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a new species of leaf insect from northern Borneo

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a new species of leaf insect from northern Borneo

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Abstract. A new species of leaf insect, *Phyllium (Phyllium) bossardi* Cumming, Le Tirant, and Teemsma, **new species** (Phasmida, Phylliidae), is described from a series of three males. A key to males of the currently known species from the siccifolium species group from Borneo is provided.

Key Words. Taxonomy, Sabah, Malaysia, walking leaf.

Introduction

Phylliidae, or leaf insects, are a lineage of the mesodiverse Phasmida. Their remarkable crypsis, with morphology that mimics leaves, makes them difficult to study due to the limited numbers that are collected and retained within collections. The remarkable similarity between congeners, and sexual dimorphism has also led many taxonomists over the years to avoid their classification due to the assumed difficulty. In recent years however their understanding has been greatly improved through recent works and extensive keys aiding in their morphological classification. Additionally, future genetic analysis work will clarify the phylogeny of the Phylliidae and the inframily resolution.

Seow-Choen (2016, 2017) revised the knowledge of Bornean Phylliidae naming eleven species between the two works. However, only four of the species were from the subgenus *Phyllium (Phyllium)*. Of the twelve known species from Borneo, all but two species are only known from male specimens. *Phyllium (Phyllium) bossardi* Cumming, Le Tirant, and Teemsma, **new species**, is the thirteenth species of walking leaf from Borneo, again unfortunately only known from male specimens. The only literature for this species was from the note on Bornean Phylliidae by Grösser (2008), the species was not figured in Bragg's (2001), or in Seow-Choen's (2016, 2017) books on Bornean phasmids.

The species is morphologically dissimilar to any currently known species of leaf insect found in the surrounding countries. The only species of leaf insect with a similar slender, elongated body shape to *P. (P.) bossardi* is *Phyllium (Phyllium) caudatum* Redtenbacher, 1906, known from Papua New Guinea, New Britain, and the Solomon Islands. However the *P. (P.) bossardi* protibiae are slender, lacking a strong angle to the interior lobe, more similar in shape to *Phyllium (Phyllium) philippinicum* Hennemann, Conle, Gottardo, and Bresseel, 2009 than to *P. (P.) caudatum*. Identification of the currently unknown female of *P. (P.) bossardi* will help to clarify the taxonomic placement of this new species.

Materials and Methods

Photos were taken by René Limoges of the Montreal Insectarium using a Nikon D810 DSLR camera with Nikon Micro-Nikkor 200 mm f/4 lens on Manfrotto 454 micrometric positioning sliding plate. Lighting was provided by two Nikon SB-25 flash units with a Cameron Digital diffusion photo box. Adobe Photoshop Elements 13 was used as post processing software. Measurements of the holotype were made to the nearest 0.1 mm using digital calipers. The holotype is deposited in the Montreal Insectarium type collection and the paratypes are retained within the private collections of the first and second author.

Phyllium (Phyllium) brossardi Cumming, Le Tirant, and Teemsma, new species

(Fig. 1, 2)

Holotype. Male: MALAYSIA: North Borneo: Sabah, Ranau: July 10th, 2007 [Coll. RC 17-278] deposited in the Montreal Insectarium type collection.

Paratypes. Two males: MALAYSIA: North Borneo: Sabah, Mt. Trus Madi [Coll. RC 17-277] retained within the Royce Cumming collection; North Borneo: Sabah, Crocker Range: June 1st, 2007 [Coll. RC 17-279] retained within the Stephane Le Tirant collection.

Differentiation. The exterior lobe of the profemora is thinner than the interior, placing *Phyllium (Phyllium) brossardi* within the siccifolium species-group as described by Hennemann et al. (2009). *Phyllium (P.) brossardi* does not appear closely related to any of the known Bornean species and can be differentiated from congenics by the slender abdomen lacking lobes or dilations and the thin arcing interior lobe of the protibiae, which in all other species is more prominent and has a triangular shape.

Coloration. Overall, coloration a pale green to straw yellow throughout, assumed to be darker and a more vibrant green in life. Compound eyes of a burnt orange color. The base of the head and the antennae are of a similar color, darkening towards the apex, which is dark brown, almost black.

Morphology. Head capsule slightly longer than wide, the vertex with a moderate number of granules with no apparent pattern. Frontal convexity broad at first but then quickly tapering to a rounded point, sparsely covered in thin transparent setae. Antennae consisting of 22–24 segments (including the scapus and pedicellus), most segments are covered in a dense covering of dark setae that are as long as the antennae segment is wide. Compound eyes large and slightly protruding away from the head. Ocelli well developed. Antennal fields of approximately the same width as the scapus. Pronotum with anterior margin concave and lateral margins that are straight and converging to a straight posterior margin that is slightly more than half the width of the anterior rim. Anterior and lateral margins of the pronotum have a distinct rim, whereas the posterior margin lacks a rim. Face of the pronotum is marked by a distinct furrow and a slightly granulose surface that does not have a detectable pattern. Prosternum is uniformly granulose with nodes of even size and slightly uneven spacing. Mesosternum surface moderately wrinkled and marked with small nodes throughout, with the most notable along the sagittal plane with margins slightly less granulose than the center. Mesopraescutum notably wider than long, with lateral margins converging to the posterior. Lateral rims with four to five major tubercles of relative uniform size, occasionally a small node or two are present among the tubercles. Mesopraescutum crest along the sagittal plane not very prominent as the surface of the mesopraescutum rises up to meet it with a face that is relatively smooth. Mesopraescutum crest along the sagittal plane with a prominent tubercle on the anterior margin and one on the posterior margin. The space between these two tubercles is variable, sometimes with small nodes, a single tubercle, or occasionally two large tubercles. Mesopleurae gently diverging; lateral margin with six to seven major tubercles, frequently with smaller node(s) between the largest of the tubercles. Face of the mesopleurae with two faint divots, one on the anterior third and one on the posterior third. Tegmina long and slender extending half way through abdominal segment IV. Alae well developed in an oval fan configuration, when folded the exposed section is slightly sclerotized and the wing reaches half way through abdominal segment IX.

Abdominal segments II through the anterior half of IV slightly diverging, posterior half of IV through anal abdominal segment gently converging. Anal abdominal segment approximately as long as wide with lateral margins that first converge gently, then converge more sharply towards the smoothly rounded apex. Poculum starting halfway through abdominal segment VIII, broad with lateral margins that reach from edge to edge of segment IX, and ending in a broad rounded apex that reaches slightly into segment X (Fig. 2C). Cerci long and slender, lateral margins only slightly curled, covered in a number of thin transparent setae and interior margin with a heavily granulose surface. Vomer stout and broad with sides gradually converging, the apical point is slender and hooks upwards into the paraproct (Fig. 2C). Profemora exterior lobes are slender, no dentition, and notably thinner than the interior lobe. Profemora interior lobe begins approximately halfway along the length, in a thin scalene triangle. Interior lobe of the profemora with five serrate teeth of even size, arranged in a 2-1-2 pattern with the pair on each end more closely spaced together than they are from the single tooth in the center, which is equidistant from the pairs of teeth on each end (Fig. 2B). Exterior lobe of the mesofemora gently arcs from end to end and lacks dentition. Interior lobe of mesofemora, which is half the width of the exterior, is straight with five to six evenly sized teeth that are unevenly spaced on the distal half of the lobe. Exterior lobe of metafemora thin and lacking dentition, relatively straight. Metafemora interior lobe gently arcing with seven to eight small serrate teeth on the distal half. Protibiae lacking exterior lobe, interior lobe reaching end to end in a smooth arc, no well defined angle. Meso- and metatibiae simple, lacking lobes completely.

Measurements of holotype [mm]. Length of body (including cerci and head, excluding antennae) 55.4, length/width of head 3.4/3.3, pronotum 3.0, mesonotum 3.0, length/width of tegmina 23.3/6.2, greatest width of abdomen 11.3, profemora 9.4, mesofemora 9.5, metafemora 11.3, protibiae 6.2, mesotibiae 5.8, metatibiae 8.1, antennae 22.4.

Distribution. The distribution knowledge of the Phylliidae of Borneo is currently inadequate due to a lack of specimens coming from the more remote parts of the island. The majority of specimens found on the island come from Sabah State, likely because of the easy access and popularity with researchers in the area. Very little is known or can be drawn from the knowledge of the single location (Sabah State) as to the overall geographic distribution of the Phylliidae. Hopefully future expeditions into the more remote areas of the island reveal the geographic distribution with more clarity.

Etymology. This species is dedicated to Georges Brossard, founder of the Montreal Insectarium, Quebec, Canada. Brossard was also involved in establishing the Newfoundland, Shanghai, and the BioParc Insectariums. The film “The Blue Butterfly” was based on the adventures of Georges Brossard and David Marenger in 1987 in the jungles of Costa Rica. Brossard was also the host of the “Insectia” series which was broadcast in 150 countries by National Geographic and Discovery Channel. Brossard has been a continuous supporter of entomology in Quebec and Canada for 40 years.

Key to the *Phyllium* (*Phyllium*) males in the *siccifolium* species-group of Borneo

1. Interior lobe of the protibiae thin and arcing from end to end without a distinct triangular shape; abdomen long and slender, at its greatest width only about 30% of the total length of the abdomen ***P. (P.) brossardi* Cumming, Le Tirant, and Teemsma, new species**
- Interior lobe of the protibiae triangular with a distinct angle; abdomen boxy, spade-shaped, or broad, with a greatest width of about 40–55% of the length of the total abdomen **2**
2. Abdominal segment IV not the widest segment, instead segments IV–V are diverging or parallel giving the abdomen a boxy appearance **3**
- Abdominal segment IV the widest segment immediately followed by segments uniformly converging towards the posterior, giving the abdomen a spade shaped appearance **4**

3. Abdominal segments IV–VI gradually diverging with segment VI the widest segment
 *P. (P.) arthurchungi* Seow-Choen, 2016
 — Abdominal segments IV–VI parallel to subparallel *P. (P.) cummingi* Seow-Choen, 2017
4. Folded tegmina reaching halfway into abdominal segment IV; mesopraescutum with prominent tubercles along sagittal crest *P. (P.) bradleri* Seow-Choen, 2017
 — Folded tegmina reaching into abdominal segment III, not reaching the anterior margin of IV; mesopraescutum with a series of small nodes along the sagittal plane, not prominent tubercles *P. (P.) chenqiae* Seow-Choen, 2017

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Figure 1. *Phyllium (Phyllium) brossardi* Cumming, Le Tirant, and Teemsma, **new species** holotype [Coll. RC 17-278]. **A)** Dorsal view. **B)** Ventral view.



Figure 2. *Phyllium (Phyllium) bossardi* Cumming, Le Tirant, and Teemsma, **new species**. **A)** Base of antennae, head, pronotum, and mesothorax [Coll. RC 17-278]. **B)** Genitalia, ventral view [Coll. RC 17-17-279]. **C)** Right foreleg [Coll. RC 17-278].