Description of *Phyllium (Phyllium) conlei*, new species, and a first look at the Phylliidae (Phasmatodea) of the Lesser Sunda Islands, Indonesia

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Date of issue: December 28, 2018
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Phylliidae (Phasmatodea) of the Lesser Sunda Islands, Indonesia
Insecta Mundi 0677: 1–9
ZooBank Registered: urn:lsid:zoobank.org:pub:909A6686-6AD1-4110-B3BC-B7213679FB19

Published in 2018 by
Center for Systematic Entomology, Inc.
P.O. Box 141874
Gainesville, FL 32614-1874 USA
http://centerforsystematicentomology.org/

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Entomology.

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Electronic copies (Online ISSN 1942-1354, CDROM ISSN 1942-1362) in PDF format
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Layout Editor for this article: Robert G. Forsyth
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Abstract. The Phylliidae (Phasmatodea) diversity of the Lesser Sunda Islands, Indonesia is preliminarily examined, and revealed to be notably lacking in completeness with only two species currently recorded. Of the nine islands/island groups within the Lesser Sunda Islands, only the westerly islands (Bali and Lombok) have single species recorded: *Phyllium (Pulchriphyllium) pulchrifolium* Audinet-Serville, 1838, from Bali, and *Phyllium (Phyllium) conlei* Cumming, Valero, and Teemsma, new species, from Lombok. The latter species is herein described and differentiated from congenerics. To conclude, with so few species recorded from the Lesser Sunda Islands, a key to species for Java and the Lesser Sunda Islands is presented for males.

Key words. Bali, leaf insect, Lombok, taxonomy, walking leaf.

Introduction

The Lesser Sunda Islands are a chain of islands containing little to no history of leaf insects based on a search through literature and through collections. The first literature record that could be found for the Lesser Sunda Islands was that of de Haan (1842) where he gives measurements of five specimens and lists two with the data of “Java, Timor” and “Timor, Nova Guinea” which he identified as *Phyllium (Phyllium) siccifolium* (Linnaeus, 1758). The accompanying figure with de Haan’s text is that of a male subadult (Fig. 1a) which without exact collection data is impossible to place taxonomically or even know if the specimen illustrated even truly was collected on Timor. Subsequent authors suggested the specimen figured was likely not *Ph. (Ph.) siccifolium* and was instead either the new species *Phyllium geryon* Gray, 1843 (Gray 1843; Westwood 1859), or was simply misidentified (Wood-Mason 1875). Gray even appears to have used de Haan’s illustration to base his own figure (a, p. 121) of his *Phyllium geryon* profemora (Gray 1843).

It is impossible to say whether or not de Haan’s subadult male was in fact from Timor or if he was referring to a different specimen for the distribution record. One such specimen which can be confidently confirmed as coming from the Lesser Sunda Islands is a male subadult from Lombok from within the Frank Hennemann collection (Germany) with the data: Indonesien: Sunda-Inseln, Prov. Nusa Tenggara Barat, Lombok, XI.2009, local collector [coll. FH No. 1019-1]. This specimen resembles the male subadult illustrated in de Haan’s work and leads us to believe that the specimen could have been of the same species as Hennemann’s Lombok specimen. With Lombok and Timor only a few small islands away of each other, it would not be surprising if they represented the same species or closely related species (Fig. 1a–b).

With the description of *Phyllium (Phyllium) conlei* Cumming, Valero, and Teemsma, new species from the island of Lombok, the specimen within the Hennemann collection could very well represent a
subadult *Ph. (Ph.) conlei* new species. But, as a subadult, an adequate identification cannot confidently be made.

*Phyllium (Phyllium) conlei* new species, with its slender abdomen, is most morphologically similar to *Phyllium (Phyllium) brossardi* Cumming, Le Tirant, and Teemsma, 2017 and *Phyllium (Phyllium) caudatum* Redtenbacher, 1906, known from Northern Borneo and Papua New Guinea respectively. It is likely that, once the female and egg of *Ph. (Ph.) conlei* new species are described, the relation to other species will become clearer and allow more accurate taxonomic placement.

This currently limited number of recorded species from the Lesser Sunda Islands is expected to increase significantly if/when the phylliid diversity of the islands is explored in more detail. At the moment, it appears as though collecting trips to these islands have either had poor luck (personal communication) or no interest in the phylliid insects. Searches through large institutional and personal phylliid collections having revealed no additional material.

**Materials and Methods**

Photos were taken with a Nikon D7100 with a Nikkor 60mm macro lens. Adobe Photoshop CC was used to prepare the plates. Measurements of the holotype were made by Pablo Valero to the nearest 0.1 mm using digital calipers. The acronym for the State Zoological Collection of Munich is ZSMC.

**Results**

*Phyllium (Pulchriphyllium) pulchrifolium* Audinet-Serville, 1838

(Fig. 2)

**Distribution expansion.** INDONESIA: East Java Province, Madura Island; Bali Province, Ubud District.

**Discussion.** It is not surprising that this species is recorded from the islands to the east of Java (the type locality) as Madura and Bali are closely situated off the coast. The distribution to the northwest on the island of Sumatra has been known for over a century. Unfortunately, there have been no recent sightings of *Ph. (Pu.) pulchrifolium* on the island despite recent *Phyllium* collecting activities (Lucas 1857; personal observation).

The recorded female from Madura Island is from the Royce Cumming collection (United States) [Coll. RC 16-031] and was collected in March 2012. The record from Bali is an observation record from several photos by tourists on vacation in Bali. The illustrated female observed by Nicolas Logelain (Belgium) from Ubud Bali in August 2013 was reported as being found in the wild (Fig. 2). The authors are not confident that *Ph. (Pu.) pulchrifolium* is native to the island of Bali as there have been records of the species being imported from Java to be put on display in local butterfly exhibits for guests to enjoy (personal communication). The authors would not be surprised by either scenario: either *Ph. (Pu.) pulchrifolium* is in fact native to Bali, which is likely with the island’s proximity to Java; or that *Ph. (Pu.) pulchrifolium* was imported by an exhibit and has since been released onto the island and now is established.

The accidental introduction of a non-native phasmid to an area where it then thrives is not unheard of. The Indian laboratory stick insect, *Carausius morosus* (Sinéty), is one such example of a species that has done quite well outside of its native range. Originally native to Southern India, this species has now become established in several additional countries as far west as South Africa and the United States (Hendrick and Wilen 2011; Baker 2015).
Phyllium (Phyllium) conlei Cumming, Valero, and Teemsma, new species
(Fig. 3a–i)


**Differentiation.** Phyllium (Phyllium) conlei new species morphologically fits within the siccifolium species-group as described by Hennemann et al., 2009 with the exterior lobe of the profemora which is thinner than the interior lobe. Phyllium (Phyllium) conlei new species is most morphologically similar to Phyllium (Phyllium) brossardi Cumming et al., 2017, and Phyllium (Phyllium) caudatum Redtenbacher, 1906 because of the slender abdomen with a maximum width of only about 30% of the overall abdominal length (Fig. 4a–c). No other males in the siccifolium species-group are known for having an abdominal shape with this ratio. It is likely that other closely related species such as Phyllium (Phyllium) riedeli van de Kamp and Hennemann, 2014, with the male still undescribed, also have a similar abdominal ratio.

Phyllium (Phyllium) conlei new species can be differentiated from Ph. (Ph.) brossardi and Ph. (Ph.) caudatum easily by the length of the antennae (Table 1). When the antennae are laying back flat along the dorsal surface of the body they are the same length as the tegmina versus notably shorter in Ph. (Ph.) brossardi with the antennae only reaching about half way along the tegmina, or antennae that are significantly longer than the tegmina in Ph. (Ph.) caudatum.

**Table 1.** Summary of distinguishing features between male Phyllium (Phyllium) conlei new species, Phyllium (Phyllium) brossardi Cumming et al., 2017, and Phyllium (Phyllium) caudatum Redtenbacher, 1906.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Ph. (Ph.) conlei (Lombok)</th>
<th>Ph. (Ph.) brossardi (Borneo)</th>
<th>Ph. (Ph.) caudatum (Papua New Guinea)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protibiae interior lobe</td>
<td>Smoothly arcing end to end and only about as wide as the protibial shaft</td>
<td>Smoothly arcing end to end and only about as wide as the protibial shaft</td>
<td>Triangular, not reaching end to end, only on the proximal two thirds of the protibial</td>
</tr>
<tr>
<td>Tegmina</td>
<td>Reaching into abdominal segment III, not past</td>
<td>Reaching at least halfway into abdominal segment IV, occasionally into segment V</td>
<td>Reaching no more than half way into abdominal segment III, generally shorter only just passing the posterior of II</td>
</tr>
<tr>
<td>Antennae length (when held flat back across the dorsal surface)</td>
<td>The same length as the resting tegmina</td>
<td>Notably shorter than resting tegmina, only a little longer than half of the tegmina length</td>
<td>Notable longer than the tegmina length with at least one third of the antennae length passing the resting tegmina</td>
</tr>
</tbody>
</table>

**Coloration.** Most of the body is of a yellow color which appears to have been caused by the drying technique as there are little patches of pale lime green throughout. The most prominent green areas are the tegmina, patches of the abdomen, and the interior lobes of the femora. The eyes are a dull rust color and the antennae are of a slightly darker yellow than that found throughout the body. As with many poorly dried Phyllium specimens it is likely the holotype was a more vibrant green in life but most of the green faded to yellow after death.

**Morphology.** Head capsule about as long as wide, with a slightly granulose vertex. Frontal convexity stout with a dull point. Antennae consisting of 21–22 segments (including the scapus and pedicellus), most basal segments are covered with pale setae that are longer as the antennae segment is wide, and the apical segments have shorter and more densely spaced setae. Compound eyes notably large but not significantly protruding away from the head. No developed ocelli. Pronotum with anterior margin only slightly concave and lateral margins that gently converge on the posterior margin that is only marginally narrower than the anterior rim. Anterior margin with a strong rim at least three times the size of the slight rims of the lateral margins, posterior margin without a rim and relatively smooth. Face of the pronotum with moderate furrow and the surrounding surface smooth. Prosternum with
slight granulation throughout, not highly noticeable. Mesosternum surface with more noticeable
granules and with an underlying texture that is wrinkled, not smooth. Metasternum with a surface
that is almost entirely wrinkled, with granulation that is not particularly noticeable. Mesopraescutum
about as wide as long, with lateral rims with four to five small tubercles with the largest on the anterior
and the posterior most little more than prominent nodes. Mesopraescutum crest along the sagittal plane
with a moderate spine on the anterior margin and the remainder lacks prominent spines due to the
wrinkled surface of the mesopraescutum disk. Mesopleura gradually diverging, ending only slightly
wider on the posterior; lateral margin with eight to ten tubercles of rather uneven size, most in close
proximity to the others or even with bases touching. Mesopleural face with two distinct pits, one on the
anterior third and one on the posterior third with the remainder of the mesopleural surface with a
wrinkled texture. Tegmina not particularly long, reaching three quarters of the way into abdominal
segment III. Alae well developed, reaching the anterior of the anal abdominal segment. Abdomen
slender, with segments II through IV gently diverging, and V through the anal abdominal segment
steadily converging. Anal abdominal segment slightly longer than wide with lateral margins that for
the anterior half are parallel then with the remainder converging prominently. Poculum starts halfway
through abdominal segment VIII, broad with lateral margins which exceed the lateral margins of
segment IX, and a posterior margin that slightly reaches under segment X. Ceri exceed the length of
segment X, lateral margins are straight and the surface of the ceri are covered in nodes throughout
and with thin transparent setae along the exterior margin. Vomer broad with margins gradually
converging, the apical point is stout and hooks upwards into the paraproct. Profemoral exterior lobe
smooth and barely detectable as they are significantly thinner than the profemoral shaft is wide and
hugs the shaft along the entire length. Profemoral interior lobe almost entirely situated on the distal
half, lobe not triangular in appearance, gently arcing and only slightly wider than the profemoral shaft
is thick. Profemoral interior lobe with five serrate teeth of almost even size, arranged in a 3-2 pattern
with the three on the proximal end similarly spaced to the two on the distal end but with a wider space
between the sets of teeth. Mesofemoral exterior lobe thin, lacks dentition, and arcs from end to end with
the widest portion on the distal third of the lobe. Mesofemoral interior lobe is the same width as the
exterior lobe but with a straighter edge and five serrate teeth on the distal third of the lobe. Metafemoral
exterior lobe thin and lacking dentition, hugging femoral shaft. Metafemoral interior lobe slightly wider
than exterior lobe with seven small dull teeth on the distal half only. No exterior protibial lobe, interior
lobe extends the entire length in a smooth arc, not triangular, with the widest portion in the center only
as wide as the shaft of the protibia. Meso- and metatibiae simple, lacking lobes.

**Measurements of holotype [mm]**. Length of body (including ceri and head, excluding antennae) 47.5, length/width of head 3.2/2.8, pronotum 2.6, mesonotum 2.1, length/width of tegmina 16.8/6.2,
greatest width of abdomen 9.0, profemora 9.0, mesofemora 9.0, metafemora 10.3, protibiae 6.3, meso-
tibiae 5.8, metatibiae 8.0, antennae 23.0.

**Distribution.** The current knowledge of the phylliid diversity of the Lesser Sunda Islands is significantly
lacking as the authors could only locate phylliid records for two of the numerous islands in the chain. *Phyllium (Phyllium) conlei new species* is currently only known from Lombok Island from the single
holotype record, but it would not be surprising if it were eventually located on other nearby islands
such as Sumbawa or other islands to the east with nonexistent phylliid records. Figure 5 illustrates
the current lack in phylliid knowledge for the Lesser Sunda Islands. Only the two most westerly islands
have records and all other islands in the chain are lacking phylliid records.

**Etymology.** Named in honor of Oskar Conle, who had the holotype in his private collection and kindly
provided the specimen for this publication.

**Key to known species for known *Phyllium* males of Java and the Lesser Sunda Islands.**

Adapted from the keys in Cumming and Le Tirant (2018) and Cumming et al. (2017).

1. Several or all tibiae with an exterior lobe; antennae ventrally serrate: [subgenus *Pulchiphyllium*] . 2
   — All tibiae lacking an exterior lobe; antennae simple/filiform: [subgenus *Phyllium*] ................. 3
2. Exterior lobe of profemur a clear obtuse angle ~130°; exterior lobe of protibiae reduced to only a sliver, many times smaller than the interior lobe; abdomen ovular with segment VII converging towards the apex. Ph. (Pu.) shurei Cumming and Le Tirant, 2018
— Exterior lobe of profemur ~100° angle; exterior lobe of protibiae notable and only slightly thinner than interior; abdomen rectangular in appearance with segments V-VII parallel to slightly widening. Ph. (Pu.) pulchrifolium Audinet-Serville, 1838

3. Interior lobe of the protibia triangular with a distinct angle, and slightly wider than the width of the protibial shaft; abdomen spade-shaped, with a greatest width of about 40–55% of the total abdomen length. Ph. (Ph.) jacobsoni Rehn and Rehn, 1933
— Interior lobe of the protibia thin and arcing from end to end without a distinct triangular shape and slender, only about as wide as the protibial shaft; abdomen long and slender, at its greatest width only about 30% of the total abdomen length. Ph. (Ph.) conlei Cumming, Valero, and Teemsma, new species

Acknowledgments

The authors thank Oskar Conle (Germany) for allowing the authors to review his collection, Nicolas Logelain for giving us permission to use his wonderful photo of Phyllium pulchrifolium found on Bali, and Frank Hennemann (Germany) for sending us the photo of his Lombok island specimen and the collection data. We also thank our two peer reviewers Sven Bradler (Germany) and Stephane Le Tirant (Canada) for their feedback on this work.

Literature Cited


Received November 1, 2018; accepted November 24, 2018.
Review editor Lawrence Hribar.
**Figure 1.** Male *Phyllium (Phyllium)* subadults. A) Illustration from de Haan's 1842 work with the possible locality of Timor. Scan courtesy of the Biodiversity Heritage Library online. B) Specimen from the collection of Frank Hennemann (Germany) collected on Lombok in 2009.

**Figure 2.** Female *Phyllium (Pulchriphyllium) pulchrifolium* found by Nicolas Logelain (Belgium) from Ubud Bali in August, 2013.
Figure 4. Comparative photo of the adult males of three species with similar morphology, specimens not to scale. A) Phyllium (Phyllium) conlei **new species**. B) Phyllium (Phyllium) brossardi Cumming et al., 2017. C) Phyllium (Phyllium) caudatum Redtenbacher, 1906.

Figure 5. Map of the Lesser Sunda Islands with two currently recorded Phylliidae species. Green point, Phyllium pulchrifolium from Ubud Bali. Yellow point, Phyllium conlei **new species** from Lombok. (Google Earth: Image Landsat/ Copernicus: Data SIO, NOAA, U.S. Navy, NGA, GEBCO: Image date December 13th, 2015; accessed October 30th, 2018).