.	<i>Oxya japonica japonica</i> (Thunberg)		+
17.	<i>Pseudoxya diminuta</i> (Walker)	+	+
<b>FAMILY CHOROTYPIDAE</b>			
Subfamily <b>Chorotypinae</b>			
18.	<i>Chorotypus biemarginatus</i> Brunner von Wattenwyl		+
Subfamily <b>Eruciinae</b>			
19.	<i>Erucius (Erucius) apicalis</i> (Westwood)		+
20.	<i>Erucius (Erucius) dimidiatipes</i> Bolívar		+
21.	<i>Erucius</i> sp. 1	+	
22.	<i>Erucius</i> sp. 2	+	
<b>FAMILY PYRGOMORPHIDAE</b>			
Subfamily <b>Pyrgomorphinae</b>			
23.	<i>Atractomorpha</i> cf. <i>psittacina</i> (Haan)	+	
<b>FAMILY TRIGONOPTERYGIDAE</b>			
Subfamily <b>Trigonopteryginae</b>			
24.	<i>Systella rafflesii</i> Westwood		+
<b>FAMILY TETRIGIDAE</b>			
Subfamily <b>Metroradorinae</b>			
25.	<i>Macromotettix</i> sp. 1	+	
26.	<i>Macromotettix</i> sp. 2	+	
27.	<i>Macromotettix</i> sp. 3	+	
Subfamily <b>Scelimeninae</b>			
28.	<i>Criotettix</i> sp.	+	
Subfamily <b>Tetriginae</b>			
29.	<i>Coptotettix</i> sp. 1	+	
30.	<i>Coptotettix</i> sp. 2	+	
31.	<i>Coptotettix</i> sp. 3	+	
32.	<i>Phaesticus insularis</i> (Hancock)	+	

	Taxon	Coll.	HR
<b>SUBORDER ENSIFERA</b>			
<b>FAMILY GRYLLIDAE</b>			
Subfamily <b>Euscyrtinae</b>			
33.	<i>Beybienkoana</i> or <i>Patiscus</i> sp.	+	
Subfamily <b>Gryllinae</b>			
34.	<i>Acanthoplistus femoratus</i> Chopard *		+
35.	<i>Gymnogryllus leucostictus</i> (Burmeister)	+	+
36.	<i>Loxoblemmus jacobsoni</i> Chopard		+
37.	<i>Velarifictorus</i> cf. <i>aspersus</i> (Walker)	+	
Subfamily <b>Itarinae</b>			
38.	<i>Itara (Gryllitara) pendleburyi</i> (Chopard) *		+
39.	<i>Itara (Itara) minor</i> Chopard		+
40.	<i>Itara</i> spp.	+	
Subfamily <b>Landrevinae</b>			
41.	<i>Duolandrevus</i> sp.	+	
42.	<i>Duolandrevus (Surdolandrevus)</i> sp.	+	
Subfamily <b>Nemobiinae</b>			
43.	<b>Pteronemobiini</b> sp. 1	+	
44.	<b>Pteronemobiini</b> sp. 2	+	
45.	<b>Pteronemobiini</b> sp. 3	+	
46.	<b>Pteronemobiini</b> sp. 4	+	
Subfamily <b>Oecanthinae</b>			
47.	<i>Xabea</i> sp.	+	
Subfamily <b>Phaloriinae</b>			
48.	<i>Trellius (Protrellius) elenae</i> Gorochov *		+
49.	<i>Trellius (Protrellius) michaili</i> Gorochov *		+
Subfamily <b>Podoscirtinae</b>			
50.	<b>Aphonoidini</b> sp. 1	+	
51.	<b>Aphonoidini</b> sp. 2	+	
52.	<i>Furcimunda bipunctata</i> (Chopard) *		+
53.	<i>Idiotrella</i> sp.	+	
Subfamily <b>Pteroplistinae</b>			
54.	<i>Kerinciola tabulophila</i> Gorochov *		+
55.	<i>Changiola pahangi</i> Gorochov *		+
56.	<i>Changiola perakensis</i> (Chopard)		+
57.	<i>Tembelingiola plana</i> Gorochov		+
Subfamily <b>Trigonidiinae</b>			
58.	<i>Amusurgus</i> sp.	+	
59.	<i>Svistella</i> (?) sp. 1 – green/ yellow	+	
60.	<i>Svistella</i> (?) sp. 2 – yellow	+	
61.	<i>Svistella</i> (?) sp. 3 – black head	+	
62.	<i>Svistella</i> (?) sp. 4 – red	+	
63.	<i>Trigonidium</i> (?) sp.	+	

## Orthoptera of Fraser's Hill

	Taxon	Coll.	HR
<b>FAMILY GRYLLOTALPIDAE</b>			
Subfamily <b>Gryllotalpinae</b>			
64.	<i>Gryllotalpa fulvipes</i> Saussure	+	
65.	<i>Gryllotalpa fraser</i> Tan & Nizam *	+	
66.	<i>Gryllotalpa</i> sp.	+	
<b>FAMILY MOGOPLISTIDAE</b>			
Subfamily <b>Mogoplistinae</b>			
67.	<i>Micronebius malaya</i> Tan & Nizam *	+	
68.	<i>Ornebius albalatus</i> Tan & Nizam *	+	
69.	<i>Ornebius pendleburyi</i> Chopard *		+
70.	<i>Ornebius</i> sp. 1	+	
71.	<i>Ornebius</i> sp. 2	+	
<b>FAMILY RHAPHIDOPHORIDAE</b>			
Subfamily <b>Rhaphidophorinae</b>			
72.	<i>Diarhaphidophora mira</i> Gorochov *		+
73.	<i>Diarhaphidophora sympatrica</i> Gorochov *		+
74.	<i>Eurhaphidophora bona</i> Gorochov *		+
75.	<i>Eurhaphidophora</i> (?) sp.	+	
76.	<i>Neorhaphidophora grata</i> Gorochov *		+
77.	<i>Rhaphidophora magna</i> Gorochov *		+
78.	<i>Rhaphidophora</i> (?) sp.	+	
79.	<i>Stonychophora</i> (?) <i>pileata</i> Gorochov *		+
80.	<i>Stonychophora trilobata</i> Gorochov *		+
<b>FAMILY GRYLLACRIDIDAE</b>			
Subfamily <b>Gryllacridinae</b>			
81.	<i>Capnogryllacris fruhstorferi</i> (Griffini)	+	
82.	<i>Larnaca (Larnaca) fasciata</i> Walker	+	
83.	<i>Larnaca (Larnaca) nigrata</i> (Brunner von Wattenwyl)	+	
84.	<i>Larnaca (Larnaca) pendleburyi</i> (Karny)	+	
<b>FAMILY TETTIGONIIDAE</b>			
Subfamily <b>Conocephalinae</b>			
85.	<i>Conocephalus (Anisoptera) maculatus</i> (Le Guillou)	+	
86.	<i>Conocephalus (Anisoptera) melaenus</i> (Haan)	+	
87.	<i>Lesina</i> sp.		+
88.	<i>Liara (Liara) alata</i> Ingrisch	+	+
89.	<i>Lichnofugia malaya</i> Tan & Ingrisch	+	
90.	<i>Macroxiphus sumatranus siamensis</i> Helfert & Sanger	+	
91.	<i>Mesagraecia</i> cf. <i>bicolor</i> Ingrisch	+	
92.	<i>Nahlaksia bidadari</i> Ingrisch & Tan	+	
93.	<i>Palaeoagraecia brunnea</i> Ingrisch		+
94.	<i>Peracca conspicuithorax</i> Griffini	+	
95.	<i>Peracca (Peracca) originalis</i> Gorochov *		+
Subfamily <b>Meconematinae</b>			
96.	<i>Alloteratura</i> (?) sp.	+	
97.	<i>Asioplugis</i> cf. <i>malacca</i> Gorochov	+	
98.	<i>Neophisis</i> (?) sp.	+	

	<b>Taxon</b>	<b>Coll.</b>	<b>HR</b>
99.	<i>Xiphidiopsis (Xiphidiopsis) angustifurca</i> Gorochov *		+
100.	<i>Xiphidiopsis</i> (?) sp.	+	
Subfamily <b>Mecopodinae</b>			
101.	<i>Mecopoda elongata</i> (Linnaeus)	+	
Subfamily <b>Phaneropterinae</b>			
102.	<i>Elbenia fraser</i> Tan *	+	
103.	<i>Elimaea (Rhaebelimaesa) aprilis aprilis</i> Gorochov *		+
104.	<i>Elimaea (Rhaebelimaesa) pseudochloris</i> Ingrisch	+	
105.	<i>Phaneroptera brevis</i> (Serville)	+	
106.	<i>Pseudopsyra bispina</i> Tan & Nizam *	+	
Subfamily <b>Pseudophyllinae</b>			
107.	<i>Phyllomimus (Phyllomimus)</i> cf. <i>inversus</i> Brunner von Wattenwyl	+	
108.	<i>Phyllomimini</i> sp.	+	
109.	<i>Promeca</i> cf. <i>perakana</i> Beier	+	



**ORTHOPTERA OF FRASER'S HILL, PENINSULAR MALAYSIA**

Based on the specimens collected by us from Fraser's Hill and historical records, short descriptions on the Orthoptera including some remarks on their taxonomy and life history are provided. References, mostly on the taxonomy of the orthopterans, are also listed as further reading. Under figure captions, BL represents body length.

**SUBORDER CAELIFERA**

**FAMILY ACRIDIDAE**

**Subfamily Acridinae**

*Phlaeoba* species

(Figs. 8, 9)

Two species of *Phlaeoba* were recorded from Fraser's Hill. One is *Phlaeoba antennata* Brunner von Wattenwyl (Fig. 8). This brown grasshopper may be found in grassy areas and is perhaps the most common species of grasshopper found in Fraser's Hill. Habitus colouration of the males are fairly different from that in the females. The females show slight differences in both the abdominal apex and colour: the epiproct is more truncated; there is the presence of two longitudinal, darkened stripes across head and pronotal lateral lobes. There are two subspecies from two different biogeographical regions: *Phlaeoba antennata antennata* Brunner von Wattenwyl from Myanmar (Indo-Burma) and *Phlaeoba antennata malayensis* Bolívar from the Malay Peninsula (Sundaland) (Mahmood et al., 2007a). Although comparison with type specimens was not made, it is highly likely that the specimens from Fraser's Hill belong to the Sundaland subspecies, and this is further corroborated by previous records by Mahmood et al. (2007b). The other species is *Phlaeoba infumata* Brunner von Wattenwyl (Fig. 9). This grasshopper differs from *Phlaeoba antennata* by the absence of white tips on the antennae. Although this was recorded in the checklist by Mahmood et al. (2007a), this species was not sighted during the recent collections in 2012 and 2013.

**References:** Willemse (1930); Willemse (2001); Mahmood et al. (2007a); Tan (2012a)

**Subfamily Catantopinae**

*Anacranae nuda* Miller

(Fig. 10)

This is a small grasshopper with body length of about 23 mm for the male and 30 mm for the female (Fig. 10A). It was described from The Gap in 1934 and had not been recorded subsequently (Miller, 1934; Mahmood et al., 2007a). During the survey in 2013, a single specimen was sighted which resembles the specimen described by N. C. E. Miller (Fig. 10B). Comparison of the photographs showed that there are distinct differences in the colouration of the head. However, the specimen could not be collected and it is not possible to ascertain the identity without the examination of the genitalia. Nevertheless, the photograph provided a record of the genus in Malay Peninsula for the first time since its original description. Interestingly, while the specimen sighted in 2013 was on grassy area along road, Miller (1934) noted that this species lives in the forest interior. Perhaps more intensive searching of the forest interior may show that this species is more apparent than currently thought.

**References:** Miller (1934); Willemse (1957)

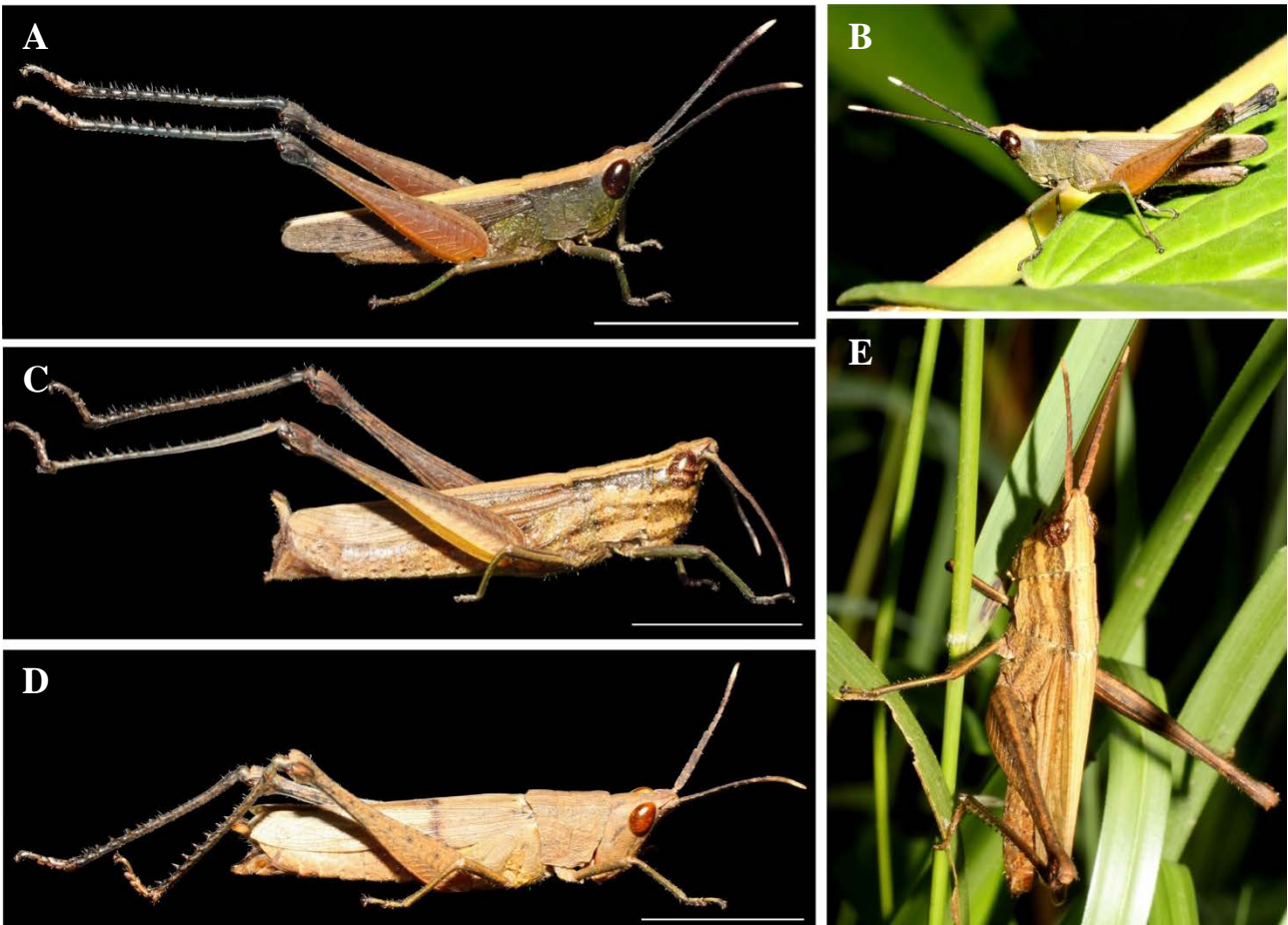


Fig. 8. *Phlaeoba antennata* Brunner von Wattenwyl: A, B, male; C–E, female adult habitus. BL = cf. 17 mm (B); = cf. 28 mm (E). Scale bar = 10 mm.



Fig. 9. *Phlaeoba infumata* Brunner von Wattenwyl: male adult habitus (BL = cf. 24 mm) (Tan, 2010b: Fig. 5).

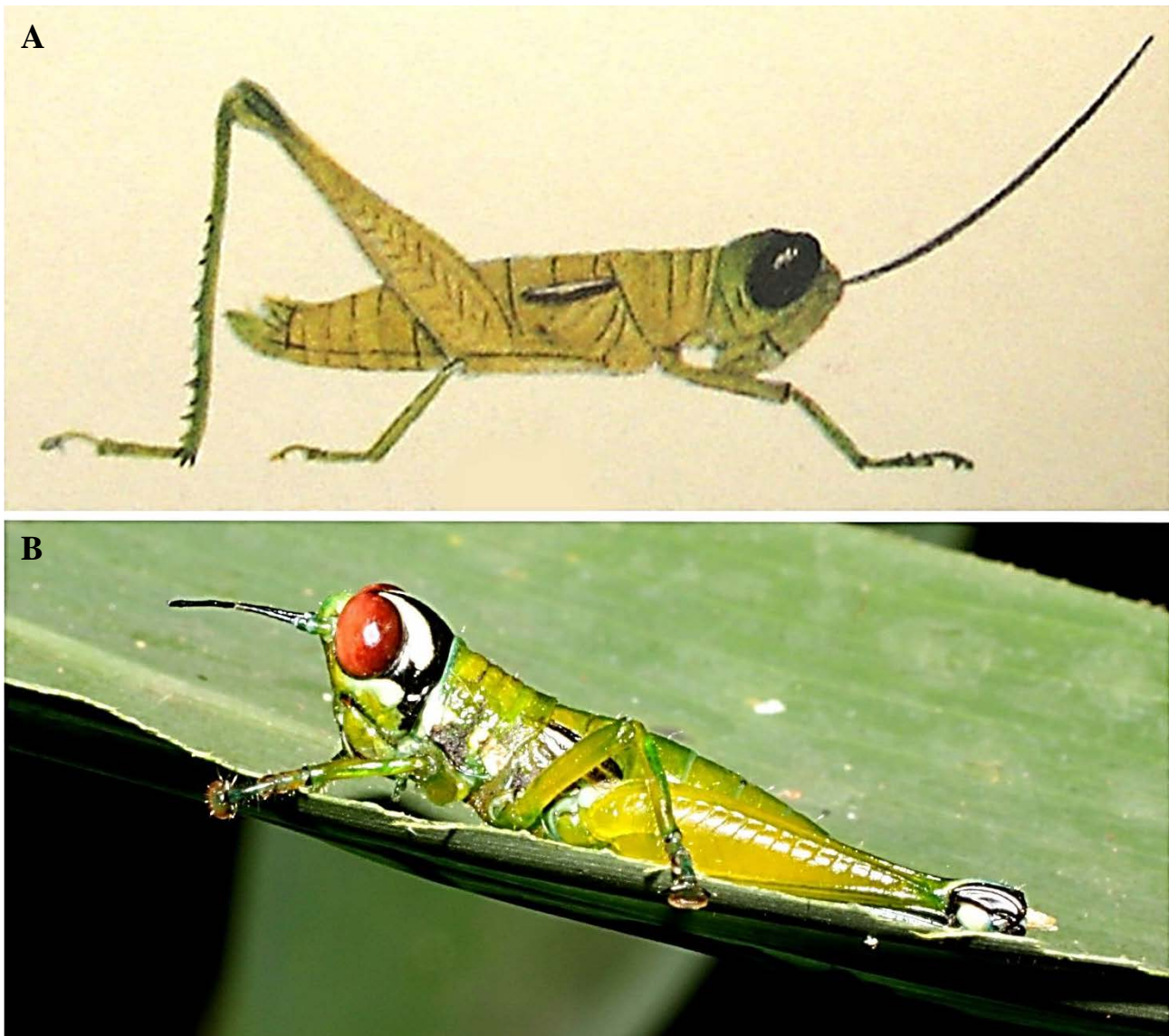


Fig. 10. *Anacranae nuda* Miller: A, male adult habitus (BL = 23 mm) (Miller, 1934: Pl. XIII, Fig. 10); B, male adult habitus (BL = cf. 20 mm).

*Eritrichius* cf. *modiglianii* Bolívar  
(Fig. 11)

This is a fairly large species among the grasshoppers recorded from Fraser's Hill. Only two individuals (a male adult and a nymph) were sighted among grasses and herbs along roads during the surveys of 2012 and 2013. The genus is monotypic, consisting of a single species described from a single female specimen from Sumatra, Indonesia: *Eritrichius modiglianii* (Bolívar, 1898). The specimen may represent the first record for this genus in Malay Peninsula, and for anywhere outside Sumatra. However, as only a male was collected from Fraser's Hill it is not possible to compare the genitalia and verify if the specimen from Fraser's Hill represents a distinct species. Moreover, the original description *Eritrichius modiglianii* was also vague and a re-description by Willemse (1930) was also incomplete as the specimen was completely discoloured and the male unknown at the time. Thus a revision of this genus along with the collection of more specimens is needed.

**References:** Willemse (1930, 1957)



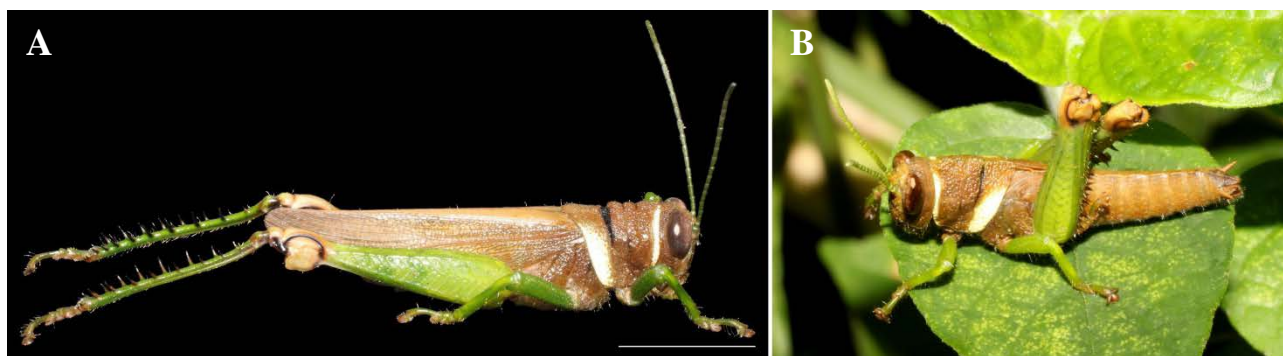


Fig. 11. *Eritrichius* cf. *Modigliani* Bolívar: A, male adult; B, and nymph (BL = cf. 25 mm) habitus. Scale bar = 10 mm.

*Lucretilis bolivari* Miller

(Fig. 12)

This grasshopper has black body with orange or yellow stripes from the head to the abdomen. The femora are also brightly orange. The wings are fairly truncated, like those of the other *Lucretilis* species. This is another grasshopper which was first described from Fraser's Hill by Miller (see Miller, 1934). It was based on a single female specimen that is now in the Natural History Museum, London (Willemse, 1956). Since then, other workers have not encountered this species (Willemse, 1956; Mahmood et al., 2007a). It was also not sighted during the surveys of 2012 and 2013.

**References:** Miller (1934); Willemse (1956); Mahmood et al. (2007a)

*Meltripata antennata* (Miller)

(Fig. 13)

This is a small grasshopper with truncated wings. Its antennae are disproportionately long with white segments at the apices. Numerous *Meltripata* species may be found in the Malay Peninsula. While it was not recorded from Fraser's Hill by Mahmood et al. (2007a), this was actually described from Fraser's Hill by Miller (1934). At such, this may represent the first record of this species in its type locality for 80 years! It was also noted that this species prefers to eat *Rubus rosaefolius* although it may eat other plant species (Miller, 1934).

**References:** Miller (1934); Mahmood et al. (2007a)

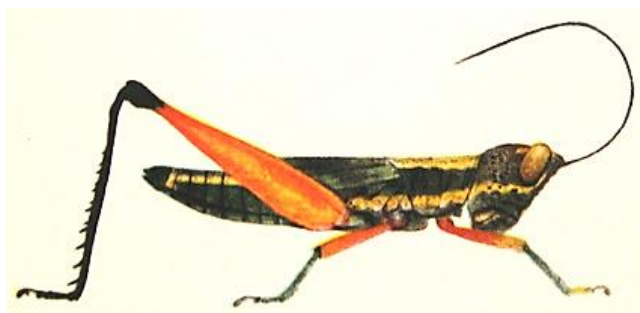


Fig. 12. *Lucretilis bolivari* Miller: female adult habitus (BL = 30 mm) (Miller, 1934: Pl. XIII, Fig. 3).

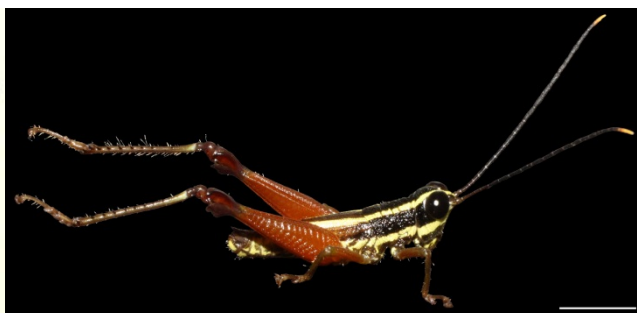


Fig. 13. *Meltripata antennata* (Miller): male adult habitus. Scale bar = 5 mm.

## Orthoptera of Fraser's Hill

### *Stenocatantops splendens* (Thunberg)

(Fig. 14)

This is a large, brown grasshopper which is fairly uncommon in Fraser's Hill. It is distinguished from many other Catantopinae species by the elongated body, well-developed wings, and hind femora, each with a dark longitudinal stripe on the outer area. Some *Stenocatantops* species were recently described from Taiwan (Yin & Yin, 2005) but only one species is so far known from the Malay Peninsula. Although the genitalia of this genus are still poorly studied, *Stenocatantops splendens* can be distinguished from other congeners by: 1) the outer medial area of the hind femur with a black medial longitudinal stripe; and 2) a bulbous prosternal process but which is moderately latero-compressed (Yin & Yin, 2005). Only a single female was collected from Fraser's Hill, thus it was not been possible to examine and compare with the male abdominal apex.

**References:** Willemes (1930); Yin & Yin (2005); Mahmood et al. (2007a); Tan (2012a)

### *Tauchira* species

(Figs. 15, 16)

Species of the genus *Tauchira* are often brightly coloured. Two species were recorded in Fraser's Hill: 1) *Tauchira polychroa* (Stål) (Fig. 15); and 2) *Tauchira rufotibialis* (Willemse) (Fig. 16). *Tauchira polychroa* may be fairly commonly observed in the grassy areas of Fraser's Hill. This species may require a taxonomic revision as population variations have been observed based on specimens from Thailand, Peninsular Malaysia, and Sumatra (Storozhenko, 2009). It is so far unclear if these differences represent mere infraspecific variation, different subspecies or distinct species (Storozhenko, 2009). The higher classification of this species remains controversial too. While some researchers place this species under the subfamily Catantopinae, others place this species under the subfamily Oxyinae (Mahmood et al., 2007a; Storozhenko, 2009; Eades et al., 2013). In Mahmood et al. (2007a), another *Tauchira* species was recorded from Fraser's Hill: *Tauchira rufotibialis*. The two species appear generally similar but may be distinguished by the the colour of hind tibiae (generally dark blue in *Tauchira polychroa* and red in *Tauchira rufotibialis* (Willemse, 1930). Although last collected in 1975, *Tauchira rufotibialis* was not sighted during our survey (Mahmood et al., 2007a).

**References:** Willemse (1930); Mahmood et al. (2007a); Storozhenko (2009); Eades et al. (2013)

### *Utanacris flavifrons* Miller

(Fig. 17)

*Utanacris* currently consists of three species, all of which are recorded only in Peninsular Malaysia (Miller, 1934). Only *Utanacris flavifrons* was described from Fraser's Hill. This grasshopper was observed to be found in the forest interior (Willemse, 1957). Recent surveys in Fraser's Hill did not yield this species. The only known information about this species is the original description and little or no sightings or records thereafter.

**References:** Miller (1934); Willemse (1957)



Fig. 14. *Stenocatantops splendens* (Thunberg): female adult habitus. Scale bar = 5 mm.

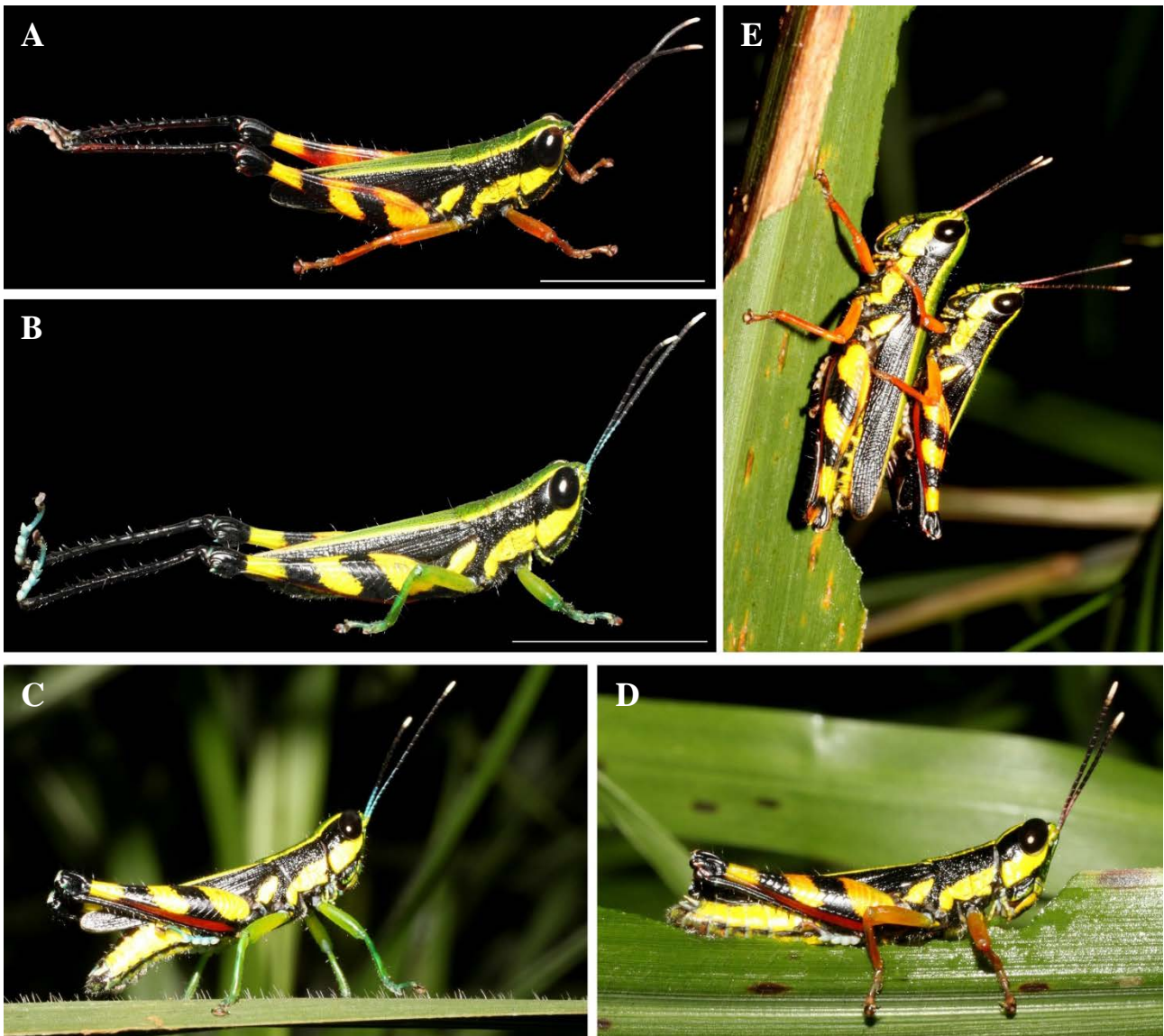


Fig. 15. *Tauchira polychroa* (Stål): A–C, male adult habitus; D, a male adult feeding on the lamina of a tall grass; E, a mating pair (male on top of female). BL = cf. 18 mm (C, D, male in E); = cf. 24 mm (female in E). Scale bar = 10 mm.



Fig. 16. *Tauchira rufotibialis* (Willemse): male adult habitus (BL = cf. 18 mm) (Eades et al., 2013).



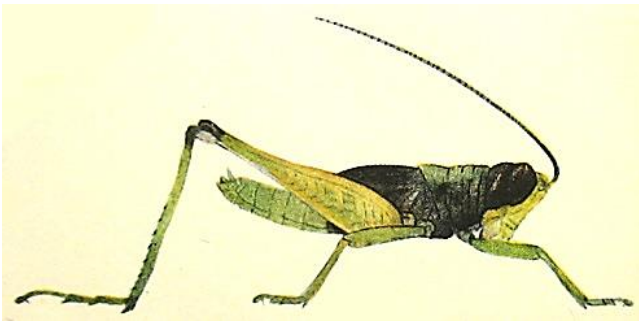


Fig. 17. *Utanacris flavifrons* Miller: male adult habitus (BL = 17 mm) (Miller, 1934: Pl. XIII, Fig. 6).

***Willemsella bicolor* Miller**  
(Fig. 18)

This is a beautiful grasshopper with red antennae and an iridescent green body. The lateral lobe of the pronotum has a yellow patch on the ventral half. It appears to prefer quieter habitats with tall grasses, such as the road en route to Jeriau Waterfall. The genus is monotypic and was described from Dusun Tua, Selangor in 1934 (Miller, 1934) based on a pair of male and female specimens. Since then, it appears that there has been no further record of this species (Mahmood et al., 2007a) and the specimens collected from Fraser's Hill represent the first records for this locality and rediscovery of this species after nearly 80 years since it was described. While this genus is poorly known taxonomically, this grasshopper is not uncommon among the tall grasses of Fraser's Hill. Currently, this species is also known to be endemic to the Malay Peninsula.

**References:** Miller (1934); Mahmood et al. (2007a)

Subfamily **Cyrtacanthacridinae**

***Valanga nigricornis* (Burmeister)**  
(Fig. 19)

This is a rather large grasshopper which is also sometimes commonly called a "locust" and known to Malay as "belalang kunyit" because it is a considerable pest in the region and may often be seen in large numbers (Willemse, 2001). This is in spite of the fact that there is little evidence that these grasshoppers are like gregarious locusts. Miller (1934) recorded this grasshopper in the gardens and plantations in various parts of Peninsular Malaysia, one site of which is The Gap. However, this presumably ubiquitous grasshopper was not recorded in Mahmood et al. (2007a) and was not sighted during the surveys of 2012 and 2013, including the garden and small plantation near Allen's Water.

**References:** Miller (1934); Willemse (2001); Mahmood et al. (2007a)

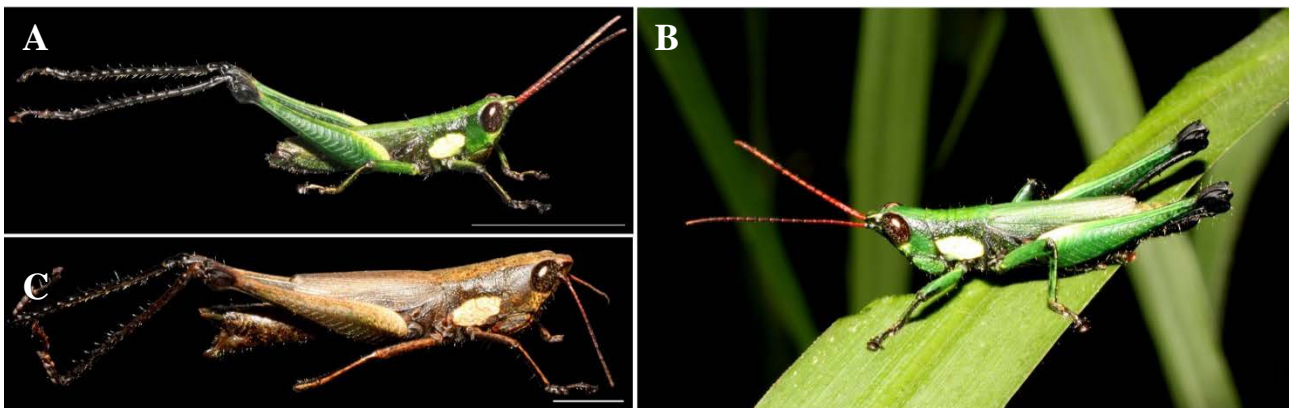


Fig. 18. *Willemsella bicolor* Miller: A, B, male; C, female adult habitus. BL = cf. 14 mm (B). Scale bars = 10 mm (A); 5 mm (C).

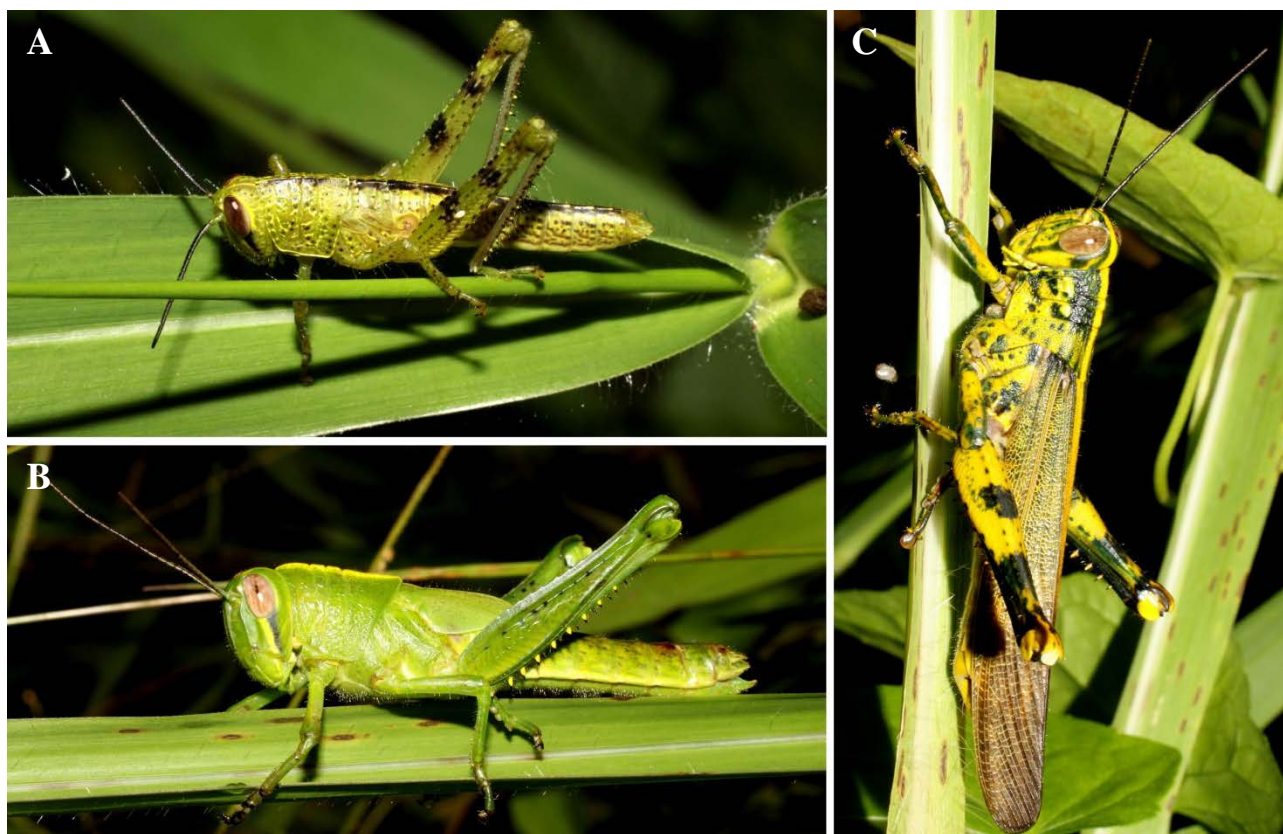


Fig. 19. *Valanga nigricornis* (Burmeister): A, B, nymphs; and C, adult. Habitus: A, BL = cf. 12 mm; B, BL = cf. 40 mm; C, BL = cf. 50 mm. Specimens photographed in Singapore.

### Subfamily Oedipodinae

#### *Aiolopus thalassinus tamulus* (Fabricius)

(Fig. 20)

This grasshopper has colour variations that range from yellow intermixing with different shades of brown (Tan, 2010a). It appears to prefer grassy sites. While this apparently ubiquitous species ranges from India, most parts of Southeast Asia, Taiwan, and even Australia, it was not sighted by us in 2012 and 2013. A detailed revision of the taxa can be found in Hollis (1968).

**References:** Hollis (1968); Mahmood et al. (2008); Tan (2010a)

#### *Pternoscirta caliginosa* (De Haan)

(Fig. 21)

This grasshopper was recorded by Miller (1934) and subsequently by Mahmood et al. (2008), but little is known of its biology, particularly when it was also not sighted during the recent surveys by us. The genus is characterised by: 1) a scabrous head and pronotum with dense short carinae and tubercles; and 2) villous ventral surface and legs (Huang et al., 2013).

**References:** Miller (1934); Mahmood et al. (2008); Huang et al. (2013)

#### *Trilophidia annulata* (Thunberg)

(Fig. 22)

This is a small grey-brown grasshopper that is characterised by deep transverse sulci along the dorsal plate of the pronotum and distinctively black and white-banded, hind tibiae. Only a single specimen was sighted and collected from a grassy area of Fraser's Hill.

**References:** Willemse (1930); Mahmood et al. (2008); Tan (2012a)



Orthoptera of Fraser's Hill

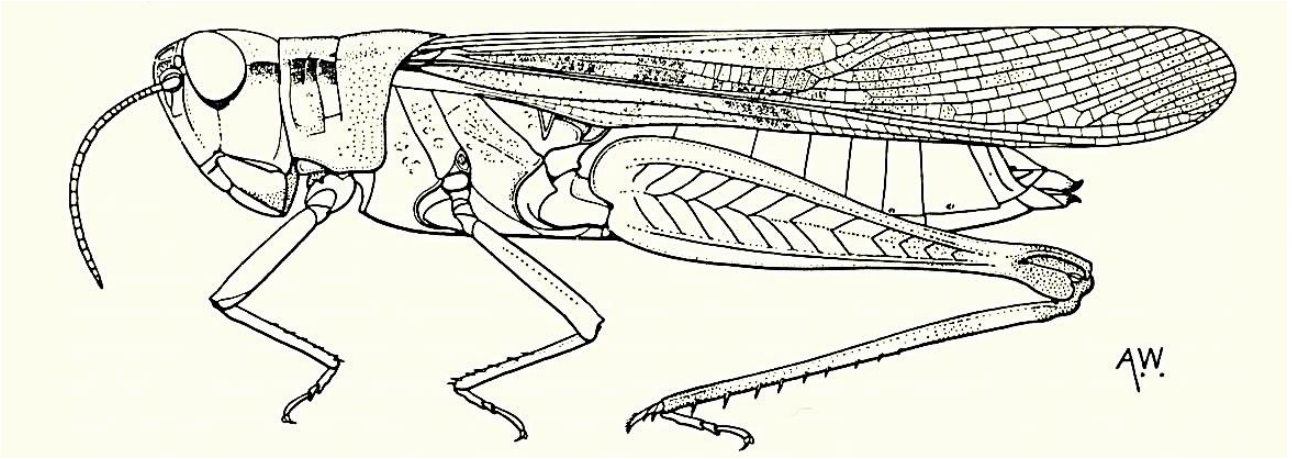


Fig. 20. *Aiolopus thalassinus tamulus* (Fabricius): female adult habitus (BL = cf. 26 mm) (Hollis, 1968: Fig. 1).



Fig. 21. *Pternoscirta caliginosa* (De Haan): female adult habitus from Singapore (BL = 22 mm) (specimen deposited in the ZRC: ZRC.ORT.800).



Fig. 22. *Trilophidia annulata* (Thunberg): female adult habitus. Scale bar = 5 mm.

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Subfamily **Oxyinae**

*Oxya japonica japonica* (Thunberg)

(Fig. 23)

This is a widely distributed species which may be found throughout Asia and even Australia (Hollis, 1971; Rentz et al., 2003; Mahmood et al., 2007a). This grasshopper is also known as the rice grasshopper because of its ability to use its laminately expanded hind tibiae to wade through shallow pools in rice padi fields and as such, it is known as a pest of rice (Willemse, 2001). Despite it being known to be ubiquitous, it was not recorded in Fraser's Hill, except in the inventory by Mahmood et al. (2007a). There are other *Oxya* species in the Malay Peninsula and they are fairly cryptic even after the examination of their external genitalia. Dissection is necessary for accurately diagnosing species of the genus (Hollis, 1971). Nevertheless, this genus may be easily differentiated from the closely related *Pseudoxya* by the longer wings reaching and surpassing the abdominal apex, and blue hind tibiae (versus bright red in those of *Pseudoxya*).

**References:** Hollis (1971); Willemse (2001); Mahmood et al. (2007a); Tan (2012a)

*Pseudoxya diminuta* (Walker)

(Fig. 24)

A small grasshopper which is probably one of the most common found in Fraser's Hill. This grasshopper can be found in short grasses and in shrubby areas. Different colour variants may be found, ranging from brown to green. This is a widely distributed species which may be found throughout Peninsular Malaysia, Singapore, and other parts of Southeast Asia (Willemse, 1930; Mahmood et al., 2007a; Tan, 2012a). This species may be called *Caryanda diminuta* in some of the literature (Hollis, 1975; Willemse, 2001), although the Orthoptera Species File (OSF) does not register the species *Caryanda diminuta* (Eades et al., 2013). However, diagnostic characteristics such as the hind tibiae with the apical half laminately expanded, cerci surpassing the epiproct and the epiphallus lacking ancorae clearly indicate that they are not *Caryanda* species (Willemse, 1930; Hollis, 1975).

**References:** Willemse (1930)—*Oxya diminuta*; Hollis (1975)—*Caryanda diminuta*; Willemse (2001)—*Caryanda diminuta*; Mahmood et al. (2007a); Tan (2012a)

## FAMILY CHOROTYPIDAE

### Subfamily **Chorotypinae**

*Chorotypus biemarginatus* Brunner von Wattenwyl

(Fig. 25)

Two subfamilies of Chorotypidae are represented in Fraser's Hill. *Chorotypus biemarginatus*, the only representative of the subfamily Chorotypinae is characterised by a leaf-like appearance. Brown colouration, along the enlarged latero-flattened pronotum and tegmina in adults mimic a dead leaf. On the pronotum, pinnate leaf-like venation along a main vein further increases the fidelity of the mimicry. This grasshopper is often sighted on the forest floor with leaf litter and its habitus allows it to camouflage among the dead leaves. Although recorded by Miller (1934), this species was not observed in 2012 and 2013 by us. It may be possible that this well-camouflaged grasshopper was too inconspicuous to be noticed.

**Reference:** Miller (1934)





Fig. 23. *Oxya japonica japonica* (Thunberg): male (BL = cf. 20 mm) (top) and female (BL = cf. 25 mm) (below) adults mating. Photographs taken in Singapore.

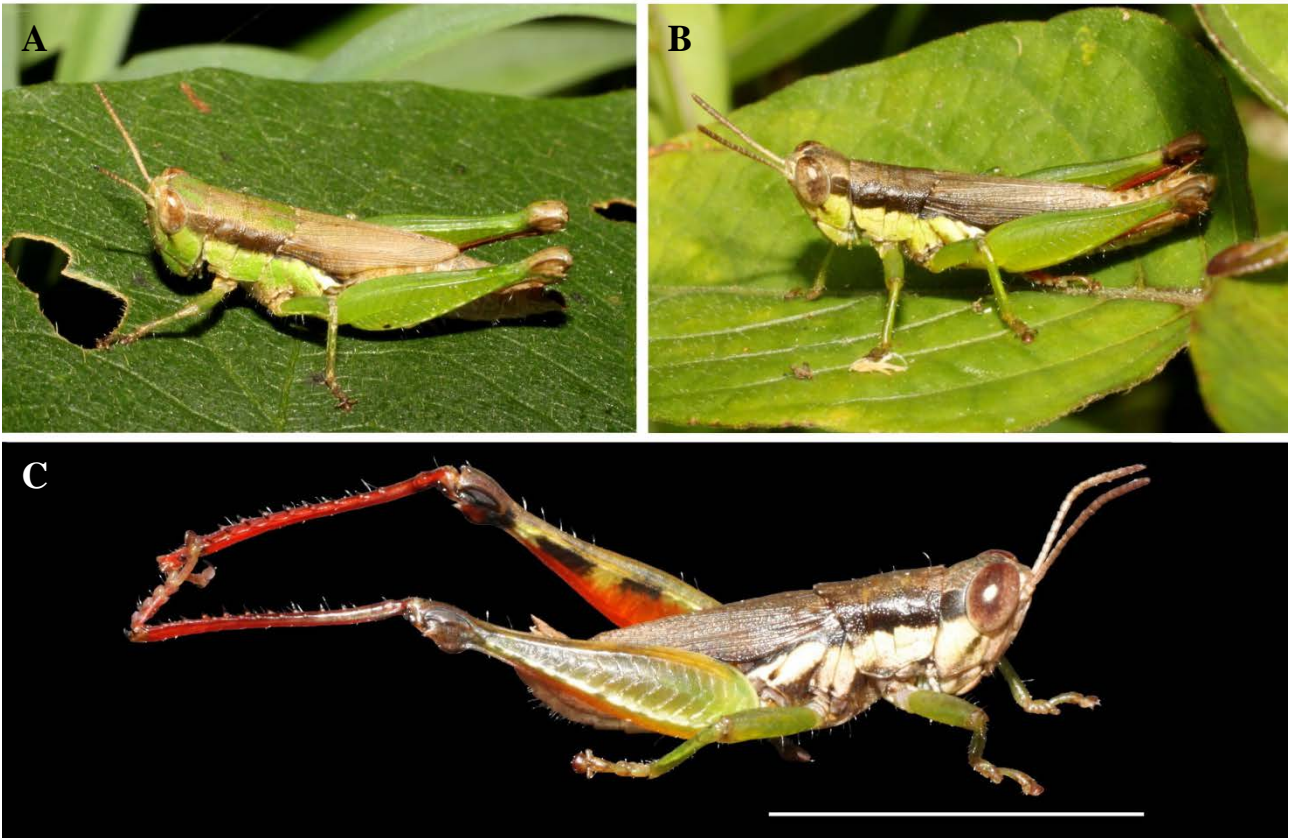


Fig. 24. *Pseudoxya diminuta* (Walker): A, female; B, C, male adult habitus. A, BL = cf. 18 mm; B, BL = cf. 15 mm. Scale bar = 10 mm.



Fig. 25. *Chorotypus biemarginatus* Brunner von Wattenwyl: female adult habitus from Singapore (BL = 34.4 mm) (specimen deposited in ZRC: ZRC.ORT.140).

*Erucius* species  
(Figs. 26, 27)

Sometimes known as the monkey grasshoppers, two species were collected from Fraser’s Hill although more species were recorded historically (Miller, 1934). Unlike many other grasshoppers in Fraser’s Hill, these monkey grasshoppers tend to occur in forested areas or their edges. Interestingly, most specimens were collected from ferns. Three genera can be recorded from Southeast Asia, namely *Erucius*, *Erianthus*, and *Mnesicles*, and they are often confused (Table 3). Examination of the genitalia is necessary for the identification to species level and this is not possible until comparison of the specimens with the type species is conducted. Nonetheless, comparison of the genitalia of the specimens from Fraser’s Hill indicates that there are two distinct species, even though the habitus are nearly identical.

**References:** Miller (1934); Tan (2012a)

Table 3. Differences between three genera of the Southeast Asian Chorotypidae: *Erucius*, *Erianthus*, and *Mnesicles*.

S/No.	Genera	Fastigium Verticis and Frontis	Fastigium and Vertex
1.	<i>Erucius</i>	Meet to form a rounded angle	–
2.	<i>Erianthus</i>	Meet to form an acute angle	strongly erected vertically, beyond the eyes
3.	<i>Mnesicles</i>	Meet to form an acute angle	projecting horizontally, slightly beyond the eyes



Orthoptera of Fraser's Hill

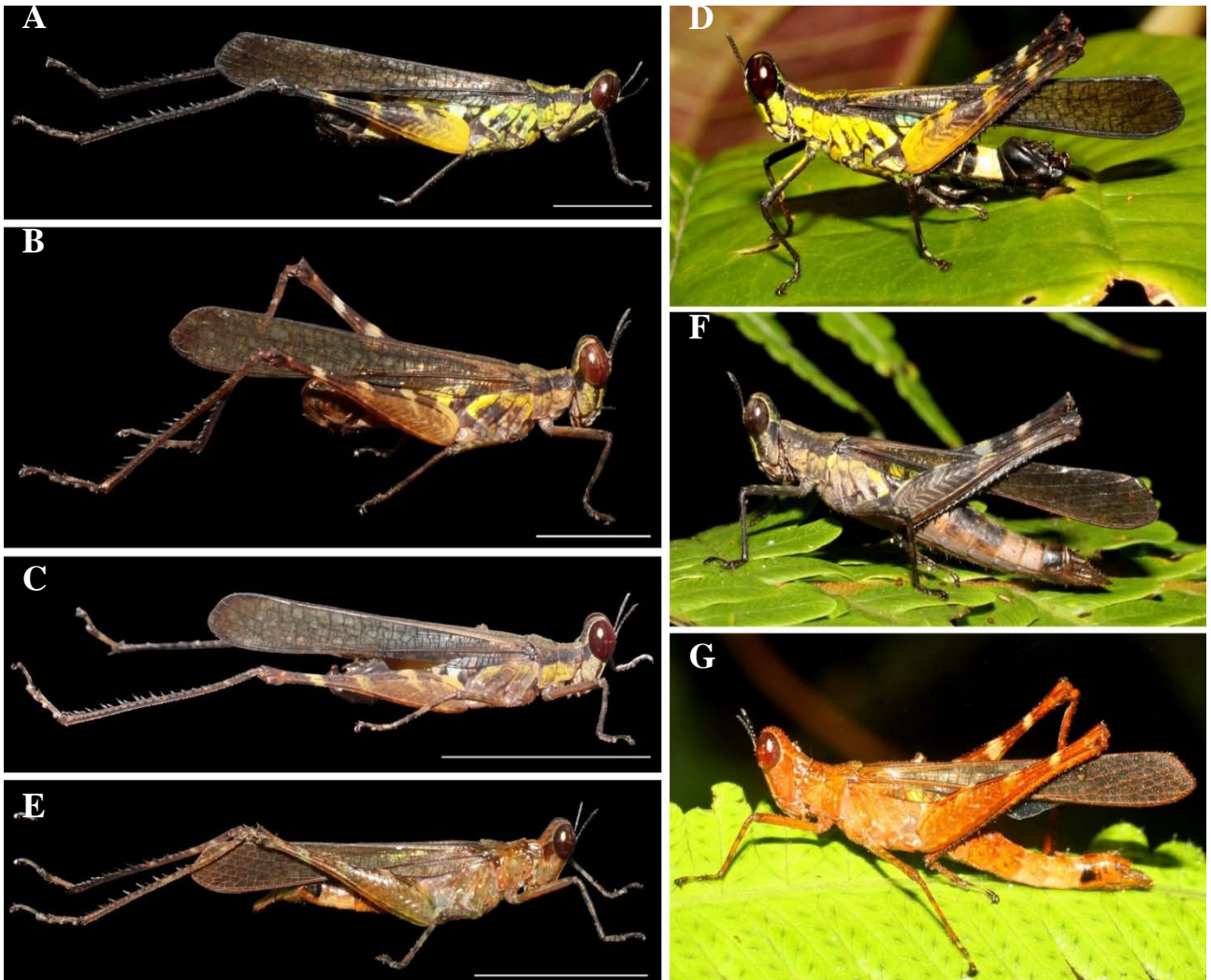


Fig. 26. *Erucius* species 1: A–D, male; E–G, female adult habitus. D, BL = cf. 13 mm; F, G, BL = cf. 15 mm. Scale bars = 5 mm (A, B); 10 mm (C, E).



Fig. 27. *Erucius* species 2: A, male; B, female adult habitus. Scale bar = 10 mm.

Tan & Kamaruddin

FAMILY PYRGOMORPHIDAE

Subfamily Pyrgomorphinae

*Atractomorpha* cf. *psittacina* (Haan)  
(Fig. 28)

Sometimes known as the tobacco grasshoppers, the head of this family of grasshoppers is clearly acutely conical. For this genus, the body is often slender, green or brown with generally smoky pink or purple, hind wings. A number of species have been recorded in Southeast Asia and closely resemble each other. Specific identification is therefore difficult (Willemse, 2001) and this was particularly a problem when only a single female was collected from Fraser's Hill.

**References:** Willemse (2001); Yin & Shi (2007); Tan (2012a)

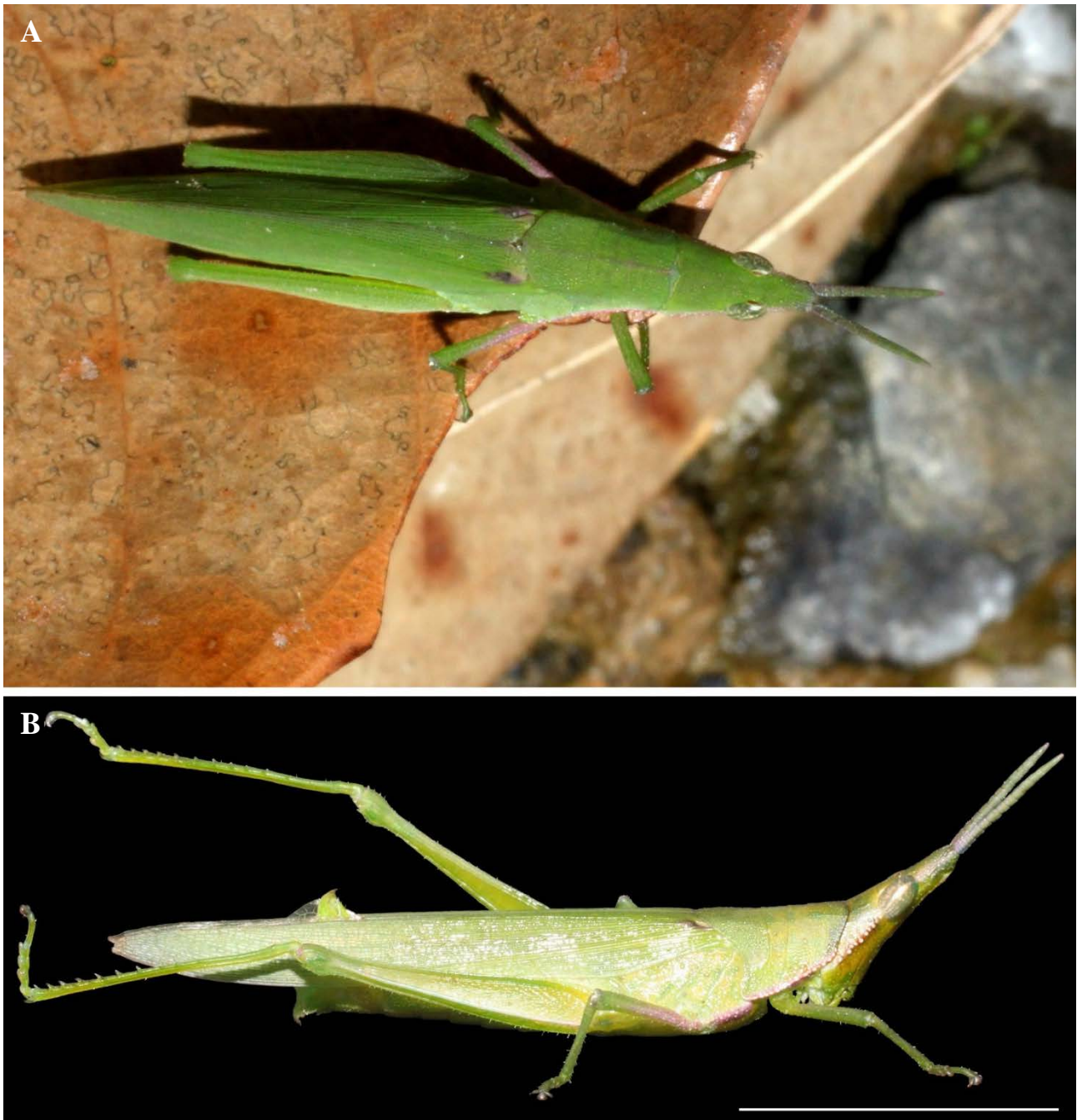


Fig. 28. *Atractomorpha* cf. *psittacina* (Haan): A, B, female adult habitus. BL = cf. 20 mm (A). Scale bar = 10 mm.



Orthoptera of Fraser's Hill

FAMILY TETRIGIDAE

Subfamily **Metroradorinae**

*Macromotettix* species

(Fig. 29)

*Macromotettix* is a pygmy grasshopper which can be characterised by eyes and vertex slightly exserted above pronotal surface; vertex rounded or obtuse; with medial carinula distinct; pronotum with dorsal plate conspicuously keeled; lateral lobe with posterior angle little produced out and hind tarsus with first and third segments subequal length. This represents the first record of the genus from Singapore and Malay Peninsula. The identification should be verified after a more comprehensive taxonomic revision of the genus (to that by Deng et al., 2007) and subfamily (Tan, 2014a). Specimens from Fraser's Hill may be tentatively grouped into also at least three morpho-species, of which they are distinguished by 1) having a white pronotal lateral lobe; 2) being wholly brown; 3) being red-brown with tint of green, respectively.

**References:** Deng et al. (2007); Tan (2014a)

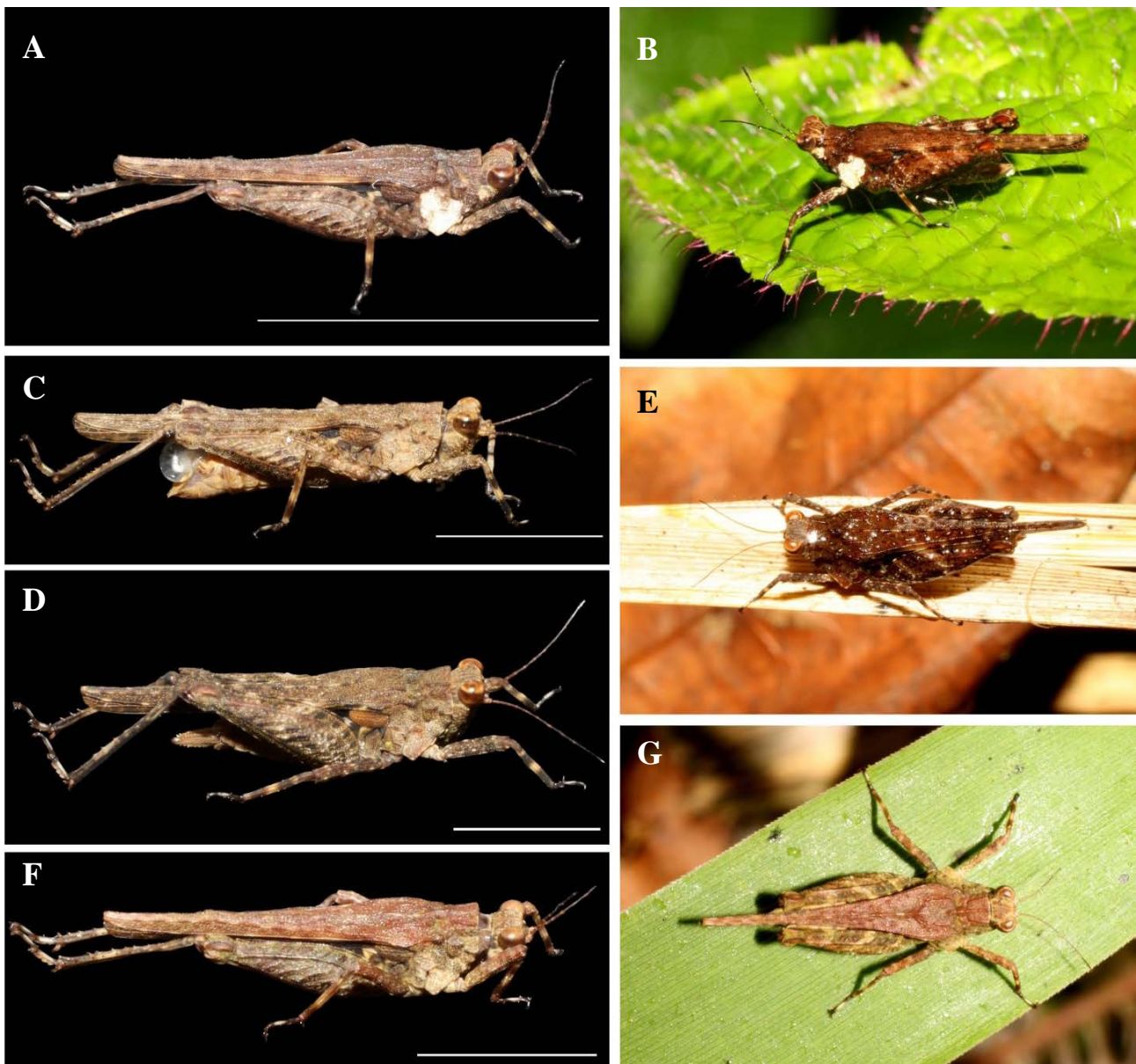


Fig. 29. *Macromotettix* species: A, B, species 1, C–E, species 2; F, G, species 3; A, B, F, G, male; C–E, female adult habitus. BL = cf. 7 mm (B, E, G). Scale bar = 10 mm (A), 5 mm (C, D, F).

Tan & Kamaruddin

Subfamily **Scelimeninae**

*Criotettix* species

(Fig. 30)

Known as the pygmy grasshoppers owing to their small size, these limno-terrestrial grasshoppers tend to be found near water sources. The pygmy grasshoppers of the subfamily Scelimeninae are generally distinguished from other subfamilies by the posterior angles of the lateral lobes of the pronotum being produced outwards (Hancock, 1907; Willemse, 1930; Tan, 2012a). The taxonomy of this genus is however in a chaotic state, as is true of many other genera of pygmy grasshoppers (Kevan, 1966; Tan, 2012a; H. Devriese, in lit.). Identification of the species is hence nearly impossible without examination of type specimens deposited in various museums. From Fraser's Hill, a species of the genus *Criotettix* was collected.

**References:** Hancock (1907); Willemse (1930); Mahmood et al. (2007b); Tan (2012a)

Subfamily **Tetriginae**

*Coptotettix* species

(Fig. 31)

Another subfamily of the pygmy grasshoppers, the Tetriginae differs from the Scelimeninae by having the posterior angles of the lateral lobes of the pronotum turned down and truncated (Hancock, 1907; Willemse, 1930; Tan, 2012a). As in many other members of the Tetrigidae, Integrative taxonomy with the use of DNA, morphological and ecological information is required for better species delimitation (Tan, 2014). As such, this genus is in need for revision before specimens may be identified accurately to specific level (Kevan, 1966; Tan, 2012a; H. Devriese, in lit.). Based purely on the general appearance, the specimens collected from Fraser's Hill may be tentatively grouped into at least three morpho-species of *Coptotettix*. Each of the three morpho-species are either 1) wholly red- brown; 2) light-brown dorsally and dark grey laterally; or 3) wholly dark-grey to black.

**References:** Hancock (1907); Willemse (1930); Mahmood et al. (2007b); Tan (2012a; 2014a)



Orthoptera of Fraser's Hill

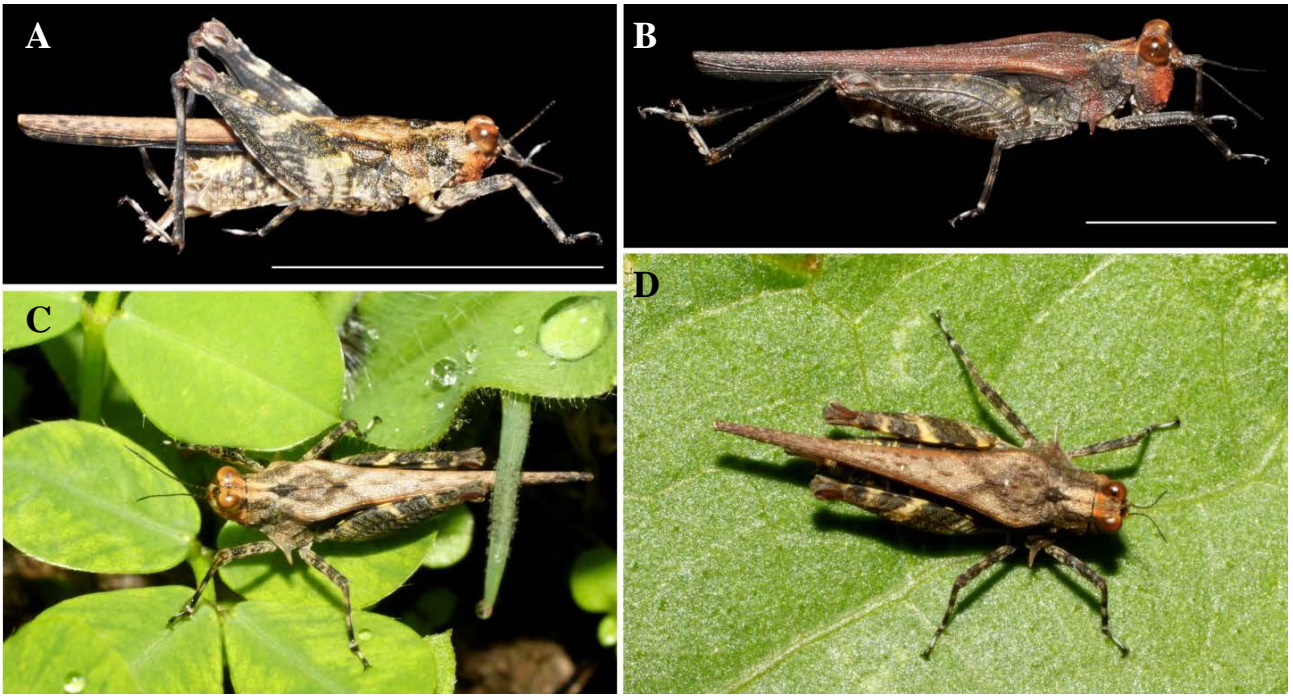


Fig. 30. *Criotettix* species: A–D, female adult habitus. C, D, BL = cf. 6 mm. Scale bar = 10 mm (A), 5 mm (B).

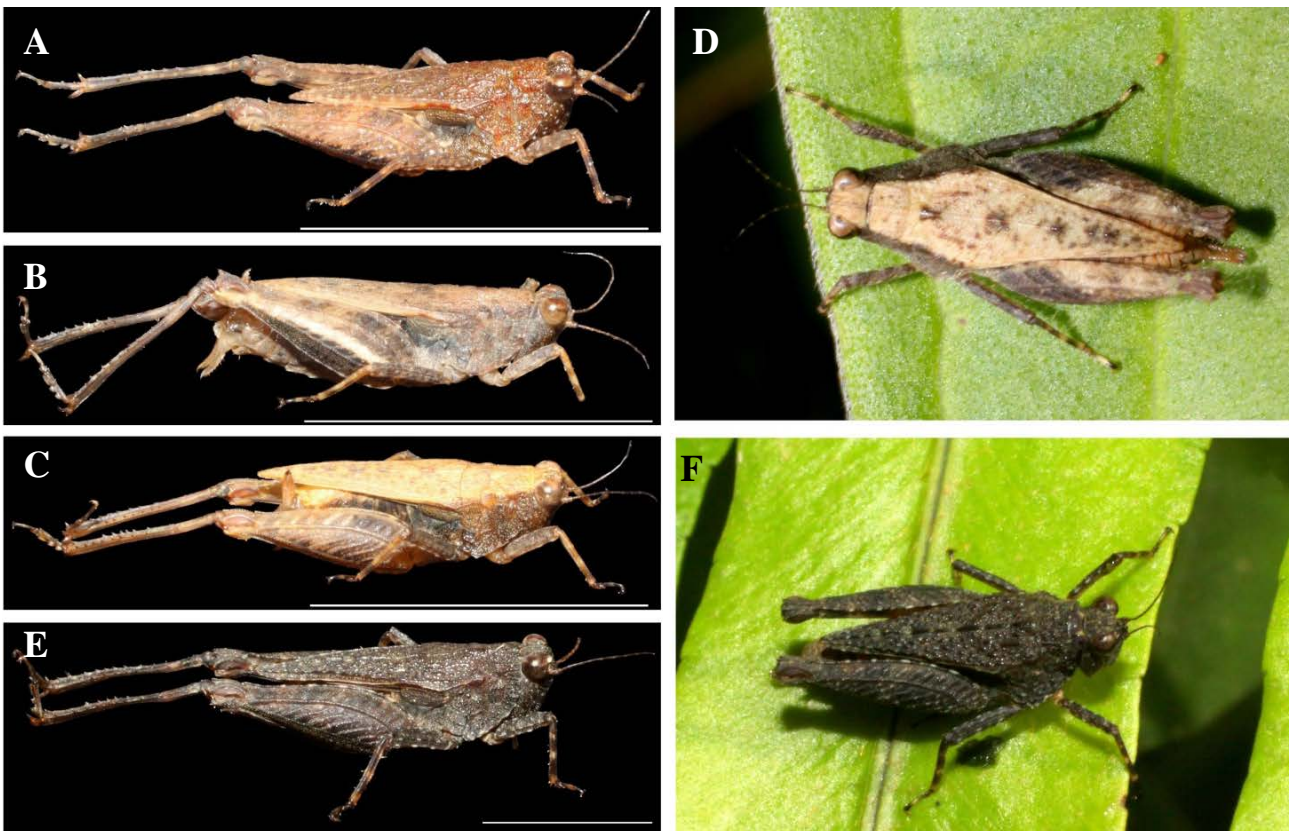


Fig. 31. *Coptotettix* morpho-species: A, species 1; B–D, species 2; E, F, species 3 female adult habitus. D, F, BL = cf. 9 mm. Scale bar = 10 mm (A, B, C), 5 mm (E).

*Phaesticus insularis* (Hancock)  
(Fig. 32)

This is another pygmy grasshopper which may be found in Fraser's Hill, belonging to the Tetriginae. However, this species can be easily distinguished from all other species of pygmy grasshoppers found in Fraser's Hill by the distinctively leaf-like, compressed and dilated apical segments of the antennae.

**References:** Hancock (1907); Willemse (1930); Mahmood et al. (2007b); Tan (2012a, 2014a)

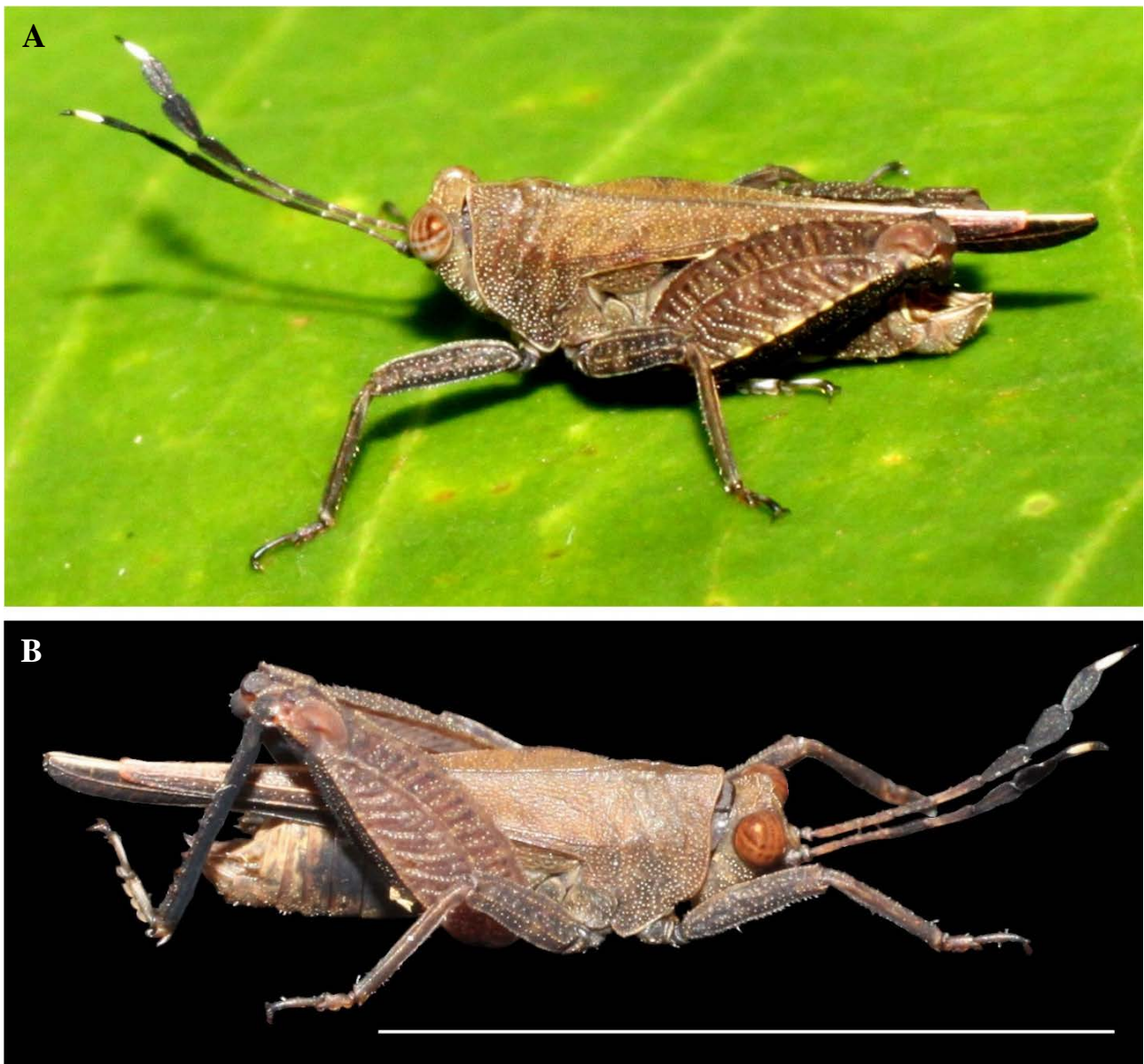


Fig. 32. *Phaesticus insularis* (Hancock): A, B, male adult habitus. BL = cf. 12 mm (A). Scale bar = 10 mm.



Orthoptera of Fraser's Hill  
FAMILY TRIGONOPTERYGIDAE

Subfamily **Trigonopteryginae**

*Systella rafflesii* Westwood  
(Fig. 33)

This grasshopper is commonly known as the leaf-mimicking grasshopper because the colour and shape of tegmina are modified to be leaf-like. Interestingly, there is also a variation in the colouration of the grasshopper that mimics different stages of a leaf: 1) green: mimicking a living leaf; 2) yellow: mimicking a wilting leaf; 3) brown: mimicking a dead leaf (Tan, 2012a). The leaf-mimicking grasshopper was recorded by Miller (1934). A single brown nymph was sighted in Fraser's Hill in 2012 but no adults or other sightings were recorded thereafter.

**References:** Miller (1934); Tan (2012a)



Fig. 33. *Systella rafflesii* Westwood: A, nymph (BL = cf. 25 mm); B, male (BL = cf. 30 mm) (top) and female (BL = cf. 40 mm) (below) adults mating. Image B photographed in Singapore.

Tan & Kamaruddin  
SUBORDER ENSIFERA  
FAMILY GRYLLIDAE  
Subfamily Euscyrtinae

*Beybienkoana* or *Patiscus* species  
(Fig. 34)

This is the only slim cricket collected from Fraser's Hill. Currently, there are at least four genera which may be found in Southeast Asia: *Beybienkoana*, *Euscyrtus*, *Euscyrtodes*, and *Patiscus*. A single female specimen collected from Fraser's Hill appears most similar to either *Beybienkoana* or *Patiscus* species: the antennal scape is wider than the frontal rostrum; the fore tibia with tympana on their internal and external surfaces; the tegmina are longer (Gorochov, 1987; Yang & Yang, 2012). However, it is difficult to differentiate between *Beybienkoana* or *Patiscus* which requires the male genitalia for verification. The slim cricket from Fraser's Hill was found among bamboo plants in which its elongated habitus and pale colouration allow it to camouflage well among the leaves and stems.

**References:** Gorochov (1987); Yang & Yang (2012)



Fig. 34. *Beybienkoana* or *Patiscus* species: A, B, female adult; C, nymph habitus. B, C, BL = cf. 14 mm. Scale bar = 5 mm.

Orthoptera of Fraser's Hill

Subfamily Gryllinae

*Acanthoplistus femoratus* Chopard

(Fig. 35)

This is a cricket described from a single female specimen from The Gap near Fraser's Hill by Chopard (see Chopard, 1931). According to the original description, this is a rather interesting species. While the general habitus is typical of the genus, it is rather large, with a poorly defined angulated insertion of the pronotal lateral lobes and is characteristically coloured (Chopard, 1931). Little information on the biology is known and this cricket was not sighted in our recent surveys.

**References:** Chopard (1931)

*Gymnogryllus leucostictus* (Burmeister)

(Fig. 36)

This is a fairly large cricket with banded legs and orange tegmina. The males may be heard calling at night (after around 1930 hours) in relatively large numbers. The male stations itself at the opening of the burrow and produces a loud, high-pitched (greater than 5 kHz) and resonant buzz. It is not easy to observe this cricket as it would retreat into the burrow quickly when it feels threatened. The burrows of this cricket tend to be found along embankments along roads. Occasionally, it may be sighted walking along a path, in day and night.

**References:** Chopard (1931); Eades et al. (2013)

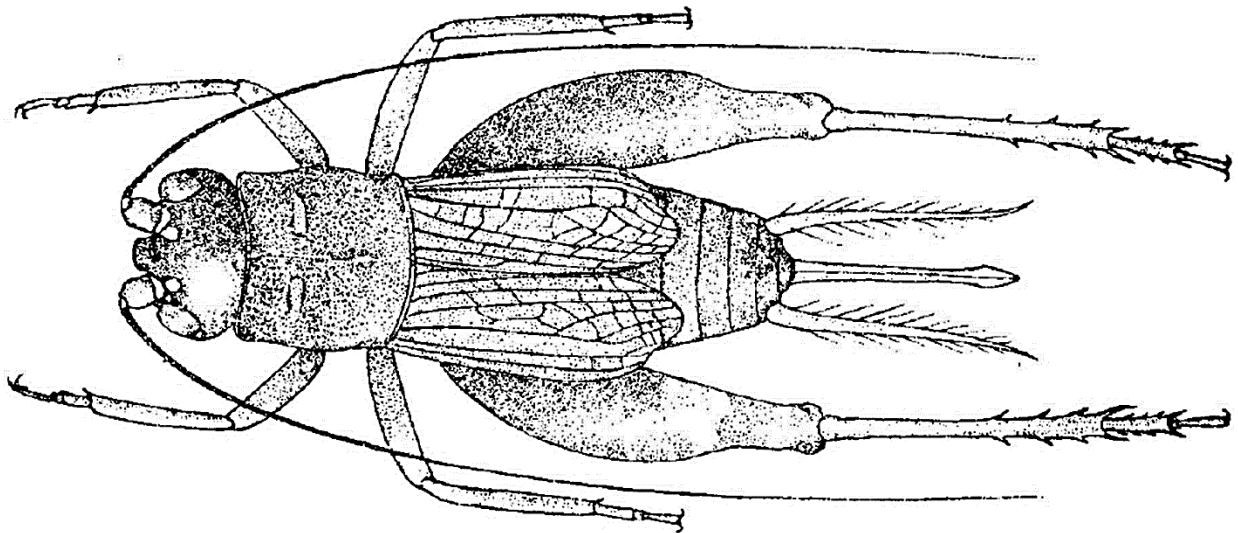


Fig. 35. *Acanthoplistus femoratus* Chopard: female adult habitus (BL = 14.5 mm) (Chopard, 1931: fig. 4a).



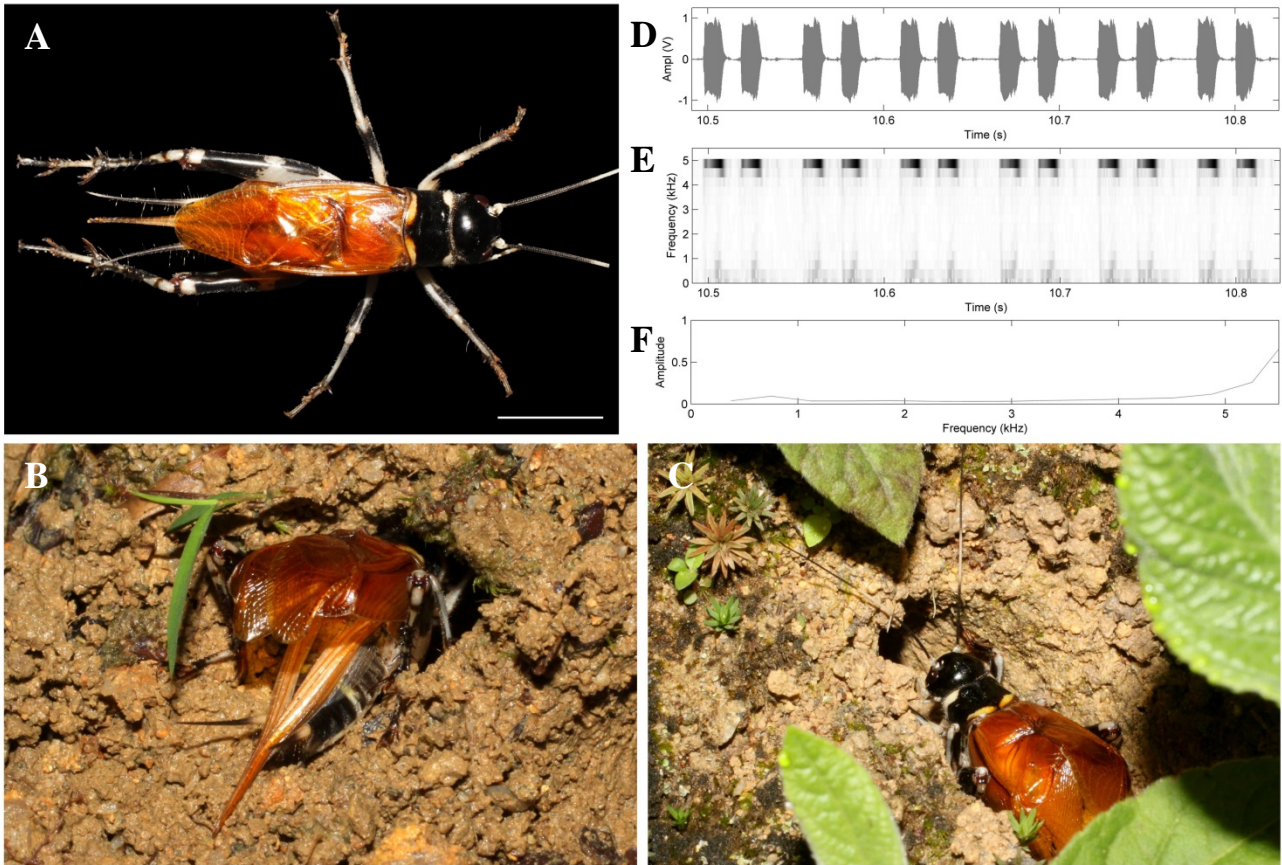


Fig. 36. *Gymnogryllus leucostictus* (Burmeister): A, male adult habitus; B, C, male adults (BL = cf. 35 mm) calling at the entrance of the burrow; D, oscillogram, E, spectrogram; F, amplitude spectrum of the calling song. Scale bar = 10 mm.

*Loxoblemmus jacobsoni* Chopard and *Velarifictorus* cf. *aspersus* (Walker)  
(Fig. 37)

These are relatively small Gryllinae species compared to *Gymnogryllus leucostictus*. Unlike *Gymnogryllus leucostictus*, they are generally dull brown. The calling song of the male is also clearly different. In *Velarifictorus* cf. *aspersus*, the burrows of males were observed to consist of two holes, where the male vibrates its tegmina to produce a high-pitched but softer chirping call to attract the females. They are fairly commonly heard at night and at times in the day but owing to their smaller size and softer calling song, this cricket may not be easily heard. At other times, the adults and nymphs may be found foraging among the leaf litter or short grasses and herbs. It is difficult to differentiate between the species of *Loxoblemmus* and *Velarifictorus*, with the examination of the genitalia and tegminal venation necessary. While recorded by Chopard (1931), *Loxoblemmus jacobsoni* was however not collected during our 2012 and 2013 surveys.

**References:** Chopard (1931); Ingrisch (1998b)



Fig. 37. *Velarifictorus* cf. *aspersus* (Walker): A, B, male adult habitus. Scale bar = 5 mm.

#### Subfamily **Itarinae**

#### *Itara* species (Fig. 38)

This is a cricket which may be found both along forest trails and in grassy plots. The male habitus differs from that of the female, in particular in its wings. The male has elaborated tegmina for stridulation that are distinctively wider than the body. The males open and vibrate the tegmina, producing chirping calls to attract the females. During our surveys, numerous females were collected but it is difficult to ascertain their identity without a corresponding male because many species have been described either only by the males or that the females are nearly identical in the descriptions. Thus, the slight differences in the subgenital plate and ovipositor of the females observed among the specimens may indicate that more than one species is found in Fraser's Hill. Two species of the genus were previously described from Fraser's Hill: *Itara (Gryllitara) pendleburyi* (Chopard) and *Itara (Itara) minor* Chopard.

**References:** Gorochov (2007a; 2008a; 2012a)





Fig. 38. *Itara* species: A, male; B–E, female adult habitus; F, male adult stridulating. D–F BL = 20 mm. Scale bars = 5 mm (A, B); 10 mm (C).

### Subfamily Landrevinae

#### **Landrevini** species (Fig. 39)

Little is known about these cryptic crickets of the subfamily Landrevinae. The males have truncated tegmina adapted for stridulation and may be found calling at night from burrows inside dead stems or logs. The nymphs were observed feeding on fungi and mosses among rotten wood.

**Reference:** Otte (1988)



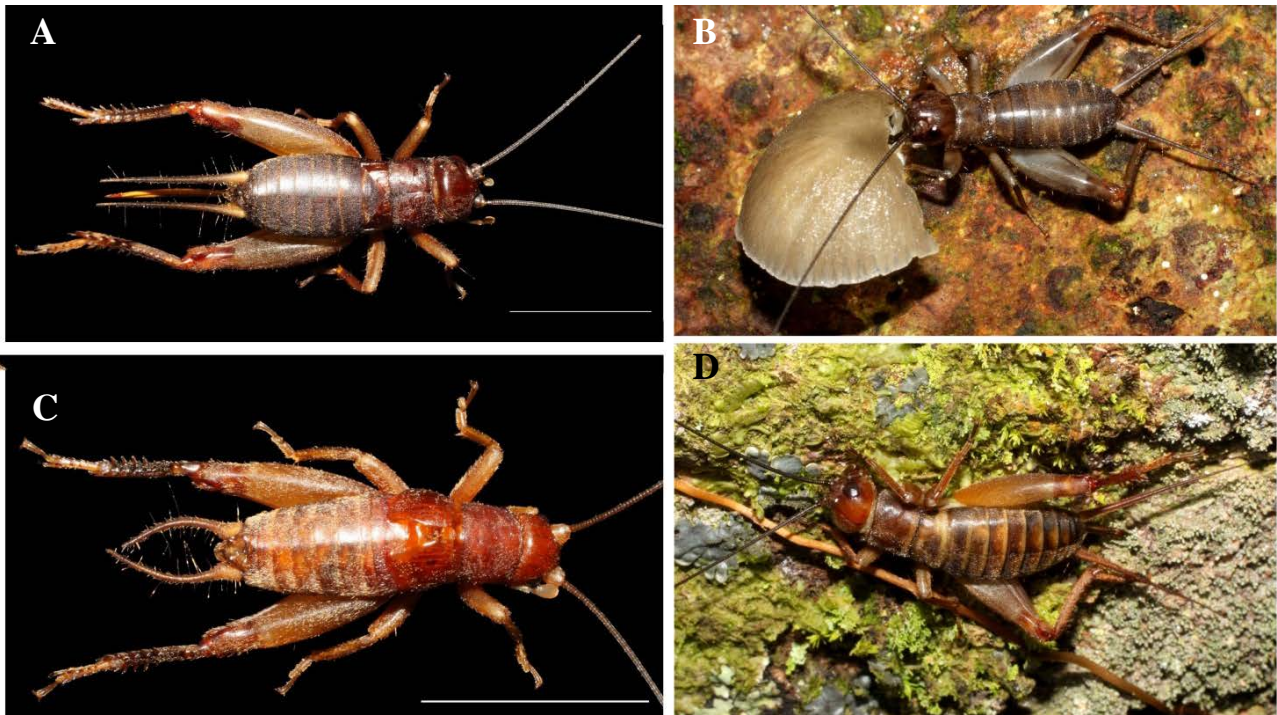


Fig. 39. Landrevini species: A, *Duolandrevus* species female adult, B, D *Duolandrevus* (*Surdolandrevus*) species male adult habitus; C, D, unidentified nymphs. Scale bar = 10 mm.

#### Subfamily **Nemobiinae**

#### **Pteronemobiini** species (Fig. 40)

Nemobiinae species are usually small and their taxonomy is poorly studied in the Southeast Asia with many undescribed species are waiting to be discovered and named. In Fraser's Hill, four species were recorded but the lack of up-to-date knowledge of the subfamily makes it difficult to identify the specimens to generic level. Nevertheless, examination of the specimens showed that the four species appear morphologically distinct (Table 4).

**References:** Otte & Alexander (1983)

Table 4. Differences between the four species of Pteronemobiini from Fraser's Hill.

Characteristic	Species 1	Species 2	Species 3	Species 4
Dorsal of head	Pale brown with six longitudinal stripes, sometimes indistinct	Pale brown with five longitudinal stripes, the mid stripe thick	Pale brown with distinct six longitudinal stripes	Black with indistinct longitudinal stripes
Dorsal plate of pronotum	Mostly pale brown	Pale brown but mostly dark brown basally	Mostly black	Black
Tegmina	With pale veins	Generally with dark veins, with pale veins distally	Mostly dark veins	Dark
Hind femora	Dark without patterns or white spots on dorsal carinae	Dark with white bands	Dark with white spots on dorsal carinae	Dark throughout, with knees red
Cerci	Dark throughout	Dark with a white ring near base	Dark throughout	Red

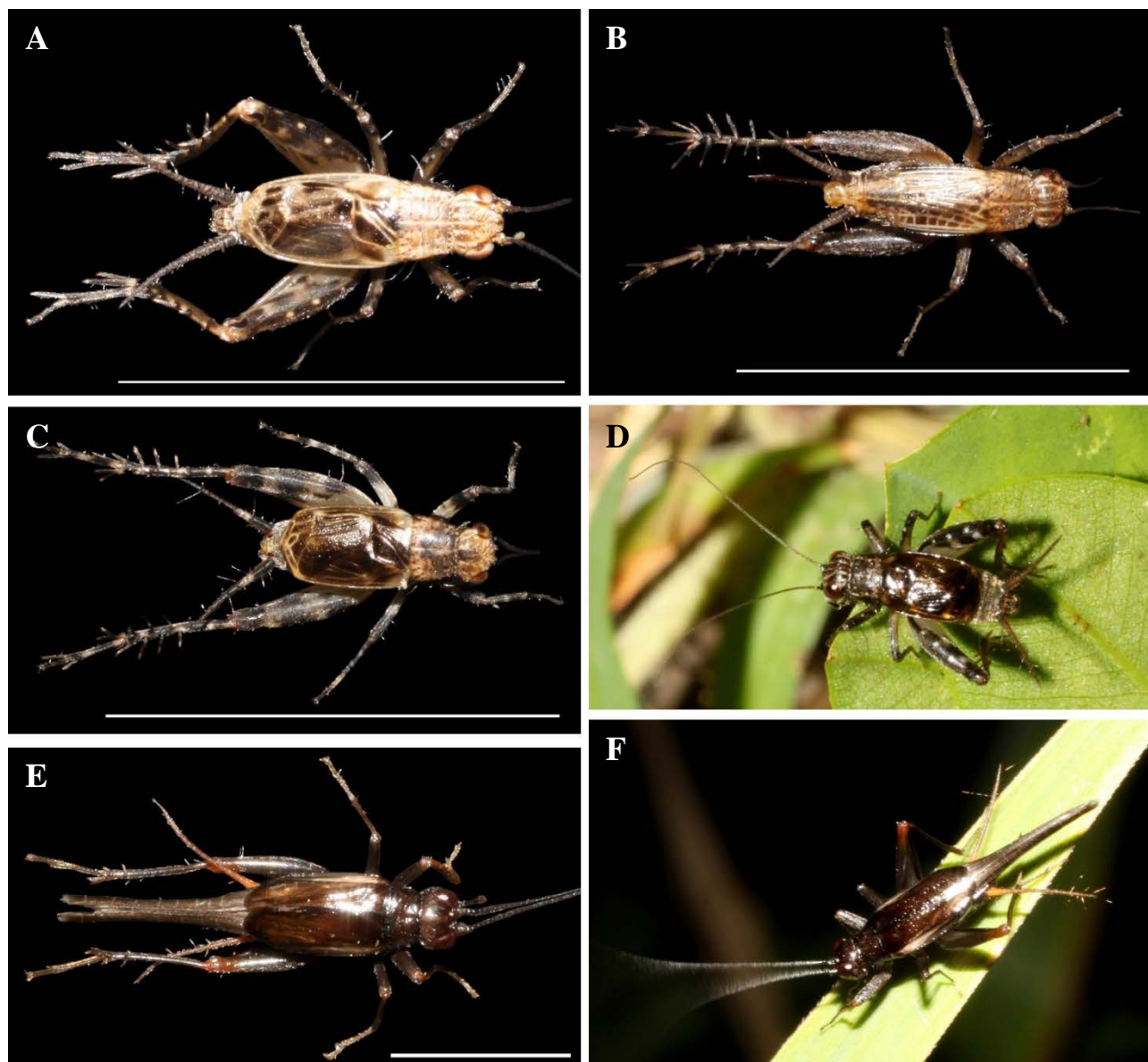


Fig. 40. Pteronemobiini species: A, B, species 1, C, species 2, D, species 3; E, F, species 4; A, C, D, male; B, E, F, female adult habitus. D, F, BL = cf. 5 mm. Scale bar = 10 mm (A–C); 5 mm (E).

### Subfamily Oecanthinae

#### *Xabea* species (Fig. 41)

Oecanthinae genera are commonly known as tree crickets, as they are often heard calling from the trees. In the Malay Peninsula, there are at least two genera are found: *Xabea* and *Oecanthus*. Although both genera appear fairly similar, examination of the specimens collected from Fraser's Hill shows that they belong to *Xabea*. *Xabea* species have cerci shorter than the mesotibiae (they are longer than the mesotibiae in *Oecanthus*); hind tibiae are without subapical spurs or small spines (subapical spurs and spines are present in *Oecanthus*) and male tegmina with bent Cu1 vein (straight in *Oecanthus*) (Otte & Alexander, 1983). Tree crickets are nonetheless poorly known taxonomically. This species was heard in considerable numbers at around 1930 h from a single tree along Mager Road.

**References:** Otte & Alexander (1983)





Fig. 41. *Xabea* species: A, male B, female adult (BL = cf. 11 mm) habitus. Scale bar = 10 mm.

***Trellius (Protrellius)* species**  
(Fig. 42)

Two species of *Trellius (Protrellius)* were described from the primary forest of Fraser's Hill by Gorochov: *Trellius (Protrellius) elenae* Gorochov (Fig. 42A) and *Trellius (Protrellius) michaili* Gorochov (Fig. 42B) (see Gorochov, 2011a). A nymph resembling that of a *Trellius* species was sighted but it is not possible to ascertain the species without the dissection of the male genitals, particularly because species of the genus are very similar morphologically. These crickets tend to live near streams and are even known to jump on the water surface with the aid of their long, hind, tibial spines and satae (A. V. Gorochov, in lit.).

**Reference:** Gorochov (2011a)



Fig. 42. *Trellius (Protrellius)* species: A, *Trellius (Protrellius) elenae* Gorochov (BL = 14.5 mm); B, *Trellius (Protrellius) michaili* Gorochov (BL = cf. 16 mm) male adult habitus. (Photographs by: A. V. Gorochov).



Orthoptera of Fraser's Hill

Subfamily **Podoscirtinae**

**Aphonoidini** species

(Figs. 43)

This is a group of slender crickets in which the species are quite similar to each other. There are about nine genera within this tribe which has a restricted Indo-Malayan distribution. Recently, a taxonomic revision of the tribe was published by Gorochov (2007b) which includes descriptions of 47 new species from the Indo-Malayan region. Unlike many other Gryllidae species, the males of these crickets lack the stridulatory apparatus. One species which was recorded and described from Fraser's Hill is *Furcimunda bipunctata* (Chopard). The genus is only recently described in 2007 by Gorochov and is based on a new species from Belum forest, Perak: *Furcimunda furcilla* Gorochov.

**Reference:** Gorochov (2007b)

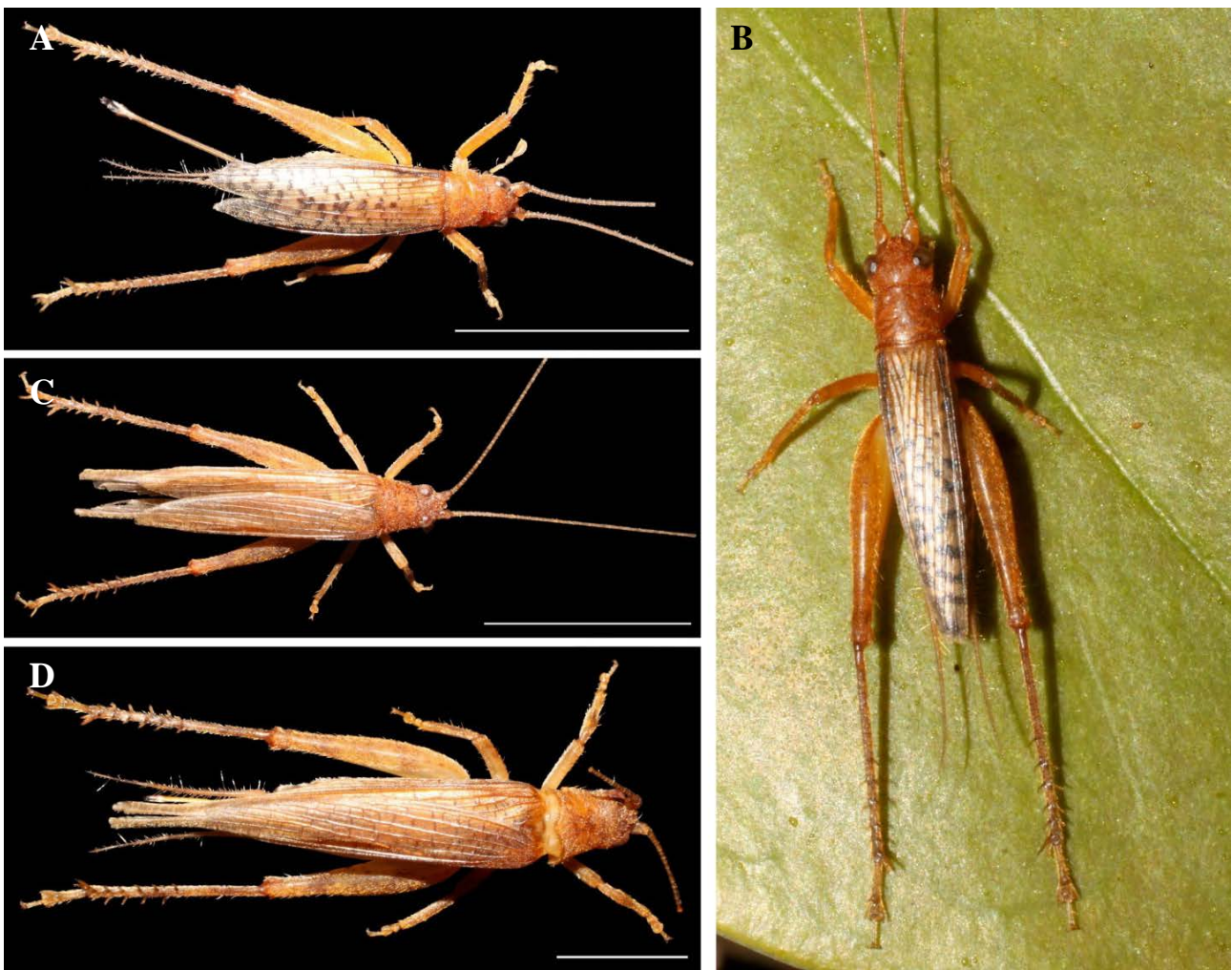


Fig. 43. Aphonoidini species: A, B, species 1, C, D, species 2; B, C, male; A, D, female adult habitus. Scale bar = 10 mm (A, C), 5 mm (D).



*Idiotrella* species

(Fig. 44)

This is another Podoscirtinae species recorded from Fraser's Hill. This species belong to the tribe Podoscirtini, whose members are generally larger than those of the tribe Aphonoidini. The two tribes are also different in that while the males of the Podoscirtini have a stridulatory organ on the tegmen, this is absent in the males of the Aphonoidini (Ingrisch, 1997). Identification to specific level is often difficult. The adults of different species are very similar and the genitalia are needed to differentiate species. The females of many species are undescribed, particularly their genitalia, making it very difficult to identify members of this tribe. There appears to have no previous record of *Idiotrella* in Fraser's Hill.

**Reference:** Ingrisch (1997)

Subfamily **Pteroplistinae**

**Pteroplistinae** species

(Fig. 45)

Pteroplistinae currently consists of nine genera, most of which are found in Southeast Asia (Eades et al., 2013). Notably, eight of the genera were only described recently and more novel genera and species are expected to be described with more discoveries in Southeast Asia. These crickets are generally small and very similar morphologically. Genitalia are thus essential for accurate identification. In Fraser's Hill, four species were recorded: *Kerinciola tabulophila* Gorochov (Fig. 45A); *Changiola pahangi* Gorochov (Fig. 45B); *Changiola perakensis* (Chopard); *Tembelingiola plana* Gorochov (Fig. 45C), of which the type locality for *Kerinciola tabulophila* and *Changiola pahangi* is Fraser's Hill (Gorochov, 2004; 2011b). Little information is however known beyond their descriptions. During the our 2012 and 2013 surveys, no species from the Pteroplistinae was sighted. This may be reasoned by their cryptic lifestyle, in which these insects hide among fissures or dead parts of tree bark in the day and are rarely found along branches (Gorochov, 2004). Further, the males of some species often sing inside their hiding refuge (Gorochov, 2004).

**References:** Gorochov (2004; 2011b)



Fig. 44. *Idiotrella* species: female adult habitus. Scale bar = 5 mm.

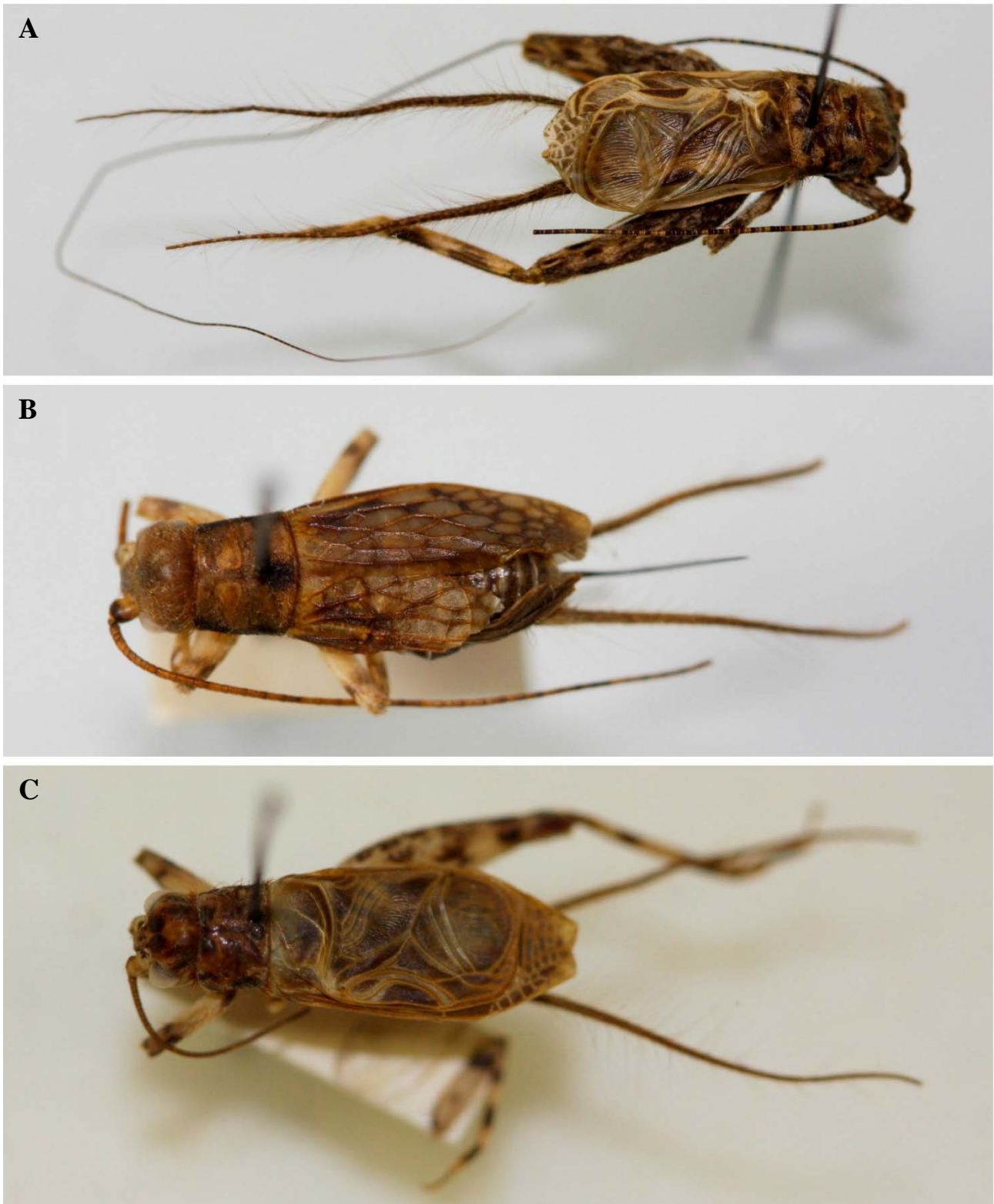


Fig. 45. Pteroplistinae species: A, *Kerinciola tabulophila* Gorochov male adult habitus (BL = cf. 12 mm); B, *Changiola pahangi* Gorochov female adult habitus (BL = cf. 11 mm); C, *Tembelingiola plana* Gorochov male adult habits (BL = 11.5 mm). (Photographs by: A. V. Gorochov).

Subfamily **Trigonidiinae**

*Amusurgus* species

(Fig. 46)

Trigonidiinae species are small crickets known as sword-tailed crickets because the ovipositors of the females are often sword-shaped, unlike that in most Gryllidae species. In Fraser's Hill, five species of sword-tailed crickets were collected. The Trigonidiinae is thus represented by the most number of species among the various subfamilies of the Orthoptera in Fraser's Hill. *Amusurgus* differs from other genera of the subfamily found so far from Fraser's Hill by the combination of: 1) hairy tegmina; 2) absence of male stridulatory apparatus; 3) absence of mirror in male tegmina; and 4) wings almost always macropterous (Otte & Alexander, 1983).

**Reference:** Otte & Alexander (1983)

*Svistella* (?) and *Trigonidium* (?) species

(Fig. 47)

*Svistella* and *Trigonidium* differ from *Amusurgus* by: 1) hairless tegmina; and 2) wings usually not macropterous. As mentioned above, the Trigonidiinae is a very diverse group of crickets and most species are also thought to be restricted in their distribution (Eades et al., 2013). Thus, it is plausible that some of the species collected from Fraser's Hill may represent species unknown to science. Nevertheless, the group is hitherto poorly known and in need of taxonomic revision. Previously, numerous species of the subfamily were described as members of the New World *Anaxipha*. Many of these descriptions are incomplete based on the modern criteria of taxonomy. Recently, some new genera such as *Svistella* were erected. Examination and revision of the types of these known species are necessary to verify the identification for the species from Fraser's Hill. At such, the identifications here are tentative.

**Reference:** Tan & Robillard (2012)

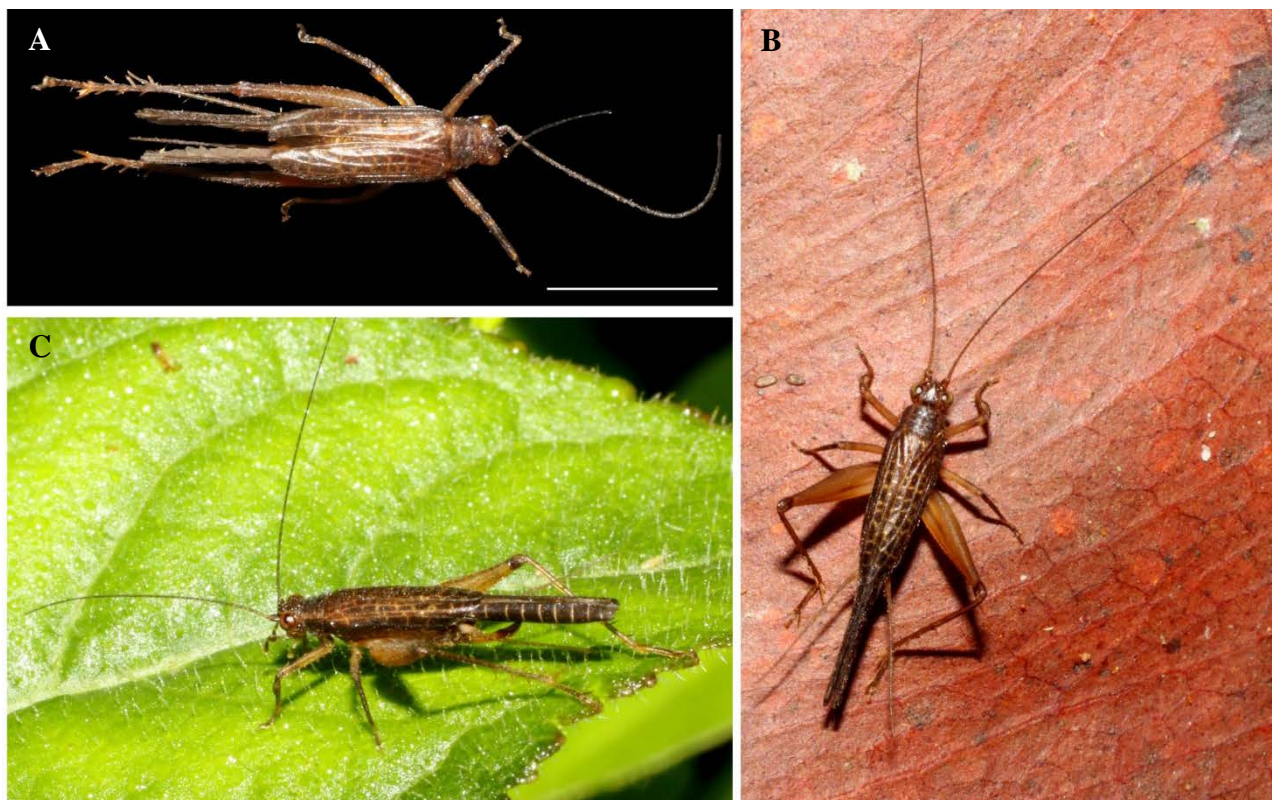


Fig. 46. *Amusurgus* species: A–C, female adult habitus. B, C, BL = cf. 5 mm. Scale bar = 5 mm.



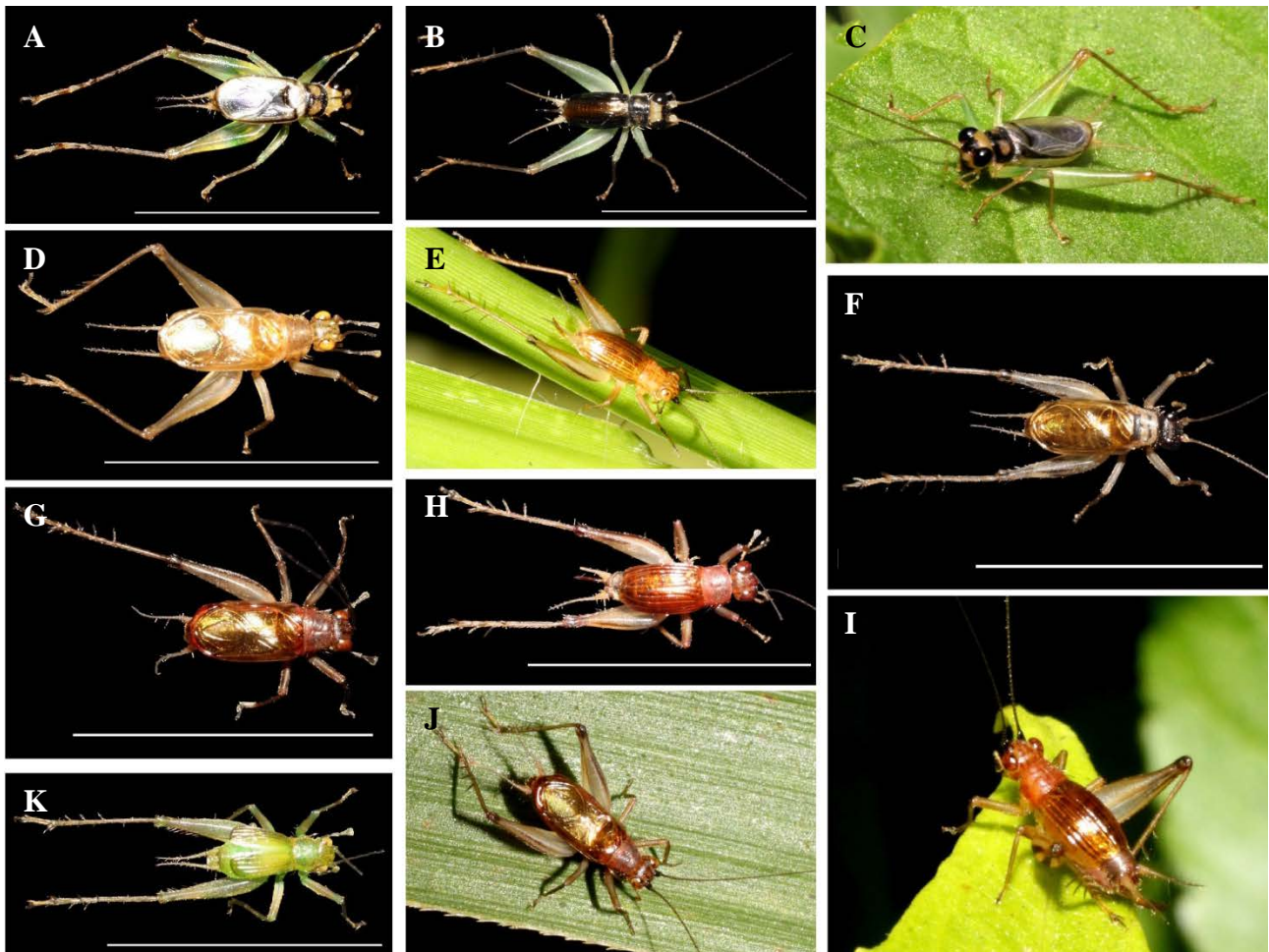


Fig. 47. *Svistella* (?) and *Trigonidium* (?) species: A–C, *Svistella* species 1; D, E, species 2; F, species 3; G–J, species 4; K, *Trigonidium* species. A, C, D, F, G, J, K, male; B, E, H, I, female adult habitus. C, E, I, J, BL = cf. 3 mm. Scale bar = 10 mm.

## FAMILY GRYLLOTALPIDAE

### Subfamily Gryllotalpinae

#### *Gryllotalpa fulvipes* Saussure (Fig. 48)

This is the smallest of the three species of mole crickets which may be found in Fraser's Hill. Previously thought to be restricted to caves and primary forest, a recent study in Singapore and observation in Fraser's Hill suggest otherwise. Although this species is listed as endangered in the Singapore Red Data Book, 2<sup>nd</sup> Edition (Davison et al., 2008), it appears to be fairly ubiquitous in Fraser's Hill. In the evening at around 1900 hours, numerous males can be heard buzzing resonantly at low frequency. Moreover, they may be heard close to human habitation. In fact, one specimen was collected on the path along Genting Road at the police station. Nevertheless, they are rarely seen as they usually hide under ground, even while calling. The males stop calling at around 1930 hours.

**References:** Chopard (1969); Davison et al. (2008); Tan (2012b)

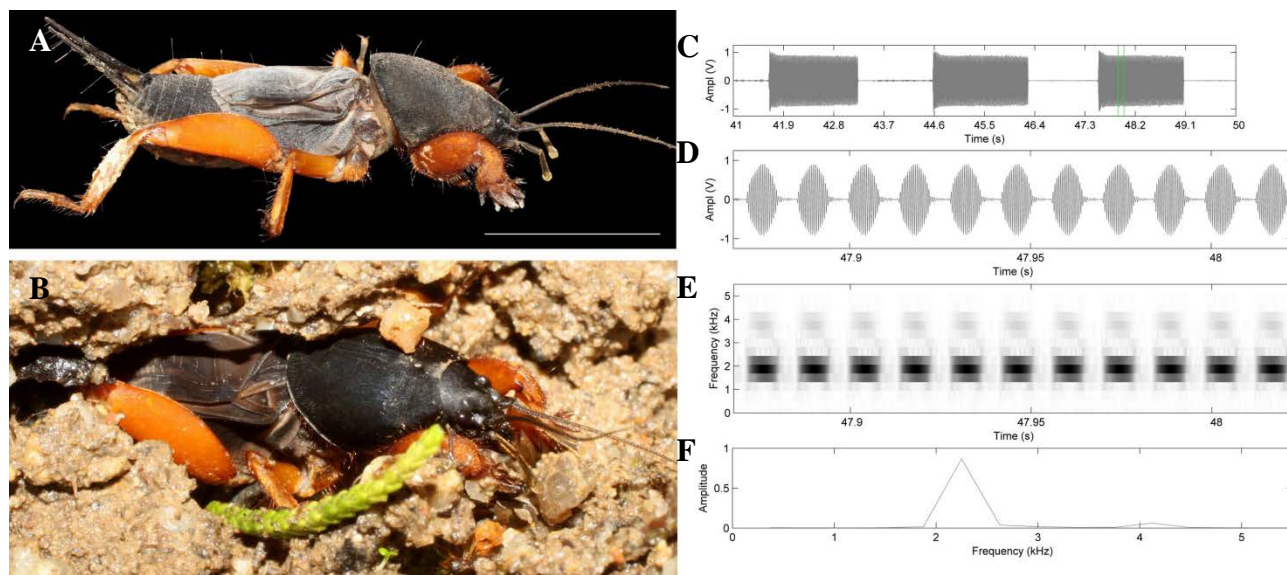


Fig. 48. *Gryllotalpa fulvipes* Saussure: A–C , male adult habitus; D–G calling song; D, E, oscillograms; F, spectrogram; G, amplitude spectrum. Scale bar = 10 mm.

### *Gryllotalpa* species

(Figs. 49, 50)

Two other species of mole crickets may be found in Fraser's Hill, both of which are larger than *Gryllotalpa fulvipes*. They also differ from *Gryllotalpa fulvipes* by their colouration and acoustics. These species are less common compared to *Gryllotalpa fulvipes* and they are often heard at around 1930 hours. One of these two mole crickets was found to be undescribed at the time of collection and has subsequently been described and named *Gryllotalpa fraser* Tan & Nizam. The general habitus of this mole cricket looks nearly identical to that of *Gryllotalpa nymphicus* Tan and *Gryllotalpa hirsuta* Burmeister but closer examination of the genitalia, tegminal venation, and acoustics suggest that they are distinct species (Tan & Nizam, 2013a). The other mole cricket was only collected once and its calling songs were not recorded.

**References:** Tan (2012b); Tan & Nizam (2013a)

## FAMILY MOGOPLISTIDAE

### Subfamily Mogoplistinae

#### *Micrornebius malaya* Tan & Nizam

(Fig. 51)

This is a small scaly cricket. The tegmina in the male are fully adapted for stridulation and not for flying. The pronotum is extended backward, covering the tegmina. Revision of this speciose genus is still incomplete with more species anticipated to be discovered and some to be transferred from similar genera such as *Cycloptiloides*, *Derectaotus*, and *Ectatoderus* (Ingrisch, 2006). Based on current knowledge, no species was described or recorded from Peninsular Malaysia (Ingrisch, 2006; Eades et al., 2013). In Fraser's Hill, one species of *Micrornebius* was collected and it was found to be an undescribed species. As this was the first *Micrornebius* described from Peninsular Malaysia, it was named after Malaya, an old name of Malaysia (Tan & Nizam, 2013c).

**References:** Ingrisch (2006); Eades et al. (2013); Tan & Nizam (2013c)



Fig. 49. *Gryllotalpa* species: A, *Gryllotalpa fraser* Tan & Nizam; B, species 2 male adult habitus. Scale bar = 5 mm.

*Ornebius* species  
(Figs. 52, 53)

This is another scaly cricket genus but of a larger size than *Micrornebius* species. Unlike *Micrornebius*, species of the genus *Ornebius* usually have the pronotum not covering the entire tegmen. They are usually found at night along forest trails. Of the material of *Ornebius*, males of only one species is known and found to be undescribed. The male of this species has characteristic pale tegmina not found in the many other known species, and thus, named *Ornebius albalatus* Tan & Nizam. Comparison of the females showed distinct differences in their genitalia and it appears that at least three species are known from the material. Previously, a species of *Ornebius* was described from Fraser's Hill: *Ornebius pendleburyi* Chopard with an amber-coloured tegmen and apical margin slightly darkened (Ingrisch, 2006). As the female is unknown and male was not collected, it is not possible to ascertain if the species is still extant in Fraser's Hill or if the females collected belong to this species.

**References:** Chopard (1969); Ingrisch (2006); Tan & Nizam (2013c)



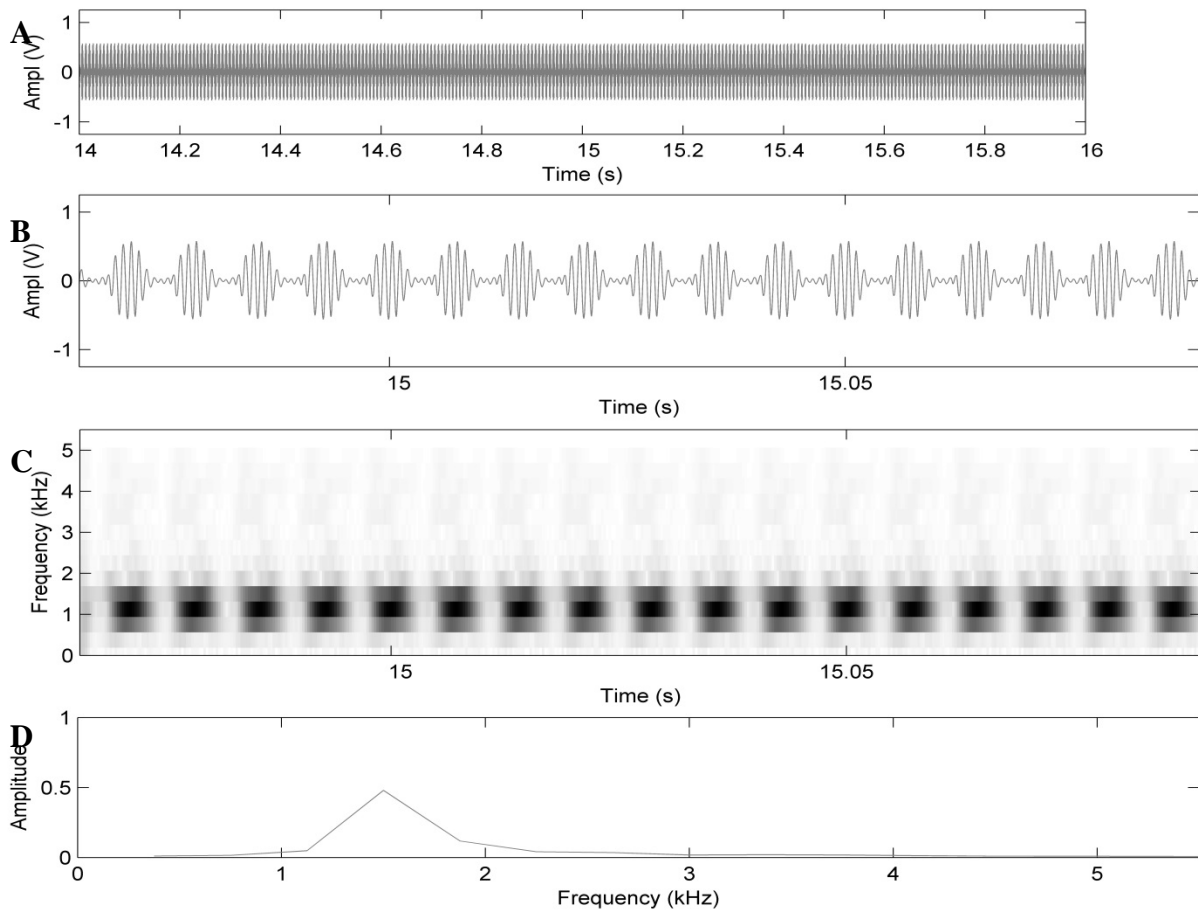


Fig. 50. *Gryllotalpa fraser* Tan & Nizam male calling song: A, B, oscillograms; C, spectrogram; D, amplitude spectrum.



Fig. 51. *Micrornebius malaya* Tan & Nizam: A, B, female; C, male adult habitus. A, BL = 4.3 mm; C, 4.1 mm (C). Scale bar = 10 mm.



Fig. 52. *Ornebius albalatus* Tan & Nizam males: A–C, adult habitus. A, C, BL = cf. 9 mm. Scale bar = 10 mm.

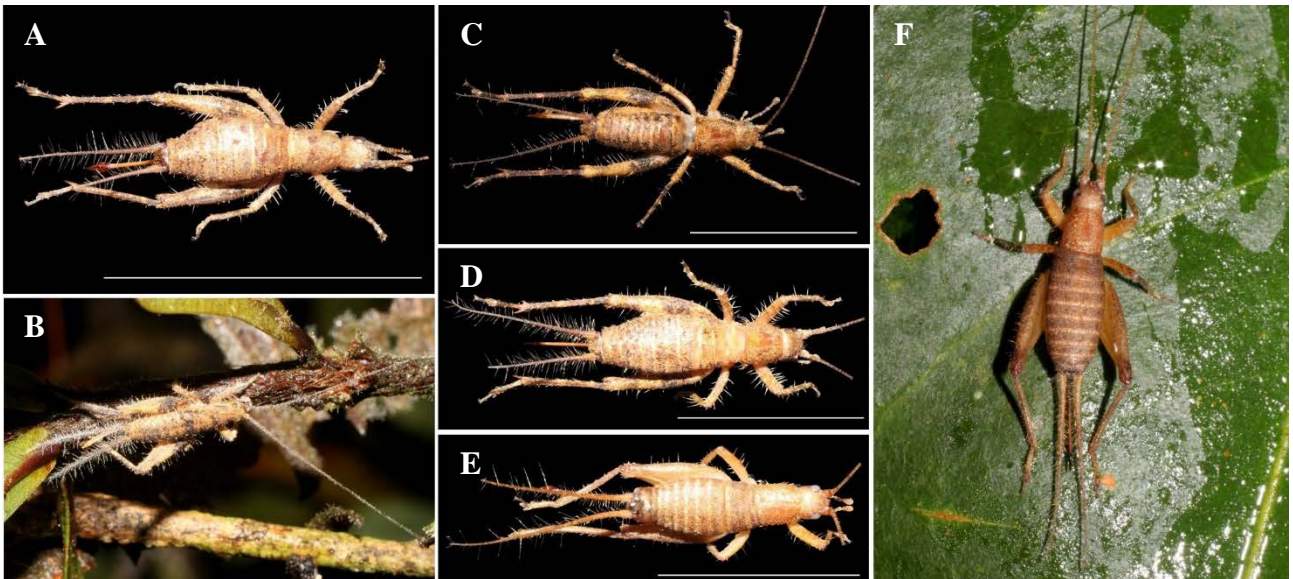


Fig. 53. *Ornebius* species females: A, *Ornebius albalatus*, B–D, species 1; E, F, species 2. B, F, BL = cf. 9 mm. Scale bar = 10 mm.



## FAMILY RHAPHIDOPHORIDAE

Subfamily **Rhaphidophorinae****Rhaphidophorinae** species

(Figs. 54, 55)

Rhaphidophorinae species are commonly known as the hump-backed crickets. Very recently, Gorochov described numerous new taxa (including new genera) from Southeast Asia (Gorochov, 2012b). Some of these taxa were described from Fraser's Hill, namely: *Diarhaphidophora mira* Gorochov, *Diarhaphidophora sympatrica* Gorochov, *Eurhaphidophora bona* Gorochov, *Neorhaphidophora grata* Gorochov, *Rhaphidophora magna* Gorochov, *Stonychophora* (?) *pileata* Gorochov, and *Stonychophora trilobata* Gorochov. However, the taxonomy is still in an unclear state with potentially more undescribed species yet to be discovered. The single female specimen collected appears to be similar to *Eurhaphidophora bona* that was described from Fraser's Hill: colouration of legs; patterns on the hind femur (brown dorsally, with numerous pale fine oblique stripes and sparse small spots below a grey longitudinal stripe); the hind femur without spines ventrally and with one distinct inner apical spine; dorsal inner apical spine of hind tibia reaching apical spine of hind basitarsus; the epiproct oval and slightly angular apically; the subgenital plate simple with acute-angled apex (different from Fraser's Hill species of other genera); ovipositor similar (Gorochov, 2012b). There are however also differences in the epiproct and apical tergites. Male specimens are required for more conclusive identification. A single male specimen was collected on the same survey night along Kindersley Trail close to the female specimen. The genitalia is simple, suggesting that it may belong to the genus *Rhaphidophora* (Gorochov, 2012b). This specimen is however different from *Rhaphidophora magna* described from Fraser's Hill in 2012. It is not easy to differentiate the genera of Rhaphidophorinae and thus this identification is tentative.

**Reference:** Gorochov (2012b)

## FAMILY GRYLLACRIDIDAE

Subfamily **Gryllacridinae***Capnogryllacris fruhstorferi* (Griffini)

(Fig. 56)

This is one of the two genera of raspy crickets which were collected from Fraser's Hill. Commonly confused as katydids, raspy crickets are known to produce silk from their mouthparts (Rentz, 2010), although such behaviour was not observed in Fraser's Hill. *Capnogryllacris fruhstorferi* is a large raspy cricket which is intensely coloured. It has long wings surpassing the abdominal apex and hence is easily distinguished from the other genus of raspy cricket recorded from Fraser's Hill.

**References:** Murphy (1973); Gorochov (2003)

*Larnaca* species

(Fig. 57)

*Larnaca* is a smaller raspy cricket which is found in Fraser's Hill, often with short-banded tegmina and with the ovipositor strongly upcurved or sickle-shaped. A total of three distinct species were collected from Fraser's Hill (Table 5): *Larnaca* (*Larnaca*) *fasciata* Walker, *Larnaca* (*Larnaca*) *nigrata* (Brunner von Wattenwyl) and *Larnaca* (*Larnaca*) *pendleburyi* (Karny).

**References:** Murphy (1973); Gorochov (2003)



Orthoptera of Fraser's Hill

Table 5. Differences between three species of *Larnaca* from Fraser's Hill.

	<i>Larnaca fasciata</i>	<i>Larnaca nigrata</i>	<i>Larnaca pendleburyi</i>
Head	Mostly orange with faint tint of black	Black	Mostly black
Pronotum	Mostly orange with faint tint of black	Mostly black; disc with pale bands along anterior and posterior margin; lobe with a large pale spot at the posterior half.	Mostly black; disc with longitudinal pale strip; lobe with a small, indistinct and pale spot at the posterior half.
Tegmen	Banded black and yellow; yellow band wider than the basal black band but about as wide as distal black band. Basal orange spot larger.	Banded black and yellow; yellow band between the black bands are narrower. Basal orange spot indistinct and smaller.	Banded black and yellow; yellow band between wider than black bands.
Leg	Black rings less prominent. Femur with single ring distinct on ventral surface, indistinct on dorsal surface; tibia with two faint ring, distal fainter.	Black rings are prominent. Femur with a single ring near to knee; tibia with two rings, larger one nearer to knee.	Black rings are prominent. Femur with a single ring very near to knee, on ventral surface, indistinct on dorsal surface; tibia with single ring very near to knee.



Fig. 54. *Eurhaphidophora* species: A, B, female adult habitus. BL = cf. 30 mm (A). Scale bar = 5 mm.

Tan & Kamaruddin

FAMILY TETTIGONIIDAE

Subfamily Conocephalinae

*Conocephalus* species

(Figs. 58, 59)

These are cone-headed katydids or meadow katydids belonging to the tribe Conocephalini, one of the two tribes of the subfamily Conocephalinae that are represented in Fraser's Hill. Two species were recorded in Fraser's Hill: *Conocephalus (Anisoptera) maculatus* (Le Guillou) (Fig. 58) and *Conocephalus (Anisoptera) melaenus* (Haan) (Fig. 59). Of the two species of *Conocephalus* found in Fraser's Hill, *Conocephalus melaenus* is more common. Males of *Conocephalus melaenus* can be heard chirping among grassy and herbaceous areas in both days and nights. *Conocephalus maculatus* can be distinguished from *Conocephalus melaenus* by hind femur with: 1) distal part and hind knee unicolourous (knee darkened in *Conocephalus melaenus*); and 2) ventral surface without spines (with spines in *Conocephalus melaenus*) (Zhou et al., 2010). During the survey, *Conocephalus melaenus* was found to be feeding on seeds of grasses and leaves of herbs, although species of this genus are also known to feed on eggs of pest insects. The nymphs of *Conocephalus melaenus* are distinctly red with black abdomen.

**References:** Willemse (2001); Zhou et al. (2010)



Fig. 55. *Rhaphidophora* species: A, B, male adult habitus. A, BL = cf. 25 mm. Scale bar = 5 mm.



Orthoptera of Fraser's Hill

*Lesina* species

(Fig. 60)

Sometimes known as a dragon-headed katydid, this is a species of cone-headed katydid belonging to the subtribe Eumegalodontina of the tribe Agraeciini. This subtribe differs from the other Agraeciini species by pronotum with lateral angles of dorsal disc projecting with spines and spinules (Ingrisch, 1998a). The phylogenetic relationship between Eumegalodontina and the other Agraeciini is still uncertain (Ingrisch, 1998a). There are two genera within the subtribe: *Ellatodon* and *Lesina* (Eades et al., 2013). The two genera differ by the presence and absence of dorsal spines on fore- and middle femora in *Lesina* and in *Ellatodon*, respectively (de Jong, 1942). Although species of this subtribe was not recorded or collected in Fraser's Hill, a photographic record by T. M. Leong showed that *Lesina* is extant in Fraser's Hill. As the specimen photographed was a female nymph, it was not possible to ascertain the species name. Nonetheless, two species were recorded from the Malay Peninsula: *Lesina intermedia* (Karny) and *Lesina vaginata* (Karny). A key to species of *Lesina* can also be found in de Jong (1942).

**References:** de Jong (1942); Ingrisch (1998a)



Fig. 56. *Capnogyllacris fruhstorferi* (Griffini): A, B, male adult habitus. B, BL = cf. 37 mm. Scale bar = 5 mm.



*Liara (Liara) alata* Ingrisch

(Fig. 61)

This is a cone-headed katydid belonging to the tribe Agraeciini. This species of Agraeciini was described in 1998 from the Ulu Gombak Field Study Centre and Krau Game Reserve (Ingrisch, 1998a). As such, the recording of this species in Fraser's Hill is novel. This katydid is often found around bamboo plants where it is found to reside near the opening of a hollow stem of the bamboo. Upon disturbance, the katydid will hide within the stem. Such an observation was also previously unrecorded by Ingrisch (1998). Females collected from Fraser's Hill also allowed the first description of the female (Tan & Ingrisch, 2014). This species is distinct from other Fraser's Hill species of the tribe Agraeciini by the presence of a black medial band on the vertex and disc of the pronotum. A detailed study of the taxonomy, phylogeny, biogeography, acoustics, and development of this tribe of cone-headed katydid can be found in Ingrisch (1998a).

**References:** Ingrisch (1998a); Tan & Ingrisch (2014)

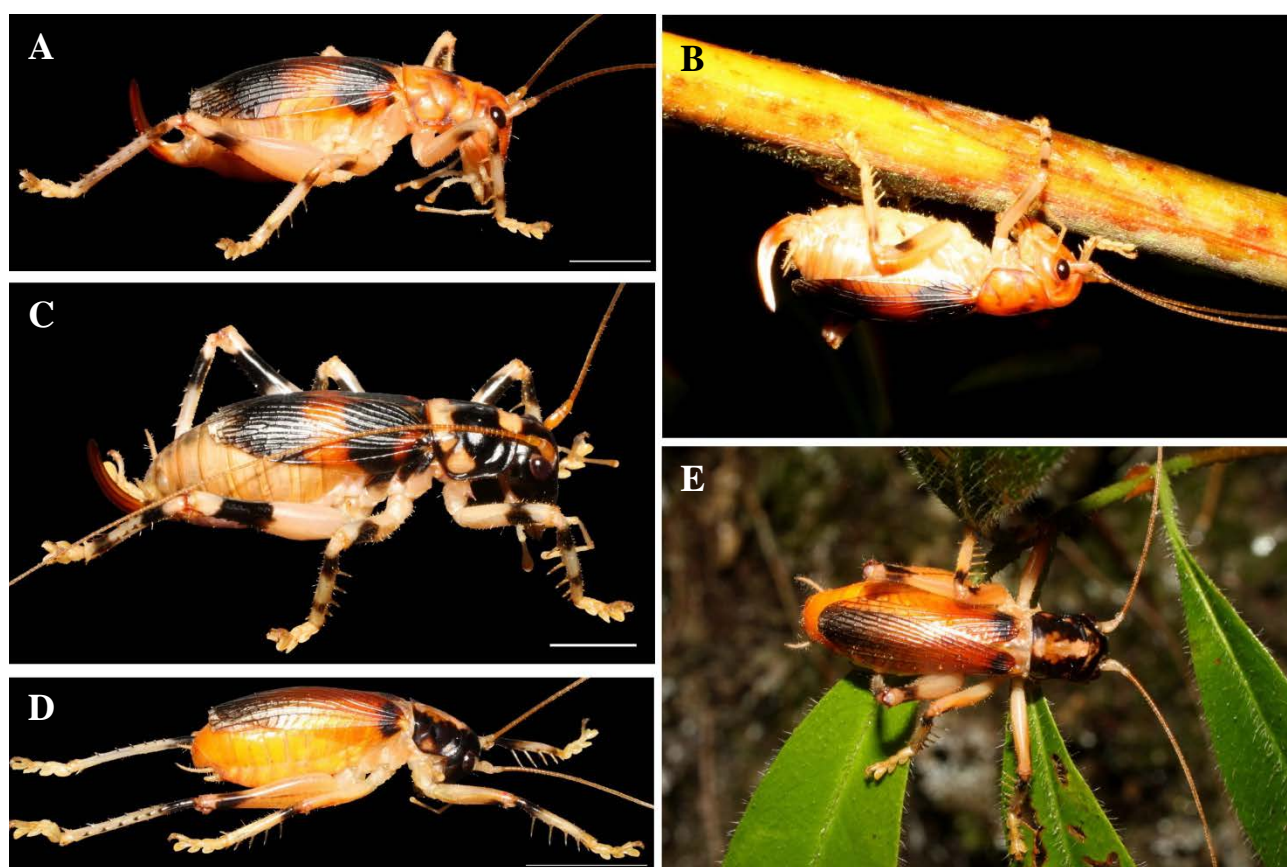


Fig. 57. *Larnaca* species: A, B, *Larnaca fasciata*; C, *Larnaca nigrata*; D, E, *Larnaca pendleburyi*; D, E, male; A–C, female adult habitus. B, BL = cf. 20 mm; E, BL = cf. 24 mm. Scale bars = 10 mm (A); 5 mm (C).



Fig. 58. *Conocephalus* (*Anisoptera*) *maculatus* (Le Guillou): A, male; B, female adult habitus. Scale bar = 10 mm.

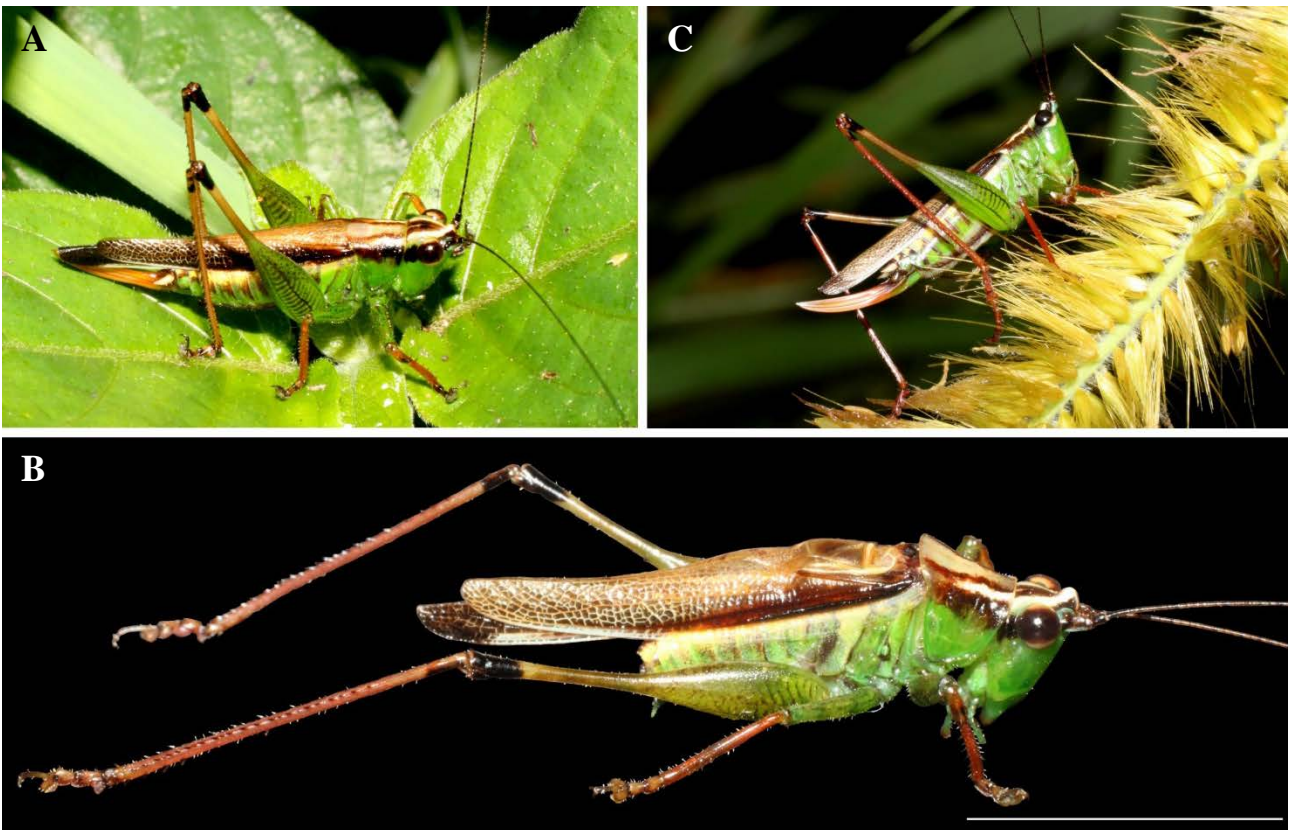


Fig. 59. *Conocephalus* (*Anisoptera*) *melaenus* (Haan): A, female; B, male adult habitus; C, a female adult feeding on seeds of grasses. A, C, BL = cf. 14 mm. Scale bar = 10 mm.





Fig. 60. *Lesina* species: female nymph habitus. (Photograph by: T. M. Leong).



Fig. 61. *Liara (Liara) alata* Ingrisch: A, male; B, female adult habitus; C, female adult (BL = cf. 37 mm) feeding on stem of bamboo; D, adult (BL = cf. 37 mm) hiding inside stem of bamboo; E, nymph (BL = cf. 35 mm) preparing for moulting. Scale bar = 5 mm.



Orthoptera of Fraser's Hill

*Lichnofugia malaya* Tan & Ingrisch

(Fig. 62)

This Agraeciini katydid may also be found in bamboo plants, often together with *Liara* (*Liara*) *alata*. However, the habitus is clearly different: its smaller size, strongly abbreviated wings, and different colouration. Similar observations of it hiding within bamboo stems were also made with this species. So far, five species are known and all are distributed only in Thailand and Vietnam (Ingrisch, 1998a) thus, this record of this genus in Peninsular Malaysia is novel and this species was also found to be undescribed (Tan & Ingrisch, 2014). It differs from all other species of the genus, with the exception of *Lichnofugia nigra* Ingrisch, 1998, by the black face and shape of subgenital plate. This species differ from Vietnamese species *Lichnofugia nigra* by the distinctly narrower face with wider expansion of the black colouration (Tan & Ingrisch, 2014). The single female adult specimen from Fraser's Hill was the paratype of the species.

**References:** Ingrisch (1998a); Tan & Ingrisch (2014)

*Macroxiphus sumatranus siamensis* Helfert & Sanger

(Fig. 63)

This is a large cone-headed katydid. Generally black in colour, the head is however rather brightly red at the frons and genae. The anterior part of tegmen is yellow with black spots and the distal part pale yellow with some dark spots. A single female was collected in Dec.2013. *Macroxiphus sumatranus siamensis* was previously a distinct species (*Macroxiphus siamensis* Helfert & Sanger from Thailand and Malaysia), and different from two other species: *Macroxiphus sumatranus* Haan and *Macroxiphus raapi* Griffini from Sumatra. However, a recent revision showed that the morphology and genitalia are very similar between the three taxa, they are currently treated as different subspecies of the same species (Ingrisch, 1998a).

**Reference:** Ingrisch (1998a)

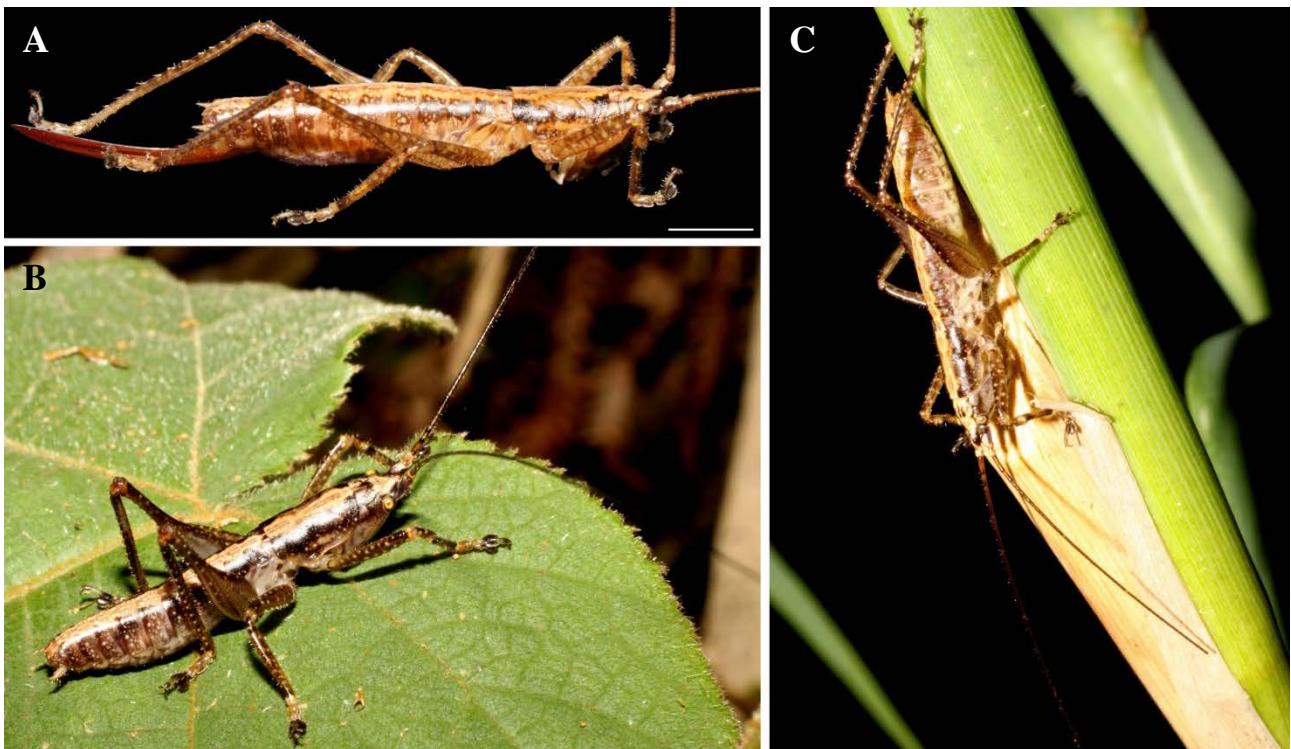


Fig. 62. *Lichnofugia malaya* Tan & Ingrisch: A, female adult; B, C, male nymph habitus. B, C, BL = cf. 5 mm. Scale bar = 5 mm.



Fig. 63. *Macroxiphus sumatranus siamensis* Helfert & Sanger: A, B, female adult habitus. B, BL = cf. 37 mm (B). Scale bar: 5 mm.

*Mesagraecia* cf. *bicolor* Ingrisch  
(Fig. 64)

This is another cone-headed katydid of the tribe Agraeciini. The habitus is similar to that of *Liara* (*Liara*) *alata* but it may be differentiated in the field by the absence of a black, medial band on the vertex and pronotum. A single female was sighted in Dec.2012 and was observed to be feeding on the stem of a grass. Without examination of the male abdominal apex, the species name could not be ascertained.

**Reference:** Ingrisch (1998a)

*Nahlaksia bidadari* Ingrisch & Tan  
(Fig. 65)

This is another species of the tribe Agraeciini. This cone-headed katydid appears to be associated with the forest rather than bamboo and/or grass as mentioned above for other species in the tribe. This species has only recently been described from Singapore and Peninsular Malaysia (from Kampung Bongsu, Pahang) (Ingrisch & Tan, 2012). This katydid is generally ochre or brown with an irregular light and dark pattern. It has a uniformly black face which makes it distinct from the species from Thailand (*Nahlaksia suphattra* Ingrisch has black and red face) (Ingrisch & Tan, 2012). The wings in adults are strongly abbreviated. This is also partly why this species is named after ‘Bidadari’, which also implies ‘nymph’ as adults may be easily mistaken as nymphs owing to the strongly abbreviated wings (Ingrisch & Tan, 2012). This species was only sighted and collected once at Fraser’s Hill. It was found dwelling among branches.

**References:** Ingrisch (1998a); Ingrisch & Tan (2012)



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Fig. 64. *Mesagraecia* cf. *bicolor* Ingrisch: A, female adult (BL = cf. 21 mm) feeding on the stem of a tall grass; B, female adult habitus. Scale bar = 10 mm.

*Palaeoagraecia brunnea* Ingrisch  
(Fig. 66)

This yellow-brown cone-headed katydid is rather widely distributed as opposed to many other species in Southeast Asia. It can be found in Thailand, Peninsular Malaysia, Vietnam, India, and even Bhutan. In Peninsular Malaysia, it was recorded mainly in highlands such as Fraser's Hill, Maxwell's Hill, and Cameron Highlands. However, this cone-headed katydid was not sighted during our 2012 and 2013 surveys and little information is known about this katydid other than its taxonomic description.

**Reference:** Ingrisch (1998a)



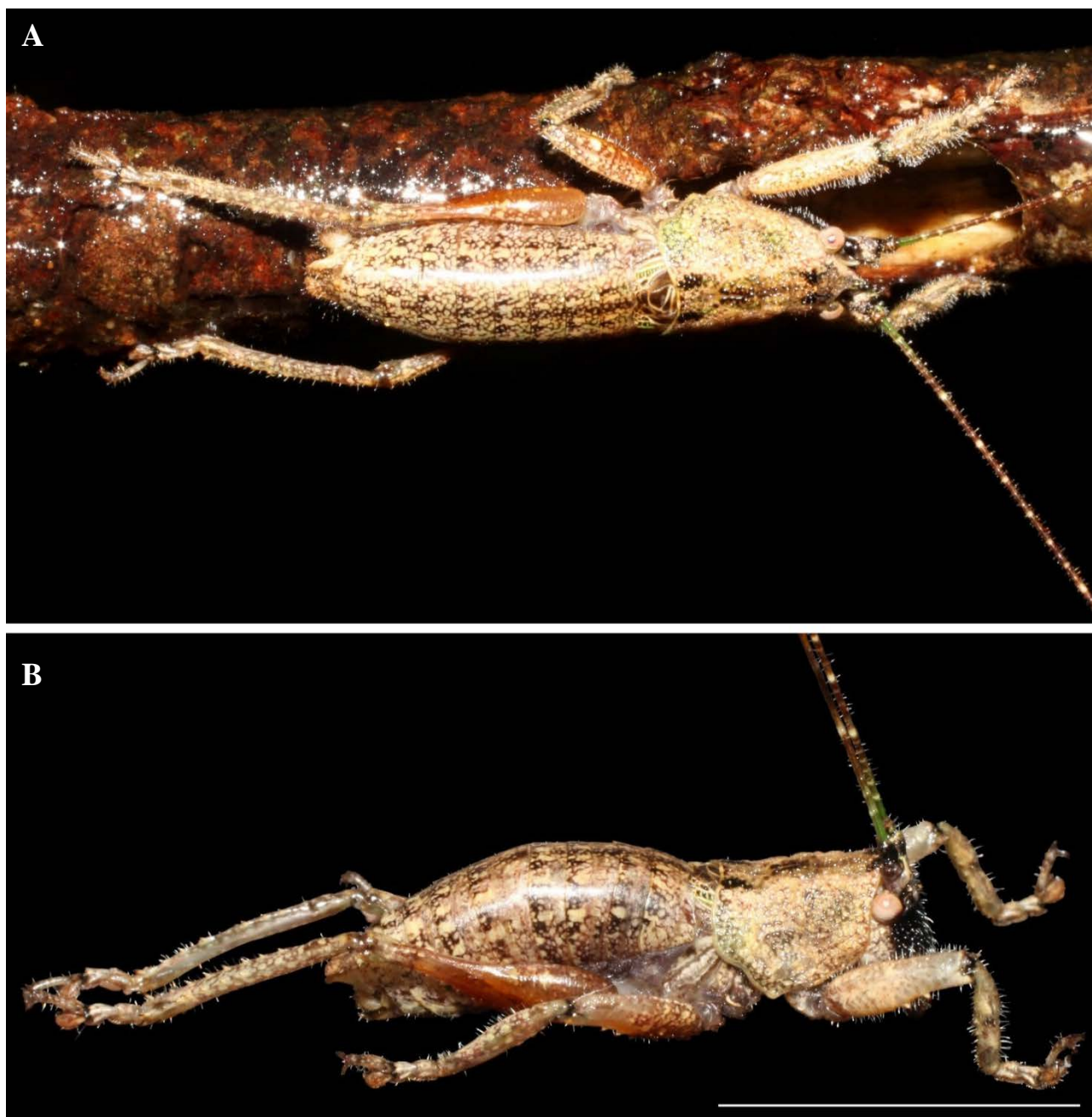


Fig. 65. *Nahlaksia bidadari* Ingrisch & Tan: A, male adult (BL = cf. 16 mm) near the burrow on a stem; B, male adult habitus. Scale bar = 10 mm.

*Peracca conspicuithorax* Griffini  
(Fig. 67)

This is similar to *Lichnofugia malaya* and *Nahlaksia bidadari*, as this brownish-testaceous cone-headed katydid also has abbreviated wings. A male and a female were collected among bamboo plants, although they were not found to reside inside the hollow stems. Such behaviour was also recorded in Ingrisch (1998a). *Peracca conspicuithorax* was described from Peninsular Malaysia and was found in different part of Peninsular Malaysia, ranging from the states of Pahang, Perak, Melaka, and Selangor (Ingrisch, 1998a). A very similar species, *Peracca mirzai* Tan & Ingrisch was described only recently from Singapore, previously thought to be of the same species as *Peracca conspicuithorax* (Tan & Ingrisch, 2014). Interestingly, the species from Singapore, though very similar in morphology, was found only near swamp forest, rather than among grassy areas.

**References:** Ingrisch (1998a); Tan & Ingrisch (2014)



Fig. 66. *Palaeoagraecia brunnea* Ingrisch: male adult habitus (BL = cf. 33 mm) (Eades et al., 2013).

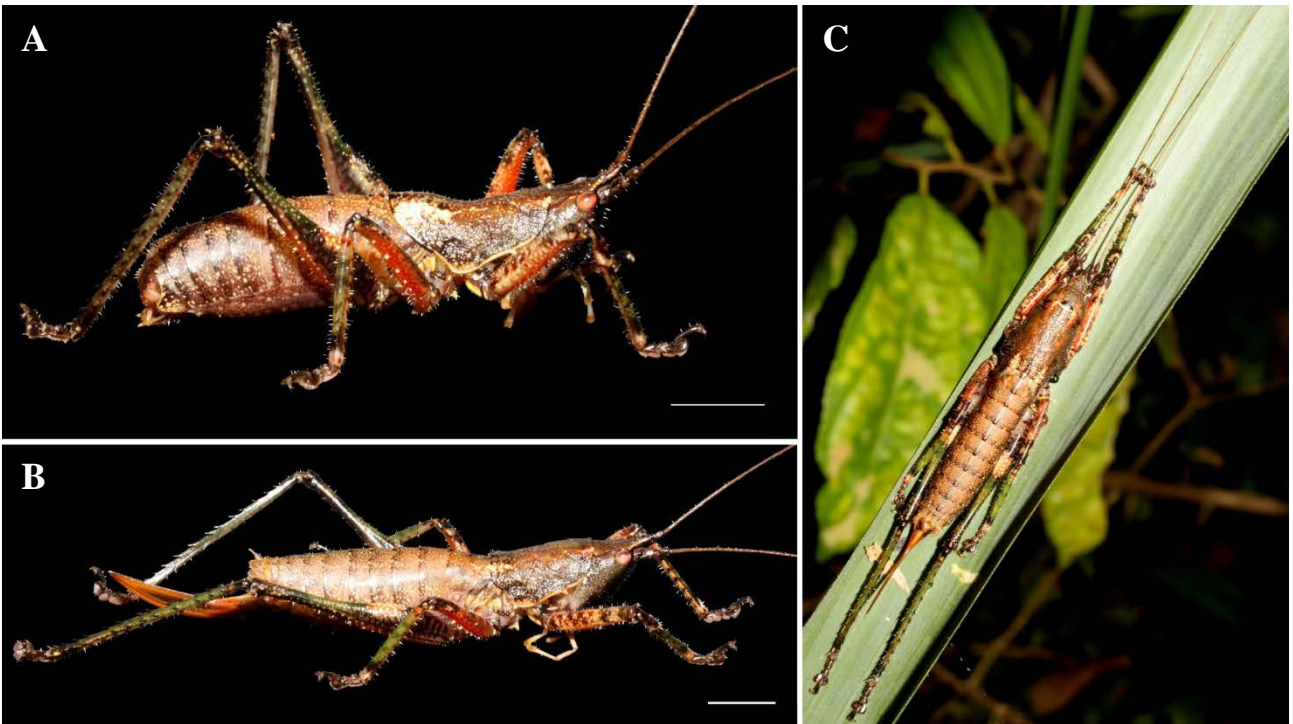


Fig. 67. *Peracca conspicuithorax* Griffini: A, male; B, C, female adult habitus; C, female adult in cryptic posture on the leaf of bamboo (BL = cf. 29 mm). Scale bar = 5 mm.

*Peracca (Peracca) originalis* Gorochov

(Fig. 68)

This is another cone-headed katydid from the genus *Peracca*. It was only very recently collected and described from Fraser's Hill and is distinctively different from many other species of the genus by the: 1) light-coloured sternites; 2) short, hind, pronotal lobe; 3) cerci with six lobes; and 4) subgenital plate with long articulated styli. Because of its morphological distinctiveness, this species was named *originalis* which means original in Latin.

**Reference:** Gorochov (2011d)

Subfamily **Meconematinae**

**Meconematini** species

(Figs. 69, 70)

Species of the tribe Meconematini are often delicate and nocturnal. The tribe is diverse and consists of many speciose genera (Gorochov, 1998; 2008b). Many species have been recently described from Southeast Asia. In fact, the generic classification of this tribe is considered premature (Gorochov, 2008b). This species differs mainly in the form of the abdominal apex but its delicate habitus often results in the abdomen shrinking upon drying, making identification difficult. As a result of its taxonomic vastness, it requires expertise to identify the species accurately to the generic, and hence specific level. One species was described from Fraser's Hill: *Xiphidiopsis (Xiphidiopsis) angustifurca* Gorochov. From our 2012 and 2013 surveys, at least two distinct taxa of Meconematini were collected they are tentatively identified as *Alloteratura* (?) species and *Xiphidiopsis* (?) species.

**References:** Gorochov (1998; 2008b)

*Asiophlugis* cf. *malacca* Gorochov

(Fig. 71)

Species of the tribe Phlugidini are also known as swayers because of their tendency to sway their body laterally. This genus is still under revision, with more species previously placed under the American genus *Phlugis* being transferred to this Asian genus (Gorochov, 2012c). More species are also expected to be described with further surveys in the region. It is only recently that one species new to science was described from Pulau Tioman (Gorochov & Tan, 2011). The specimens from Fraser's Hill are very similar to *Asiophlugis thaumasia* (Hebard) from Singapore and *Asiophlugis malacca* Gorochov from the Peninsular Malaysia (Gorochov 1998; Tan, 2011). However, close examination of the abdominal apex indicates clear differences compared to *Asiophlugis thaumasia*. Unfortunately, only the females of *Asiophlugis malacca* are known and it is not possible to ascertain if the specimens from Fraser's Hill are new or are males of *Asiophlugis malacca*. Work is currently underway to solve this taxonomic problem.

**References:** Gorochov (1998); Gorochov & Tan (2011); Tan (2011); Gorochov (2012c)

*Neophisis* (?) species

(Fig. 72)

This is another delicate katydid of the subfamily Meconematinae but belonging to the tribe Phisidini of which the species are commonly known as the long-legged spider katydids. When threatened, this katydid assumes a cryptic posture under a leaf. A revision of the tribe in the region was conducted by Jin & Kevan (1992).

**References:** Jin & Kevan (1992); Rentz (2010)





Fig. 68. *Peracca (Peracca) originalis* Gorochov male adult habitus (BL = cf. 28 mm). (Photograph by: A. V. Gorochov).



Fig. 69. *Alloteratura (?)* species: A, B, female adult habitus. A, BL = cf. 10 mm. Scale bar = 10 mm.

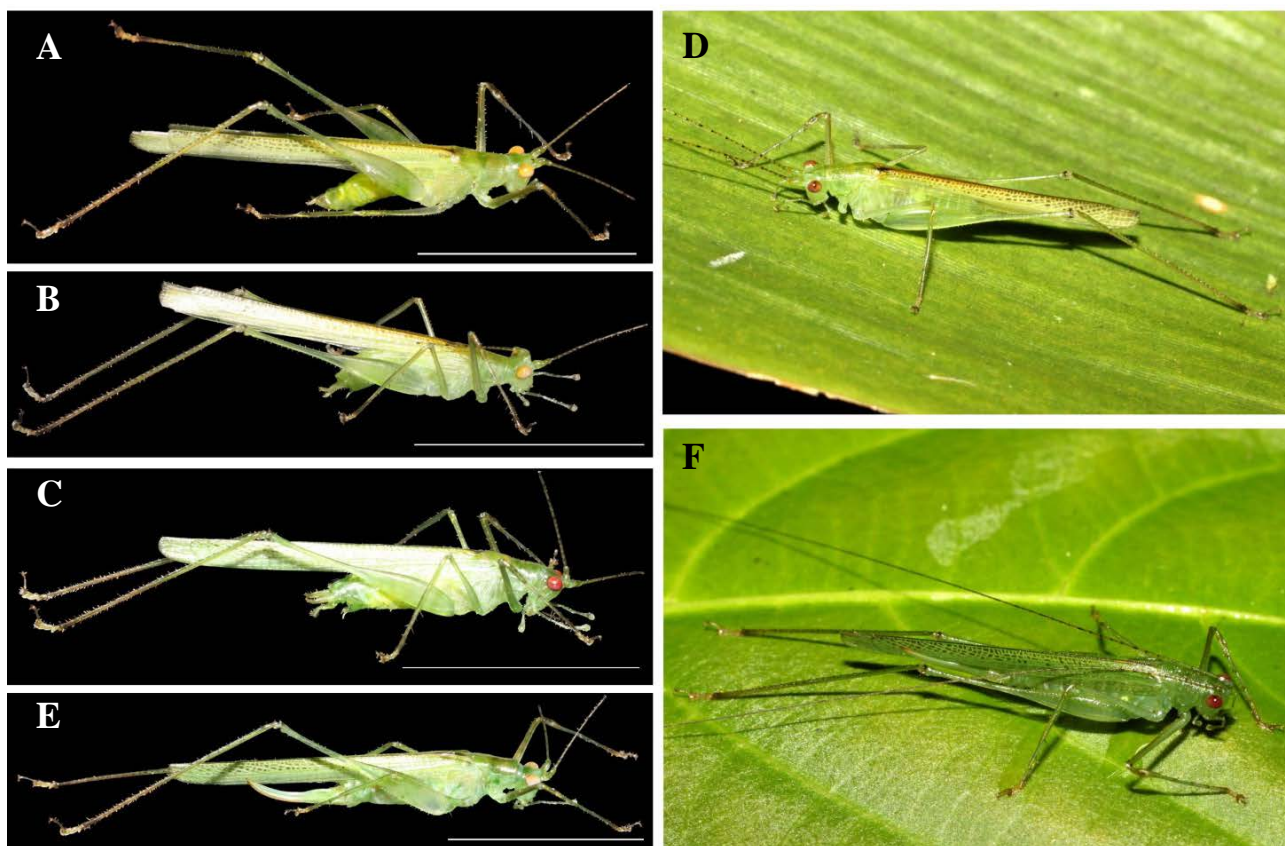


Fig. 70. *Xiphidiopsis* (?) species: A–D, male; E, F, female adult habitus. D, BL = cf. 10 mm; F, BL = cf. 11 mm. Scale bar = 10 mm.

#### Subfamily Mecopodinae

##### *Mecopoda elongata* (Linnaeus) (Figs. 73, 74)

This is a large katydid, and perhaps one of the largest found in Fraser's Hill so far. It is sometimes locally known as walang werik (Willemse, 2001). A taxonomic revision is necessary for this species as acoustic analysis suggests that there may exist more than one cryptic species (Nityananda & Balakrishnan, 2006). In Fraser's Hill, two types of male sound were observed, one recorded in Dec. 2012 and the other in May 2013. Both are clearly different. The song recorded in Dec. consists of a series of fairly homogeneous chirping trills. Each trill can be separated into three distinct subtypes of different wave forms. The first part is lowest in amplitude and highest in pulse rate. The second part is loudest in amplitude but lowest in pulse rate. The calling song recorded in May consists of a series of wailing chirps. Unfortunately, the male recorded in May was not collected so it is not possible to examine its morphology. It is therefore unclear if the differences in the songs signify intrapopulation, sibling species, or temporal variation.

**References:** Willemse (2001); Nityananda & Balakrishnan (2006)



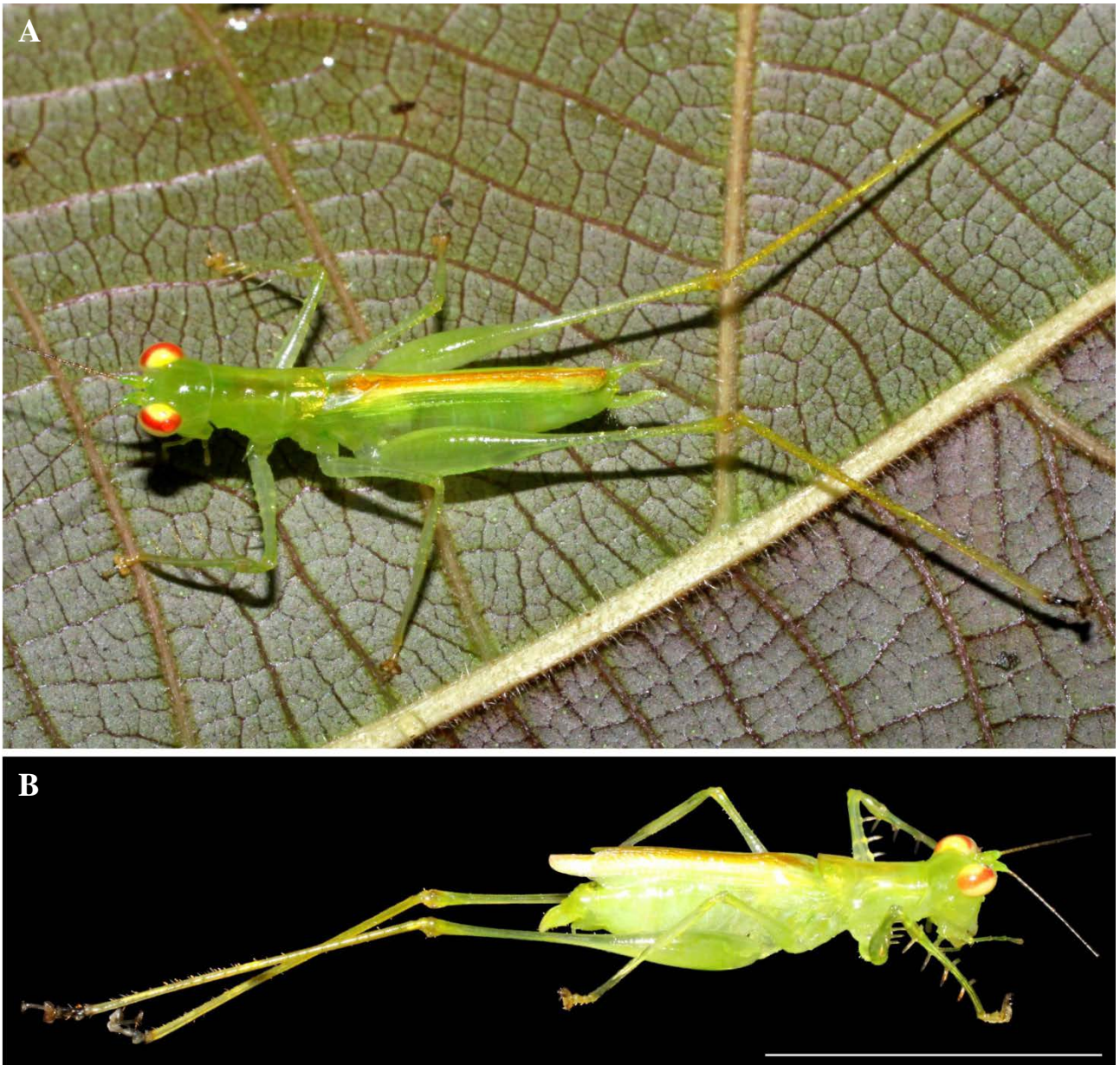


Fig. 71. *Asiophlugis* cf. *malacca* Gorochov: A, B, male adult habitus. A, BL = cf. 13 mm. Scale bar = 10 mm.



Fig. 72. *Neophisis* (?) species: A, C, male; B, female adult habitus. C, BL = cf. 10 mm. Scale bar = 10 mm.





Fig. 73. *Mecopoda elongata* (Linnaeus): A, male adult habitus; B, a nymph (BL = cf. 30 mm) hiding among leaves; C, male adult (BL = cf. 36 mm) calling. Scale bar = 10 mm.

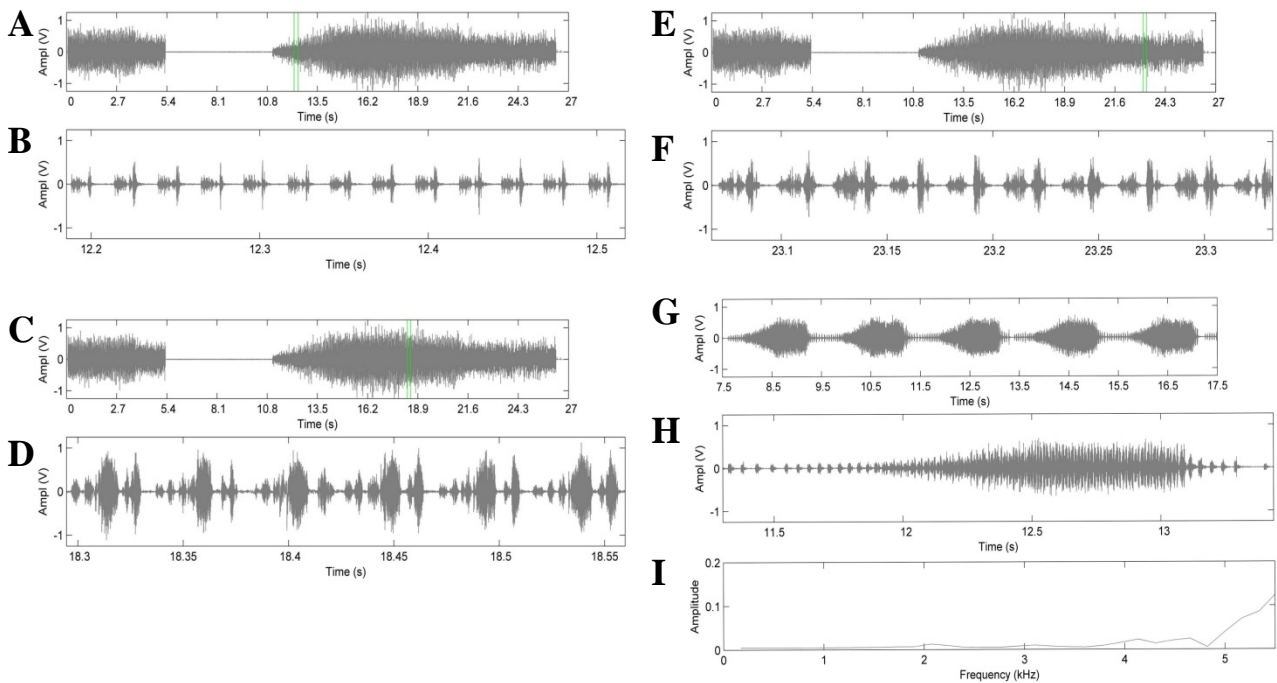


Fig. 74. *Mecopoda elongata* (Linnaeus) male calling songs: A–F calling song recorded in Dec. 2012; G–I, in May 2013; A–H oscillograms; I, amplitude spectrum; A, B, oscillograms of first; C, D, second; E, F, third sections.

Orthoptera of Fraser's Hill  
Subfamily **Phaneropterinae**

*Elbenia fraser* Tan  
(Fig. 75)

This is a new species recently described from Fraser's Hill based on a single male collected. No other sighting of this species was made during our surveys. Among the four species of Phaneropterinae collected, this species appears to be rare, compared to *Elimaea (Rhaebelimaea) pseudochloris* Ingrisch and *Phaneroptera brevis* (Serville) which are much more abundant in Fraser's Hill. Of the 19 species of the genus currently known, seven species were described from different parts of Peninsular Malaysia (Tan, 2014b). However, the specimen from Fraser's Hill has a distinctly different male genitalia from all known species. An annotated key to the species of *Elbenia* can be found in Tan (2014b).

**Reference:** Murphy (1973); Tan (2014b)

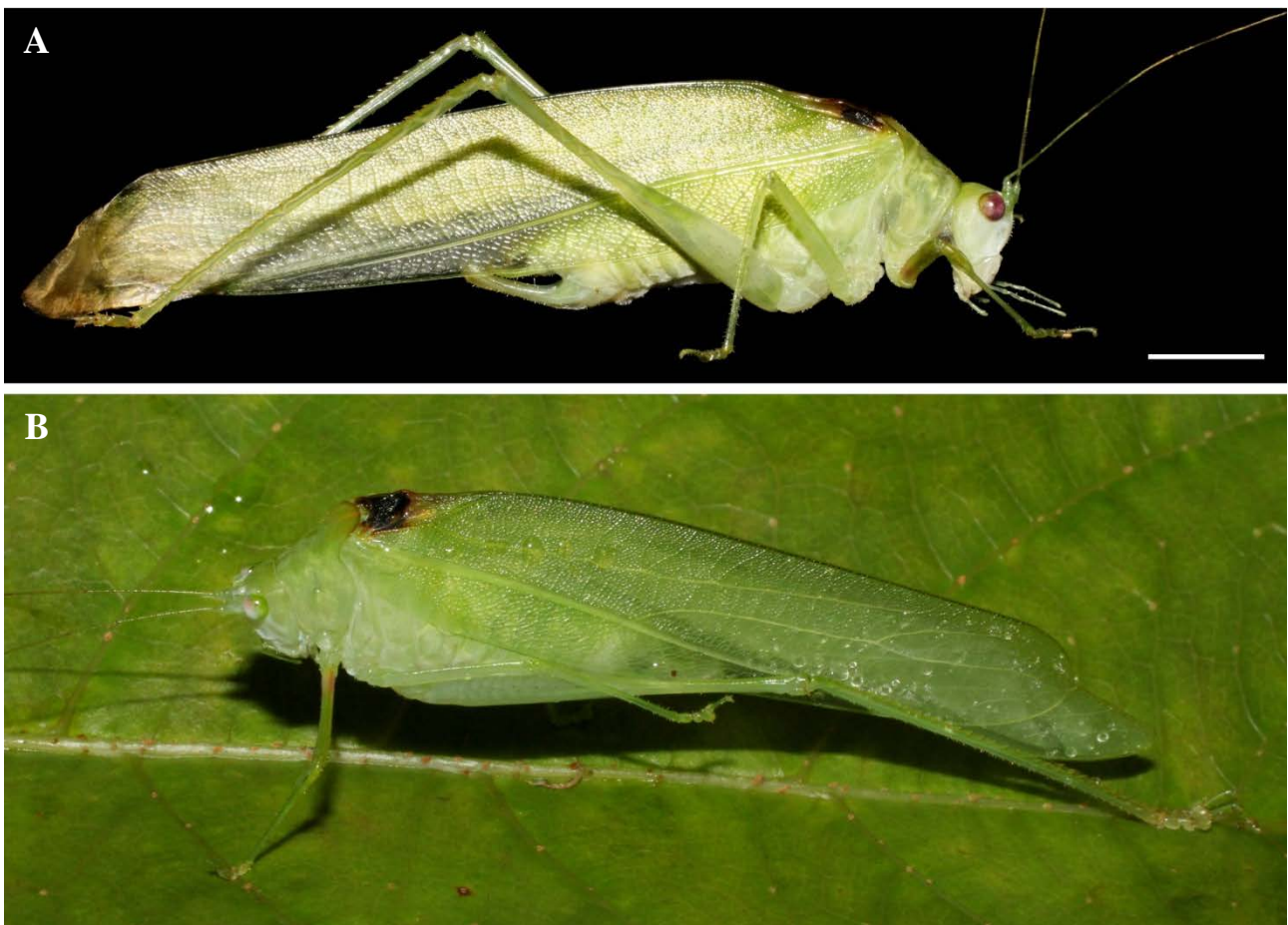


Fig. 75. *Elbenia fraser* Tan: A, B, male adult habitus. B, BL = 24.7 mm. Scale bar = 5 mm.



*Elimaea (Rhaebelimaea)* species

(Fig. 76)

Species of the Phaneropterinae are sometimes known as the bush katydids. One specious genus is the *Elimaea* which consists of nine subgenera (Eades et al., 2013). Two species of *Elimaea (Rhaebelimaea)* were recorded from Fraser's Hill: 1) *Elimaea (Rhaebelimaea) aprilis aprilis* Gorochov; and 2) *Elimaea (Rhaebelimaea) pseudochloris* Ingrisch. *Elimaea (Rhaebelimaea) aprilis aprilis* was described from Fraser's Hill but this was not sighted during our recent surveys (Gorochov, 2011c). *Elimaea (Rhaebelimaea) pseudochloris* was previously described from Thailand and the record from Fraser's Hill represents the first in Peninsular Malaysia (Ingrisch, 1998c; Tan & Nizam, 2013b). Species of the subgenus are known to be highly restricted in distribution and tend to inhabit forest habitats (Ingrisch, 1998c; Tan & Nizam, 2013b). This species may be heard quite commonly at night at the forest edge among shrubs and tall grasses. However, it is often very difficult to locate this species. The katydid is usually well camouflaged among the vegetation and would stop calling once it senses some disturbance or threat. In the day or when inactive, this katydid will also remain motionless in a tripod, cryptic posture as a form of camouflage.

**References:** Ingrisch (1998c); Gorochov (2011c); Tan & Nizam (2013b)

*Phaneroptera brevis* (Serville)

(Fig. 77)

This is another bush katydid and is perhaps the most common and abundant katydid in Fraser's Hill. This diurnal katydid could be seen calling and feeding on plant parts among grassy and herbaceous areas in the day. Matings were also observed during the day.

**Reference:** Murphy (1973)

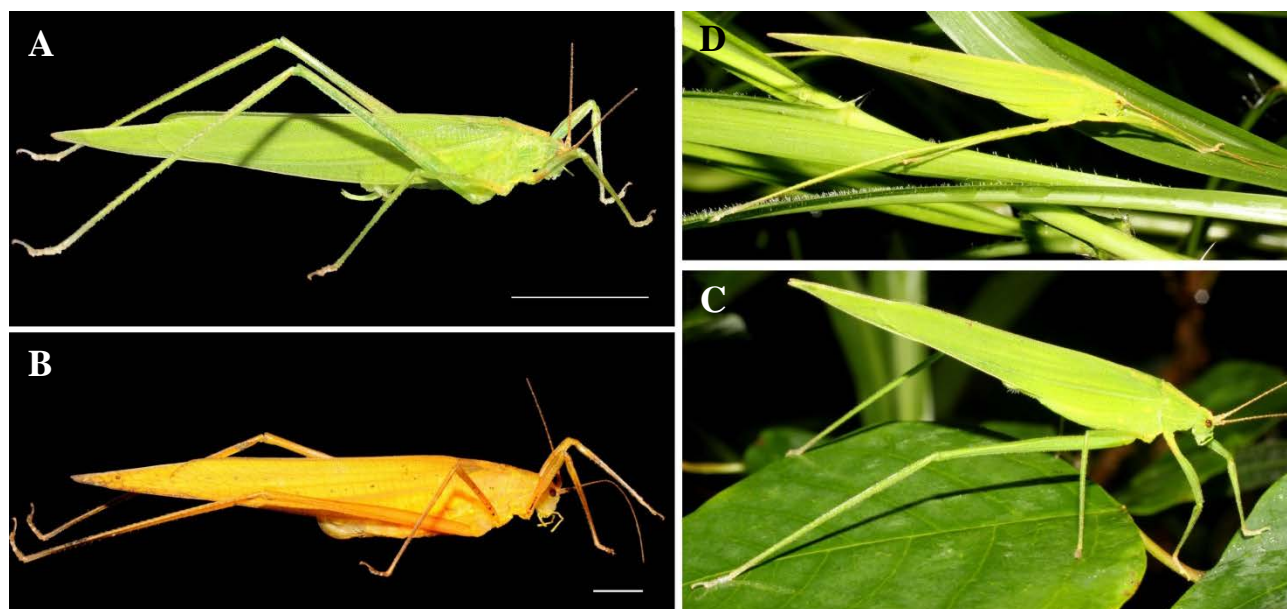


Fig. 76. *Elimaea (Rhaebelimaea) pseudochloris* Ingrisch: A, male; B, female adult habitus; C, D, adult males (BL = cf. 15 mm) in tripod, cryptic postures. Scale bars = 10 mm (A); 5 mm (B).



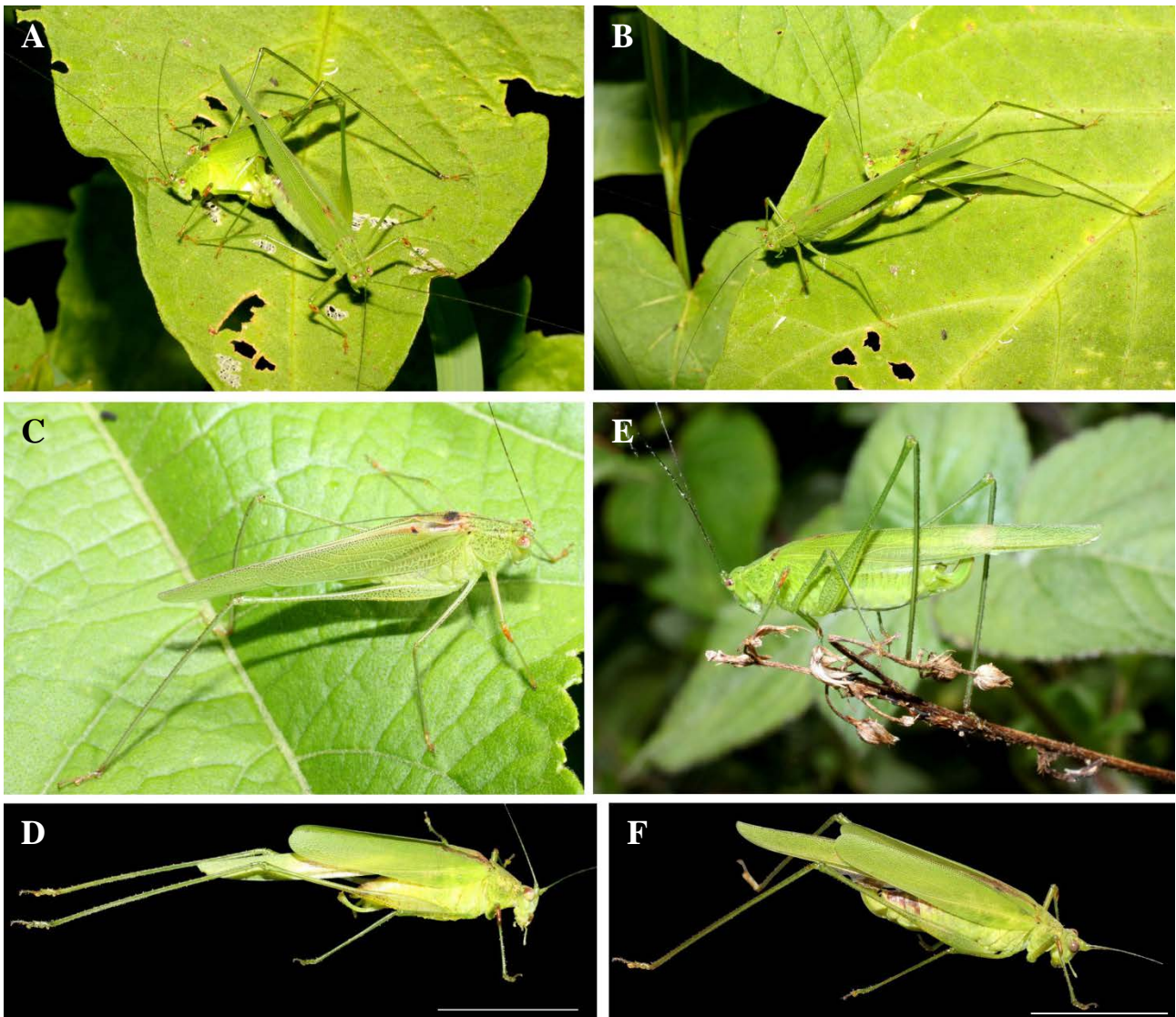


Fig. 77. *Phaneroptera brevis* (Serville): A, B, a mating pair; C, D, male; E, F, female adult habitus. BL = cf. 13 mm (A–E). Scale bar = 10 mm.

*Pseudopsyra bispina* Tan & Nizam  
(Fig. 78)

This is another bush katydid recorded from Fraser's Hill and it was recently described as a new species. As with *Elbenia* species, only a single male specimen was collected. Little information is available with regard to its life history as the specimen was found dead on the floor of a corridor in Puncak Inn. Similar to many other genera of Phaneropterinae, the venation of the tegmen is an important diagnostic character. The specimen has radial (R) and medial (M) veins not stronger than the cross veins and the M running into the R, characteristic of either *Pseudopsyra* or *Psyrana*. *Pseudopsyra* is a poorly known genus in which only three species were previously known—one from Malay Peninsula and two from China. Comparison with photographs from Hebard (1922) and Liu & Kang (2006) showed that while the male abdominal apex is similar to that of *Pseudopsyra mirabilis* Hebard described from Penang and other species from China, there are also slight but diagnostic differences (Tan & Nizam, 2013b).

**References:** Hebard (1922); Murphy (1973); Liu & Kang (2006); Tan & Nizam (2013b)



Fig. 78. *Pseudopsyra bispina* Tan & Nizam: male adult habitus. Scale bar = 5 mm.

### Subfamily **Pseudophyllinae**

*Phyllomimus (Phyllomimus)* cf. *inversus* Brunner von Wattenwyl  
(Fig. 79)

This is a leaf-mimicking katydid which can be heard calling on the leaves of trees at night which sounds like the word ‘katydid’. As such, this katydid subfamily is also known as the true katydid, being the first of the kind to be discovered. When disturbed, this katydid will stop calling and spread out the wings and stay compressed to the leaf to blend into the environment, thus giving its name ‘leaf-mimicking’.

**References:** Murphy (1973); Tan (2012c)

**Phyllomimini** species  
(Fig. 80)

A single specimen of another species belonging to the same tribe as *Phyllomimus (Phyllomimus)* cf. *inversus* Brunner von Wattenwyl was collected from Fraser’s Hill. It is smaller and more delicate relative to *Phyllomimus (Phyllomimus)* cf. *inversus*. While the body is generally yellow green, the vertex of head, including the fastigium, is distinctively dark red. Similar to other Pseudophyllinae species, this katydid also spreads out its wings and stays compressed to leaves when threatened. Only one male specimen was collected near a grassy area.

**Reference:** Murphy (1973)

*Promeca* cf. *perakana* Beier  
(Fig. 81)

This is another species of leaf-mimicking katydid collected from Fraser’s Hill. This species is larger and brown compared to the other two species of the Pseudophyllinae. In the Pseudophyllinae, the tegminal venation is an important diagnostic character. *Promeca* has the medial (MA) and cubital (Cu) veins separated from their base; the MA vein runs closer to the Cu vein than the radial (R) veins; the R veins originate beyond the middle of the tegmen.

**Reference:** Murphy (1973)





Fig. 79. *Phyllomimus (Phyllomimus) cf. inversus* Brunner von Wattenwyl: male adult habitus. Scale bar = 10 mm.



Fig. 80. Phyllomimini species: A, B, male adult habitus. BL = cf. 30 mm (B). Scale bar = 5 mm.



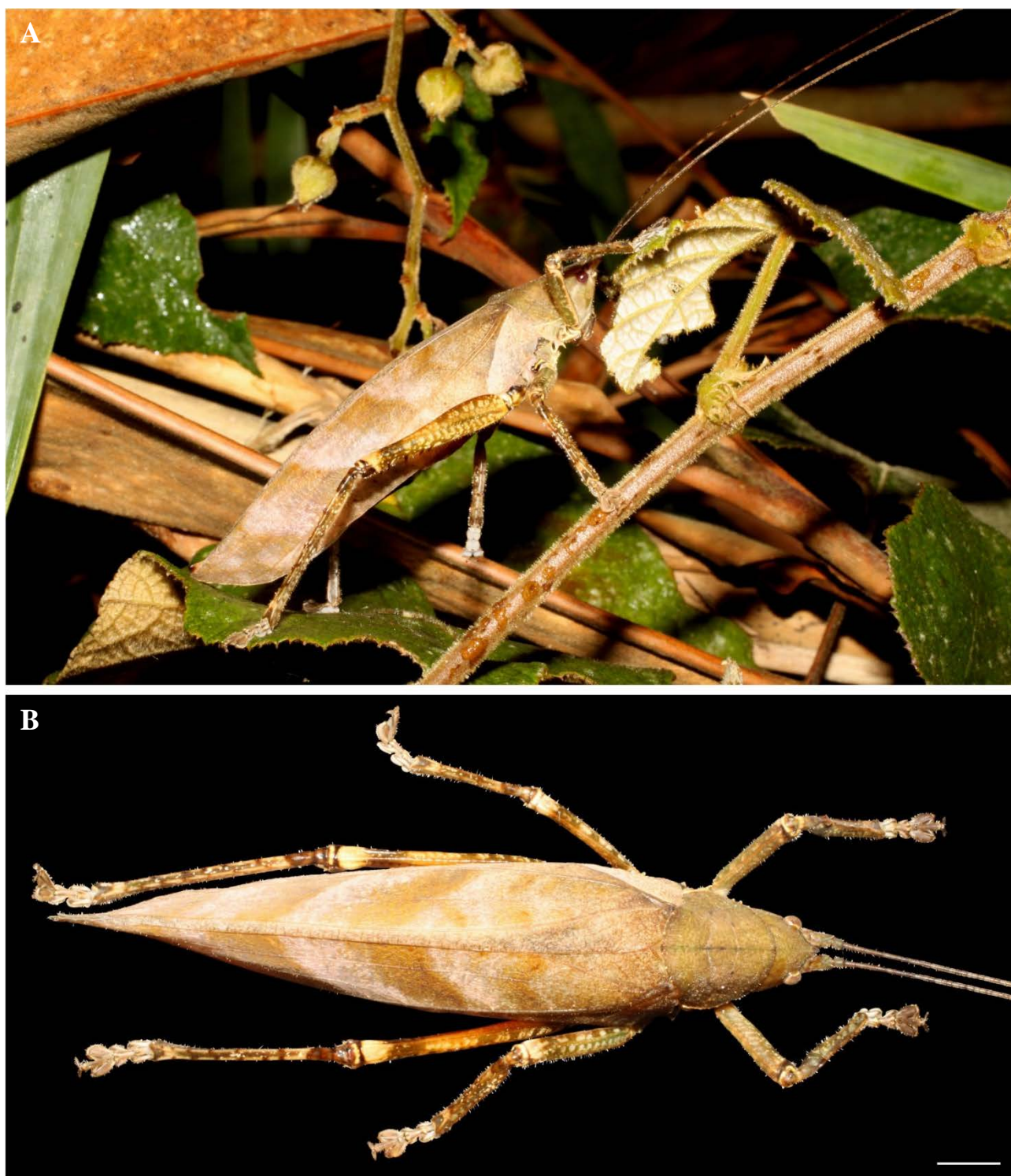


Fig. 81. *Promeca cf. perakana* Beier: A, B, female adult habitus. A, BL = cf. 55 mm. Scale bar = 5 mm.

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## APPENDIX 1

Material examined from the collections in Dec.2012, May 2013 and Dec.2013. Remarks: Under sex (S), M represents male, F represents female and N represents nymph (identifiable). \*Under altitude is measured in terms of metres above sea level. \*\* represents species which are not included in the checklist as only nymphs were collected and not conclusively identified.

Family (Subfamily)		Locality Name		Locality Data			Collection Data	
Reference Number	S	Name of Taxon	GPS Coordinates		Altitude*	Microhabitat	Date	Time
<b>Acrididae</b> ( <b>Acridinae</b> )		<i>Phlaeoba antennata</i> Brunner von Wattenwyl						
FRA.12.009	F	Jeriau Waterfall	N03.72581	E101.71354	990 ± 112	short grass near stream	20 Dec.12	1345
FRA.12.013	M	Jeriau Waterfall	N03.72622	E101.71332	1004 ± 8	short grass near stream	20 Dec.12	1400
FRA.12.014	F	Jeriau Waterfall	N03.72610	E101.71352	980 ± 7	short grass near stream	20 Dec.12	1405
FRA.12.024	F	Jeriau Waterfall	N03.72734	E101.71269	962 ± 6	grass/ herb near stream	20 Dec.12	1510
FRA.12.051	F	Peninjau Road after Kindersley Trail entrance	N03.71401	E101.74535	1230 ± 6	grass	22 Dec.12	1339
FRA.13.016	F	Jeriau Road, en route to Jeriau Waterfall	N03.71837	E101.72996	1228 ± 8.1	on leaves of short grasses and shrubs	15 May 13	1454
<b>Acrididae</b> ( <b>Catantopinae</b> )		<i>Eritrichius cf. modiglianii</i> Bolívar						
FRA.12.113	M	Jeriau Road, en route to Jeriau Waterfall	N03.71934	E101.72940	1190 ± 6	among herb	29 Dec.12	2014
<b>Acrididae</b> ( <b>Catantopinae</b> )		<i>Meltripata antennata</i> (Miller)						
FRA.13.024	M	Peninjau Road	N03.71420	E101.74595	1254 ± 5.7	on leaves of grasses	17 May 13	1925
FRA.13.051	F	Ledegham Road	N03.71693	E101.73931	1276 ± 8.0	on leaf of shrub	7 Dec.13	1444
<b>Acrididae</b> ( <b>Catantopinae</b> )		<i>Stenocatantops splendens</i> (Thunberg)						
FRA.13.037	F	Jeriau Road, en route to Jeriau Waterfall	N03.72027	E101.72901	1189 ± 6.6	on short grasses	19 May 13	1454
<b>Acrididae</b> ( <b>Catantopinae</b> )		<i>Tauchira polychroa</i> (Stål)						
FRA.12.011	M	Jeriau Waterfall	N03.72610	E101.71363	989 ± 6	leaf near stream	20 Dec.12	1353
FRA.12.037	M	Lady Maxwell Road	N03.71811	E101.74006	1277 ± 5	tall grass	21 Dec.12	1341
FRA.12.077	M	Behind the Paddock	N03.71595	E101.74260	1213 ± 7	grass	26 Dec.12	1338
FRA.12.089	F	Jeriau Road, en route to Jeriau Waterfall	N03.71945	E101.72937	1189 ± 5	tall grass	27 Dec.12	1342
FRA.12.091	F	Jeriau Road, en route to Jeriau Waterfall	N03.71952	E101.72937	1203 ± 5	tall grass	27 Dec.12	1346
FRA.12.092	M	Jeriau Road, en route to Jeriau Waterfall	N03.72120	E101.72175	1101 ± 7	tall grass	27 Dec.12	1448
<b>Acrididae</b> ( <b>Catantopinae</b> )		<i>Willemsella bicolor</i> Miller						
FRA.12.088	M	Jeriau Road, en route to Jeriau Waterfall	N03.71944	E101.72936	1214 ± 6	tall grass	27 Dec.12	1338
FRA.12.090	M	Jeriau Road, en route to Jeriau Waterfall	N03.71952	E101.72937	1203 ± 5	tall grass	27 Dec.12	1346
FRA.12.112	M	Jeriau Road, en route to Jeriau Waterfall	N03.71943	E101.72935	1209 ± 5	tall grass	29 Dec.12	2005
FRA.13.035	F	Jeriau Road, en route to Jeriau Waterfall	N03.71836	E101.72987	1227 ± 5.7	on leaves of grasses	19 May 13	1409

## Orthoptera of Fraser's Hill

Family (Subfamily)		Locality Name	Locality Data			Collection Data		
Reference Number	S	Name of Taxon	GPS Coordinates		Altitude*	Microhabitat	Date	Time
<b>Acrididae</b> ( <b>Oedipodinae</b> )		<i>Trilophidia annulata</i> (Thunberg)						
FRA.13.036	F	Jeriau Road, en route to Jeriau Waterfall	N03.71956	E101.72936	1206 ± 6.2	on leaves of grasses	19 May 13	1435
<b>Acrididae</b> ( <b>Oxyinae</b> )		<i>Pseudoxya diminuta</i> (Walker)						
FRA.12.015	M	Jeriau Waterfall	N03.72610	E101.71352	980 ± 7	short grass near stream	20 Dec.12	1405
FRA.12.030	M	Lady Maxwell Road	N03.71637	E101.73805	1288 ± 7	grass/ herb	21 Dec.12	1244
<b>Chorotypidae</b> ( <b>Eruciinae</b> )		<i>Erucius</i> sp. 1						
FRA.12.040	M	Valley Road	N03.71308	E101.73893	1258 ± 6	on fern	21 Dec.12	1419
FRA.12.041	M	Valley Road	N03.71308	E101.73893	1258 ± 6	on fern	21 Dec.12	1419
FRA.12.066	F	Hemnant Trail	N03.71523	E101.73832	1237 ± 9	on leaf of fern	24 Dec.12	2021
FRA.12.083	F	Kindersley Trail	N03.71032	E101.73892	1287 ± 8	under fern leaf	26 Dec.12	2019
FRA.13.001	F	Semantan Road	N03.71837	E101.72979	1259 ± 6.5	on fern leaf	13 May 13	1940
FRA.13.015	M	Quarry Road	N03.71751	E101.74273	1213 ± 4.9	on leaves of grasses	15 May 13	1335
FRA.13.033	M	Near Allen Water	N03.71314	E101.73293	1287 ± 6.2	on leaves of shrub	18 May 13	2007
<b>Chorotypidae</b> ( <b>Eruciinae</b> )		<i>Erucius</i> sp. 2						
FRA.12.060	F	Bishop Trail	N03.71991	E101.74060	1233 ± 7	on leaf of palm	23 Dec.12	1416
FRA.12.065	M	Bishop Trail	N03.71707	E101.73761	1279 ± 7	on leaf of fern	24 Dec.12	1957
<b>Pyrgomorphidae</b> ( <b>Pyrgomorphinae</b> )		<i>Atractomorpha</i> cf. <i>psittacina</i> (Haan)						
FRA.12.094	F	Jeriau Road, en route to Jeriau Waterfall	N03.71984	E101.72445	1147 ± 6	short grass/ bare ground	27 Dec.12	
<b>Tetrigidae</b> ( <b>Metrordorinae</b> )		<i>Macromotettix</i> sp. 1						
FRA.12.001	M	near Kindersley Trail exit	N03.71008	E101.73899	1296 ± 5	grassy/ shrubby	19 Dec.12	1851
<b>Tetrigidae</b> ( <b>Metrordorinae</b> )		<i>Macromotettix</i> sp. 2						
FRA.13.007	F	Kindersley Trail	N03.71006	E101.73913	1305 ± 5.2	on forest floor	14 May 13	1451
FRA.13.028	F	Peninjau Road	N03.71408	E101.74536	1251 ± 6.8	on leaves of grasses	17 May 13	1955
<b>Tetrigidae</b> ( <b>Metrordorinae</b> )		<i>Macromotettix</i> sp. 3						
FRA.13.027	M	Peninjau Road	N03.71401	E101.74554	1251 ± 5.4	on leaves of shrub	17 May 13	1946
<b>Tetrigidae</b> ( <b>Scelimeninae</b> )		<i>Criotettix</i> sp.						
FRA.12.005	F	near Hemnant Trail entrance at mosque	N03.71369	E101.73535	1300 ± 7	on short grass near flowing water and drain	20 Dec.12	1010
FRA.12.006	F	near Hemnant Trail entrance at mosque	N03.71369	E101.73535	1300 ± 7	on short grass near flowing water and drain	20 Dec.12	1010

## Tan &amp; Kamaruddin

Family (Subfamily)		Locality Name	Locality Data			Collection Data		
Reference Number	S	Name of Taxon	GPS Coordinates		Altitude*	Microhabitat	Date	Time
FRA.12.007	F	near Hemnant Trail entrance at mosque	N03.71369	E101.73535	1300 ± 7	on short grass near flowing water and drain	20 Dec.12	1010
FRA.12.032	F	Lady Maxwell Road	N03.71730	E101.73936	1283 ± 6	short grass	21 Dec.12	1314
FRA.13.006	M	Mager Road	N03.70844	E101.73840	1301 ± 9.7	in net	14 May 13	1407
<b>Tetrigidae</b> ( <b>Tetriginae</b> )		<i>Coptotettix</i> sp. 1						
FRA.12.025	F	Jeriau Waterfall	N03.72734	E101.71269	962 ± 6	grass/ herb near stream	20 Dec.12	1510
FRA.12.026	M	Jeriau Waterfall	N03.72734	E101.71269	962 ± 6	grass/ herb near stream	20 Dec.12	1510
<b>Tetrigidae</b> ( <b>Tetriginae</b> )		<i>Coptotettix</i> sp. 2						
FRA.12.012	F	Jeriau Waterfall	N03.72608	E101.71349	969 ± 7	short grass near stream	20 Dec.12	1356
FRA.12.036	M	Lady Maxwell Road	N03.71747	E101.73947	1276 ± 7	short grass	21 Dec.12	1320
FRA.12.093	F	Jeriau Road, en route to Jeriau Waterfall	N03.72183	E101.72411	1111 ± 6	short grass/ bare ground	27 Dec.12	?
FRA.12.106	F	Behind the Paddock	N03.71680	E101.74300	1229 ± 11	on leaf of herb/ shrub	29 Dec.12	1456
<b>Tetrigidae</b> ( <b>Tetriginae</b> )		<i>Coptotettix</i> sp. 3						
FRA.13.018	F	Ledegham Road	N03.71906	E101.74116	1286 ± 6.5	on short shrub	16 May 13	1109
<b>Tetrigidae</b> ( <b>Tetriginae</b> )		<i>Phaesticus insularis</i> (Hancock)						
FRA.12.052	M	Peninjau Road after Kindersley Trail entrance	N03.71438	E101.74603	1262 ± 7	grass	22 Dec.12	1346
FRA.13.049	F	Jeriau Road, en route to Jeriau Waterfall	N03.71978	E101.72763	1178 ± 6.3	on fern leaf	6 Dec.13	1008
<b>Gryllidae</b> ( <b>Euscyrinae</b> )		<i>Beybienkoana</i> or <i>Paticus</i> sp.						
FRA.13.032	F	Peninjau Road	N03.71461	E101.74204	1274 ± 7.3	on leaves of bamboo	17 May 13	2107
<b>Gryllidae</b> ( <b>Gryllinae</b> )		<i>Gymnogryllus leucostictus</i> (Burmeister)						
FRA.12.027	M	near Abu Suradi Trail entrance	N03.71366	E101.73502	1246 ± 12	burrow on slope calling	20 Dec.12	2013
<b>Gryllidae</b> ( <b>Gryllinae</b> )		<i>Velarifictorus</i> cf. <i>aspersus</i> (Walker)						
FRA.13.002	M	Semantan Road	N03.71816	E101.72956	1241 ± 3.6	chirping under short grasses	13 May 13	2001
FRA.13.038	M	Mager Road	N03.70866	E101.73994	1281 ± 4.6	calling in burrow (with two openings)	19 May 13	1929
<b>Gryllidae</b> ( <b>Itarinae</b> )		<i>Itara</i> spp.						
FRA.12.023	F	Jeriau Waterfall	N03.72728	E101.71248	965 ± 6	herb near stream and forest	20 Dec.12	1458
FRA.13.013	F	Puncak Inn	N03.71194	E101.73595	1268 ± 8.7	dying on floor	15 May 13	0745
FRA.13.017	F	Hemnant Trail	N03.71356	E101.73564	1248 ± 6.3	on leaves of fern	15 May 13	1926
FRA.13.019	M	Ledegham Road	N03.71915	E101.74131	1293 ± 5.6	calling on leaves of treelets	16 May 13	1950
FRA.13.021	F	Ledegham Road	N03.71836	E101.74066	1290 ± 4.8	on leaves of grasses	16 May 13	2030



## Orthoptera of Fraser's Hill

Family (Subfamily)		Locality Name	Locality Data			Collection Data		
Reference Number	S	Name of Taxon	GPS Coordinates		Altitude*	Microhabitat	Date	Time
FRA.13.045	F	Ledegham Road	N03.71854	E101.74086	1285 ± 4.5	on leaves of tall grasses	20 May 13	2002
<b>Gryllidae</b> ( <b>Landrevinae</b> )		<b>Landrevini</b> sp. 1						
FRA.12.053	F	Hemnant Trail	N03.71453	E101.73754	1234 ± 9	deadwood	22 Dec.12	1922
<b>Gryllidae</b> ( <b>Landrevinae</b> )		<b>Landrevini</b> sp. 2						
FRA.12.070	M	Mager Trail	N03.71197	E101.73460	1295 ± 8	on twig of treelet	25 Dec.12	2015
<b>Gryllidae</b> ( <b>Nemobiinae</b> )		<b>Pteronemobiini</b> sp. 1						
FRA.12.008	M	near Hemnant Trail entrance at mosque	N03.71349	E101.73515	1300 ± 5	on short grass near flowing water and drain	20 Dec.12	1026
FRA.12.035	F	Lady Maxwell Road	N03.71747	E101.73947	1276 ± 7	short grass	21 Dec.12	1320
FRA.12.078	M	Behind the Paddock	N03.71607	E101.74261	1217 ± 7	bare ground near grassy area	26 Dec.12	1343
<b>Gryllidae</b> ( <b>Nemobiinae</b> )		<b>Pteronemobiini</b> sp. 2						
FRA.12.033	M	Lady Maxwell Road	N03.71747	E101.73947	1276 ± 7	short grass	21 Dec.12	1320
FRA.12.034	M	Lady Maxwell Road	N03.71747	E101.73947	1276 ± 7	short grass	21 Dec.12	1320
<b>Gryllidae</b> ( <b>Nemobiinae</b> )		<b>Pteronemobiini</b> sp. 3						
FRA.13.003	M	Semantan Road	N03.71817	E101.72958	1240 ± 3.8	on short grasses	13 May 13	2006
<b>Gryllidae</b> ( <b>Nemobiinae</b> )		<b>Pteronemobiini</b> sp. 4						
FRA.13.022	F	Ledegham Road	N03.71833	E101.74055	1286 ± 5.5	on leaves of grasses	16 May 13	2035
<b>Gryllidae</b> ( <b>Nemobiinae</b> )		<b>Pteronemobiini</b> sp. 5 **						
FRA.12.097	N	Maxwell Trail	N03.72278	E101.74063	1261 ± 8	on forest floor	28 Dec.12	1344
FRA.12.098	N	Maxwell Trail	N03.72278	E101.74063	1261 ± 8	on forest floor	28 Dec.12	1344
<b>Gryllidae</b> ( <b>Oecanthinae</b> )		<i>Xabea</i> sp.						
FRA.12.080	M	Mager Road	N03.70800	E101.73971	1266 ± 5	calling on tree	26 Dec.12	1949
FRA.13.053	F	Mager Road	N03.70795	E101.73969	1283 ± 5.0	on leaf of tree	7 Dec.13	1949
<b>Gryllidae</b> ( <b>Podoscirtinae</b> )		<b>Aphonoidini</b> sp. 1						
FRA.12.047	F	Mager Trail	N03.71090	E101.73586	1255 ± 7	on leaf	21 Dec.12	1950
<b>Gryllidae</b> ( <b>Podoscirtinae</b> )		<b>Aphonoidini</b> sp. 2						
FRA.12.099	M	Bishop Trail	N03.71708	E101.73766	1230 ± 8	on leaf of shrub	28 Dec.12	19127
FRA.13.043	F	Ledegham Road	N03.71898	E101.74100	1286 ± 6.6	on leaves of bamboo	20 May 13	1938
<b>Gryllidae</b>		<i>Idiotrella</i> sp.						

## Tan &amp; Kamaruddin

Family (Subfamily)		Locality Name	Locality Data			Collection Data		
Reference Number	S	Name of Taxon	GPS Coordinates		Altitude*	Microhabitat	Date	Time
<b>(Podoscirtinae)</b>								
FRA.13.054	F	Mager Road	N03.70804	E101.73974	1273 ± 6.1	on leaf of tall grasses	7 Dec.13	1958
<b>Gryllidae</b> <i>Amusurgus</i> sp.								
<b>(Trigonidiinae)</b>								
FRA.13.005	F	Abu Suradi Trail	N03.71255	E101.73414	1214 ± 10.9	on forest floor	14 May 13	1322
<b>Gryllidae</b> <i>Svistella</i> (?) sp. 1								
<b>(Trigonidiinae)</b>								
FRA.12.038	M	Valley Road	N03.71686	E101.74073	1237 ± 7	on ground	21 Dec.12	1402
FRA.12.072	F	Valley Road	N03.71684	E101.74068	1236 ± 8	on crysantumn plant	26 Dec.12	1325
FRA.12.073	F	Valley Road	N03.71684	E101.74068	1236 ± 8	on crysantumn plant	26 Dec.12	1325
FRA.12.074	M	Valley Road	N03.71684	E101.74068	1236 ± 8	on crysantumn plant	26 Dec.12	1325
FRA.12.075	M	Valley Road	N03.71684	E101.74068	1236 ± 8	on crysantumn plant	26 Dec.12	1325
FRA.12.076	M	Valley Road	N03.71684	E101.74068	1236 ± 8	on crysantumn plant	26 Dec.12	1325
<b>Gryllidae</b> <i>Svistella</i> (?) sp. 2								
<b>(Trigonidiinae)</b>								
FRA.12.108	M	Jeriau Road, en route to Jeriau Waterfall	N03.71981	E101.72960	1189 ± 5	tall grass	29 Dec.12	1949
FRA.12.109	F	Jeriau Road, en route to Jeriau Waterfall	N03.71981	E101.72960	1189 ± 5	tall grass	29 Dec.12	1951
<b>Gryllidae</b> <i>Svistella</i> (?) sp. 3								
<b>(Trigonidiinae)</b>								
FRA.12.020	M	Jeriau Waterfall	N03.72673	E101.71310	964 ± 5	grass near stream	20 Dec.12	1438
<b>Gryllidae</b> <i>Svistella</i> (?) sp. 4								
<b>(Trigonidiinae)</b>								
FRA.12.019	F	Jeriau Waterfall	N03.72676	E101.71307	964 ± 5	grass near stream	20 Dec.12	1430
FRA.12.021	F	Jeriau Waterfall	N03.72673	E101.71310	964 ± 5	grass near stream	20 Dec.12	1438
FRA.12.022	F	Jeriau Waterfall	N03.72673	E101.71310	964 ± 5	grass near stream	20 Dec.12	1438
FRA.12.042	F	Pine Tree Road near Allan's Water	N03.71322	E101.73277	1277 ± 5	tall grass	21 Dec.12	1834
FRA.12.110	M	Jeriau Road, en route to Jeriau Waterfall	N03.71981	E101.72960	1189 ± 5	tall grass	29 Dec.12	1952
<b>Gryllidae</b> <i>Trigonidium</i> (?) sp.								
<b>(Trigonidiinae)</b>								
FRA.12.054	M	Hemnant Trail	N03.71563	E101.73843	1276 ± 8	on leaf of palm	22 Dec.12	1938
FRA.12.055	M	Hemnant Trail	N03.71563	E101.73843	1276 ± 8	on leaf of palm	22 Dec.12	1938
FRA.12.056	M	Hemnant Trail	N03.71563	E101.73843	1276 ± 8	on leaf of palm	22 Dec.12	1938
<b>Gryllotalpidae</b> <i>Gryllotalpa fraser</i> Tan & Nizam								
<b>(Gryllotalpinae)</b>								
FRA.12.096	M	Mager Road near Singapore House	N03.70806	E101.73912	1263 ± 6	calling underground on slope with short grass	27 Dec.12	1951
FRA.13.039	M	Mager Road near Singapore House	N03.70804	E101.73917	1273 ± 4.3	calling in burrow	19 May 13	1943
FRA.13.040	M	Mager Road near Singapore House	N03.70820	E101.73927	1268 ± 6.5	calling in burrow	19 May 13	1947

## Orthoptera of Fraser's Hill

Family (Subfamily)		Locality Name	Locality Data			Collection Data		
Reference Number	S	Name of Taxon	GPS Coordinates		Altitude*	Microhabitat	Date	Time
<b>Gryllotalpidae</b> ( <b>Gryllotalpinae</b> )		<i>Gryllotalpa fulvipes</i> Saussure						
FRA.12.010	N	Jeriau Waterfall	N03.72600	E101.71349	970 ± 8	under rock	20 Dec.12	1350
FRA.12.079	M	Genting Road near Police Station	N03.71126	E101.73639	1227 ± 6	underground	26 Dec.12	1926
FRA.12.095	M	Mager Road	N03.70873	E101.73895	1244 ± 6	underground	27 Dec.12	1922
FRA.13.042	M	Ledegham Road	N03.71915	E101.74146	1284 ± 4.4	calling under burrow	20 May 13	1926
<b>Gryllotalpidae</b> ( <b>Gryllotalpinae</b> )		<i>Gryllotalpa</i> sp.						
FRA.13.044	M	Ledegham Road	N03.71898	E101.74111	1288 ± 4.4	calling under burrow	20 May 13	1944
<b>Mogoplistidae</b> ( <b>Mogoplistinae</b> )		<i>Micrornebius malaya</i> Tan & Nizam						
FRA.12.002	M	Kindersley Trail	N03.71028	E101.73898	1290 ± 6	undergrowth, on leaf	19 Dec.12	1955
FRA.12.029	F	Abu Suradi Trail	N03.71326	E101.73437	1300 ± 7	twig	20 Dec.12	2116
FRA.12.050	M	Peninjau Road after Kindersley Trail entrance	N03.71385	E101.74153	1263 ± 7	dead twigs and fern with trees on cliff	22 Dec.12	1255
FRA.12.059	M	Hemnant Trail	N03.71366	E101.73669	1274 ± 9	on leaf	22 Dec.12	2021
<b>Mogoplistidae</b> ( <b>Mogoplistinae</b> )		<i>Ornebius albalatus</i> Tan & Nizam						
FRA.12.003	M	Kindersley Trail	N03.71040	E101.73915	1290 ± 7	on dead twig, on fern	19 Dec.12	2013
FRA.12.039	F	Valley Road	N03.71686	E101.74073	1237 ± 7	on shrub	21 Dec.12	1402
FRA.12.069	F	Abu Suradi Trail	N03.71264	E101.73402	1306 ± 6	on twig on tree	25 Dec.12	1945
FRA.13.041	M	Mager Road	N03.70794	E101.73969	1283 ± 6.5	on leaves of grasses	19 May 13	1956
FRA.13.047	M	Bishop Trail	N03.71711	E101.73766	1284 ± 5.1	on leaves of treelet	20 May 13	2114
<b>Mogoplistidae</b> ( <b>Mogoplistinae</b> )		<i>Ornebius</i> sp. 1						
FRA.12.028	F	Abu Suradi Trail	N03.71323	E101.73431	1309 ± 9	twig	20 Dec.12	2110
FRA.12.046	F	Mager Trail	N03.71207	E101.73462	1307 ± 6	on twig	21 Dec.12	1925
<b>Mogoplistidae</b> ( <b>Mogoplistinae</b> )		<i>Ornebius</i> sp. 2						
FRA.12.044	F	Mager Trail	N03.71206	E101.73460	1298 ± 7	on leaf	21 Dec.12	1916
<b>Rhaphidophoridae</b> ( <b>Rhaphidophorinae</b> )		<i>Eurhaphidophora</i> (?) sp.						
FRA.13.012	F	Kindersley Trail	N03.71027	E101.73898	1310 ± 6.5	on forest floor	14 May 13	2047
<b>Rhaphidophoridae</b> ( <b>Rhaphidophorinae</b> )		<i>Rhaphidophora</i> (?) sp.						
FRA.13.011	M	Kindersley Trail	N03.71023	E101.73910	1307 ± 7.4	on forest floor	14 May 13	2043
<b>Rhaphidophoridae</b> ( <b>Rhaphidophorinae</b> )		<i>Rhaphidophorinae</i> sp. **						
FRA.12.004	N	Kindersley Trail	N03.71090	E101.73890	1340 ± 15	on the ground	19 Dec.12	2037



## Tan &amp; Kamaruddin

Family (Subfamily)	Locality Name	Locality Data				Collection Data		
Reference Number	S	Name of Taxon	GPS Coordinates		Altitude*	Microhabitat	Date	Time
<b>Gryllacrididae</b> (Gryllacridinae)		<i>Capnogryllacris fruhstorferi</i> (Griffini)						
FRA.13.023	M	Ledegham Road	N03.71680	E101.73898	1288 ± 5.3	on leaves of shrub	16 May 13	2122
FRA.13.048	M	Ledegham Road, near to Silver Park Apartments	N03.71610	E101.73547	1293 ± 7.0	on short grasses	20 May 13	2154
<b>Gryllacrididae</b> (Gryllacridinae)		<i>Larnaca (Larnaca) fasciata</i> Walker						
FRA.13.009	F	Mager Road	N03.70937	E101.74005	1287 ± 4.9	on leaves of shrub	14 May 13	2022
<b>Gryllacrididae</b> (Gryllacridinae)		<i>Larnaca (Larnaca) nigrata</i> (Brunner von Wattenwyl)						
FRA.13.034	F	Near Allen Water	N03.71240	E101.73367	1289 ± 6.7	on leaves of tall grasses	18 May 13	2041
<b>Gryllacrididae</b> (Gryllacridinae)		<i>Larnaca (Larnaca) pendleburyi</i> (Karny)						
FRA.12.071	M	Mager Trail	N03.71206	E101.73471	1285 ± 7	on leaf	25 Dec.12	2033
<b>Tettigoniidae</b> (Conocephalinae)		<i>Conocephalus (Anisoptera) maculatus</i> (Le Guillou)						
FRA.12.017	M	Jeriau Waterfall	N03.72676	E101.71310	965 ± 4	grass near stream	20 Dec.12	1422
FRA.12.107	F	Behind the Paddock	N03.71680	E101.74328	1200 ± 9	on grass	29 Dec.12	1510
<b>Tettigoniidae</b> (Conocephalinae)		<i>Conocephalus (Anisoptera) melaenus</i> (Haan)						
FRA.12.084	M	Jeriau Road, en route to Jeriau Waterfall	N03.71840	E101.72977	1246 ± 8	tall grass	27 Dec.12	1326
FRA.12.085	M	Jeriau Road, en route to Jeriau Waterfall	N03.71840	E101.72977	1246 ± 8	tall grass	27 Dec.12	1326
FRA.12.086	M	Jeriau Road, en route to Jeriau Waterfall	N03.71840	E101.72977	1246 ± 8	tall grass	27 Dec.12	1326
FRA.12.087	F	Jeriau Road, en route to Jeriau Waterfall	N03.71840	E101.72977	1246 ± 8	tall grass	27 Dec.12	1326
<b>Tettigoniidae</b> (Conocephalinae)		<i>Liara (Liara) alata</i> Ingrisch						
FRA.13.004	F	Semantan Road	N03.71732	E101.73096	1256 ± 6.9	feeding on bamboo leaves	13 May 13	2028
FRA.13.026	F	Peninjau Road	N03.71408	E101.74557	1252 ± 5.5	burrowed inside bamboo	17 May 13	1940
FRA.13.029	M	Peninjau Road	N03.71486	E101.74442	1276 ± 6.6	burrowed inside bamboo	17 May 13	2031
<b>Tettigoniidae</b> (Conocephalinae)		<i>Lichnofugia malaya</i> Tan & Ingrisch						
FRA.13.020	F	Ledegham Road	N03.71851	E101.74084	1289 ± 4.9	on leaves of tall grasses	16 May 13	2021
FRA.13.025	N	Peninjau Road	N03.71414	E101.74567	1251 ± 5.6	on leaves of tall grasses	17 May 13	1937
FRA.13.031	N	Peninjau Road	N03.71496	E101.74291	1270 ± 8.5	on leaves of short grasses	17 May 13	2052
<b>Tettigoniidae</b> (Conocephalinae)		<i>Macroxiphus sumatranus siamensis</i> Helfert & Sanger						
FRA.13.055	F	Mager Road	N03.70839	E101.74004	1267 ± 5.1	on leaf of shrub near cliff	7 Dec.13	2030
<b>Tettigoniidae</b> (Conocephalinae)		<i>Mesagraecia</i> cf. <i>bicolor</i> Ingrisch						
FRA.12.114	F	Jeriau Road, en route to Jeriau Waterfall	N03.71843	E101.73001	1221 ± 6	tall grass	29 Dec.12	2034

## Orthoptera of Fraser's Hill

Family (Subfamily)	Locality Name		Locality Data			Collection Data		
Reference Number	S	Name of Taxon	GPS Coordinates		Altitude*	Microhabitat	Date	Time
<b>Tettigoniidae</b> (Conocephalinae)		<i>Nahlaksia bidadari</i> Ingrisch & Tan						
FRA.12.068	M	Abu Suradi Trail	N03.71344	E101.73436	1296 ± 7	on dead twig	25 Dec.12	1930
<b>Tettigoniidae</b> (Conocephalinae)		<i>Peracca conspicuithorax</i> Griffini						
FRA.13.008	M	Mager Road	N03.70913	E101.73999	1283 ± 4.9	on leaves of plant	14 May 13	2015
FRA.13.030	F	Peninjau Road	N03.71535	E101.74415	1263 ± 7.8	on leaves of grasses	17 May 13	2040
<b>Tettigoniidae</b> (Conocephalinae)		<i>Peracca</i> sp. **						
FRA.12.103	N	Bishop Trail	N03.71780	E101.73766	1235 ± 7	on leaf of pandan	28 Dec.12	2005
<b>Tettigoniidae</b> (Meconematinae)		<i>Alloteratura</i> (?) sp.						
FRA.12.101	F	Bishop Trail	N03.71750	E101.73759	1260 ± 6	under leaf of treelet	28 Dec.12	1946
<b>Tettigoniidae</b> (Meconematinae)		<i>Asiophlugis</i> cf. <i>malacca</i> Gorochov						
FRA.12.063	M	Bishop Trail	N03.71734	E101.73763	1268 ± 7	under leaf of tree	24 Dec.12	1937
FRA.12.104	M	Ledegham Road near Silver Park Apartment	N03.71661	E101.73767	1277 ± 8	under leaf of treelet	28 Dec.12	2029
<b>Tettigoniidae</b> (Meconematinae)		<i>Neophisis</i> sp.						
FRA.12.062	M	Bishop Trail	N03.71772	E101.73766	1253 ± 6	under leaf of tree	24 Dec.12	1923
FRA.12.100	F	Bishop Trail	N03.71730	E101.73762	1240 ± 7	on leaf of palm	28 Dec.12	1936
<b>Tettigoniidae</b> (Meconematinae)		<i>Xiphidiopsis</i> (?) sp.						
FRA.12.043	F	Mager Trail	N03.71209	E101.73441	1274 ± 6	under leaf	21 Dec.12	1908
FRA.12.045	F	Mager Trail	N03.71202	E101.73462	1283 ± 6	on leaf	21 Dec.12	1922
FRA.12.049	M	Peninjau Road after Kindersley Trail entrance	N03.71387	E101.74168	1266 ± 8	shrub/ short tree on cliff	22 Dec.12	1254
FRA.12.057	F	Hemnant Trail	N03.71445	E101.73798	1306 ± 9	on leaf	22 Dec.12	2003
FRA.12.058	M	Hemnant Trail	N03.71448	E101.73779	1276 ± 9	on leaf	22 Dec.12	2008
FRA.12.064	M	Bishop Trail	N03.71713	E101.73760	1264 ± 7	under leaf of tree	24 Dec.12	1952
FRA.12.067	F	Hemnant Trail	N03.71438	E101.73743	1272 ± 7	on leaf of fern	24 Dec.12	2034
FRA.12.102	F	Bishop Trail	N03.71750	E101.73759	1260 ± 6	under leaf of treelet	28 Dec.12	1946
<b>Tettigoniidae</b> (Mecopodinae)		<i>Mecopoda elongata</i> (Linnaeus)						
FRA.12.016	M	Jeriau Waterfall	N03.72610	E101.71352	980 ± 7	short grass near stream	20 Dec.12	1405
FRA.12.111	M	Jeriau Road, en route to Jeriau Waterfall	N03.71981	E101.72949	1183 ± 6	tall grass calling	29 Dec.12	2000
<b>Tettigoniidae</b> (Phaneropterinae)		<i>Elbenia fraser</i> Tan.						
FRA.13.052	M	Ledegham Road	N03.71717	E101.73931	1280 ± 5.2	on leaf of shrub	7 Dec.13	1452
<b>Tettigoniidae</b>		<i>Elimaea (Rhaebelimaea) pseudochloris</i> Ingrisch						

## Tan &amp; Kamaruddin

Family (Subfamily)		Locality Name	Locality Data			Collection Data		
Reference Number	S	Name of Taxon	GPS Coordinates		Altitude*	Microhabitat	Date	Time
<b>(Phaneropterinae)</b>								
FRA.12.061	M	Behind Shahzan Inn	N03.71137	E101.73701	1272 ± 9	on leaf of tree calling	23 Dec.12	2230
FRA.12.081	M	Mager Road	N03.70802	E101.73979	1277 ± 7	tall grass	26 Dec.12	1957
FRA.12.082	M	Mager Road	N03.70802	E101.73979	1277 ± 7	tall grass	26 Dec.12	1957
FRA.13.046	F	Ledegham Road	N03.71806	E101.73991	1280 ± 5.3	on leaves of shrub	20 May 13	2029
<b>Tettigoniidae</b> <i>Phaneroptera brevis</i> (Serville)								
<b>(Phaneropterinae)</b>								
FRA.12.018	F	Jeriau Waterfall	N03.72676	E101.71307	964 ± 5	grass near stream	20 Dec.12	1430
FRA.12.031	M	Lady Maxwell Road	N03.71646	E101.73870	1271 ± 6	grass/ herb	21 Dec.12	1252
FRA.12.048	M	Peninjau Road after Kindersley Trail entrance	N03.71101	E101.73866	1296 ± 7	on shrub	22 Dec.12	1216
<b>Tettigoniidae</b> <i>Pseudopsyra bispina</i> Tan & Nizam								
<b>(Phaneropterinae)</b>								
FRA.13.014	M	Puncak Inn	N03.71194	E101.73595	1268 ± 8.7	dying on floor	15 May 13	0745
<b>Tettigoniidae</b> <i>Phyllomimus (Phyllomimus)</i> cf. <i>inversus</i> Brunner von Wattenwyl								
<b>(Pseudophyllinae)</b>								
FRA.12.105	M	Ledegham Road near Silver Park Apartment	N03.71661	E101.73767	1277 ± 8	on leaf calling	28 Dec.12	2032
<b>Tettigoniidae</b> <i>Phyllomimini</i> sp.								
<b>(Pseudophyllinae)</b>								
FRA.13.050	M	Jeriau Road, en route to Jeriau Waterfall	N03.72016	E101.72895	1190 ± 5.9	on leaf of tall grasses	6 Dec.13	1040
<b>Tettigoniidae</b> <i>Promeca</i> cf. <i>perakana</i> Beier								
<b>(Pseudophyllinae)</b>								
FRA.13.010	F	Mager Road	N03.70945	E101.74002	1285 ± 4.8	on leaves of shrub and grass	14 May 13	2027