Zootaxa 3952 (1): 001–080
www.mapress.com/zootaxa/

Monograph

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3952.1.1
http://zoobank.org/urn:lsid:zoobank.org:pub:44BBD067-D364-40B6-A40B-CF544A8EDBBB

ZOOTAXA

3952

Revision of the frog fly genus *Caiusa* Surcouf, 1920 (Diptera, Calliphoridae), with a note on the identity of *Plinthomyia emimelania* Rondani, 1875

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Magnolia Press
Auckland, New Zealand

Accepted by J. O'Hara: 12 Mar. 2015; published: 30 Apr. 2015

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(*Zootaxa* 3952)

80 pp.; 30 cm.

30 Apr. 2015

ISBN 978-1-77557-685-3 (paperback)

ISBN 978-1-77557-686-0 (Online edition)

FIRST PUBLISHED IN 2015 BY

Magnolia Press

P.O. Box 41-383

Auckland 1346

New Zealand

e-mail: zootaxa@mapress.com

http://www.mapress.com/zootaxa/

ISSN 1175-5326 (Print edition)

ISSN 1175-5334 (Online edition)

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Abstract

The Oriental, Australasian and Oceanian genus *Caiusa* Surcouf, 1920 is revised, species concepts being based on male and female genitalia. A key to males for all known species, and a key to females for all except one are given. All relevant types still in existence have been studied, complete synonymies given and the geographical distribution reconsidered. The eight species included in the genus are: *Caiusa borneoensis* **sp. nov.** (Malaysia, Thailand, Vietnam); *Caiusa coomani* Séguy, 1948 (China, Malaysia, Singapore, Thailand, Vietnam); *Caiusa indica* Surcouf, 1920 (Australia, Cambodia, India, Indonesia, Malaysia, Papua New Guinea, Philippines, Singapore, Solomon Islands, Sri Lanka, Thailand, Vietnam); *Caiusa karrakerae* **sp. nov.** (Malaysia, Thailand); *Caiusa kurahashii* **sp. nov.** (Indonesia, Japan, Philippines); *Caiusa pooae* **sp. nov.** (Thailand); *Caiusa testacea* Senior-White, 1923 (India, Nepal, Sri Lanka) and *Caiusa violacea* Séguy, 1925, **stat. rev.** (Cambodia, China, Laos, Malaysia, Taiwan, Thailand, Vietnam). A lectotype is designated for *Caiusa indica* to fix the interpretation of the name. *Caiusa nigronitens* Senior-White, 1923, **syn. nov.** and *Caiusa surcoufi* Bezzi, 1927, **syn. nov.** are established as junior synonyms of *Caiusa indica*. *Caiusa violacea* is correctly diagnosed and errors in the original description of the female holotype are pointed out. *Caiusa dubiosa* Villeneuve, 1927 is established as a junior synonym of *C. violacea*, **syn. nov**. Seven *Caiusa* species have been reared from the egg mass of various species of frogs. The reproductive mode of the eighth species, i.e., *C. indica*, is unknown. Five species, i.e., *C. borneoensis*, *C. coomani*, *C. karrakerae*, *C. kurahashii* and *C. violacea* have been reared from one or more of the foam nesting frog species *Chiromantis nongkhorensis* (Cochran, 1927), *Polypedates leucomystax* (Gravenhorst, 1927), *Polypedates megacephalus* Hallowell,

1861, *Rhacophorus annamensis* Smith, 1924, *Rhacophorus dulitensis* Boulenger, 1892, *Rhacophorus kio* Ohler & Delorme, 2005 and *Rhacophorus owstoni* (Stejneger, 1907) all belonging in the family Rhacophoridae in Anura. These five *Caiusa* species all have a specialised ovipositor tip, with small spine-like setae on the ST8 and the hypoproct, probably enabling the flies to oviposit on a foam nest with a hardened outer surface. They form a monophyletic group on account of these features of the ovipositor, unique in the Oestroidea. The sixth species, *C. testacea*, has been reared from a frog egg mass, the frog species being unknown. Its ovipositor structure is also unknown. The seventh species, *C. pooae*, has been reared once from the jelly-like egg mass of *Feihyla hansenae* (Cochran, 1927), also in Rhacophoridae. *Caiusa pooae* females do not have spine-like setae on the ovipositor, a fact correlated with the soft outer surface of the jelly-like egg mass on which a *C. pooae* female had oviposited. The extreme rarity of *C. pooae* oviposition on *Feihyla hansenae* egg masses may indicate that this fly perhaps has another, unknown, regular oviposition substrate. *Caiusa pooae* and *C. indica* make up a second monophyletic group within *Caiusa*. *Caiusa indica*, the most common and most widespread species of the genus, has an ovipositor structure similar to *C. pooae*. Its breeding substrate is unknown and it occurs both within and outside the distributional area of Rhacophoridae. Possibly both *C. indica* and *C. pooae* share a regular oviposition substrate that has still to be discovered. The holotype female of *Plinthomyia emimelania* Rondani, 1875 from Sarawak is established as a member of the genus *Bengalia* Robineau-Desvoidy, 1830, thus *Plinthomyia* Rondani, 1875 becomes a junior synonym of *Bengalia* Robineau-Desvoidy, 1830, **syn. nov.** It is removed from the synonymy of *Phumosia* Robineau-Desvoidy, 1830.

Key words: Calliphoridae, *Caiusa*, *Phumosia*, *Plinthomyia*, frog flies, precocious eggs, Anura, Rhacophoridae, *Chiromantis*, *Feihyla*, *Polypedates*, *Rhacophorus*, new species, Oriental Region, Australasian and Oceanian Region

Introduction

The Oriental, Australasian and Oceanian genus *Caiusa* was erected almost a century ago by Surcouf (1920: 52) for two nominal species. One, from southern India, he named *C. indica*. The other, from Australia, he left to Bezzi to name (cf. Bezzi 1927). *Caiusa indica* was based on one male and one female from the Tamil Nadu province. Surcouf distinguished the genus from *Phumosia* Robineau-Desvoidy by the presence of only a single anterior katepisternal seta and much finer vestiture on the gena. He mentioned that the specimens before him had a mesonotum which was shining black at middle ["noir brillant au milieu"], but elsewhere yellowish brown ["jaune brunâtre"] and an abdomen that was yellow at base ["à base jaune"] but apically shining black with metallic reflection ["à apex d'un noir brillant à reflet métallique"].

Senior-White (1923a) described a second species, *C. testacea,* on the basis of several males and females from various parts of Sri Lanka, which had an all testaceous mesonotum and an abdomen concolorous with the thorax, thus also testaceous. This was in contrast to *C. indica* in which the posterior part of the abdomen exhibited varying amounts of black, sometimes shining with a violet tinge. He also mentioned that his new species "is almost certainly the species reared by Mr. Ballard, Government Entomologist, Madras [now Chennai], from the egg masses of a frog. These specimens are now with Major Patton". This was the first time that any species of *Caiusa* was mentioned to have a life cycle associated with frogs. Senior-White *et al.* (1940: 74) were more precise as to the provenance of the specimens, stating that the "Coimbatore specimens were reared from a frog's egg mass".

Senior-White (1923b) also described a third nominal species, *C. nigronitens*, on the basis of a single female from Singapore, having a shining black mesonotum (except for the postpronotal lobe = "humeri"), including the scutellum, and a shining black abdomen (except for the anteriormost parts of T1+2) "with a tinge of bluish".

Séguy (1925) described a fourth nominal species, *C. violacea*, on the basis of a female specimen from Cambodia, having an abdomen with T1–3 "roux [reddish yellow]" and T4–T5 "noirs au fond, à reflets pourprés, bleu ou violets suivant la lumières [with black ground colour, and purple, blue or violet reflections according to direction of light]". Unfortunately Séguy introduced a gross error in his description by giving the number of *post acr* setae as 3–4, the same number as the *post dc* setae. The erroneous description was adopted by all subsequent students of this genus, starting with Senior-White *et al.* (1940), who included *C. violacea* in their key on the basis of the erroneous number of *post acr* setae. Séguy (1946) added a second record of *C. violacea*, also a female, from Laos. *Caiusa violacea* has since remained an uninterpretable name, incorporated in keys following the lead of Senior-White *et al.* (e.g., by Kurahashi 1989a), although never based on examined specimens.

Villeneuve (1927) described a fifth nominal species, *C. dubiosa*, based on a single female from Taiwan. It had a yellow body, "les deux derniers segments abdominaux exceptés: le segment III teinté de noir violacé, le segment IV plus ou moins verdâtre [except for the last two abdominal segments: T4 tainted with purplish black; T5 more or

less greenish]". He was obviously hesitant regarding its generic assignment and attached a question mark after the name of the genus, writing: "*Caiusa* (?) *dubiosa*". On the next page in the same paper he even assigned it to a new subgenus, *Pseudocaiusa*, this time under *Phumosia* Robineau-Desvoidy.

Hennig (1941) listed *C. dubiosa* as a junior synonym of *C. testacea*, on the authority of a letter from Senior-White, and since then no one has reconsidered the status of this nominal species.

Bezzi (1927) described a sixth nominal species, *C. surcoufi*, on the basis of "a single, rather old specimen in the writer's collection from Queensland [Australia]". This specimen had already been seen by Surcouf (1920) who assigned it to *Caiusa* but refrained from describing it as a new species (see above). Surcouf noted that it differed from *C. indica* by having an all yellow thorax and other features. Malloch (1926, 1927) listed further records of *C. surcoufi* from Australia.

Finally, Séguy (1948) described a seventh nominal species, *C. coomani*, on the basis of an unstated number of males from Vietnam, characterised by the mesonotum "avec une bande longitudinale médiane brune n'atteignant pas le scutellum [with a median longitudinal brown band not reaching the scutellum]", whereas in the key, he used the expression "[u]ne bande mésonotale grise bien limitée étendue antérieurement [a well defined grey mesonotal band present anteriorly]".

Zumpt (1954) synonymised *Caiusa* under *Phumosia* Robineau-Desvoidy, an action accepted by many workers on the group, but not all. Chinese workers (Fan 1965, Fan 1992, Fan 1997, Feng *et al*. 1998) kept *Caiusa* as a separate genus.

Keys to *Caiusa* species have been published by Senior-White (1926), Senior-White *et al*. (1940), Séguy (1948), James (1971) and Kurahashi (in numerous faunistic works, usually included in keys to *Phumosia*). All keys are based on external colour features, sometimes also including the number of *pd* setae on the hind tibiae. A few authors have included features of the genitalia. One of them was Senior-White (1923a) who gave illustrations of the male genitalia, republished by Senior-White *et al*. (1940). Unfortunately, they are not easy to interpret, except for the shape of the pregonites in the case of *C. indica*.

Typically, *C. violacea* has usually been keyed out because of the alleged elevated number of *post acr* setae (3–4 pairs opposed to 1 pair in other species), *C. nigronitens* because of a very dark scutellum (as opposed to yellowish). *Caiusa testacea* and *C. indica* have been separated on the colour of the mesonotum, whether all pale testaceous (*C. testacea*) or with dark markings (*C. indica*) (Senior-White *et al*. 1940). Séguy (1948: 147) is the only one to key out *C. testacea* on the basis of an all pale yellowish brown body ["[c]orps uniformément d'un brun jaune pâle"], thus by implication, also a pale yellow abdomen. Senior-White *et al.* (1940) and Kurahashi & Bunchu (2011), when keying out *C. testacea*, usually mention an all pale testaceous mesonotum only, indicating that they included specimens with an all yellow mesonotum in combination with a posteriorly dark abdomen in this taxon. This is evident from the study of numerous specimens Kurahashi has identified. *Caiusa coomani*, allegedly with a well defined greyish median stripe on an otherwise pale mesonotum, is usually the last species to be keyed out. It is not included in the key of Senior-White *et al*. (1940) because it had not been described at the time.

Kurahashi (1989c, see also 2010 and 2014) reported a fly he identified as "*Phumosia coomani* Séguy" from Japan. The specimen has turned out to be misidentified, and the specimen belongs, together with other Japanese material from localities nearby, to a new undescribed species (*C. kurahashii* **sp. nov.**).

During the subsequent years, faunistic treatments and catalogues of various Oriental, Australasian and Oceanian countries have listed these nominal species according to these alleged distinguishing features (e.g., Kurahashi & Bunchu 2011).

Regarding the relationship with frogs, Yorke (1983) reported that egg masses of *Polypedates leucomystax* (Gravenhorst, 1929) in Malaysia were infested by fly larvae. These were identified as "… *Lucilia* sp. (probably *cuprina*) a common calliphorid fly in this region…" (Yorke 1983: 236). This is certainly based on misidentification of *Caiusa* larvae. Unfortunately, the larvae were not reared to the adult stage.

Lin & Lue (2000) pointed to the obligate association of certain frog flies with frog eggs as a key factor for frog embryo mortality. The association with frogs for members of the genus *Caiusa* was studied in great detail by Lue & Lin (2000) and Lin *et al*. (2000) who investigated 803 foam nests of various rhacophorid frogs infested by a single frog fly species in Taiwan. They described the oviposition behaviour and host selection of this fly, which they called "*Caiusa coomani*" and which had infested all the examined foam nests. To my knowledge, theirs is the first use of the term "frogfly" (in a single word) for a species belonging to the genus *Caiusa*. However, these authors used the keys by Fan (1992) for identification (cf. Lue & Lin 2000: 275) and therefore got the name of their flies

wrong. The "*Caiusa coomani*" in Fan's work is a misidentification of *C. violacea* (see below). I conclude that the frog fly they studied was *C. violacea*, the only species of *Caiusa* in Taiwan.

Rognes (2011a) established the identity of the frog fly *C. coomani* Séguy, 1948 by studying the type material, designating a lectotype, describing the male genitalia, and reporting on the identity of the fly which was predatory on the embryos of the Brown Tree frog *Polypedates megacephalus* Hallowell, 1861 in Hong Kong, and which had been reared by Nancy E. Karraker from the foam nests of this frog species.

Karraker (2013) since reported on the predation of the frog embryos by *C. coomani* (as *Phumosia coomani*) in Hong Kong under various conditions of shading of the foam nests.

Subsequently Karraker, with co-workers, reared numerous flies from various rhacophorid frog foam nests in several South East Asian countries (not Hong Kong) during the years 2010–2011, of which I received 37 males and 32 females belonging to five separate species. All the species could be circumscribed unequivocally by reference to male and female genitalia (see Methods below). One of the species (from Malaysia and Singapore) turned out to be *C. coomani*, as defined by the lectotype designated by Rognes (2011a). The four others could not be identified. Hence a full revision of the genus was necessary to accomplish this task.

The aims of the study are as follows:

(1) To diagnose the genus *Caiusa* with reference to male and female genital features and to discuss diagnostic and synapomorphic features of the genus, including its particular biology.
(2) To diagnose all eight known *Caiusa* species with reference to male and (as far as possible) female genitalia.
(3) To establish a valid nomenclature based on the study of all types.
(4) To diagnose and describe four new species, i.e., *C. borneoensis* **sp. nov.**, *C. karrakerae* **sp. nov.**, *C. kurahashii* **sp. nov.** and *C. pooae* **sp. nov.**
(5) To assign the old names *C. violacea* Séguy, 1925 and *C. dubiosa* Villeneuve, 1927, both based on female types, to taxa defined by reference to male genitalia.
(6) To list rhacophorid host species where known.
(7) To reconsider the geographical distribution of the species.

Material and methods

Material. The starting point for this study was material obtained through the rearing of frog flies from the foam nests of various rhacophorid frogs by the herpetologists Nancy E. Karraker and collaborators in China (Hong Kong) (2009, 2010, 2014), China (Yunnan: Xishuangbanna) (2010), Malaysia (Sabah) (2010), Singapore (2011) and Thailand (Sakaerat Environmental Research Station) (2010, 2011, 2014) and Anna B. Vassilieva in Vietnam. Data pertaining to this material are summarised in Tables 1 and 2.

In all cases (except one) only one species was found in each clutch. Since each clutch of reared flies was established as monospecific on the basis of dissected male specimens, females of the same clutch were assigned to the same species as the males. The rearing results made it possible to characterize five *Caiusa* species on the basis of male genitalia and to correctly associate females with males. Subsequently, the ovipositor of all the five reared species was dissected and described.

The frog species involved, listed in Tables 1 and 2, all belong to the anuran family Rhacophoridae. The geographical range of Rhacophoridae is listed by Frost *et al*. (2006) as follows: Tropical sub-Saharan Africa; South India and Sri Lanka; Japan; northeastern India to eastern China south through the Philippines and Greater Sundas; Sulawesi. Distributional maps can be found in Li *et al*. (2011, fig. 1) and Li *et al*. (2013, fig. S1).

The reared calliphorid specimens belong to five species in the genus *Caiusa* Surcouf (*C. borneoensis* **sp. nov.**, *C. coomani*, *C. karrakerae* **sp. nov.**, *C. pooae* **sp. nov.** and *C. violacea*).

It was necessary to use the ovipositor morphology to interpret an old unused name based on a female holotype, i.e., *C. violacea* Séguy, 1925. The holotype was dissected and its ovipositor morphology established. The conspecific and previously dissected male and female specimens of a taxon with the manuscript placeholder name "A" were found to belong to the nominal species *C. violacea* as their ovipositor morphology matched that of the *C. violacea* holotype.

TABLE 1. Material of *Caiusa* reared from frog egg masses by Nancy E. Karraker and co-workers in the years 2009–2014, listed chronologically (in KR).

Code on label	Frog species	Locality	Egg mass collected	Collector	Males	Females	Fly identity	Males dissected	Females dissected	G.pr. slide #	Notes
-	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 19, 2009	N E Karraker	3	3	*C. coomani*	0	0		
SF1	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	2	1	*C. coomani*	1	1	409	
SF3	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	1	2	*C. coomani*	1	0		
SF5	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	2	1	*C. coomani*	1	1		No genital slide, ovipositor in glycerol in vial
SF6	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	0	3	*C. coomani*	-	2	415	Other female with ovipositor in glycerol in vial
SF7	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	1	2	*C. coomani*	1	0		
SF8	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	0	3	*C. coomani*	-	0		
SF12	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	1	1	*C. coomani*	0	0		
OF1	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	1	2	*C. coomani*	0	0		
OF3	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	1	2	*C. coomani*	0	0		
OF4	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	1	2	*C. coomani*	1	1	414	
OF5	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	1	1	*C. coomani*	1	0		
OF6	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	1	2	*C. coomani*	0	0		
OF7	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	2	1	*C. coomani*	1	0		
OF9	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	May 2010	N E Karraker	2	1	*C. coomani*	1	0		
rhan-k-1	*Rhacophorus angulirostris* Ahl, 1927	Mt. Kinabalu, Sabah, Malaysia	June 2010	N E Karraker	9	1	*C. borneoensis* **sp. nov.**	4	1	410	
pole-x-1	*Polypedates leucomystax* (Gravenhorst, 1829)	Xishuangbanna, Yunnan, China	August 18, 2010	W K Fu	3	7	*C. violacea*	2	1	411	
pole-t-1	*Polypedates leucomystax* (Gravenhorst, 1829)	Sakaerat ERS, Thailand	August 20, 2010	N E Karraker	3	2	*C. violacea*	2	0		
pole-t-2	*Polypedates leucomystax* (Gravenhorst, 1829)	Sakaerat ERS, Thailand	August 26, 2010	N E Karraker	3	2	*C. violacea*	2	1	416	
chno-t-1	*Chiromantis nongkhorensis* (Cochran, 1927)	Sakaerat ERS, Thailand	August 27, 2010	N E Karraker	2	3	*C. karrakerae* **sp. nov.**	1	1	408	
chno-t-2	*Chiromantis nongkhorensis* (Cochran, 1927)	Sakaerat ERS, Thailand	August 29, 2010	N E Karraker	3	2	*C. violacea*	2	0		
rhdu-d-1	*Rhacophorus dulitensis* Boulenger, 1892	Danum Valley, Sabah, Malaysia	November 2, 2010	J Sheridan	1	1	*C. karrakerae* **sp. nov.**	1	0		
pole-d-1	*Polypedates leucomystax* (Gravenhorst, 1829)	Danum Valley, Sabah, Malaysia	November 7, 2010	J Sheridan	2	3	*C. coomani*	1	0		

……continued on the next page

TABLE 1. (Continued)

Code on label	Frog species	Locality	Egg mass collected	Collector	Males	Females	Fly identity	Males dissected	Females dissected	G.pr. slide #	Notes
pole-s-1	*Polypedates leucomystax* (Gravenhorst, 1829)	Singapore	May 2011	S Poo	4	6	*C. coomani*	2	0		
rhki-t-2	*Rhacophorus kio* Ohler & Delorme, 2005	Sakaerat ERS, Thailand	August 30, 2011	N E Karraker	3	2	*C. borneoensis* **sp. nov.**	2	1		No genital slide, ovipositor in glycerol in vial
rhki-t-1	*Rhacophorus kio* Ohler & Delorme, 2005	Sakaerat ERS, Thailand	September 5, 2011	N E Karraker	3	2	*C. karrakerae* **sp. nov.**	2	0		
chha-t-1	*Feihyla hansenae* (Cochran, 1927)	Sakaerat ERS, Thailand	October 20, 2011	S Poo	1	2	*C. pooae* **sp. nov.**	1	1	421	
pome-h1	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	July 3, 2014	N E Karraker	10	10	*C. coomani*	0	0		1 undissected male with visible genitalia
pome-h2	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	July 7, 2014	N E Karraker	10	10	*C. coomani*	1	0		
pome-h3	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	July 8, 2014	N E Karraker	10	10	*C. coomani*	1	0		
pome-h4	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	July 9, 2014	N E Karraker	10	10	*C. coomani*	1	0		
pome-h5	*Polypedates megacephalus* Hallowell, 1861	Lamma Island, Hong Kong, China	July 10, 2014	N E Karraker	10	10	*C. coomani*	1	0		
pole-t3	*Polypedates leucomystax* (Gravenhorst, 1829)	Sakaerat ERS, Thailand	August 6, 2014	N E Karraker	19	21	*C. violacea*	7	0		In alcohol, pinned by KR
pole-t4	*Polypedates leucomystax* (Gravenhorst, 1829)	Sakaerat ERS, Thailand	August 7, 2014	N E Karraker	9	10	*C. violacea*	1	0		In alcohol, pinned by KR
pole-t7	*Polypedates leucomystax* (Gravenhorst, 1829)	Sakaerat ERS, Thailand	August 8, 2014	N E Karraker	10	5	*C. violacea* (4) / *C. coomani* (1)	5	0		Mixed infestation,
Sum					144	146		47	11		

TABLE 2. Material of *Caiusa* reared from frog egg masses by Anna B. Vassilieva in the years 2009–2014, listed chronologically (in KR).

Code	Frog species	Locality	Fixed in ethanol	Collector	Males	Females	Fly identity	Males dissected	Females dissected	Notes
-	*Polypedates megacephalus* Hallowell, 1861	Vietnam, Cat Tien National Park	April 2009	Anna B Vassilieva	2	1	*C. violacea*	1	0	Photograph only of female
ABV-00195	*Rhacophorus annamensis* Smith, 1924	Vietnam, Dak Lak province, Krong Bong district, approximate coordinates 12°23'42"N, 108°21'01"E, nearly 1000 m a.s.l.	19 April 2013	Anna B Vassilieva	2	3	*C. borneoensis* **sp. nov.**	2	1	Female all pale, hardly sclerotised; female cerci and epiproct and hypoproct and ST8 sclerotised.
ABV-00669	*Polypedates megacephalus* Hallowell, 1861	Vietnam, Dak Lak province, Krong Bong district, approximate coordinates 12°27'54"N, 108°20'20"E, nearly 700 m a.s.l.	3–4 June 2014	Anna B Vassilieva	1	4	*C. violacea*	1	0	All pale specimens, almost not sclerotised.

Among all the reared clutches only one (pole-t7, 8 August 2014) had been infested by two fly species.

None of the reared specimens were fully sclerotised. This is especially noteworthy in the ovipositor sclerites. This fact should be kept in mind when comparing the ovipositor of wild caught females of the new species with the figures given here. It also made it impossible to make good measurements of the body length.

Subsequently I studied museum material of *Caiusa* from a number of institutions and both males and females were dissected for examination of genitalia. In addition a number of species of *Phumosia* in the same institutions were studied for comparative purposes.

Genitalia preparation. The method used for preparation of genitalia is described in Rognes (2009), although with these smaller *Caiusa* specimens the boiling time in KOH was reduced to 1–2 minutes. The metallic sheen of the dark segments of the abdomen disappeared with this treatment. The darkness itself, however, remained in the integument, still contrasting with the yellow colour of the preceding segments, and can be observed on the dried abdomen glued to card on the pin. For flat-mounted ovipositor slides the outstretched ovipositor (itself a difficult operation) was torn open with fine pointed Dumont #5 tweezers along the pleural membrane on one side while in glycerol, the unit consisting of the epiproct and the two surstyli was separated from the hypoproct and some distance was established between the ST8 and the hypoproct. The ovipositor was then transferred to alcohol, and mounted in Euparal on microslides. It was manipulated into position in that medium with the aid of insect pins before adding the coverglass. The preparation was kept flat by a placing a small weight on the coverglass for a few weeks while the Euparal resins hardened.

Acronyms for specimen depositories.

ANIC	Australian National Insect Collection, CSIRO, Canberra, Australia
BMNH	Natural History Museum, London, United Kingdom
BPBM	Bernice Pauahi Bishop Museum, Honolulu, Hawaii, USA
CMNH	Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, USA
CNC	Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada
HNHM	Hungarian Natural History Museum, Budapest, Hungary
IDD	International Department of Dipterology, Tokyo, Japan
KR	Private collection of Knut Rognes, Oslo, Norway (ultimately to be transferred to the Oxford University Museum of Natural History, Oxford, United Kingdom)
MNHN	Muséum national d'Histoire naturelle, Paris, France
MSNG	Museo Civico di Storia Naturale "Giacomo Doria", Genova, Italy
MSNM	Museo Civico di Storia Naturale, Milano, Italy
NHRS	Naturhistoriska Riksmuseet, Stockholm, Sweden
NSMT	National Museum of Nature and Science, Ibaraki, Japan
NTU	Insect Museum of National Taiwan University, Taipei, Taiwan
SDEI	Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany
USNM	Smithsonian Institution, National Museum of Natural History, Washington D.C., USA
WSU	Washington State University, The James Entomological Collections, Pullman, Washington, USA
ZMUM	Zoological Museum, Moscow State University, Moscow, Russia

Abbreviations used for setae and abdominal sclerites.

acr	acrostichal setae
ad	anterodorsal
av	anteroventral
dc	dorsocentral setae
h	humeral setae
ia	intra-alar setae
kepst	katepisternal setae
npl	notopleural setae

p	posterior
pa	postalar setae
pd	posterodorsal
ph	posthumeral setae
post acr	postsutural acrostichal setae
post dc	postsutural dorsocentral setae
prst	presutural seta
prst acr	presutural acrostichal setae
prst dc	presutural dorsocentral setae
pv	posteroventral
sa	supra-alar setae
ST	abdominal sternite
T	abdominal tergite
v	ventral

Photography. The techniques used for photography were explained in Rognes (2012, 2013).

Terminology and geographical names. The general morphological terminology follows Rognes (1991), but "humeral callus" has been replaced by "postpronotal lobe". Geographical names follow *The Times Comprehensive Atlas of the World*, *10th Edition*, *1999* (*Millennium Edition*), or *Google Earth* (version 7.1.2.2041). Some locality names from Taiwan were interpreted according to Chiu *et al*. (1984). Some Chinese pictograms of a few Taiwanese localities were copied from the web-site http://en.wikipedia.org/wiki/Hengchun (accessed on 3 December 2014). The name of the Taiwan locality "Kankau", visited by the collector Sauter in the past, was not found on Google Earth, but on Google (as "Cape Kankau" or "Kankau Bay").

Format of lists of material. In the "Material examined" lists for each species, specimens are listed separately for each specimen depository. Specimen depositories are sorted alphabetically according to their acronyms, which are underlined and in boldface font. Under each depository, the specimens are sorted by country. Specimen labels are numbered successively from the top to the bottom of the pin, the numbers being enclosed within parentheses. The lines on each label are separated by a slash (/). If the label text itself contains a printed or a handwritten slash, then the label lines are separated by double slashes (//). The label text is cited without use of quotation marks to simplify the typesetting. Records are frequently annotated.

Amphibian nomenclature. For the rhacophorid frog species I have followed the most recent nomenclature explained in Frost (2014), based on very recent phylogenetic analyses (e.g., Frost *et al*. 2006, Grosjean *et al.* 2008, Li *et al.* 2009, Li *et al.* 2011, *Li et al.* 2013, Aowphol *et al.* 2013). This nomenclature differs in a few cases from the traditional names I received from the herpetologists who identified the frogs and who reared the flies. In spite of this, some older synonyms (e.g., *Chiromantis hansenae* for *Feihyla hansenae*, and *Chirixalus nongkhorensis* for *Chiromantis nongkhorensis*) which I have used on various slide labels and elsewhere have not been changed. The names of frog genera are always written in full in the text.

Phylogenetic analysis. The seven *Caiusa* taxa for which the ovipositor structure is known and *Calliphora vicina*, *Pollenia rudis* and *Phumosia abdominalis* as outgroups were coded for 24 characters of which five were multistate. The data matrix, character names and character states given in the Appendix were entered in the file *RognesCaiusaPhyl.ss* (available on request). The file was analysed with the parsimony programs Nona (implementing search under equal weights) and PeeWee (implementing search under implied weights) (Goloboff 1993, 1993–1997). All characters were treated as unordered and only unambiguous support for clades were considered (*amb*-). Trees were treated internally as dichotomous (*poly*-). An exact search was in Nona (*whennig; mswap*+) as well as in PeeWee. The tree with highest fit was output and printed through WinClada (Nixon 2002) and printouts scanned for further treatment in Photoshop Elements.

Genus *Caiusa* Surcouf, 1920

Caiusa Surcouf, 1920: 52. Type-species: *Caiusa indica* Surcouf, by monotypy.

Pseudocaiusa Villeneuve, 1927: 393 (as subgenus of *Phumosia*). Type species: "*Caiusa* (?) *dubiosa*" Villeneuve, 1927: 392 [named *Phumosia dubiosa* on p. 393] [= *Caiusa violacea* Séguy, 1925], by monotypy.

Surcouf did not explicitly designate a type species for his new genus. In his own words he created it "pour deux espèces dont l'un provient de Trichinopoly et de Kattapuli (Inde méridionale) et l'autre du Queensland [for two species, of which one comes from Trichinopoly and from Kattapuli (South India) and the other from Queensland]". The first-mentioned species was named *Caiusa indica* on p. 53, the second was mentioned on p. 54 in these words:

> "Nous rapportons à ce genre [*Caiusa*] un insecte appartenant au P^r^ BEZZI et qui provient de Queensland. Il se rapproche de *Phumosia analis* Macquart (1843) [now = *Phumosia abdominalis* Robineau-Desvoidy, 1830] et en diffère par la bande frontale noire en entier, la couleur de l'apex de l'abdomen et par l'aile qui est uniformément rembrunie. Le thorax entièrement jaune écarte cette espèce de *Caiusa indica*".
>
> [We assign to this genus an insect belonging to P^r^ BEZZI and which originates from Queensland. It is close to *Phumosia analis* Macquart (1843) and differs by the totally dark frontal vitta, by the colour of the apex of the abdomen and by the wing being evenly brownish coloured. The totally yellow thorax sets this species apart from *Caiusa indica*.]

A comparison of this statement with the text on a label on the holotype of *Caiusa surcoufi* (Fig. 87) suggests that the latter was written by Surcouf himself.

Evidently, Surcouf did not name this latter Queensland species in the original publication. Rather, he left the specimen eventually to be employed by Bezzi, the owner of the specimen, as holotype for his new nominal species *Caiusa surcoufi* Bezzi, 1927: 246.

Thus, *Caiusa* was established on the basis of two originally included species, of which only one was denoted in the original publication by an available name. James (1977) and Kurahashi (1989d) both treated *C. indica* as type species for *Caiusa*, by monotypy. This action complies with the Code, Article 68.3 (ICZN 1999), which stipulates that "[w]hen an author establishes a new nominal genus-group taxon for a single taxonomic species and denotes that species by an available name, the nominal species so named is the type species. Fixation by this means is deemed to be fixation by monotypy, … regardless of whether the author considered the nominal genus-group taxon to contain other species which he or she did not cite by name, …".

The genus as conceived here, includes eight named species, i.e., *C. borneoensis* **sp. nov.**, *C. indica* Surcouf, *C. coomani* Séguy, *C. karrakerae* **sp. nov.**, *C. kurahashii* **sp. nov.**, *C. pooae* **sp. nov.**, *C. testacea* Senior-White and *C. violacea* Séguy, and, possibly, one unnamed species, known so far from a single female only.

Diagnosis. Ground colour orange-yellow, but abdominal tip most often dark with bluish sheen. Parafacial bare. Katatergite with long erect setulae. 1+1 *kepst*. 1 (–2) *post acr*. 4 *post dc*. Male pregonite long with an almost right angled bend, bend carrying 2–3 very long setae, and the part distal to the bend often quite long and always directed horizontally outwards (Fig. 98). No denticles anywhere on the aedeagal membrane. Female ovipositor sclerites moderately long and spermathecae globular (Fig. 196).

Synapomorphies. The long and bent pregonite carrying 2–3 very long setae at the bend, the part distal to the bend always directed horizontally outwards, and the absence of denticles and sclerotisations anywhere on the aedeagal membrane, are clearly synapomorphic features defining this genus. The structure of the pregonite is unique among calliphorids.

Description. Male. Body length 6–9mm. *Head*. Frons narrower than width of anterior ocellus (Figs. 35, 55, 60, 88, 94, 100, 140, 175). Ground colour orange yellow, occiput dark, except lowermost triangular area of postgena which is yellow. Frontal vitta dark reddish yellow, almost obliterated in upper part of frons. Parafacial bare, densely silvery microtomentose. Fronto-orbital plate narrow, silvery microtomentose with 6–8 frontal setae reaching upwards to middle of frons. An irregular row of small black setulae present outside of frontal setae. In upper part the tomentosity of the fronto-orbital plates is thinning out. Occiput greyish tomentose with pale or dark setulae. Area between posterior eye margin and postocular row of cilia densely silvery tomentose, with intrapostocular cilia. Gena with grey microtomentosity and numerous black setulae. Vibrissa situated above lower facial margin. Supravibrissal setulae ascending to at most two-fifths of the facial ridges. Facial membrane greyish yellow, with a couple of small setulae a little above lower facial margin (Fig. 178). Lower facial margin, vibrissal

corners, facial ridges and area in front of genal dilation yellow. Strong inner vertical setae, moderately strong ocellar setae. Antennal scape and pedicel yellow, first flagellomere yellow with some darkening in distal half. Pedicel with 1 strong seta and numerous black ground setulae. Arista long plumose to apex on both sides. Eye facets slightly to conspicuously enlarged in upper half, but the transition zone not very distinct (Figs. 94, 151, 176).

Thorax. Ground colour orange yellow. In most specimens of most species some, at least presutural, darkening middorsally outwards to between *acr* and *dc* rows of setae. In other species the mesonotum is all yellow without darkenings. Also some irregular darkenings of pleuron in some species. In one species most of the thorax is dark in some specimens from some geographical areas (*C. indica*) whereas all pale in other areas (e.g., Solomon Islands). Postpronotal lobe yellow. 3 *h*, diminishing in size medially, numerous black ground setulae. Mesonotum with black ground setulae. 1–3 + 1 *acr*, rarely a second pair of *post acr* just in front of the strong prescutellar pair; *prst acr* weak. 2 + 4 *dc*. 1 + 3 *ia*. 3 *sa*. 2 *pa*. 2 *ph*, outermost *ph* outside a line through the *prst*. Notopleuron with 2 *npl* and numerous short black ground setulae. Postalar callus yellow. Proepisternal depression and prosternum with pale setulae. Anepisternum with numerous thin black setae all over, strongest in upper anterior part. 7–8 anepisternal marginal setae. Anepimeron bare in anterior half, posterior half with long thin erect setulae all over; a cluster of stronger shorter setulae in uppermost part. Katepisternum with short black ground setulae all over. 1 + 1 *kepst*. Katatergite with numerous erect pale or black setulae. Anatergite with a few short black setulae below lower calypter. Postalar wall with numerous black or pale setulae. Scutellum usually yellow, in occasional specimens darkened, with black ground setulae. 3 pairs of marginal scutellar setae, the lateral pair sometimes doubled or tripled. 1 pair of discal scutellar setae close to apical scutellars. The lateral wall of scutellum with densely set ground setulae. Thin black or pale setulae of varying length invading lateral third or more of under surface of scutellum towards the middle, where the setulae sometimes being very sparse, short or lacking (very careful observation needed). Coxopleural streak absent. Metasternal area bare. Anterior thoracic spiracle large (Figs. 92, 93). Posterior thoracic spiracle with a very small posterior lappet and a very long anterior lappet, forcing the katepimeron upwards at its hind end (Fig. 93, 174, 198).

Wing. Hyaline, sometimes with an even very slight yellowish tinge. Tegula, basicosta and subcostal sclerite yellow. Sometimes a few short setulae on the distal part of vein R_1 (Figs. 37, 165). Upper calypter translucent with a slightly darkened rim. Lower calypter greyish, translucent or slightly infuscate.

Legs. Yellow, in some species hind tibia darkened. Fore tibia with 3 *ad*, 1 *pv* at distal third. Mid tibia with 1 *ad*, 1 *pd*, 2 *p*, 1 *v*. Hind coxa with pale setulae on hind surface. Hind tibia with 3–4 *ad*, 2 *av*, 1–5 *pd*.

Abdomen. Usually T4 and T5 dark with bluish metallic sheen, but there is variation in the extent of abdominal darkening. In one species (*C. testacea*) the abdomen usually all yellow without darkened areas (except some specimens from Nepal). In another species (*C. indica*) abdomen sometimes all yellow or sometimes all dark. All tergites with densely set black ground setulae. Weak marginal setae on T1+2 and T3, stronger and more or less erect on T4 and T5. Some weak erect discal setulae on T5. Abdominal sternites not overlapping medial edges of corresponding tergites.

Genitalia. Epiphallus narrow and long (Figs. 27, 114). Distiphallus with hook-shaped, single-pointed rather long and slender paraphallic process (Fig. 27). No denticles anywhere on the aedeagal membrane. Pregonite long with an almost right angled bend, the bend carrying 2–3 very long setae. The part distal to the bend variable in length, from rather long (Fig. 66), to very short (Fig. 28) or even shorter than that, and directed horizontally outwards.

Female. Similar to male except for these features. *Head*. Female frons at vertex / head width ratio 0.242–0.330 (Figs. 36, 83, 104, 142, 163, 185, 199, 202). 8–10 frontal setae. Fronto-orbital plates silvery microtomentose all the way to vertex, but less dense in upper part. Frontal vitta dark, reddish anteriorly, bare, slightly microtomentose. Outer and inner vertical setae strong. 1 strong reclinate (slightly lateroclinate) orbital seta. 2 strong proclinate orbital setae. Between posterior proclinate orbital seta and reclinate orbital seta an area with rather numerous short ground setulae. Eye facets uniform in size.

Abdomen. T5 hardly with erect discal setulae. Alpha-setae on anterior margin of ST2–ST7.

Ovipositor. A moderately long narrow tube with short (*C. indica*, *C. pooae*) to moderately elongate sclerites. ST8 short, almost rectangular, with a few "normal" setae of various lengths in *C. indica* and *C. pooae* (Figs. 74, 145), but a very small rounded sclerite with a number of short spine-like setae in the other species examined (e.g., Figs. 47, 48). Epiproct with microtrichiae, especially around base of setae, and a variable number of long setae. ST8 and female cerci without microtrichiae, except in *C. pooae*. Hypoproct covered with microtrichiae, in all the

examined species. In *C. indica* and *C. pooae* the hypoproct also carries a number of "soft" setae of variable size in an irregular pattern on most of the disc (Figs. 74, 146). Along the circumference the soft setae are longer. In *C. borneoensis*, *C. coomani*, *C. karrakerae*, *C. kurahashii* and *C. violacea* the disc of the hypoproct carries ventrally a number of rather short and strong spine-like setae positioned in an area shaped like a V pointing posteriorly, the spinous setae often placed very regularly (Fig. 172). There are very few soft setae on the disc, but along the distal circumference soft setae are retained. These spine-like setae are opposing the spine-like setae of the ST8 forming a kind of "jaw" or "grip" (Fig. 47). The function of this structure is not known, but it is possibly used to secure the ovipositor tip to the outer surface or crust of the foam nest while depositing eggs or larvae, or is possibly used to rip open the crust to deposit the eggs or larvae securely within the foam nest. This type of ovipositor tip is unique in the Oestroidea to my knowledge. The only known specimens of *C. pooae* were descended from a female that had oviposited on the soft gelatinous egg mass of the tree frog *Feihyla hansenae*. See section on *Caiusa pooae*, below, for a detailed report by Sinlan Poo on the circumstances around the rearing of the flies from the egg mass of this frog species. The breeding substrate of *C. indica* is not known. Spermathecae spherical (Fig. 196).

Biology

Oviparous or larviparous?

Caiusa indica is certainly oviparous. A very large number of eggs (100+) were observed in a dissected female from Vietnam (in IDD) (Figs. 81, 82) and also in a dissected female from Solomon Islands (Guadalcanal) (in USNM). In a specimen of *C. indica* (Malaysia, Borneo, Sarawak in IDD) an empty egg membrane with a distinct plastron was found in the uterovaginal tube, so this is a case of a precocious egg hatching before having been deposited (Fig. 77).

The other members are also inferred to be oviparous, as supported by this observation by Nancy E. Karraker:

> "If I collect a foam nest and place it 'face down' on the water in a dish (meaning the side of the foam nest that was not attached to the vegetation - the side the flies would have visited), and shake it a little bit, tiny rice-shaped objects fall into the water. They do not move." (E-mail, 2 July 2014, about an egg mass of an unknown species, possibly *C. coomani*.)

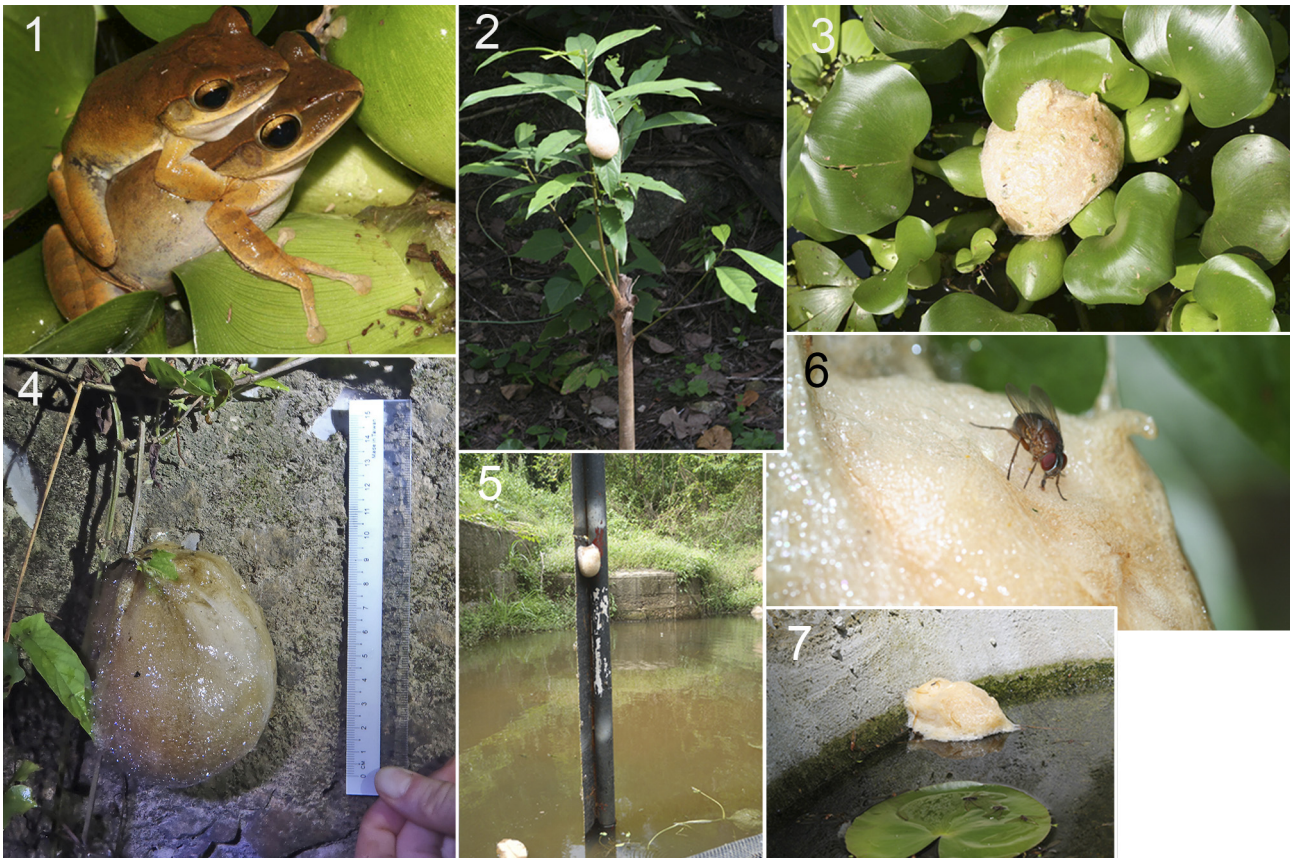
Lue & Lin (2000) described the eggs of *C. violacea* from Taiwan (as "*C. coomani*") and reported on the infestation by this fly of foam nests of numerous frog species. Lin *et al*. (2000) described the oviposition behaviour of *C. violacea*. The flies visited foam nests during a very short period of time in the early morning from sunrise to at most about 2 hours after (Lin *et al*. 2000: 284 fig. 2) and the time used for oviposition varied from 4 to 35 minutes (Lin *et al*. 2000: 286 table 1). For *Polypedates megacephalus* in Hong Kong, the surface of the foam nest begins to dry about 4 hours after deposition, forming a thin outer crust (Karraker 2013).

In the present study, a large first instar larva was found in the uterovaginal tube, or emerging from the vaginal opening, in three species (*C. borneoensis*, *C. coomani* and *C. violacea*). In these cases the larva was always single, and in no cases were a number of small first instars found in the female abdomen, as is commonly the case in dissection of larviparous species. In the *C. borneoensis* case, about 25 large yolk-filled and undeveloped eggs (no plastron was observed) were found in the abdomen while the apparently fully developed first instar larva was positioned in the uterovaginal tube (Figs. 40–43). The exact location of the eggs was probably the ovaries, but these were destroyed by the KOH treatment. In the cases of females of *C. coomani* and *C. violacea* carrying a single first instar larva in the uterovaginal tube, no eggs were observed. *Caiusa karrakerae* and *C. pooae* have females only known from reared specimens, not having reached reproductive age. In *C. kurahashii* no larvae were found in the single female dissected. *Caiusa testacea* females caught in the wild have not been dissected due to paucity of material.

In view of the very short time period in the very early morning suitable for oviposition by the *Caiusa* females, a time of the day when few collectors are likely to be around, it is possible that the female flies caught at a later time of the day may not have succeeded in finding a suitable oviposition site. It is therefore possible that eggs have developed to maturity within the genital ducts in some of such females while they were searching for oviposition sites. In four dissected wild caught females of *C. borneoensis* a fully developed first instar was found in two (50%);

in five dissected wild caught females of *C. coomani* three had fully developed first instar larvae (60%); in 12 wild caught dissected females of *C. violacea* one had a fully developed first instar larvae inside (8%). Thus, the occurrences of fully developed first instars within the female uterovaginal duct are most likely examples of precocious eggs (i.e., eggs that develop to the first instar instead of being laid as eggs in oviparous species; Erzinçlioglu 1990, Wells & King 2001), and not evidence of larvipary. Similar cases of an almost hatched first instar larva within the uterovaginal tube have also been observed in the oviparous species *Pollenia atramentaria* (Szpila, pers. comm.). Herting (1965) treats this subject in Tachinidae.

Thus I conclude that all *Caiusa* species are oviparous despite the findings of mature first instar larvae in their uterovaginal duct.



FIGURES 1–7. Rhacophorid frogs and their egg masses. **1.** *Polypedates megacephalus*, male and female in amplexus, Hong Kong. **2.** Foam nest of *P. megacephalus* suspended in a tree, Hong Kong. **3.** Foam nest of *P. megacephalus* on Hyacinth plant in water, Hong Kong. **4.** Foam nest of *Polypedates leucomystax*, Thailand, showing size. **5.** Foam nest of *Polypedates leucomystax* on a pole, Thailand. **6.** *Caiusa* female on a foam nest of *Polypedates megacephalus*, Hong Kong. **7.** Foam nest of *P. megacephalus* on surface of water. Photographs 1, 2, 3, 6, 7 reproduced by courtesy of N.E. Karraker; photographs 4, 5 reproduced by courtesy of S. Poo.

Oviposition on frog egg masses

Five *Caiusa* species have been reared from the egg masses of tree frogs of the family Rhacophoridae, i.e., *C. borneoensis*, *C. coomani*, *C. karrakerae*, *C. pooae* and *C. violacea*.

The eggs of five frog species common in Thailand are preyed upon by *Caiusa* larvae (Table 1). The frogs are *Chiromantis nongkhorensis* (Cochran, 1927) (Figs. 11, 12, 13) [recently transferred to *Chiromantis* Peters, 1854 from *Chirixalus* Boulenger, 1893, see Frost (2014)], *Feihyla hansenae* (Figs. 8–11, 144) [recently transferred to *Feihyla* Frost *et al*., 2006 from *Chiromantis*, see Frost (2014)], *Polypedates megacephalus* (Figs. 1–3, 6, 7), *P. leucomystax* (Figs. 4, 5) and *Rhacophorus kio* (Figs. 14, 15).

The eggs of two further tree frog species, *Rhacophorus angulirostris* Ahl, 1927 and *Rhacophorus dulitensis* Boulenger, 1892 (not illustrated), were preyed upon by *Caiusa* larvae in Malaysia (Sabah) (Table 1).

In Vietnam, Anna Vassilieva reared *C. violacea* from egg masses of *Polypedates megacephalus* and *C. borneoensis* from *Rhacophorus annamensis* Smith, 1924 (Table 2).

The eggs of *Rhacophorus owstoni* (Stejneger, 1907), an endemic species of Japan (IUCN 2014), were preyed upon by larvae of *C. kurahashii* according to labels on the reared specimens.

All these frog species produce foam nests, except *Feihyla hansenae* (Grosjean *et al.* 2008, Li *et al.* 2009).

When in amplexus (Figs. 1, 14), females, or both males and females, of foam breeding species beat their legs and form a foam, in which eggs and sperm are deposited. The foam nests are attached to various objects, such as stones, leaves, lianas, poles, or branches and may be in contact with water or suspended above a water source, close to the surface. The eggs are embedded within the foam, and are usually not visible from outside, with a few exceptions (Fig. 13, arrow). The outer surface of the foam subsequently hardens into a crust. The hardness of the crust varies among species. One species, *Rhacophorus kio*, hides the egg clutch by folding leaves around it (Fig. 15) (S. Poo in e-mail 4 September 2014). The eggs mature into embryos which, when mature, hatch within the foam matrix, and hatchlings drop into the water below and fulfill their development there.

Feihyla hansenae, like its congeners (see Grosjean *et al.* 2008, Li *et al*. 2009, Li *et al*. 2011, Aowphol *et al*. 2013, Frost 2014), does not produce a foam nest (Figs. 8–11, 144). Each egg has an outer membrane surrounding the embryo, but the eggs are not surrounded by a foamy pliable mass. All the eggs (with embryos) are enveloped within a common gelatinous membrane (Fig. 10). The outer surface of the gelatinous egg mass does not harden into a crust. The species is unique in that the eggs are guarded by the female who keeps the eggs moist (Sheridan & Ocock 2008, Poo & Bickford 2013) (Fig. 9). S. Poo has published a video-clip showing the female wiping her hind feet over the egg mass keeping it moist (Poo 2014; to watch select 'Videos', and seek out the sequence at 43–53 seconds from start). Sometimes the females descend to the ground and soak for a while in a nearby pond below. Then they return and re-position themselves over the egg mass. According to Sheridan & Ocock (2008), adults sit on the clutches approximately 72% of the time, both day and night.

Due to the transparency of *Feihyla hansenae* gel clutches, one can see the frog embryos enlarging and darkening as they develop (Fig. 10, bottom). Four to six days after having been deposited the eggs of this species will drop or be washed by rain from the vegetation into a seasonal pool of water below and hatch into tadpoles (Sheridan & Ocock 2008).

Foam egg masses may be visited by several females (N.E. Karraker in e-mail 9 July 2014) of the same fly species, and in one case a mixed infestation by *C. coomani* and *C. violacea* was observed in the foam nest of *Polypedates leucomystax* (Table 1, pole-t7).

The size of the frog egg masses varies. Those of *Polypedates leucomystax* average about 500 eggs (Sheridan 2009) and egg masses of *Polypedates megacephalus* average about 350 eggs (Fig. 4, Karraker 2013). Egg masses of *Chiromantis nongkhorensis* contain about 300 eggs (Fig. 11), and those of *Feihyla hansenae*, the smallest, are reported to have 150–250 eggs (Poo & Bickford 2013, S. Poo in e-mail 4 September 2014). In Fig. 11, the size of the foamy egg mass of *Chiromantis nongkhorensis* is shown to be much larger than the jelly-like one of *Feihyla hansenae*.

The flies, when ready for oviposition, probably detect the frog egg mass by olfaction.

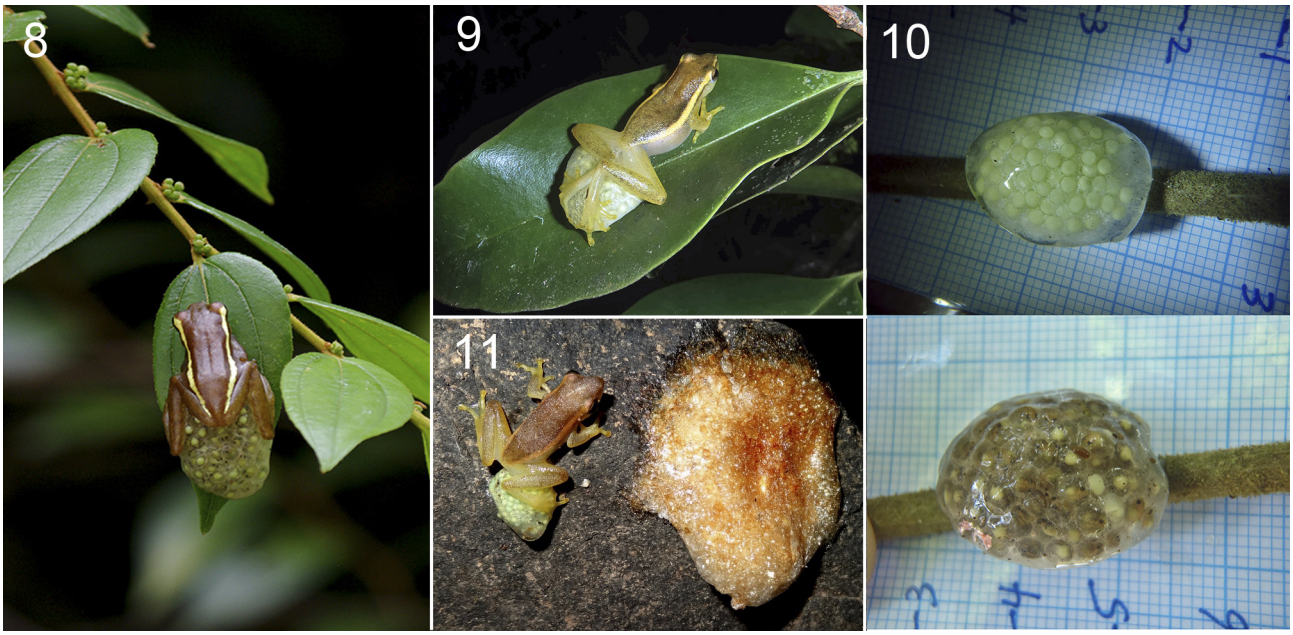
The time that elapses from infestation of the egg mass to adult flies is about a week (N.E. Karraker in e-mail 2 August 2014).

Caiusa testacea has been reared from "frog egg mass" (Senior-White 1923a) but the frog species is not known. *Caiusa indica* has never been reared from frog egg masses. It is frequent both within and outside the distributional area of frogs of the family Rhacophoridae. Its breeding habits are unknown. Both species have been reported to parasitize *Megachile nana* bees in India (see below).

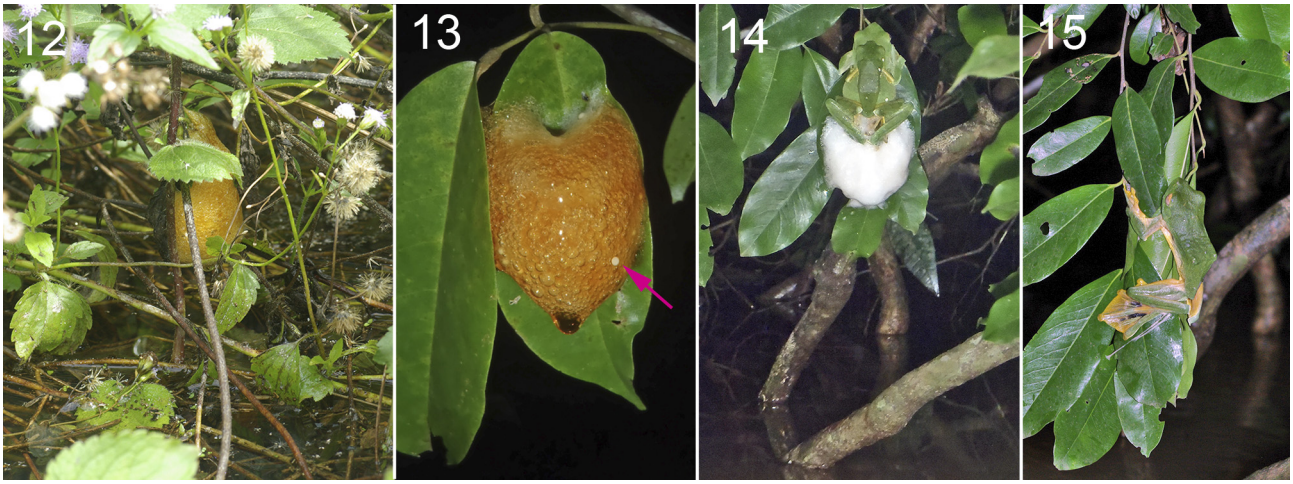
Breeding in Megachile *bees nests*

Kapil & Jain (1980) reported damage by parasites to efforts of breeding *Megachile* Latreille bees (Hymenoptera: Megachilidae) for increased pollination purposes in India. The parasites were bombyliids, chalcid wasps, chrysidids, cucko bees, and tachinids. The "two species of tachinids—*Caiusa indica* and *C. testacea* (Diptera: Calliphoridae) are the parasites of *M. nana*." (Kapil & Jain 1980: 27). The "activity of the parasites specially *Coelioxys* [Latreille] [Hymenoptera: Megachilidae] and *Caiusa* spp. have been a perpetual phenomenon almost throughout the active period of the bees, except a few winter months" (Kapil & Jain 1980: 27–28, table 20). So far

observations of this kind of breeding strategy have not been published elsewhere for any *Caiusa* species. It is thus possible that these reports are based on misidentification of the species involved.



FIGURES 8–11. Rhacophorid frogs and their egg masses. **8.** *Feihyla hansenae*, female, attending to egg mass attached to leaf, Thailand. **9.** *Feihyla hansenae*, female, attending to egg mass attached to leaf (note position of feet), Thailand. **10.** *Feihyla hansenae*, egg mass, 0 (upper) and 4 days old (lower), Thailand. **11.** *Feihyla hansenae* (left) and *Chiromantis nongkhorensis* (right) egg masses, note size difference, Thailand. Photographs 8–10 reproduced by courtesy of S. Poo; photograph 11 reproduced by courtesy of P.F. Erickson.



FIGURES 12–15. Rhacophorid frogs and their egg masses. **12.** *Chiromantis nongkhorensis* egg mass, hidden in vegetation, Thailand. **13**. *Chiromantis nongkhorensis* egg mass, note colour; to the lower right an egg is exposed on the surface (white circular dot at end of arrow), Thailand. **14.** *Rhacophorus kio* pair making foam nest above water surface, Thailand. **15.** *Rhacophorus kio* female covering foam nest with leaves, Thailand. Photographs 12–15 reproduced by courtesy of S. Poo.

Adult nourishment

The adult flies are attracted to various substances for nourishment, such as fish and excrement, according to label information. For *C. indica*, Kurahashi (2003b: 280) mentions "decaying meat in dense forests". Kurahashi (1989b: 207) notes that it is "… attracted to decaying animal matter and fruits", and Kurahashi & Magpayo (2000: 31) state that adults "are attracted to fish baits".

Comparison with *Phumosia* Robineau-Desvoidy

Both *Caiusa* and *Phumosia* belong in the calliphorid subfamily Phumosiinae, sharing the synapomorphic possession of thin, erect and long setae on the katatergite and a very short ST8 in the ovipositor (Figs. 23, 33, 47, 49, 71, 72, 74, 118, 128, 167).

Almost all Oriental, Australasian and Oceanian *Phumosia* species have 2 + 1 *kepst*, whereas all *Caiusa* species have 1+1 *kepst*. However, *P. elegans* Kurahashi (1989b: 204) and *P. flavipennis* Kurahashi *et al*. (1997: 24) have only 1 + 1 *kepst* like *Caiusa*. They are clearly *Phumosia* species, however, on account of the male genitalia.

In all *Phumosia* the pregonite is of the common short straight vertical type without very long setae, and the aedeagus has spicules and sclerotisations on the aedeagal membrane. The ovipositor tube is very short, broad at base, with very wide pleural membranes and very short abdominal tergites (Figs. 16, 17, 19). Each T8 half is very short, and represented only with a row of setae in *P. abdominalis* Robineau-Desvoidy (Figs. 16, 19), a similar condition being figured for *P. murphyi* Hii Lu King & Kurahashi (Hii Lu King & Kurahashi 1977). The hypoproct is covered by numerous microtrichiae and has a number of long and short "soft" setae, but is without short spine-like setae (Fig. 23). Likewise, the ST8 has numerous long "soft" setae in addition to a cover of microtrichiae (Fig. 23), but lacks short spine-like setae. ST8 microtrichiae are present in *C. pooae* but absent from the other females of *Caiusa* examined here. The spermathecae are very elongate and rod-like (Fig. 20), not spherical as in *Caiusa* (Figs. 41, 77, 186, 191, 194, 196). The cerci of the female ovipositor have a dense cover of microtrichiae among the strong setae (Fig. 19) (see also Rognes 1997: 63 fig. 20). Such microtrichiae are present in *C. pooae* but absent from the other females of *Caiusa* examined here. Wings are most often infuscate to some degree, except *P. murphyi*, in which the wings are hyaline.

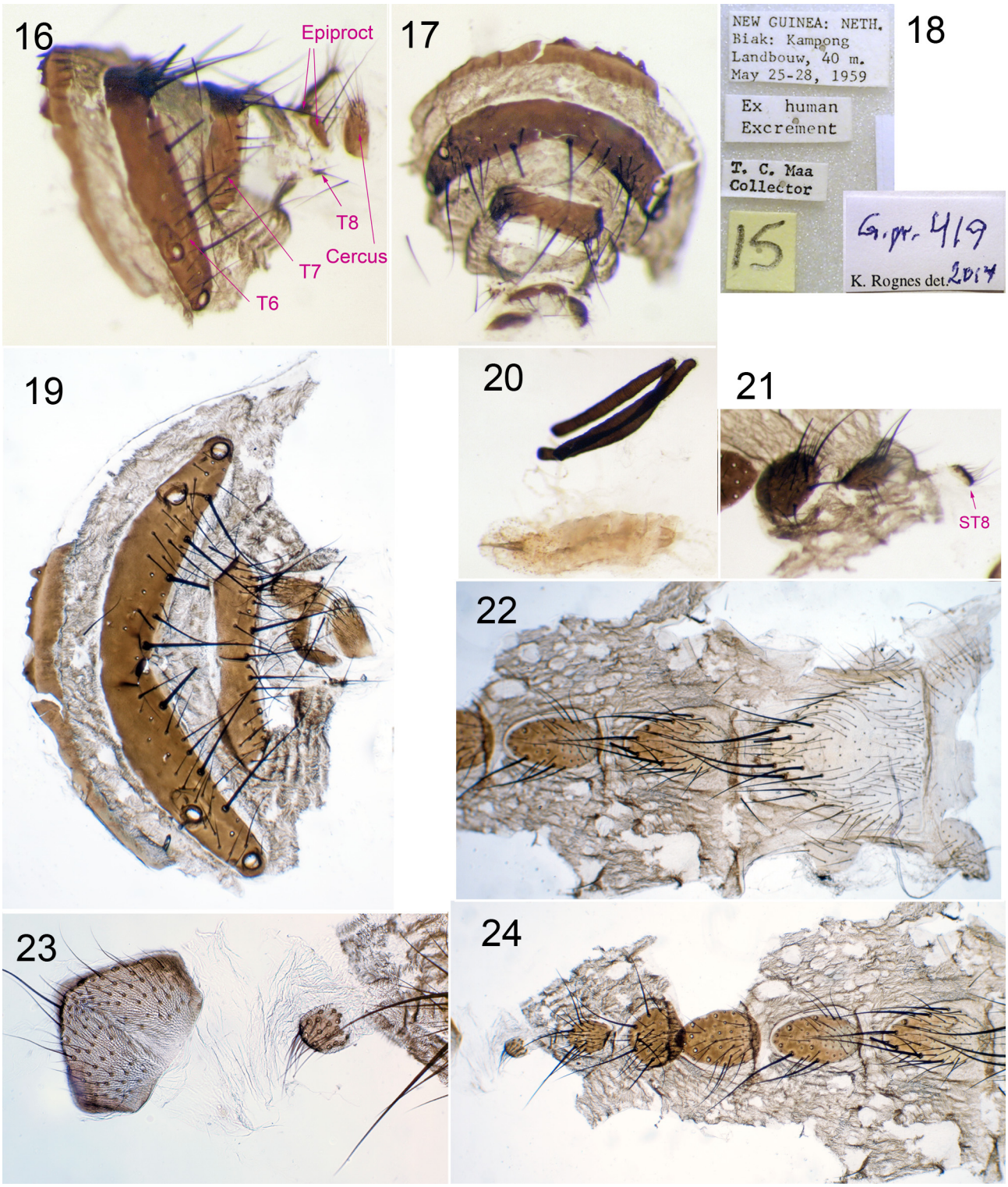
An important feature that has not been used to distinguish *Phumosia* from *Caiusa*, is the fact that in all Oriental, Australasian and Oceanian *Phumosia* the *h-sc* node carries a small bundle of usually black, sometimes pale, setulae on the lower side of the wing, whereas it is quite bare in *Caiusa* [but see section "Unnamed *Caiusa* or *Phumosia* species", below]. I have observed this feature in specimens of *P. abdominalis* (BPBM, MNHN, SDEI, WSU), *P. costata* Malloch (BPBM, SDEI), *P. marginata* James (paratype in WSU), *P. pallida* James (paratypes in BPBM, KR, WSU), *P. promittens* Walker (BPBM, MNHN, WSU) and *P. viridis* Kurahashi (BPBM, KR). It has been described for *P. elegans* Kurahashi by Kurahashi (1989b 204), for *P. murphyi* by Hii Lu King & Kurahashi (1977: 223), for *P. nigricauda* Kurahashi & Magpayo by Kurahashi & Magpayo (2000: 32), for *P. njonja* Kurahashi by Kurahashi (1989b: 207), for *P. setulosa* Kurahashi & Magpayo by Kurahashi & Magpayo (2000: 36) and for *P. viridis* Kurahashi by Kurahashi (1989a: 124). The feature was not mentioned in the description of *P. flavipennis* by Kurahashi *et al*. (1997: 25) and not in the description of *P. hunanensis* Fan *et al*. in Fan (1997:440, 652). Rueda (1985) reports this feature in *P. abdominalis*, *P. costata* and P. *promittens*.

Zumpt (1956, and elsewhere) never mentioned the *h-sc* node for any Afrotropical *Phumosia* species, but a quick glance through the Afrotropical material available to me at present, reveals that both conditions occur. It is likely that *Phumosia* as conceived at present is not a monophyletic group.

The breeding biology also speaks for a separate status for *Caiusa*. All species seem to be oviparous (apart from frequent cases of "precocious eggs") and all are known to have oviposited on frog egg masses (except *C. indica*), or, in a possible unconfirmed case of *C. indica*, in the nests of *Megachile* bees. Species of the genus *Phumosia*, however, are larviparous. A single big first instar larva was found in the uterovaginal tube of a specimen of *P. abdominalis* from Indonesia (Papua) (in WSU) (Fig. 20, bottom) (*Note*. The label [Fig. 18] mentions "Biak", which is an island in the present day Indonesian province of Papua). In the Afrotropical species *P. imitans* Villeneuve a large number of first instar larvae were found in a bilobed uterus (in coll. KR). No *Phumosia* species have so far been reared from frog egg masses or are known to parasitize arthropods.

Keys to species of *Caiusa* Surcouf

There is an outstanding problem, marked by an asterisk [*], with the first item in the keys to both males and females. I have seen a female specimen which looks like a *Caiusa* in most respects, but it has a few black setulae on *h-sc* node on the underside of the wing (Figs. 206, 207). See chapter "Unnamed *Caiusa* or *Phumosia* species" for more details.



FIGURES 16–24. *Phumosia abdominalis* Robineau-Desvoidy, ovipositor (all from female from Indonesia, Papua, in WSU). **16.** T6–T8, epiproct and cerci, oblique dorsolateral view, in glycerol. **17.** T6–T8, epiproct and cerci, oblique dorsoposterior view, in glycerol. **18.** Labels on pinned specimen. Uppermost label mentions "Biak" which is an island in the Indonesian province of Papua. **19.** Flat-mounted T6–T8, epiproct and cerci, in Euparal (G.pr. 419). **20.** Spermathecae and vagina with a large first instar larva, in glycerol. **21.** ST6–ST8, in glycerol. **22.** Flat-mounted ST1–ST4, in Euparal (G.pr. 419). **23.** Flat-mounted hypoproct and ST8, in Euparal (G.pr. 419). **24.** Flat-mounted ST3–ST8, in Euparal (G.pr. 419).

Key to males

Male genitalia should be dissected and closely examined before any attempt at identification is made. External colour is variable and undue reliance on this feature may lead to errors.

1 The *h-sc* node on underside of wing with a bundle of black or pale setulae; parafacial setulose or bare; *kepst* 2+1 (lower anterior one sometimes weak or even absent); 3–4 *post dc*; lower surface of scutellum with pale setulae all over, also in middle; wings infuscate (except *P. murphyi*) . . . . . Oriental, Australasian and Oceanian *Phumosia* Robineau-Desvoidy

\- The *h-sc* node on underside of wing bare [*], but usually a few long black setae at junction of R_1 and R_{2+3} on underside close by; parafacial bare; *kepst* 1+1; 4 *post dc*; lower surface of scutellum with pale setulae absent from middle; wings hyaline; safe identification requires examination of genitalia (*Caiusa* Surcouf) 2

2 Cerci longer than surstylus, straight, and not bent backwards at middle in lateral view (Figs. 44, 45, 110, 111, 137, 138); usually abdominal T4 and T5 dark and with a bluish metallic sheen, sometimes T4 pale 3

\- Cerci slightly or much shorter than surstylus, in lateral view almost straight, bent downwards, or bent more or less backwards at middle (Figs. 25, 26, 64, 65, 68, 69, 120, 121, 127, 128, 131, 159, 160, 167, 168); abdominal colour variable from all yellow, with varying amount of darkness on T4 and T5, to almost all dark 5

3 Cerci rather narrow, in posterior view with a broad U or V-shaped bay in apical half, with pointed tips, tips flattened from side to side apically (Fig. 44); surstylus broad basally, very narrow distally, distal narrow part curving strongly downwards in lateral view (Fig. 45); thoracic dorsum varying from all yellow-orange to darkened all over; a presutural middorsal grey vitta on yellow-orange background just encompassing *prst acr* setae often present but is not diagnostic, sometimes thoracic dorsum dark on most of disc . . . . . *Caiusa coomani*

\- Cerci in posterior view with an apical slit only (Figs. 110, 137), not a V or U-shaped bay; surstylus not narrow or bent strongly downwards apically 4

4 Cerci in posterior view narrow and slender, evenly narrowing from base to tip, apically with a long narrow slit (Fig. 110); surstylus narrow, gently curved, broadest at tip in lateral view, tip blunt (Figs. 111, 112), in posterior view broad basally, then narrow, and distally with an inwardly curved and slightly widened tip; hind tibia with 2–4 *pd* setae . . . . . *Caiusa karrakerae* **sp. nov.**

\- Cerci in posterior view dagger-shaped, large, strong and long, narrow in basal part (the dagger handle), widening out and broadest at middle, narrowing distally to a point with a short narrow slit (Fig. 137); surstylus in lateral view a massive, slightly curved, pointed 'beak' (Fig. 138), in posterior view narrow, of uniform width, in middle part curving inwards, distally curving slightly outwards again; pregonite a massive hook, the part distal to long setae short, strong and pointed (Fig. 139); hind tibia with 4 *pd* setae (male holotype); thorax with grey stripe middorsally anterior to suture . . . . . *Caiusa pooae* **sp. nov.**

5 Cerci straight in lateral view, apically its upper edge curving down a little (Fig. 26), sometimes very little; cerci broad with parallel outer edges in posterior view, in apical third outer edges converging to a point, leaving a narrow slit with almost parallel sides (Fig. 25) or a narrow V-shaped incision (Fig. 30) between apices; surstylus in lateral view of even width and curving slightly downward, tip blunt (Fig. 26); in dorsal view surstylus curving towards midline distally; pregonite with the distal process (beyond bases of long setae) short, usually more slender and much shorter than basal part, often appearing like a narrow finger grafted on to the main basal part (Fig. 28), sometimes even shorter than figured; abdominal T4 and T5 dark with a bluish metallic sheen; hind tibia often rather dark, with (1)2–5 *pd*; R_1 sometimes with a row of small black setulae in distal part on upper surface of wing (Fig. 37) . . . . . *Caiusa borneoensis* **sp. nov.**

\- Cerci bent more or less backwards in lateral view (Figs. 65, 69, 97, 121, 128, 160, 168) 6

6 Cerci almost straight or only slightly bent backwards in lateral view, only slightly shorter than surstylus, apically dorsal edge not curving down (Figs. 65, 69, 97, 121, 128); cerci in posterior view with a very wide bay (Figs. 64, 68, 90, 96, 102), or no bay at all, only a slit (Figs. 120, 125, 126, 127, 131) 7

\- Cerci most often conspicuously bent backwards, rather short, much shorter than surstylus; cerci in posterior view with a pronounced distal bay between apices; cerci basally wide, in posterior view greatest width at a level far proximal to deepest point of bay, from this point lateral edges of cerci gradually converging distally; surstylus in posterior view rather broad, medial side of surstylus in posterior view forming half-circle (Figs. 159, 167, 181), tip very broad; hind tibia usually with 2 *pd* of equal size 8

7 Cerci in posterior view broad with a wide and deep U or V-shaped bay (Figs. 64, 68, 90, 96, 102), outer edge convex and strongly sclerotised (darker colour than elsewhere), distance between distal points of cerci slightly shorter than width of bay at maximum, sometimes tips are almost touching each other; bay deeper than length of junction of basal parts of cerci; width of cerci in posterior view greatest usually roughly at level with deepest point of bay; cerci in lateral view with distal half narrow, of even width and rather long, only slightly bent backwards (Figs. 65, 69, 91, 97); surstylus in lateral view slightly narrowed at distal third, usually widening out again beyond this point, tip blunt (Figs. 65, 69, 91, 97); distal part of pregonite (distal to long setae) strikingly long (Figs. 66, 98); hind tibia with 1 *pd* at middle (sometimes one above it); thoracic dorsum usually darkened all over, scutellum usually yellow, and hind half of abdomen, T4+T5, usually dark with bluish metallic sheen; however, specimens occur which have the thoracic dorsum all pale (Figs. 86, 88, 92, 93, 100, 104), or scutellum all dark (Fig. 95), or abdomen all dark, except for base of T1+2 (Fig. 76), or abdomen all pale (Fig. 93) . . . . . *Caiusa indica*

\- Cerci in posterior view narrow, distally with a narrow slit only (Figs. 120, 125, 126, 127, 131); lateral edges of cerci converging gradually from base to tip; surstylus in lateral view as in Figs. 121,128; hind tibia with 1–2 *pd*; thoracic dorsum irregularly darkened almost all over, sometimes pale with a greyish stripe, or all dark; T4 and T5 all or irregularly dark with a bluish metallic sheen (Japanese specimens from Ishigaki-Jima, Iriomote-Jima, Okinawa-Jima and Indonesian specimen from Java); or all yellow (male specimen from the Philippines) . . . . . *Caiusa kurahashii* **sp. nov.**

8 Surstylus in lateral view rather broad and short (Fig. 160), very gently curved on lower side; in posterior view broad; abdominal T4 and T5 all yellow without any darkening and without metallic sheen (occasionally post-mortem darkening due to internal organs shining through integument, but these are not metallic bluish and disappear completely after KOH treatment, South India and Sri Lanka) or with posterior segments dark even with bluish sheen (2 of 3 Nepal specimens); thoracic dorsum all yellow, sometimes a weak presutural middorsal grey dusted vitta indicated . . . . . *Caiusa testacea*

- Surstylus in lateral view rather long and narrow (Fig. 168), tip usually slightly expanded in exact lateral view; abdominal T4 and T5 wholly or partly dark, dark areas with bluish metallic sheen, sometimes also parts of T3 dark, abdomen never all yellow; thoracic dorsum usually all yellow, though a broad dark presutural middorsal grey dusted vitta just encompassing the *prst acr* setae sometimes present (mimicking the frequent condition in *C. coomani*), sometimes dark all over . . . *Caiusa violacea*

Key to females

Female genitalia should be dissected and closely examined (preferably in a flat mount) before any attempt at identification is made. External adult colour is variable and undue reliance on this feature will likely lead to errors. The ovipositor structure of *C. testacea* is unknown, for which reason this species is excluded from the key.

1 The *h-sc* node on underside of wing with a bundle of black or pale setulae; parafacial setulose or bare; *kepst* 2+1 (lower anterior one sometimes weak or even absent); 3–4 *post dc*; lower surface of scutellum with pale setulae all over, also in middle; wings infuscate (except *P. murphyi*); spermathecae in female very elongate, length about 10–15x width . . . . . Oriental, Australasian and Oceanian *Phumosia* Robineau-Desvoidy

- The *h-sc* node on underside of wing bare [*], but usually a few long black setae at junction of R_1 and R_{2+3} on underside close by; parafacial bare; *kepst* 1+1; 4 *post dc*; lower surface of scutellum with pale setulae absent from middle; wings hyaline; female spermathecae spherical; safe identification requires examination of ovipositor (*Caiusa* Surcouf) 2

2 ST8 short and square with soft setae, one pair longer than the others, no short spine-like setae (Figs. 71, 72, 73, 74, 78, 79, 106, 108, 145, 146, 147); hypoproct neither with spine-like setae, only soft short or long setae not arranged in a distinct V-shaped area (Figs. 71, 72, 73, 74, 79, 108, 145, 146); ST6 and ST7 shorter than wide (Figs. 73, 78, 145) 3

- ST8 very short, easily overlooked, with short strong spinous setae (Figs. 31, 32, 33, 47, 48, 49, 117, 118, 119, 134, 135, 171, 172); hypoproct with numerous strong short spine-like setae grouped together in a well defined V-shaped area (Figs. 33, 47, 49, 118, 135, 172); ST6 wider than long or as wide as long; ST7 always much longer than wide (Figs. 32, 48, 117, 134, 171); T8 without marginal setae 4

3 ST8 and cerci with microtrichiae (Figs. 147, 148); T8 without marginal setae (Fig. 146) . . . . . *C. pooae* **sp. nov.**

- ST8 and cerci without microtrichiae; T8 with marginal setae on both sides (Figs. 74, 79) . . . . . *Caiusa indica*

4 ST6 wider than long (Figs. 48, 117, 134); each T8 half short, wider than long, shaped as an irregular triangle pointing medially (Figs. 49, 118, 135) 5

- ST6 at most as wide as long, rounded (Figs. 32, 171, 195); each T8 half elongate-oval and about twice as long as wide (Fig. 33) or short triangular, as long as wide (Fig. 172) 7

5 T7 sclerotised middorsally only, sclerotised area reaching more than halfway to fore margin, no anteriorly diverging lateral T7 sclerotisations (Figs. 116, 117) . . . . . *Caiusa karrakerae* **sp. nov**.

- T7 sclerotised in two lateral areas, these parts anteriorly diverging, no middorsal sclerotised area (Figs. 48, 134) 6

6 T7 lateral sclerotisations connect broadly posteriorly in the middorsal area; each T7 lateral half somewhat longer than half the width of posterior edge of T7, shorter than ST7 (Fig. 134) . . . . . *Caiusa kurahashii* **sp. nov.**

- T7 lateral sclerotisations do not connect broadly posteriorly in the middorsal area; each T7 lateral half almost as long as ST7 (Fig. 48) . . . . . *Caiusa coomani*

7 T8 half elongate, not triangular, twice as long as broad (Fig. 33) . . . . . *Caiusa borneoensis* **sp. nov.**

- T8 half short, as long as broad, triangular, pointing medially (Figs. 171, 196) . . . . . *Caiusa violacea*

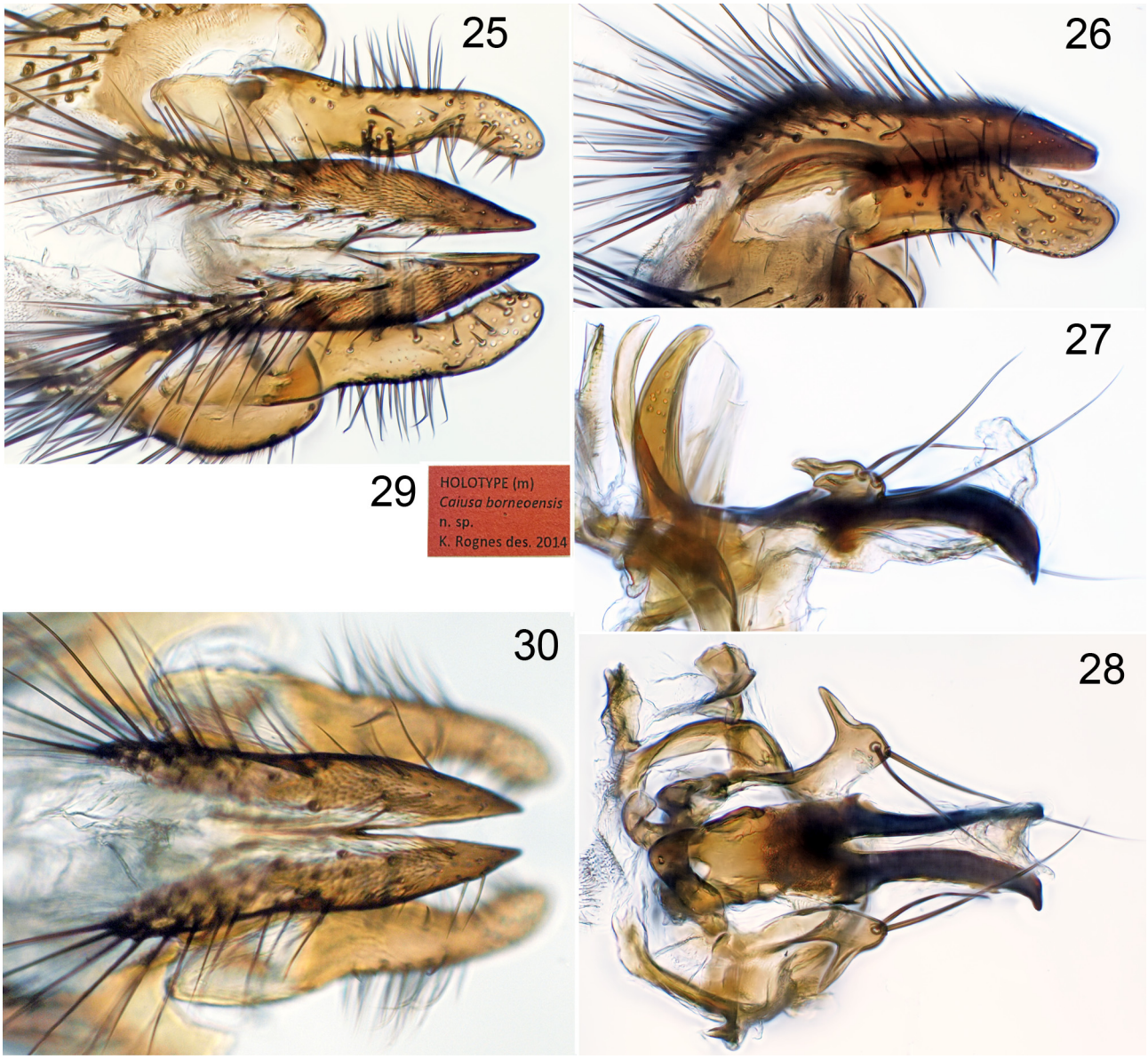
1. *Caiusa borneoensis* sp. nov.

Tables 1, 2; Figs. 25–43.

Holotype male, Malaysia, Sabah, Mt. Kinabalu (KR), here designated. For details, see Type material, below.

Phumosia testacea: Tumrasvin *et al.* 1979: 254, figs. 10, 15, 33, 40, 49, 56, 64. Thailand. Misidentification, not *C. testacea* Senior-White.

Note. Their fig. 15 shows a very short distal section of the pregonite. Their fig. 40 shows a rather narrow V-shaped slit between the tips of the cerci, sometimes found among *C. borneoensis* specimens. Their fig. 56 shows elongate T8 sclerites of the ovipositor and their fig. 64 shows a rounded ST6 and projections directed anteriorly from the base of the hypoproct, probably sclerotised lingulae, also found in *C. borneoensis* females (Fig. 33). They also describe their specimens to have up to 3 *pd* setae on the hind tibia. All of this indicates that they had specimens of *C. borneoensis* before them.



FIGURES 25–30. *Caiusa borneoensis* **sp. nov.** (25–29 from holotype in KR; 30 from male paratype (rhki-t-2) from Thailand in KR). **25.** Cerci and surstyli, posterior view. **26.** Cerci and surstyli, left lateral view. **27.** Aedeagus, pre- and postgonites, left lateral view. **28.** Aedeagus, pre- and postgonites, dorsal view. **29.** Label. **30.** Cerci and surstyli, posterior view.

Etymology. The specific epithet is an adjective derived from the name of the island Borneo with the addition of the suffix *-ensis* meaning "pertaining to," "originating in".

Diagnosis. *Male*. Cerci straight in lateral view, apically its upper edge curving down a little (Fig. 26), but not always. Cerci broad with parallel outer edges in posterior view, in apical third outer edges converging to a point, a narrow slit with almost parallel sides (Fig. 25) or a narrow V-shaped incision (Fig. 30) present between apices. Surstylus in lateral view of even width and curving slightly downward, tip blunt (Fig. 26). In posterior view surstylus curving towards midline distally. Pregonite with the distal process, beyond bases of long setae, short, usually more slender and much shorter than basal part, often appearing like a narrow finger grafted on to the main basal part (Fig. 28). Mesonotum and scutellum clear yellow. Abdominal T4 and T5 dark with a bluish metallic sheen, sometimes also part or almost all of T3 dark. Hind tibia often rather dark, with (1) 2–5 *pd*. Hind tibia often rather dark, in lower third with rather erect *pd* ground setulae in a row (Fig. 39). R_1 sometimes with a row of small black setulae in distal part on upper surface of wing (Fig. 37).

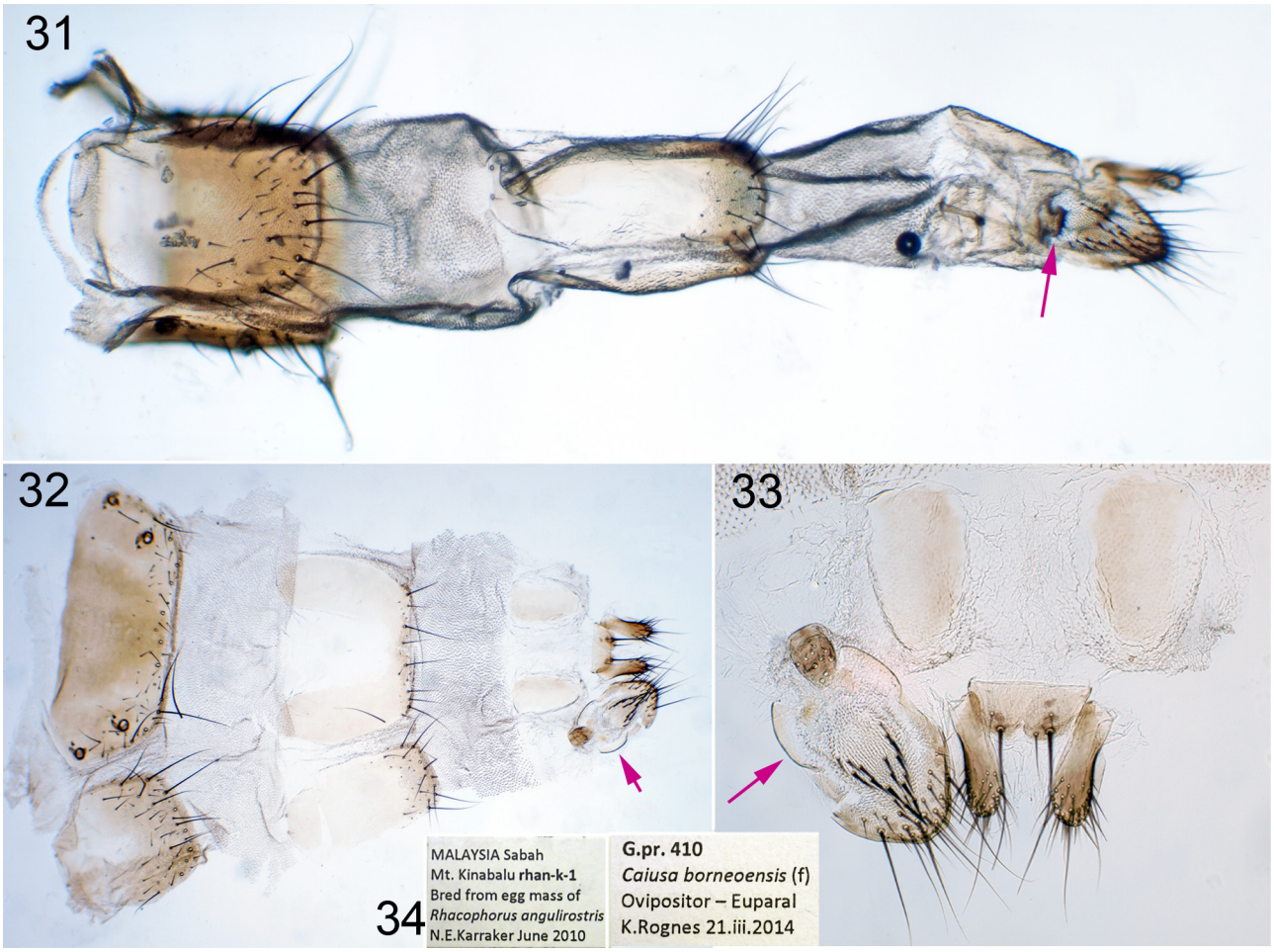
Female. Frons at vertex / head width ratio: 0.275–0.292 (mean 0.283, n=6). In ovipositor T6 wide, moderately short (anteroposteriorly). Ovipositor rather long. ST6 as wide as long, rounded (Fig. 32). T7 halves long, connected

to each other over a short distance posteriorly, no microtrichiae invading this junctional area from behind. ST7 much longer than wide (Fig. 32). T8 without marginal setae (Fig. 33), each T8 half elongate-oval and about twice as long as wide (Fig. 33). ST8 very short, easily overlooked, with short strong spinous setae (Fig. 33). Hypoproct with small spine-like setae grouped together in a well defined V-shaped area (Fig. 33). Sclerotised lingulae proceeding anteriorly from base of hypoproct (Fig. 33). Epiproct with very few setae. Otherwise similar to male.

Immature stages. A single mature first instar larva was found within the uterovaginal tube of two of four dissected wild caught specimens (Figs. 40–42). In the same individuals about 25 large orange (due to yolk) eggs were present (Fig. 43).

Biology. Adults taken on fresh human excrement [assumed to be feeding]. Trapped by fish bait. Taken in light trap. Reared from foam nests of *Rhacophorus annamensis* (Vietnam) by Anna Vassilieva and foam nests of *Rhacophorus angulirostris* (Malaysia, Sabah) and *Rhacophorus kio* (Thailand) (Figs. 14, 15) by N.E. Karraker.

Discussion. The male genitalia display some variation. Several dissected males have a distal narrow V-shaped gap between the apices of the cerci rather than a slit with almost parallel edges, as seen in posterior view. A similarly shaped gap is present in the BMNH male, one of the IDD males from Thailand (#1) and in the KR males from rhki-t-2 (Table 1) (Fig. 30). Among the two males from Vietnam, one has a very narrow slit, the other has a V-shaped gap. In lateral view both Vietnam males have the tip of the cerci almost straight and narrow, upper edge of apex not curving downwards, and the surstylus is narrower than shown in Fig. 26. All *C. borneoensis* males have a pregonite with a short distal part, like a bird's beak. In the Vietnam material the distal part of the pregonite (the 'beak') is even shorter, about half the length of the one shown in Fig. 28, almost just a knob.

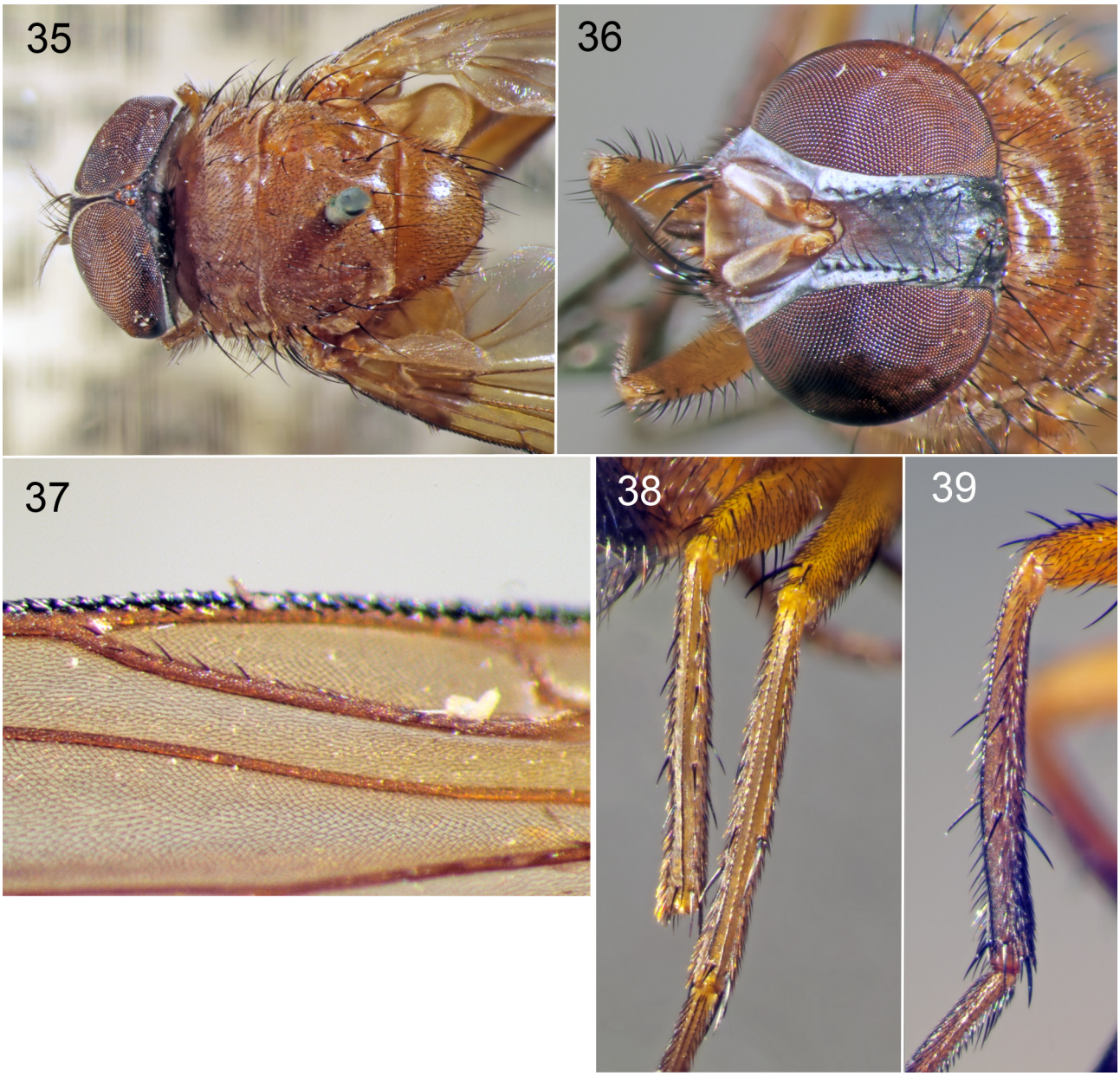


FIGURES 31–34. *Caiusa borneoensis* **sp. nov.** (all from female paratype [rhan-k-1] from Malaysia in KR). **31.** Extended ovipositor before being flat-mounted, ventral view. Arrow points to ST8. **32.** Flat-mounted ovipositor (slide G.pr. 410). Arrow points to lingula on one side. **33.** Tip of ovipositor showing T8, epiproct, cerci, ST8 and hypoproct with lingulae (arrow). **34.** Labels on slide G.pr. 410.

Distribution. Malaysia (Sabah, Sarawak), Thailand, Vietnam.

Type material. Holotype male, in KR, labelled (1) rhan-k-1 / Mt. Kinabalu / Sabah, Malaysia / June 2010 / NE Karraker [printed]; (2) n.sp.B-2 [in pencil]; (3) HOLOTYPE (m) / *Caiusa borneoensis* / n. sp. / K. Rognes des. 2014 [printed on red label]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin between labels 1 and 2. Reared from a foam nest of *Rhacophorus angulirostris*. The specimen has setulae on distal section of R_1 on upper surface of wing.

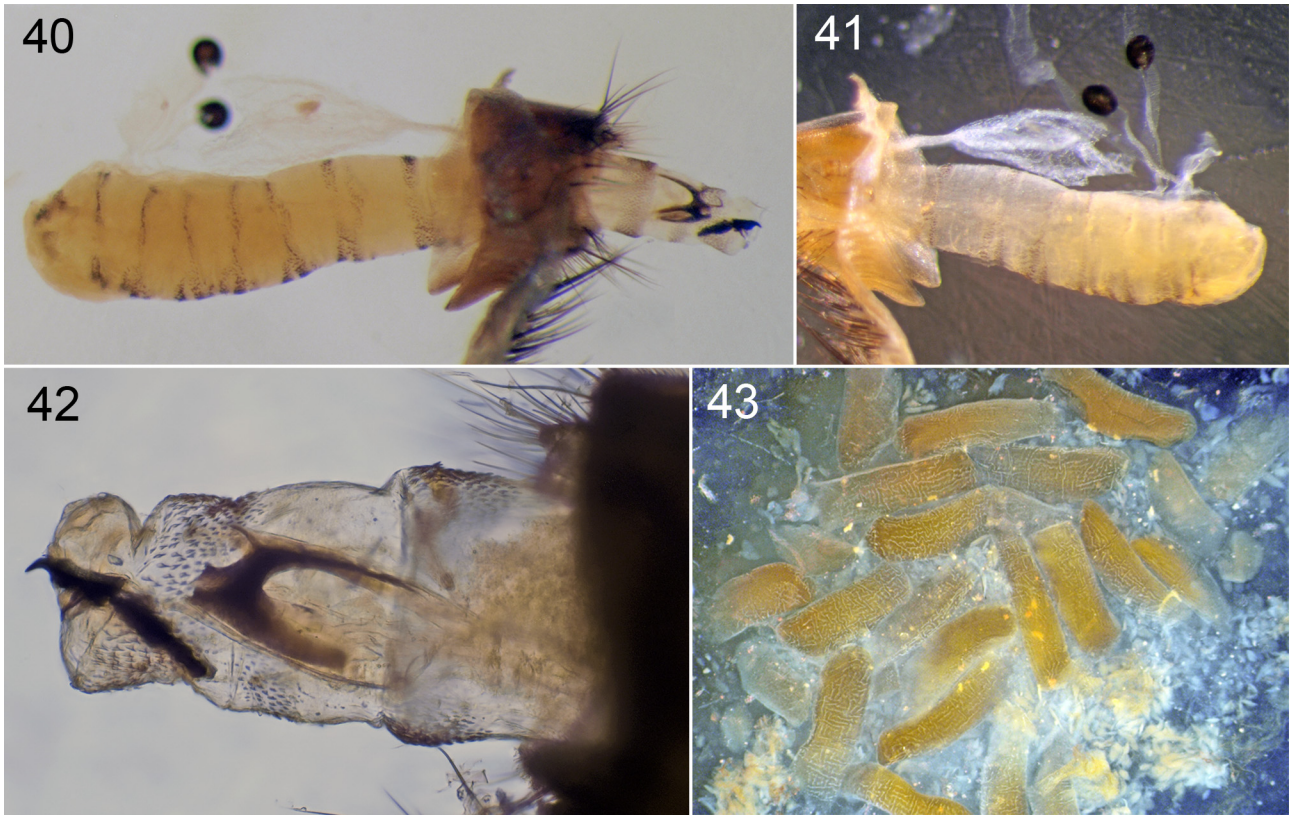
Paratypes (19 males and 16 females). **BMNH: Malaysia (Sarawak)** (1 male and 1 female): 1 male labelled (1) SARAWAK: / Foot of Mt. Dulit. / Junction of rivers / Tinjar & Lejok. / 18.ix.1932 [printed except for day which is handwritten]; (2) H / 274 [handwritten in pencil]; (3) Oxford Univ.Exp. / B.M.Hobby & / A.W.Moore. / B.M.1933-254 [printed]; (4) Trap 1. Fish [printed]; (5) Caiusa / testacea / S.W. / det R.Senior White 1938 [handwritten, except last line which is printed]. T5 and T4 all dark with bluish sheen, T3 also partly dark. Dissected by KR; ST1–5 and genitalia in glycerol in glass microvial on pin; dried T1–5 glued to card on pin. • 1 female labelled (1) SARAWAK: / Foot of Mt. Dulit. / Junction of rivers / Tinjar & Lejok. / 18.ix.1932 [printed except for day which is handwritten]; (2) Oxford Univ.Exp. / B.M.Hobby & / A.W.Moore. / B.M.1933-254 [printed]; (3) Trap 1. Fish [printed]; (4) Caiusa / testacea / S.W. / det R.Senior White 1938 [handwritten, except last line which is printed]. T5 and T4 all dark with bluish sheen, T3 also partly dark. **BPBM**: **Malaysia (Sabah)** (10 females): 1 female labelled (1) NORTH BORNEO (SE) / Forest Camp, 19km / N. of Kalabakan / 19.XI.1962; (2) K.J. Kuncheria / Collector / BISHOP; (3) Phumosia ♀ / testacea / (S.-White, 1923) / Det. H. Kurahashi. Dissected by KR. T1–5 glued to card on pin. ST1–5 and ovipositor with spermathecae and a mature first instar larva (Figs. 40–43) in glycerol in glass microvial on pin. Given a white handwritten "diss. #1" label. • 1 female labelled (1) NORTH BORNEO (SE) / Forest Camp, 19km / N. of Kalabakan / 17.XI.1962; (2) K.J. Kuncheria / Collector / BISHOP; (3) Phumosia ♀ / testacea / (S.-White, 1923) / Det. H. Kurahashi. • 1 female labelled (1) NORTH BORNEO (SE) / Forest Camp, 19km / N. of Kalabakan / 17.XI.1962; (2) K.J. Kuncheria / Collector / BISHOP; (3) Phumosia ♀ / testacea / (S.-White, 1923) / Det. H. Kurahashi. • 1 female labelled (1) NORTH BORNEO (SE) / Forest Camp, 19km / N. of Kalabakan / 60m, 14.XI.1962; (2) K.J. Kuncheria / Collector / BISHOP; (3) Phumosia ♀ / testacea / (S.-White, 1923) / Det. H. Kurahashi. • 1 female labelled (1) NORTH BORNEO (SE) / Forest Camp, 19km / N. of Kalabakan / 60m, 24.X.1962; (2) K.J. Kuncheria / Collector / BISHOP; (3) Phumosia ♀ / testacea / (S.-White, 1923) / Det. H. Kurahashi. • 1 female labelled (1) NORTH BORNEO (SE) / Forest Camp, 19km / N. of Kalabakan / 60m, 21.X.1962; (2) K.J. Kuncheria / Collector / BISHOP; (3) Phumosia ♀ / testacea / (S.-White, 1923) / Det. H. Kurahashi. • 1 female labelled (1) NORTH BORNEO (SE) / Forest Camp, 19km / N. of Kalabakan / 8.XI.1962; (2) Y. Hirashima / Collector / BISHOP; (3) Phumosia ♀ / testacea / (S.-White, 1923) / Det. H. Kurahashi. • 1 female labelled (1) NORTH BORNEO (SE) / Forest Camp, 19km / N. of Kalabakan / 19.XI.1962; (2) K.J. Kuncheria / Collector / BISHOP; (3) Phumosia ♀ / testacea / (S.-White, 1923) / Det. H. Kurahashi. • 1 female labelled (1) NORTH BORNEO (SE) / Forest Camp, 19km / N. of Kalabakan / 30.X.1962; (2) Y. Hirashima / Light Trap / BISHOP; (3) Phumosia ♀ / testacea / (S.-White, 1923) / Det. H. Kurahashi. Dissected by KR. T1–5 glued to card on pin. ST1–5 and ovipositor with spermathecae and a mature first instar larva in glycerol in glass microvial on pin. Given a white handwritten "diss. #2" label. • 1 female labelled (1) BORNEO (BRIT. N.) / Sandakan Bay (NW) / Sepilok For. Res. / 1–10m., X-26-1957; (2) Ex fresh human / excrement; (3) J. L. Gressitt / Collector; (4) Phumosia ♀ / testacea / (S.-White, 1923) / Det. H. Kurahashi. **IDD**: **Malaysia (Sarawak)** (3 males and 1 female): 1 male labelled (1) MALAYSIA: BORNEO / Sarawak State, / Kuching Division, / Borneo Highlands, / forest, 1034m, 16-18.ix.11 / Coll. S.H. Tan [printed on white label]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 male labelled (1) MALAYSIA: BORNEO / Sarawak, Lanjak- / Entimau Wildlife / Sanctuary, Engkai R. / forest, 29.vi-3.vii.2012 / Coll. Kurahashi. Dissected by KR; ST1–5 and genitalia in glycerol in glass microvial on pin; dried T1–5 glued to card on pin. • 1 male labelled (1) MALAYSIA: BORNEO / Sarawak State, / Sibu Division, / Lanjak Entimau Wildlife / Sanctuary, Helipad / hill top, 161m, 7-8.ix.2011 / Col. H. Kurahashi. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 female labelled (1) MALAYSIA: BORNEO / Sarawak State, / Kuching Division, / Borneo Highlands, forest / 1034m, 16-18.ix.2011 / Col. H. Kurahashi. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. **Thailand** (4 males and 1 female): 1 male ("no.1") labelled (1) THAILAND: CHIANG MAI / Sirindhorn Observatory / Doi Suthep-Pui National Park / 817m, 11.iii.2011 / Coll. Hiromu Kurahashi. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial



FIGURES 35–39. *Caiusa borneoensis* **sp. nov.** (35, 36, from male and female paratypes from Malaysia, Sarawak, in BMNH; 37, from dissected female paratype from Malaysia, Sabah, in BPBM; 38, from female paratype from Malaysia, Sabah, in BPBM; 39, from male paratype from Malaysia, Sarawak, in IDD). **35.** Head and thorax, dorsal view. **36.** Female head, anterodorsal view. **37.** Part of left wing with vein R_1, from above. **38.** Right hind and mid tibia, posterior view. **39.** Right hind tibia, anterodorsal view.

on pin. • 1 male ("no.2") labelled (1) THAILAND: CHIANG MAI / Sirindhorn Observatory / Doi Suthep-Pui National Park / 817m, 11.iii.2011 / Coll. Hiromu Kurahashi. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 male labelled (1) THAILAND: CHIANG MAI / Sirindhorn Observatory / Doi Suthep-Pui National Park / 817m, 11.iii.2011 / Coll. Hiromu Kurahashi. Not dissected. • 1 female labelled (1) THAILAND: CHIANG MAI / Sirindhorn Observatory / Doi Suthep-Pui National Park / 817m, 11.iii.2011 / Coll. Hiromu Kurahashi; (2) Ovipositor turned inside out / by accident, still T8 visible as long oval sclerites and / ST6 as long as broad / K. Rognes 2014. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5, ovipositor and spermathecae in glycerol in glass microvial on pin between labels 1 and 2. • 1 male (staged with long pin for specimen through large foam stage) labelled (1) THAILAND: CHIANG MAI / Doi Suthep-Pui Mt. / Sirindhorn Observatory / 817m, 15.xi.2011 / Coll. H. Kurahashi. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. **KR: Malaysia (Sabah):** 8 males and 1 female

labelled (1) rhan-k-1 / Mt. Kinabalu / Sabah, Malaysia / June 2010 / NE Karraker. Three of the males dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. One female dissected by KR. Dried T1–5 glued to card on pin. Yellow label reading #410 refers to slide G.pr. 410. All specimens reared from a foam nest of *Rhacophorus angulirostris*. The holotype is from the same reared series. **Thailand:** 3 males and 2 females labelled (1) rhki-t-2 / Sakaerat ERS / Thailand / 30 Aug 2011 / NE Karraker. One of the males has a label (2) B / K. Rognes det. [first line handwritten]. Two males dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. One female dissected by KR. Dried T1–5 glued to card on pin. ST1–5, spermathecae and extended ovipositor in glycerol in glass microvial on pin. All specimens reared from foam nest of *Rhacophorus kio*.



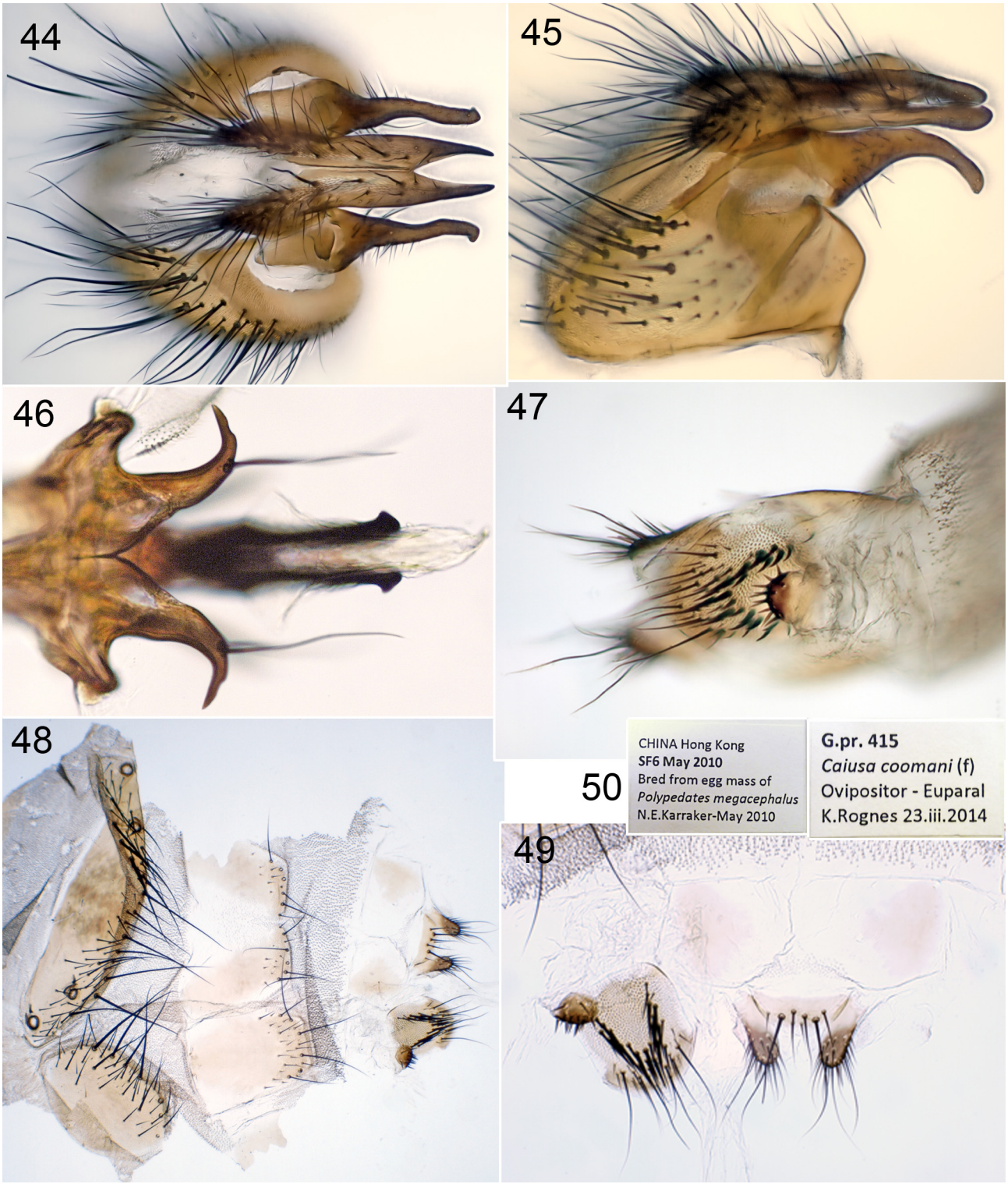
FIGURES 40–43. *Caiusa borneoensis* **sp. nov.** (all from dissected female paratype, "diss #1", from Malaysia, Sabah, in BPBM; 40, 41, 43, through stereomicroscope, 42, through compound microscope). **40.** Mature first instar larva halfway out of ovipositor tip, note yellow-coloured inside due to yolk. **41.** Mature first instar larva halfway out of ovipositor tip, different background lighting. **42.** Anterior end of larva, showing parts of mouthparts broken. **43.** Yolk-filled eggs.

Other material. KR: Vietnam: 2 males and 3 females, labelled (1) ABV-00195 (m) or (f) / VIETNAM, Dak Lak province / Krong Bong district, approximate / coordinates 12°23'42"N, / 108°21'01"E, nearly 1000 m a.s.l. / Anna Vassilieva leg. 19.iv.2013 / (pinned from alcohol by K. Rognes). The specimens are very immature and incompletely sclerotised. The presence of a dark middorsal stripe on mesonotum is possibly due to immaturity and hence incompletely formed internal organs. None of the males have setulae on R_1, but two of the three females have either 4 setulae on right side and 2 on left, or 1 on left and 1 on right side. Hind tibia with 3–4 *pd* on left side, 3 *pd* on right side (males), and 2–4 *pd* on both sides (females). T4 and T5 dark with bluish sheen. T3 also partly dark. Reared from the foam nest of *Rhacophorus annamensis*.

2. *Caiusa coomani* Séguy, 1948

Table 1; Figs. 44–63.

Lectotype male, Vietnam, Hoa Binh Province (MNHN), by designation of Rognes (2011a: 28)



FIGURES 44–50. *Caiusa coomani* Séguy (44–46, from male from Hong Kong, in KR ["OF4"]; 47–50, from female from Hong Kong, in KR ["SF6"]). **44.** Cerci and surstyli, posterior view. **45.** Cerci, surstyli and epandrium, left lateral view. **46.** Pregonites, ventral view. **47.** Tip of ovipositor, oblique ventral view, before being flat-mounted. **48.** Flat-mounted ovipositor, G.pr. 415. **49.** Tip of flat-mounted ovipositor, G.pr. 415. **50.** Labels on slide G.pr. 415.

Caiusa coomani Séguy, 1948: 146.

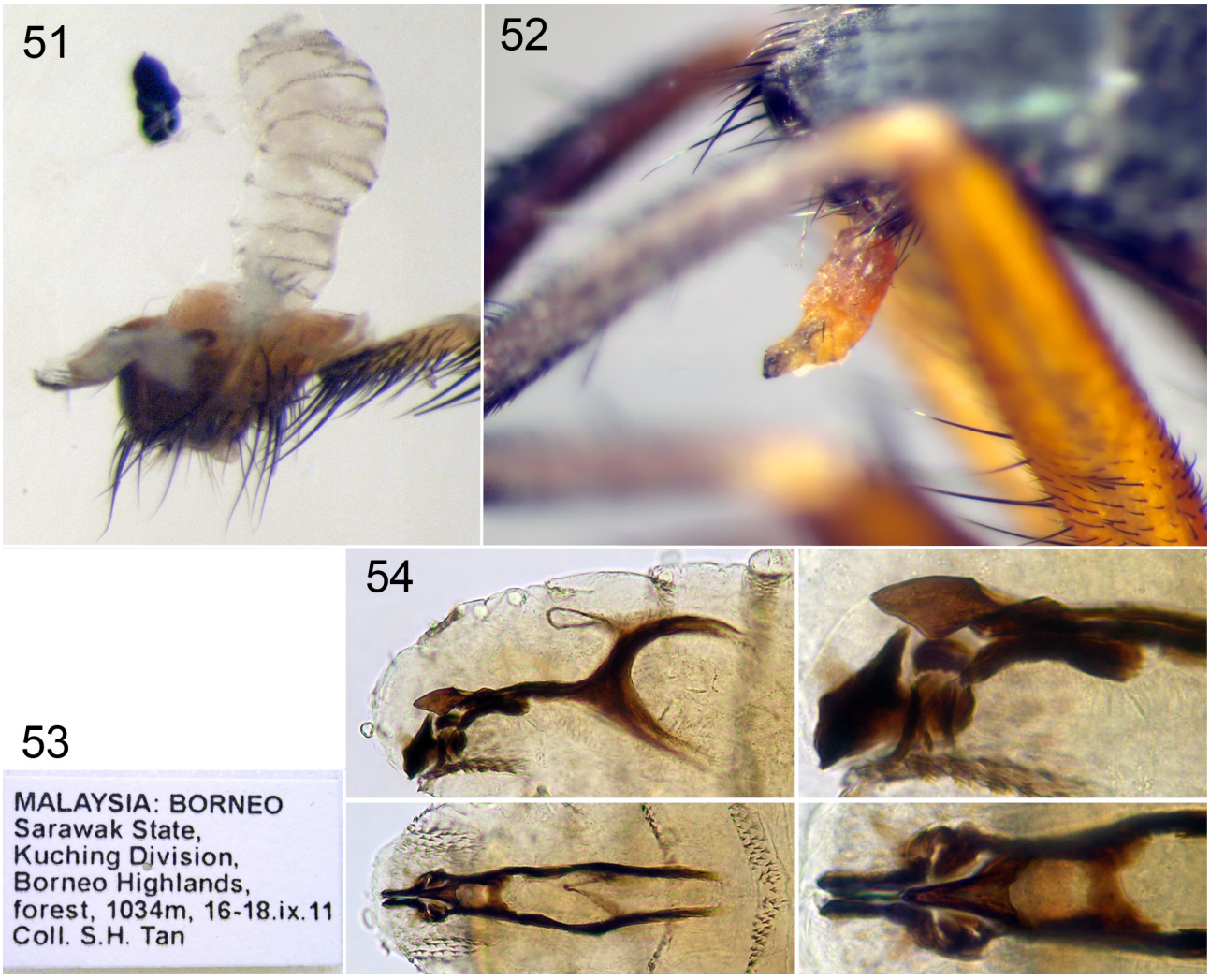
Phumosia coomani: Kurahashi *et al.* 1997: 24. Female in BPBM referred to as "… Kuala Lumpur, 24–31 Dec. 1958, L.W. Quate" examined and dissected (see below for details of specimen). Correctly identified.

Phumosia indica: Kurahashi *et al.* 1997: 27. Male in BPBM labelled "… Forest Camp, 19 km N of Kalabakan, 4 Nov. 1962, K.J.Kuncheria leg." seen and dissected. Misidentification, not *C. indica* Surcouf (see below for details of specimen).

Phumosia coomani: Rognes 2011a. Lectotype designation; records from China (Hong Kong); description and figures of male genitalia; rearing records from foam nests of *Polypedates megacephalus*.

Phumosia coomani: Karraker 2013. Investigation of survival of embryos of *Polypedates megacephalus* in foam nests infested by larvae of *Caiusa coomani* in China (Hong Kong) in shaded and not shaded conditions.

Diagnosis. *Male.* Cerci straight, apically not bent backwards in lateral view. Cerci rather narrow, in posterior view with a broad U or V-shaped bay in apical half, with pointed tips, tips flattened from side to side apically (Fig. 44). Surstylus broad basally, very narrow distally, distal narrow part curving strongly downwards in lateral view (Fig. 45). Surstylus in posterior view curving slightly inwards first and then outwards again apically. Mesonotum varying from all yellow-orange to darkened all over. Scutellum yellow. A presutural middorsal grey or dark vitta on yellow-orange background just encompassing *prst acr* setae often present but not always and not diagnostic. T4 and T5 usually all dark with bluish metallic sheen. Hind tibia with 2 (–3) *pd*. Distal part of R_1 usually bare, extremely rarely with 1–3 small setulae (1 male of those without code in Table 1).



FIGURES 51–54. *Caiusa coomani* Séguy (51, from female from Malaysia, Sarawak, Kurahashi leg., in IDD; 52–54, from female from Malaysia, Sarawak, Tan leg., in IDD). **51.** Mature first instar larva within uterus. **52.** Mature first instar larva protruding from tip of abdomen. **53.** Labels on specimen with protruding larva. **54.** Mouthparts of first instar larva that had been protruding from ovipositor tip. Left: lateral (upper) and dorsal (lower) views. Right: close-up of distal mouthparts (reproduced by courtesy of K. Szpila).

Female. Frons at vertex / head width ratio: 0.258–0.330 (mean 0.297, n= 16). In ovipositor T6 broad, very short (anteroposteriorly). ST6 much wider than long (Fig. 48). ST7 rather wide, but much longer than wide. T7 halves long, not connected to each other posteriorly, microtrichiae invading area between posterior third of T7 halves. T8 short, about as long as broad, without marginal setae. ST8 very short. Hypoproct with spinous setae in a well defined V-shaped area, arms of the V being narrow. Otherwise as in male.

Immature stages. A mature first instar larva was present in the uterovaginal tube ready to be deposited in 3 of 5 dissected wild caught females (Figs. 51, 52). Mouthparts of a larva shown in Fig. 54. A puparium was present on pin of 2 males and 2 females from Malaysia (all tagged "01107") in WSU and on 1 male and 1 female similarly tagged in USNM (Figs. 56–58, 62). Anterior spiracle fan with 9–10 branches. Posterior spiracle with slanting slits. Inner end of middle slit not far retracted from level of inner end of upper and lower slits (Fig. 57).

Biology. Reared from foam nests of *Polypedates megacephalus* (Hong Kong), *Polypedates leucomystax* (Malaysia, Singapore, Thailand) (Table 1). Labels occur on museum material with annotations "hatched out from frog spawn" (Malaysia) and "reared; foam nest of frog *Polypedates*".

Discussion. An easily identified species in the male sex, particularly because of the downwardly bent surstylus in lateral view. Variations in the darkness of the mesonotum has led to numerous misidentifications in collections, specimens with dark mesonotum misidentified as *C. indica*, and specimens with pale mesonotum as *C. testacea*.

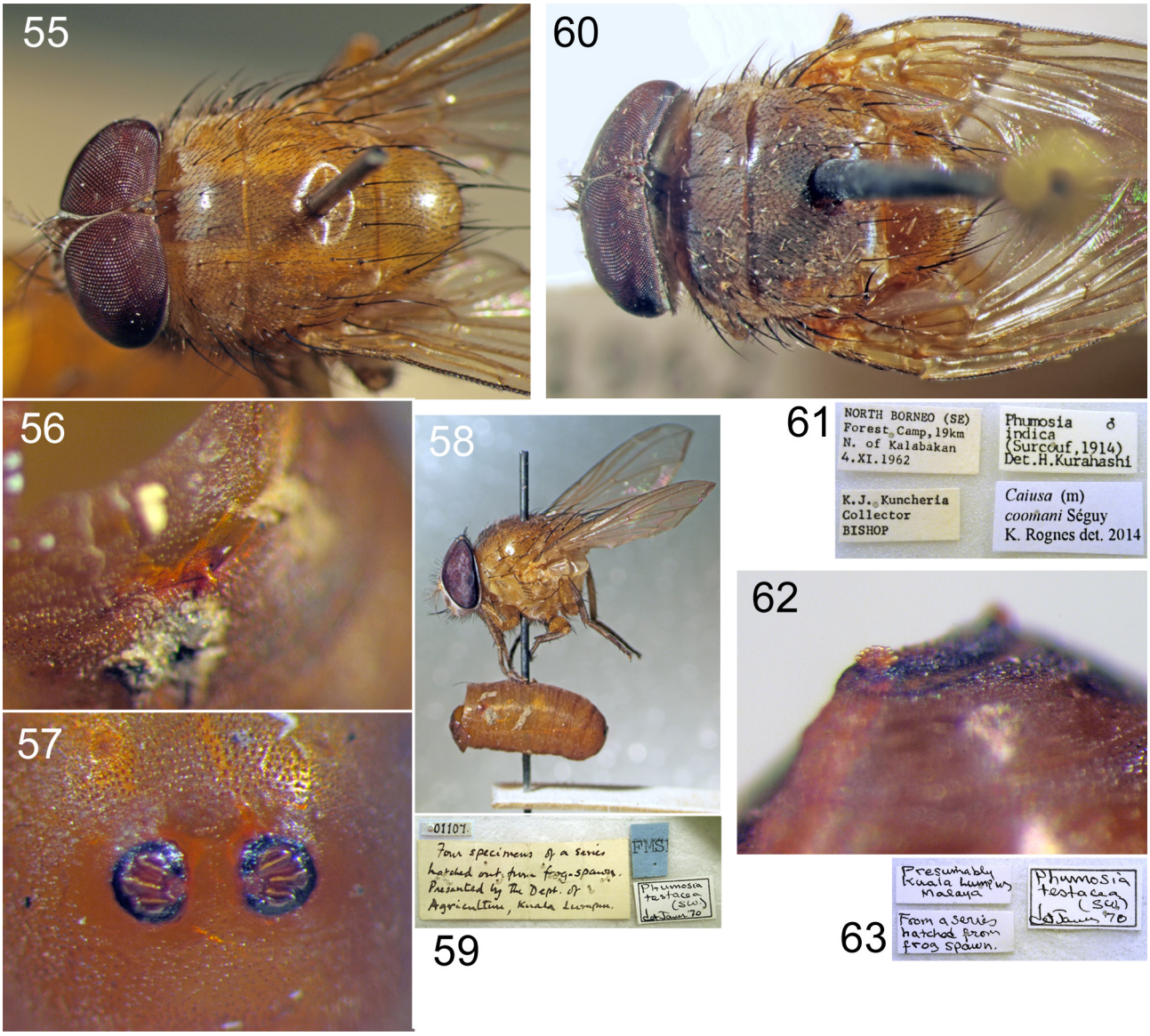
Distribution. China (Hong Kong); Malaysia (Sabah, Sarawak, West Malaysia); Singapore; Thailand; Vietnam. Published records of "*Caiusa coomani*" from Taiwan and mainland China (Fan 1965, Fan 1992, Fan 1997, Feng *et al*. 1998, Lin *et al*. 2000, Lue & Lin 2000) are based on misidentifications of specimens of *C. violacea*.

Material examined. Type material. Lectotype male (MNHN), Vietnam [as "Tonkin"], Hoa-Binh province. See Rognes (2011a) for details.

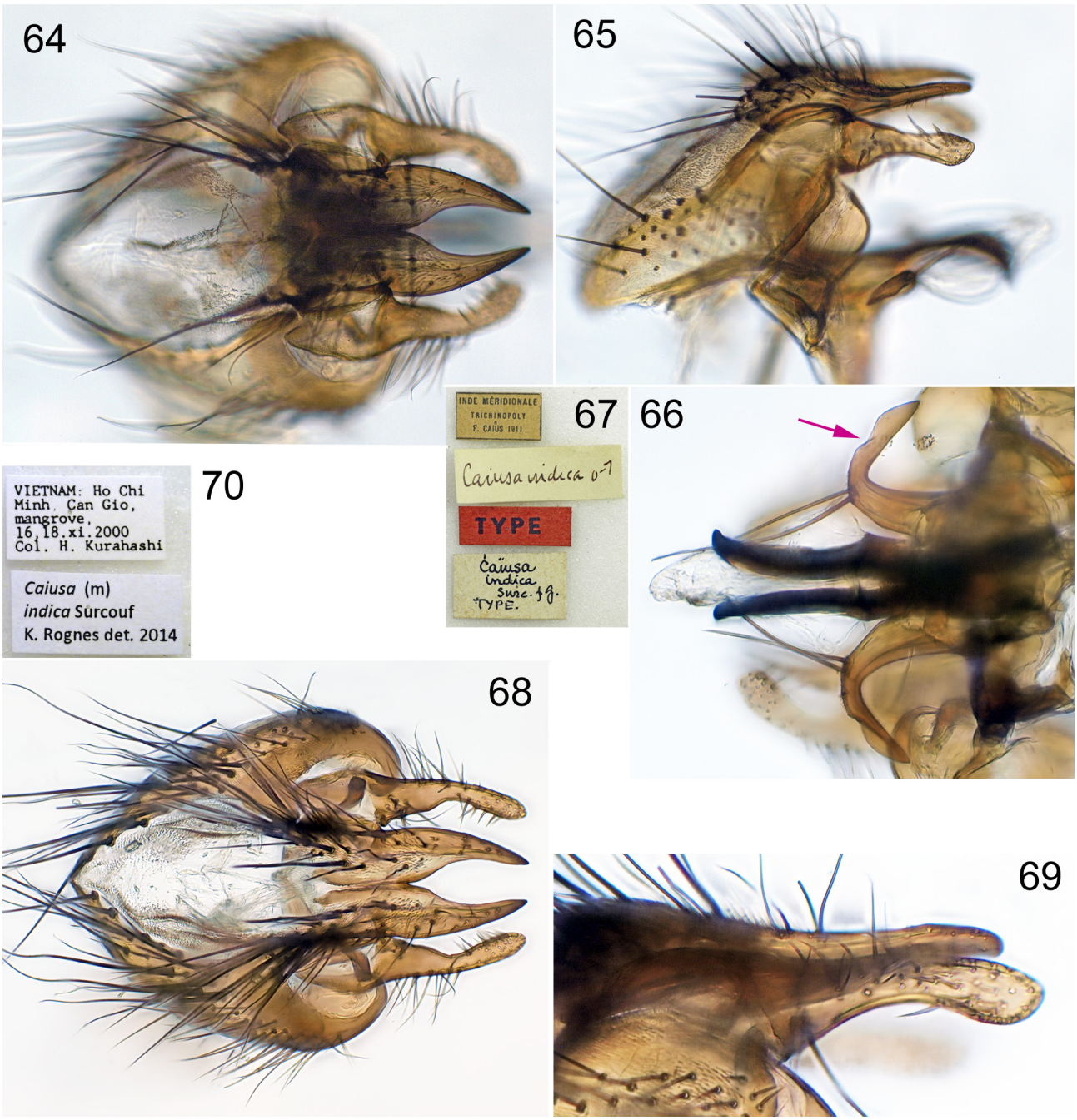
Other material. BMNH: Malaysia (West Malaysia): 1 male labelled (1) WEST MALAYSIA / Trengganu / Terangan. [printed, except last line which is handwritten]; (2) MARDI M10954 / 10-13.10.83 Hanifah col. [printed, except date and number after the M in first line]; (3) C.I.E.COLL / A. 15881 [yellow label; printed except number]. Most of T4 and all T5 bluish black. Dissected by KR. Dried T1–5 glued to card on pin, with a leg. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 male labelled (1) F.M.S. [Federated Malay States] / Taiping. / W.B. Orme. / B.M.1911-181. [printed]; (2) Caiusa / testacea / S.W. / det.R.Senior White 1938 [handwritten except last line which is printed]. Dissected by KR. Dried T1–5 glued to plastic stage plate. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 female labelled (1) F.M.S. [Federated Malay States] / Taiping. / W.B. Orme. / B.M.1911-181. [printed]; (2) Caiusa / testacea / S.W. / det.R.Senior White 1938 [handwritten except last line which is printed]. Not dissected. Identity assumed since associated with a male captured at the same time and place. **Singapore:** 1 male labelled (1) Bukit Timah Forest / SINGAPORE / D.H. Murphy 5.2.76 / Taban Valley [printed except date and last line]; (2) Caiusa sp? / narrow yellow / palps. / D.H. Murphy det. [pencil handwriting, except last line which is printed]. Genitalia in a drawn out position and clearly visible. **BPBM: Malaysia (Sabah):** 1 male labelled (1) NORTH BORNEO (SE) / Forest Camp, 19km / N. of Kalabakan / 4.XI.1962 [printed]; (2) K.J. Kuncheria / Collector / BISHOP [printed]; (3) Phumosia ♂ / indica / (Surcouf, 1914) / Det. Kurahashi [printed]. [Published by Kurahashi *et al*. 1997, p. 27]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Mesonotum dark, scutellum yellow (Fig. 60). • 2 females labelled (1) NORTH BORNEO / Tawau District / Kalabakan, Primary / Forest, 8-15.XI.58 [printed]; (2) Fish Bait Trap [printed]; (3) L.W. Quate / Collector [printed]; (4) Phumosia ♀ / indica / (Surcouf, 1914) / Det. Kurahashi [printed]. Both dissected by KR, both with T1–5 glued to card on pin. One specimen has an additional label (5) G.pr. 420, the uterus with spermathecae in glycerol in glass microvial on pin, and ST1–5 and ovipositor flat mounted on a separate slide numbered G.pr. 420. The second female has the ST1–5 and ovipositor in glycerol in glass microvial on pin. Both have dark mesonotum, yellow scutellum. **Malaysia (West Malaysia):** 1 female labelled (1) MALAYA / Kuala Lumpur / 24-31.XII.1958; (2) L. W. Quate / Collector; (3) Phumosia ♀ / coomani / (Séguy, 1948) / Det. Kurahashi. [Published by Kurahashi *et al*. 1997, p. 24]. Pale mesonotum with narrow dark middorsal thoracic stripe. Dissected by KR. Ovipositor segments 7 and 8 were inverted into the abdomen, a first instar larva present in the uterus. ST1–5 with telescoped ovipositor and first instar larva in situ in glycerol in glass microvial on pin. [I had an accident with this specimen. Most of the legs were broken off, but glued back to card (1 fore leg, 1 mid leg, one hind leg and one hind tibia)]. **IDD: Malaysia (Sarawak):** 1 male labelled (1) MALAYSIA: BORNEO / Sarawak State, / Sibu Division, / Katibas River, / Tupang River, / forest, 11.ix.2011 / Col. H. Kurahashi; (2) Caiusa (m) / coomani Séguy / K. Rognes det. 2014. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and

genitalia in glycerol in glass microvial on pin. Mesonotum dark. Scutellum yellow. • 1 female labelled (1) MALAYSIA: BORNEO / Sarawak State, / Sibu Division, / Katibas River, / Dujau River, / forest, 10.ix.2011 / Col. H. Kurahashi; (2) Caiusa (f) / coomani Séguy / K. Rognes det. 2014 / + larva I. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and extended ovipositor with first instar larva and spermathecae inside, in glycerol in glass microvial on pin between labels (Fig. 51, which shows a photograph of larva inside uterovaginal tube with spermathecae before extension of ovipositor). Mesonotum dark like in *C. indica*. Scutellum yellow. • 1 female labelled (1) MALAYSIA: BORNEO / Sarawak State, / Kuching Division, / Borneo Highlands, / forest, 1034m, 16-18.ix.11 / Coll. S.H.Tan; (2) Caiusa (f) / coomani Séguy / K. Rognes det. 2014; (3) Protruding part of a / first instar larva / sent to K. Szpila / 9 October 2013. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and ovipositor (with posterior part of first instar larva) in glycerol in glass microvial on pin. Mesonotum dark. *Note*. This female had a first instar larva protruding from tip of abdomen (Fig. 52). I succeeded in getting the larva loose and sent it to K. Szpila (Poland) who prepared the mouthparts (Fig. 54). Later it turned out that what he got was only the anterior half of the larva. Subsequently I dissected the abdomen and prepared the ovipositor. The remaining parts of the larva remained within the ovipositor. **Thailand:** 1 male (staged with very long stage pin) labelled (1) THAILAND: CHIANG MAI / Mae Taeng Dist. / Mae Taeng Elephant Camp / 345m 14.xi.2011 / Coll. H. Kurahashi; (2) Caiusa (m) / coomani Séguy / K. Rognes det. 2014. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 male (staged with very long stage pin) labelled (1) THAILAND: CHIANG MAI / Doi Suthep-Pui Mt. / Tham Phra Leusri / 15.xi.2011 / Coll. H.Kurahashi; (2) Caiusa (m) / coomani Séguy / K. Rognes det. 2014. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Both with mesonotum pale orange, with presutural dark middle stripe. Hind tibia with 2 *pd*. **Vietnam:** 1 male labelled (1) VIETNAM: Ninh Binh / Prov., Gia Vien / Cuc Phuong, 170m / 10-11.vii.1997 / Col. H. Kurahashi [printed]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. **KR** (Table 1): **China (Hong Kong)** (69 males 77 females): 1 male 1 female labelled (1) CHINA, Hong Kong / Lamma Island, Tai Peng / 19.V.2009 / Nancy Karraker leg.; (2) Reared from eggs of / the brown tree frog / *Polypedates megacephalus* / Received from Terry / Whitworth Sept. 2009); (3) *Caiusa* (m) / *coomani* Séguy / K. Rognes det. 2009. [Specimens included in Rognes 2011a]. • 2 males and 2 females labelled (1) Hong Kong Lamma Island / Tai Peng / 19 May 2009 / N. Karraker / Reared from eggs of / Polypedates megacephalus (brown tree frog) [Unavailable at the time for inclusion in Rognes (2011a)]. • 16 males and 24 females from Hong Kong, Lamma Island, Taipeng, 19 May 2009 and May 2010 (reared from foam nests of *Polypedates megacephalus*) [Specimens included in Rognes (2011a) who gave the total number as "18 males and 24 females", whereas the correct sum is 17 males and 25 females]. 8 males and 5 females dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia (spermathecae and ovipositors in case of females) in glycerol in glass microvial on pin. Three of the females with flat mounted ovipositor on microscope slides # 409, 414, 415. • 50 males and 50 females from Hong Kong, Lamma Island, Taipeng, 3–10 July 2014 (reared from foam nests of *Polypedates megacephalus*) (pome-h1, pome-h2, pome-h3, pome-h4, pome-h5) 4 males 0 females dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia (spermathecae and ovipositors in case of females) in glycerol in glass microvial on pin. **Malaysia (Sabah):** 2 males and 3 females labelled (1) pole-d-1 / Danum Valley / Sabah, Malaysia / 7 Nov 2010 / J Sheridan [printed]. Reared from foam nest of *Polypedates leucomystax*. 1 male dissected by KR. Dried T1–5 glued to card on pin, together with a lost leg. ST1–5 and genitalia in glycerol in glass microvial on pin. **Singapore:** 4 males and 6 females labelled (1) pole-s-1 / Singapore / May 2011 / S Poo [printed]. Reared from *Polypedates leucomystax*. 2 males dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. **Thailand:** 1 male labelled (1) pole-t7 / Sakaerat ERS / Thailand / 8 August 2014 / NE Karraker / M [handwritten in pencil across right edge of label]. Reared from *Polypedates leucomystax*. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. [Mixed infestation with *C. violacea*.]. **NHRS: Malaysia (West Malaysia):** 1 male labelled (1) sample / #2 [handwritten]; (2) Malaysia: / Kuala Lumpur / late May 2003 / M. Kennedy [printed]; (3) Reared; foam / nest of frog / *Polypedates* [printed]; (3) Hunterian Mus // GLAHM // Zoo/24/2003 [printed]; (5) NHRS-BYWS / 000000842 [printed in boldface]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Pale mesonotum with greyish stripe under some angles of light. 2 *pd* on each hind tibia. Pinned from the side. Teneral. **USNM: Malaysia (West Malaysia):** 1 male labelled (1) 01107 / Malaya / Serdang [now = Seri Kembangan, Selangor province] / 23.7.1936 / Entom.Div. / Agric. Dept. / Frog's eggs [lines 1, 3, much of 4, and 7 handwritten]; (2) N. Baranov / Coll. 1960 [printed]; (3) Caiusa / testacea / S.W. [handwritten]; (4) Loan from / USNMNH /

2067772 [printed]. Genitalia visible. Staged, puparium on smaller pin below specimen. • 1 female labelled (1) 01107 / Malaya / Serdang / 23.7.1936 / Entom.Div. / Agric. Dept. / Frog's eggs [lines 1, 3, much of 4, and 7 handwritten]; (2) N. Baranov / Coll. 1960 [printed]; (3) Caiusa / testacea / S.W. [handwritten]; (4) Loan from / USNMNH / 2067772 [printed]. Staged, puparium below specimen on smaller pin. *Note*. 4 specimens (2m 2f) of *Caiusa coomani* in WSU (see below) have a 01107 tag, these WSU specimens hatched out of frog spawn, all four with puparium. The USNM specimens are probably from the same reared series. **WSU: Malaysia (West Malaysia):** 1 male labelled (1) 01107 [printed on reverse side]; (2) Four specimens of a series / hatched out from frog-spawn. / Presented by the Dept. of / Agriculture, Kuala Lumpur. [handwritten on large folded label]; (3) FMS [printed on blue label]; (4) Phumosia / testacea / (SW.) / det. James '70 [handwritten]. The specimen carries a puparium. Dissected by KR. Dried T1–5 glued to stage. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 male labelled (1) 01107 [printed on reverse side]; (2) Presumably / Kuala Lumpur / Malaya [handwritten by James]; (3) From a series / hatched from / frog spawn. [handwritten by James]; (3) Phumosia / testacea / (SW.) / det. James '70 [handwritten]. The specimen caries a puparium. • 2 females labelled (1) 01107 [printed on reverse side]; (2) Phumosia / testacea / (SW.) [handwritten]; (2) FMS [printed on blue label]. Both specimens carry a puparium.



FIGURES 55–63. *Caiusa coomani* Séguy (55–59, from male #2 from Malaysia, Kuala Lumpur, in a series of 4 specimens reared from frog spawn; 60, 61, from male from Malaysia, Sabah, in BPBM; 62, 63, from male #1 from Malaysia, Kuala Lumpur, in a series of 4 specimens reared from frog spawn). **55.** Head and thorax, dorsal view. **56.** Anterior puparial horn. **57.** Posterior spiracles of puparium. **58.** Staged specimen with puparium. **59.** Labels on staged specimen. **60.** Head and thorax dorsal view. **61.** Labels. **62.** Anterior puparial spiracle fan. **63.** Labels.



FIGURES 64–70. *Caiusa indica* Surcouf, male (64–67, from lectotype in MNHN; 68–70, from male from Vietnam in IDD). **64.** Cerci and surstyli, posterior view. **65.** Cerci, surstyli and epandrium, left lateral view. **66.** Distiphallus and pregonites, ventral view. Arrow points to very long distal section of pregonite. **67.** Labels. **68.** Cerci and surstyli, posterior view. **69.** Cerci and surstyli, left lateral view (enlarged). **70.** Labels.

3. *Caiusa indica* Surcouf, 1920

Figs. 64–109.

Lectotype male, India, Tamil Nadu, Tiruchirappalli (as "Trichinopoly") (MNHN), here designated. For details, see Type material, below.

Caiusa indica Surcouf, 1920: 53.

Caiusa [without name]: Surcouf 1920: 54.

Note. "Nous rapportons à ce genre un insecte appartenant au P^r^ BEZZI et qui provient de Queensland. Il se rapproche de *Phumosia analis* Macquart (1843) [now = *Phumosia abdominalis* Robineau-Desvoidy, 1830] et en diffère par la bande frontale noire en entier, la couleur de l'apex de l'abdomen et par l'aile qui est uniformément rembrunie. Le thorax entièrement jaune écarte cette espèce de *Caiusa indica*.

[*We assign to this genus an insect belonging to P^r^ BEZZI. It ressembles* Phumosia analis *Macquart and differs from it by the all black frontal vitta, by the colour of the apex of the abdomen and by the wing which is uniformly light brownish. The entirely yellow thorax sets this species apart from* Caiusa indica]". For more on this specimen, see entry for *Caiusa surcoufi* Bezzi, below.

Caiusa indica: Senior-White 1923a: 309. Description of both sexes. "Redescribed from seven males and four females from Colombo … and one female from Sudu-ganga … The abdominal colour appears variable". On his Plate X is a figure of the genitalia, showing the pregonite with long setae.

Caiusa nigronitens Senior-White, 1923b: 38. Holotype female in "Royal Hungarian Museum, Buda-Pesth" [= HNHM], by monotypy ("[d]escribed from a unique female in good condition, Singapore, 20th to 26th January 1902 (*Biro.*)"). Not examined. According to Zoltán Soltész and László Papp (e-mails 3 February 2014), both at HNHM, the holotype was lost in fire during the Hungarian revolution in 1956 . Type locality: Singapore. **Syn. nov.**

Caiusa indica: Senior-White 1926: 134. "South India and Ceylon"; also in key p. 134.

Caiusa nigronitens: Senior-White 1926: 134. "Known only from Singapore"; also in key p. 134.

Paratricyclea (*Caiusa*) sp.: Malloch 1926: 497.

Note. "An Australian species, the exact identity of which is not known to me, is represented by a specimen of each sex before me. It is paler than the other species, having the thoracic dorsum without black marks. I hope to clear up the identity of this species later. Surcouf mentions having seen a specimen of this genus from Queensland, which no doubt belonged to this species".

Caiusa surcoufi Bezzi, 1927: 246. Holotype female, in MSNM, by original designation ("[t]ype ♀, a single, rather old specimen in the writer's collection from Queensland"). Not examined, but examined on my behalf by Fabrizio Rigato at MSNM. Photographs (Figs. 83–87) seen. **Syn. nov.**

Note. In the holotype, which is in bad condition, the thoracic dorsum is testaceous all over, abdomen pale testaceous, apart from weak darkenings on hind parts of abdominal segments. The frons is rather broad, diverging somewhat posteriorly, like other *C. indica*. Bezzi (1927: 246) considered *C. surcoufi* "[n]ear *C. testacea*, Sen.-White, from India, but distinguished by the entirely yellow abdomen; …". This last statement is curious in view of the fact that Senior-White (1923b) described *Caiusa testacea* as having the abdomen "concolorous with thoracic dorsum, unmarked" and "the thorax and scutellum [as] testaceous…", from which follows that the abdomen was described by Senior-White as entirely yellow. Perhaps Bezzi had made for himself a concept of *C. testacea* that only included specimens with a dark posterior abdominal half. In any case, on the next page he wrote: "Thorax entirely reddish… Abdomen entirely reddish, only the hind borders of third and fourth segments being a little bluish and shining".

Paratricyclea (*Caiusa*) *surcoufi*: Malloch 1927: 323. Australia: Queensland, Northern Territory.

Note. Malloch wrote: "Male and female.—Shining fulvous testaceous; … Abdomen broadly blackish blue at apex". Malloch lists material as follows: "Male, Melville Island, N.T. (G.F. Hill); Darwin, N.T. (G. F. Hill); females, Stapleton, N.T. (G. F. Hill) and Marwood, near Mackay, Queensland (W. C. Harvey); original locality, Queensland (Bezzi)". I have examined specimens in USNM labelled with text similar to that given for Darwin and Stapleton.

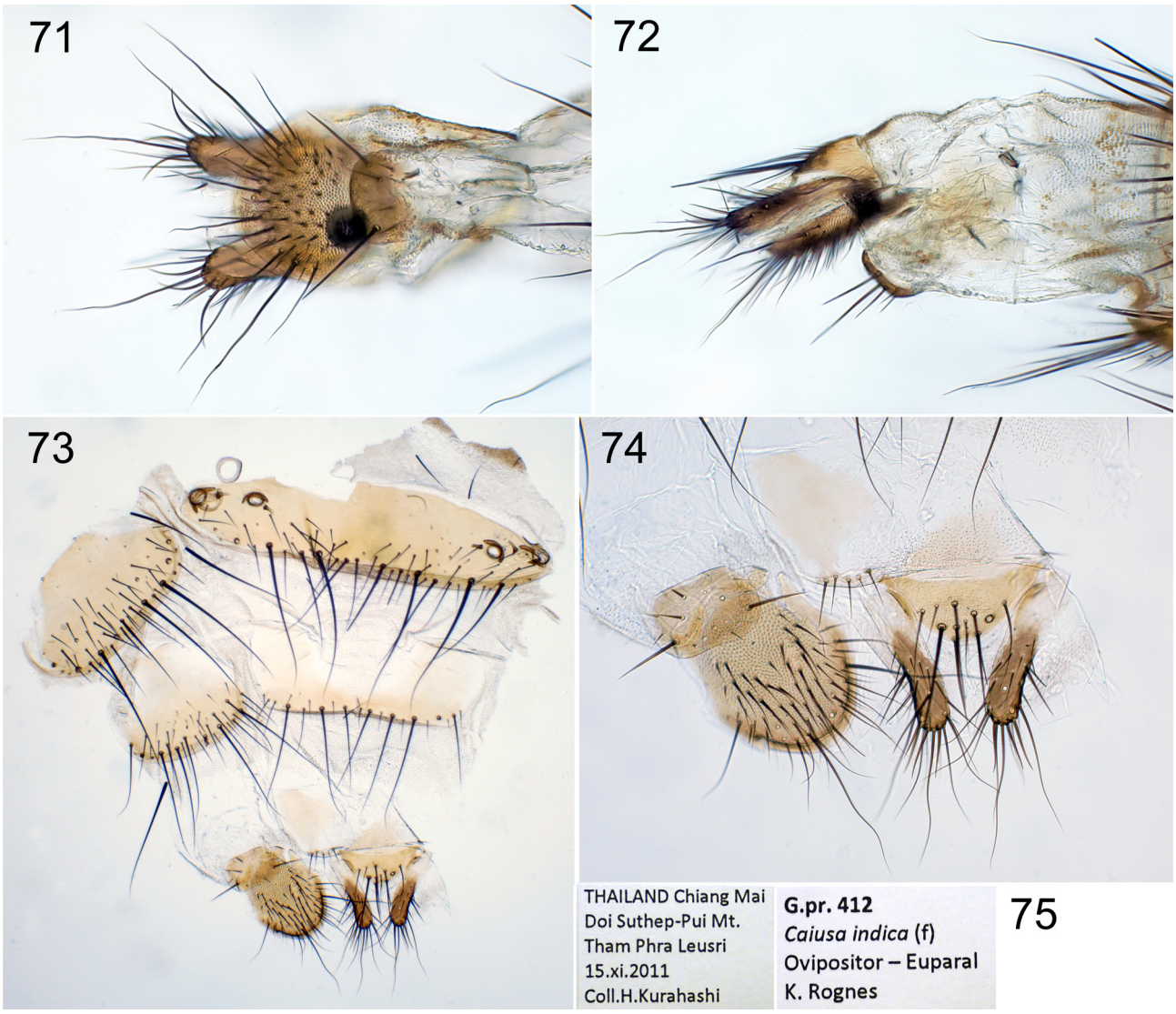
Caiusa indica: Townsend 1931: 371. Citing a "Female Ht in Paris, from India, …".

Note. There are now two syntypes, a male and a female, in MNHN, both labelled "TYPE" (see section "Material examined. Type material." below). I do not accept Townsend's statement as a lectotype fixation because no label data or other information is given identifying the specimen beyond any doubt in the MNHN collections (ICZN 1999, Article 74.5). It is possible that only the female (Surcouf's specimen) was present in MNHN when Townsend visited the museum in 1928, but the existence of the syntypic male, "appartenant au P^r^. Bezzi", should have been known to him from Surcouf's work (1920: 53) and mentioned.

Caiusa indica: Senior-White *et al.* 1940: 70. Description; new records. They state: "*Type*, ♂ in Bezzi's collection, Turin ?; ♀ in the Paris Museum?." indicating that they did not accept (or know about) Townsend's (1931) citation of a female "Ht" in Paris.

Caiusa nigronitens (as *nigro-nitens*): Senior-White *et al.* 1940: 74. Description; new records.

Note. They state that "[I]t is possible that this species is no more than a variety of *indica* Surcouf, …".



FIGURES 71–75. *Caiusa indica* Surcouf, female, ovipositor (71, 72, from female from Vietnam, Ho Chi Minh, in IDD; 73–75, from female from Thailand, in IDD). **71.** Tip of ovipositor, showing ST8, hypoproct and cerci, ventral view. **72.** Tip of ovipositor, showing ST8, hypoproct, cerci and epiproct, right lateral view. **73.** Ovipositor, flat-mounted (G.pr. 412). **74.** Tip of flat-mounted ovipositor (enlarged), showing ST8, hypoproct, T8, epiproct and cerci. Right T8 half folded partly beneath the epiproct. **75.** Labels (2) on microscope slide G.pr. 412.

Phumosia indica: James 1971: 9. Papua New Guinea.

Phumosia indica: James 1977: 537. Catalog entry (Oriental Region).

Phumosia indica: Hii Lu King & Kurahashi 1977: 222. In key only.

Phumosia indica: Tumrasvin *et al.* 1979: 253, figs. 7, 18, 35, 46, 53, 60, 63. Thailand.
Note. Their figures of male and female genitalia are evidently from *C. indica*.

Phumosia indica: Rueda 1985: 338. Philippines.
Note. This is the only *Phumosia* species Rueda explicitly describes as having the *h-sc* node bare ventrally: "*Sc* bare at humeral crossvein". The chaetotaxy given as "dc 2+3" is obscure, but the male genitalia (his fig. 13) look partly right, apart from the pregonite.

Phumosia testacea: Kurahashi 1987: 51. Papua New Guinea (Bougainville I.). Misidentification, not *C. testacea* Senior-White.
Note. In WSU is a completely yellow male (mesonotum also yellow) from Bougainville I. (Fig. 93). It will run to *testacea*

in Kurahashi's key on p. 51. But the genitalia are unequivocally = *C. indica*. All *Caiusa* I have seen and dissected from New Guinea are *C. indica*.

Phumosia indica: Kurahashi 1987: 51. Papua New Guinea (Bougainville I.)

Phumosia indica: Kurahashi 1989b: 207. Indonesia: Sulawesi. "… attracted to decaying animal matter and fruits".

Phumosia surcoufi: Kurahashi 1989d: 709. Catalog entry.

Phumosia indica: Kurahashi 1989d: 709. Catalog entry.

Phumosia testacea: Kurahashi 1989d: 709. Catalog entry. Entry for Papua New Guinea (Bougainville I.). Misidentification, not *C. testacea* Senior-White.

Phumosia indica: Kurahashi *et al.* 1997: 27. Malaysia (West Malaysia, Sabah).

Phumosia nigronitens: Kurahashi *et al.* 1997: 27. Malaysia (West Malaysia, Sabah).

Phumosia indica: Kurahashi & Magpayo 2000: 31. Philippines. "Adults are attracted to fish baits".

Phumosia nigronittens [sic]: Kurahashi & Magpayo 2000: 28 (in key). Philippines.

Phumosia nigronitens: Kurahashi & Magpayo 2000: 34. Philippines.

Phumosia indica: Kurahashi 2001: 243. Sri Lanka. [2♂ 2♀ in BPBM examined.]

Phumosia indica: Kurahashi & Chowanadisai 2001: 193. Vietnam. Parts of material (in BPBM) examined.

Phumosia indica: Kurahashi 2003a: 130. Indonesia (West Papua, Batanta I, "Valibit").

Phumosia indica: Kurahashi 2003b: 280. "JAMES (1971) recorded this species from the Solomon Islands (Guadalcanal I., Tenaru River). We failed to discover this species during the survey". See next entry.

Phumosia testacea: Kurahashi 2003b: 280. Solomon Islands (Choiseul I., Malaita I., Guadalcanal I., San Cristobal I.). Misidentifications, not *C. testacea* Senior-White.

Phumosia nigronitens: Kurahashi & Leh 2007: 266.

Phumosia surcoufi: Kurahashi 2007. Catalog entry. Entry for "Australia (Qld); Australia (NT)" probably based on Bezzi, 1927 and Malloch, 1927.

Phumosia indica: Kurahashi 2007. Catalog entry.

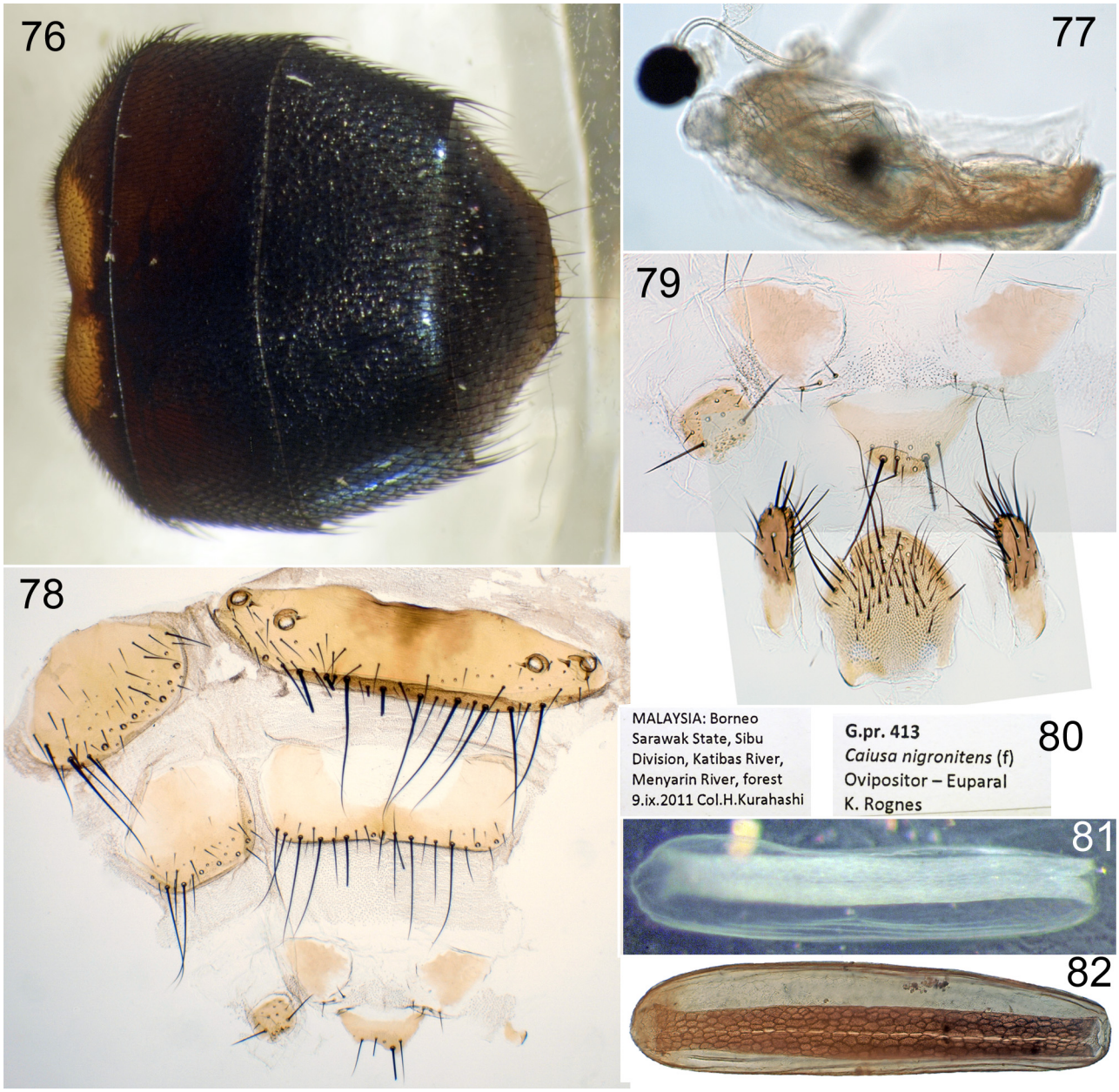
Phumosia testacea: Kurahashi 2007. Catalog entry. Entries for Papua New Guinea (Bougainville I.), Solomon Islands and Taiwan: misidentifications, not *C. testacea* Senior-White.

Diagnosis. *Male.* Cerci in posterior view with a very wide and deep U or V-shaped bay. Cerci with outer edge convex and strongly sclerotised (darker colour than elsewhere). The distance between distal points of cerci slightly shorter than width of bay at maximum, sometimes tips are almost touching each other. Cerci in lateral view only slightly shorter than surstylus, with distal half narrow, of even width and rather long, only slightly bent backwards. Surstylus in lateral view slightly narrowed at distal third, usually widening out again beyond this point, tip blunt. Distal part of pregonite (distal to long setae) strikingly long (Fig. 66, arrow). In wing the *h-sc* node bare below. Hind tibia with 1 *pd* at middle, sometimes another smaller seta above it. Thoracic dorsum colour variable from all yellow to mostly dark. Scutellum colour variable, from all yellow, to darkened on most of disc (except margins) to all dark or black. Abdominal colour variable, from all yellow, via yellow on anterior half and dark with bluish sheen in posterior half, to all dark or black with at most a small yellow area basally on T1+2.

Female. Frons at vertex / head width ratio 0.283–0.325 (mean 0.300, n=73). Female frons usually broadening slightly towards vertex (Fig. 83). In ovipositor T6 very broad and short, a narrow band. ST6 much wider than long. T7 halves connected in midline posteriorly, each lateral half shorter than half the posterior edge of T7. ST7 also

wider than long. T8 half as wide as long, with marginal setae on both sides. ST8 short and square with soft setae, one pair longer than the others, no short spine-like setae. Hypoproct without spine-like setae, only soft long setae not arranged in a distinct V-shaped area. Otherwise as in male.

Immature stages. *Eggs*. Two well developed folds along the dorsal surface with a plastron. The longitudinal folds attached to the dorsal surface will be unfolded during the oviposition. In the opinion of Andrzej Grzywacz (e-mails 2 October 2014) the egg morphology indicates that they are laid in a moist substrate or soil. Well developed folds should indicate such preferences for breeding substrate. Presence of well developed folds, or *Phaonia*-type of egg according to Skidmore (1985), is a rather primitive feature in Muscidae. Such folds or even broader are also present in Fanniidae. The colour of the plastron in Fig. 82 is most likely an artifact. *Other immature stages*. Unknown.



FIGURES 76–82. *Caiusa indica* Surcouf, female (76–80, from female from Malaysia, Borneo, Sarawak, in IDD; 81, 82, from female from Vietnam, Ninh Bin Prov. in IDD). **76.** abdomen, dorsal view. **77.** Dissected uterovaginal tube with egg inside. **78.** Ovipositor, flat-mounted (G.pr. 413). **79.** Detail (partly reconstructed) of ovipositor, showing ST8, T8, epiproct, hypoproct and cerci (G.pr. 413). **80.** Labels (2) on microscope slide G.pr. 413. **81.** Egg with milky white hatching pleats folded towards each other. Micropylar end to the right. Stereomicroscope photograph. **82.** Egg with brown hatching pleats. Microscope photograph. Brown colour likely artifactual.

Biology. Unknown. It has never been reported to have been reared from tree frog egg masses. Rhacophorid frogs do not occur in Australia (Tyler 1998), New Guinea or in Solomon Islands (Li *et al*. 2011; Li *et al*. 2013) where *C. indica* is frequent. There are unconfirmed reports that *Caiusa indica* is a parasite of *Megachile nana* bees in India (Kapil & Jain 1980), possibly based on misidentifications. Kurahashi (1989b: 207) reports it is "… attracted to decaying animal matter and fruits". Kurahashi & Magpayo (2000: 31) reports that adults "are attracted to fish baits".

Discussion. Both a widespread and a variable species in external appearance. Some specimens of *C. indica* from Indonesia (East Kalimantan), Malaysia (Sabah, Sarawak and West Malaysia) and Singapore have a very dark abdomen and a dark scutellum. Such specimens have been treated as a separate species (*C. nigronitens*), but there are all degrees of intermediate darkness of both the scutellum and the abdomen, so a separate status cannot be upheld.

Specimens of *C. indica* from Australia, Papua New Guinea and Solomon Islands often have an all pale mesonotum or sometimes with a darker middorsal stripe. Such specimens have either been identified as *C. surcoufi* or misidentified as *C. testacea*. A pale mesonotum has also been observed in a *C. indica* specimen from India (Kerala, IDD) (Figs. 88–91) captured at the same time and place as three males with a dark mesonotum.

Two *Caiusa indica* specimens (1 male, 1 female) from Solomon Islands (Malaita, Maluu) in BMNH have an all testaceous (not darkened at all) thoracic dorsum and 1 *pd* on hind tibia. The male has a darkened abdominal tip, but the female has an all yellow abdomen without darkenings. Both specimens have been identified (according to labels) as *Phumosia surcoufi* Bezzi by Kurahashi, but similarly labelled specimens were published by Kurahashi (2003b: 280) as *P. testacea* (see entry in synonymy list, above). Kurahashi even reported not to have captured *C. indica* in Solomon Islands although James had. Dissected male genitalia show clearly that the material belongs to *C. indica*.

Similarly, 1 male and 1 female from Solomon Islands (Guadalcanal) in BMNH, are also *C. indica*. The male was dissected by KR and has an all yellow thoracic dorsum, whereas the female is slightly darkened. Abdomen in both specimens are dark apically. Hind tibia with 2 *pd* in male, 1 *pd* in female.

One male from Solomon Islands (Choiseul, Malangona) in BPBM is also *C. indica.* A specimen with the same label data has been published by Kurahashi (2003b: 280) as *P. testacea*.

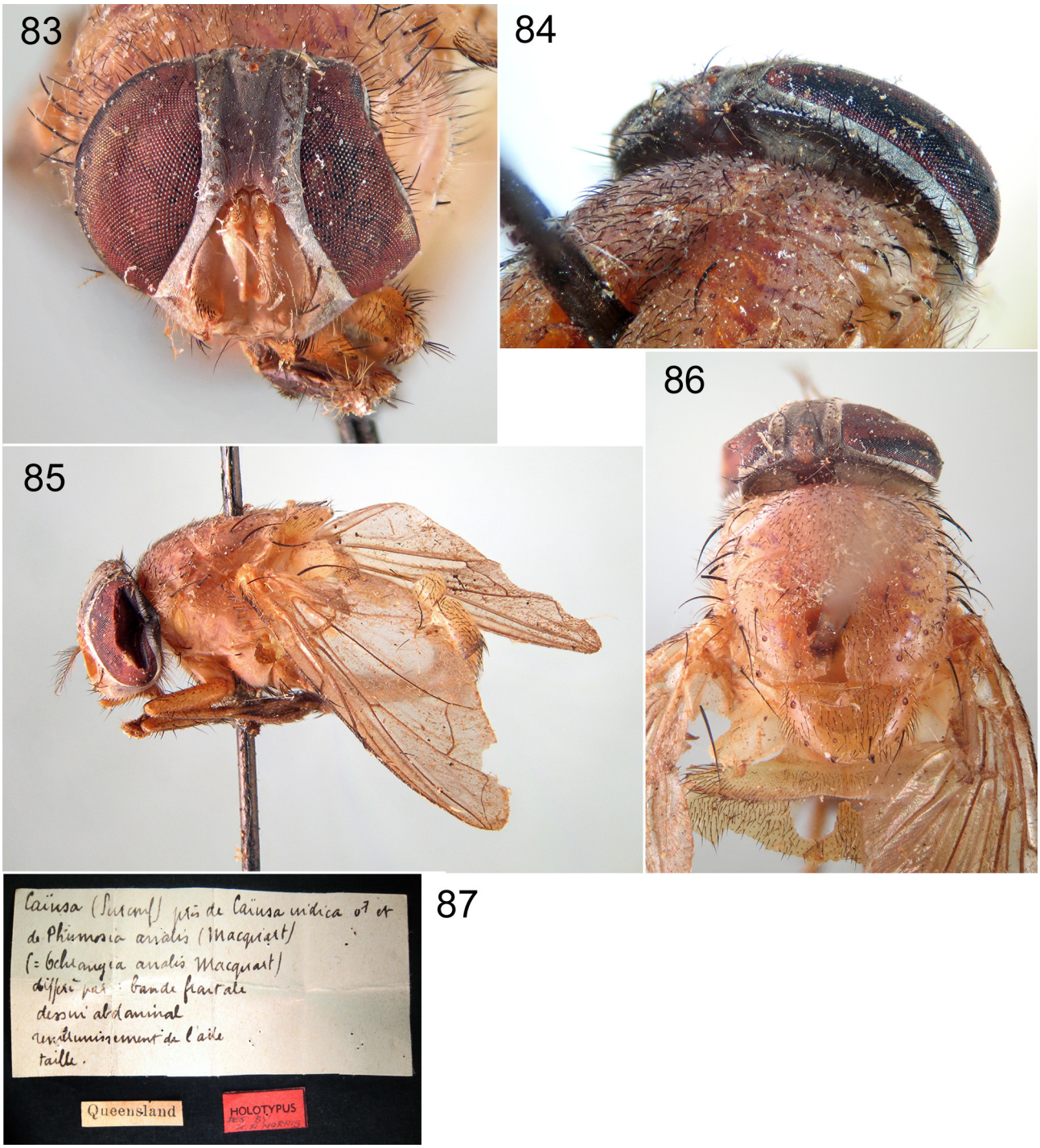
Specimens from Solomon Islands (Guadalcanal) where both thorax and abdomen are yellow are present in USNM among specimens with a dark abdominal tip. An all yellow male specimen from Papua New Guinea (Bougainville I, Piva) is present in WSU (Figs. 93, 94).

Distribution. Australia (Northern Territory, Queensland,), Cambodia, India (Kerala, Tamil Nadu), Indonesia (East Kalimantan, Papua, West Java, West Papua), Malaysia (Sabah, Sarawak, West Malaysia), Papua New Guinea, Philippines, Singapore, Solomon Islands, Sri Lanka, Thailand, Vietnam.

Material examined. Type material. *Caiusa indica* Surcouf, 1920: 53. **Lectotype** male, in MNHN, here designated, labelled (1) INDE MÉRIDIONALE / TRICHINOPOLY / F. [P?] CAIUS 1911[printed]; (2) Caiusa indica ♂ [Surcouf's handwriting]; (3) TYPE [black print on red label]; (4) Caïusa / indica / Surc. fg. / TYPE. [Séguy's handwriting] (Fig. 67); (5) LECTOTYPE male / *Caiusa indica* / Surcouf 1920: 53 / K. Rognes des. 2012 [black laser print on red label]. *Note. Caiusa indica* was described by Surcouf (1920: 53) on the basis of two syntypes, a male from "Trichinopoly (Inde méridionale, 1911)" and a female from "Kattapuli (Cap Comorin, 1912)" both captured by "F. Caius". The female (as "[l]e type ♀") was stated to be in Surcouf's own collection, while the male (as "le type ♂") belonged to "Pr Bezzi". I received a male and female specimen under *Caiusa indica* in Bezzi's collection on loan from MSNM. Neither specimen fitted the original description, and the label data did not correspond to those given by Surcouf, so these specimens were not accepted as syntypes. The true syntypes were found in MNHN. I have selected and here designate the male as lectotype to fix the interpretation of the name. I have dissected it. Dried T1–5 glued to card above label 1. Genitalia (Figs. 64–67) and ST1–5 in glycerol in glass microvial on pin. The specimen lacks the left fore leg and the right mid- and hind legs. Fore tibia with 1 *pv* and 3 *ad*. Mid tibia with 1 *ad*, 1 *pd* and 2 *p*. Hind tibia with 1 *pd* at middle, and 2 *av* and 2 *ad* at middle.

Paralectotype female, in MNHN, here designated, labelled (1) Kattapuli / Cap Comorin [now = Kanyakumari, Tamil Nadu, India] 12.1? / P. Caius [Surcouf's handwriting and underlining of the letter P]; (2) TYPE [red print on darkened paper]; (3) Caïusa / indica / Surc. fg. / TYPE. [Séguy's handwriting]; (4) PARALECTOTYPE / female / *Caiusa indica* / Surcouf 1920: 53 / K. Rognes des. 2012 [black laser print on red label]. *Note*. The P is underlined on the uppermost label written by Surcouf, suggesting that "notre ami F. [sic] Caius" (Surcouf 1920: 53) has a

given name beginning with a P and not an F as it appears on all the Trichinopoly labels I have seen (e.g., fig. 67), including those of *Bengalia varicolor* (Bezzi's specimen in Milan, Rognes 2009: 60) and *B. pallidicoxa* (holotype, Rognes 2009: 59). Looking closely at the F in all these labels I have come to the conclusion that some black print is lacking in the upper half-circle of the letter giving the "P" the appearance of an "F". I hereby retract my earlier statement (Rognes 2009: 56), that the "F." was unmistakable. Séguy (1946) used "F. Caius" once (p. 83, line 7 from below) and "P. Caius" five times (p. 83, line 3 from above; p. 84, line 3 from below; p. 87, lines 10 and 11 from below, p. 90, line 20 from above) when citing of Surcouf's name, and in all the records involving Trichinopoly Séguy cites a "P". It is a mystery why Surcouf (1920: 53) cited his friend's first name with an F.



FIGURES 83–87. *Caiusa indica* Surcouf, female (all from holotype of *Caiusa surcoufi* Bezzi in MSNM). **83.** Head, anterodorsal view. **84.** Head and thorax, right oblique posterodorsal view. **85.** Habitus, lateral view. **86.** Thorax, head, parts of abdomen and wings, dorsal view. **87.** Labels (3). All photographs reproduced by courtesy of Fabrizio Rigato.

Caiusa nigronitens Senior-White, 1923b: 38. **Holotype** female, "a unique female in good condition, Singapore, 20th to 26th January 1902 (*Biro*.)". In the Royal Hungarian Museum, Buda-Pesth [HNHM]". Not examined. According to Zoltán Soltész and László Papp, both at HNHM, the holotype was lost in the fire in during the revolution in November 1956 (e-mail 3.ii.2014). It is not present in BMNH (Nigel Wyatt, e-mail 17.ii.2014).

Caiusa surcoufi Bezzi, 1927: 246. **Holotype** female (Figs. 83–87), in MSNM, labelled: (1) Queensland [printed]; (2) HOLOTYPUS / DES BY / K.R.NORRIS [red label; first line black print; two last lines in pencil]; (3) Caïusa (Surcouf) près de Caïusa indica ♂ et / de Phumosia analis (Macquart) / (= Ochromyia analis Macquart) / diffère par bande frontale / dessin abdominal / rembrunissement de l'aile / taille [large label in Surcouf's handwriting]. 1+1 *kepst*. 2+2 *acr*. Thoracic dorsum testaceous all over, abdomen pale testaceous, apart from weak darkenings on posterior margins of abdominal segments T1+2 and T4. Female frons width as in other *indica*. Holotype in very bad condition, much of abdomen eaten away, only fore pair of legs present.

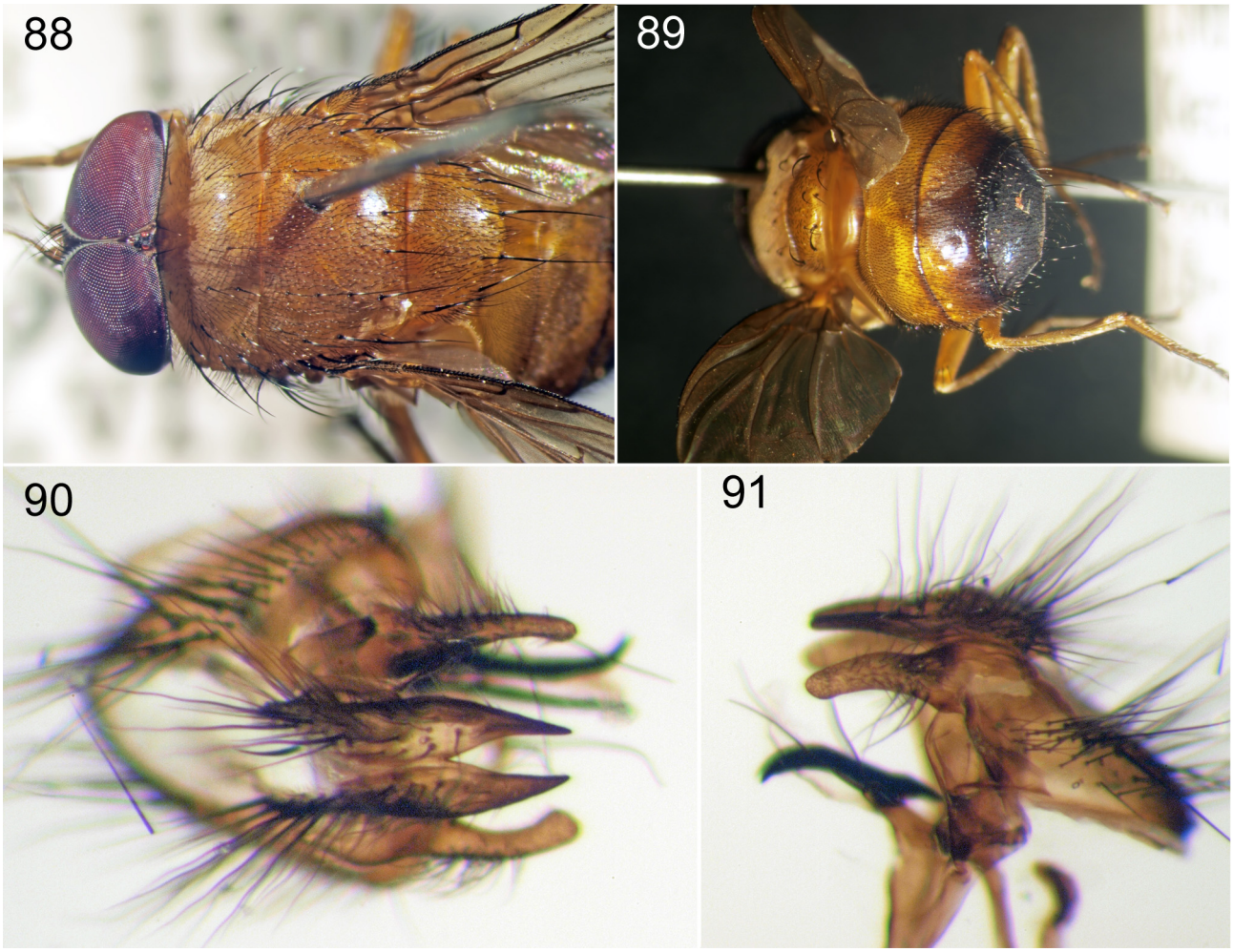
Other material. ANIC: Australia (Northern Territory): 1 male labelled (1) Howard Springs, N.T. / 12 June 1964 / K.R.Norris. Genitalia visible. Both hind tibiae have 2 *pd* setae. T5 and most of T4 are dark with bluish sheen. Mesonotum almost unmarked, testaceous. **Australia (Queensland):** 1 male, staged, labelled (1) Burnside, N.Aust. / 28 Mar 1929 / T.G. Campbell [printed, except number 28 which is handwritten]; (2) Attracted to and feeding in human excrement [printed on yellow label]. Low on the pin is a plastic rectangle with dissected genitalia embedded in an orange substance below a coverglass. Habitus photograph, dorsal view, with labels, and various stacked photographs of the genitalia on the slide examined. The mesonotum is all testaceous and unmarked. Hind tibia cannot be seen in the habitus photograph. Cerci with wide apical bay, tips close, enclosing the bay. Pregonite with long distal section. [Both specimens placed in ANIC collection under *C. surcoufi*, only photographs seen]. **BMNH: Indonesia (East Kalimantan):** 1 male (staged) labelled (1) Central-Borneo./ Boven-Mahakam / Long Iram 2.-5.29. [printed]; (2) Dr. M.v.Kühlewein / Eing. Nr. 121, 1929. [printed]; (3) Caiusa / nigronitens S.W. / det. D. Aubertin 1933 [handwritten except last line which is printed]. Dissected by KR. Dried T3–5 glued to plastic stage plate on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Scutellum dark. Hind tibia with 1 *pd* each, abdominal T1+2 yellow, T3 dark along hind border, T4 and T5 dark. **Malaysia (Sarawak):** 1 male (staged) labelled (1) Oxford Univ.Exp. / B.M.Hobby & / A.W.Moore. / B.M.1933-254 [printed]; (2) Fish / trap. [printed]; (3) SARAWAK: / Foot of Mt.Dulit. / Junction of rivers / Tinjar & Lejok. / 21.ix.1932 [printed except day in date]; (4) H / 300 [in pencil on small square brownish label]; (5) Caiusa / nigronitens / S.W. / det.R.Senior White 1938. [handwritten in black ink, except last line which is printed]. Dissected by KR. Dried T1–5 glued to plastic stage. ST1–5 and genitalia in glycerol in glass microvial on pin. Hind tibia with 1 *pd* on each side. Abdomen dorsally dark on T5, T4 and a slight dark margin on T3. Abdomen pale ventrally, except T5. • 1 female (staged) labelled (1) Oxford Univ.Exp. / B.M.Hobby & / A.W.Moore. / B.M.1933-254 [printed]; (2) Trap 1. Fish. [printed]; (3) SARAWAK: / Foot of Mt.Dulit. / Junction of rivers / Tinjar & Lejok. / 18.ix.1932 [printed except day in date]; (4) H / 274 [in pencil on small square brownish label]; (5) Caiusa / nigronitens / S.W. / det.R.Senior White 1938. [handwritten in black ink, except last line which is printed]. 1 *pd* on both hind tibiae. Abdomen all dark, even posterior margin of T1+2. Scutellum all dark, also along margin. **Malaysia (West Malaysia):** 1 male labelled (1) MALAYA / Kuala Lumpur / Jan 18th 1932 / H. M. Pendlebury [printed, except date and last digit in year which are handwritten; a long stippled line across label at middle]; (2) Phumosia / indica / (Surcouf) / det James '70 [handwritten]. Dissected by KR. Dried T3–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Hind tibia both with 1 *pd*. Scutellum pale. Abdomen dark on T4 and T5, some darkening along a narrow margin of T3. Mesonotum narrowly yellow at sides, else dark. • 1 female labelled (1) MALAY PENINS: / West Coast / Pulau Jarak / at light 19th April 1932 / E. Seimund. [printed; line 4 is handwritten, except month and year which are printed]; (2) Phumosia / indica / (Surc) [handwritten by James]. Scutellum dark. Left hind tibia with 1 *pd* (right lost). Abdomen with T5, T4 and posterior half of T3 dark; also a narrow hind margin of T1+2 dark. • 1 female labelled (1) MALAY PENIN: / Selangor, F.M.S. / Kuala Lumpur / at light / feb 7th 1937 / H.M. Pendlebury. [printed; line 4 and parts of line 5 are handwritten]; (2) Phumosia / indica / (Surc) [handwritten by James]. Scutellum dark. T5, T4, narrow margins of T3 and T1+2 dark. Hind tibia with 1 *pd* each. • 1 female (staged) labelled (1) MALAY PEN. / Kuala Lumpur. / 19.v.24 / G.H.Corbett / and B.A.R.Gater / 1202 [underlined along right edge of label] [printed, except lines 2 and 3 and text along edge, which are handwritten]; (2) Caiusa / indica ♀ / Surc. [handwritten in ink]; (3) Pres.by / Imp.Inst.Ent. / B.M.1934-557 [printed]; (4) I think this may / be C. nigronitens. / D. A.'36. S.-W. [handwritten]; (5) This is C. / nigronitens. S.W. [handwritten]. Abdomen all dark, yellow colour only on anterior part of T1+2 in middle, scutellum all dark, though slightly paler along margin. Hind

tibia with 1 *pd* each. **Papua New Guinea:** 1 male labelled (1) NEW BRITAIN / Keravat / 23-24.vii.1965 / R.W.Crosskey [printed, except line 3 which is partly handwritten]. Dissected by KR. Dried T1–5 glued to polyporus stage on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Mesonotum with a dark median vitta partly divided by a very narrow median line, dark area expanded laterally near postpronotal lobes, lateral yellow parts of mesonotum behind suture rather wide. Scutellum pale. Hind tibiae with 1 *pd* each. Abdomen dark on T5 (disappeared after KOH boiling). • 1 female labelled (1) Papua New Guinea / Central P., 20Km / SE Port Moresby / 31.iii.1984 J.W. Ismay / Swept, bushes [printed; date in line 4, and line 5 handwritten]. Mesonotum dark. Hind tibia 1 *pd* each. Abdomen with T5 and T4 all dark with bluish sheen, hind margin of T3 also dark, especially laterally. **Singapore:** 1 male labelled (1) Bukit Timah Forest / SINGAPORE / D.H.Murphy 5.2.76 / Taban Valley [printed, except date and last line]; (2) Caiusa / nigronitens / D.H.Murphy det. [pencil handwriting, except last line which is printed]; (3) Pres. By / D.H. Murphy / BM 1980 – 183 [printed]. Cerci and surstyli exposed. Scutellum dark. Hind tibia with 1 *pd* each, abdomen dark on T5, T4 and much of T3. • 1 female labelled (1) Bukit Timah Forest / SINGAPORE / D.H.Murphy 5.2.76 / Taban Valley [printed, except date and last line]; (2) Caiusa / nigronitens / D.H.Murphy det. [pencil handwriting, except last line which is printed]; (3) Pres. By / D.H. Murphy / BM 1980 – 183 [printed]. 2 *pd* right hind tibia, left hind tibia lost. Scutellum all dark except slightly pale along margin. T1+2 yellow, T3–T5 all dark, though T3 slightly paler along anterior margin. **Solomon Islands:** (four specimens placed as *Caiusa testacea*): 1 male labelled (1) SOLOMON IS. // Kukum // Guadalcanal // 14/1/65 // PJM Greenslade // 16130 [across left side of label] [yellow label, first and third line printed, else with pencil handwriting]. Very short pin. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Mesonotum all yellow, no darkenings. Hind tibia with 2 *pd* each. Hind third of T4 and hind three fourths of T5 dark. • 1 female labelled (1) SOLOMON IS. / Guadalcanal / Kukum / 27.12.1963 / M.McQUILLAN / 10207 [across left side of label] [printed, except lines 3 and 4, and text across left side which is handwritten]. Irregular darkenings on a pale mesonotum. Hind tibia with 1 *pd* each. T5 dark, most of T4 dark, irregularly bordered anteriorly, yellow area anteriorly. • 1 male labelled (1) SOLOMON IS: / Malaita I. / Maluu / 27. Jan. 1978 / S. Shinonaga [printed label]; (2) Phumosia / surcoufi ♂ / Bezzi / Det. H. Kurahashi [handwritten, except last line which is printed; a dark line across label between lines 2 and 3]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Mesonotum all yellow, no darkenings, except that margin of scutellum is even yellower. Hind tibia with 1 *pd* each. Hind half of T4 and all of T5 dark. • 1 female labelled (1) SOLOMON IS: / Malaita I. / Maluu / 27. Jan. 1978 / S. Shinonaga [printed label]; (2) Phumosia / surcoufi ♀ / Bezzi / Det. H. Kurahashi [handwritten, except last line which is printed; a dark line across label between lines 2 and 3]. Mesonotum, scutellum and abdomen all yellow, no darkenings at all. Hind tibia with 1 *pd* each. **Sri Lanka:** 1 male (staged) labelled (1) Ceylon. / Henaratgoda. / 6.VI.91. / Lt Col.Yerbury. / 1892—192. [printed except date]; (2) Caiusa / indica / Surc. / det.R.Senior White 1938. [handwritten, except last line which is printed]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Mesonotum yellow at sides, else dark. Scutellum pale. Hind tibia both with 1 *pd*. Abdomen dark only on T5 and hind fourth of T4. Specimen mouldy. • 1 female (staged) labelled (1) Ceylon. / Henaratgoda. / 16.VI.91. / Lt Col.Yerbury. / 1892—192. [printed, except date]; (2) Caiusa / indica Surc. / det.R.Senior White 1938. [handwritten, except last line which is printed]. Mesonotum yellow at sides, else dark. Scutellum pale. Hind tibia both with 1 *pd*. Abdomen dark only on T5 and hind fourth of T4. Specimen mouldy. • 1 male (staged) labelled (1) Ceylon / Velverry / 10.I.92 / Lt Col.Yerbury. / 1892—192. [printed, lines 2 and 3 are handwritten]; (2) Caiusa / indica / Surc. / det.R.Senior White 1938. [handwritten, except last line which is printed]. Not dissected. Mesonotum yellow at sides, else dark. Scutellum pale. Hind tibia both with 1 *pd*. Abdomen dark only on T5 and hind fourth of T4. • 1 female (staged) labelled (1) Ceylon. / Perivipancheram. / 10.vi.92. / Lt Col.Yerbury. / 1892—192. [printed, date handwritten]; (2) Caiusa / indica / Surc. / det.R.Senior White 1938. [handwritten, except last line which is printed]. Mesonotum yellow at sides, else dark. Scutellum pale. Hind tibia both with 1 *pd*. Abdomen dark only on T5, hind fourth of T4. **BPBM: Australia (Northern Territory):** 1 female labelled (1) AUSTRALIA: N.T. / Darwin 24.ix.58 [printed, except date which is handwritten]; (2) Ex fresh human / excrement [printed]; (3) J. L. Gressitt / Collector / BISHOP MUSEUM [printed]. Occiput with pale hairs only, except immediately below row of postocular cilia where some scattered hairs are black on left side in uppermost part; on right side of occiput all pale, no black hairs. All yellow thoracic dorsum, no darkenings anywhere. No setulae on R_1. Hind tibia with 2 *pd* each. Abdomen with posterior two thirds of T4 (in middle a triangular dark area reaching hind border of T3) and all T5 darkened with a very slight bluish sheen on T5. Frons converging. **Australia (Queensland):** 1 male labelled (1)

Cairns / N.Q. 20 [printed, except number]; (2) J. F. Illingworth / Coll. Ex.tibark [printed, except tibark which is handwritten]; (3) Phumosia / (Caiusa) / indica Surc. [handwritten on yellowish label with black frame]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. ["tibark" = ti bark = bark of Ti tree = bark of *Cordyline fruticosa*]. • 1 female labelled (1) Cairns / 19 / N.Q. [printed, except number]; (2) J. F. Illingworth / Coll. Ex. Tree. • 1 female labelled (1) Cairns Q. / 9-20 [printed, except numbers]; (2) J. A. Kusohe / Coll [printed]; (3) Collection of W.M.Giffard [printed]. • 1 female labelled (1) AUSTRALIA: SE Qld. / W. of Brisbane / Moggill Farm, 25m / 27.I. 1951 [printed]; (2) Malaise Trap / J.L. Gressitt [printed]. Frons broad, converging. Occiput only with pale hairs, except a few scattered black hairs in uppermost part. Thoracic dorsum all yellow, undarkened anywhere. No setulae on R_1. Hind tibia have 2 *pd* each (1 large lower, 1 weak upper). Abdomen with a small triangular darkening at middle on posterior half of T3; all T4 dark; T5 dark in two broad patches laterally on each side covering two thirds of length of tergite, middle third undarkened in full length of T5; the dark patches with metallic bluish sheen. **Malaysia (Sabah):** 1 male labelled (1) BRITISH N. BORNEO / Kalabakan / 10-19.XI.1958 [printed]; (2) Fly trap bait / Dead fish [printed, except fish]; (3) L.W. Quate / Collector [printed]; (4) Phumosia ♂ / nigronitens / (S.-White, 1923) / Det. H. Kurahashi. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Male frons reduced to a line narrower than neighbouring eye facets. Thorax dark except area around postpronotal lobe. Scutellum dark. Dark brown calypters. Hind tibia with 1 *pd* on both sides. Abdomen dorsally all dark, except fore margin of T1+2; abdomen ventrally yellow on T1+2, T3 and T4 and partly on T5. • 1 female labelled (1) BRITISH N. BORNEO / Kalabakan / 10-19.XI.1958 [printed]; (2) Fly trap bait / Dead fish [printed, except fish]; (3) L.W. Quate / Collector [printed]; (4) Phumosia ♀ / nigronitens / (S.-White, 1923) / Det. H. Kurahashi. Thorax dark except area around postpronotal lobe. Scutellum dark, but tip orange. Hind tibia with 1 *pd* on both sides. Abdomen dark, except fore margin of T1+2; abdomen ventrally yellow on T1+2, T3, T4 and T5. • 1 female labelled (1) NORTH BORNEO / Kalabakan / 19.XI.1958 [printed except day]; (2) Fish / bait traps [printed, except Fish]; (3) L. W. Quate / Collector [printed]; (4) Phumosia ♀ / nigronitens / (S.-White, 1923) / Det. H. Kurahashi. Thorax dark except area around postpronotal lobe. Scutellum dark. Hind tibia with 1 *pd* on both sides. Abdomen dark, except fore margin of T1+2; abdomen ventrally yellow on T1+2 and T3. **Malaysia (Sarawak):** 1 male labelled (1) BORNEO: SARAWAK / Kapit District / Merirai V., 30 - / 300m., VIII-1- / 6 – 1958, T. Maa; (2) T. C. Maa / Collector; (3) Phumosia ♂ / nigronitens / (S.-White, 1923) / Det. H. Kurahashi. Hind tibia with 1 *pd* (both sides). Thoracic dorsum and scutellum dark. Postpronotal lobe orange. Postalar wall setulae black. Calypters very slightly darkened. Abdominal T1+2 and anterior half of T3 orange. T4 and T5 dark. T5 with a slight bluish sheen with greyish microtomentum. The above 2♂ 2♀ have been published by Kurahashi *et al*. (1997: 28). • 2 males labelled (1) SARAWAK: 3rd Division: // Kapit Distr.: Sg. Men- // gion (nr.) Ng. Tekalit // 1:37′N / 113:35′E // VIII-IX.1971; (2) K.J.Frogner, Coll. / BISHOP Museum. One of the males has been dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. The dissected male has a dark abdomen, with just the anterior edge of T1+2 pale. The undissected male has T1–3 pale, T4–T5 dark. In both thoracic dorsum all dark, including scutellum. • 1 female labelled (1) BORNEO: SARAWAK / Nr. Kuching 10m / IX - 17 – 1958; (2) Sweeping grass; (3) Alpinia; (4) sedge; (5) J. L. Gressitt / Collector. Thorax dark, except postpronotal lobe. Abdomen all dark except for small area anteriorly on T1+2. P**apua New Guinea:** 1 female labelled (1) NEW GUINEA: PAPUA / C. Dist. Otomata / Plant'n, 1m, E. of / Moresby, 2.XI.1960 [printed]; (2) Malaise Trap / J.L. Gressitt [printed]; (3) 17 [pencil, square yellow label]; (4) Phumosia / indica / (Surc.) [James's handwriting]. • 1 female labelled (1) NEW GUINEA: PAPUA / C. Dist. Otomata / Plant'n, 1m, E. of / Moresby, 2.XI.1960 [printed]; (2) Malaise Trap / J.L. Gressitt [printed]; (3) 13 [pencil, square yellow label]; (4) Phumosia / indica / (Surc.) [James's handwriting]. • 1 female labelled (1) NEW GUINEA: PAPUA / W. District / Oriomo Govt. Sta. / 26–28.X.1960 [printed]; (2) Malaise Trap / J.L. Gressitt [printed]; (3) 11 [pencil, square yellow label]; (4) Phumosia / indica / (Surc.) [James's handwriting]. • 1 female labelled (1) NEW GUINEA: PAPUA / W. District / Oriomo Govt. Sta. / 26–28.X.1960 [printed]; (2) Ex fresh human / excrement; (3) J.L. Gressitt / Collector [printed]; (4) 15 [pencil, square yellow label]; (4) Phumosia / indica / (Surc.) [James's handwriting]. • 1 female labelled (1) NEW GUINEA: PAPUA / W. District / Oriomo Govt. Sta. / 26–28.X.1960 [printed]; (2) Ex fresh human / excrement; (3) J.L. Gressitt / Collector [printed]; (4) 16 [pencil, square yellow label]; (4) Phumosia / indica / (Surc.) [James's handwriting]. • 1 female labelled (1) NEW GUINEA: PAPUA / W. District / Oriomo Govt. Sta. / 26–28.X.1960 [printed]; (2) Malaise Trap / J.L. Gressitt [printed]. • 1 female [staged] labelled (1) NEW GUINEA: PAPUA / W. District / Oriomo Govt. Sta. / 26–28.X.1960 [printed]; (2) Malaise Trap / J.L. Gressitt [printed]; (3) 12 [pencil, square yellow label]; (4)

Phumosia / indica / (Surc.) [James's handwriting]. • 1 male labelled (1) NEW GUINEA: PAPUA / W. District / Oriomo Govt. Sta. / 26–28.X.1960 [printed]; (2) MALAISE TRAP / J.L. Gressitt [printed]; (3) 1 [pencil, yellow square label]; (4) Phumosia / indica / (Surcouf) / det James '70 [James's handwriting]. • 1 male labelled (1) NEW GUINEA: PAPUA / W. District / Oriomo Govt. Sta. / 26–28.X.1960 [printed]; (2) Malaise Trap / J.L. Gressitt [printed]. • 1 male labelled (1) NEW GUINEA: PAPUA / W. District / Oriomo Govt. Sta. / 26–28.X.1960 [printed]; (2) Malaise Trap / J.L. Gressitt [printed]; (3) 3 [pencil, yellow square label]; (4) Phumosia / indica / (Surc.) [James's handwriting]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 male labelled (1) NEW GUINEA: PAPUA / Port Moresby / May 19, 1956 [printed]; (2) J.L. Gressitt / Light Trap [printed]; (3) 4 [pencil, yellow square label]; (4) Phumosia / indica / (Surc.) [James's handwriting]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 female labelled (1) NEW GUINEA: PAPUA / Daradae, nr. Java- / rere, Musgrove R. / 100m.? X-3-1958 [printed]; (2) Ex Human / Excrement [printed]; J.L. Gressitt / Collector [printed]. • 1 female (staged) labelled (1) NEW GUINEA (SE) / Brown River/ 23.X.1960 [printed]; (2) J.L. Gressitt / Collector [printed]. • 1 female labelled (1) NEW GUINEA: PAPUA / Kura, 9 m / 12.VIII.1964 / H. Clissold [printed]; (2) H. Clissold / Light Trap / BISHOP MUS. [printed]. • 1 female labelled (1) NEW GUINEA: PAPUA / Cape Rodney, 10 m / 2–4.XI.1960 [printed]; (2) Malaise Trap / J.L. Gressitt [printed]; (3) Phumosia / indica / (Surcouf) / det James '70 [James's handwriting]. • 2 males labelled (1) NEW GUINEA: SE / Cape Rodney / 4.XI.1960 / 09:30 - 17:30 [printed]; (2) L.&M. Gressitt / Collectors / BISHOP Mus. [printed]. Both dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. • 2 females labelled (1) NEW GUINEA: NE / Green River / Post, 200 m / 26.VI.1963 [printed]; (2) Dry forest [printed]; (3) R. Straatman / Collector / BISHOP [printed]. • 1 female labelled (1) NEW GUINEA: NE / Green R / Post, 200 m / 24.VI.1963 [printed; some text, not cited, has been stricken out; digit 4 in day handwritten]; (2) Dry forest [printed]; (3) R. Straatman / Collector / BISHOP [printed]. • 1 female labelled (1) PAPUA: FLY R / Kiunga, 35m / August, 1969 [printed]; (2) J.&M. Sedlacek / Collectors / BISHOP [printed]. **Solomon Islands:** 1 male labelled (1) SOLOMON IS. / CHOISEUL I. / Malangona, 10m / 2.III.1964 [printed]; (2) P. Shanahan / Collector / BISHOP [printed]; (3) Phumosia ♂ / testacea / (S.-White, 1923) / Det. H. Kurahashi [printed]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Hind tibia with 1 *pd* on right side, 1 *pd* and 1 weak *pd* on left hind tibia. Presutural dark vitta on thoracic dorsum, else pale. T1–3 pale, T4 (except narrow anterior border) and T5 dark. A specimen with the same label data (in National Science Museum Tokyo) has been published by Kurahashi (2003b: 280, as *Phumosia testacea*) who also presented figures of genitalia (based on a Guadalcanal I. specimen, cf. Kurahashi 2003b: 277) which clearly are of *C. indica* not *C. testacea*. • 1 female labelled (1) SOLOMON IS.: / Guadalcanal, Honiara / 0-100m, XII.1976 [printed, except month and 6 in year, which are handwritten]; (2) N.L.H. Krauss / Collector / BISHOP MUSEUM [printed]. Mouldy. Frons broad, converging. Thoracic dorsum pale, except for a broad presutural grey vitta. No setulae on R_1. Hind tibia with 1 large *pd* at middle and 1 weak above it on both sides. Abdomen dark on T4 and T5, also triangular dark area at middle of T3. • 1 female labelled (1) Vella Lavella [Solomon Islands] / O[?]LD CRATER 60m / 20 Dec 1963 / P. SHANAHAN [handwritten]. Very dirty specimen. All pale yellow thorax and abdomen, with no darkenings anywhere. R_1 without setulae. Hind tibia (left) with a visible strong *pd*; elsewhere impossible to study setae; same with right hind tibia. **Sri Lanka:** 1 male labelled (1) SRI LANKA / nr Shinharaja / Forest, 100-200m / 21-22.VI.1989 / Col. H. Kurahashi [printed]; (2) Phumosia ♂ / indica / (Surcouf, 1914) / Det. H. Kurahashi [printed]. Thoracic dorsum dark at middle outwards to *sa* and *prst*, including some yellow areas laterally. Postpronotal lobe orange. Postalar wall setulae black. Scutellum yellow. Hind tibia with 1 *pd* on left, 1 *pd* on right side. Abdominal T1+2 yellow, T3 yellow with narrow dark marginal band (cf. HT of *surcoufi*). T4 yellow with broad marginal band (1/3) dark. T5 all dark with a bluish sheen. • 1 male labelled (1) SRI LANKA / nr Shinharaja / Forest, 100-200m / 21-22.VI.1989 / Col. H. Kurahashi [printed]; (2) Phumosia #m / indica / (Surcouf, 1914) / Det. H. Kurahashi [printed]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Thoracic dorsum dark at middle outwards to *sa* and *prst*, including some yellow areas laterally. Postpronotal lobe orange. Postalar wall setulae black. Scutellum yellow. Hind tibia with 1 *pd* on left, 1 *pd* on right side. Abdominal T1+2 yellow, T3 yellow with narrow dark marginal band. T4 yellow with a narrow (1/5) marginal band dark. T5 all dark with a bluish sheen. • 1 female labelled (1) SRI LANKA / nr Shinharaja / Forest, 100-200m / 21-22.VI.1989 / Col. H. Kurahashi [printed]; (2) Phumosia #f / indica / (Surcouf, 1914) / Det. H. Kurahashi [printed]. Hind tibia with 1 *pd* on left, 2 *pd* on right side. Abdominal T1+2 and T3 yellow with narrow dark marginal bands (like in holotype of *C. surcoufi*). Thoracic

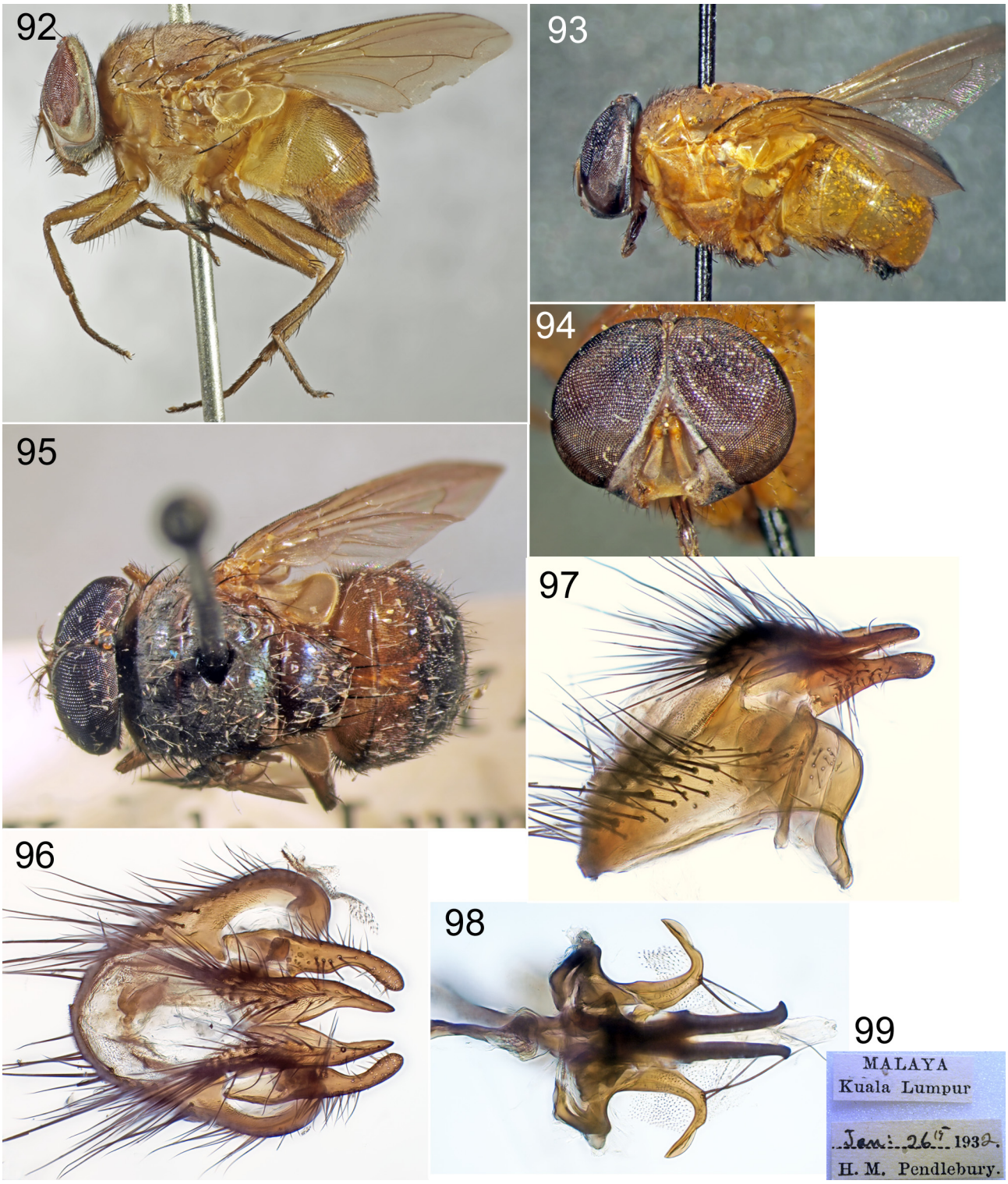
dorsum dark at middle outwards to *dc* rows behind suture, in front of suture darkening slightly wider, including some yellow areas laterally. Postpronotal lobe orange. Postalar wall setulae black. Scutellum yellow. T4 yellow, hind third dark. T5 all dark with a slight bluish sheen. • 1 female labelled (1) SRI LANKA / nr Shinharaja / Forest, 100-200m / 21-22.VI.1989 / Col. H. Kurahashi [printed]; (2) Phumosia #f / indica / (Surcouf, 1914) / Det. H. Kurahashi [printed]. Thoracic dorsum dark at middle outwards to *sa* and *prst*, including some yellow areas laterally. Postpronotal lobe orange. Postalar wall setulae black. Scutellum yellow. Hind tibia with 2 *pd* on left, 2 *pd* on right side. Abdominal T1+2 and T3 yellow with narrow dark marginal bands. T3 with a dark oval spot at middle. T4 all dark. T5 all dark with a slight bluish sheen. • 1 female labelled (1) SRI LANKA / nr Shinharaja / Forest, 100-200m / 21-22.VI.1989 / Col. H. Kurahashi [printed]; (2) Phumosia #f / indica / (Surcouf, 1914) / Det. H. Kurahashi [printed]. Thoracic dorsum dark at middle outwards to *dc*, including some yellow areas laterally. Postpronotal lobe orange. Postalar wall setulae black. Scutellum yellow. Hind tibia with 2 *pd* on left, 1 *pd* on right side. Abdominal T1+2 and T3 and T4 all yellow. T5 almost all dark but not everywhere. (Specimens from the same locality have been published by Kurahashi 2001). **Vietnam:** 1 female labelled (1) VIET NAM. M'Drak / E. of BanMeThuot / 4-600m, 8-19.XII.60 [printed]; (2) C.M. Yoshimoto / Collector [printed]; (3) Phumosia ♀ / indica / Surcouf 1914 / Det. H.Kurahashi [pencil handwriting]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and ovipositor with spermathecae in glycerol in glass microvial on pin. ST8 with soft setae, no spine-like ones. Marginal setae on T8 halves. • 1 male labelled (1) VIET NAM / BanMeThuot 500 m / 20-24.XII.1960 [printed]; (2) C.M. Yoshimoto / Collector [printed]; (3) Phumosia ♂ / indica / Surcouf 1914 / Det. H.Kurahashi [pencil handwriting]. Dissected by KR. Dried T1–5 and one leg glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 male labelled (1) VIET NAM / BanMeThuot 500 m / 20-24.XII.1960 [printed]; (2) C.M. Yoshimoto / Collector [printed]; (3) Phumosia ♂ / indica / Surcouf 1914 / Det. H.Kurahashi [pencil handwriting]. **CMNH: Papua New Guinea:** 1 female labelled (1) NEW GUINEA / Port Moresby / Brown River / 29 Dec. 1984 / E. Sugiyama; (2) Phumosia ♀ / indica / (Surcouf, 1914) / Det. H. Kurahashi. Frons broad at vertex, narrowing forwards in typical *C. indica* fashion. Darkened mesonotum almost to *ia* setae, with yellow margin all around, at middle yellow from behind hindmost *acr*. Postpronotal lobe yellow. Hind tibiae with 1 strong *pd* at middle, a weaker one above it on proximal fifth. **CNC: Sri Lanka:** 1 male labelled (1) SRI LANKA: / nr. Shinharaja / Forest 100-200m / 21-22.VI.1989 / Col. H. Kurahashi [printed]; (2) Phumosia #m / indica / (Surcouf, 1914) / Det. H. Kurahashi [printed]; (3) Caiusa / indica / CNC loan [printed on yellow label]. Thoracic dorsum mostly dark before suture, behind it dark along middle third. Hind tibia with 1 *pd* on both sides. T4 pale only at sides. T5 with mottled darkenings, hardly bluish sheen. • 1 female labelled (1) SRI LANKA: / nr. Shinharaja / Forest 100-200m / 21-22.VI.1989 / Col. H. Kurahashi [printed]; (2) Phumosia #f / indica / (Surcouf, 1914) / Det. H. Kurahashi [printed]; (3) Caiusa / indica / CNC loan [printed on yellow label]. Thoracic dorsum mostly dark. Hind tibia with 1 *pd* on both sides. T4 and T5 with mottled darkenings, partly bluish sheen. • 1 male labelled (1) Piliyandala, W.P. / Ceylon 7-V-67 / P.B. Karunaratne [printed]; (2) Caiusa / indica Sf / Det. Shewell. 1973 [handwritten; line 3 printed, except two last digits of year]; (3) Caiusa / indica / CNC loan [printed on yellow label]. Dissected by Shewell before reception. Part of T3, all T4 and T5, ST5, ST3 and ST4; epandrium (partly destroyed) and bacilliform sclerite (absent on right side) in glycerol in glass microvial. T4 dark along hind fifth. T5 mottled dark, pale midline, darkening broadly reaching fore margin. • 1 female labelled (1) Nugegoda, W.P. / Ceylon 8-VII-67 / P.B.Karunaratne [printed, except handwritten date]; (2) Caiusa / indica / CNC loan [printed on yellow label]. **IDD: India:** 3 males labelled (1) INDIA 1500m / Kerala St. / Ponmudi / 16-19.VI.1989 / Col. H.Kurahashi [printed]; (2) Phumosia ♂ / indica (Surcouf, 1914) / Det. Kurahashi [printed]. 1 male dissected by KR. Dried T1–5 glued to card on pin, genitalia in glycerol in glass microvial on pin. • 1 male labelled (1) INDIA 1500m / Kerala St. / Ponmudi / 16-19.VI.1989 / Col. H.Kurahashi [printed]; (2) Phumosia ♂ / testacea (S.-White, 1923) / Det. Kurahashi [printed]. Dissected by KR. Dried T1–5 glued to card on pin, genitalia in glycerol in glass microvial on pin. Mesonotum all yellow. **Malaysia (Sarawak):** 1 female labelled (1) MALAYSIA: BORNEO / Sarawak State, / Sibu Division, Katibas River, / Menyarin River, / forest, 9.ix.2011 / Col. H. Kurahashi [printed]; (2) G.pr. 413 / K. Rognes det. [partly handwritten]; (3) *Caiusa* (f) *nigronitens* S-W / K. Rognes det. 2013; (4) *Caiusa* (f) / *indica* Surcouf / K. Rognes det. 2014. Dissected by KR. T1–5 glued to card on pin, ST1–5 and spermathecae in glycerol in glass microvial on pin. The number 413 refers to flat-mounted slide of ovipositor (Figs. 78–80). • 1 male labelled (1) MALAYSIA: BORNEO / Sarawak State, / Sibu Division, / Katibas River, / Dujau River, forest, 10.ix.2011 / Col. H. Kurahashi [printed]; (2) *Caiusa* (m) *nigronitens* S-W / K. Rognes det. 2013; (3)



FIGURES 88–91. *Caiusa indica* Surcouf, male (all from specimen with pale mesonotum from India, Kerala, in IDD). **88.** Head and thorax, dorsal view. **89.** Habitus, posterodorsal view. **90.** Cerci and surstyli, posterior view. **91.** Cerci, surstyli, epandrium and aedeagus with pregonites, right lateral view.

Caiusa (m) / *indica* Surcouf / K. Rognes det. 2014. Dissected by KR. T1–5 glued to card on pin, ST1–5 and genitalia in glycerol in glass microvial on pin. • 2 males and 1 female labelled (1) MALAYSIA: BORNEO / Sarawak State / Sibu Division, / Katibas River, / Tupang River, / forest, 11.ix.2011 / Col. H. Kurahashi [printed]; (2) *Caiusa* (m/f) *nigronitens* S-W / K. Rognes det. 2013; (3) *Caiusa* (m/f) / *indica* Surcouf / K. Rognes det. 2014. 1 male dissected by KR. T1–5 glued to card on pin, ST1–5 and genitalia in glycerol in glass microvial on pin. The abdomen of undissected male pale on T1+2 and most of T3. The mesonotum and scutellum dark, except postpronotal lobe. • 1 female labelled (1) MALAYSIA: BORNEO / Sarawak, Lanjak- / Entimau Wildlife / Sanctuary, Engkari R. / forest, 29.vi-3.vii.2012 / Coll. H. Kurahashi [printed]. Not dissected. Very dark. **Thailand:** 1 male and 4 females labelled (1) THAILAND: CHIANG MAI / Doi Suthep-Pui Mt. / Sirindhorn Observatory / 817 m. 15.xi.2011 / Coll. H. Kurahashi. 1 male and 1 female dissected by KR. Dried T1–5 glued to card on pin, ST1–5 and genitalia / ovipositor in glycerol in glass microvial on pin. • 1 male and 2 females labelled (1) THAILAND: CHIANG MAI / Doi Suthep-Pui Mt. / Tham Phra Leusri / 15.xi.2011 / Coll. H. Kurahashi. 1 male and 1 female dissected by KR. Dried T1–5 glued to card on pin, ST1–5 and genitalia / spermathecae in glycerol in glass microvial on pin. Dissected female with label reading "G.pr. 412". Ovipositor flat mounted on slide numbered G.pr. 412. **Vietnam:** 1 male and 1 female labelled (1) VIETNAM: Ho Chi / Minh, Cu Chi, 50m / secondary forest / 17.xi.2000 / Col. H. Kurahashi [printed]. • 1 male and 12 females labelled (1) VIETNAM: Ho Chi / Minh, Can Gio / Mangrove / 16.18.xi.2000 / Col. H. Kurahashi [printed]. 1 male and 3 females dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia / ovipositor in glycerol in glass microvial on pin. • 1 female labelled (1) VIETNAM: Ninh Binh / Prov., Gia Vien / Cuc Phuong, 170m /10-11.vii.1997 / Col. H. Kurahashi [printed]. Dissected by KR. Dried T1–5 glued to card on pin, ST1–5 and ovipositor in glycerol in glass microvial on pin.

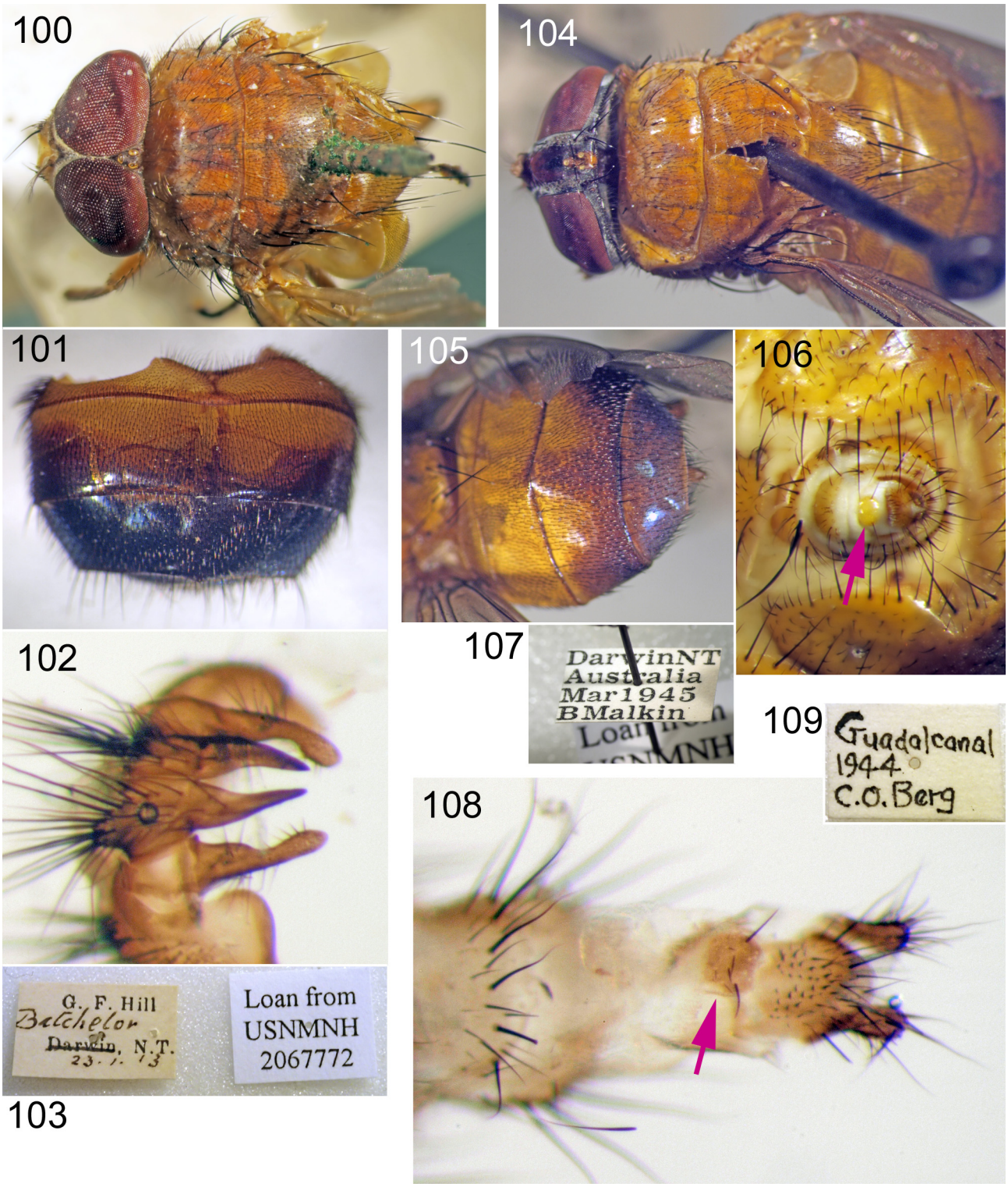
Hundreds of eggs in abdomen. • 2 males and 1 female labelled (1) VIETNAM: ThuaThien / Hue Prov., Phu Loc / Bach Ma N.P. / 500 m, 5.xi.2001 / Col. H. Kurahashi [printed]. 1 male and 1 female dissected by KR. Dried T1–5 glued to card on pin, ST1–5 and genitalia / spermathecae in glycerol in glass microvial on pin. Ovipositor flat mounted on slide numbered G.pr. 417. • 1 male labelled (1) VIETNAM: Lam Dong / Prov., Bao Loc, / Damb'ri, 800m / 6,8.xi.2000 / Col. H. Kurahashi [printed]; (2) Caiusa (m) / indica Surcouf / K. Rognes det. 2013 [printed].



FIGURES 92–99. *Caiusa indica* Surcouf, male (92, specimen from Solomon Is, Guadalcanal, in BMNH; 93, 94, specimen from Papua New Guinea, Bougainville I, Piva, in WSU; 95–99, specimen from Malaysia, Kuala Lumpur in WSU). **92.** Habitus, left lateral view (before dissection). **93.** Habitus, left lateral view (before dissection). **94.** Head, anterior view. **95.** Habitus, dorsal view. **96.** Cerci and surstyli, posterior view. **97.** Cerci, surstyli and epandrium, left lateral view. **98.** Ejaculatory sclerite, pregonites and distiphallus, ventral view. **99.** Labels (2).

Dissected by KR. Dried T1–5 glued to card on pin, ST1–5 and genitalia in glycerol in glass microvial on pin. **USNM: Australia (Queensland):** 1 male (staged) labelled (1) Cairns, Qld / HartleysCrk / 24 April 1957 [printed]; (2) W.W.Wirth / Collector [printed]; (3) Loan from / USNMNH / 2067772 [printed]. • 1 female labelled (1) Cairns / N.Q 2 [printed, except number]; (2) J. F. Illingworth / Coll. Ex flowers [printed, except flowers]; (3) Caiusa / surcoufi Bezzi / (at least of / Mall. 1927) / det / Sabrosky [handwritten, except det Sabrosky], (4) Loan from / USNMNH / 2067772 [printed]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 (in one piece) + ovipositor segments 6 and 7 (in one piece) + segment 8, epiproct, cerci, hypoproct and uterus with spermathecae (also in one piece) in glycerol in glass microvial on pin. Dissection was not quite successful: the ovipositor was partly turned inside out because of unintended pull on the intestines at the start of cleansing of the broken-off abdomen for tracheae. This caused the terminal segments of the ovipositor to be drawn into the seventh segment. During the eversion process the ovipositor was severed between segments 7 and 8. There was also some damage to the T7 which was split middorsally at the hind margin. However, all the essential features are clearly visible: narrow T6 and T7; short, broad ST6 and ST7; short square to triangular T8 halves; unarmed ST8 and hypoproct. **Australia (Northern Territory):** 1 male (staged) labelled (1) G. F. Hill / Batchelor / ~~Darwin~~ N.T. / 23.1.13 [printed, except Batchelor and date, most of third line stricken out]; (2) Loan from / USNMNH / 2067772 [printed]. Dissected by KR. Dried T1–5 glued to stage. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 female (staged) labelled (1) Darwin / G. F. Hil [sic] [printed]; (2) Loan from / USNMNH / 2067772 [printed]. • 1 female labelled (1) Darwin N.T. / Australia / Mar 1945 / BMalkin [printed]; (2) Loan from / USNMNH / 2067772; (3) ST8! [handwritten by KR]. • 1 female (staged) labelled (1) G. F. Hill / Stapleton / ~~Darwin~~ N.TY. / 19.2.13 [lines 2 and 4 handwritten, most of line 3 stricken out]; (2) Paratricyclea / (Caiusa) / australis / Paratype / det. JRMalloch [handwritten, except det JRMalloch]; (3) ? Not / publ. / = his record of / P. (C.) surcoufi [Notes 11: 323] / det / Sabrosky [handwritten except det Sabrosky]; (4) Loan from / USNMNH / 2067772 [printed]. Sabrosky assumes the label text "Paratricyclea (Caiusa) australis Paratype" is a manuscript name he doubts has been published. It is not mentioned in Malloch (1927). "Notes 11: 323" refers to Malloch's 1927 paper. **India:** 1 male labelled (1) INDIA, Kerala: / South Malabar, / Walayar Forest, / 1000ft., / Oct. 1956 / P.S. Nathan [printed]; (2) Phumosia / indica / (Surcouf) / det. Woodley 1984 [handwritten, except last line]; (3) Loan from / USNMNH / 2067772 [printed]. Genitalia drawn out and visible. **Indonesia (Papua):** 1 female labelled (1) NEW GUINEA / Hollandia [now = Jayapura]: Netzer / Nov. '44 [printed]; (2) Loan from / USNMNH / 2067772 [printed]. Mesonotum with broad dark stripe. Scutellum yellow. Both hind tibiae with 2 pd, upper weaker. Abdomen dark on T5, T4 and partly T3. **Indonesia (West Java):** 1 male labelled (1) Depok / Java [printed]; (2) Bryant& / Palmer Coll [printed]; (3) Phumosia / ferruginea / ♂ Dol. / Det. CHTT [handwritten except last line]; (4) Loan from / USNMNH / 2067772 [printed]. T5 is absent. Genitalia are glued to corner of label 2. **Malaysia (West Malaysia):** 1 female (staged) labelled (1) MALAY PENIN: / Selangor, F.M.S. / KualaLumpur / at light / 24.9. 1924 / H.M. Pendlebury. [printed, except lines four and five which are mostly handwritten]; (2) Loan from / USNMNH / 2067772 [printed]. Dissected by KR. Dried T1–5 glued to stage. Ovipositor and ST1–5 (one piece) in glycerol in glass microvial on pin. The specimen stood in a row of 5 specimens identified as *Phumosia nigronitens* according to the USNM loan invoice, 4 from Malaysia and 1 from Singapore. Mesonotum very dark, postpronotal lobes yellow, and abdomen very dark dorsally, except for anterior half of T1+2. The ovipositor shows all the morphological features of a *Caiusa indica* female. • 2 females (staged) labelled (1) MALAY PENIN: / Selangor, F.M.S. / KualaLumpur / at light / nov. 4th 1924 / H. M. Pendlebury [printed, except lines four and five which are mostly handwritten]; (2) Loan from / USNMNH / 2067772 [printed]. Not dissected. The specimens are dark as usual, but has yellow colour shining weakly through laterally on T3, in one of them also yellow colour in lateral small patches on the scutellum. • 1 female (staged) labelled (1) MALAY PENIN: / Selangor, F.M.S. / KualaLumpur / at light / nov. 21st 1924 / H. M. Pendlebury [printed, except lines four and five which are mostly handwritten]; (2) Loan from / USNMNH / 2067772 [printed]. The specimen is also dark, but has yellow colour all over T3, also yellow colour along the edge of the scutellum. **Papua New Guinea:** 1 female (staged) labelled (1) Bougainville I / I-VI-5-1944 / ABGuerney [printed]; (2) Loan from / USNMNH / 2067772 [printed]. **Philippines:** 1 male labelled (1) Novaliches / RizalLuzon [now = Quezon] / PI 6.5.30 [date handwritten]; (2) F Rivera / collr [printed]; (3) ♂ [printed in red]; (4) Loan from / USNMNH / 2067772 [printed]. Genitalia bent out and visible. Mesonotum mostly dark: Scutellum yellow. Hind tibia with 2 *pd*, upper one small. All legs lost on left side. T5 and most of T4 dark. • 1 male labelled (1) Novaliches / RizalLuzon / PI 6.5.30 [date handwritten]; (2) F Rivera / collr [printed]; (3) Loan from / USNMNH / 2067772 [printed]. Genitalia not visible, not dissected. Mesonotum mostly dark. Scutellum yellow.

Hind tibia with 2 *pd*, upper one small. All legs in situ. T5 and most of T4 dark. • 1 female (staged) labelled (1) PuertoPrincesa / PalawanPI [printed]; (2) RCMcGregor / Collector [printed]; (3) Caiusa / indica / Surcouf / det. Sabrosky [handwritten except last line]; (4) Loan from / USNMNH / 2067772 [printed]. Not dissected. I had an accident and the specimen had to be re-glued to the stage. • 1 male labelled (1) 320 [printed]; (2) Osmena / Samar IV 1945 [partly printed]; (3) COLL. / J.LAFFOON [handwritten]; (4) Loan from / USNMNH / 2067772 [printed]. Dissected by KR. Dried T1–5 glued to card on pin. Genitalia in glycerol in glass microvial on pin. • 1 male labelled (1) Manila PI / 8-21-24 [partly printed]; (2) RCMcGregor / Collector [printed]; (3) ♂ [printed in red]; (4) Phumosia / abdominalis / A. RD [handwritten]; (5) Phumosia / indica / det. FRMagpayo [handwritten]; (6) Loan from / USNMNH / 2067772 [printed]. Genitalia exerted and visible. Mesonotum dark. Scutellum yellow. Hind tibia with 1 *pd*. T5 and T4 dark with bluish sheen, a median triangular dark area middorsally on T3. **Singapore:** 1 female (staged) labelled (1) Singapore / May 1924 / Coll. [printed, except 24 which is handwritten]; (2) Paratricyclea / (Caiusa) / nigronitens / S.W. / Det. / J.R.Malloch [mostly handwritten, printed black frame and determiner's name]; (3) Loan from / USNMNH / 2067772 [printed]. This specimen with slightly more yellow on the abdomen and mesonotum than those from Kuala Lumpur in the row of five "Phumosia nigronitens" specimens in USNM (see above). **Solomon Islands:** 1 male labelled (1) L Florida I / Solomon Is / Mar 1945 / GEBohart [printed]; (2) Phumosia / testacea / (Senior-White) / det. Woodley 1984 [handwritten, except most of last line]; (3) Loan from / USNMNH / 2067772. • 6 males and 8 females labelled (1) L Florida I / Solomon Is / Mar 1945 / GEBohart [printed]; (2) Loan from / USNMNH / 2067772. 1 male dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. • 2 males labelled (1) 202 [printed]; (2) Lunga Valley / Guadalcanal / X 1944 [printed except month]; (3) Laffoon Coll. [printed]; (4) Loan from / USNMNH / 2067772 [printed]. 1 male dissected by KR. Dried T1–5 glued to card on pin. Genitalia in glycerol in glass microvial on pin. • 3 males and 1 female labelled (1) 208 [printed]; (2) Lunga Valley / Guadalcanal / X 1944 [printed except month]; (3) Laffoon Coll. [printed]; (4) Loan from / USNMNH / 2067772 [printed]. • 1 male and 1 female labelled (1) 210 [printed]; (2) Lunga Valley / Guadalcanal / X 1944 [printed except month]; (3) Laffoon Coll. [printed]; (4) Loan from / USNMNH / 2067772 [printed]. • 1 male labelled (1) 201 [printed]; (2) Uma sami R., / Guadalcanal / X 1944 [printed except month]; (3) Laffoon Coll. [printed]; (4) Loan from / USNMNH / 2067772 [printed]. • 1 female labelled (1) Lunga R. / Guadalcanal / Solomon Is. [printed]; (2) Nov. / 1944 [last line handwritten]; (3) Jean Laffoon / coll. [printed]; (4) Loan from / USNMNH / 2067772 [printed]. • 6 males and 4 females labelled (1) Guadalcanal / 1944 / C.O.Berg [handwritten]; (2) Loan from / USNMNH / 2067772 [printed]. 1 male dissected by KR. Dried T1–5 glued to card on pin, genitalia in glycerol in glass microvial on pin. 2 females dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and ovipositor in glycerol in glass microvial on pin. In one of the females the abdomen contained a large number of eggs with prominent hatching pleats (similar to those in Figs. 81, 82). The other had no eggs. 1 dissected and 1 undissected female all yellow, i.e., also abdomen yellow. • 1 male (staged) labelled (1) SOLOMON ISL.: / Guadalcanal / Deep Jungle / Nov.3. 1944 / David G. Hall [printed]; (2) Loan from / USNMNH / 2067772 [printed]. Dissected by KR. Dried T1–5 glued to stage. Genitalia in glycerol in glass microvial on pin. • 1 female labelled (1) SOLOMON IS / Guadalcanal / 20-24 Oct'43 / D.G. Hall [printed]; (2) Phumosia / testacea / (Senior-White) / det. Woodley 1984 [lines 1–3 handwritten; last line printed except year]; (3) Loan from / USNMNH / 2067772 [printed]. Specimen all yellow, also abdomen. **Sri Lanka:** 1 female labelled (1) SRI LANKA: Kur Dist. / Kurunegala / Badagomuwa Jungle / Collected by hand / 10 - 11 - IX – 1980 [printed]; (2) K.V.Krombein / P.B.Karunaratne / T.Wijesinhe / L.Jayawickrema / V. Gunawardane [printed]; (3) Loan from / USNMNH / 2067772 [printed]. Dissected by KR. Dried T1–5 + left hind leg glued to card on label. Ovipositor and ST1–5 (one piece) in glycerol in glass microvial on pin. **WSU: Indonesia (West Papua):** 1 male labelled (1) Steinkool [= Bintuni] / N.N.Guinea / G.V. Hansen [handwritten]; (2) Phumosia / indica / (Surcouf) / det. James 70 [handwritten]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 female labelled (1) NYA GUINEA, 13/ 6 // Wailibit [now Wailebet or Wai Lebed, Google citing 'Lonely Planet'] Batanta // Sten Bergman, -49 [printed]; (2) Riksmuseum / Stockholm [printed on green label]; (3) 18 [pencil handwriting]; (4) Phumosia / indica [handwritten by James; label cut along middle; trace of the word "Surcouf" visible along lower border] [Similarly labelled specimen in Kurahashi 2003a]. **Malaysia (West Malaysia):** 1 male labelled (1) MALAYA / Kuala Lumpur [printed]; (2) Jan: 26th 1932. / H.M. Pendlebury. [printed; except date and 2 in year which are handwritten]. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Specimen with a very dark scutellum (Fig. 95). **Papua New Guinea:** 1 male labelled (1) IN TRAP [printed]; (2) Moitaka / Pt Moresby / March 1962 / K R Norris [printed]; (3) AUST.NAT. / INS.COLL. [printed on green label]; (4) Phumosia / indica [handwritten by James].



FIGURES 100–109. *Caiusa indica* Surcouf (100–103, dissected male specimen from Australia, N.T., Batchelor, in USNM; 104–107, undissected female specimen from Australia, N.T., Darwin in USNM; 108, 109, dissected female specimen from Solomon Is, Guadalcanal in USNM). **100.** Head and thorax, dorsal view. **101.** Detached abdomen before dissection, dorsal view. **102.** Cerci and surstyli, posterior view. **103.** Labels (2). **104.** Head and thorax, dorsal view. **105.** Abdomen, posterodorsal view. **106.** Tip of abdomen, ventral view. Arrow points to ST8. **107.** Labels. **108.** Tip of ovipositor, ventral view. Arrow points to ST8. **109.** Label.

Dissected by KR. Dried T1–5 + right mid leg glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. Dorsum of thorax dark laterally to slightly beyond rows of *dc* setae. T5 not very dark, slightly

bluish laterally. Left hind tibia with 2 *pd*, right with 1 *pd*. • 1 male labelled (1) NEW GUINEA: PAPUA / W. District / Oriomo Govt. sta. / 26-28.X.1960 [printed]; (2) Malaise Trap / J.L. Gressitt [printed]; (3) Phumosia / indica / (Surc.) / det. James 70 [handwritten]. • 1 female labelled (1) NEW GUINEA: PAPUA / W. District / Oriomo Govt. Sta. / 26-28.X. l 960 [printed]; (2) Ex fresh human / excrement [printed]; (3) J. L. Gressitt / Collector [printed]; (4) 14 [pencil handwriting]; (5) Phumosia / indica / (Surc.) [handwritten by James]. • 1 female labelled (1) Lae / New Guinea / March 1962 / K R Norris [printed]; (2) AUST.NAT. / INS.COLL. [printed on green label]; (3) Phumosia / indica [handwritten by James]. Both hind tibiae with 2 pd, upper one smaller than lower. • 1 female labelled (1) New Guinea / 1944 / B.C. Fluke [handwritten; the F resembles the digit 7]. KR labelled *C. indica* female. Both hind tibiae with 1 *pd*. • 1 male labelled (1) Piva - III - 45 / Bougainville [printed except date]; (2) Solomon Is. / A.I.Walz [printed]. Dissected by KR. Dried T1–5 on card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. All yellow specimen (Figs. 93, 94). All legs lost, except right mid leg. Most setae and setulae also lost. **Philippines:** 1 male labelled (1) San Jose, / Mondoro, P.I. [= Philippine Islands] / N - 5 - 45 [printed except last line which is handwritten]; (2) Ross & Skinner / Collectors [printed]; (3) Phumosia / indica / (Surc.) [handwritten by James]. Dissected by KR. Dried T1–5 + right mid leg glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. **Solomon Islands:** 1 female labelled (1) Guadalcanal / & Florida Is. / I-III-1945 / J.R.Stuntz [printed]; (2) Phumosia / (Caiusa) [pencil handwriting]. Both hind tibiae with 1 *pd*. T5 brownish, not metallic (not evident that darkness is in the integument or inside it). **ZMUM: Cambodia:** 1 male labelled (1) CAMBODIA, Koh Kong prov., / vill. Tatai env., / 16-18.IV.2010 O.Kosterin [printed].

4. *Caiusa karrakerae* sp. nov.
Table 1; Figs. 110–119.

Holotype male, Thailand, Sakaerat ERS [= Environmental Research Station] (KR), here designated. For details, see Type material, below.

Etymology. The species is named after Nancy E. Karraker, University of Rhode Island, Rhode Island, USA, in honour of her contribution to the knowledge of the fly genus *Caiusa*, by rearing four species, of these two new to science, to the adult stage from infested egg masses of various rhacophorid frogs in South East Asia. The specific name is a noun in genitive case formed from the modern personal name of a woman (ICZN, Article 31.1.2.) by adding the suffix *-ae* to the stem *karraker*.

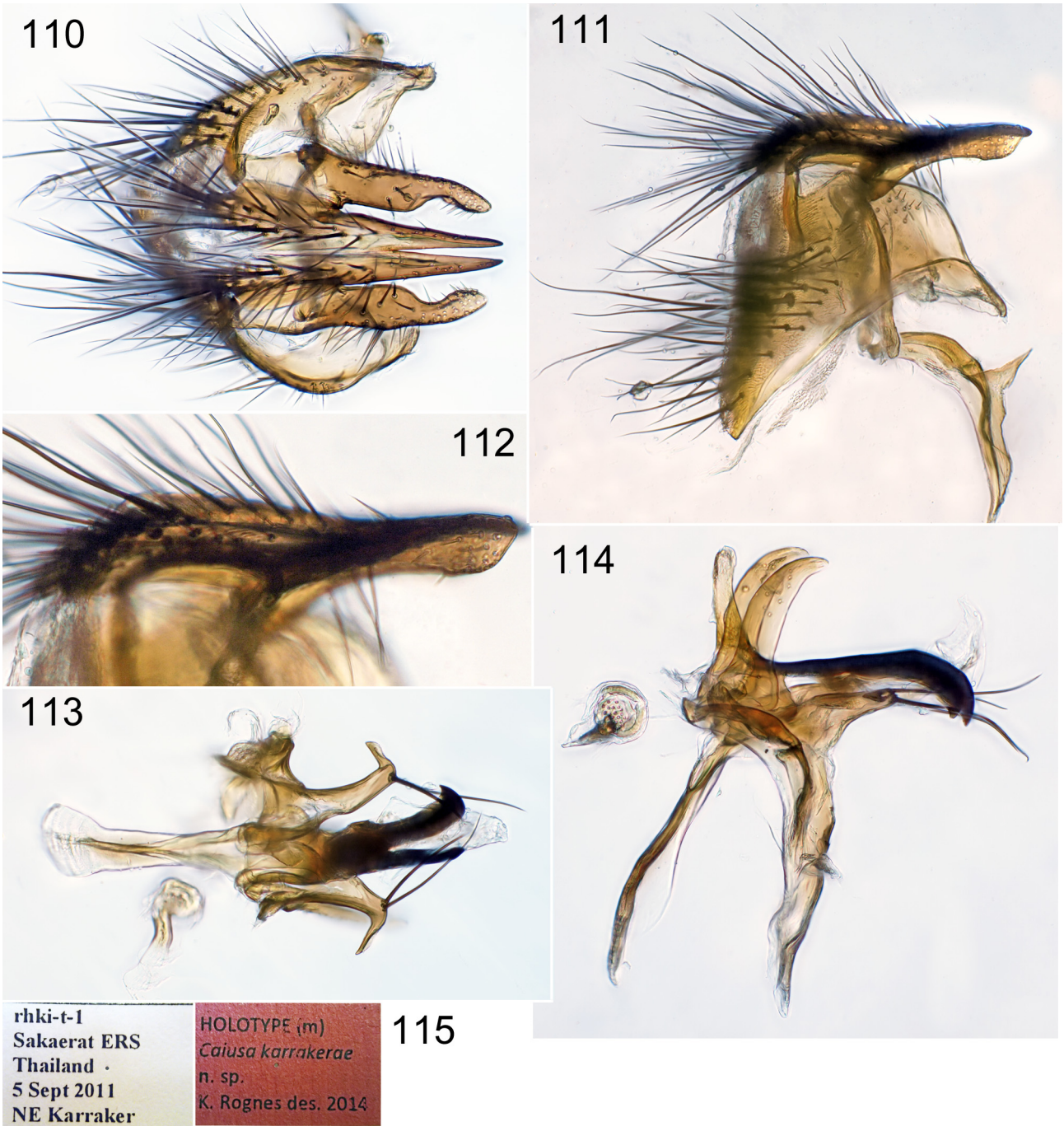
Diagnosis. *Male*. Cerci straight in lateral view, longer than surstylus. Cerci in posterior view narrow and slender, evenly narrowing from base to tip, apically with a long narrow slit (Fig. 110). Surstylus narrow, gently curved, broadest at tip in lateral view, tip blunt (Figs. 111, 112); in posterior view broad basally, then narrow, and distally with an inwardly curved and slightly widened tip. Pregonite with the distal process (beyond bases of long setae) short (Fig. 113). Colour variable. In clutch rhdu-d-1 (Table 1) thoracic dorsum dark except laterally, abdominal T4 and T5 dark with bluish sheen, partly also T3. Legs rather dark. In clutch rhki-t-1 (Table 1) thorax pale yellow with irregular dark areas, and only T5 dark. Legs yellow. In the clutch chno-t-1 (Table 1) thoracic dorsum pale with a middorsal dark presutural stripe, abdominal T4 and T5 dark. Legs yellow. Hind tibia with 2 *pd* on both hind tibia in 5 males, in one male 3 *pd* on left and 4 *pd* on right hind tibia.

Female. Frons at vertex / head width ratio: 0.242–0.254 (mean 0.248, n=5), thus a very narrow frons in all clutches. Species apparently recognisable on this feature alone. In ovipositor ST6 wider than long (Fig. 117). T7 sclerotised middorsally only, sclerotised area reaching more than halfway to fore margin, no anteriorly diverging lateral T7 sclerotisations (Fig. 117). ST7 longer than wide. T8 half short, wider than long (Fig. 118). ST8 very short, with short strong spinous setae (Fig. 118). Hypoproct ventrally with numerous strong spine-like setae grouped in a well defined V-shaped area (Fig. 118). Epiproct with few setae. Hind tibia with 2 *pd* setae. Otherwise as in male.

Immature stages. Unknown.

Biology. Reared from foam nests of *Chiromantis nongkhorensis*, *Rhacophorus dulitensis* and *Rhacophorus kio*.

Discussion. Similar to *C. kurahashii* but cerci longer than surstylus, the surstyli are different and the T7 of the ovipositor lacks lateral sclerotisations.



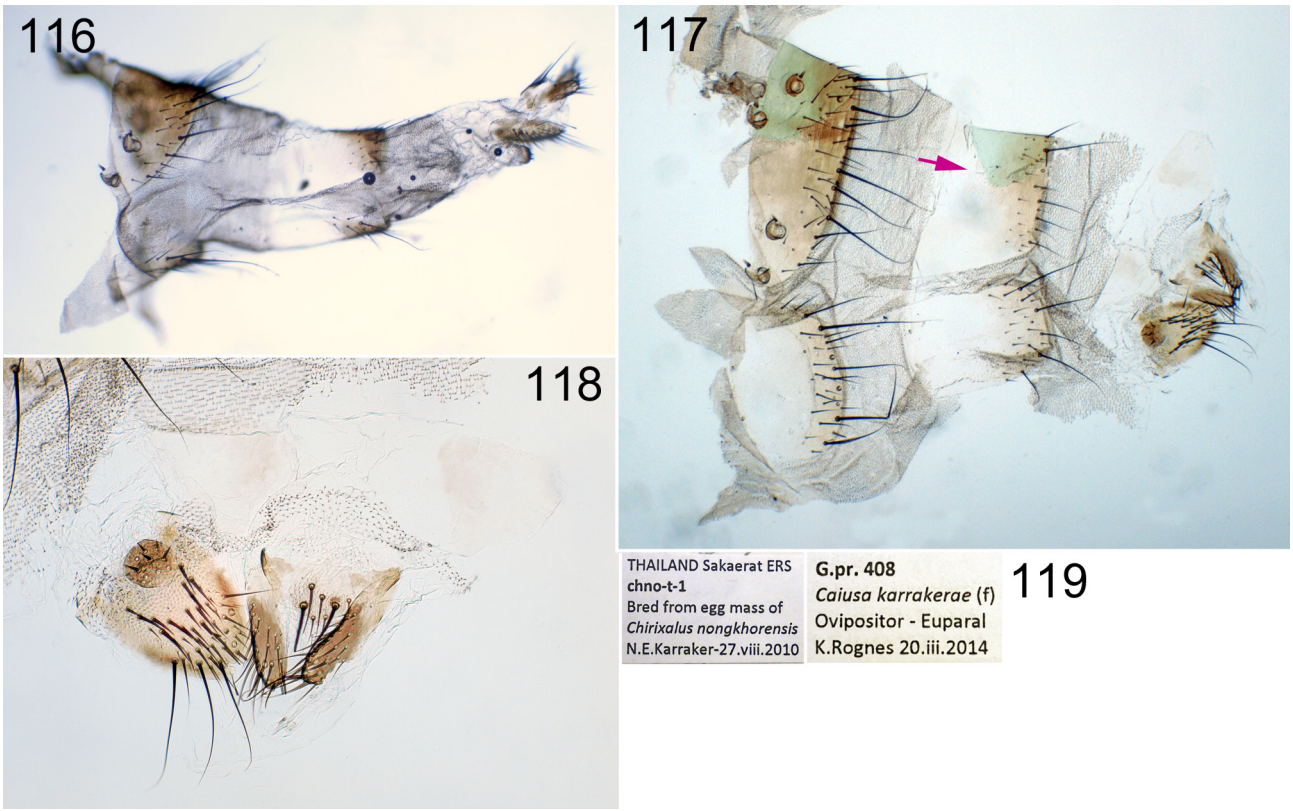
FIGURES 110–115. *Caiusa karrakerae* **sp. nov.** (all from holotype in KR). **110.** Cerci and surstyli, posterior view. **111.** Cerci, surstyli, epandrium and hypandrium, left lateral view. **112.** Cerci and surstyli, left lateral view, enlarged. **113.** Phallapodeme, ejaculatory sclerite, pregonites and distiphallus, ventral view. **114.** Phallapodeme, ejaculatory sclerite, hypandrium, postgonites, pregonites and distiphallus, left lateral view. **115.** Labels (2).

Distribution. Malaysia (Sabah), Thailand. The doubtful occurrence in Papua New Guinea (see below) is not included in its distributional area, at present.

Type material. **Holotype** male, in KR, labelled: (1) rhki-t-1 / Sakaerat ERS / Thailand / 5 Sept 2011 / NE Karraker [printed on white label]; (2) HOLOTYPE (m) / *Caiusa karrakerae* / n.sp. / K. Rognes des. 2014 [printed on red label]. Dissected by KR. Dried T1–5 glued to card on pin. Genitalia in glycerol in glass microvial on pin. Reared from foam nest of *Rhacophorus kio*.

Paratypes (5 males and 6 females). **KR: Thailand:** 2 males and 2 females labelled (1) rhki-t-1 / Sakaerat ERS / Thailand / 5 Sept 2011 / NE Karraker [printed on white label]; (2) PARATYPE (m or f) / *Caiusa karrakerae* / n.sp.

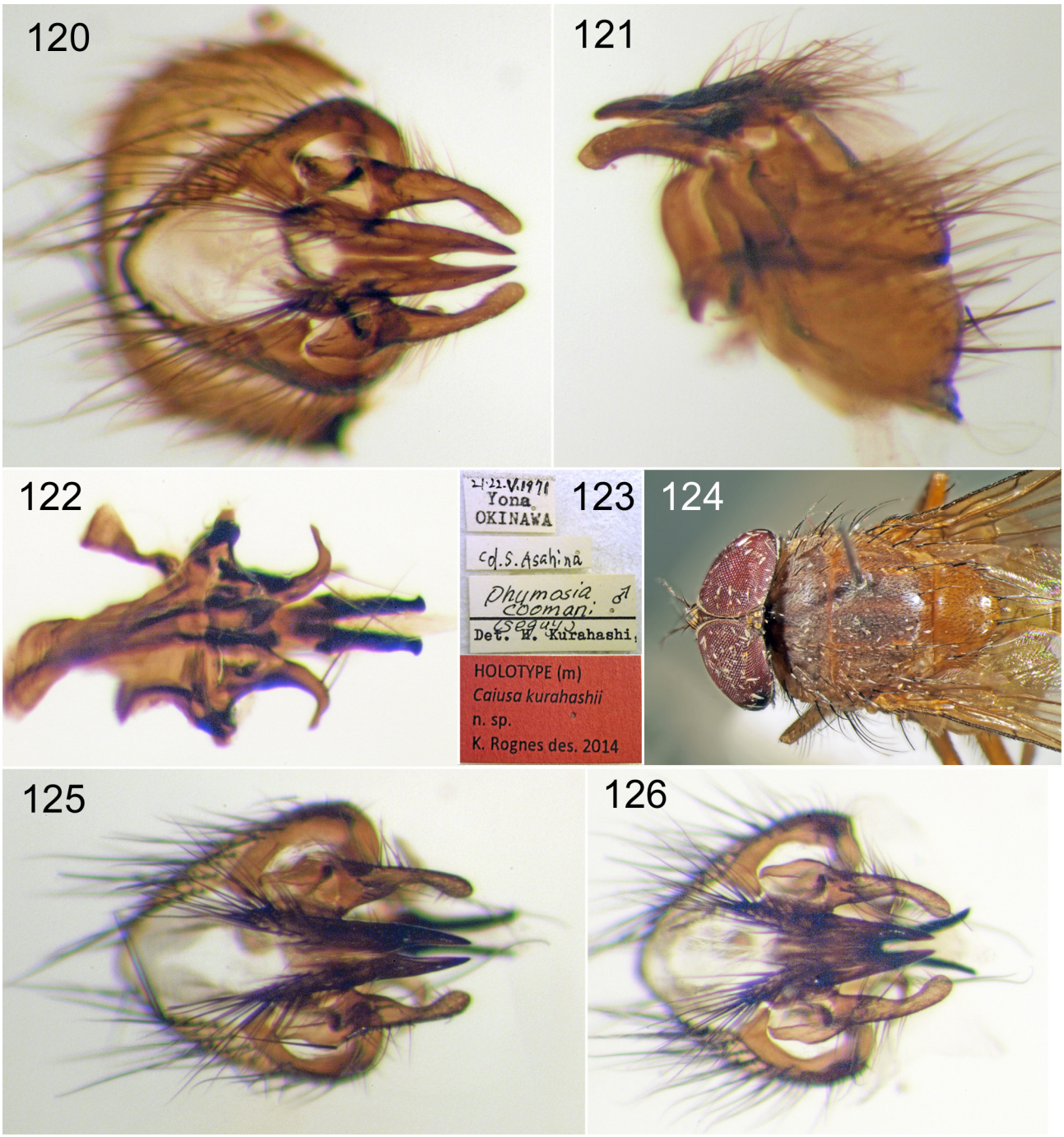
/ K. Rognes des. 2014 [printed on red label]. 1 male dissected by KR. Dried T1–5 glued to card on pin. Genitalia in glycerol in glass microvial on pin. Reared from foam nests of *Rhacophorus kio*. • 2 males and 3 females labelled (1) chno-t-1 / Sakaerat ERS / Thailand / 27 Aug 2010 / N Karraker; (2) PARATYPE (m or f) / *Caiusa karrakerae* / n.sp. / K. Rognes des. 2014 [printed on red label]. 1 male and 1 female dissected by KR. Dissected male with dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin between labels 1 and 2. Dissected female with dried ST1–5 and all mid and hind legs glued to card on pin. Spermathecae and ST1–5 in glycerol in glass microvial on pin between labels 1 and 2; an additional label reading "slide # 408" between vial and paratype label. Female ovipositor flat mounted on slide # 408. Reared from foam nests of *Chiromantis nongkhorensis*. **Malaysia (Sabah):** 1 male and 1 female labelled (1) rhdu-d-1 / Danum Valley / Sabah, Malaysia / 2 Nov 2010 / J Sheridan [printed on white label]; (2) PARATYPE (m or f) / *Caiusa karrakerae* / n.sp. / K. Rognes des. 2014 [printed on red label]. Male dissected by KR. Dried T1–5 glued to card on pin. Genitalia in glycerol in glass microvial on pin between labels 1 and 2. Reared from foam nest of *Rhacophorus dulitensis*.



FIGURES 116–119. *Caiusa karrakerae* **sp. nov.** (all from dissected female paratype from Thailand in KR). **116.** Extended ovipositor in glycerol before flat-mounting. **117.** Flat-mounted ovipositor, G.pr. 408. T6 and T7 partly folded beneath upper edge (green areas). Arrow points to anterior tip of middorsal sclerotisation of T7. **118.** Tip of ovipositor, enlarged. **119.** Labels on slide G.pr. 408.

Other material. Doubtfully included here, and not as a paratype. **BPBM: Papua New Guinea:** 1 female labelled (1) NEW GUINEA: NE / Arau, 1400 m / 40 km E. of Kai- / nantu, X-16-'59 [printed]; (2) T. C. Maa / Collector / BISHOP [printed].; (3) Caiusa (f) ? / karrakerae n. sp. / K. Rognes des. 2014. Very narrow frons with parallel sides. Frons at vertex / head width ratio 0.235. Thoracic dorsum with broad dark vitta presuturally and postsuturally to at least middle of thorax (pin hides the rest of the thorax along midline). Apparently only 3 *post dc* setae on left side, but positioned as if 4, position no 2 lacks pore but has a white spot. On right side, the mesonotum has an upturned flap close to pin torn from the rest of the upper surface, it carries two pores for two setae, the hindmost is easy to spot, the foremost is on the surface of the flap facing anterolaterally and near the edge. In addition there is one pore in front of and one pore behind flap, thus a total of 4 *post dc* on right side. Mid and hind leg with femora and tibia dark (brown) contrasting with yellow colour elsewhere. Hind tibia with 2 *pd*. Abdomen with dark, shining brown T4 and T5, no metallic bluish sheen. Not dissected.

Note. Rhacophorid frogs do not occur in New Guinea (Li *et al*. 2013).



FIGURES 120–126. *Caiusa kurahashii* **sp. nov.** (120–124 from holotype in IDD, 125 from male paratype from Ishigaki-Jima, Japan, in IDD; 126 from male paratype from Iriomote-Jima, Japan, in IDD). **120.** Cerci and surstyli, posterior view. **121.** Cerci, surstyli, epandrium and TST7+8, right lateral view. **122.** Pregonites, ventral view. **123.** Labels (4). **124.** Head and thorax, dorsal view. **125.** Cerci and surstyli, posterior view. **126.** Cerci and surstyli, posterior view.

5. *Caiusa kurahashii* sp. nov.

Figs. 120–136.

Holotype male, Japan, Okinawa, Yona (IDD), here designated. For details, see Type material, below.

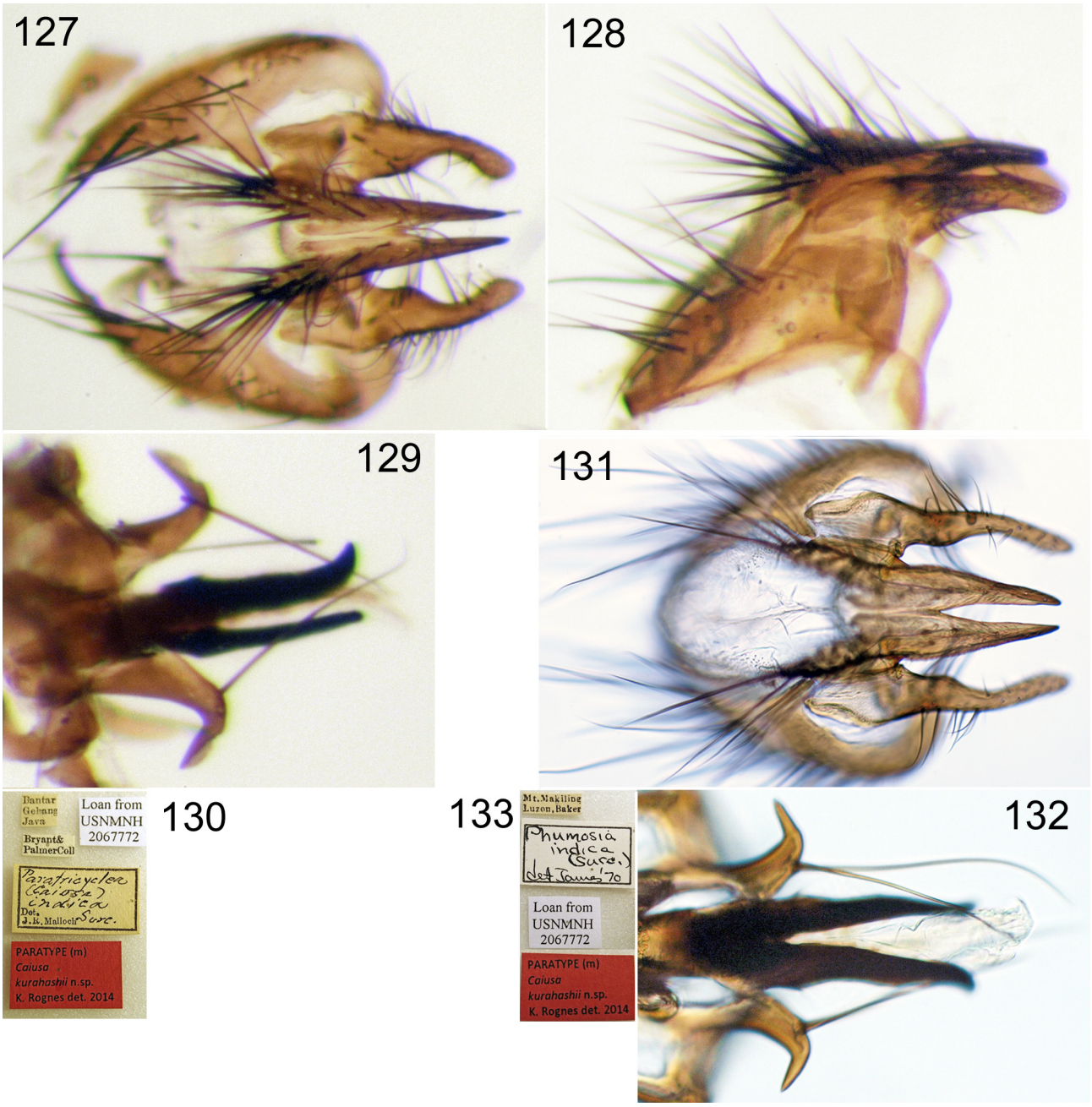
Paratricyclea (*Caiusa*) *indica*: Malloch 1926: 496. 1 male in USNM "from Java which agrees entirely with Surcouf's description". Examined. Misidentification, not *C. indica* Surcouf.

Phumosia coomani: Kurahashi 1989c: 318. 1 male in IDD, "Nansei Islands, Japan", S. Asahina leg. Examined. Misidentification, not *C. coomani* Séguy.

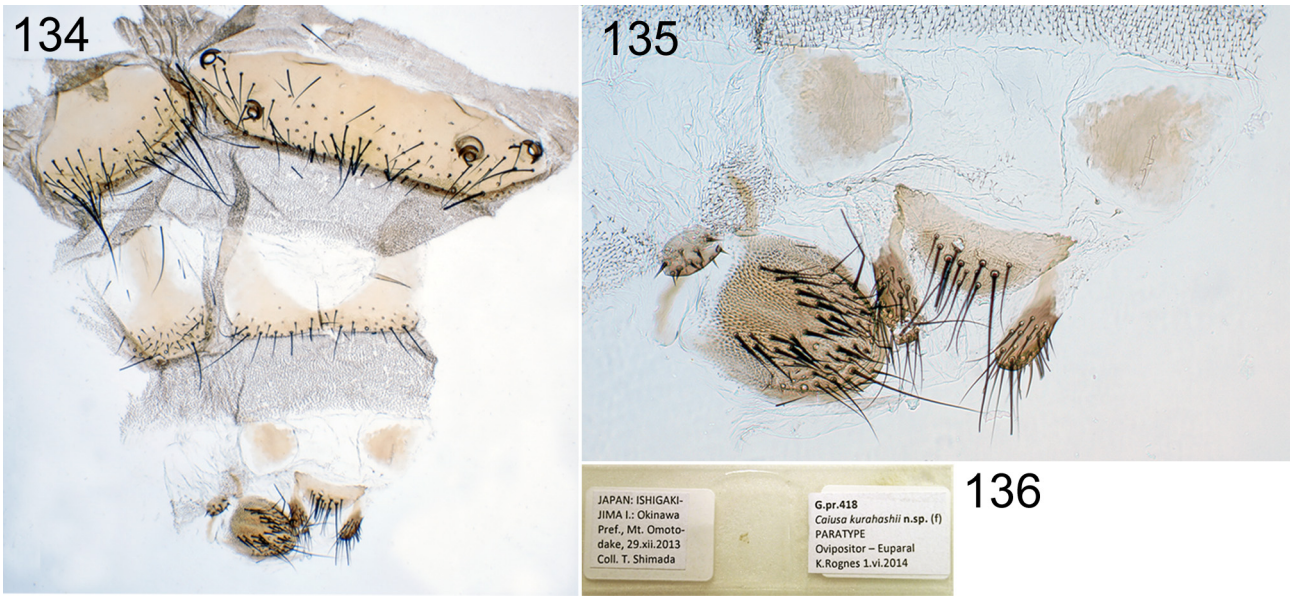
Phumosia coomani: Kurahashi 2010: 71. Misidentification, not *C. coomani* Séguy.

Phumosia coomani: Kurahashi 2014: 812. Misidentification, not *C. coomani* Séguy.

Etymology. The species is named after Hiromu Kurahashi, Tokyo, Japan, to honour his immense contribution to the knowledge of Diptera in the Oriental, Australasian and Oceanian Regions and in gratitude for his generous help with material of *Caiusa* for this study. The specific name is a noun in genitive case formed from the modern personal name of a man (ICZN, Article 31.1.2.) by adding the suffix *-i* to the stem *kurahashi.*



FIGURES 127–133. *Caiusa kurahashii* **sp. nov.** (127–130 from male paratype from Indonesia, Java, in USNM; 131–133 from male paratype from Philippines, Luzon, in USNM). **127.** Cerci and surstyli, posterior view. **128.** Cerci, surstyli and epandrium, left lateral view. **129.** Pregonites, ventral view. **130.** Labels (5). **131.** Cerci and surstyli, posterior view. **132.** Pregonites, dorsal view. **133.** Labels (4).



FIGURES 134–136. *Caiusa kurahashii* **sp. nov.** (all from dissected female paratype from Ishigaki-Jima, Japan, in IDD). **134.** Flat-mounted ovipositor, G.pr. 418. **135.** Tip of flat-mounted ovipositor, enlarged. **136.** Slide G.pr. 418 with labels.

Diagnosis. *Male*. Cerci long, narrow, gradually tapering in posterior view, apically with a narrow slit (Figs. 120, 125, 127, 131). Cerci shorter than surstylus, and apically straight or slightly bent backwards in lateral view (Figs. 121, 128). Surstylus in lateral view of even width and slightly curving downward (Figs. 121, 128). Thoracic dorsum irregularly darkened almost all over, sometimes pale with a greyish stripe, or all dark. *h-sc* node in wing bare below. Hind tibia with 1–2 *pd*. T4 and T5 all or irregularly dark with a bluish metallic sheen (Japanese specimens from Ishigaki-Jima, Iriomote-Jima, Okinawa-Jima and Indonesian specimen from Java) or all yellow (male specimen from the Philippines).

Female. Frons at vertex / head width ratio 0.275–0.300 (mean 0.287, n=5). In ovipositor T6 wide, moderately short. ST6 broader than long. T7 halves rather broadly connected middorsally posteriorly. Each T7 lateral half longer than half the width of posterior edge of T7. ST7 much longer than wide (Fig. 134). T8 halves short, wider than long, shaped as an irregular blunt triangle pointing medially. ST8 very short, easily overlooked, with short strong spinous setae. Epiproct with numerous setae. Hypoproct with long and strong spinous setae clustered in V-shaped area, the arms of the V being composed of several rows of setae (Fig. 135). Otherwise as in male.

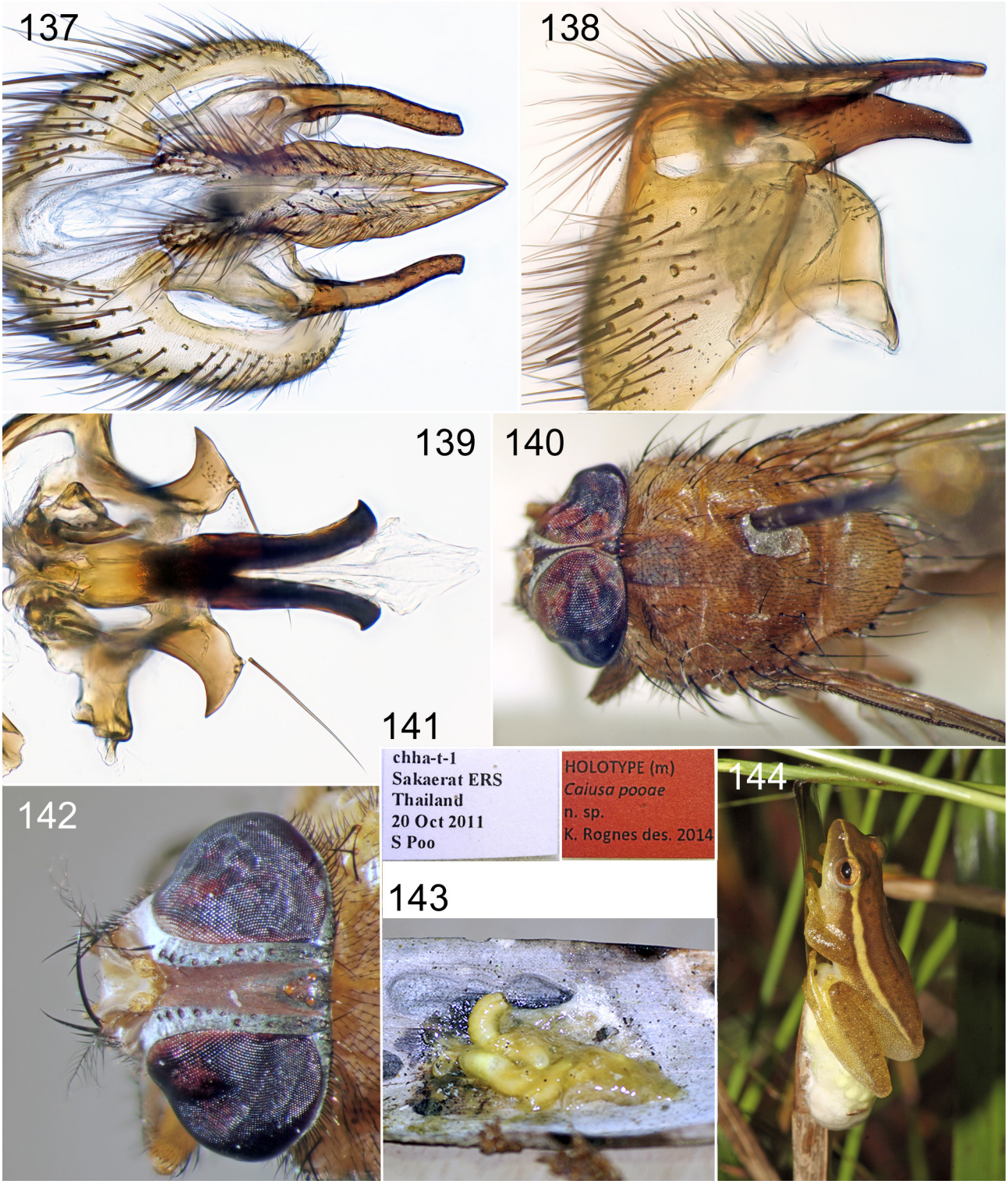
Immature stages. Unknown.

Discussion. Similar to *C. karrakerae* but cerci in male shorter than surstylus, and the surstylus is different. T7 of ovipositor with well developed T7 halves, connected conspicuously at the posterior edge in middle. Epiproct with numerous setae.

Biology. Seven males from Japan (Iriomote-jima) have been reared from *Rhacophorus owstoni* (Stejneger, 1907).

Distribution. Indonesia (West Java), Japan, Philippines.

Type material. Holotype male, in IDD, labelled: (1) 21·22.V.1971 / Yona / OKINAWA [first line handwritten]; (2) Col. S.Asahina [handwritten]; (3) Phumosia ♂ / coomani / (Séguy) / Det. H. Kurahashi [handwritten except last line which is printed; a black line across label above printed name]; (4) HOLOTYPE (m) / *Caiusa kurahashii* / n.sp. / K. Rognes des. 2014 [printed on red label]. The holotype is staged and had already been dissected by Kurahashi at reception. Most of the abdomen and genitalia in glycerol in glass microvial on pin.



FIGURES 137–144. *Caiusa pooae* **sp. nov.** (137–141 from holotype in KR; 142 from dissected female paratype in KR; 143, remains of egg clutch of *Feihyla hansenae* on palm leaf; 144, *Feihyla hansenae* female guarding her eggs). **137.** Cerci and surstyli, posterior view. **138.** Cerci, surstyli and epandrium, left lateral view. **139.** Pregonites and aedeagus, dorsal view. **140.** Head and thorax, dorsal view. **141.** Labels (2). **142.** Head, dorsal view. **143.** Five larvae in remains of egg clutch, these were reared to the holotype and the two paratypes in KR and two other adults. **144.** *Feihyla hansenae*, female, with eggs. Photograph 143 reproduced by courtesy of S. Poo; photograph 144 reproduced by courtesy of N.E. Karraker.

Paratypes (12 males and 5 females). **IDD: Japan (Iriomote Jima):** 7 males labelled (1) JAPAN: IRIOMOTE-JIMA / Okinawa Pref. / Sagara-gawa R. / 29.I. 2002 / Coll. M. Toda [printed]; (2) ex. / Rhacophorus / owstoni [handwritten]; (3) Phumosia ♂ / coomani / (Séguy, 1948) / Det.H.Kurahashi [printed]; (4) PARATYPE (m)

/ *Caiusa kurahashii* / n.sp. / K. Rognes des. 2014 [printed on red label]. 2 males dissected by KR, abdominal T1–5 glued to card on pin above labels, ST1–5 and genitalia in glycerol in glass microvial above paratype label. **Japan (Ishigaki Jima):** 3 males and 5 females labelled: (1) JAPAN: ISHIGAKI-: / JIMA I.: Okinawa / Pref., Mt. Omoto- / dake, 29.XII.2013 / Coll. T. Shimada [printed]; (2) PARATYPE (m) / *Caiusa kurahashii* / n.sp. / K. Rognes des. 2014 [printed on red label]. 1 male dissected by KR. Dried abdominal T1–5 glued to card on pin above labels. ST1–5 and genitalia in glycerol in glass microvial above paratype label. 2 females dissected by KR, in both females the dried abdominal T1–5 glued to card on pin above labels; in first female ST1–5 and spermathecae in glycerol in glass microvial on pin, below vial is a label reading "G.pr. 418 / K. Rognes det. 2014", ovipositor flat-mounted in Euparal on separate microscope slide marked G.pr. 418; in second female ST1–5 and extended ovipositor in glycerol in glass microvial on pin. Slide 418 labelled as shown in Fig. 136. **USNM: Indonesia (West Java):** 1 male labelled (1) Bantar / Gebang / Java [printed]; (2) Bryant& / PalmerColl [printed]; (3) Paratricyclea / (Caiusa) / indica / Surc. / Det. / J.R.Malloch [handwritten except last two lines; label with black frame on all sides]; (4) Loan from USNMNH / 2067772 [printed]; (5) PARATYPE (m) / *Caiusa* / *kurahashii* n.sp. / K. Rognes det. 2014 [printed on red label]. Dissected by KR. T3–T5 glued to card on pin, ST3–5 and genitalia in glycerol in glass microvial on pin. **Philippines (Luzon):** 1 male labelled (1) Mt. Makiling / Luzon, Baker [printed]; (2) Phumosia / indica / (Surc.) / det. James '70 [handwritten on label with black frame]; (3) Loan from / USNMNH / 2067772 [printed]; (4) PARATYPE (m) / *Caiusa* / *kurahashii* n.sp. / K. Rognes det. 2014 [printed on red label]. Dissected by KR. T1–T5 glued to card on pin, ST1–5 and genitalia in glycerol in glass microvial on pin. *Note on USNM specimens:* The Java specimen has the T4–T5 dark. The Makiling specimen had a dark tip of abdomen, but apparently not in the integument because after KOH treatment abdomen turned all yellow. The Makiling specimen is the male "from Luzon" mentioned by Malloch (1926: 497) which "agrees well with the female, having the dorsum of the thorax blackened and the abdomen entirely yellow-testaceous, but there are no humeral hairs present", the female referred to being the specimen discussed below under "Unnamed *Caiusa* or *Phumosia* species".

6. *Caiusa pooae* sp. nov.

Table 1; Figs. 137–149.

Holotype male, Thailand, Sakaerat ERS [Environmental Research Station] (KR), here designated. For details, see Type material, below.

Etymology. The species is named after Sinlan Poo, National University of Singapore, Singapore, in honour of her outstanding contribution by rearing 5 larvae (Fig. 143) to the adult stage from a single infested egg mass of *Feihyla hansenae* (Cochran, 1927) (Hansen's tree frog). This is the first and only infested egg mass ever observed from among 1000+ observations of the egg mass of this frog in Thailand (Sinlan Poo in e-mail 28 August 2014). The specific name is a noun in genitive case formed from the modern personal name of a woman (ICZN, Article 31.1.2.) by adding the suffix *-ae* to the stem *poo*.

Diagnosis. *Male*. Hind tibia with 4 *pd* on both sides. Cerci longer than surstylus, and not bent backwards in lateral view. Cerci in posterior view dagger-shaped, large, strong and long, narrow in basal part, widening out and broadest at middle, narrowing distally to a point with a short narrow slit (Fig. 137). Surstylus in profile view a massive, slightly curved, pointed 'beak' (Fig. 138). Surstylus in posterior view narrow, of uniform width, in middle part curving inwards, distally curving slightly outwards again. Pregonite a massive hook, the part distal to long setae short, strong and pointed (Fig. 139).

Female. Hind tibia with 2 *pd* on both sides in dissected paratype. In the undissected paratype 3 *pd* on left and 3–4 *pd* on right side. Frons at vertex / head width ratio: 0.258–0.271 (mean 0.265, n=2). ST6 and ST7 both shorter than wide (Fig. 145). T7 with microtrichiae on disc on both sides, microtrichiae also invading the T7 middorsally from behind. T8 short, only sclerotised as a narrow band laterally (Fig. 146), lateral sclerites widely separated from each other. ST8 short and square with soft setae, no short spine-like setae present (Fig. 146). Both ST8 and cerci covered with microtrichiae (Figs. 147, 148), which is unique within *Caiusa*. Hypoproct with well sclerotised lingulae (Fig. 146, arrows).

Immature stages. Unknown, but five third instar larvae shown in Fig. 143. Puparium belonging to undissected female paratype in KR, undescribed.

Biology. Reared from the egg mass of Hansen's tree frog *Feihyla hansenae*. No female was observed attending the egg clutch. There is no evidence that the frog eggs or very early embryos were dead, or for that matter, alive, at oviposition. Observations to that effect are missing. Here is a detailed account by S. Poo (in e-mail 4 September 2014, slightly edited) of the circumstances around the rearing of the five adult specimens (my italics):

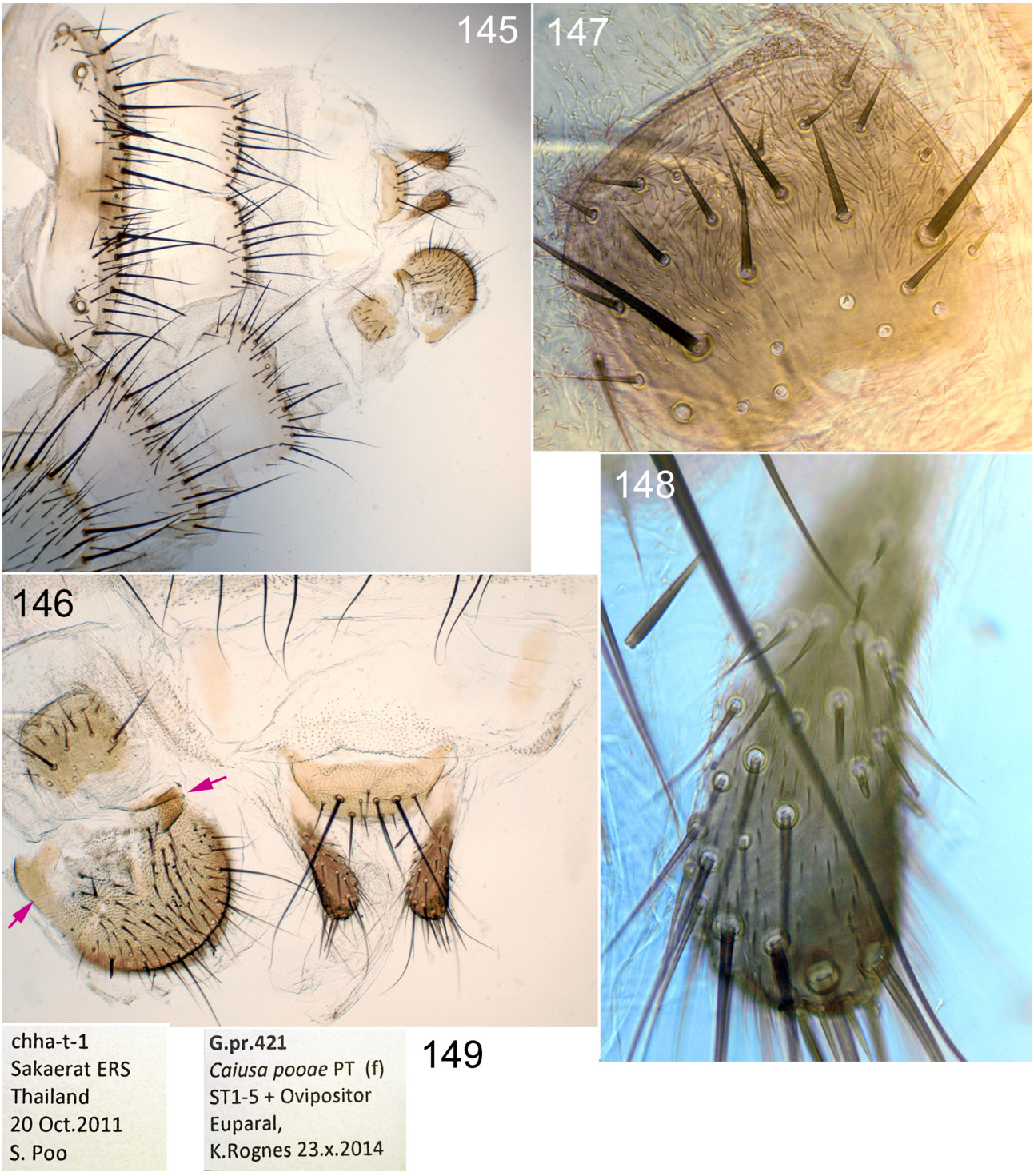
> This *Chiromantis hansenae* egg clutch was attached to a palm leaf that had fallen from the tree, but was hanging on some liana over the pond. This is not uncommon for *Chiromantis hansenae* egg clutches, as they can be attached to leaves (dead or alive), branches, grasses, rocks, and anything that is overhanging the pond. I saw the frog egg clutch within roughly12 hours of when it was laid (this is a nocturnal frog, with the majority of egg clutches laid between 9 pm–3 am, my first sighting was around 7–9 am). I did not record data for the frog egg clutch, as the position it was in was a bit out of reach for the type of measurements I was taking. *The frog eggs did not show any signs of abnormality at first discovery. I cannot say whether there was fly infestation at this point, since I was not close enough to examine for fly eggs or young larvae. I revisited the site twice daily and discovered the fly larvae between 1–3 days after frog eggs were laid (duration of egg stage for* Chiromantis hansenae *is 3–5 days, average 4.5 days).* Upon discovery of fly infestation, I removed the section of the palm leaf with the frog egg clutch remains and fly larvae and took the larvae photos I sent you (Oct 11, 2011) [Fig. 143].The palm leaf was placed in a plastic ziplock bag with some additional dead leafs, and fly larvae were allowed to pupariate. Unfortunately, I did not record the time of pupariation or the date when flies first emerged. My recollection is that it was similar to the other *Caiusa* flies from *Polypedates leucomystax*, *Chirixalus nongkhorensis*, and *Rhacophorus kio* egg clutches I have reared in the past (roughly a week as larvae, and a week or less as puparium? I am sorry I do not have the exact duration). One or two days after the flies emerged, they were preserved in ethanol.
>
> I would only add that the female frog that is supposed to provide parental care and attend her egg clutch was never seen for this clutch. In my surveys, frog eggs without female parental care invariably end in mortality [Poo & Bickford 2003]. I suspect the egg attendance behavior by female frogs is one of the reasons *Chiromantis hansenae* egg clutches are so rarely infested by flies. Female frogs often position themselves over egg clutches, covering eggs for about 70% of the time. Other reasons, of course, could be their gelatinous (instead of foam) structure and their small size compared to other frog eggs (rough estimate for exposed surface area: *Chiromantis hansenae* = 2cm sq, *Chirixalus nongkhorensis* = 50cm sq, *Polypedates leucomystax* = 300cm sq).

Discussion. All *Caiusa* species, apart from *C. indica* and *C. pooae*, have small, stiff, spine-like setae on the ST8 and hypoproct, a structure that seems to make the fly able to pierce the crust on the surface of the foam nest made by foam nesting frogs, although this has never been observed. The egg mass of *Feihyla hansenae* (Figs. 8–11) does not harden into a crust, and is kept moist and soft by the guarding female (Fig. 144). One female of *C. pooae* obviously managed to oviposit on this type of egg mass without the "spiny" ovipositor tip structure found in female flies ovipositing on foam nests.

Distribution. Thailand.

Type material. Holotype male, in KR, labelled (1) chha-t-1 / Sakaerat ERS / Thailand / 20 Oct 2011 / S Poo; (2) HOLOTYPE (m) / *Caiusa pooae* / n. sp. / K. Rognes des. 2014 [printed on red label]. Reared from egg mass of *Feihyla hansenae*. Thorax, including mesonotum and scutellum bright yellow, a greyish brown darker vitta on prescutum, the lateral edge of which is situated midway between *prst acr* and *prst dc* setae. Pleuron with black ground setae, including postalar wall, but katatergite with long erect yellow setae. Abdominal T5 all dark with bluish metallic sheen. T4 dark in posterior half, otherwise yellow. Hind tibia with 4 *pd* on each side. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin between labels 1 and 2.

Paratypes (2 females). **KR: Thailand:** 1 female labelled (1) chha-t-1 / Sakaerat ERS / Thailand / 20 Oct 2011 / S Poo; (2) PARATYPE (f) / *Caiusa pooae* / n. sp. / K. Rognes des. 2014 [printed on red label]. No dark vitta on prescutum. Hind tibia with 2 *pd* on each side. T5 all dark, T4 dark in posterior half. Dissected by KR. ST3–5 glued to card on pin. Spermathecae in glycerol in glass microvial on pin. Ovipositor flat-mounted on slide G.pr. 421 • 1 female labelled (1) Fly from / Chiromantis hansenae / 2011.10.20 / Sakaerat, Thailand [handwritten by S. Poo, two last lines on reverse side]; (2) PARATYPE (f) / *Caiusa pooae* / n. sp. / K. Rognes des. 2014 [printed on red label]. Thoracic dorsum with dark presutural vitta, lateral boundary situated between *prst acr* and *prst dc*. Hind tibia with 3 *pd* on each side. Pinned from alcohol by KR. Puparium, dry, with one lid and no third instar mouthparts, in plastic vial on separate pin.



FIGURES 145–149. *Caiusa pooae* **sp. nov.** (all from dissected female paratype in KR). **145.** Flat-mounted ovipositor, G.pr. 421. **146.** Tip of flat-mounted ovipositor, enlarged. Arrows point to sclerotised lingulae. **147.** ST8, high magnification. **148.** Right cercus, high magnification. **149.** Labels on slide G.pr. 421 (2).

7. *Caiusa testacea* Senior-White, 1923

Figs. 150–166.

Holotype male, Maskeliya, Sri Lanka (BMNH), by original designation. For details, see Type material below.

Caiusa testacea Senior-White, 1923a: 310. Sri Lanka (Maskeliya, Suduganga, Kandy, Niroddumunai).

Caiusa testacea: Senior-White *et al*. 1940: 74. Sri Lanka, India (Coimbatore), only.

Phumosia testacea: Kurahashi & Thapa 1994: 208. Nepal.

Note. There are numerous records of "*Phumosia testacea*" by Kurahashi in various papers and catalogues, e.g., the record of a single female from Bangladesh by Kurahashi & Banu (1989: 103), the records of males and females from Malaysia by Kurahashi *et al*. (1997: 29), the records of males and females from the Philippines by Kurahashi & Magpayo (2000: 38), the record of a single male from Laos by Kurahashi & Chowanadisai (2001: 193), the records from Thailand by Kurahashi & Bunchu (2011: 263), and the country listings in the Catalog of the Diptera of the Australasian and Oceanian Regions (Kurahashi, 1989d, 2007). These records cannot be trusted since they are not based on examination of male or female genitalia, and may belong to several different species of *Caiusa*. I have not made any attempts at interpreting such records, except for cases (1) where I have seen material identified by Kurahashi, (2) where I have seen specimens labelled similarly to records published by Kurahashi, such as in the case of records of misidentified "*P. testacea*" from Solomon Islands (Kurahashi 2003b) (see above in the synonymy of *C. indica*), or (3) where records are very likely based on misidentifications, such as the case of records of "*P. testacea*" from Bougainville Islands (Kurahashi 1987) (see above in the synonymy of *C. indica*), since the species is not known to occur there. Some entries of "*C. testacea*" or "*P. testacea*" in the synonymies of various species and preceded by a question mark, are perhaps doubtful.

Diagnosis. *Male*. Cerci short and in lateral view bent backwards. Cerci with a pronounced distal bay between apices. Cerci basally wide, in posterior view greatest width at a level far proximal to deepest point of bay, from this point lateral edges of cerci gradually converging distally. Surstylus in posterior view rather broad, medial side forming narrow (short, with short radius) half-circular excavations (Fig. 159). Surstylus in lateral view rather broad and short (Fig. 160), very gently curved on lower side. The most distant point of the surstylus in lateral view is close to an imaginary line continuing the upper edge beyond the tip (Fig. 160). Thoracic dorsum all yellow, sometimes a weak presutural middorsal grey dusted vitta indicated. T4 and T5 usually all yellow without any darkening and without metallic sheen (post-mortem darkenings may be present due to internal organs shining through integument, but these are not metallic bluish and disappear completely after KOH treatment) or sometimes with darkenings that have a bluish metallic sheen.

Female. Frons at vertex / head width ratio: 0.267–283 (mean 0.278, n=3). Ovipositor unknown.

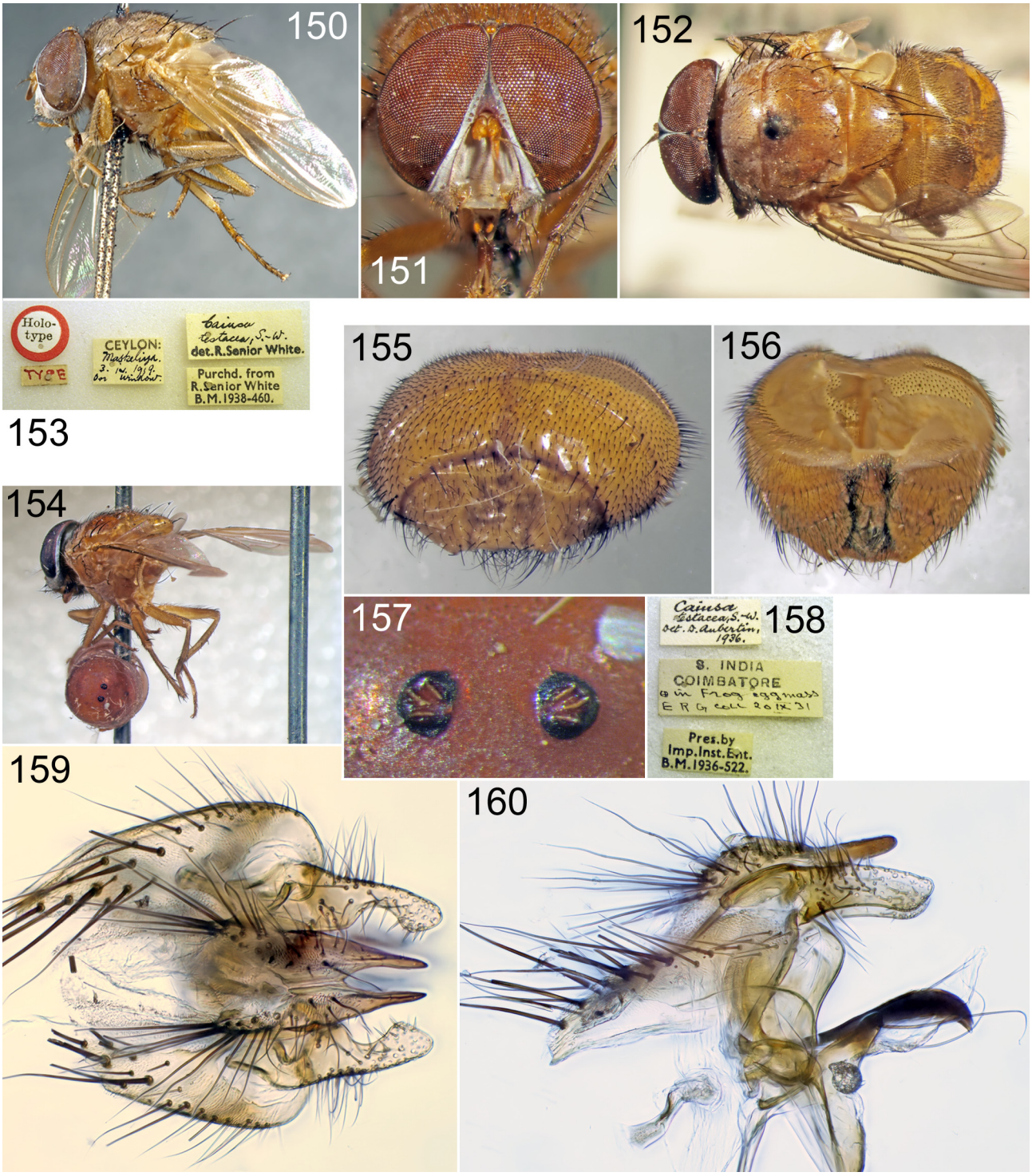
Immature stages. Puparium present on the Coimbatore specimens in BMNH (Fig. 154). Posterior spiracles of puparium shown in Fig. 157. Three slanting spiracular slits. Middle slit with medial end much more laterally placed than the similar point of upper and lower slits.

Biology. Reared from frog egg mass. Frog species unknown.

Discussion. Male genitalia very similar to those of *C. violacea*, but surstylus in lateral view broader and shorter, and in posterior view broader. Material from India and Sri Lanka always lacks abdominal darkenings. The three Nepal specimens examined varied: one had an abdomen that was all yellow, one had darkenings and bluish metallic sheen on parts of T5 only (disappeared after KOH treatment), and the third (from "Naubise-Monari") had darkenings on T5 (with bluish sheen) and on parts of T4 and T3 (no bluish sheen). Possibly *C. testacea* and *C. violacea* form a pair of sister-species with vicariant distribution, sharing similar cercal bays and general shape of the surstylus.

Distribution. India, Nepal, Sri Lanka.

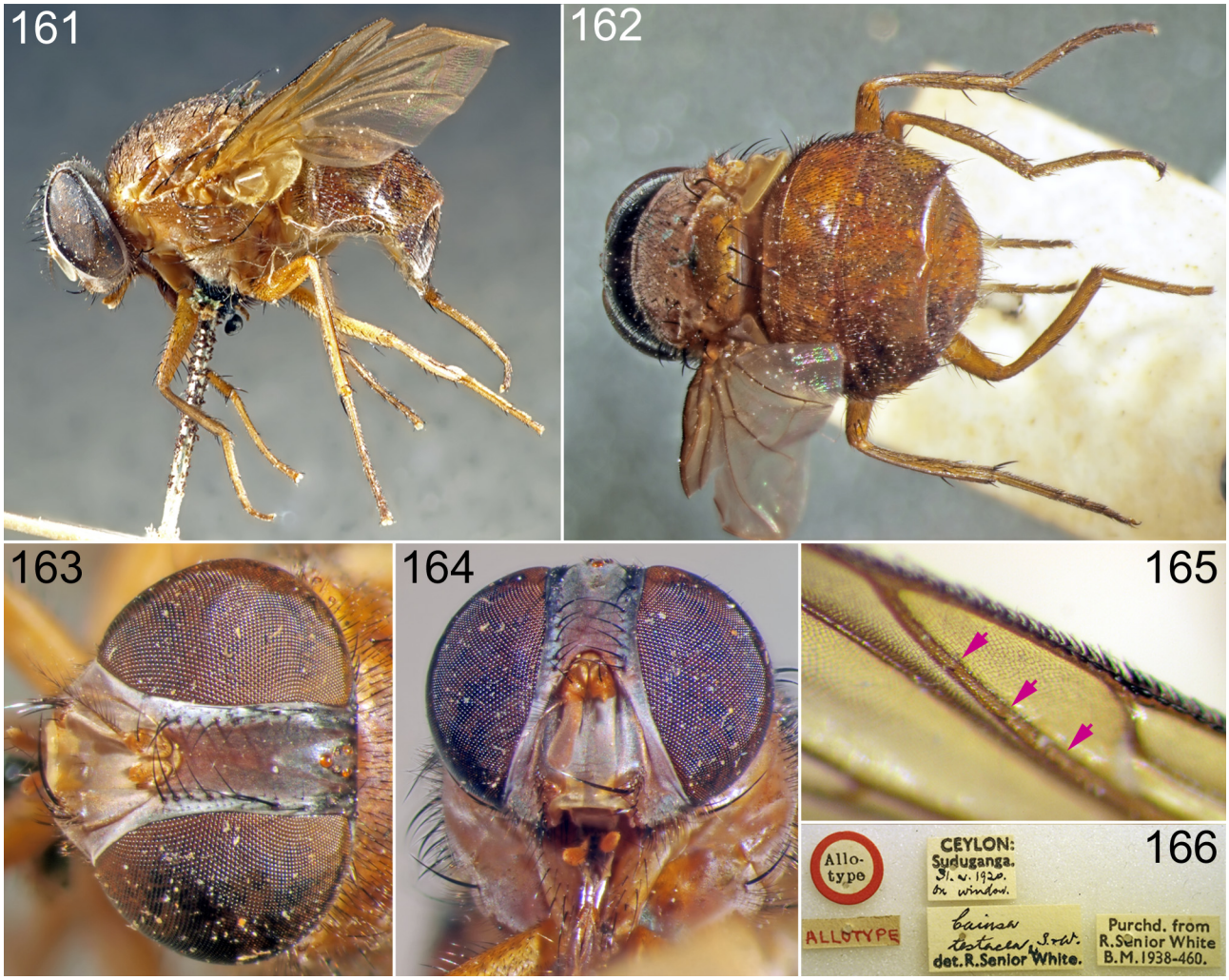
Material examined. Type material. *Caiusa testacea* Senior-White, 1923. **Holotype** male, in BMNH, labelled (1) Holo- / type [circular label with red rim]; (2) TYPE [rectangular label with red ink handwriting]; (3) CEYLON: / Maskeliya / 3.iv.1919. / On window [handwritten except printed line 1]; (4) Caiusa / testacea, S.-W. / det. R.Senior White. [handwritten; last line printed]; (5) Purchd. From / R. Senior White / B.M.1938-460 [printed]. Not dissected. *Note.* Senior-White had several specimens of both sexes from several localities before him when he described the species, but "a male from Emelina Estate, Maskeliya district (4,200 feet), on window, April 3, 1919 (N. K. Jardine)" was selected and listed as "type", hence this specimen is holotype by original designation.



FIGURES 150–160. *Caiusa testacea* Senior-White (150–153 from holotype in BMNH; 154–160 from dissected male in BMNH [#1]). **150.** Habitus, left lateral view. **151.** Head, anterior view. **152.** Habitus, dorsal view. **153.** Labels (5). **154.** Habitus, abdomen removed, with puparium. **155.** Detached abdomen, posterodorsal view. **156.** Detached abdomen, ventral view. **157.** Puparium, posterior spiracles. **158.** Labels (3). **159.** Cerci and surstyli, posterior view. **160.** Cerci, surstyli, epandrium, ejaculatory sclerite and aedeagus, left lateral view.

Paratypes (1 female and 1 male [slide only]). **BMNH: Sri Lanka:** 1 female (staged) labelled (1) Allo- / type [circular label with red rim]; (2) ALLOTYPE [rectangular label with red ink handwriting, facing down]; (3) CEYLON: / Suduganga / 31.v.1920. / On window [handwritten, except lines 1 and 2 printed]; (4) Caiusa / testacea, S.-W. / det.R.Senior White. [handwritten; last line printed]; (5) Purchd. From / R. Senior White / B.M.1938-460 [printed, facing down]; (6) *Caiusa* (f) / *testacea* S-W. / K. Rognes det. 2014. Left wing with a few setulae on distal

part of R_1 (Fig. 165). Right wing absent at reception. Four more paratypes ("co-types") in "Colombo Museum collection, three males from Kandy, August 19, 1914, and a female from Niroddumunai, …", not seen. • 1 male, slide only; slide labelled (1) Caiusa testacea / mihi / Kandy. 19.viii.14. / In Colombo Mus. / Colln. / ♂ genitalia 28.iv.22. [handwritten]; (2) Not a type. [handwritten in black ink by A.C. Pont]. In spite of the text written by Pont along the short edge of the slide, I think this genitalia preparation was made from one of the four "co-types", i.e., from one of the three males from Kandy. Thus the slide is made from a paratype. I am not able to interpret this whole-mount of the epandrial and hypandrial complexes.



FIGURES 161–166. *Caiusa testacea* Senior-White (all from female paratype in BMNH). **161.** Habitus, left lateral view. **162.** Habitus, posterodorsal view. **163.** Head, dorsal view. **164.** Head, anterior view. **165.** Parts of left wing, dorsal view. Arrows point to small setulae on R_1. **166.** Labels (5).

Other material. BMNH: India: 1 male (staged, with puparium, lid with third instar larval mouthparts) labelled (1) S. INDIA / COIMBATORE / x in Frog eggmass / E R G coll 20 IX 31 [handwritten, except lines 1 and 2 which are handwritten]; (2) Caiusa / testacea, S.-W. / Det. D. Aubertin, / 1936. [handwritten]; (3) Pres. By / Imp.Inst.Ent. / B.M.1936-522. [printed, facing down]; (4) *Caiusa* (m) / *testacea* S-W / K. Rognes det. 2014; (5) #1 [red handwriting by KR]. Dissected by KR. Dried T1–5 glued to celluloid stage, genitalia in glycerol in glass microvial on pin. • 1 female (staged, with puparium, one lid with third instar larval mouthparts) labelled (1) S. INDIA / COIMBATORE / x in frog eggmass / E R G coll 20 IX 31 [handwritten, except lines 1 and 2 which are handwritten]; (2) Pres. By / Imp.Inst.Ent. / B.M.1936-522. [printed, facing down]; (3) *Caiusa* (f) / *testacea* S-W / K. Rognes det. 2014); (4) #2 [red handwriting by KR]. • 1 male (staged) labelled (1) ♂ [printed]; (2) Guindy, / Saidapet, / S. India. / 1909. / Capt. W.S.Patton, / I.M.S. / 1909.345 [handwritten]; (3) *Caiusa* (m) / *testacea* S-W (K. Rognes det. 2014); (4) #3 [red handwriting by KR]. Dissected by KR. Dried T1–5 glued to card below stage.

Genitalia in glycerol in glass microvial on pin. Lost wing glued to label 1. **Sri Lanka:** 1 female (staged) labelled (1) Ceylon. / Mahaganay. / 17.1.92. / Lt.Col. Yerbury. / 1892—192. [printed, except line 3 which is handwritten]; (2) Caiusa / testacea / S.W. / det.R.Senior White 1938 [handwritten, except last line which is printed]; (3) *Caiusa* (f) / *testacea* S-W (K. Rognes det. 2014); (4) #4 [red handwriting by KR]. **CNC: Sri Lanka:** 1 male labelled (1) Kohuwala, W.P. / Ceylon 8.VII.67 / P.B. Karunaratne [printed, except handwritten date]; (2) Caiusa indica / Scrf / (Sen.-Wh. / concept) / Det. Shewell. 1983 [handwritten; last line printed except two last digits in year]; (3) Caiusa / testacea / CNC loan [printed on yellow label]; (4) Caiusa (m) / testacea S-W / K. Rognes det. 2014 [printed]. Thoracic dorsum all yellow, abdomen all yellow (T1+2, T3 and T4, in situ, all yellow; T5, in glycerol, yellow). Dissected already by Shewell (?) before I received the specimen. I do not agree with Shewell who seemed to believe that this specimen represents Senior-White's concept of *C. indica*. Hind tibia with 2 *pd* on both sides, the upper on right side weak, both on left side strong. Hind legs partly covered with fungal hyphae. **NSMT: Nepal:** 2 males labelled (1) NEPAL: Narayani / Parsa, Nijgarh / 300m, forest / 3.X.1990 / Col. H.Kurahashi; (2) Phumosia ♂ / testacea / (S.-White, 1923) / Det.H.Kurahashi. One of the males dissected by KR. Dried T1–5 glued to card below stage. Genitalia in glycerol in glass microvial on pin. • 1 male labelled (1) NEPAL: / Naubise-Monari / 2000m / 20.VIII.1987 / Col. H.Kurahashi; (2) Phumosia ♂ / testacea / (S.-White, 1923) / Det.H.Kurahashi. Not dissected. **USNM: Sri Lanka:**1 male labelled (1) CEYLON: Pol.Dist. / Pimburettawa, 13 / mi.S Mannampitiya / 9-12-XI-70, 1850′ / O. S. Flint, Jr. [printed]; (2) Loan from / USNMNH / 2067772 [printed]. Dissected by KR. Dried ST1–5 glued to card on pin. Genitalia in glycerol in glass microvial on pin.

8. *Caiusa violacea* Séguy, 1925, stat. rev.

Tables 1, 2; Figs. 167–201.

Holotype female, Cambodia (MNHN), by monotypy. For details, see Type material, below.

Caiusa violacea Séguy, 1925: 441. Cambodia [as "Cambodge (Harmand)"] ["Harmand" is the name of the collector, whose full name is François Jules Harmand]. Erroneously diagnosed as having 3–4 *post acr*.

Caiusa violacea: Séguy 1946: 83. A specimen cited from Laos. Examined. For details see Other material examined, below.

Caiusa dubiosa Villeneuve, 1927: 392. Holotype female (SDEI), by monotypy. Type locality: Taiwan (Koshun). For details see Type material below. **Syn. nov.**

Caiusa violacea: Senior-White *et al*. 1940: 70. They give a translation of Séguy's 1925 description, and repeat the errors regarding the number of *post acr* setae also in their own key.

Caiusa testacea: Hennig 1941: 180, misidentification, not *C. testacea* Senior-White, 1923.
Note. Cited as a senior synonym of *Caiusa dubiosa* Villeneuve, 1927, "nach Senior-White in litt.". This is an error on the part of Senior-White. *Caiusa dubiosa* is a junior synonym of *C. violacea* Séguy.

Caiusa coomani: Fan 1965: 171, fig. 663a. Misidentification, not *C. coomani* Séguy.

Phumosia indica: James 1977: 537. Catalog entry for Taiwan (as "Formosa"). Misidentification, not *C. indica* Surcouf.

Phumosia dubiosa: James 1977: 538. Catalog entry as a synonym [by error] under *Phumosia testacea* (Senior-White, 1923).

Phumosia violacea: entered in various keys by Kurahashi since assumed to denote a taxon having 3–4 *post acr* setae, but never based on actually observed specimens.
Note. The original description is erroneous as to the number of *post acr* setae, see below.

Phumosia indica: Kurahashi 1989d: 709. Catalog entry for Taiwan. Misidentification, not *C. indica* Surcouf.

Caiusa coomani: Fan 1992: 531, fig. 1104 [on p. 460]. Misidentification, not *C. coomani* Séguy.

Caiusa coomani: Fan 1997: 443, fig. 136 [on p. 444], 652. Misidentification, not *C. coomani* Séguy.

Caiusa coomani: Feng *et al*. 1998: 1454, fig. 2944 [on p. 1456]. Misidentification, not *C. coomani* Séguy.

Caiusa indica: Feng *et al*. 1998: 1454. Entry for Taiwan only. Misidentification, not *C. indica* Surcouf.

Caiusa testacea: Feng *et al*. 1998: 1454. Entry for Taiwan only. Misidentification, not *C. testacea* Senior-White.

Phumosia indica: Lin & Chen 1999: 115. Taiwan. Misidentification, not *C. indica* Surcouf.

? *Phumosia testacea*: Kurahashi & Magpayo 2000: 38. Misidentifications, not *C. testacea* Senior-White.
Note. In their key on p. 28 "dorsum and abdomen" are described as "pale brownish", thus concolorous. I have not seen any material identified by Kurahashi from the Philippines, and it is possible that Philippine material of "*testacea*" belongs either to *C. violacea* or to the "Unnamed *Caiusa* or *Phumosia* species" treated in a separate section below.

Caiusa coomani: Lin *et al.* 2000: 292. Misidentification, not *C. coomani* Séguy.

Caiusa coomani: Lue & Lin 2000: 280. Misidentification, not *C. coomani* Séguy.

? *Phumosia testacea*: Kurahashi & Chowanadisai 2001: 193. Laos. Misidentification, not *C. testacea* Senior-White. I have not examined this material, but *C. violacea* is recorded from Laos by Séguy (1946: 83), see above. Possibly this was the species before Kurahashi & Chowanadisai.

Phumosia indica: Kurahashi 2007. Catalog entry. Entry for Taiwan: misidentification, not *C. indica* Surcouf.

Caiusa indica: Yang *et al*. 2014: 96 (material from Shanping, Taiwan in CMNH). Misidentification, not *C. indica* Surcouf.

Caiusa testacea: Yang *et al*. 2014: 96 [citing Hennig (1941: 180)]. Misidentification, not *C. testacea* Senior-White.

Caiusa sp.: Yang *et al*. 2014: 96. 1 male in NTU from New Tapei city examined in 2013 and dissected by me. I labelled it "*Caiusa / new species A* / K. Rognes det. 2013" at the time (e-mail to Hiromu Kurahashi with cc to Ms. Shih-Tsai Yang 20 September 2013).

Diagnosis. *Male.* Cerci short and in lateral view bent backwards in apical part. Cerci with a pronounced distal bay between apices, sometimes bay narrower than shown in Figs. 167, 181. Cerci basally wide, in posterior view greatest width at a level far proximal to deepest point of bay, from this point lateral edges of cerci converging distally. Surstylus in posterior view rather broad, medial side forming a wide half-circular excavation (radius long). Surstylus in lateral view rather long and narrow (Fig. 168), very gently curved on lower side, sometimes slightly expanded apically with a distinct nick just before apex on lower side. Along the upper lateral edge it carries long densely set setae. Thoracic dorsum all yellow to all dark, most often with a presutural middorsal grey vitta (Figs. 175, 176). Posterior abdominal segments, usually at least T4 and T5, always dark with metallic blue sheen.

Female. Frons at vertex / head width ratio 0.267–0.317 (mean 0.288, n=24). ST6 as long as wide. T7 invaded from behind by microtrichiae middorsally. ST7 very long, longer than in *C. coomani*, much longer than T7 halves. T8 small inwardly pointing triangles (Fig. 172). Hypoproct with a conspicuous V-shaped area with spinous setae. Otherwise as in male.

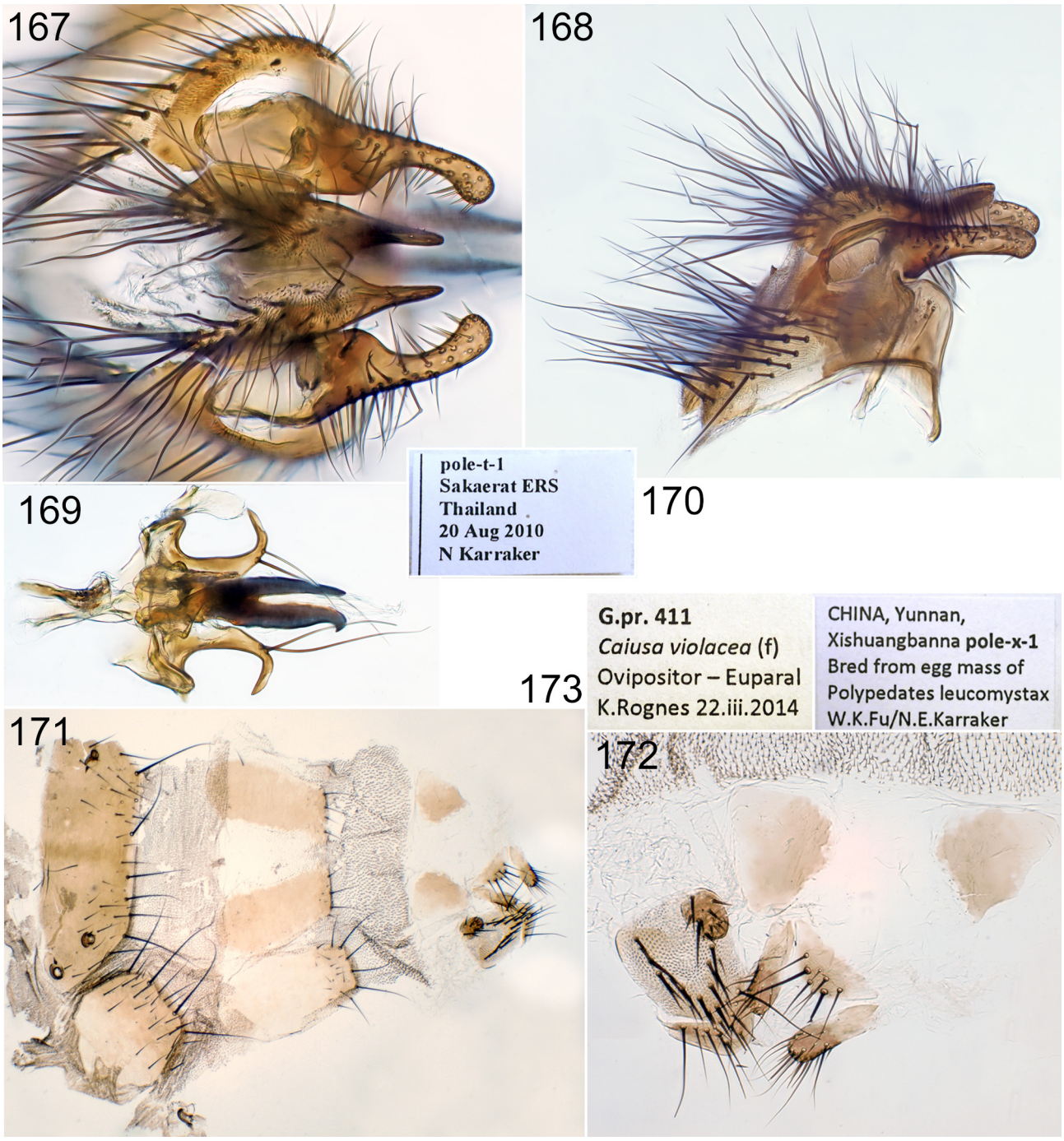
Immature stages. A single mature first instar larva was found in the uterovaginal tube in one wild caught female (HT of *C. violacea*). It has long hairlike setae at segment boundaries (Figs. 194, 196). Mouthparts shown in Fig. 193.

Biology. Reared from egg masses of *Chiromantis nongkhorensis* (N.E. Karraker) and *Polypedates leucomystax* (W.K. Fu, N.E. Karraker, A.Vassilieva) (Tables 1, 2). Mixed infestation with *C. coomani* in foam nest of *Polypedates leucomystax* in Thailand (Table 1, pole-t7).

Discussion. Male genitalia very similar to those of *C. testacea*, but separable on the shape of the surstylus and, most often, by the colour of the abdomen. I have never seen an all yellow abdomen in male or female *C. violacea*.

Distribution. Cambodia, China (Guangdong, Xishuangbanna), Laos, Malaysia (West Malaya, Sabah), Taiwan, Thailand, Vietnam.

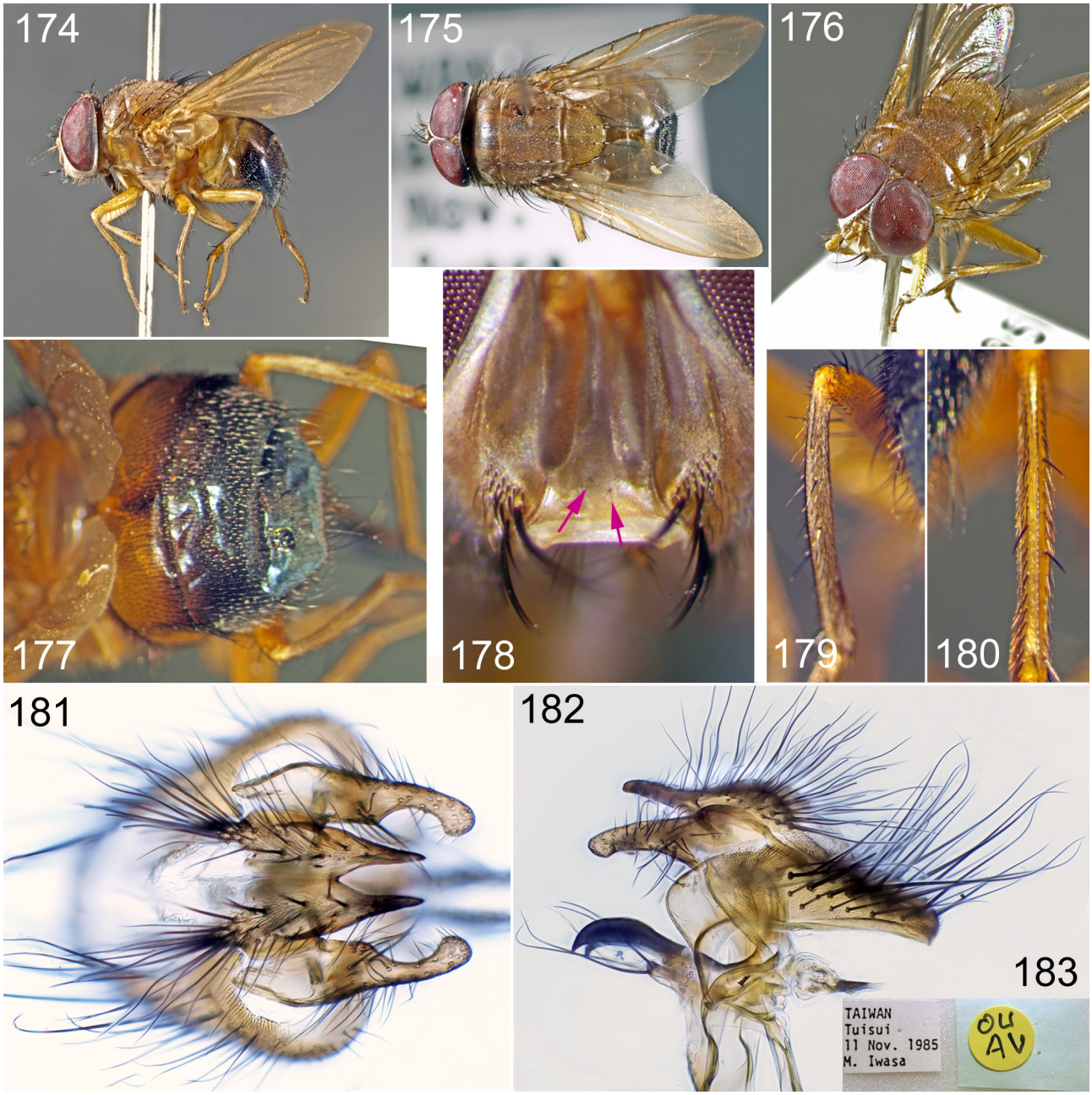
Material examined. Type material. *Caiusa violacea* Séguy, 1925. **Holotype** female (staged), in MNHN, labelled (1) 2905 / 75 [handwritten on circular label]; (2) MUSEUM PARIS / CAMBODGE / HARMAND 1875 [printed]; (3) TYPE [black print on red label]; (4) Caïusa / violacea / TYPE Séguy / E. SÉGUY det. 1925. [handwritten, except last line which is printed; year of date is handwritten]; (5) HOLOTYPE female / *Caiusa violacea* / Séguy, 1925: 441 / K. Rognes des. 2012 [printed on red label] (Figs. 184, 188). *Note*. *Caiusa violacea*



FIGURES 167–173. *Caiusa violacea* Séguy (167–170 from dissected male from Thailand; 171–173 from dissected female from China, Yunnan, both in KR). **167.** Cerci and surstyli, posterior view. **168.** Cerci, surstyli and epandrium, left lateral view. **169.** Pregonites, ventral view. **170.** Label. **171.** Flat-mounted ovipositor, G.pr. 411. **172.** Tip of flat-mounted ovipositor, enlarged. **173.** Labels on slide G.pr. 411 (2).

was described from an unstated number of females, but only one female exists in MNHN, hence it is a holotype by monotypy. It was diagnosed erroneously by Séguy as having 3–4 *post acr* (as well as 3–4 *post dc*) but the type has only 1 *post acr* (Fig. 190) as other *Caiusa* species. It is possible that Séguy mistook the *post dc* setae for the *post acr*, since the number of *post dc* appears to be 3 on the right side and 4 on the left (Fig. 190). However, the apparently lacking *dc* on the right side is hidden deep down in the cleft to the right of the thick pin. Hind tibia with 2 *pd*. T4 and T5 dark with bluish metallic sheen. Presutural thorax described correctly as having a "large bande médiane longitudinale présuturale, brune". I dissected the holotype to establish its identity. Photographs from the dissection, including labels, are shown in Figs. 191–197. The dissection turned out to be very difficult as a mature

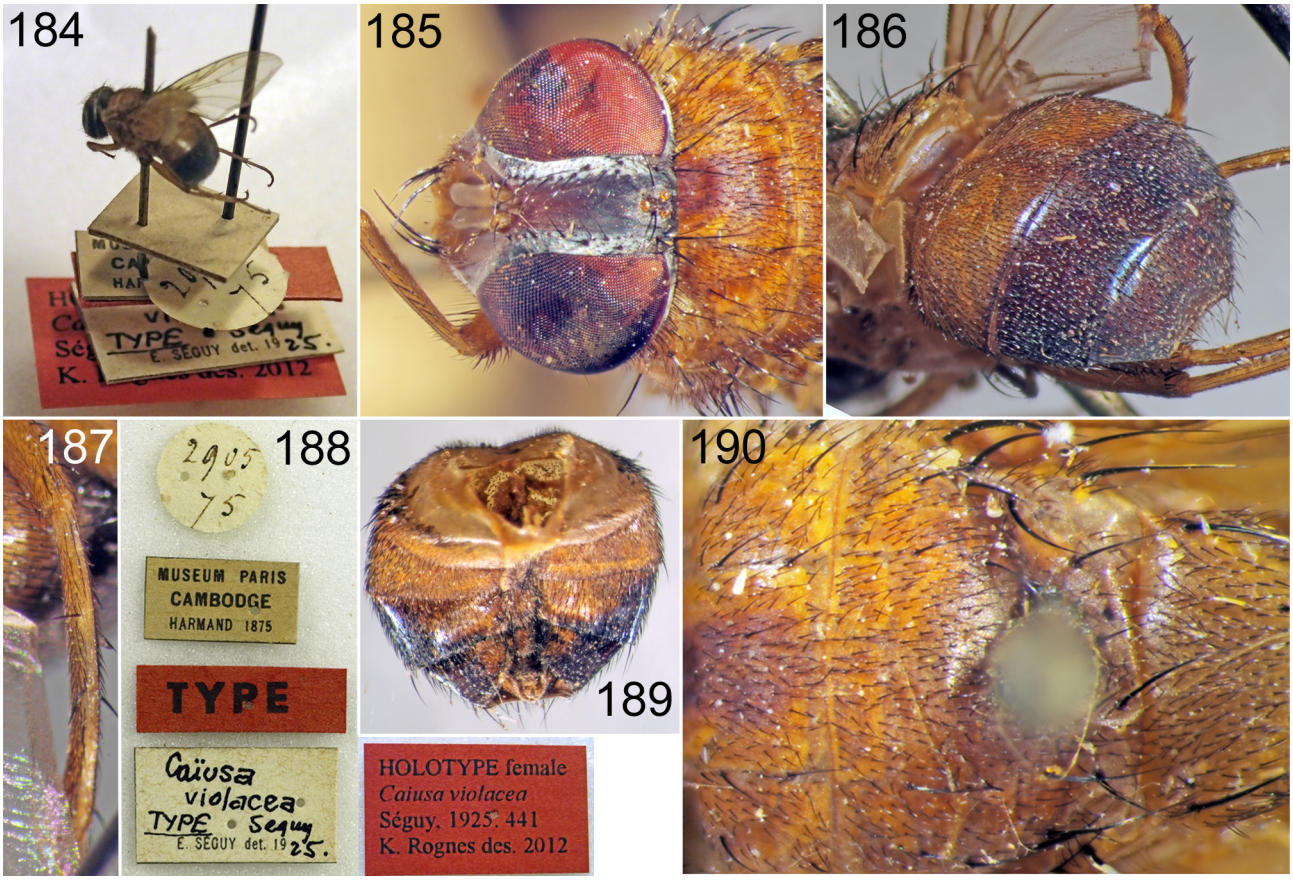
first instar larva was present in the uterovaginal tube, its anterior segments projecting among dirt from the hind end of the abdomen (Fig. 193). Unfortunately, I tore the anterior segments off the first instar larva in an attempt to extend the ovipositor. This part of the larva, containing the mouthparts, is now stored in glycerol in a glass microvial on a separate pin, labelled as shown in Fig. 192. The ST6 and T6 were removed as a unit (Fig. 195). The remaining parts of the ovipositor were successfully extended with the remaining parts of the larva inside (Fig. 196), and are now stored in glycerol in a glass microvial on a separate pin labelled as shown in Fig. 197.



FIGURES 174–183. *Caiusa violacea* Séguy (all from dissected male from Taiwan in IDD). **174.** Habitus, left lateral view. **175.** Habitus, dorsal view. **176.** Habitus, oblique left anterodorsal view. **177.** Abdomen, posterodorsal view. **178.** Facial ridges, facial plate, lower facial margin and first flagellomeres, anterior view. Arrows point to minute setulae a little above lower facial margin. **179.** Left hind tibia, posterodorsal view. **180.** Right hind tibia, dorsal view. **181.** Cerci and surstyli, posterior view. **182.** Cerci, surstyli, epandrium, aedeagus and pregonites, right lateral view. **183.** Labels (2).

Caiusa dubiosa Villeneuve, 1927. **Holotype** female, in SDEI, labelled: (1) Koshun [恒春 = Hengchun 恆春 at 22°00'15"N, 120°44'38"E] / Formosa / Sauter VIII.08 [printed, except date which is handwritten]; (2) Phumosia / (Caiusa ?) / dubiosa ♀ / Typ. Villen. [handwritten by Villeneuve]; (3) ~~TYPUS~~ [black print on red label, text stricken out by single line]; (4) Holotypus [print on red label]; (5) Coll. DEI / Müncheberg [printed]; (6) Examined

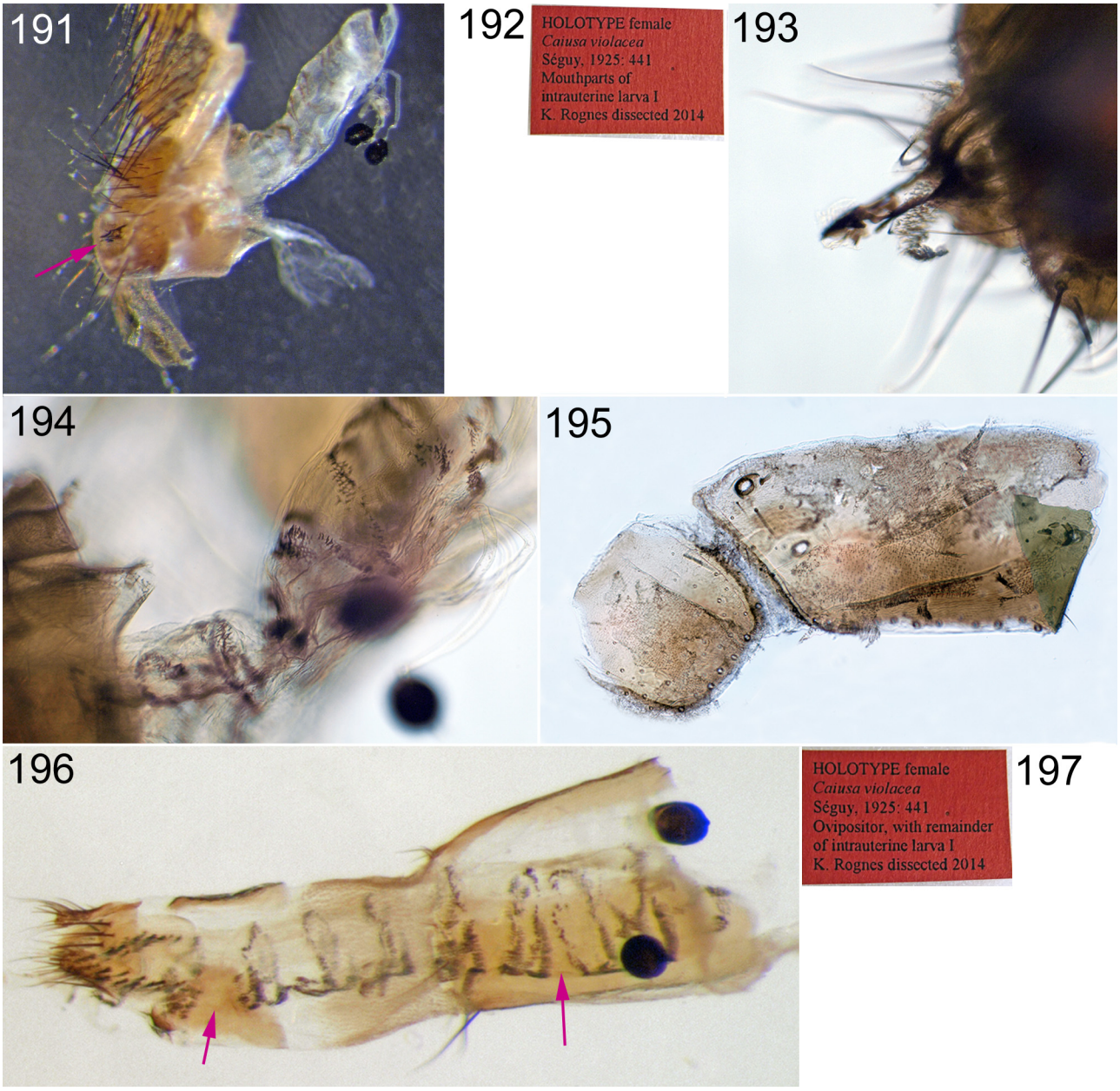
by / Knut Rognes / in 2010 [printed]; (7) DEI Diptera / **# 300020** [printed, label facing down]; (8) *Caiusa* (f) / *violacea* Séguy, 1925 / K. Rognes 2014. (Figs. 198–201). *Note*. *Caiusa dubiosa* was described from "[u]ne ♀ unique …", without use of the word "Type" or equivalent expression, hence it is a holotype by monotypy. The grey middorsal presutural stripe very distinct. Hind tibia with 2 *pd*. T4 and T5 dark, with bluish metallic sheen. No setulae on distal part of R_1 on right wing. Left wing destroyed at the exit of R_1. I re-examined the specimen in 2014, but have not dissected it. There is only one species of *Caiusa* known so far in Taiwan. Thus, the name *C. dubiosa* from 1927 must be a junior synonym of the valid name *C. violacea*.



FIGURES 184–190. *Caiusa violacea* Séguy (all from dissected holotype in MNHN). **184.** Holotype with stage and labels, before dissection. **185.** Head, anterodorsal view. **186.** Abdomen, oblique left posterodorsal view. **187.** Right hind tibia, posterodorsal view. **188.** Labels (5). **189.** Detached abdomen, ventral view. **190.** Mesonotum, close-up view. Opaque area is top of pin.

Other material. BPBM: Malaysia (Sabah): 1 female labelled (1) BRITISH N. BORNEO / Kalabakan / 10-19.XI.1958 [printed]; (2) In Jungle [printed]; (3) L.W. Quate / Collector [printed]; (4) Phumosia ♀ / indica / (Surcouf, 1914) / Det. Kurahashi [printed]; (5) Caiusa (f) / violacea Séguy / K. Rognes det. 2014. Dissected by KR. T1–5 glued to card on pin. ST6 and T6 [as two separate pieces] + distal section of ovipositor as a unit [T7, ST7, T8, ST8, hypoproct; with cerci and epiproct dislodged and partly destroyed] in glycerol in glass microvial on pin. Dark mesonotum. Yellow scutellum. Hind tibia with 2 pd. T4-T5 dark. T8 halves short, not elongate as in *C. borneoensis*. **CMNH: Taiwan** (3 males and 2 females): 1 male labelled (1) TAIWAN: Kaohsiung. / Shanping. 640 m. / 21-30 April 1988 / C. Young, R. Davidson / J. Rawlins; (2) Phumosia ♂ / indica / (Surcouf, 1914) / Det. H.Kurahashi. Mesonotum rather dark, mottled dark brown, scutellum pale. Lower calypter brownish. T4 and T5 dark with bluish sheen. Hind tibia with 2 *pd* on both sides. Dissected by KR. The dried abdominal T1–5 glued to card on pin. ST1–5 and genitalia kept in glycerol in glass microvial on pin. • 1 male labelled (1) TAIWAN: Kaohsiung. / Shanping. 640 m. / 21-30 April 1988 / C. Young, R. Davidson / J. Rawlins; (2) Phumosia ♂ / testacea / (S.-White, 1923) / Det. H.Kurahashi. Mesonotum with a presutural greyish stripe enclosing the *prst acr*, another very narrow greyish stripe outside of it, just inside the *prst dc* row. Postsutural part of mesonotum mottled dark, scutellum pale. Lower calypter brownish. T4 and T5 dark with bluish sheen. Hind tibia with 2 *pd* on both sides.

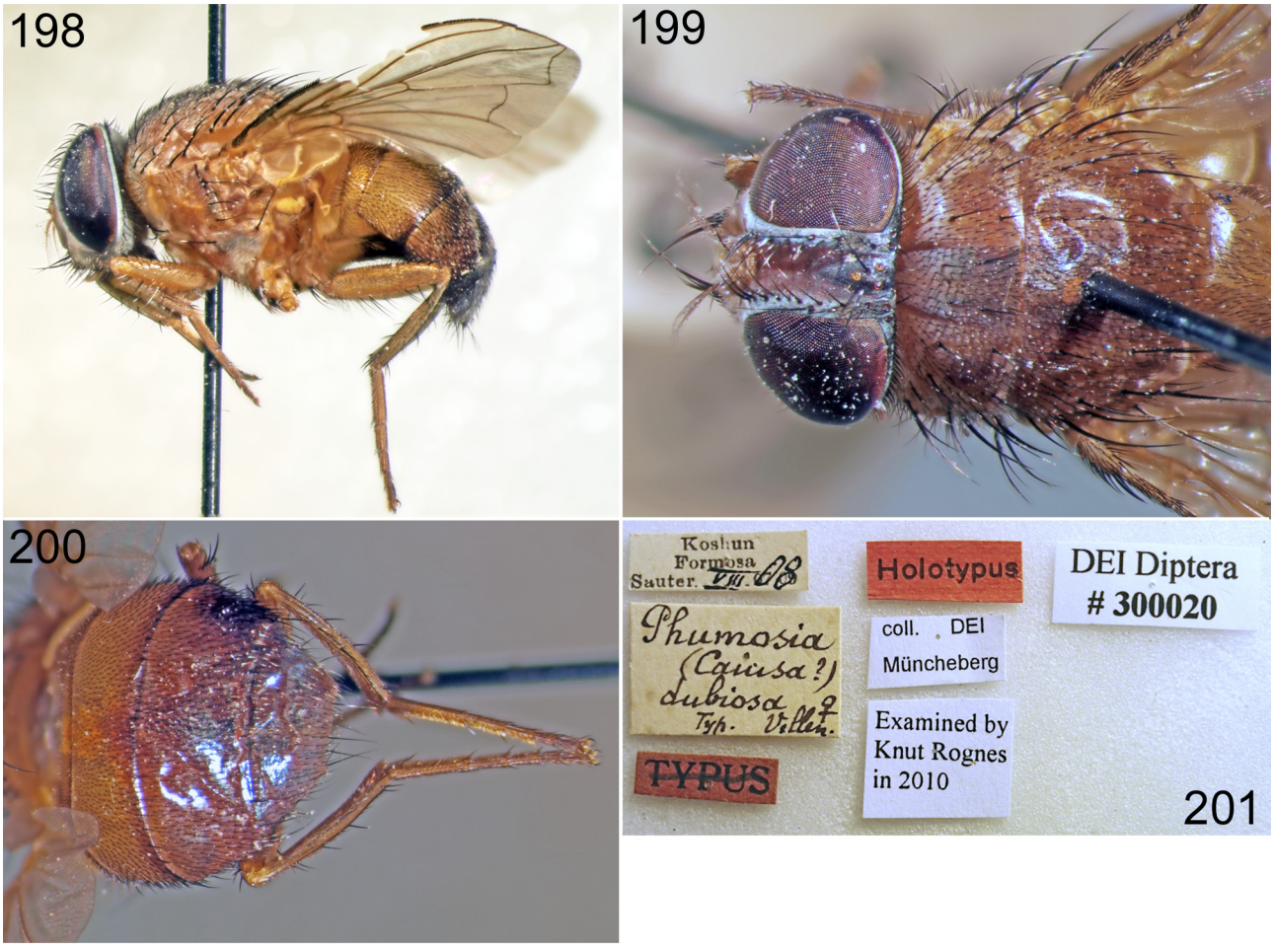
Dissected by KR. The dried abdominal T1–5 glued to card on pin. ST1–5 and genitalia kept in glycerol in glass microvial on pin. • 1 male labelled (1) TAIWAN: Kaohsiung. / Shanping. 640 m. / 21–30 April 1988 / C. Young, R. Davidson / J. Rawlins; (2) Phumosia ♂ / testacea / (S.-White, 1923) / Det. H.Kurahashi. Not dissected. T4 and T5 dark with bluish sheen. Hind tibia with 2 *pd* on both sides. • 1 female labelled (1) TAIWAN: Kaohsiung. / Shanping. 640 m. / 21–30 April 1988 / C. Young, R. Davidson / J. Rawlins; (2) Phumosia ♀ / testacea / (S.-White, 1923) / Det. H.Kurahashi. T4 and T5 dark with bluish sheen. Hind tibia with 2 *pd* on both sides. • 1 female labelled (1) TAIWAN: Kaohsiung. / Shanping. 640 m. / 21-30 April 1988 / C. Young, R. Davidson / J. Rawlins; (2) Phumosia ♀ / testacea / (S.-White, 1923) / Det. H.Kurahashi. T4 and T5 dark with bluish sheen. Hind tibia with 2 *pd* on both sides.



FIGURES 191–197. *Caiusa violacea* Séguy (all from dissections of holotype in MNHN). **191.** Abdominal sternites ST3–5 and telescoped ovipositor with projecting uterus containing first instar larva. Arrow points to anterior part of first instar larva visible at apex of ovipositor. **192.** Label on pin with glass microvial containing detached larval first segments and mouthparts in glycerol. **193.** Anterior part of larva projecting from tip of ovipositor. **194.** Segments of first instar uterine larva within uterus, note spermathecal ducts. **195.** ST6 and T6 of ovipositor. Area marked in green is lateral part of T6 folded over the part medial to it. **196.** Ovipositor with remainder of first instar larva, ST6 and T6 removed. Arrows point to T7 and T8 halves. **197.** Label on pin with glass microvial containing ovipositor with uterine larva in glycerol.

IDD: Malaysia (West Malaysia): 1 female labelled (1) MALAYSIA: MALAYA / Johor State / Pontian Dist., / Peradin River, swamp, 7.v.2008 / Coll. H. Kurahashi [printed]. Dissected by KR. T1–5 glued to card on pin; ST1–5 and ovipositor in glycerol in glass microvial on pin. Mesonotum pale with a weak middorsal *prst* dark stripe. Hind tibia with 2 *pd*. ST6 about as long as broad. T7 with microtrichiae between halves posteriorly. T8 halves triangular inwardly pointing. **Malaysia (Sarawak):** 1 female labelled (1) MALAYSIA: BORNEO / Sarawak State, / Sibu Division, / Katibas River, / Tupang River, / forest, 11.ix.2011 / Col. H. Kurahashi; (2) Caiusa (f) / violacea Séguy / K. Rognes det. 2014. Dissected by KR. Mesonotum dark, like *indica.* ST6 as short as wide. ST7 very long compared to T7 halves. T8 halves short. **Taiwan:** 1 male labelled (1) TAIWAN / Tuisui / 11 Nov. 1985 / M. Iwasa [printed]; (2) OU / AV [circular yellow label on a blue square bit of paper]. Dissected by KR (Figs. 174–183). T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. **Thailand:** 1 female labelled (1) THAILAND: CHIANG MAI / Doi Saket District / Doi Nang Krew 1015 m / 10.iii.2011 / Coll. Hiromu Kurahashi [printed]. Mesonotum with a weak middorsal *prst* dark stripe. Hind tibia with 2 *pd*. Dissected by KR. T1–5 glued to card on pin; ST1–5 and ovipositor in glycerol in glass microvial on pin. ST6 about as long as broad. T7 with microtrichiae between halves. T8 halves triangular and inwardly pointing. **Vietnam:** 6 males and 12 females labelled (1) VIETNAM: Ninh Binh / Prov., Gia Vien / Cuc Phuong, 170m /10-11.vii.1997 / Col. H. Kurahashi [printed]. 3 males and 2 females dissected by KR. Dried T1–5 glued to card on pin, ST1–5 and genitalia / ovipositor in glycerol in glass microvial on pin. • 1 male labelled (1) VIETNAM: Son La / Prov., nr. Moc Chau / Truong Yen, 900m / 19-21.vi.1997 / Col. H. Kurahashi [printed]. Dissected by KR. T1–5 glued to card on pin, ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 female labelled (1) VIETNAM: ThuaThien / Hue Prov., Phu Loc / Bach Ma N.P. / 500 m, 5.xi.2001 / Col. H. Kurahashi [printed]. Dissected by KR. T1–5 glued to card on pin, ST1–5 and ovipositor in glycerol in glass microvial on pin. • 1 female labelled (1) VIETNAM: Vinh Phu / Prov., Mt. Tam Dao / 930-1230m / 13.vii.1997 / Col. H. Kurahashi [printed]. Dissected by KR. T1–5 glued to card on pin, ST1–5 and ovipositor in glycerol in glass microvial on pin. **KR** (47 males and 48 females) (Tables 1, 2)**: China (Yunnan):** 3 males and 7 females labelled (1) pole-x-1 / Xishuangbanna / Yunnan, China / 18 Aug 2010 / WK Fu; (2) Caiusa (m/f) / violacea Séguy / K. Rognes det. 2014. 2 males and 1 female dissected by KR. Dried T1–5 glued to card on pin. Genitalia (m) / ST1–5 + spermathecae (f) in glycerol in glass microvial on pin. Dissected female carrying a label with number "G.pr. 411", referring to a slide with flat-mounted ovipositor (Figs. 171, 172). All reared from egg mass of *Polypedates leucomystax*. **Thailand:** 3 males and 2 females labelled (1) pole-t-1 / Sakaerat ERS / Thailand / 20 Aug 2010 / N Karraker; (2) Caiusa (m / f) / violacea Séguy / K. Rognes det. 2014. 2 males dissected by KR. Dried T1–5 glued to card on pin. Genitalia in glycerol in glass microvial on pin. • 3 males and 2 females labelled (1) pole-t-2 / Sakaerat ERS / Thailand / 26 Aug 2010 / N Karraker; (2) Caiusa (m/f) / violacea Séguy / K. Rognes det. 2014. 2 males and 1 female dissected by KR. Dried T1–5 glued to card on pin. Genitalia (m) and spermathecae (f) in glycerol in glass microvial on pin. Female ST1–5 lost. Dissected female carrying a label with number "G.pr. 416", referring to a slide with flat-mounted ovipositor. All reared from egg mass of *Polypedates leucomystax*. • 3 males and 2 females labelled (1) chno-t-2 / Sakaerat ERS / Thailand / 29 Aug 2010 / N Karraker; (2) Caiusa (m/f) / violacea Séguy / K. Rognes det. 2014. 2 males dissected by KR. Dried T1–5 glued to card on pin. Genitalia in glycerol in glass microvial on pin. All reared from egg mass of *Chiromantis nongkhorensis*. • 19 males and 21 females labelled (1) pole-t3 MALE [or FEMALE] / Sakaerat ERS / Thailand / 6 August 2014 / NE Karraker (pinned / from alcohol by K. Rognes); (2) Caiusa (m/f) / violacea Séguy / K. Rognes det. 2014. 7 males dissected by KR. Dried T1–5 glued to card on pin. Genitalia in glycerol in glass microvial on pin. • 9 males and 10 females labelled pole-t4 MALE [or FEMALE] / Sakaerat ERS / Thailand / 7 August 2014 / NE Karraker (pinned / from alcohol by K. Rognes); (2) Caiusa (m/f) / violacea Séguy / K. Rognes det. 2014. • 4 males labelled (1) pole-t7 / Sakaerat ERS / Thailand / 8 August 2014 / NE Karraker / M [handwritten in pencil across right edge of label]. Reared from *Polypedates leucomystax*. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. [Mixed infestation with *C. coomani*.]. **Vietnam:** 2 males labelled (1) VIETNAM / Cat Tien National Park / From eggs of / *Polypedates leucomystax* / April 2009, Anna Vasillieva; (2) Caiusa (m) / violacea Séguy, 1925 / K. Rognes det. 2014. 1 male dissected by KR. Dried T1–5 glued to card on pin. Genitalia in glycerol in glass microvial on pin. • 1 male and 4 females labelled (1) ABV-00669 (m) or (f) / VIETNAM, Dak Lak province / Krong Bong district, approximate / coordinates 12°27'54"N, / 108°20'20"E, nearly 700 m a.s.l. / Anna Vassilieva leg. 3-4.vi.2014 / (pinned from alcohol by K. Rognes). Male dissected by KR. Dried T1–5 glued to card on pin. Genitalia in glycerol in glass microvial on pin. The specimens are very immature and incompletely sclerotised. **MNHN: Laos:** 1 female labelled (1) LAOS / Xieng Khouang / le

28 – IV 1919 / R.Vitalis de Salvaza [lines 1, parts of line 3, line 4 printed; line 2 and most of date on line 3 handwritten]; (2) MUSEUM PARIS / Coll. J.HERVÉ-BAZIN 1923 [printed]; (3) COTYPE [red print]; (4) Caiusa / violacea / cotype Seg. / E. Séguy vid. 46 [handwritten, except last line which is printed, but year handwritten]; (5) Not syntype / *Caiusa* / *violacea* / Séguy, 1925: 441 [printed on red label; this undated label placed on pin by K. Rognes in 2012]. *Note.* This specimen was cited by Séguy (1946: 83). It is obviously not a syntype, since it was labelled "cotype" by Séguy only in 1946, and not included in the original description from 1925. It has no nomenclatural status. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and ovipositor, including spermathecae, in glycerol in glass microvial on pin. **NTU: Taiwan:** 1 male labelled (1) TAIWAN: NEWTAIPEI / Xindian Dist., / Sikanshui / ca 500 m; secondary forest / 22.i.2013 / Coll. Y.R.Huang [printed]; (2) *Caiusa new species A* / K. Rognes det. 2013. Dissected by KR. The dried abdominal T1–5 glued to carton on pin; ST1–5 and genitalia kept in glycerol in glass microvial on pin. Published as *Caiusa* sp. by Yang *et al*. (2014: 96). **SDEI: Taiwan:** 1 male labelled (1) Kankau [bay or cape east of Koshun 恒春 = Hengchun 恒春 at 22°00'15"N, 120°44'38"E] (Form.) / H. Sauter IX.12 [printed]; (2) Stein det. [printed]; (3) Tarsinipes [in Stein's handwriting]; (4) Phumosia / abdominalis RD / ♂ / DetCHTT [handwritten, except last line which is printed; label with black frame]. Mesonotum pale. Right mid leg and both hind legs lost. On left mid leg only basitarsus remains of the tarsal segments. T5 and most of T4 dark with bluish sheen. T3 with some darkening along hind margin. Dissected by KR. Dried T1–5 glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin.



FIGURES 198–201. *Caiusa violacea* Séguy (all from holotype of *Caiusa dubiosa* Villeneuve in SDEI). **198.** Habitus, left lateral view. **199.** Head and thorax, dorsal view. **200.** Abdomen and hind tibiae, posterodorsal view. **201.** Labels (7).

USNM: China (Guangdong): 1 male labelled (1) Mei-hsien, E. / Kwantung, S. / China 7-19-36 [printed]; (2) ALMelander / Collection / 1961 [printed, green pattern printed on right third of label]; (3) Loan from / USNMNH / 2067772 [printed]. Dissected by KR. Dried abdominal tergites glued to card on pin. ST1–5 and genitalia in glycerol in glass microvial on pin. **WSU: Malaysia (West Malaysia):** 1 male labelled (1) MALAY PENIN: / Pahang, F.M.S. / Kuala Lipis / May 27th 1926 / H M. Pendlebury. [printed except lines 3 and 4 which are handwritten]; (2)

1075 [printed]; (3) FMS [printed on blue label]; (4) Phumosia / testacea / (SW) / det James 70 [handwritten]. Dissected by KR. Dried abdominal tergites glued to stage. ST1–5 and genitalia in glycerol in glass microvial on pin. • 1 female labelled (1) MALAY PENIN. / KEDAH, NR. JITRA / CATCHMENT AREA / 10th April 1928 [printed, except day in date], [on the reverse side:] H. M. Pendlebury. / Coll: / F. M. S. Museums. [printed]; (2) Phumosia / var. of / indica ? / (SW) [sic] / det James '70 [handwritten]; (3) FMS [printed on blue label]. Dissected by KR. Dried T1–5 glued to card on pint. ST1–5 and ovipositor in glycerol in glass microvial on pin. ST6 as long as broad, ST7 long. T8 short. Mesonotum all yellow. T4–T5 dark with bluish metallic sheen. Both hind tibiae lost. **ZMUM: Vietnam:** 1 female labelled (1) S. Vietnam, 100km NW / t. Ho Chi Minh / Ma Da 22.VI.1994 / N. Beliaeva [printed]. A brown vitta on prescutum and anterior part of postsutural mesonotum. T4 and T5 dark with bluish metallic sheen. Dissected by KR. Dried T1–5 glued to card on pin. Extended ovipositor, spermathecae, and cerci + epiproct + hypoproct (in one piece) in glycerol in glass microvial on pin. ST6 about as long as wide. Short and triangular T8 sclerites. Spinous short setae on hypoproct in a V. Very small ST8 with short spinous setae, as usual. 4 spermathecae.

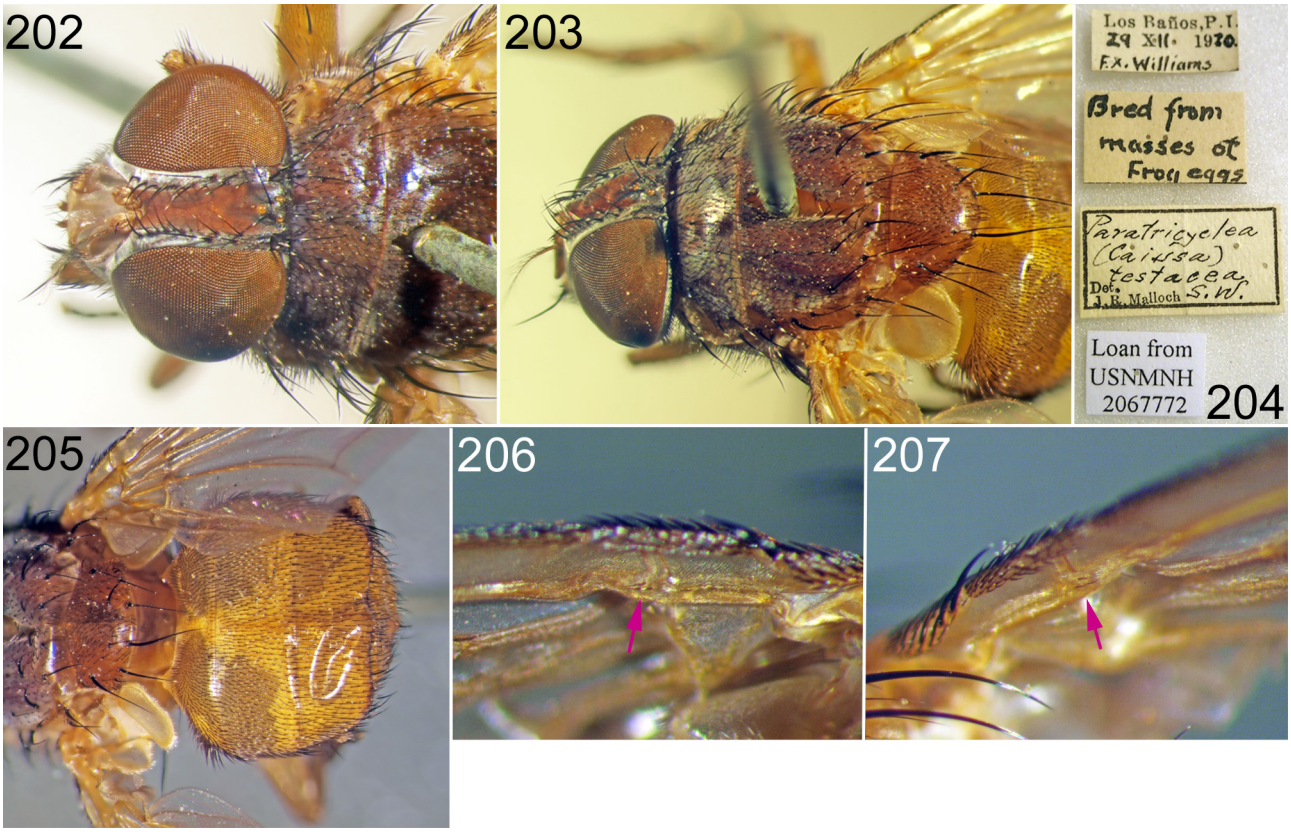
Unnamed *Caiusa* or *Phumosia* species

Figs. 202–207.

Paratricyclea (*Caiusa*) *testacea*: Malloch 1926: 497. Philippines. Misidentification, not *C. testacea* Senior-White.

Phumosia testacea: Rueda 1985: 331, 337. Philippines. Misidentification, not *C. testacea* Senior-White.

In USNM is a female specimen from the Philippines which looks like a *Caiusa* in most respects, but it has a few black setulae on *h-sc* node on the underside of the wing, reminiscent of many *Phumosia* species. The male sex is not known, so it cannot be assigned to genus with confidence yet. This creates a problem with the first couplet in the key to both males and females of *Caiusa*, above.



FIGURES 202–207. Unnamed *Caiusa* or *Phumosia* species (all from female from Philippines, Mt. Makiling, in USNM). **202.** Head, anterodorsal view. **203.** Head and thorax, dorsolateral view. **204.** Labels (4). **205.** Abdomen. **206.** Parts of right wing, ventral view. Arrow points to setulae on *h-sc* node. **207.** Parts of left wing, ventral view. Arrow points to setulae on *h-sc* node.

Diagnosis. Frons / head width ratio: at vertex: 34.5 / 120 = 0.29; at narrowest: 30 / 120 = 0.25. Parafacial bare. Mesonotum, including scutellum dark. 1+1 *kepst*. 2 *post acr* (just before the scutellum, the pair before the hindmost one weak) and 4 *post dc*. Hind tibia with 2 *pd* setae. Wings hyaline. Abdomen all yellow, except for a very narrow darkening along hind margin of T4 and T5. I have refrained from dissecting it, waiting for a male to turn up. It may be a *Phumosia*, if not, it is a new species of *Caiusa*.

Discussion. The specimen was discussed by Malloch (1926: 497) who misidentified it as "*Paratricyclea* (*Caiusa*) *testacea*, Senior-White", mainly because it had been reared from frog eggs. All known *C. testacea* females have a yellow mesonotum, including scutellum, without dark markings, and lack setulae on the *h-sc* node on the underside of the wing.

Rueda (1985) recorded two female specimens of a species he called "*Phumosia testacea* (Senior-White, 1923)" and recorded for the first time in the Philippines. The frons was measured as 0.18x head width, but his drawing (Rueda 1985: 338 fig 12 a) does not bear out such a narrow frons (measured on drawing as 0.9 / 2.95 = 0.31). It is interesting, however, that while he described *Phumosia abdominalis* as having "*Sc* with black setulae at base below" (p. 332), *Phumosia promittens* as having "*Sc* with several black setulae at base below" (p. 334), and *Phumosia costata* as having "*Sc* with a patch of black setulae at base below" (p. 335), he also described the females of his "*Phumosia testacea*" as having "lower surface of *Sc* with few black setulae at or near humeral cross vein below" (p. 337, males were not known). *Phumosia indica*, however, is described flatly as having "*Sc* bare at humeral cross vein" (p. 340). From his figures of the male genitalia his *P. indica* appears correctly identified. *Caiusa testacea* never has setulae on the underside of the *h-sc* node, so Rueda misidentified his female specimens. Interestingly, he described the abdomen as "[e]ntirely testaceous", and the hind tibia with 2 *pd*. Possibly the females of Rueda and Malloch with setulae at the *h-sc* node belong to the same Philippine species, still unknown in the male sex.

Material examined. USNM: Philippines: 1 female labelled (1) Los Baños, P.I. / 29.xii.1930 / F.X.Williams [partly printed, partly handwritten]; (2) Bred from / masses of / frog eggs [handwritten]; (3) Paratricyclea / (Caiusa) / testacea / S.W. / Det. / J.R.Malloch [last two lines printed on label with a black frame]; (4) Loan from / USNMNH / 2067772 [printed]; (5) ? *Caiusa* n. sp. (f) / h-sc node setulose / below / K. Rognes det. 2014 [printed on red label].

Phylogenetic analysis of the genus *Caiusa*

The exact search performed in Nona (*whennig; mswap+*) found four trees of 43 steps with ensemble consistency index of 0.65 and ensemble retention index of 0.62. The exact search in PeeWee found one tree of length 43 steps and a fit of 165.5 (k=3). Tree 0 of those found in Nona was the same as the one found in PeeWee. The three other trees found in Nona had a fit of 164.5 (k=3) when measured in PeeWee. The tree with the highest fit is shown in Fig. 212, with unambiguous character state changes mapped on to the branches.

The following monophyletic groups emerged from the analysis of the data given in the Appendix.

Phumosiinae (Phumosia abdominalis + *all* Caiusa *species*)
katatergite setulose (2: 0>1)
ST8 of ovipositor very small, circular or oval (19: 2>1)

Genus *Caiusa*
parafacial bare (0: 0>1)
pregonite horizontal, bent at about 90 degrees, 2–3 long very setae at bend (5: 1>0);
aedeagal membrane bare (6: 1>0)

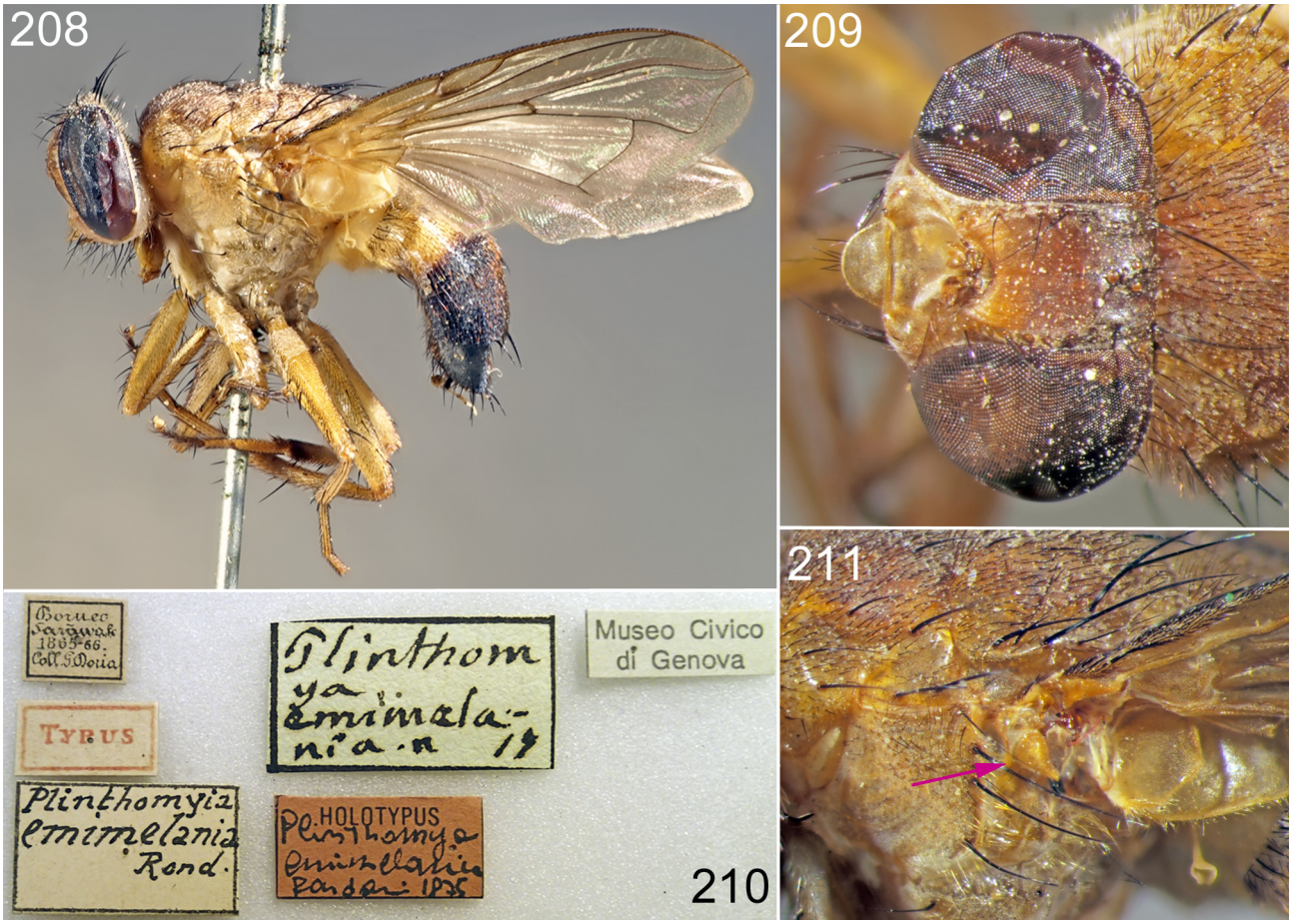
C. indica + *C. pooae*
ST7 of ovipositor shorter than wide (15: 2>0);
ST8 of ovipositor more or less square or rectangular (19: 1>0)

C. borneoensis + *C. coomani* + *C. karrakerae* + *C. kurahashii* + *C. violacea*
ST8 of ovipositor with short, spinous setae (18: 0>1);
hypoproct of ovipositor short spinous setae on disc arranged in a V (22: 0>1)

C. karrakerae + *C. kurahashii*
male cerci very narrow (3: 0>1)

C. borneoensis + *C. coomani* + *C. violacea*
unsupported

C. coomani + *C. violacea*
male cerci with apical bay (4: 1>0);
T7 halves not connected posteriorly (11: 0>1);
ovipositor with microtrichiae extending forwards between T7 halves from behind (13: 1>0)



FIGURES 208–211. *Plinthomyia emimelania* Rondani (all from holotype in MSNG). **208.** Habitus, left lateral view. **209.** Head, anterodorsal view. **210.** Labels (6). **211.** Area around greater ampulla (arrow), left lateral view.

The five species *C. borneoensis*, *C. coomani*, *C. karrakerae*, *C. kurahashii* and *C. violacea* oviposit on foam nests, which, shortly after having been deposited by the frogs, develop an external crust of varying hardness. The spine-like setae on ST8 (character state 18:1) and hypoproct (character state 22:1) form a structure that may be used for securing the tip of the ovipositor, or for just piercing the outer crust of the egg mass deep enough to facilitate placement of the eggs in a suitable micro-environment, i.e., into a sufficiently moist part of the foam. Together they form a monophyletic group of species ovipositing on the foam nest of the foam breeding rhacophorid genera *Chiromantis* Peters, 1854, *Polypedates* Tschudi, 1838 and *Rhacophorus* Kuhl & Hasselt, 1822 (Li *et al*. 2009).

The two species *C. indica* and *C. pooae* make up the sister group of the group *C. borneoensis* + *C. coomani* + *C. karrakerae* + *C. kurahashii* + *C. violacea*. Both share two apomorphies of the ovipositor, i.e., a ST7 shorter than wide (character state 15:0) and a more or less square or rectangular ST8 (character state 19:0) and both lack the "spinous" tip of the ovipositor, showing no short spine-like setae on ST8 (character state 18:0) or hypoproct (character state 22:0), both plesiomorphic features at this level.

Only once is a female *C. pooae* known to have oviposited on the soft gelatinous egg mass of *Feihyla hansenae* (Figs. 8–10, 144), and it was able to oviposit successfully on this jelly without any specialised armature of the ovipositor tip. This type of egg mass is without an external crust; rather, the female guards the eggs and keeps them moist by sweeping the hind feet over them (Poo 2014). The female may leave the egg mass to descend into water to rehydrate, during which period the egg mass is accessible to oviposition by flies.

Even if taking into account the effect of parental care on lowering the frequency of infestation of the egg-mass of *Feihyla hansenae*, the extreme rarity of fly oviposition on *Feihyla hansenae* egg clutches, just a single case among 1000+ observations of its egg mass, is remarkable. For this reason one reviewer suggested that the oviposition of *C. pooae* on the *Feihyla hansenae* egg mass was a single chance event, not of regular occurrence, and that egg clutches of *Feihyla hansenae* possibly are not the primary prey of *C. pooae*.

The egg deposition site of *C. indica* is not known, but the morphology of the egg indicates that it is laid on a soft substrate. It is therefore possible that both *C. indica* and *C. pooae* share a similar regular oviposition site that has yet to be discovered.

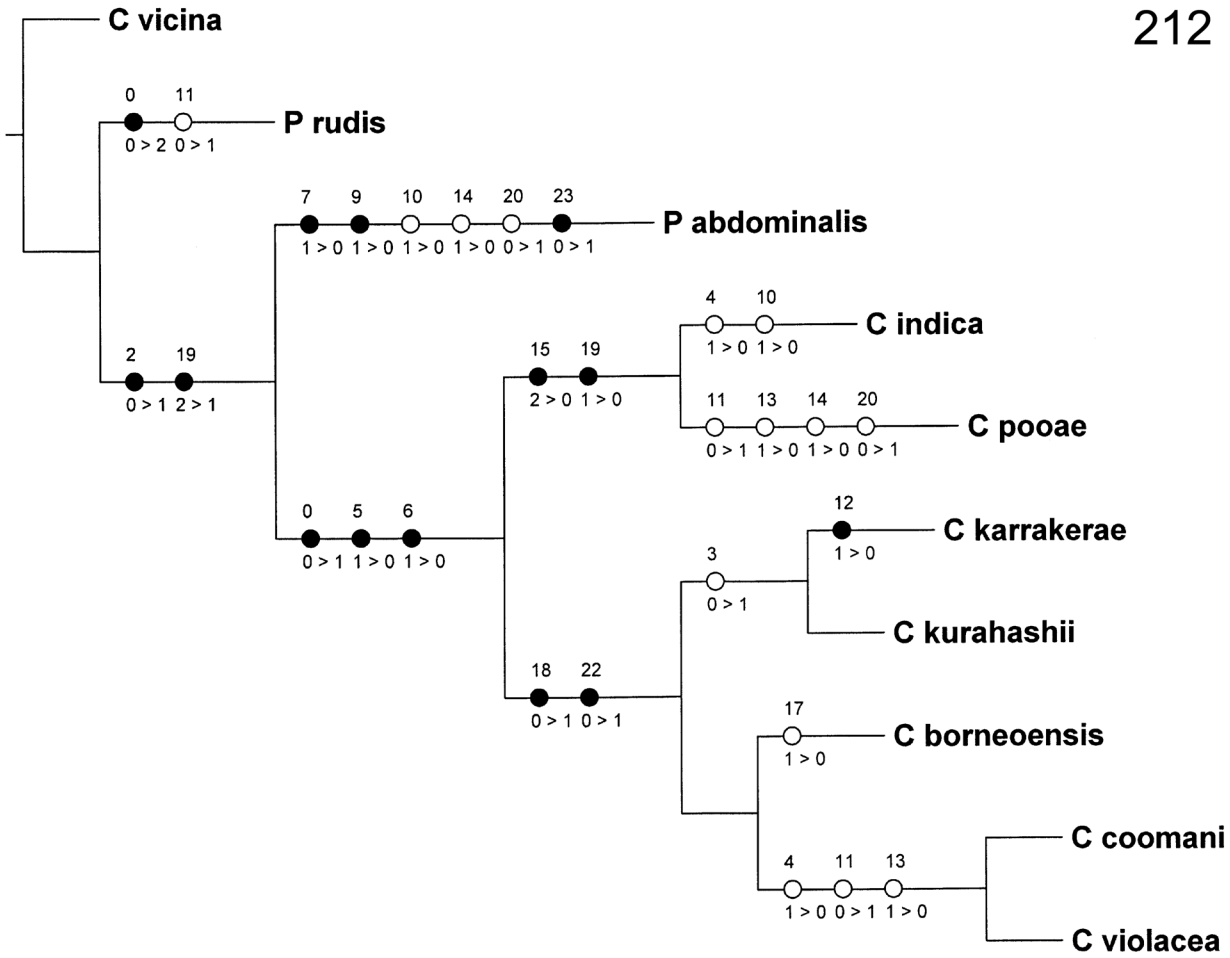


FIGURE 212. The most parsimonious tree with highest fit found in Nona and PeeWee. Circles (filled or open) mark unambiguous apomorphic changes, open circles mark changes to homoplasious states (hash mark setting "only discontinuous states mapped as homoplasies"). Length 43 steps, fit 165.5 (k=3), CI 0.63 and RI 0.63. Output from WinClada.

Note on the identity of *Plinthomyia emimelania* Rondani, 1875
Figs. 208–11.

In their study of Rondani genus-group names, O'Hara *et al*. (2011) followed James's (1977) treatment of *Plinthomyia* Rondani as a junior synonym of *Phumosia* Robineau-Desvoidy, an opinion dating back to Bezzi (1913) and Surcouf (1920). James thus listed *P. emimelania* Rondani as a species under the genus *Phumosia*. I

wanted to check whether it perhaps was a *Caiusa* since in the original description Rondani mentioned that the posterior half of the abdomen was dark (*emimelania* means 'half black'). I received for study from MSNG the holotype of *P. emimelania* Rondani, 1875: 428 captured in Borneo (Sarawak). Apparently, it has not been examined by anyone in the intervening 139 years. It turned out to be a *Bengalia* female in good condition (Figs. 208, 209, 211), with a very narrow dark margin to T1+2, hind half of T3 and all of T4 and T5 more or less shining black. It keys out to *B. hobbyi* Senior-White *et al*., 1940 in their "Fauna of the British India" work, on account of the pointed lower part of the greater ampulla (Fig. 211), lack of ventral seta on the mid tibia and the colour of the mesonotum and abdomen. Thus the name *emimelania* precedes the name *hobbyi* by 65 years. In view of Lehrer's (2005) many new nominal taxa related to *B. hobbyi*, one cannot be sure that it is the same species. The type locality of *B. hobbyi* is Sarawak, the same as the type locality of *P. emimelania*. Whatever the species is, the nominal genus *Plinthomyia* Rondani, 1875: 427 becomes a junior synonym of *Bengalia* Robineau-Desvoidy, 1830, one of the very old ones, **syn. nov.** For a complete list of *Bengalia* synonyms, see Rognes (2011b). An exact interpretation of the species must await a revision of the *Bengalia labiata* species-group (Rognes 2006), where *P. emimelania* belongs, because of the pointed greater ampulla.

Acknowledgements

Special thanks go to Nancy E. Karraker (University of Rhode Island, USA), Sinlan Poo (National University of Singapore) and Anna B. Vassilieva (ZMUM) for the gift of precious fly material reared from various frog species in South East Asia, and for introducing me to the fascinating subject of rhacophorid frog biology. I also thank Yngve Brodin (NHRS), Christophe Daugeron (MNHN), Neal Evenhuis (BPBM), Hiromu Kurahashi (IDD), Frank Menzel (SDEI), Jim O'Hara (CNC), Andrey L. Ozerov (ZMUM), Fabrizio Rigato (MSNM), Akihiko Shinohara (NSMT), Maria Tavano (MSNG), Nikita Vikhrev (ZMUM), Norman E. Woodley (USNM), Nigel P. Wyatt (BMNH), Chen Young (CMNH) and Richard S. Zack (WSU) for loan of material in their care. Fabrizio Rigato (MSNM) and David Yeates and Chris Manchester (ANIC) kindly provided photographs of type material and other material of *Caiusa* from Australia. Francesca Erickson (University of Wisconsin-Madison, USA), Nancy Karraker and Sinlan Poo provided photographs of frogs and their egg masses and generously permitted their use in this publication. Andrzej Grzywacz, Nicolaus Copernicus University, Poland, gave me advice on egg morphology, and Krzysztof Szpila, Nicolaus Copernicus University, Poland, prepared the first instar larva of *C. coomani* shown in Fig. 54 and generously let me use his photographs. Zoltán Soltész and László Papp (both HNHM) informed me about the fate of the holotype of *C. nigronitens*. Adrian C. Pont gave advice on Stein's handwriting. Jim O'Hara kindly gave assistance concerning some locality names in Taiwan. Many thanks to the University Library of the University of Stavanger, Stavanger, Norway, for outstanding library services, and to Richard Greene, Smithsonian Institution, Natural History Library, Washington, DC, USA for help with the acquisition of rare literature. Finally, I want to thank my wife, Agnete Rognes, for her careful proofreading of the manuscript. The reviewers P. Cerretti, Rome, Italy and T. Whitworth (WSU) are thanked for careful work and an anonymous reviewer for valuable suggestions concerning the biology of *Caiusa* flies.

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Appendix. Characters and states used for the phylogenetic analysis, including data matrix.

Character 0—parafacial setulosity
0: setulose in upper part only
1: bare
2: setulose all over

Character 1—katepisternal setae
0: 1+1
1: 2+1

Character 2—katatergite
0: bare
1: setulose

Character 3—male cerci, width
0: normal width
1: very narrow

Character 4—male cerci
0: apical bay
1: apical slit

Character 5—male pregonite
0: horizontal, bent at about 90 degrees, 2–3 very long setae at bend
1: vertical, no bend

C. pooae pregonite (Fig. 139) differs from the other *Caiusa* species (e.g., *C. violacea*, Fig. 169) in being much more massive, but has been given the same code.

Character 6—aedeagal membrane
0: bare
1: with denticles and sclerotisations

Character 7—ovipositor tube
0: very short
1: moderately long

Character 8—ST6 of ovipositor, length
0: much shorter than wide
1: about as long as wide
2: much longer than wide

Character 9—T7 of ovipositor
0: a narrow band across with parallel anterior and posterior edges
1: not an undifferentiated band across

Character 10—T7 halves of ovipositor, length
0: shorter than half width of hind margin of T7
1: as long as or longer than half width of hind margin of T7

I have coded *C. karrakerae* as inapplicable for this character, since there are no lateral sclerotisations.

Character 11—T7 halves of ovipositor
0: broadly connected at hind margin of T7
1: not connected

Character 12—T7 halves of ovipositor, presence
0: no lateral T7 halves, only middorsal sclerotisation
1: lateral halves present, no middorsal sclerotisation

Character 13—T7 of ovipositor, microtrichosity at middle posteriorly
0: microtrichiae extending forwards between T7 halves from behind
1: no microtrichiae between T7 halves

Character 14—T7 halves of ovipositor, microtrichosity on disc
0: large areas of disc with microtrichiae
1: no microtrichiae on disc

Character 15—ST7 of ovipositor, length
0: shorter than wide
1: as long as wide
2: longer than wide

Character 16—T8 halves of ovipositor, marginal setae
0: absent
1: present

The T8 of *P. abdominalis* is very rudimentary, but carries long setae (Figs. 16, 17, 19). They are interpreted as marginal setae.

Character 17—T8 halves of ovipositor, shape
0: elongate, longer than broad
1: about as long as broad
2: shorter than broad

The T8 of *P. abdominalis* is very rudimentary, but shorter than broad (Fig. 19). The T8 in *C. pooae* consists of short narrow sclerotisations on each side, widely separated from each other, and very much narrower and shorter than in *C. borneoensis*. It is likely that the medial parts of each T8 half have not sclerotised properly because of the immaturity of the specimen dissected. I have coded *C. pooae* with state 1 for this character.

Character 18—ST8 of ovipositor, type of setae
0: soft setae only
1: short, spinous setae

Character 19—ST8 of ovipositor, shape
0: more or less square or rectangular
1: very small, circular or oval
2: long

Character 20—ST8 of ovipositor, microtrichosity
0: absent
1: present

Character 21—cerci of ovipositor, microtrichosity beside setae

0: absent
1: present

Character 22—hypoproct of ovipositor, disc vestiture
0: no short spinous setae, only soft setae
1: short spinous setae arranged in a V

Character 23—reproduction
0: oviparous
1: larviparous

Data matrix

```
Character                11111 11111 2222
Number         01234 56789 01234 56789 0123

C_vicina       01011 11121 10111 21002 0000
P_rudis        20001 11111 11111 21002 0100
P_abdominalis  01101 11010 0---0 21201 1101
C_borneoensis  10101 00111 10111 20011 0010
C_coomani      10100 00101 11101 20111 0010
C_indica       10100 00101 00111 01100 0000
C_karrakerae   10111 00101 --0-1 20111 0010
C_kurahashii   10111 00101 10111 20111 0010
C_pooae        10101 00101 11100 00100 1100
C_violacea     10100 00111 11101 20111 0010
```