

Frog flies

The Oriental, Australasian and
Oceanian genus *Caiusa* Surcouf, 1920

(Diptera, Calliphoridae, Phumosiinae)



Herpetologist

- Nancy E. Karraker, University of Rhode Island, USA
 - * Reared 5 *Caiusa* species from foam nests of named frogs in SE Asia for the first time
 - * 3 are new to science

&

Diptera taxonomist

- Knut Rognes, University of Stavanger, Norway
 - Revised taxonomy of *Caiusa* worldwide

Here are the frogs:



Order
Anura

Family
Rhacophoridae

Note the expanded
toe tips

This species is
***Polypedates
megacephalus***

Photo: Nancy E. Karraker

Mating frogs beat their legs during amplexus to form a foam. The eggs are laid in the foam and covered with seminal fluid, before the foam hardens into a protective casing. The foam is laid on vegetation above a water source.



Photo: Nancy E. Karraker



Caiusa flies oviposit / larviposit on the foam.

Flies lay their eggs at first light. Later a crust forms on the surface.

Fly larvae devour the developing frog embryos.

A female *Caiusa* fly on a foam nest



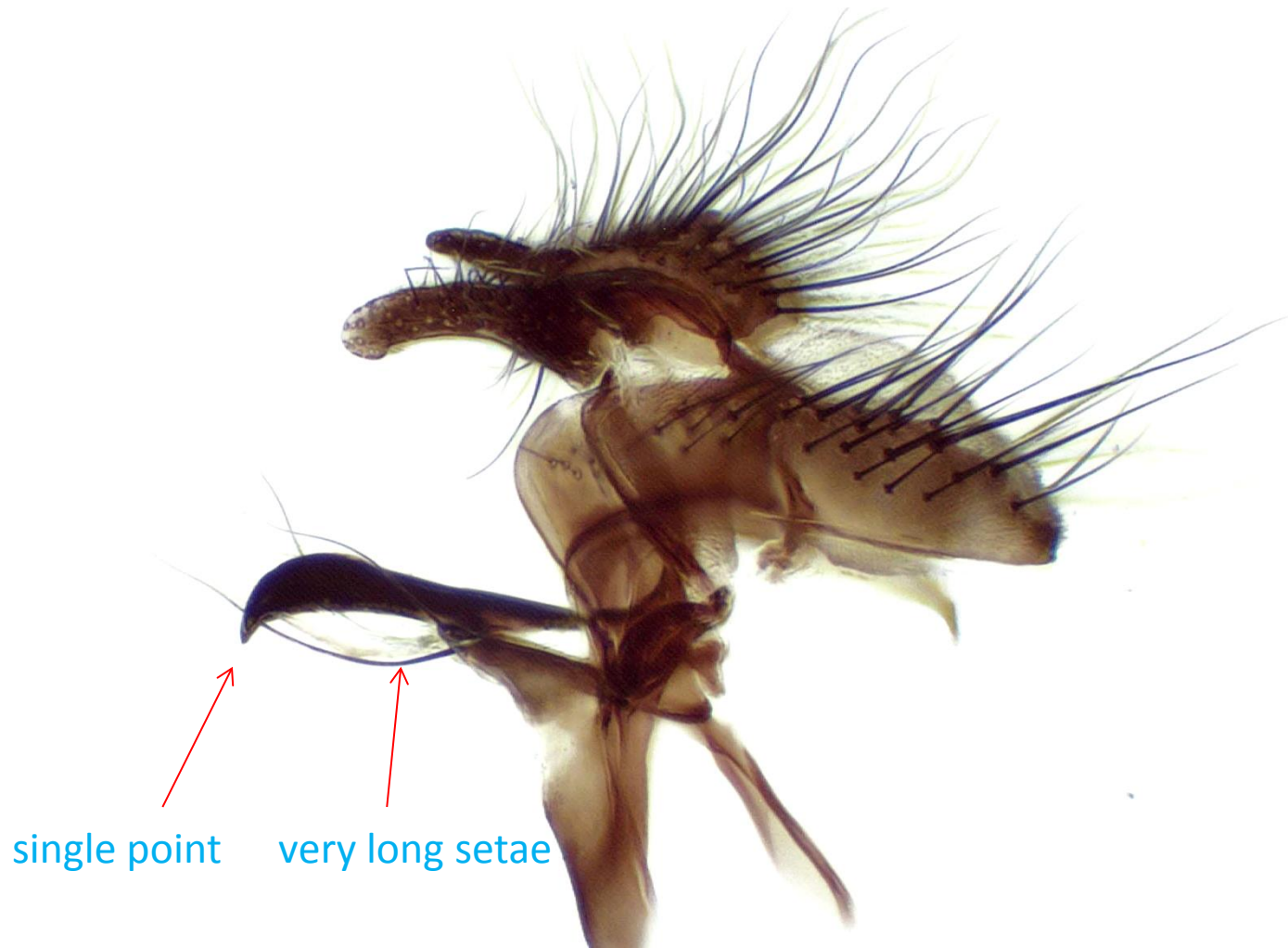
(photo: Nancy E.Karraker)

Most *Caiusa* look like this:



Caiusa violacea – male, Taiwan

Caiusa – male genital capsule (1)



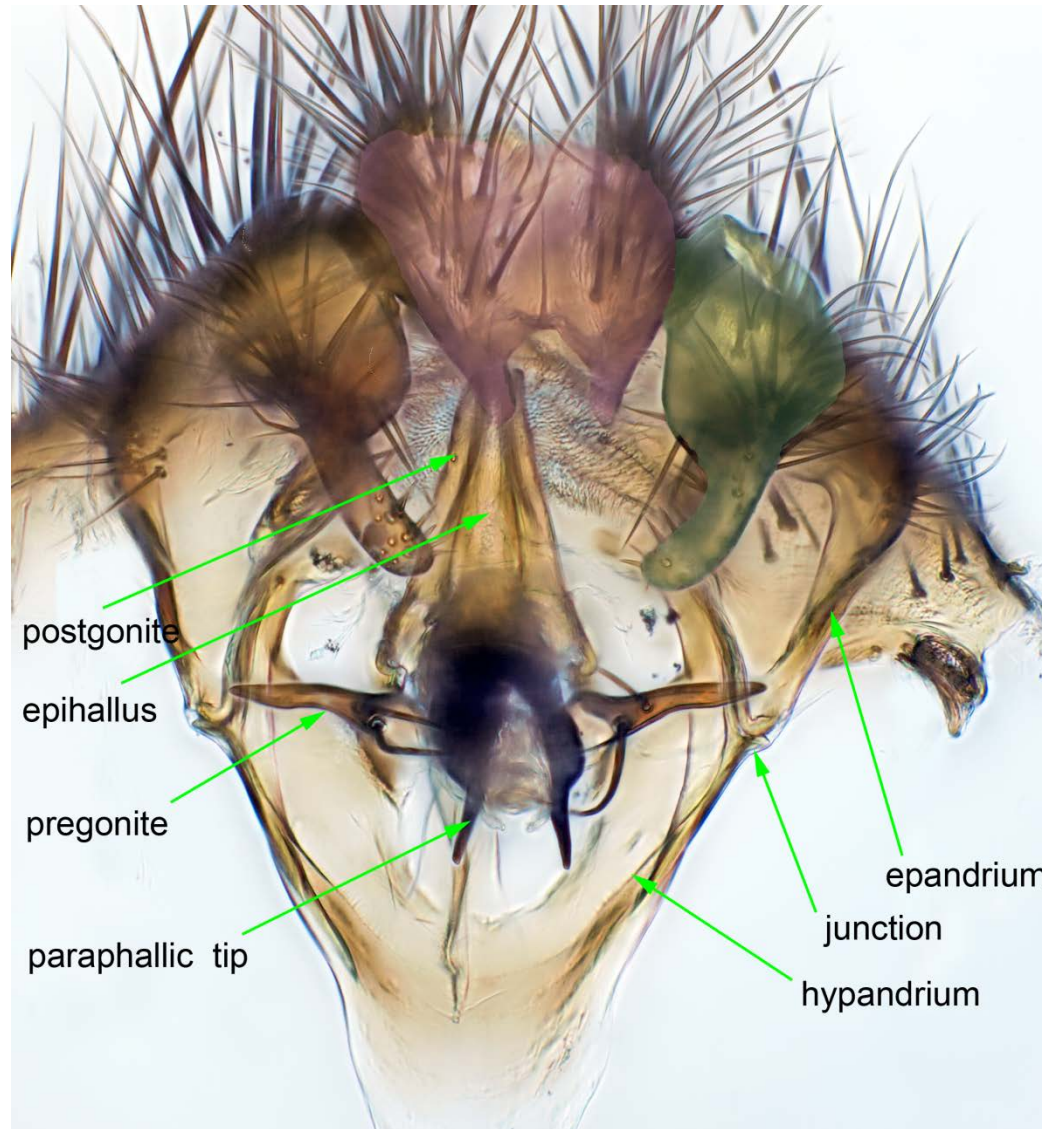
single point

very long setae

(Ozerov photo)

Caiusa violacea – Vietnam

Caiusa - male genital capsule (2)



Cerci (red),
with apical
bay;

surstylus
(green)

Note horizontal
position of distal
part of **pregonite**

postgonite

epihallus

pregonite

paraphallic tip

epandrium

junction

hypandrium

C. violacea
- Thailand

Caiusa pregonites

- strongly curved
- distal part horizontal
- 2-3 very long setae at bend



C. violacea

8 good *Caiusa* species (1)

Only underlined species have commonly been recognised in the past

1. *indica* Surcouf, 1920 [Type species][India]
nigronitens Senior-White, 1923, **syn.nov.**
[Singapore]
surcoufi Bezzi, 1927, **syn. nov.**
[Queensland, Australia]
2. *testacea* Senior-White, 1923
[Sri Lanka]
3. *coomani* Séguy, 1948
[Vietnam]
[taxon cleared up as late as in 2011]

8 good *Caiusa* species (2)

4. *violacea* Séguy, 1925, **stat.rev.** [Cambodia]
dubiosa Villeneuve, 1927, **syn. nov.** [Taiwan]
[*newspeciesA* – placeholder name]
5. *newspeciesB* **sp. nov.** [bred from Malaysia, Thailand]
6. *newspeciesC* **sp. nov.** [bred from Malaysia, Thailand]
7. *newspeciesD* **sp. nov.** [bred from Thailand]
8. *newspeciesX* **sp. nov.** [bred from Japan, Iriomote-Jima]

Previous *Caiusa* taxonomy (1)

- Species concepts based mainly on colour
 - scutellum colour
 - mesonotum colour
 - abdomen colour

Previous *Caiusa* taxonomy (2)

- **Mesonotum** colour variable within most species
- **Genitalia** never described adequately
- Numerous in misidentifications

Revised *Caiusa* taxonomy

- **Male genitalia** and **female ovipositor** today the basis of species concepts in *Caiusa*
- Examples to follow

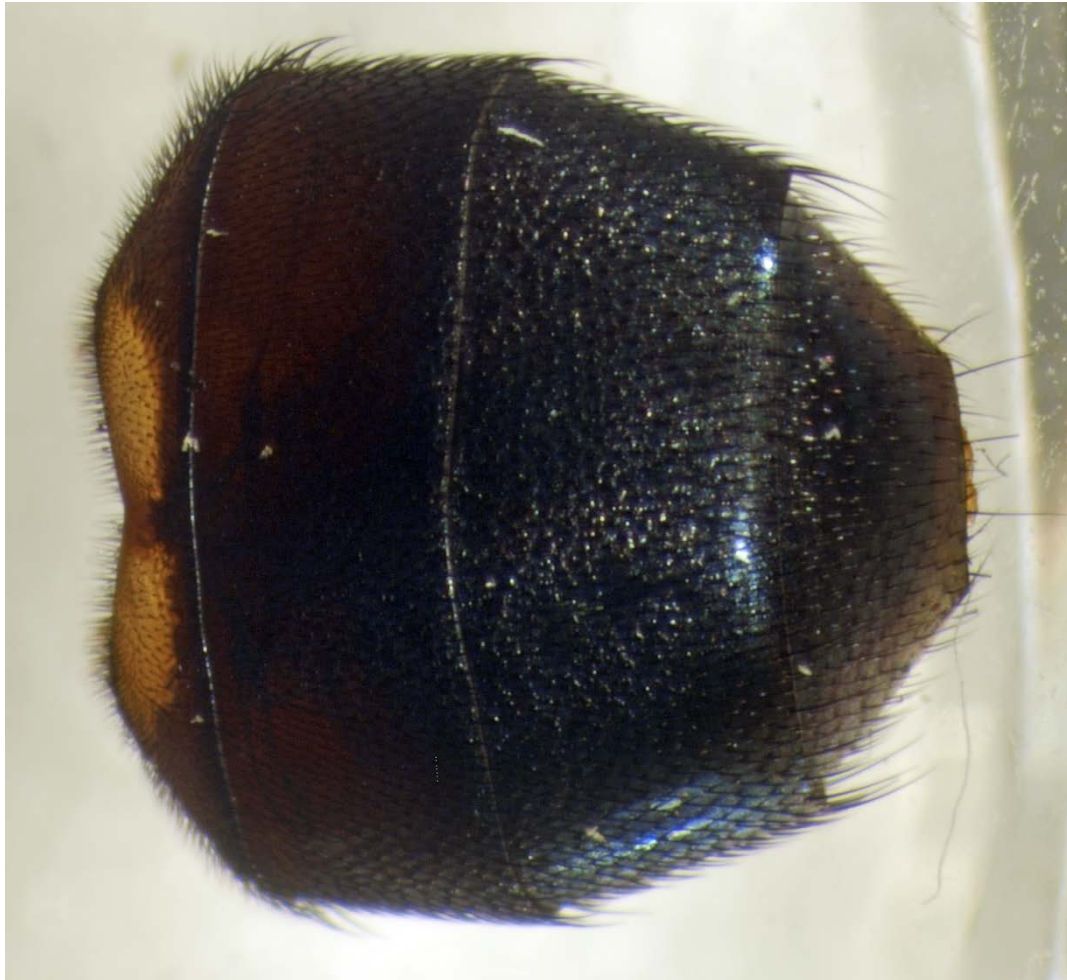
Caiusa indica – colour variants (1)



Dark mesonotum;
proximal abdomen
pale

Caiusa indica, male – Kuala Lumpur (WSU)

Caiusa indica – colour variants (2)



Abdomen almost all black;
this colour variant is the basis for the nominal species
C. nigronitens S-W
(a synonym)

MALAYSIA: Borneo
Sarawak State, Sibul
Division, Katibas River,
Menyarin River, forest
9.ix.2011 Col.H.Kurahashi

female

Caiusa indica – colour variants (3)



All yellow
mesonotum,
dark
abdominal
tip

Male – Guadalcanal, Solomon Islands (BMNH)

Similarly labelled specimens published as *C. testacea*

Caiusa indica – colour variants (4)



Male – Piva, Bougainville I., Papua New Guinea (WSU)
All yellow thorax, even all yellow abdomen.

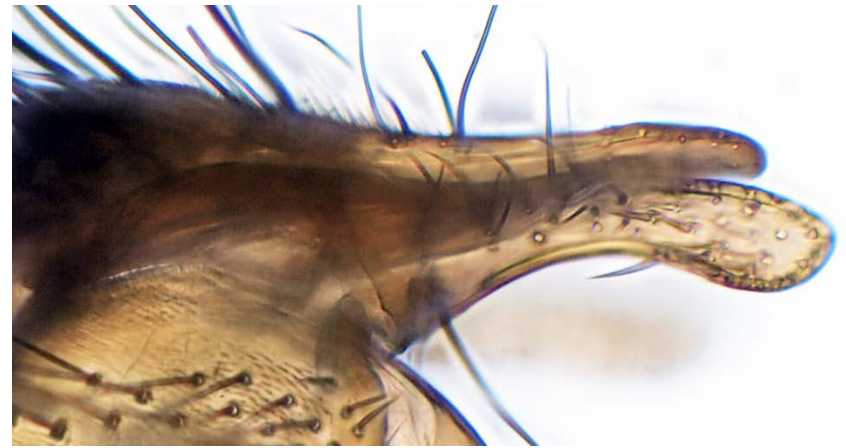
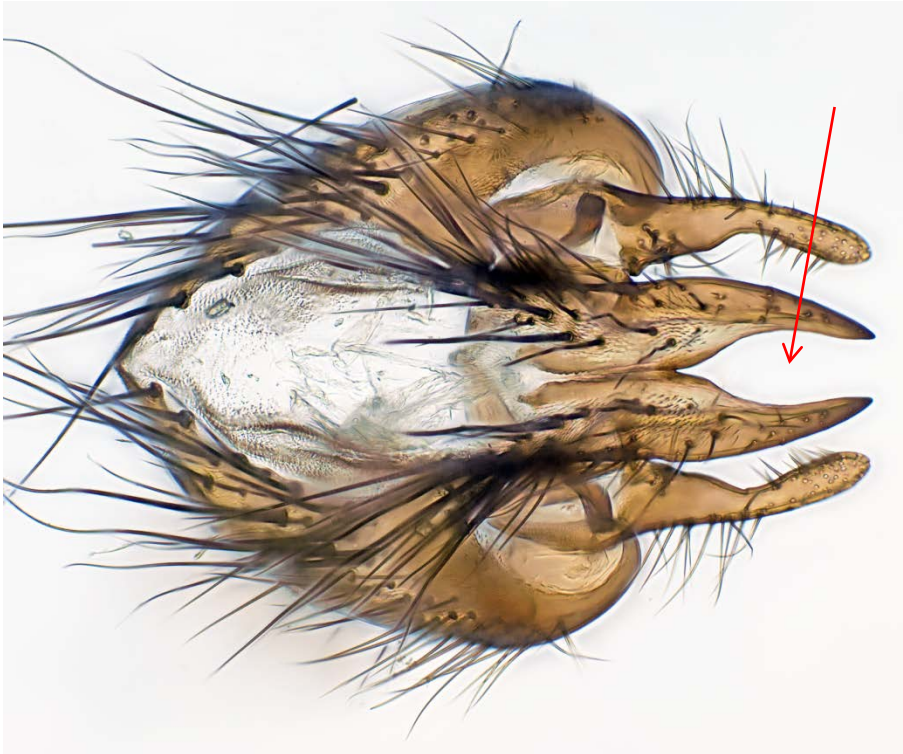
Caiusa indica – cerci and surstyli (1)



Large apical bay between tips of cerci;
tips of cerci hardly bent backwards

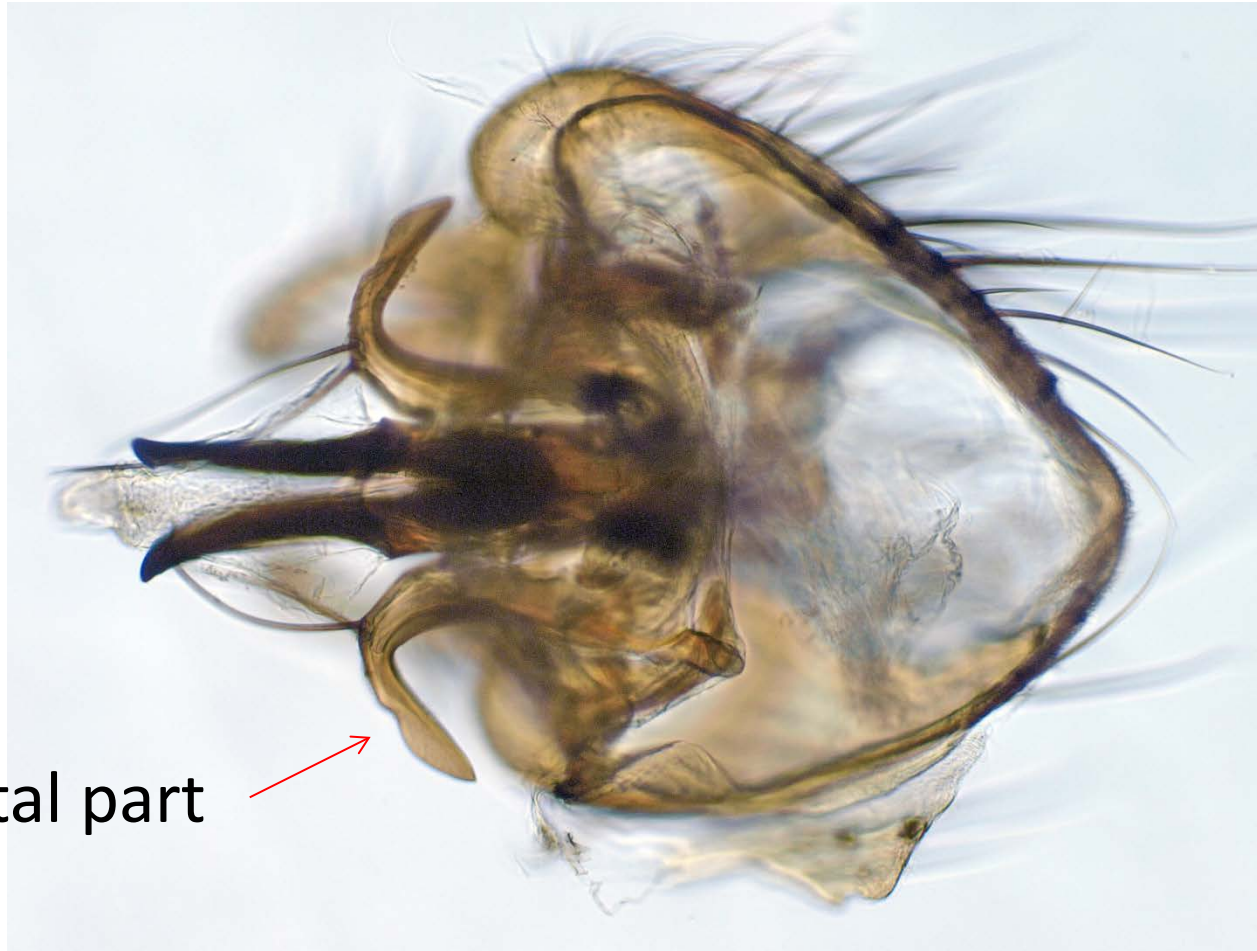
Lectotype of *Caiusa indica* Surcouf, 1920

Caiusa indica – cerci and surstyli (2)



Vietnam: Ho Chi Minh, Can Gio, mangrove, 16,18.xi.2000, H. Kurahashi leg.

Caiusa indica – pregonites



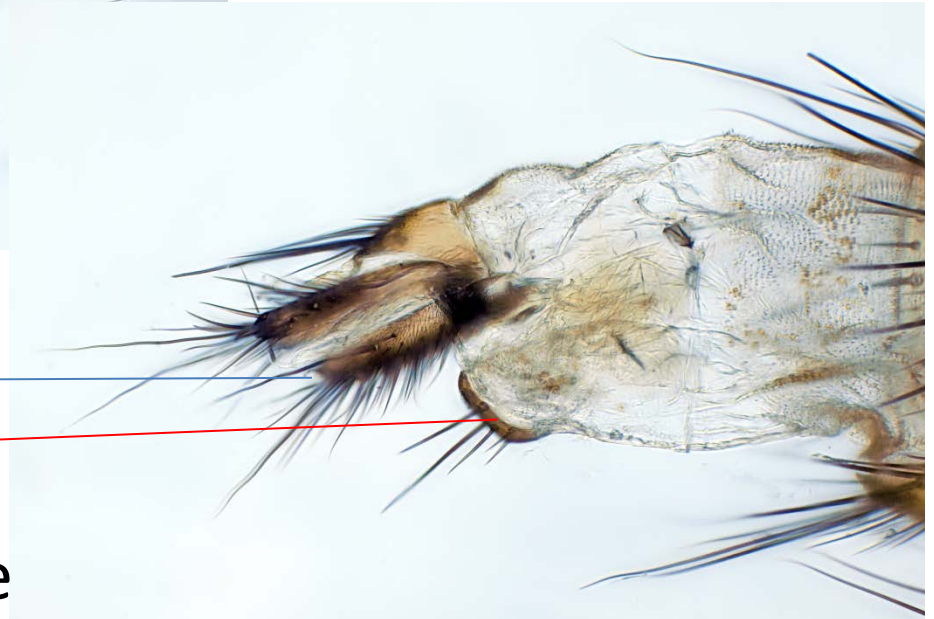
Long distal part

Lectotype of *Caiusa indica* Surcouf, 1920

Caiusa indica – biological notes

- Never bred from the foam nests of Rhacophorid frogs
- Occurs also in areas outside of the distributional area of Rhacophoridae (i.e., Papua New Guinea, Solomon Is and Australia)
- The ovipositor tip different from other *Caiusa* species in **hypoproct** and **ST8**

Caiusa indica - ovipositor tip

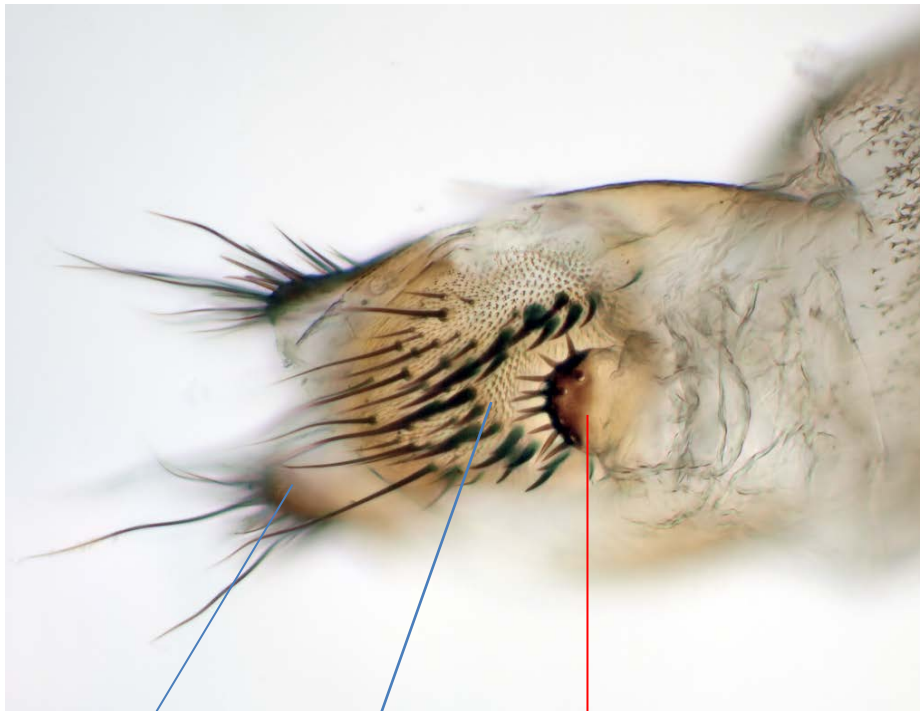


hypoproct

ST8

both with long soft setae

Caiusa coomani - ovipositor tip



cercus

hypoproct ST8



hypoproct ST8

both with short spinous setae

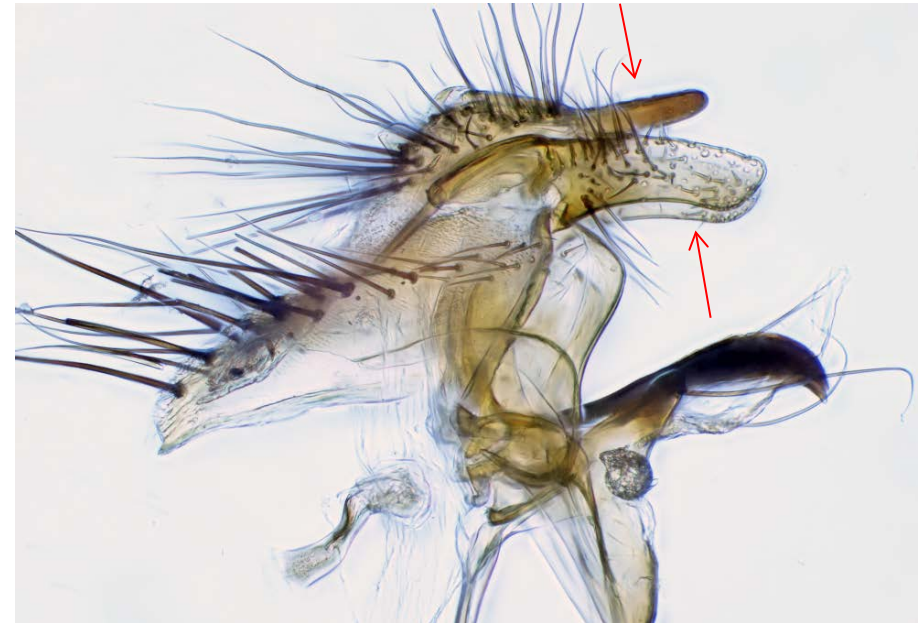
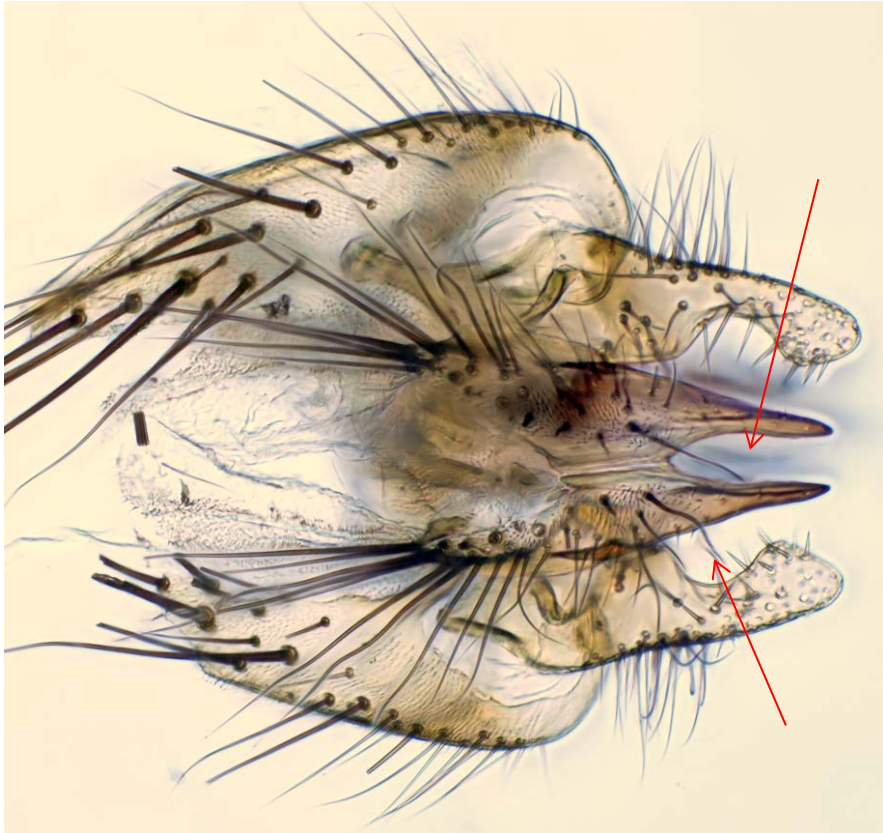
Caiusa testacea - habitus



All yellow
mesonotum,
and abdomen

Holotype, Sri Lanka, Maskelyia, BMNH

Caiusa testacea – cerci and surstyli



India: Tamil Nadu, Coimbatore (BMNH)

Caiusa coomani – colour variants (1)



Kuala Lumpur, Malaysia (WSU) «Bred from frog spawn»
Misidentified as *C. testacea* because of pale mesonotum.

Caiusa coomani – colour variants (2)



«North Borneo (SE) Forest camp, 19 km N of Kalabakan ...» (BPBM)
Misidentified as *C. indica*, because of dark mesonotum.

Caiusa coomani – cerci and surstyli



Cerci longer than surstyli; cerci with small bay;
surstyli bent strongly downwards

Caiusa violacea – habitus



Caiusa violacea – female Vietnam

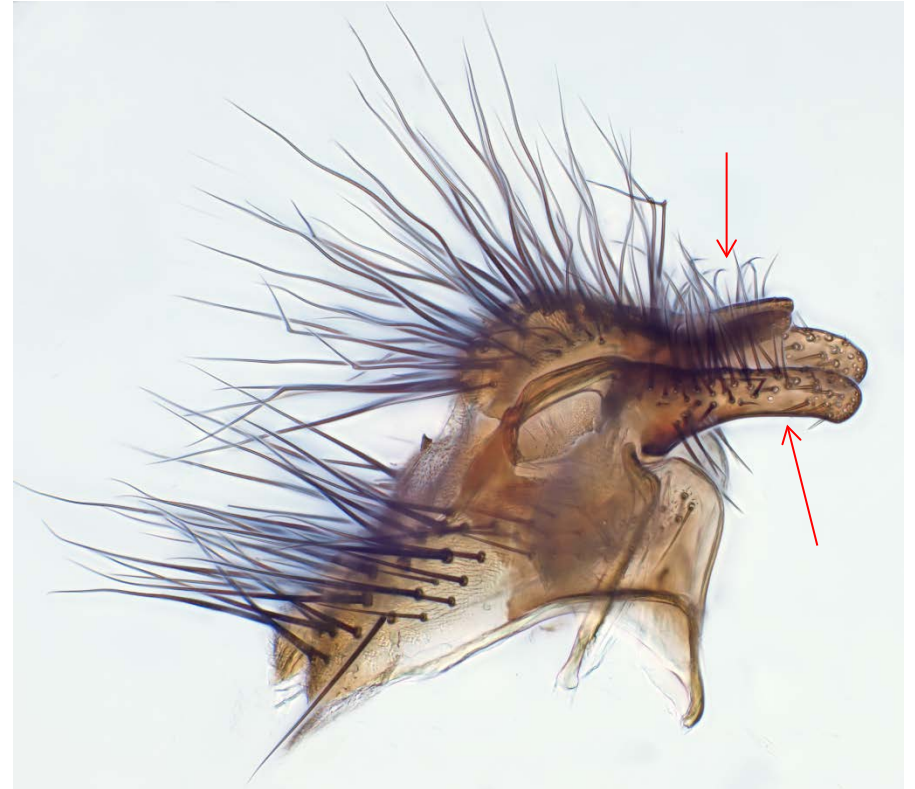
(Ozerov photo; Anna Vassilieva leg.)

Mesonotum often with dark stripe, as in *C. coomani*; may also be all dark, as in *C. indica*

Misidentified as *C. coomani* in Chinese reference works

The only *Caiusa* species in Taiwan

Caiusa violacea – cerci and surstyli



Ex *Polypedates leucomystax*, Sakaerat ERS, Thailand (*C. newspecies*A)

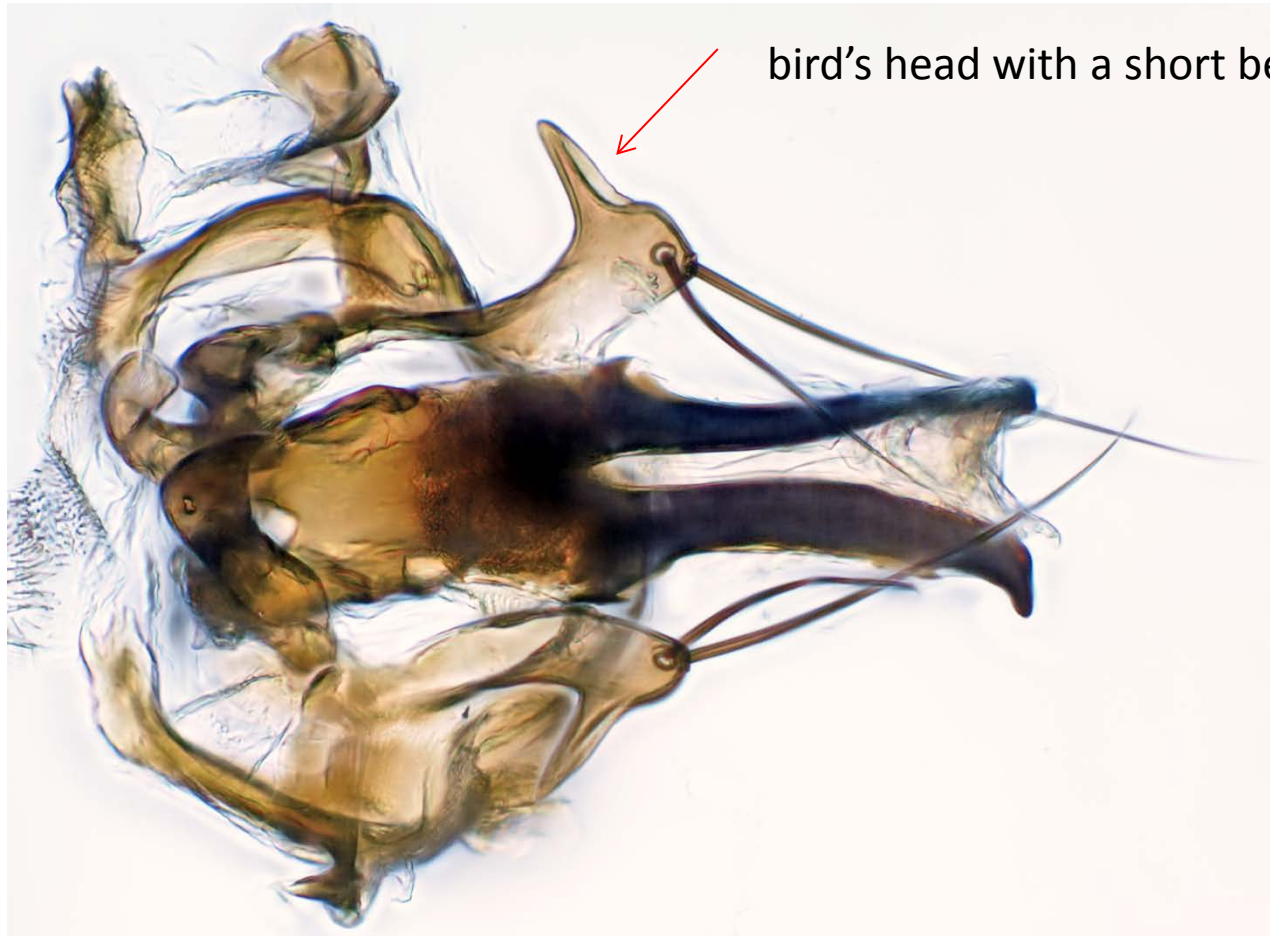
Caiusa newspeciesB – cerci and surstyli



No bay at apex of cerci, upper edge bent down distally

Ex *Rhacophorus angulirostris* , Mt Kinabalu, Sabah, Malaysia

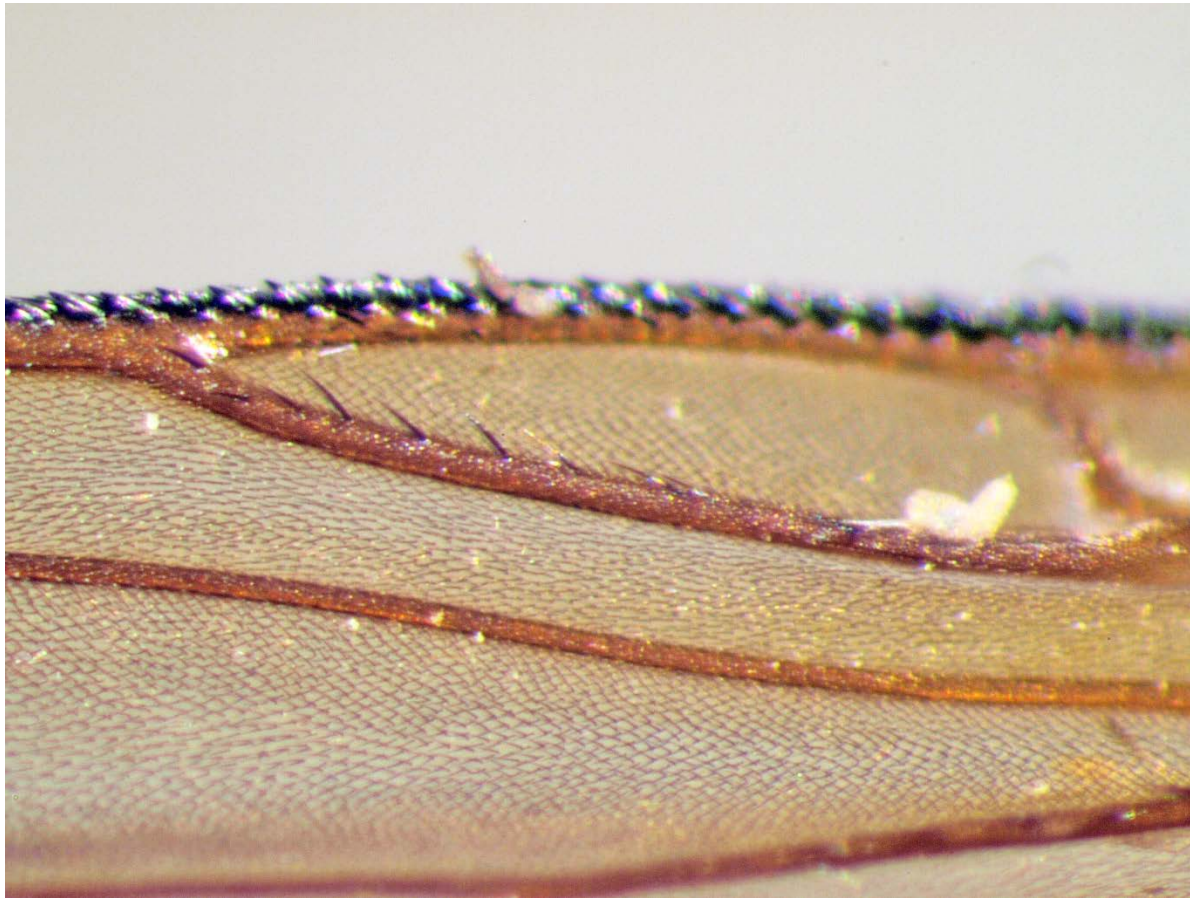
Caiusa newspeciesB – pregonites



bird's head with a short beak!

Ex *Rhacophorus angulirostris* , Mt Kinabalu, Sabah, Malaysia

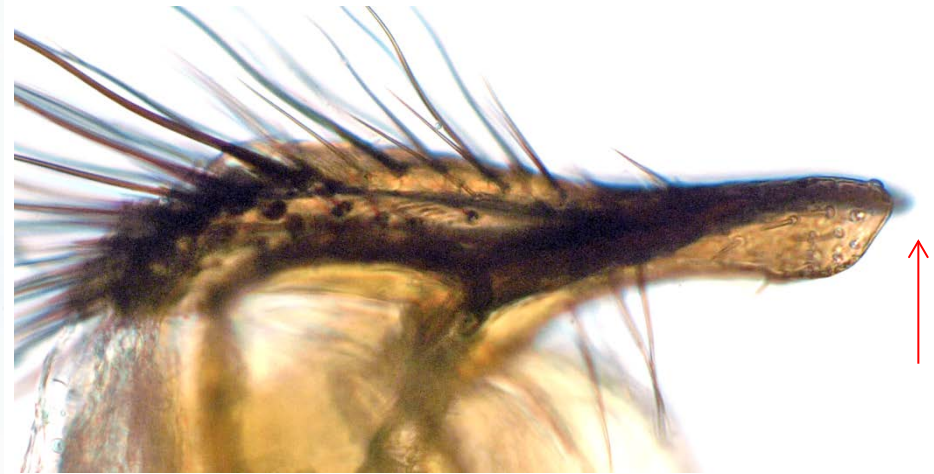
*Caiusa newspecies*B – distal section
of vein R₁ often with setulae



BPBM: North Borneo (Brit. N.), female, «Ex fresh human excrement»

*Caiusa newspecies*C

– cerci and surstyli

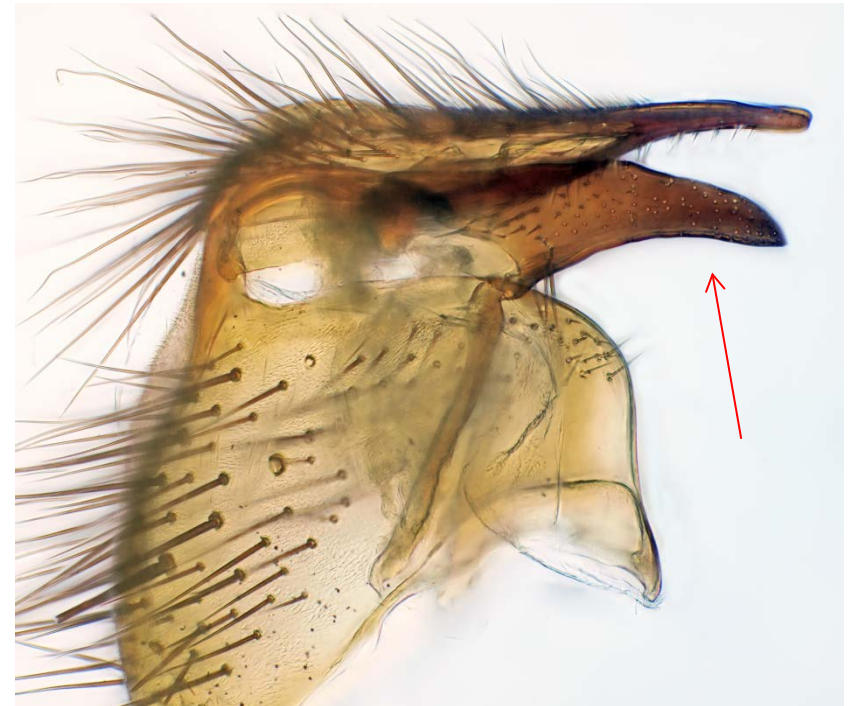
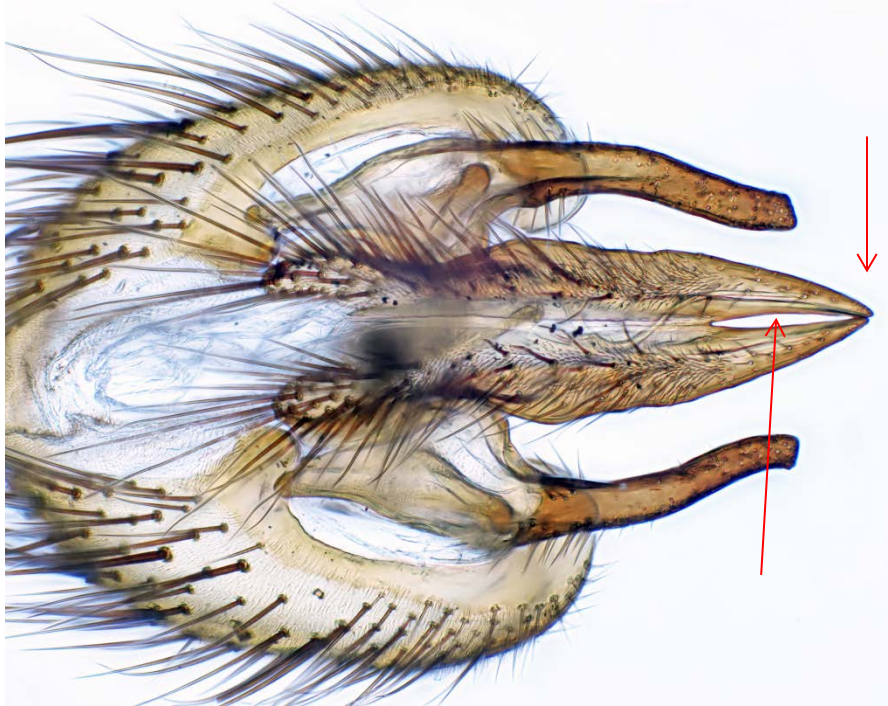


Cerci very narrow, straight, with slit, no bay;
longer than surstyli

Ex *Rhacophorus kio*, Sakaerat ERS, Thailand

*Caiusa newspecies*D

– cerci and surstyli

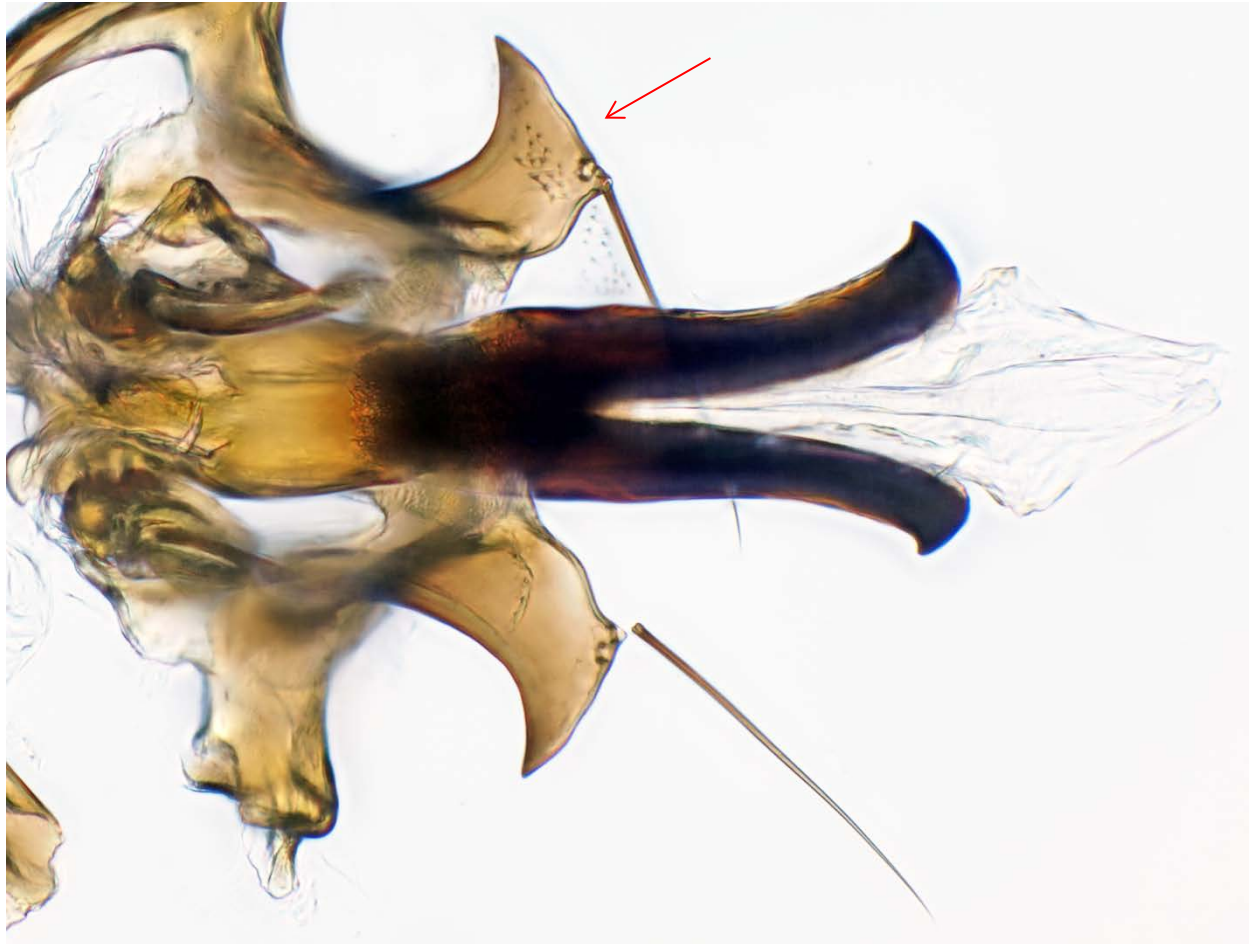


Cerci longer than surstyli, no bay;
surstyli massive, sickle-shaped

Ex *Chiromantis hansenae*, Sakaerat ERS, Thailand, not a foam nesting species

*Caiusa newspecies*D

– pregonites



also
massive,
and
sickle-
shaped

Ex *Chiromantis hansenae*, Sakaerat ERS, Thailand



The rhacophorid
frog
*Chiromantis
hansenae*,
female guarding
her egg mass
(not in a foam
nest)

(Photo: Nancy E.Karraker)

Caiusa newspeciesX – cerci and surstyli



Narrow apical slit between tips of cerci;
cerci shorter than surstyli



Japan, *Yona, Okinawa*, main island, Ryukyu Islands 21-22.V.1971, loan from H. Kurahashi (misidentified as *C. coomani*)

C. newspeciesX

- Endemic to Japan
- Bred from *Rhacophorus owstoni*, a frog endemic to the islands **Iriomote-jima** and **Ishigaki-jima** in the Ryukyu Island chain.
- Also found in Ryukyu Islands outside these two islands.

Rhacophorus owstoni
Owston's Green Tree Frog



Frog endemic to Japan – also found on **Iriomote-jima** and **Ishigaki-jima** islands.

Caiusa –distribution of species (1)

C. indica: Australia (Queensland, NT); India (Tamil Nadu); Indonesia; Malaysia (Malaya, Sarawak); Papua New Guinea (incl. Bougainville Is); Philippine Islands; Singapore; Solomon Islands; Sri Lanka; Thailand; Vietnam

C. testacea: India; Sri Lanka; Nepal (?)

C. coomani: China (Hong Kong), Malaysia (Malaya, Sabah, Sarawak), Singapore, Thailand, Vietnam

Caiusa –distribution of species (2)

C. violacea: Cambodia; China (Yunnan, Guangdong); Malaysia (Malaya, Sabah?); Taiwan; Thailand; Vietnam

C. newspeciesB: Malaysia (Sarawak, Sabah); Thailand

C. newspeciesC: Malaysia (Sabah); Thailand

C. newspeciesD: Thailand

C. newspeciesX: Japan (Ryukyu Islands)

Frog foam nests from which *Caiusa* have been bred

- Caiusa coomani* – *Polypedates leucomystax*, *Polypedates megacephalus*
- C. testacea* – «frog spawn»
- C. violacea* – *Polypedates leucomystax*, *Chirixalus nongkhorensis*
- C. newspeciesB* – *Rhacophorus angulirostris*, *Rhacophorus kio*
- C. newspeciesC* – *Chirixalus nongkhorensis*, *Rhacophorus dulitensis*,
Rhacophorus kio
- C. newspeciesD* – *Chiromantis hansenae*
- C. newspeciesX* – *Rhacophorus owstoni*

- C. indica* – no known breeding from frog foam nests

There are records of *C. indica* and *C. testacea* parasitizing the nests of the bee in *Megachile nana* in India

Breeding of *Caiusa* species by Nancy E. Karraker

- Five species (*C. coomani*, *C. violacea*, *C. newspeciesB*, *C. newspeciesC*, *C. newspeciesD*) were among 111 specimens bred from more than 26 foam nests of named frogs in SE Asia by Nancy E. Karraker.

This made it possible to

- Characterise all *Caiusa* species on the basis of male genitalia,
- Associate females with males,
- Establish diagnostic descriptions of ovipositor morphology for 6 species (still lacking: *testacea* and *newspeciesD*)

Acknowledgements

- Christophe Daugeron, MNHN, Paris, France
- Neal Evenhuis, BPBM, Honolulu, USA
- Hiromu Kurahashi, IDD, Tokyo, Japan
- Frank Menzel, SDEI, Müncheberg, Germany
- Andrey L. Ozerov, MSU, Moscow, Russia
- Fabrizio Rigato, MSNM, Milan, Italy
- Nikita Vikhrev, ZMUM, Moscow, Russia
- Norman E. Woodley, USNM, Washington D.C., USA
- Nigel P. Wyatt, BMNH, London, UK
- David Yeates and Chris Manchester, ANIC, CSIRO, Australia
- Chen Young, CMNH, Pittsburgh, Pennsylvania, USA
- Richard S. Zack, WSU, Pullman, USA