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Leaf insects from Luzon, Philippines, with descriptions of four new species, the new genus *Pseudomicrophyllium*, and redescription of *Phyllium* (*Phyllium*) *geryon* Gray, 1843, (Phasmida: Phylliidae)

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Abstract

Examination of unidentified Phylliidae specimens revealed a number of undescribed species from the island of Luzon, Philippines. Morphological and molecular study of specimens from the obscure phasmid genus *Microphyllium* Zompro, 2001, revealed a new species, which we describe as *Microphyllium haskelli* Cumming **sp. nov.**. It is here described and differentiated from the two other species in the genus, both currently only known from adults of a single sex. *Pseudomicrophyllium* Cumming **gen. nov.** is described as a new genus within Phylliidae with the type species *Pseudomicrophyllium faulkneri* Cumming **gen. et sp. nov.** as the sole known species in the genus. As is unfortunately often the case in the leaf-mimicking family Phylliidae, this new genus and species is only known from a single specimen. In addition to the new genus, two new *Phyllium* (*Phyllium*) species from the *siccifolium* species-group are named and described as *Ph.* (*Ph.*) *antonkozlovi* Cumming **sp. nov.** and *Ph.* (*Ph.*) *bourquei* Cumming & Le Tirant **sp. nov.**. In addition to the newly described species, *Phyllium* (*Phyllium*) *geryon* Gray, 1843 is redescribed from a nearly perfect specimen, completing some of the morphological knowledge gaps currently missing because of the severely damaged holotype specimen. A key to all known species of Phylliidae from Luzon is included. Holotype specimens for all four new species will be deposited in the National Museum of the Philippines type collection and paratype specimens will be deposited into the San Diego Natural History Museum collection or retained within the first author's collection.

Key words: DNA barcodes, Philippines, Luzon, new species, Phylliinae, holotype, *Phyllium*, Mountain Province, leaf insect

Introduction

Leaf insects in the family Phylliidae are camouflaged by resembling the color, shape, and venation of dicotyledonous leaves. This remarkable crypsis presumably reduces predation by visually oriented predators, but also thwarts attempts to study them in the tropical Asian forests where they live. Many species are known from just a handful of specimens, and adult specimens of at least one sex are currently unknown for many species. Specimens in the Philippine-endemic phylliid genus *Microphyllium* are rarely encountered. The species *pusillulum* was described from a single adult female by James A. G. Rehn and John W. H. Rehn (1933), and placed in the genus *Phyllium*, making it the smallest species in that taxon. Several decades later, Oliver Zompro (2001) erected the genus *Microphyllium* with *M. spinithorax* as its sole species based on the adult male holotype and two nymph female paratypes. When Hennemann *et al.,* (2009), reexamined Rehn & Rehn's small *pusillulum* holotype, they transferred the species to the genus *Microphyllium* based on similarities with the *M. spinithorax* female nymph paratypes designated by Zompro in 2001. Hennemann *et al.,* (2009) also hypothesized that *M. pusillulum* and *M.*

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spinithorax might be the same, sexually dimorphic species known only from adult female and male specimens, respectively. Thus, the female nymphs designated by Zompro as *M. spinithorax* might be *M. pusillulum* nymphs.

The morphology of an insect changes drastically during its development from egg to adult, and sexual dimorphism of adult Phylliidae can be pronounced. However, protein-coding mitochondrial DNA sequences are relatively constant within species but variable enough between species to be a useful tool for associating different sexes and life stages of a single species (Wells *et al.,* 2001). To clarify the species-level status of *Microphyllium pusillulum* and *M. spinithorax* and to associate immature stages (nymphs) with adults of these taxa, we sequenced mitochondrial DNA barcodes from six *Microphyllium* specimens collected on Luzon, Philippines, of varying developmental stages and sexes, including one confidently identified adult female *M. pusillulum.*

Abbreviations Used:

ANSP	Academy of Natural Sciences, Drexel University, Philadelphia: United States
BMNH	Natural History Museum, London: England
SDNHM	San Diego Natural History Museum, San Diego, California: United States
PNM	National Museum of the Philippines, Manila: Philippines
[Coll. RC]	Private collection of Royce Cumming, California: United States
HT	Holotype
PT	Paratype
M.	*Microphyllium* Zompro, 2001
Ph. (*Ph.*)	*Phyllium* (*Phyllium*) Illiger, 1798
Ps.	*Pseudomicrophyllium* Cumming **gen. nov.**

Materials and methods

Morphological Examination. Morphological evaluations of all specimens in first author's collection were made using a Leica ZOOM 2000 microscope. Photos of the material from the first author's collection were taken by Danny Burk or by the first author. Photos taken by Danny Burk were done using a Canon 5DS R digital camera with a 65mm 1–5x macro lens and were focus stacked using photo stacking software. Photos taken by the first author were taken using a Canon 5D Mark II and a MP-E 65mm macro lens and stacked using Zerene photo stacking software, version 1.04, 64-bit. Photos of the material from the collection of Stéphane Le Tirant 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 Cameron Digital diffusion photo box. Adobe Photoshop Elements 13 was used as post processing software. Photos of the holotype *M. pusillulum* were taken by Jason Weintraub at ANSP using an Olympus OM-D E-M10 Micro 4/3 digital camera equipped with an Olympus M.Zuiko Digital ED 60mm f/2.8 macro lens. Measurements of anatomical figures were made to the nearest 0.1 mm using digital calipers. To identify the putative *M. pusillulum* female with confidence, the first author visited the ANSP to compare morphology of the holotype to the specimen in question. Morphological comparison between the field-collected *Microphyllium* males to the *M. spinithorax* holotype could not be done in person. Instead, the male specimens were compared with the original description by Zompro (2001) and the genitalia illustration in Wedmann *et al*. (2007). Morphological comparison of the *Phyllium* (*Phyllium*) *geryon* holotype could not be done in person, but fortunately detailed photos of the specimen are available online at the Phasmida Species File http://phasmida.speciesfile.org (author: Paul D. Brock).

DNA Extraction and Sequencing. We did not attempt to incorporate any type specimens of *Microphyllium* in our molecular analysis, as their DNA was probably too degraded for PCR amplification because of their age. Only specimens from the first author's collection were used, as they are only around three years old. A single leg was removed from each dried specimen and stored at room temperature in the dark prior to analysis. DNA was extracted from each leg using a CTAB phenol-chloroform extraction protocol. A 658 bp fragment of the mitochondrial gene *cytochrome c oxidase* subunit I (COI) was amplified from whole genomic extracts using the universal primers LCO1490 (5'-**TAATACGACTCACTATAGGG**TCWACWAATCATAAAGATATTGG-3') and

HCO2198 (5'-**ATTAACCCTCACTAAAG**TAAACTTCAGGGTGACCAAAAAATCA-3'). These primer sequences include the original primers of Folmer *et al.,* (1994) with T7 and T3 tails concatenated on the 5' end of LCO1490 and HCO2198 respectively ("tails" indicated in bold; Wahlberg & Wheat, 2008). Addition of these primer tails increases PCR success for specimens with degraded DNA (Regier & Shi, 2005). Each PCR reaction consisted of 2.5µl 5x GoTaq® Flexi buffer, 2.5 µl of 25 mM $MgCl_2$, 0.5 µl of 10mM dNTPs, 1.25 µl of 10mM for each primer, 0.125 µl 5U/µl of TaKaRa polymerase, 15.58 µl of H_2O, and 1.3 µl template DNA for a total volume of 25 µl per reaction which was amplified under the following thermal cycler conditions: 95° C for 7 min, followed by 40 cycles at 95° C for 30 sec, 56.5° C for 90 sec and 72° C for 2 min, and 72°C for 10 min. PCR products were visualized on agarose gels before being sent for sequencing to Macrogen (macrogenusa.com) for EXO-SAP PCR clean-up and bidirectional sequencing. We sequenced the COI barcode from six leaf insect specimens and included a COI sequence of *Phyllium* (*Pulchriphyllium*) *giganteum* as an outgroup (GenBank accession AB477461; Kômoto *et al*., 2011).

Phylogenetic Analysis. Alignment of nucleotide sequences were performed using MUSCLE (Edgar 2004) implemented in Seaview 4.2.4 (Gouy *et al.,* 2010) and sequences were assembled and trimmed with Sequencher 5.0 (genecodes.com).

jModelTest 2.1.5 (Darriba *et al.,* 2012) selected the GTR+G model of sequence evolution using the AICc criterion. Bayesian phylogenetic analysis was performed with MrBayes 3.2.6 on the XSEDE server running BEAGLE (Ronquist *et al.,* 2012) via the CIPRES Science Gateway (phylo.org; Miller *et al.,* 2010). Four Markov chains, one cold and three heated, were run simultaneously for 5 million generations. Trees were sampled every 1000 generations, and the first 25% of sampled trees were discarded as burn-in before calculating a consensus tree.

To assess parsimony support for relationships among taxa, TNT 1.1 (Goloboff, *et al.*, 2008) was implemented to run 1000 bootstrap replicates using symmetric resampling summarized as absolute frequencies (Goloboff *et al*., 2003). PAUP* 4.0a152 (Swofford, 2002) was used to calculate uncorrected pairwise distances between COI sequences.

Results

***Microphyllium* Zompro, 2001.** Morphological examination of the *M. pusillulum* holotype confirmed the identification of the unknown specimen [Coll. RC 16-096] as *M. pusillulum* on morphological grounds, though the two specimens were slightly different in length (Table 3). Numerous morphological differences were found between the *Microphyllium* males in the first author's collection and descriptions of the *M. spinithorax* holotype described in the literature (Table 5).

Analyses of DNA sequence data suggest that five of the six specimens examined are a single species distinct from *M. pusillulum*. Moreover, the morphology of the three male specimens differs from *M. spinithorax*, indicating that these individuals belong to a new *Microphyllium* species, which we describe below as *M. haskelli*. We were therefore unable to test the hypothesis that *M. pusillulum* and *M. spinithorax* are conspecific, nor could we identify a *M. pusillulum* male. Indeed, our results raise an additional question: are the two female nymphs designated *M. spinithorax* paratypes by Zompro (2001) in fact *M. spinithorax*, *M. haskelli*, or—as suggested by Hennemann *et al.*—nymphs of *M. pusillulum*? *Microphyllium pusillulum* (Rehn & Rehn, 1933) has a wide distribution across the Cordillera Central mountain range of Luzon, and it would not be surprising if *M. spinithorax* was synonymous. However, this decision must be withheld until fresh material of *M. spinithorax* can be studied.

Uncorrected pairwise distances between a single specimen of *Phyllium* (*Pulchriphyllium*) *giganteum* (Kômoto *et al*., 2011) (selected as an outgroup) and five *Microphyllium haskelli* (Table 1) ranged from 18.8% to 21.3%. Distances between a single *M. pusillulum*, and five *M. haskelli* ranged from 15.5% to 18.8%, while distances among the five *M. haskelli* ranged from 0% to 2.2% (Table 1). Phylogenetic trees constructed using parsimony and Bayesian optimality criteria were completely congruent and highly supported (Fig. 1). The use of mitochondrial DNA barcodes in taxonomy has been criticized, and there are several situations in which barcode variation or lack thereof can be misleading, including heteroplasmy, introgression between species, introgression of mitochondrial genes into the nuclear genome (numts), and infection by *Wolbachia* or other intracellular bacterial parasites (Hurst & Jiggins, 2008; Kodandaramaiah *et al.,* 2013; Rubinoff *et al.,* 2006; Song *et al.,* 2008). However, these criticisms are not particularly relevant here because it is unlikely that all five *Microphyllium haskelli* and the single *M.*

pusillulum samples have numts, since all sequences could be translated into amino acids without stop codons, and because *Wolbachia* is unknown within Phasmida (Pérez-Ruiz *et al.,* 2015; Sven Bradler, *pers. comm.* April, 2017).

TABLE 1. Uncorrected pairwise distances between COI barcodes amplified from three phylliid species show intraspecific genetic variation of <2% within the *M. haskelli* sampled, but distances over 15% between different species. The *Phyllium giganteum* sequence, referenced by its accession number, was obtained from NCBI (GenBank; ncbi.nlm.nih.gov).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) *M. haskelli* ♂ [Coll. RC 16-097]	-						
(2) *M. haskelli* ♂ [Coll. RC 16-098]	0.00304	-					
(3) *M. haskelli* ♂ [Coll. RC 16-099]	0.0216	0.0183	-				
(4) *M. haskelli* ♀ [Coll. RC 16-128]	0.0216	0.0183	0	-			
(5) *M. haskelli* ♀ [Coll. RC 16-183]	0	0.00304	0.0216	0.0216	-		
(6) *M. pusillulum* ♀ [Coll. RC 16-096]	0.161	0.158	0.155	0.155	0.161	-	
(7) *P. giganteum* (AB477461)	0.214	0.213	0.213	0.213	0.214	0.188	-

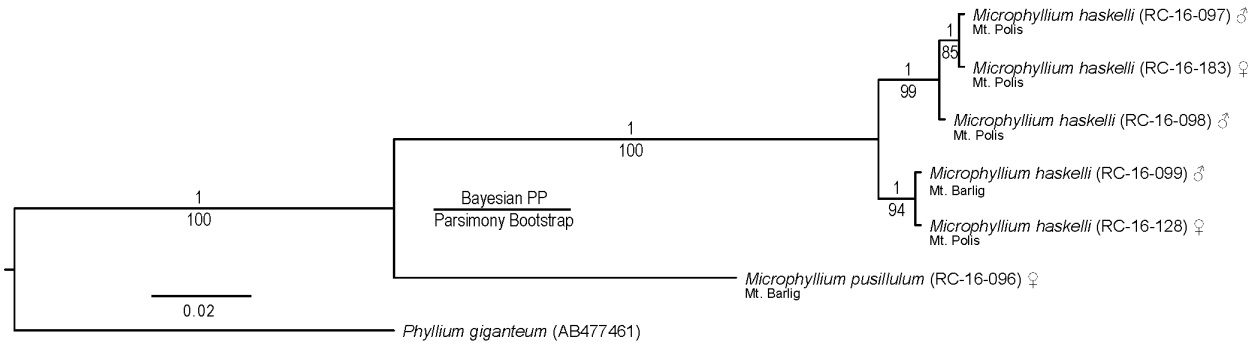

FIGURE 1. Gene tree of COI barcode sequences from three phylliid species. The inferred relationships are strongly supported, as indicated by parsimony bootstrap and Bayesian posterior probability (PP) support. The species, gender, collection code, and collection locality within Luzon, Philippines, are indicated for each *Microphyllium* specimen.

***Pseudomicrophyllium* Cumming gen. nov.** For several years, specimen RC 16-129 was stored papered in the *Microphyllium* tray of the first author's collection because of its small size. It was not until the specimen was pinned that its uniqueness became evident. Its antennae, thorax, and abdomen are shaped like a *Phyllium* (*Phyllium*) male, but its size and legs were more akin to *Microphyllium*. The unique male instead represents an undescribed genus. *Pseudomicrophyllium* Cumming **gen. nov.** is here established with a single species and placed within the tribe Phylliini due to its similarity to both *Phyllium* Illiger, 1798 and *Microphyllium* Zompro, 2001.

***Phyllium* (*Phyllium*) Illiger, 1798.** With this work focusing on the island of Luzon, three *Phyllium* (*Phyllium*) species are discussed, two of which are new species. The two new species appear closely related to *Phyllium* (*Phyllium*) *philippinicum* Hennemann *et al.*, 2009 in many aspects. From Isabela Province, *Phyllium* (*Phyllium*) *antonkozlovi* Cumming **sp. nov.** males can immediately be differentiated by their more robust antennae. The female is currently unknown but is assumed to look similar to *Phyllium* (*Ph.*) *philippinicum* because of the size of the male and the shared morphological similarities between the two species.

Phyllium (*Phyllium*) *bourquei* Cumming & Le Tirant **sp. nov.** is described as a new species from Nueva Vizcaya province. It was initially thought to be a new population of *Phyllium* (*Ph.*) *philippinicum* because of its similar size and profemora. However, females can easily be differentiated by their shorter subgenital plate only

reaching about half way under the anal abdominal segment (almost reaching the apex of the anal abdominal segment in *Ph.* (*Ph.*) *philippinicum*) and the margins of the mesopleurae, which are more heavily marked by robust tubercles (Figs. 18A&B). In *Ph.* (*Ph.*) *philippinicum* the mesopleurae margins are only marked by three prominent tubercles in the center and a few minor tubercles anteriorly and posteriorly (Fig. 18C). Males can be differentiated by the mesopraescutum with a distinct crest along the sagittal plane with nodes that steadily decrease in size (Fig. 17B) (vertex of the mesopraescutum almost completely smooth in *Ph.* (*Ph.*) *philippinicum* (Fig. 17C)). These two new species represent the fifth and sixth described species of *Phyllium* (*Phyllium*) recorded from Luzon to date.

In addition, a small *Phyllium* (*Phyllium*) specimen from eastern Luzon was analyzed and found to be the elusive *Phyllium* (*Phyllium*) *geryon* Gray, 1843. This species has not been seen in over a century, and because of its brief original description and severely damaged holotype, a redescription of the species is presented. The holotype is missing many morphological features commonly used for identification including antennae, forelegs, and midlegs; unique features of the thorax were therefore most useful for comparison. These features, coupled with the size of the specimen, length of tegmina, genitalia, and general body shape, all indicate that the specimen is *Phyllium* (*Phyllium*) *geryon*.

Treatment of Genera and Species

Microphyllium Zompro, 2001

Type species: *Microphyllium spinithorax* Zompro, 2001 by original designation

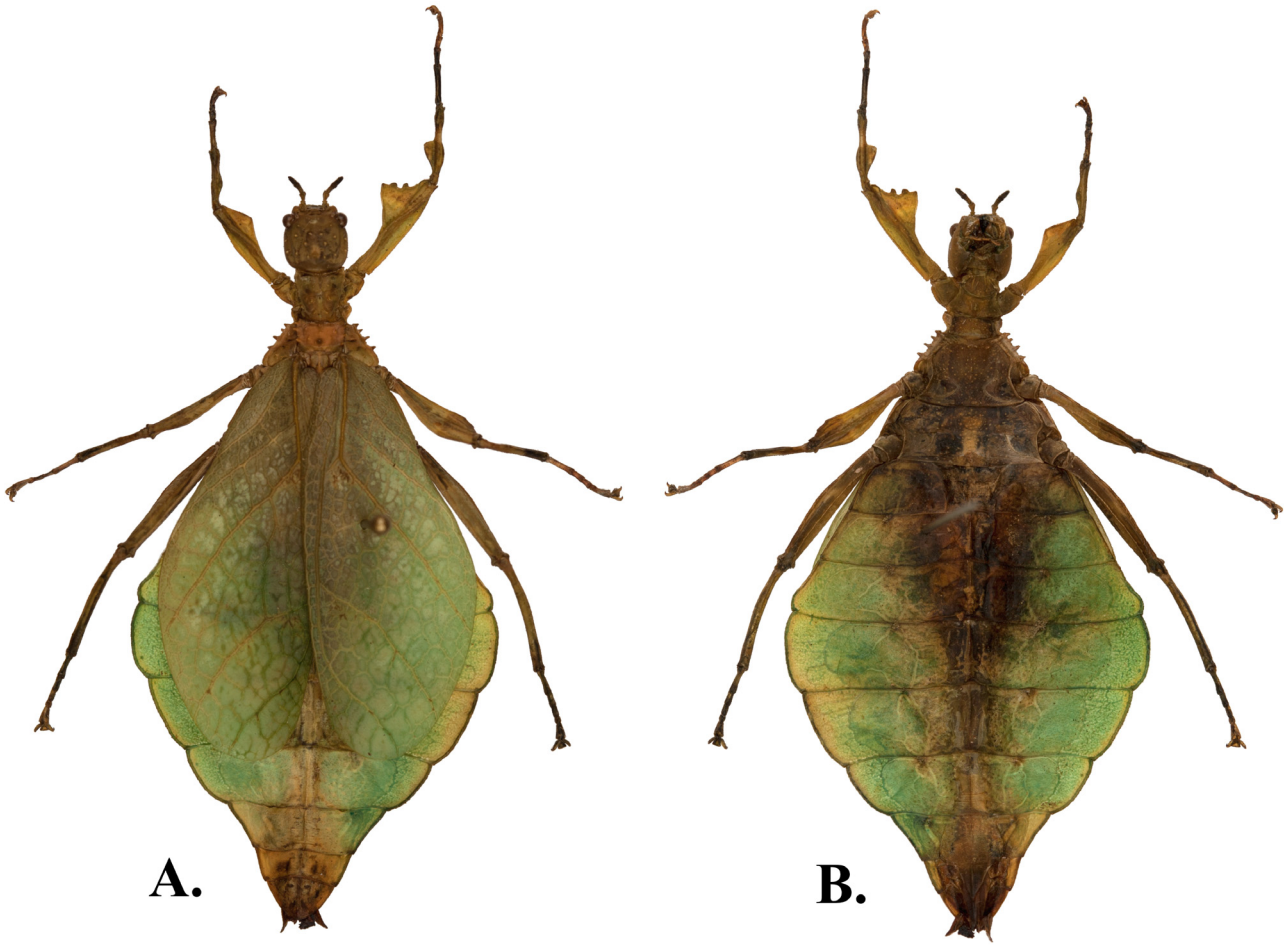

FIGURE 2. *Microphyllium pusillulum* (Rehn & Rehn, 1933), [Coll. RC 16-096], **A:** dorsal view; **B:** ventral view.

***Microphyllium pusillulum* (Rehn & Rehn, 1933)**
(Figs. 2A&B, 5B, 6A&B, 7A&B)

Material examined [2♀]: PHILIPPINES: 1♀: HOLOTYPE: Philippines, Luzon, Nueva Viscaya Province, Imugan (W. Boettcher.) [Hebard Collection, Type no. 1255.]; 1♀: Philippines, North Luzon, Mountain Province, Mt. Barlig, June, 2014. [Coll. RC 16-096].

***Microphyllium haskelli* Cumming, gen. nov.**
(Figs. 3A&B, 4A&B, 5A&C, 6C, 7C, 9A, 10A, 11A&B)

Material examined [3♂, 1♀ adult, & 1♀ L-4 nymph]: HOLOTYPE: 1♂: Philippines, North Luzon, Mountain Province, Mt. Barlig (June, 2014) [Coll. RC 16-099]. (Deposited in the National Museum of the Philippines type collection. PNM)

PARATYPES: 1♂: Philippines, North Luzon, Mountain Province, Mt. Polis (July, 2014) [Coll. RC 16-098] (Deposited in the San Diego Natural History Museum collection. SDNHM)

1♂: Philippines, North Luzon, Mountain Province, Mt. Polis (July, 2014) [Coll. RC 16-097] (Retained within the Royce Cumming Collection.)

1♀: Philippines, North Luzon, Mountain Province, Mt. Polis (May, 2014) [Coll. RC 16-128]; (Retained within the Royce Cumming Collection.)

1♀ (L-4 nymph): Philippines, North Luzon, Mountain Province, Mt. Polis (December, 2014) [Coll. RC 16-183] (Retained within the Royce Cumming Collection.)

Comparison. With the males and females of *M. haskelli* confirmed through genetic analysis, each gender is compared against the holotypes of the two currently recognized species. Side by side comparison between the females of *M. pusillulum* and *M. haskelli* can be found in Table 4, and comparisons between males of *M. haskelli* and *M. spinithorax* can be found in Table 5.

Description. Description of the coloration based upon the dried specimens. Both paratype male specimens match closely to the holotype in morphology and coloration. The female description is based on adult specimen [Coll. RC 16-128]. Many features characterize this species such as: smallest of the adult female *Microphyllium* examined at only 40.5 mm long, and with a rather stout mesopraescutum and mesopleurae; protibiae rather long and slender; profemora with a smooth triangular lobe with small teeth; abdomen smooth sided and wide (maximum width 20.6 mm). Also, many features heavily and irregularly granulose (head capsule, pronotum, prosternum, mesosternum).

♂♂. *Coloration*. Pale green throughout most of the body but with antennae an off orange and thorax that is more brown than pale green.

Morphology. Head capsule broad with slightly convex cheeks and rough vertex with ~40 unevenly spaced granules in no apparent pattern (Fig. 10A). Compound eyes large and bulbous, no ocelli present, instead there is a notable furrow between the antennal fields. Antennae with 21 segments that are short and with beadlike rounded segments. Apical antennomere cylindrical with full rounded apex, about 2x longer than wide. Pronotum lateral sides convex with a slight rim, wider rim on the anterior margin which is concave. Pronotum face irregularly granulose with ~20 granules, a slight groove along the median plane with a notable pit to the anterior and another closer to the center. Pro- and mesosternum heavily granulose throughout with evenly sized but irregularly spaced nodes. Mesopraescutum not cleanly formed, rising above the mesopleurae sharply not allowing the lateral margins to be distinct, the rudimentary margins of the mesopraescutum are marked with +/-4 tubercles of varying size and spacing. Overall mesopraescutum marked with 8–10 irregularly spaced and sized tubercles/nodes. Of these, those on the median plane are; two on the anterior rim, one in the center and a notably larger tubercle on the posterior at least 2X the size of any other on the mesopraescutum. Mesopleurae only slightly diverging with five spiniform tubercles unevenly spaced. Surface of the mesopleurae are marked with two pits on the posterior half and an irregularly granulose surface throughout. Tegmina (length 8.6–9.5 mm, maximum width 2.8–2.9 mm), extending three-quarters of the way into abdominal segment III. Alae (length 17.3–18.1 mm), well developed oval configuration, only slightly sclerotized on the exposed fold. Abdominal segment II slightly diverging, segments III–VIII with approximately parallel margins, IX–X gradually tapering towards the pointed apex. Poculum rather

long and tapering, completely covering the vomer and projects will into the anal segment (Figs. 11A & B). Profemora slender with a slight interior lobe on the anterior half with three small teeth and no exterior lobe (Fig. 9A). Protibiae without lobes (Fig. 9A). Exterior and interior lobe of meso- and metafemora gently rounded and of equal size, interior lobes slightly serrate. Meso- and metatibiae lacking lobes.

♀♀. *Coloration*. Cream to pale green throughout most of the body and tegimina, thorax closer to pale orange in color. Compound eyes burnt orange in color. The granulation throughout is of a similar color to the surface upon which it is found.

TABLE 2. Measurements in mm of *Microphyllium haskelli* specimens. L = length; W = width.

Species Author	*M. haskelli* Cumming sp. nov.				
Measurements [mm]	[Coll. RC 16-183] (L-4) ♀	[Coll. RC 16-128] ♀	[Coll. RC 16-097] ♂	[Coll. RC 16-098] ♂	[Coll. RC 16-099] ♂
L. body***	25.1	40.5	26.7	26.0	25.7
L./W. head	2.5/2.6	4.2/4.0	1.8/2.0	1.9/2.0	1.5/2.0
L. antennae	1.1	1.8	9.2	8.4	9.3
L. pronotum	1.8	2.5	1.5	1.6	1.4
L. mesonotum	2.2	2.5	1.8	2.0	1.6
L/greatest W. of tegmina	3.2/1.2	24.4/9.6	9.5/2.8	8.6/2.8	8.7/2.9
L/greatest W. of alae	-/-	-/-	18.1/10.4	17.3/12.1	17.4/10.1
Greatest W. of abdomen	10.9	20.6	3.9	3.6	2.8
L. profemora	4.7	6.7	4.4	4.8	5.0
L. mesofemora	4.1	6.5	4.4	4.6	5.0
L. metafemora	5.6	8.9	5.8	5.8	5.8
L. protibiae	3.6	5.0	3.4	3.6	3.5
L. mesotibiae	3.4	5.4	3.4	3.6	3.5
L. metatibiae	5.0	7.5	4.3	4.7	4.2

Morphology. Head capsule approximately as long as wide with an irregularly granulose vertex (some arranged in anterior to posterior lines, others without a detectable pattern) with a notable posteromedian tubercle. The small protuberance between the compound eye and antennal base has a notable pit in the center. The frontal convexity has a slight covering in setae and is approximately a third the size of the compound eyes. Antennae moderately slender and elongate (1.8 mm), shorter than postocular section of head capsule (2.2 mm), and consisting of nine segments (Fig. 5A). Antennae covered in setae of varying sizes, with the apical antennomere (IX) with the most variety in size and the greatest density. Apical antennomere cylindrical with rounded apex, about 2x longer than wide and >2x as long as VIII. Pronotum roughly rectangular, widest at the anterior, which has a distinct concave rim. Lateral rims on the pronotum are roughly parallel until the posterior third where the rim begins to weaken and converge on the posterior which lacks a distinct rim. Face of pronotum irregularly granulose with a distinct furrow in the center on the median plane, and a weaker furrow perpendicular to it. Prosternum irregularly granulous, rather small and compact and with a notable protuberance in the center about twice the size of those around it. Mesopraescutum at its widest point, twice as wide as long (width-length ratio 2.05:1), gradually narrowing towards the posterior. Lateral margins marked with 5 major and 1–2 minor tubercles of various sizes. Mesopraescutum disk with a slight rim on the anterior margin, and along the median plane there are two distinct tubercles close together with the posterior one being about twice the size as the anterior protuberance found on the rim (Fig. 6C). The anterior protuberance found on the rim is also slightly split with two distinct points. Mesopleurae gradually diverging with lateral margins armed with 5 unevenly spaced tubercles, the most prominent of which are on the anterior. Mesopleurae face also marked with several weak granules as well as a clear pit located in the center. Mesosternum irregularly granulous throughout. Tegmina (length 24.4 mm, maximum width 9.6 mm) extending to the posterior margin of abdominal segment VII. Alae rudimentary. Abdominal segments II–IV gradually widening

with the posterior of segment IV the widest segment and V–X gradually tapering towards the apex. Anal segment at its widest, wider than long (width-length ratio 1.72:1), with a pointed apex. Subgenital plate short, only extending slightly over the posterior of segment IX, ending in a rounded point (Fig. 7C). Gonapophyses rather short as well only slightly protruding from under the subgenital plate (Fig. 7C). Profemora with a very narrow exterior lobe. Interior lobe wider than exterior lobe, obtuse in angle, and only slightly dentate with 3+/- distinct teeth. Protibiae lacking an exterior lobe and the interior lobe is reduced to a sliver. Exterior and interior lobe of mesofemora gently rounded, interior lobe with slight dentation and only slightly wider than exterior. Exterior and interior lobe of metafemora gently rounded with exterior lobe rather thin, interior lobe slightly serrate.

Measurements of the holotype and paratypes can be found in table 2 and can be compared against measurements of *M. pusillulum* and *M. spinithorax* specimens found in table 3.

TABLE 3. Measurements in mm of *M. spinithorax* and *M. pusillulum* specimens. L = length; W = width.

Species Author	*M. spinithorax* Zompro, 2001		*M. pusillulum* (Rehn & Rehn, 1933)	
Measurements [mm]	HT ♂*	PT ♀ (L-4)*	[Coll. RC 16-096] ♀**	HT: Type no. 1255♀**
L. body***	24.2	29.2	42.3	47.0
L./W. head	1.8/-	3.2/-	4.6/3.6	4.9/4.4
L. antennae	-	-	2.0	****
L. pronotum	-	-	2.5	3.0
L. mesonotum	-	-	2.1	3.2
L/greatest W. of tegmina	-	-	23.4/9.7	25.0/10.5
L/greatest W. of alae	-	-	-	-
Greatest W. of abdomen	-	-	21.4	23.0
L. profemora	4.1	-	6.5	7.2
L. mesofemora	4.0	4.7	6.3	7.3
L. metafemora	4.8	6.2	8.3	8.9
L. protibiae	3.0	-	4.8	5.5
L. mesotibiae	2.9	3.7	4.7	5.5
L. metatibiae	4.0	5.0	7.4	8.2

* Taken from the original description.
**First author's measurements.
***Including head and cerci, excludes antennae.
****Missing from the specimen.

TABLE 4. Comparison between species of known adult female *Microphyllium* Zompro, 2001.

	M. pusillulum (Rehn & Rehn, 1933)	*M. haskelli* Cumming **sp. nov.**
Head Capsule	Vertex w/ ~15 regularly spaced granules	Vertex w/ ~40+ small unevenly spaced granules
Pronotum	6 granules (2 X 3 configuration)	Irregularly granulose, no pattern
Profemur	Interior lobe angle of ~90°, with 2 broad teeth	Interior lobe obtuse angle, with 3 small teeth
Protibia	Slight exterior lobe and distinct rounded triangular interior lobe	Without an exterior lobe and interior lobe greatly reduced
Mesopraescutum	Lateral margins marked with 3 tubercles	Lateral margins with 4 nubby major tubercles and 1–2 minor tubercles
Subgenital Plate	Short, ending in a sharp point	Short, ending in a rounded point
Gonapophyses	Long and slender reaching apex of abdomen	Short, only slightly protruding from under the subgenital plate

TABLE 5. Comparison between species of known adult male *Microphyllium* Zompro, 2001.

	M. haskelli Cumming **sp. nov.**	*M. spinithorax* Zompro, 2001*
Pedicellus	Half or more than height of scapus	Short, disk-like, less than half as long as scapus
Antennae segments	21 (count includes scapus and pedicellus)	20 (count includes scapus and pedicellus)
Terminal antennae segment	A full rounded cone, no excavation or reduction in size	Anterior part flat, with a spoon-like excavation
Tegmina	Reaching posterior of III	Reaching posterior of IV
Alae	Reaching ½ through IX	Reaching posterior margin of VIII
Genitalia	Poculum with a pointed apex that covers the vomer	**Poculum with a rounded apex, exposing the vomer below

*Taken from Zompro, 2001 original description.
**As illustrated by Wedmann, S. *et al*., 2007.

Etymology. This new species is a patronym named in honor of world famous forensic entomologist Dr. Neal H. Haskell of Rensselaer, Indiana, United States. Dr. Haskell has been an invaluable mentor to the first author as he works on his master's degree.

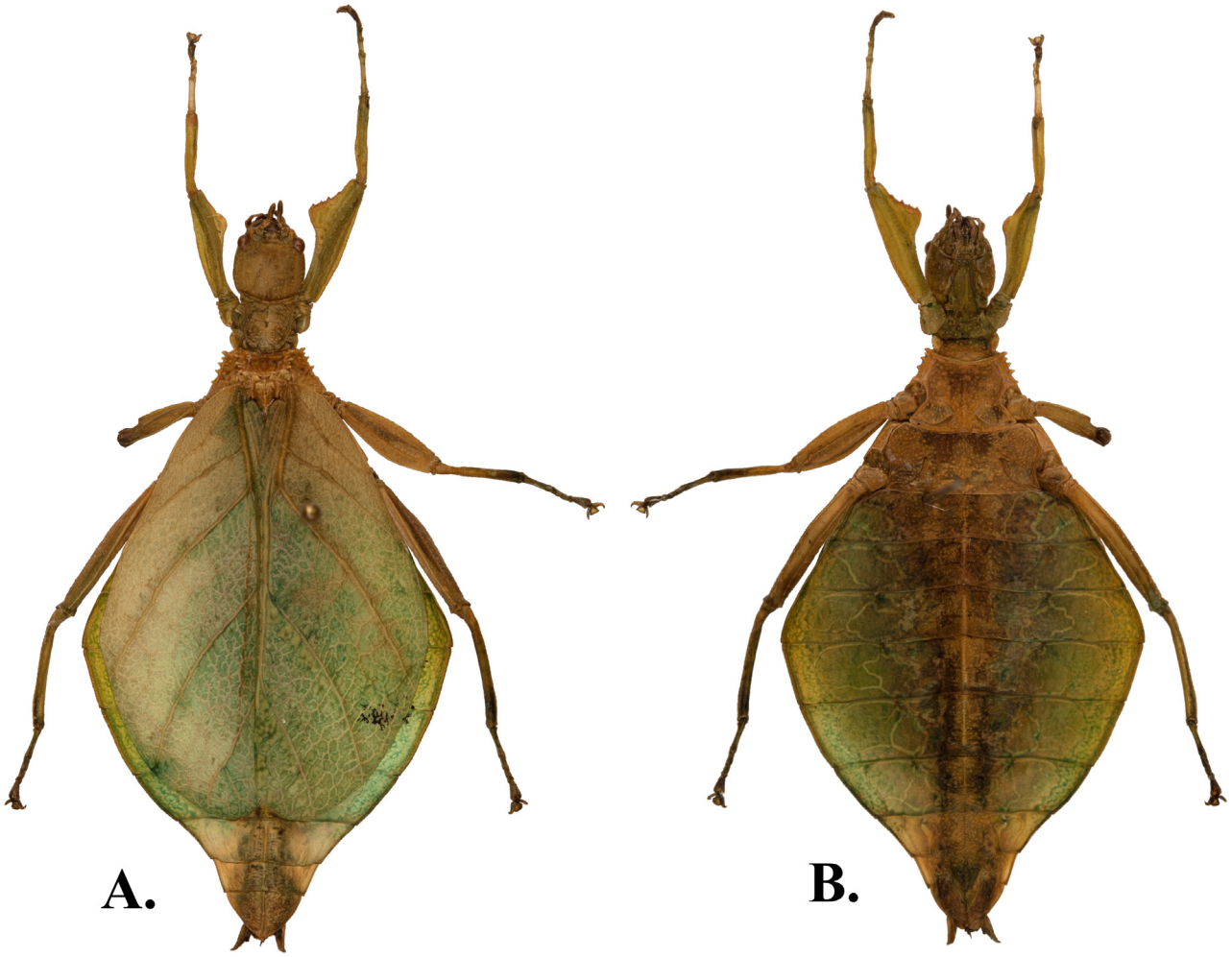

FIGURE 3. *Microphyllium haskelli* Cumming **sp. nov**., PT [Coll. RC 16-128]. **A:** dorsal view; **B:** ventral view.

FIGURE 4. Male *Microphyllium haskelli* Cumming **sp. nov.,** PT [Coll. RC 16-097], **A:** dorsal view; **B:** ventral view.

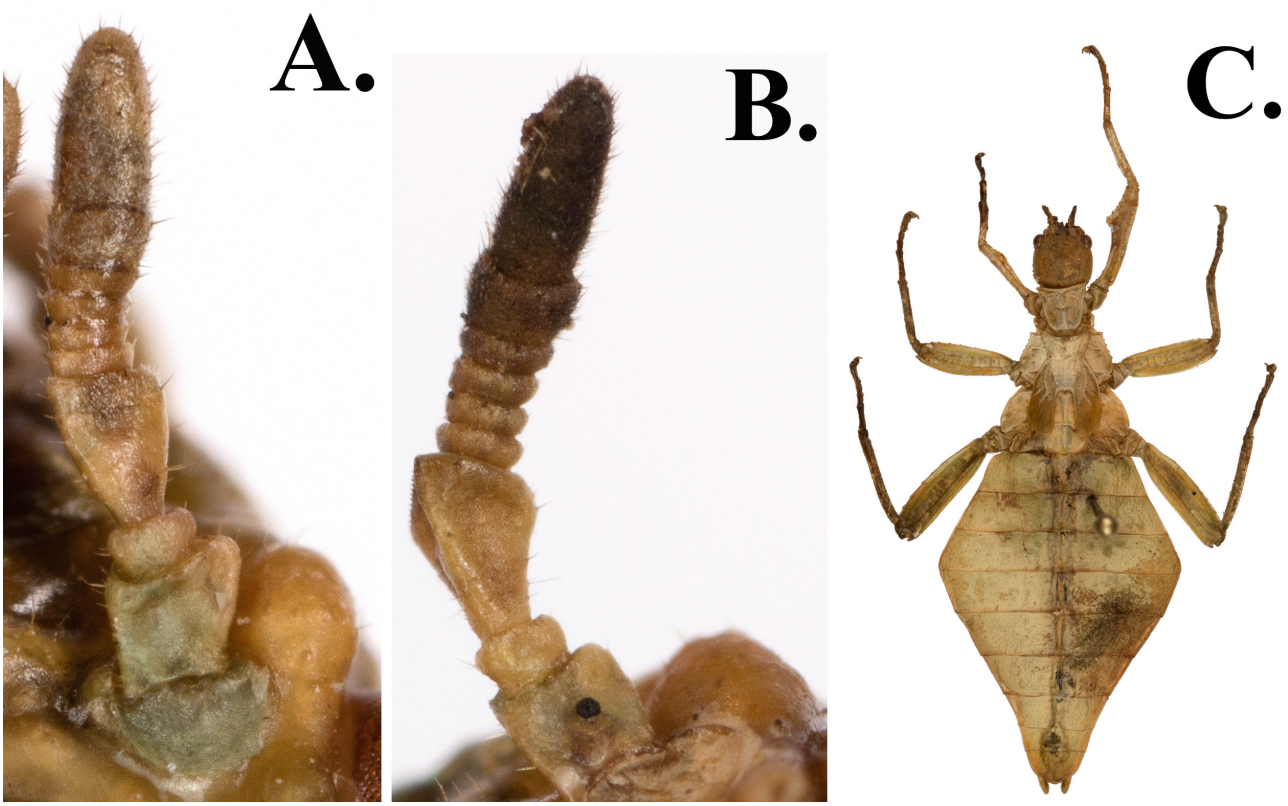

FIGURE 5. Antennae of female **A:** *Microphyllium haskelli* Cumming **sp. nov**., PT [Coll. RC 16-128] (D. Burk/Indiana, USA); **B:** *M. pusillulum* (Rehn & Rehn, 1933), [Coll. RC 16-096] (D. Burk/Indiana, USA); **C:** dorsal view female nymph *M. haskelli* Cumming **sp. nov**., PT [Coll. RC 16-183].

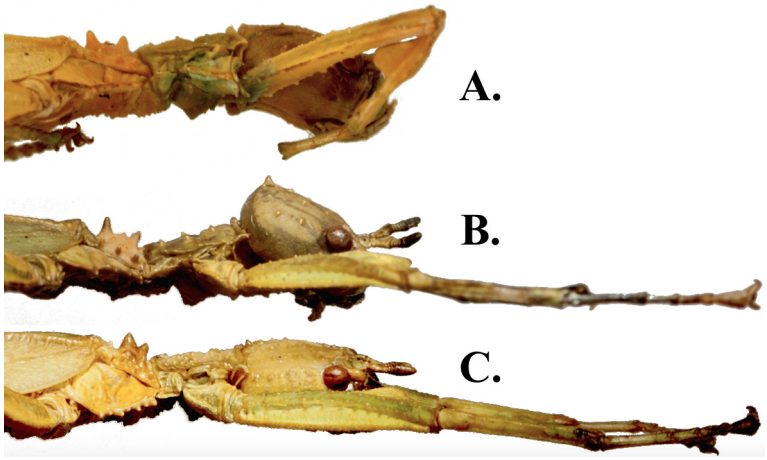

FIGURE 6. Side view of *Microphyllium* female thorax and head. **A:** *M. pusillulum* HT (J.D. Weintraub/ANSP Entomology); **B:** *M.pusillulum* [Coll. RC 16-096]; **C:** *M. haskelli* Cumming **sp. nov.,** PT [Coll. RC 16-128].

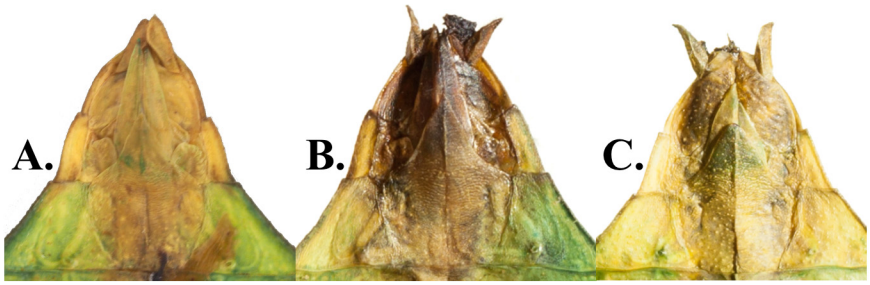

FIGURE 7. Ventral view of *Microphyllium* female genital plates **A:** *M. pusillulum* HT (J.D. Weintraub/ANSP Entomology); **B:** *M.pusillulum* [Coll. RC 16-096]; **C:** *M. haskelli* Cumming **sp. nov.,** PT [Coll. RC 16-128].

Pseudomicrophyllium **Cumming gen. nov.**

Type Species: *Pseudomicrophyllium faulkneri* Cumming **gen. et sp. nov.**

Etymology: The genus is named because it was thought for several years to be a new *Microphyllium* species because of its size and it was not until closer examination that it was revealed it to be a new genus evading detection right under the first author's view because of those similarities.

Diagnosis. ♂: Appearing closely related to *Phyllium* (*Phyllium*) with characteristics such as the antennae, thorax, but the body size and spination of the legs are reminiscent of *Microphyllium.* The combination of the below morphological features characterize males of the new genus and differentiate it from the other known phylliid genera.

Antennae: Long and filiform with long setae, similar to *Phyllium* (*Phyllium*).

Profemora: Completely lacking an exterior lobe, interior lobe greatly reduced, similar to *Microphyllium*.

Protibia: Lacking both exterior and interior lobes, similar to *Microphyllium*.

Thorax: Similar to *Phyllium* (*Phyllium*) with a distinct mesopraescutum.

The most evident feature that differentiates *Pseudomicrophyllium* **gen. nov**. from *Microphyllium* Zompro, 2001 are the long filiform antennae. Abdominal shape in the walking leaf family is a feature that has proven to be very variable in female *Phyllium* and more stable in male *Phyllium*. However not enough is known about the male variation of abdominal shape in the small phylliid genera of Luzon to use abdominal shape as a strong morphological feature in their differentiation and identification. Antennae structure is a feature that has proven much more stable throughout the family and this emphasis is reflected in the dichotomous key at the end of this work.

♀: UNKNOWN

***Pseudomicrophyllium faulkneri* Cumming sp. nov.**
(Figs. 8A&B, 9B, 10B&C, 11C)

HOLOTYPE: ♂: Philippines, North Luzon, Ifugao, Banaue (IX-2014) [Coll. RC 16-129]. (Deposited in the National Museum of the Philippines type collection. PNM)

Description. Description of the coloration based upon the dried specimen. Body length similar in size to known *Microphyllium* males but with antennae just over double the length of the characteristic short bead-like antennae of *Microphyllium*.

Coloration. Pale throughout most of the HT likely due to the drying process. The compound eyes are of a reddish brown coloration. Venation of the tegmina is of a yellow to orange color but this, too, is assumed to have been a vivid green in life.

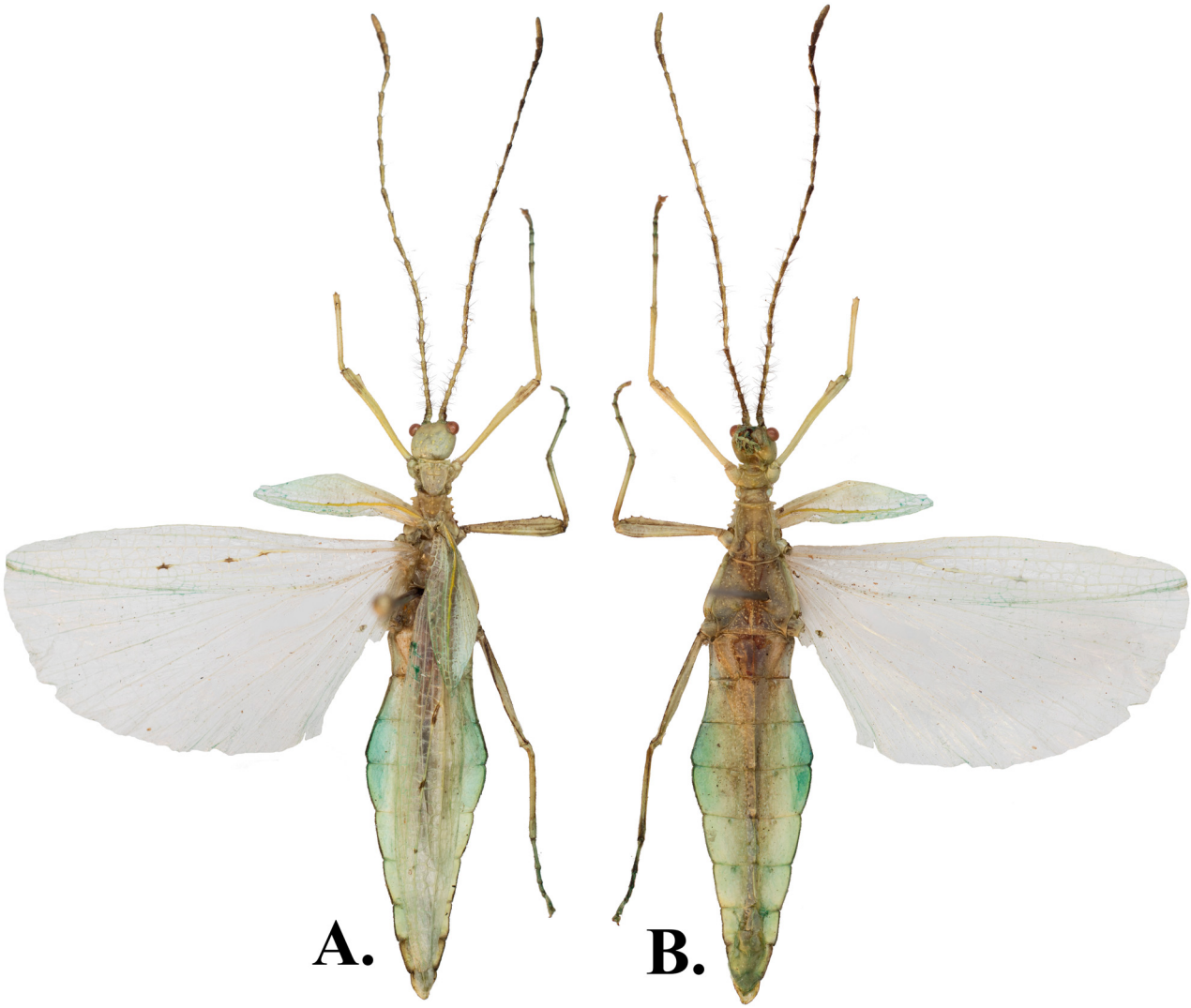

FIGURE 8. Male *Pseudomicrophyllium faulkneri* Cumming **gen. et sp. nov**., HT [Coll.RC 16-129], **A:** dorsal view; **B:** ventral view.

Morphology. Head capsule broad with convex cheeks and vertex smooth with ~16 evenly spaced granules (Fig. 10B). Compound eyes large and bulbous, no ocelli. Antennae with 23 segments, long and slender with setae length that at times can be over twice the width of the segment it is protruding from (Fig. 10C). Apical antennomere cylindrical with rounded apex, about 2x longer than wide. Pronotum with an anterior margin twice as wide as the posterior margin, and lateral sides rather straight with a slight rim, wider rim on the anterior margin (Fig. 10B). Pronotum face smooth with 6 evenly spaced nodes, a slight groove along the median plane on the anterior half along with a slight perpendicular groove. Prosternum with slight uneven granulation throughout. Mesopraescutum

with slightly narrowing lateral margins marked with 3 evenly spaced tubercles and disk face distinctly raised along the median plane marked with three tubercles, the one on the anterior rim is the smallest of the three and the posterior most at least 2X the size of the other two. Just lateral to the tubercles of the median plane are 2 nodes on each side on the mesopraescutum disk face (Fig. 10B). Mesopleurae only slightly diverging with four tubercles evenly spaced (Fig. 10B). Mesosternum with slight uneven granulation throughout. Tegmina (length 8.2 mm, maximum width 1.8 mm) rather small, extending to the middle of abdominal segment II. Alae (length 19.7 mm), well developed oval configuration, only slightly sclerotized on the exposed fold. Abdominal segment II slightly converging, segments III–IV gradually diverging with IV the widest segment, V–X gradually tapering towards the apex. Anal segment as long as wide and with a rounded apex. Poculum projecting well into the anal segment and covering a majority of the vomer (Fig. 11C). Profemora slender with a slight interior lobe on the anterior 1/5th as a small rounded triangle (Fig. 9B). Protibiae lacking both interior and exterior lobes (Fig. 9B). Exterior and interior lobe of meso- and metafemora gently rounded with interior lobes slightly serrate.

Measurements [*mm*]: Length of body (excludes cerci which are lacking in the HT) 27.8, length/width of head 2.4/2.3, length of pronotum 1.7, length of mesonotum 1.7, length of tegmina 8.3, greatest width of tegmina 1.8, length of alae 19.7, greatest width of abdomen 5.9, length of profemora 5.1, length of mesofemora 4.8, length of metafemora 5.4, length of protibiae 3.9, length of mesotibiae 3.6, length of metatibiae 4.5, length of protarsi 5.1, length of antennae 20.1.

Etymology. This new species is a patronym named in honor of David Faulkner of California, USA. Faulkner has been a mentor to the first author over the years and was the first to introduce him to forensic entomology.

FIGURE 9. Male left foreleg **A:** *Microphyllium haskelli* Cumming **sp. nov.,** PT [Coll. RC 16-098] (D. Burk/Indiana, USA); **B:** *Pseudomicrophyllium faulkneri* Cumming **gen. et sp. nov**., HT (D. Burk/Indiana, USA).

***Phyllium* Illiger, 1798**

Type species: *Phyllium* (*Phyllium*) *siccifolium* (Linnaeus, 1758) by original description.

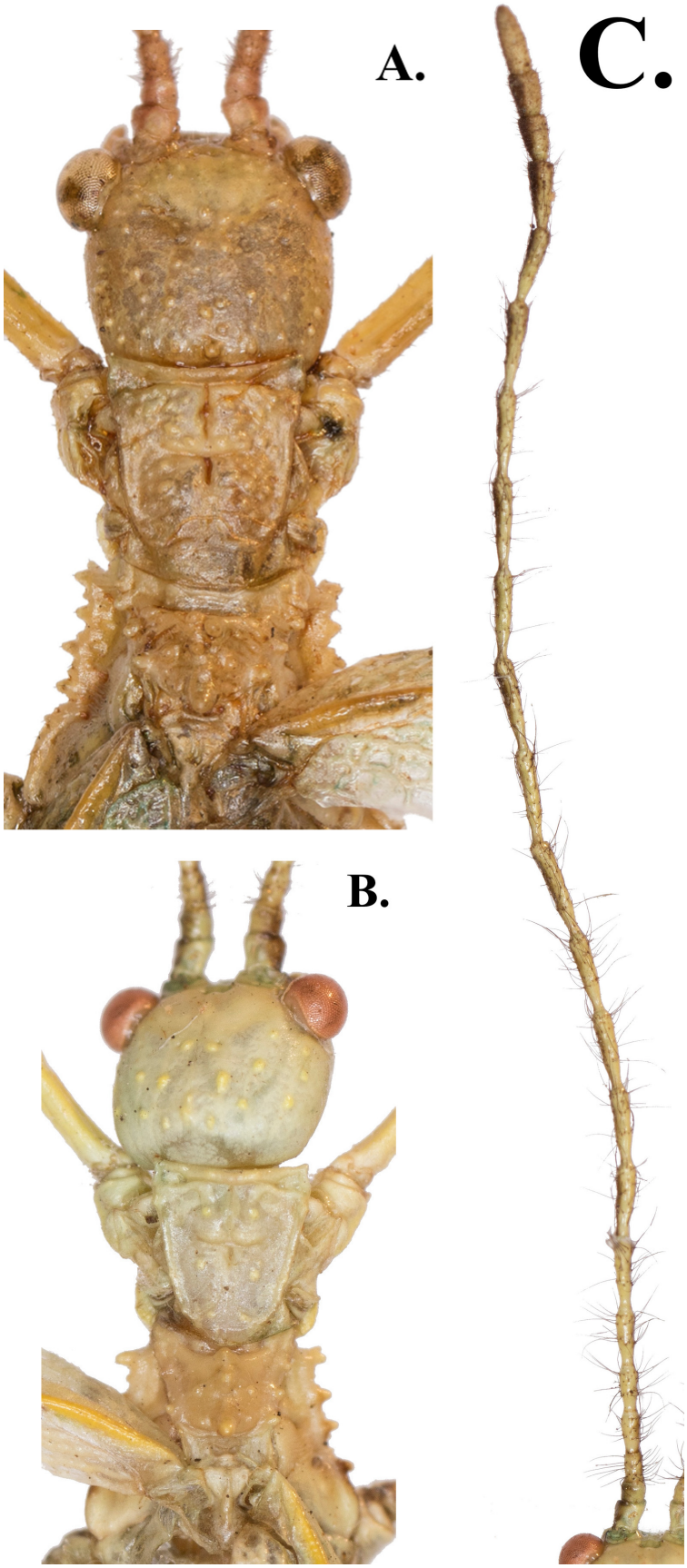

FIGURE 10. Male *Microphyllium haskelli* Cumming **sp. nov.,** PT [Coll. RC 16-098] (D. Burk/Indiana, USA), **A:** head and thorax. Male *Pseudomicrophyllium faulkneri* Cumming **gen. et sp. nov**., HT (D. Burk/Indiana, USA); **B:** head and thorax; **C:** left antennae.

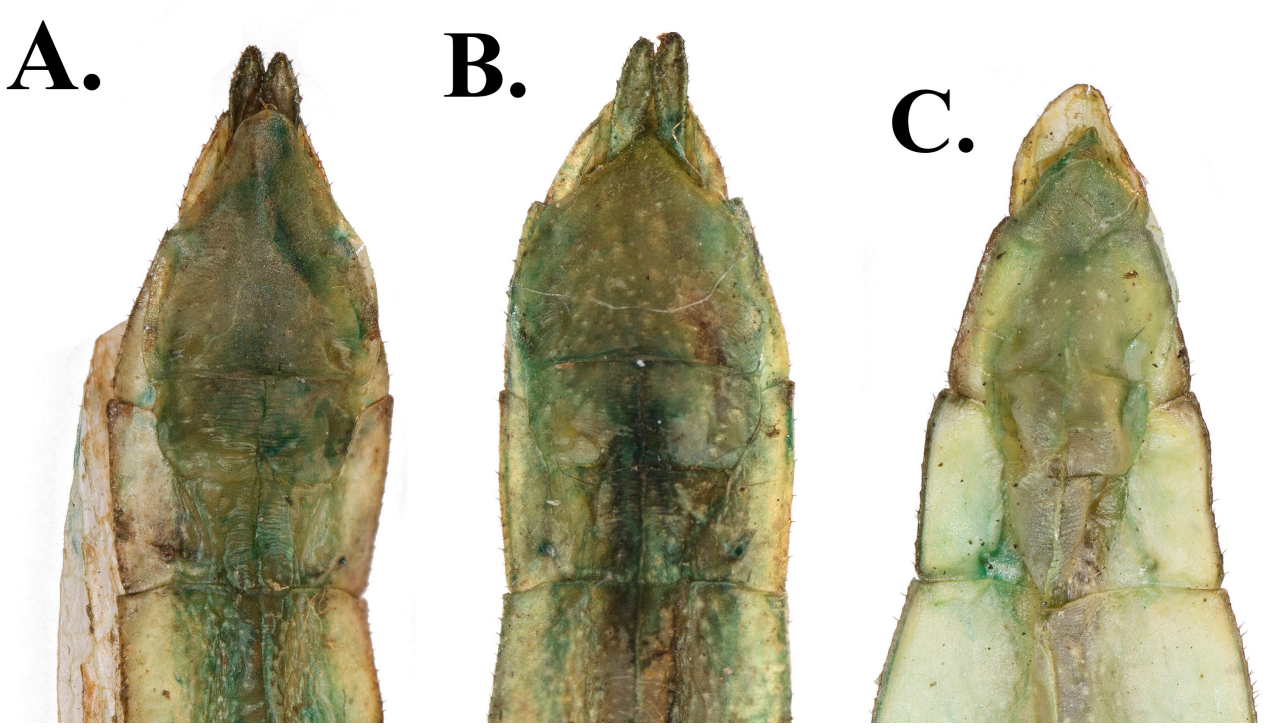

FIGURE 11. Ventral view of male genitalia, **A:** *Microphyllium haskelli* Cumming **sp. nov.,** PT [Coll. RC 16-098] (genital plate open away from body); **B:** *M. haskelli* Cumming **sp. nov.,** PT [Coll. RC 16-097] (genital plate tucked against the body); **C:** male *Pseudomicrophyllium faulkneri* Cumming **gen. et sp. nov**., HT.

***Phyllium* (*Phyllium*) *antonkozlovi* Cumming sp. nov.**
(Figs. 12A&B & 13A,B,&C)

HOLOTYPE: 1♂ Philippines, Luzon, Isabela Prov., Dindin (VIII-2014) [Coll. RC 16-122]
(Deposited in the National Museum of the Philippines. PNM)

Discussion. With the lack of exterior lobes of the tibiae and simple antennae this new species is placed within the subgenus *Phyllium* (*Phyllium*), species-group placement however is tentative. Hennemann *et al*., 2009 describe the males of the *siccifolium* species-group as having an exterior lobe of the profemora which is always distinctly narrower than the interior lobe, a feature only weakly accurate for *Ph.* (*Ph.*) *antonkozlovi* **sp. nov.** (Fig. 13C). However, the interior lobe leads us to believe that *Ph.* (*Ph.*) *antonkozlovi* **sp. nov.** is closely related to *Phyllium* (*Phyllium*) *philippinicum* Hennemann *et al.*, 2009 because of the teeth of the profemora that are small and evenly spaced. *Phyllium* (*Ph.*) *antonkozlovi* **sp. nov.** can immediately distinguishable from *Ph.* (*Ph.*) *philippinicum* Hennemann *et al.*, 2009 by the robust antennae segments and lack of developed ocelli. Because of the male's similarity to *Phyllium* (*Phyllium*) *philippinicum*, it is predicted that the female will also be morphologically similar to *Ph.* (*Ph.*) *philippinicum* females. It is unlikely that this male specimen is the unknown male of the other known Philippine species, which is known only from females. The large size of the male (57.4 mm) suggests a female similar in size to *Ph.* (*Ph.*) *philippinicum* females (77.5–88.0 mm, Hennemann *et al.*, 2009). *Phyllium* (*Ph.*) *bilobatum* Gray, 1843 is known only from the female holotype with the vague locality of "Philippines" is much too small (65.0 mm) to be the unknown *Ph.* (*Ph.*) *antonkozlovi* **sp. nov.** female. The holotype *Phyllium* (*Ph.*) *woodi* Rehn & Rehn, 1933 is closest to the expected size of the unknown *Ph.* (*Ph.*) *antonkozlovi* **sp. nov.** female (76.0 mm in length), but *Ph.* (*Ph.*) *woodi* is currently only known from Sibuyan Island, far from the type locality of *Ph.* (*Ph.*) *antonkozlovi* **sp. nov.** and is morphologically dissimilar to *Ph.* (*Ph.*) *philippinicum* females. *Phyllium* (*Ph.*) *geryon* Gray, 1843 is also much too small to be the *Ph.* (*Ph.*) *antonkozlovi* **sp. nov.** female (*Ph.* (*Ph.*) *geryon* holotype 62.0 mm in length and specimen [Coll RC 17-256] only 65.7 mm in length).

Description. Description is based upon the HT male as no other specimens are known to exist and the female is currently unknown. Rather average in size for known *Phyllium* (*Phyllium*) males at 57.4 mm in length. Antennae

however are shorter and robust, approximately the length of the extended forelegs (most *Phyllium* (*Phyllium*) antennae are longer than the extended forelegs by 3 to 6 antennal segments).

Coloration. Despite being dried, the lime green coloration has not faded as much as most walking leaves color often does. Antennae are very deep brown color and are darker than the cherry red compound eyes. Spination is mostly of a similar color to the surface it is found on.

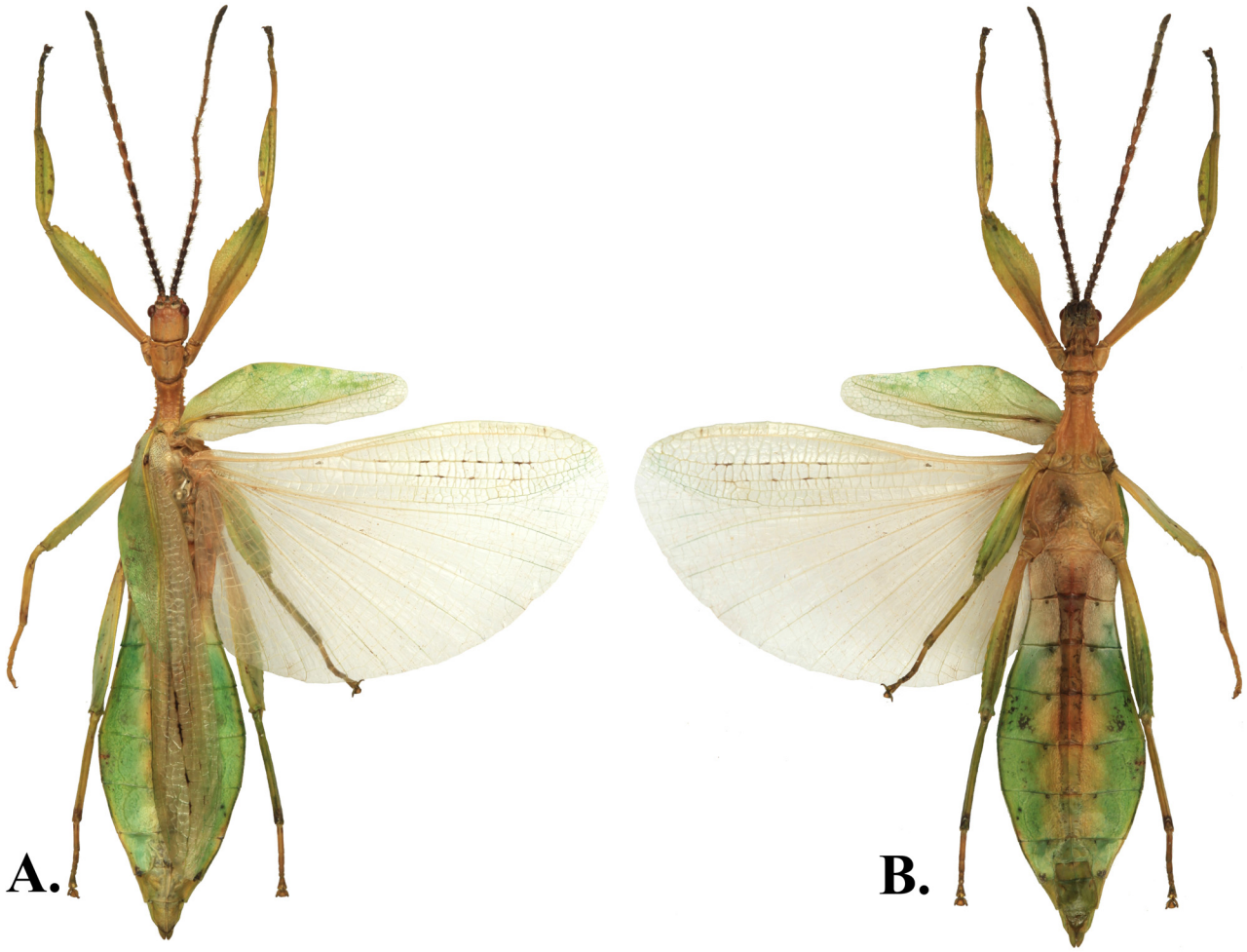

FIGURE 12. *Phyllium* (*Phyllium*) *antonkozlovi* Cumming **sp. nov.,** HT, [Coll. RC 16-122], **A:** dorsal view; **B:** ventral view.

Morphology. Head capsule about as broad as long with rather straight cheeks creating a boxy overall shape (Fig. 13A). Rather large and distinct antennal fields, vertex smooth with only a slightly noticeable posteromedian tubercle. Compound eyes of medium size only slightly protruding, ocelli highly reduced to only a slight marking on the capsule indicating where they were. Antennal rather robust, and consisting of 23 segments. Basal segments are beadlike and cylindrical (Fig. 13A). Apical antennomere cylindrical with rounded apex, about 2x longer than wide. Pronotum relatively smooth but with a distinct furrow and slight pit along the median plane and three less notable pits along the anterior rim. Anterior margin concave, lateral and posterior margins slightly convex. Shape roughly trapezoidal with the anterior length about twice that of the posterior. Anterior and lateral margins with slight rims. Prosternum smooth except for slight granulation. Mesopraescutum approximately twice as long than wide, slightly narrower towards the posterior. Lateral margins with 6–7 tubercles of uniform size but somewhat unevenly spaced. Mesopraescutum disc only slightly raised along the median plane with a relatively smooth crest marked by a prominent tubercle on the anterior rim and another in the center, in addition to these two prominent tubercles there are 4–5 lesser nodes. Mesopleurae only slightly diverging from mesopraescutum lateral margins, with 3–4 distinct tubercles and 7–9 minor tubercles intermixed. Mesosternum rather smooth without notable granules. Tegmina (length 21.2 mm, maximum width 6.7 mm), extending about a third the way through abdominal segment IV. Alae (length 37.9 mm), well developed, oval fan configuration with exposed section slightly sclerotized. Abdominal segment II slightly tapering, segments III –V gradually widening with VI marking the

widest segment, VI–X gradually tapering towards the apex. Spiracles distinctly visible on the ventral surface, located on the anterior margin of segments III–VIII near the median plane. Anal segment not tapering evenly creating a pentagonal shape with a rounded apex. Poculum rather short with a flat apex, slightly projecting over the posterior margin of abdominal segment IX and exposing the vomer, which is rather wide (Fig. 13B). Profemora with a narrow rounded exterior lobe and slightly thicker interior lobe, which is serrate with 5–6 distinct teeth pointing anteriorly, which are more or less evenly spaced (Fig. 13C). Protibiae lacking exterior lobe, interior lobe only a smooth arch, not triangular. Exterior and interior lobes of mesofemora gently rounded and slightly serrate with the exterior lobe slightly narrower. Exterior and interior lobes of metafemora gently rounded with interior lobe wider and serrate.

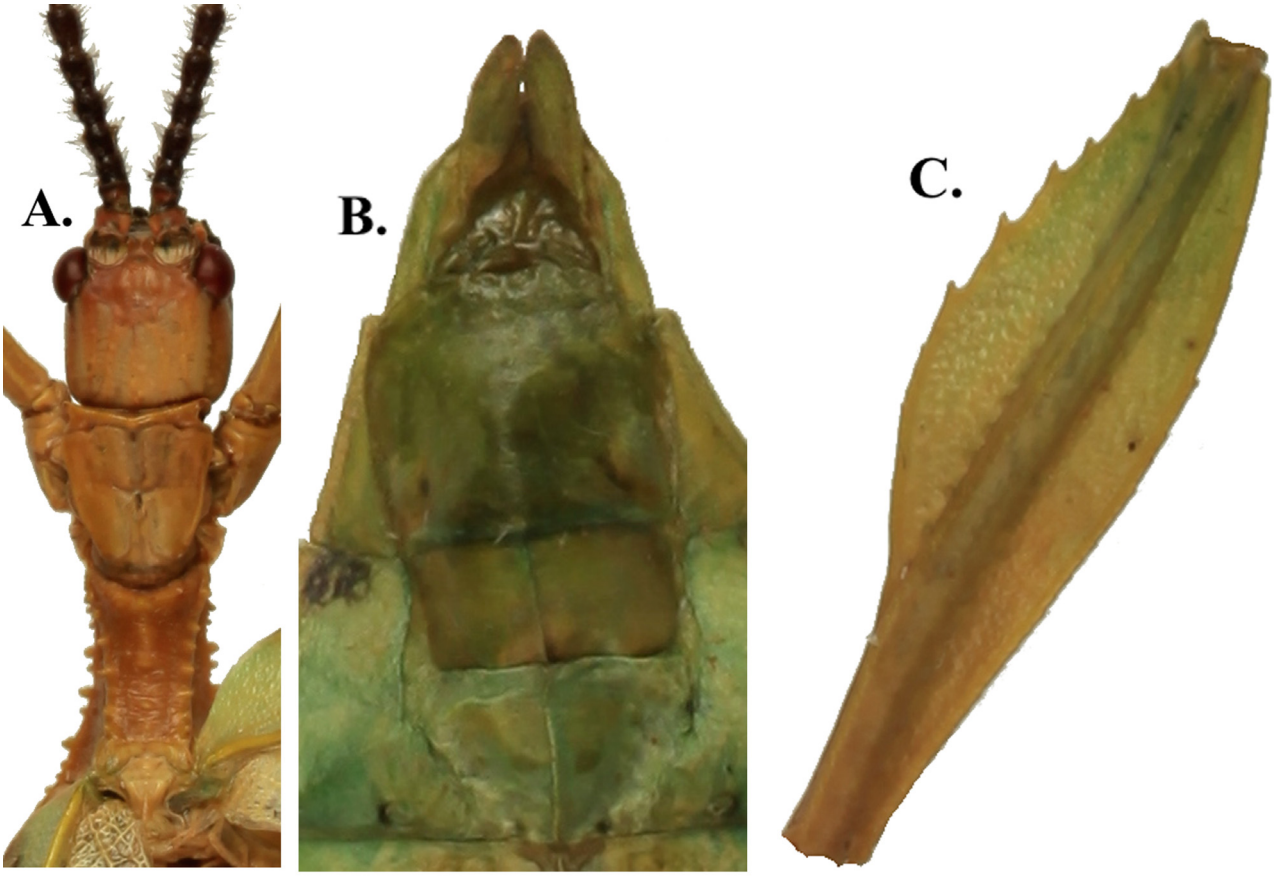

FIGURE 13. *Phyllium* (*Phyllium*) *antonkozlovi* Cumming **sp. nov.,** HT [Coll. RC 16-122], **A:** antennae, head, and thorax; **B:** genitalia ventral view; **C:** right profemora.

Measurements [mm]: Length of body 57.4, length/width of head 3.8/3.5, length of pronotum 3.5, length of mesonotum 5.0, length of tegmina 21.2, greatest width of tegmina 6.7, length of alae 37.9, greatest width of abdomen 13.3, length of profemora 13.3, length of mesofemora 11.1, length of metafemora 15.6, length of protibiae 9.4, length of mesotibiae 7.8, length of metatibiae 10.9, length of protarsi 7.2, length of antennae 27.1.

Etymology. This new species is a patronym named in honor of Anton Olegovich Kozlov, long time friend to the first author and well-known Russian field entomologist.

***Phyllium* (*Phyllium*) *bourquei* Cumming & Le Tirant sp. nov.**

(Figs. 14A,B&C, 15A,B,C,D&E 16A,B&C, 17A&B, 18A,B,&D)

HOLOTYPE: ♀: Philippines, Luzon, Nueva Vizcaya, Kayapa, March, 2017 [Coll. RC 17-203].
(Deposited in the National Museum of the Philippines. PNM)
PARATYPES: 1♀: Philippines, Luzon, Nueva Vizcaya, August, 2007 [Coll. RC 17-255].
1♂: Philippines, Luzon, Nueva Vizcaya, Belanue, May, 2014 [Coll. RC 16-201].

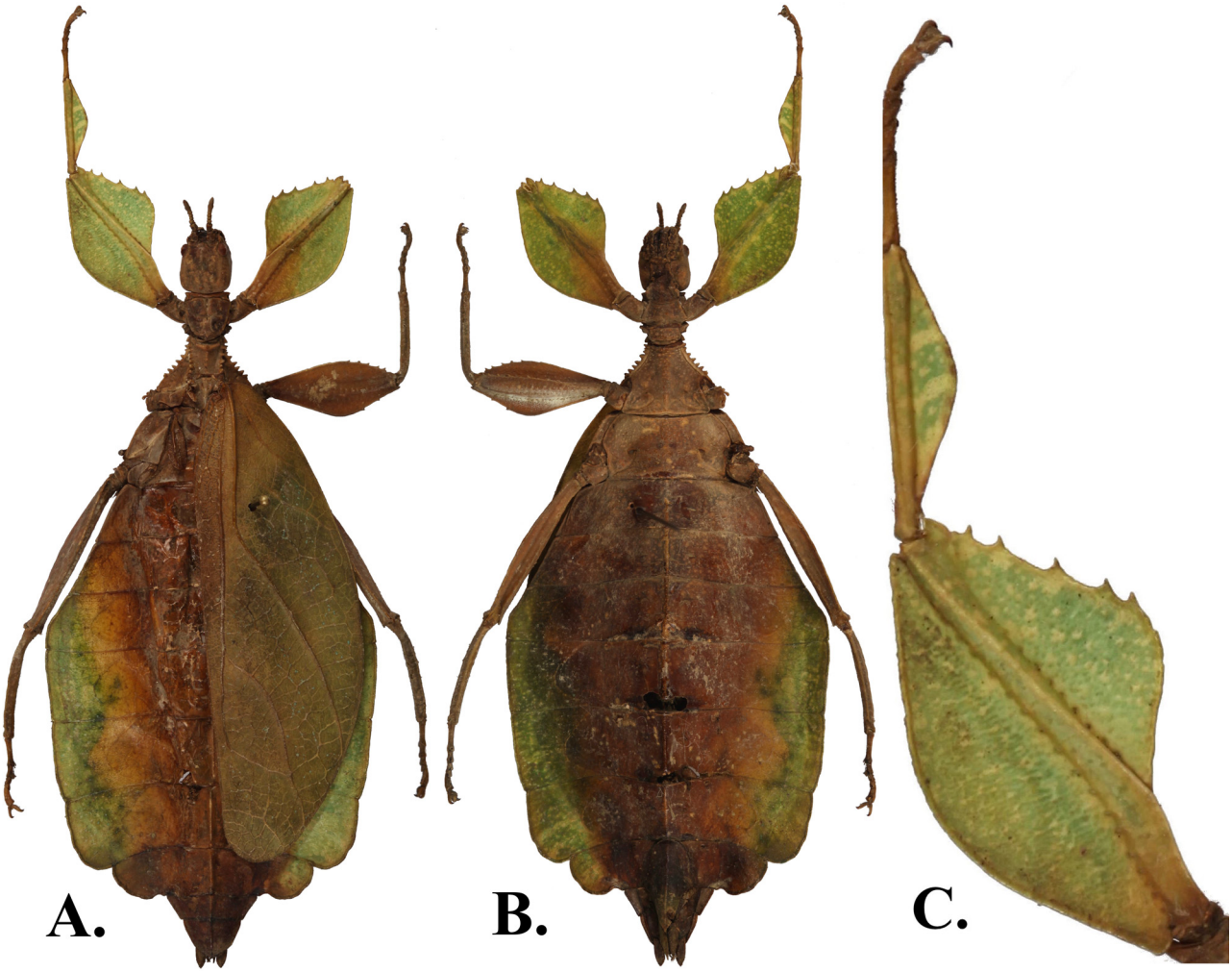

FIGURE 14. *Phyllium* (*Phyllium*) *bourquei* Cumming & Le Tirant **sp. nov.** HT female [Coll. RC 17-203], **A:** dorsal view; **B:** ventral view; **C:** left foreleg.

Coauthored with Stéphane Le Tirant, Montreal, Canada, whose collection originally contained the paratype female. **Discussion.** This species was originally thought to be *Phyllium* (*Phyllium*) *philippinicum* Hennemann *et al.*, 2009 found outside its known range. Upon closer examination, several differences became clear. Like *Ph.* (*Ph.*) *philippinicum,* this new species falls under the *siccifolium* species-group of Hennemann, *et al*., 2009 because the female lacks developed alae and the male has an exterior lobe of the profemora that is more slender than the interior lobe. It is possible that future genetic analysis will find that these two populations are not conspecific, but the marked differences in the female genitalia led us to here describe them with species level status. The geographic isolation of the two populations, *Ph.* (*Ph.*) *philippinicum* from the Zambales Range, and *Ph.* (*Ph.*) *bourquei* from the Caraballo Mountains, separated by the Central Luzon Plains, also led to the decision to erect the new species.

Description. Description is based upon the HT female and the paratype male/female specimens. Coloration is based upon the dried specimens here illustrated, it is assumed the colors were lighter in life.

♂♂**.** *Coloration*. Pale green throughout (except for areas of rot), other areas (antennae and thorax in particular) paler in color, more straw colored than green. No eyespots noted on the abdomen in the male paratype.

Morphology: Head capsule length and width approximately equal (Fig. 17A). Distinct antennal fields, vertex mostly smooth, only slight granulation on the posterior end and around a broad but short posteromedian tubercle. Compound eyes large and protruding, ocelli well developed. Antennal simple, and consisting of 23 segments (including scapus and pedicelus) and with long thin setae. Apical antennomere cylindrical with rounded apex, slightly more than 3x longer than wide and covered with short dense setae. Pronotum relatively smooth, with a distinct furrow and slight pit along the median plane. Anterior margin concave, lateral and posterior margins

slightly convex. Shape roughly trapezoidal with the anterior length slightly less than twice that of the posterior. Anterior and lateral margins with distinct rims. Prosternum with moderate granulation. Mesopraescutum approximately as long as wide, and only slightly narrower towards the posterior. Lateral margins with 5–6 decent sized tubercles of slightly different sizes and somewhat unevenly spaced. Mesopraescutum disc raised along the median plane with a crest marked by a prominent tubercle on the anterior rim followed by three others of steadily decreasing size and even spacing with the smallest ending near the posterior rim (Fig. 17B). The surface of the mesopraescutum disc on each side of the crest is free of nodes. Mesopleurae slightly diverging from mesopraescutum lateral margins for the first 1/3 and then gradually widening for the remainder. Mesopleurae margins with 5 distinct tubercles predominantly on the anterior and 3 minor tubercles intermixed on the posterior portion. Prosternum fully covered in granules of varying sizes, but none more notable than the others. Mesosternum rather smooth but with notable granules along the sagittal plane, more heavily marked on the anterior. Tegmina (length 17.9 mm, maximum width 5.2 mm), extending to the anterior margin of abdominal segment IV. Alae (length 37.7 mm), well developed, oval fan configuration with exposed section slightly sclerotized. Abdominal segment II with parallel margins, segments III – first 2/3 of segment IV gradually widening with IV marking the widest segment, posterior 1/3 of IV–X gradually tapering towards the apex, at first only slightly then more prominently creating a spade shaped abdomen. Spiracles only just visible on the ventral surface, located on the anterior margin of segments III–VIII near the median plane. Anal segment posterior half somewhat evenly rounded apex. Poculum rather stout with a straight posterior margin, slightly projecting over the posterior margin of abdominal segment IX and exposing the vomer, which is rather wide with a single stout terminal hook (Fig. 15C). Exterior lobe of profemora narrow, at its widest point only slightly wider than the shaft of the femur. Exterior lobe of the profemora relatively smooth, only marked by small, barely notable teeth pointing anteriorly. Interior lobe not starting until a third the way up the femur and arching in a rounded triangle marked with six to seven small anteriorly pointing teeth that are not quite evenly spaced (Fig. 16C). Protibiae lacking exterior lobe, interior lobe only a smooth arch, almost triangular in shape. Exterior and interior lobes of mesofemora gently rounded and approximately equal in width and both lightly serrate. The interior lobe marked more heavily with six to seven tightly packed teeth, the exterior lobe less serrate, marked with three more widely spaced teeth. Exterior and interior lobes of metafemora gently rounded; interior lobe notably wider and with eight serrate teeth; exterior lobe lacking serration. Meso- and metatibiae simple, lacking lobes or serration.

♀♀. *Coloration*. Most of the holotype is discolored but a pale green is still detectable on the margins of the abdomen and forelegs. The paratype is mostly a paler color and almost completely discolored.

TABLE 6. Measurements in mm of *Phyllium* (*Phyllium*) *bourquei* Cumming & Le Tirant **sp. nov.** type specimens. L = length; W = width.

Specimen	HT ♀ [Coll. RC 17-203]	PT ♀ [Coll. RC 17-255]	PT ♂ [Coll. RC 16-201]
L. body*	85.2	83.6	51.6
L./W. head	7.6/6.1	7.7/6.1	2.9/2.7
L. antennae	4.7	4.3	28.9
L. pronotum	5.1	4.7	2.5
L. mesonotum	6.9	5.7	3.7
L/greatest W. of tegmina	55.2/18.1	52.6/16.7	17.9/5.2
L/greatest W. of alae	6.6/-	-/-	37.7/19.8
Greatest W. of abdomen	38.1	36.0	11.7
L. profemora	18.1	17.6	10.6
L. mesofemora	15.3	15.2	9.0
L. metafemora	19.8	19.4	11.6
L. protibiae	11.1	11.1	7.2
L. mesotibiae	10.6	10.2	6.2
L. metatibiae	14.8	14.7	8.3

*Including head and cerci, excludes antennae.

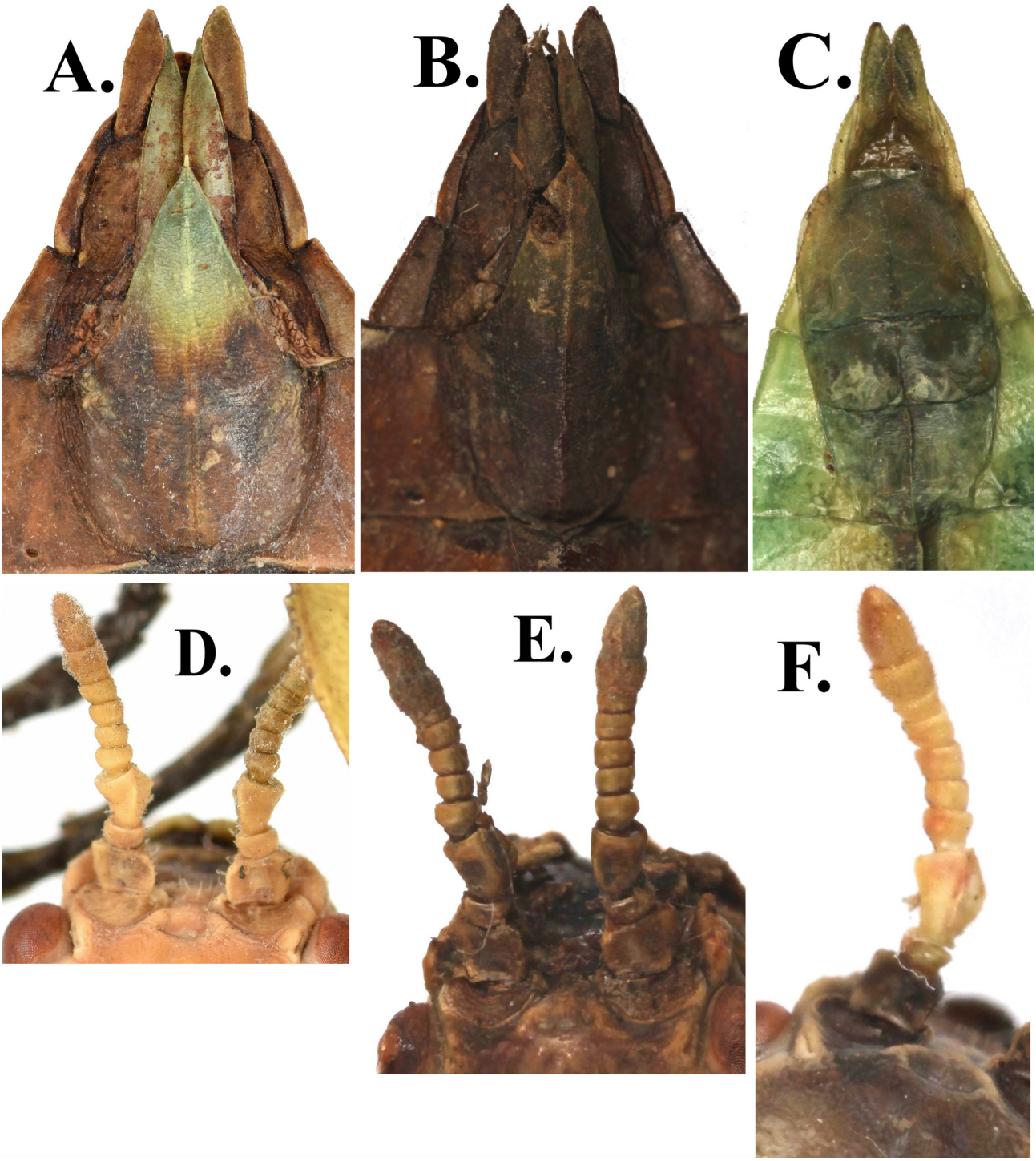

FIGURE 15. Ventral view genitalia of *Ph.* (*Ph.*) *bourquei* Cumming & Le Tirant **sp. nov.**, **A**: PT female [Coll. RC 17-255] (R. Limoges/Montreal Insectarium); **B:** HT female [Coll. RC 17-203]; **C:** PT male [Coll. RC 16-201]. Female antennae, **D:** *Ph.* (*Ph.*) *bourquei* Cumming & Le Tirant **sp. nov.** PT female [Coll. RC 17-255] (R. Limoges/Montreal Insectarium); **E:** *Ph.* (*Ph.*) *bourquei* Cumming & Le Tirant **sp. nov.** HT female [Coll. RC 17-203]; **F:** *Ph.* (*Ph.*) *philippinicum* Hennemann *et al*., 2009 [Coll. RC 16-142].

Morphology. Head capsule longer than wide with the posterior 1/4 sparsely granulose with a notable posteromedian tubercle at least three times the size of any other node. Antennae moderately slender and elongate, slightly longer than the postocular section of the head capsule, and consisting of ten segments (Figs. 15D&E). Antennae mostly lacking setae, the terminal two segments are the only ones with notable setae covering. Apical antennomere cylindrical with rounded apex, only slightly longer than the preceding segment. Pronotum relatively

smooth, with a distinct furrow and slight pit along the median plane. Anterior margin concave, lateral and posterior margins slightly convex. Shape roughly trapezoidal with the anterior width approximately twice that of the posterior. Anterior margin with distinct rim, lateral margins with weak rims. Mesopraescutum only slightly narrowing towards the posterior and approximately the same length as the width. Lateral margins marked with ~6 robust major tubercles of relatively uniform size. Mesopraescutum disk with a prominent rim on the anterior margin marked by a distinct spine followed by four small but clear nodes along the sagittal plane (Figs. 18A,B,&D). Mesopleurae uniformly diverging with lateral margins armed with ~7–8 robust tubercles. Mesopleurae face relatively smooth but marked with a clear pit located on the anterior third and a slight pit on the posterior third. Prosternum irregularly granulous throughout. Mesosternum mostly smooth but with notable granules along the sagittal plane, more heavily marked on the anterior. Tegmina extending slightly past the anterior margin of abdominal segment VIII. Alae rudimentary. Abdominal segments II- the first 2/3 of IV gradually widening, with segment IV marking the widest segment. The posterior third of IV–X tapering towards the apex with segments VII and VIII lobed. Anal segment at its widest, slightly wider than long, with a broad apex. Subgenital plate with a fine point reaching about half way under the anal abdominal segment (Figs. 15A&B). Gonapophyses rather long, slightly protruding from under the anal abdominal segment when viewed dorsally. Profemora with a widely rounded exterior lobe that has a relatively smooth outer margin. Interior lobe, slightly narrower than exterior lobe and slightly more angled, anterior portion of the margin marked with 5 small saw-like teeth of equal size and shape, but not with perfectly equal spacing. Protibiae lacking an exterior lobe and the interior lobe a rounded isosceles triangle. Exterior and interior lobe of mesofemora gently rounded; exterior lobe slightly wider than interior lobe due to the shape being more angled than the interior lobe, which is gently arching. Exterior lobe is marked with two to three widely spaced small teeth, interior lobe marked more heavily with serrate dentition (five to six teeth). Exterior and interior lobe of metafemora gently rounded with exterior lobe rather thin, interior lobe slightly wider and with seven serrate teeth, exterior lobe lacking dentition. Meso- and metatibiae simple, lacking lobes or serration.

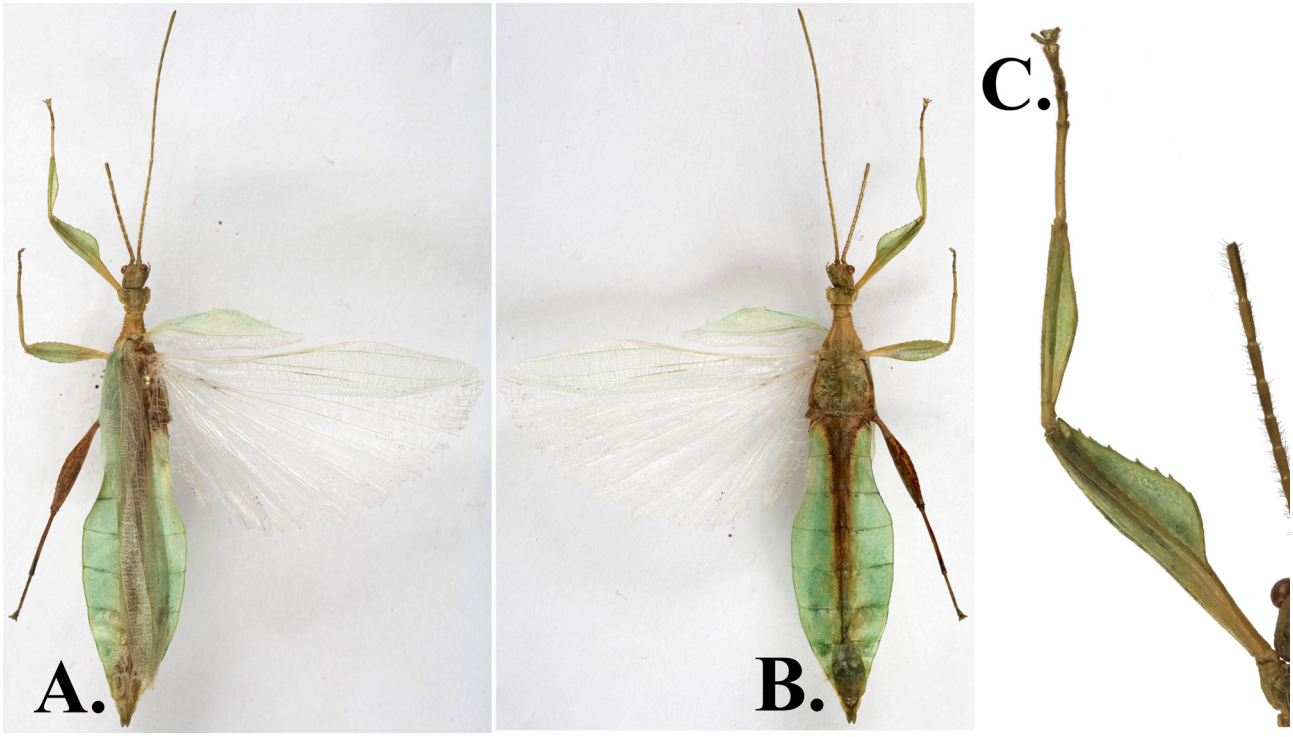

FIGURE 16. *Phyllium* (*Phyllium*) *bourquei* Cumming & Le Tirant **sp. nov.** PT male [Coll. RC 16-201], **A:** dorsal view; **B:** ventral view; **C:** left foreleg.

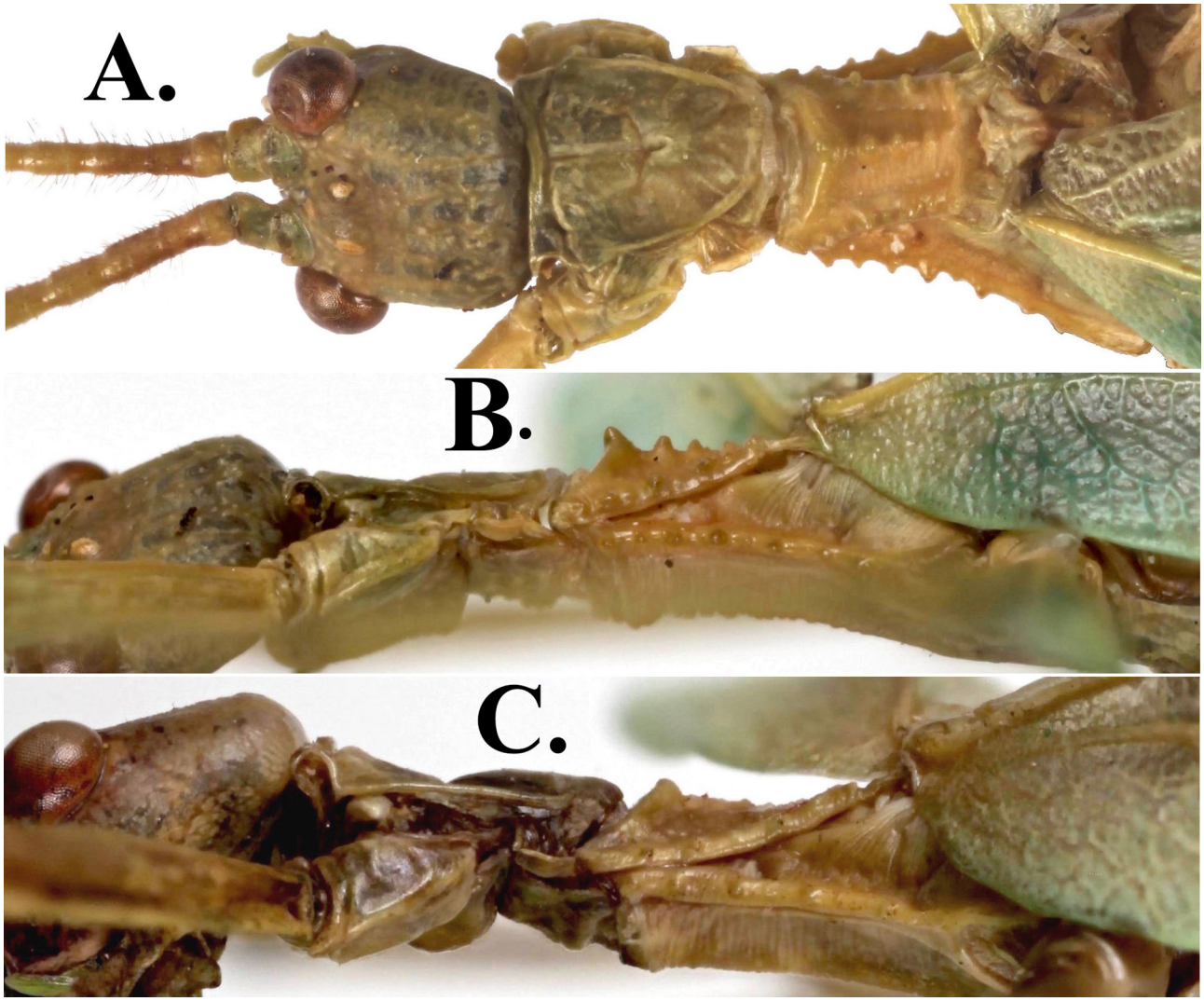

FIGURE 17. Male dorsal view of base of antennae, head, and thorax of *Phyllium* (*Phyllium*) *bourquei* Cumming & Le Tirant **sp. nov.** PT male [Coll. RC 16-201], **A:** base of antennae, head, and thorax. Side view of males; **B:** *Ph.* (*Ph.*) *bourquei* Cumming & Le Tirant **sp. nov.** PT male [Coll. RC 16-201], **C:** *Ph.* (*Ph.*) *philippinicum* Hennemann *et al*., 2009 [Coll. RC 16-162].

Measurements of the type material can be found within table 6.

Etymology. This species is dedicated to Mr. Pierre Bourque. He was mayor of the City of Montreal from 1994 to 2001. Mr. Bourque was also one of the most innovative directors of the Montreal Botanical Garden from 1980 to 1994. Among other things, he was responsible for the creation of new greenhouses, the Floralies Internationales de Montréal, the Japanese Garden, the Chinese Garden, the Tree House, the Montreal Biodome and the Montreal Insectarium. Thanks to Mr. Bourque, the Montreal Botanical Garden has become the second largest in the world.

***Phyllium* (*Phyllium*) *geryon* Gray, 1843**

(Figs. 19A&B & 20A,B,C&D)

Material examined [2♀]: PHILIPPINES: 1♀: HOLOTYPE: 42. 72 Phil. Isl.; Philippine Islands; geryon, G.R.Gray, Cumings; Phyllium geryon G.R.Gray, Philippine Islds.; BMNH(E) #845232 [examined from detailed photos available on Phasmida Species File http://phasmida.speciesfile.org (author: Paul D. Brock)]; 1♀: Philippines, Luzon, Aurora Province, Dingalan Municipality, August, 2017 [Coll. RC 17-256].

Discussion. Originally only known from the inexact type locality of "Inhabits the Philippine Islands" from Gray's 1843 description, *Phyllium* (*Phyllium*) *geryon* represents the tenth species of Phylliidae confirmed from

Luzon. The small *Phyllium* specimen in the first author's collection was originally expected to be difficult to compare morphologically to the damaged holotype, because many of the most frequently used features are missing. However, several unique features that still remain on the holotype allow us to confidently identify the punitive specimen. The granulation/spination of the head and thorax of the holotype were the most important features of the broken specimen to allow confident identification.

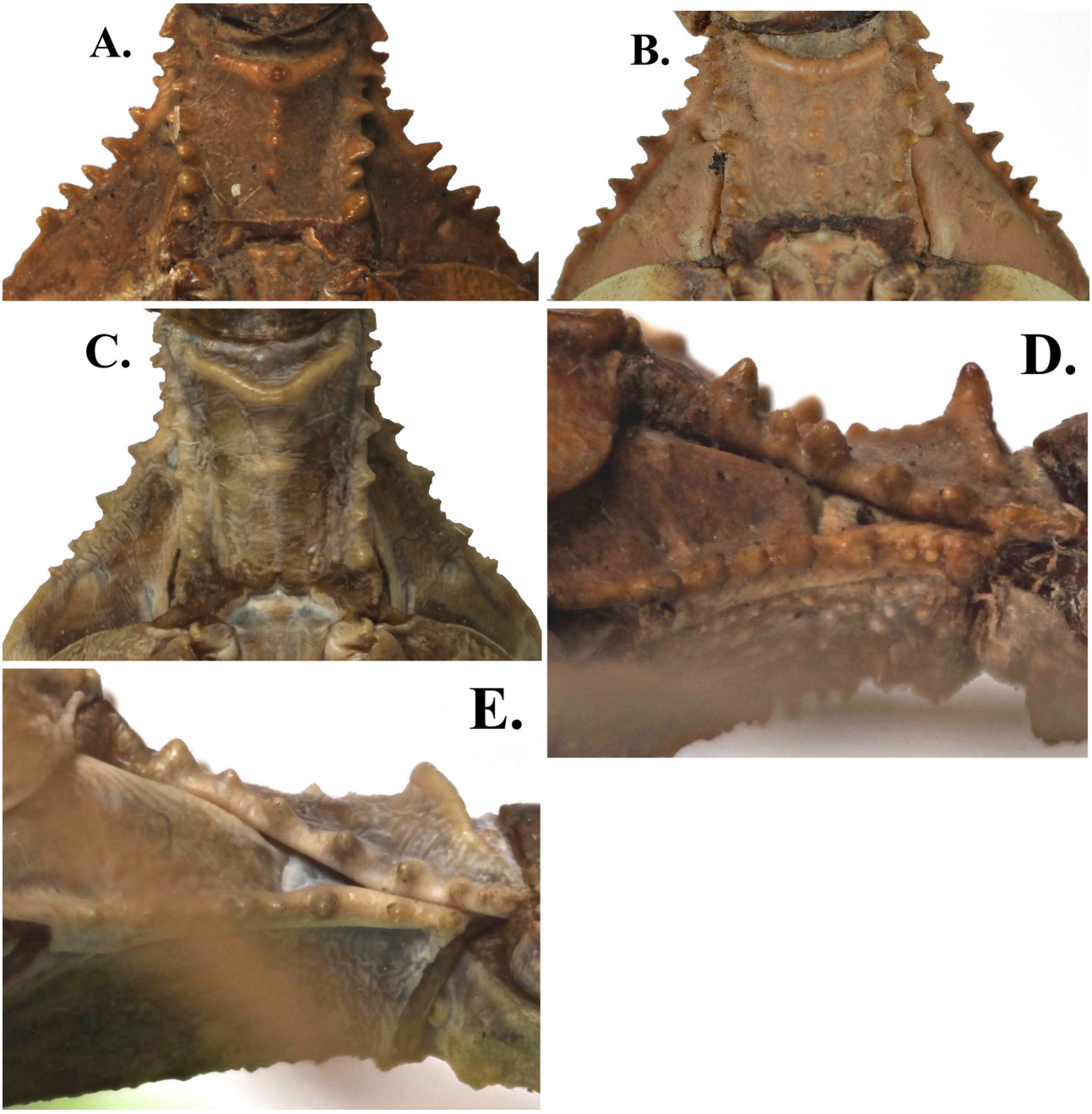

FIGURE 18. Female thorax dorsal view, **A:** *Phyllium* (*Phyllium*) *bourquei* Cumming & Le Tirant **sp. nov.** HT [Coll. RC 16-203]; **B:** *Ph.* (*Ph.*) *bourquei* Cumming & Le Tirant **sp. nov.** PT [Coll. RC 17-255]; **C:** *Ph.* (*Ph.*) *philippinicum* Hennemann *et al*., 2009 [Coll RC 16-142]. Female thorax side view, **D:** *Ph.* (*Ph.*) *bourquei* Cumming & Le Tirant **sp. nov.** HT [Coll. RC 17-203]; **E:** *Ph.* (*Ph.*) *philippinicum* [Coll RC 16-142].

The most striking feature on the thorax that identifies *Phyllium* (*Ph.*) *geryon* is the spination along the crest of the mesopraescutum. The anterior rim lacks a spine, and is instead followed by a notable spine in the center and ends in a large prominent spine on the posterior that, in profile, is at least twice the size of the anterior rim (Fig. 20D). Also the five well-defined tubercles of the mesopleurae with one to two small nodes placed between each were perfectly reflected in the specimen and is not something that we have seen in examination of dozens of other

Phyllium species. The other features of the thorax also match perfectly but are not as unique as the posterior spine of the mesopraescutum crest.

The only feature that did not match perfectly between specimens was the apex shape of the subgenital plate. In the holotype the apex is sharply pointed and in the specimen from the first author's collection the apex is rounded. The length of the subgenital plate however matches between the two individuals (both short, only reaching the posterior of segment IX) and the difference in terminal shape is assumed to be the result of being worn down, or a slight deformity resulting in a dulled point.

Many of the features described below are described for the first time, as it appears the holotype has been damaged for most of its existence. The profemora that was illustrated in the original description is the only feature that has drawn notable discussion over the years, as it is unclear if it belonged to the actual holotype or if it was a recreated illustration from deHaan's work the year before (de Haan, 1842). The profemora illustration in Gray's work certainly appears to be the same as the male nymph illustrated the year before which de Haan listed as belonging to a *Phyllium* (*Phyllium*) *siccifolium* male nymph. The determination by de Haan is likely erroneous as he lists the specimen as coming from "Timor, Nova Guinea" a locality not known to have *Phyllium* (*Phyllium*) *siccifolium* and is instead more likely to belong to one of the many New Guinea native Phylliidae that have since been described.

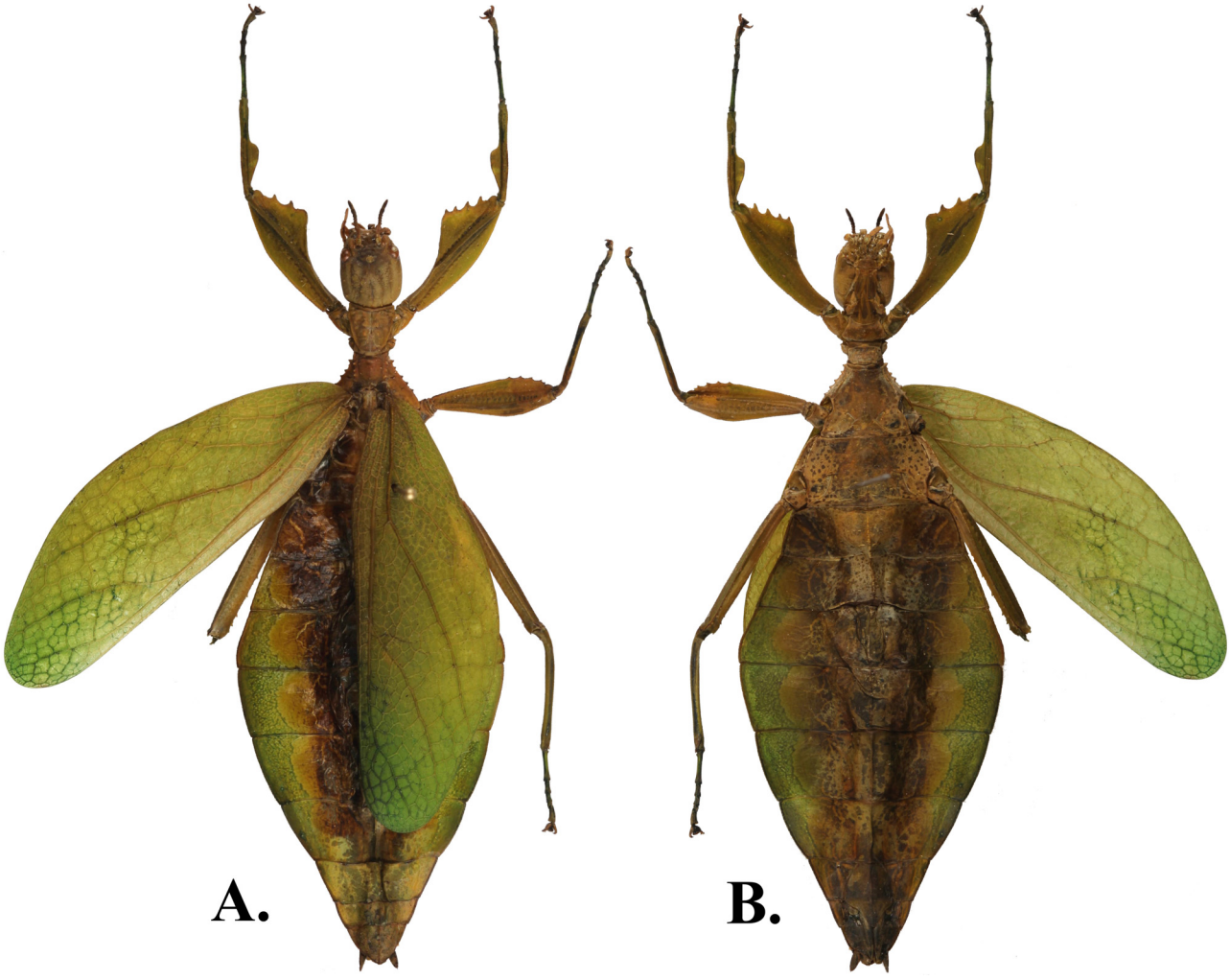

FIGURE 19. Female *Phyllium* (*Phyllium*) *geryon* Gray, 1843 [Coll. RC 17-256], **A:** dorsal view; **B:** ventral view.

We do find it odd however that while Gray appears to have illustrated a male nymphs profemora and assumed that it was equivalent to the *Phyllium* (*Ph.*) *geryon* holotype, he did place a great deal of importance on the shape of the profemora of Phylliidae, dividing his 1843 work into three divisions based solely on the exterior lobe of the profemora. From the specimen in the first author's collection it is clear that the exterior lobe of the profemora, although not very wide (slightly thinner than the interior lobe) is complete and present, not absent as Gray

describes. This leads us to believe that the holotype, even from the time of Gray's original observation was missing its forelegs and Gray looking to use the profemora as a key feature in his work went looking for a specimen with a similar body shape to the *Phyllium* (*Ph.*) *geryon* holotype and found de Haan's male nymph adequate. The first mention that the forelegs were missing from the holotype, and first to suggest that perhaps Gray only illustrated the nymph from de Haan, was Westwood only sixteen years latter when he observed the specimen and found the forelegs "wanting" (Westwood, 1859). Rehn and Rehn in 1933 also discussed their suspicion of the missing exterior lobe of the profemora and surprisingly guessed that *Phyllium* (*Ph.*) *geryon* was native to Luzon, a guess incorrectly based on their assumption that *Phyllium* (*Ph.*) *geryon* was closely related to *Microphyllium pusillulum* which they based on the small size and thin exterior lobe of the profemora.

♀♀**.** *Coloration*. Pale to darker green throughout most of the body and tegimina, some areas discolored from drying. Compound eyes burnt orange. The granulation throughout is of a similar color to the surface upon which it is found or slightly lighter such as those found on the head capsule.

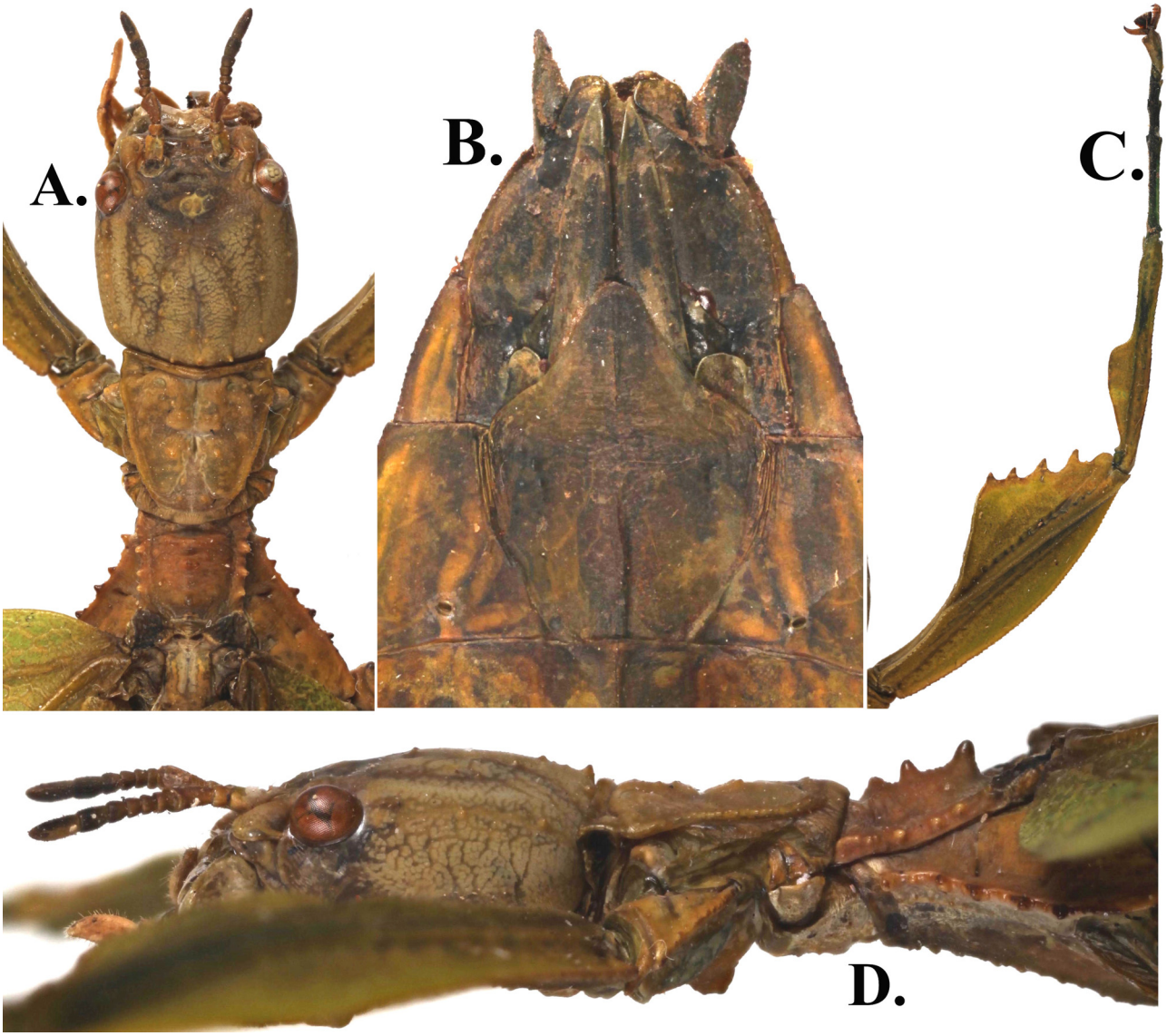

FIGURE 20. Female *Phyllium* (*Phyllium*) *geryon* Gray, 1843 [Coll. RC 17-256], **A:** antennae, head, and thorax; **B:** genitalia ventral view; **C:** right profemora; **D:** lateral view of antennae, head, and thorax.

Morphology. Head capsule slightly longer than wide with a moderately detectable pattern of granules. Lateral to the prominent posteromedian tubercle there is a node about half the size, followed by two to three other similarly sized nodes following the margins of the head. Interior to those nodes there are several nodes on the posterior half of the head capsule pointing from the compound eyes back to the posteromedian tubercle forming a "V" pattern

(Fig. 20A). The small protuberance between the compound eye and antennal base is marked with a notable pit in the center. The frontal suture is also well furrowed. The frontal convexity has a slight covering in setae and is only slightly smaller than the size of the compound eyes, which are also smaller and less bulbous. Antennal fields only slightly wider than the base of the antennae. Antennae moderately slender and elongate (4.0 mm), approximately the same length as the postocular section of head capsule, and consisting of nine segments (Fig. 20A). Antennae covered in setae of varying sizes, most sparse except for antennomeres VIII and IX with the most variety in size and the greatest quantity of setae. Apical antennomere cylindrical with rounded apex, about 2.5x longer than wide and about 1.5x as long as segment VIII which is notably longer than any of the other preceding four segments. Pronotum roughly trapezoidal, widest at the anterior, which is at least twice the length of the anterior rim. Lateral rims on the pronotum are roughly parallel for the first quarter of the length and then converging to the posterior margin. The anterior rim is distinct and slightly concave, lateral rims are moderate to weak and the posterior margin has no rim. Face of pronotum irregularly granulose with a distinct furrow on the median plane on the anterior half. Mesopraescutum almost a square with a length that equals the width and lateral margins that are only slightly converging. Lateral margins marked with three large tubercles and slight granulation on the anterior end. Mesopraescutum disk crest has an anterior rim slightly granulose and lacking a spine, followed by a notable spine in the center of the disk and ending in a large prominent spine on the posterior that, in profile, is at least twice the size of the anterior rim (Fig. 20D). Mesopleurae evenly diverging with lateral margins armed with five evenly sized but slightly unevenly spaced tubercles. Between each tubercle there is one to two small nodes. Mesopleurae face smooth except for two clear pits, one on the anterior third and one on the posterior third. Prosternum irregularly granulous throughout, the anterior half is sloped into a point, not flat like the posterior half. Mesosternum irregularly granulous throughout, those along the sagittal plane slightly larger. Tegmina (length 39.2 mm, maximum width 12.6 mm) extending almost half way into abdominal segment VII. Alae rudimentary. Abdominal segments II–IV gradually widening with the posterior of segment IV the widest segment and V–X uniformly tapering towards the apex. Anal segment at its widest, wider than long (width-length ratio 1.67:1), with a relatively rounded apex. Subgenital plate short, only reaching the posterior of segment IX, sides slightly convex and ending in a rounded point (Fig. 20B). Gonapophyses long and reaching the apex of the subgenital plate (Fig. 20B). Profemora with narrow exterior lobe, slightly thinner than the interior lobe, margin appears smooth without magnification, but under low magnification, the entire margin is marked with small tight, evenly spaced dentition. Interior lobe wider than exterior lobe, obtuse in angle, and marked on this specimen with prominent teeth, two teeth on the left profemora and four teeth on the right profemora. Protibiae lacking an exterior lobe and the interior lobe is only present on the posterior half of the tibiae as a rounded triangle that drops sharply to the tibiae near the middle. Meso- and metafemora exterior and interior lobe gently rounded, interior lobe with notable serrate dentation and approximately twice the width of the exterior lobe. Meso- and metatibiae simple, lacking lobes or dentition.

Measurements [mm] of specimen [Coll. RC 17-256]: Length of body 65.7, length/width of head 6.5/5.6, length of pronotum 4.0, length of mesonotum 5.0, length of tegmina 39.2, greatest width of tegmina 12.6, length of alae --, greatest width of abdomen 23.9, length of profemora 12.7, length of mesofemora 11.2, length of metafemora 13.8, length of protibiae 9.1, length of mesotibiae 8.0, length of metatibiae 12.2, length of protarsi 8.3, length of antennae 4.0.

Distribution

Checklist of Phylliidae species currently confirmed from Luzon, Philippines, and their recorded ranges. See figure 21 for an illustrated map of the distributions.

Phylliidae, Phylliinae, Phylliini:
Microphyllium Zompro, 2001
Microphyllium pusillulum (Rehn & Rehn, 1933)
[Central Luzon (Mountain* & Nueva Vizcaya Prov.)]
Microphyllium spinithorax Zompro, 2001
[Luzon (Benguet Prov.**)]

Microphyllium haskelli Cumming **sp. nov.**
[Luzon (Mountain Prov.)]
Pseudomicrophyllium Cumming **gen. nov.**
Pseudomicrophyllium faulkneri Cumming **gen. et sp. nov.**
[Central Luzon (Ifugao Prov.)]
Phyllium Illiger, 1798
Phyllium (*Phyllium*) *ericoriai* Hennemann, *et al.*, 2009
[Luzon (Manila, Aurora*, Quirino*, & Quezon Prov.); Batan Is.; Marinduque Is.; Cantanduanes Is.*]
Phyllium (*Phyllium*) *bonifacioi* Lit & Eusebio, 2014
[Northern Luzon (Cagayan Prov.* & Northern Luzon***)]
Phyllium (*Phyllium*) *philippinicum* Hennemann, *et al*., 2009****
[Western Luzon (Bataan Prov.)]
Phyllium (*Phyllium*) *antonkozlovi* Cumming **sp. nov.**
[Eastern Luzon (Isabela Prov.)]
Phyllium (*Phyllium*) *bourquei* Cumming & Le Tirant **sp. nov.**
[Luzon (Nueva Vizcaya Prov.)]
Phyllium (*Phyllium*) *geryon* Gray, 1843
[Luzon (Aurora Prov.)*]

*New record for the distribution of the species, see below section.
**The type material of *M. spinithorax* is only labeled with the location "St. Thomas" which is assumed to be Mt. Santo Tomas in Benguet Province (Collins & Morris, 1985), located in the Cordillera Central mountain range, the same range that all *Microphyllium* collection instances are from, adding validity to this assumption.
***The exact location of the type material was not given by the authors.
****In Grösser's 2011 work "New Insights and Critical Remarks on certain species of Walking Leaves" he suspected that *Phyllium* (*Phyllium*) *philippinicum* Hennemann, *et al*., 2009 was not a valid species and was actually a hybrid. With the popularity of many *Phyllium* currently in culture throughout Europe the concern of crossed cultures is valid. However, when Hennemann *et al.* described *Ph.* (*Ph.*) *philippinicum* they only used specimens from the original stock collected by Ismael O. Lumawig and Thierry Heitzmann in June of 2001, not specimens from one of the many untraceable cultures (or possibly hybridized cultures) currently circulating in the phasmid breeding community.

While the first author was organizing the Phylliidae collection of the California Academy of Sciences collection, two specimens (a subadult female and an adult male) from the U.S. Naval Base at Subic Bay (a location near the type locality of *Ph.* (*Ph.*) *philippinicum*) were examined. Morphologically these specimens match with the original description given by Hennemann *et al.* and key out to *Ph.* (*Ph.*) *philippinicum.* The pair was collected by James E. Tobler on the 12th of November, 1965, almost 40 years before the species was brought into culture in Europe, therefore, this historic pair gives validity to the species status of *Ph.* (*Ph.*) *philippinicum* Hennemann *et al.,* 2009.

Discussion of new distribution records. *Microphyllium pusillulum* from Mountain Province (Mt. Barlig) from the single female [Coll RC. 16-096], previously only known from the HT record; Imugan, Nueva Vizcaya Province.

Phyllium (*Phyllium*) *ericoriai* from Aurora Province (Dingalan) and Quirino Province (Nagtipunan) from several males and females in the first author's collection; Cantanduanes Island (Ibong Sapa) is a recent record noted from personal communication with Feliciano Avila de Leon Jr. (June, 2017).

Phyllium (*Phyllium*) *bonifacioi* from Cagayan Province (Santa Ana Mts.) from a male/female pair in the first author's collection. Note that the type locality in the original description of the species was not specific and could have been Cagayan Province; communication with the authors of *Phyllium* (*Phyllium*) *bonifacioi* was unsuccessful

Phyllium (*Phyllium*) *geryon* from Aurora Province, Luzon is the first precise locality for this little known species. Gray's original distribution note of "Inhabits the Philippine Islands", has led to much confusion over the years and erroneous records. Several authors over the years have mistakenly noted *Ph.* (*Ph.*) *geryon* from localities such as Java or New Caledonia (see Hennemann *et al*., 2009 for a thorough explanation of these erroneous localities).

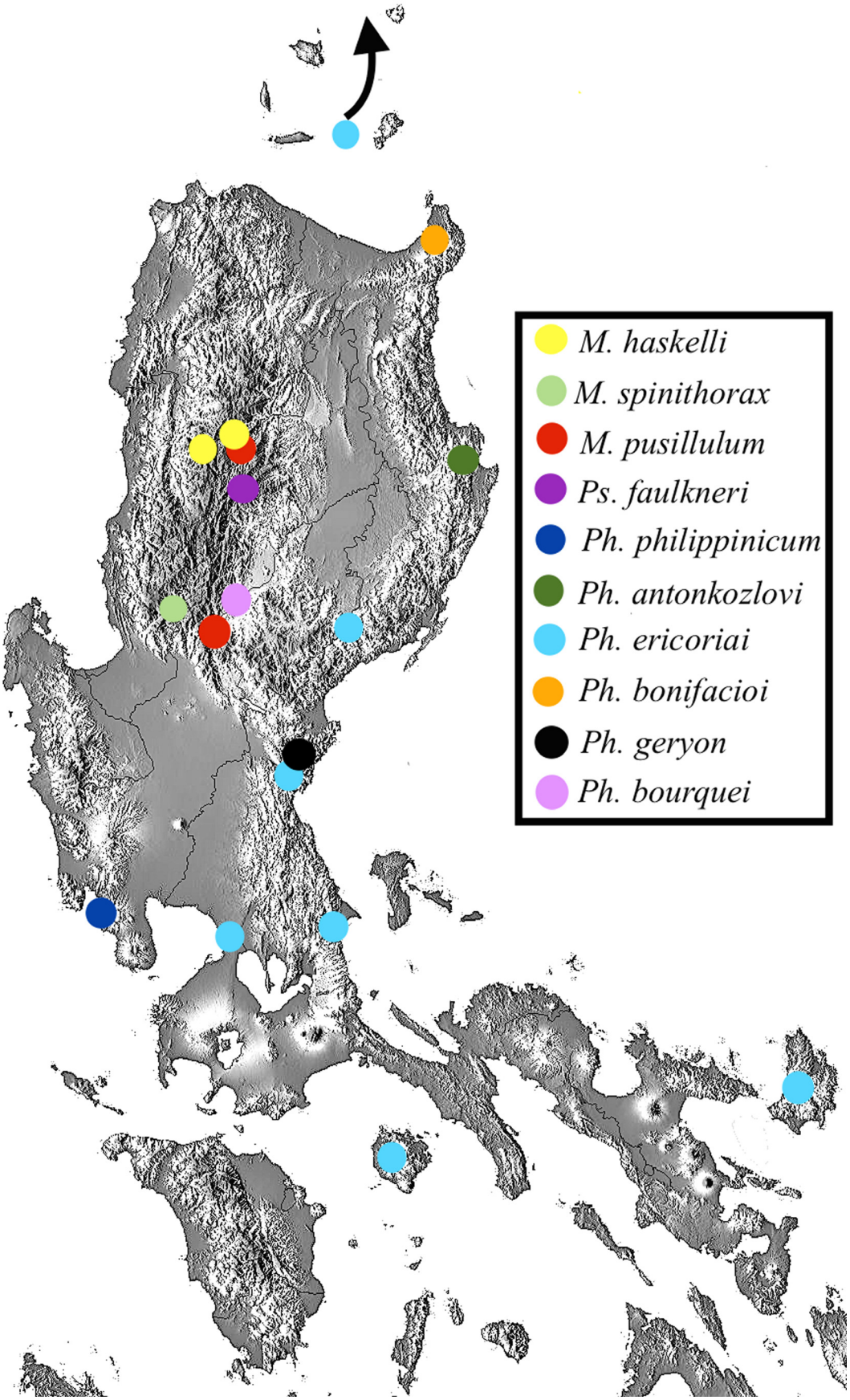

FIGURE 21. Distribution map with all current known records for species confirmed from Luzon, Philippines. Original image downloaded from: https://commons.wikimedia.org/wiki/File:Relief_Map_Of_The_Philippines.png under the creative commons license originally created by user: Seventide.

Average elevation, in meters, of *Microphyllium* and *Pseudomicrophyllium* collection sites.*
Mt. Santo Tomas (Benguet Prov.) [~2,200 m]
Mt. Polis (Mountain Prov.): [~1,800 m]
Mt. Barlig (Mountain Prov.): [~1,800 m]
Banaue (Ifugao Prov.): [~1,300 m]
Imugan (Nueva Vizcaya Prov.): [~1,000 m]

*Elevations found using Google Earth (2016 Google sources: Image Landsat/ Copernicus; Data SIO, NOAA, U.S. Navy, NGa, GEBCO).

Key to known genera, species-groups, and species confirmed from Luzon, Philippines

♂♂*

1. Protibiae lacking both exterior and interior lobes (figs. 9A&B); average size small (~24–28mm) . . . . . 2.
- Protibiae with a distinct interior lobe, lacking exterior lobe (fig. 16C); average size medium to large (~49–65mm): *Phyllium* (*Phyllium*) Illiger, 1798: . . . . . 4.
2. Antennae short (about the length of the outstretched forelegs or less); individual antennae segments short and beadlike: *Microphyllium* Zompro, 2001 . . . . . 3.
- Antennae filiform and notably longer than forelegs: *Pseudomicrophyllium* **gen. nov**. . . . . *Pseudomicrophyllium faulkneri* Cumming **gen. et sp. nov.**
3. 21 antennal segments; terminal antennae segment a full rounded cone; pedicellus more than half the length of the scapus, not short and disk-like; tegmina reaching posterior of abdominal segment III. . . . . *M. haskelli* Cumming **sp. nov.**
- 20 antennal segments; anterior of terminal segment flat with a spoon-like excavation; pedicellus short, disk-like, less than half as long as the scapus; tegmina reaching posterior of abdominal segment IV. . . . . *M. spinithorax* Zompro, 2001
4. Exterior lobe of profemora larger than or equal in width to interior lobe; teeth on the interior lobe of varying sizes: (*celebicum* species-group) . . . . . 5.
- Exterior lobe of profemora slightly to notably thinner than interior lobe and without a strong angle (figs. 13C & 16C); teeth of the profemora relatively even in size and shape (figs. 13C & 16C): (*siccifolium* species-group) . . . . . 6.
5. Abdominal segments V–VII widening; VII and VIII lobed; VII widest segment; interior lobe of mesofemora notably wider than exterior lobe. . . . . *Ph.* (*Ph.*) *ericoriai* Hennemann *et al.*, 2009
- Abdominal segments VI–VII subparallel; VII–X converging, weakly lobed; interior and exterior lobe of mesofemora of a similar width . . . . . *Ph.* (*Ph.*) *bonifacioi* Lit & Eusebio, 2014
6. Antennae thin and filiform, setae frequently longer than twice the width of the segment they are found on; ocelli well developed (fig. 17A) . . . . . 7.
- Antennae robust, most setae length are less than or equal to the width of the segment they are found on; ocelli severely reduced (fig. 13A). . . . . *Ph.* (*Ph.*) *antonkozlovi* Cumming **sp. nov.**
7. Anterior end of the mesopraescutum width notably shorter than the length of the mesopraescutum giving it a long, slender appearance; crest along the sagittal plane of the mesopraescutum with a single prominent spine (on the anterior rim), vertex relatively smooth, at most with small evenly sized nodes (fig. 17C) . . . . . *Ph.* (*Ph.*) *philippinicum* Hennemann *et al.*, 2009
- Anterior end of the mesopraescutum approximately equal in width to the length of the mesopraescutum giving it a stout appearance; crest along the sagittal plane of the mesopraescutum with a prominent spine (on the anterior rim) followed by nodes that steadily decrease in size, not nodes of the same size (fig. 17B) . . . . . *Ph*. (*Ph.*) *bourquei* Cumming & Le Tirant **sp. nov.**

♀♀**

1. Overall body length small (40–47mm); length of apical antennomere approximately equal to or longer than the combined length of segments IV–VIII (figs. 5A&B): *Microphyllium* Zompro, 2001. . . . . 2.
- Overall body length medium to large (~60–100mm); apical antennomere notably shorter than the combined length of segment IV-final segment before the apical antennomere (figs. 15D,E,&F): *Phyllium* (*Phyllium*) Illiger, 1798 . . . . . 3.
2. Protibiae with distinct interior lobe and slight exterior lobe; subgenital plate with a fine point; gonapophyses long and slender reaching the apex of the abdomen (figs. 7A&B) . . . . . *M. pusillulum* (Rehn & Rehn, 1933)
- Protibiae without an exterior lobe and interior lobe greatly reduced; subgenital plate with a smooth rounded point; gonapophyses short, only slightly protruding from under the subgenital plate (fig. 7C) . . . . . *M. haskelli* Cumming **sp. nov.**
3. Alae well developed: (*celebicum* species-group) . . . . . 4.
- Alae greatly reduced: (*siccifolium* species-group) . . . . . 5.
4. Abdominal segment VII lateral margin with distinct lobe; angle of exterior lobe of profemora approaching 90 degrees. . . . . *Ph.* (*Ph.*) *ericoriai* Hennemann *et al*., 2009

- Abdominal segment VII lateral margin with indistinct lobe & converging posteriorly; angle of exterior lobe of profemora obtuse . . . . . *Ph.* (*Ph.*) *bonifacioi* Lit & Eusebio, 2014

5. Antennae with ten segments; 5–7 small saw-like teeth on interior lobe of profemora (fig. 14C); interior lobe of the protibiae extending the full length of the protibiae . . . . . 6.

- Antennae with nine segments; 4 large triangular teeth on the interior lobe of the profemora (fig. 20C); interior lobe of the protibiae only on the posterior half. . . . . *Ph.* (*Ph.*) *geryon* Gray, 1843

6. Subgenital plate almost reaching apex of the anal abdominal segment; mesopleurae margins are only marked by three prominent tubercles in the center and a few minor tubercles anteriorly and posteriorly (fig. 18C). . . . . *Ph.* (*Ph.*) *philippinicum* Hennemann *et al*., 2009

- Subgenital plate only reaching half way under the anal abdominal segment (figs. 15A&B); mesopleurae margins more heavily marked by 7–8 robust tubercles (figs. 18A&B) . . . . . .*Ph.* (*Ph.*) *bourquei* Cumming & Le Tirant **sp. nov.**

* Male *Microphyllium pusillulum* (Rehn & Rehn, 1933) and *Ph.* (*Ph.*) *geryon* Gray, 1843 unknown.
** Female *Pseudomicrophyllium* Cumming **gen. nov.** and *Ph.* (*Ph.*) *antonkozlovi* Cumming **sp. nov.** females unknown, female *M. spinithorax* Zompro, 2001 excluded from the key because only known specimens are the immature paratypes.

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