

## Supplements to the knowledge of *Phantasca* Redtenbacher, 1906, with the descriptions of four new species from French Guiana (Phasmatoidea, Diapheromeridae, Diapheromerinae)

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**Abstract.** – Four new species of the genus *Phantasca* Redtenbacher, 1906 (*Phantasca bulbosa* n. sp., *P. arlequina* n. sp., *P. kawensis* n. sp. and *P. margaritae* n. sp.) from French Guiana are described and illustrated. The female of *P. femorata* Hennemann, Conle, Bellanger, Lelong & Jourdan, 2018, is re-described due to subsequent discovery of an adult specimen, and the previously unknown egg is described for the first time. The male of *P. ruboligata* Hennemann *et al.*, 2018, is re-described with the holotype illustrated to rule out confusion with the male of *P. margaritae* n. sp. A barcoding study based on COI gene of eight species of *Phantasca* is presented and supports their inclusion within the genus.

**Résumé.** – Complément à la connaissance du genre *Phantasca* Redtenbacher, 1906, avec les descriptions de quatre espèces nouvelles de Guyane (Phasmatoidea, Diapheromeridae, Diapheromerinae). Quatre nouvelles espèces du genre *Phantasca* Redtenbacher, 1906 (*Phantasca bulbosa* n. sp., *P. arlequina* n. sp., *P. kawensis* n. sp. et *P. margaritae* n. sp.) de Guyane sont décrites et illustrées. La femelle de *P. femorata* Hennemann *et al.*, 2018, est redécrite suite à la découverte ultérieure d'un spécimen adulte, et l'œuf jusqu'alors inconnu est décrit pour la première fois. Le mâle de *P. ruboligata* Hennemann *et al.*, 2018, est redécrit avec l'holotype illustré pour clarifier une confusion avec le mâle de *P. margaritae* n. sp. Une étude génétique basée sur le gène COI de huit espèces de *Phantasca* est présentée et soutient leur inclusion au sein du genre.

**Keywords.** – *Phantasca*, new species, taxonomy, morphology, eggs, French Guiana, barcoding.

The genus *Phantasca* was originally established by REDTENBACHER (1906 : 111) for three Brazilian species described by WESTWOOD (1859). HENNEMANN *et al.* (2018) have presented a revision of *Phantasca* which added three previously misplaced species to the genus and described six new species from French Guiana and Ecuador, making a total of 13 known species. CHIQUETTO-MACHADO *et al.* (2018) have subsequently presented a description and illustrations of the previously unknown female and egg of the type-species *P. phantasma* (Westwood, 1859) based on specimens from the state of Pará, Brazil. The latter species is not known from French Guiana, as explained in HENNEMANN *et al.* (2018 : 37), but was listed in error in CONLE *et al.* (2020 : 125).

In November 2016, the two first authors, both members of the ASPER team, conducted an inventory of the Phasmatoidea of the “Réserve naturelle nationale de la Trinité” in French Guiana (BELLANGER *et al.*, 2018). On the return journey to Cayenne, a short stop was made between Roura and Kaw in order to look for some additional specimens. Among the insects collected at this occasion were specimens of two unpublished species of the genus *Phantasca* Redtenbacher, 1906, which are here described from both sexes and the eggs.

At the same locality, an adult female of *Phantasca femorata* Hennemann, Conle, Bellanger, Lelong & Jourdan, 2018, was found by the third author in July 2017, also member of the ASPER. The original description of the female of this species was based on a premature specimen, so we here describe the female from an imago along with the previously unknown eggs. Furthermore, a unique male of a third unpublished species of *Phantasca* was found at this locality and could be associated to a male collected by the “Groupe d’Etude des Phasmes” in 1992 and a female from Mitaraka mountains collected during the field work of MNHN “La Planète Revisitée” in 2015. This new species is also described herein.

In October 2019, the second author spent a few days in Saül, French Guiana. During night prospection he found one male and two females of another unpublished species of the genus, also described herein based on both sexes and the egg. Scrutiny revealed that the male of this new species had already been collected previously but was mistaken with the very similar *Phantasca ruboligata* Hennemann, Conle, Bellanger, Lelong & Jourdan, 2018. Actually, several male paratypes of this latter species are in fact this new species. Since the illustrations of the male *P. ruboligata* presented by HENNEMANN *et al.* (2018) show the male of the new species, a re-description and illustration of the male holotype of *P. ruboligata* are presented herein to rule out any further confusion.

In October and November 2019, the third author conducted an inventory of twenty days in French Guiana. Additional specimens of *Phantasca* were collected and sequenced, that allowed considering molecular studies.

The present study adds considerably to our knowledge of this interesting genus and raises the number of known species of *Phantasca* to ten for French Guiana and 17 worldwide. Moreover, we also present a first attempt of a phylogenetic approach to reflect the intrageneric relationships within *Phantasca*, based on molecular data using mitochondrial COI genes of eight species.

## MATERIAL AND METHODS

Measurements are given in millimetres with a precision of  $\pm 0.1$  mm for the insects, and  $\pm 0.01$  mm for the eggs and were taken with callipers. Adults and eggs were examined under a Novex AP-8 and a Wild Heerbrugg MB binoculars. Photographs of specimens were taken with various cameras: Konica Dimage A200; Olympus Tough TG-5; Nikon D5200 equipped with an AF Micro Nikkor 40 mm lens (f/2.8G) and a Nikon D800 equipped with an AF Micro-Nikkor 60 mm lens (f/2.8D) and SB-R200 flash-lights. Photographs of the eggs were taken with the Nikon D800 camera equipped with an AF Micro-Nikkor 60 mm lens with 68 mm extension tubes and SB-R200 flash-lights. Focus stacking was performed with an automated rail StackShot from Cognisys and Zerene Stacker software.

The classification is based on ZOMPRO (2001, 2004) and the recent work of SIMON *et al.* (2019). Listed information and type data are based on the online database Phasmida Species File (BROCK *et al.*, 2018) and the revision published by HENNEMANN *et al.* (2018). The terminology of the egg capsule follows CLARK-SELLICK (1997).

Sampling and preserving of specimens as well as rearing methods are detailed in JOURDAN *et al.* (2014 : 488) and BELLANGER *et al.* (2021 : 80).

Genomic DNA samples were isolated from pieces of pro-basitarsus suspended in ethanol. Tissue samples (most less than five years old) were sent to the Canadian Center for DNA Barcoding (CCDB) at University of Guelph for extraction, Polymerase Chain Reaction (PCR) and further barcoding. PCRs were performed using the classic primers C\_LepFolF/C\_LepFolR, amplifying a mitochondrial sequence from gene COI (cytochrome oxidase). The sequences were aligned with Muscle program (EDGAR, 2004) and the quality of alignment was evaluated with the web-based program GUIDANCE2 (SELA *et al.*, 2015; PENN *et al.*, 2010). The consensus neighbour

joining tree was inferred by the Maximum Likelihood method and General Time Reversible model with 10 000 bootstraps using MEGA X (KUMAR *et al.*, 2018). Sequences divergence was calculated using MEGA X (KUMAR *et al.*, 2018). Most of the specimens used for the phylogeny are stored in public collections (INRAE, MNHN) with their BOLD number.

**Abbreviations used.** – MNHN, Muséum national d'Histoire naturelle, Paris, France; INRAE, collection of INRAE, Centre de Ressources Biologiques, France, Petit Bourg, Guadeloupe; ASPER, collection of the members of ASPER (PL: housed in Philippe Lelong collection, Sainte-Foy-d'Aigrefeuille, France; TJ: housed in INRAE collection, Petit Bourg, Guadeloupe; YB: housed in Yannick Bellanger collection, Trédias, France); OC, personal collection of Oskar Conle, Duisburg, Germany; FH, personal collection of Frank H. Hennemann, Bad Homburg, Germany.

## RESULTS

“Anareolatae”, Occidophasmata, Diapheromeridae, Diapheromerinae, Diapheromerini,  
“Clonistria-group”

Genus *Phantasca* Redtenbacher, 1906

*Phantasca* Redtenbacher, 1906: 111. Type-species: *Phasma phantasma* Westwood, 1859 : 126, by subsequent designation (ZOMPRO, 2001 : 223). GÜNTHER, 1940 : 500; BRADLEY & GALIL, 1977 : 180; BRAGG, 2001 : 641; ZOMPRO, 2001 : 223; ZOMPRO, 2004 : 318; OTTE & BROCK, 2005 : 264; JOURDAN *et al.*, 2014 : 490; HENNEMANN *et al.*, 2018.

*Phantasca arlequina* Jourdan, Bellanger, Lelong, Hennemann & Conle, **n. sp.** (fig. 1-13, 96)

<http://zoobank.org/207A5E67-8EDF-49B2-AD07-8E032A84E9A7>

HOLOTYPE: ♂, “Guyane fr. – route de Kaw, N4°39'50.2”, W52°18'15.6”, 27-VII-2017, rec. T. Jourdan, GUY17-026; BOLD GFPHASM19-006” (INRAE).

PARATYPES (1 ♀, 2 ♂): 1 ♀, Monts Tumuc-Humac, Massif du Mitaraka, Layon B, 54.4509°O 2.2357°N 280 m - 54.4547°O 2.2405°N 365 m, 23.II-10.III.2015, nuit; Muséum de Paris, Guyane Française, F. Legendre & S. Hugel rec., Planète revisitée Guyane 2015; MNHN-EO-PHAS1122; 2015 GUY SH 288; BOLD GFPHASM19-030 (MNHN); 1 ♂, Guyane fr. – A7S1N12, 27.VII rec. GEP, det. P.E. Roubaud (MNHN); 1 ♂, Guyane, Montagne de Kaw, 5-12 VIII 92, PK39 A5, Roubaud, Auvray, Rarchaert rec. (MNHN).

**Diagnosis.** – The male differs from other species of the genus by its very distinctive colouration, but especially by the orange to reddish head which has a light green marking between the eyes. Male of *P. poeciloptera* (Günther, 1940) is similarly colourful and does resemble this new species but lacks the brown postocular line, has very different markings on the last three abdominal segments, has hook-like cerci and a bicolour anal fan of the alae. From the similar *P. bulbosa*, the male of *P. arlequina* differs in the fused abdominal sternum VIII and tergum VIII, the different drawings on tergite VIII (fig. 98) and the larger size. Also, the Ecuadorian *P. amabile* Hennemann, Conle, Bellanger, Lelong & Jourdan, 2018, could be fairly similar in several aspects but the male of *P. arlequina* is easily distinguished by the slender, brown postocular line (lacking in *P. amabile*), the much shorter poculum, the lack of black longitudinal median streak on the head and pronotum as well as the lack of fine longitudinal median sepia stripe on mesonotum. From the close *P. ruboligata*, the male of *P. arlequina* differs in the slightly incurved cerci (hook-like in *P. ruboligata*; fig. 98), in having two black dots anteriorly and one black spot posteriorly on sternum VII (entirely greenish in *P. ruboligata*), in having a medio-longitudinal black line on sternum VIII, and in the very different drawings on the three last tergites (fig. 98).

The female differs from the other species of the genus by the stockier appearance, a subgenital plate very convex and bulgy in its sub-basal portion and very elongated cerci, but shares these features with *P. adiposa* Hennemann, Conle, Bellanger, Lelong & Jourdan, 2018. *Phantasca arlequina* however differs from *P. adiposa* by a slenderer general shape with the

body and legs notably thinner and relatively more elongate and the abdominal terga II to VII distinctly longer than wide (only about 1.25× longer than wide in *P. adiposa*).

**Description of the female.** – Size medium for the genus (body length 69.7 mm; tab. I and fig. 1-6). Form fairly robust and stocky, entirely smooth.

**Colour.** General colour of body mid green to yellowish (but probably degraded by the process of preservation). Eyes brown, vertex with a lighter green spot between the eyes. Scapus and pedicellus brown greenish on the dorsal part and light brown on the ventral part, antennomere I brown blackish on the ventral part. Antennae mid green. cervix, probasisternum, pro- meso- metafurcasternum, meso- meta-precoxae light brown. Sterna II-VII with a brown spot in the basal portion.

**Head** elongated, rectangular and flat. Frons with a pair of circular little humps between the eyes. Eyes circular and prominent. Scapus rectangular, almost 2× as long as wide and more than 1.4× as long as pedicellus; pedicellus rounded; segment III slightly shorter than scapus and pedicellus combined.

**Thorax.** Pronotum considerably shorter and narrower than head, with a transverse median sulcus slightly curved and expanding over entire width of segment. Mesonotum slightly broadened posteriorly with a pair of symmetric patterns on the margins of the apical portion, slightly more than 2× as long as head and pronotum combined and almost 1.4× as long as metanotum and median segment combined. Median segment 1.2× as long as metanotum.

**Legs.** All legs with all carinae distinctly deflexed and fairly lamellate. All femora and tibiae with all the ventral and dorsal carinae pubescent. Profemora slightly longer than metafemora and 1.5× longer than mesofemora. Profemora slightly longer than protibiae; mesofemora and metafemora almost of same length as their corresponding tibiae. All basitarsi with a pair of hairy lines on the ventral carinae, meso- and metabasitarsi with lines of long and straight hairs on the ventral carinae, in particular on the basal portion. Pro- and metabasitarsi about 1.3× longer than the remaining tarsomeres combined; mesobasitarsus of equal length than the remaining tarsomeres combined.

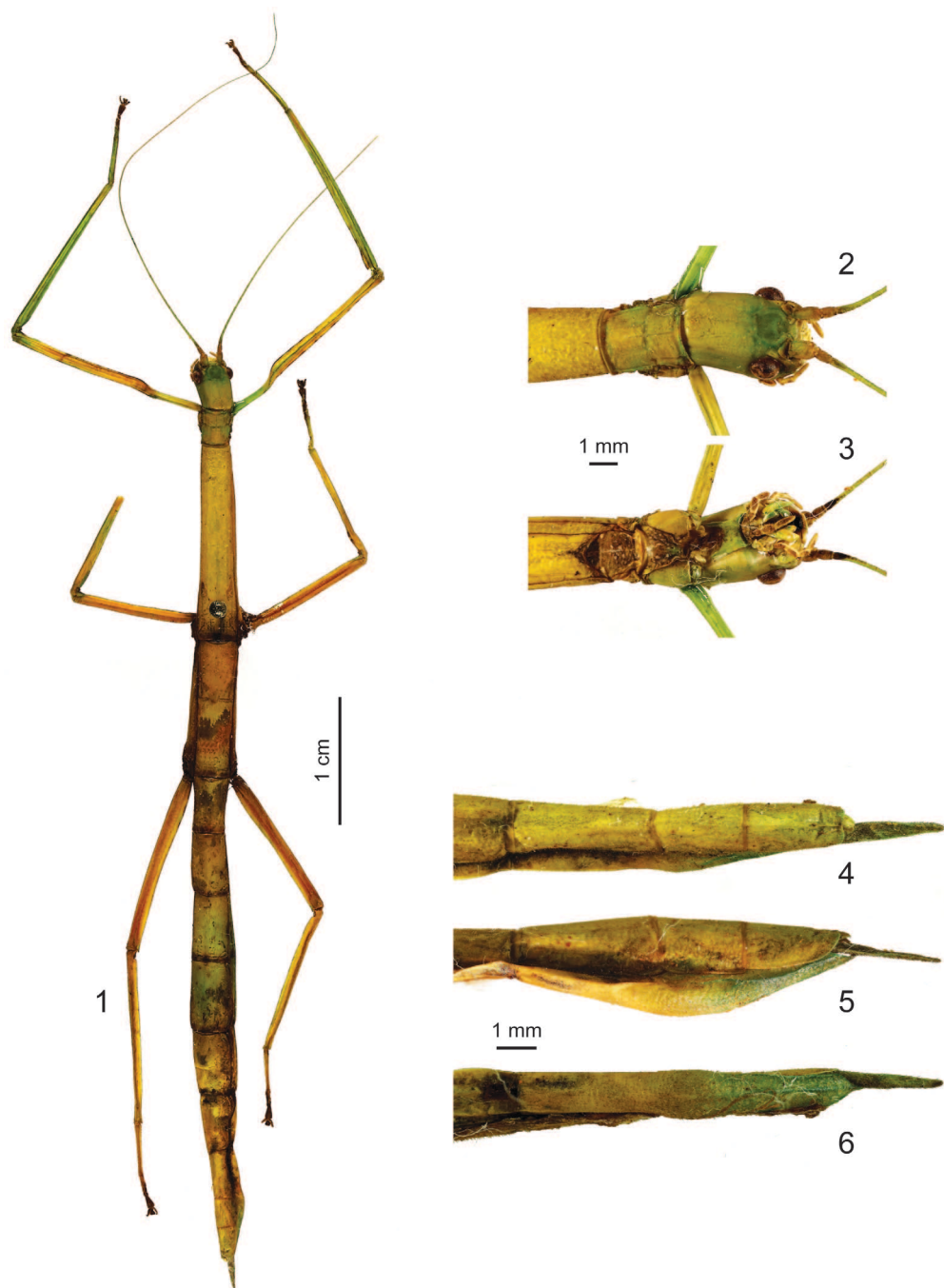
**Abdomen** wholly covered by small hairs. Segments II to V gradually widening and VI to X narrowing progressively. Tergum II the narrowest, 1.8× longer than wide, lateral margins slightly depressed in the middle. V and VI the widest. Tergum V the longest, slightly longer than VI and IV, and 1.6× longer than wide. III slightly shorter than IV, VII slightly shorter than III, II shorter than VII and VIII shorter than II. IX and X the shortest and almost of same length. Praeopercular organ prominent, near the posterior margin of sternum VII, forming by a black hole and a spiniform brown lump. Anal segment almost 2× longer than wide, gradually narrowing toward the apex and distinctly indented, third apical with a median carina in relief. Epiproct rounded and slightly indented, distinctly projecting beyond the apex of anal segment. Cerci large, straight, hairy and about equal in length to anal segment, narrowing gradually until rounded

**Table I.** – Measurements of adult female and males of *Phantasca arlequina* [mm].

	♂, HT [INRAE]	♀, PT [MNHN]	♂, PT [MNHN]
<b>Body</b>	51.2	69.7	49.1
<b>Antennae</b>	49.0	>32.2	>47.2
<b>Head</b>	2.83	4.1	2.4
<b>Pronotum</b>	1.9	2.7	1.6
<b>Mesonotum</b>	9.8	14.4	8.8
<b>Metanotum</b>	-	4.5	-
<b>Median segment</b>	-	5.5	-
<b>Tegmina</b>	3.0	-	3.0
<b>Alae</b>	23.5	-	22.8
<b>Profemora</b>	16.2	15.7	15.6
<b>Mesofemora</b>	11.0	10.1	10.9
<b>Metafemora</b>	14.4	13.9	14.5
<b>Protibiae</b>	16.9	13.9	14.8
<b>Mesotibiae</b>	10.2	10.2	8.8
<b>Metatibiae</b>	14.9	14.4	14.2



apex. Subgenital plate hairy, boat-shaped and strongly convex in the median portion, apical portion with a median carina in relief, apex strongly narrowed and forming an acute point very slightly exceeding the posterior margin of the anal segment.



**Fig. 1-6.** – *Phantasca arlequina* n. sp., ♀. – 1, Habitus, dorsal view. – 2-3, Anterior part : 2, dorsal view; 3, ventral view. – 4-6, Apex of abdomen: 4, dorsal view; 5, lateral view; 6, ventral view.

**Description of the male.** – Small to medium-sized for the genus (body length 49.1–53.5 mm; tab. I and fig. 7–13, 96), slender and of typical form; very colourful.

**Colour.** The colour is described from photos of the live holotype, that were taken before its preparation. Body colour light green. Vertex orange, and light green between the eyes, with a dark brown postocular streak along genae. Eyes black. Cervix black. Frons, scapus, pedicellus and antennomere III orange with ventral surface black. Pro- and mesonotum light green, pro-, meso- and metabasisternum black. Epimerum I–III with a distinct black elongated and short mark. Tegmina light green. Costal region of alae light green; anal region translucent. Abdomen light green up to tergum VII dorsally and black ventrally up to sternum VI; terga VIII–X orange with a distinctive black pattern; tergum VIII with two central black longitudinal lines fading posteriorly and two black wave-shaped lines on each side; tergum IX with two black thick lines enlarging posteriorly; tergum X with two black longitudinal lines these slightly blurred towards the end. Sternum VII light green with two small merging black dots posteriorly, and one black spot anteriorly. Sternum VIII orange with a medio-longitudinal black line. Cerci beige. Meso- and metafemora light green and progressively orange towards the apex. Pre-apical portion of all femora darker and almost black ventrally. All tibiae and tarsomere orange. Profemora light green in the compressed basal part, then orange. All coxae and trochanters orange, meso- and metafemora light green to orange apically and profemora light green only in the basal quarter, then orange. All tibiae and tarsomeres orange.

**Head.** Elongated, about  $1.3\times$  as long as wide and slightly narrowed posteriorly; frons with a pair of small humps between the eyes. Eyes circular and prominent (fig. 8–10). Antennae almost as long as body; scapus rectangular, almost  $2\times$  as long as wide and more than  $1.5\times$  as long as pedicellus; pedicellus rounded; segment III as long as scapus and pedicellus combined.

**Thorax.** Pronotum considerably shorter and narrower than head, with a transverse median sulcus at about  $2/5$  of its length which is slightly curved and expanding over entire width of segment. Mesonotum slightly more than  $2\times$  as long as head and pronotum combined, slightly broadened posteriorly. Tegmina very slender in their anterior half, progressively enlarging and with the apical portion rounded and inwardly directed; central hump small. Alae reaching half way along tergum V.

**Legs.** All long and thin; all femora slightly shorter than their corresponding tibiae. Profemora distinctly longer than head, pro- and mesonotum combined; metatibiae projecting considerably beyond apex of abdomen. Pro- and metabasitarsi more than  $2\times$  as long as the following tarsomeres combined; mesobasitarsus slightly less than  $2\times$  as long as the remaining tarsomeres.

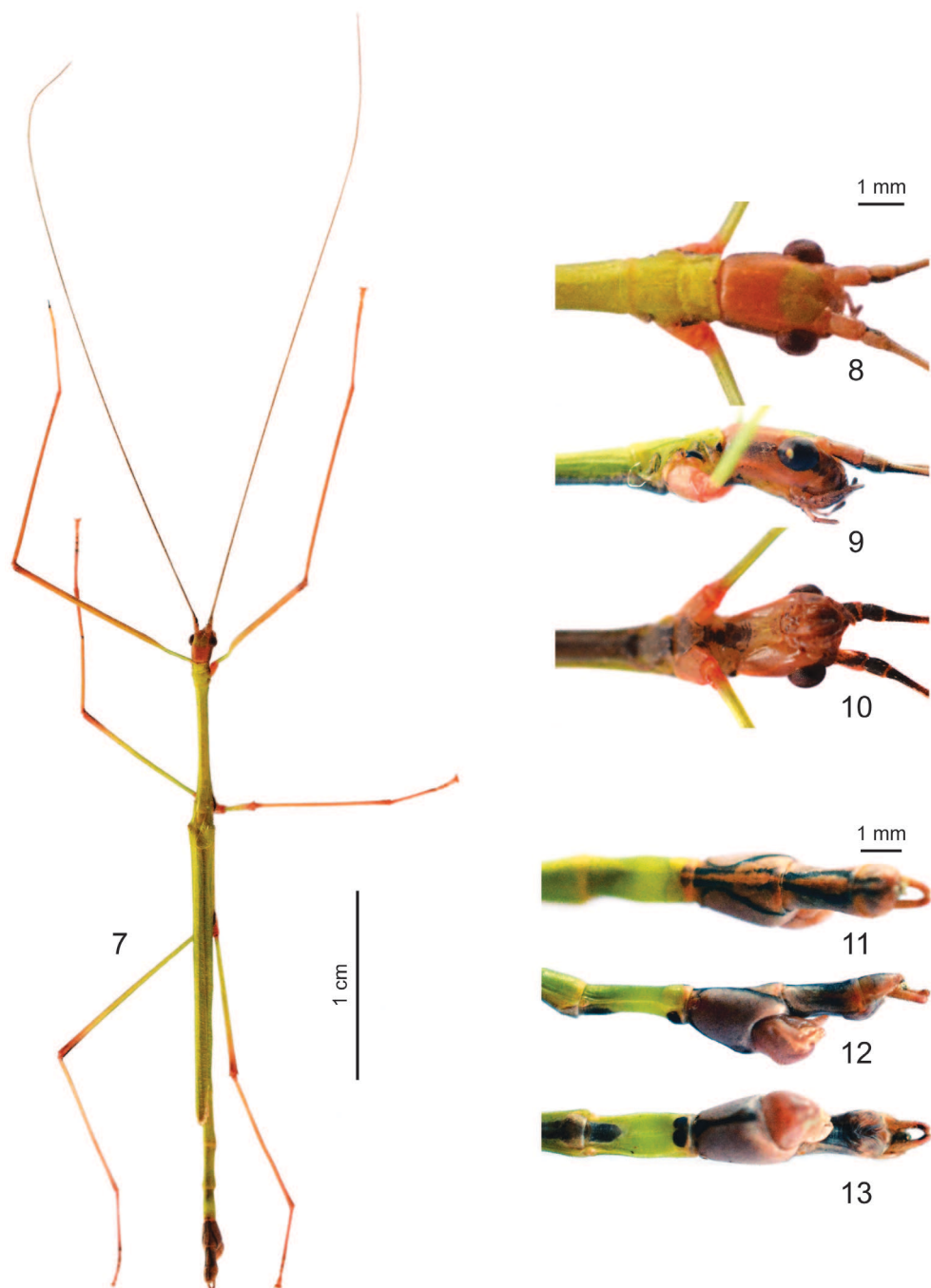
**Abdomen.** Segments II–VII almost of same width; VIII distinctly broader; IX narrower and widening gently posteriorly; X slightly wider than IX. Terga II–VI of same length; VII almost  $2\times$  shorter than VI; VIII slightly shorter than VII; IX gently shorter than VIII; X almost  $2\times$  shorter than IX; apex of anal segment rounded. Cerci long, stout and slightly incurved, almost of same length as anal segment and strongly exceeding its apex. Sternum VIII swollen, rounded and fused with tergum VIII; dextral side slightly longer than sinistral side (fig. 12–13). Poculum bulging with the apex rounded and up-curving, slightly curved towards the left. Vomer hook-like and up-curving.

**Etymology.** – The species name refers to the pretty coloration of the male, especially the red legs and the black “mask” on the genae, features shared with the famous character of the “*commedia del arte*”: Arlequin, Arlecchino.

**Comments.** – While describing *Phantasca ruboligata*, the authors did not have at hand the more extensive material now available. The male of this latter species is very similar to the male of *Phantasca arlequina* and careful re-examination of the entire type-series of *P. ruboligata* has shown the paratypes in the collection of MNHN and labeled “♂, Guyane fr. – A7SIN12, 27.VII rec. GEP det. P.E. Roubaud (MNHN)” and “♂, Guyane, Montagne de Kaw, 5–12 VIII 92, PK39 A5, Roubaud, Auvray, Rarchaert rec (MNHN)” to be *P. arlequina*. Those specimens are here designated as paratypes of this new species.

These males were caught by canopy fogging in 1993 (GROUPE D'ÉTUDE DES PHASMES, 1993) as indicated by the tree numbers “A7SIN12” and “A5”. A female was collected in the Mitaraka mountains, French Guiana, in 2015 during the field work of MNHN “La Planète Revisité” and although from a far distant locality this specimen could be assigned to *P. arlequina*

with barcoding (fig. 97). This new species is so far only known from the Kaw mountains and Mitaraka mountains, French Guiana, but is presumed to have an even wider distributional range. The description of the male is based on the wild caught specimen sampled by T. Jourdan.



**Fig. 7-13.** – *Phantasca arlequina* n. sp., ♂. – 7, Habitus, dorsal view. – 8-10, Anterior part: 8, dorsal view; 9, lateral view; 10, ventral view. – 11-13, Apex of abdomen: 11, dorsal view; 12, lateral view; 13, ventral view.

***Phantasca bulbosa* n. sp.** (fig. 14-35)

<http://zoobank.org/3DC021BF-16B2-4A4C-8695-49B3E33784B8>

**HOLOTYPE:** ♀, “GUYKAW16-069, 12.XI.2016, Guyane fr. – route de Kaw, Camp Caïman – PK27 depuis Roura, N4°34'13,1” ; W52°12'53,9” , alt. 300 m., *rec. Yannick Bellanger & Philippe Lelong*, ASPER” (MNHN).

**PARATYPES** (1 ♀, 4 ♂, 5 eggs): 1 ♂, GUYKAW16-047, 12.XI.2016, Guyane fr. – route de Kaw, Camp Caïman – PK28 depuis Roura, N4°34'11,7” ; W52°12'41,8” , alt. 300 m., *rec. Yannick Bellanger & Philippe Lelong*, ASPER (MNHN); 2 ♂, GUYKAW16-058 & -059, 13.XI.2016, Guyane fr. – route de Kaw, Camp Caïman – PK27 depuis Roura, N4°34'13,1” ; W52°12'53,9” , alt. 300 m., *rec. Yannick Bellanger & Philippe Lelong*, ASPER (MNHN); 1 ♀, GUYKAW16-064, *idem* (MNHN); 1 ♂, GUY17-047, 3.VIII.2017, Guyane fr., piste de Bélizon, N4°19'30.7” , W52°20'21.7” , *rec. T. Jourdan* (INRAE); 5 eggs, élevage F1 Y. Bellanger, XII.2017 (MNHN).

**OTHER STUDIED MATERIAL** (5 ♀, 5 ♂, 34 eggs): 1 ♂, Guyane fr. – route de Kaw Camp Caïman, élevage F1 Yannick Bellanger 8.IX.2017 (ASPER-YB); 2 ♀, *idem*, 30.X.2017 & 13.XII.2017 (ASPER-YB); 1 ♀, Guyane fr. – route de Kaw, élevage F1 Yannick Bellanger IX.2017 (ASPER-PL); 1 ♂, Guyane fr. – route de Kaw Camp Caïman, élevage Yannick Bellanger 16.V.2018 (ASPER-YB); 2 ♂, *idem*, 10.VIII.2018 (ASPER-YB); 1 ♂, *idem*, 15.IX.2018 (ASPER-YB); 1 ♂, *idem*, 29.X.2018, WG1PHAJA20-084 (ASPER-YB); 1 ♀, *idem*, 29.X.2018 (ASPER-YB); 1 ♀, *idem*, 11.II.2019, WG1PHAJA20-083 (ASPER-YB); 10 eggs, élevage F1 Y. Bellanger, XII.2017 (ASPER-YB); 1 egg, sauvage, 11.XI.2016; 7, VII.2017 élevage F1 Y. Bellanger (ASPER-PL); 23 eggs, ex Zucht Y. Bellanger 2017, Herkunft: Franz. Guayana, Route de Kaw, Camp Caïman, F1-Generation (FH, No. 0987-E).

**Diagnosis.** – This species strongly resembles *P. puppeia* (Westwood, 1859) in various morphological aspects, but the male differs by the considerably shorter mesonotum ( $2.2\times$  as long as head and pronotum combined in *P. bulbosa*;  $3\times$  as long as head and pronotum combined in *P. puppeia*), longer median segment ( $2.3$  to  $2.4\times$  as long as metanotum in *P. bulbosa*;  $2\times$  as long as metanotum in *P. puppeia*) and longer cerci (at least as long as anal segment in *P. bulbosa*; about  $0.75\times$  the length of anal segment in *P. puppeia*). Also, the drawings on the three last tergites are very different (fig. 98).

From *P. valgius* (Westwood, 1859), the male differs by the more elongated antennomere III, which is about  $3\times$  as long as pedicellus (only  $1.3\times$  in *P. valgius*), and the longer cerci, which are only about  $2/3$  the length of anal segment in *P. valgius*. Furthermore, although the unique known specimen (holotype) of *P. valgius* is very damaged and discoloured, it does not show any trace of drawing on the three last tergites; also, WESTWOOD (1859: 126, plate X, figure 3) does not mention any colour or drawing in his original description and figures.

From *P. ruboligata*, the male can be separated by the shape of the cerci, which are straight in *P. bulbosa* but hook-shaped in *P. ruboligata*, and the shorter poculum.

From *P. arlequina*, the male differs by the coloration of head, which is green in *P. bulbosa* and orange to reddish in *P. arlequina*. Furthermore, *P. arlequina* has the abdominal sternum VIII and tergum VIII fused with each other, while they are well separated in *P. bulbosa*. Drawings on tergite VIII are also very different (fig. 98).

Females are characteristic for having a prominent protuberance on abdominal tergum VI. The only other species which possess this kind of structure on tergum VI are *P. quadrilobata* (Chopard, 1911) and *P. femorata*, but both are very distinct from this species in various other aspects such as the larger size as well as the rounded lobes of the mesotibiae of *P. quadrilobata* and lobes of meso- and metafemora of *P. femorata*, both of which are lacking in *P. bulbosa*.

**Description of the female.** – Small for the genus (body length 63.1–65.4 mm; tab. II and fig. 14-22, 34 *in vivo*). General shape slender. Surface of body smooth except for protuberances on abdominal tergum VI. Apterous.

**Table II.** – Measurements of adult females and males of *Phantasca bulbosa* [mm].

	♀, HT [MNHN]	♀, PT [MNHN]	♂, PT (range from 4 specimens) [MNHN]
<b>Body</b>	63.1	65.4	43.1-48.1
<b>Antennae</b>	>25.8	33.3	43.0-47.8
<b>Head</b>	3.8	4.3	2.1-2.1
<b>Pronotum</b>	2.7	2.8	1.4-1.5
<b>Mesonotum</b>	14.9	16.1	8.1-9.7
<b>Metanotum (including median segment)</b>	8.7	9.1	7.9-8.1
<b>Tegmina</b>	-	-	1.3-1.4
<b>Alae</b>	-	-	19.9-21.6
<b>Profemora</b>	15.2	15.5	14.8-15.5
<b>Mesofemora</b>	9.5	9.9	9.0-10.4
<b>Metafemora</b>	11.8	13.2	12.9-13.9
<b>Protibiae</b>	12.8	13.8	15.4-16.0
<b>Mesotibiae</b>	8.4	9.2	9.5-9.7
<b>Metatibiae</b>	11.5	12.7	13.8-14.2

General colour of body light green, the basal part of profemora sometimes light brown. Terga sparsely covered with small whitish spots, slightly larger on the thorax. Greyish and more or less intermittent medio-longitudinal dorsal line that runs from the head to the posterior margin of abdominal tergum V (more pronounced in living specimens). Eyes brown. Ventral surface of profemora and protibiae sometimes marbled with grey and white. Thoracic sterna and abdominal sternum VII of wild specimens darker and brownish. Tarsi greenish, the basitarsus light brown at the extremity. Antennae thin and light green with the extremity light brown. Abdominal sterna III to VI with 2 small dark-brown, symmetric and longitudinal spots on their posterior margin, increasingly pronounced towards VI; sternum VII with only one central spot on the posterior margin. Cerci and extremity of anal segment light brown.

*Head.* Completely smooth; about 1.6× as long as wide, flat, gently narrowing toward posterior. Eyes circular and prominent (fig. 16-18). Antennae slightly exceeding extremity of the anterior legs and reaching posterior part of abdominal segment II or the anterior part of III; pedicellus 2/3 the length of scapus.

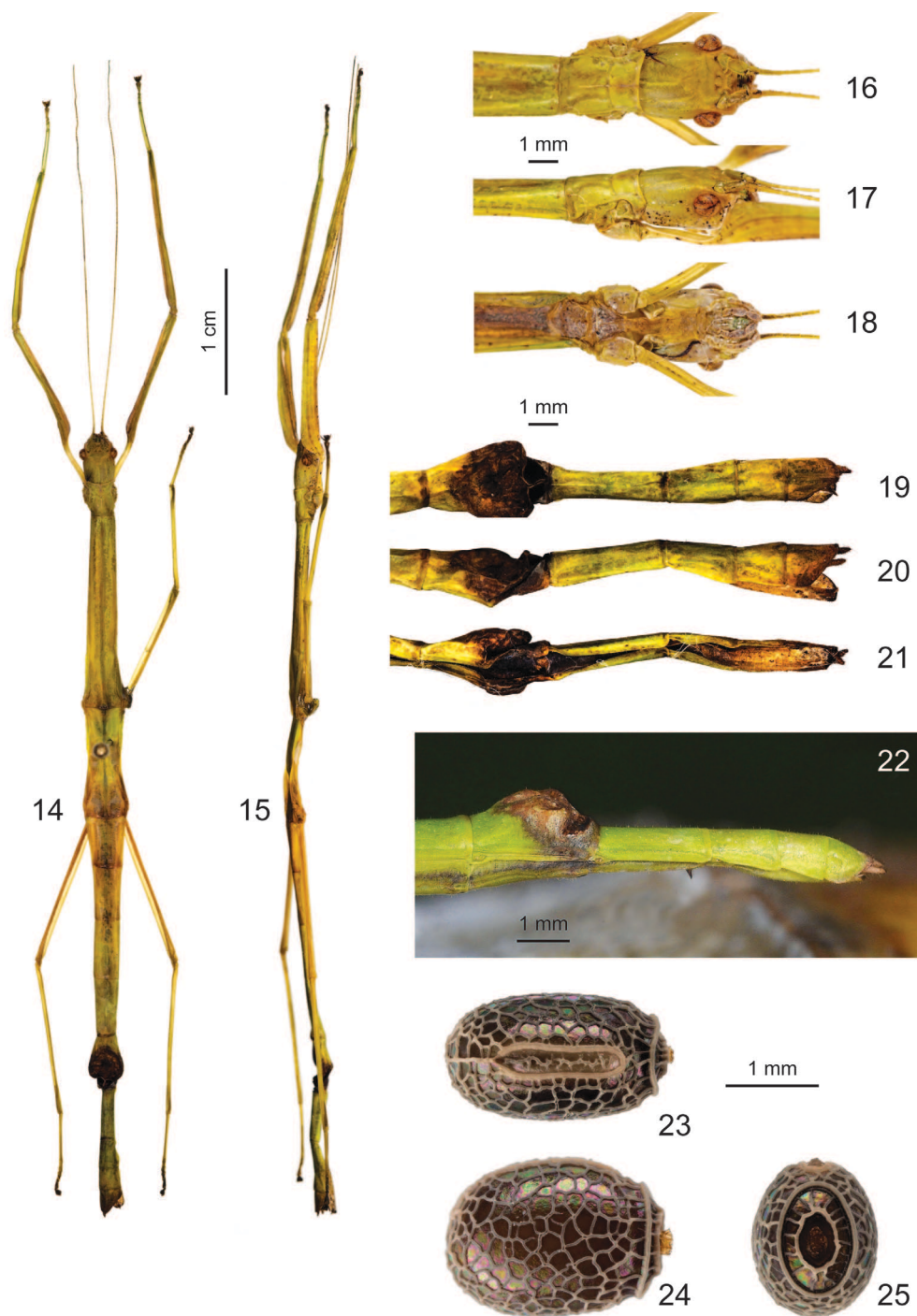
*Thorax.* Pronotum rectangular, about 1.5× as long as wide and 1.4 to 1.5× shorter than head; with a well visible transverse median sulcus and a visible medio-longitudinal sulcus. Mesonotum elongated and smooth, broader in its posterior part; about 2.3× as long as head and pronotum combined and 1.7 to 1.8× as long as metanotum and median segment combined. Metanotum smooth.

*Legs.* All very delicate and wholly unarmed, the profemora somewhat stockier than mid and hind legs; profemora longer than other femora with dorso-anterior carina elevated. Pro- and metabasitarsi longer as the combined length of remaining tarsomeres; mesobasitarsus equal in length to the remaining tarsomeres combined.

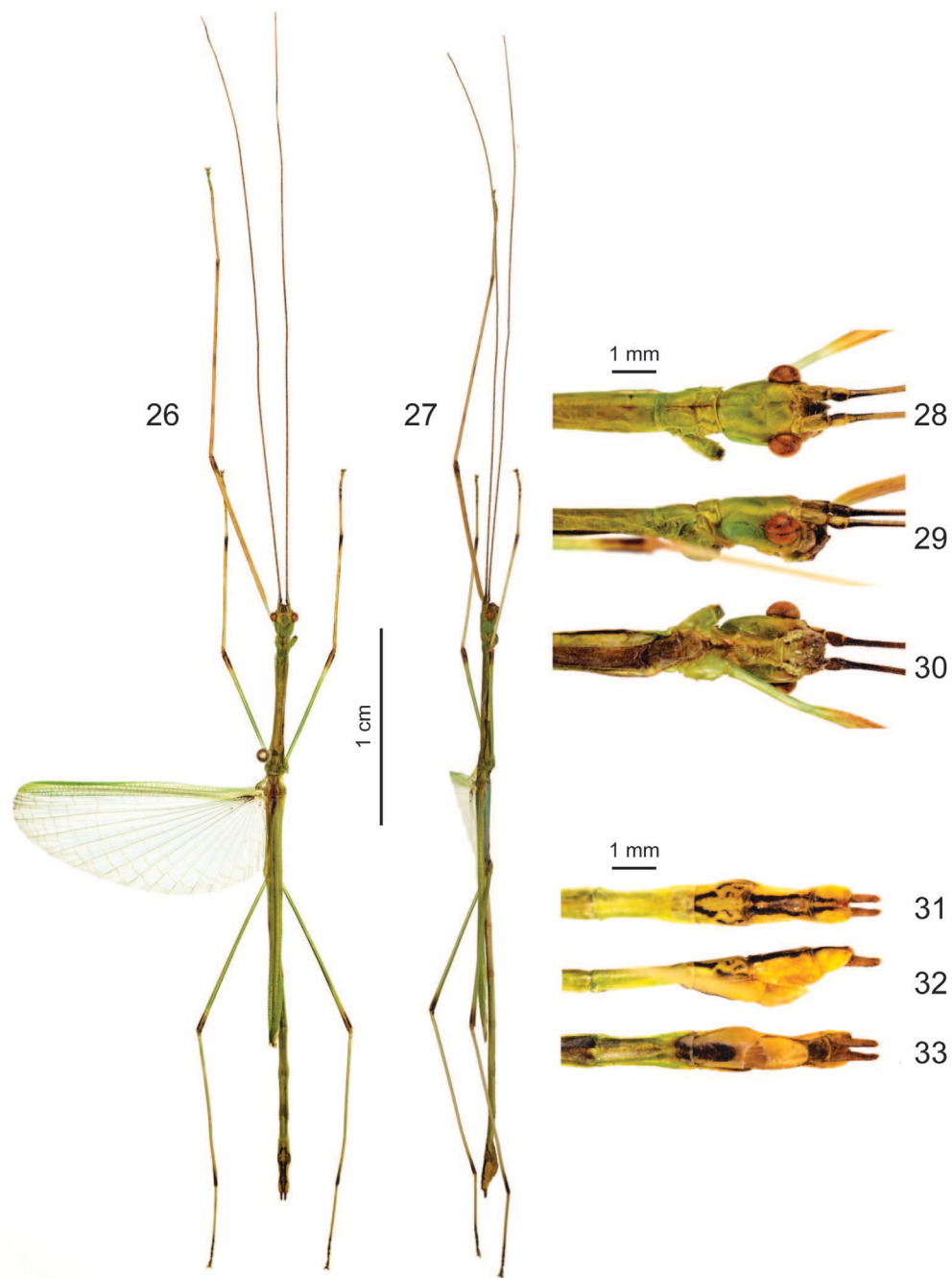
*Abdomen.* Median segment almost 1.5× as long as metanotum. Segments II to VI wider than the others; V and VI the longest; II to VII about 1.9× as long as wide. Praeopercular organ prominent and near the posterior margin of sternum VII, formed by a brown, spiniform median process. Tergum VI strongly widened medially (1.4× as wide as the anterior part of the segment, and 1.5× as wide as posterior part) and bearing irregularly shaped, verrucose, light to dark brown protuberance in its posterior portion; this structure elevated and more or less ace of spades shaped anteriorly (fig. 19-22). Anal segment roughly as wide as long, gradually narrowing toward the apex; posterior margin flat. Epiproct small and rounded. Cerci short and straight, with rounded apex; exceeding the anal segment by about 1/5 of its length. Subgenital plate very convex in its posterior two-thirds, with truncated and obtusely rounded apex; reaching to apex of the anal segment; maculated with light brown. Gonapophyses VIII up-curving and slightly exceeding the apex of anal segment.

*Description of the male.* – Small size for the genus (body length 43.1-48.1 mm; tab. II and fig. 26-33, 35 *in vivo*), slender and with body entirely smooth. Winged. General colour of body pale green. Metanotum marbled with brown between bases of wings; median segment cream to green. Anterior legs cream with dark-brown spots, median and posterior legs plain greenish cream. Mesosternum brown. Apex of all





**Fig. 14-25.** – *Phantasca bulbosa* n. sp. – 14-22, ♀: 14-15, habitus (14, dorsal view; 15, lateral view); 16-18, anterior part (16, dorsal view; 17, lateral view; 18, ventral view); 19-21, apex of abdomen (19, dorsal view; 20, lateral view; 21, ventral view); 22, apex of abdomen with “bulb” *in vivo*, lateral view. – 23-25, Egg: 23, dorsal view; 24, lateral view; 25, apical view of operculum.



**Fig. 26-33.** – *Phantasca bulbosa* n. sp., ♂. – 26-27, Habitus: 26, dorsal view; 27, lateral view. – 28-30, Anterior part: 28, dorsal view; 29, lateral view; 30, ventral view. – 31-33, Apex of abdomen: 31, dorsal view; 32, lateral view; 33, ventral view.

femora, tibiae and tarsomeres dark-brown. Eyes and antennae brown. Tegmina pale green and translucent. Costal region of alae pale green to hyaline in apical half and with an elongated dark spot at the base along the empusal vein. Anal region translucent with light green veins; radial veins 1-6 slightly darker at their base. Abdominal terga II-VII light green, VIII-X cream with blackish markings (fig. 31); VII darker at posterior margin; VIII with a distinct dark brown V-shaped marking at anterior margin that roughly extends to mid of segment and followed by a pair of short longitudinal circular spots followed by a couple of symmetric C-shaped markings laterally. IX with a pair of longitudinal black lines that gradually diverge towards posterior. X with a pair of longitudinal median black lines, that are distinct in the anterior half and fade towards the posterior. Sterna II and III light brown, IV and V cream to light green, VI and VII light green; V-VII with a pair of dark brown spots close to posterior margin; VIII with a triangular dark spot at anterior margin (merging with the posterior spot of sternum VII) pointing to the apex, and a spade-shaped spot ending almost at the posterior margin; IX cream coloured. Cerci cream coloured with the distal half darker. Basal portion of antennae black ventrally and pedicellus also with the interior surface black.

**Head.** Slightly elongated,  $1.5\times$  as long as wide and gently narrowed posteriorly; flattened dorsally. Eyes circular and prominent (fig. 28-30). Antennae considerably longer than the anterior legs and almost of same length as body; scapus rectangular with a black spot in its internal anterior part; pedicellus  $1.5\times$  shorter than scapus, rounded and black on the inside.

**Thorax.** Pronotum rectangular, about  $2\times$  as long as wide and considerably shorter than the head; with a transverse median sulcus and a medio-longitudinal sulcus in its anterior 2/3. Mesonotum  $2.3$  to  $2.7\times$  as long as head and pronotum combined, gently broadening posteriorly. Metanotum rectangular, about  $2\times$  as long as wide. Tegmina and alae of same colour as the body, with all major veins mid to dull green. Tegmina very short and slender, apex barely reaching the basal part of alae. Intero-basal portion of costal region of alae with a black spot. Sometimes with small green spots on the radial vein in the basal third. Anal fan of alae transparent greenish. Alae reaching the middle of tergum V.

**Legs.** Very long and delicate; pro- and metafemora slightly shorter than the corresponding tibiae; mesofemora roughly of same length as mesotibiae; metatibiae considerably projecting beyond apex of abdomen. Pro- and metabasitarsi about  $2\times$  as long as the combined length of remaining tarsomeres; mesobasitarsus slightly longer than the remaining tarsomeres combined.

**Abdomen.** Median segment  $2.3$  to  $2.4\times$  as long as metanotum. Segments II-VII almost of equal width; VIII broader, particularly in posterior portion; IX and X narrower. Terga II to V of uniform length and equal in length to VII and VIII combined; VI shorter, but longer than VII; VII of same length as IX and X combined; IX slightly longer than VIII; X the shortest. Apex of anal segment with a distinct indentation that forms two rounded lobes. Cerci long and straight, cylindrical and with a rounded apex; slightly longer than anal segment (fig. 31-33). Sternum VII bulging. Poculum large and elongated, roundly triangular in ventral aspect with the apex obtusely rounded, not reaching the anal segment. Vomer distinct, triangular and forming an acute, up-curving terminal hook with a black tip. Posterior margins of anal segment with six black denticles ventrally.

**Description of the egg.** – General colour brown (tab. III, fig. 23-25). Capsule ovoid, distinctly oval in cross-section, about  $1.2\times$  as long as high, and almost  $1.5\times$  as long as wide; surface brown, smooth and shiny, covered by an irregular and raised light brown network, forming cells of irregular sizes and shapes. Opercular collar distinct and light brown. Micropylar plate elongate, about  $0.75\times$  as long as the length of capsule and slightly widened posteriorly; surface smooth, shiny and brown, with an irregular raised medio-longitudinal ridge; outer margin slightly raised and cream coloured. Micropylar cup small and median line short. Operculum oval, of same colour and with same network as the capsule, the outer margin slightly raised; capitulum represented by a raised rim and some irregularly shaped acute ridges in the centre, dark brown.

Table III. – Measurements of the egg of *Phantasca bulbosa* [mm].

Capsule total length (incl. operculum)	Capsule length	Capsule height	Capsule width	Operculum small diameter	Operculum large diameter	Micropylar plate length
2.5	2.2	1.8	1.5	0.8	1.2	1.2

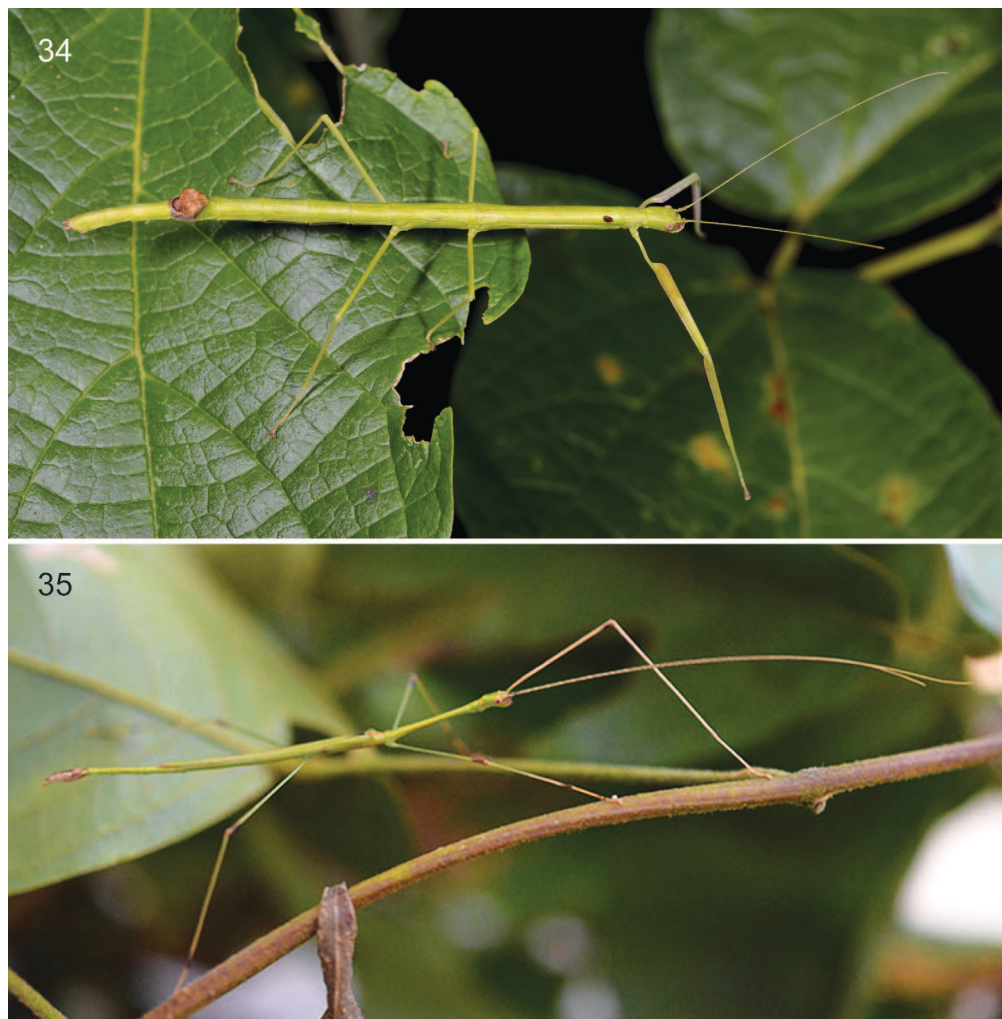


Fig. 34-35. – *Phantasca bulbosa* n. sp., in vivo – 34, ♀. – 35, ♂.

**Etymology.** – The species name (latin *bulbosus*, bulbous) refers to the distinctive protuberances on abdominal tergum VI of the female.

**Comments.** – Five of the six type specimens have been found at the same locality and on the same host shrub along the road between Roura and Kaw. Only one other male has been found in Bélizon by Toni Jourdan in 2017. Unfortunately, the natural food plant could not yet be identified.

Breeding was possible in Europe using eucalyptus (*Eucalyptus* sp., Myrtaceae) as an alternative food plant and allowed us to obtain more sample specimens.

*Phantasca femorata* Hennemann, Conle, Bellanger, Lelong & Jourdan, 2018 (fig. 36-46)

**Type material.** – Holotype: ♀ (penultimate instar), 25.VII, A7 S1 N12, P.E. Roubaud det. (MNHN).

Paratypes: 1 ♀ (penultimate instar), 25.VII, A6 S1 N7, P.E. Roubaud det. (MNHN); 1 ♂, GUY15-016 5.VIII.2015, Guyane française, St Elie, N5°17.725' W53°03.093', rec. T. Jourdan, ASPER (ASPER-PL); 1 ♂,



Französisch Guyana, Commune de Roura, Montagne de Chevaux, RN2 PK22, 4°44'56"N 52°26'28"W, alt. 75 m SEAG, *leg. Stéphane Brûlé* 24.VI.2012 (OC, No. 0335-1); 4 eggs, wild (ASPER-PL).

**New material examined.** – ♀, GUY17-038, 8.VII.2017, Camp Caïman, Kaw, Guyane française 4°34'11"N - 52°12'41,5"W, *rec. T. Jourdan*, ASPER (INRAE); 7 eggs laid by the female GUY17-038 (ASPER-PL).

**Diagnosis.** – *Phantasca femorata* is similar to the two larger species of the genus *P. quadrilobata* and *P. guianensis* Hennemann, Conle, Bellanger, Lelong & Jourdan, 2018, but the female readily differs from both species by the large rounded lobes of the meso- and metafemora (fig. 36) and the lateral swellings on abdominal tergum VI (fig. 36, 41).

The eggs of *Phantasca femorata* are very distinctive by having a strongly hairy capsule, which is a unique feature in the genus (fig. 42-44).

**Redescription of the female.** – Size large (body length 117.5 mm; tab. IV and fig. 36-41, 45-46 *in vivo*), fairly stocky body and legs. Body smooth except for swellings on tergum VI which are covered with short and dark bristles that are only seen with strong magnification.

Body uniformly greyish brown to greenish grey. Ventral body surface slightly paler. Head bluish grey to greenish, almost khaki. Mouthparts light beige. Eyes yellow with a faint black network of lines, antennae of same colour as body. Pronotum with a black longitudinal line close to lateral margins. Meso- and metanotum with dotted lines near lateral margins, that are alternately black and yellow. Meso- and metapleurae yellow with longitudinally directed brown mottling. Meso- and metasternum and abdominal sterna II-VI covered with irregular brownish mottling. Junctions of meso- and metanotum and of median segment and abdominal tergum II forming a slight yellowish orange swelling, less distinct on the junction between Terga III and IV. Lateral margins of abdominal segment III and IV with a black longitudinal line that stresses the segment delineation, also visible but less distinct on V. Legs brown and variegated with light brown. Meso- and metatarsi yellow, protarsi pale cream.

**Head.** Smooth, roundly rectangular and flattened, about 1.6× as long as wide, with the genae almost parallel-sided; vertex entirely smooth with a fairly distinct coronal suture. Eyes circular prominent, length contained 1.7× in that of genae (fig. 37-38). Antennae exceeding the end of the anterior legs and reaching about half way along abdominal segment II. Scapus 1.9× as long as wide, flattened dorsally and apical part wider than basal part; pedicellus 1.7× shorter than scapus, rounded apically; first antennomere very slightly longer than pedicellus.

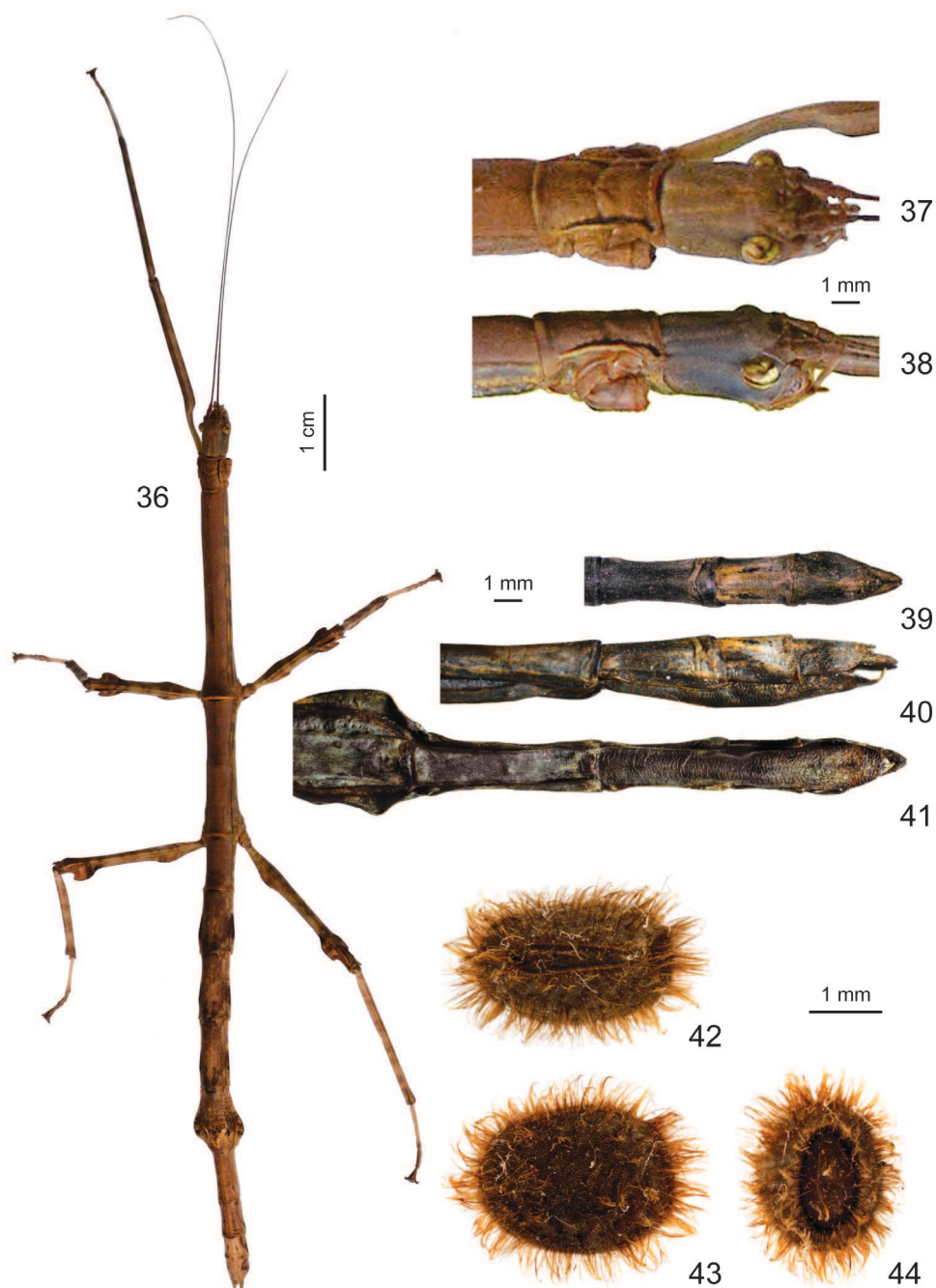
**Thorax.** Pronotum shorter and narrower than head, rectangular with the lateral margins somewhat concave, slightly more than 1.5× as long as wide; longitudinal median sulcus well defined and ending some distance before posterior margin; transverse median sulcus very distinct, gently curved and expanding over entire width of segment. Mesonotum 2,8× as long as head and pronotum combined and 8× as long

**Table IV.** – Measurements of the adult female of *Phantasca femorata* GUY17-038 in comparison with the immature type specimens [mm]. (Measurements of the head of holotype and paratype not provided in the original description).

	♀, GUY17-038	♀, HT	♀, PT
<b>Body</b>	117.5	83.3	90.4
<b>Antennae</b>	59.0	44.8	50.7
<b>Head</b>	5.5	-	-
<b>Pronotum</b>	4.8	3.2	3.5
<b>Mesonotum</b>	27.3	18.9	20.7
<b>Metanotum</b>	8.6	5.9	6.5
<b>Median segment</b>	9.53	6.8	7.3
<b>Profemora</b>	25.0	17.4	20.3
<b>Mesofemora</b>	15.9	10.5	12.4
<b>Metafemora</b>	21.1	14.3	15.5
<b>Protibiae</b>	22.0	16.0	17.7
<b>Mesotibiae</b>	14.9	10.4	11.7
<b>Metatibiae</b>	22.6	15.1	16.5



as wide; posterior margin slightly inflated over its entire width. Metanotum slightly shorter than median segment; Metanotum and median segment combined 4.5× as long as wide. Median segment distinct with two light brown oval spots at the junction with metanotum on both sides of a central scale-like asperity.



**Fig. 36-44.** – *Phantasca femorata* Hennemann *et al.* – 36-41, ♀: 36, habitus, dorsal view; 37-38, anterior part (37, dorsal view; 38, lateral view); 39-41, apex of abdomen (39, dorsal view; 40, lateral view; 41, ventral view). – 42-44, Egg: 42, dorsal view; 43, lateral view; 44, apical view of operculum.

**Legs.** Stocky and fairly short for the genus, with characteristic femoral lobes. Profemora longer than protibiae, mesofemora slightly longer than mesotibiae and metafemora shorter than metatibiae. Median legs distinctly shorter than the others. Meso- and metafemora with the two-outer ventral carinae weakly deflexed sub-basally and with a prominent, rounded lobe sub-apically, which extends by roughly the diameter of femur; dorsal carinae very slightly curved basally and deflexed apically. Meso- and metatibiae with the two dorsal carinae slightly deflexed apically. Mesobasitarsus about as long as the remaining tarsomeres combined; pro- and metabasitarsus decidedly longer.

**Abdomen.** Slightly longer than head, thorax and median segment combined. Tergum II shorter than the next four and of same length than VII; tergum IV and V roughly of same length and the longest; tergum III and VI of equal length; tergum VIII longer than the two next and tergum IX slightly shorter than tergum X; tergum II to V almost of uniform width; tergum VI slightly swollen dorsally with two very slight bumps on the posterior half, and lateral margins deflexed pre-posteriorly to form a narrow rounded lobe; lateral margins of tergum VII slantwise and wider posteriorly, notably exceeding sternum VII and forming a fringe; same thing but less distinct for the tergum VIII. Sternite VII shorter than all previous; VIII-X of uniform width and slightly narrower than previous. Subgenital plate swollen with an acutely pointed apex, slightly projecting over the anal segment. Epiproct small, roundly triangular, tectinate and decidedly projecting over posterior margin of anal segment. Cerci obtuse, straight with a blunt apex and projecting beyond anal segment by about half of its length (fig. 39-41).

**Description of the egg.** – Ovoid, 1.2× as long as high and 1.6× as long as wide (tab. V, fig. 42-44). Whole capsule surface dark brown to black, very minutely and regularly granulose, wholly and densely covered with long and light brown hairs grouped into tufts. Micropylar plate elongated, slender and widened posteriorly; about 1.4 to 1.5× shorter than the capsule, and almost reaching the opercular collar; smooth except for a medio-longitudinal hairy strip, that is dividing in two strips posteriorly; outer margin light brown, slightly raised and covered with brown hairs. Micropylar cup scarcely visible, dark brown; median line distinct, raised, light brown and hairy. Operculum flat and oval, 1.6× as long as wide; with the same granulose surface as the capsule; outer margin with a row of brown hairs and also central portion covered with brown hairs.

**Table V.** – Measurements of the egg of *Phantasca femorata* [mm], average of nine eggs.

Capsule total length (incl. operculum)	Capsule height	Capsule width	Operculum small diameter	Operculum large diameter	Micropylar plate length
2.8	2.3	1.7	0.91	1.49	1.91

**Comments.** – Both females used for the original description (HENNEMANN *et al.*, 2018 : 14) are penultimate instar nymphs. The description of a now available adult female is meant to complete the morphological description of this species and to provide more details on the colouration of the live insect. The egg is described here for the first time based on samples laid by the female from Camp Caïman in 2017.

The here described female was found as a penultimate instar nymph in Kaw mountains on an unidentified species of the genus *Ferdinandusa* Pohl (Rubiaceae), that was about five meters in height. The specimen made its final moult in captivity and was fed on an unidentified Melastomataceae species.

***Phantasca kawensis*** Bellanger, Lelong, Jourdan, Hennemann & Conle, **n. sp.** (fig. 47-68)

<http://zoobank.org/C720EA04-E932-4241-A3FA-829BAF2C352E>

**HOLOTYPE:** ♀, “GUYKAW16-070, 09.XI.2016, Guyane fr. – route de Kaw, Camp Caïman – PK27 depuis Roura, N4°34'12,8”; W52°12'52,4”, alt. 300 m., *rec. Yannick Bellanger & Philippe Lelong*, ASPER (MNHN).

**PARATYPES** (3 ♂, 4 ♀, 5 eggs): 1 ♂, Guyane fr. – route de Kaw, Camp Caïman, N4.0095, W52.0037, GUY19-021 21.X.2019; BOLD GFPHASM19-042 (INRAE); 1 ♂, Guyane fr. – route de Kaw, Camp Caïman,

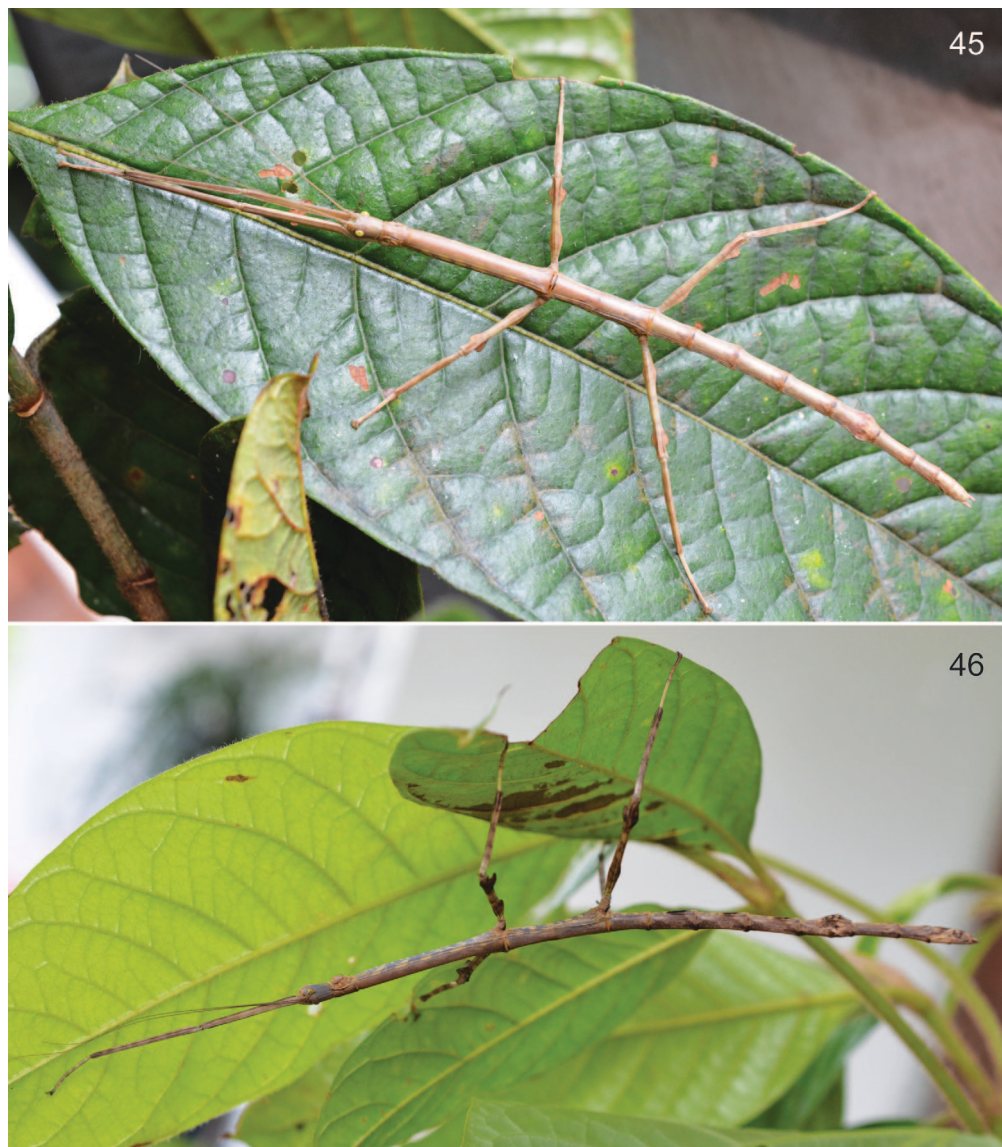


Fig. 45-46. – *Phantasca femorata* Hennemann *et al.*, ♀, in vivo.

élevage F1 Yannick Bellanger, GUYKAW16-077, 4.VIII.2017 (MNHN); 1 ♂, *idem*, GUYKAW16-078, 23.X.2017 (MNHN); 1 ♀, *idem*, GUYKAW16-073, 8.IX.2017 (MNHN); 1 ♀, *idem*, GUYKAW16-074, 8.IX.2017 (MNHN); 1 ♀, *idem*, GUYKAW16-075, 13.IX.2017 (MNHN); 1 ♀, *idem*, GUYKAW16-076, 8.IX.2017 (MNHN); 5 eggs, élevage F1 Y. Bellanger, XII.2017 (MNHN).

OTHER STUDIED MATERIAL (1 ♂, 6 ♀, 87 eggs): 5 ♀, Guyane fr. – route de Kaw, Camp Caïman, élevage F1 Yannick Bellanger 6.XI.2017 (2), 9.XI.2017, 4.XII.2017, 18.XII.2017 (ASPER-YB); 1 ♂, *idem*, élevage F2 Y. Bellanger, 26.IX.2018 (ASPER-YB) ; 1 ♀, Guyane fr. – route de Kaw, élevage F1 Yannick Bellanger X.2017 (ASPER-PL); 53 eggs: ex Zucht: Y. Bellanger 2017, Herkunft: Franz. Guyana, route de Kaw, Camp Caïman, F1-Generation (FH, No. 0988-E); 13 eggs, XI.2016, laid by the female holotype (ASPER-YB); 1 egg, XI.2016, laid by the female holotype (ASPER-PL); 20 eggs, élevage F1 Y. Bellanger, IX.2017 (ASPER-PL).

**Diagnosis.** – *Phantasca kawensis* n. sp. is very similar to *P. nigrolineata* Hennemann, Conle, Bellanger, Lelong & Jourdan, 2018, but the male of *P. kawensis* is larger and differs by the transparent light brown anal area of the alae (transparent grey in *P. nigrolineata*), the less elongated sternum VIII (fig. 99) and the in-curved cerci. The female differs in the much shorter cerci and the rounded shape of the subgenital plate extremity (forming an apical point in *P. nigrolineata*) (fig. 100). Eggs are very similar to those of *P. nigrolineata* as well, but in *P. kawensis* the operculum is slightly more elevated and the capsule is narrower at the opercular collar. From other virtually similar species, the female may be separated from *P. quadrilobata* by the lack of swellings on abdominal tergum VI and from *P. guianensis* by the much shorter cerci. The male differs from *P. quadrilobata* and *P. guianensis* by the very different markings on the vertex (fig. 101).

**Description of the female.** – Size medium to large for the genus (body length 81.0-91.0 mm; tab. VI and fig. 47-54, 66-67 *in vivo*), slender. General colour mid to light brown, sometimes greenish, with a darker and more or less visible medio-longitudinal dorsal line from the head to the abdominal extremity.

**Head.** Smooth and almost parallel-sided, about 1.7× as long as wide; vertex with a dark medio-longitudinal line in posterior 2/3 that stops at the frons between the eyes (fig. 49). Antennae of same colour as the body, exceeding the anterior legs and reaching posterior margin of abdominal segment III; scapus longer than wide and compressed dorsally; pedicellus shorter and rounded.

**Thorax.** Pronotum about 1.3× shorter than head and slightly narrower, almost rectangular, with a curved transverse median sulcus, and a well visible medio-longitudinal sulcus. Mesonotum smooth, 2.2 to 2.6× as long as head and pronotum combined, very slightly widening towards the posterior and with a very weak medio-longitudinal carina; metanotum smooth. Meso- and metasternum bearing small tubercles, some of them blackish.

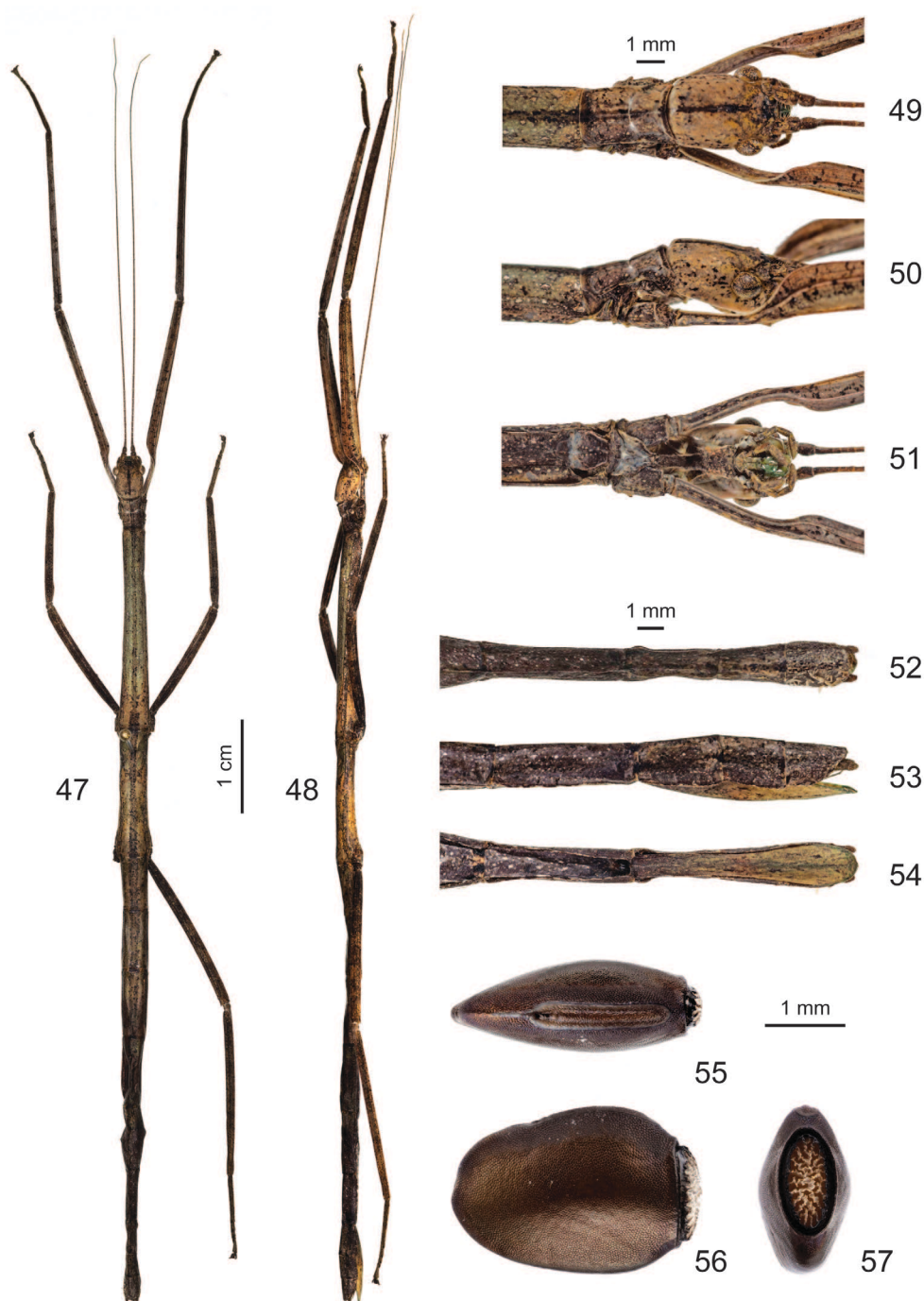
**Legs.** Of the same colour as body, with many dark brown spots. Profemora about as long as protibiae, and slightly longer than mesonotum; mesofemora very slightly longer than mesotibiae; metafemora very slightly shorter than metatibiae; anterodorsal carina of profemora raised sub-basally; medio-ventral carina of meso- and metatibiae slightly raised basally. Pro- and metabasitarsus strikingly longer than remaining tarsomeres combined; mesobasitarsus about as long as remaining tarsomeres combined.

**Abdomen.** Smooth dorsally. Median segment scarcely discernible. Abdominal segments II to VI roughly of uniform width, VII slightly narrowing from anterior to posterior, VIII to X roughly uniform in width. Terga II to V increasing in length, VI to IX decreasing in length; IV and VI roughly of uniform length and very slightly shorter than V, which is the longest; III and VII roughly of same length; IX and X

**Table VI.** – Measurements of adult females and males of *Phantasca kawensis* [mm].

	♀, HT [MNHN]	♀, PT (range based on 4 specimens)	♂, PT (range based on 3 specimens)
<b>Body</b>	81.4	87.3-91.0	58.2-59.0
<b>Antennae</b>	44.2	53.1-55.8	66.8-67.4
<b>Head</b>	4.4	4.7-4.9	2.6-2.7
<b>Pronotum</b>	3.2	3.2-3.7	1.9-2.0
<b>Mesonotum</b>	19.9	19.7-21.3	11.5-12.6
<b>Metanotum</b>	12.5 (incl. median segment)	12.2-13.4 (incl. median segment)	3.2-3.2
<b>Median segment</b>	-	-	7.2-7.3
<b>Tegmina</b>	-	-	2.6-2.8
<b>Alae</b>	-	-	25.8-26.4
<b>Profemora</b>	20.1	21.2-22.1	19.1-19.7
<b>Mesofemora</b>	12.7	14.9-15.1	13.4-13.6
<b>Metafemora</b>	16.1	17.1-19.5	17.7-18.2
<b>Protibiae</b>	18.9	21.8-22.4	22.1-23.2
<b>Mesotibiae</b>	11.5	13.9-14.4	13.8-14.3
<b>Metatibiae</b>	16.8	19.3-19.6	19.3-20.4





**Fig. 47-57.** – *Phantasca kawensis* n. sp. – 47-54, ♀: 47-48, habitus (47, dorsal view; 48, lateral view); 49-51, anterior part (49, dorsal view; 50, lateral view; 51, ventral view); 52-54, apex of abdomen (52, dorsal view; 53, lateral view; 54, ventral view). – 55-57, Egg: 55, dorsal view; 56, lateral view; 57, apical view of operculum.



the shortest and of similar length. Anal segment slightly carinated medio-longitudinally especially in its posterior half and with posterior margin slightly indented medially. Sterna III to VI with two dark spots posteriorly. Praeopercular organ formed by a small hump in front of a V-shaped hollow, located close to posterior margin of sternum VII and inserted in a black spot. Sternum II weakly coriaceous and covered with several small granules. Subgenital plate with a raised lateral carina in basal half and a slightly raised medio-longitudinal carina over whole length; apex rounded and very slightly exceeding the anal segment. Cerci straight and slender, narrower towards the extremity, covered with short dark hairs, with a rounded apex and slightly projecting beyond the anal segment and subgenital plate. Epiproct hardly visible and very slightly exceeding the anal segment. Gonapophyses elongated and slightly up-curving but hardly visible and staying considerably before the apex of subgenital plate (fig. 53).

**Description of the male.** – Fairly large for the genus (body length 58.2-59.0 mm; tab. VI and fig. 58-65, 68 *in vivo*), very slender and of typical form; general colour of body ranging from greenish to pale brown with dark markings. Terga II to IX covered with sparse dark brown spots, II to V (sometimes also VI) with two symmetric dark brown and elongated spots in the posterior half. Tergum VI with posterior part darker. Sterna II to VII with black spots and a distinct medio-longitudinal line; VII with an elongated and triangular dark spot on each side of the medio-longitudinal carina.

**Head.** Smooth, longer than wide, almost parallel-sided, slightly broader at the eyes; vertex with a distinctive dark, elongate median marking (fig. 60). Antennae elongated, longer than body, notably exceeding the anterior legs, looking monochromatic at sight but with a smooth transition from light brown on the posterior part to greenish on the anterior part under magnifying glass; scapus twice as long as wide and compressed dorsoventrally, with the interior margin darker; pedicellus shorter and rounded.

**Thorax.** Pronotum slightly shorter than head, almost rectangular, with a curved transverse median sulcus and a distinct medio-longitudinal sulcus. Mesonotum more than 3× as long as head and pronotum combined; covered by sparse dark brown spots and markings. Tegmina light brown, short and very slender in its basal half and wider in its posterior half; posterior half with a prominent hump and a truncated apex. Alae reaching abdominal tergum V; costal area light brown marbled with dark brown; anal area uniformly translucent light brown.

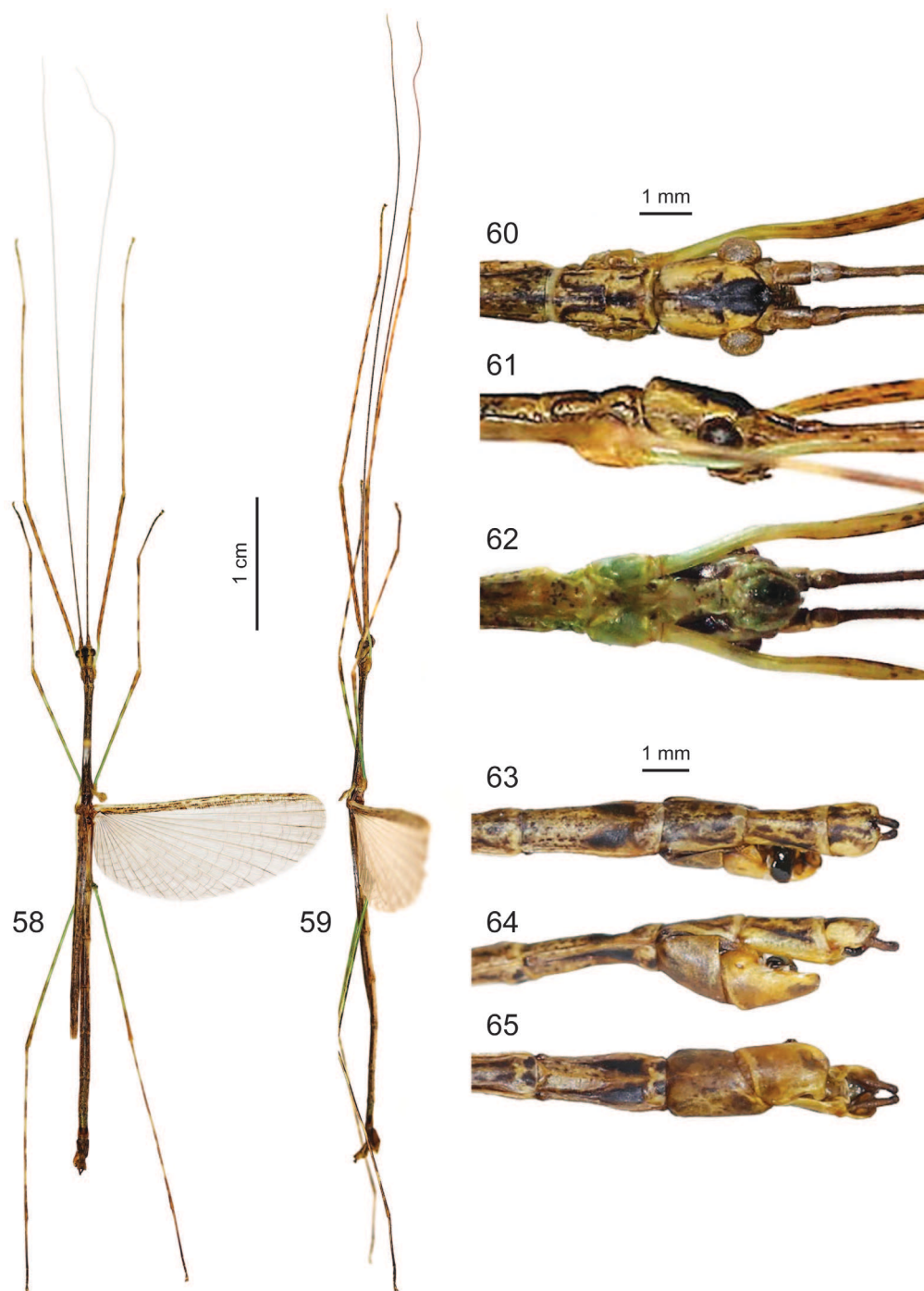
**Legs.** Very long and delicate. All femora and tibiae more or less distinctly annulated; anterior and posterior femora shorter than their corresponding tibiae; median femur almost equal in length to corresponding tibia. All tarsi elongated, with 2<sup>nd</sup> tarsomere as long as 5<sup>th</sup> and as long as 3<sup>rd</sup> and 4<sup>th</sup> combined; probasitarsus and metabasitarsus about twice as long as all following tarsomeres combined; 4<sup>th</sup> tarsomere the shortest.

**Abdomen.** Considerably longer than head, thorax and median segment combined. Median segment more than 2.2 to 2.3× as long as metanotum. Terga II to IV of equal length, V slightly shorter, VI and VII decreasing in length; VIII and IX of same length and shorter than VII. Anal segment the shortest and about as long as wide, slightly wider in its anterior part, with the posterior margin indented medially and forming two rounded lobes. Tergum VIII the widest. Sternum VIII swollen, rounded and slightly longer than tergum VIII; dextral side obviously longer than sinistral side. Poculum small and rounded, with the apex slightly up-curving; right lateral margin with a fairly large and rounded indentation. Vomer triangular in shape and terminating in an upward directed hook. Cerci round in cross-section, in-curved, very slightly directed downward and notably projecting beyond the anal segment with the apex rounded and the base obviously thicker (fig. 63-65).

**Description of the egg.** – Strongly laterally compressed and lens-shaped (tab. VII, fig. 55-57); dorsal and ventral surfaces and polar area tectiform; dorsal surface more convex than ventral surface; the ventral surface almost straight in its central part. Capsule plain dark brown, about 1.3× as long as high and 2.1× as long as wide; obviously narrower at the operculum collar; whole surface minutely and

Table VII. – Measurements of the egg of *Phantasca kawensis* [mm].

Capsule total length (incl. operculum)	Capsule length	Capsule height	Capsule width	Operculum small diameter	Operculum large diameter	Micropylar plate length
3.1	2.8	2.1	1.3	0.5	1.2	1.5



**Fig 58-65.** – *Phantasca kawensis* n. sp., ♂. – 58-59, Habitus: 58, dorsal view; 59, lateral view. – 60-62, Anterior part: 60, dorsal view; 61, lateral view; 62, ventral view. – 63-65, Apex of abdomen: 63, dorsal view; 64, lateral view; 65, ventral view.

densely pitted and shiny. Micropylar plate notably shifted towards the anterior, elongated and parallel-sided with only the posterior part very slightly widened, about  $6.2\times$  as long as wide; surface very minutely granulose; interior part of the same colour as the capsule and slightly raised, outer margin grey; posterior side closed by the micropylar cup, which is bowl-shaped. Median line distinct, short and not reaching polar area. Operculum oval,  $2.4\times$  as long as wide and covered by a raised and very irregular network of basically radially directed uneven ridges; these transparent whitish and the outer margin of operculum black.

**Etymology.** – The species name refers to the type-locality in the “Montagne de Kaw”, which is the only currently known location for the species.

**Comments.** – Only the holotype female was found *in natura*. It was kept alive in captivity for a few weeks in order to obtain eggs for breeding purposes. Breeding in Europe was possible

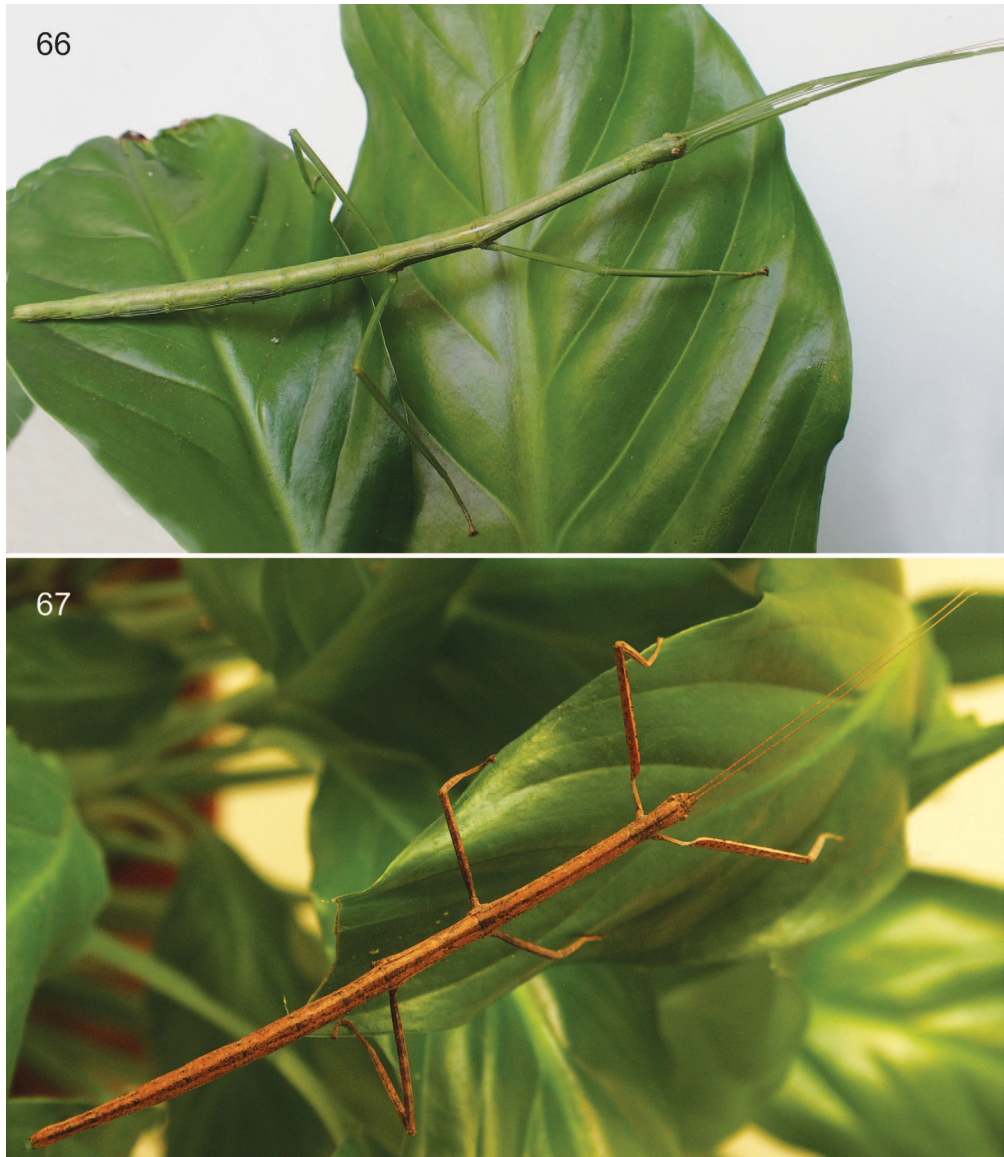


Fig. 66-67. – *Phantasca kawensis* n. sp., ♀ *in vivo*.





Fig. 68. – *Phantasca kawensis* n. sp., ♂ in vivo.

using *Rosa* spp. and *Rubus* spp. (Rosaceae) as alternative food plants and has resulted in knowledge of the male. Incubation of the eggs took about 130 days at temperatures of 18-20°C. In the same conditions, males reached maturity in 120 days while females took 125-130 days. The F1 captive reared paratype females are slightly larger than the holotype. So far, nothing is known about the natural food plants.

***Phantasca margaritae*** Bellanger, Lelong, Jourdan, Hennemann & Conle, n. sp. (fig. 69-85)  
<http://zoobank.org/6FAD0A81-09AE-42C9-843B-1071771C6C72>

HOLOTYPE: ♀, Guyane fr., Saül, Piste de l'aérodrome, Rec. Yannick Bellanger 28.X.2019 (MNHN).

PARATYPES (18 ♂, 1 ♀): 1 ♂, Guyane fr., Saül, Belvédère, GUY13-070, 8-23.X.2013, Rec. ASPER (Bellanger, Lelong & Jourdan) (MNHN); 1 ♀, Guyane fr., Saül, Piste de l'aérodrome, Rec. Yannick Bellanger, 28.X.2019; BOLD GFPHASM19-060 (MNHN); 1 ♂, *idem* (MNHN); 1 ♂, Französisch Guyana, Commune de Saül, leg. L. Sénécaux, 7.VIII.1989 (OC-0333-1); 1 ♂, Französisch Guyana, Commune de Roura, Montagne des Chevaux, RN2 PK22, 4°44'56"N – 52°26'28"W, alt. 75 m, SEAG, leg. Stéphane Brûlé 4.IV.2010 (OC-0333-4); 1 ♂, *idem*, 4.III.2013, Lichtfang (OC-0333-5); 1 ♂, *idem*, 21.X.2012 (OC-0333-6); 1 ♂, *idem*, 1.II.2011 (OC-0333-7); 1 ♂, *idem*, 19.XII.2011 (OC-0333-8); 1 ♂, *idem*, 18.III.2012 (OC-0333-11); 1 ♂, *idem*, 16.V-11.VII.2009 (OC-0333-14); ); 1 ♂, *idem*, 1.XI.2009 (OC-0333-15); 1 ♂, *idem*, 14.II.2010 (OC-0333-16); 1 ♂, *idem*, 17.X.2015 (OC-0333-23); 1 ♂, *idem*, 13.XII.2014 (OC-0333-24); 1 ♂, Französisch Guyana, Commune de Mana, Laussat (westlich), 5°28'31.6N – 53°35'07.3W, P4 terra firme, leg. Greg Lamarre (OC-0333-17); 1 ♂, Französisch Guyana, Commune de Saül, Aussichtspunkt Belvedere de Saül, 3°37'22"N – 53°12'57"W, 326 m, SEAG, leg. Stéphane Brûlé, 11.I.2011 (OC-0333-19); 1 ♂, Französisch Guyana, Commune de Roura, Montagne des Chevaux, RN2 PK22, 4°44'56"N – 52°26'28"W, alt. 75 m, SEAG, leg. Stéphane Brûlé, 12.II.2015, Lichtfang, Gen 0202 (OC-0333-21); 1 ♂, *idem*, 12.II.2015, Gen 0164 (OC-0333-22); 2 eggs, laid by the holotype and paratype females (YB).

**Diagnosis.** – This species strongly resembles *P. ruboligata*, but the male differs in the dorsal coloration of abdominal terga VIII to X (fig. 98), bright red scapus dorsally (pale green in *P. ruboligata*; fig. 102), longer black apical end of the femora, larger and more visible black coloration covering episternum I and epimerum I (only epimerum I in *P. ruboligata*), reddish apex of the tegmina (blackish in *P. ruboligata*), almost entirely fused abdominal tergum and sternum VIII (suture well visible in *P. ruboligata*) and lack of a terminal hook of the vomer. The female can be distinguished from that of *P. ruboligata* in its shorter body, two yellowish longitudinal dorsal streaks that run from the mesonotum to the end of the abdomen (only visible in live specimens), lack of bright red in the lower portion of anterolateral surface and inner anterolateral portion of profemora, and the reddish scapus. Females of both species however share the longitudinal black line along the upper margin of epimerum I, which is very thin in *P. ruboligata* but thicker and about half the height of the epimerum in *P. margaritae*. Eggs are also very similar to those of *P. ruboligata* but in *P. margaritae* the raised network of ridges of the capsule is more fine-meshed, the raised rim that surrounds the capitulum is irregular and there is a slight opercular angle (no opercular angle in *P. ruboligata*). The close relationship with *P. ruboligata* is well supported by both morphology and molecular data (fig. 97).

**Description of the female.** – Small for the genus (body length 55.2–56.7 mm; tab. VIII, fig. 69–72, 84 *in vivo*). General shape slender. Surface of body smooth. Apterous.

**Colour** of body light green dorsally with two longitudinal yellowish streaks from mesonotum to the end of abdomen and pale green to pale cream ventrally with a blackish streak from mesosternum to abdominal sternum VII (all yellow streaks only visible in live specimens). Epimerum I with a longitudinal black line along upper margin. Legs light green; joint of femora and tibiae reddish; tarsi and apical part of carinae of femora and tibiae more or less black. Scapus reddish; antennae light green dorsally and black ventrally, from pedicellus to their apex. Cerci light brown, more or less black interiorly.

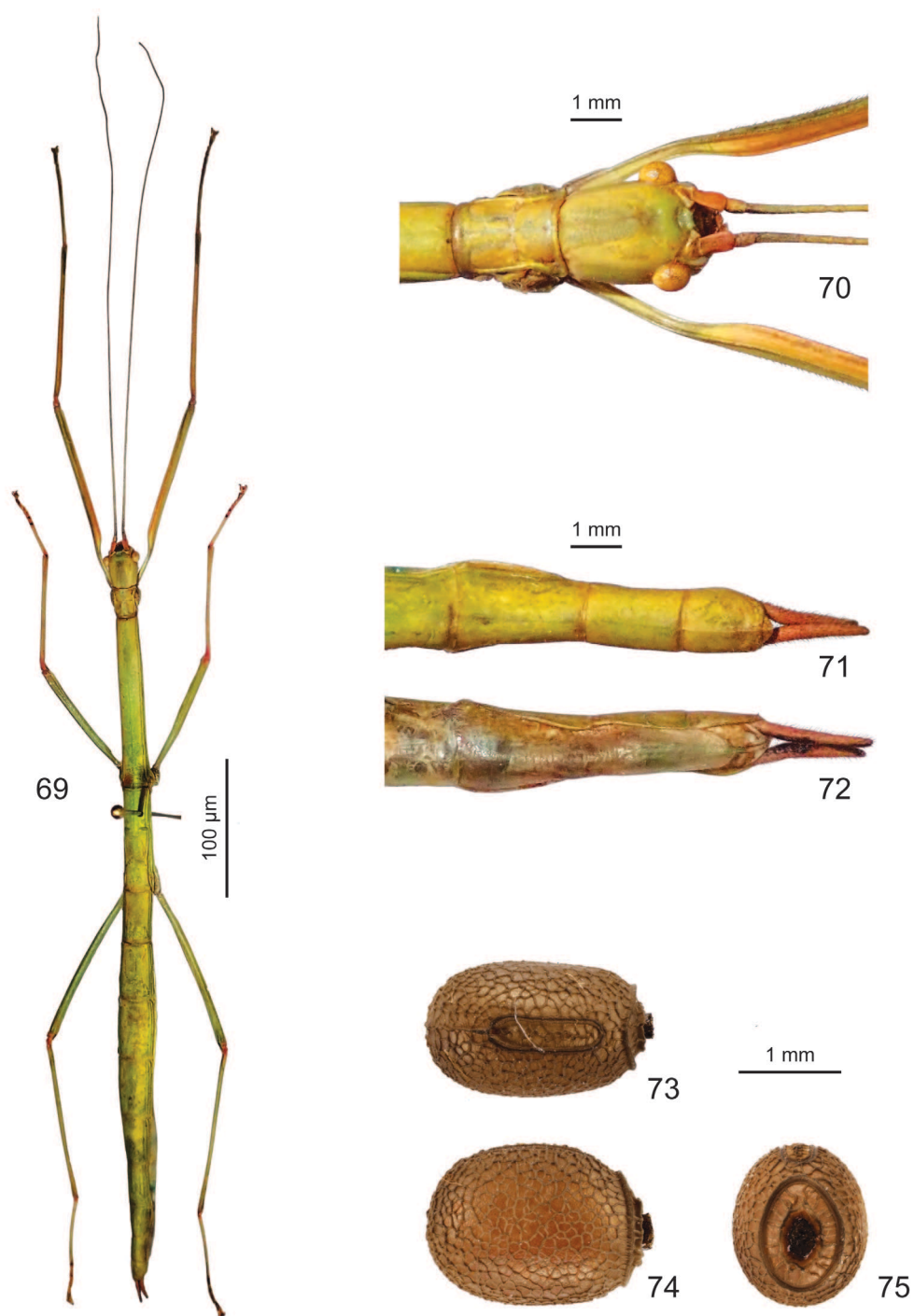
**Head** smooth and roundly rectangular; about 1.5–1.6× as long as wide, almost flat. Eyes circular and prominent. Antennae exceeding extremity of the anterior legs and reaching posterior part of abdominal segment V or the anterior part of VI; pedicellus about 2/3 the length of scapus.

**Thorax.** Pronotum shorter and narrower than head, about 1.4× as long as wide; transverse median sulcus distinct, slightly curved, noticeably displaced towards the anterior and expanding over entire width of segment. Mesothorax 2.3–2.6× as long as head and pronotum combined, 1.5–1.7× as long as metanotum and median segment combined, almost uniform in width but slightly narrowed toward the anterior and slightly broader toward the posterior.

**Table VIII.** – Measurements of adult females and males of *Phantasca margaritae* [mm].

	♀, HT [MNHN]	♀, PT [MNHN]	♂, PT [MNHN]	♂, PT [MNHN]
<b>Body</b>	55.2	56.7	47.3	50.1
<b>Antennae</b>	40.2	42.8	48.7	52.3
<b>Head</b>	2.7	3.3	2.3	2.5
<b>Pronotum</b>	2.1	2.5	1.5	1.5
<b>Mesonotum</b>	12.4	13.2	10.3	10.1
<b>Metanotum (including median segment)</b>	7.9	7.7	8.5	8.2
<b>Tegmina</b>	-	-	3.3	3.1
<b>Alae</b>	-	-	22.5	22.9
<b>Profemora</b>	14.0	14.5	16.5	16.5
<b>Mesofemora</b>	9.9	10.1	11.7	11.5
<b>Metafemora</b>	13.1	12.2	15.1	-
<b>Protibiae</b>	12.5	13.0	16.2	17.3
<b>Mesotibiae</b>	9.1	9.1	10.9	11.2
<b>Metatibiae</b>	12.8	14.0	16.0	-





**Fig. 69-75.** – *Phantasca margaritae* n. sp. – 69-72, ♀ holotype: 69, Habitus, dorsal view; 70, anterior part, dorsal view; 71-72, apex of abdomen (71, dorsal view; 72, ventral view). – 73-75, Egg: 73, dorsal view; 74, lateral view; 75, apical view of operculum.

*Legs.* All fairly long and slender. Profemora longer than mesothorax and longer than all other femora. Probasitarsus about  $2\times$  longer than remaining tarsomeres combined, mesobasitarsus as long as remaining tarsomeres combined, and metabasitarsus about  $1.5\times$  longer than remaining tarsomeres combined.

*Abdomen.* Median segment  $1.5\times$  as long as metanotum and gently constricted medially. Segments II to IV increasing in length and width, IV as long and as wide as V and the longest and widest, VI to X decreasing in length, X the shortest. Praeopercular organ indistinct. Anal segment sub-rectangular in dorsal aspect, slightly longer than wide and the posterior margin with a very shallow median indentation. Epiproct projecting over anal segment, roundly triangular. Gonapophyses VIII slender and slightly exceeding the apex of the subgenital plate. Cerci very long, slender, rounded in cross section and very slightly curved, narrowing toward the apex; considerably longer than anal segment. Subgenital plate elongated and lanceolate, constricted in its middle, with an obtuse apex which does not reach the anal segment apex.

**Description of the male.** – Small for the genus (body length 47.3–50.1 mm; tab. VIII, fig. 76–83, 85 *in vivo*), slender with body surface smooth. Winged.

*Colour* of body light green dorsally. Pro- and mesosternum and ventral surface of abdomen pale green to brown; metasternum brown to cream; episternum I and epimerum I with a black longitudinal streak. Tegmina and alae of same colour as body, with all major veins mid to dull green; apex of tegmina reddish, apex and interobasal portion of costal region of alae black. Anal fan of alae transparent but the apical portion with a slight brownish hue. Abdominal tergum VIII with a bold black longitudinal marking antero-medially narrowing toward posterior and two diverging black stripes post-laterally; IX with a bold black anteromedian marking slightly narrowing toward posterior. Cerci red. Antennae pale green to greyish dorsally and brown ventrally with ventral surface of the pedicellus and antennomere III black; scapus bright red and black ventro-apically; pedicellus and antennomere III dull grey. All coxae, apex of all femora and base of all tibiae and tarsomeres bright red. Pre-apical portion of all femora as well as apex of all tibiae and all tarsomeres black. All femora and tibiae occasionally with a few weakly defined black spots ventrally.

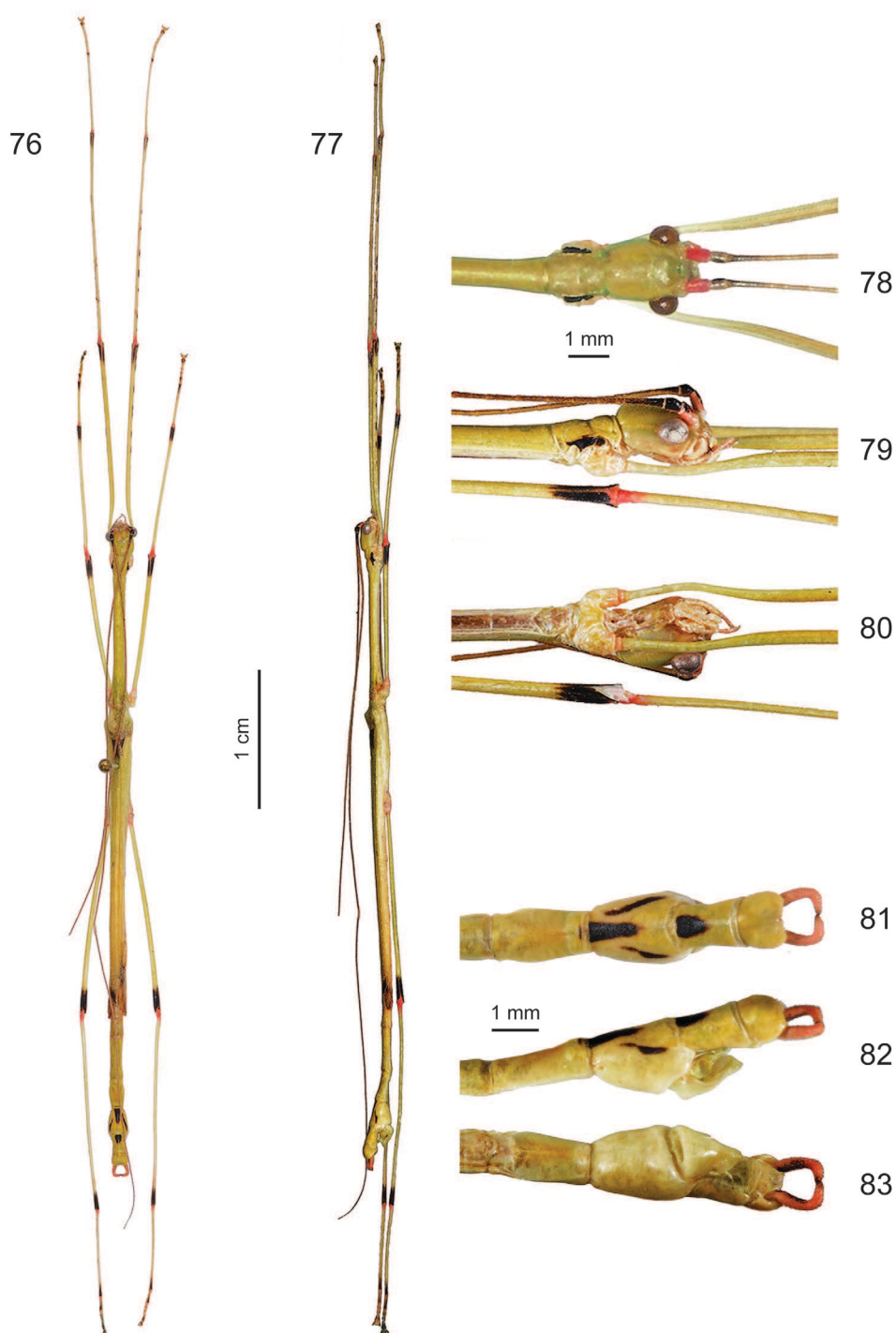
*Head* oval, sub-globose,  $1.2\text{--}1.3\times$  longer than wide and with the vertex gently convex; broadest at the eyes. Vertex anteriorly with a pair of very shallow swellings between the eyes. Eyes large, circular and projecting hemispherically. Antennae slightly longer than body; scapus flattened, slightly narrowed basally, about  $1.5\times$  longer than wide; pedicellus almost cylindrical, slightly narrower basally.

*Thorax.* Pronotum considerably shorter and narrower than head; median sulcus distinct and slightly displaced towards the anterior, expanding over entire width of segment; longitudinal sulcus less visible and not reaching the anterior and posterior extremities of segment. Mesonotum  $2.3$  to  $2.7\times$  longer than head and pronotum combined. Metanotum including median segment about  $0.8\times$  the length of mesonotum. Tegmina gradually narrowed towards the base, with the apical portion truncated. Alae reaching about halfway along abdominal tergum V.

*Legs.* All long and slender. Profemora longer than all other femora and longer than head, pronotum and mesonotum combined. Metatibiae projecting considerably beyond the apex of abdomen. Pro- and metabasitarsi more than  $2\times$  longer than the remaining tarsomeres combined.

*Abdomen* longer than head, thorax and median segment combined. Median segment about  $2.5\times$  longer than metanotum. Terga II to IV very slightly increasing in length; tergum V shorter than II; terga V to X decreasing in length, X the shortest. Segment VI narrowed medially. Tergum VII narrowed pre-medially; VIII strongly inflated and considerably broader than all other segments; fused with sternum VIII and without any visible suture. Anal segment slightly wider than long, broader than IX, widened towards the posterior and the posterior margin with a shallow median and the outer lateral portions obtusely rounded. Poculum small with the lateral margins strongly excavated, considerably narrower laterally in the apical portion and with an obtusely triangular apex. Vomer very small with a rounded apex. Cerci long and hook-shaped, angled in-ward by about  $90^\circ$ , longer than anal segment and considerably projecting beyond abdominal apex.

**Description of the egg.** – Small and ovoid (tab. IX, fig. 73–75), about  $1.2\times$  as long as high and  $1.5\times$  as long as wide. Dorsal surface slightly more convex than ventral surface, polar area rounded. Capsule covered by an irregular and dense network of slightly raised ridges; the spaces in between almost smooth



**Fig 76-83.** – *Phantasca margaritae* n. sp., ♂. – 76-77, Habitus: 76, dorsal view; 77, lateral view. – 78-80, Anterior part: 78, dorsal view; 79, lateral view; 80, ventral view. – 81-83, Apex of abdomen: 81, dorsal view; 82, lateral view; 83, ventral view.

and slightly glossy. Micropylar plate elongate and almost parallel-sided, displaced towards the anterior pole; about half the length of the capsule; outer margin protruded, interior portion with a similar network as the surface of the capsule; dorsal and ventral extremities rounded. Micropylar cup small, hardly visible, bowl-shaped. Median line visible and not reaching polar pole. Operculum slightly convex, oval and narrowed

Table IX. – Measurements of the egg of *Phantasca margaritae* [mm].

Capsule total length (incl. operculum)	Capsule length	Capsule height	Capsule width	Operculum small diameter	Operculum large diameter	Micropylar plate length
2.25	2.20	1.85	1.50	0.90	1.30	1.10

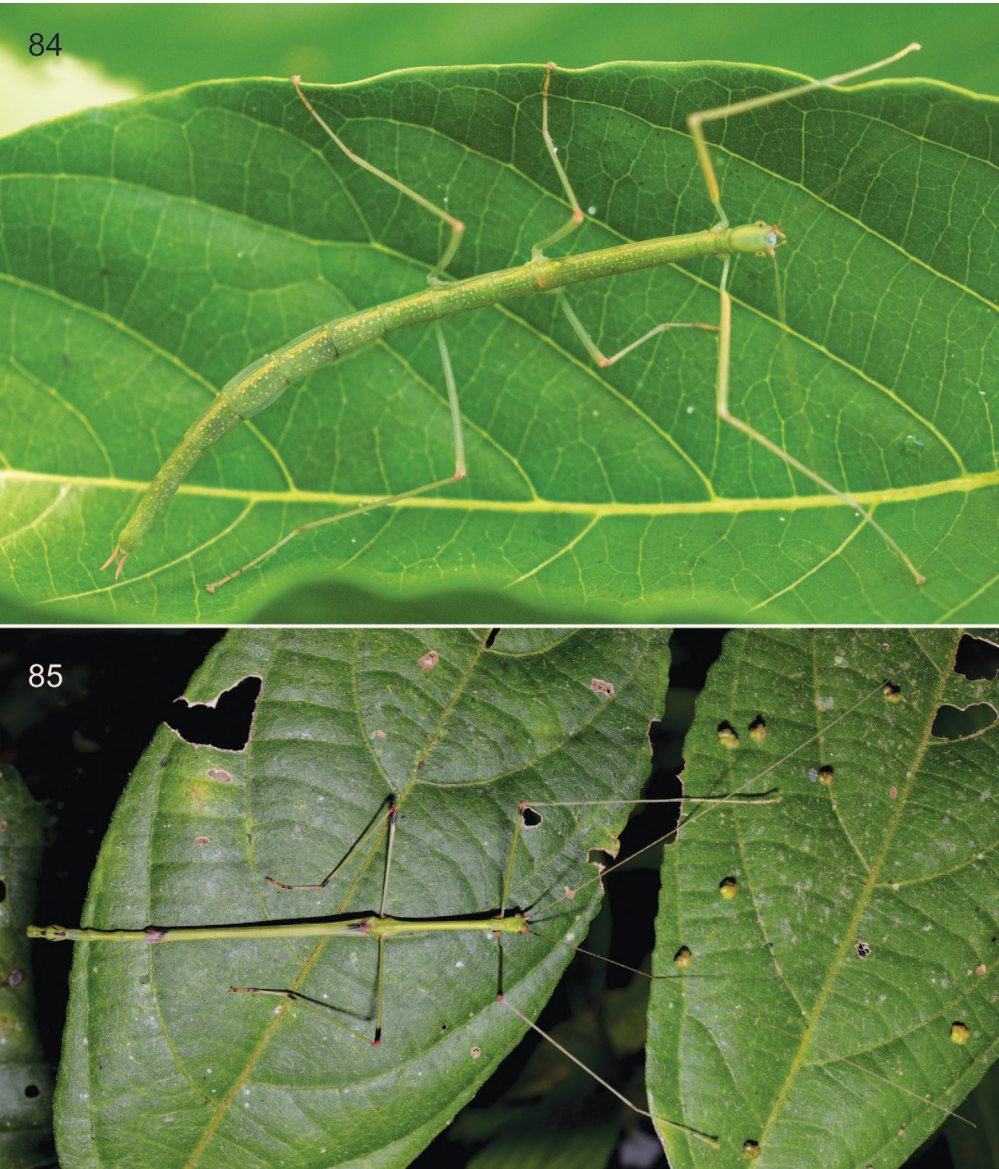


Fig. 84-85. – *Phantasca margaritae* n. sp., in vivo. – 84, ♀ (photography Vincent Guillemot). – 85, ♂.



towards the dorsal surface; capitulum small and forming an open and raised network, surrounded by an oval but irregular raised rim with several radially directed ridges. General colour light ochraceous brown, ridges slightly darker; capitulum dark brown.

**Etymology.** – This pretty new species is dedicated to Margaux Bellanger, daughter of the first author.

**Comments.** – So far only known from French Guiana with specimens collected in Saül and Roura (Montagne des Chevaux) and males observed by the first author in Roura (Réserve Naturelle Trésor). One of the paratypes males has been collected by the ASPER team while their inventory of Phasmatodea in Saül for the “Parc Amazonien de Guyane” and was referred to as *Phantasca* sp. III by JOURDAN *et al.* (2014: 489).

***Phantasca ruboligata*** Hennemann, Conle, Bellanger, Lelong & Jourdan, 2018 (fig. 86-95)

**Type material.** – Holotype: ♂, Guyane, Montagne de Kaw, 5-12.VIII.1992, Roubaud, Auvray, Rarchaert rec. (MNHN).

Paratypes (15 ♂, 7 ♀, 3 eggs): 1 ♂, Guyane, Montagne de Kaw, 5-12.VIII.1992, Roubaud, Auvray, Rarchaert rec. (MNHN); 1 ♂, 27.VII, A7 S1 N12, P.E. Roubaud det. (MNHN); 1 ♀, no data, Roubaud, Auvray, Rarchaert rec. (MNHN); 1 ♀, GUY15-098, 9.VIII.2015, Guyane française, Route de Roura, N4°41.747' W52°18.339, rec. T. Jourdan, ASPER (ASPER-PL); 1 ♀, GUY15-097, *idem* (ASPER-PL); 1 ♂, GUYKAW16-023, Guyane fr. – route de Kaw, Camp Caïman – PK28 depuis Roura, N4°34'11.7"; W52°12'41.8", 11.XI.2016, rec. P. Lelong & Y. Bellanger (MNHN); 1 ♂, GUYKAW16-024, *idem* (ASPER-PL); 1 ♂, GUYKAW16-023, *idem*, 12.XI.2016 (ASPER-PL); 1 ♀, GUYKAW16-057, Guyane fr. – route de Kaw, Camp Caïman – PK27 depuis Roura, N4°34'13.1"; W52°12'53.9", 13.XI.2016, rec. P. Lelong & Y. Bellanger (MNHN); 1 ♀, GUYKAW16-056, *idem* (ASPER-PL); 1 ♂, Französisch Guyana, Commune de Roura, Montagne des Chevaux, RN2 PK22, 4°44'56"N – 52°26'28"W, alt. 75 m, SEAG, leg. Stéphane Brûlé, 19.VII.2014, Lichtfang (OC-0333-2); 1 ♂, *idem*, 20.I.2013 (OC-0333-3); 1 ♂, *idem*, 29.I.2012 (OC-0333-12); 1 ♂, *idem*, 23.IV.2012 (OC-0333-13); 1 ♂, *idem*, 7.II.2015 (OC-0333-25); 1 ♂, *idem*, 12.II.2015, Lichtfang, Gen 0167 (OC-0333-20); 1 ♂, Französisch Guyana, Commune de Saül, Aussichtspunkt Belvedere de Saül, 3°37'22"N – 53°12'57"W, 326 m, SEAG, leg. Stéphane Brûlé, 7.III.2011 (OC-0333-9); 3 eggs, Französisch Guyana, Route de Roura, N4°41.747' W52°18.339, leg. T. Jourdan, 9.VIII.2015 (FH-0947-E1); 3 ♂, 2 ♀, 10 eggs, ex Zucht F. Hennemann 2017, Herkunft: Französisch Guayana, Route de Roura, N4°41.747' W52°18.339, leg. T. Jourdan, 9.VIII.2015 (FH 0947-1–0947-4, E2).

**New material examined** (9 ♂, 5 ♀). – 1 ♂, GUY19-028, 9.XI.2019, Guyane fr. – Piste de St-Elie, prox. Carbet, N5°17'32.1"; W53°3'8.6", rec. Toni Jourdan, Marine Perrier, Nicolas Hausherr & Emmanuelle Loeb; BOLD GFPHASM19-043 (INRAE); 2 ♂, GUY17-024 & -25, 27.II.2017, Guyane fr. – Route de Kaw, N4°39'50.2"; W52°18'15.6", rec. Toni Jourdan; BOLD GFPHASM19-003 & -004 (INRAE); 1 ♂, Guyane fr. – Roura, Elevage F1 Y. Bellanger, 28.VIII.2016 (ASPER-YB); 2 ♂, Guyane fr. – Roura, Elevage F2 Y. Bellanger, VII.2017 et 23.X.2017; 3 ♀, *idem*, 23.X.2017, 28.XI.2017 et 13.XII.2017; 3 ♂, Guyane fr. – Roura, Elevage Y. Bellanger, 10.VIII.2018, 29.X.2018 et VIII.2018; 2 ♀, *idem*, 29.X.2018 et 11.II.2019.

**Diagnosis.** – The male of *Phantasca ruboligata* differs from all others species of the genus by the long and hook-like cerci, and an almost entirely light green body (head included); these characters are only shared with *P. margaritae*. From this latter species however, male of *P. ruboligata* differs by the dorsal markings of abdominal terga VIII to X (fig. 91), the pale green scapus dorsally (bright red in *P. margaritae*; fig. 102), the shorter and darker black coloration of the apical surface of femora, the shorter and thinner black coloration covering only epimerum I (epimerum I and episternum I in *P. margaritae*) and in the blackish apex of the tegmina (reddish in *P. margaritae*). Female is similar to that of *P. nigrolineata* Hennemann *et al.*, 2018 but differs by the stockier body and legs, bright red interior surface of the profemora (plain green in *P. nigrolineata*), longer median segment and longer, apically acutely pointed cerci, which are decidedly longer

than the anal segment (blunt apically and at best equal in length to the anal segment in *P. nigro-lineata*). From the female of *Phantasca margaritae* it differs by the longer body, the bright red interior surface of the profemora (plain green in *P. margaritae*), the green scapus (reddish in *P. margaritae*) and the much thinner black line along the upper part of epimerum I. From the close *P. arlequina*, the male of *P. ruboligata* differs in the hook-like cerci (slightly incurved in *P. arlequina*; fig. 98), in the entirely greenish sternum VII (with two black dots anteriorly and one black spot posteriorly in *P. arlequina*), and in lacking any drawing on sternum VIII (with a medio-longitudinal black line in *P. arlequina*).

**Redescription of the male.** – Small for the genus (tab. X, fig. 86-95), slender with body surface smooth. Winged.

**Colour** characteristic, plain pale to mid green, sometimes with a yellowish hue. Head, with a faint mid to dull green postocular streak along genae and lateral margins of mesonotum somewhat darker green than rest of body. Eyes beige brownish. Scapus, pedicellus pale green dorsally and black ventrally, antennae pale green. Prosternum as well as ventral side of abdomen pale green to brown; mesosternum dull black, metasternum brown to cream; epimerum I with a black streak. Apex of tegmina dull blackish, apex and intero-basal portion of costal region of alae blackish. Anal fan of alae transparent, with only the apical portion slightly greyish. Abdominal sterna VI with a pair of faded, black markings at the apical portion. Abdominal tergum VII with a thin and wave-shaped line in the apical portion. VIII with a black longitudinal linear marking with irregular edges antero-medially; from the anterior margin until just over half of the segment, two further arcuate black and thin stripes post-laterally. IX with a black anteromedian linear marking with irregular edges, that extends up to two-thirds of the segment. Cerci greenish on the basal portion and beige yellowish to orange on the apical portion. Apical part of coxae as well as trochanter of all legs pinkish red; apex of all femora and base of all tibiae and tarsomeres bright red. Pre-apical portion of all femora as well as apex of all tibiae and all tarsomeres black. All femora and tibiae occasionally with a few weakly defined black spots ventrally. Basal portion of ventral surface of profemora with a thin, slightly pinkish line.

**Head.** Oval, sub-globose, with the vertex gently convex and about 1.2× as long as wide; broadest at the eyes. Vertex anteriorly with a pair of shallow humps between the eyes. Eyes large, circular, projecting hemispherically and their length contained about 1.5× in that of genae. Antennae filiform and long, strongly projecting beyond anterior legs. Scapus somewhat narrowed basally and almost 1.5× as long as wide, pedicellus sub-globose and antennomere III almost 2× as long as pedicellus.

**Table X.** – Measurements of the holotype of *Phantasca ruboligata* Hennemann *et al.* [mm]. (Measurement of the head of holotype not provided in the original description).

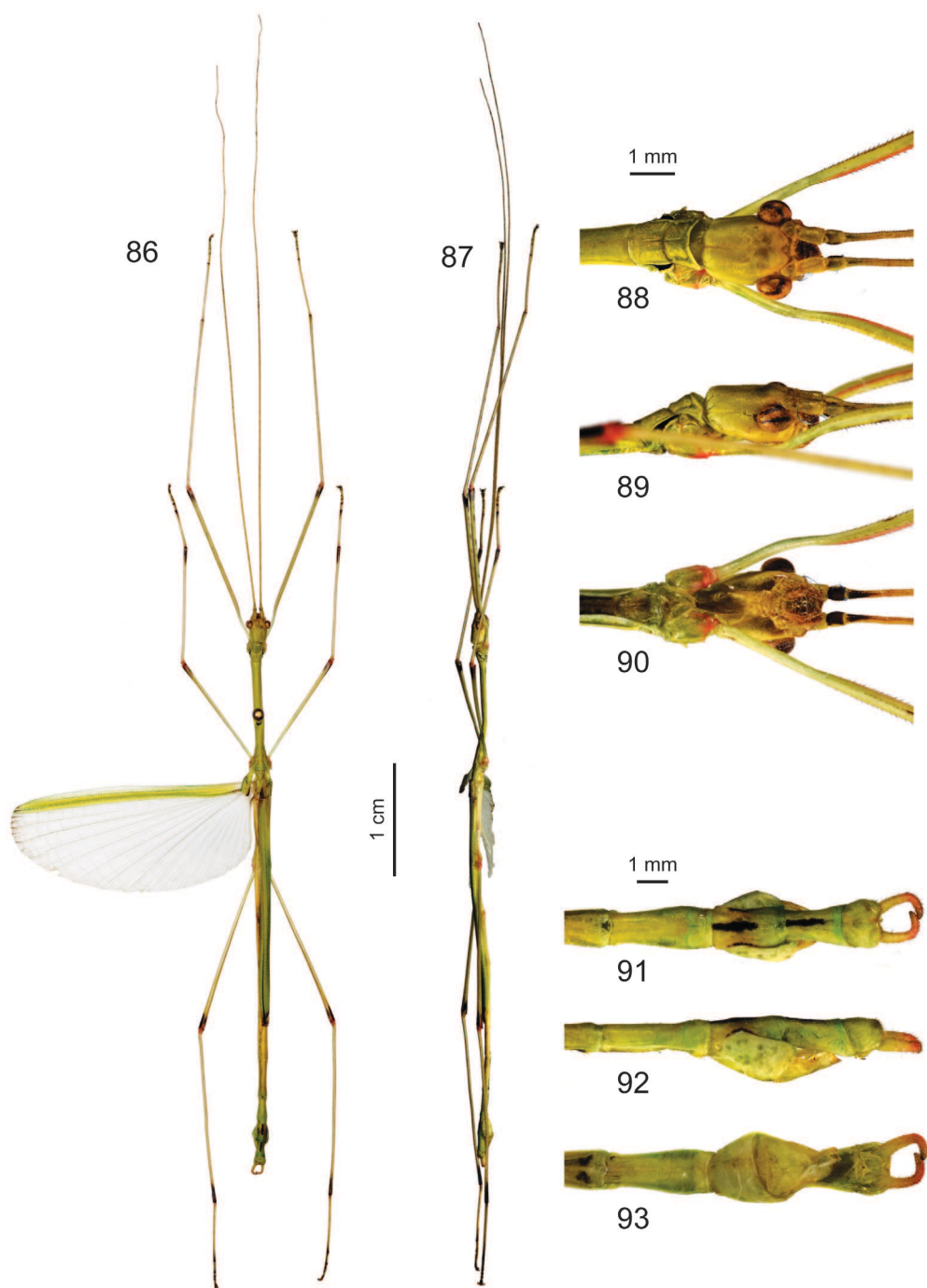
	♂, HT
<b>Body</b>	49.8
<b>Antennae</b>	ca 57.0
<b>Head</b>	-
<b>Pronotum</b>	2.3
<b>Mesonotum</b>	9.8
<b>Metanotum</b>	3.2
<b>Median segment</b>	5.5
<b>Tegmina</b>	3.2
<b>Alae</b>	21.9
<b>Profemora</b>	16.4
<b>Mesofemora</b>	11.5
<b>Metafemora</b>	17.1
<b>Protibiae</b>	18.0
<b>Mesotibiae</b>	11.6
<b>Metatibiae</b>	16.8

**Thorax.** Pronotum considerably shorter and narrower than head, the transverse median sulcus somewhat displaced towards the anterior, slightly arcuate, fairly distinct and expanding over entire width of segment. Mesothorax more than 2.4× as long as head and pronotum combined. Tegmina gradually narrowed towards the base, with the apical portion roundly spatulate and the central protuberance small, moderately developed and bright green. Alae slightly exceeding the anterior margin of the tergum V.

**Legs.** All long and slender. Profemora a little longer than head, pro- and mesothorax combined, mesofemora somewhat longer than mesothorax and metatibiae, projecting considerably beyond apex of abdomen. Pro- and metabasitarsi more than 2× as long as the remaining tarsomeres combined; mesobasitarsus only about 1.5× as long as remaining tarsomeres combined.

**Abdomen.** Segments II-IV roughly equal in length and about 5× as long as wide; V-VII gradually decreasing in length, with VII only about half the length of II-IV; VII narrowed in anterior portion and slightly deflexed and rounded in posterior





**Fig 86-93.** – *Phantasca ruboligata* Hennemann *et al.*, ♂. – **86-87**, Habitus: **86**, dorsal view; **87**, lateral view. – **88-90**, Anterior part: **88**, dorsal view; **89**, lateral view; **90**, ventral view. – **91-93**, Apex of abdomen: **91**, dorsal view; **92**, lateral view; **93**, ventral view.

half. Tergum VIII considerably wider than all preceding terga and slightly deflexed medially; weakly separated from sternum VIII by a narrow black stripe. Tergum IX slightly shorter and narrower than VIII and gradually widening in posterior half. Anal segment slightly shorter than wide; posterior margin with a shallow indentation medially and the outer lateral portions obtusely rounded. Vomer weakly developed, with only a very small triangular terminal hook. Poculum bowl-shaped, overlapping the posterior lateral margins of tergum VIII, up-curving sinistrally. Cerci long, pubescent, hook-shaped and somewhat longer than anal segment, projecting considerably beyond apex of abdomen.



**Fig. 94.** – *Phantasca rubiligata* Hennemann *et al.*, habitus of the holotype (MNHN).

**Comments.** – While describing *Phantasca rubiligata*, the authors did not have at hand the additional material now available. The male of this species is very close to that of *P. margaritae* (see diagnosis above) and the discovery of this latter has shown that several males of the paratype series of *P. rubiligata* actually are *P. margaritae*. These males are here added to the paratype series of *P. margaritae* (see above). Since the description and illustration of the male of *P. rubiligata* were based on specimens of both species it is above redescribed and the holotype male is illustrated (fig. 94).

Moreover, scrutiny has shown that four specimens of the paratypes series of *P. rubiligata* belong to others species.

– The male labelled “♂, Französisch Guyane, Commune de Roura, Montagne des Chevaux, RN2 PK22, 4°44’56’’N - 52°26’28’’W, alt. 75 m, SEAG, leg. Stéphane Brûlé 14.I.2012 (OC-0333-10)” is *P. adiposa*.

– The female labelled “♀, Französisch Guyane, Commune de Roura, Montagne des Chevaux, RN2 PK22, 4°44’56’’N - 52°26’28’’W, alt. 75 m, SEAG, leg. Stéphane Brûlé 15.VIII.2014 (OC-0333-18)” most probably is a penultimate instar female *P. guianensis* (sub-adult female).

– From the two males in the collection of MNHN and labelled “♂, 27.VII, A7 S1 N12, P.E. Roubaud det (MNHN)”, one is a true *P. rubiligata* listed above (fig. 95) but the other (fig. 96) is *P. arlequina* and is here selected as a paratype of the latter.

– The male labelled “♂, Guyane, Montagne de Kaw, 5-12 VIII 92, PK39 A5, Roubaud, Auvray, Rarchaert rec. (MNHN)” is *P. arlequina* and is included in its paratypes series.



**Fig. 95-96.** – *Phantasca* spp., habitus of male paratypes (MNHN) with the same labels. – 95, *P. ruboligata* Hennemann et al. – 96, *P. arlequina* n. sp.

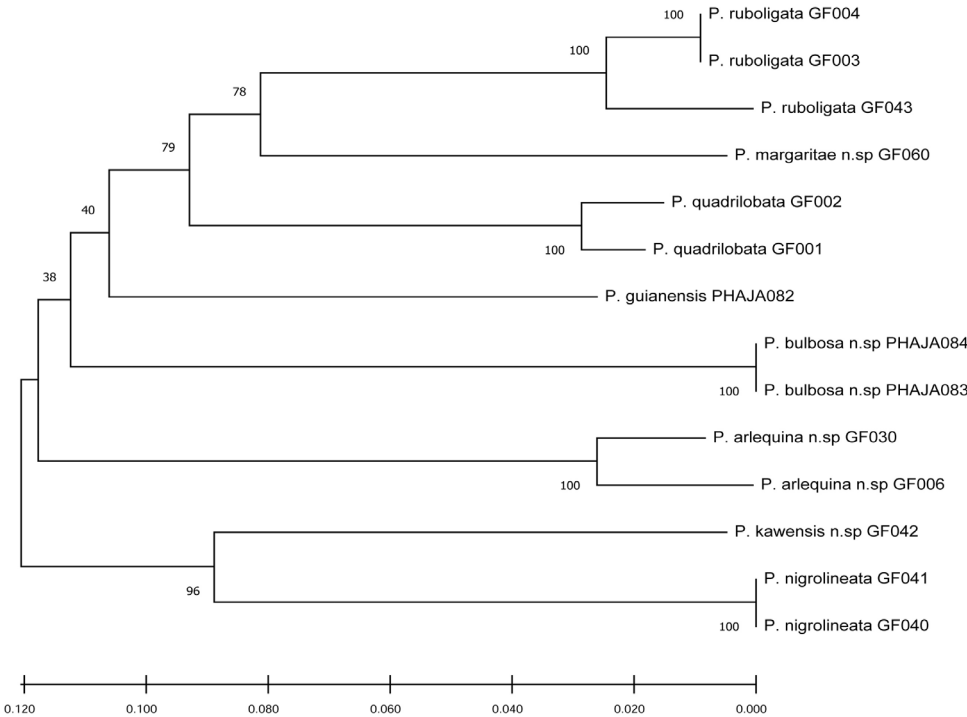
GENETIC DISTANCE ANALYSIS

Fourteen specimens from eight species have been successfully sequenced for COI gene (tab. XI): *Phantasca ruboligata* (3), *P. margaritae* (1), *P. quadrilobata* (2), *P. guianensis* (1), *P. arlequina* (2), *P. nigrolineata* (2), *P. kawensis* (1) and *P. bulbosa* (2). The genetic distance tree (fig. 97) shows the distances between the sequenced specimens of these species.

Between 15 and 24%, the range of interspecific distances of *Phantasca* appears to be very high (table XII). Intraspecific divergence was found in *P. ruboligata* from specimens from

**Table XI.** – List of barcoded specimens of *Phantasca* from this study (in alphabetical order).

Species	BOLD number	Sex and collection number	Deposit	GenBank accession number
<i>P. arlequina</i>	GFPHASM19-030	♀, MNHN-EO-PHAS1122 (PT)	MNHN	ON258606
<i>P. arlequina</i>	GFPHASM19-006	♂, GUY17-026 (HT)	INRAE	ON258613
<i>P. bulbosa</i>	WG1PHAJA20-083	♀, no collection number	ASPER-YB	ON258605
<i>P. bulbosa</i>	WG1PHAJA20-084	♂, no collection number	ASPER-YB	ON258604
<i>P. guianensis</i>	WG1PHAJA20-082	♀, no collection number	ASPER-YB	ON258612
<i>P. kawensis</i>	GFPHASM19-042	♂, GUY19-021 (PT)	INRAE	ON258609
<i>P. margaritae</i>	GFPHASM19-060	♀, no collection number (PT)	MNHN	ON258602
<i>P. nigrolineata</i>	GFPHASM19-040	♂, GUY19-005	INRAE	ON258601
<i>P. nigrolineata</i>	GFPHASM19-041	♂, GUY19-006	INRAE	ON258608
<i>P. quadrilobata</i>	GFPHASM19-001	♂, GUY17-041	INRAE	ON258611
<i>P. quadrilobata</i>	GFPHASM19-002	♀, GUY17-020	INRAE	ON258607
<i>P. ruboligata</i>	GFPHASM19-043	♂, GUY19-028	INRAE	ON258600
<i>P. ruboligata</i>	GFPHASM19-004	♂, GUY17-024	INRAE	ON258603
<i>P. ruboligata</i>	GFPHASM19-003	♂, GUY17-025	INRAE	ON258610



**Fig. 97.** – Neighbour joining tree of *Phantasca* spp. from French Guiana, based on COI genes.

Table XII. – Divergence matrix.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. <i>P. margaritae</i> GFPHASM19-060													
2. <i>P. arlequina</i> GFPHASM19-030	0,225861												
3. <i>P. arlequina</i> GFPHASM19-006	0,237066	0,043179											
4. <i>P. bulbosa</i> WG1PHAJA20-084	0,218972	0,230261	0,234426										
5. <i>P. bulbosa</i> WG1PHAJA20-083	0,218972	0,230261	0,234426	0,000000									
6. <i>P. guianensis</i> WG1PHAJA20-082	0,191008	0,186897	0,203885	0,196489	0,196489								
7. <i>P. kawensis</i> GFPHASM19-042	0,191756	0,237273	0,245615	0,233423	0,233423	0,234895							
8. <i>P. nigrolineata</i> GFPHASM19-041	0,233572	0,216840	0,235779	0,240599	0,240599	0,212308	0,172536						
9. <i>P. nigrolineata</i> GFPHASM19-040	0,233572	0,216840	0,235779	0,240599	0,240599	0,212308	0,172536	0,000000					
10. <i>P. quadrilobata</i> GFPHASM19-002	0,170744	0,211389	0,235572	0,210832	0,210832	0,170067	0,217126	0,216511	0,216511				
11. <i>P. quadrilobata</i> GFPHASM19-001	0,170508	0,206036	0,229934	0,210530	0,210530	0,163415	0,212020	0,214415	0,214415	0,023823			
12. <i>P. ruboligata</i> GFPHASM19-043	0,149980	0,248201	0,239815	0,228149	0,228149	0,181259	0,234090	0,246028	0,246028	0,158746	0,156327		
13. <i>P. ruboligata</i> GFPHASM19-004	0,155086	0,231241	0,220832	0,216551	0,216551	0,170103	0,215936	0,238084	0,238084	0,160094	0,157679	0,039395	
14. <i>P. ruboligata</i> GFPHASM19-003	0,155086	0,231241	0,220832	0,216551	0,216551	0,170103	0,215936	0,238084	0,238084	0,160094	0,157679	0,039395	0,000000

Kaw Mountains and Saint-Elie (3.9%), and also in specimens of *P. quadrilobata* from Bélizon and Saint-Laurent-du-Maroni (2.4%). High levels of divergence have already been found in several other insect orders, such as Lepidoptera (EFETOV *et al.*, 2019) or Orthoptera (KIM *et al.*, 2020). However, in aspect of the small number of samples used in our preliminary approach, any evaluation of the divergences appears premature at this point and must await more comprehensive sampling of a larger number of species.

The genetic analysis allowed us to demonstrate the parity of the male and female of *P. arlequina*, which due to the strong sexual dimorphism was difficult to argue based on morphology alone. Divergence of 4.3% was found between both specimens, which remains within the limits of the intraspecific sequence variation in the genus, despite geographical distance of both sampled specimens. This information retrieved from molecular data allowed us to describe both sexes of this new species. Both sequenced specimens of *P. arlequina* seem to be very distant to all other species sampled in our approach (> 18%).

Consensus tree demonstrated genetic relative proximity of *P. ruboligata* and *P. margaritae* on one hand, with distances of 14.9 to 15.5% between both species, and between *P. nigrolineata* and *P. kawensis* on the other hand with a divergence of about 17.2 % (table XII). Increasing species samples will allow gaining a better understanding of species relationships in the genus.

#### SPECIES INCLUDED IN THE GENUS AND THEIR KNOWN DISTRIBUTION

<i>Phantasca adiposa</i> Hennemann <i>et al.</i> , 2018	[French Guiana]
<i>Phantasca amabile</i> Hennemann <i>et al.</i> , 2018	[Ecuador]
<i>Phantasca arlequina</i> <b>n. sp.</b>	[French Guiana]
<i>Phantasca bulbosa</i> <b>n. sp.</b>	[French Guiana]



<i>Phantasca femorata</i> Hennemann <i>et al.</i> , 2018	[French Guiana]
<i>Phantasca guianensis</i> Hennemann <i>et al.</i> , 2018	[French Guiana]
<i>Phantasca heteronemia</i> (Günther, 1940)	[Peru]
<i>Phantasca kawensis</i> <b>n. sp.</b>	[French Guiana]
<i>Phantasca margaritae</i> <b>n. sp.</b>	[French Guiana]
<i>Phantasca montana</i> (Redtenbacher, 1908)	[Peru]
<i>Phantasca nigrolineata</i> Hennemann <i>et al.</i> , 2018	[French Guiana]
<i>Phantasca phantasma</i> (Westwood, 1859)	[Brazil]
<i>Phantasca poeciloptera</i> (Günther, 1940)	[Colombia & Peru]
<i>Phantasca puppeia</i> (Westwood, 1859)	[Brazil]
<i>Phantasca quadrilobata</i> (Chopard, 1911)	[French Guiana]
<i>Phantasca ruboligata</i> Hennemann <i>et al.</i> , 2018	[French Guiana]
<i>Phantasca valgius</i> (Westwood, 1859)	[not known]

### KEY TO SPECIES OF *PHANTASCA*

The following key is a modified version of the identification key provided in HENNEMANN *et al.* (2018: 6) to include the four new species described in the present study.

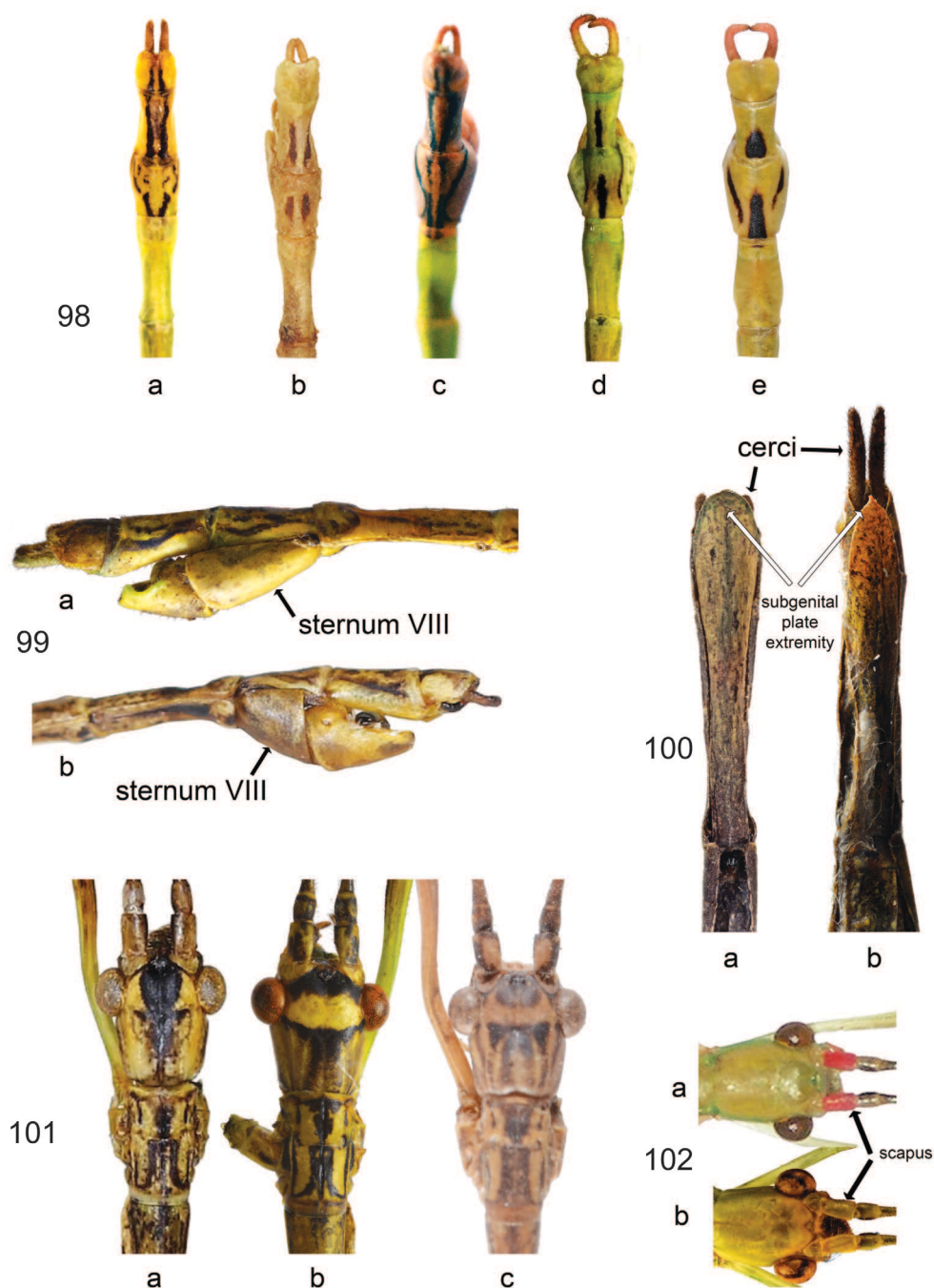
#### *Males*

1. Cerci short, arcuately upcurving and not projecting over posterior margin of anal segment ..... 2
  - Cerci long and projecting distinctly over posterior margin of anal segment ..... 3
2. Apex of cerci blunt; poculum large with posterior margin labiate and angled downward; posterior margin of anal segment with a wide triangular median excavation; head without a distinct pale marking on frons..... *Phantasca phantasma*
  - Apex of cerci acutely pointed; poculum small, cup shaped with the posterior margin obtusely angulate and dorsal directed; posterior margin of anal segment with a small median indentation; head with a large, distinctly pale cream to whitish marking on frons ..... *P. quadrilobata*
3. Cerci angled inward and  $\pm$  hook-shaped ..... 4
  - Cerci straight or at best gently incurving ..... 6
4. More or less plain green or brown insects; anal fan of alae transparent ..... 5
  - Very colourful insects with head, most of legs and cerci red; anal fan of alae dark brown with the basal half bright orange ..... *P. poeciloptera*
5. Very slender, bright green insects; coxae and bases of all tibiae bright red; base of alae with a black marking interiorly; posterior margin of poculum slightly narrowed and gently bi-lobate .... 16
  - Stocky, dull greenish brown; abdominal sterna II-V black; base of alae without a dark marking; posterior margin of poculum widened, obtusely angular and preceded by a conspicuous narrowing ..... *P. heteronemia*
6. Head  $\pm$  unicoloured, without conspicuous dark markings ..... 7
  - Head with distinct and well-defined dark markings or lines ..... 10
7. Very delicate insects; head indistinctly wider than pronotum ..... 8
  - Comparatively stocky; head globose and almost  $2\times$  as wide as pronotum ..... *P. adiposa*
8. All longitudinal veins of tegmina and alae marked with brown ..... *P. valgius*
  - Tegmina and costal region of alae plain green ..... 9
9. Cerci about  $0.75\times$  as long as anal segment; mesonotum  $3\times$  as long as head and pronotum combined; median segment  $2\times$  as long as metanotum ..... *P. puppeia*
  - Cerci at least as long as anal segment; mesonotum  $2.2\times$  as long as head and pronotum combined; median segment  $2.3$  to  $2.4\times$  as long as metanotum ..... *P. bulbosa*
10. Head with a single bold central black marking or longitudinal stripe or streaks ..... 11
  - Head with various dark markings ..... 13

11. Head with postocular longitudinal streaks; colourful insect, head orange to reddish with a light green part behind eyes, tibiae and tarsi reddish ..... *P. arlequina*  
 – Head with black longitudinal stripe extending on pronotum ..... 12
12. Colourful insects, green with bases of tibiae red and apices of femora and tibiae black; costal region of alae with a dark brown longitudinal stripe interiorly; posterior margin of anal segment bi-lobate with a deep and narrow median incision ..... *P. amabile*  
 – Greenish brown insects; no dark longitudinal stripe on costal region of alae; posterior margin of anal segment only with a very slight median indentation ..... *P. nigrolineata*
13. Cerci short and projecting beyond apex of abdomen by no more than half the length of anal segment ... 14  
 – Cerci very long and projecting beyond apex of abdomen by almost the length of anal segment; anal segment flattened and almost parallel-sided, the posterior margin with a wide triangular excavation ..... *P. guianensis*
14. Head elongate, cheeks parallel-sided and with two fine dark longitudinal postocular stripes .....  
 ..... *P. femorata*  
 – Head ovoid, vertex with dark bolds and stripes dorsally ..... 15
15. Costal area of alae light brown marbled with dark brown; tergum VIII and IX of same length ....  
 ..... *P. kawensis*  
 – Costal area of alae green with the interior portions pale brown; tergum IX 1.2× as long as VIII ..  
 ..... *P. montana*
16. Scapus green; apex of tegmina blackish; black coloration only on epimerum I ..... *P. ruboligata*  
 – Scapus reddish; apex of tegmina reddish; black coloration on episternum I and epimerum I .....  
 ..... *P. margaritae*

**Females.** – The females of *Phantasca amabile*, *P. heteronemia* (Günther, 1940), *P. montana* (Redtenbacher, 1906), *P. poeciloptera* (Günther, 1940), *P. puppeia* (Westwood, 1859) and *P. valgius* (Westwood, 1859) are not known.

1. Cerci at best equal in length to anal segment ..... 2  
 – Cerci lanceolate and distinctly longer than anal segment ..... 9
2. Cerci elongate and > 3/4 the length of anal segment; femora and tibiae without lobes ..... 3  
 – Cerci < 2/3 the length of anal segment ..... 5
3. Very slender insects, abdominal segments II-VII at least 2× as long as wide ..... 4  
 – Stocky insects; subgenital plate strongly convex medially, cerci as long as anal segment ..... 10
4. All femora slender; subgenital plate flattened; abdomen fully smooth ..... *Phantasca nigrolineata*  
 – Profemora with an anterodorsal carina raised; subgenital plate strongly convex in posterior two-thirds; abdominal segment VI with a verrucose protuberance ..... *P. bulbosa*
5. Femora or tibiae with lobes; body length > 10 cm ..... 6  
 – Femora and tibiae without lobes; body length < 10 cm; thorax and abdomen smooth dorsally; subgenital plate slightly exceeding anal segment and with rounded apex ..... *P. kawensis*
6. Bases of profemora bright red interiorly ..... *P. guianensis*  
 – Bases of profemora green to beige ..... 7
7. Abdominal tergum VI smooth without swellings ..... *P. phantasma*  
 – Abdominal tergum VI with a pair of swellings ..... 8
8. Lateral margins of abdominal tergum VI not deflexed; femora without lobe ..... *P. quadrilobata*  
 – Lateral margins of abdominal tergum VI roundly deflexed; meso- and metafemora with a rounded sub-apical lobe on both outer ventral carinae and these carinae gently deflexed sub-basally, and smaller sub-basal lobe on both outer ventral carinae ..... *P. femorata*
9. Dorsally plain green; bright red coloration on the lower portion of interior surface and inner portion of ventral surface of profemora; scapus green ..... *P. ruboligata*  
 – Dorsally light green with two longitudinal yellowish streaks from mesonotum to the end of abdomen (only visible in live specimens); profemora green; scapus reddish ..... *P. margaritae*
10. Femora broadened, tergum II-VII indistinctly longer than wide ..... *P. adiposa*  
 – Femora slender, tergum II-VII distinctly longer than wide ..... *P. arlequina*



**Fig. 98-102.** – Comparison of *Phantasca* spp. – **98**, Comparison of the drawings of the three last tergite of males in dorsal view [**a**, *P. bulbosa*; **b**, *P. puppeia* (photography Paul D. Brock, by courtesy of NHMUK); **c**, *P. arlequina*; **d**, *P. ruboligata*; **e**, *P. margaritae*]. – **99**, Comparison of the sternum VIII length (**a**, *P. nigrolineata*; **b**, *P. kawensis*). – **100**, Comparison of the subgenital plates and cerci of females (**a**, *P. kawensis*; **b**, *P. nigrolineata*). – **101**, Comparison of the drawings on the head of the males (**a**, *P. kawensis*; **b**, *P. quadrilobata*; **c**, *P. guianensis*). – **102**, Comparison of the scapus of males (**a**, *P. margaritae*; **b**, *P. ruboligata*).

## CONCLUSION

With four new species described in the present paper, the genus *Phantasca* currently accounts for 17 known species. Ten of these are known from French Guiana. More species of the genus are very likely to be discovered, both in French Guiana and South America in general. For instance, the fourth author is aware of at least two further still undescribed species from Brazil. The present study highlights some difficulties in delineating species within the genus and hints at the importance of collecting additional specimens, carefully ascribing sexes to the right species, especially given the high level of sexual dimorphism in the genus (a case which is best resolved by rearing from eggs collected from wild females) and carefully examine specimens. While this sampling is apparently still too limited for presenting a comprehensive systematization of the genus, these molecular data confirmed the match of a male and a female of the same species that were found independently. It also supported the assignation of morphologically quite similar specimens to distinct species status.

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