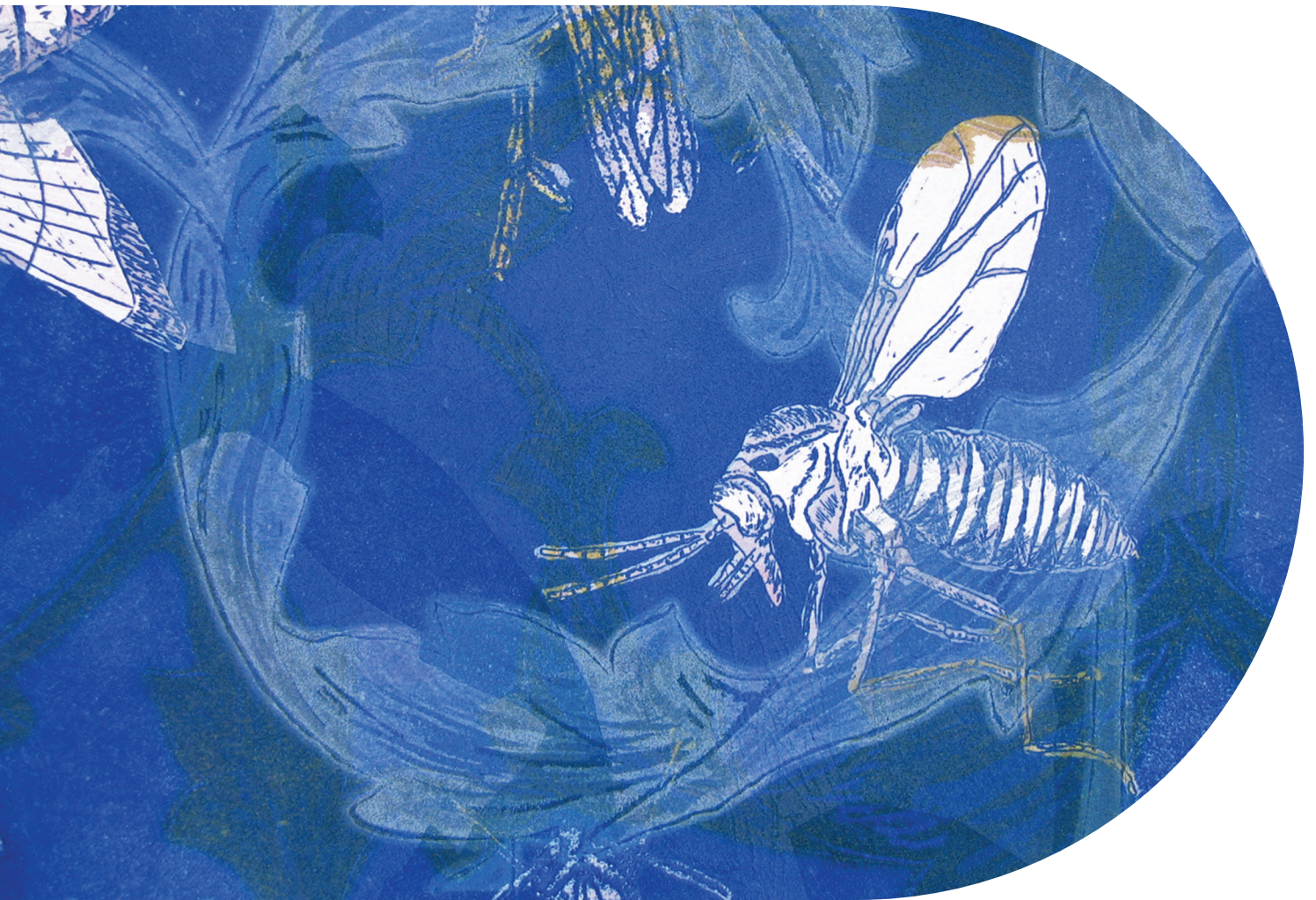




**Pictorial key to
adult female
Culicoides Latreille,
1809 (Diptera:
Ceratopogonidae)
from Australia**

Glenn A Bellis and Alan L Dyce

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We extend our sincere appreciation to Dr Glenn Bellis for his invaluable contribution as the author of this manual. His extensive expertise in entomology and dedication to advancing vector surveillance under the National Arbovirus Monitoring Program have been instrumental in producing a resource that supports accurate species identification. We also recognise the contributions of Alan Dyce (Honorary Research Fellow, CSIRO Division of Entomology, Canberra, Australia).

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Contact

Animal Health Australia

Phone: (02) 6232 5522

Email: aha@animalhealthaustralia.com.au

Web: www.animalhealthaustralia.com.au

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Introduction and scope

This key provides for the first time, a comprehensive identification aid for female specimens of all species of *Culicoides* reported from Australia, plus a few important exotic species. It is primarily aimed at biosecurity officers tasked with the detection of incursions of new species into Australia or extensions of the range of existing species.

The key is a logical extension of the Dyce et al (2007) Pictorial atlas of Australasian *Culicoides* wings and the key for female specimens of species present in NT, WA and SA by Bellis et al (2015) as it additionally includes species occurring in all other Australian jurisdictions, excepting the offshore island territories. Like the Bellis et al (2015) key, this key focusses on characters visible on unmounted specimens, excepting in cases where species are only separable using characters like spermathecae or antennal sensilla which are generally only visible on mounted specimens, although antennal sensilla are often visible by placing specimens onto a microscope slide and viewing under a compound microscope. Female specimens of some species are inseparable morphologically and these species are taken to a species group or complex; workers requiring species-level identification of such specimens will need to employ other methods, such as DNA barcoding, to obtain a result.

This key includes all species reported from Australia by Dyce et al (2007) plus some additional species that have come to light

since that publication. Species and subgeneric placement follow that listed in Dyce et al (2007). Exotic species included are those that pose a significant threat by their proximity to a pathway into Australia and/or their potential to alter the ecology of midge-borne diseases should they become established. Readers should be aware that the advent of DNA barcoding of Australian *Culicoides* specimens has largely occurred after the Dyce et al (2007) wing picture atlas was produced. These analyses have revealed significant numbers of potential cryptic species in the Australian fauna (Bellis et al 2013; 2014; Gopurenko et al 2015 and unpublished data; Mee et al 2021). These ongoing studies are providing a valuable contribution towards improving our understanding of the systematics of *Culicoides*. Many of these potential cryptic species however, remain unresolved as reliable morphological differences are yet to be revealed so the present key does not attempt to differentiate them.

As females are the most commonly collected specimens and are more important from an epidemiological perspective, this key has been developed specifically to identify female specimens. While for many species wing pattern characters are consistent for males and females, for many others these patterns are not consistent and male specimens will often not run cleanly to species. Additionally, the key often relies on non-wing characters such as palpal sensory pits, antennal shape and sensilla, which are generally not consistent between male and female specimens.

This identification aid is actually a series of keys which workers are encouraged to use to systematically place their specimens into a species. A key to non-predaceous Ceratopogonid genera allows workers to confirm if their specimen belongs to genus *Culicoides*. Workers who are unsure that their specimen belongs to family Ceratopogonidae are referred to other identification aids, for example the keys in *Insects of Australia* by CSIRO (1991), to confirm their specimen is a biting midge.

Following a systematic approach, workers with a specimen belonging to genus *Culicoides* are then referred to the key to subgeneric groupings within the genus. Many species will come out in this key while others will only be identified to a subgeneric group, and workers are referred to the respective subgeneric group key to take their specimen to a species. Fact sheets, plates of illustrations and a list of antennal sensilla distributions are provided for all species included in the key to allow workers to see images of important characters, distribution maps, diagnoses and biology data which should lend confidence to identifications obtained via the key.

Four of the species listed in Dyce et al (2007) are not included in this key as they are currently only known from male specimens. These species are *C. dubiosum* Dyce & Wirth from Iron Range, Qld, which Dyce and Wirth (1997) themselves suggest is possibly the male of one or other species in the Purus Group. There are also 2 undescribed species in the Melanesiae Group. One of these, from Charleville, Qld, has an entirely unpatterned wing so the female is expected to come out at couplet 77, 78 or 79 in the subgeneric key. The other from Bamaga, Qld, has a wing quite similar to *C. melanesiae* so the female is likely to come out somewhere near *C. melanesiae* in the subgeneric key. The final exemption is *C. Ornatus* Group sp no 3. This species is known from 2 males collected in SW WA. A female wing was illustrated by Dyce et al (2007), but re-examination of that specimen suggests it is not conspecific with the males. The female is likely to be similar to female *C. ornatus* so will likely come out somewhere near this species in the key to species belonging to the Ornatus Group. Any females belonging to the Ornatus Group from SW WA should be examined closely to confirm they do not belong to this species. Currently the only species in that group that is known to occur in southwest WA is *C. Ornatus*

Group sp no 8 which has a greatly swollen 3rd palpal segment and this character should help to distinguish this species from females of *C. Ornatus* Group sp no 3.

A summary of the biology, economic importance, biogeography and systematic history of the Australasian *Culicoides* fauna is provided in Dyce et al (2007) and Bellis et al (2015) and readers are referred to those documents for a brief introduction into this genus. Similarly, the methods used in this key are the same as those used by Bellis et al (2015).

Acknowledgements

Production of a key to the entire Australian *Culicoides* fauna was a long term goal of Alan Dyce but he unfortunately passed away before his dream could be realised. I should point out that Alan has not seen this series of keys, nor was he even aware of their production and he is listed as a co-author based on contributions unearthed in the piles of notes, illustrations, draft keys, unpublished manuscripts and the curated collection of specimens he left behind and from long discussions we had while he was still working. I know that he would have wanted to acknowledge a long list of his colleagues, most particularly Mike Muller, Harry Standfast and Toby St George who together founded the team that led veterinary vector research in Australia, if not the world, from the late 1960's until the 1990's.

This project was funded by the National Arbovirus Monitoring Program (NAMP). Less directly, insect specimens collected by that program have made an enormous contribution to this project, as has the ongoing funding used to support a reference entomological service and team of entomologists to the program.

This project, being a logical extension to the wing atlas of Dyce et al (2007), must acknowledge all of the people associated with that earlier publication. Most of the photographs of wings used in the key are those produced by Ian Roper while at the CSIRO McMaster Laboratory and digitised by Craig O'Brien at Trannys (40 Falcon St, Crows Nest, NSW). Additionally, many of the specimens used to prepare and test the keys were collected by the people acknowledged by Dyce et al (2007) as well as more recent collectors, largely employed by the NAMP or Northern Australia Quarantine

Strategy (NAQS) of the Australian Department of Agriculture, Fisheries and Forestry. In particular we acknowledge Lorna Melville, Neville Hunt, Marion Seymour, Luke Halling, Ralph Stutchbury, Alan Bishop, Adrian Nicholas, Bill Doherty, Birgit Loecker, Emma Watkins, Andrew Moss, Cassandra Wittwer and Stacey Anderson for their collecting efforts. We'd also like to thank the following people for the many, many hours spent processing specimens and submitting them to us for identification and incorporation into our collective datasets: Leanne Nelson, Adrian Nicholas, Alan Bishop, Stacey Anderson, Neville Hunt, Martin Shivas, Jean-Bernard Duchemin, Bill Doherty, Grant Bellis, Birgit Loecker, Natalie Leo, Harry McKenzie, Tony Postle, Luke Halling and Anna Genge. Additionally, many of the slides used to prepare this key were made by Dean Gibson and Gleniss Wellings and we are indebted to them both for their help. We are also grateful to David Yeates of the Australian National Insect Collection for the loan of specimens from that collection.

No project of this size can progress without significant managerial support. In particular we thank the management team from NAMP, including Ian Langstaff, Bronwyn Hendry, Mikhaila Nye and Emily Sears, and from NAQS including James Walker, Les Howard, Brian Read, Beth Cookson, Skye Fruean and Darren Peck.

An important part of this project was to road test the keys with the target audience to ensure it will meet the needs of NAMP. This included a workshop involving the majority of midge researchers in Australia that was held at the Orange Agricultural Institute and hosted by Birgit Loecker and the NSW DPI team at Orange. Participants included representatives from NAMP as well as from the NSW Department of Primary Industries and the Victorian Department of Energy, Environment and Climate Action. We thank Luke Watson, Anna Genge, Amber Gane, Asif Ahmed, Belinda Keen, Bill Doherty, Birgit Loecker, Bronwyn Hendry, Catherine Phillips, David Britton, David Gopurenko, Emily Sears, Farhat Khan, Grant Bellis, Leanne Nelson, Melissa Klein, Natalie Leo, Natsuda Puttharak, Peter Mee, Sukanya Akepati, Viliami Heimoana and Zoe Edwards for their contributions to that workshop and the long list of suggested improvements to the key which resulted from the workshop. We are also grateful to this team for subsequent comments on later drafts of the keys.

Although this key deals entirely with the morphology of *Culicoides*, significant input from DNA work, led by David Gopurenko of NSW DPI at Wagga Wagga, has bolstered support for and helped define the boundaries of many of the taxa included herein. We are indebted to David in particular for his tireless patience explaining the limitations and contributions of genetic analysis to the taxonomy of *Culicoides*.

Key to subfamilies and the non-predaceous genera of Ceratopogonidae

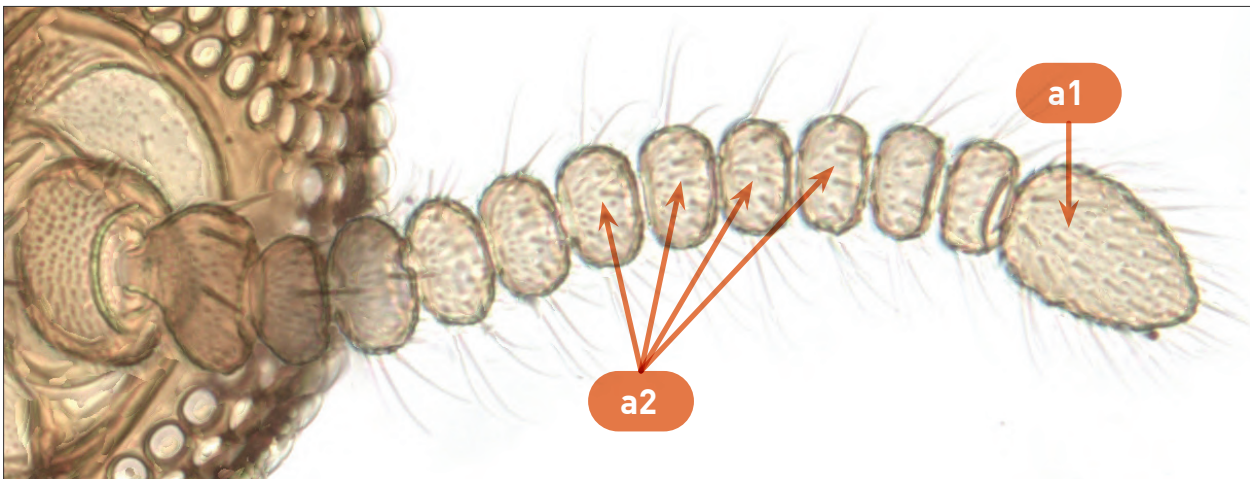
1

Female antennal flagellum with 12 segments and only the distal segment (a1) distinctly longer than the rest of the flagellar segments (a2)

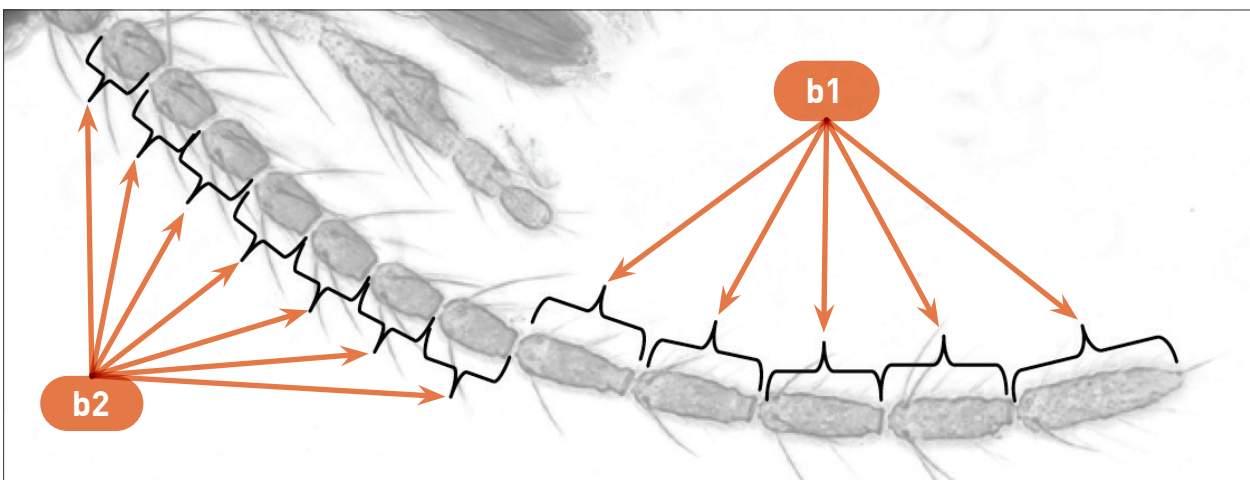
Subfamily
Leptoconopinae
Leptoconops

Female antennal flagellum with 13 segments of which the distal 4, 5 or 6 (b1) are usually individually longer than any of the basal 7 or 8 flagellar segments (b2)

2



Leptoconops



Culicoides

2

Apical flagellomere with terminal nipple which is constricted basally (a)

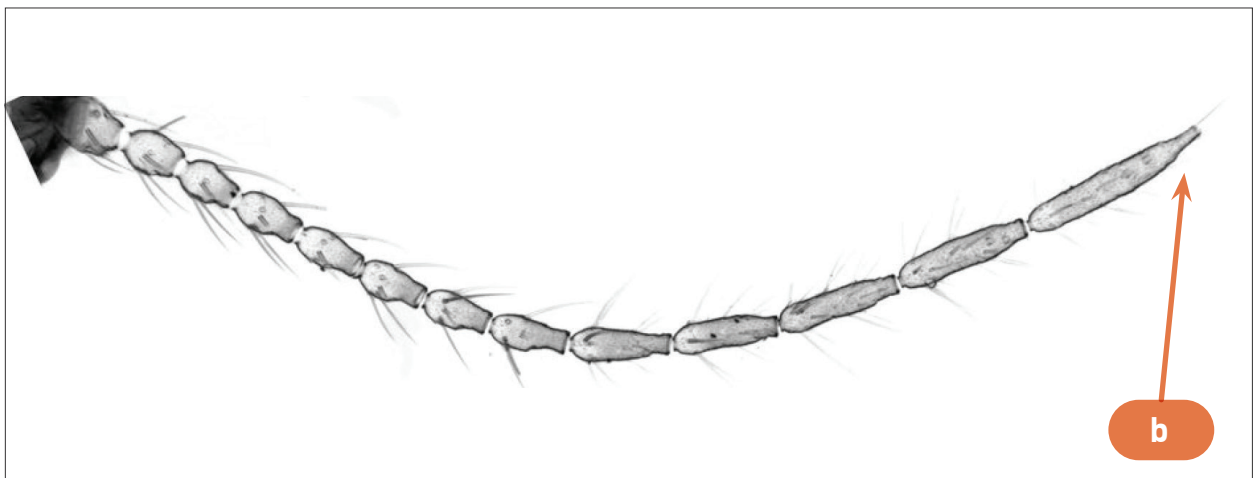
Subfamily
Forcipomyiinae 3

Apical flagellomere without terminal nipple although it may be strongly tapered (b)

4



Forcipomyia



Culicoides

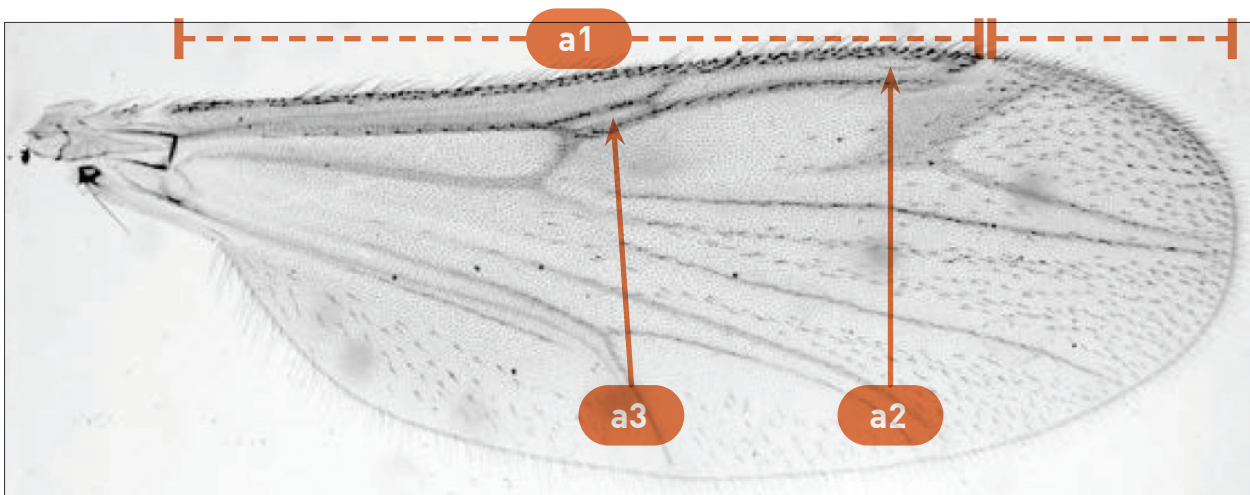
3

Wing slightly hairy; Costa reaching well beyond middle of wing (a1);
2nd radial cell (a2) at least twice as long as first (a3)

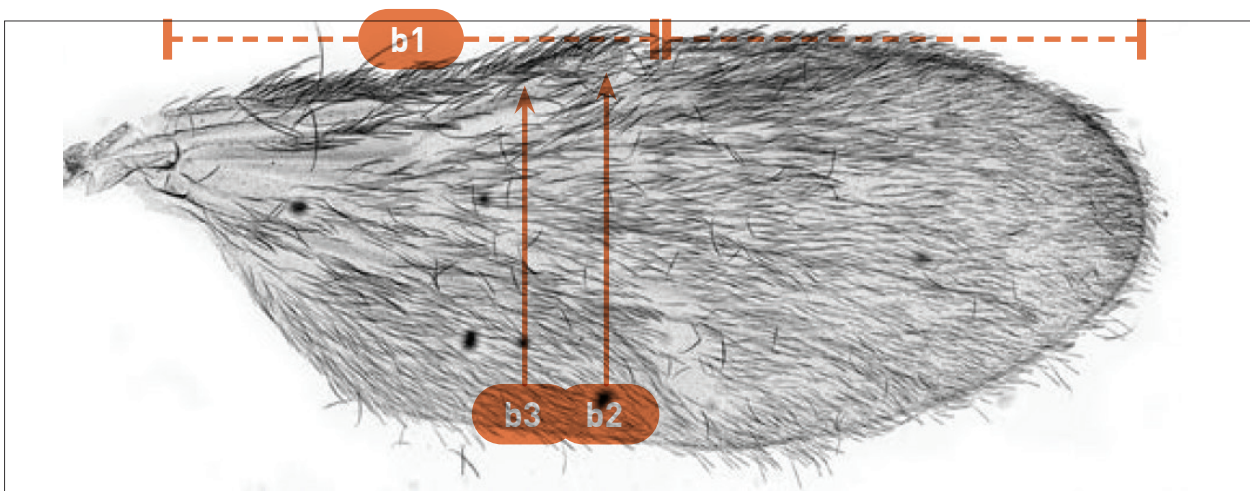
Atrichopogon

Wing densely hairy; Costa short, at most 0.6 of wing length; 2nd
radial cell (b2) less than twice as long as first (b1)

Forcipomyia



Atrichopogon



Forcipomyia

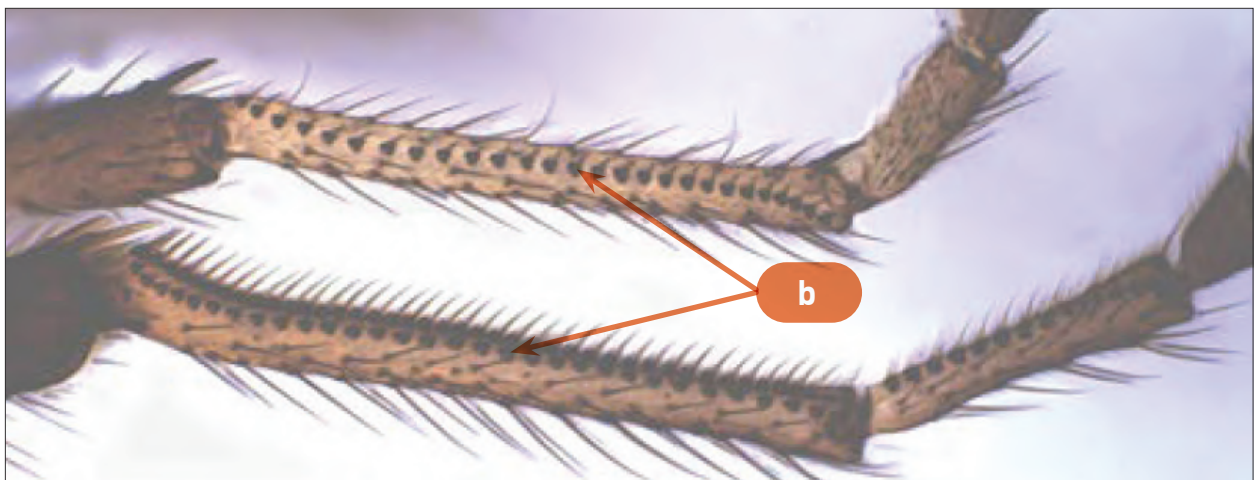
4

Hind first tarsomere with scattered setae or, at most, a row of strong bristles of uneven length (a)

5

Hind first tarsomere with row of evenly spaced palisade setae of even length (b)

Subfamily
Ceratopogoninae tribes
other than Culicoidini,
predaceous genera



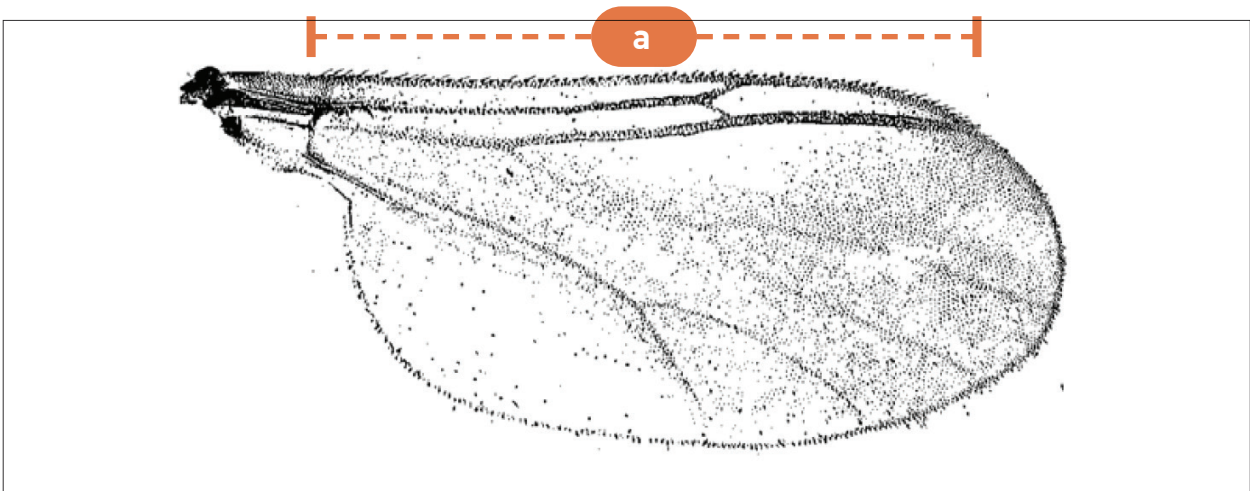
5

Wing unpatterned; costa long, at least 0.8 of wing length (a)

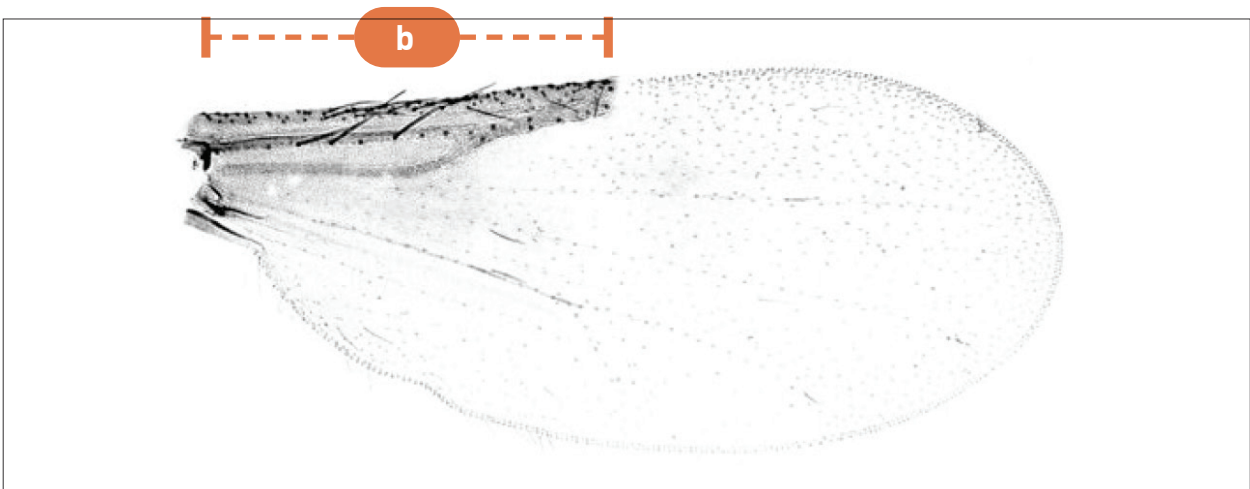
Subfamily
Leptoconopinae
Austroconops

Wing with or without pattern; costa short, at most 0.6 of wing length (b)

6



Austroconops (photo credit Borkent et al 1987)



Dasyhelea

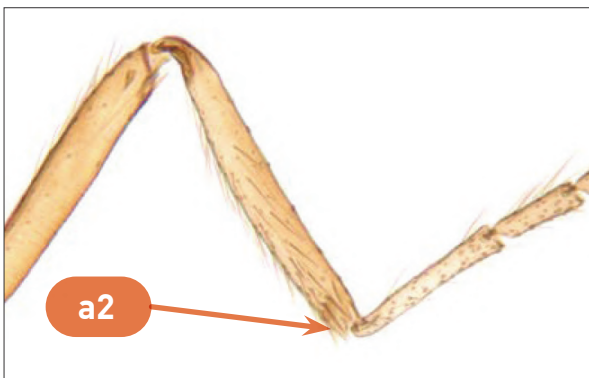
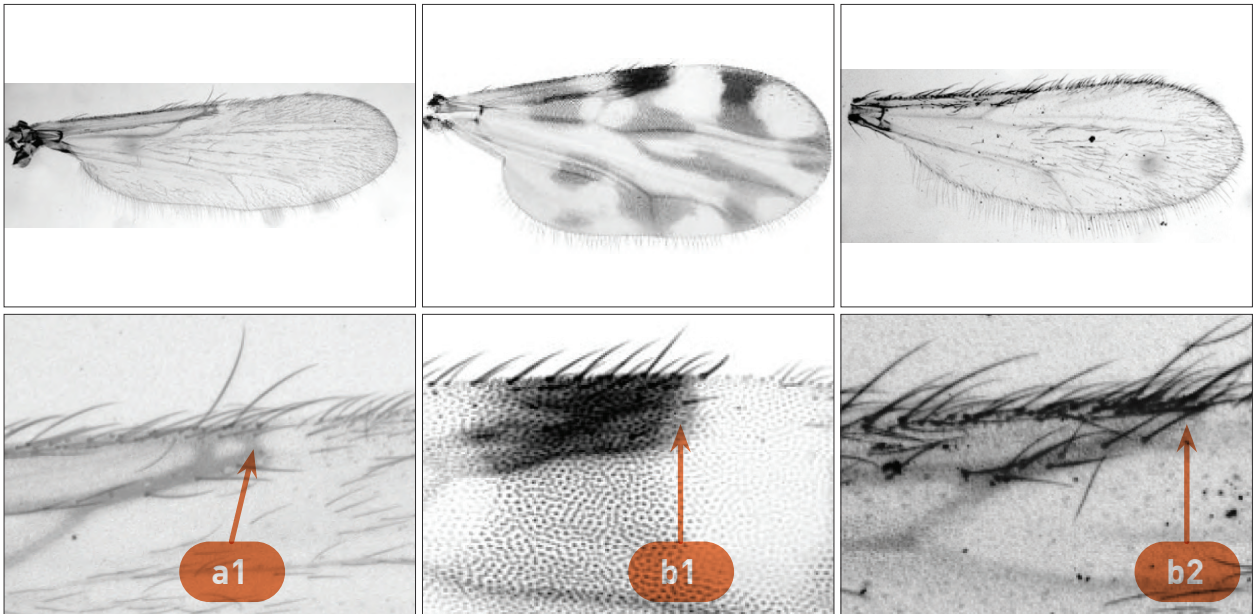
6

Wing unpatterned; second radial cell distinct and somewhat or completely truncated apically (a1); fore tibiae without apical spine (a2)

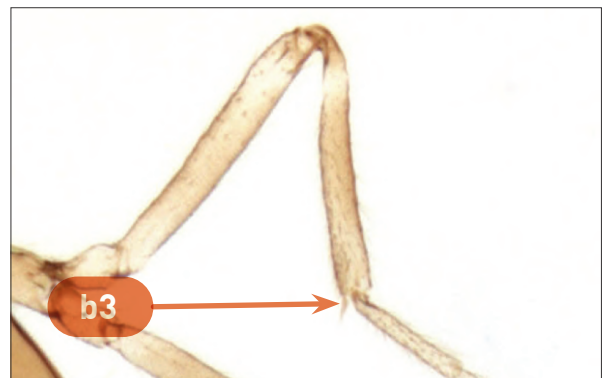
Subfamily
Dasyhelinae *Dasyhelea*

Wing with or without pattern; second radial cell rounded (b1) or absent (without lumen) (b2); fore tibiae with apical spine (b3)

Subfamily
Ceratopogoninae Tribe
Culicoidini 7



Dasyhelea



Culicoides

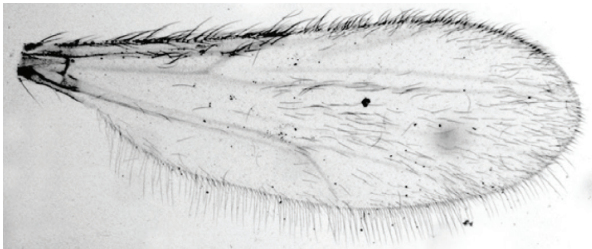
7

Costa extending less than half distance to wing tip (a1); radial cells absent, without lumen (a2); wing transparent and without pattern of pale markings

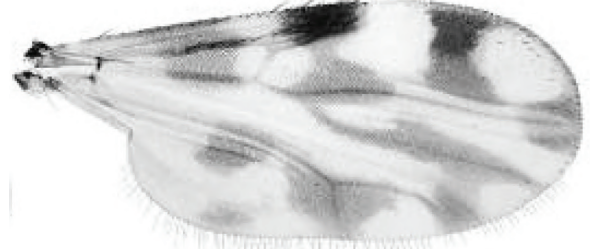
Paradasyhelea

Costa extending beyond mid point of wing (b1); radial cells distinct, at least 1 cell with lumen (b2); wing grey and most species have a pattern of pale markings

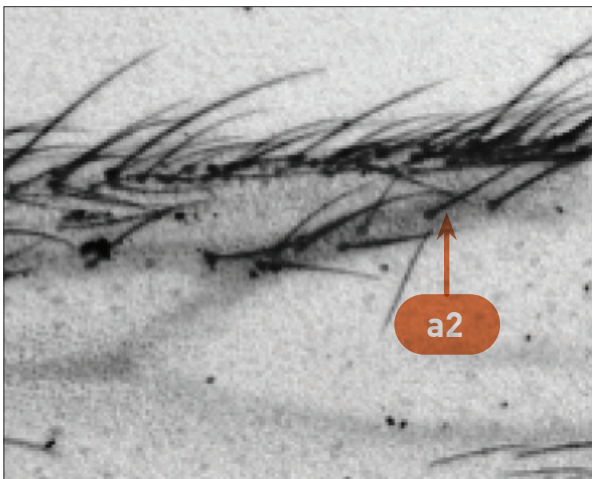
Culicoides



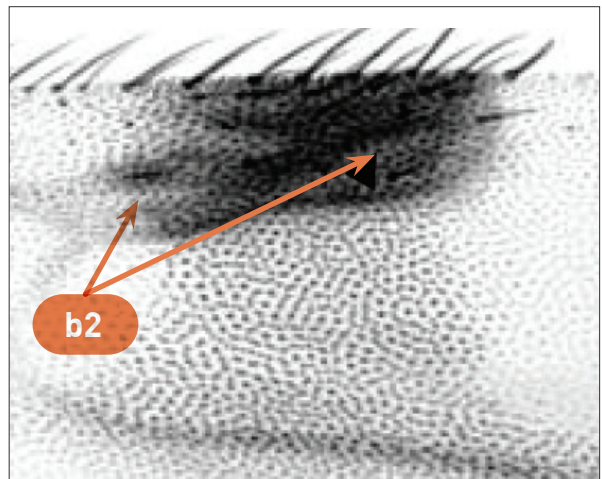
Paradasyhelea



Culicoides

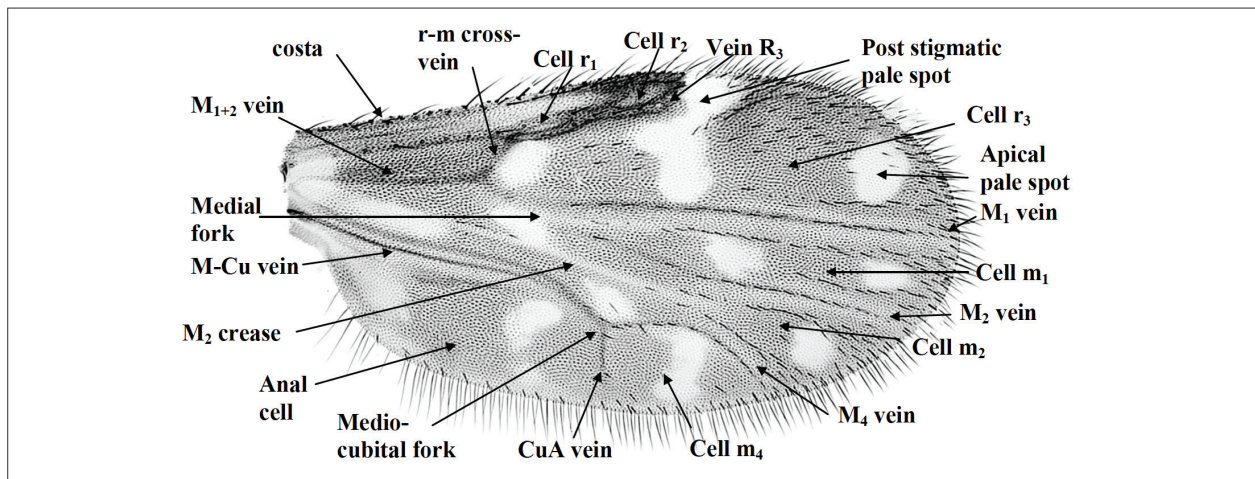


Paradasyhelea



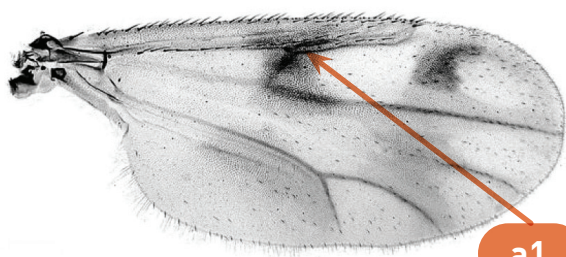
Culicoides

Key to subgeneric groups of *Culicoides* present in Australia for female specimens

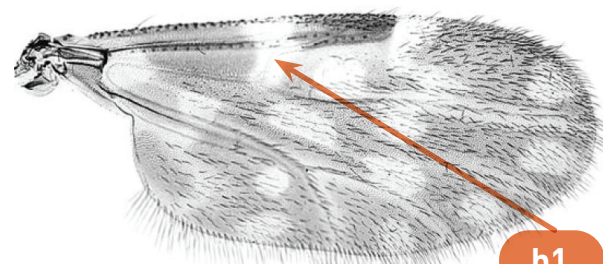


C. clavipalpis

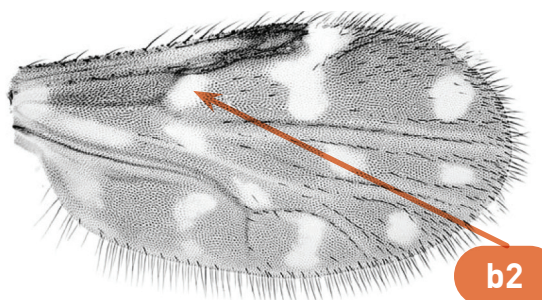
1	Wing with dark spot centred over and apicad of r-m cross-vein (a1) (coastal Qld, NT & nWA)	Coronalis Gp
	Wing with pale spot over (b1) or immediately apicad of (b2) r-m cross-vein or without distinct pale or dark spot over r-m cross-vein (b3)	2



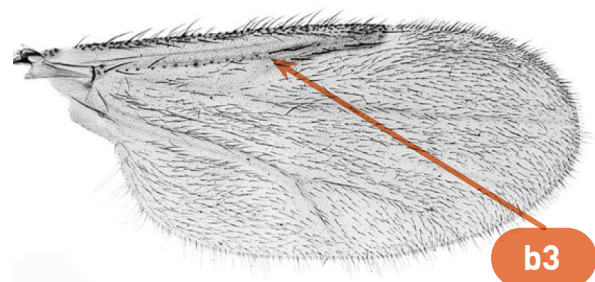
Coronalis Gp sp no 1



C. histrio



C. clavipalpis



C. immaculatus

2

Fourth tarsal segment cordate (heart shaped), about as long as wide and distinctly wider than adjacent segments (a) coastal

3

Fourth tarsal segment parallel-sided or weakly triangular, distinctly longer than wide and of similar width to adjacent segments (b)

5



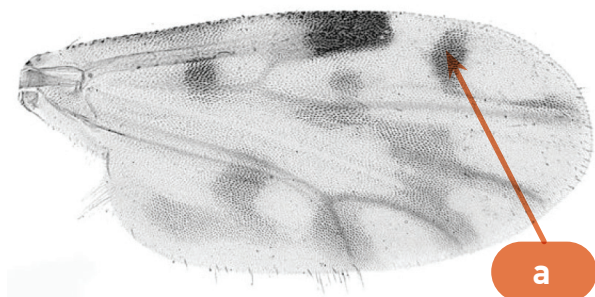
3

Prominent transverse or quadrate dark spot separating post stigmatic and apical pale spots in cell r_3 (a)

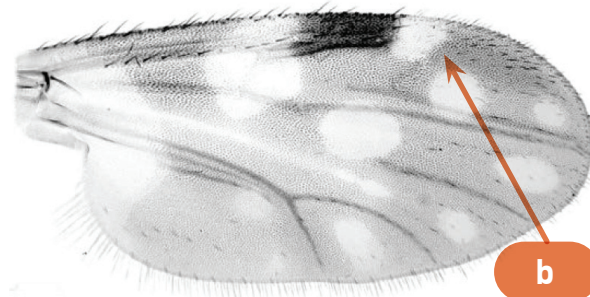
4

Dark spot separating post stigmatic and apical pale spots in cell r_3 oblique or absent (b)

Molestus Gp (pt)



Molestus Gp sp no 1

*C. molestus*

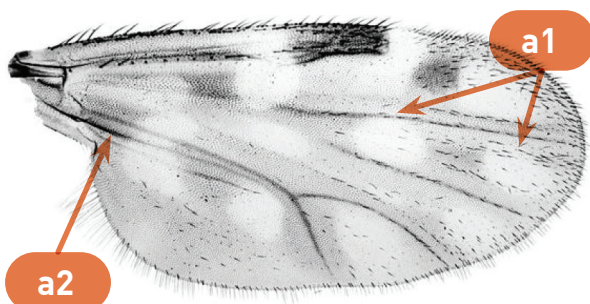
4

Cell m_1 with 2 discrete pale spots (a1); M-Cu vein with dark spot near base (a2) (coastal Qld, NT & nWA)

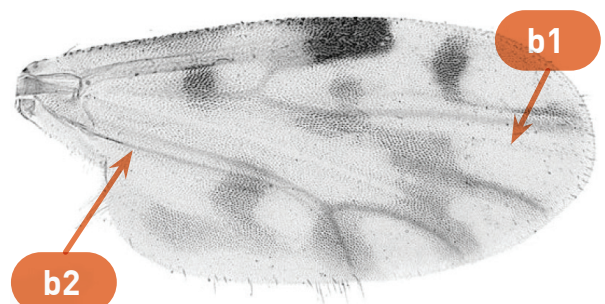
C. cordiger
Ornatus Group (pt)

Cell m_1 with a single large pale spot apically (b1); M-Cu vein without dark spot near base (b2) (coastal NT)

Molestus Gp sp no 1



C. cordiger dark form



Molestus Gp sp no 1

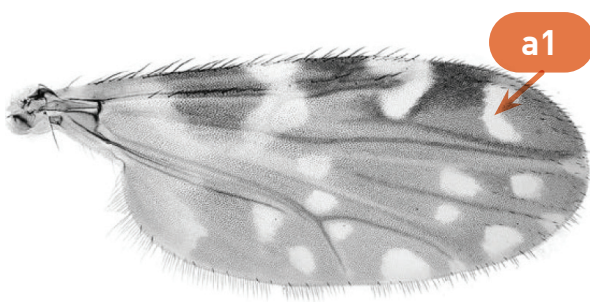
5

[2] Wing with at least one distinct pale spot in cell r_3 apical to post stigmatic spot (a1)

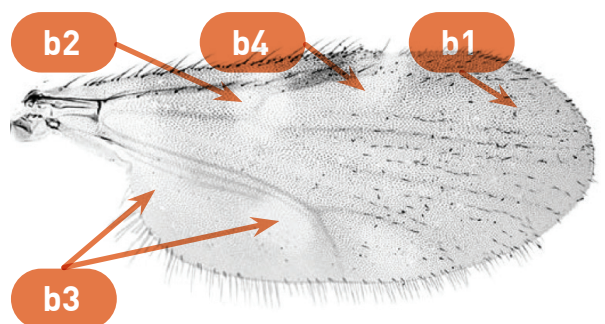
6

Wing pattern weak or absent, pale spots may be present over r-m cross-vein (b2), in posterior of wing (b3) or poststigmatic (b4) but not apical to poststigmatic spot in cell r_3 (b1)

67



C. peregrinus



Antennalis Gp sp no 11

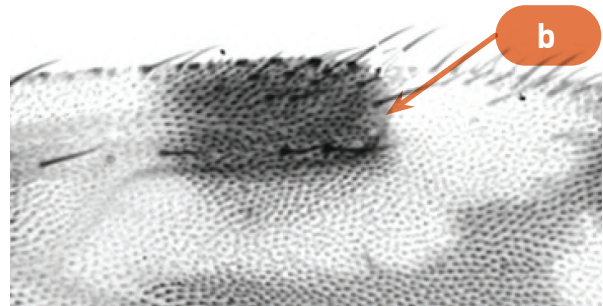
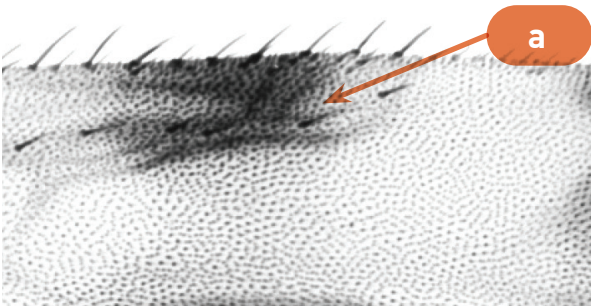
6

Lumen of cell r_2 included in poststigmatic pale spot (a)

7

Lumen of cell r_2 evenly coloured throughout; in some specimens part of the apical vein is included in a pale marking but the pale marking does not encroach into the lumen of the cell (b)

37



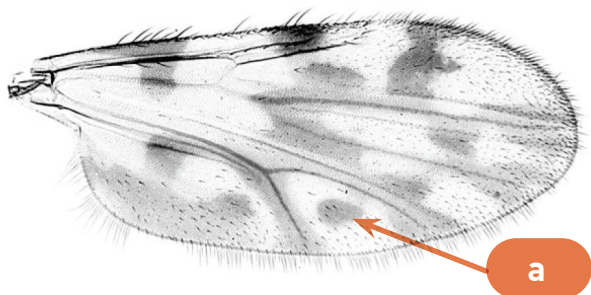
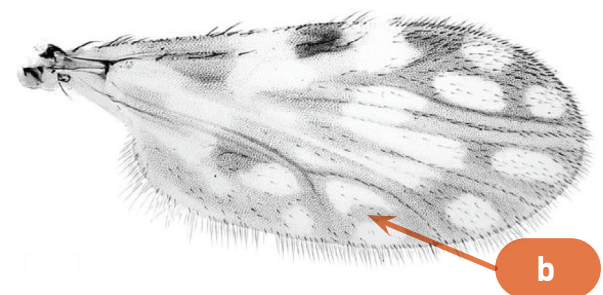
7

Cell m_4 with discrete dark spot entirely surrounded by pale areas (a)

(exotic) Pulicaris complex

Cell m_4 without discrete dark spot entirely surrounded by pale areas (b)

8

*C. punctatus**C. marksii*

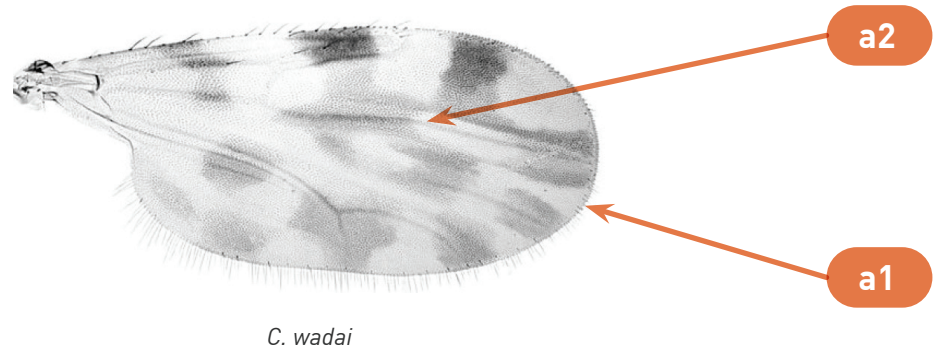
8

Apical pale marking in cell m_1 part of complex marking contiguous from margin of wing (a1) crossing vein M_1 and extending basad towards posterior margin of poststigmatic pale spot in cell r_3 (a2)

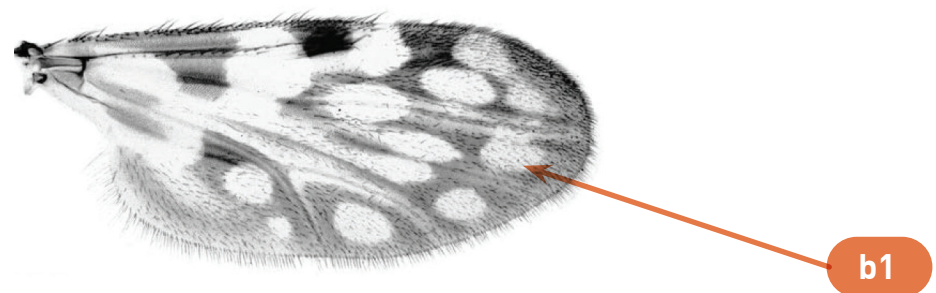
9

Apical pale marking in cell m_1 either not reaching margin of wing (b1) or, if reaching wing margin (b2), not extending basad along vein M_1 to level of poststigmatic pale spot (b3)

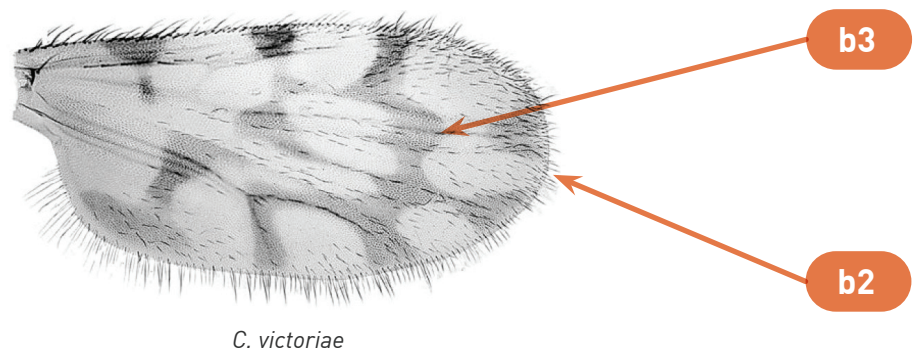
10



C. wadai



C. multimaculatus



C. victoriae

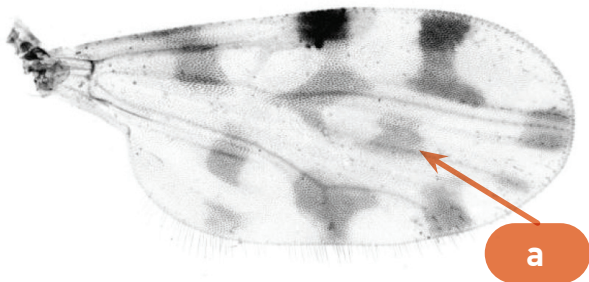
9

Dark marking present over medial part of vein M_2 (a)

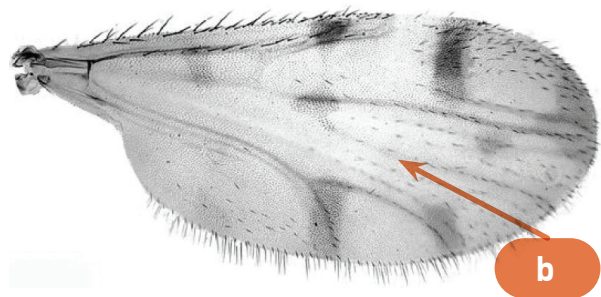
Subgenus *Avaritia* (pt)

No dark markings over medial part of vein M_2 (b)

Victoriae Gp sp no 5 (pt)



C. nudipalpis



Victoriae Gp sp no 5

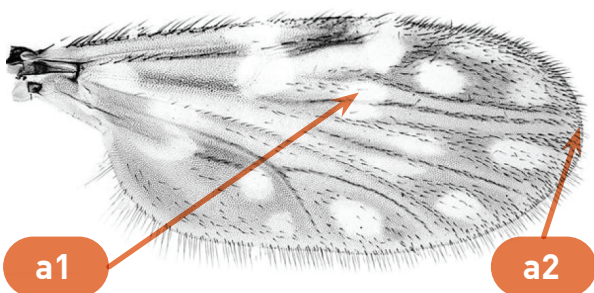
10

(8) Cell r_3 with discrete pale marking (a1) present immediately posterior to poststigmatic pale spot but not extending along vein M_1 to margin of wing (a2)

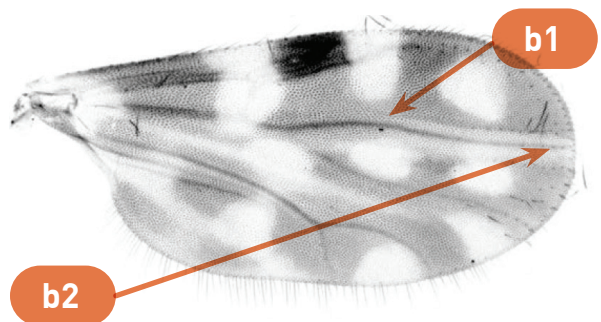
11

Cell r_3 without discrete pale marking present immediately posterior to poststigmatic pale spot (b1) or if present, then extending along vein M_1 to margin of wing (b2)

24



C. mcmillani



C. jacobsoni

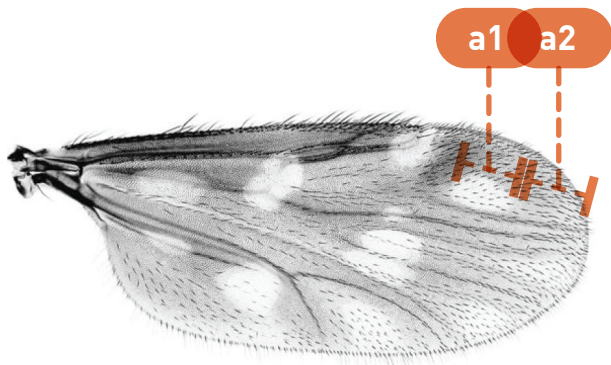
11

Apical pale spot in cell r_3 at least its own diameter (a1) from apex of wing (a2)

12

Apical pale spot in cell r_3 less than its own diameter (b1) from apex of wing (b2)

17



C. antennalis



Victoriae Gp sp no 12

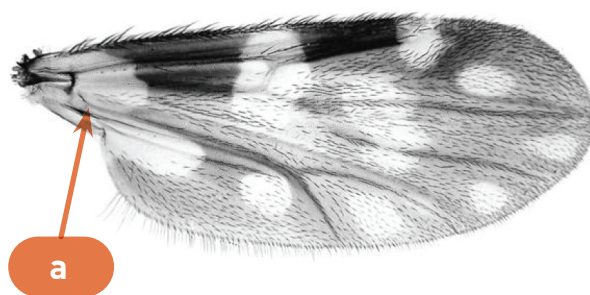
12

Base of vein M-Cu included in pale marking (a)

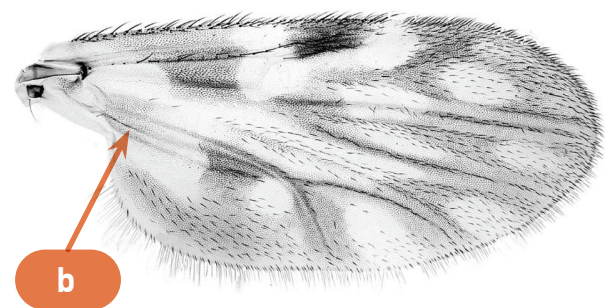
13

Base of vein M-Cu included in dark marking (b)

14



C. bancrofti



C. cuniculus

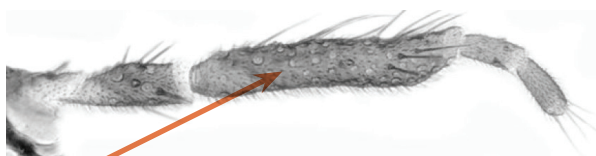
13

3rd palpal segment cylindrical, at least 4 times as long as wide and lacking a pit (a)

C. bancrofti

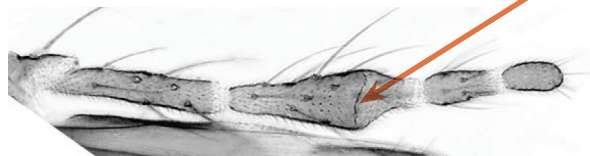
3rd palpal segment clavate, no more than 3 times as long as wide and with a definite sensory pit (b)

Antennalis Gp sp no 1



a

C. bancrofti



b

Antennalis Gp sp no 1

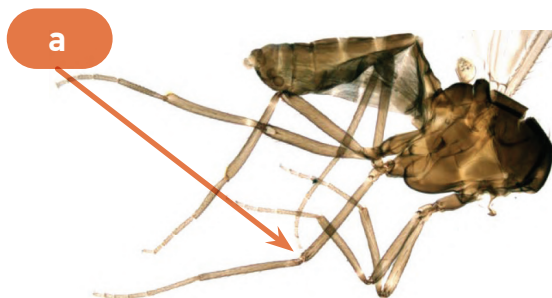
14

Mid leg unbanded (a)

C. antennalis (pt)

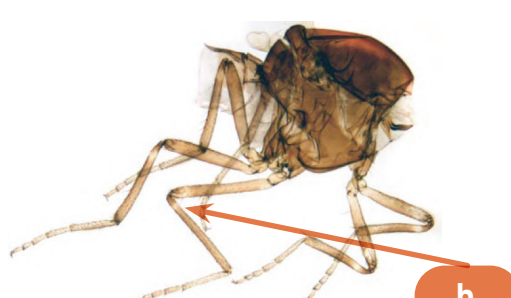
Mid leg with at least a definite subbasal pale band on tibia (b)

15



a

C. antennalis



b

C. cuniculus

15

Hind femora with distinct subapical pale band (a)

Marksomyia (pt)

Hind femora dark to apex (b)

16



C. kayi



C. dycei

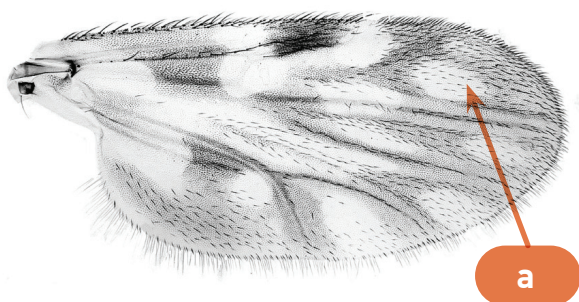
16

Apical pale spot in cell r_3 irregularly-shaped, often bilobed (a)

C. cuniculus

Apical pale spot in cell r_3 rounded (b)

C. dycei (pt)



C. cuniculus



C. dycei

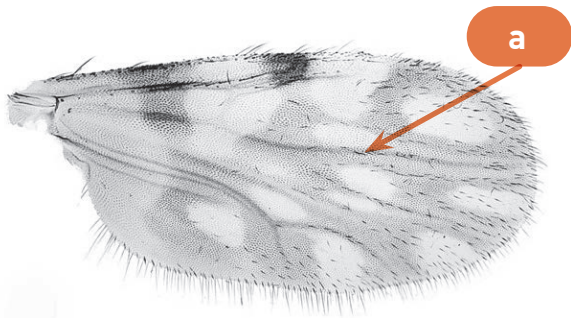
17

(11) Vein M_1 not included in a pale marking (a) NQld

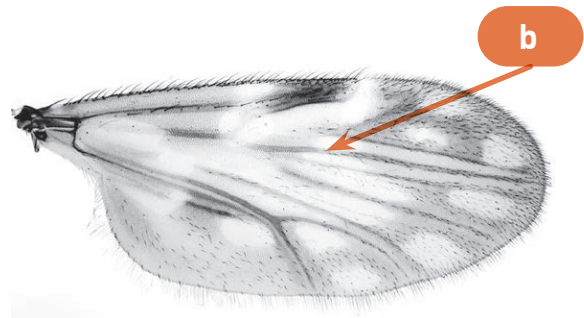
Victoriae Gp sp no 12

Subbasal part of vein M_1 included in pale marking (b)

18



C. Victoriae Gp sp no 12



C. Victoriae Gp sp no 14

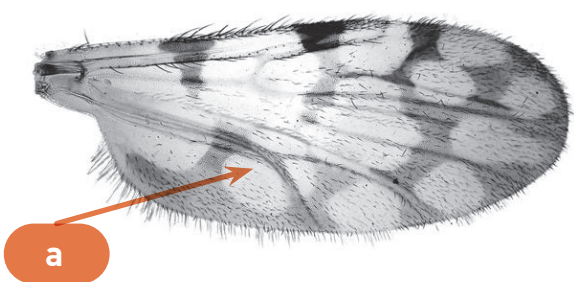
18

Medio-cubital fork included in large, rounded pale spot (a)

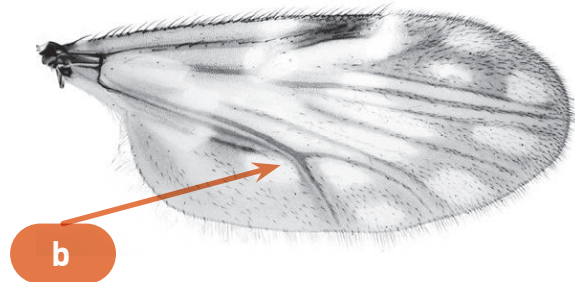
Victoriae Gp (pt)

Medio-cubital fork not included in pale spot (b)

19

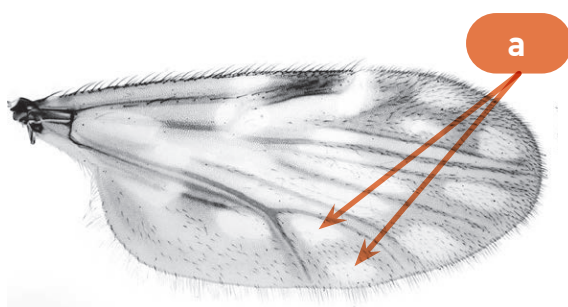


Victoriae Gp sp no 15

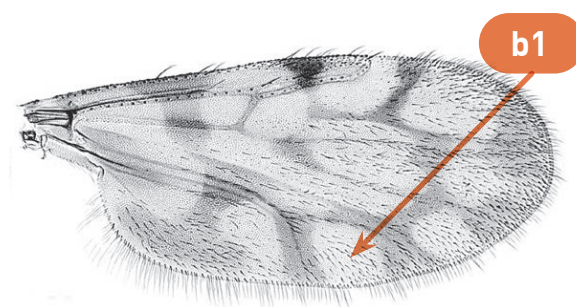


Victoriae Gp sp no 14

19	Cell m_4 with 2 pale spots (a)	20
	Cell m_4 with 1 pale spot (b)	21

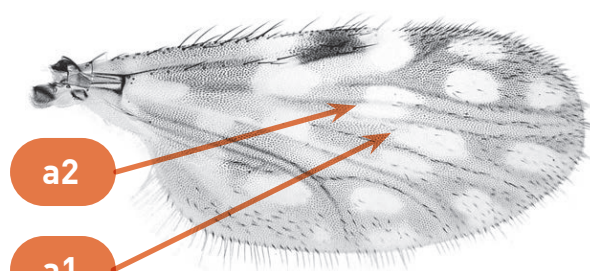


Victoriae Gp sp no 14

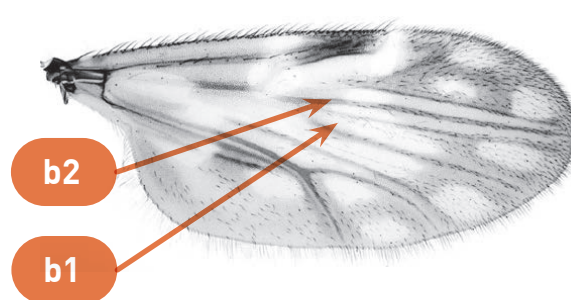


C. victoriae

20	Base of basal pale spot in cell m_1 (a1) distal to base of pale spot over vein M_1 (a2).	<i>Marksomyia</i> (pt)
	Base of basal pale spot in cell m_1 (b1) level with base of pale spot over vein M_1 (b2)	21



C. zentae



Victoriae Gp sp no 14

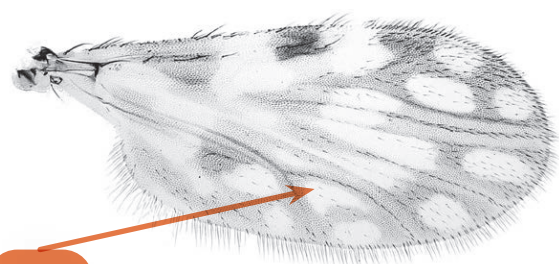
21

Basal pale spot in cell m_4 boomerang-shaped (a1); hind femora with basal and subapical pale bands (a2)

Marksomyia (pt)

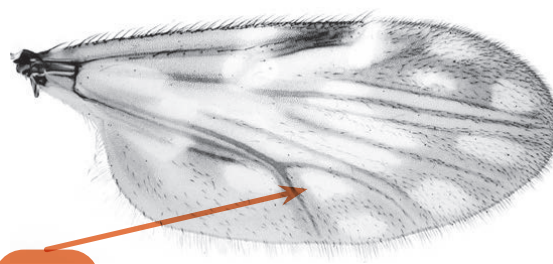
Basal pale spot in cell m_4 ovoid or triangular (b1); hind femora without basal and subapical pale bands (b2)

Victoriae Gp sp no 14 (pt)



a1

C. marksii



b1

C. Victoriae Gp sp no 14



a2

C. marksii



b2

Victoriae Gp sp no 14

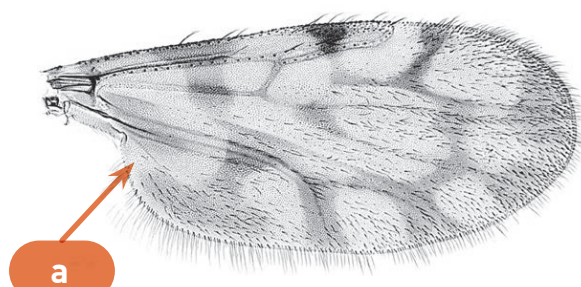
22

(19) Basal pale spot in anal cell reaching wing margin (a)

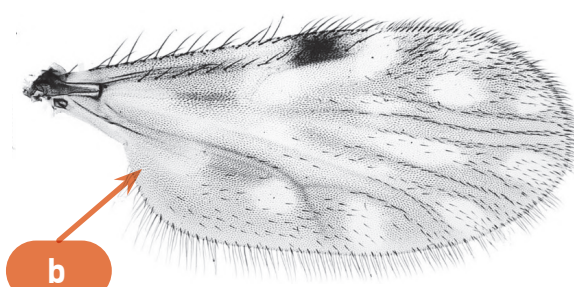
Victoriae Gp (pt)

Basal pale spot in anal cell not reaching wing margin (b)

23



C. victoriae



C. dycei

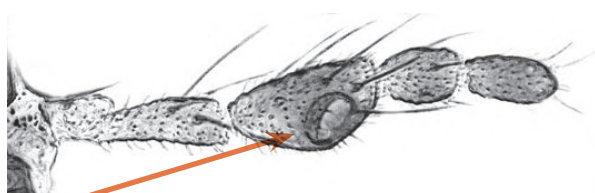
23

3rd palpal segment short, little longer than wide (a1); Basal pale marking in cell m_1 elongate, basal edge (a2) level with basal edge of pale marking over vein M_1 (a3); anal cell with single apical pale spot (a4)

C. dycei (pt)

3rd palpal segment longer, at least twice as long as wide (b1); Basal pale marking in cell m_1 ovoid, basal edge (b3) distal to basal edge of pale marking over vein M_1 (b4); anal cell with two apical pale spots (b4)

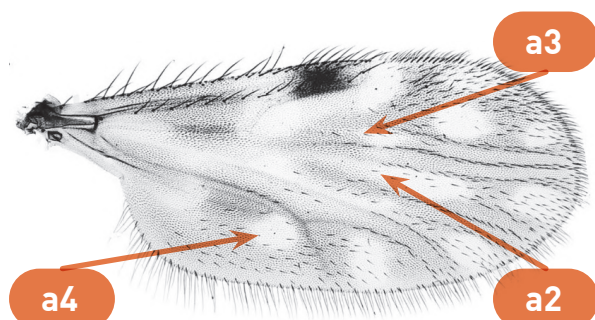
C. mcmillani



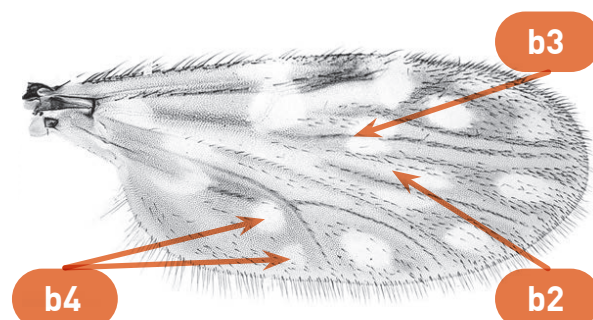
a1



b1



C. dycei



C. mcmillani

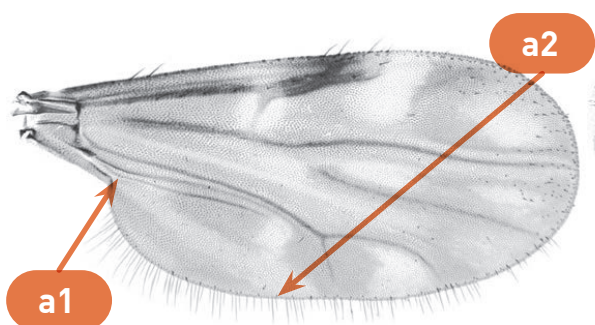
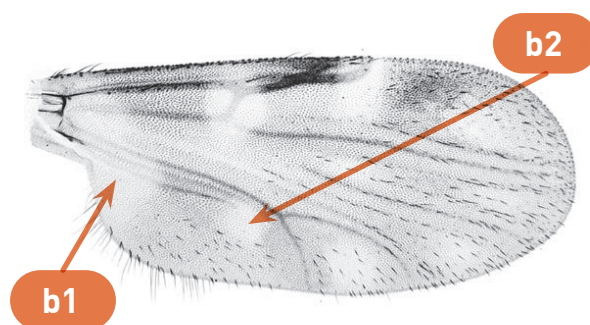
24

(10) Anal cell with elongate pale stripe extending from base of cell (a1) to wing margin close to apex of vein CuA (a2)

Avaritia (pt)

Anal cell with basal (b1) and apical (b2) pale spots not joined by pale stripe

25

*C. obscurus*

Victoriae Gp sp no 2

25

Apical pale spot in cell r_3 at least its own width (a1) from apex of wing (a2)

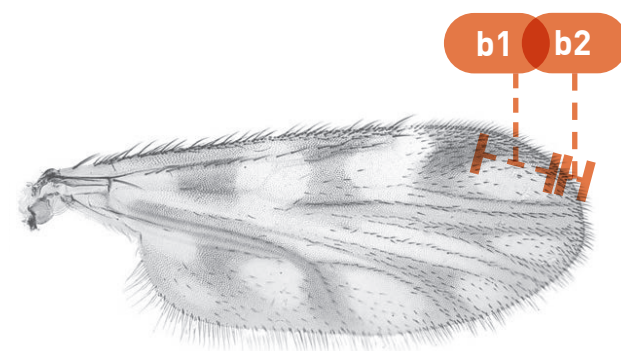
26

Apical pale spot in cell r_3 less than its own width (b1) from apex of wing (b2)

30



Antennalis sp no 2

*C. hornsbyensis*

26

Wing with 1 radial cell

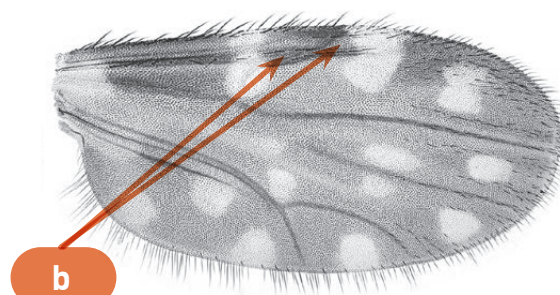
(subgenus *Haemophoructus*) *calcaratus*

Wing with 2 radial cells

27



C. calcaratus



C. sumatrae

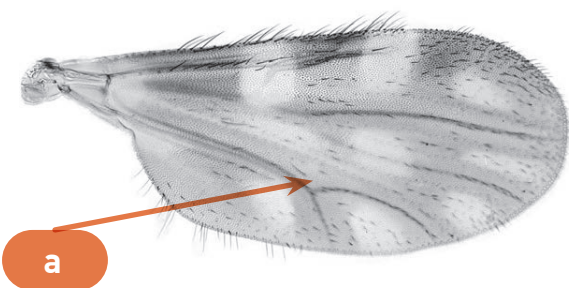
27

Compact pale spot between front of M-Cu fork and m_2 crease absent (a)

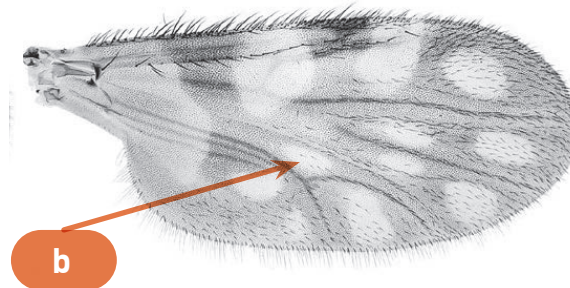
28

Compact pale spot between front of M-Cu fork and m_2 crease present (b)

29



Antennalis Gp sp no 2



C. henryi

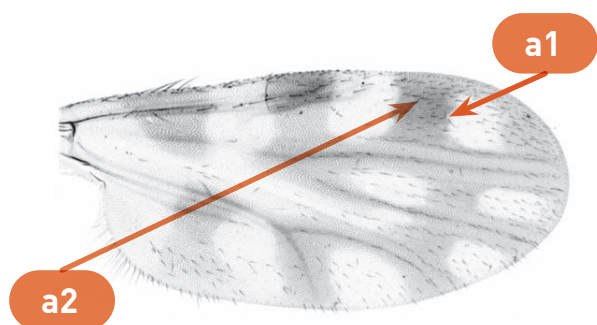
28

Apical pale marking in cell r_3 truncate basally (a1) creating quadrate dark marking adjacent to poststigmatic pale spot (a2)

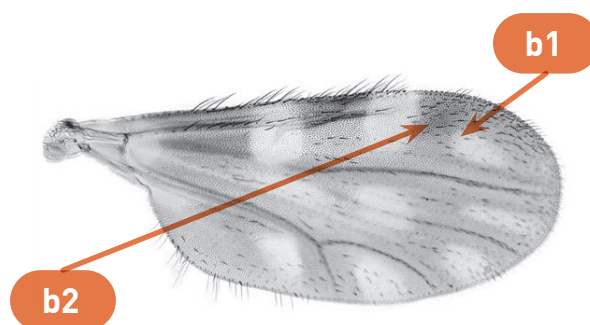
Victoriae Gp (pt)

Apical pale marking in cell r_3 rounded basally (b1) dark marking apicad of poststigmatic pale spot not quadrate (b2)

Antennalis Gp (pt)



C. bundyensis



Antennalis Gp sp no 2

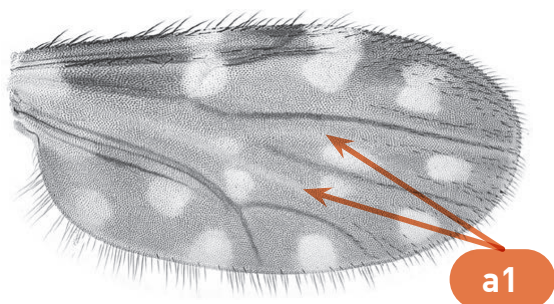
29

Basal pale markings in cells m_1 and m_2 with faint linear extensions towards base of wing (a1); hind tibia with distinct apical pale band (a2)

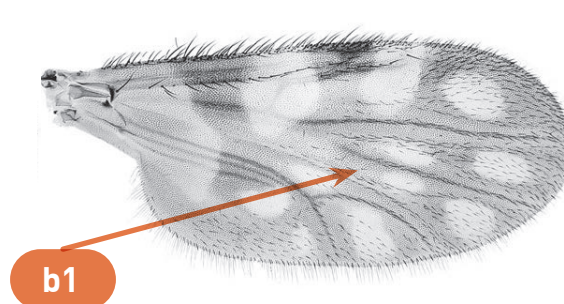
subgenus Hoffmania

Basal pale markings in cells m_1 and m_2 ovoid, without linear extensions towards base of wing (b1); hind tibia dark to apex (b2)

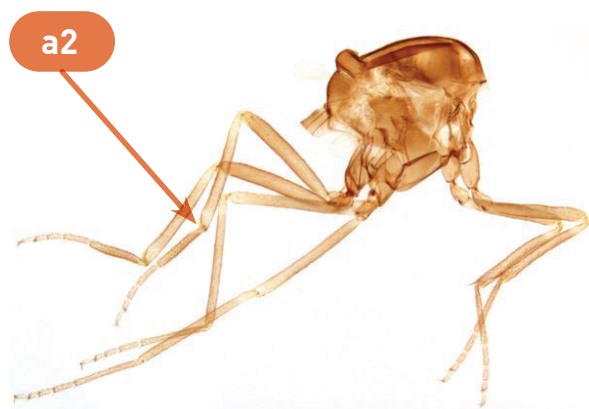
Victoriae Gp (pt) - henryi



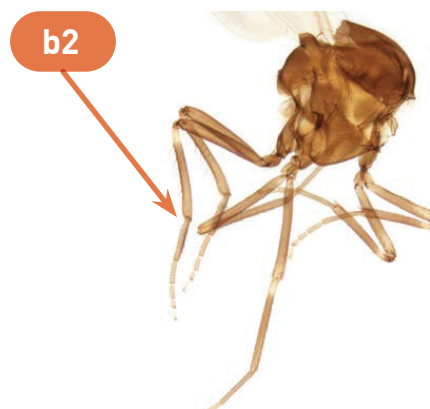
C. sumatrae



C. henryi



C. novaguineanus



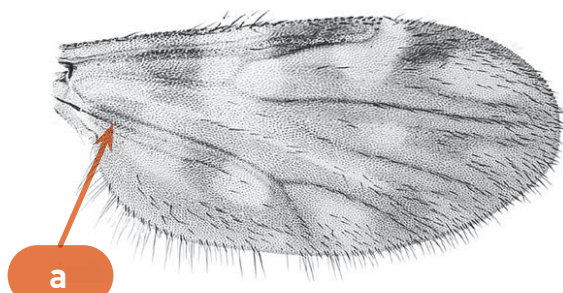
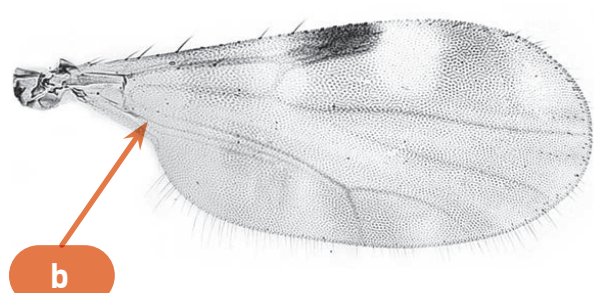
C. henryi

30

[25] Base of vein M-Cu included in dark marking

31

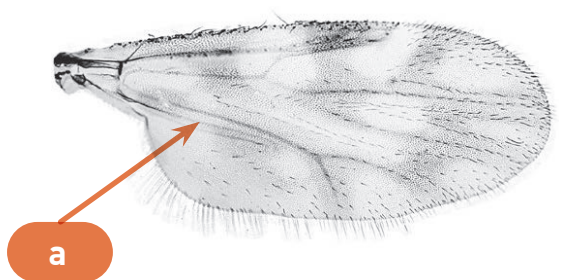
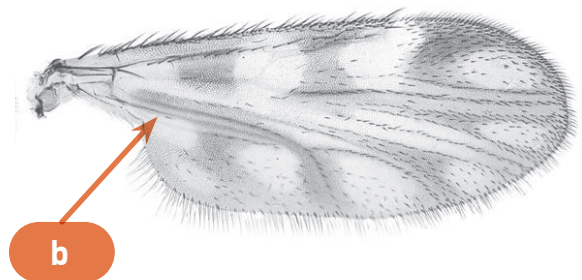
Base of vein M-Cu included in pale marking

33*C. papuensis**C. minimus***31**

Medial part of vein M-Cu included in pale marking (a)

Ornatus Gp (pt)

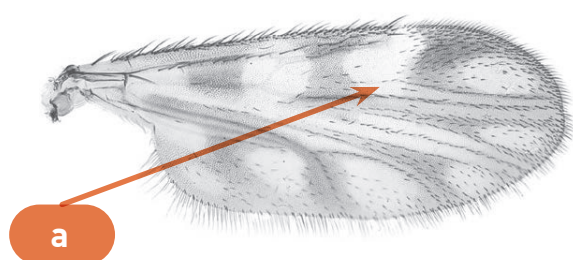
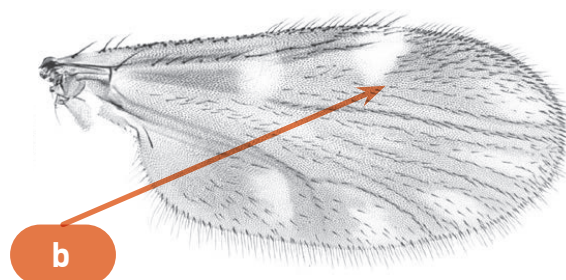
No part of vein M-Cu included in pale marking (b)

32*C. peliliouensis**C. hornsbyensis*

32

Poststigmatic pale spot reaching vein M_1 (a)*C. hornsbyensis*Poststigmatic pale spot not reaching vein M_1 (b)

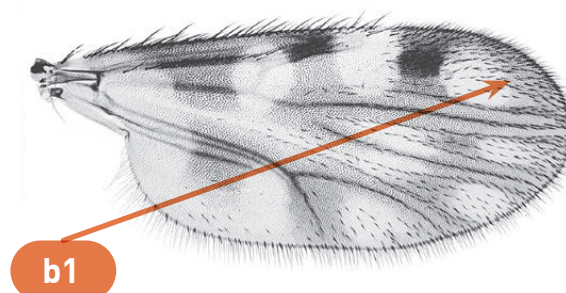
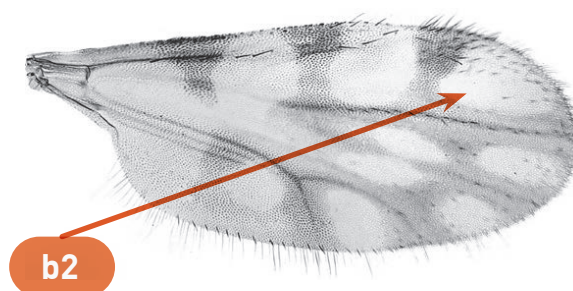
Antennalis Gp (pt)

*C. hornsbyensis**C. gladysae*

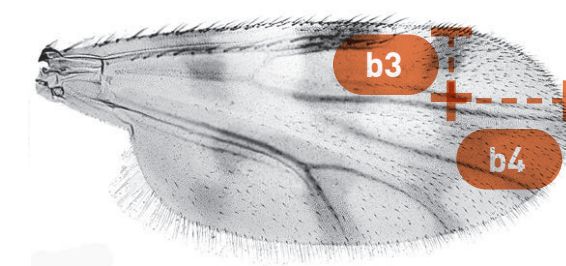
33

(29) Apical pale marking in cell r_3 quadrant-shaped; broadly reaching margin of wing and with perpendicular basal (a1) and posterior edges (a2) of about equal length*Avaritia* – Actoni Gp (pt)Apical pale marking in cell r_3 either not reaching margin of wing (b1), elongate (b2) or with rounded or unequal basal (b3) or posterior edges (b4)

34

*C. minimus**C. bundyensis*

Victoriae Gp sp no 6

*C. pangkorensis*

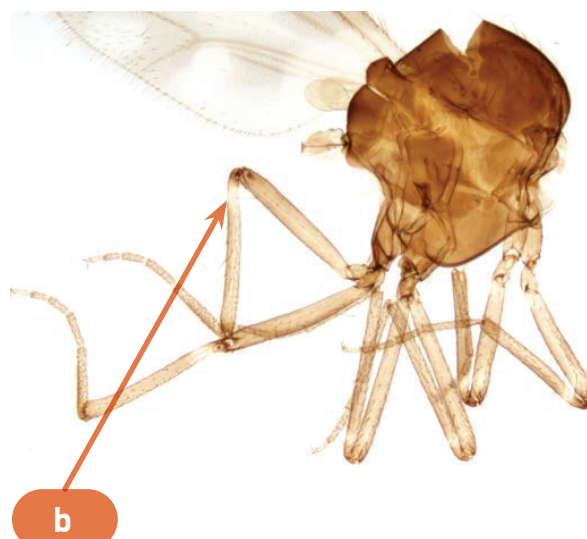
34

Hind tibia dark to base (a)

Ornatus Gp (pt)

Hind tibia with subbasal pale band (b)

35

*C. pangkorensis**C. bundyensis*

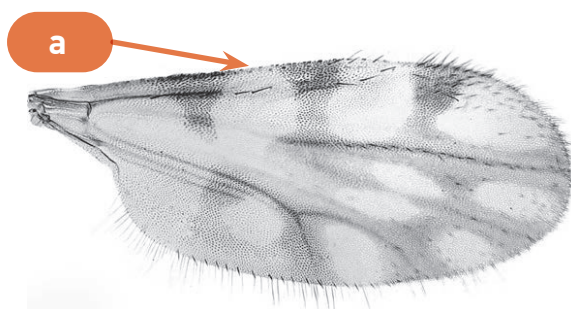
35

Pale spot over r-m cross-vein broadly reaching wing margin (a)

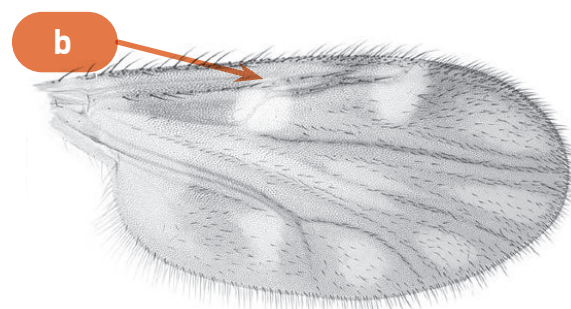
Victoriae Gp

Pale spot over r-m cross-vein not reaching wing margin (b)

36



Victoriae Gp sp no 6



Antennalis Gp sp no 3

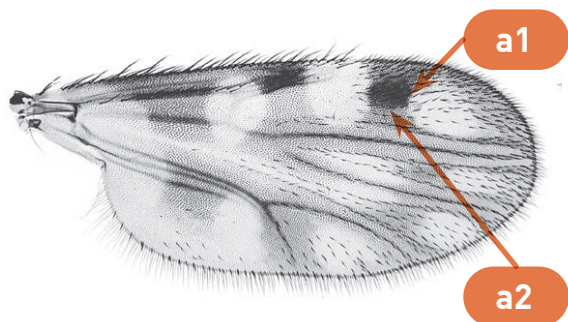
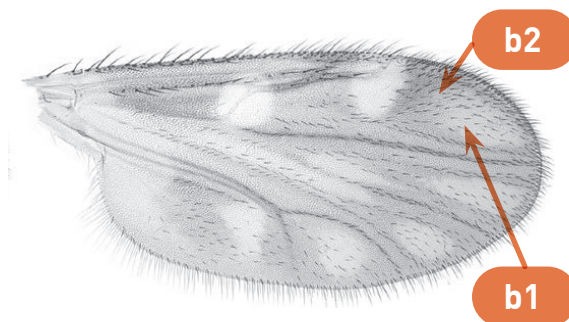
36

Apical pale marking in cell r_3 truncate basally (a1) so that subapical dark marking (a2) is quadrate

C. bundyensis (pt)

Apical pale marking in cell r_3 ovoid (b1), subapical dark marking with indistinct apical edge (b2)

Antennalis Gp sp no 3

*C. bundyensis*

Antennalis Gp sp no 3

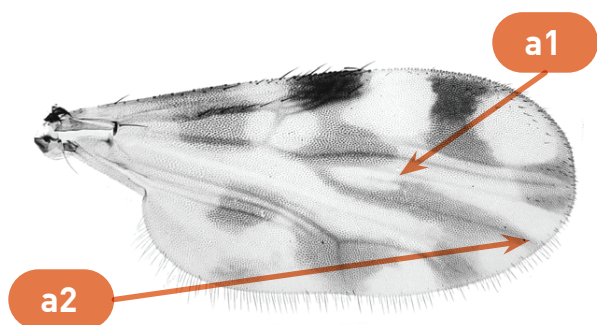
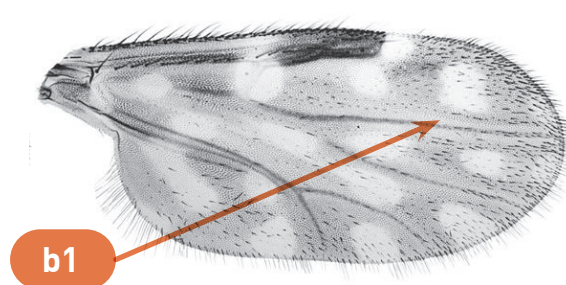
37

(6) Posterior edge of pale marking over vein M_1 more or less straight from apical margin of basal pale spot in cell m_1 (a1) to wing margin near apex of vein M_2 (a2)

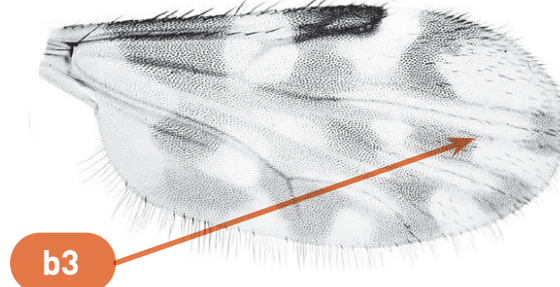
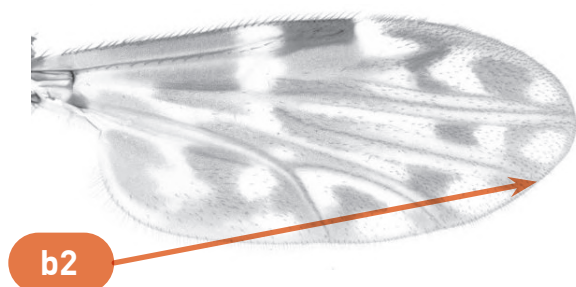
C. brevitaris (pt)

Pale marking over vein M_1 either absent (b1), does not reach wing margin near apex of vein M_2 (b2) or with 90° bend where it joins with apical pale spot in cell m_1 (b3)

38

*C. sonorensis*

Williwilli Gp sp no 7



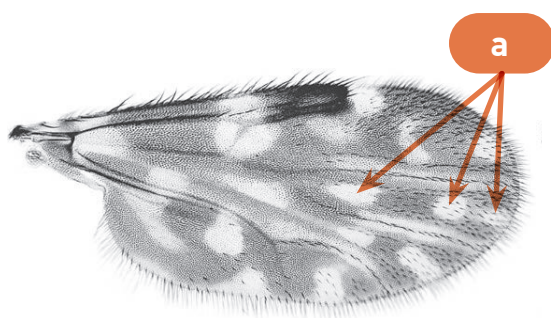
38

Cell m_1 with 3 or more pale spots (a)

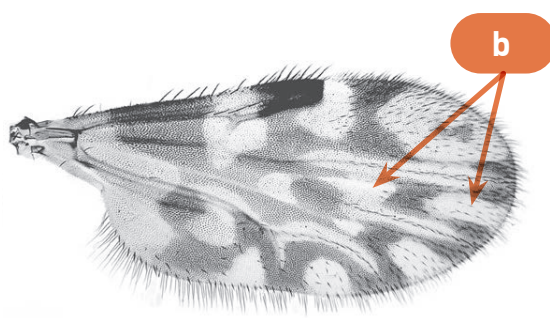
39

Cell m_1 with 2 or fewer pale spots (b)

43



C. narrabeenensis



C. williwilli

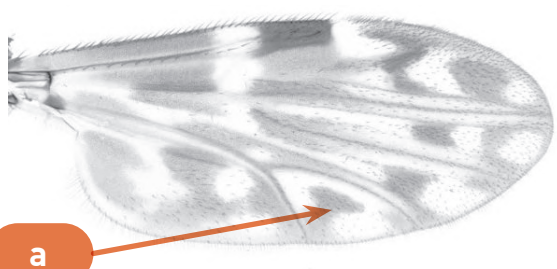
39

Cell m_4 with C-shaped pale spot (a)

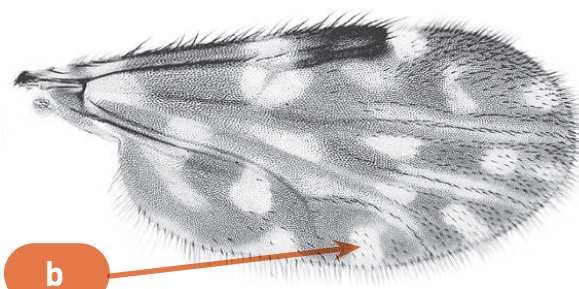
40

Cell m_4 with simple, rounded pale spot (b)

41



C. sonorensis



C. narrabeenensis

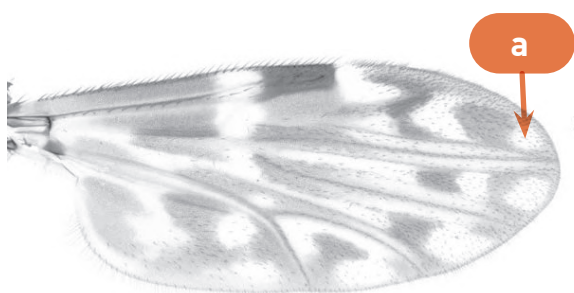
40

Apical pale spot in cell r_3 compact and located in apex of cell (a)

sonorensis (exotic)

Apical pale spot in cell r_3 large and distant from apex of cell by about its own diameter (b)

rabauli



C. sonorensis



C. rabauli

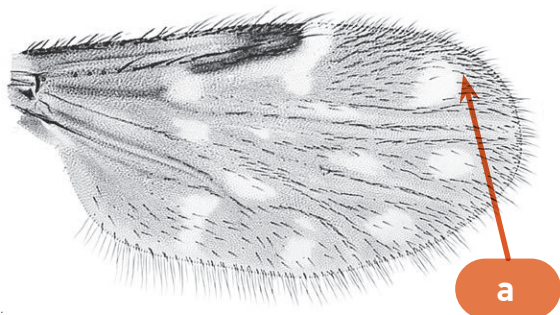
41

Apical pale spot in cell r_3 distant from apex of wing by at least its own diameter (a)

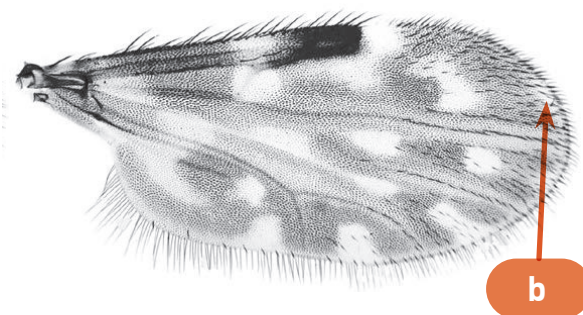
Clavipalpis sp no 9

Apical pale spot in cell r_3 closer than its own diameter from apex of wing (b)

42



Clavipalpis Gp sp no 9



Williwilli Gp sp no 18

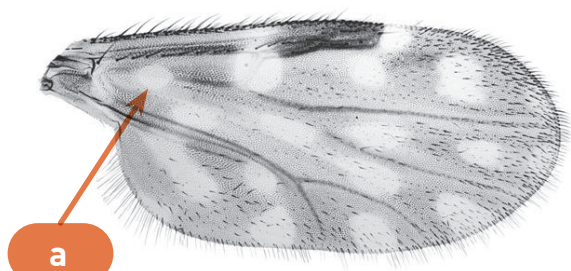
42

Vein M_{1+2} with base included in dark marking and with a round subbasal pale spot (a)

C. circumbasalis (pt)

Vein M_{1+2} with base included in a pale marking (b)

Williwilli Gp (pt)



C. circumbasalis



Williwilli Gp sp no 18

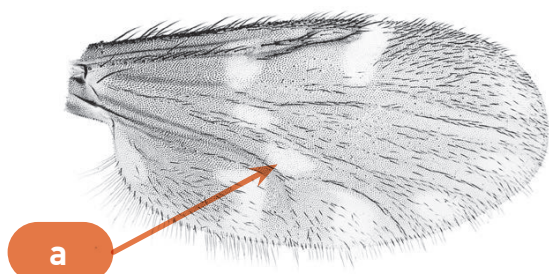
43

[38] Compact pale spot between front of M-Cu fork and M_2 crease present (a)

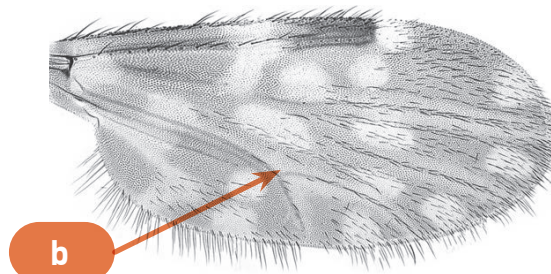
44

Compact pale spot between front of M-Cu fork and M_2 crease absent (b)

46



Clavipalpis Gp sp no 14



C. guttifer

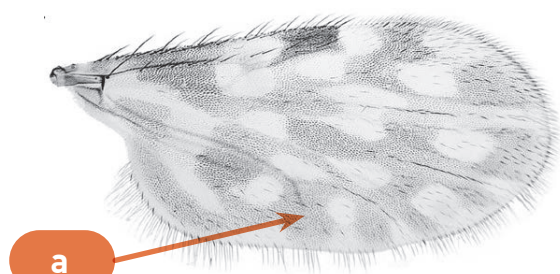
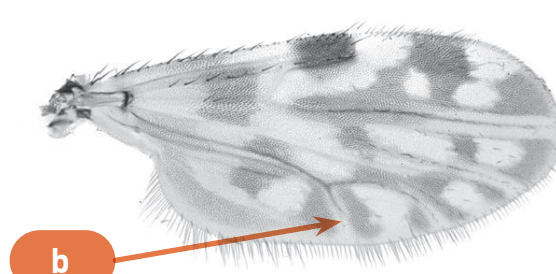
44

CuA vein not included in pale marking (a)

Clavipalpis Gp (pt)

CuA vein at least partially included in pale marking (b)

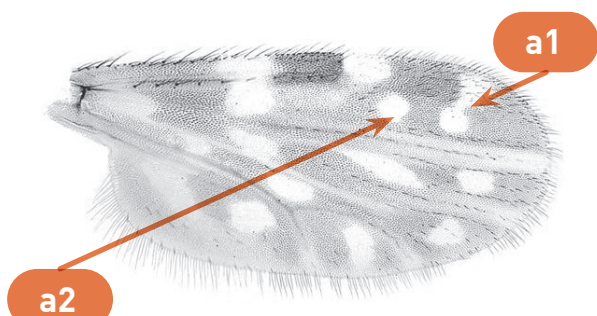
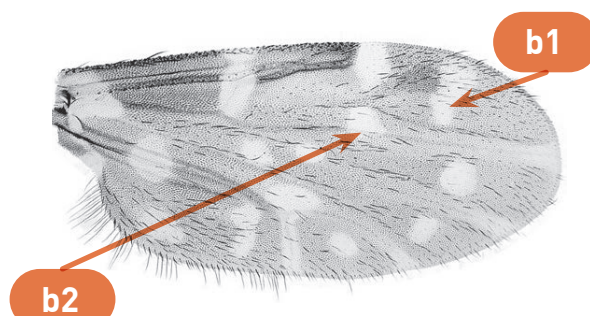
45

*C. bunrooensis**C. oxystoma*

45

Apical pale spot in cell r_3 bilobed (a1); pale spot posterior to poststigmatic pale spot not touching vein M_1 (a2)(Subgenus *Remmia*)
oxystoma (pt)Apical pale spot in cell r_3 transverse or ovoid (b1); pale spot posterior to poststigmatic pale spot touching or crossing vein M_1 (b2)

Shermani Gp (pt)

*C. oxystoma**C. interrogatus*

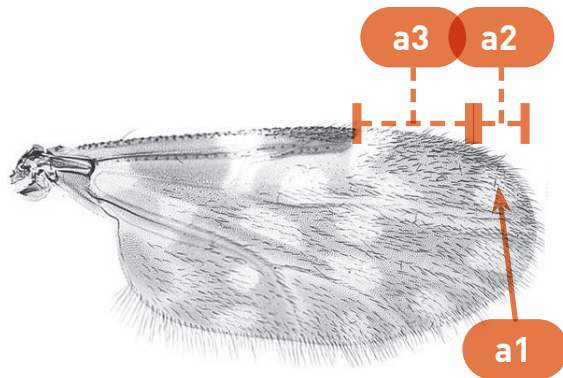
46

(43) Apical pale spot in cell r_3 compact, round and centred near apex of cell (a1); at least twice its own length (a2) from cell r_2 (a3)

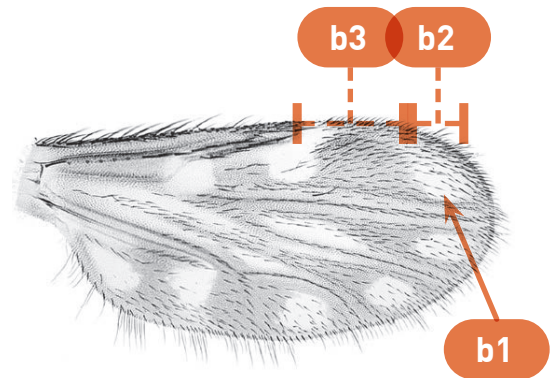
47

Apical pale spot in cell r_3 elongate or irregularly shaped and/or not centred near apex of cell (b1); at most 1.5 times its own length (b2) from cell r_2 (b3)

48



C. histrio



C. leanderensis

47

Cell r_3 with 2 or 3 distinct pale markings in addition to poststigmatic (a)

subgenus *Meijerehelea*

Cell r_3 with 1 distinct pale marking in addition to poststigmatic (b)

C. shermani



C. arakawae



C. shermani

48

(46) Apex of vein M_2 included in pale marking (a)

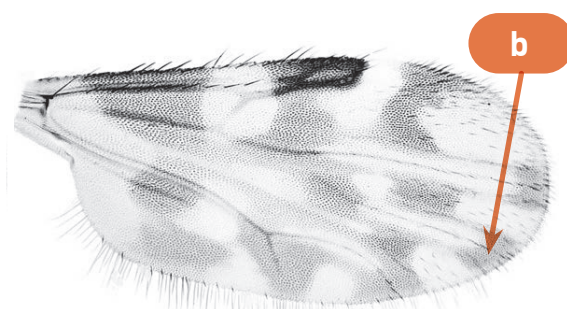
49

Apex of vein M_2 not included in pale marking (b)

51



C. oxystoma



Williwilli Gp sp no 7

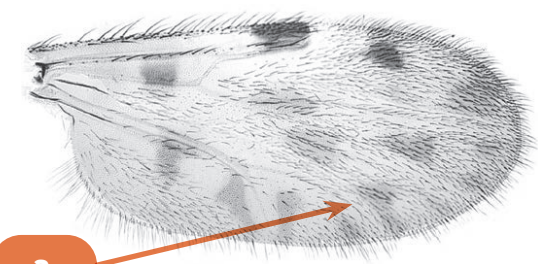
49

At least apical 2/3 of vein M_4 included in pale marking (a)

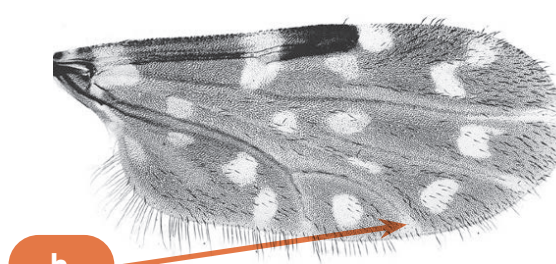
C. loughnani

At most, only very tip of vein M_4 included in pale marking (b)

50



C. loughnani



C. sigmoidus

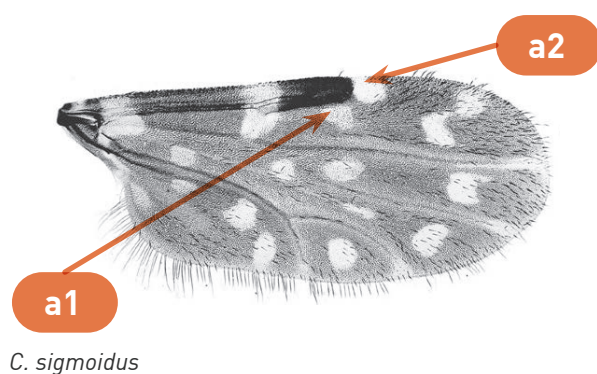
50

Medial pale marking in cell r_3 (a1) basal to poststigmatic pale spot (a2)

C. sigmoidus

Medial pale marking in cell r_3 (b1) distal to poststigmatic pale spot (b2)

C. oxystoma (pt)



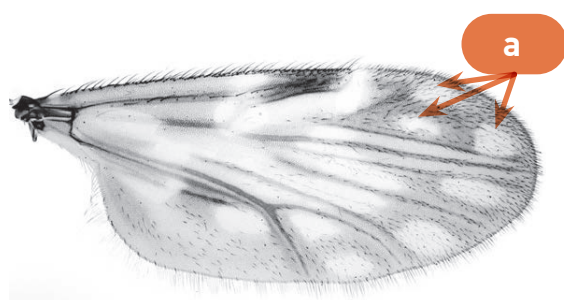
51

[48] Cell r_3 with 3 pale markings distal to poststigmatic pale spot (a)

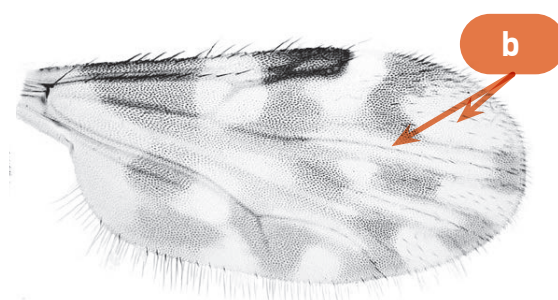
Victoriae Gp sp no 14 (pt)

Cell r_3 with less than 3 pale markings distal to poststigmatic pale spot (b)

52



Victoriae Gp sp no 14



Williwilli Gp sp no 7

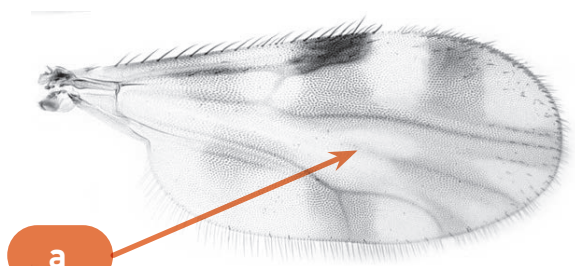
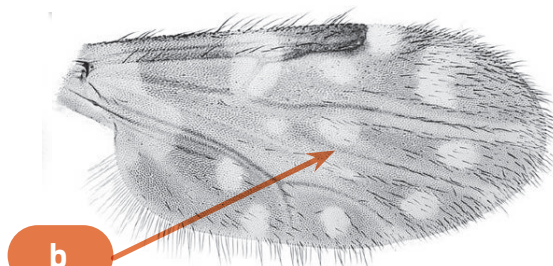
52

Vein M_2 partially included in pale marking (a)

53

Vein M_2 not included in pale marking (b)

57

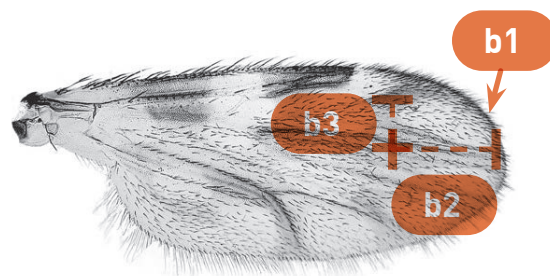
*C. actoni*

Clavipalpis Gp sp no 2

53

Apical pale marking in cell r_3 quadrant-shaped i.e. broadly reaching margin of wing and with perpendicular basal (a1) and posterior edges (a2) of about equal lengthsubgenus *Avaritia* –
Actoni Gp (pt)Apical pale marking in cell r_3 either not or only narrowly reaching margin of wing (b1) or with rounded, unequal basal (b3) or posterior edges (b2)

54

*C. minimus**C. mackerassi*

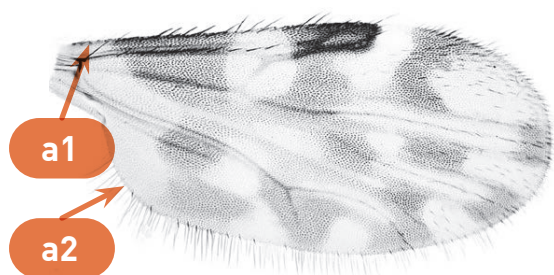
54

Pale marking at base of wing continuous from costa (a1) to wing margin in anal cell (a2)

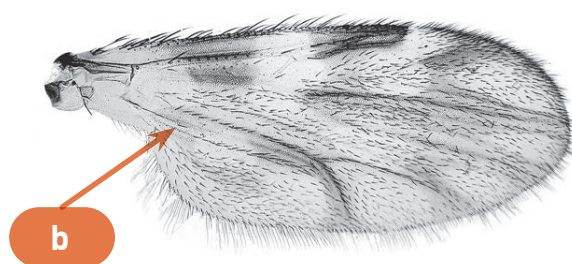
Williwilli Gp (pt)

Pale marking at base of wing interrupted by dark marking over base of M-Cu vein (b)

55



Williwilli Gp sp no 7



C. mackerassi

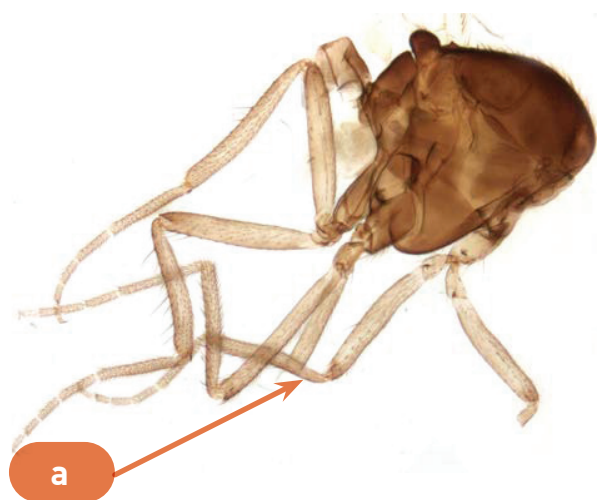
55

Fore tibia without subbasal pale band (a)

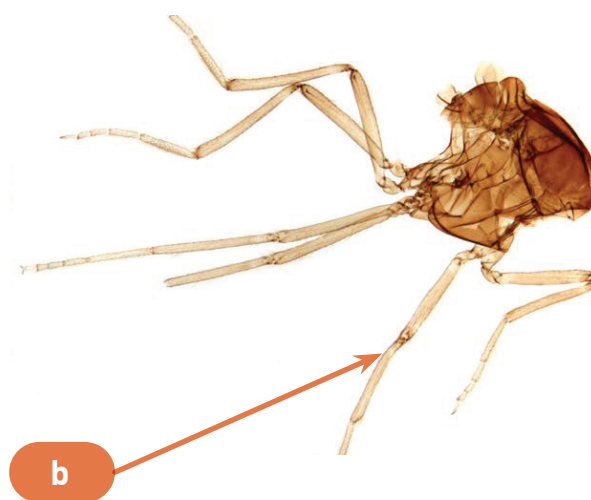
C. mackerassi

Fore tibia with subbasal pale band (b)

56



C. mackerassi



C. pseudopalpalis

56

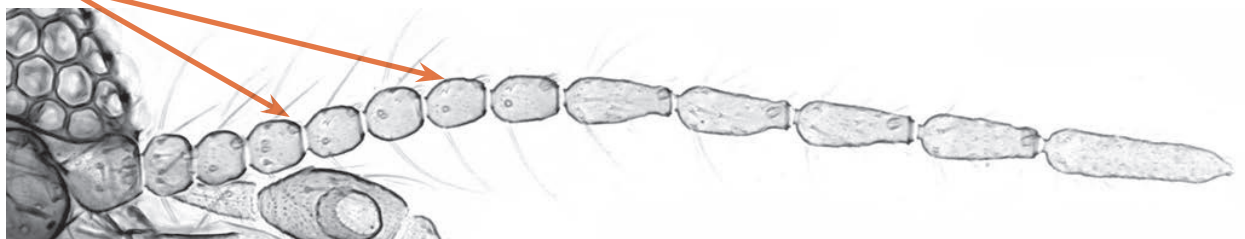
Antennal flagellar segments 4-7 barrel-shaped, little longer than wide (a)

Williwilli Gp (pt)

Antennal flagellar segments 4-7 distinctly longer than wide (b)

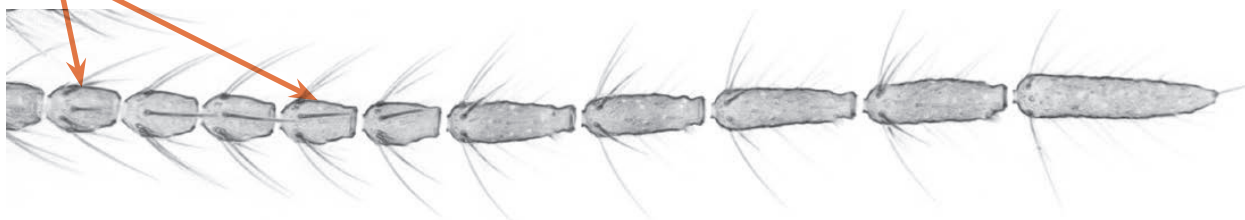
Ornatus Gp (pt)

a



C. austropalpalis

b



C. ornatus

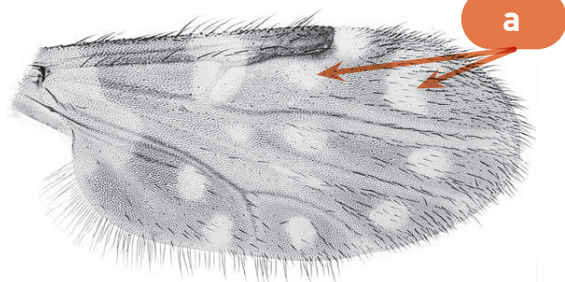
57

[52] Cell r_3 with 2 pale spots in addition to poststigmatic pale spot (a)

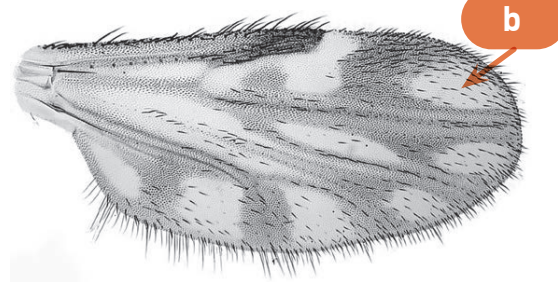
Clavipalpis Gp sp no 2

Cell r_3 with 1 pale spot in addition to poststigmatic pale spot (b)

58



Clavipalpis Gp sp no 2



Shermani Gp sp no 1

58

Cell m_1 with less than 2 pale spots (a)

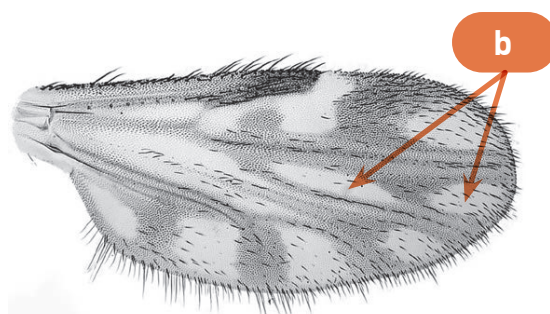
59

Cell m_1 with 2 pale spots (b)

62



Shermani Gp sp no 2



Shermani Gp sp no 1

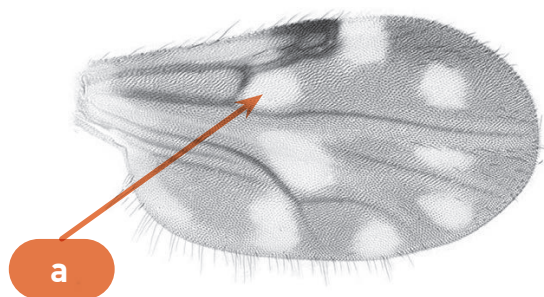
59

Pale marking over r-m cross-vein centred distal to the vein (a)

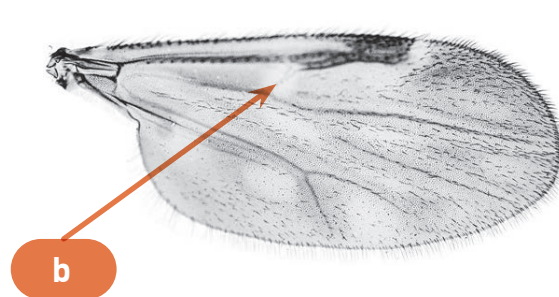
Clavipalpis Gp sp
no 19 (pt)

Pale marking over r-m cross-vein centred over the vein (b)

60



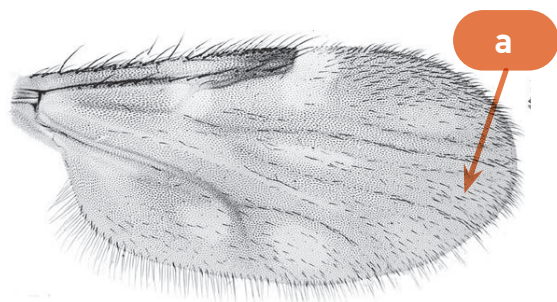
Clavipalpis Gp sp no 19

*C. flumineus*

60

Cell m_1 without apical pale spot (a)Williwilli Gp
(*austropalpalis* pt)Cell m_1 with apical pale spot (b)

61

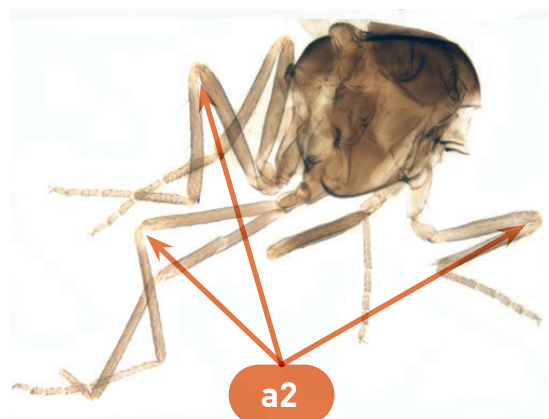
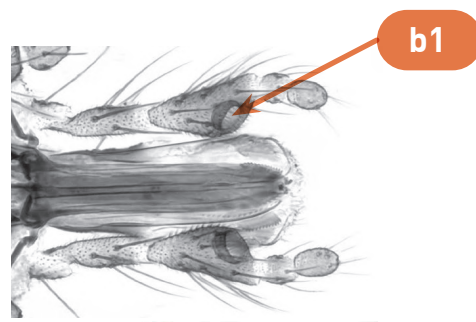
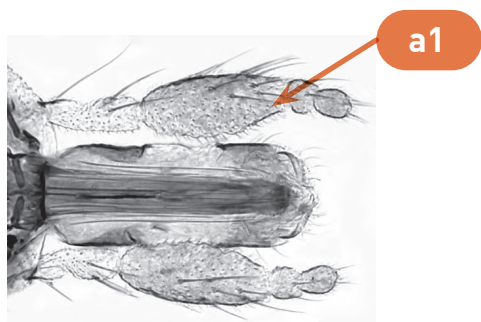
*C. austropalpalis**C. flumineus*

61

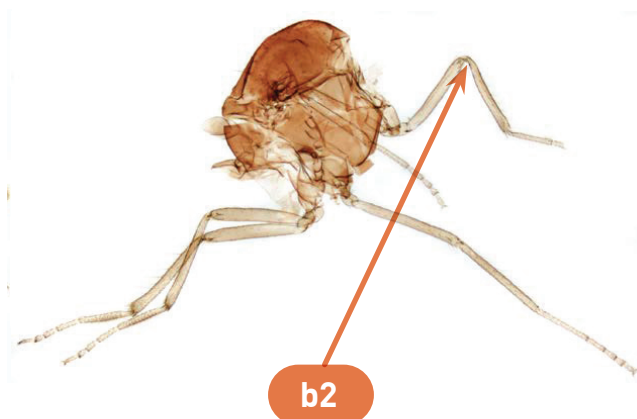
3rd palpal segment without a pit (a1); all tibiae with a strong subbasal pale band (a2)

Shermani Gp sp no 2

3rd palpal segment with a circular sensory pit (b1); all tibiae unbanded (b2)

C. flumineus (pt)

Shermani Gp sp no 2

*C. flumineus*

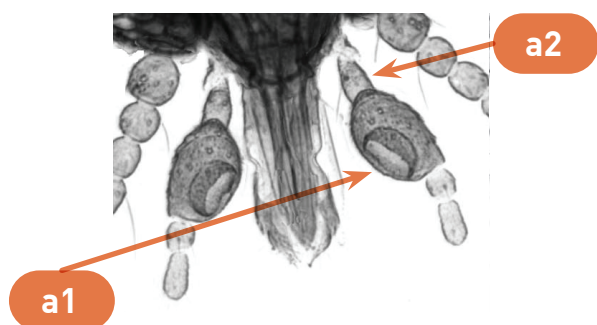
62

[58] 3rd palpal segment egg shaped , evenly curved on both sides (a1), more than twice length of 2nd segment (a2)

63

3rd palpal segment triangular, almost straight on outer edge and abruptly narrowing apicad of pit (b1); less than twice length of 2nd segment (b2)

64



C. austropalpalis



C. flumineus

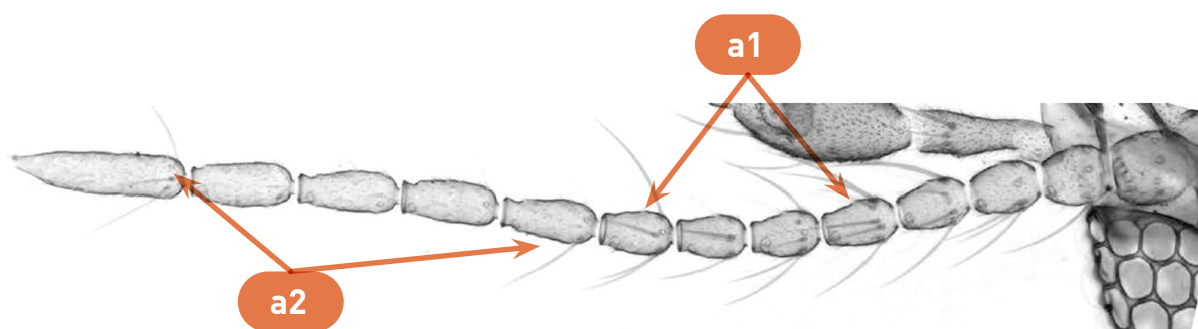
63

Antennal flagellomeres 4-8 distinctly longer than wide (a1); at least some of distal 5 flagellomeres with SCH (a2)

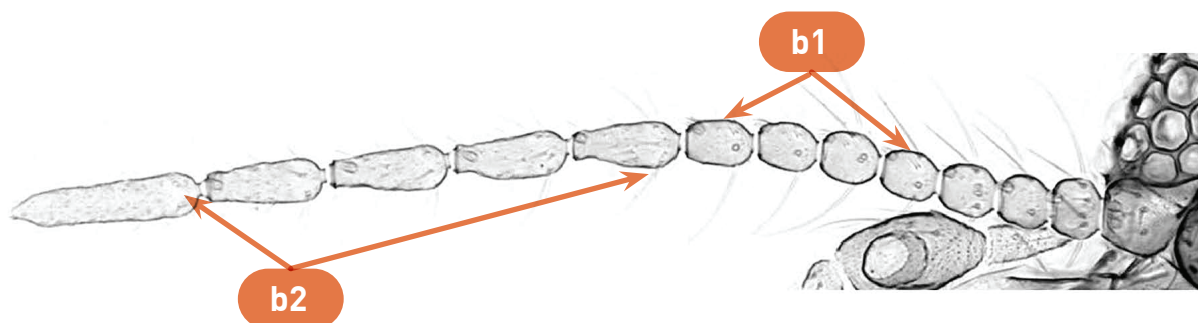
Ornatus Gp sp no 8

Antennal flagellomeres 4-8 about as long as wide (b1); distal 5 flagellomeres without SCH (b2)

Williwilli Gp (pt)



Ornatus gp sp no 8



C. pseudopalpalis

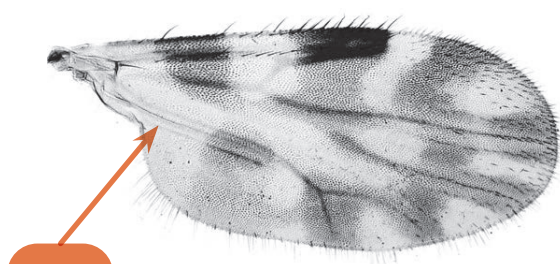
64

(62) Base of vein M-Cu entirely included in pale marking (a)

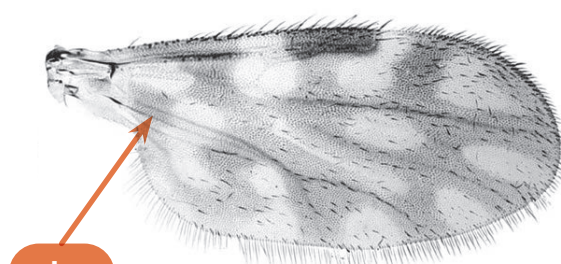
Williwilli Gp (pt)

Base of vein M-Cu with dark marking (b)

66



a

C. yasumatsui

b

Ornatus sp no 6

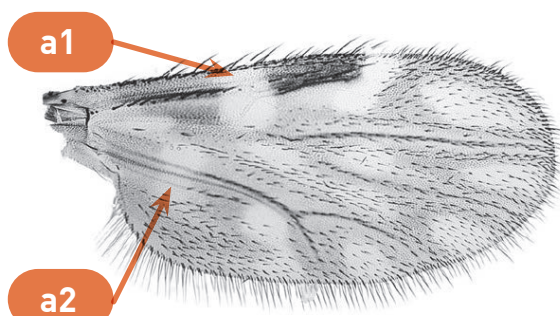
65

Basal pale marking in anal cell crossing vein M-Cu subbasally to join with basal pale marking in cell m_2 (a1) or pale spot over r-m cross-vein reaching margin of wing (a2)

Ornatus Gp (pt)

Basal pale marking in anal cell not crossing vein M-Cu subbasally to join with basal pale marking in cell m_2 (b1); pale spot over r-m cross-vein not reaching margin of wing (b2)

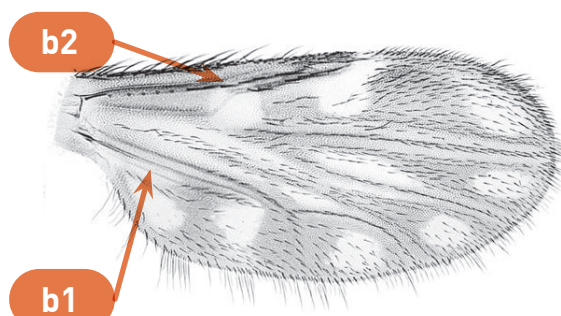
66



a1

a2

Ornatus Gp sp no 8



b2

b1

C. leanderensis

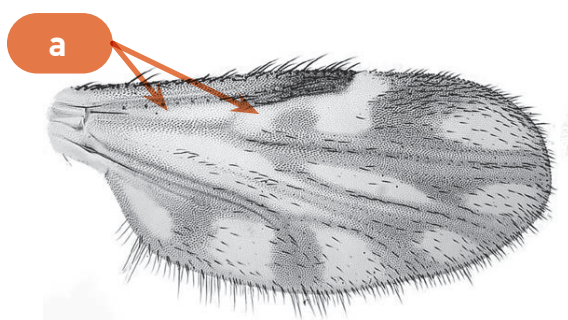
66

Pale spot over r-m cross-vein elongate, extending towards base of wing (a)

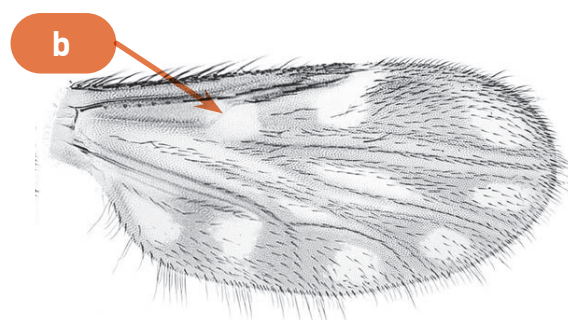
Shermani Gp sp no 1

Pale spot over r-m cross-vein rounded, not extending towards base of wing (b)

C. leanderensis



Shermani Gp sp no 1



C. leanderensis

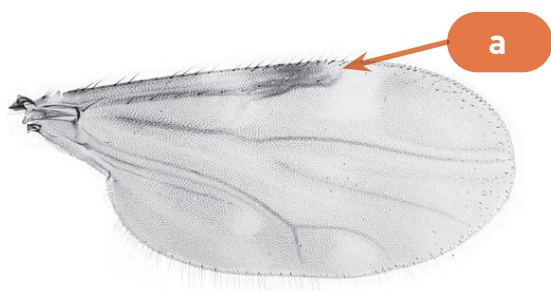
67

[5] Cell r_2 pale at apex (a)

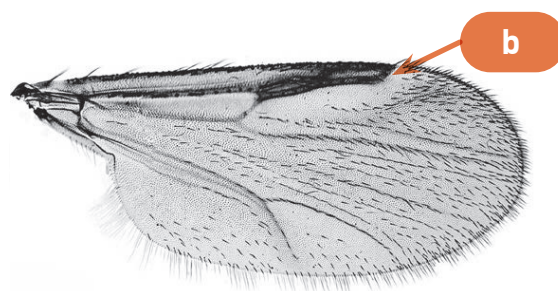
68

Cell r_2 evenly coloured throughout (b)

71



C. obscurus



C. purus

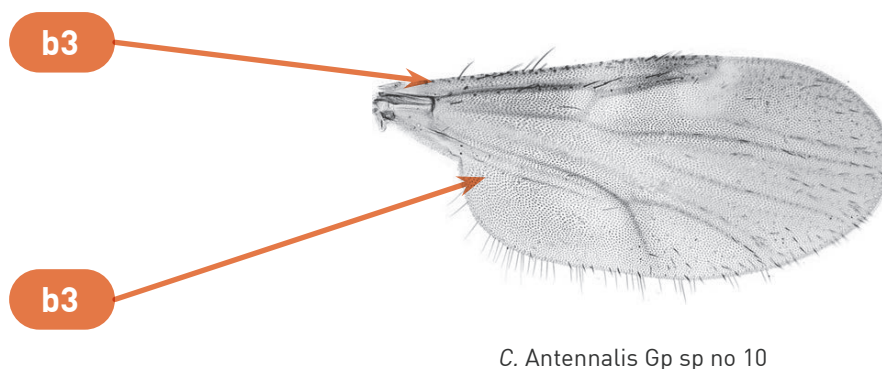
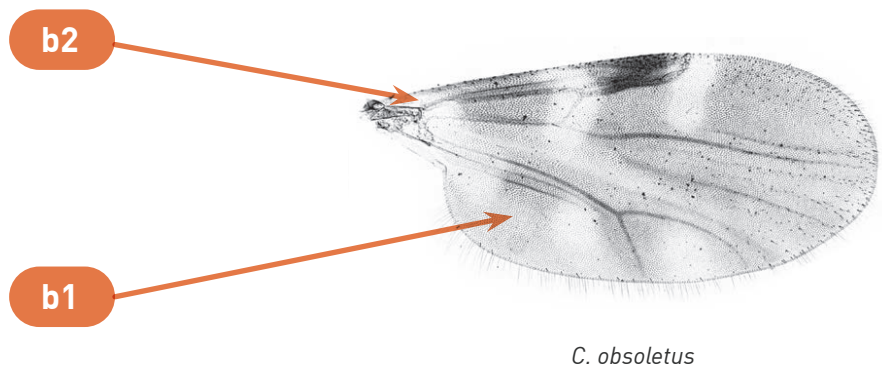
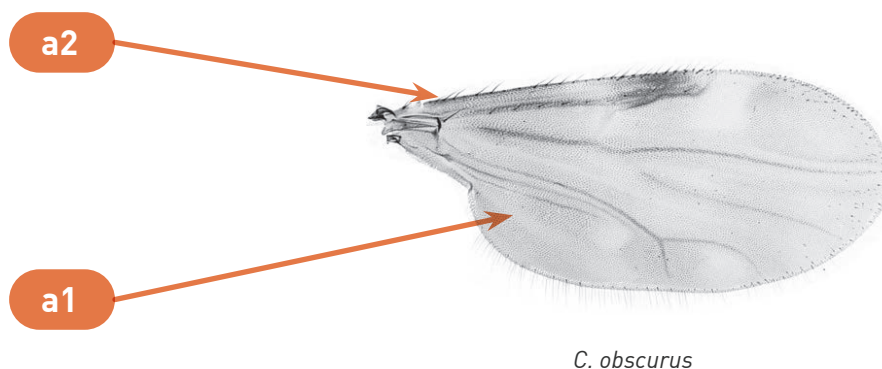
68

Pale stripe running longitudinally through middle of anal cell (a1),
base of costa not included in pale marking (a2) (coastal and sub-
coastal NQ, NT & nWA)

C. obscurus (pt)
(= *pungens*)

No longitudinal pale stripe in anal cell (b1), base of costa included in
pale marking (b2) or not (b3)

69



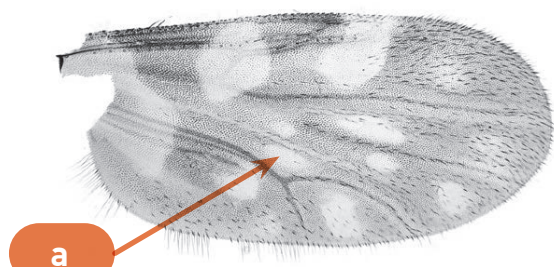
69

Compact pale spot between front of M-Cu fork and M_2 crease present
(a)

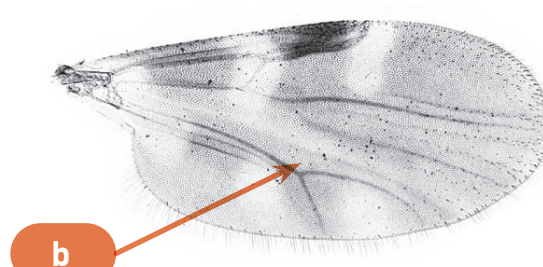
Victoriae Gp -
C. henryi (pt)

Compact pale spot between front of M-Cu fork and M_2 crease absent
(b)

70



C. henryi



C. obsoletus

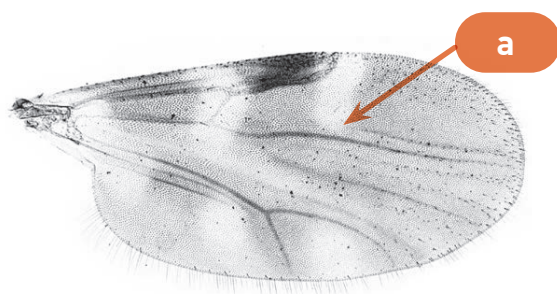
70

Post stigmatic pale spot transverse, extending almost to vein M_1 (a)

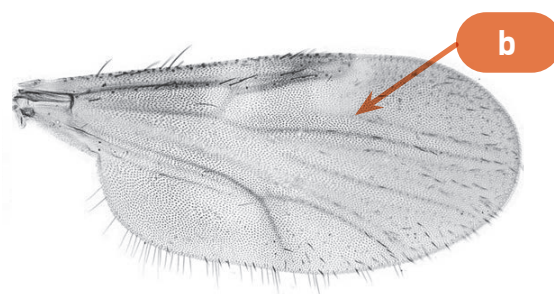
(exotic) *Obsoletus*
complex

Post stigmatic pale spot rounded and not extending almost to vein M_1 (b)

Antennalis Gp (pt)



C. obsoletus



C. Antennalis Gp sp no 10

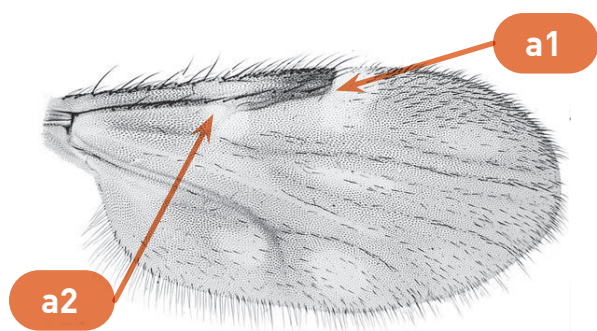
71

(66) Wing with pale post stigmatic spot (a1) and over r-m cross-vein (a2) both distinct

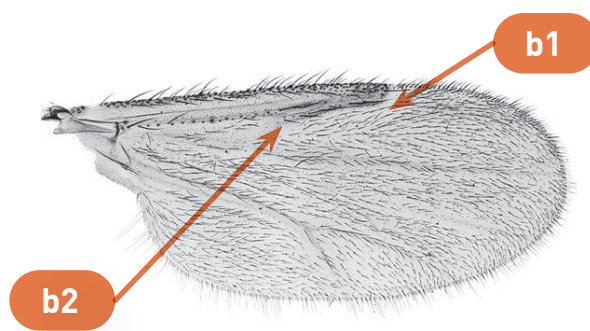
72

Wing with pale post stigmatic spot weak or absent (b1); pale spot over r-m cross-vein absent (b2)

77



C. austropalpalis



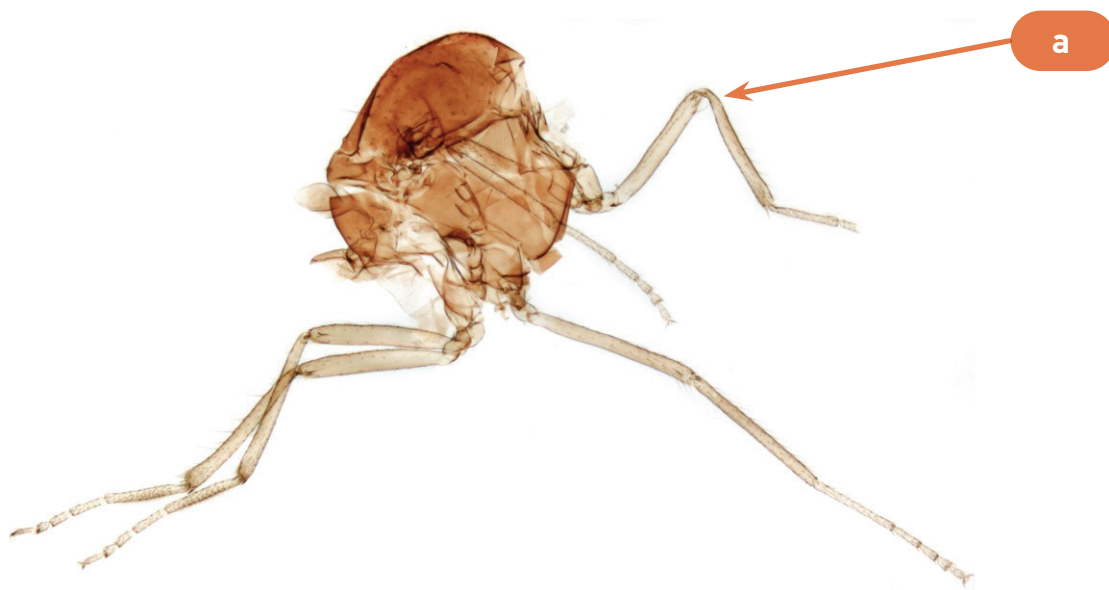
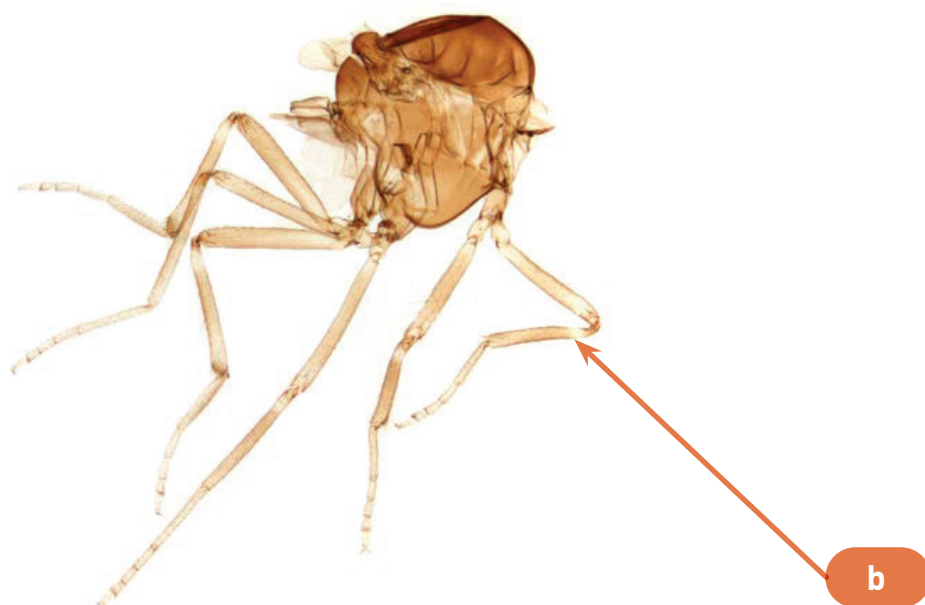
C. immaculatus

72

Legs unbanded (a)

C. flumineus (pt)

At least fore tibiae with distinct subbasal pale band (b)

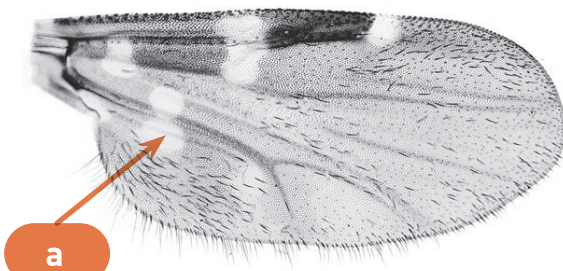
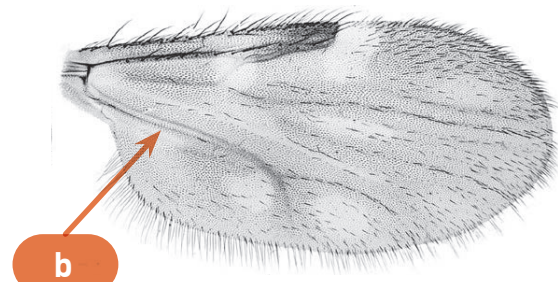
73*C. flumineus**C. ornatus*

73

Vein M-Cu with distinct pale marking over medial section (a)

C. dryadeus

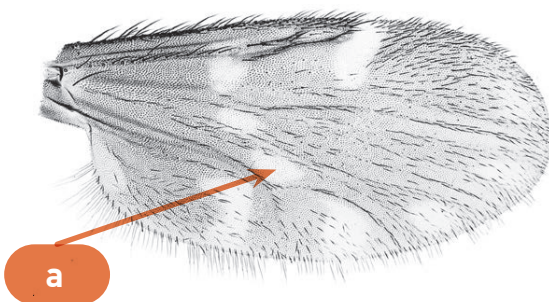
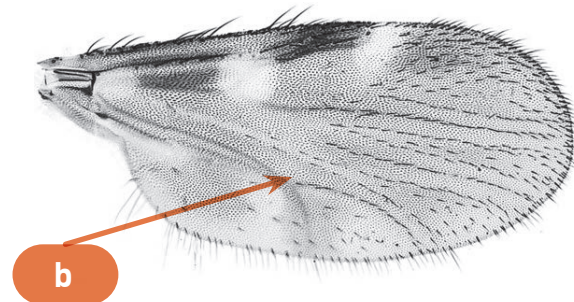
Vein M-Cu without distinct pale marking over medial section (b)

74*C. dryadeus**C. austropalpis***74**

Small rounded pale spot immediately anterior to fork of M-Cu vein (a)

Clavipalpis Gp sp no 14

No pale spot immediately anterior to fork of M-Cu vein (b)

75*Clavipalpis* Gp sp no 14*C. moreensis*

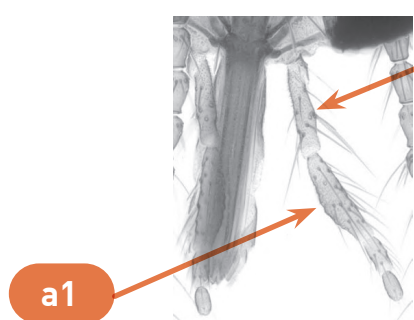
75

Third palpal segment (a1) almost cylindrical, little wider than adjoining segments (a2) and lacking sensory pit

Melanesiae Gp (pt)

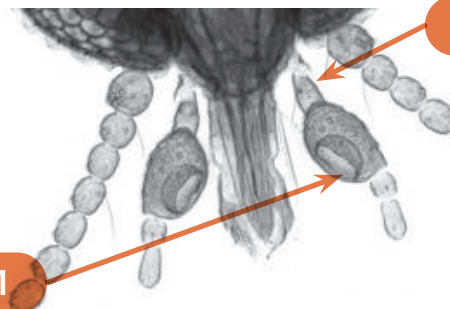
Third palpal segment (b1) swollen medially at least twice as wide as adjoining segments (b2) and bearing a prominent sensory pit

76



C. melanesiae

a2



C. austropalpalis

b2

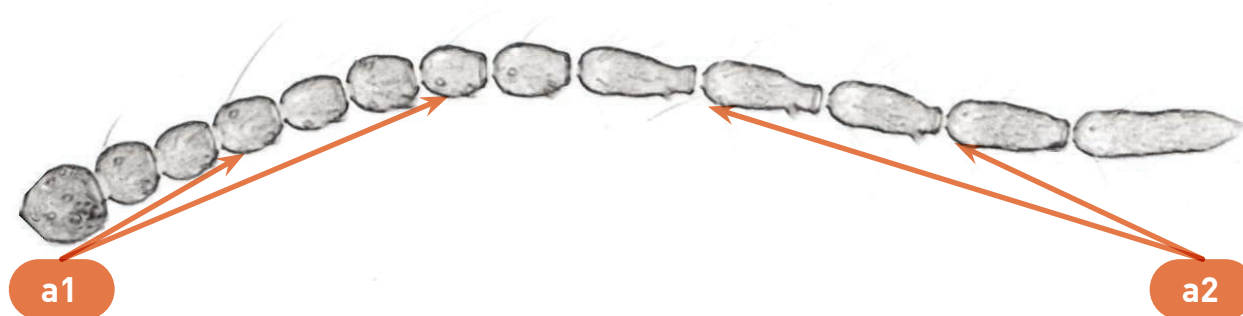
76

Flagellar segments 4-7 globular, little longer than wide (a1); distal 5 flagellar segments without basal whorl of SCh (a2)

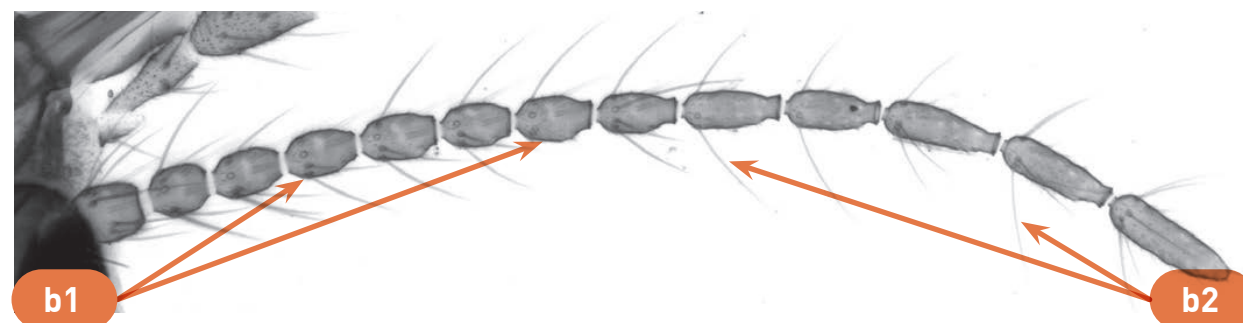
Williwilli Gp (pt)

Flagellar segments 4-7 distinctly longer than wide (b1); distal 5 flagellar segments bearing whorls of 3-6 SCh (b2)

Shermani Gp (pt)



C. austropalpalis



C. moreensis

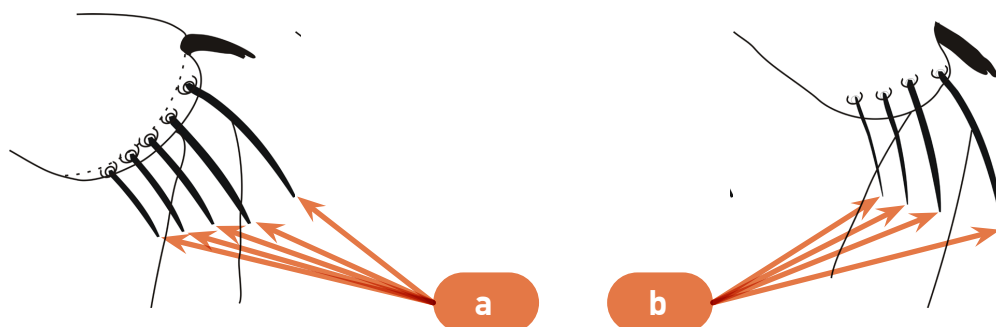
77

(70) Tibial comb with 5 spines (a)

Kusaiensis Gp

Tibial comb with 4 spines (b)

78



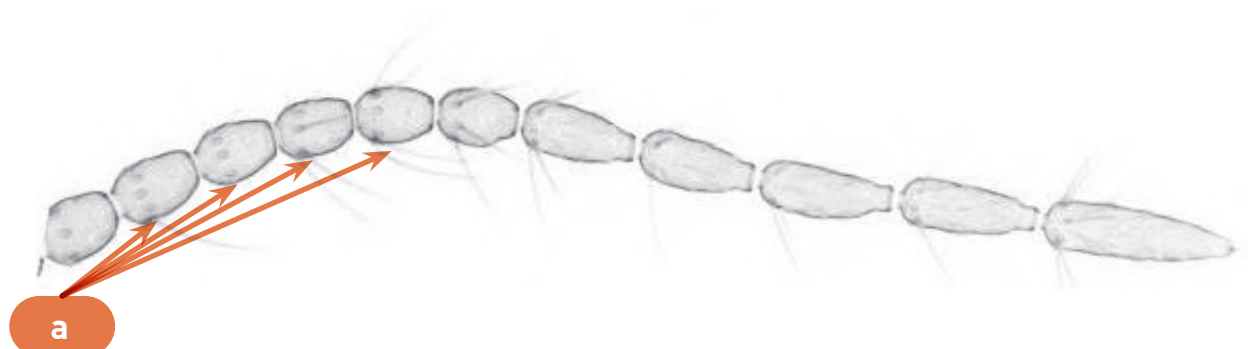
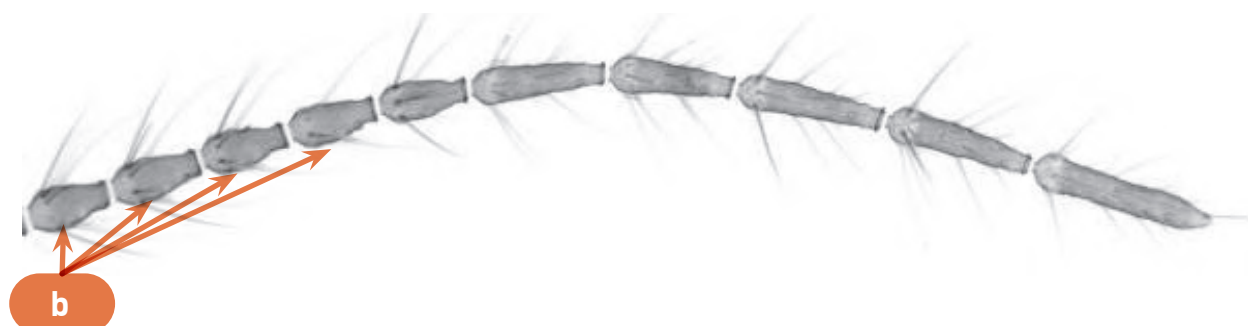
78

Basal antennal flagellomeres 4-7 barrel shaped, evenly convex, about 1.5 times longer than wide (a)

79

Basal antennal flagellomeres 4-7 vase shaped, narrowed subapically, at least twice as long as wide (b)

Purus Gp

*C. immaculatus**C. purus*

79

Legs unbanded (a1); distal 5 flagellar segments with basal whorl of SCh (a2)

Immaculatus Gp

Legs with at least fore tibia bearing a pale band (b1); distal 5 flagellar segments without basal whorl of SCh (b2)

Williwilli Gp (pt)



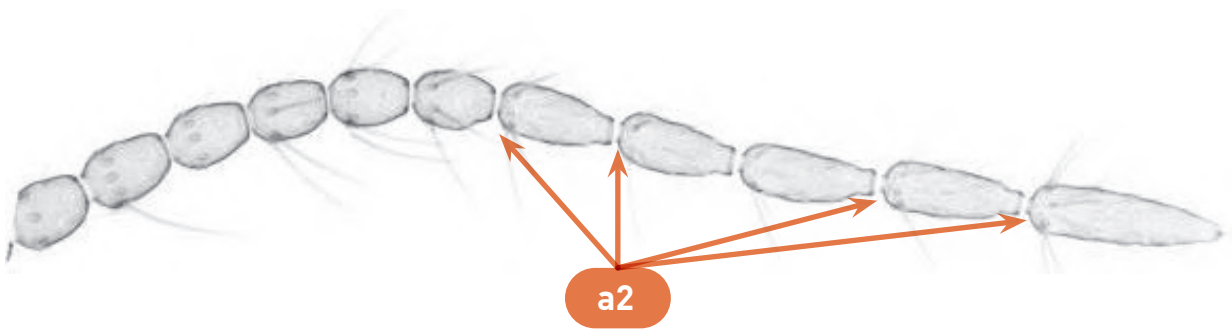
a1

C. immaculatus



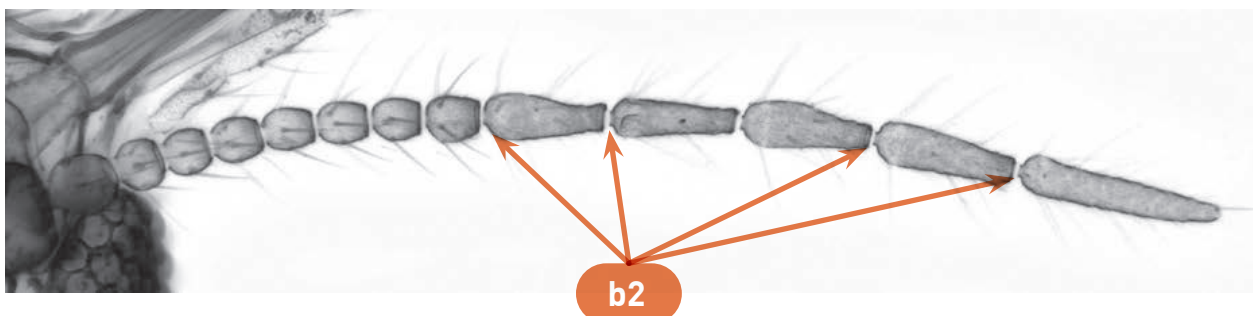
b1

C. smeei



a2

C. immaculatus

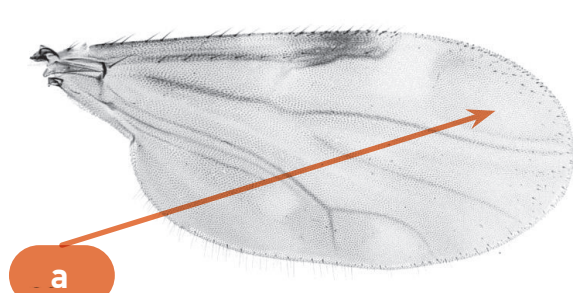


b2

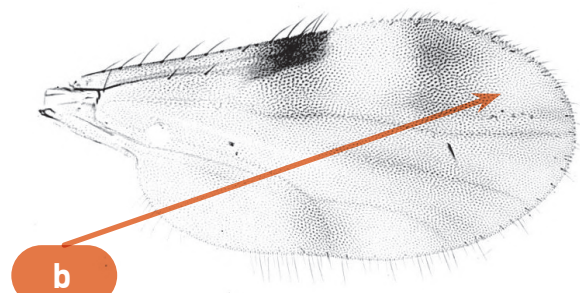
C. smeei

Key to females of species of *Culicoides* subgenus *Avaritia* from Australia and some important exotic species

1	Wing with cell r_3 without distinct pale marking apical to post stigmatic pale spot (a)	2
	Wing with cell r_3 with distinct pale marking apical to post stigmatic pale spot (b)	3

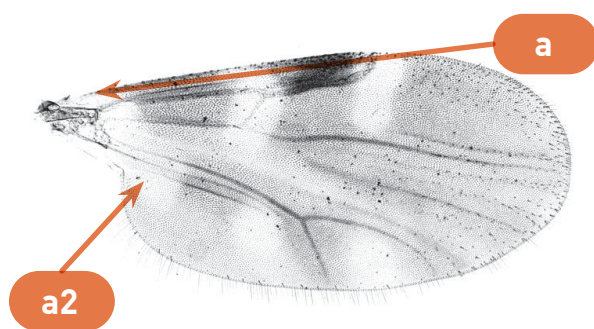


C. obscurus

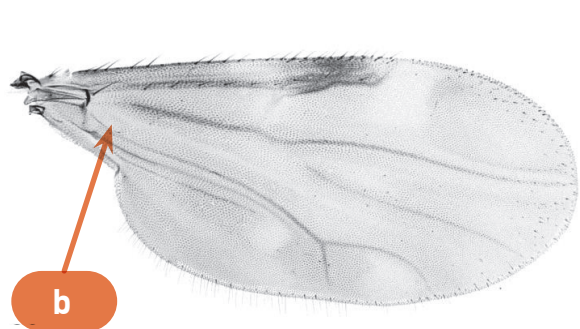


C. minimus

2	Wing with basal pale marking extending from costa (a1) to base of anal cell (a2)	Obsoletus complex (exotic)
	Base of wing not included in pale marking (b)	<i>C. obscurus</i> (pt)



C. obsoletus



C. obscurus pale form

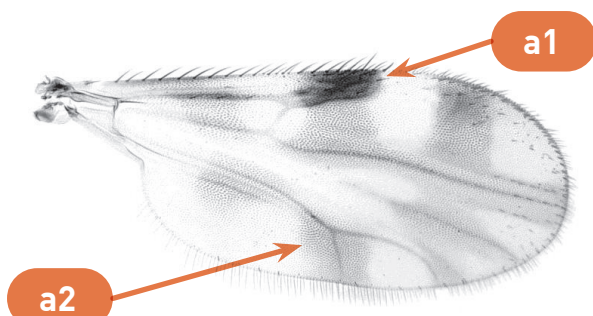
3

(1) Wing with cell r_2 dark almost to apex (a1); dark marking over vein CuA quadrate (a2)

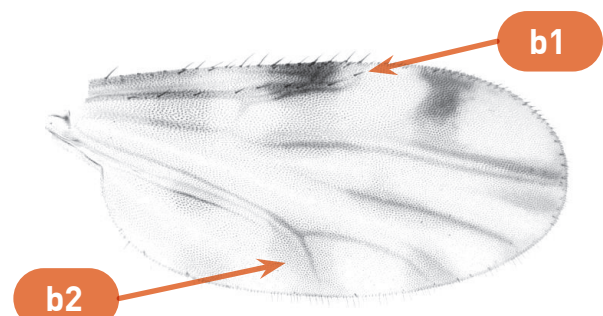
Actoni Gp 4

Wing with at least part of lumen of cell r_2 included in post stigmatic pale spot (b1) and/or dark marking over vein CuA tapered posteriorly, at least along proximal edge (b2)

5



C. actoni



C. brevipalpis

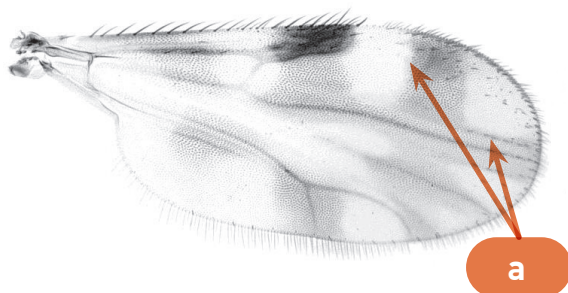
4

Wing with pale markings relatively distinct with well defined edges (a). Sensilla coeloconica present on flagellomere 10

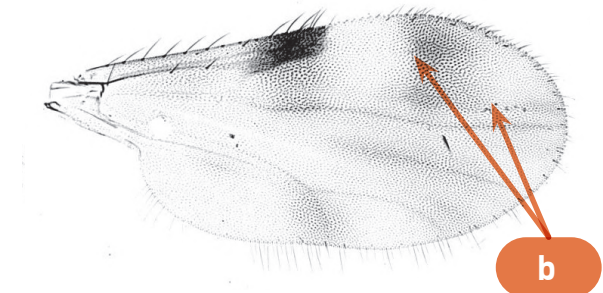
C. actoni

Wing with pale markings relatively indistinct and with poorly defined edges (b). Sensilla coeloconica absent from flagellomere 10

C. minimus



C. actoni



C. minimus

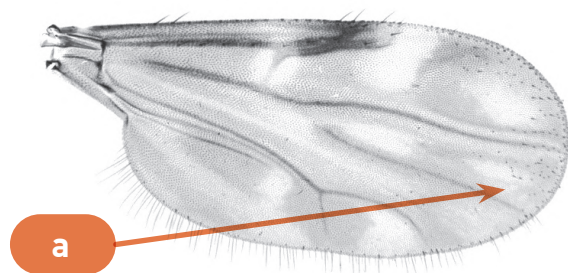
5

Distal pale spot in cell m_1 not reaching wing margin (a) or indistinct

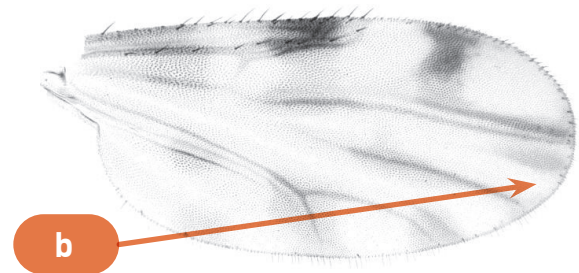
6

Distal pale spot in cell m_1 reaching wing margin (b)

8



C. obscurus



C. brevipalpis

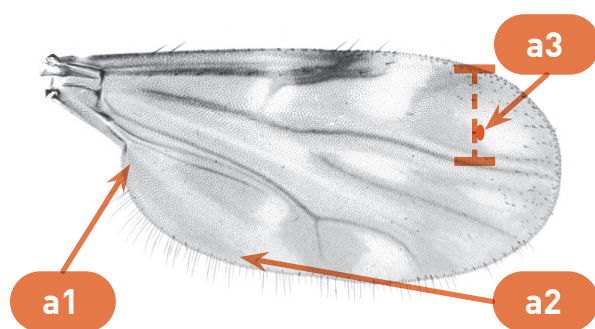
6

Dark longitudinal stripe continuous from base of anal cell (a1) to posterior wing margin (a2); centre of distal pale spot in cell r_3 closer to vein M_1 than to anterior wing margin (a3), wing usually vaguely patterned, coastal northern Australia

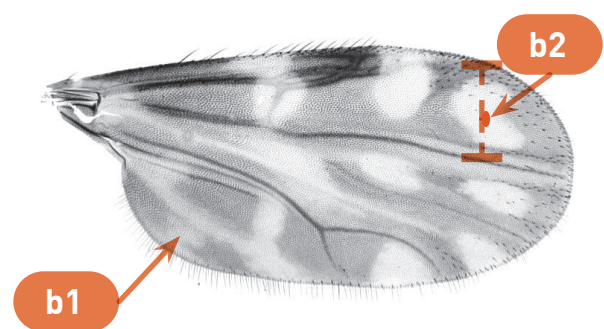
C. obscurus

Dark longitudinal stripe in anal cell often interrupted by pale marking about midlength (b1); centre of distal pale spot in cell r_3 about midway between vein M_1 and anterior wing margin (b2), wing always distinctly patterned

(*Jacobsoni* Gp) 7

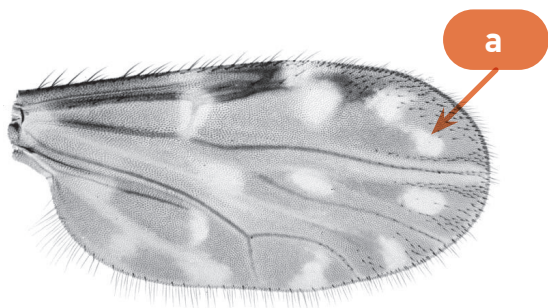
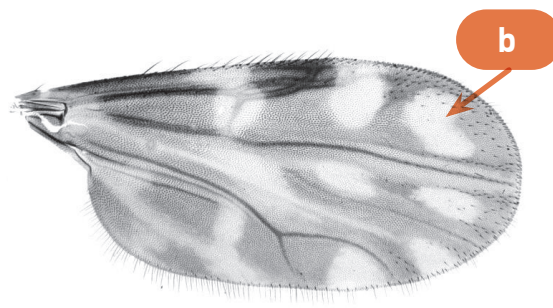


C. obscurus



C. jacobsoni

7

Distal pale spot in cell r_3 bilobed (a)*Avaritia* sp no 2Distal pale spot in cell r_3 crescent shaped (b)*C. jacobsoni**Avaritia* sp no 2*C. jacobsoni*

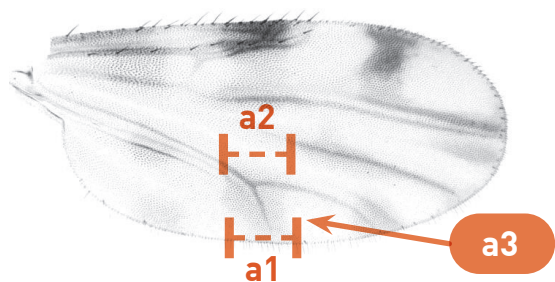
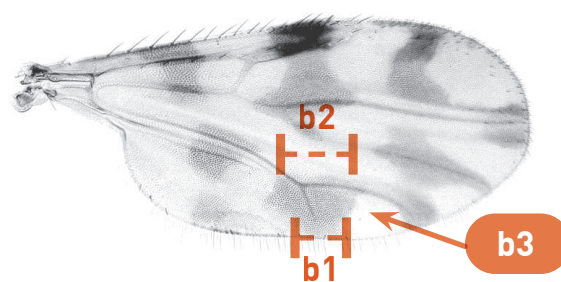
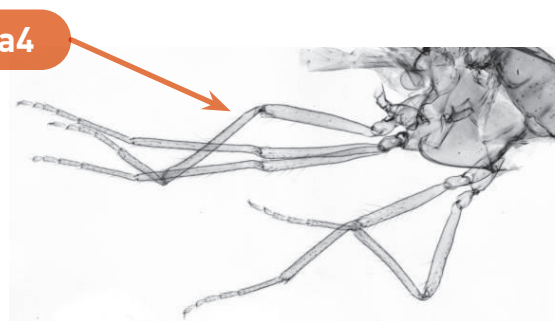
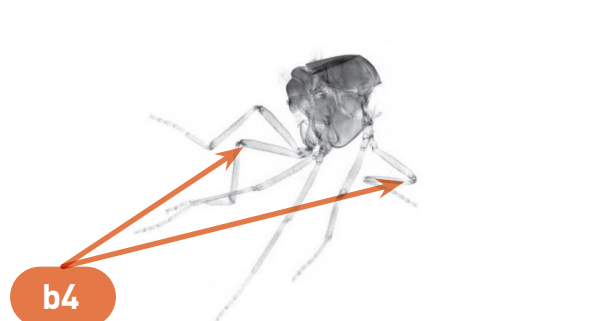
8

(5) Dark marking over CuA vein rectangular with posterior width (a1) about the same as anterior width (a2) and with apical edge more or less parallel to CuA vein (a3); legs with indistinct markings and knees not dark (a4)

C. brevipalpis

Dark marking over CuA vein almost triangular with posterior width (b1) distinctly less than anterior width (b2) and with apical edge (b3) distinct and curved towards apex of wing, i.e. not parallel to vein CuA; legs with distinct pale banding at least on hind tibiae and all knees dark (b4)

9

*C. brevipalpis**C. fulvus**C. brevipalpis**C. brevitarsis*

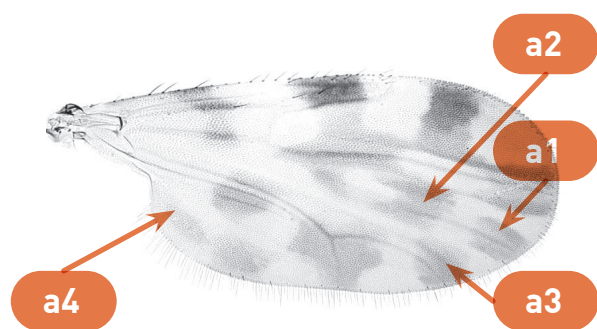
9

Dark marking at apex of vein M_2 quadrate (a1) and not joined to basal dark areas along vein M_2 (a2) or apex of vein M_{3+4} (a3); anal cell with dark longitudinal stripe basally (a4)

(Boophagus group) 10

Dark marking at apex of vein M_2 not quadrate and either continuous to apex (b1) and/or joined to dark marking at apex of vein M_{3+4} (b2), if apparently separate (b3) then not quadrate and distinctly narrower than quadrate dark marking at end of vein M_1 (b4) and anal cell without dark longitudinal stripe basally (b5)

11

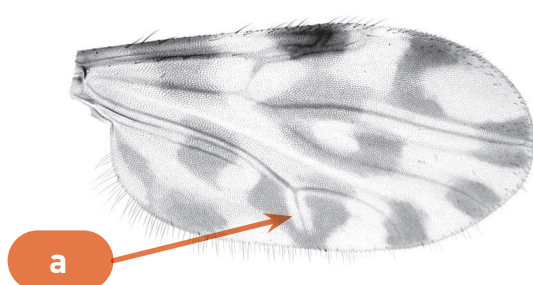
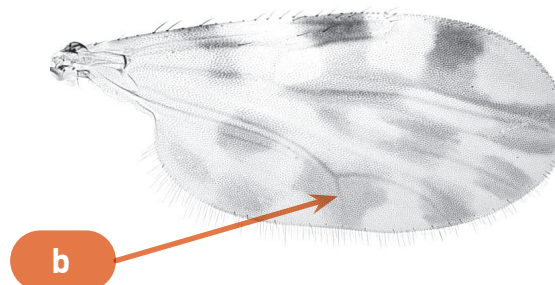
*C. wadai**C. orientalis**C. imicola**C. nudipalpis*

10

Part of CuA vein included in pale marking (a)

C. boophagus

CuA vein entirely included in dark marking (b)

C. wadai*C. boophagus**C. wadai*

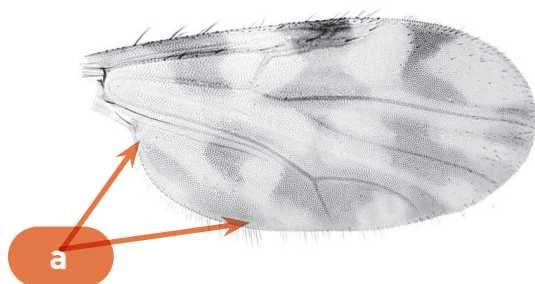
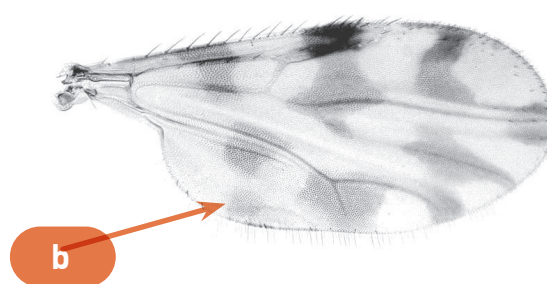
11

Posterior dark marking in anal cell elongate and extending to base of the cell (a)

12

Posterior dark marking in anal cell quadrate or rounded, never extending to base of the cell (b)

13

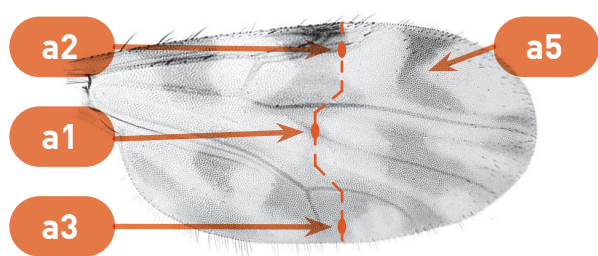
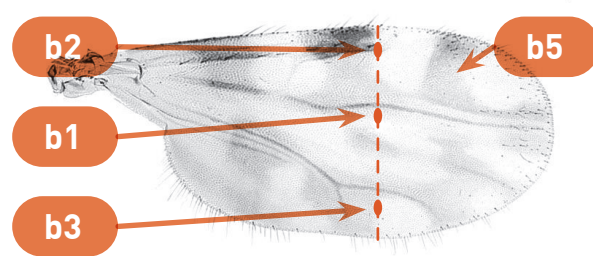
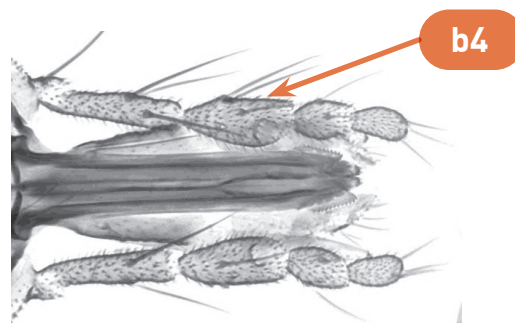
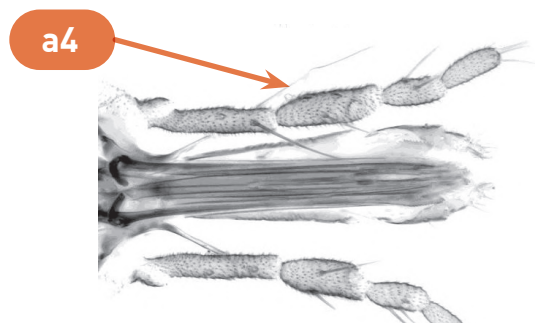
*C. orientalis**C. fulvus*

12

Proximal edge of basal pale spot in cell m_1 (a1) basal to distal edge of both post stigmatic spot (a2) and pale spot in cell m_4 (a3), 3rd palpal segment relatively long and narrow (a4); apical dark marking in cell r_3 narrowed medially (a5)

C. orientalis (exotic)

Proximal edges of basal pale spot in cell m_1 (b1), post stigmatic spot (b2) and pale spot in cell m_4 (b3) roughly in a straight line, 3rd palpal segment relatively short and stout (b4); apical dark marking in cell r_3 not narrowed medially (b5)

C. dumdumi*C. orientalis**C. dumdumi*

13

[11] Apical pale marking in cell m_1 reaching or crossing vein M_2 subapically (a1) then narrowing apically (a2)

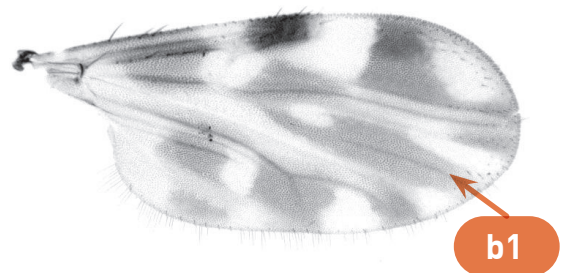
14

Apical pale marking in cell m_1 not reaching or crossing vein M_2 subapically or if reaching vein M_2 then not narrowing apically (b1)

15



C. imicola



C. asiana

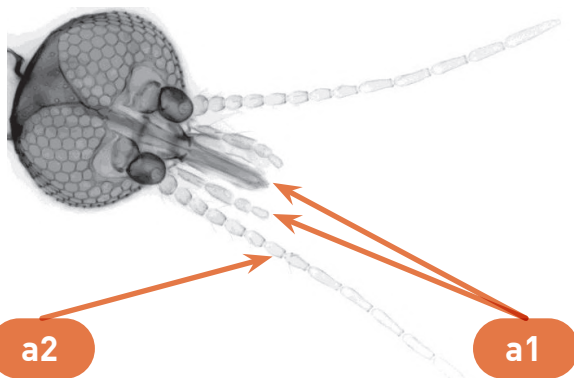
14

Proboscis and palpi relatively short (a1), not or barely reaching base of antennal flagellar segment 7 (a2); Proboscis:head ratio 0.66-0.73

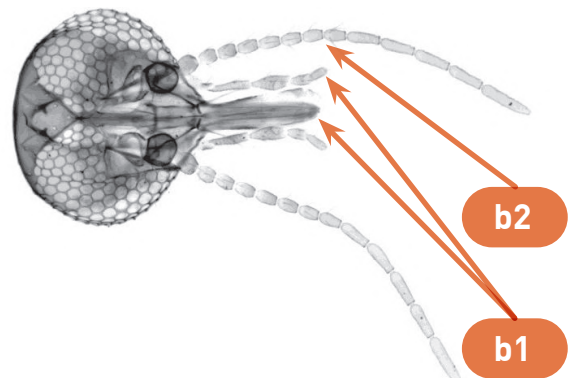
C. nudipalpis

Proboscis and palpi relatively long (b1), easily reaching apex of antennal flagellar segment 7 or base of segment 8 (b2); Proboscis:head ratio 0.82-1.02

C. imicola (exotic)



C. nudipalpis



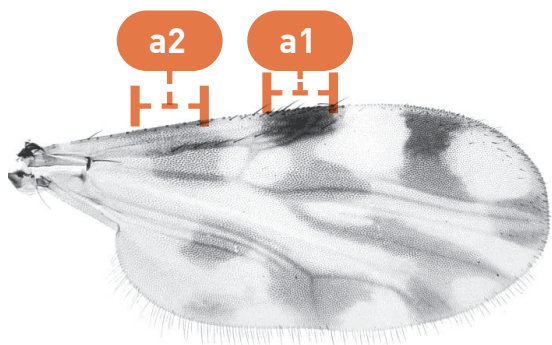
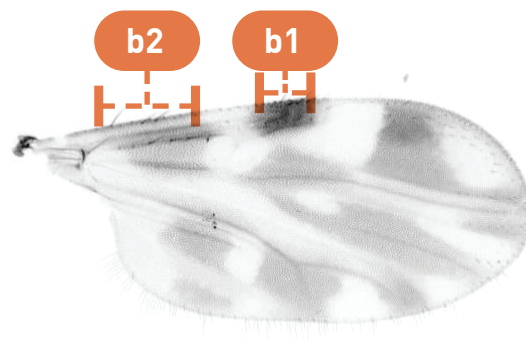
C. imicola

15

Wing with stigma (a1) of similar length or longer than proximal dark marking on costa (a2)

16

Wing with stigma (b1) distinctly shorter than proximal dark marking on costa (b2)

C. asiana (exotic)*C. brevitarsis**C. asiana*

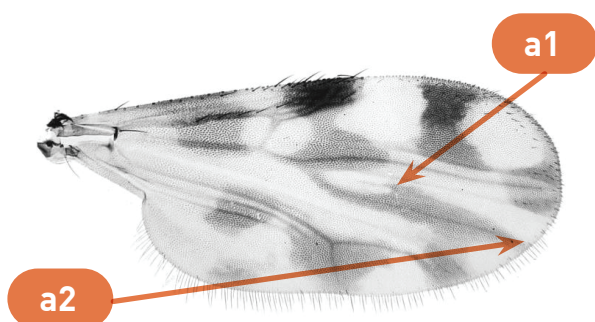
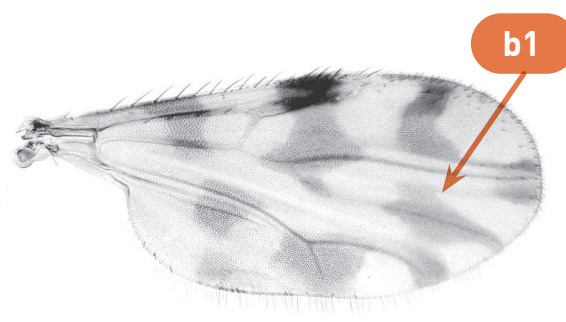
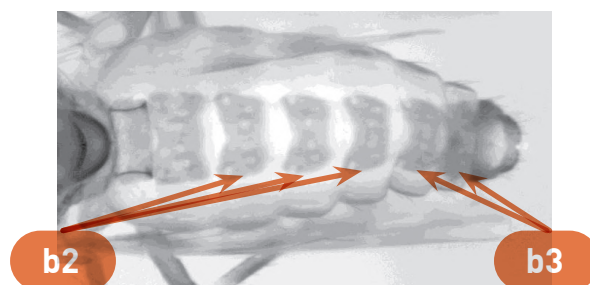
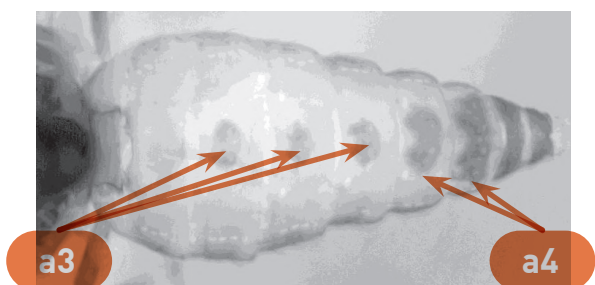
16

Anterior edge of dark marking over vein M_2 more or less straight from apical margin of basal pale spot in cell m_1 (a1) to wing margin (a2); abdominal tergites III-V small, ovoid, no more than 1.5 times as wide as long (a3) and distinctly narrower than tergites VI and VII (a4)

C. brevitarsis

Anterior edge of dark marking on vein M_2 with 90° bend apicad of basal pale spot (b1); abdominal tergites III-V (b2) rectangular or crescent-shaped, about twice as wide as long and of similar size to tergites VI and VII (b3)

17

*C. brevitarsis**C. fulvus*

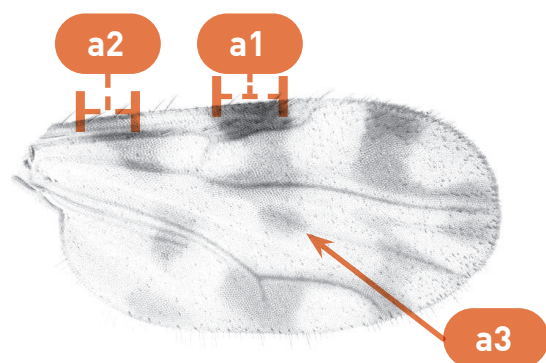
17

Stigma (a1) distinctly longer than basal dark mark on costa (a2), dark marking at base of vein M_2 more or less discrete and not part of other dark markings (a3)

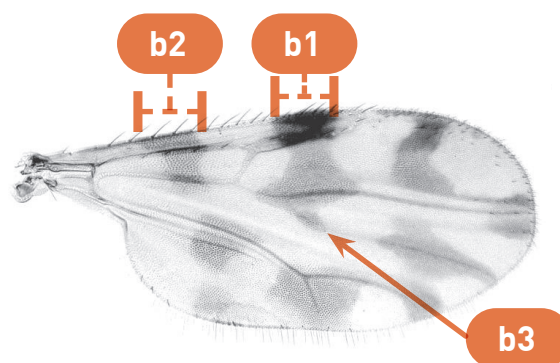
C. flavipunctatus

Stigma (b1) of similar length to basal dark mark on costa (b2), dark marking at base of vein M_2 an extension of the dark marking at base of vein M_1 (b3)

C. fulvus

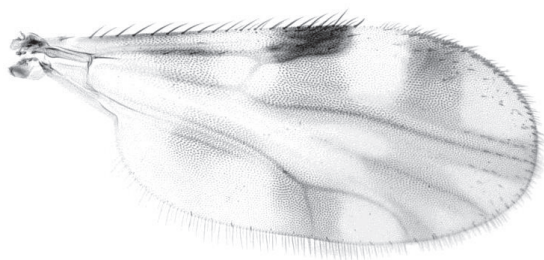


C. flavipunctatus



C. fulvus

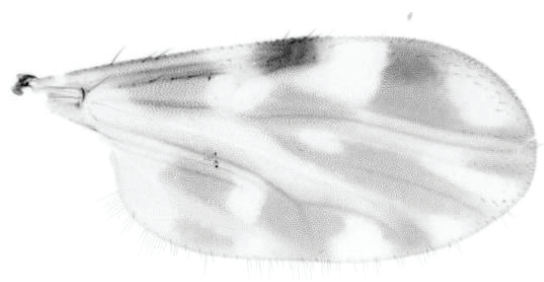
Wing picture atlas of Austro-Oriental *Avaritia*



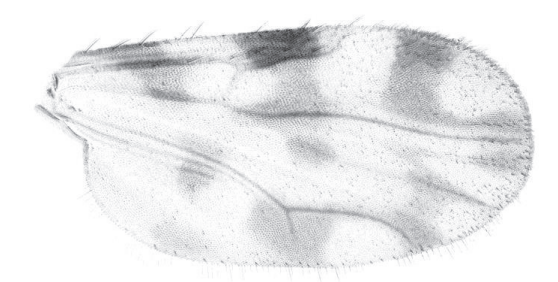
C. actoni



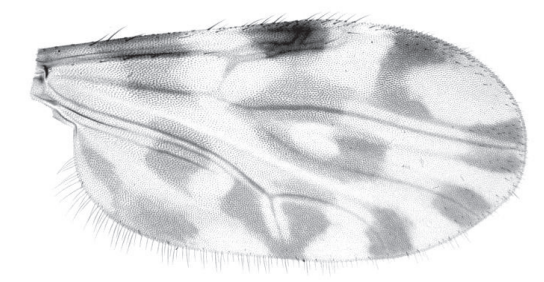
C. dumdumi



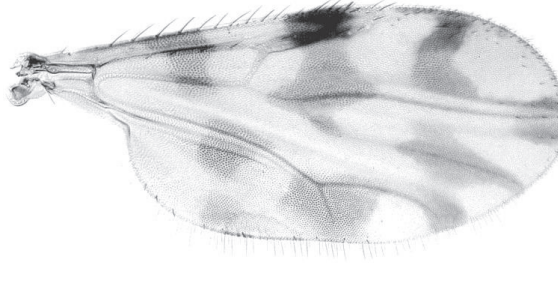
C. asiana



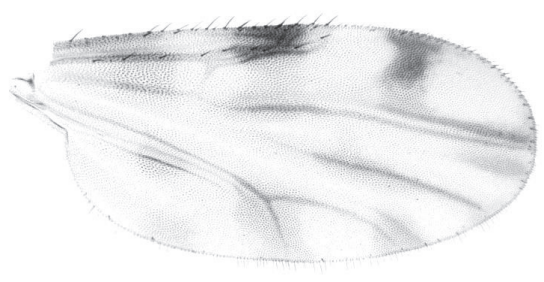
C. flavipunctatus



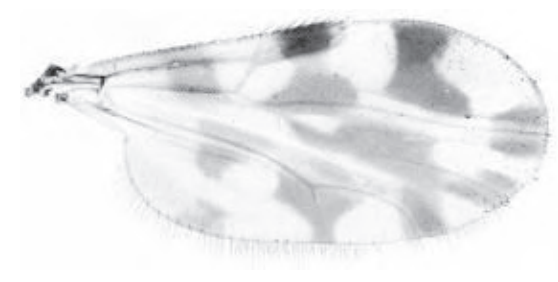
C. boophagus



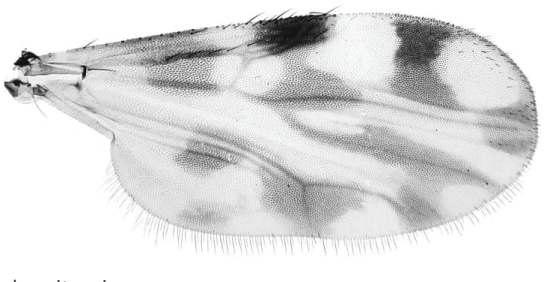
C. fulvus



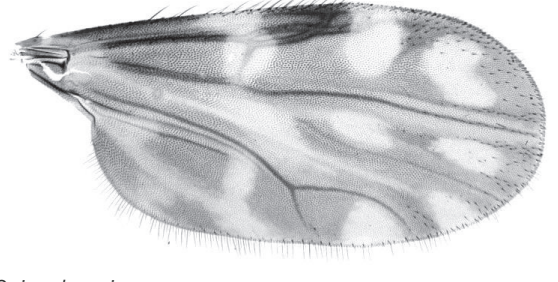
C. brevipalpis



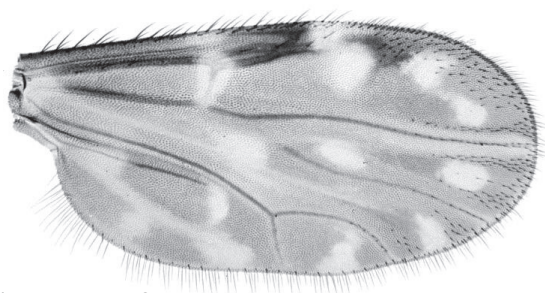
C. imicola



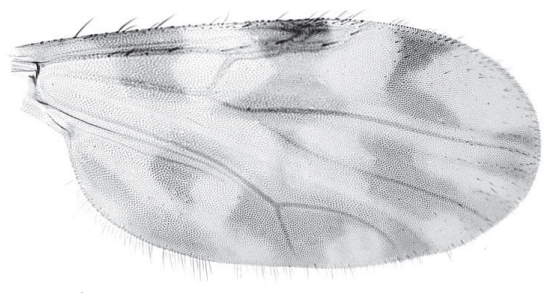
C. brevitarsis



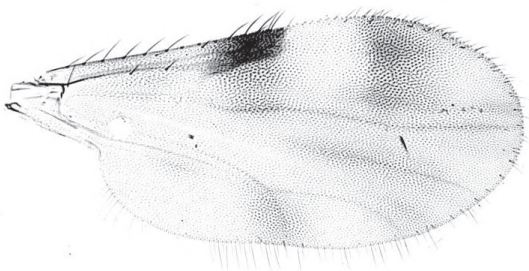
C. jacobsoni



C. Avaritia sp no 2



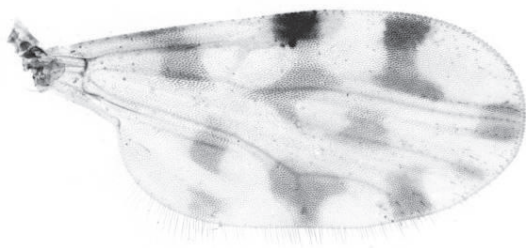
C. orientalis



C. minimus



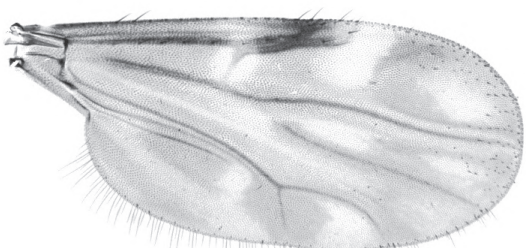
C. wadai



C. nudipalpis



C. obscurus (pale form)



C. obscurus (dark form)

Culicoides subgenus Avaritia

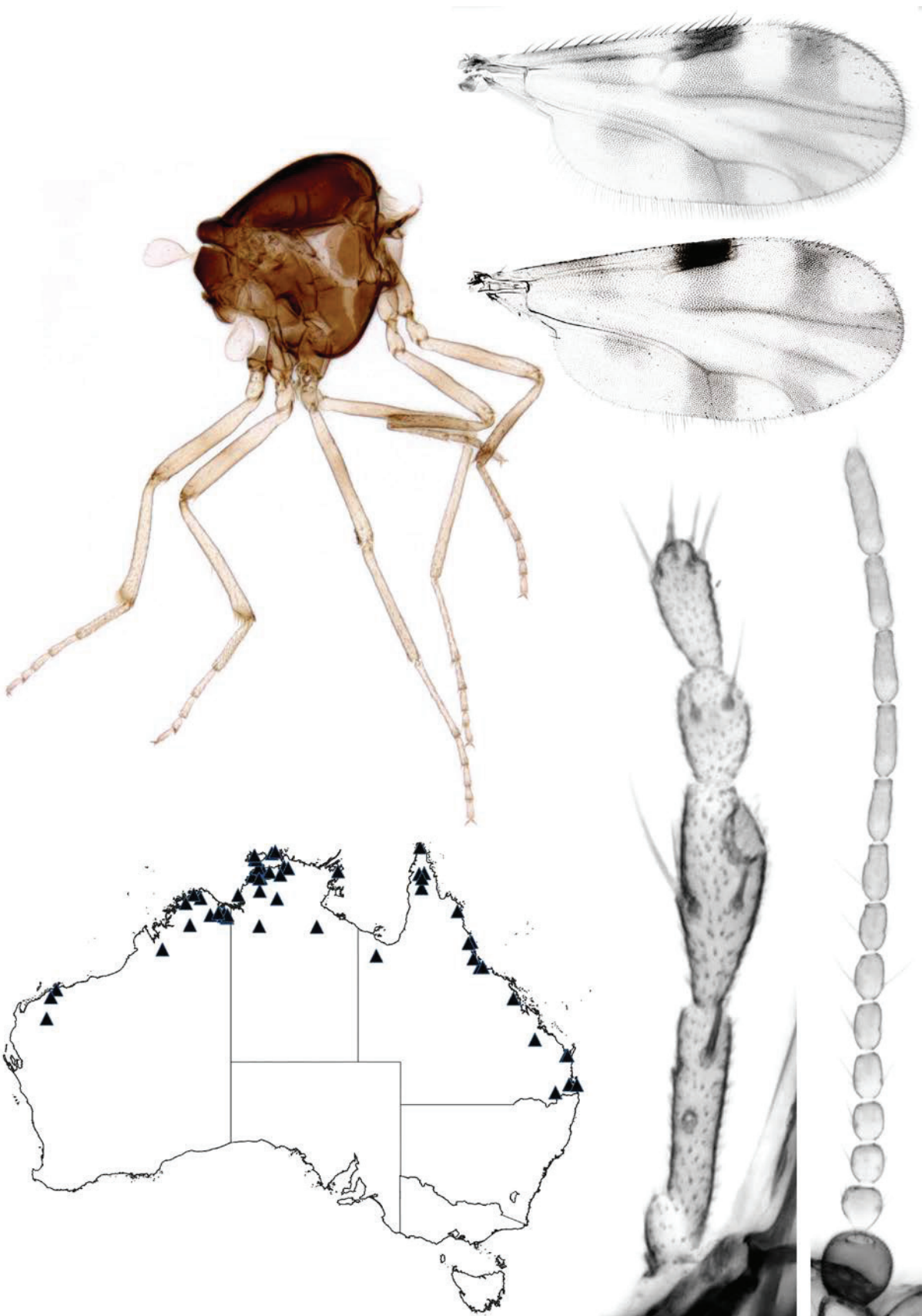
Culicoides subgenus *Avaritia* Fox 1955:218

Type species	<i>Ceratopogon obsoletus</i> Meigen
Synonyms	Nil.
Distribution	Worldwide in all biogeographic regions. In Australia, confined to northern WA, NT, Qld, NSW and Vic.
Number of species worldwide	Differences in opinion of the diagnosis of this subgenus, particularly in Asia, confound efforts to provide an accurate list or count of species. Australian species have been placed following the system provided by Wirth & Hubert (1989). Borkent and Dominiak (2020) list 106 species in this subgenus but several of these almost certainly do not belong here; indeed 4 of the species listed have since been removed to subgenus <i>Hoffmania</i> (Duan et al 2022) and no doubt others will continue to be removed as our understanding of this subgenus improves.
Number of species in Australia	15, including 1 undescribed.
Hosts	Where known, hosts include large mammals.
Vector status	Contains a high proportion of known vectors of BTV and other bovid pathogens.
Immature habitat	Animal dung-pats, moist turf high in organic matter, fungal fruiting bodies, rotting organic matter, moist leaf litter. Larvae are unable to swim and sink in tap water, as do pupae.
Diagnosis	Can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Tibial comb with 5 spines, that closest to the spur longest; SCo absent from basal flagellar segments and always present on 11-13; SCh absent from distal flagellar segments, apical pale markings in cells r_3 , m_1 and m_2 reaching wing margin (except in <i>obscurus</i> and species in the Jacobsoni complex), basal and apical pale markings in anal cell joined by a pale longitudinal stripe (difficult to see in <i>actoni</i> , <i>minimus</i> and some specimens of <i>obscurus</i>).

Culicoides actoni

Culicoides actoni Smith 1929: 255 (India)

Synonyms	<i>imperceptus</i> Das Gupta 1962; <i>okumensis</i> Arnaud 1956: 119).
Distribution	Top End of NT, northern and eastern Qld, Kimberley region of WA, rarely detected in the Pilbara. Also present in PNG, Solomon Is, widespread in southern Asia north to China, Japan and Korea. DNA evidence, however, suggests that Australian populations are distinct (Gopurenko et al 2015).
Hosts	Bovids, marsupials, horses (Muller et al 1981, Kay et al 1978, Melville et al unpublished data).
Vector status	Proven vector of Bluetongue virus (Standfast et al 1985). Probable vector of <i>Onchocerca gibsoni</i> (Buckley 1938 as <i>pungens</i>).
Immature habitat	Cassowary dung (Dyce unpublished). No doubt other media are also utilised as the distribution of <i>C. actoni</i> exceeds that of the cassowary.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apical pale marking in cell m_1 complex or triangular, reaching wing margin and often joining pale marking along vein M_1 ; Eyes hairy, dark marking over vein CuA quadrate, apical pale marking in cell r_3 quadrant shaped with perpendicular proximal and posterior margins, SCo present on flagellomere 12.

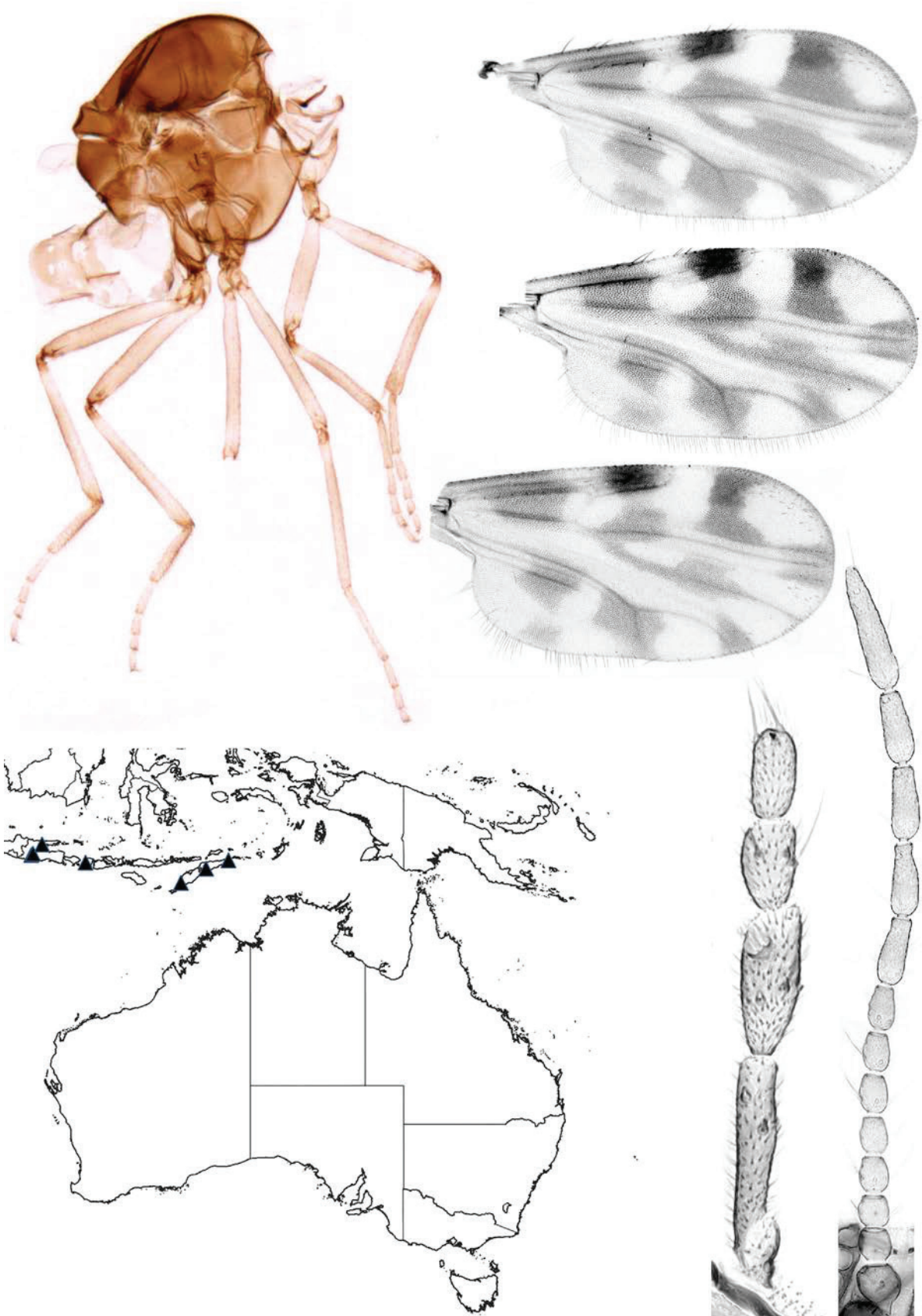


C. actoni

Culicoides asiana

Culicoides asiana Bellis in Bellis et al. 2015: 29. New name for *asiatica* Bellis. Japan

Synonyms	<i>asiatica</i> Bellis, in Bellis et al. 2014: 407 (preoccupied by <i>Culicoides asiaticus</i> Gutsevich and Smatov, 1966).
Distribution	Absent from Australia. Widespread in southern and eastern Asia west to Yunnan Province, China, north to Japan, south to Timor-Leste.
Hosts	Unknown but association with livestock viruses suggests livestock are hosts.
Vector status	Likely vector of Bluetongue (Yanase et al 2010) and Akabane (Yanase et al 2019) viruses.
Immature habitat	Bovine dung (Yanase et al 2013)
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Abdominal tergites 3-5 rounded, not wider than long; apical pale marking in cell m_1 complex, reaching wing margin and joining pale marking along vein M_1 ; Anterior edge of dark marking over vein M_2 usually more or less straight from near base of vein M_1 extending to the wing margin near apex of vein M_2 ; stigma distinctly shorter than basal dark marking on costa.

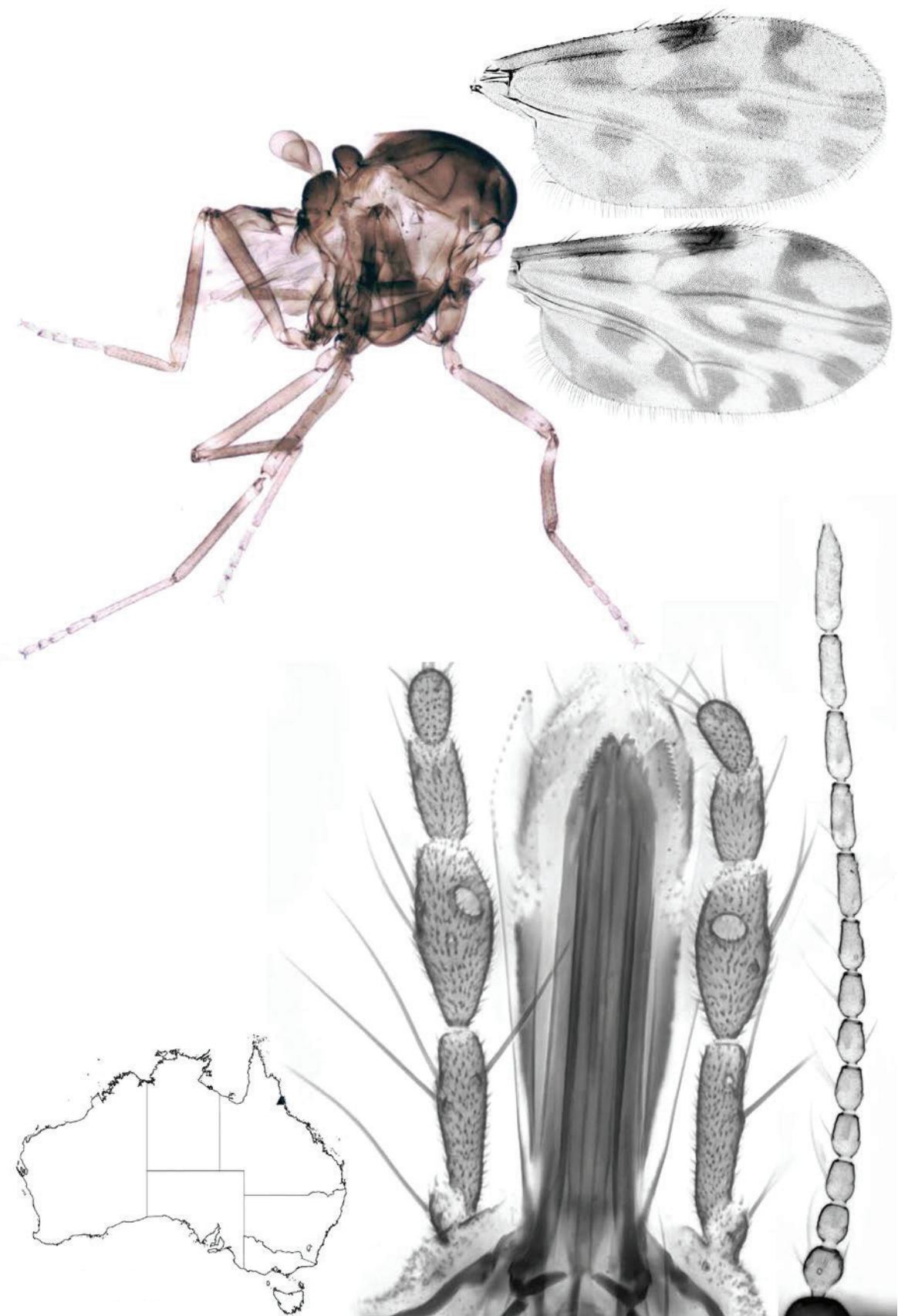


C. asiana

Culicoides boophagus

Culicoides boophagus Macfie 1937: 116

Synonyms	Nil.
Distribution	Rainforest habitat in northern Qld. Also present in PNG and widespread in SE Asia.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; Apical pale marking in cell m_1 complex, reaching wing margin and joining pale marking along vein M_1 ; dark marking at apex of vein M_2 quadrate and discrete; narrow pale marking extending over base of vein CuA .

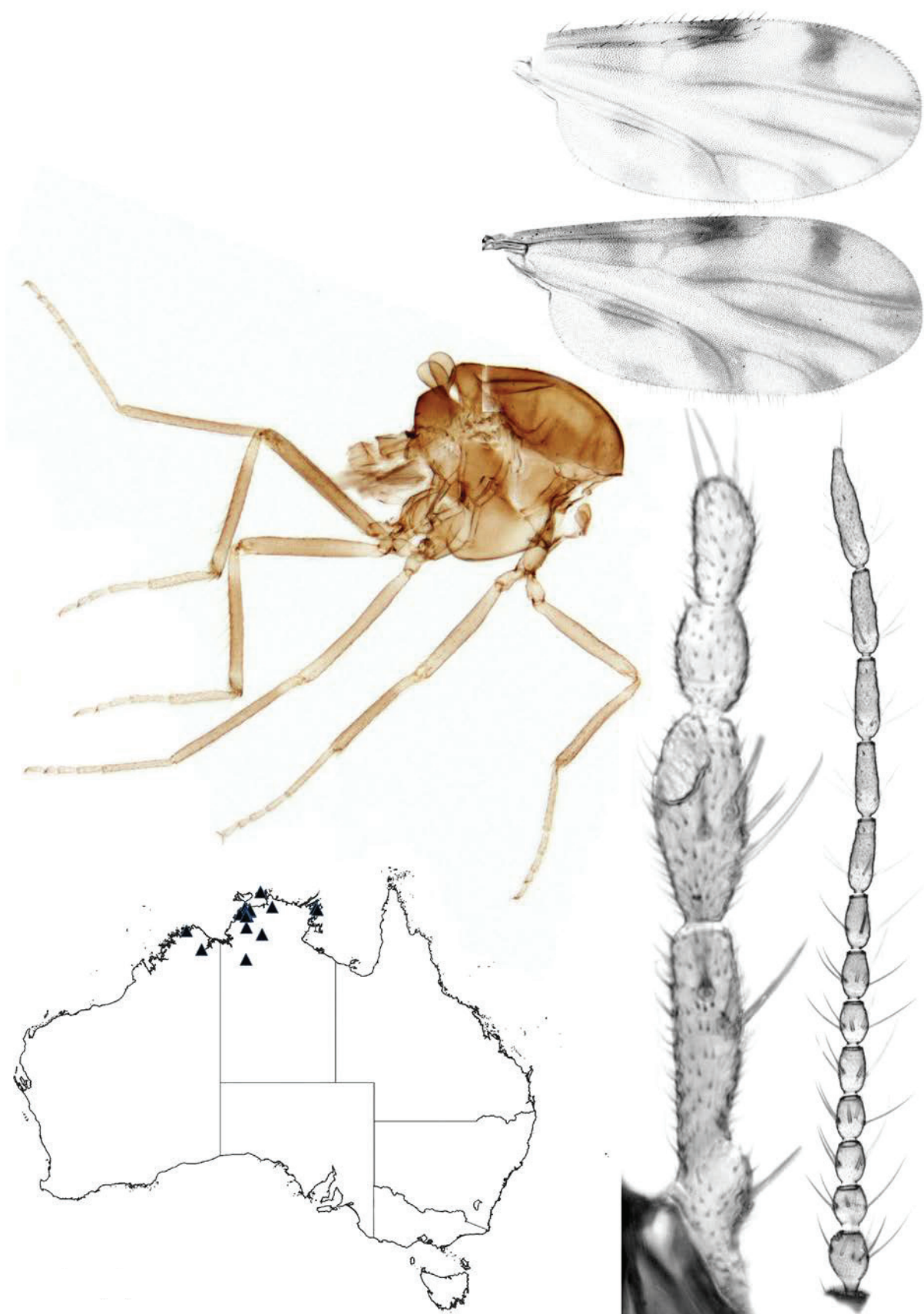


C. boophagus

Culicoides brevipalpis

Culicoides brevipalpis Delfinado 1961: 654 (Philippines)

Synonyms	Nil although Dyce & Wirth (1983) suggest possible synonymy with <i>C. autumnalis</i> Sen & Das Gupta.
Distribution	Kimberley region of WA, Top End of NT. Widespread in SE Asia, north to Japan although genetic evidence suggests Australian populations differ to those of mainland Asia (Gopurenko et al 2015).
Hosts	Bovids, horse (Muller et al 1981).
Vector status	Poor vector of BTV (Standfast et al 1985).
Immature habitat	Discrete bovid dung pats (Dyce 1982).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; Apical pale marking in cell m_1 complex, reaching wing margin and joining pale marking along vein M_1 ; dark marking over vein CuA rectangular; foreknees concolorous with femora and tibia.



C. brevipalpis

Culicoides brevitarsis

Culicoides brevitarsis Kieffer 1917: 187 (Queensland)

Synonyms	<i>robertsi</i> Lee & Reye 1953: 386; <i>radicitus</i> Delfinado 1961: 657; <i>superfulvus</i> Das Gupta 1962: 253.
Distribution	Kimberley region of WA, rarely detected in the Pilbara, Top End of NT, northern and eastern Qld, Eastern NSW. Widespread in the western Pacific and throughout SE Asia although historical confusion with <i>C. asiana</i> blurs the northern limits of its distribution.
Hosts	Bovids, horses, humans, marsupials, sheep (Lee et al 1962; Kay 1973; Muller & Murray 1977; Muller et al. 1981; Kay & Lennon 1982).
Vector status	Proven vector of Bluetongue virus, probable vector of Akabane virus. A large number of viruses have been detected from field-collected specimens of this species, see Table 1 for details. Causative agent of Queensland itch in horses (Reik 1954).
Immature habitat	Discrete bovid dung pats (Canon and Reye 1966), soft, formed pats of horse or sheep dung (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Abdominal tergites 3-5 rounded, not wider than long; apical pale marking in cell m_1 complex, reaching wing margin and joining pale marking along vein M_1 ; Anterior edge of dark marking over vein M_2 more or less straight from near base of vein M_1 extending to the wing margin near apex of vein M_2 ; stigma at least as long as basal dark marking on costa.

Table 1. Viruses associated with *Culicoides brevitarsis*

Virus	Reference
Aino	Muller et al (1982)
Akabane	Doherty et al (1972); St George et al (1978); Cybinski & Muller (1990)
Bluetongue	Standfast et al (1985); Muller (1987); Bellis et al (1994)
Bovine ephemeral fever	Cybinski and Muller (1990); St George et al (1977)
bunyip creek	Cybinski and Muller (1990)
CSIRO village	Cybinski & Muller (1990)
D'Aguilar	Doherty et al (1972); Cybinski & Muller (1990)
Douglas virus	St George et al (1979)
Epizootic haemorrhagic disease	St George et al (1983); Parsonson and Snowdon (1985); Cybinski & Muller (1990)
Kimberley	Zakrewski & Cybinski (1984)
Ngaingan	Doherty et al (1972)
Peaton virus	St George et al 1980
Samford	Doherty et al 1972
Tibrogargan	Muller et al 1982
Tinaroo	Muller et al 1982
CSIRO 58	Muller et al 1982
CSIRO 157	Muller et al 1982
CSIRO 11	Muller et al 1982
CSIRO 753	Muller et al 1982

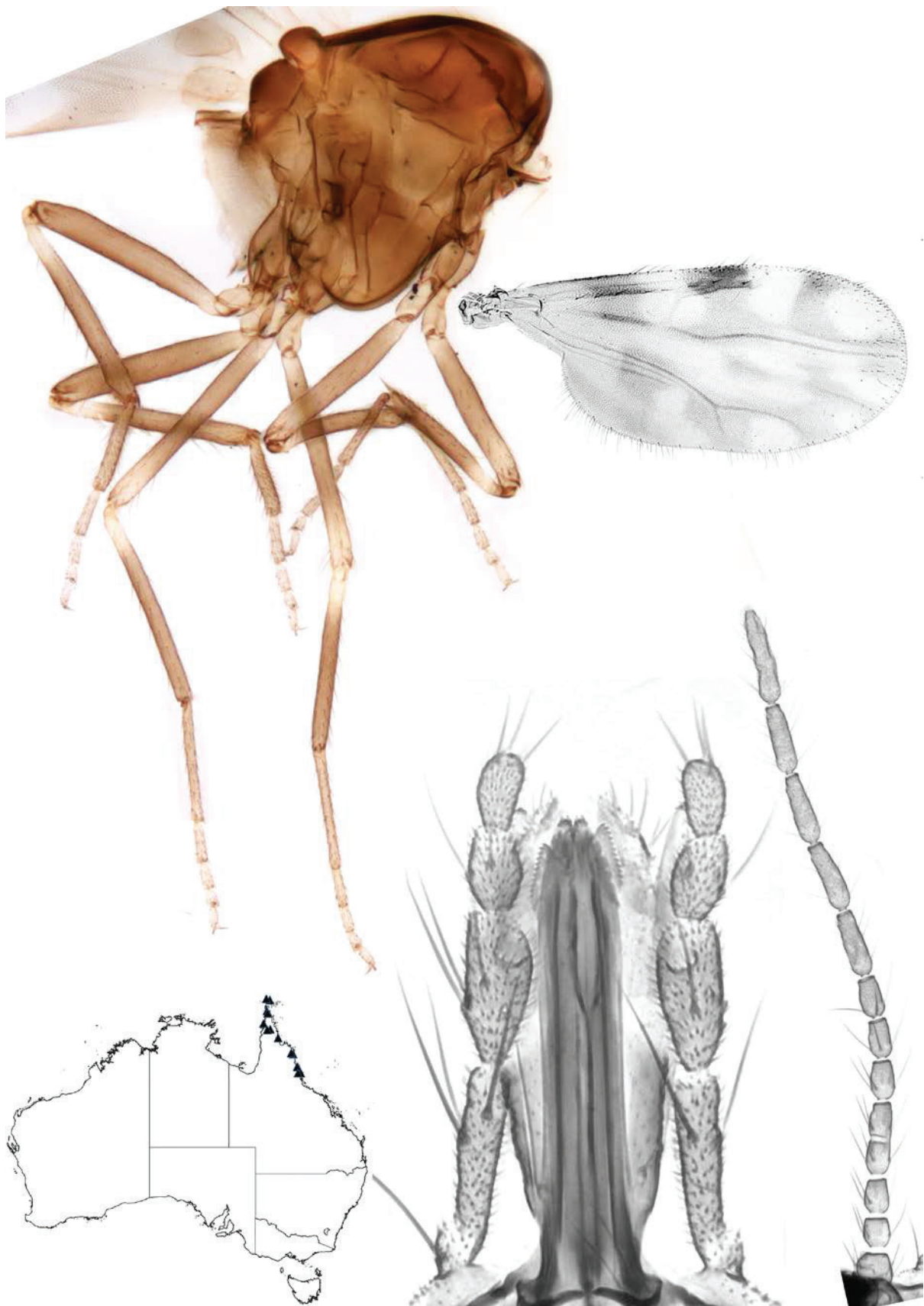


C. brevitarsis

Culicoides dumdumi

Culicoides dumdumi Sen & Das Gupta 1959: 628

Synonyms	Nil.
Distribution	Northeastern Qld, south to Innisfail. Patchy distribution in southern Asia, reported only from India and Borneo. Present in PNG and Solomon Is.
Hosts	Unknown.
Vector status	Potential vector of BTV (Standfast et al 1985; Bellis & Dyce 2005).
Immature habitat	Rotting seaweed (Wirth & Hubert 1989).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; Apical pale marking in cell m_1 complex, reaching wing margin and joining pale marking along vein M_1 ; abdominal tergites 3-4 rectangular, noticeably wider than long, base of anal cell with longitudinal dark stripe extending from base of cell to margin of wing near apex of cell; basal pale spot in cell m_1 in line with poststigmatic pale spot and spot in cell m_4 .

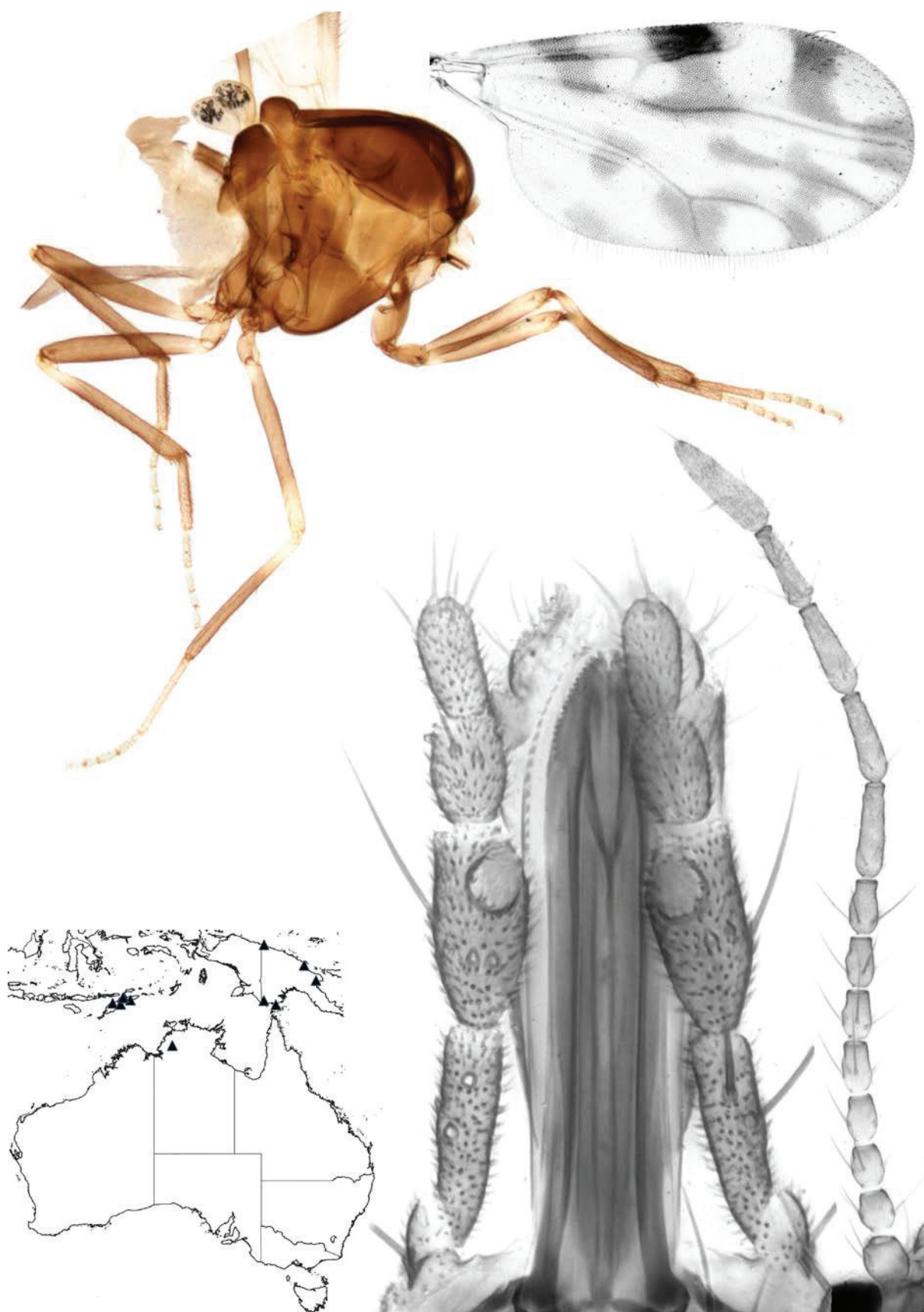


C. dumdumi

Culicoides flavipunctatus

Culicoides flavipunctatus Kitaoka 1975: 199 (Japan)

Synonyms	Nil.
Distribution	Absent from Australia although single specimens have been detected in NT and northern Qld (Bellis et al 2015). Widespread but apparently uncommon in southern Asia, from India to PNG and north to southern China and Japan.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; Apical pale marking in cell m_1 complex, reaching wing margin and joining pale marking along vein M_1 ; abdominal tergites 3-4 rectangular, noticeably wider than long, base of anal cell pale; basal dark marking on costa shorter than stigma; basal pale spot in cell m_1 in line with or distal to level of poststigmatic pale spot and spot in cell m_4 .



C. flavipunctatus

Culicoides fulvus

Culicoides fulvus Sen & Das Gupta 1959: 628

Synonyms	Nil.
Distribution	Kimberley region of WA, Top End of NT, northeastern Qld, south to Townsville. Widespread in southern Asia, including India and southern China, east to Solomon Is.
Hosts	Cattle (Muller et al 1981).
Vector status	Proven and highly efficient vector of BTV (Standfast et al 1985).
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; apical pale marking in cell m_1 complex, reaching wing margin and joining pale marking along vein M_1 ; base of anal cell pale; basal dark marking on costa of similar length to stigma. Abdominal tergites 3-4 rectangular, noticeably wider than long.

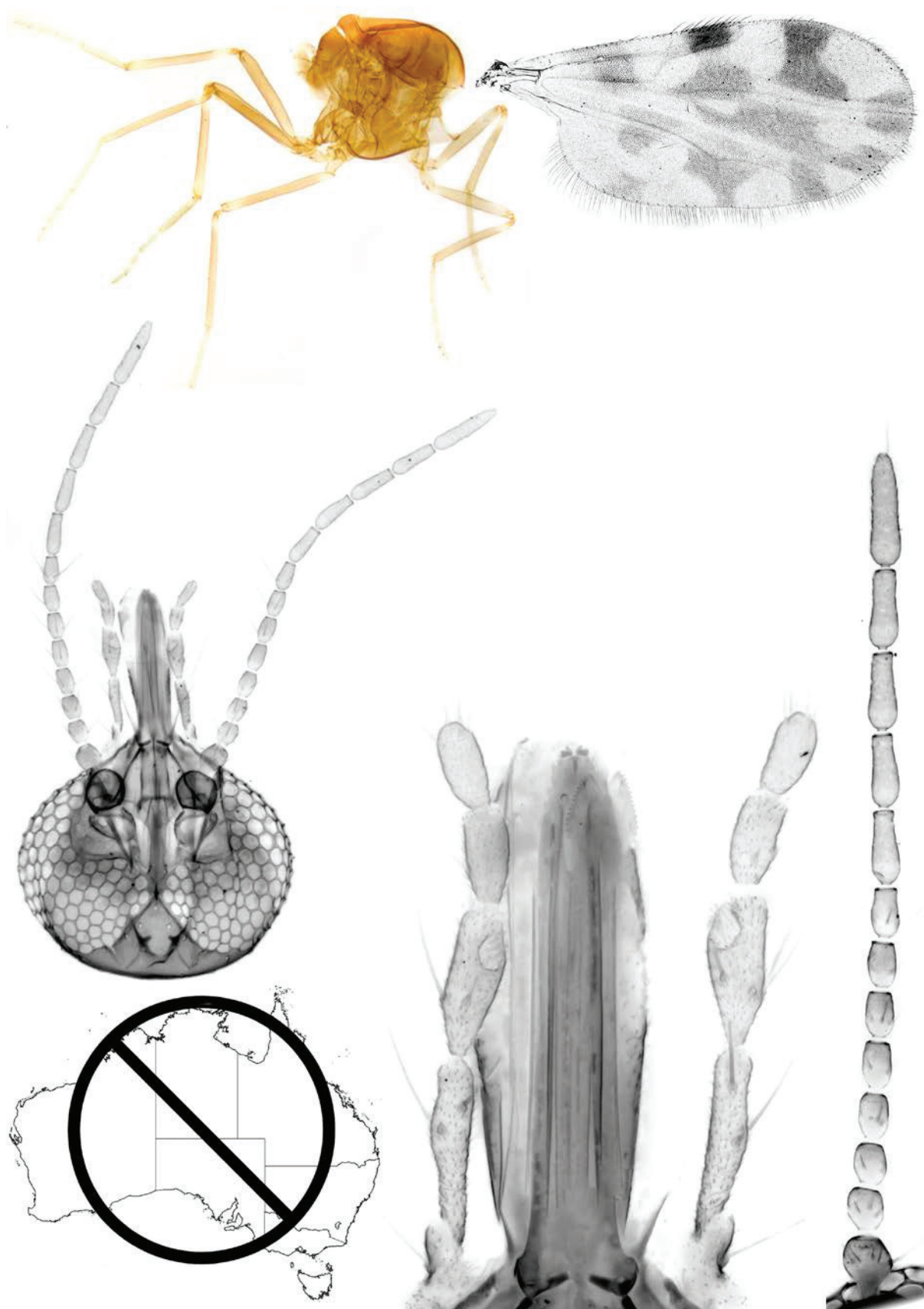


C. fulvus

Culicoides imicola

Culicoides imicola Kieffer 1913:11

Synonyms	<i>Culicoides pallidipennis</i> Carter, Ingram and Macfie, 1920: 265. <i>Culicoides minutus</i> Sen and Das Gupta, 1959: 622 <i>Culicoides pseudoturgidus</i> Das Gupta, 1962: 538
Distribution	Widespread in Old World tropics from South Africa, north to Mediterranean Europe, east to northern Thailand and south eastern China.
Hosts	Bovids, horses, other large mammals.
Vector status	Proven vector of BTV and African Horse sickness, probable vector of Lesiteles, Nyabira, Sabo, Shamonda, Simbu and Equine Encephalosis viruses (Meiswinkel et al 2004).
Immature habitat	Rich mixture of organic matter and water saturated soil (Mellor & Pitzolis 1979)
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Abdominal tergites 3-5 rounded, not wider than long. Cell r_2 pale apically; apical pale marking in cell m_1 complex, reaching wing margin and joining pale marking along vein M_1 ; posterior edge of pale marking in cell m_1 broadening to reach or cross vein M_2 subapically then narrowing apically. Proboscis and palpi relatively long, reaching flagellar segment 7 or 8.

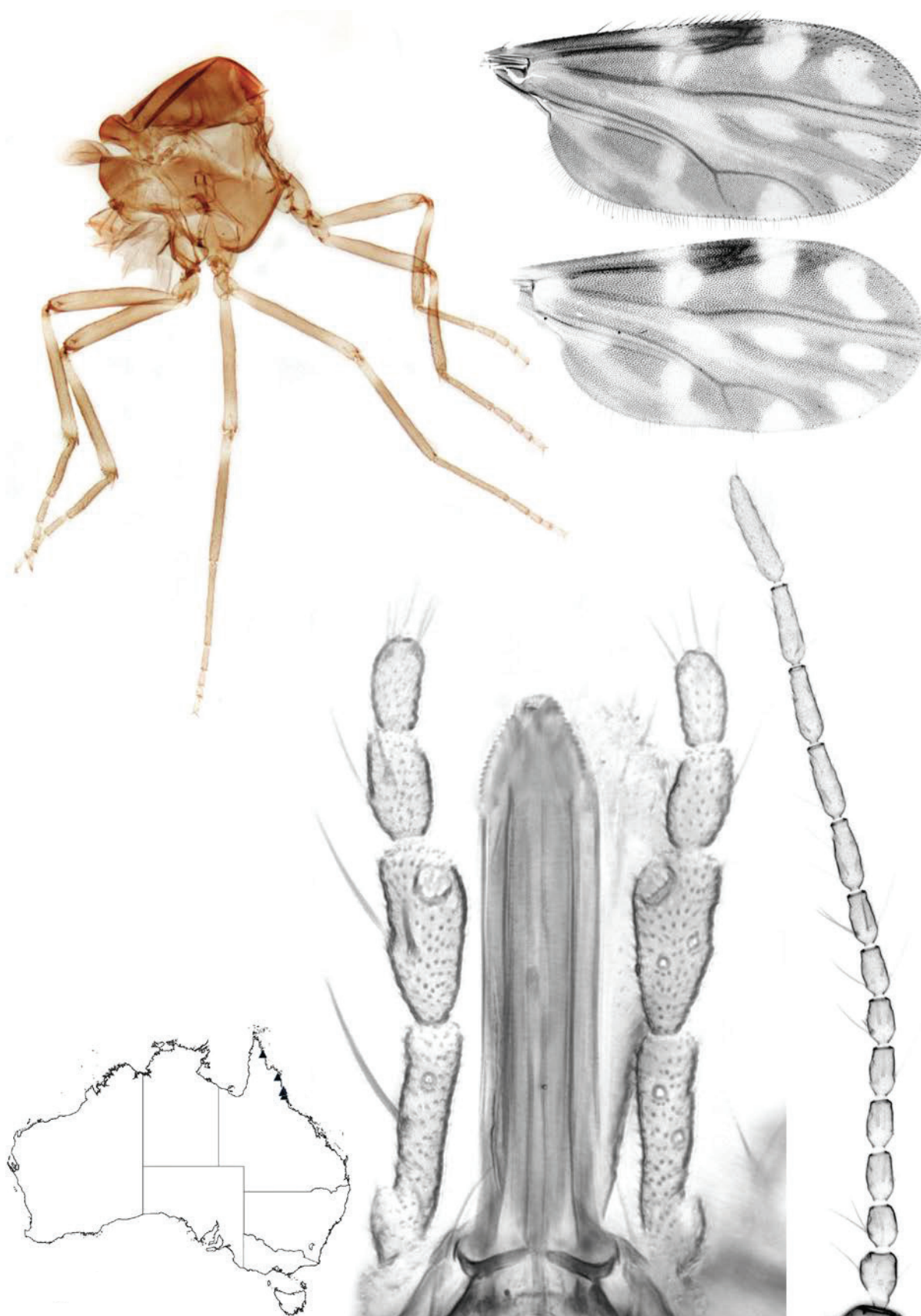


C. imicola

Culicoides jacobsoni

Culicoides jacobsoni Macfie 1934: 215

Synonyms	<i>Culicoides buckleyi</i> Macfie 1937:117; <i>kitaokai</i> Tokunaga 1955: 6 <i>unisetiferus</i> Tokunaga 1959: 236
Distribution	Rainforests of northern Qld. Widespread in Asia north to Korea, east to Solomon Is. although genetic evidence suggests Australian populations are distinct (Gopurenko et al 2015).
Hosts	Unknown.
Vector status	Potential vector of BTV and Tibet Orbivirus in China (Duan et al 2021).
Immature habitat	Rotting flower heads and fruit (Wirth & Hubert 1989), cassowary dung (Dyce unpublished).
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; basal and apical pale markings in anal cell joined by a pale longitudinal stripe; apical pale markings in cells r_3 and m_1 not reaching wing margin; centre of distal pale spot in cell r_3 about midway between vein M_1 and wing margin, apical pale marking in cell r_3 crescent-shaped.

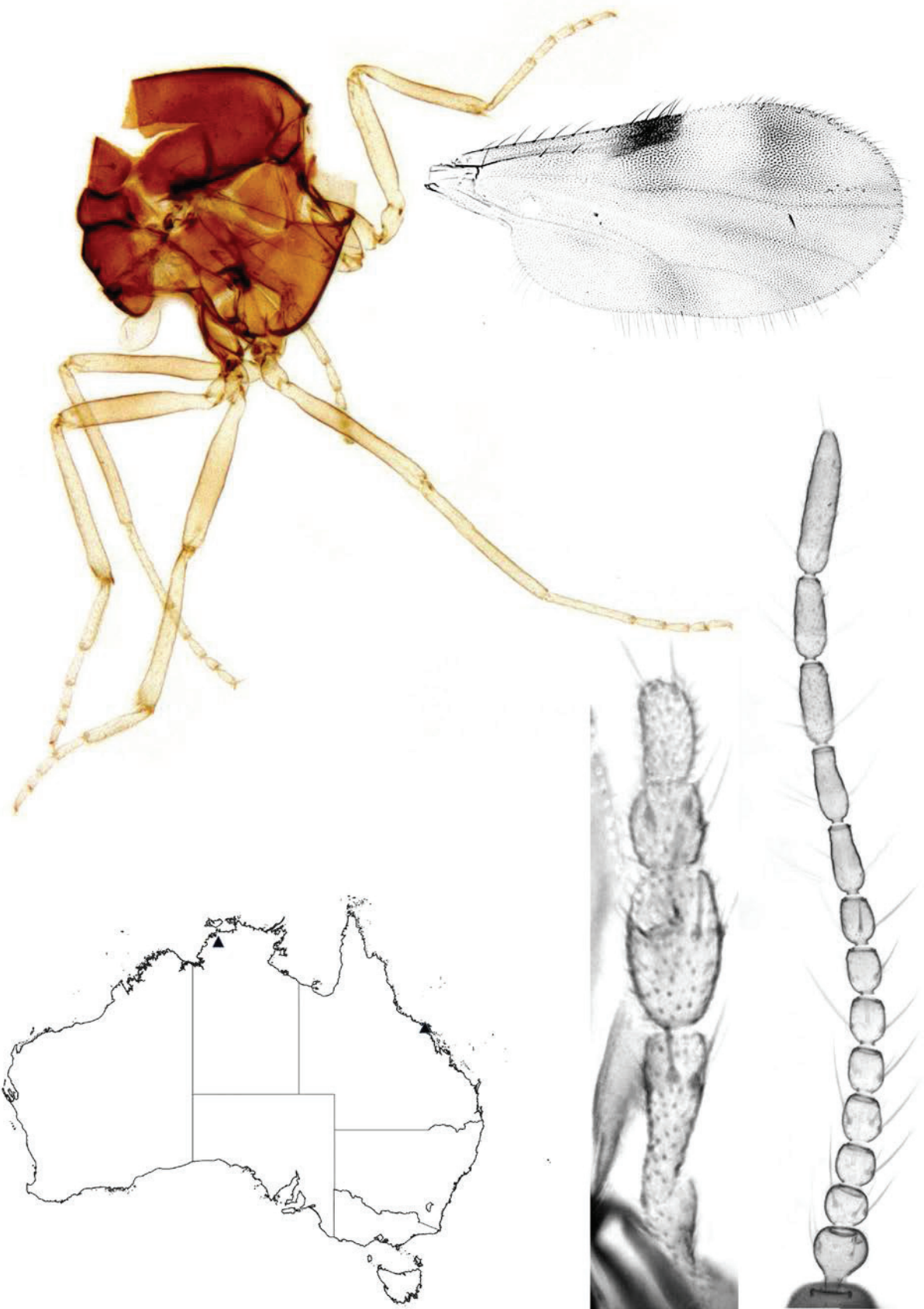


C. jacobsoni

Culicoides minimus

Culicoides minimus Wirth & Hubert 1989: 251

Synonyms	Nil.
Distribution	Top End of NT, Kimberley region of WA and northern Qld, although there is some doubt over the identification of these Australian specimens. Widespread in SE Asia including Timor, Indonesia, Malaysia and Thailand.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apical pale marking in cell m_1 complex or triangular, reaching wing margin and often joining pale marking along vein M_1 ; Eyes hairy, dark marking over vein CuA quadrate, apical pale marking in cell r_3 quadrant shaped with perpendicular proximal and posterior margins, SCo absent from flagellomere 12. Variation in the characters that separate <i>C. actoni</i> from <i>C. minimus</i> have been observed in Australian populations of <i>C. actoni</i> casting doubt over Australian records of <i>C. minimus</i> .

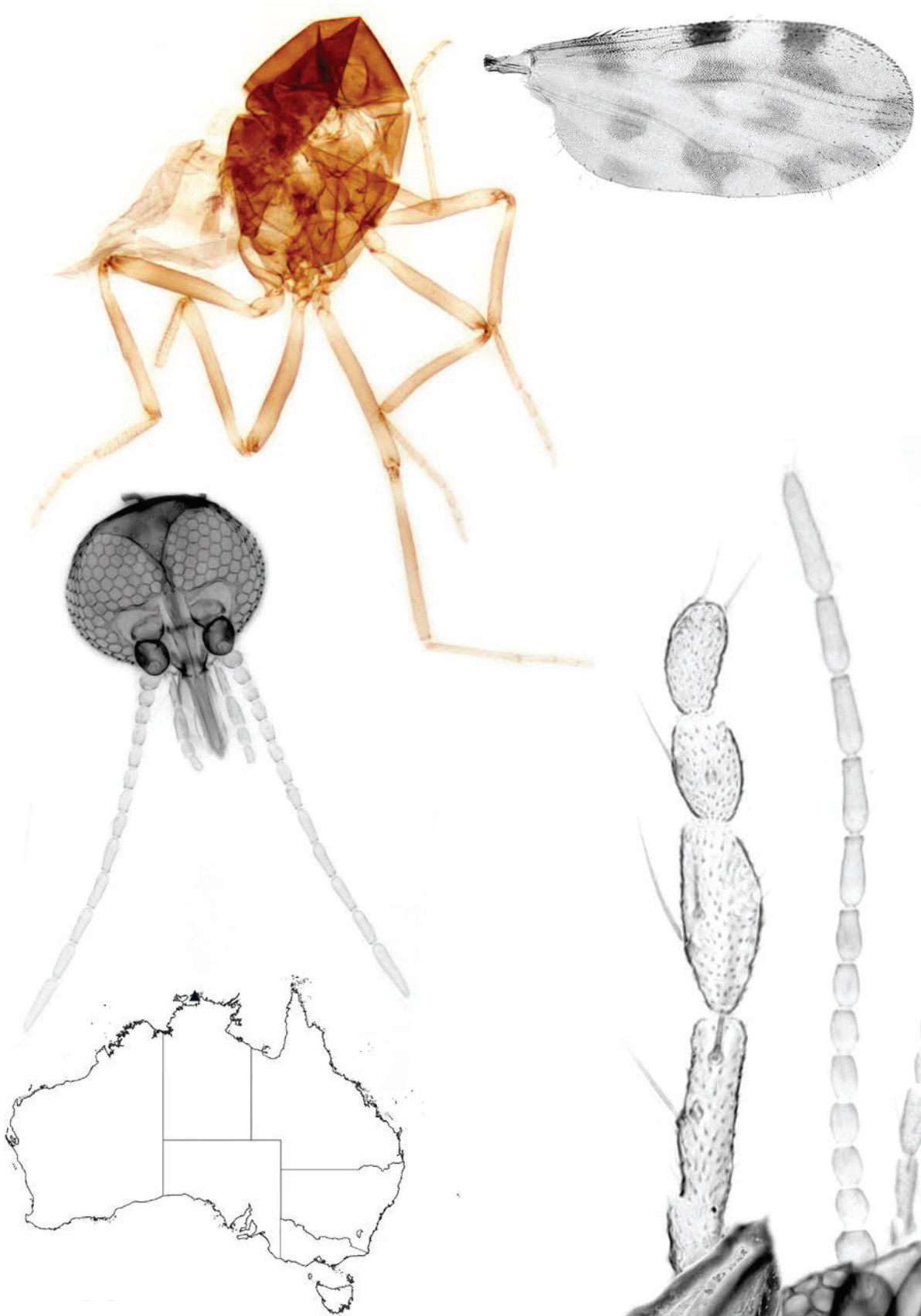


C. minimus

Culicoides nudipalpis

Culicoides nudipalpis Delfinado 1961: 655

Synonyms	Nil.
Distribution	Limited distribution in Top End of NT. Eastern Indonesia, Timor-Leste, Philippines, PNG. Records from Hainan (Yu et al 2005) and Taiwan (Lien et al 1998) require confirmation as they may refer to <i>C. imicola</i> .
Hosts	Mammals (Bellis et al 2005).
Vector status	Possible vector of BTV (Bellis et al 2005).
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Abdominal tergites 3-5 rounded, not wider than long; Cell r_2 pale apically; Apical pale marking in cell m_1 complex, reaching wing margin and joining pale marking along vein M_1 ; posterior edge of pale marking in cell m_1 broadening to reach or cross vein M_2 subapically then narrowing apically.

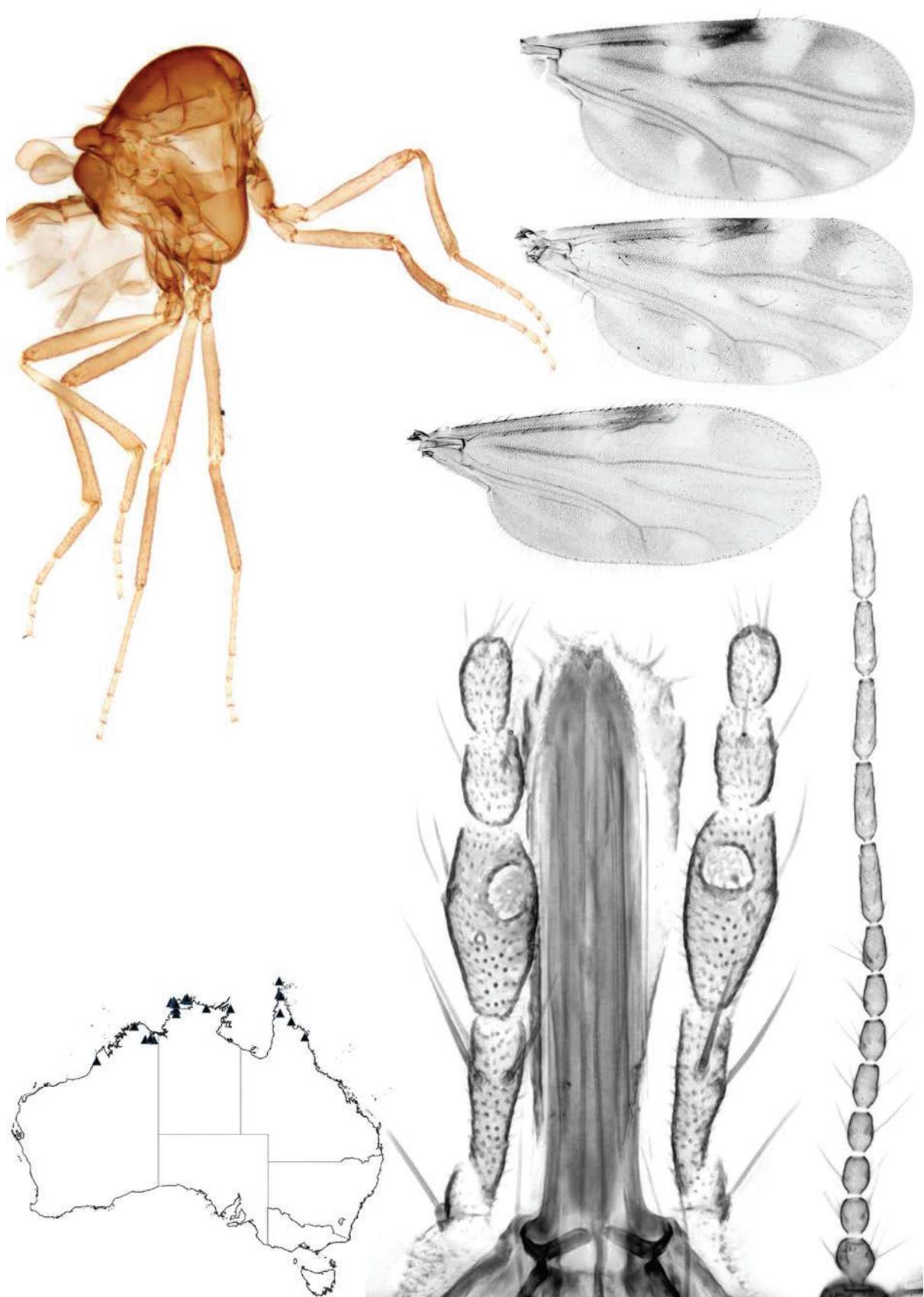


C. nudipalpis

Culicoides obscurus

Culicoides obscurus Tokunaga in Tokunaga & Murachi 1959: 347 (Palau)

Synonyms	<i>pungens</i> de Meijere 1909: 200
Distribution	Northern coastal WA, NT and Qld. Widespread in southern Asia from Thailand to Solomon Is.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown but likely coastal.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; basal and apical pale markings in anal cell joined by a pale longitudinal stripe; apical pale markings in cells r_3 and m_1 , if present, not reaching wing margin; centre of distal pale spot in cell r_3 closer to vein M_1 than wing margin.

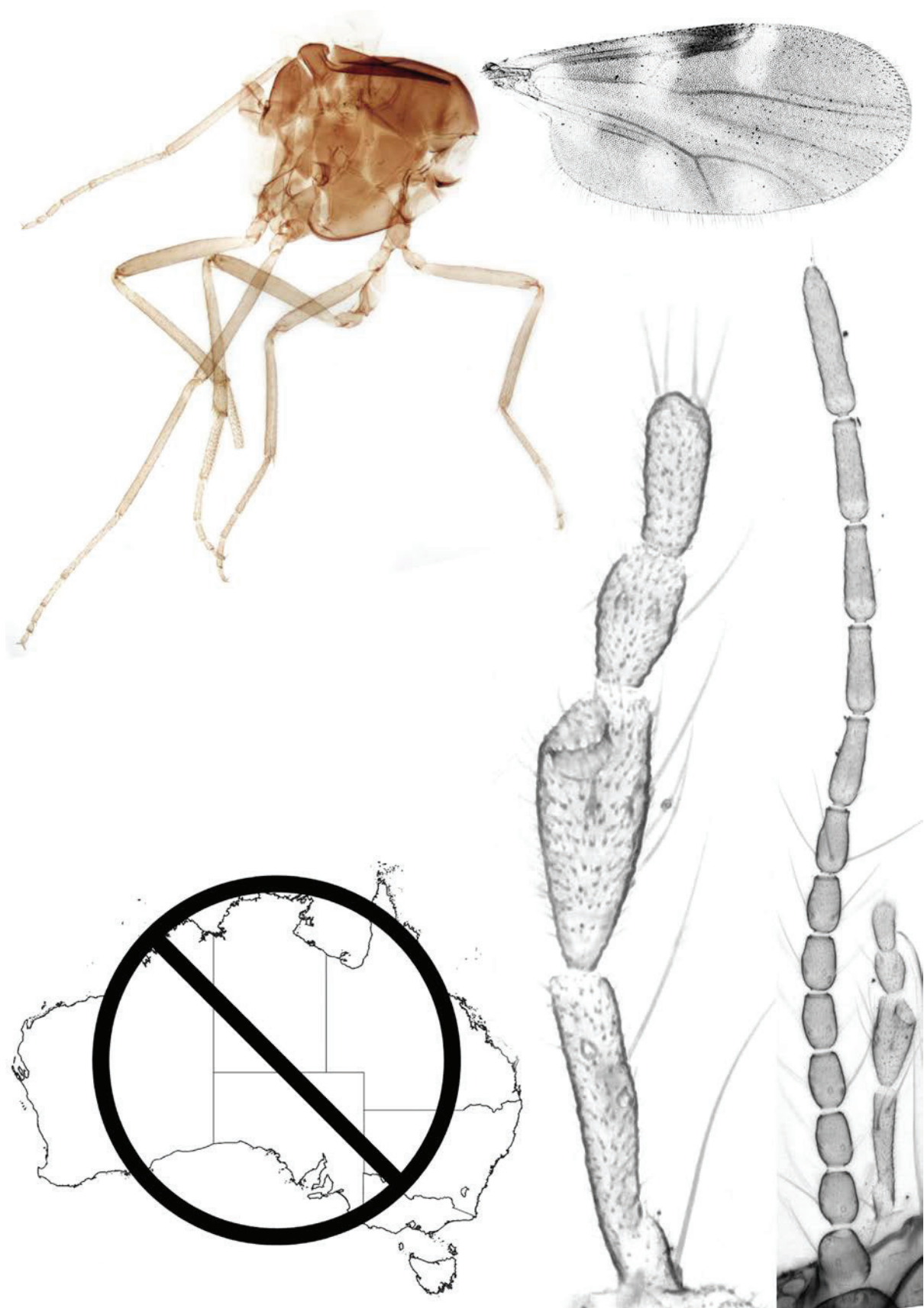


C. obscurus

Culicoides obsoletus

Culicoides obsoletus (Meigen) 1818:76 (Ceratopogon)(Europe)

Synonyms	<i>varius</i> (Winnertz, 1852): 35 (<i>Ceratopogon</i>). Germany. <i>yezoensis</i> (Matsumura, 1911): 60 (<i>Ceratopogon</i>). Russia (Sakhalin Oblast). <i>lacteinervis</i> Kieffer, 1919: 47. Slovak Republic, Ukraine. <i>rivicola</i> Kieffer, 1921: 56. Germany. <i>clavatus</i> Kieffer, 1921: 56. Germany. <i>heterocerus</i> Kieffer, 1921: 57. Germany. <i>pegobius</i> Kieffer, 1922: 235. Germany. <i>kabyliensis</i> Kieffer, 1922: 505. Algeria. <i>concitus</i> Kieffer, 1922: 71. Germany. <i>intermedius</i> Okada, 1941: 22 (as variety of <i>obsoletus</i> Meigen, preoccupied by <i>Dasyhelea intermedia</i> Santos Abreu, 1918. Japan. <i>sintrensis</i> Cambournac, 1956: 591. Portugal. <i>seimi</i> Shevchenko, 1967: 173. Ukraine.
Distribution	Absent from Australia. Holarctic.
Hosts	Bovids, sheep, humans, chicken (Calvo et al 2012).
Vector status	Confirmed vector of Bluetongue and Schmallenburg viruses, potential vector of African horse sickness virus (Purse et al 2015).
Immature habitat	Marshes, swamps, acid grassland, temporary organically enriched pools, rotting vegetable matter, banana stumps, horse manure heaps, maize silage residues, leaf litter and damp debris within tree-holes (Kettle & Lawson, 1952; Mellor & Pitzolis, 1979; Zimmer et al, 2008).
Diagnosis	Part of a complex of species which can all be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Apical pale marking in cell r_3 very weak or absent; Cell r_2 pale apically; poststigmatic pale spot transverse, extending almost to vein M_1 .

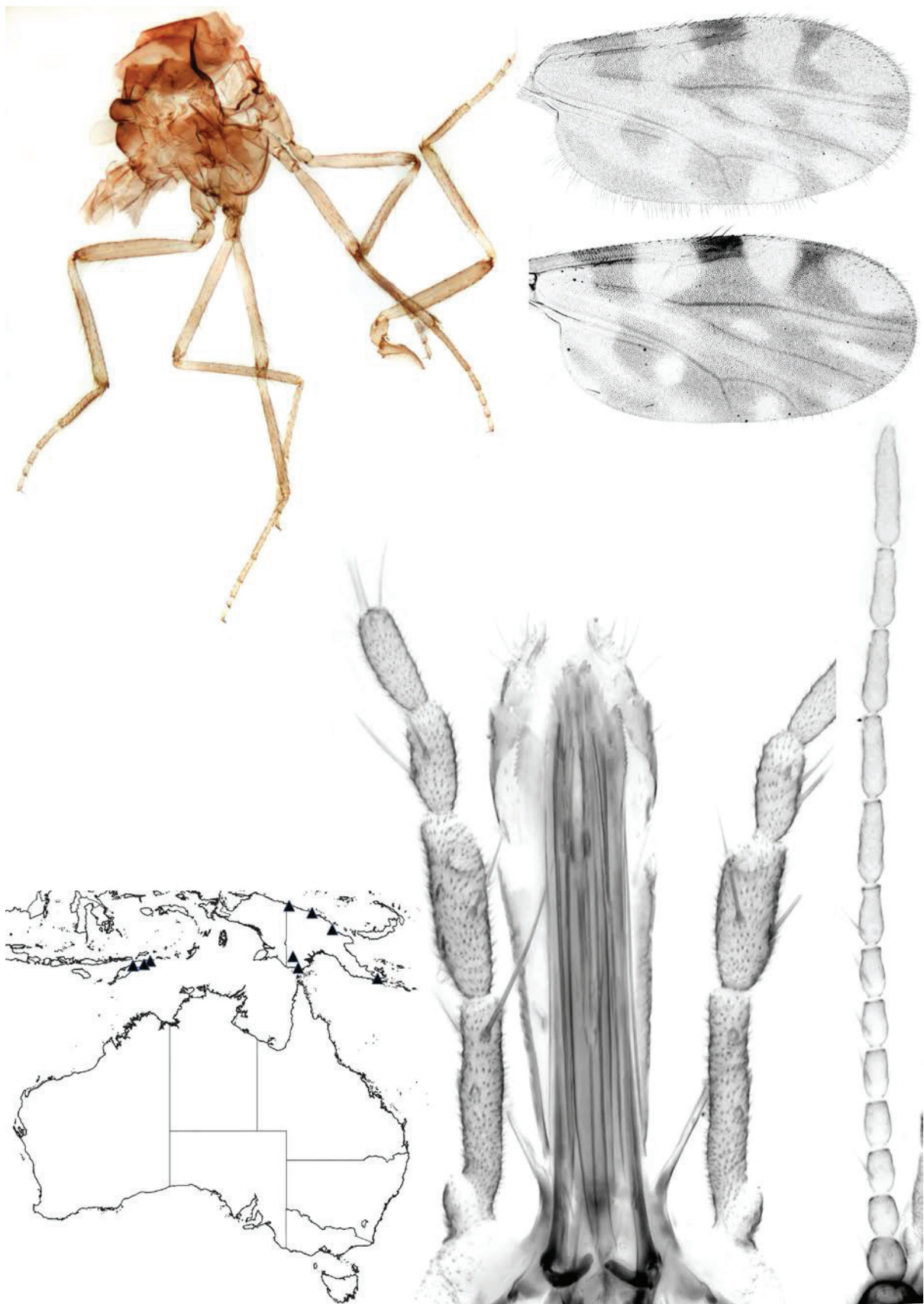


C. obsoletus

Culicoides orientalis

Culicoides orientalis Macfie 1932: 490

Synonyms	<i>nayabasari</i> Das Gupta 1963: 35
Distribution	Exotic to Australia. Widespread in southern Asia, north to China, west to India, east to Solomon Is.
Hosts	Cattle (Buckley 1938), mammals (Bellis et al 2005).
Vector status	Potential vector of <i>Onchocerca gibsoni</i> (Buckley 1938) and EHDV (Duan et al 2022).
Immature habitat	Old manure piles (Buckley 1938).
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; apical pale marking in cell m_1 complex, reaching wing margin and joining pale marking along vein M_1 ; basal and apical pale markings in anal cell joined by a pale longitudinal stripe; dark longitudinal stripe extending from base of anal cell to wing margin near the apex of the anal cell; basal dark marking on costa about as long as stigma. 3rd palpal segment about 3 times as long as wide.

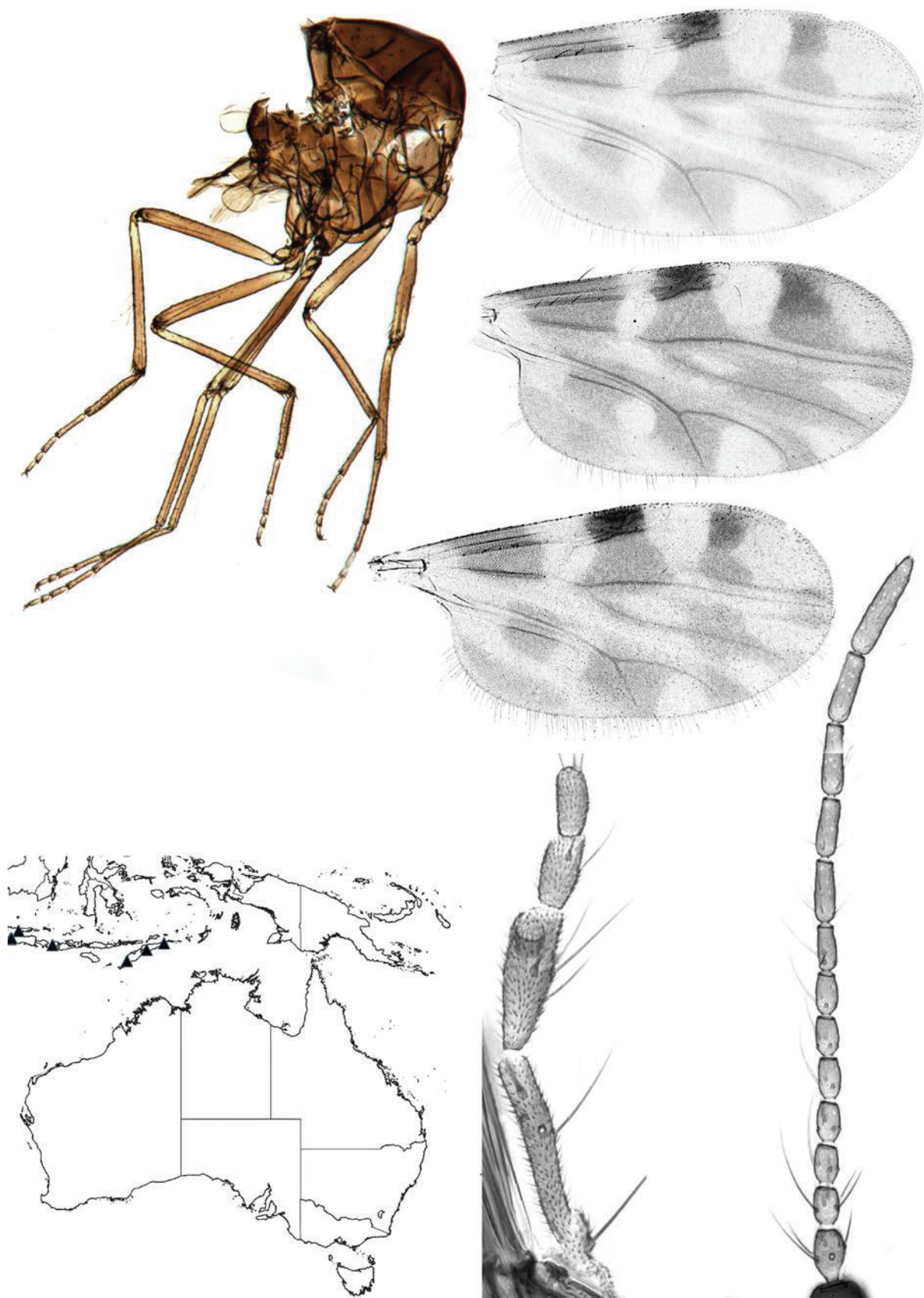


C. orientalis

Culicoides tainanus

Culicoides tainanus Kieffer 1916: 114

Synonyms	<i>maculatus</i> (Shiraki) 1913: 294 [<i>Ceratopogon</i>] <i>kii</i> Tokunaga 1937: 284 <i>sigaensis</i> Tokunaga 1937: 322 <i>kyotoensis</i> Tokunaga 1937: 329 <i>suborientalis</i> Tokunaga 1951: 106
Distribution	Exotic to Australia. Widespread but uncommon in southern Asia, more common in the Palaearctic region north to Korea. Genetic evidence suggests the presence of multiple species (Duan et al 2022). Record from Irian Jaya by Sukarsih et al 1983 was based on a misidentification of <i>C. orientalis</i>
Hosts	Unknown but presence of livestock-associated viruses suggests livestock are hosts.
Vector status	Potential vector of Akabane (Yanase et al 2019), Bluetongue (Kato et al 2016), Banna and Tibet Orbivirus (Duan et al 2021; 2022).
Immature habitat	Unknown
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; Apical pale marking in cell m_1 complex, reaching wing margin and joining pale marking along vein M_1 ; basal and apical pale markings in anal cell joined by a pale longitudinal stripe; dark longitudinal stripe extending from base of anal cell to wing margin near the apex of the anal cell; basal dark marking on costa longer than stigma. 3rd palpal segment about 3 times as long as wide.

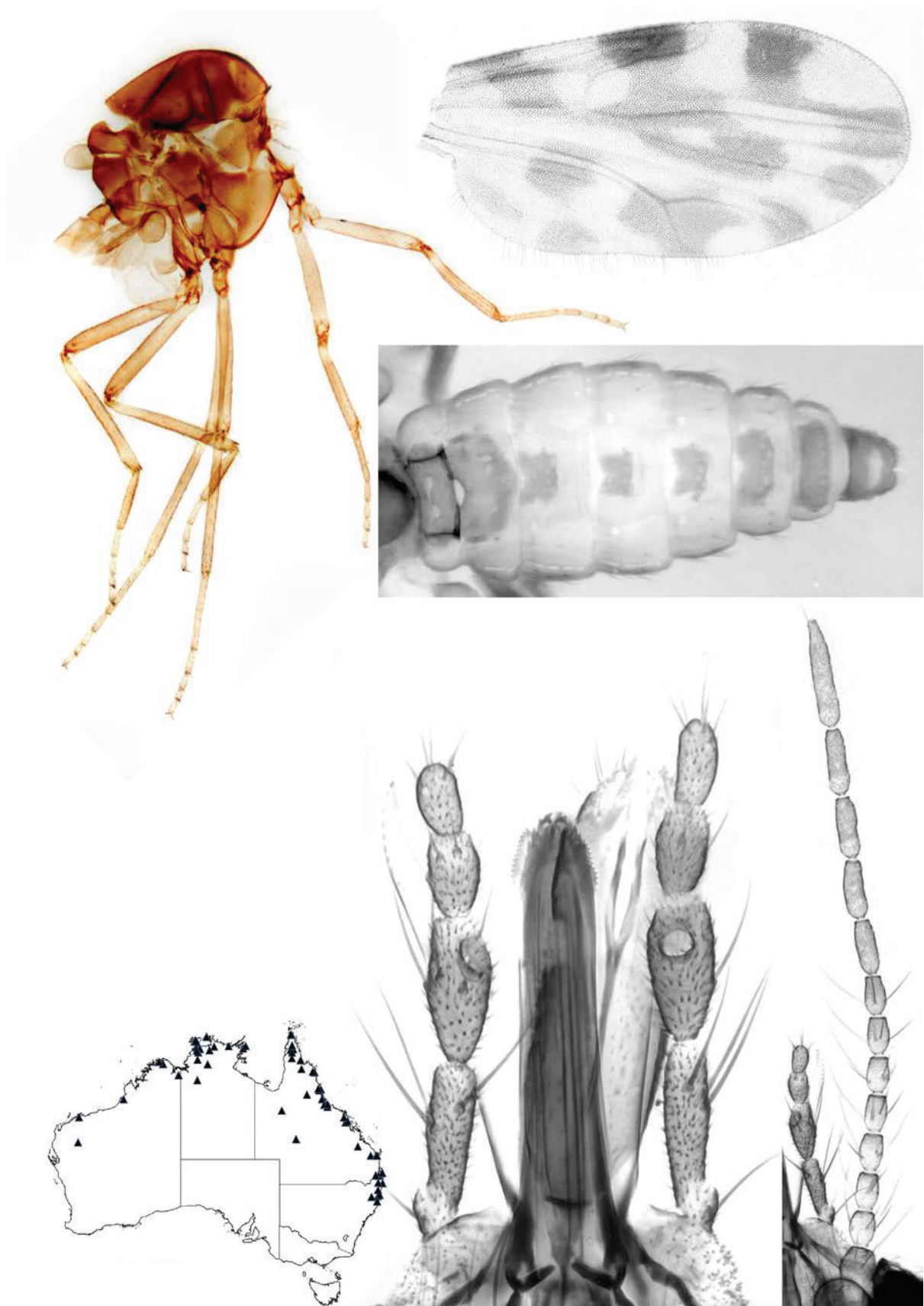


C. tainanus

Culicoides wadai

Culicoides wadai Kitaoka 1980: 14

Synonyms	<i>Culicoides suzukii</i> Kitaoka (misident) Standfast et al (1978; 1979).
Distribution	Kimberley region of WA, Top End of NT, northern and eastern Qld, northeastern NSW. Widespread in SE Asia, north to Japan.
Hosts	Bovids (Muller et al 1981).
Vector status	Probable vector of BTB (Standfast et al 1985; Bellis et al 1994), likely vector of Akabane (Cybinski & Muller 1990).
Immature habitat	Discrete bovid dung pats (Dyce 1982).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; apical pale marking in cell m_1 complex, reaching wing margin and joining pale marking along vein M_1 ; dark marking at apex of vein M_2 quadrate, discrete; vein CuA entirely included in dark marking.

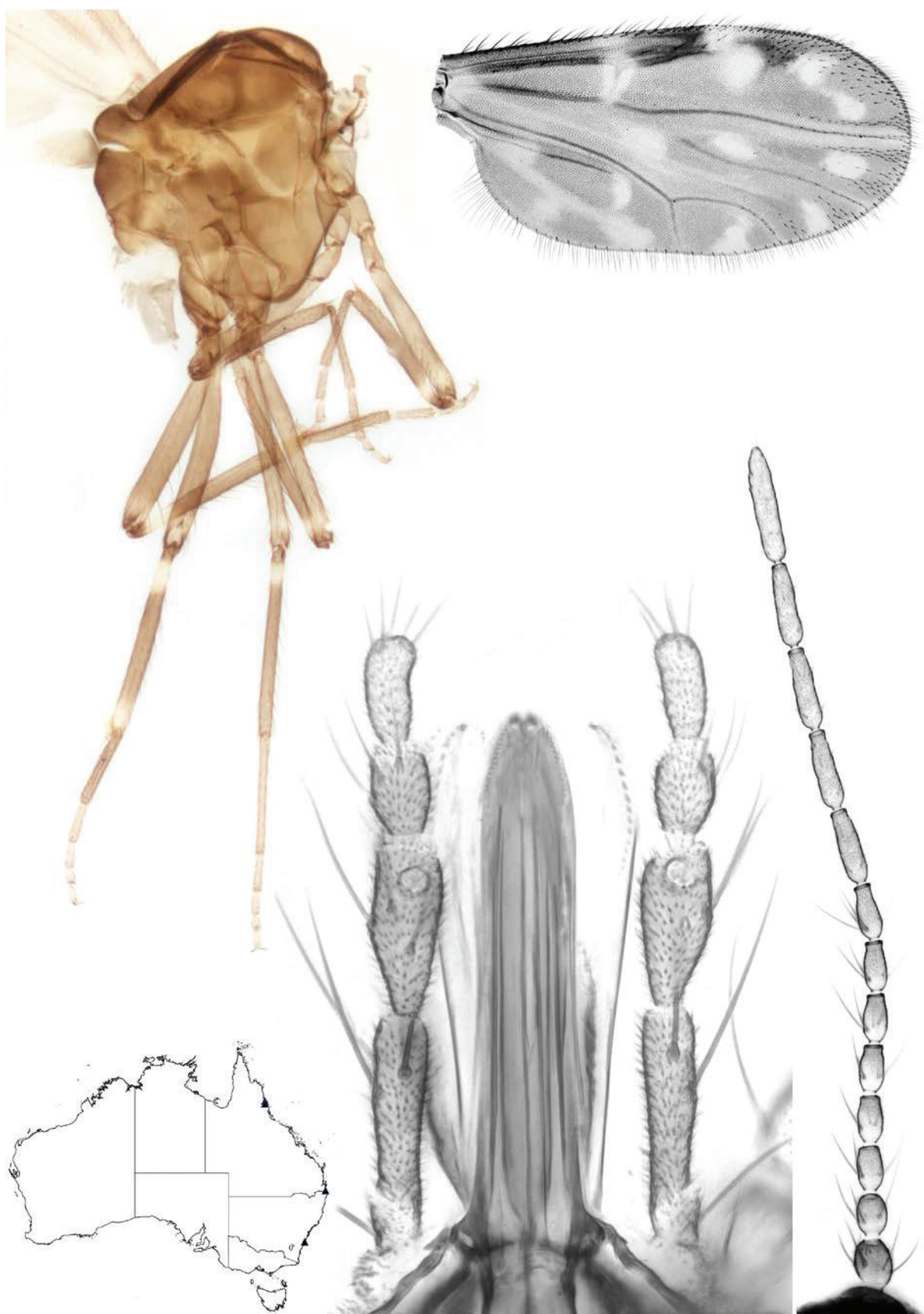


C. wadai

Culicoides Avaritia sp no 2

Culicoides Avaritia sp no 2 (Dyce et al 2007:19)

Synonyms	Nil.
Distribution	Rainforests of eastern Australia.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Cattle dung pats (Bishop & McKenzie unpublished), fungal fruiting body (Dyce unpublished).
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; basal and apical pale markings in anal cell joined by a pale longitudinal stripe; apical pale markings in cells r_3 and m_1 not reaching wing margin; centre of distal pale spot in cell r_3 about midway between vein M_1 and wing margin, apical pale marking in cell r_3 sigmoidal.



C. Avaritia sp no 2

Subgenus *Drymodesmyia* Vargas

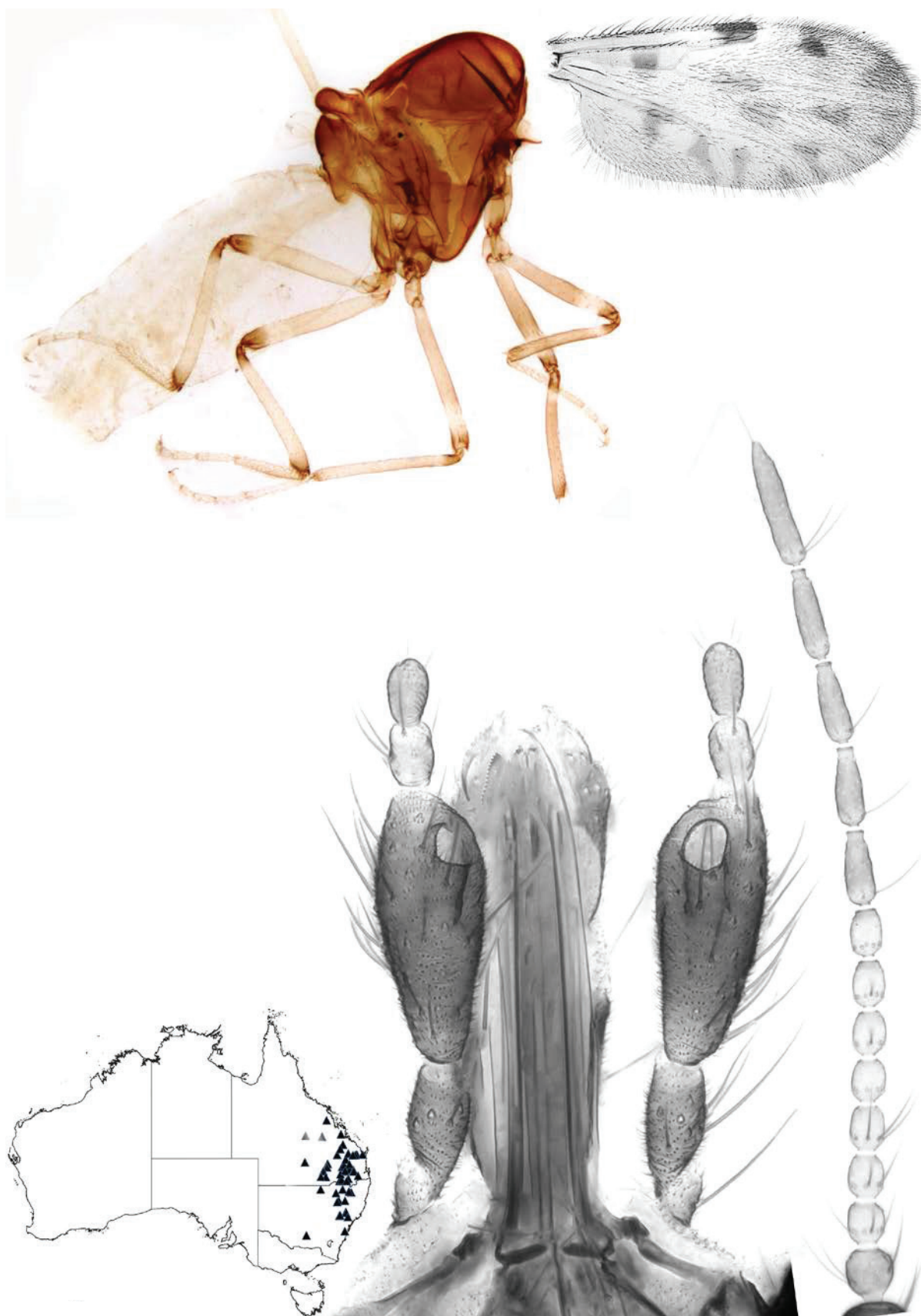
Culicoides subgenus *Drymodesmyia* Vargas, 1960:40.

Type species	<i>Culicoides copiosus</i> Root and Hoffman, by original designation.
Synonyms	Nil.
Distribution	The subgenus <i>Drymodesmyia</i> is naturally limited to the southern Nearctic and northern Neotropical region. <i>C. loughnani</i> is one of a large number of species that exploit rot pockets in cacti and euphorbs. Species of this subgenus could potentially occur wherever prickly pears and <i>Cactoblastis</i> have been introduced, e.g. South Africa, Mediterranean Basin.
Number of species worldwide	Borkent & Dominiak (2020) list 25 species.
Number of species in Australia	1, accidentally introduced during biocontrol program for prickly pear (Dyce 1969).
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Rot pockets of prickly pear following attack by <i>Cactoblastis</i> moth larvae.
Diagnosis	Female specimens can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Veins CuA and M ₄ pale throughout and vein M ₁ and M ₂ almost entirely pale.

Culicoides loughnani

Culicoides loughnani Edwards 1922: 165 (Jamaica)

Synonyms	Nil.
Distribution	Southeastern Qld and eastern NSW. Accidentally introduced from Central America (Dyce 1969).
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Rot pocket of prickly pear leaves.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Veins CuA and M ₄ pale throughout and vein M ₁ and M ₂ almost entirely pale.



C. loughnani

Culicoides subgenus *Haemophoructus*

Haemophoructus Macfie, 1925. 349

Type species	<i>Haemophoructus maculipennis</i> Macfie, by monotypy.
Synonyms	Nil.
Distribution	Widespread in tropical Asia. Also present in New Guinea and northern Australia.
Number of species worldwide	Borkent & Dominiak (2020) list 16 species.
Number of species in Australia	1.
Hosts	Mammalian, including large mammals.
Vector status	None known.
Immature habitat	Observed living in, but probably not feeding on, animal dung in water (Howarth 1985; Dyce unpublished). Howarth (1985) also reared adults from polluted stream margins.
Diagnosis	Female specimens can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Wing with 1 radial cell.

Culicoides calcaratus

Culicoides calcaratus Wirth & Hubert 1989: 157 (Malaysia)

Synonyms	Nil.
Distribution	Kimberley, Top End of NT; Widespread in SE Asia.
Hosts	Bovids (Muller et al 1981 as <i>C. Haemophoructus</i> sp.).
Vector status	Unknown.
Immature habitat	Stream margins and animal dung (Howarth 1985).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Large, dark species. Cells r_1 and r_2 fused into single cell; apical pale marking in cell r_3 transverse.



C. calcaratus

Key to female specimens of Australian species of *Hoffmania*

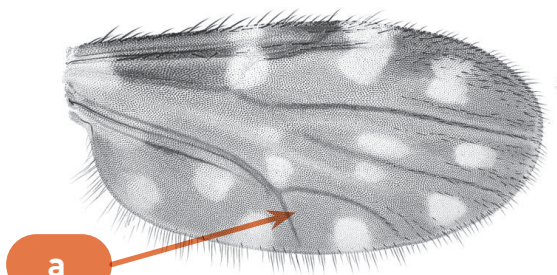
1

Base of cell m_4 dark (a)

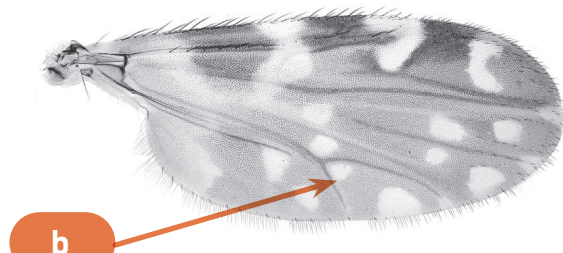
C. sumatrae

Base of cell m_4 with a pale marking (b)

2



C. sumatrae



C. peregrinus

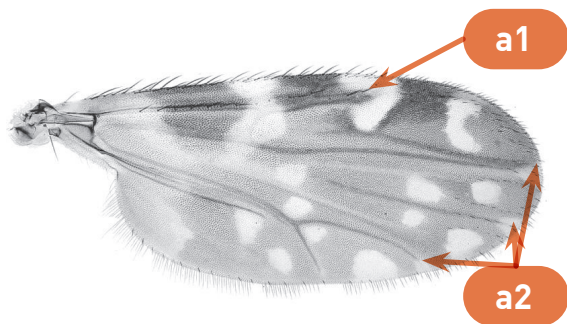
2

Basal edge of poststigmatic spot penetrated by narrow rectangular dark stripe along vein R_3 (a1); Apex of veins M_1 , M_2 and M_{3+4} included in pale marking (a2)

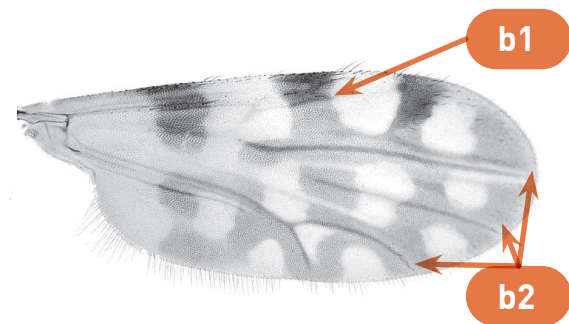
C. peregrinus

Basal edge of poststigmatic spot straight or evenly curved without narrow rectangular dark stripe along vein R_3 (b1). Apex of veins M_1 , M_2 and M_{3+4} not included in pale marking (b2)

C. novaguineanus



C. peregrinus



C. novaguineanus

Culicoides subgenus Hoffmania

Culicoides subgenus *Hoffmania* Fox, 1948:21

Type species	<i>Culicoides inamollae</i> Fox and Hoffman (= <i>C. insignis</i> Lutz), by original designation.
Synonyms	Nil.
Distribution	Widespread in tropical Americas, Africa and Asia. Also present in New Guinea and northern Australia.
Number of species worldwide	Borkent & Dominiak (2020) list 80 species but confusion over the status of this subgenus in parts of Asia (see Duan et al 2022) mean that this is probably an underestimate.
Number of species in Australia	3.
Hosts	Mammalian, including large mammals.
Vector status	The Neotropical <i>C. insignis</i> is a known vector of BTV. <i>C. peregrinus</i> has been associated with BTV.
Immature habitat	The widespread and abundant <i>C. peregrinus</i> is apparently the only species of the subgenus associated with ground water bodies; common in rice paddies and puddles and recovered from old buffalo wallows in Northern Territory. Four other species have been reared from rotting jungle fruit, decaying banana stem and tree wounds (Howarth 1985) and <i>C. sumatrae</i> from a fungal fruiting body, rotting flower heads, rotting fruit and from Cassowary dung which often contains partly digested fruit (Dyce, unpublished).
Diagnosis	Female specimens can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Wing with 2 radial cells; cell r_2 pale apically; a pair of pale spots straddling the mid point of vein M_2 , these joined to basal pale spots in those cells by narrow pale stripes. SCh absent from flagellomeres 9-13.

Culicoides novaguineanus

Culicoides novaguineanus Tokunaga 1959: 223 (New Guinea)

Synonyms	Nil.
Distribution	Cape York Peninsula; Papua New Guinea.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; large, dark species; apices of veins M_1 , M_2 and M_4 without a small pale marking at apex; 2 pale spots in cell M_4 , medial part of vein M_1 not included in pale marking.

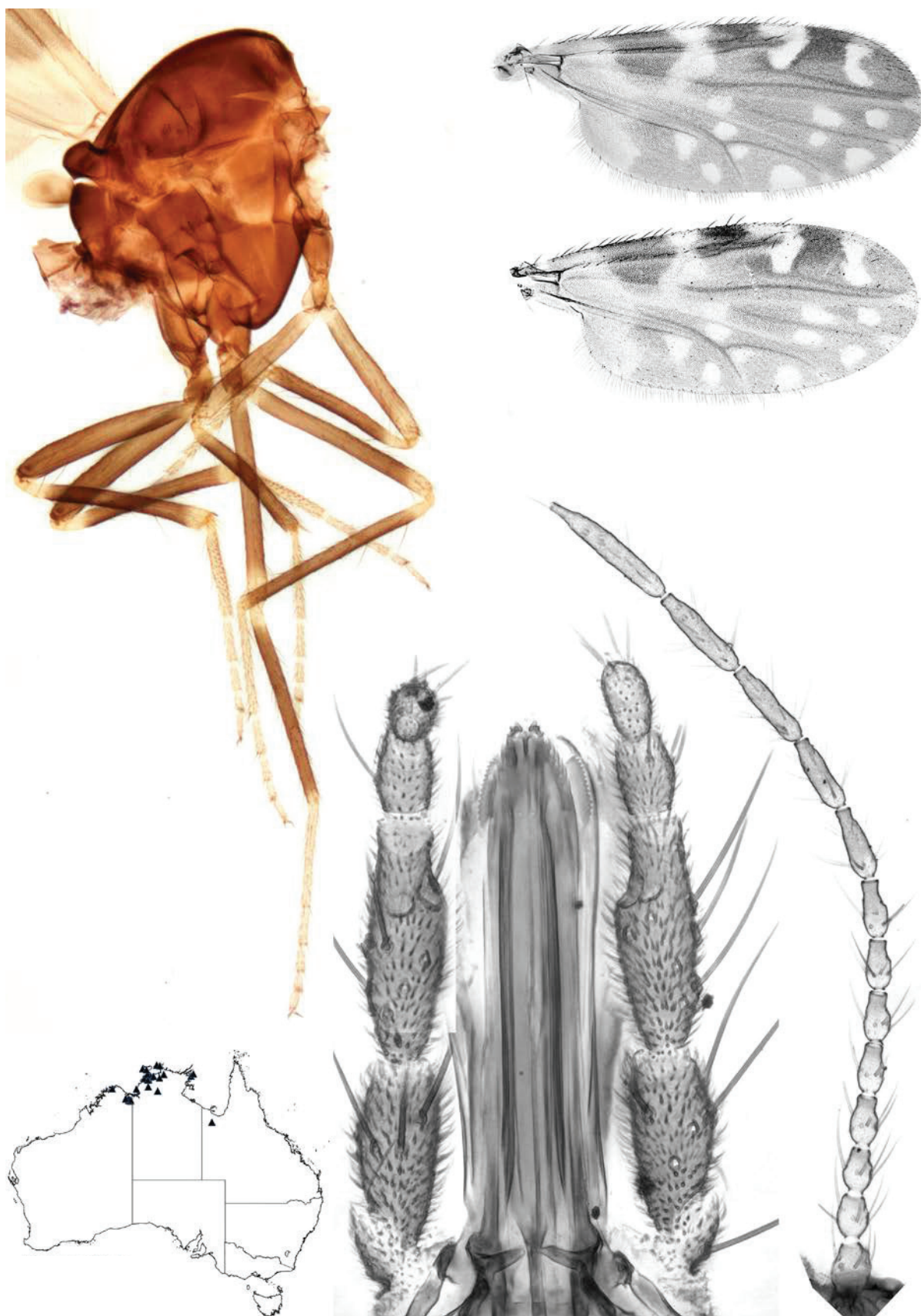


C. novaguineanus

Culicoides peregrinus

Culicoides peregrinus Kieffer 1910: 191 (India)

Synonyms	<i>judicandus</i> Bezzi 1916: 8; <i>esmoneti</i> Salm 1917: 136 <i>philippinensis</i> Kieffer 1921a: 564 <i>assamensis</i> Smith & Swaminath 1932: 183 <i>quadratus</i> Tokunaga 1951: 108;
Distribution	Kimberley, Top End of NT, Qld records require confirmation; Widespread and common in southern Asia.
Hosts	Bovids, horse, human, marsupial (Muller et al 1981), pigs, poultry (Wirth & Hubert 1989).
Vector status	Poor vector of BTV (Standfast et al 1985). Possible vector of CSIRO 25 and Beatrice Hill viruses (Standfast et al 1984).
Immature habitat	Shaded muddy pools and polluted drains (Edwards 1922); stream margins (Buckley 1938); old shaded buffalo wallow, polluted stream margins (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; Large, dark species; Apices of veins M_1 , M_2 and M_4 each with a small pale marking.



C. peregrinus

Culicoides sumatrae

Culicoides sumatrae Macfie 1934: 190 (Malaysia)

Synonyms	<i>amamiensis</i> Tokunaga 1937:325 <i>kagiensis</i> Tokunaga 1937: 327 <i>ohmorii</i> Takahashi 1958: 113 <i>assimilis</i> Delfinado 1961: 660
Distribution	Cape York Peninsula; Papua New Guinea. Widespread in Asia.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Polyporous fungi (Macfie 1934); Arum leaf axils (Howarth 1985); Rotting ginger flowers (Wirth & Hubert 1989) and casswary dung (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 pale apically; large, dark species; 1 pale spot in cell M_4 ; 2 pale spots in distal half of anal cell. Hind tibia dark to base and with apical pale band.



C. sumatrae

Key to females of species of *Marksomyia* present in Australia

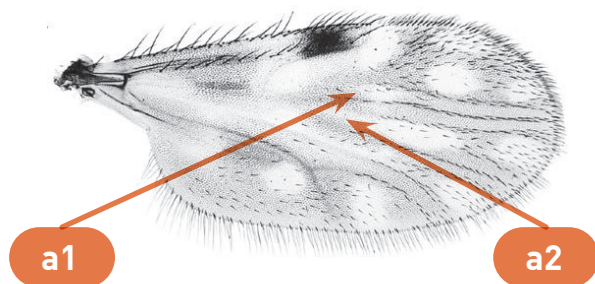
1

Base of basal pale spot in cell m_1 (a1) aligned with or basal to base of pale spot over vein M_1 (a2)

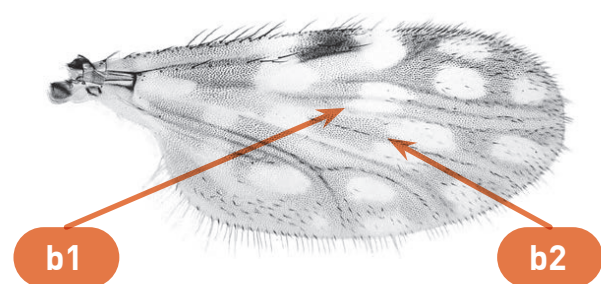
2

Base of basal pale spot in cell m_1 (b1) distinctly apical to base of pale spot over vein M_1 (b2)

3



C. dycei



C. zentae

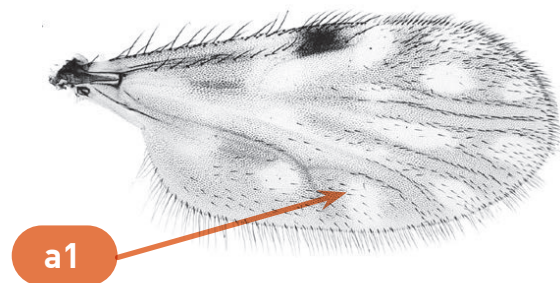
2

Cell m_4 with 1 pale spot distant from base of cell (a1), Hind femora unbanded or weakly banded (a2)

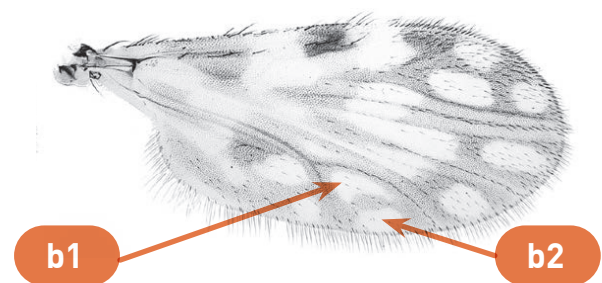
C. dycei

Cell m_4 with 2 pale spots, the anterior one (b1) near base of cell and cupping the posterior spot (b2) which may be weak (b3) or partially fused with anterior spot into one large spot (b4), Hind femora with strong basal and subapical pale bands (b5)

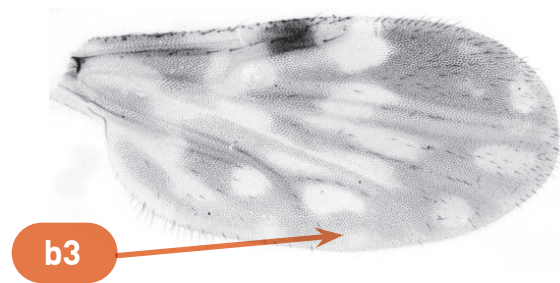
C. marksi



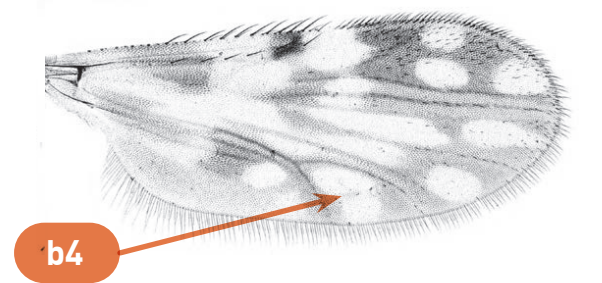
C. dycei typical form



C. marksi



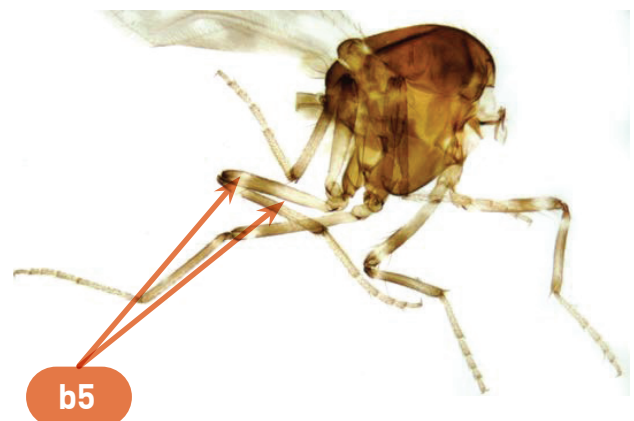
C. marksi variant



C. marksi variant



C. dycei



C. marksi

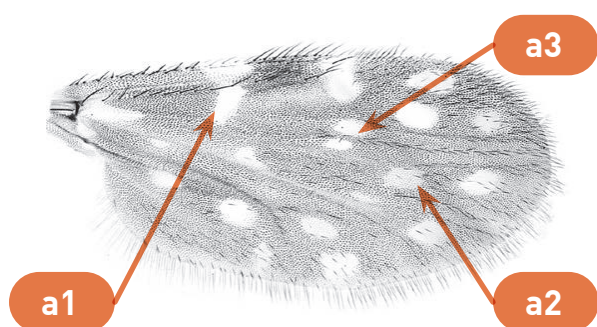
3

Pale markings on wing compact, pale marking over r-m cross-vein linear, with narrow posterior projection (a1); basal pale spot in cell m_1 (a2) small and round, at least its own diameter from pale spot over medial part of vein M_1 (a3)

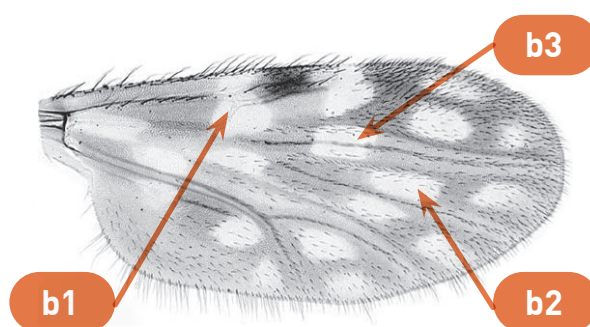
C. parvimaculatus

Pale markings on wing larger and more diffuse, pale marking over r-m cross-vein rounded and broadening posteriorly (b1); basal pale spot in cell m_1 (b2) elongate and less than its own diameter from pale spot over medial part of vein M_1 (b3)

4



C. parvimaculatus



C. kayi

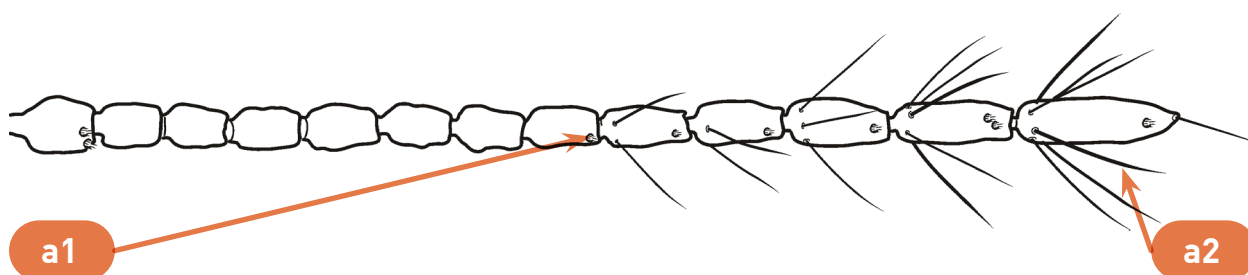
4

SCh present on flagellomere 8 (a1); flagellomere 13 with at least 5 SCh (a2)

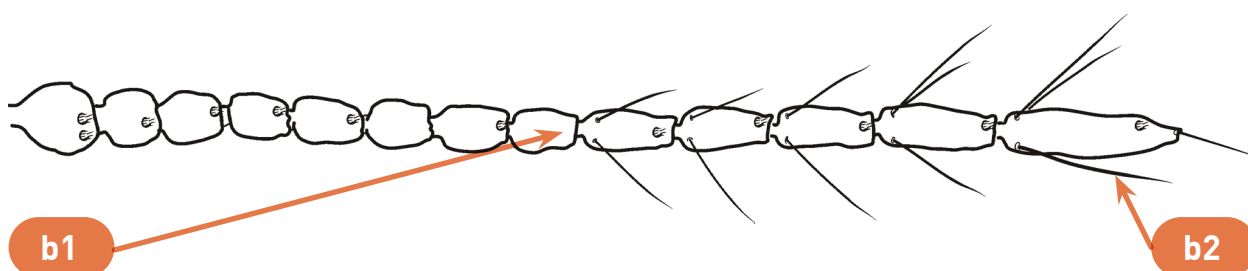
C. kayi

SCh rarely present on flagellomere 8 (b1); flagellomere 13 with 2 or 3 SCh (b2)

C. zentae

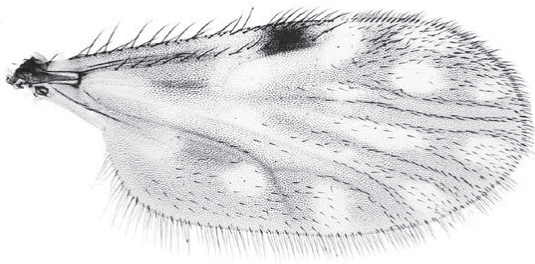


C. kayi

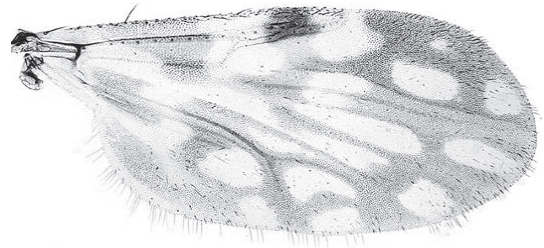


C. zentae

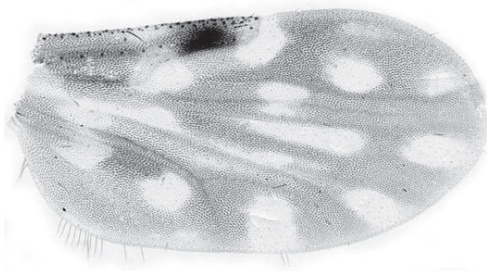
Wing picture atlas of Australian *Culicoides* (*Marksomyia*)



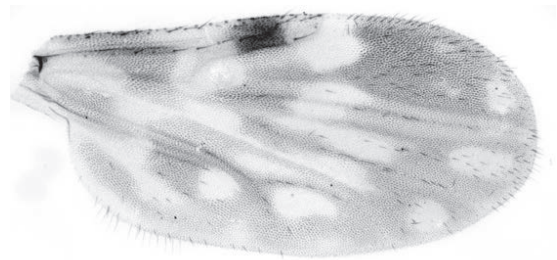
C. dycei typical form



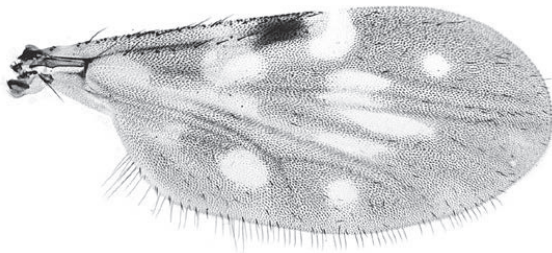
C. marksii reduced wing pattern



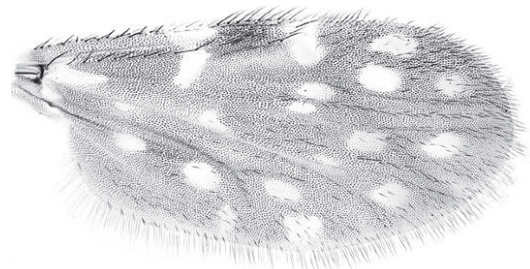
C. dycei reduced wing pattern



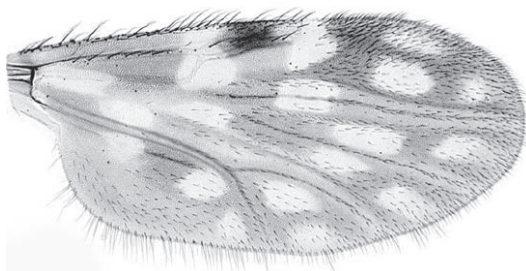
C. marksii reduced wing pattern



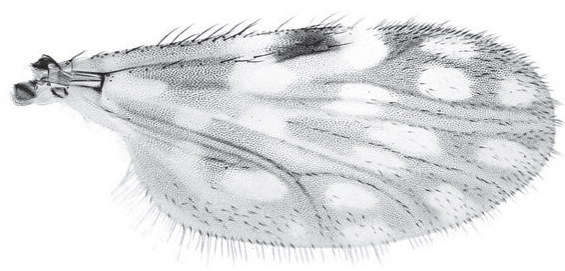
C. dycei reduced wing pattern



C. parvimaculatus



C. kayi



C. zentae



C. marksii typical form

Culicoides subgenus Marksomyia

Culicoides subgenus *Marksomyia* Bellis & Dyce 2011:36

Type species	<i>Culicoides marksii</i> Lee and Reye, by original designation.
Synonyms	Nil but referred to as the Marksii Group by Dyce et al 2007.
Distribution	Widespread in Australia with a single species present in New Guinea and the Solomon Islands.
Number of species worldwide	6.
Number of species in Australia	5.
Hosts	Mammalian, including large mammals.
Vector status	12 viruses have either been isolated from or shown to replicate in species belonging to this subgenus. All but one of these are presumed to infect marsupials, which are the major host of these species.
Immature habitat	Free swimming larvae live in the margins of either fresh or brackish ground water bodies.
Diagnosis	Female specimens can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: presence of 3, partially sclerotized spermathecae. Wing with cell r_2 pale apically; typically with 3 pale spots distally in cell r_3 although these can be reduced to 1 or 2 spots in some individuals. Distal flagellomeres little longer than basals; SCh present on flagellomeres 9-13.

Culicoides dycei

Culicoides dycei Lee and Reye, 1953: 390 (New South Wales)

Synonyms	Nil.
Distribution	Widespread and common in all states.
Hosts	Marsupials, cattle, sheep, (Muller & Murray 1977, Kay et al 1978).
Vector status	Possible vector of Wallal and Warrego viruses (Muller et al 1982).
Immature habitat	Margin of fresh water bodies, inland rivers (Dyce & Murray 1966).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Presence of 3 spermathecae, entirely unsclerotised and difficult to see. Majority of specimens with 3 pale spots distally in cell r_3 ; base of basal pale spot in cell m_1 level with base of pale spot over vein M_1 ; 1 pale spot in cell m_4 ; single pale spot in distal half of anal cell. 3rd palpal segment less than twice as long as wide.



C. dycei

Culicoides kayi

Culicoides kayi Bellis and Dyce, 2011: 46 (Western Australia)

Synonyms	Nil. Reported as Marksi Group sp no 2 by Dyce et al (2007).
Distribution	Southern WA.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_3 with 3 pale spots distal to poststigmatic pale spot; base of basal pale spot in cell m_1 distinctly apical to base of pale spot over vein M_1 ; 2 pale spots in cell m_4 ; 2 pale spots in distal half of anal cell; basal pale spot in cell m_1 elongate and less than its own diameter from pale spot over medial part of vein M_1 ; pale spot over r-m cross-vein rounded and broadening posteriorly. SCo present on flagellomere 8; flagellomere 13 with at least 5 SCh.



C. kayi

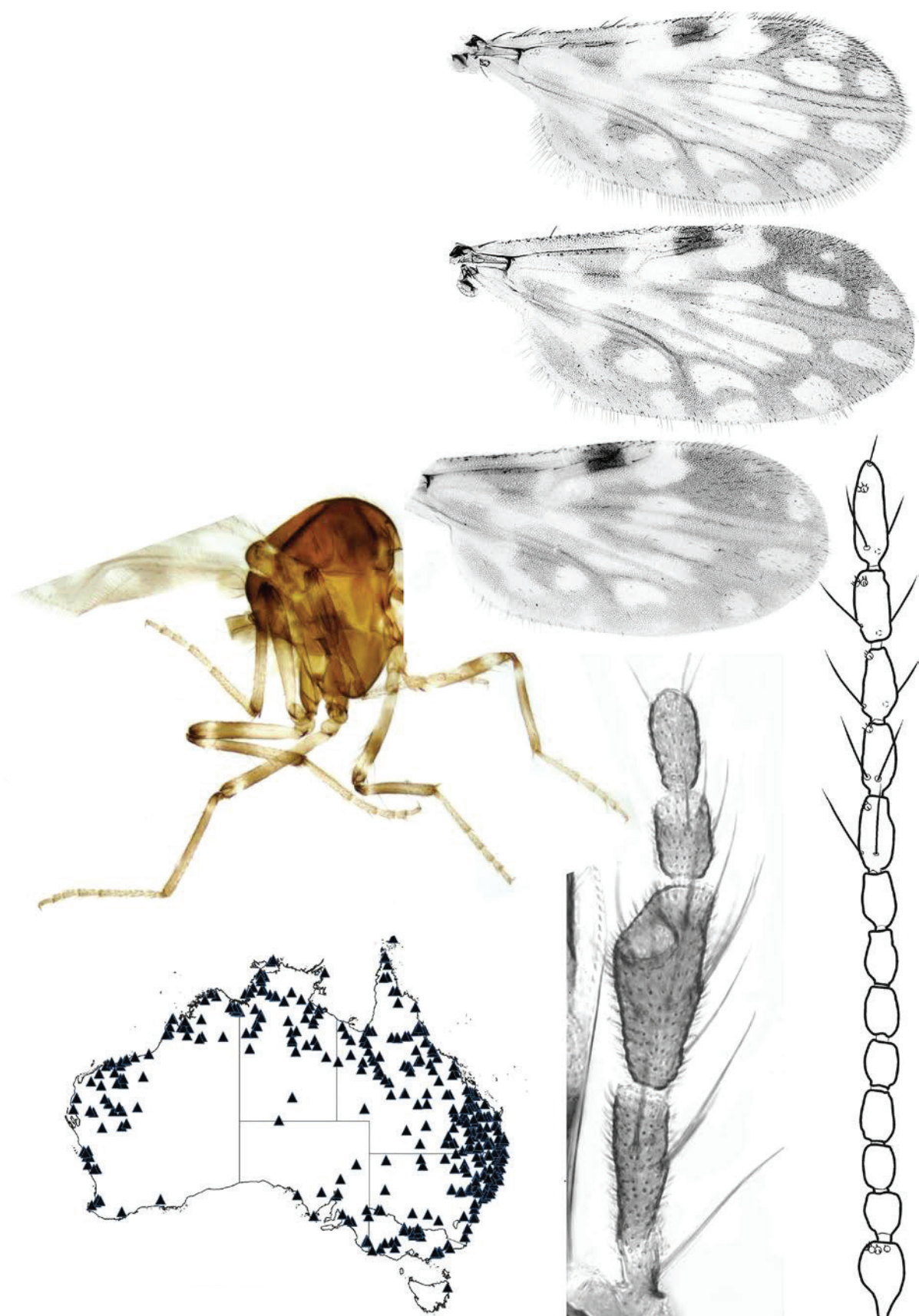
Culicoides marksi

Culicoides marksi Lee & Reye 1953: 392 (NSW)

Synonyms	Nil.
Distribution	Widespread and common in all states.
Hosts	Cattle, buffalo, marsupials, sheep, horse, dog, human (Kay 1973; Lee et al. 1962, Muller & Murray 1977; Beveridge et al. 1981; Muller et al. 1981).
Vector status	Associated with several viruses (Table 2). Potential vector of <i>Onchocerca gibsoni</i> (Beveridge et al 1981).
Immature habitat	Margin of fresh water bodies, bore drains (Dyce & Murray 1966; Kettle & Elson 1976; Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Presence of 3 partially sclerotised spermathecae. Majority of specimens with 3 pale spots distally in cell r_3 ; base of basal pale spot in cell m_1 level with base of pale spot over vein M_1 ; basal pale marking in cell m_4 boomerang-shaped, cupping distal marking.

Table 2. Viruses isolated from *C. marksi*

Virus	Reference
Barmah forest	Standfast et al (1984)
Belmont	Standfast et al (1984)
CSIRO 79	Standfast et al (1984)
CSIRO 80	Standfast et al (1984)
Ephemeral fever virus	St George et al (1977)
Eubenangee	Standfast et al (1984)
Humpty Doo	Standfast et al (1984)
Leanyer	Standfast et al (1984)
Midjinbarry	Muller et al 1982
Parker's Farm	Standfast et al (1984)
Wallal	Standfast et al (1984)
Warrego	Standfast et al (1984)

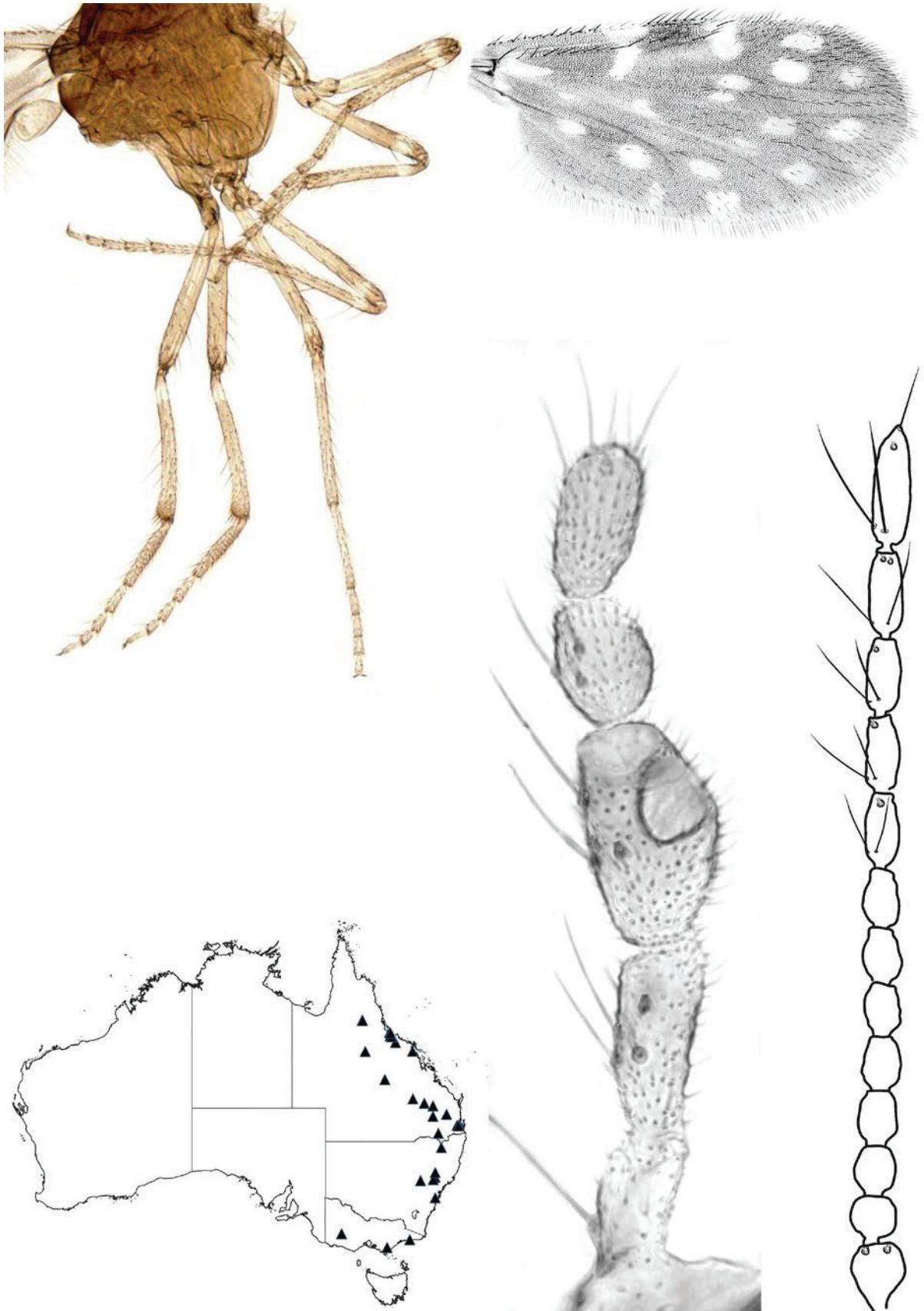


C. marksi

Culicoides parvimaculatus

Culicoides parvimaculatus Lee & Reye 1953: 391 (NSW)

Synonyms	Nil.
Distribution	Eastern Qld and NSW, Victoria.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Sandy mud stream margins (Lee 1956); sandy margins of heath-water pools (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Abdomen with 3 partially sclerotised spermathecae. Cell r_3 with 3 pale spots distal to poststigmatic pale spot; cell m_4 with 2 ovoid pale spots; base of basal pale spot in cell m_1 apical to base of pale spot over vein M_1 ; basal pale spot in cell m_1 small and round, greater than its own diameter from pale spot over medial part of vein M_1 ; pale spot over r-m cross-vein linear with narrow posterior projection.

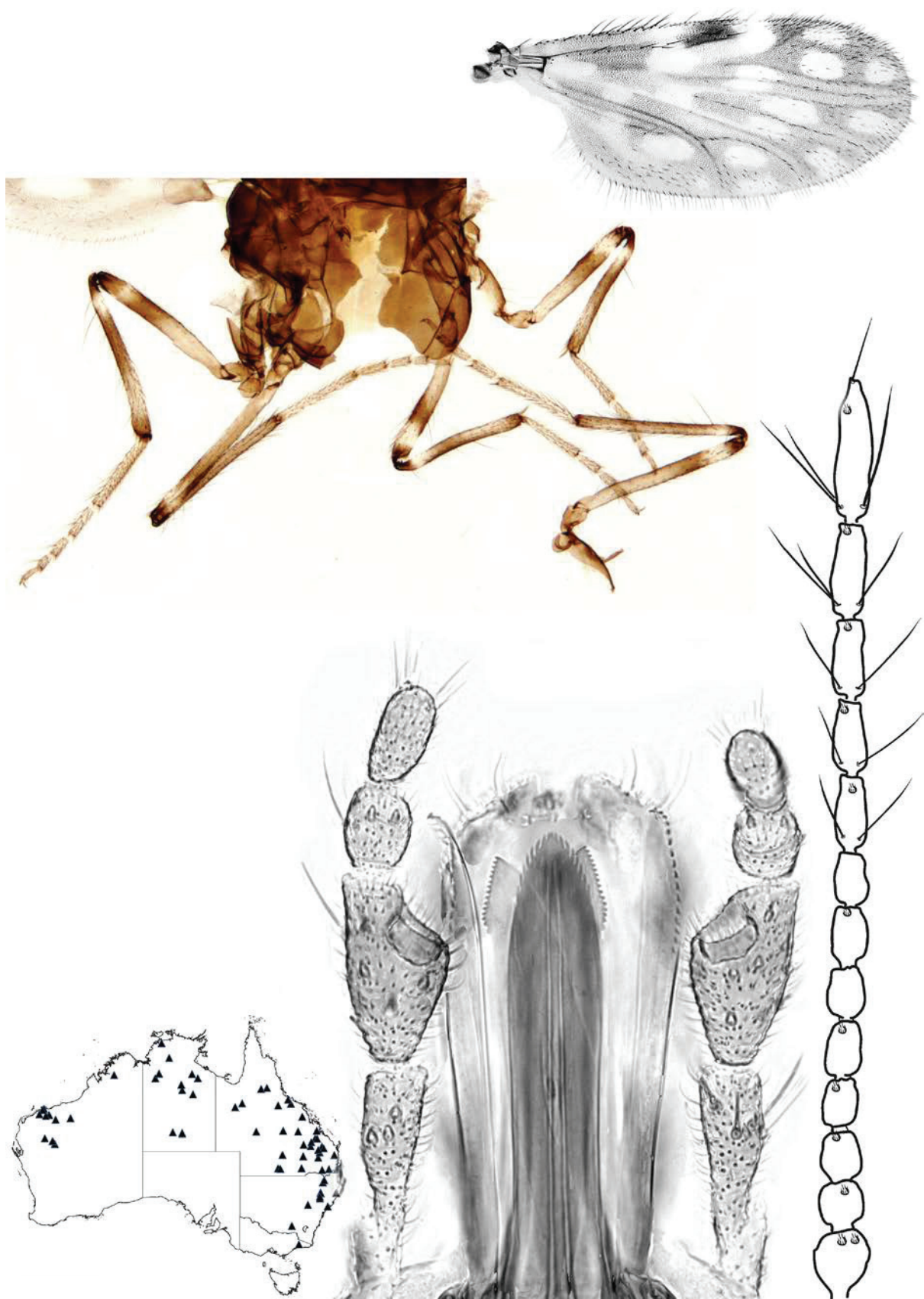


C. parvimaculatus

Culicoides zentae

Culicoides zentae Bellis and Dyce 2011: 44 (Queensland)

Synonyms	Nil. Reported as Marksi Group sp no 1 by Dyce et al (2007) and Mc Master sp 121 by Muller et al (1981).
Distribution	Northern WA, widespread in NT, Qld and NSW, northern Victoria.
Hosts	Marsupials (Muller et al. 1981).
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_3 with 3 pale spots distal to poststigmatic pale spot; base of basal pale spot in cell m_1 distinctly apical to base of pale spot over vein M_1 ; 2 pale spots in cell m_4 ; 2 pale spots in distal half of anal cell, basal pale spot in cell m_1 elongate and less than its own diameter from pale spot over medial part of vein M_1 ; pale spot over r-m cross-vein rounded and broadening posteriorly. SCo usually absent from flagellomere 8; flagellomere 13 with 2 or 3 SCh.



C. zentae

Key to females of species of *Meijerehelea* present in Australasia

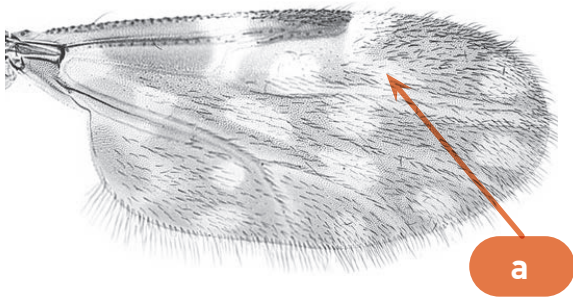
1

Post stigmatic spot crescent-shaped, posteriorly extending towards apex of cell r_3 (a)

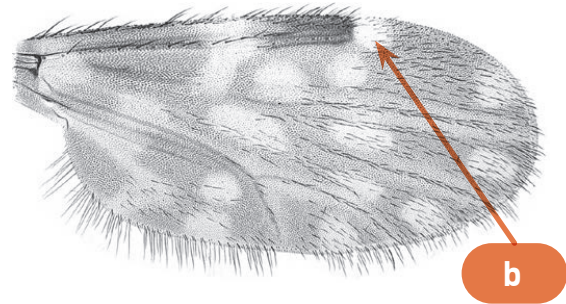
C. histrio

Post stigmatic spot rounded (b) or fused with the pale spot posterior to cell r_2

2



C. histrio



C. guttifer

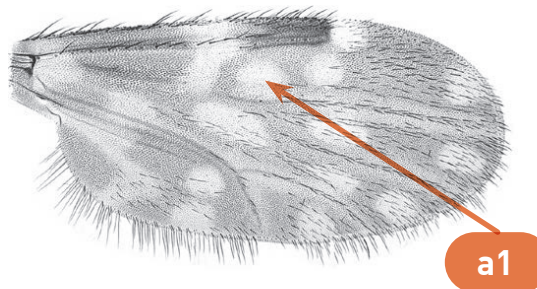
2

Pale spot posterior to radial cells touching vein M_1 (a1); spermathecal duct long, spermatheca often around midpoint of abdomen (a2)

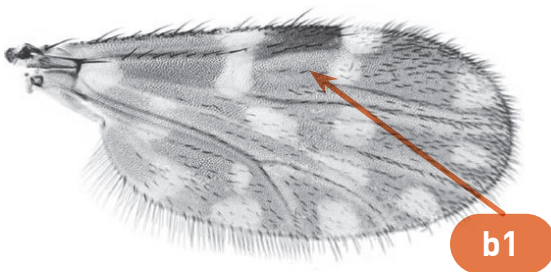
C. guttifer

Pale spot posterior to radial cells either absent (b1) or not touching vein M_1 (b2); spermathecal duct shorter, spermatheca usually close to apex of abdomen (b3)

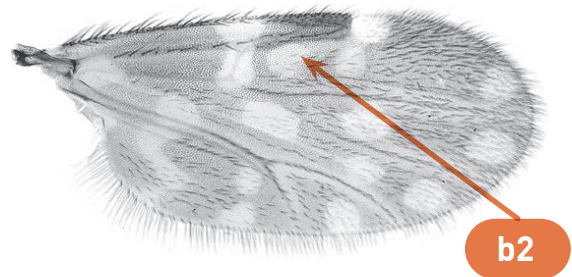
C. arakawae (exotic)



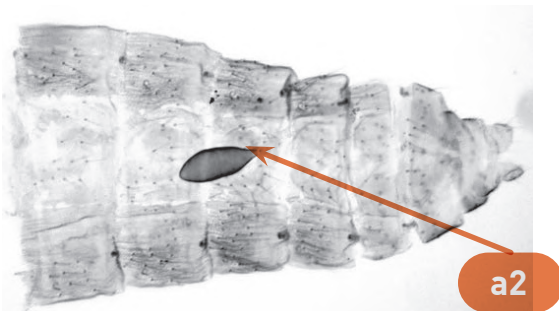
C. guttifer



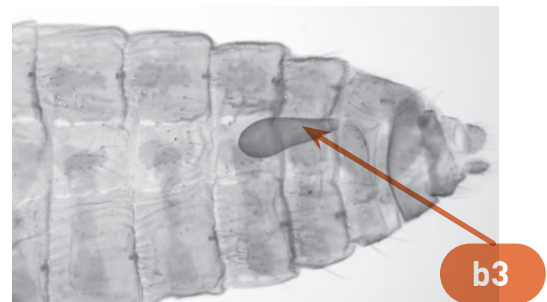
C. arakawae



C. arakawae



C. guttifer



C. arakawae

Culicoides subgenus *Meijerehelea*

Culicoides subgenus *Meijerehelea* Wirth and Hubert, 1961: 23

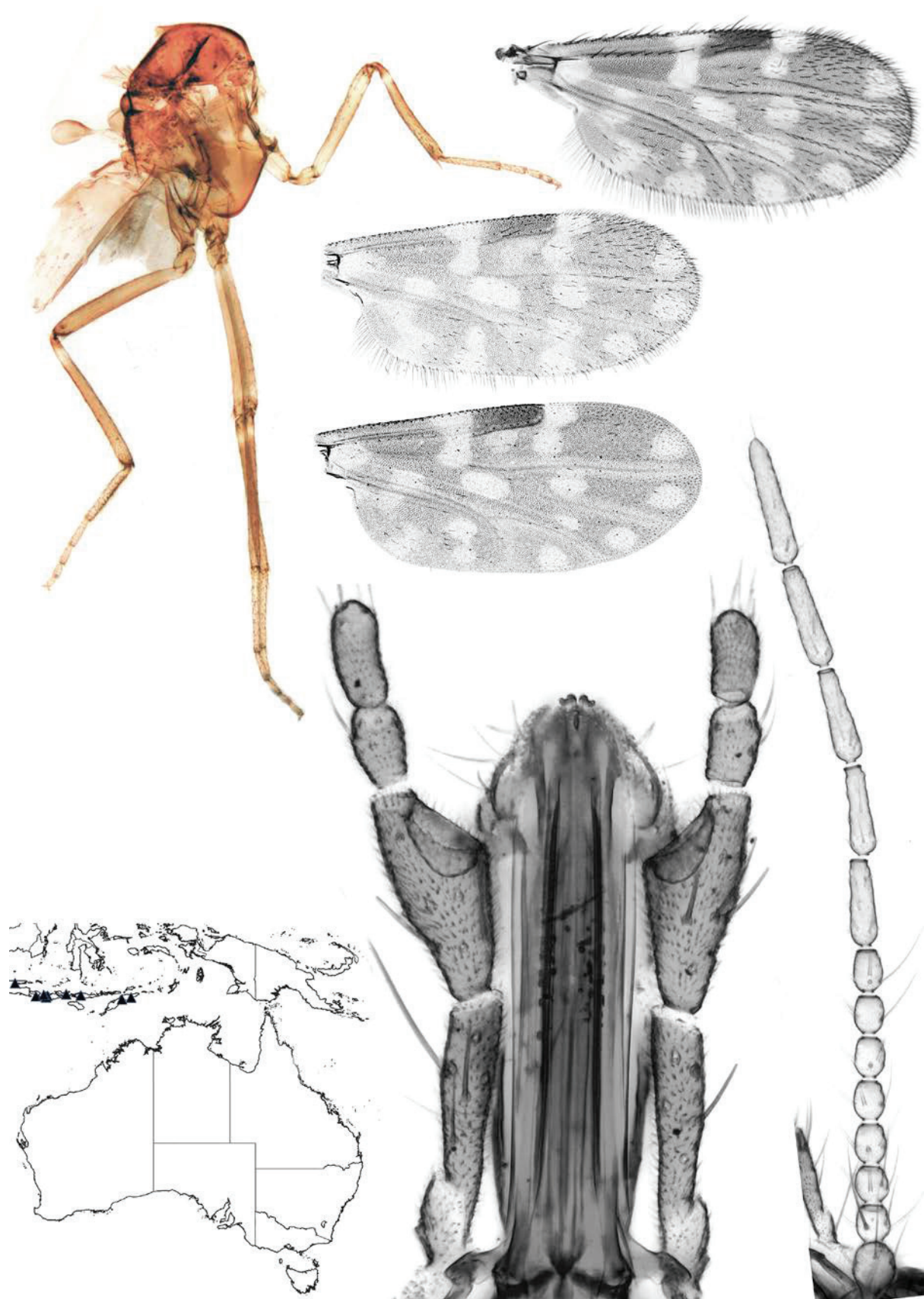
Type species	<i>Ceratopogon guttifer</i> de Meijere, by original designation.
Synonyms	Nil.
Distribution	Widespread in Africa, Asia and the western Pacific.
Number of species worldwide	Borkent & Dominiak (2020) list 11 species. Some authors do not recognise this subgenus and place the Asian representatives into <i>C. subg. Beltranmyia</i> Vargas. It is consequently possible that some Asian species currently placed into <i>C. subg. Beltranmyia</i> actually belong to <i>C. subg. Meijerehelea</i> .
Number of species in Australia	2.
Hosts	Avian, including chickens.
Vector status	Associated with protozoan and viral pathogens of birds. One African species has been experimentally infected with African horse sickness virus.
Immature habitat	Ground water margins both fresh and estuarine; variable soil types ranging from sandy to organic silt admixtures sometimes polluted by dung and/or with vegetation.
Diagnosis	Female specimens can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Abdomen with a single, often sac-like, spermathecae. Wing with cell r_2 not pale apically; poststigmatic pale spot divided into two distinct spots; cell m1 with 2 pale spots. SCh absent from distal 5 flagellomeres.

Culicoides arakawae

Ceratopogon arakanae [sic] Matsumura in litt.; Arakawa, 1910: 411 (Japan)

Ceratopogon arakawae Arakawa; Matsumura, 1915: 56 (Japan;)

Synonyms	<i>Culicoides arakawai</i> (Arakawa); Delfinado, 1961: 640 (Philippines) <i>sugimotonis</i> Shiraki, 1913: 289 (Formosa) <i>alboguttatus</i> Kieffer, 1921 b: 563 (Formosa) <i>shimai</i> Sasaki, 1928: 687 (Japan) <i>daleki</i> Smith and Swaminath, 1932: 185 (Assam) <i>micropunctatus</i> Tokunaga, 1951: 105 (Java).
Distribution	Absent from Australia. Widespread in Asia, east to New Guinea.
Hosts	Chickens (Kitaoka & Cheah 1983).
Vector status	Vector of fowl malaria, <i>Leucocytozooan caulleryi</i> (Akiba 1960). Potential vector of fowl pox virus (Fukuda et al 1979).
Immature habitat	Surface mud of rice paddies and irrigation ditches (Tokunaga et al. 1961, Kitaoka and Morii 1963), buffalo wallows and streams (Howarth 1985)
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Round pale spot immediately posterior to cell r_1 , if present, never touching vein M_1 , poststigmatic pale spot split into two rounded spots, the posterior one slightly basad of the anterior one. Single spermathecae attached by medium length duct and if visible then usually distad of abdominal segment 6.

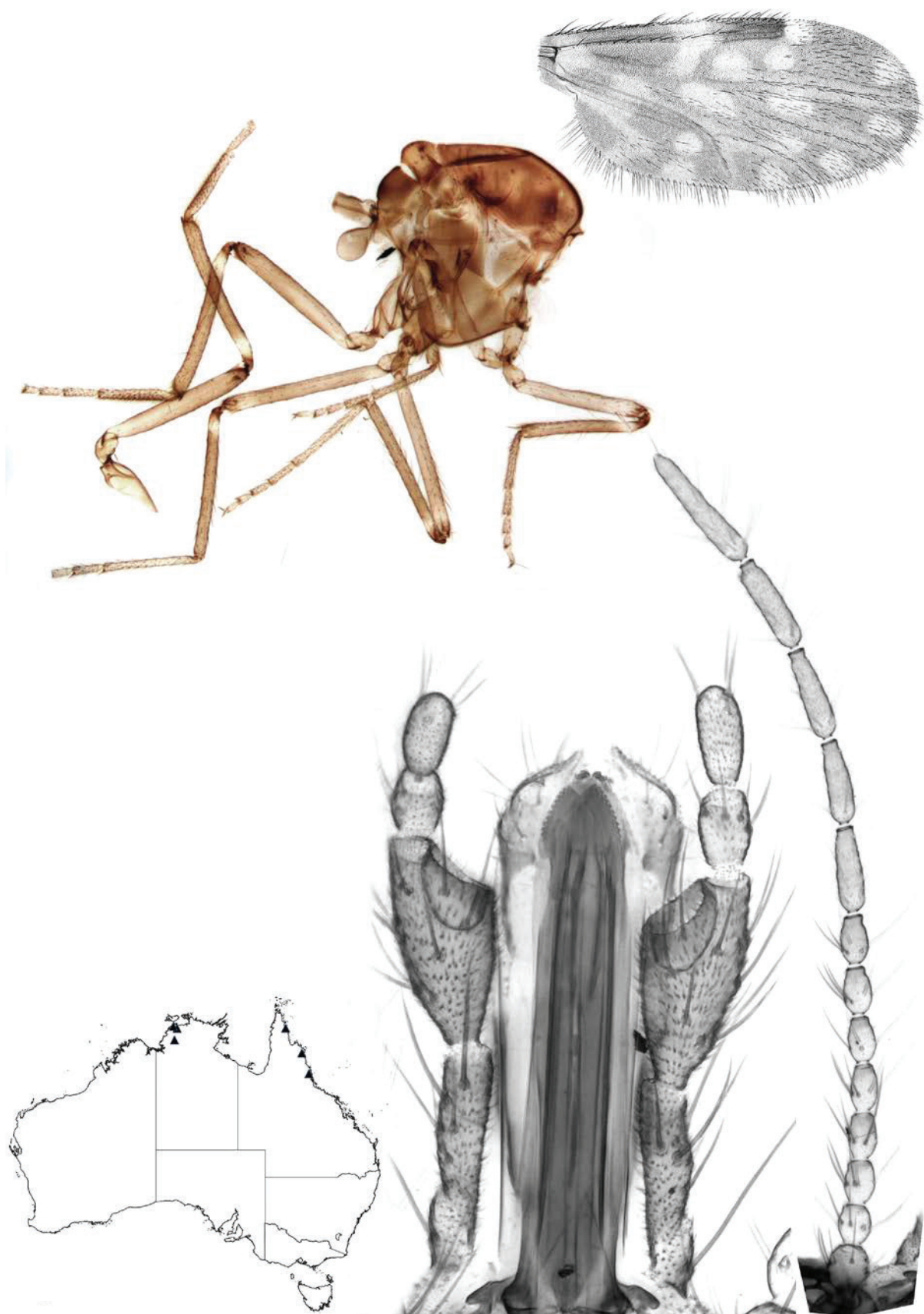


C. arakawae

Culicoides guttifer

Culicoides guttifer (de Meijere) 1907: 209 (as *Ceratopogon*) (Indonesia, Java)

Synonyms	Nil.
Distribution	Top End of NT and Cape York Peninsula. Widespread in southern and eastern Asia.
Hosts	Chickens (Kitaoka & Cheah 1983).
Vector status	Unknown.
Immature habitat	Muddy pool and stream margins (Edwards 1922; Howarth 1985)
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Round pale spot present immediately posterior to cell r_1 and touching vein M_1 , poststigmatic pale spot split into two rounded spots, the posterior one slightly basad of the anterior one. Single spermathecae attached by very long duct and usually visible around abdominal segment 5.

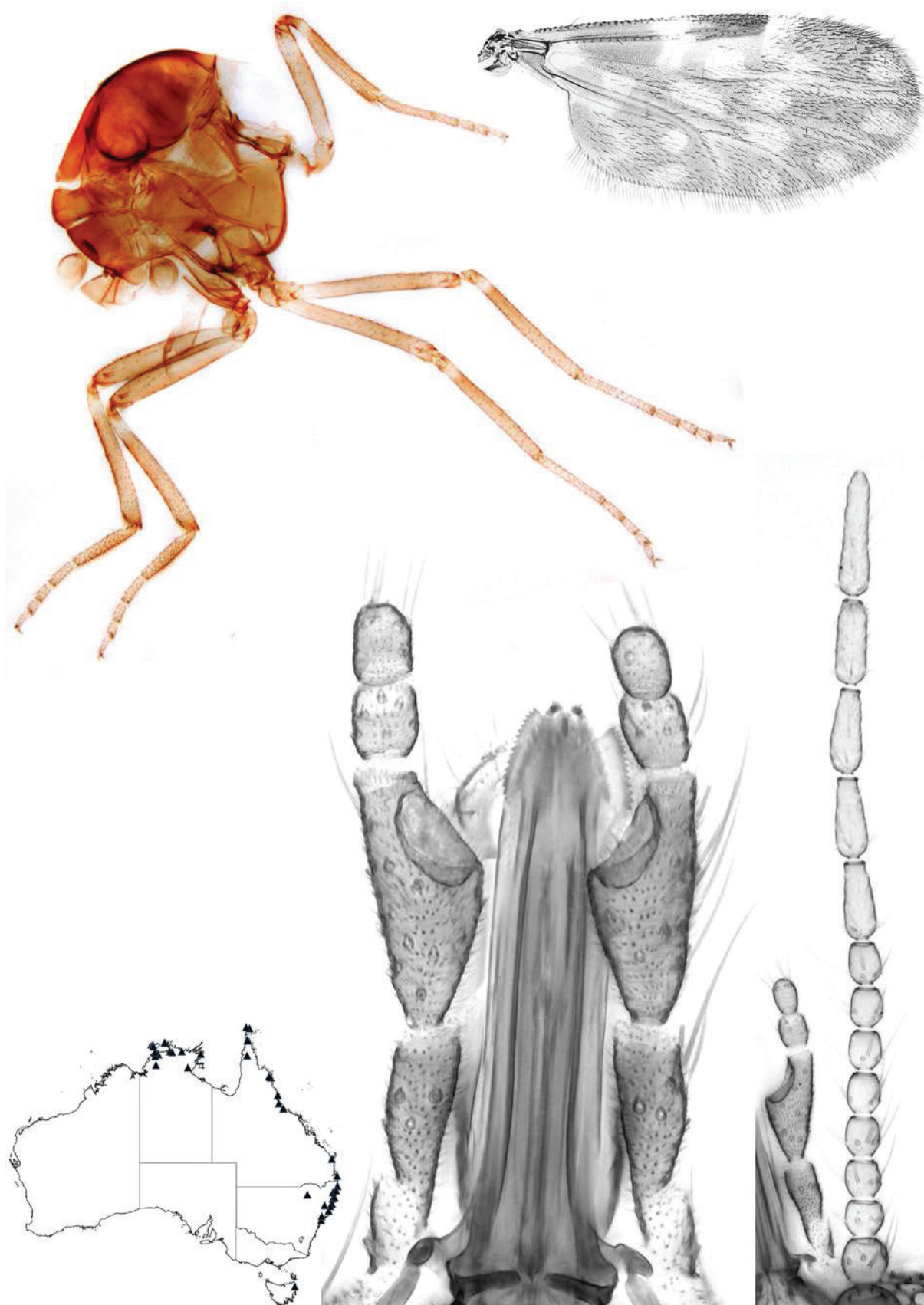


C. guttifer

Culicoides histrio

Culicoides histrio Johannsen 1946: 190 (as variant of *guttifer*) (Guam).

Synonyms	<i>mackayensis</i> Lee & Reye 1953: 383
Distribution	Coastal NT, Qld and NSW. Widespread in Asia, east to New Guinea.
Hosts	Birds (Reye & Lee 1961; Muller et al 1981).
Vector status	Potential vector of Thimiri virus (Standfast et al 1984).
Immature habitat	Mangrove flats and tidal marshes (Reye and Lee 1961, Kettle and Elson 1978); Soft muck above tidal Juncus marsh (Wirth & Hubert 1989); disused buffalo wallow (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Abdomen with single spermatheca. Round pale spot present immediately posterior to cell r_1 , posterior part of poststigmatic pale spot crescent shaped and directed apically.



C. histrio

Culicoides subgenus Remmia

Culicoides subgenus Remmia Glukhova, 1977: 116

Type species	<i>Ceratopogon schultzei</i> Enderlein, by original designation.
Synonyms	Nil. Widely reported as the Schultzei Group.
Distribution	Widespread in Africa and southern Asia. Also present in New Guinea and northern Australia.
Number of species worldwide	Borkent & Dominiak (2020) list 8 species.
Number of species in Australia	1.
Hosts	Mammalian, including large mammals.
Vector status	The single species in Asia and Australasia, <i>C. oxystoma</i> , is a notorious pest of livestock. It has been shown to be a poor vector of BTV and has been associated with several other livestock pathogens.
Immature habitat	Ground water body margins exposed to sunlight, rarely vegetated and often with blue-green algae present. In South Africa the type species is often associated with emergent mineralised ground waters, others in animal trampled, often dung polluted, pond margins and marginal silt of recently flooded rivers.
Diagnosis	Female specimens can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Wing with cell r_2 dark to apex; apical pale spot in cell r_3 bilobed, apex of vein CuA included in a pale spot.

Culicoides oxystoma

Culicoides oxystoma Kieffer 1910: 193 (India)

Synonyms	<i>kiefferi</i> Patton 1913: 336; <i>mesopotamiensis</i> Patton 1920: 246; <i>pattoni</i> Kieffer 1921:7; <i>housei</i> Causey 1938:407; <i>punctigerus</i> Tokunaga 1951: 101 <i>alatus</i> Das Gupta & Ghosh 1956: 162 Widely recorded, erroneously, as <i>schultzei</i> (Enderlein 1908: 459).
Distribution	Kimberley region of WA, Top End of NT, north-eastern Qld. Widely distributed through Asia, north to Japan, east to PNG, west to India, possibly as far as northern Africa.
Hosts	Bovids, horse, pig (Muller et al 1981).
Vector status	Associated with a wide range of livestock viruses (Table 3).
Immature habitat	Mud on the margins of buffalo wallows, drains, ponds etc (Howarth 1985)
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apical pale marking in cell r_3 bilobed; Veins M_1 , M_2 and CuA with pale apex; discrete, round pale spot present posterodistad to poststigmatic pale spot.

Table 3. Viruses associated with *Culicoides oxystoma*

Virus	Reference
Akabane virus	Kurogi et al (1987) ; Yanase et al (2019)
Aino	Yanase et al (2005)
Bluetongue virus	Standfast et al (1985)
bunyip creek	Standfast et al (1984); Kato et al 2016
chuzan	Miura et al (1988) ; Yanase et al (2005)
D'Aguilar	Doherty et al (1973); Muller et al (1982); Yanase et al (2005); Kato et al 2016
Marrakai	Standfast et al (1984)
Kasba	Kurogi et al (1989)
Sathuperi virus	Kato et al 2016
EHDV including Ibaraki virus	Yanase et al (2005)



C. oxystoma

Key to females of Australian species in the Antennalis group

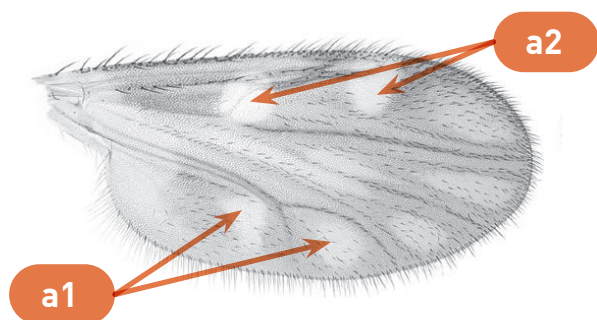
1

Wing with definite pale spots in anal cell and cell m_4 (a1) of similar intensity to poststigmatic and r-m pale spots (a2)

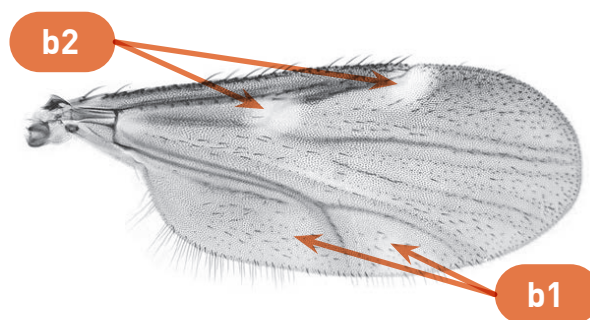
2

Pale spots in anal cell or cell M_4 (b1) if present, distinctly less intense than poststigmatic and r-m pale spots (b2)

6



Antennalis Gp sp no 3



Antennalis Gp sp no 5

2

Apical pale spot in cell r_3 at least its own diameter from margin of wing (a)

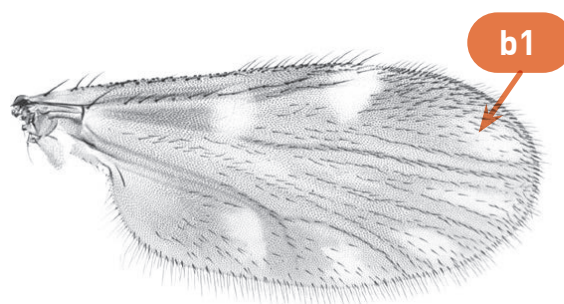
3

Apical pale spot in cell r_3 closer than its own diameter to margin of wing (b1) or indistinct (b2)

5



Antennalis Gp sp no 2



C. gladysae dark var



C. gladysae typical

3

Wing with large pale area covering base of M-Cu vein (a)

Antennalis Gp sp no 1

Wing without large pale area at base; base of M-Cu vein dark (b)

4



Antennalis Gp sp no 1



Antennalis Gp sp no 2

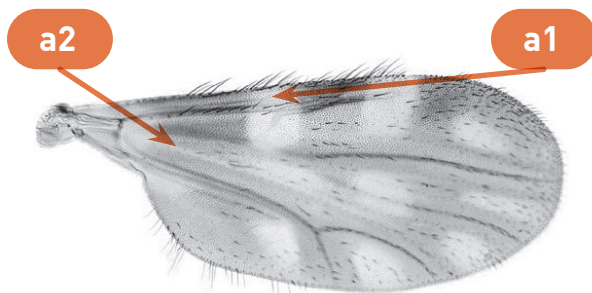
4

Pale spot over r-m cross-vein reaching margin of wing (a1), vein M_2 without sub-basal pale spot (a2)

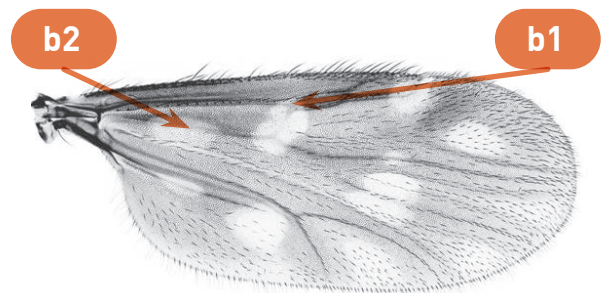
Antennalis Gp sp no 2

Pale spot over r-m cross-vein not reaching margin of wing (b1), vein M_2 with sub-basal pale spot (b2)

C. antennalis



Antennalis Gp sp no 2



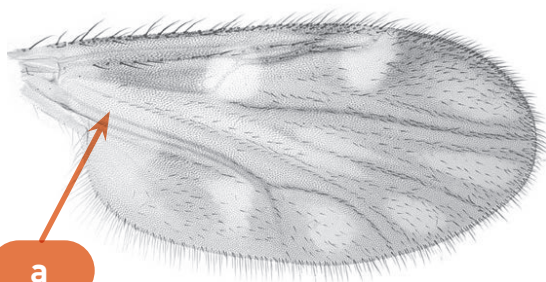
C. antennalis

5

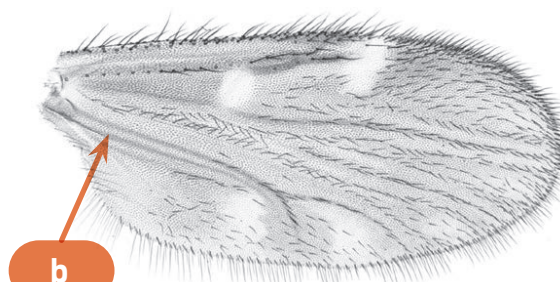
(2) Wing with large pale area covering base of M-Cu vein (a)

Antennalis Gp sp no 3

Wing without large pale area at base; base of M-Cu vein included in dark marking (b)

C. gladysae

Antennalis Gp sp no 3

*C. gladysae*

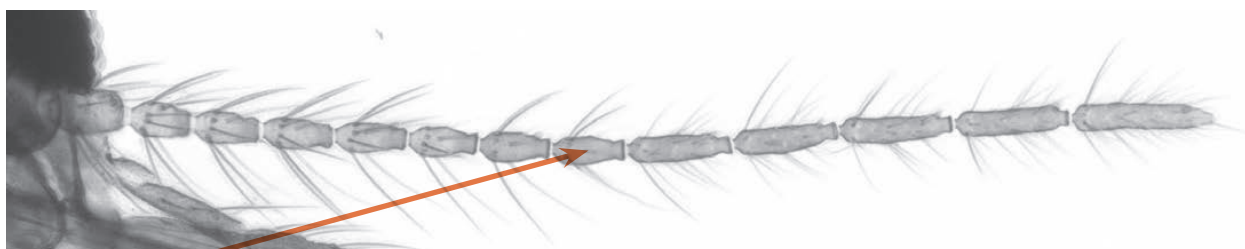
6

(1) Flagellomere 8 more than twice as long as wide and either cylindrical or slightly vasiform (a)

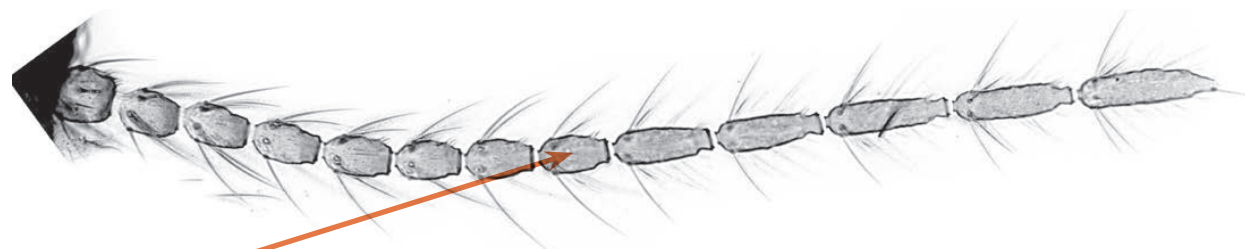
7

Flagellomere 8 no more than twice as long as wide and barrel shaped (b)

8



a



b

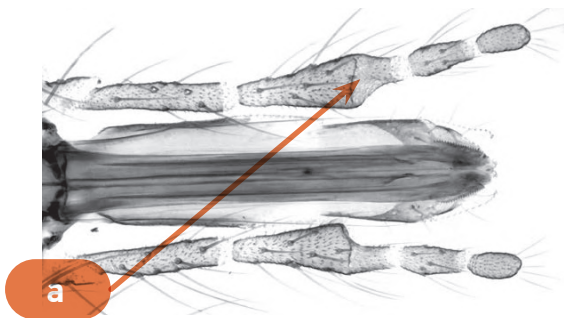
7

Spermathecae very large, palpal pit lacking apical edge (a), cave-dwelling

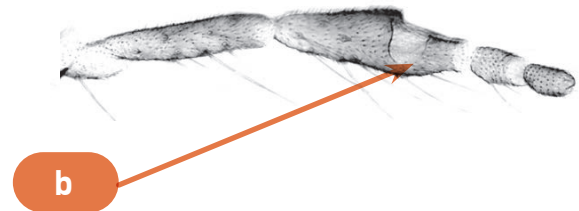
Antennalis Gp sp no 14

Spermathecae smaller, palpal pit irregularly shaped but with definite apical edge (b), non-cave-dwelling

Antennalis Gp sp no 4



Antennalis Gp sp no 14



Antennalis Gp sp no 4

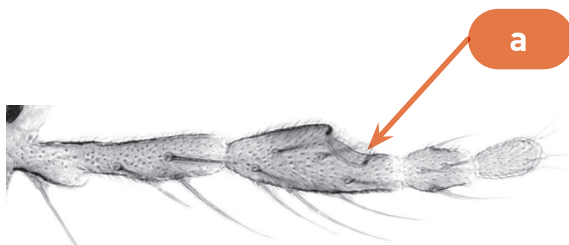
8

(6) 3rd palpal segment with ovoid pit, lateral edges laying oblique to the segment and with a strong apical margin (a)

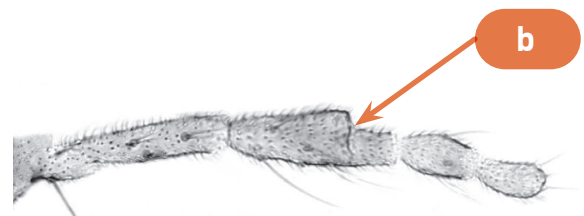
9

3rd palpal segment with irregular pit laying almost at right angles to the segment and lacking an apical margin (b)

11



Antennalis Gp sp no 5



Antennalis Gp sp no 9

9

Pale spot over r-m cross-vein rarely crossing vein Rs, not reaching wing margin (a); SCo present on flagellomeres 5 and 7; N Qld

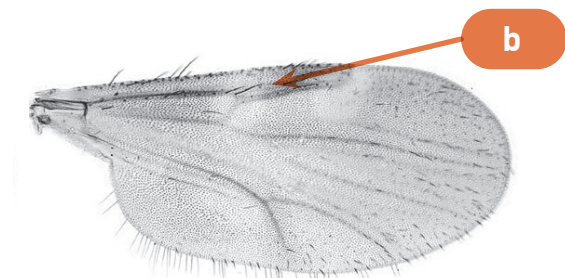
Antennalis Gp sp no 5

Pale spot over r-m cross-vein distinctly crossing vein Rs and usually reaching margin of wing (b); SCo absent from flagellomeres 5-7 NT or WA

10



a



b

Antennalis Gp sp no 5

Antennalis Gp sp no 10

10

Hind tibia without basal pale band (a); SCo present on flagellomere 8

Antennalis Gp sp no 10

hind tibia without basal pale band (b); SCo absent from flagellomere 8

Antennalis Gp sp no 11



a

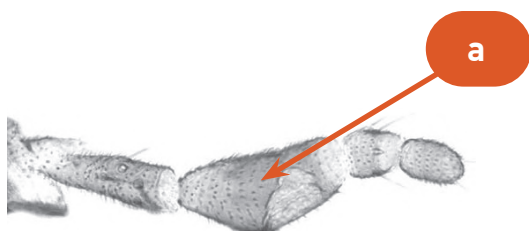


b

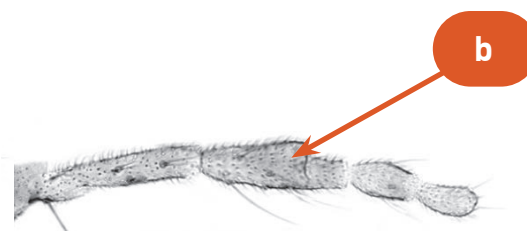
Antennalis Gp sp no 10

Antennalis Gp sp no 11

11	[8] 3rd palpal segment relatively stout (PR 2.15) NSW	Antennalis Gp sp no 7
	3rd palpal segment relatively slender (PR>2.8)	12



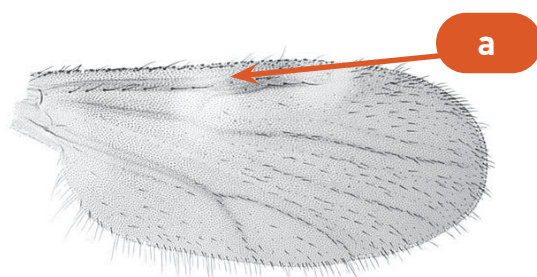
Antennalis Gp sp no 7



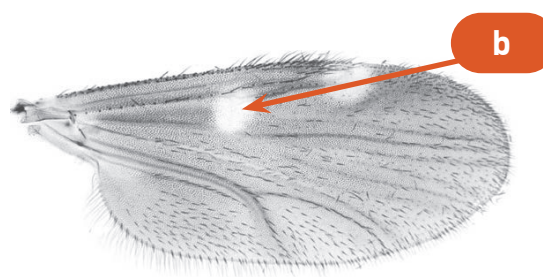
Antennalis Gp sp no 9

12	SCo absent from flagellomeres 3-7	Antennalis Gp sp no 8
	SCo present on some of flagellomeres 3-7	13

13	Pale spot over r-m cross-vein reaching margin of wing	Antennalis Gp sp no 9
	Pale spot over r-m cross-vein not reaching margin of wing (3)	14



Antennalis Gp sp no 9



mykutowyczi

14	SCo absent from flagellomeres 3-6	Antennalis Gp sp no 6
	SCo present on some of flagellomeres 3-6	<i>mykutowyczi</i>

Antennalis Group

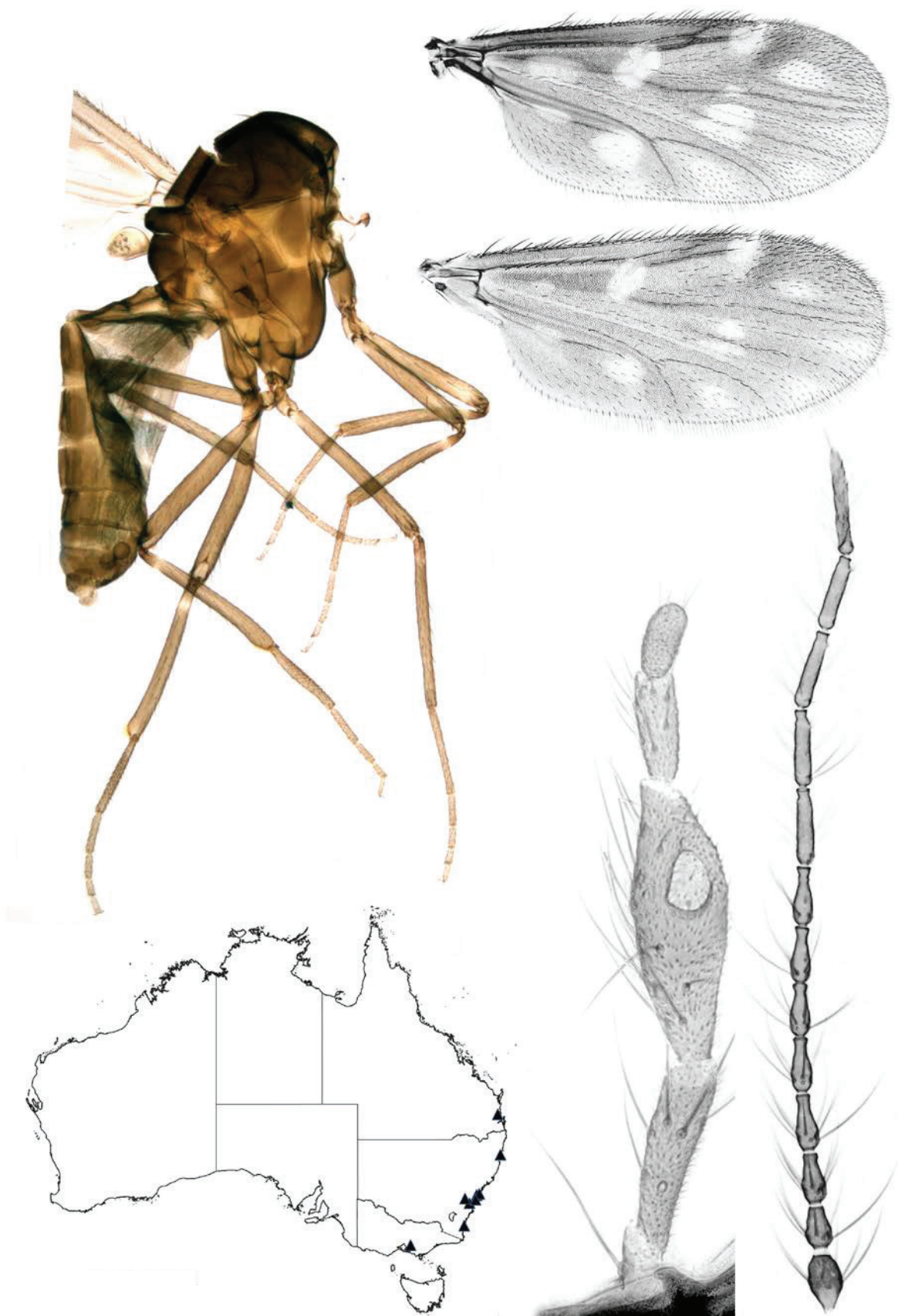
Culicoides Antennalis Gp Dyce 2001:137, Dyce et al 2007:30

Nominate species	<i>Culicoides antennalis</i> Lee & Reye
Synonyms	Nil.
Distribution	Australia and New Guinea.
Number of species worldwide	Endemic to the Australasian region with 3 described and 14 undescribed species.
Number of species in Australia	15, including 12 undescribed.
Hosts	Where known, mammalian, including large mammals.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Tibial comb with 4 spines, that closest to the spur longest; legs lacking conspicuous markings. SCo always present on 9-13; SCh present on distal flagellar segments. Cell r_2 pale apically, apical pale markings in cells r_3 , m_1 , m_2 m_4 and anal cell single, weak or absent in many species.

Culicoides antennalis

Culicoides antennalis Lee & Reye 1953: 386 (New South Wales)

Synonyms	Nil.
Distribution	Southeastern Qld, eastern NSW, Victoria.
Hosts	Sheep (Murray 1970).
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of cell r_2 pale; Apical pale marking in cell r_3 not closer than its own diameter from wing margin; apical pale marking in cell m_1 reaching wing margin; vein M with base included in dark marking but with pale spot present subbasally. Mid tibia unbanded. 3rd palpal segment bearing a rounded pit.

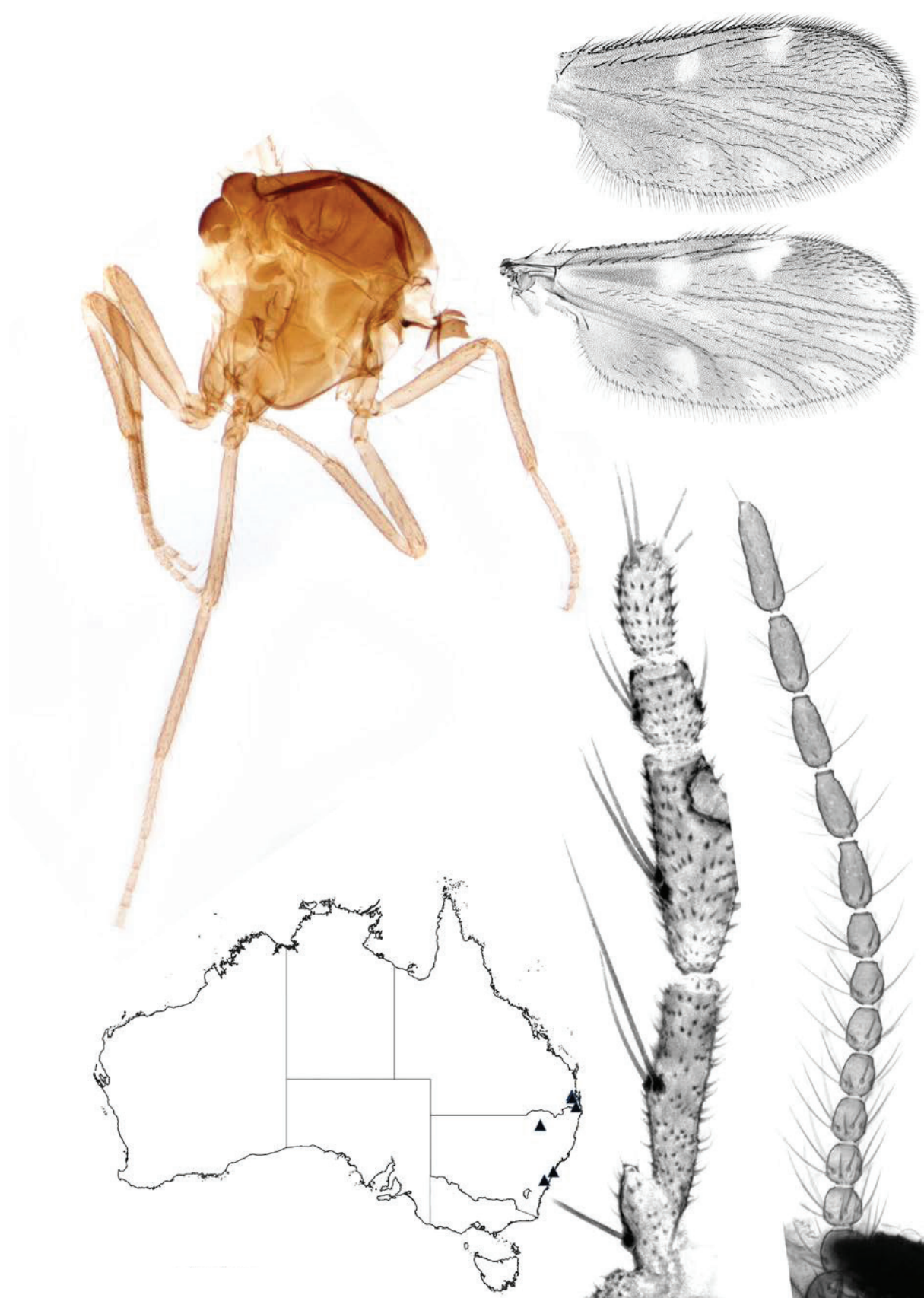


C. antennalis

Culicoides gladysae

Culicoides gladysae Kettle, Elson & Dyce 1976: 173 (Queensland)

Synonyms	Nil.
Distribution	South-eastern Qld, eastern NSW.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Rot pockets in trees (Kettle et al 1976).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of cell r_2 pale; vein M_1 not included in pale marking; cell m_1 with at most 1 distinct pale marking; cell m_4 with distinct pale marking; poststigmatic pale spot not extending towards vein M_1 ; apical pale spot in cell r_3 closer to wing apex than to poststigmatic pale spot; without large pale area at base of wing; tibial comb with 4 spines;.

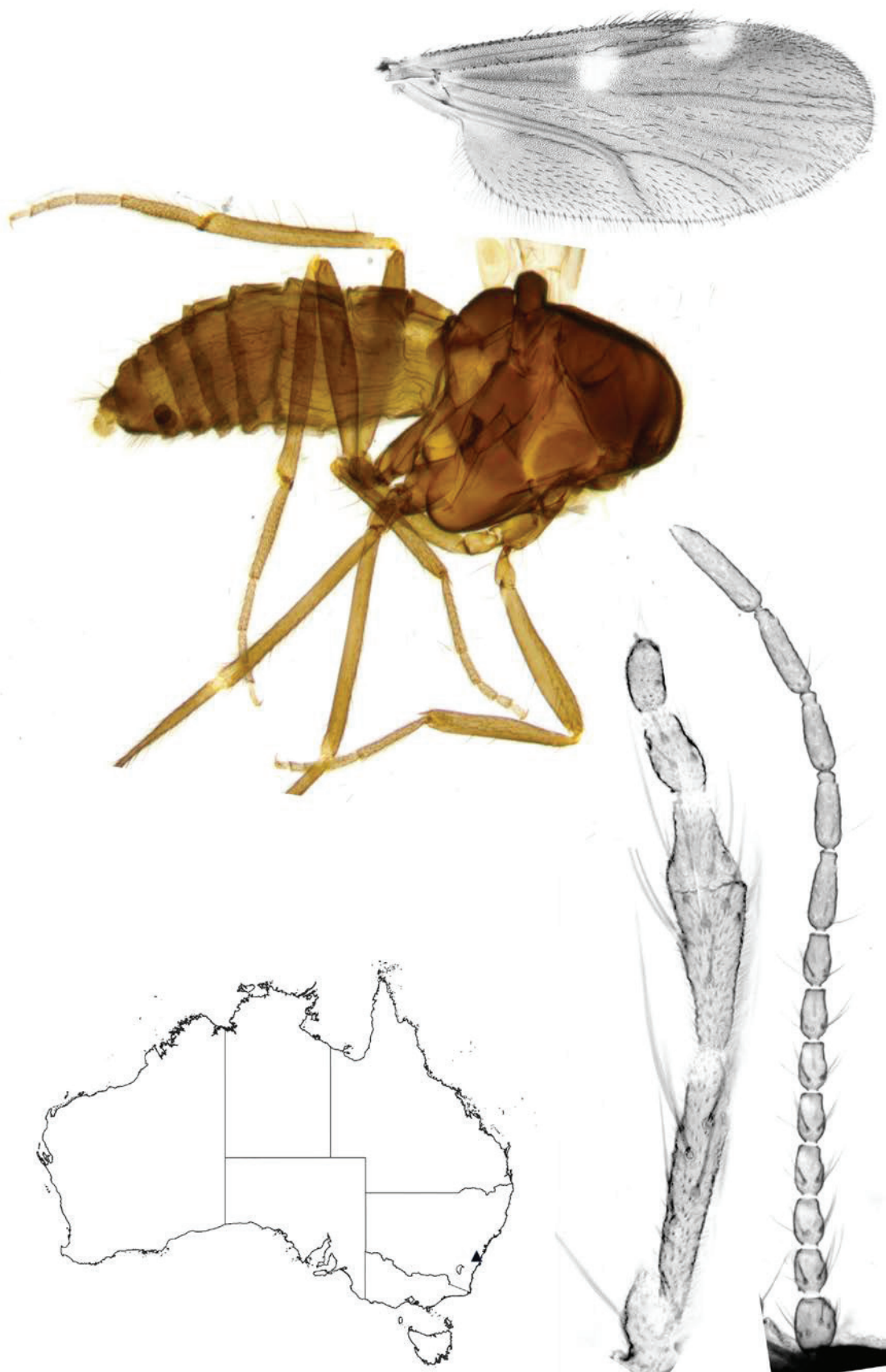


C. gladysae

Culicoides mykytowyczi

Culicoides mykytowyczi Lee & Reye 1963: 359 (New South Wales)

Synonyms	Nil.
Distribution	Southern Tablelands region of NSW.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of cell r_2 pale; cells m_1 and m_4 without pale markings; Poststigmatic pale spot not extending towards vein M_1 ; pale spot over r-m cross-vein not reaching margin of wing. Flagellomere 8 no more than twice as long as wide; SCo usually present on some of flagellomeres 3-6. Palpal pit without strong apical margin. Tibial comb with 4 spines;.

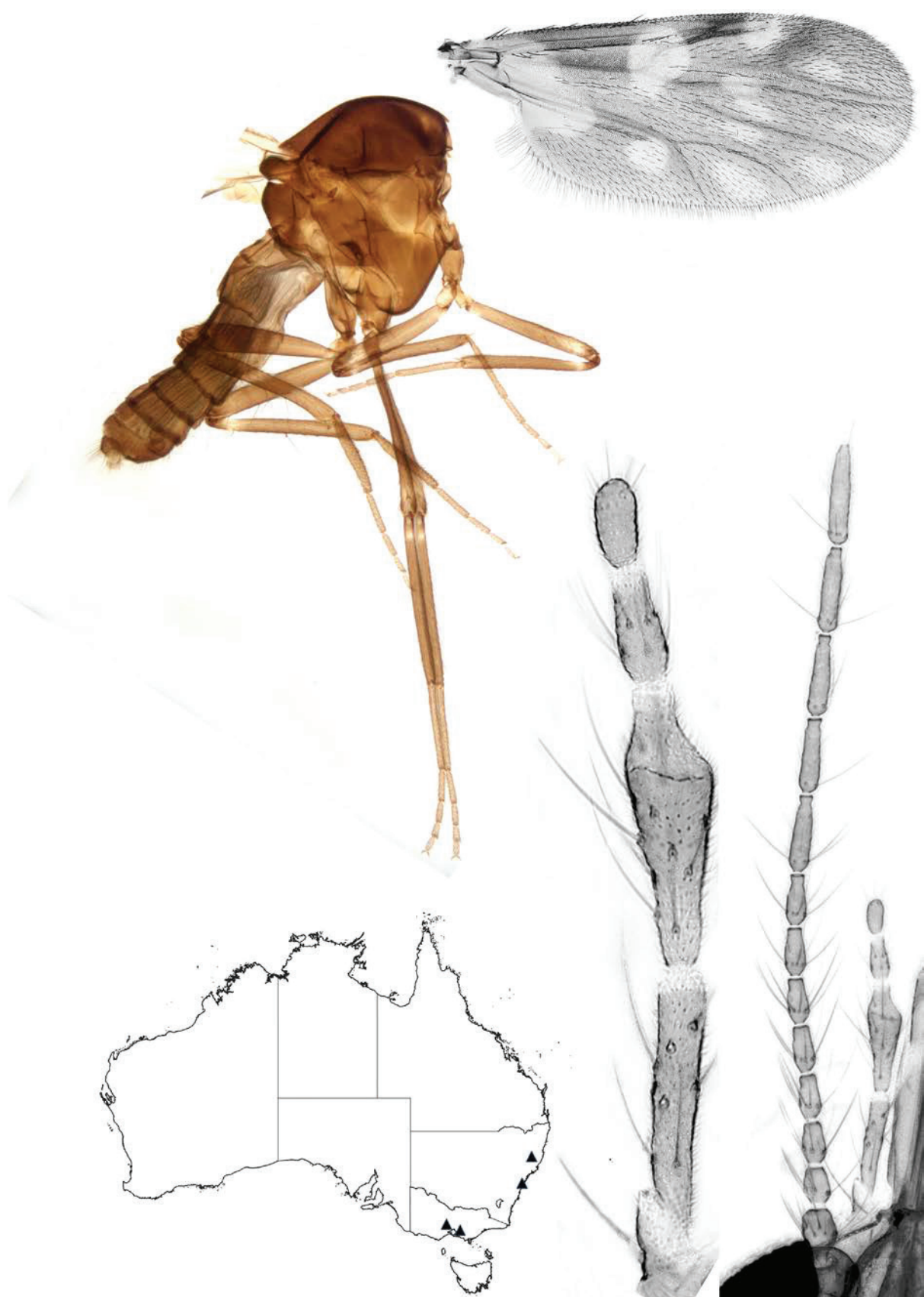


C. mykitowyczi

Culicoides Antennalis Group sp no 1

Culicoides Antennalis Gp sp no 1 Dyce et al 2007:30

Synonyms	Nil.
Distribution	Eastern NSW, Victoria.
Hosts	Sheep (Murray 1970).
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apical pale marking in cell r_3 not closer than its own diameter from wing margin; 2 pale spots in cell m_1 ; Cell r_3 usually with pale marking present immediately posterior to poststigmatic pale spot; base of vein M-Cu entirely included in pale area. 3rd palpal segment with a distinct pit.

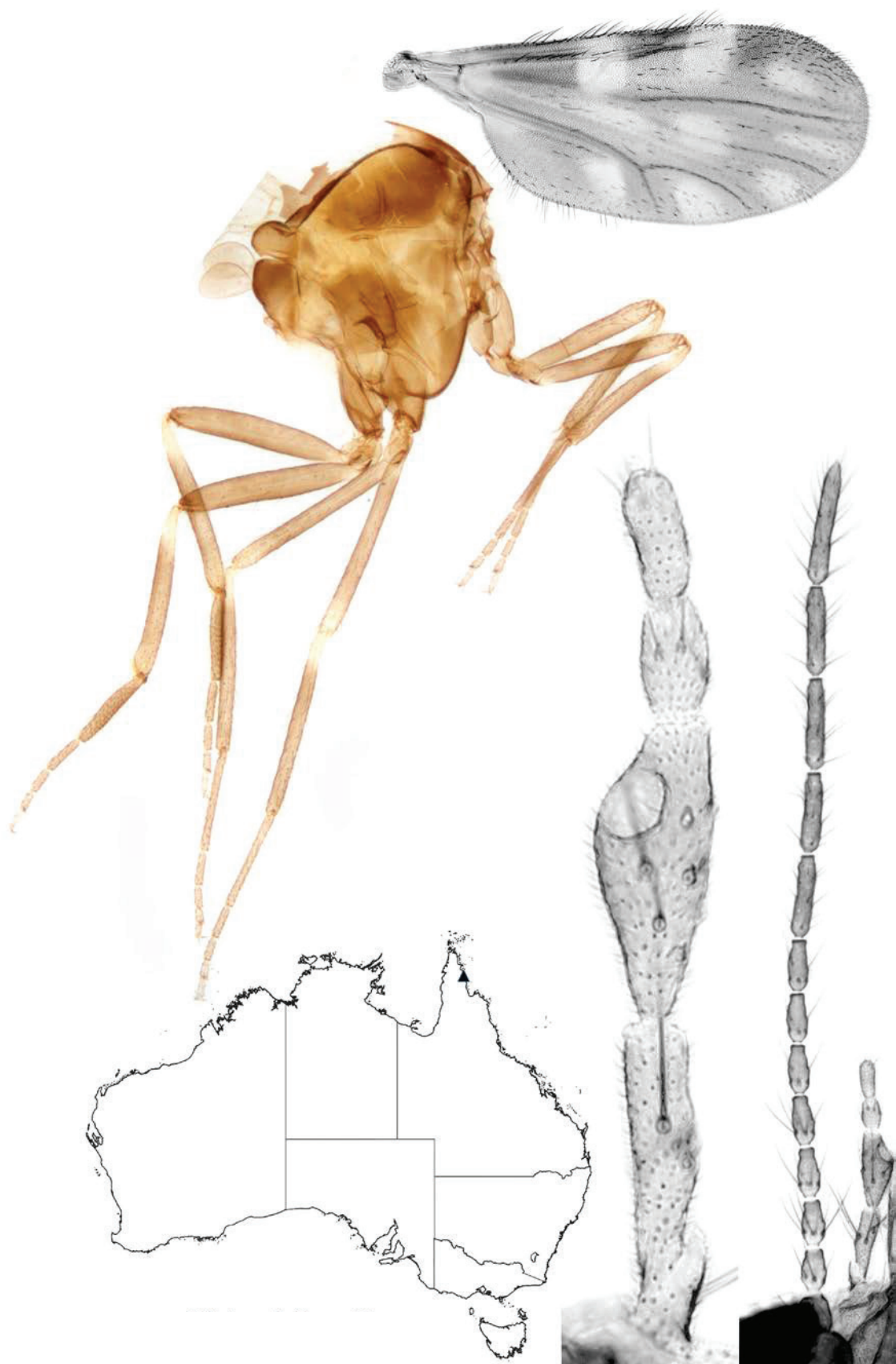


C. Antennalis Gp sp no 1

Culicoides Antennalis Group sp no 2

Culicoides Antennalis Gp sp no 2 Dyce et al 2007:31

Synonyms	Nil.
Distribution	Cape York Peninsula.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Pair of pale spots straddling medial portion of vein M_2 ; Apical pale marking in cell r_3 not closer than its own diameter from apex of cell; 2 pale spots in cell m_1 ; cell r_3 with pale marking present immediately posterior to poststigmatic pale spot. 3rd palpal segment with a distinct pit. Midtibia with basal pale band; hind tibia dark to apex.

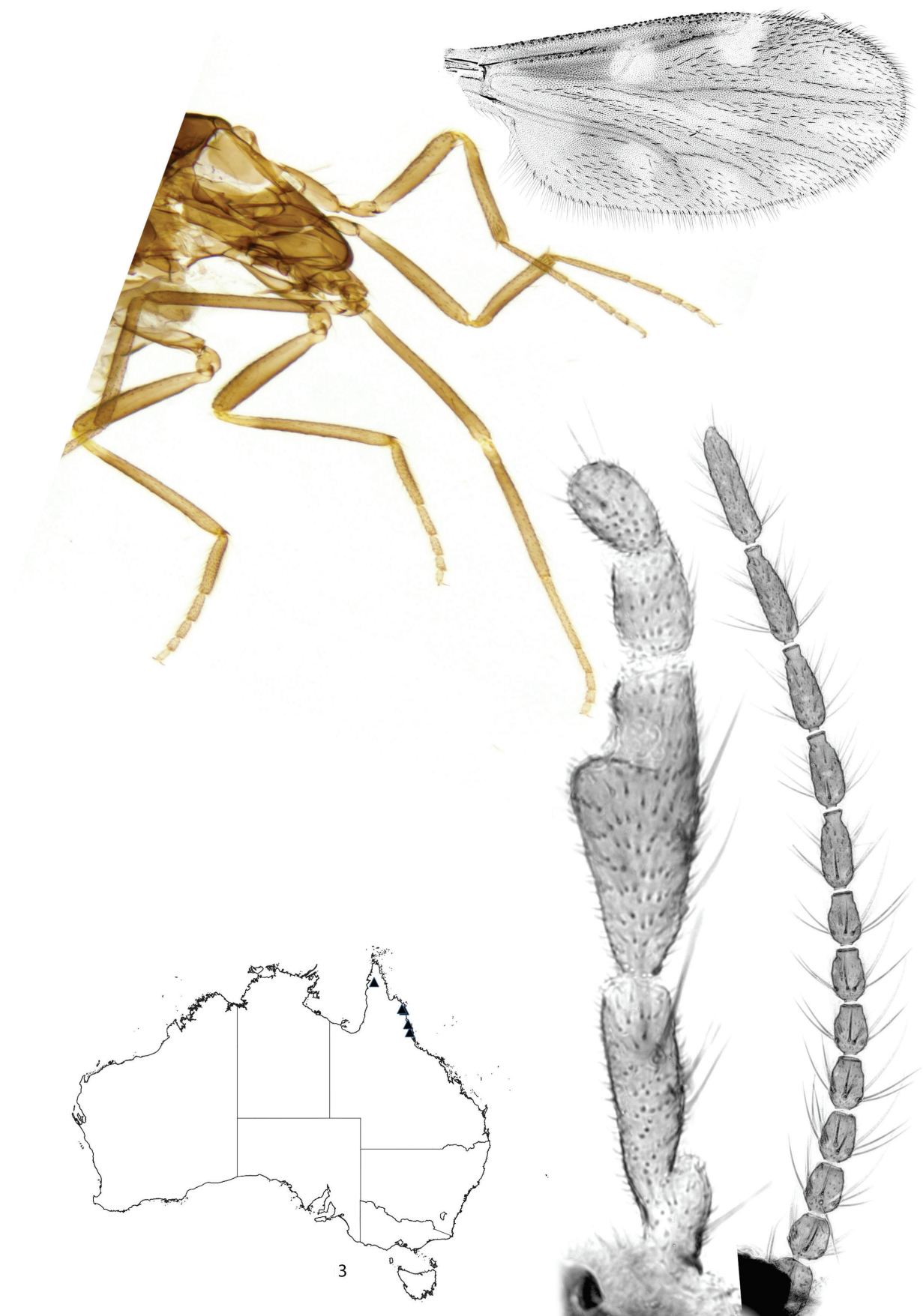


C. Antennalis Gp sp no 2

Culicoides Antennalis Group sp no 3

Culicoides Antennalis Group sp no 3 Dyce et al 2007:31

Synonyms	Nil.
Distribution	Northern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Pair of pale spots covering medial portion of vein M_2 ; pale spot over r-m cross-vein not reaching wing margin; cell m_4 with single distinct pale marking; apical pale spot in cell r_3 closer to wing apex than to poststigmatic pale spot; without large pale area at base of wing. Tibial comb with 4 spines.



C. Antennalis Gp sp no 3

Culicoides Antennalis Group sp no 4

Culicoides Antennalis Gp sp no 4 Dyce et al 2007:32

Synonyms	Nil.
Distribution	Northern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of cell r_2 pale; cells m_1 and m_4 without pale markings; Poststigmatic pale spot not extending towards vein M_1 . Flagellomere 8 more than twice as long as wide; palpal pit irregular but with definite apical edge. Tibial comb with 4 spines



C. Antennalis Gp sp no 4

Culicoides Antennalis Group sp no 5

Culicoides Antennalis Gp sp no 5 Dyce et al 2007:32

Synonyms	Nil.
Distribution	Cape York Peninsula.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of cell r_2 pale; cells m_1 and m_4 without pale markings; Poststigmatic pale spot not extending towards vein M_1 . Flagellomere 8 no more than twice as long as wide Palpal pit with strong apical margin. Anepisternite with dark marking near anterior edge. Tibial comb with 4 spines.

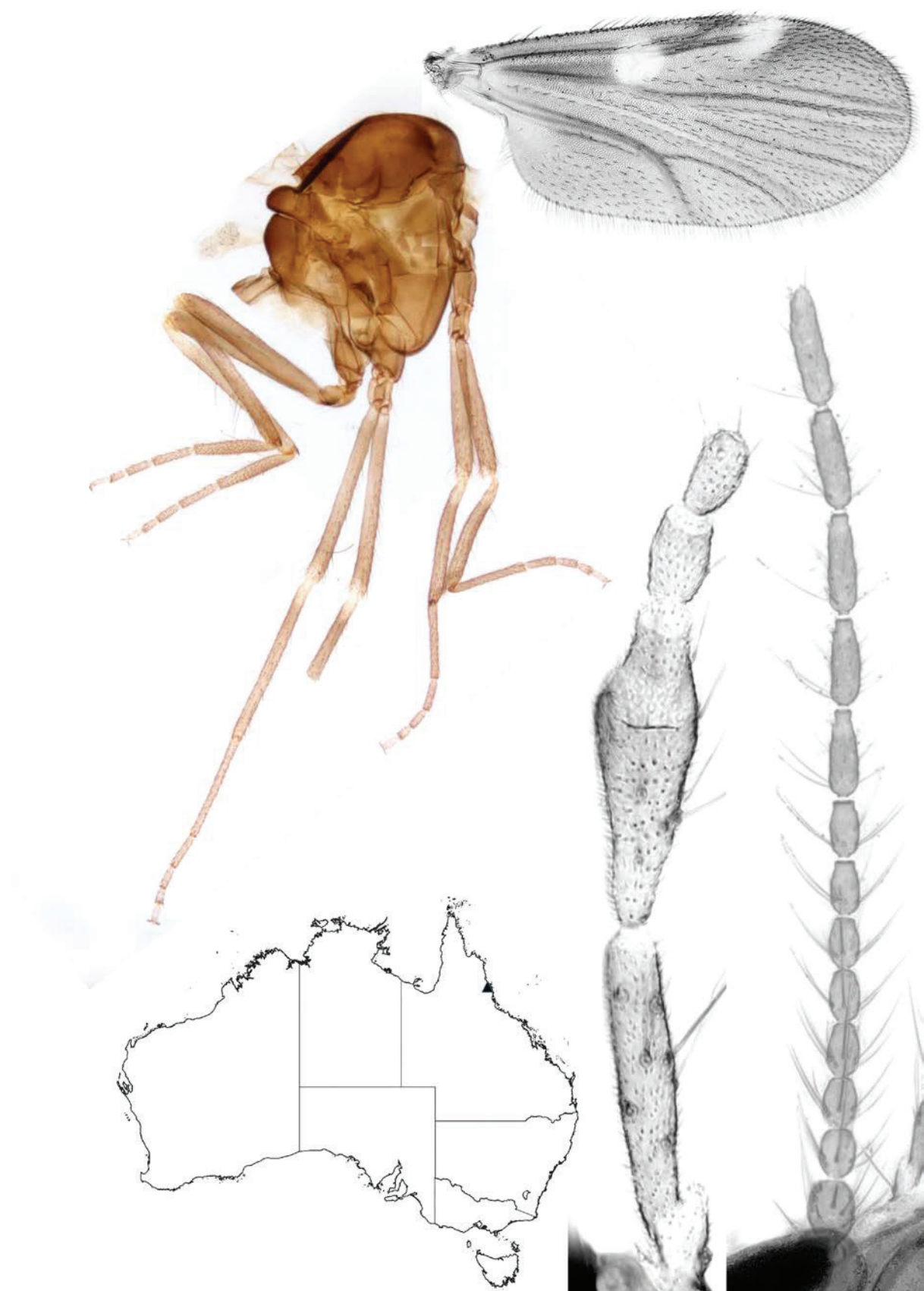


C. Antennalis Gp sp no 5

Culicoides Antennalis Group sp no 6

Culicoides Antennalis Gp sp no 6 Dyce et al 2007:32

Synonyms	Nil.
Distribution	Atherton Tablelands region of northern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of cell r_2 pale; cells m_1 and m_4 without pale markings; poststigmatic pale spot not extending towards vein M_1 ; pale spot over r-m cross-vein not reaching margin of wing. Flagellomere 8 no more than twice as long as wide; SCo usually present on flagellomere 7. Palpal pit without strong apical margin. Tibial comb with 4 spines.



C. Antennalis Gp sp no 6

Culicoides Antennalis Group sp no 7

Culicoides Antennalis Gp sp no 7 Dyce et al 2007:32

Synonyms	Nil.
Distribution	Sydney region of NSW.
Hosts	Unknown, possibly including wombat.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of cell r_2 pale; cells m_1 and m_4 without pale markings; poststigmatic pale spot not extending towards vein M_1 . Flagellomere 8 no more than twice as long as wide; palpal pit without strong apical margin; 3rd palpal segment relatively stout. Tibial comb with 4 spines.

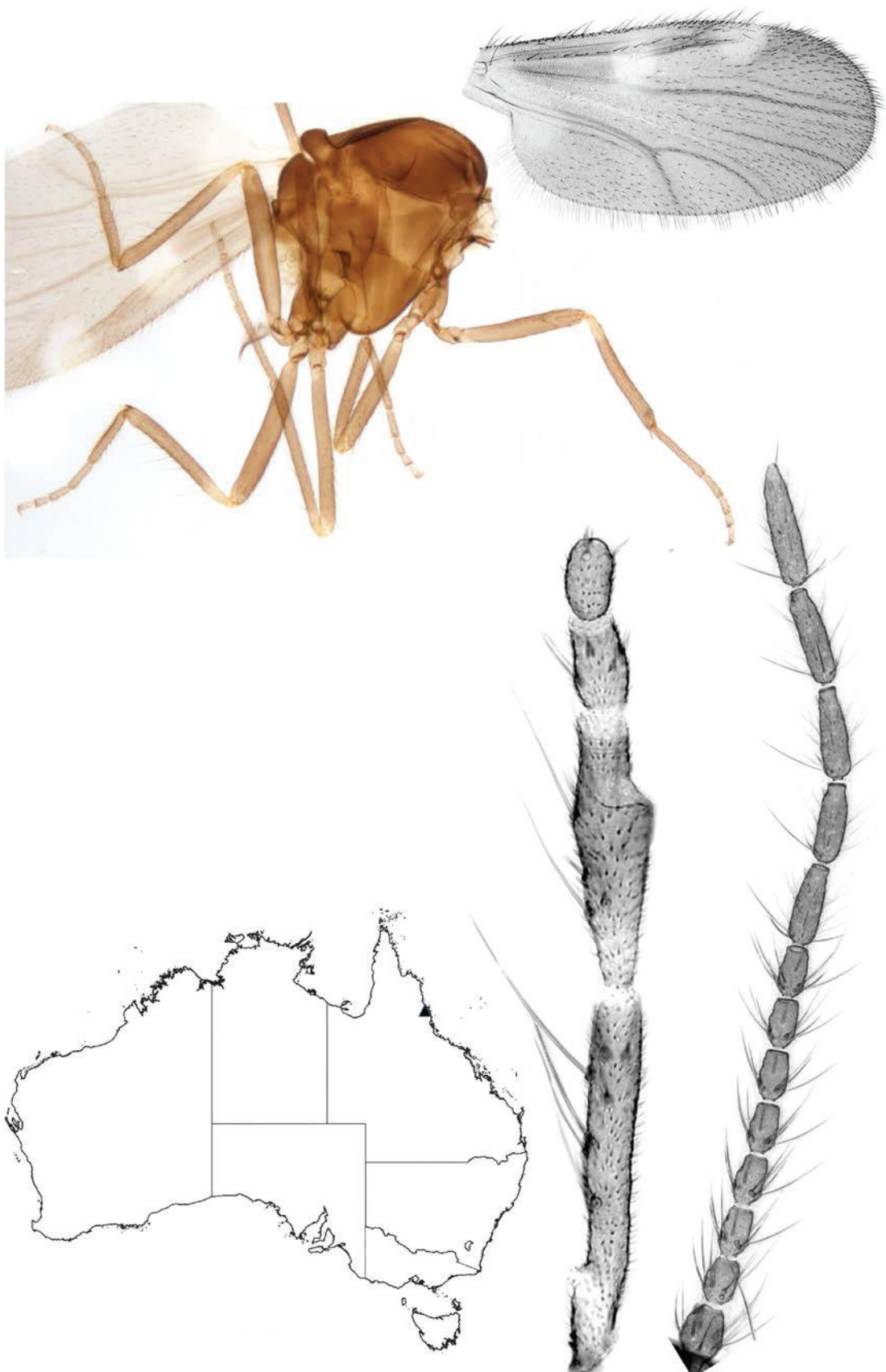


C. Antennalis Gp sp no 7

Culicoides Antennalis Group sp no 8

Culicoides Antennalis Gp sp no 8 Dyce et al 2007:32

Synonyms	Nil.
Distribution	Atherton Tablelands region of northern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of cell r_2 pale; cells m_1 and m_4 without pale markings; poststigmatic pale spot not extending towards vein M_1 . Flagellomere 8 no more than twice as long as wide; SCo absent from flagellomeres 3-7. Palpal pit without strong apical margin. Tibial comb with 4 spines.

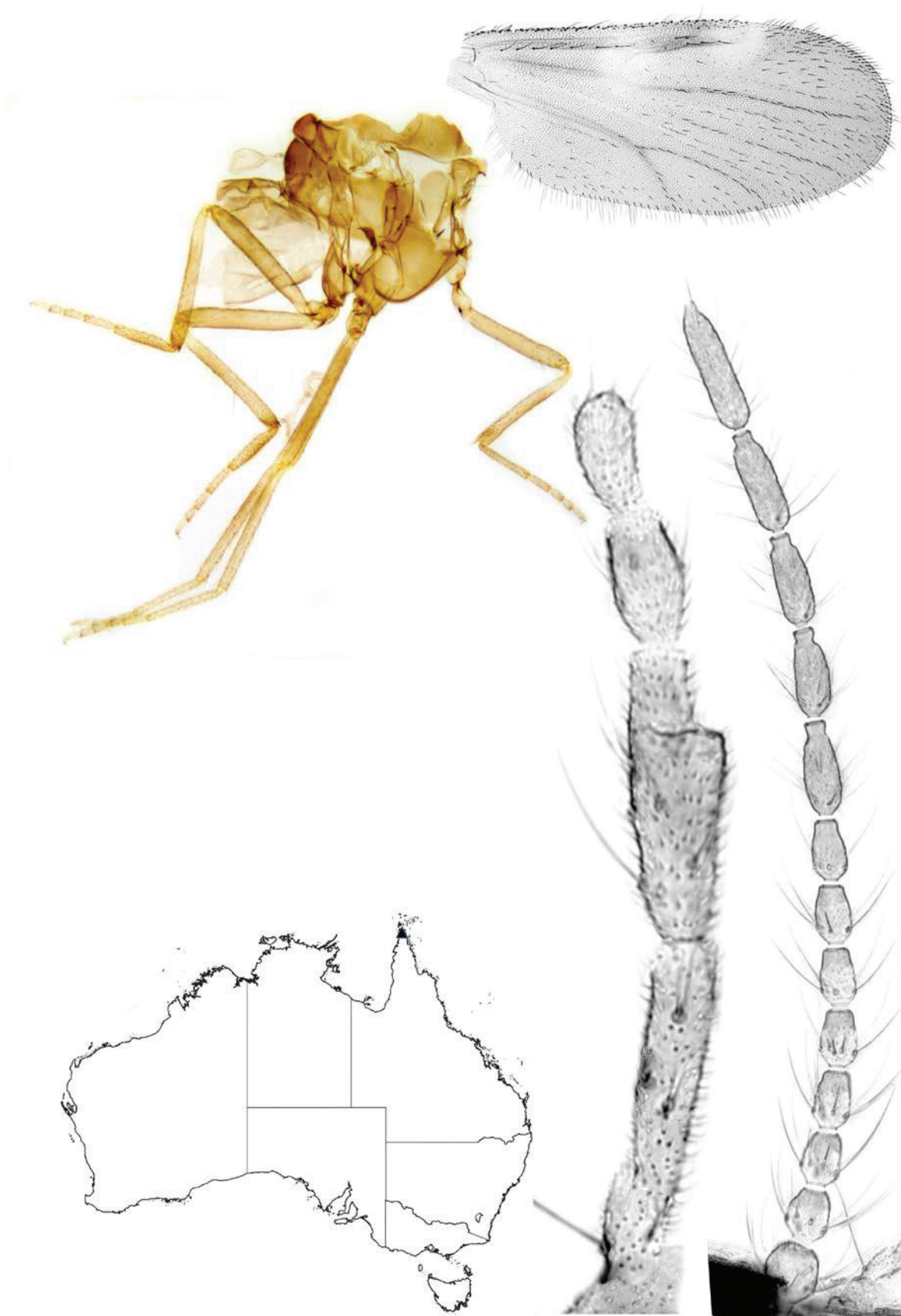


C. Antennalis Gp sp no 8

Culicoides Antennalis Group sp no 9

Culicoides Antennalis Gp sp no 9 Dyce et al 2007:33

Synonyms	Nil.
Distribution	Cape York Peninsula region of northern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of cell r_2 pale; cells m_1 and m_4 without pale markings; poststigmatic pale spot not extending towards vein M_1 ; pale spot over r-m cross-vein reaching margin of wing. Flagellomere 8 no more than twice as long as wide; SCo usually present on flagellomeres 2, 5 and 7. Palpal pit without strong apical margin. Tibial comb with 4 spines.



C. Antennalis Gp sp no 9

Culicoides Antennalis Group sp no 10

Culicoides Antennalis Gp sp no 10 Dyce et al 2007:33

Synonyms	Nil.
Distribution	Top End of NT.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of cell r_2 pale; cells m_1 and m_4 without pale markings; poststigmatic pale spot not extending towards vein M_1 . Flagellomere 8 no more than twice as long as wide. Palpal pit with strong apical margin. Anepisternite entirely pale, hind tibiae dark to base. Tibial comb with 4 spines.

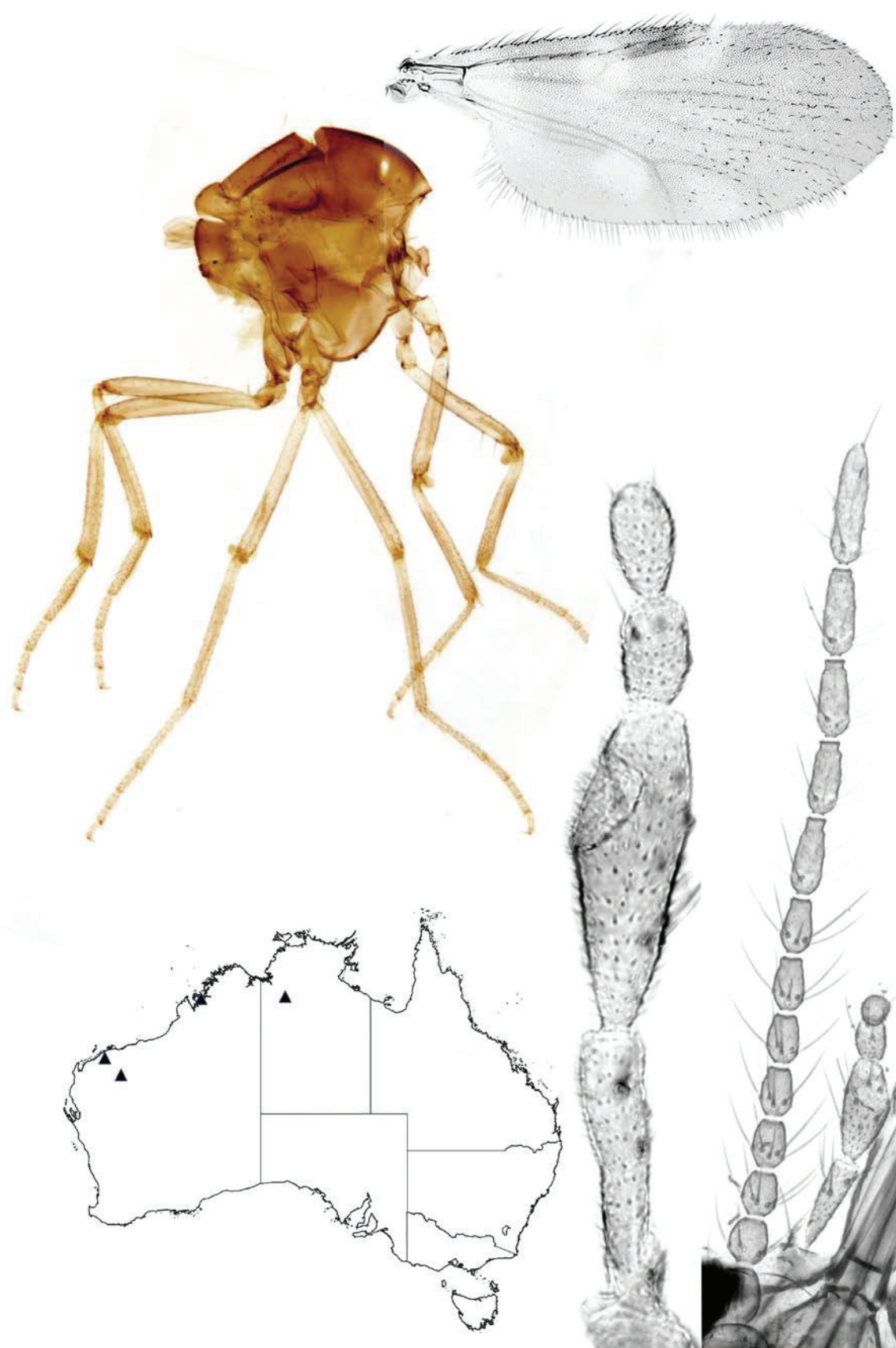


C. Antennalis Gp sp no 10

Culicoides Antennalis Group sp no 11

Culicoides Antennalis Gp sp no 11 Dyce et al 2007:33

Synonyms	Nil.
Distribution	Northwestern NT, Pilbara and Kimberley regions of WA.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of cell r_2 pale; cells m_1 and m_4 without pale markings; poststigmatic pale spot not extending towards vein M_1 . Flagellomere 8 no more than twice as long as wide. Palpal pit with strong apical margin. Anepisternite entirely pale. Hind tibiae with subbasal pale band. Tibial comb with 4 spines.

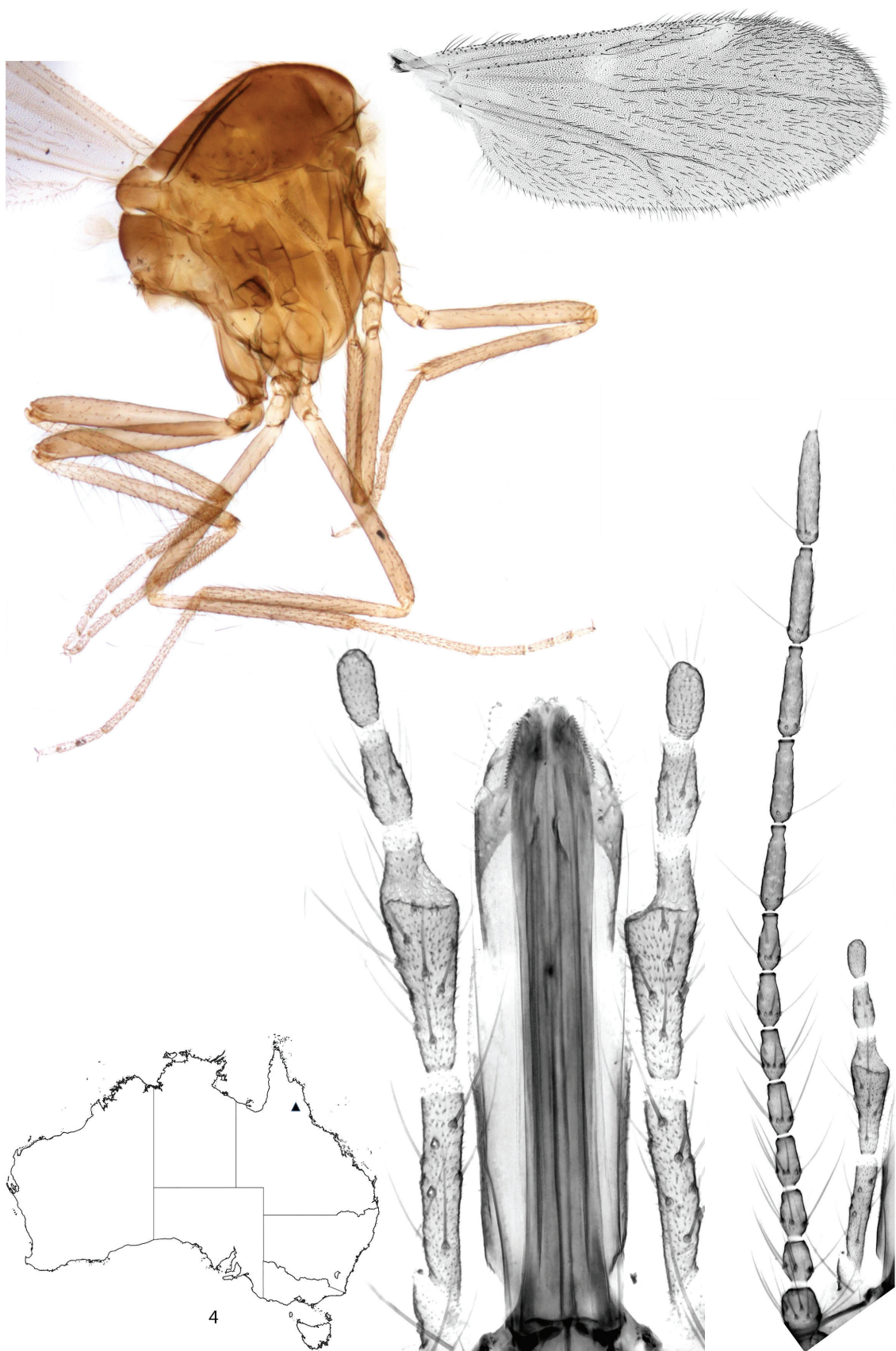


C. Antennalis Gp sp no 11

Culicoides Antennalis Group sp no 14

Culicoides Antennalis Gp sp no 14 Dyce et al 2007:34

Synonyms	Nil.
Distribution	Chillago caves, northern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown but apparently associated with caves.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of cell r_2 pale; cells m_1 and m_4 without pale markings; poststigmatic pale spot not extending towards vein M_1 . Flagellomere 8 more than twice as long as wide. Palpal pit lacking definite apical edge. Tibial comb with 4 spines.



C. Antennalis Gp sp no 14

Culicoides Bancrofti Group

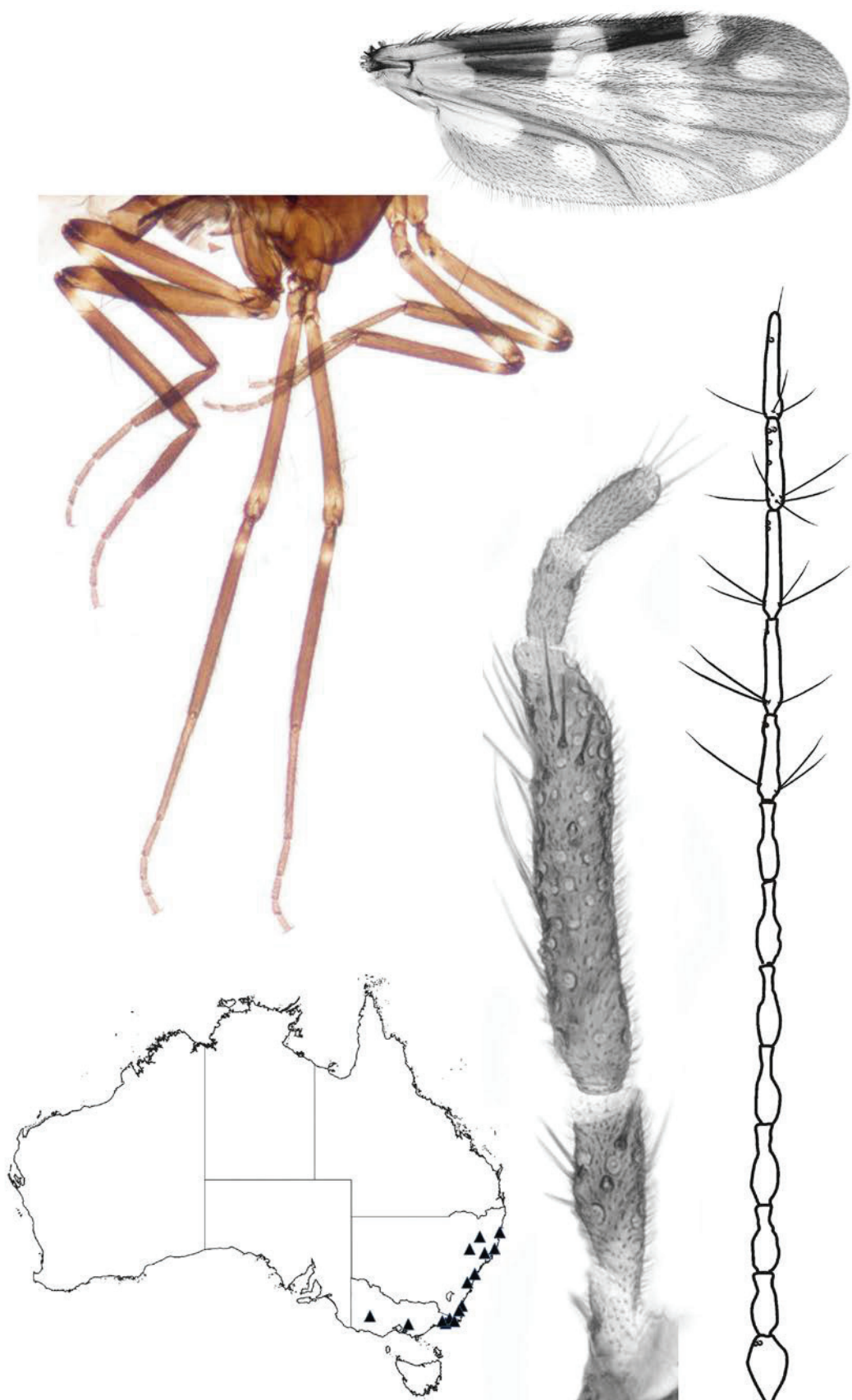
Culicoides Bancrofti Gp Bellis & Dyce 2012:51

Nominate species	<i>Culicoides bancrofti</i> Lee & Reye
Synonyms	Nil.
Distribution	Australia.
Number of species worldwide	Two species, both endemic to Australia.
Number of species in Australia	2.
Hosts	Mammalian, including large mammals.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: 3rd palpal segment greatly enlarged, at least 4 times as long and twice as wide as 4th segment, lacking a pit. Tibial comb with 4 spines, that closest to the spur longest. SCo always present on 9-13; SCh present on distal flagellar segments. Wing pattern well defined, cell r_2 pale apically.

Culicoides bancrofti

Culicoides bancrofti Lee & Reye 1953: 387 (New South Wales)

Synonyms	Nil.
Distribution	Victoria, eastern NSW, southeastern Qld.
Hosts	Human (Reye 1992).
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 3rd palpal segment very long, cylindrical and lacking a pit, sensilla scattered over entire surface, also present distally on 2nd segment. Cell r_2 pale apically; pale marking present over basal part of vein M_1 .

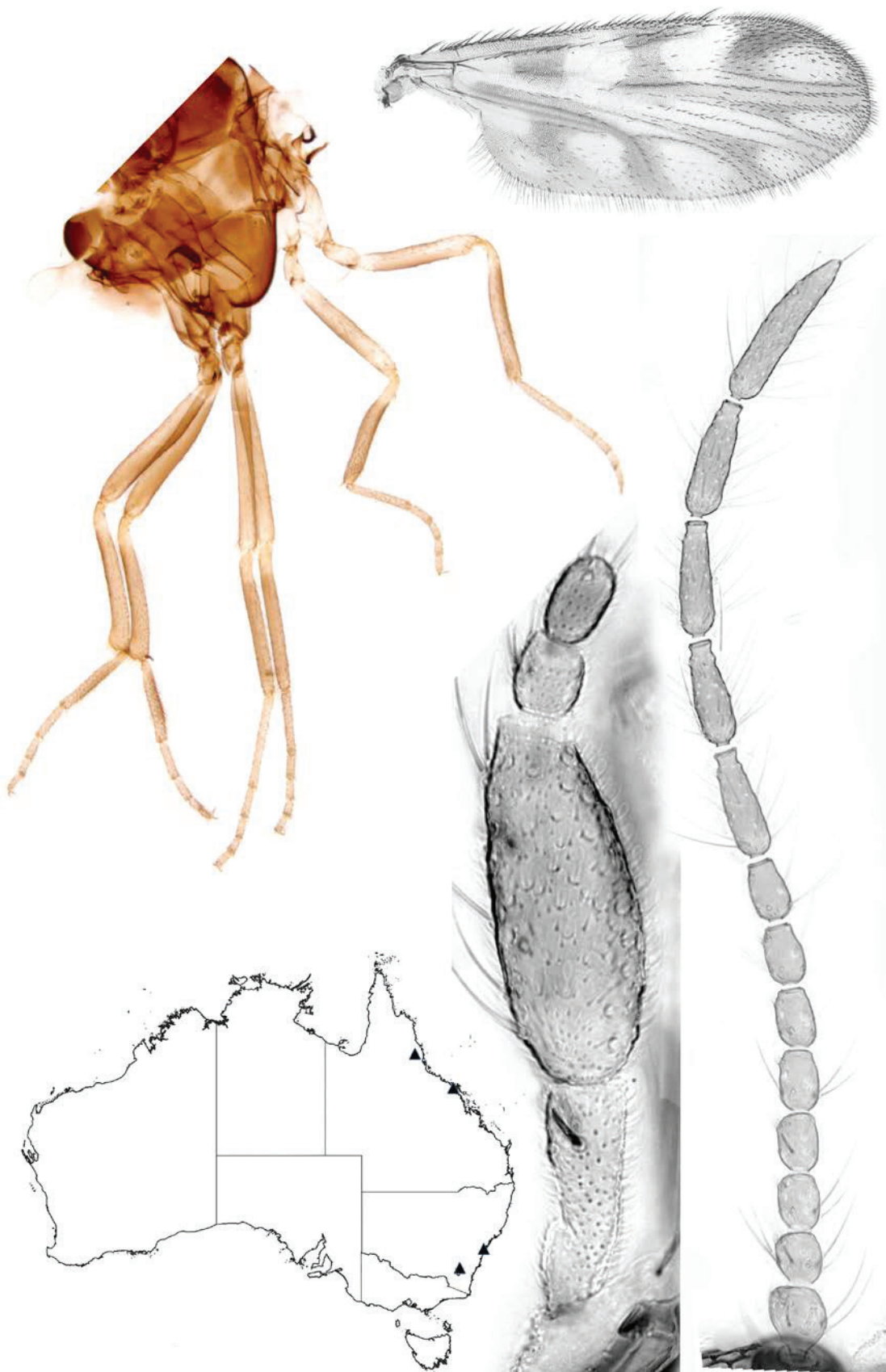


C. bancrofti

Culicoides hornsbyensis

Culicoides hornsbyensis Lee & Reye 1963: 361 (New South Wales)

Synonyms	Nil.
Distribution	Eastern Qld and NSW.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 3rd palpal segment very long, cylindrical and lacking a pit. Cell r_2 pale apically; poststigmatic pale spot reaching vein M_1 .



C. hornsbyensis

Key to females of species in the Clavipalpis Group

1

Apical spot in cell r_3 irregularly shaped (a)

2

Apical spot in cell r_3 circular, ovoid or indistinct (b)

4



C. bunrooensis



Clavipalpis Gp sp no 8

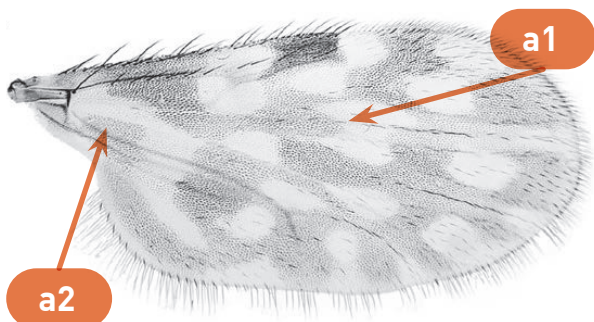
2

Vein M_1 with pale marking posterior to poststigmatic pale spot (a1); base of M-Cu with dark marking (a2)

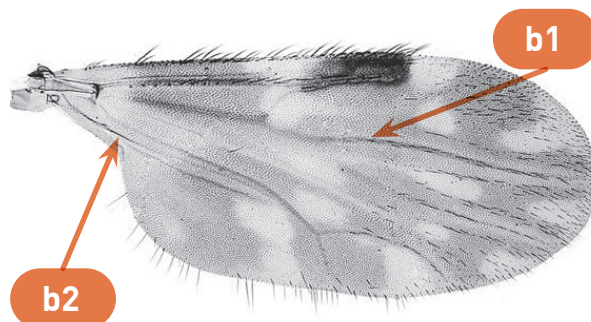
C. bunrooensis

Vein M_1 without pale markings (b1); base of M-Cu without dark marking (b2) NQld

3



C. bunrooensis



C. notatus

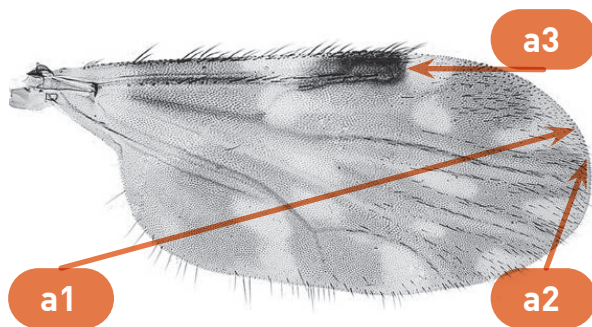
3

Apical spot in cell r_3 (a1) closer to wing apex (a2) than to cell r_2 (a3)

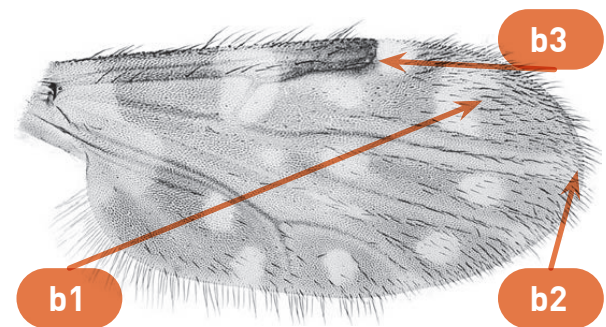
C. notatus

Apical spot in cell r_3 (b1) equidistant between wing apex (b2) and cell r_2 (b3)

Clavipalpis Gp sp no 2



C. notatus



Clavipalpis Gp sp no 2

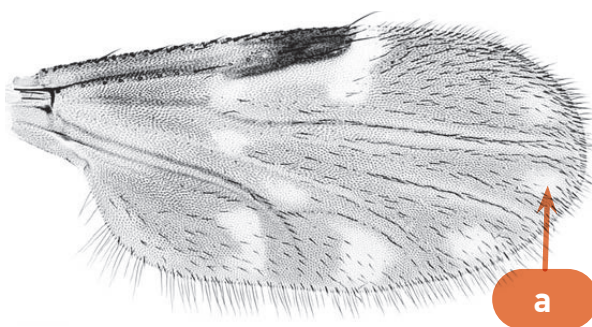
4

[1] Cell m_1 with single pale spot, at wing margin (a)

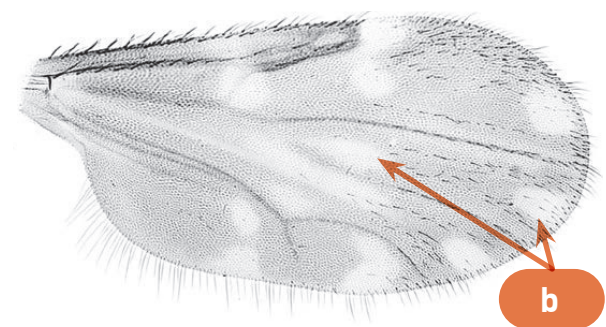
5

Cell m_1 with two or three pale spots (b)

8



C. marginalis



Clavipalpis Gp sp no 10

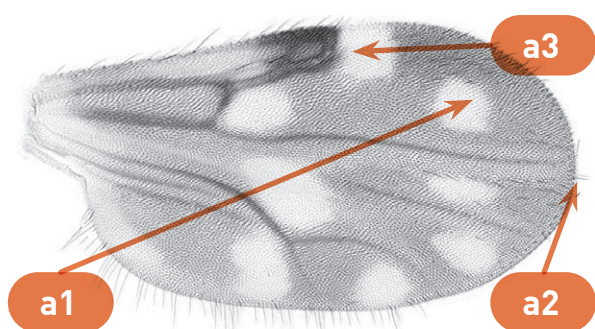
5

Apical spot in cell r_3 (a1) equidistant between wing apex (a2) and poststigmatic pale spot (a3)

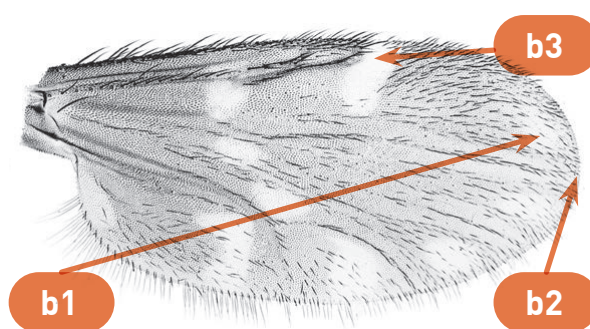
Clavipalpis Gp sp no 19

Apical spot in cell r_3 (b1) much closer to wing apex (b2) than to poststigmatic pale spot (b3) or indistinct

6



Clavipalpis Gp sp no 19



Clavipalpis Gp sp no 14

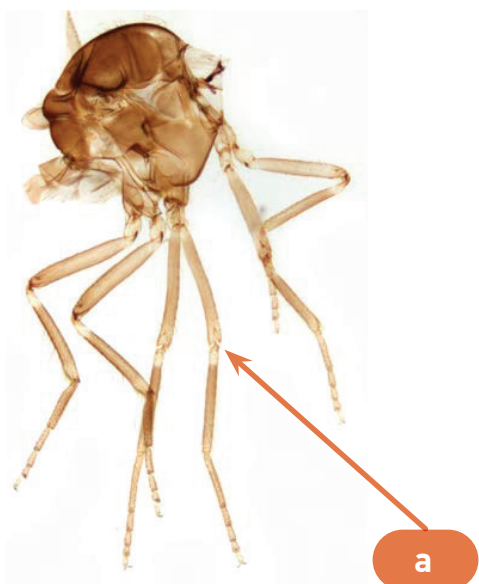
6

Mid knees pale (a)

Clavipalpis Gp sp no 8

Mid knees dark (b)

7



Clavipalpis Gp sp no 8

*C. marginalis*

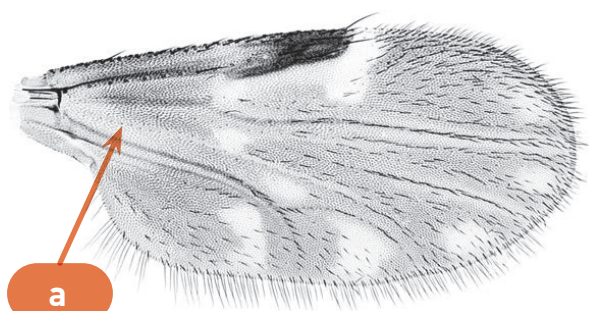
7

Base of vein M-Cu included in pale marking over base of wing (a)

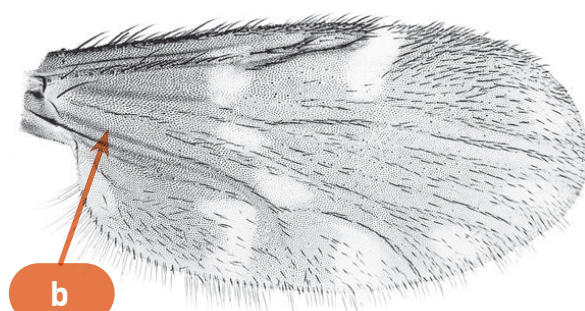
C. marginalis

Base of vein M-Cu included in dark marking (b)

Clavipalpis Gp sp no 14



C. marginalis



Clavipalpis Gp sp no 14

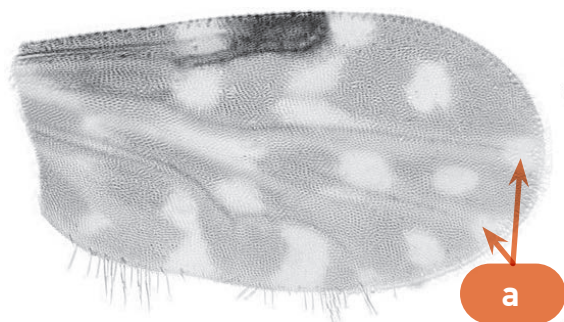
8

[4] Veins M_1 and M_2 both with small pale spot at apex (a)

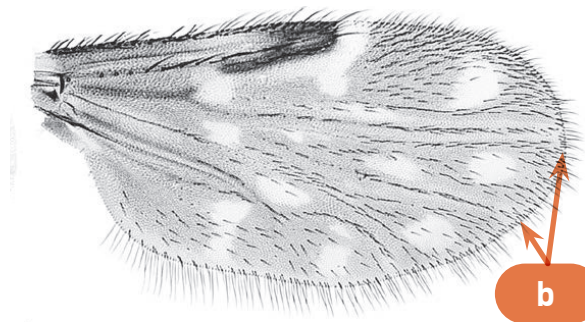
Clavipalpis Gp sp no 1

Veins M_1 and M_2 both without apical pale spot (b)

9



Clavipalpis Gp sp no 1



Clavipalpis Gp sp no 9

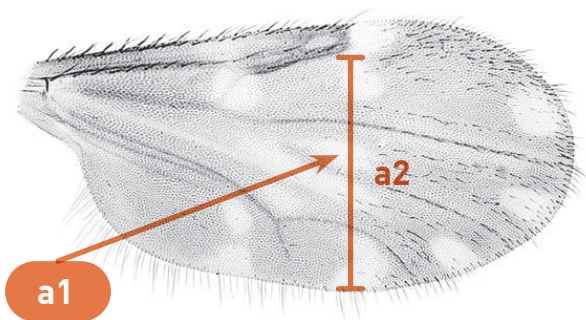
9

Proximal pale spot in cell m_1 (a1) sub-basal, directly below poststigmatic pale spot, more or less in line with pale spot in cell m_4 (a2)

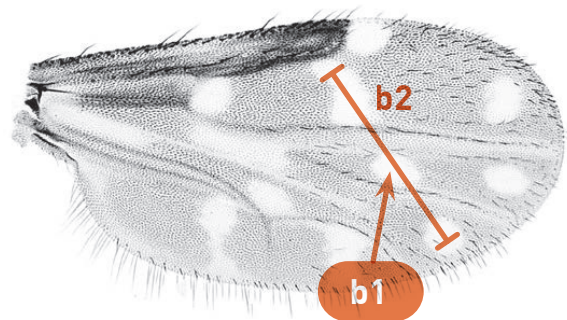
10

Proximal pale spot in cell m_1 central (a1), diagonally distal to poststigmatic pale spot and in line with marginal pale spot in cell m_2 (b2)

12



Clavipalpis Gp sp no 10



Clavipalpis Gp sp no 6

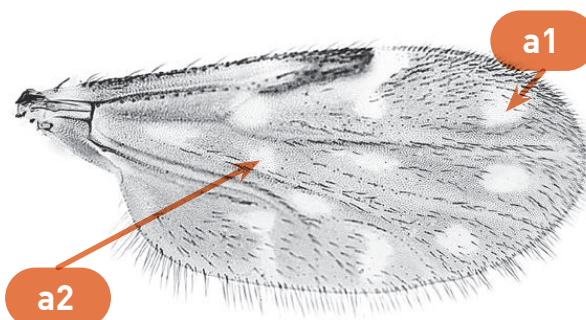
10

Distal pale spot in cell r_3 distant from wing margin (a1), pale spot below M petiole (a2) small, rounded, not extending distally beyond level of fork

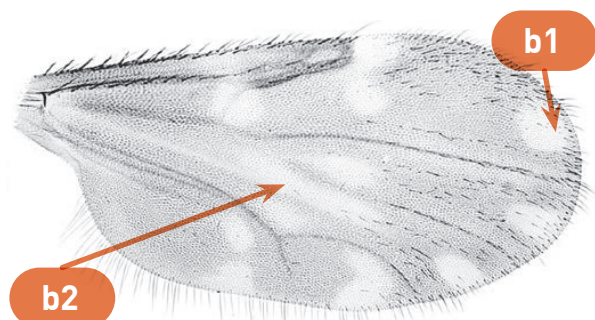
Clavipalpis Gp sp no 11

Distal pale spot in cell r_3 touching wing margin (b1), pale spot below M petiole (b2) extended distally beyond level of fork

11



Clavipalpis Gp sp no 11



Clavipalpis Gp sp no 10

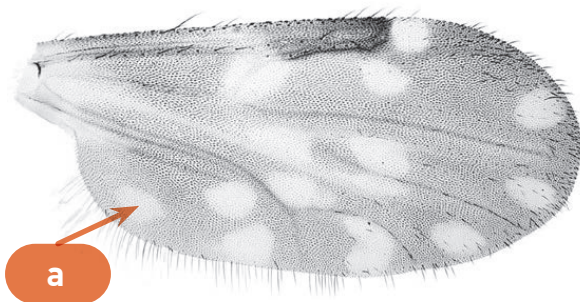
11

Base of anal cell with rounded pale spot (a)

Clavipalpis Gp sp no 13

Base of anal cell without rounded pale spot (b)

Clavipalpis Gp sp no 10



Clavipalpis Gp no 13



Clavipalpis Gp sp no 10

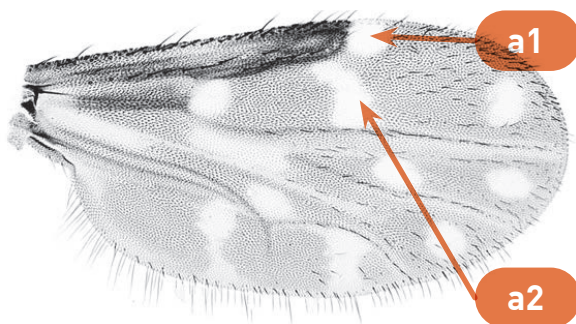
12

(9) Poststigmatic pale spot divided into small round spot distal to cell r_2 (a1) and an irregularly shaped spot posterior to cell r_2 (a2)

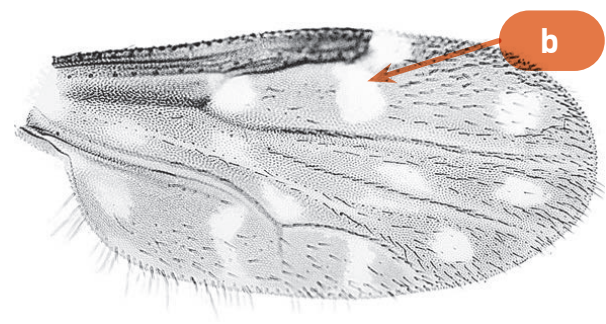
Clavipalpis Gp sp no 6

Poststigmatic pale spot an undivided irregularly shaped spot extending from cell r_2 towards vein M_1 (b)

13



Clavipalpis Gp sp no 6

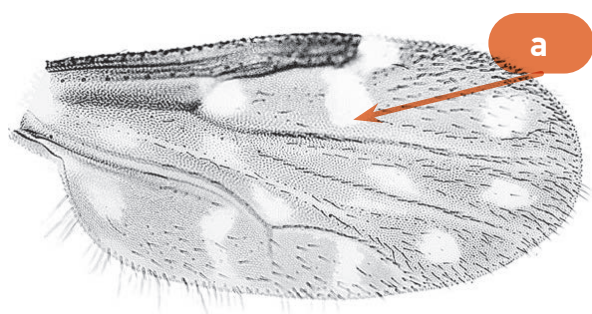
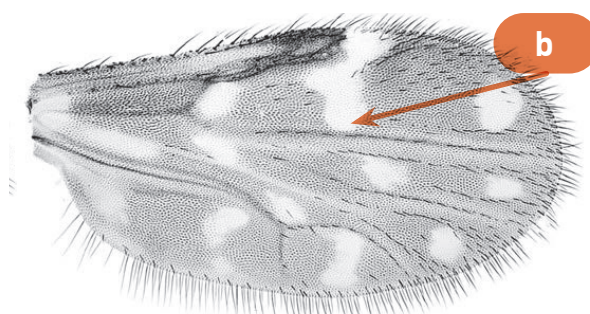


C. parviscriptus

13

Posterior lobe of poststigmatic pale spot not reaching vein M_1 (a)

14

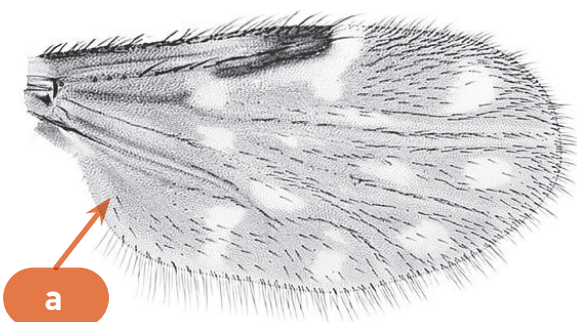
Posterior lobe of transverse pale band reaching vein M_1 (b)*C. clavipalpis**C. parviscriptus**C. clavipalpis*

14

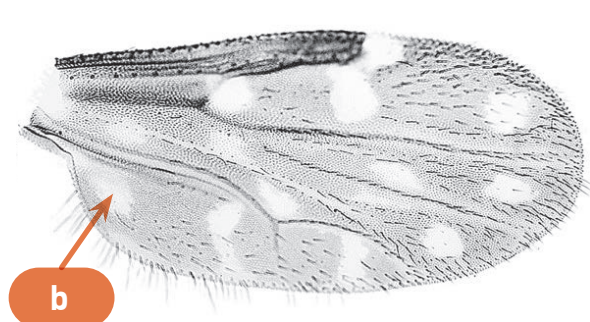
Base of anal cell without pale spot (a)

Clavipalpis Gp sp no 9

Base of anal cell with pale spot (b)

C. parviscriptus

Clavipalpis Gp sp no 9

*C. parviscriptus*

Culicoides Clavipalpis Group

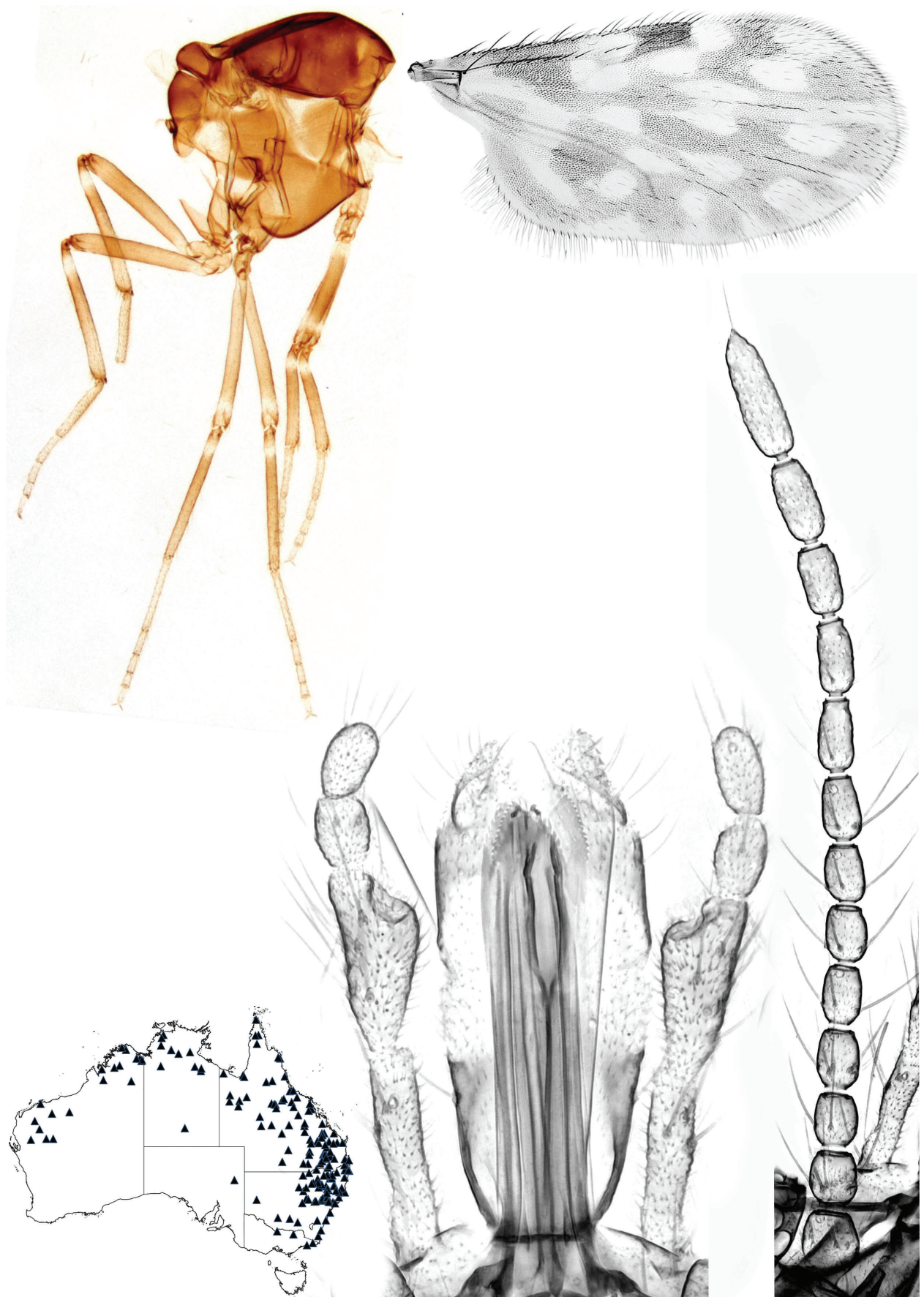
Culicoides Clavipalpis Group Wirth & Hubert 1989:364

Nominate species	<i>Culicoides clavipalpis</i> Mukerji
Synonyms	Nil.
Distribution	The Australasian fauna of the <i>clavipalpis</i> group are a continuation of the same group (9 spp.) recorded by Wirth and Hubert (1989) from the Oriental Region. Wirth & Hubert (1989) indicated that this group is the counterpart of the African <i>similis</i> group, first noted by Cornet and Chateau (1970) and added to by Khamala and Kettle (1971) and later Glick (1990). A complex relationship exists between the <i>clavipalpis</i> group and the <i>williwilli</i> group in the Australasian and Oriental Regions and such Neotropical subgenera as <i>Drymodesmyia</i> and <i>Diphaomyia</i> and with the subgenus <i>Synhelea</i> in Africa but the intricacies of the broad relationship await resolution.
Number of species worldwide	9 species in SE Asia (Wirth & Hubert 1989) and 34 in Australasia (Dyce et al 2007). The African checklist is confused with species placed by various authors into subgenus <i>Synhelea</i> or the <i>similis</i> group such that the distinction is difficult to ascertain.
Number of species in Australia	15.
Hosts	Unknown for most species. <i>C. bunrooensis</i> has been reported feeding on mammals.
Vector status	Unknown.
Immature habitat	Predominately container breeders, for example tree holes, although <i>C. bunrooensis</i> has been reared from ground water margins.
Diagnosis	Can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Wing strongly patterned in most species; cell r_2 dark to apex; discrete small pale spot lying in front of medio-cubital fork in most species. SCo and SCh absent from flagellomeres 9-13, 3rd palpal segment with a round pit in most species.

Culicoides bunrooensis

Culicoides bunrooensis Lee & Reye 1955: 238 (Qld)

Synonyms	Nil.
Distribution	Widespread in Pilbara and Kimberley regions of WA, throughout NT, Qld and NSW and northern Victoria.
Hosts	Sheep, marsupial (Muller & Murray 1977).
Vector status	Unknown.
Immature habitat	Mud on stream and pond margins (Dyce & Murray 1966).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Apical pale spot in cell r_3 bilobed; CuA not included in pale marking.

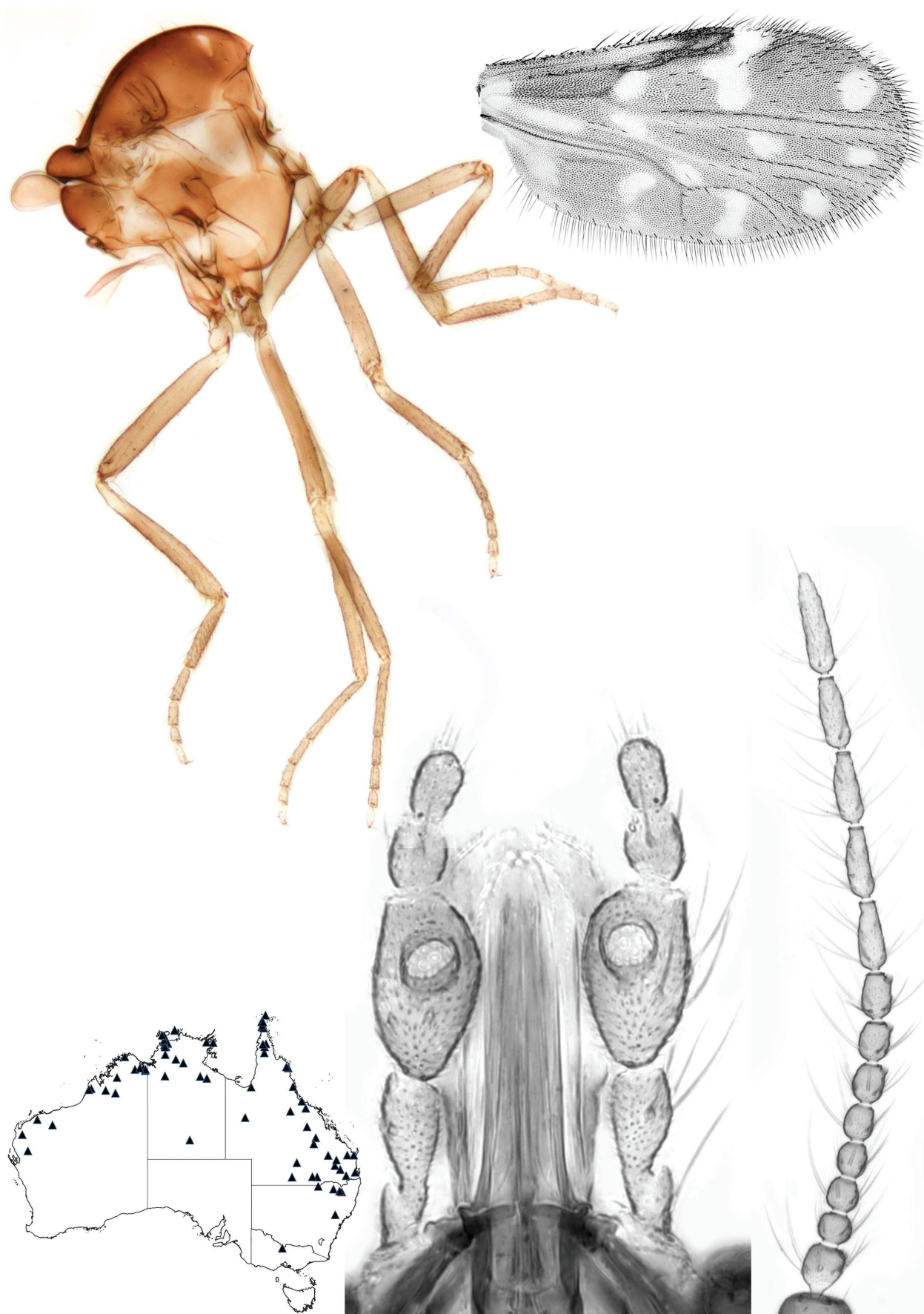


C. bunrooensis

Culicoides clavipalpis

Culicoides clavipalpis Mukerji 1931: 1052 (India)

Synonyms	<i>candidus</i> Sen & Das Gupta 1959:620
Distribution	Widespread in Pilbara and Kimberley regions of WA, throughout NT, Qld and northeastern NSW. Widespread in Asia west to India and north to Korea.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Leaf detritus in tree wound in fork of tree (Howarth 1985); tree hole (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Compact pale spot between front of M-Cu fork and M_2 crease present; poststigmatic pale spot trilobed, reaching vein M_1 .

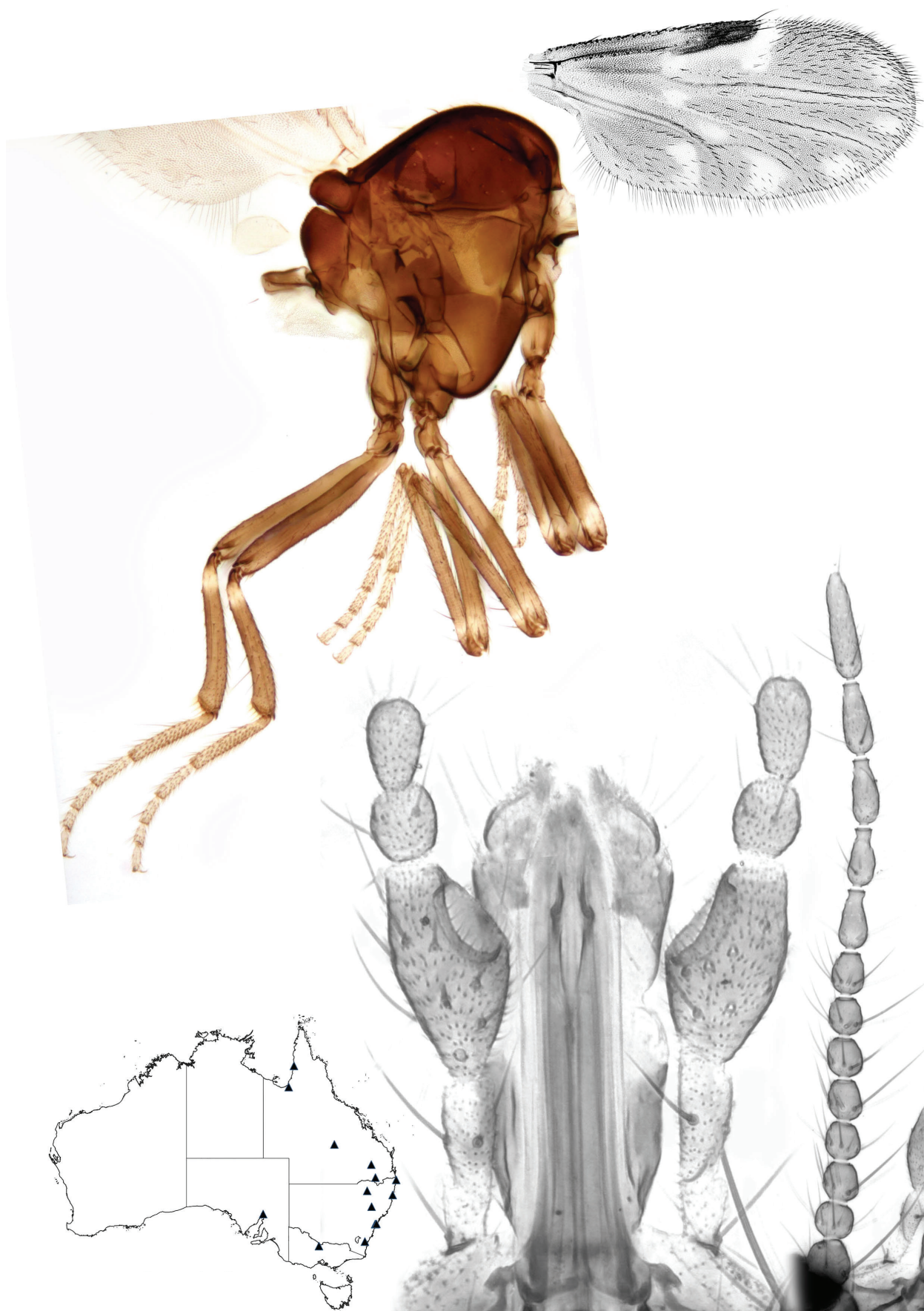


C. clavipalpis

Culicoides marginalis

Culicoides marginalis Lee & Reye 1963: 354 (New South Wales)

Synonyms	Nil.
Distribution	Widespread in Qld, present in eastern NSW, Victoria and south-eastern SA.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Tree holes (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Compact pale spot between front of M-Cu fork and M_2 crease present; Cell m_1 with 1 pale spot; base of M-Cu included in pale marking over base of wing; mid knees dark.

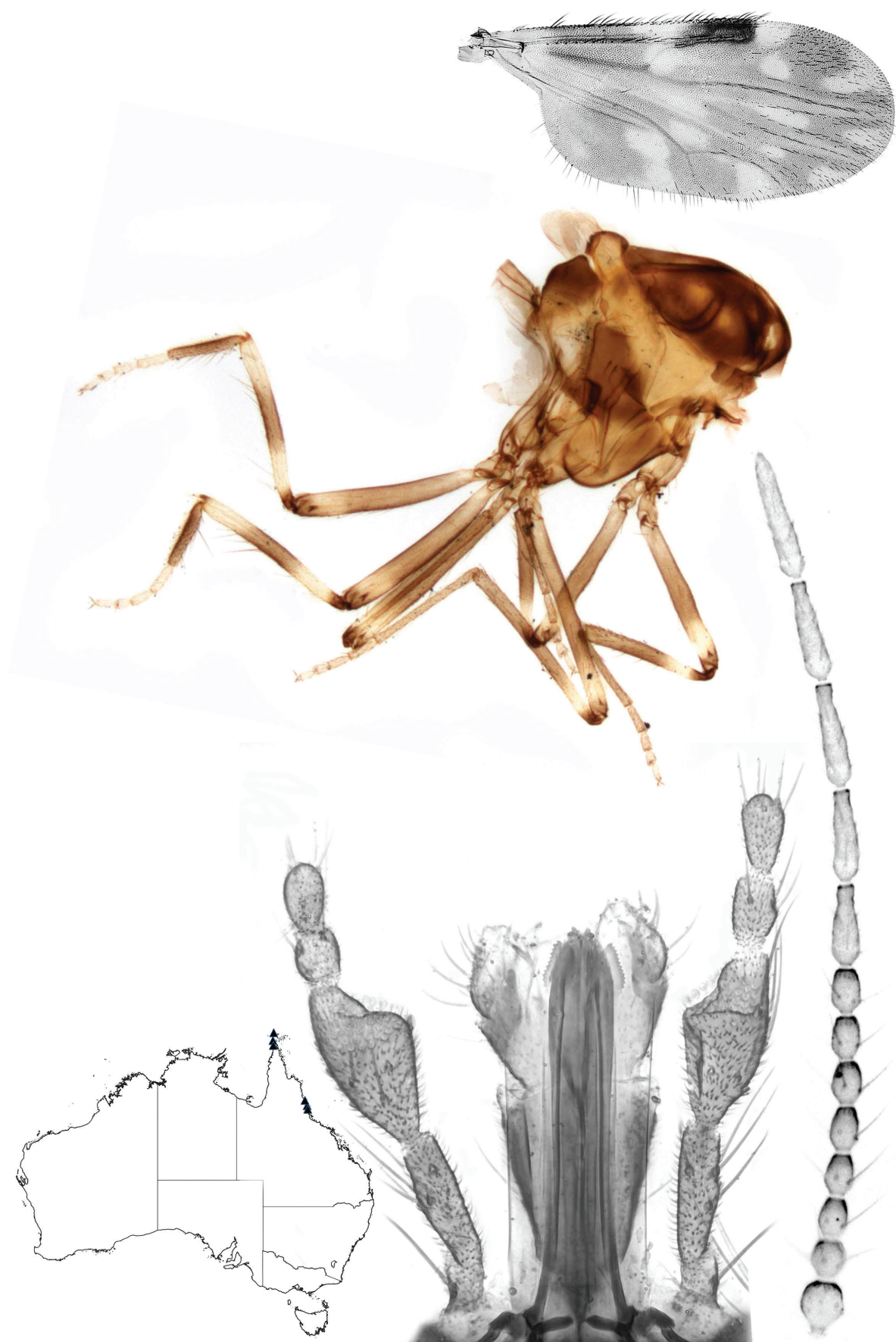


C. marginalis

Culicoides notatus

Culicoides notatus Delfinado 1961: 648 (Philippines)

Synonyms	<i>papuae</i> Tokunaga 1962: 481.
Distribution	Northern Qld. Widespread in SE Asia, also in PNG and the Solomon Is.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Mud on stream and pond margins (Howarth 1985).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Apical pale spot in cell r_3 expanded apically, broadly reaching wing margin; round pale spot present immediately posterior to poststigmatic pale spot. Mainland Asian populations of this species have a rounded pale spot apically in cell r_3 .

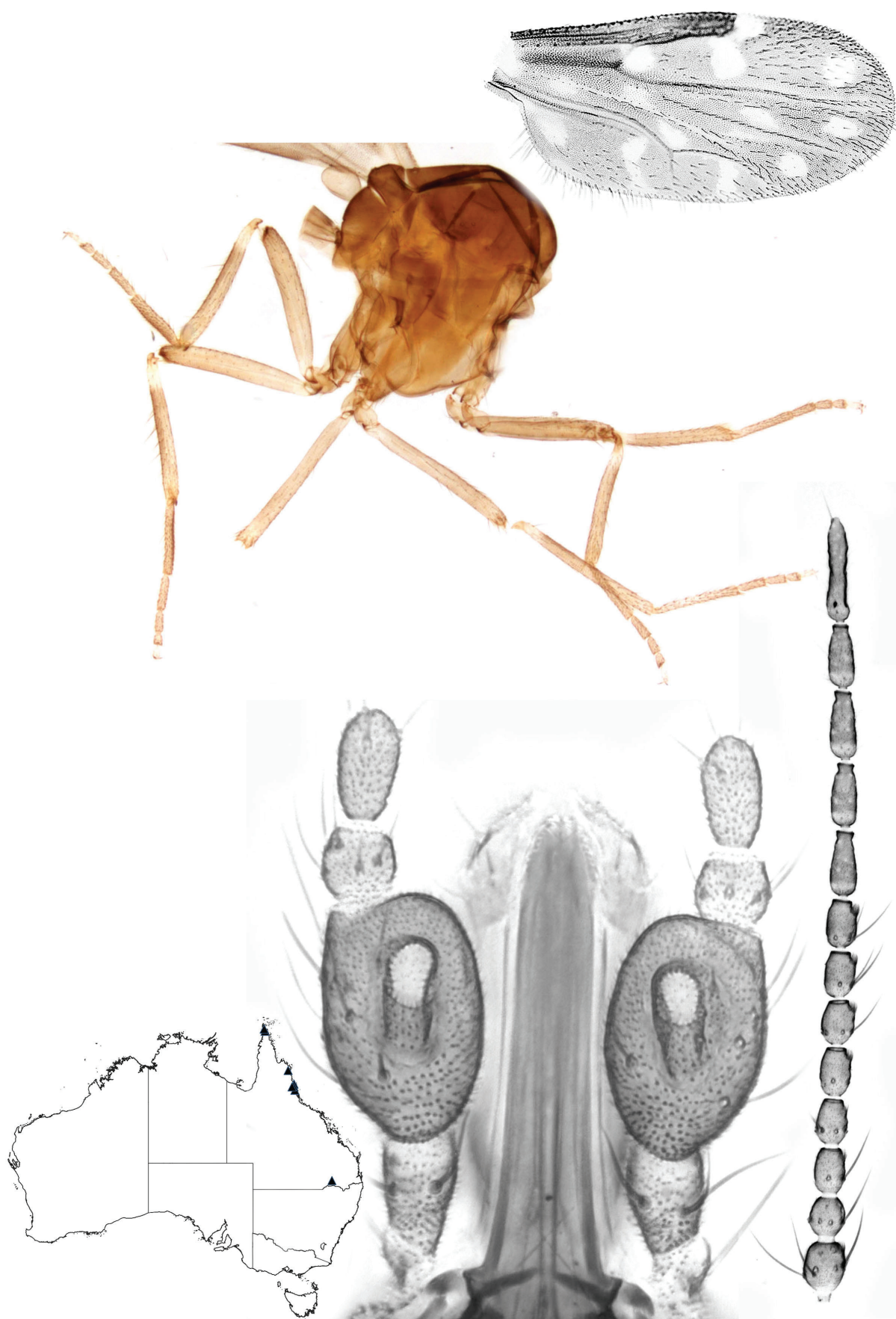


C. notatus

Culicoides parviscriptus

Culicoides parviscriptus Tokunaga 1959: 213 (East Papua)

Synonyms	Nil.
Distribution	North-eastern Qld. Records from southern Qld require confirmation.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Tree holes and rotting banana stem (Wirth & Hubert 1989).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Compact pale spot between front of M-Cu fork and M_2 crease present; Proximal pale spot in cell m_1 in centre of cell; poststigmatic pale spot not reaching vein M_1 ; pale spot present in base of anal cell.

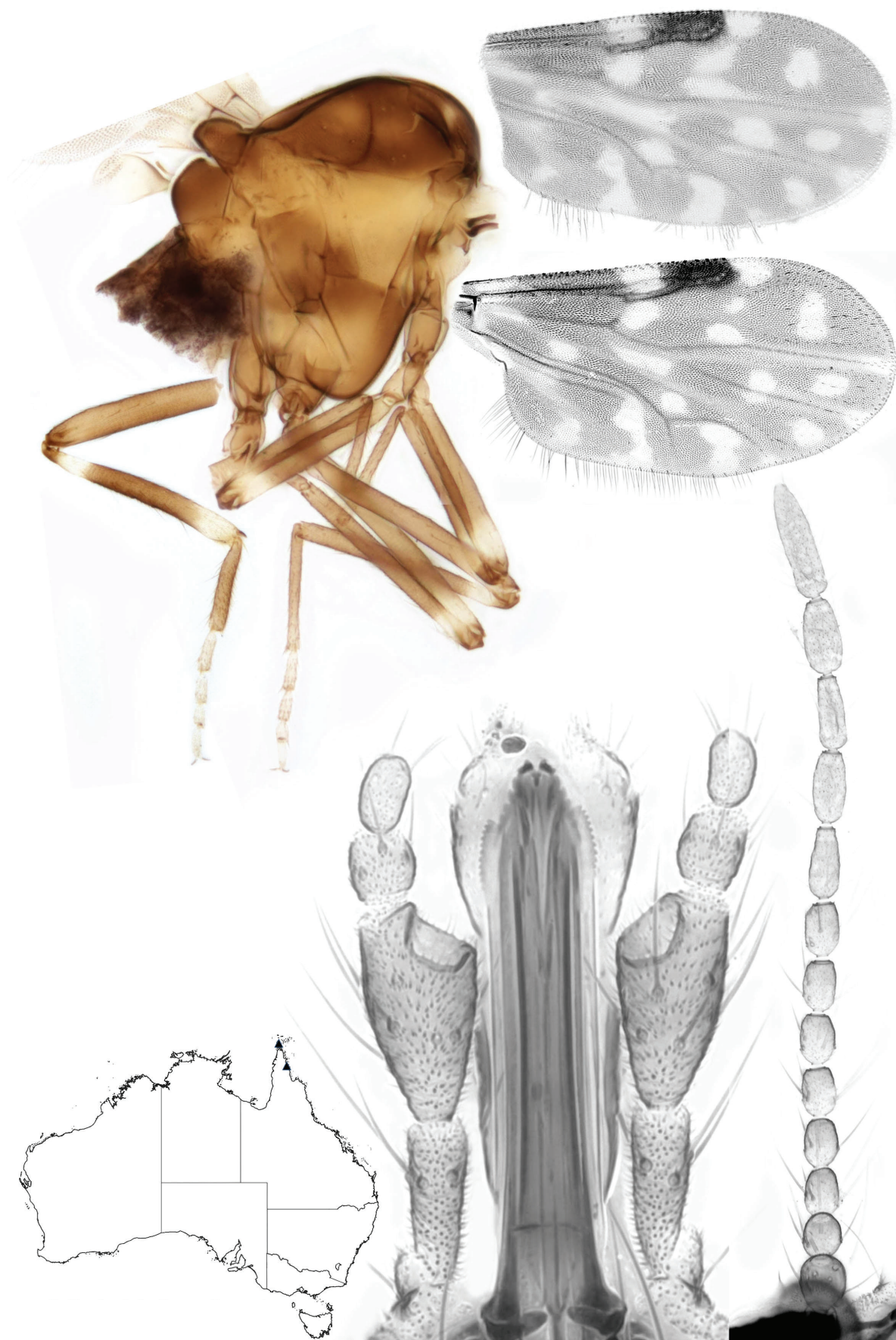


C. parviscriptus

Culicoides Clavipalpis Group sp no 1

Culicoides Clavipalpis Gp sp no 1 Dyce et al 2007:35

Synonyms	Nil.
Distribution	Cape York Peninsula and Torres Strait, Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Compact pale spot between front of M-Cu fork and M_2 crease present; small pale spots at the apex of veins M_1 and M_2 .

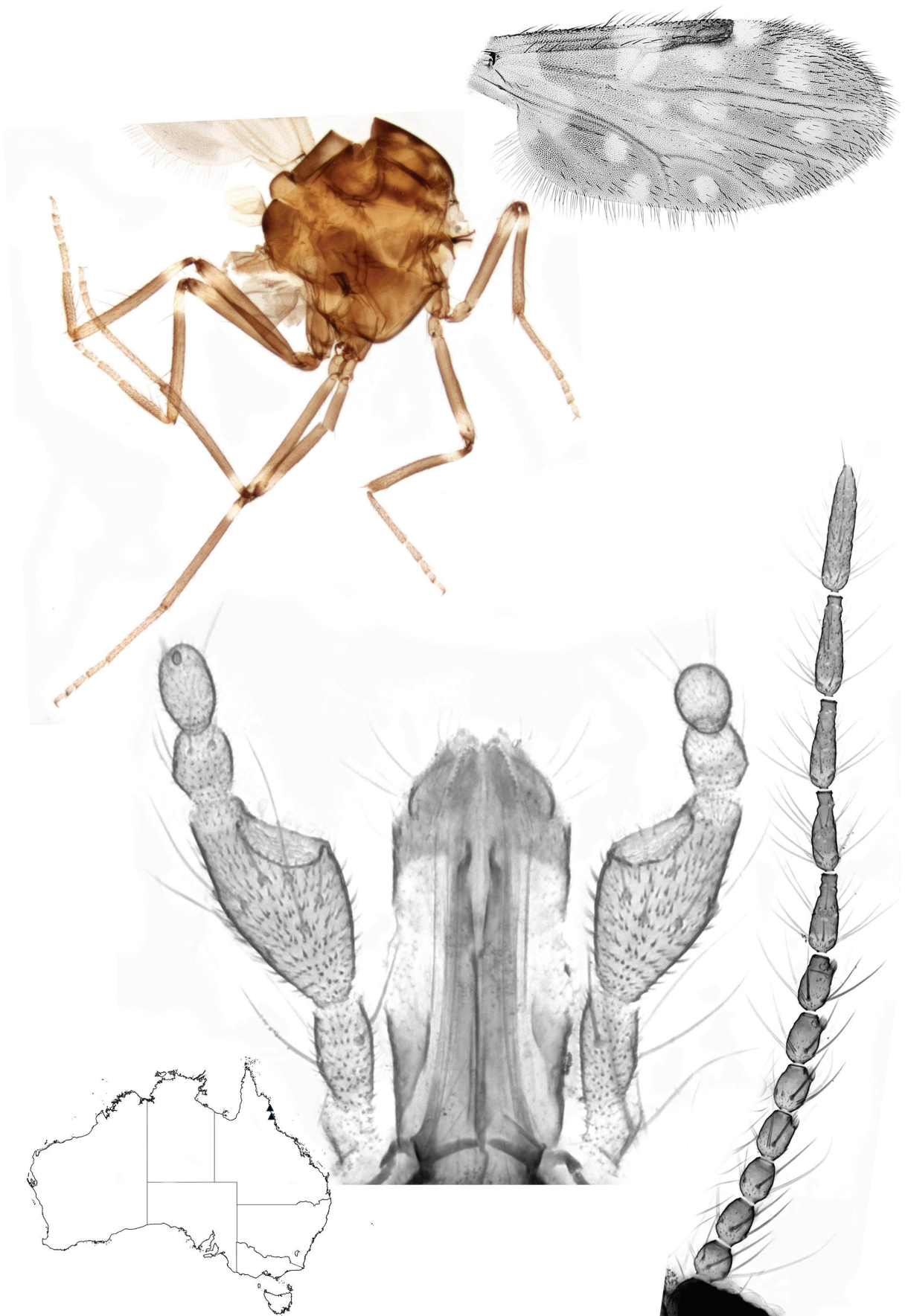


C. Clavipalpis Gp sp no 1

Culicoides Clavipalpis Group sp no 2

Culicoides Clavipalpis Gp sp no 2 Dyce et al 2007:35

Synonyms	Nil.
Distribution	Northern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Apical pale marking in cell r_3 crescent-shaped and more than its own diameter from the apex of the cell; rounded pale spot present posterior to cell r_2 .

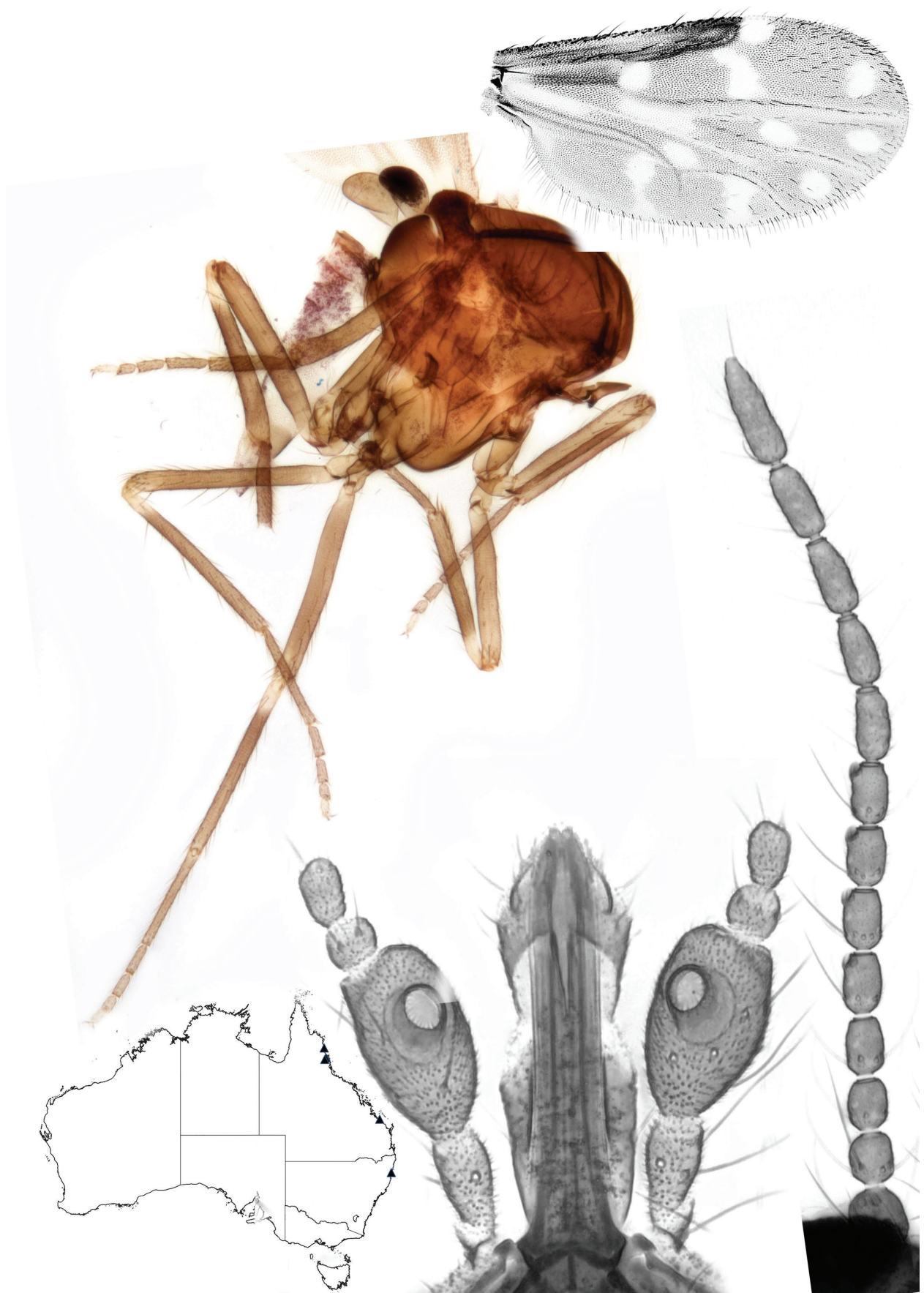


C. Clavipalpis Gp sp no 2

Culicoides Clavipalpis Group sp no 6

Culicoides Clavipalpis Gp sp no 6 Dyce et al 2007:37

Synonyms	Nil.
Distribution	Rainforests of Qld and northern NSW.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Compact pale spot between front of M-Cu fork and M_2 crease present; Cell m_1 with 2 pale spots, proximal spot near centre of the cell; Poststigmatic pale spot divided into a rounded spot at the apex of cell r_2 and a transverse marking extending to vein M_1 .

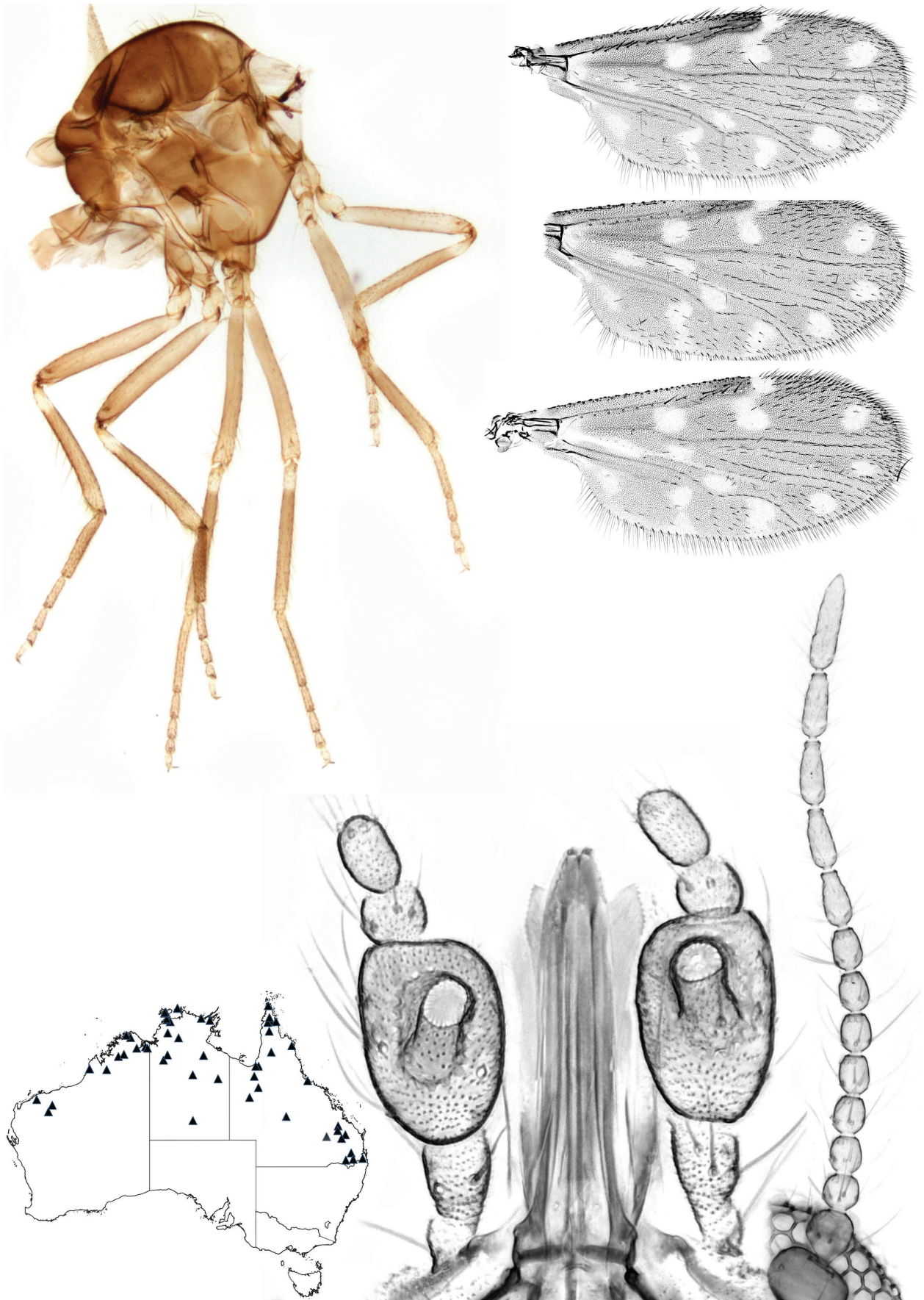


C. Clavipalpis Gp sp no 6

Culicoides Clavipalpis Group sp no 8

Culicoides Clavipalpis Gp sp no 8 (Dyce et al 2007:38)

Synonyms	Nil.
Distribution	Widespread in Qld, NT and northern WA.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Compact pale spot between front of M-Cu fork and M_2 crease present; Cell m_1 with 1 pale spot; Poststigmatic pale spot bilobed but not extending to vein M_1 ; mid knees pale.

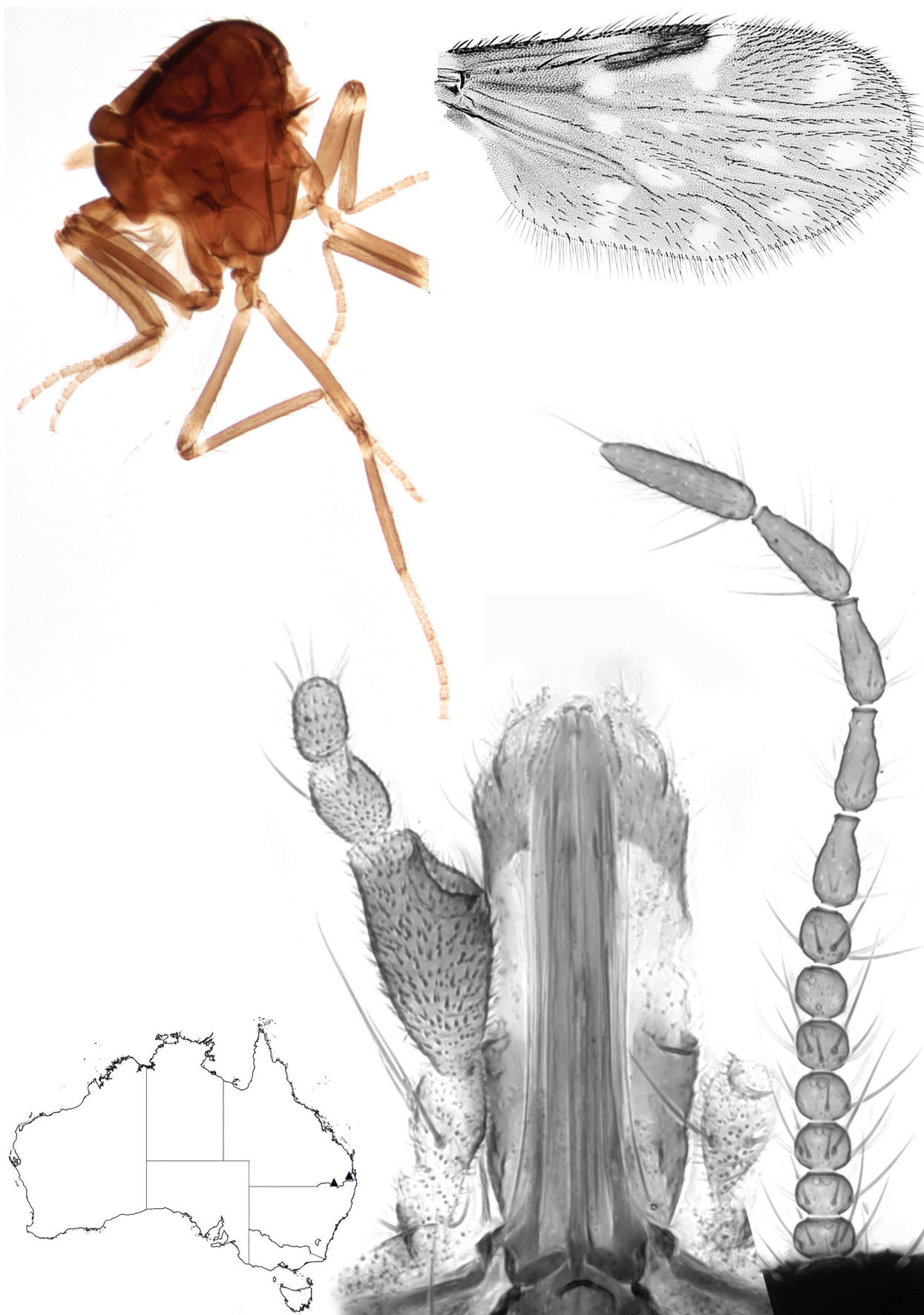


C. Clavipalpis Gp sp no 8

Culicoides Clavipalpis Group sp no 9

Culicoides Clavipalpis Gp sp no 9 Dyce et al 2007:38

Synonyms	Nil.
Distribution	Known from a single specimen collected in SE Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Compact pale spot between front of M-Cu fork and M_2 crease present; Cell m_1 with 2 pale spots, the proximal one close to the centre of the cell; Poststigmatic pale spot not extending to vein M_1 ; anal cell with a single, distal pale spot; no pale markings over apices of veins M_1 and M_2 .

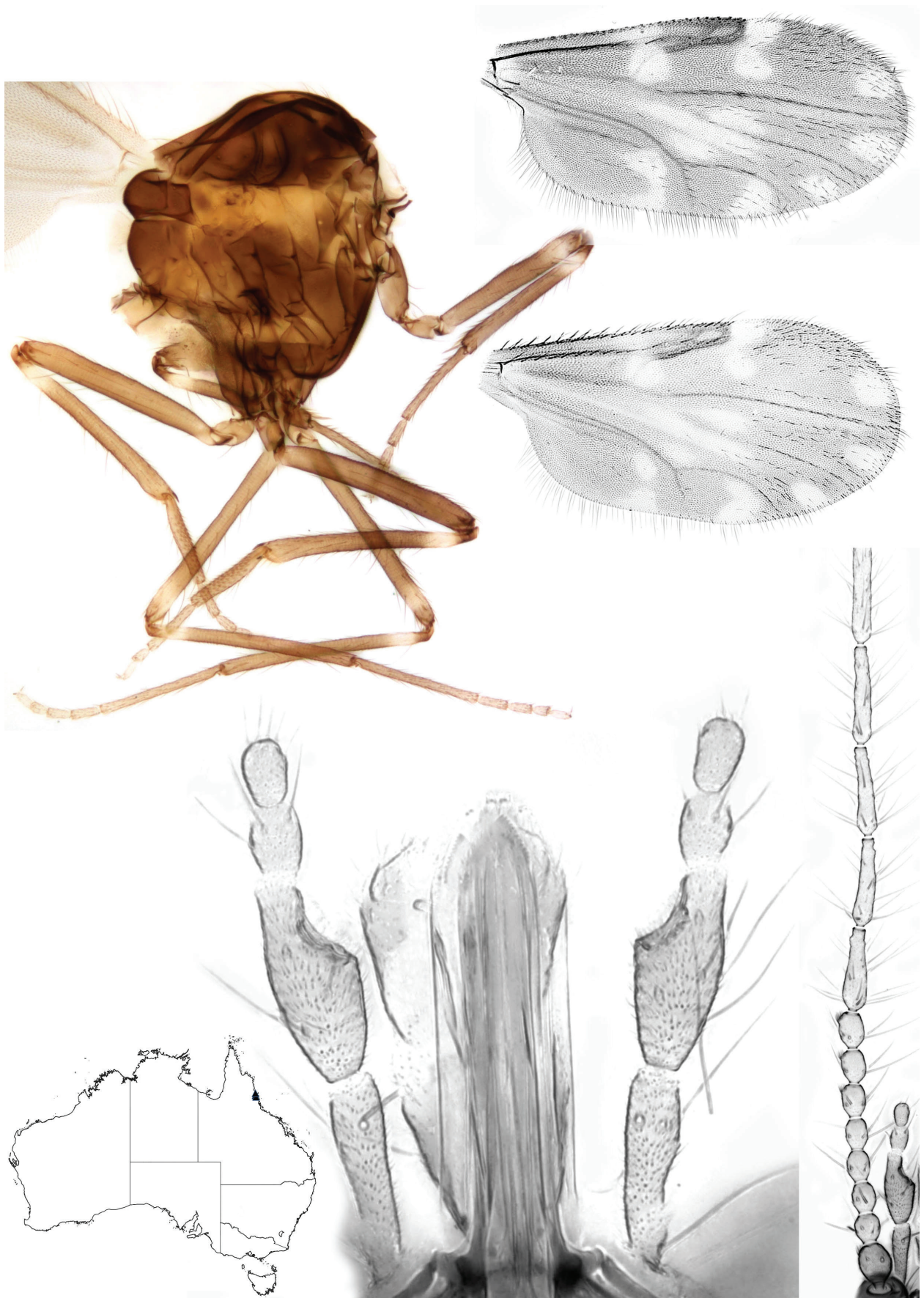


C. Clavipalpis Gp sp no 9

Culicoides Clavipalpis Group sp no 10

Culicoides Clavipalpis Gp sp no 10 Dyce et al 2007:38

Synonyms	Nil.
Distribution	North Qld rainforests.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Compact pale spot between front of M-Cu fork and M_2 crease present; Cell m_1 with 2 pale spots, the proximal one close to the base of the cell; Apical pale spot in cell r_3 reaching or almost reaching wing margin; anal cell without basal pale spot.

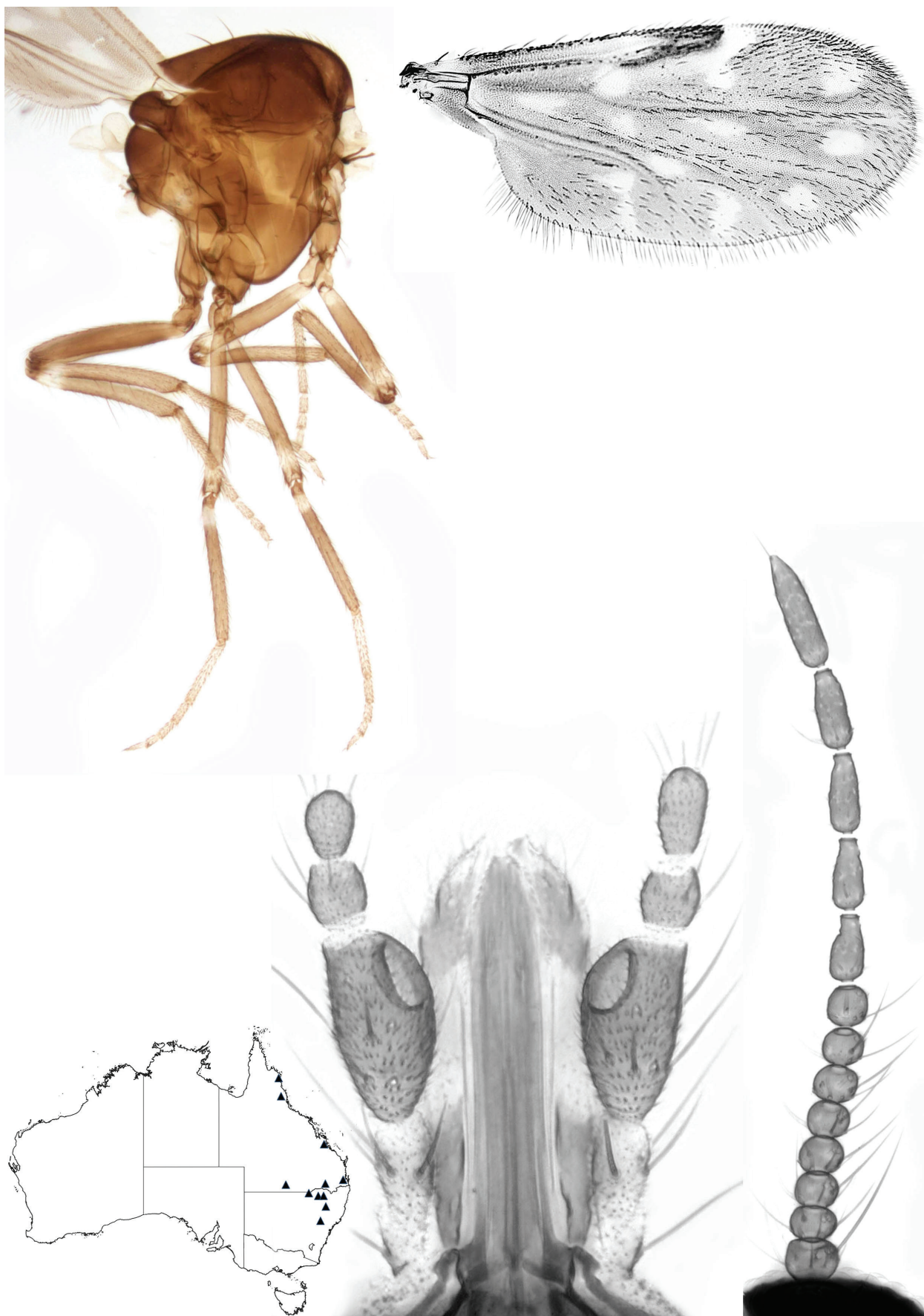


C. Clavipalpis Gp sp no 10

Culicoides Clavipalpis Group sp no 11

Culicoides Clavipalpis Gp sp no 11 Dyce et al 2007:39

Synonyms	Nil.
Distribution	Eastern Qld and NSW.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Compact pale spot between front of M-Cu fork and M_2 crease present; Cell m_1 with 2 pale spots, the proximal one close to the base of the cell; Apical pale spot in cell r_3 not reaching wing margin; anal cell with a single, distal pale spot.



C. Clavipalpis Gp sp no 11

Culicoides Clavipalpis Group sp no 13

Culicoides Clavipalpis Gp sp no 13 Dyce et al 2007:39

Synonyms	Nil.
Distribution	Eastern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Compact pale spot between front of M-Cu fork and M_2 crease present; Cell m_1 with 2 pale spots, the proximal one close to the base of the cell; Apical pale spot in cell r_3 reaching or almost reaching wing margin; anal cell with a basal and distal pale spots.



C. Clavipalpis Gp sp no 13

Culicoides Clavipalpis Group sp no 14

Culicoides Clavipalpis Gp sp no 14 Dyce et al 2007:39

Synonyms	Nil.
Distribution	Atherton Tablelands, Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Compact pale spot between front of M-Cu fork and M_2 crease present; Cell m_1 with 1 pale spot; 3rd palpal segment without a pit.



C. Clavipalpis Gp sp no 14

Culicoides Clavipalpis Group sp no 19

Culicoides Clavipalpis Gp sp no 19 Dyce et al 2007:40

Synonyms	Nil.
Distribution	Rainforests in northern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Cassowary dung (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; Compact pale spot between front of M-Cu fork and M_2 crease present; Cell m_1 with 1 pale spot; apical pale spot in cell r_3 more than its own diameter from wing margin.



C. Clavipalpis Gp sp no 19

Culicoides Coronalis Group

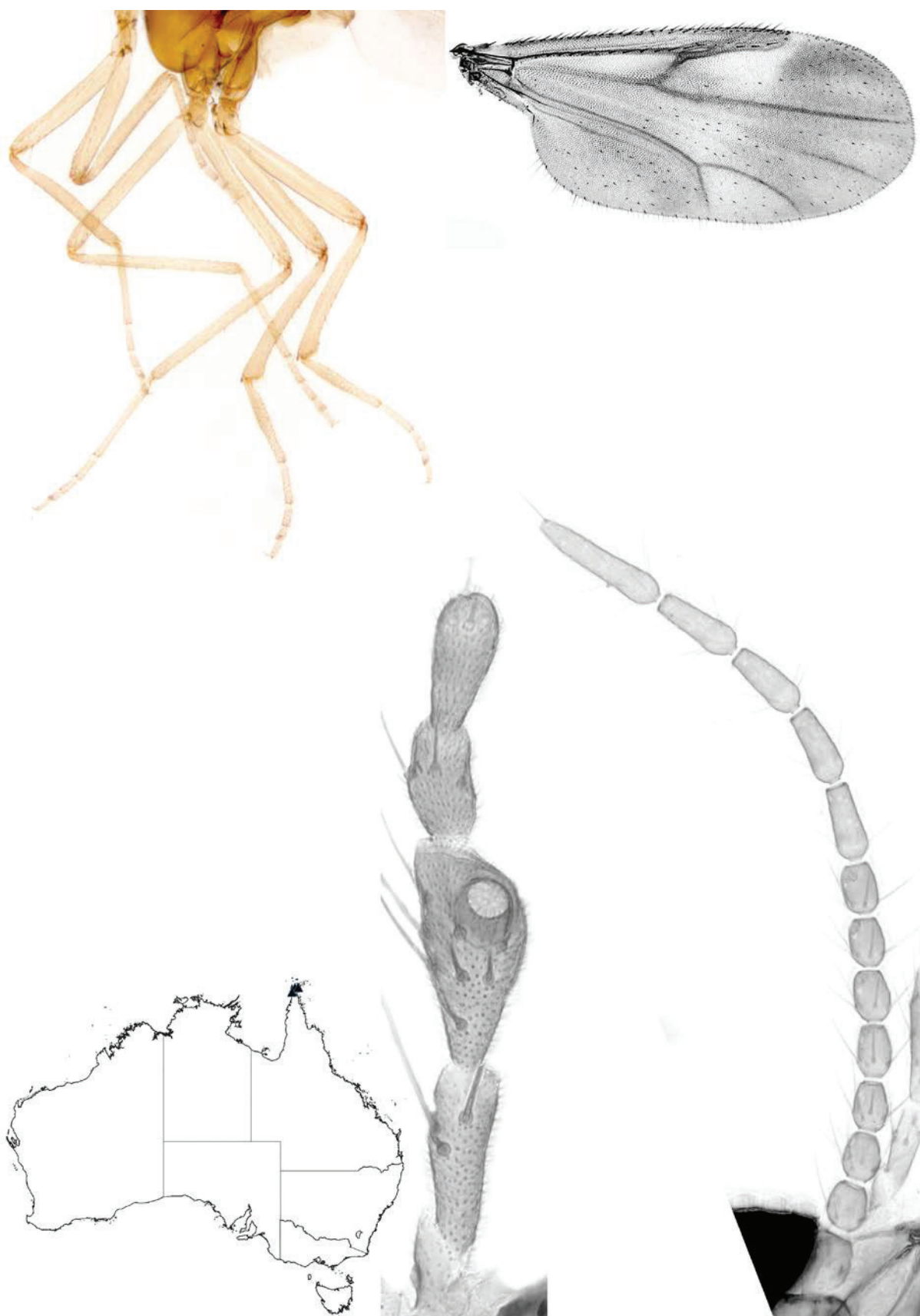
Culicoides Coronalis Gp Dyce unpublished

Nominate species	<i>Culicoides coronalis</i> Lee & Reye
Synonyms	Nil.
Distribution	Coastal northern Australia, New Guinea, Solomon Islands, Indonesia, Timor-Leste, the Andaman Is and the Philippines.
Number of species worldwide	2.
Number of species in Australia	2, 1 of which is undescribed.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown but almost certainly maritime.
Diagnosis	Can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Wing with dark marking centred over r-m cross-vein; cell r_2 dark to apex.

Culicoides coronalis

Culicoides coronalis Lee & Reye 1955: 234 (Queensland)

Synonyms	Nil.
Distribution	Coastal Cape York Peninsula and Torres Strait, Qld. Also in New Guinea, Solomon Is, SE Asia and the Andaman Is.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown but distribution records suggest marine habitats.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: dark marking over r-m cross-vein; cell r_2 dark to apex. Female <i>C. coronalis</i> and <i>C. Coronalis</i> sp no 1 are indistinguishable.

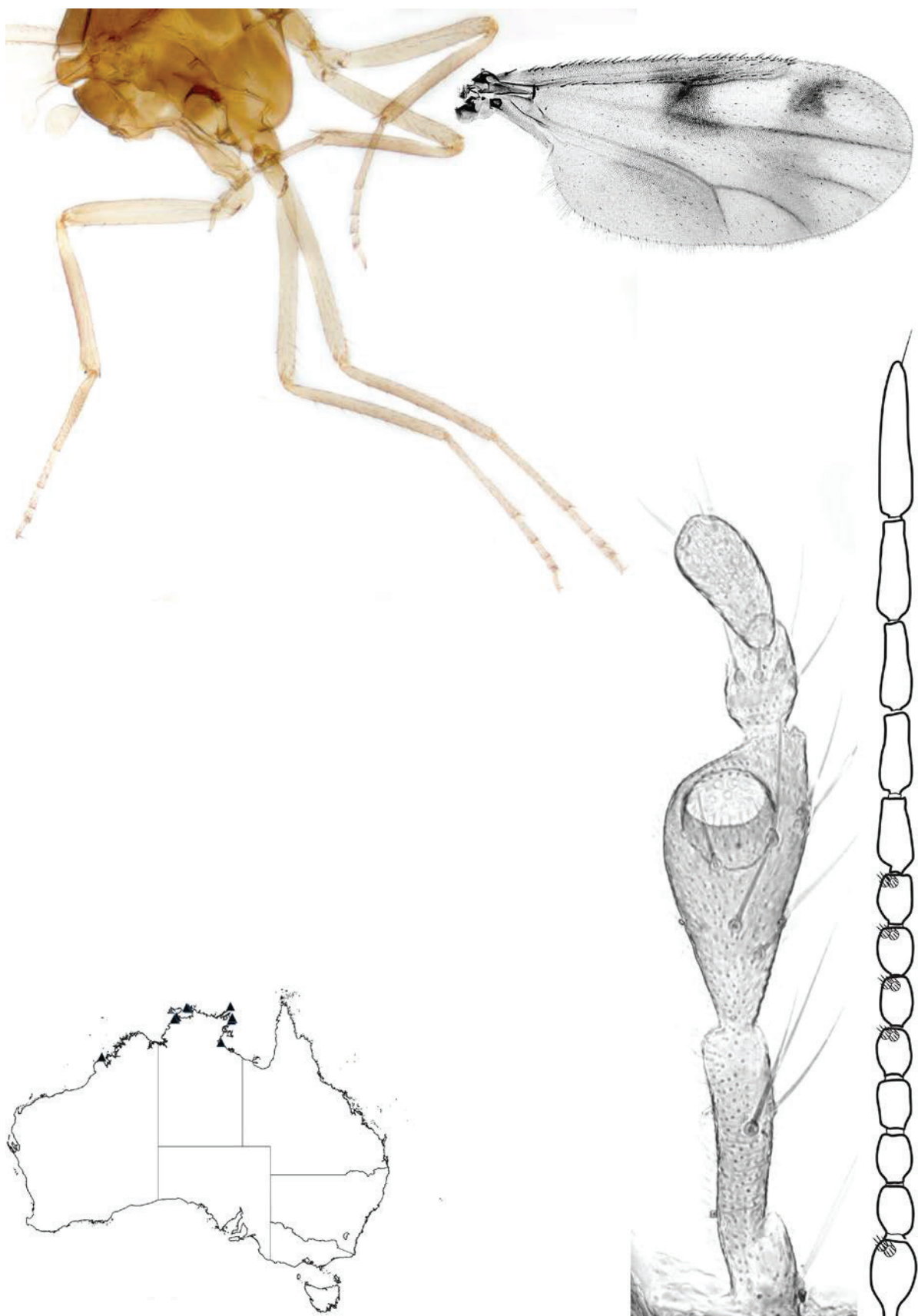


C. coronalis

Culicoides Coronalis Gp sp no 1

Culicoides Coronalis Group sp no 1

Synonyms	Nil.
Distribution	Coastal NT and northern WA. Also in Timor-Leste.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown but distribution records suggest marine habitats.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Dark marking over r-m cross-vein; cell r_2 dark to apex. Female <i>C. coronalis</i> and <i>C. Coronalis</i> Gp sp no 1 are indistinguishable.



C. coronalis Gp sp no 1

Culicoides Immaculatus Group

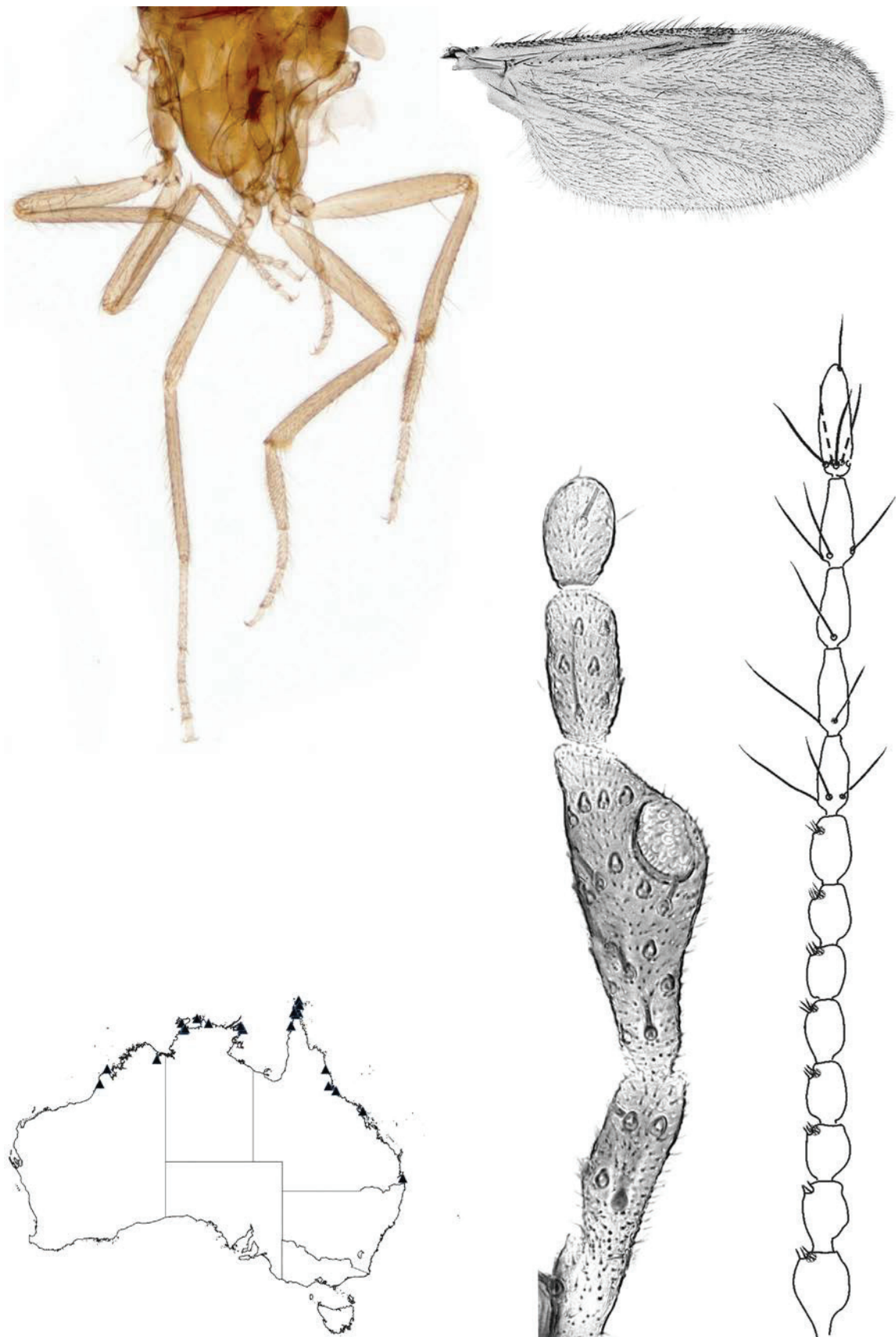
Culicoides Immaculatus Gp Bellis & Dyce 2013:22

Nominate species	<i>Culicoides immaculatus</i> Lee & Reye
Synonyms	Nil.
Distribution	Northern Australia, New Guinea, Indonesia and the Pacific.
Number of species worldwide	4 species.
Number of species in Australia	2.
Hosts	Known to feed on humans (Reye 1992; Shivas et al 2022).
Vector status	None known.
Immature habitat	Unknown but almost certainly maritime.
Diagnosis	Female specimens can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Wing without pale marking over r-m cross-vein. Legs unbanded; tibial comb with 4 spines. Antennal flagellar segments 4-7 barrel shaped, no more than 1.5 times as long as wide.

Culicoides immaculatus

Culicoides immaculatus Lee & Reye 1953: 375 (Qld)

Synonyms	Nil.
Distribution	Coastal NT, northern WA and Qld.
Hosts	Human (Reye 1992).
Vector status	Unknown.
Immature habitat	Unknown but distribution records suggest marine habitats.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: no marking over r-m cross-vein; legs unbanded; tibial comb with 4 spines; antennal flagellar segments 4-7 barrel shaped, no more than 1.5 times as long as wide. Female <i>C. immaculatus</i> and <i>C. shivasi</i> are morphologically indistinguishable.

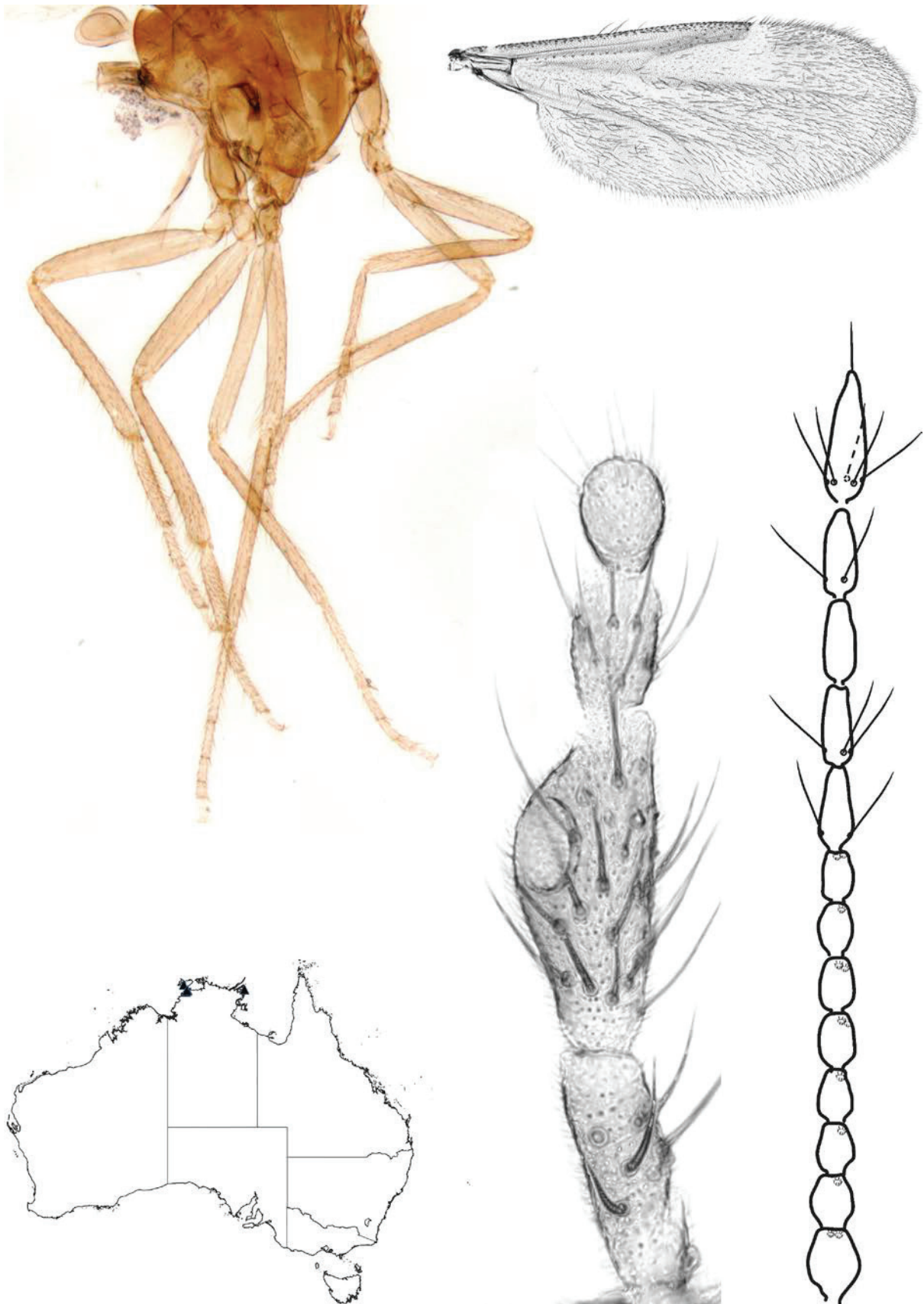


C. immaculatus

Culicoides shivasi

Culicoides shivasi Bellis in Bellis et al (2013) (NT)

Synonyms	Nil.
Distribution	Coastal northern NT.
Hosts	Human (Shivas 1999; Shivas et al 2022).
Vector status	Unknown.
Immature habitat	Shivas et al (2022) collected low numbers of this species in emergence traps in mangroves.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: No marking over r-m cross-vein. Legs unbanded; tibial comb with 4 spines. Antennal flagellar segments 4-7 barrel shaped, no more than 1.5 times as long as wide. Female <i>C. immaculatus</i> and <i>C. shivasi</i> are morphologically indistinguishable.



C. shivasi

Culicoides Kusaiensis Group

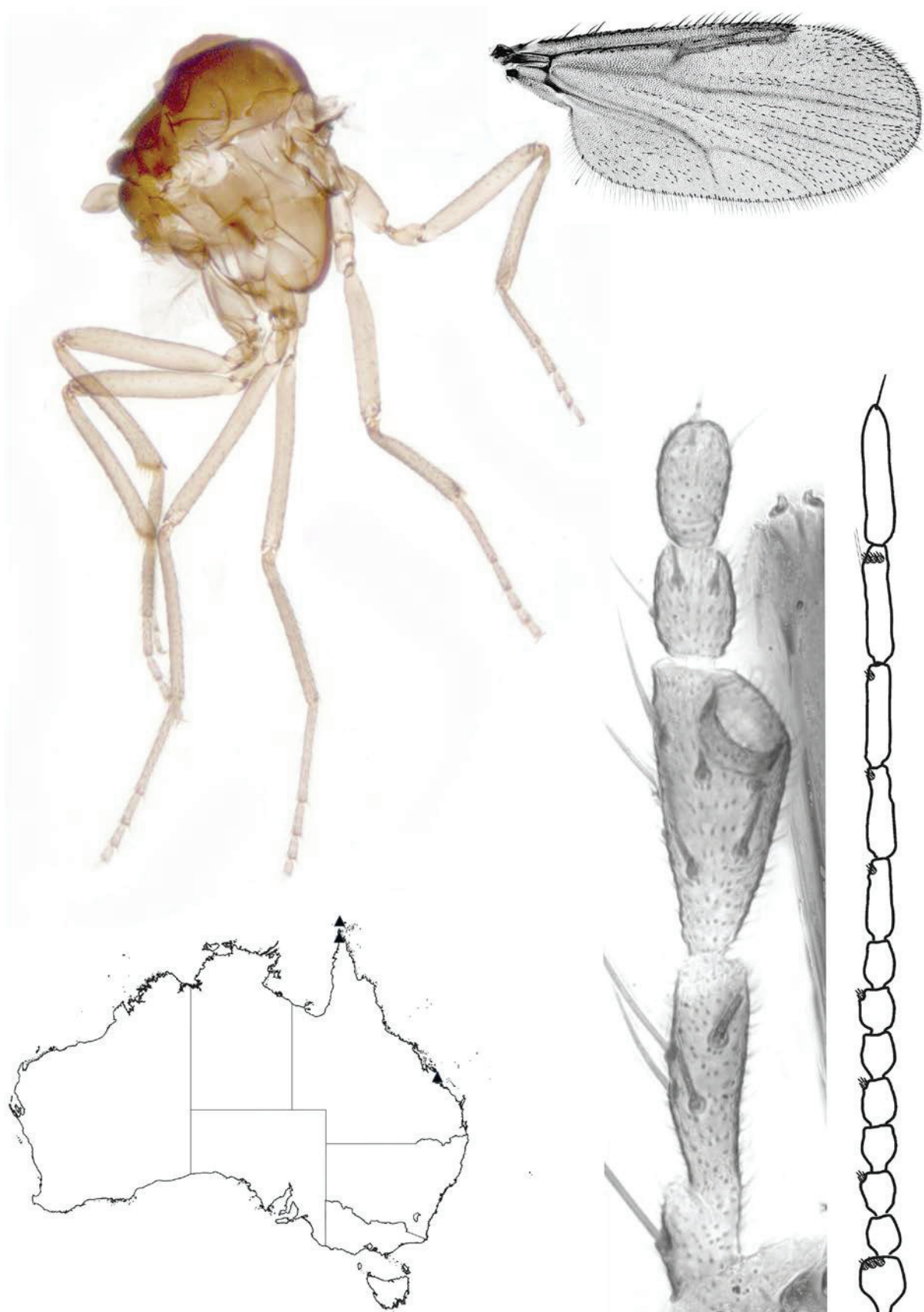
Culicoides Kusaiensis Gp Dyce unpublished

Nominate species	<i>Culicoides kusaiensis</i> Tokunaga 1940: 215.
Synonyms	Nil.
Distribution	Northern Australia, Melanesia, Micronesia, SE Asia, Seychelles Is.
Number of species worldwide	3.
Number of species in Australia	2.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown but almost certainly maritime.
Diagnosis	Female specimens can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Wing without pale marking over r-m cross-vein. Legs unbanded; tibial comb with 5 spines.

Culicoides kusaiensis

Culicoides kusaiensis Tokunaga 1940: 215 (Micronesia)

Synonyms	Nil.
Distribution	Coastal Qld. Also present in New Guinea, Indonesia, Solomon Is and Asia.
Hosts	Human (Lambrecht 1970).
Vector status	Unknown.
Immature habitat	Unknown but likely coastal.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: No markings over r-m cross-vein. Tibial comb with 5 spines; tibiae unbanded, SCh absent from flagellomeres 9-13.
Notes	DNA analyses of populations from the Pacific indicate the presence of multiple lineages that may represent cryptic species (Gopurenko & Bellis unpublished data).



C. kusaiensis

Culicoides leei

Culicoides leei Tokunaga 1960: 72 (PNG)

Synonyms	Nil.
Distribution	Coastal Qld. Also present in New Guinea and the Solomon Is.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: No markings over r-m cross-vein. Tibial comb with 5 spines; tibiae with basal pale bands. SCh present on flagellomeres 9-13.



C. leei

Culicoides Melanesiae Group

Culicoides Melanesiae Gp Dyce unpublished.

Nominate species	<i>Culicoides melanesiae</i> Macfie, 1939:368.
Synonyms	Nil.
Distribution	Endemic to the Australasian region.
Number of species worldwide	5, 3 known only as males.
Number of species in Australia	4, 2 known only as males.
Hosts	Largely unknown. Kay et al. (1978) reported human hosts for <i>C. melanesiae</i> .
Vector status	Unknown.
Immature habitat	Container breeding, particularly tree holes (Dyce unpublished).
Diagnosis	Female specimens can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Wing cell r_2 dark to apex; pale spots poststigmatic and over r-m cross-vein always present. Tibial comb with 4 spines. SCh present on distal 5 flagellomeres.

Culicoides leanderensis

Culicoides leanderensis Lee & Reye 1963: 355 (Qld)

Synonyms	Nil.
Distribution	Widespread but uncommon in Qld and NSW.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Tree holes (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; apical pale spot in cell r_3 not centred near apex of cell, at most 1.5 times its own length from cell r_2 ; basal pale marking in anal cell not crossing vein M-Cu subbasally to join with basal pale marking in cell m_2 ; Pale spot over r-m cross-vein rounded, not extending towards base of wing. Fore femora unbanded.

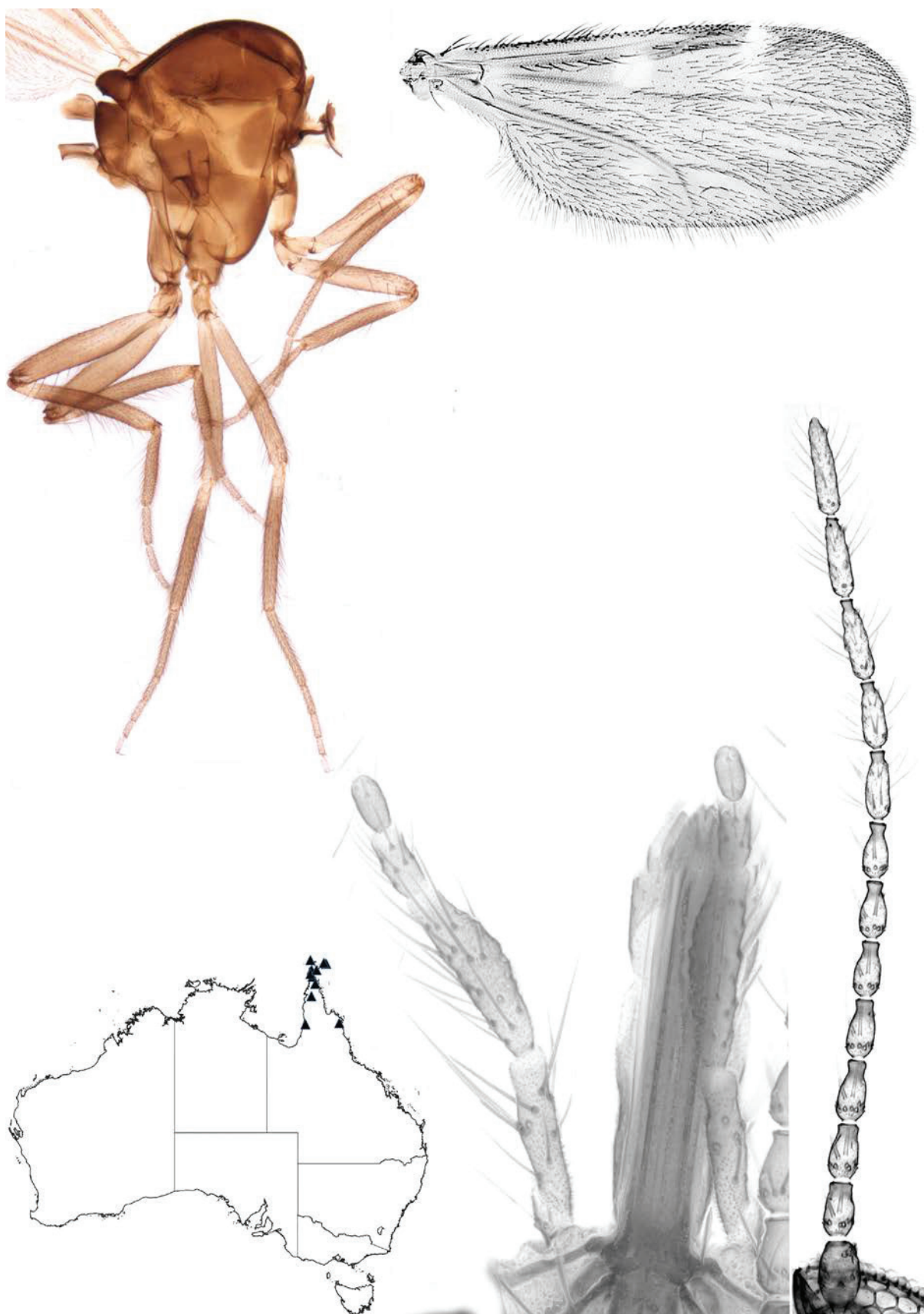


C. leanderensis

Culicoides melanesiae

Culicoides melanesiae Macfie 1939: 368 (PNG)

Synonyms	Nil.
Distribution	New Guinea, Cape York Peninsula and Torres Strait, Qld.
Hosts	Human (Kay et al 1978).
Vector status	Unknown.
Immature habitat	Tree holes (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing without pattern excepting pale spots over r-m cross-vein and poststigmatic; 3rd palpal segment almost cylindrical and without a pit.
Notes	An undescribed species related to <i>C. melanesiae</i> is known from a single male specimen collected at Bamaga, Cape York Peninsula. The female is unknown but the wing pattern of the male is very similar to that of <i>C. melanesiae</i> .



C. melanesiae

Key to female specimens of the Molestus Group present in Australia

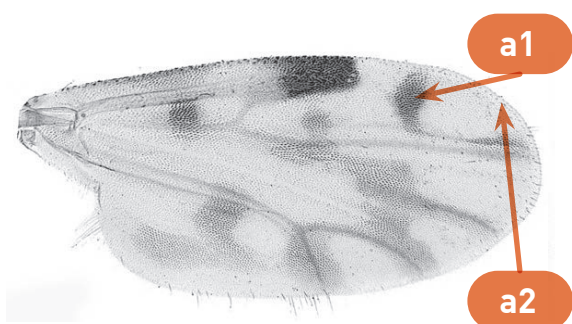
1

Prominent transverse dark spot separating post stigmatic and apical pale spots in cell r_3 (a1); Apical pale marking in cell r_3 broadly reaching wing margin (a2) coastal NT

Molestus Gp sp no 1

Prominent dark spot separating post stigmatic and apical pale spots in cell r_3 oblique or absent (b1); Apical pale marking in cell r_3 narrowly or not reaching wing margin (b2)

2



C. Molestus Gp sp no 1



C. Molestus Gp sp no 7

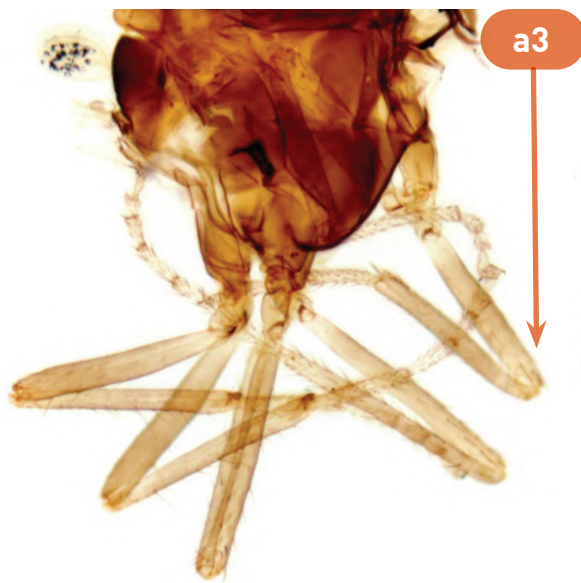
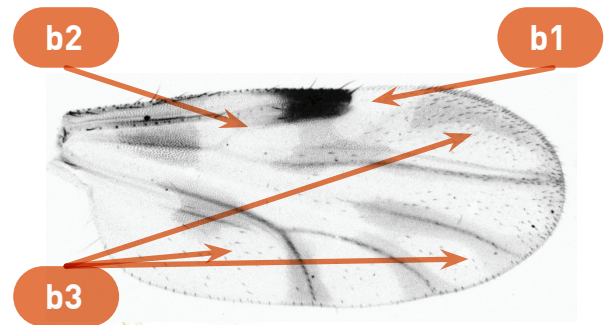
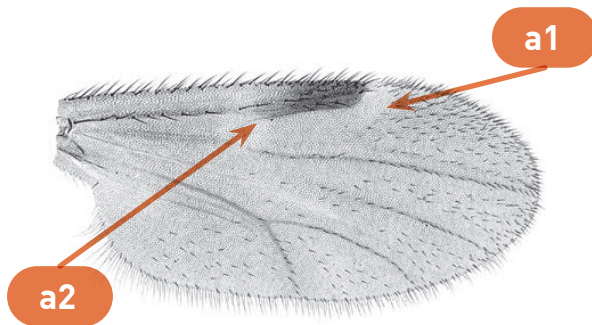
2

Wing pattern vague; pale spots if present, only evident post stigmatic (a1) and/or over r-m cross-vein (a2) or very weakly present in base of wing or cells m_1 and m_4 ; fore legs without pale bands (a3)

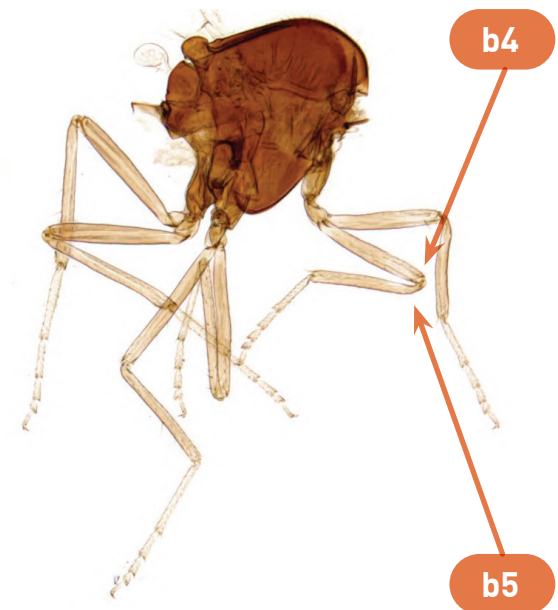
3

Wing with prominent pale spots (b3) in addition to post stigmatic (b1) and over r-m cross-vein (b2); fore femora with pale apical or subapical band (b4) and fore tibia with pale basal or subbasal band (b5)

4



Molestus Gp sp no 5



Molestus Gp sp no 6

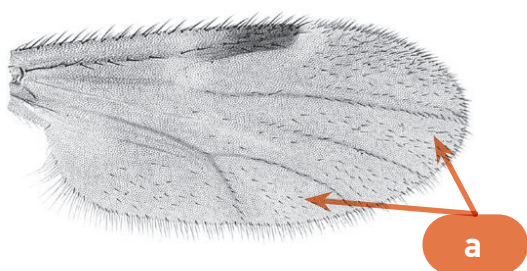
3

Antennal flagellomere 3 rarely bearing SCo, flagellomere 4 without SCo, smaller species, wing length usually less than 1mm, cells m_1 and m_4 with barely discernible pale markings (a) Coastal NSW, Qld and NT

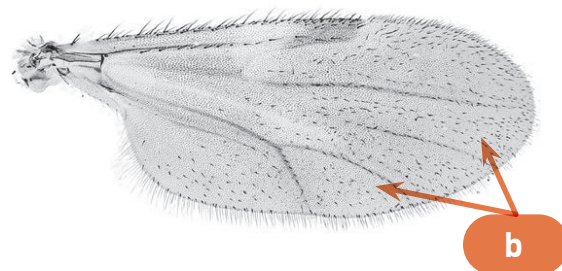
Molestus Gp sp no 5

Antennal flagellomere 3 always with 1 or 2 SCo, flagellomere 4 usually with 1 SCo, larger species, wing length usually greater than 1mm, cells m_1 and m_4 without pale markings (b) Coastal NSW, Vic

C. subimmaculatus



Molestus Gp sp no 5



C. subimmaculatus

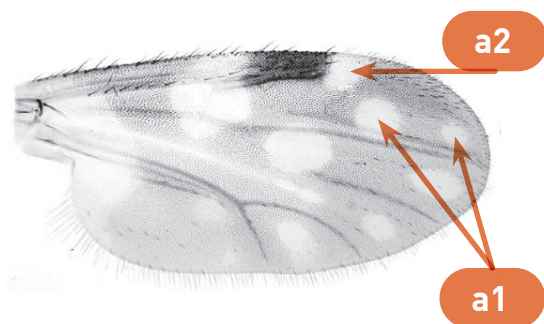
4

Cell r_3 with 2 pale spots (a1) apical to post stigmatic spot (a2)

5

Cell r_3 with 1 elongate pale spot (b1) apical to post stigmatic spot (b2) or with pale marking indistinct

6



C. molestus



C. submagnesianus

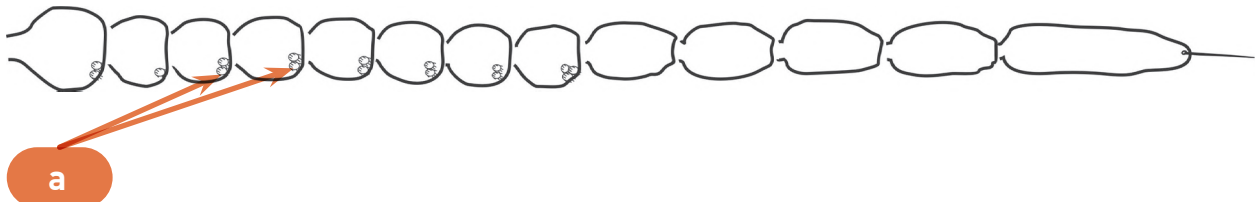
5

SCo present on flagellomeres 3 and 4 (a) NQld

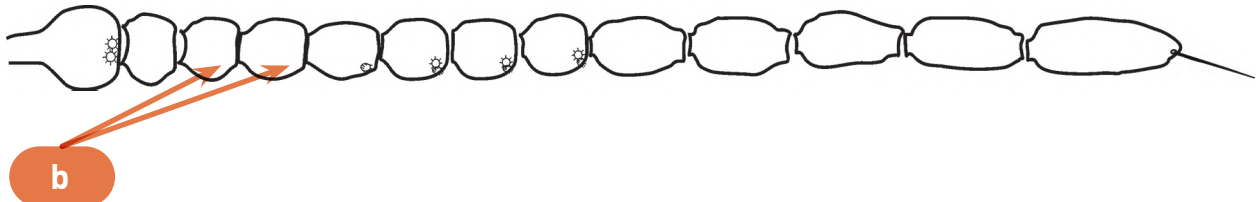
Molestus Gp sp no 7

SCo absent from flagellomeres 3 and 4 (b)

C. molestus



Molestus Gp sp no 7



C. molestus

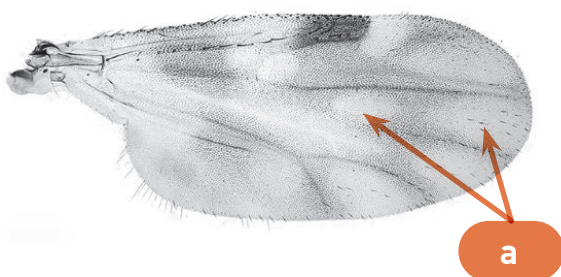
6

Cell m_1 with 2 pale spots (a) NQld

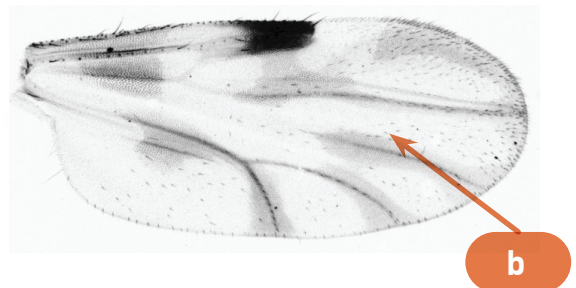
C. submagnesianus

Cell m_1 with 1 elongate pale spot (b)

7



C. submagnesianus



Molestus Gp sp no 6

7

Hind femora with distinct apical pale band (a1); hind knee pale (a2)

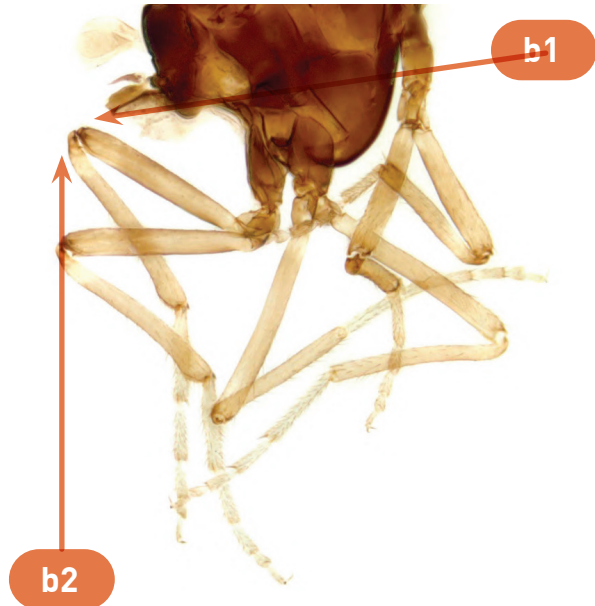
Molestus Gp sp no 4

Hind femora dark to apex (b1); hind knee dark (b2)

8



Molestus Gp sp no 4



Molestus Gp sp no 3

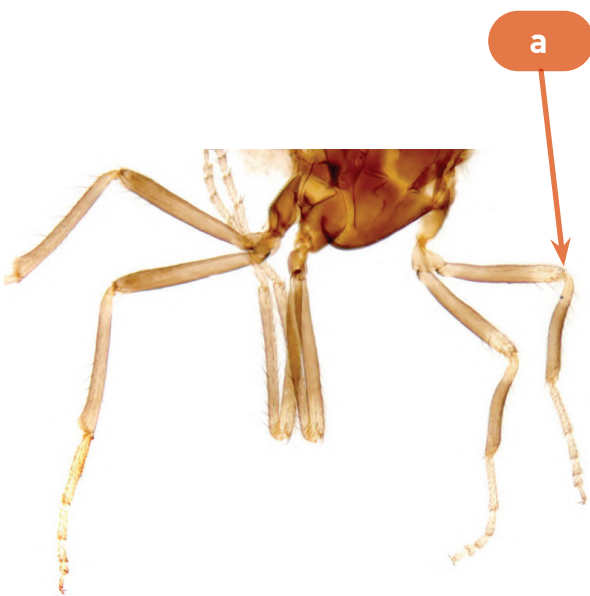
8

SCo present on flagellomere 4; fore knee pale (a)

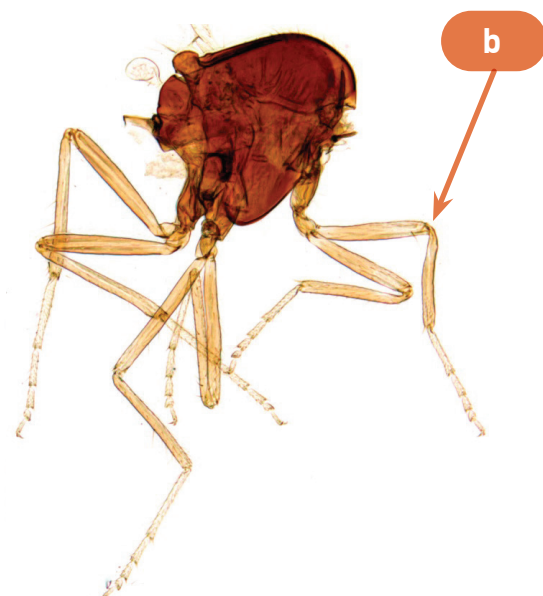
Molestus Gp sp no 2

SCo absent from flagellomere 4; fore knee not pale (b)

9



Molestus Gp sp no 2



Molestus Gp sp no 6

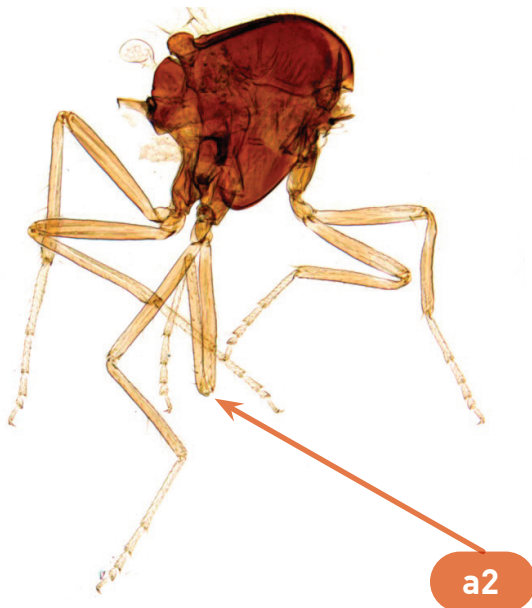
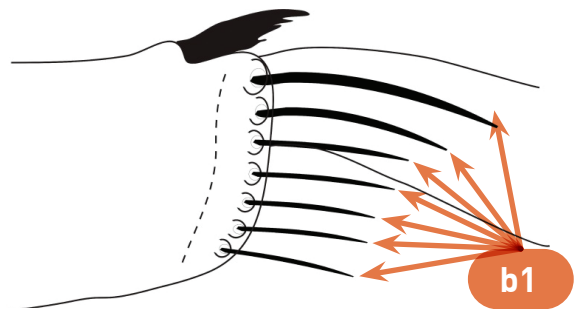
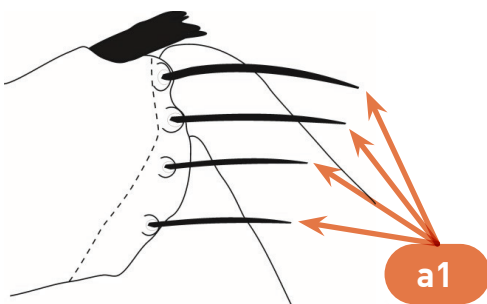
9

Tibial comb with 4-5 spines (a1); mid knees concolorous with femora (a2)

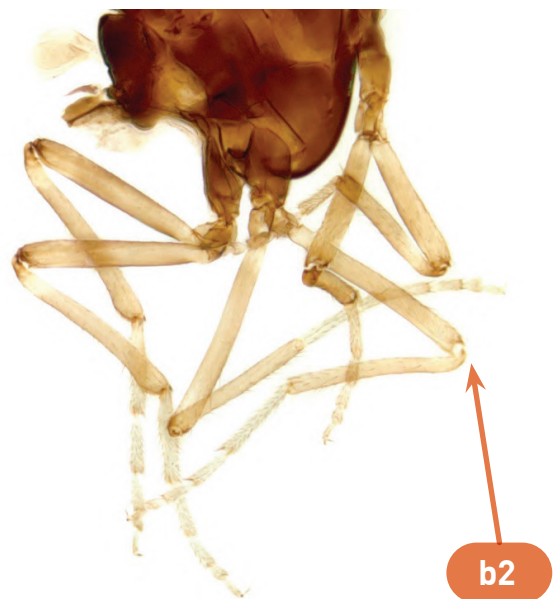
Molestus Gp sp no 6

Tibial comb with 6-7 spines (b1); mid knees paler than femora (b2)

Molestus Gp sp no 3



Molestus Gp sp no 6



Molestus Gp sp no 3

Culicoides Molestus Group

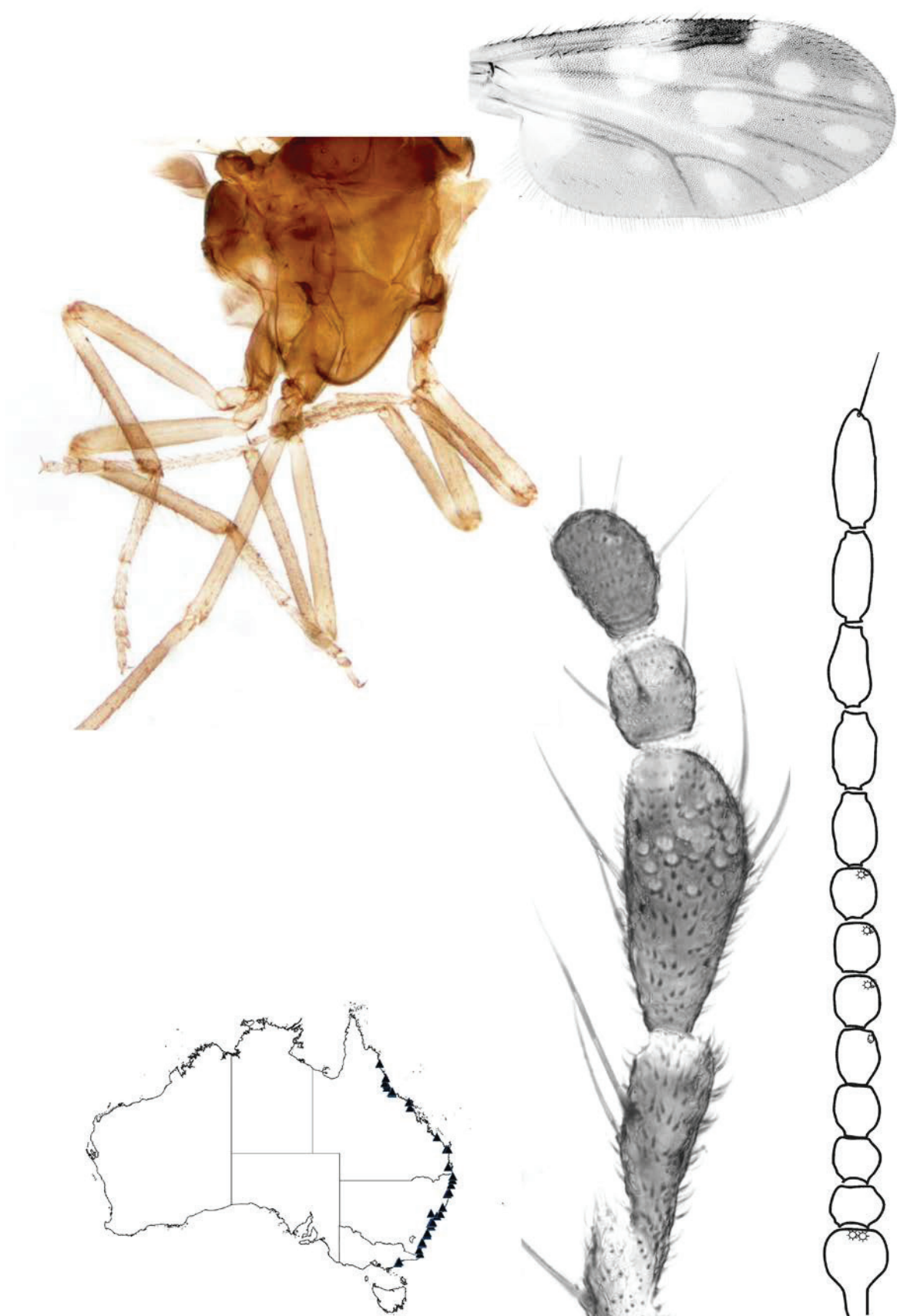
Culicoides Molestus Gp Dyce unpublished

Nominate species	<i>Culicoides molestus</i> (Skuse), 1889: 305.
Synonyms	Nil.
Distribution	Endemic to the Australasian region with a single species in SE Asia. Possibly also represented by a single species in the Middle East and another in eastern Africa.
Number of species worldwide	12 with possibility of 2 further species from the Middle East and eastern Africa.
Number of species in Australia	10.
Hosts	Sheep, human, flying fox, birds.
Vector status	Unknown.
Immature habitat	Estuarine sands.
Diagnosis	Female specimens can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Wing cell r_2 dark to apex; pale spots poststigmatic and over r-m cross-vein always present. 3rd palpal segment without a pit. 4th tarsal segment chordate. SCh absent from distal 5 flagellomeres.

Culicoides molestus

Culicoides molestus (Skuse) 1889: 305 (*Ceratopogon*) (NSW)

Synonyms	Nil.
Distribution	Coastal eastern Qld south of Port Douglas, eastern NSW, Victoria.
Hosts	Sheep, human, flying fox, birds (Lee et al. 1962, Reye & Lee 1961, Ferguson & Cawthorne 1980).
Vector status	Unknown. Significant pest of humans.
Immature habitat	Intertidal sand in brackish water, estuaries, canals etc (Reye 1992).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 4th tarsal segment of all legs chordate; rounded pale spot present posterodistal to poststigmatic pale spot; SCo absent from flagellomeres 3 and 4.

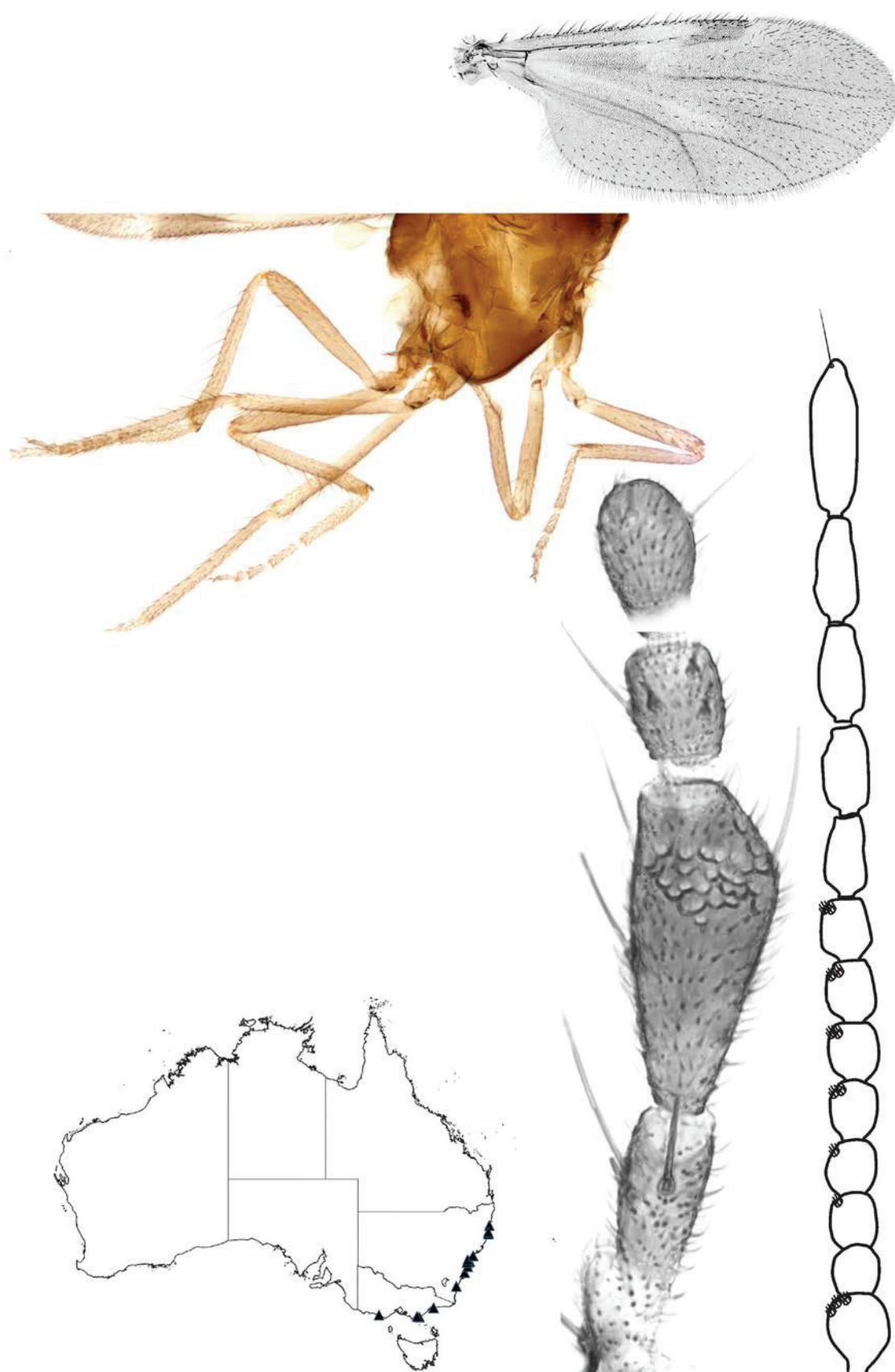


C. molestus

Culicoides subimmaculatus

Culicoides subimmaculatus Lee & Reye 1953: 375 (NSW)

Synonyms	Nil.
Distribution	Coastal Victoria and NSW north to Coffs Harbour.
Hosts	Human, sheep, flying fox although historical confusion between this species and <i>C. molestus</i> Group sp no 5 suggests that some of the host records for <i>C. subimmaculatus</i> may refer to the undescribed species.
Vector status	Unknown.
Immature habitat	Estuarine <i>Salicornia</i> salt flats on sand.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 4th tarsal segment of all legs chordate; wing without pattern except over r-m cross-vein and poststigmatic; SCo present on flagellomeres 3 and 4.

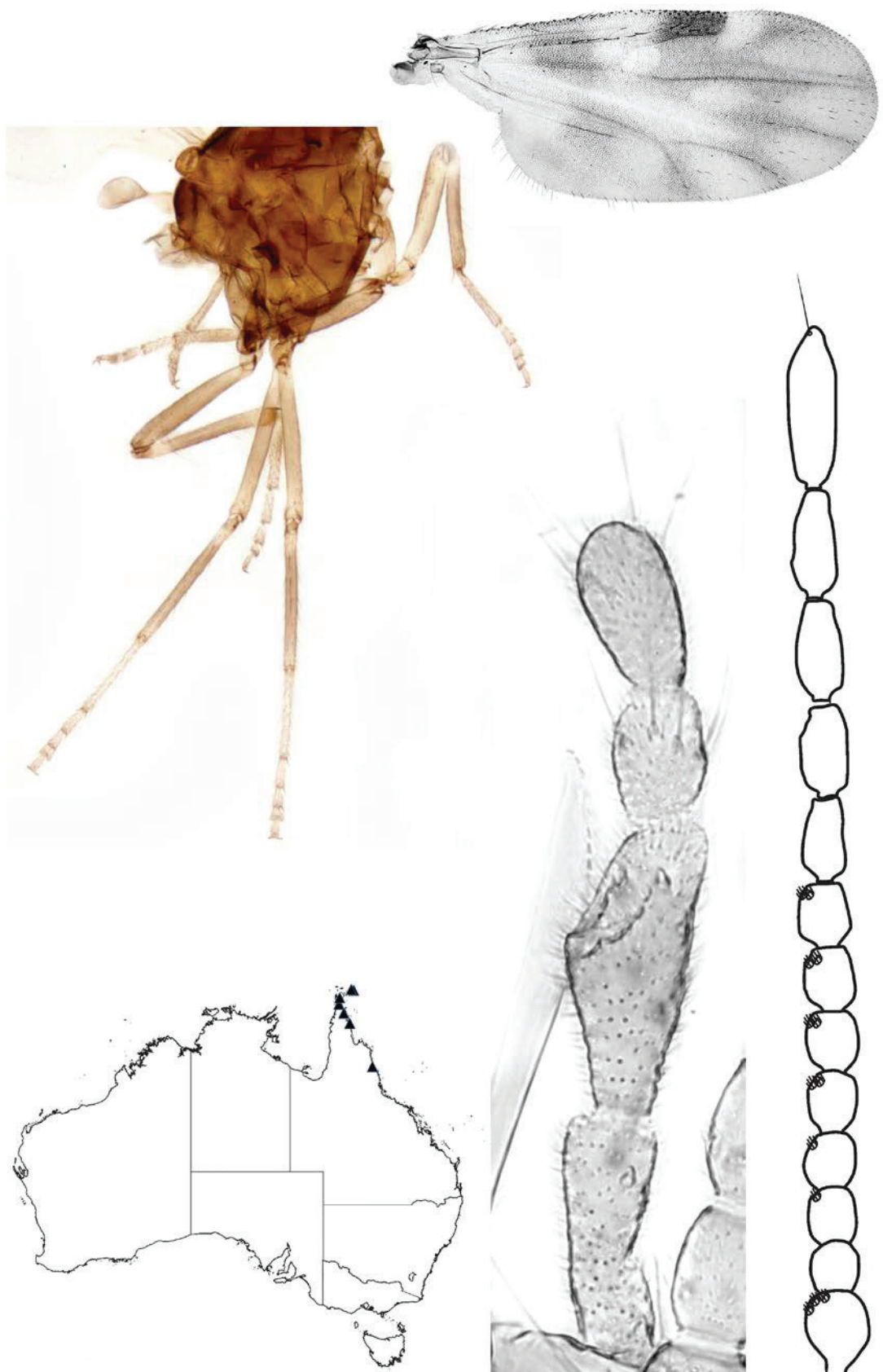


C. subimmaculatus

Culicoides submagnesianus

Culicoides submagnesianus Tokunaga 1962: 484 (PNG)

Synonyms	Nil.
Distribution	Cape York Peninsula, south to Port Douglas. Papua New Guinea.
Hosts	Unknown although Reye (1992) suggests this species is a pest of humans.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 4th tarsal segment of all legs chordate; cell m_1 with 2 pale spots; basal edge of apical pale marking in cell r_3 oblique.

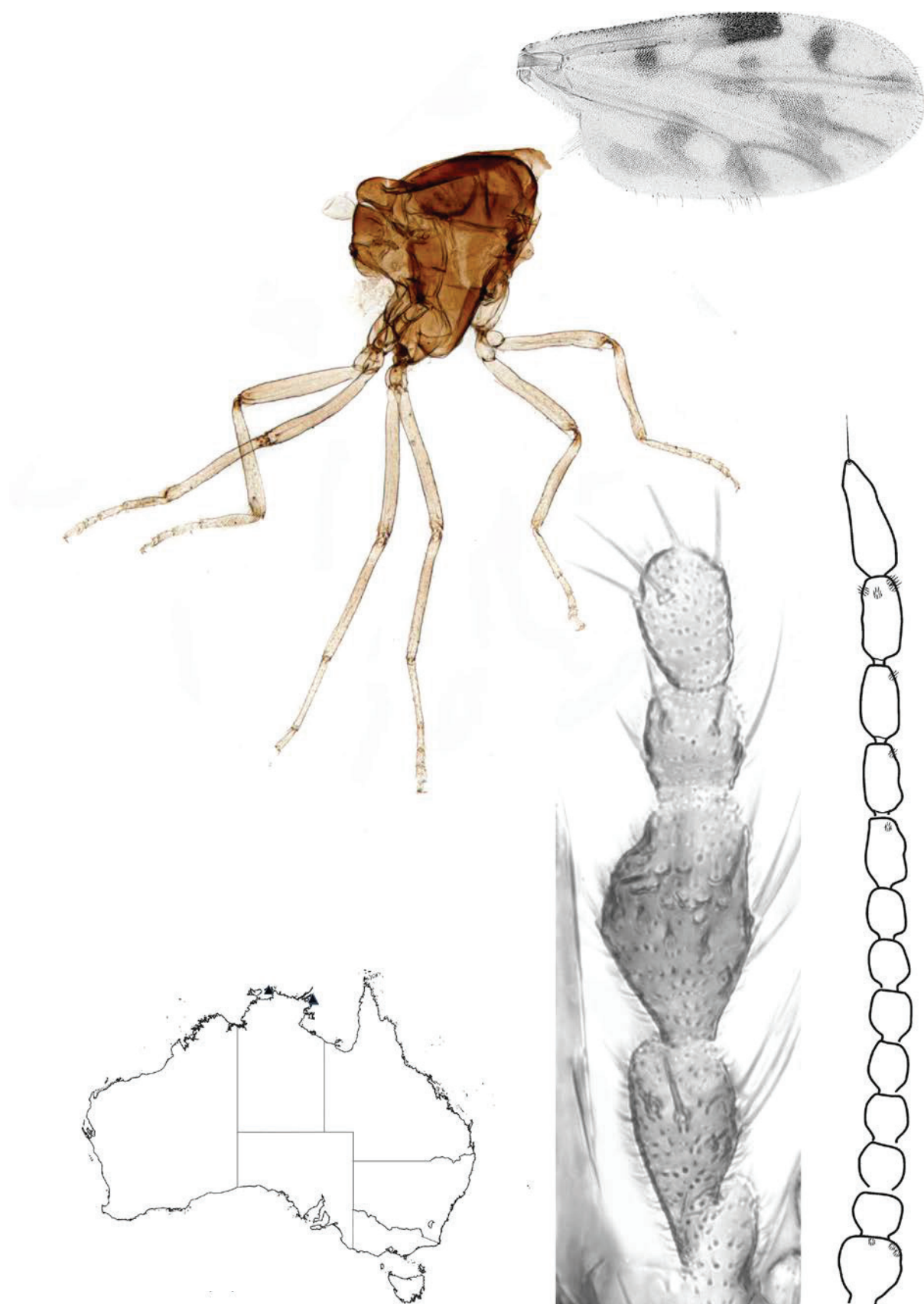


C. submagnesianus

Culicoides Molestus Group no 1

Culicoides Molestus Gp no 1 Dyce et al 2007:48

Synonyms	Nil.
Distribution	Coastal NT.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 4th tarsal segment of all legs chordate. Poststigmatic pale marking crossing vein M_1 ; Cell m_1 with a single large pale spot apically.

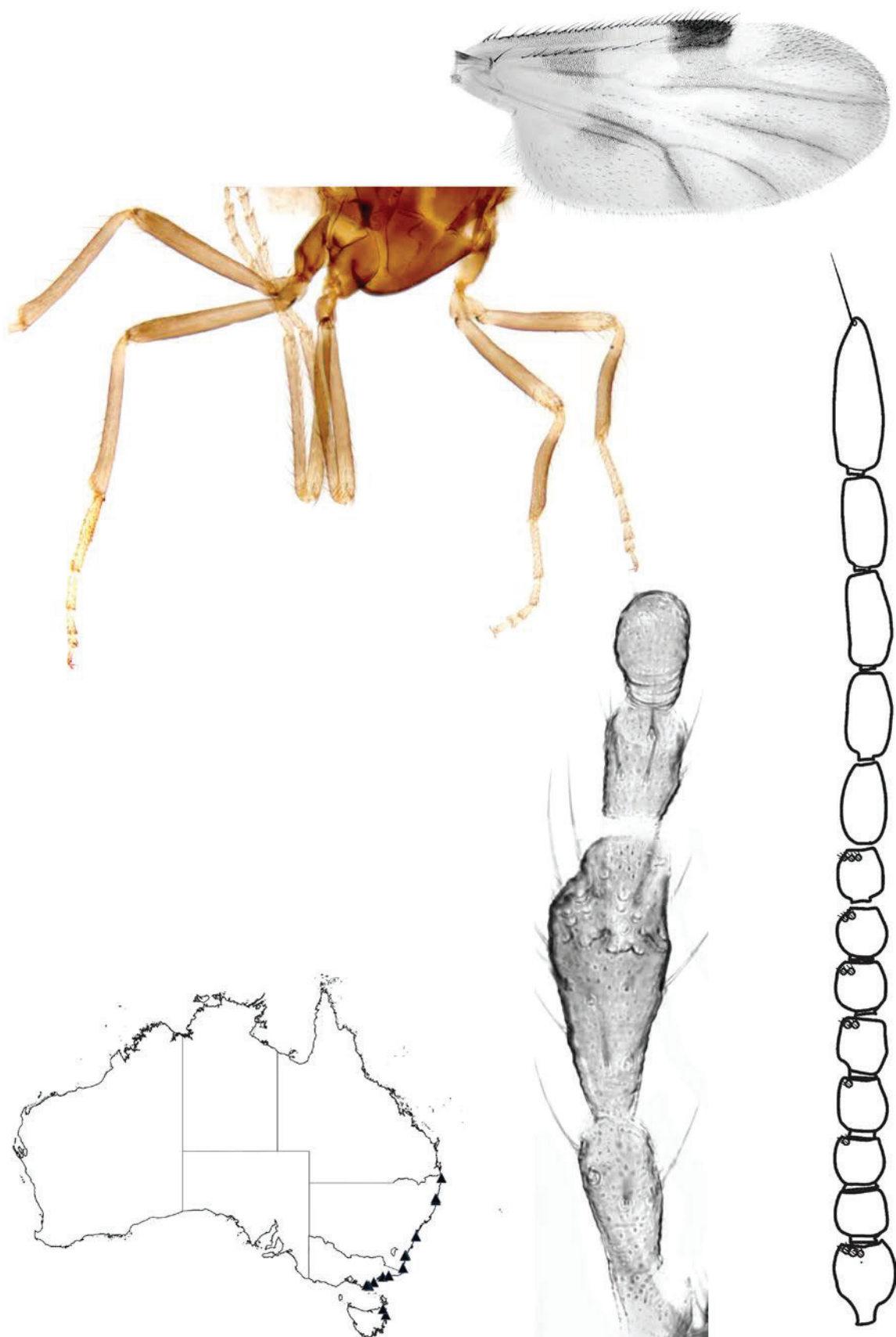


C. Molestus Gp sp no 1

Culicoides Molestus Group no 2

Culicoides Molestus Gp no 2 Dyce et al 2007:48

Synonyms	Nil.
Distribution	Coastal NSW, Victoria and Tasmania.
Hosts	Human, goat (Dyce unpublished).
Vector status	Unknown.
Immature habitat	Coarse estuarine sands adjacent to mangrove flat bounded by bluegreen algae in subsurface (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 4th tarsal segment of all legs chordate; elongate dark markings along veins M_2 , M_4 and CuA; Cell m_1 with 1 elongate pale spot; hind femora dark to apex, fore knees pale; tibial comb with 4 spines.

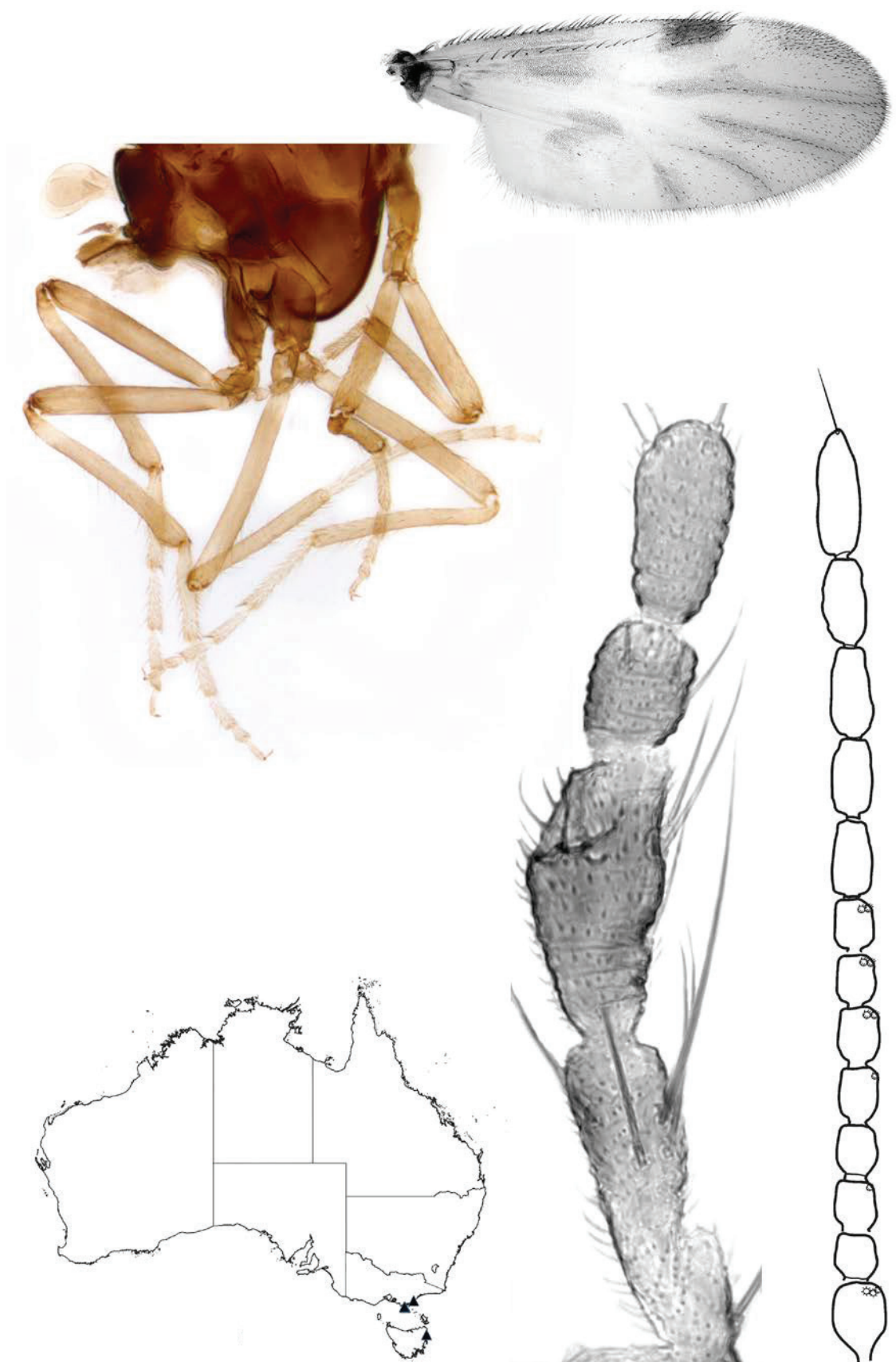


C. Molestus Gp sp no 2

Culicoides Molestus Group no 3

Culicoides Molestus Gp no 3 Dyce et al 2007:48

Synonyms	Nil.
Distribution	Coastal Victoria and Tasmania
Hosts	Human (Dyce unpublished).
Vector status	Unknown.
Immature habitat	Intertidal sand in brackish water, estuaries (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 4th tarsal segment of all legs chordate; elongate dark markings along veins M_2 , M_4 and CuA; Cell m_1 with 1 elongate pale spot. Hind femora dark to apex, tibial comb with 6-7 spines.

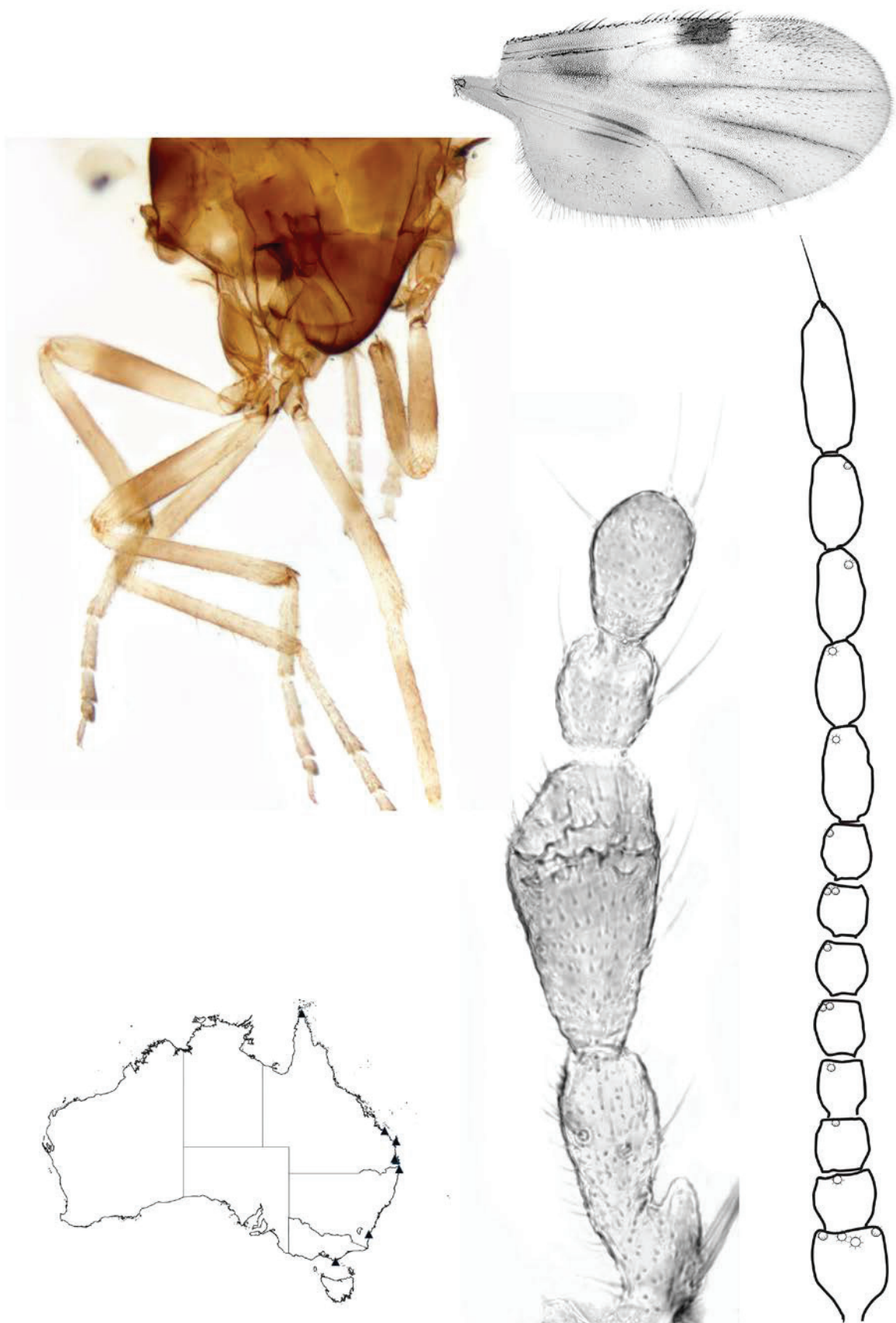


C. Molestus Gp sp no 3

Culicoides Molestus Group no 4

Culicoides Molestus Gp no 4 Dyce et al 2007:48

Synonyms	Nil.
Distribution	Coastal Victoria, NSW and Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Intertidal sand in brackish water, estuaries (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 4th tarsal segment of all legs chordate; hind femora with broad pale apical band.

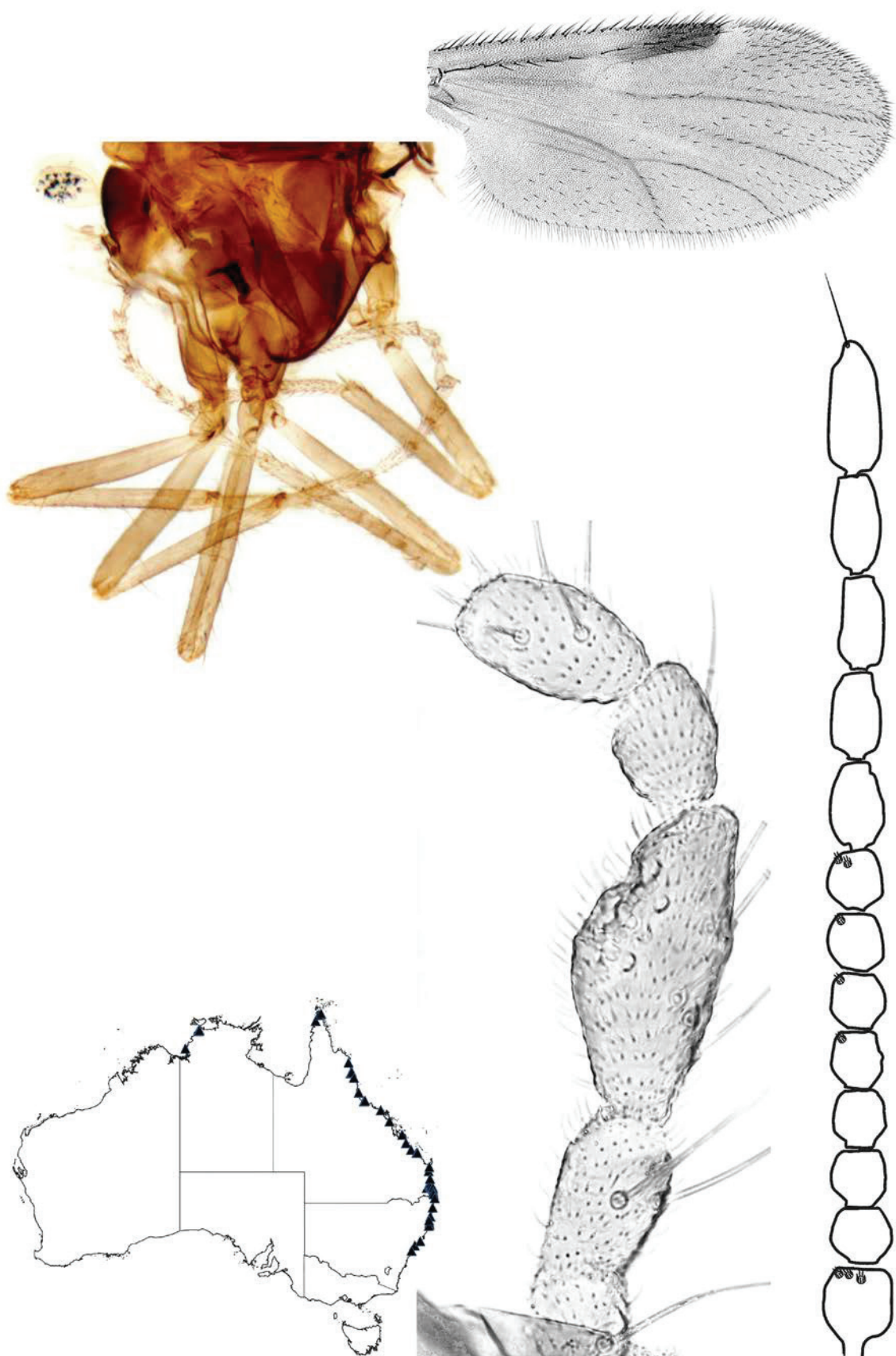


C. Molestus Gp sp no 4

Culicoides Molestus Group no 5

Culicoides Molestus Gp no 5 Dyce et al 2007:49

Synonyms	<i>Culicoides subimmaculatus</i> (misident) Lee & Reye (1953:375); Reye & Lee (1961); Lee <i>et al.</i> (1962; 1963); Marks & Reye (1966:90, 1967:90, 1973:98 1982:68); Kay (1973); Kettle & Elson (1976); Edwards (1980; 1982; 1989); Kay & Lennon (1982); Edwards <i>et al.</i> (1987)
Distribution	Coastal NSW south to Sydney, coastal Qld and NT. Also southern New Guinea.
Hosts	Human although historical confusion between this species and <i>C. subimmaculatus</i> suggests that some of the host records for <i>C. subimmaculatus</i> may refer to this species.
Vector status	Unknown.
Immature habitat	Intertidal sand, possibly associated with crab holes.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 4th tarsal segment of all legs chordate; wing without pattern except over r-m cross-vein and poststigmatic; SCo absent from flagellomeres 3 and 4.

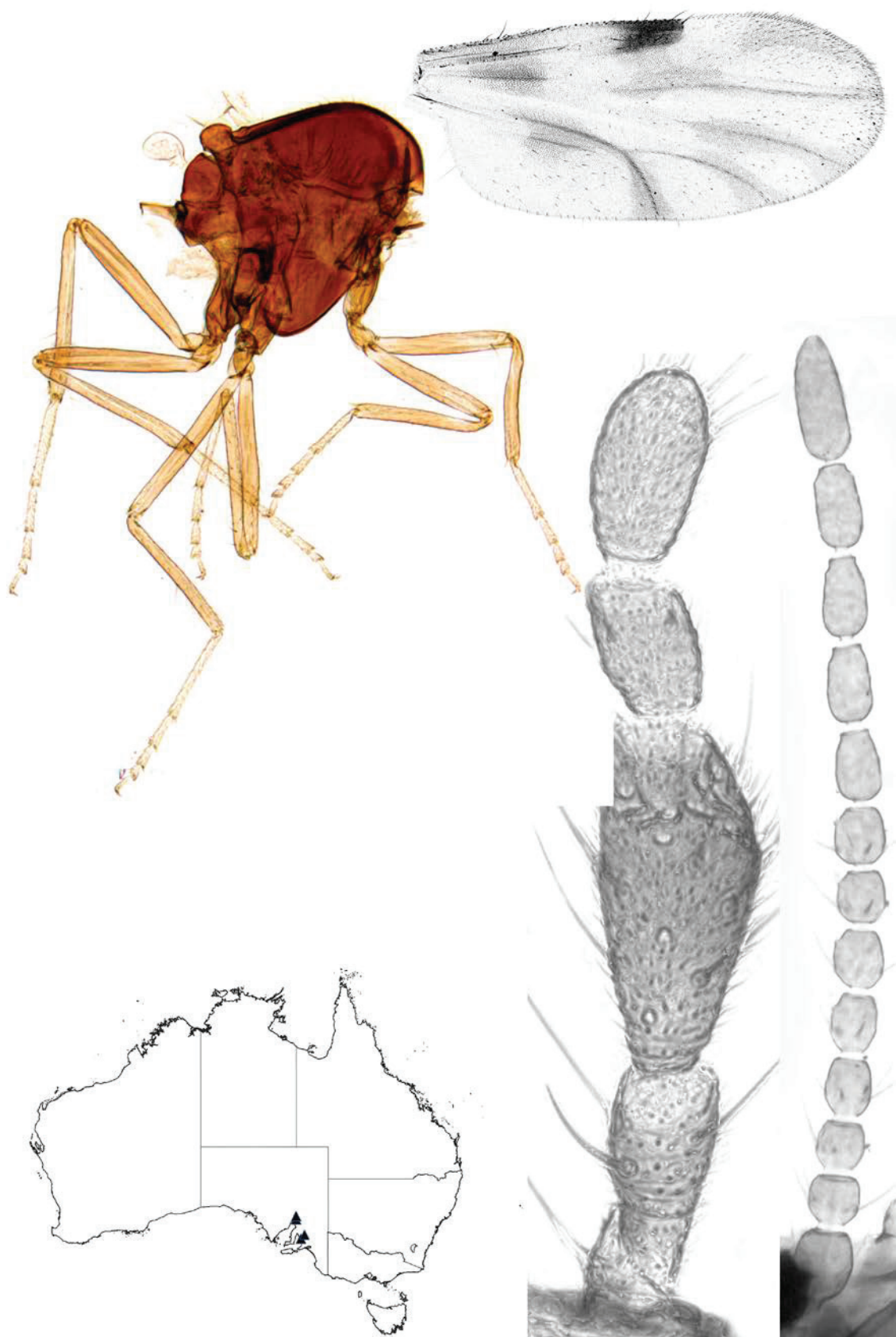


C. Molestus Gp sp no 5

Culicoides Molestus Group no 6

Culicoides Molestus Gp no 6 (*C. roperi*) Bellis 2013:292

Synonyms	Nil.
Distribution	Coastal South Australia.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 4th tarsal segment of all legs chordate; hind femora dark to apex; fore knee not pale; hind tibial comb with 4 spines. Wing with elongate dark markings along veins M ₂ , M ₄ and CuA.

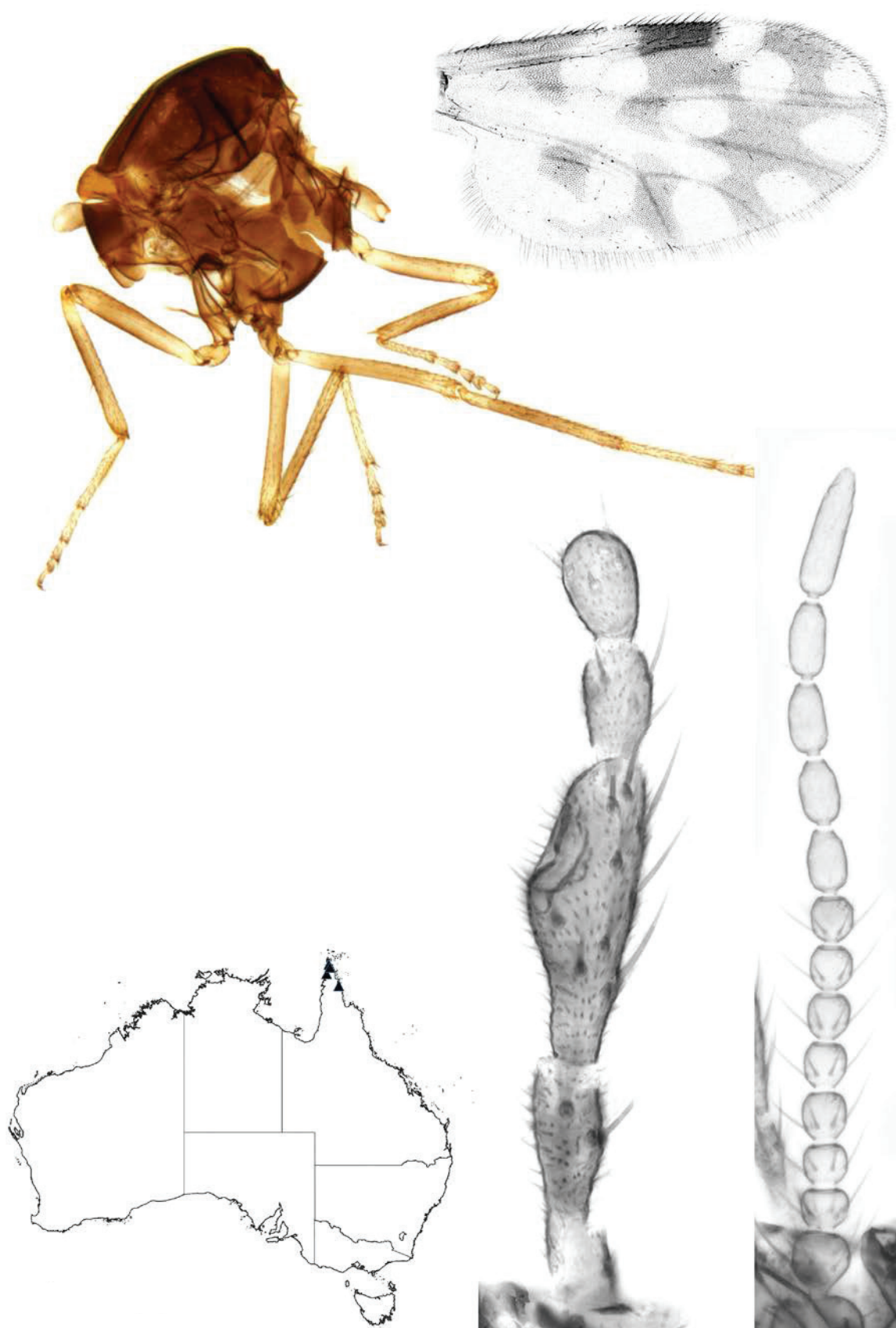


C. Molestus Gp sp no 6

Culicoides Molestus Group no 7

Culicoides Molestus Gp no 7

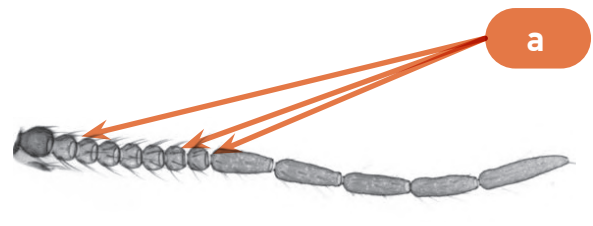
Synonyms	Nil.
Distribution	Cape York Peninsula.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 4th tarsal segment of all legs chordate. Wing with rounded pale spot present posterodistal to poststigmatic pale spot. SCo present on flagellomeres 3 and 4.



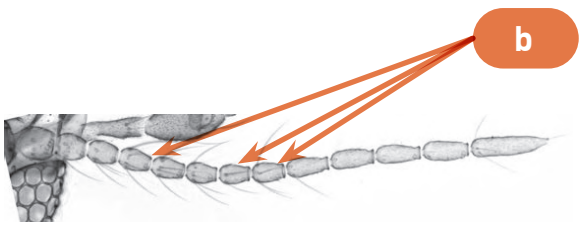
C. Molestus Gp sp no 7

Key to female specimens of Australian species belonging to the Ornatus Group

1	Basal antennal segments compressed, about as wide as long (a)	2
	Basal antennal segments longer than wide (b)	3

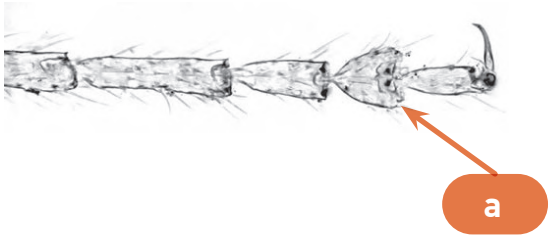


C. cordiger



Ornatus Gp sp no 8

2	Fourth tarsal segment chordate (heart shaped), about as long as wide and distinctly wider than 3rd segment (a)	<i>C. cordiger</i>
	Fourth tarsal segment parallel-sided, distinctly longer than wide and of similar width to 3rd segment (b)	<i>C. papuensis</i>



C. cordiger



C. papuensis

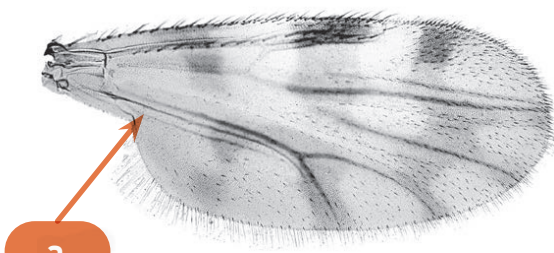
3

Base of M-Cu vein included in large pale marking (a) coastal NT

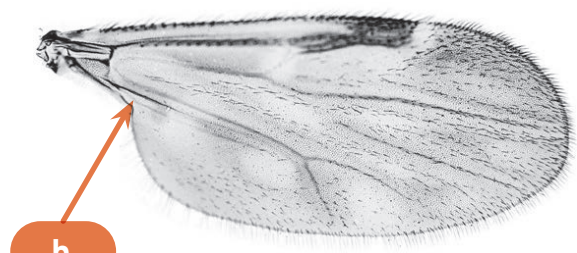
C. pangkorensis

Base of M-Cu vein included in dark marking (b)

4



C. pangkorensis



C. flumineus

4

Cell r_3 with 2 pale spots distal to poststigmatic (a) coastal NQ

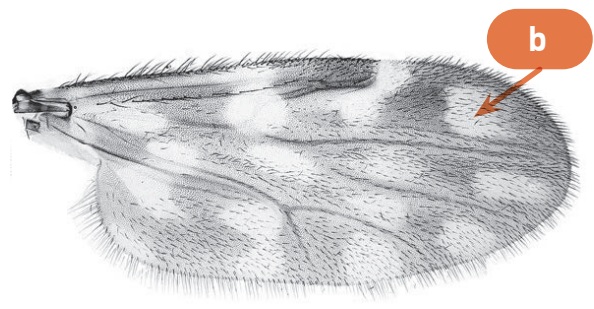
C. circumbasalis (pt)

Cell r_3 with 1 pale spot distal to poststigmatic (b)

5



C. circumbasalis



C. marmoratus

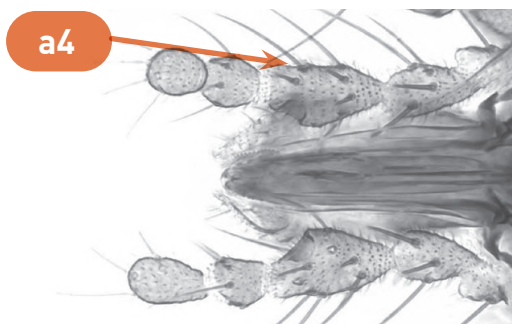
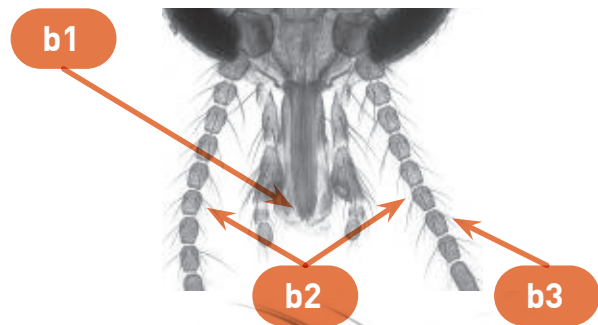
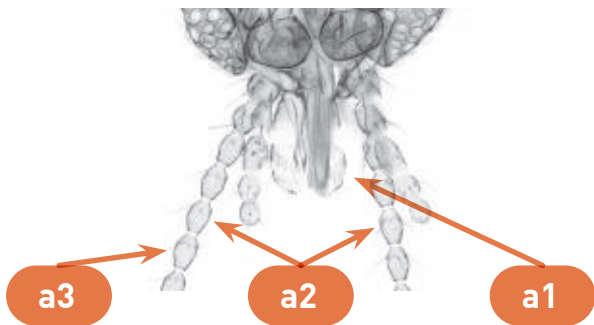
5

Proboscis (a1) short, not reaching 5th antennal flagellomere (a2), palpus also short, not reaching 6th antennal flagellomere (a3); 3rd palpal segment less than twice as long as wide (a4)

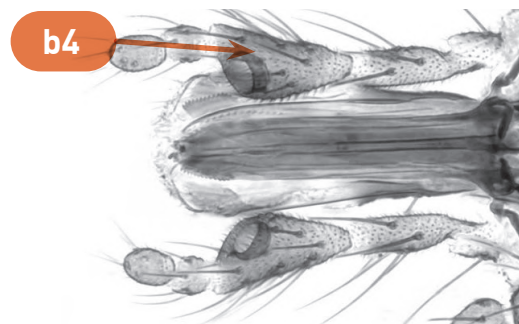
6

Proboscis (b1) long, reaching at least to 6th antennal flagellomere (b2), Palpus reaching at least flagellar segment 7 (b3); 3rd palpal segment at least twice as long as wide (b4)

7



Ornatus Gp sp no 10



C. flumineus

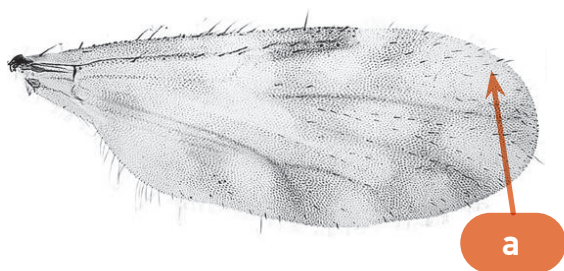
6

Apical pale spot in cell r_3 reaching margin of wing (a) northern WA

Ornatus Gp sp no 9

Apical pale spot in cell r_3 not reaching margin of wing (b) NQ and NT

Ornatus Gp sp no 10



Ornatus Gp sp no 9

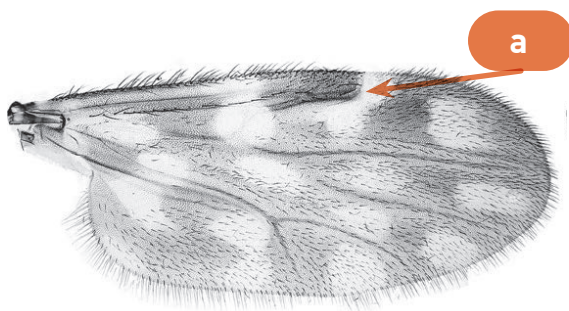


Ornatus Gp sp no 10

7

Cell r_2 dark to apex (a)

8

Cell r_2 with pale apex (b)*C. peliliouensis**C. marmoratus**C. peliliouensis*

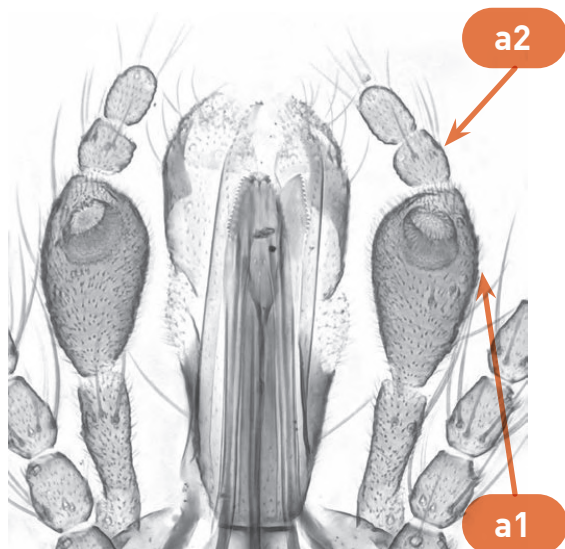
8

3rd palpal segment egg-shaped, widest near midpoint and with outer edge convex (a1), at least 4 times longer than 4th palpal segment (a2);

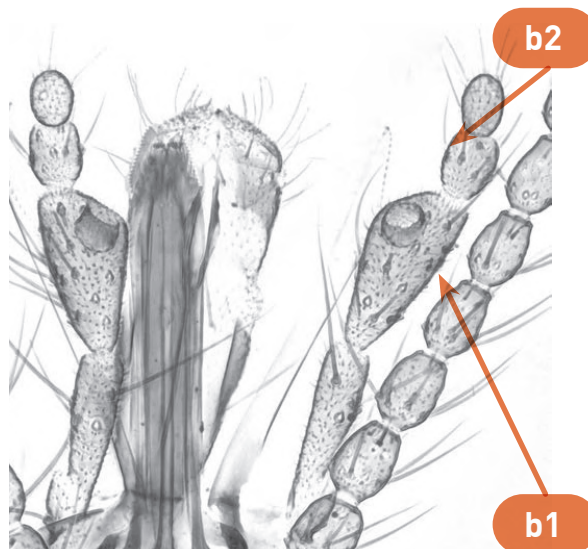
Ornatus Gp sp no 8

3rd palpal segment clavate, widest near apex, outer edge almost straight (b1); little more than 3 times longer than 4th segment (b2); coastal

9



Ornatus Gp sp no 8

*C. ornatus*

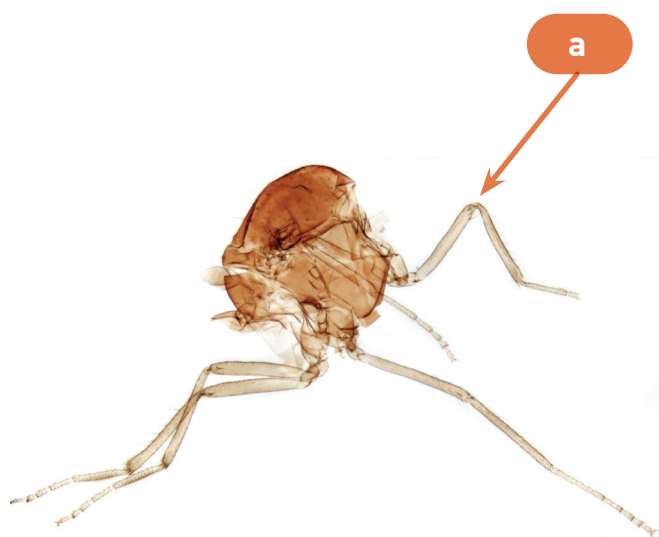
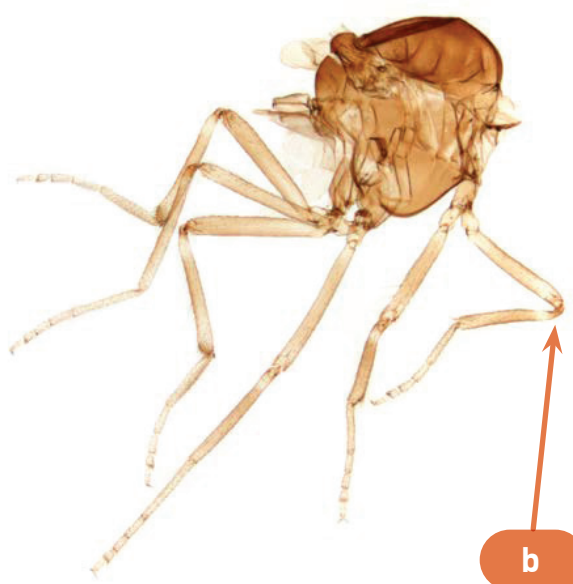
9

Legs unbanded (a)

C. flumineus

At least fore tibiae with distinct subbasal pale band (b)

10

*C. flumineus**C. ornatus*

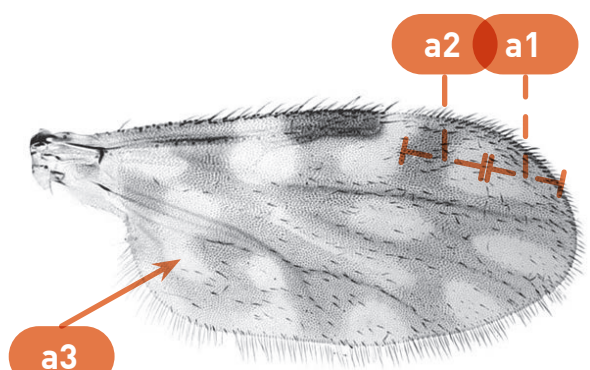
10

Apical pale spot in cell r_3 distant from apex of cell, centre point about equidistant from apex of cell (a1) and poststigmatic pale spot (a2), if in doubt, then flagellar segments 10-13 without SCh; basal pale spot in anal cell extended posteriorly into rectangle or crescent shape (a3);

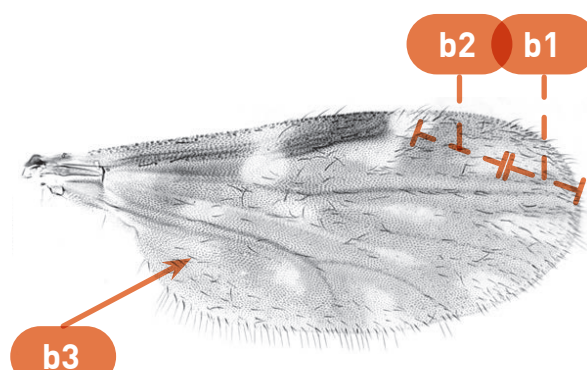
11

Apical pale spot in cell r_3 elongate and usually reaching apex of cell, centre point closer to apex of cell (b1) than to poststigmatic pale spot (b2) if in doubt, then flagellar segments 10-13 with at least 1 SCh; basal pale spot in anal cell ovoid (b3);

13



Ornatus Gp sp no 6

*C. ornatus*

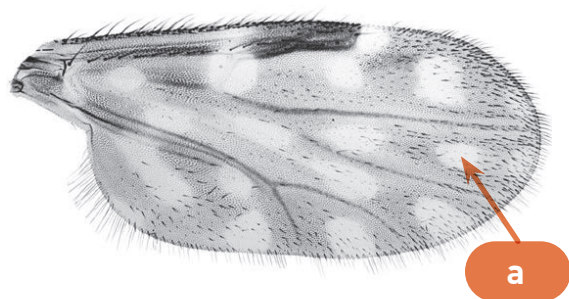
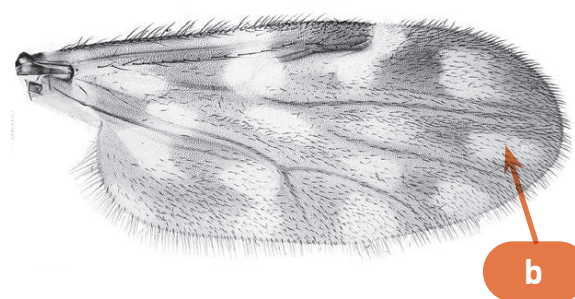
11

Apical pale spot in cell m_1 compact and distant from wing margin (a)

C. circumbasalis (pt)

Apical pale spot in cell m_1 elongate and reaching wing margin or almost so (b)

12

*C. circumbasalis**C. marmoratus*

12

3rd palpal segment with large, irregular and shallow (a1), often divided (a2), sensory pit spanning almost the full width of the segment

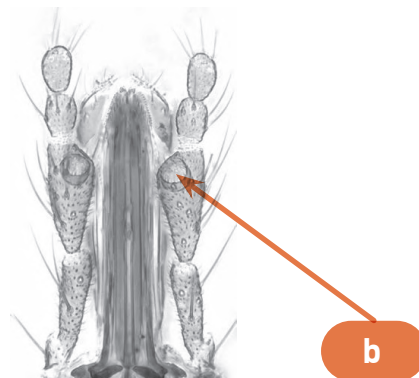
C. marmoratus

3rd palpal segment with smaller, round and moderately deep sensory pit spanning no more than $\frac{3}{4}$ of the width of the segment (b)

Ornatus Gp sp no 6



C. marmoratus



Ornatus Gp sp no 6

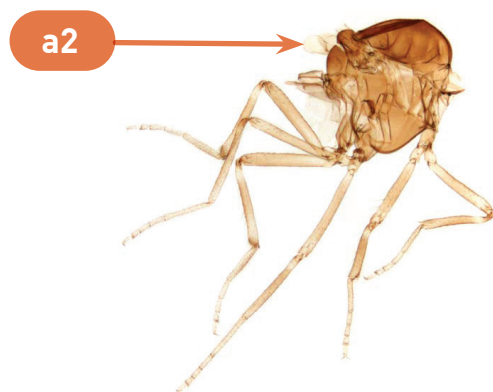
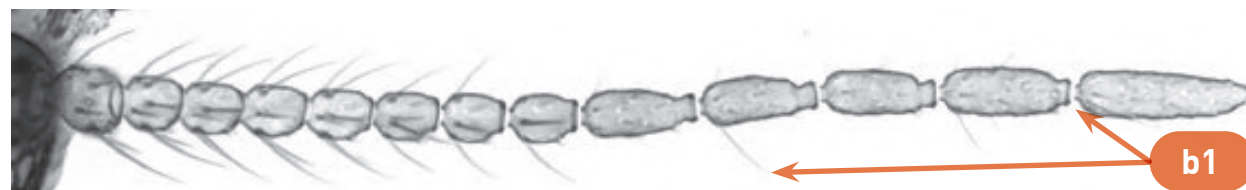
13

(10) Distal 5 flagellomeres each with a basal whorl of 4 – 6 Sch (a1); halteres pale (a2)

C. ornatus

Distal 5 flagellomeres with a basal whorl of 1-2 Sch (b1); halteres dark (b2)

C. longior



Culicoides Ornatus Group

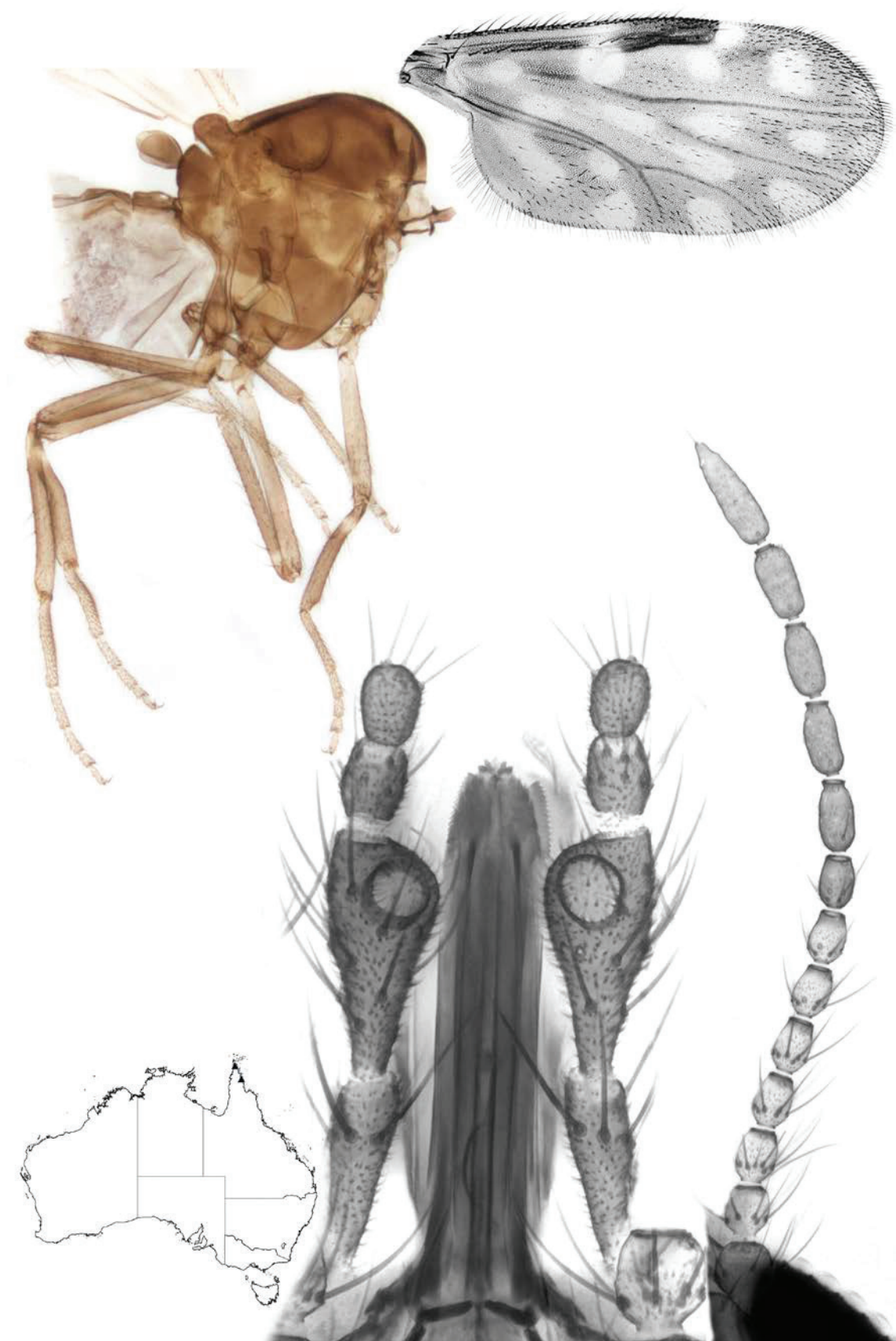
Culicoides Ornatus Gp Wirth & Hubert 1989:293

Nominate species	<i>Culicoides ornatus</i> Taylor 1913: 73.
Synonyms	Nil.
Distribution	Widespread in Asia, Australasia and the Pacific, most species confined to coastal areas.
Number of species worldwide	Borkent & Dominiak (2020) list 30 described species although species from the Palaearctic Claggi Gp, which is almost certainly synonymous with the Ornatus Gp, are listed under Oecacta so their figure underestimates the total. To these totals we must add a further 10 undescribed species from Australasia.
Number of species in Australia	14.
Hosts	Sheep, human, flying fox, birds.
Vector status	Unknown.
Immature habitat	Usually estuarine or mangrove forests, sometimes inland in saline or brackish ground waters (e.g. bore drains).
Diagnosis	Female specimens can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Distal ring of 4-6 SCo present on flagellomere 12. Tibial comb in most species with 4 spines. Wing with poststigmatic pale spot usually curved posteriorly to wrap around cell r_2 .

Culicoides circumbasalis

Culicoides circumbasalis Tokunaga 1959: 232 (New Guinea)

Synonyms	<i>praesignis</i> Delfinado 1961:652.
Distribution	Cape York Peninsula and Torres Strait, Qld. Widespread in Asia and Papua New Guinea.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown but distribution data suggests coastal.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cells r_3 and m_1 each usually with 3 pale spots, the apical one sometimes indistinct; cell r_2 dark to apex; Vein M with pale marking distad of base.



C. circumbasalis

Culicoides cordiger

Culicoides cordiger Macfie 1934: 193 (Malaysia)

Synonyms	<i>magnesianus</i> Lee & Reye 1953:385.
Distribution	Coastal Qld, NT and WA south to Pilbara region. Widespread in Asia and Papua New Guinea.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Mangrove forest [Shivas et al 2022].
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: 4th tarsal segment of all legs chordate. 3rd palpal segment with rounded pit. Cell m_1 with 2 pale spots. Basal flagellomeres individually about half length of individual distal flagellomeres.

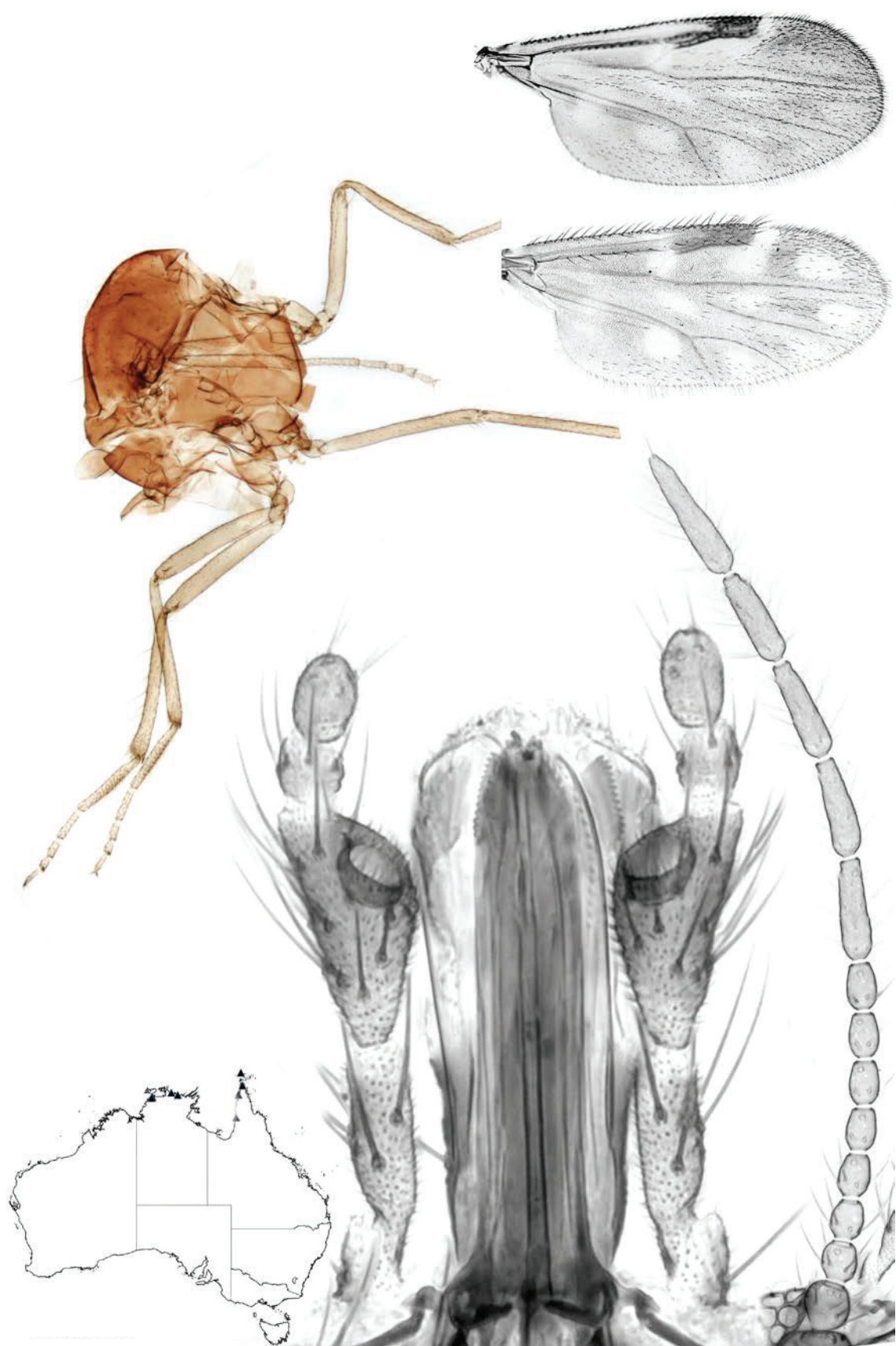


C. cordiger

Culicoides flumineus

Culicoides flumineus Macfie 1937: 116 (Malaysia)

Synonyms	Nil.
Distribution	Coastal northern NT and Qld. Widespread in SE Asia.
Hosts	Human (Reye 1992; Shivas et al 2022).
Vector status	Unknown.
Immature habitat	Mangrove forest (Shivas et al 2022).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; base of vein M-Cu not included in pale spot; apical pale spot in cell r_3 , when present, closer than its own diameter to apex of cell; SCh absent from all 5 distal flagellomeres; fore tibia dark to base.

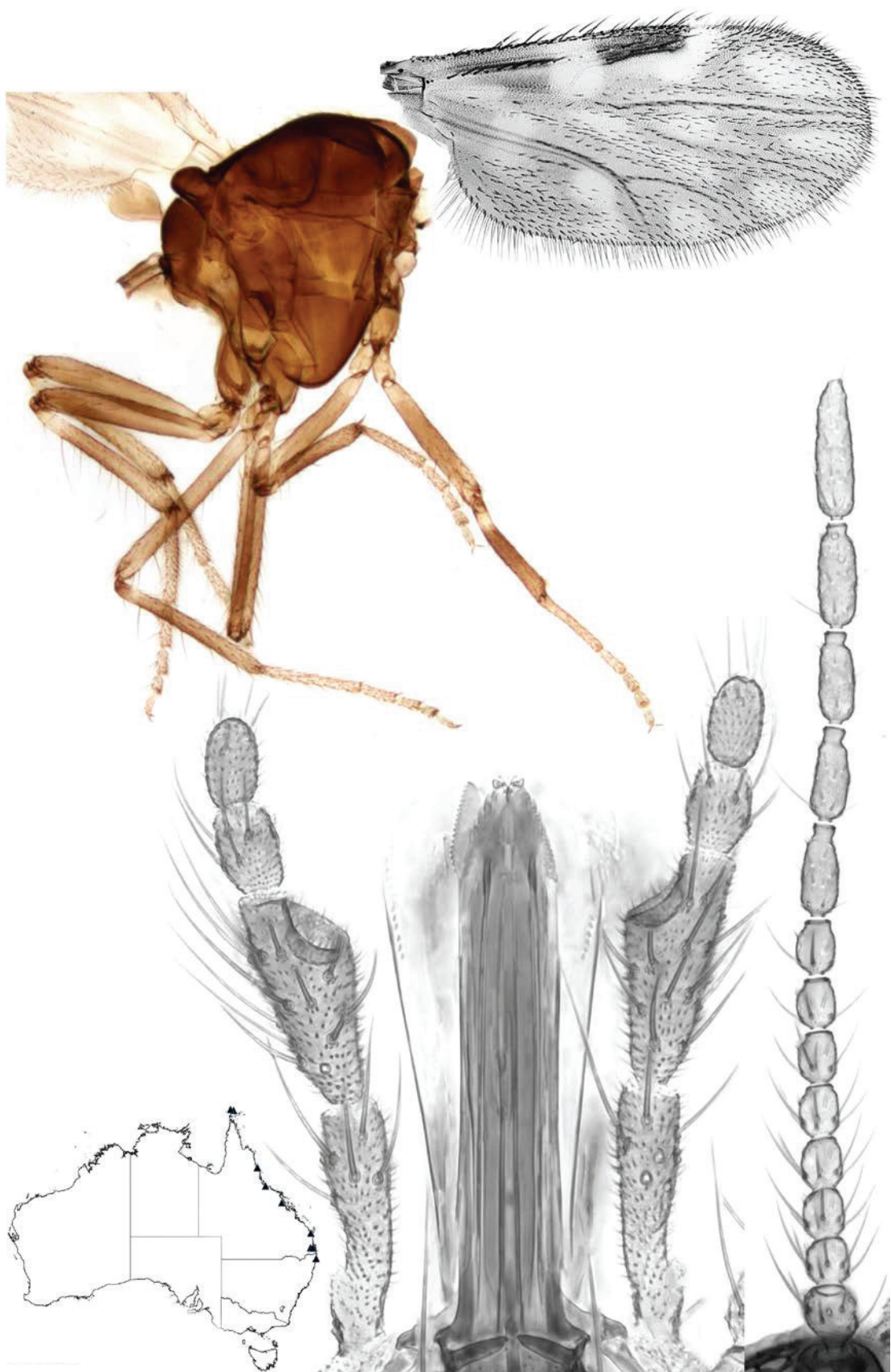


C. flumineus

Culicoides longior

Culicoides longior Hagan & Reye 1986: 340 (Queensland)

Synonyms	Nil.
Distribution	Coastal Qld and northern NSW.
Hosts	Human (Hagan & Reye 1986).
Vector status	Unknown.
Immature habitat	Mangrove forest mud.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; poststigmatic pale spot bilobed with posterior lobe sitting below cell r_2 ; cell r_3 with 1 pale spot distal to poststigmatic, mid-point slightly closer to cell apex than to poststigmatic pale spot. Distal ring of 4-6 SCo present on flagellomere 12; 1-2 SCh present on all 5 distal flagellomeres. Haltere with stem and base mottled brown.

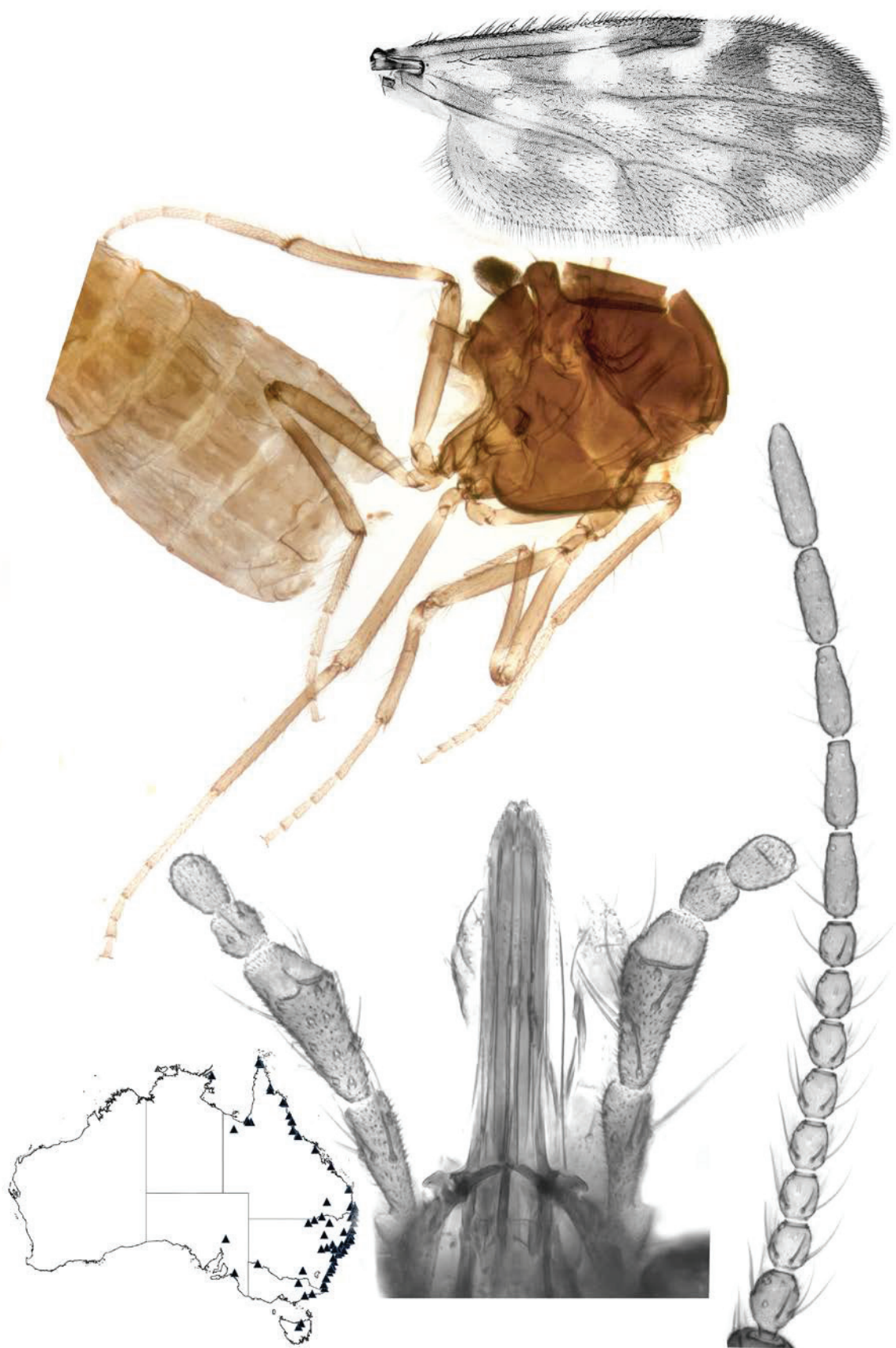


C. longior

Culicoides marmoratus

Culicoides marmoratus (Skuse) 1889: 304 (*Ceratopogon*) (NSW)

Synonyms	Nil.
Distribution	Coastal Victoria, NSW and Qld. Records from inland site require confirmation.
Hosts	Sheep, human (Kay 1973; Lee et al. 1962, Muller & Murray 1977).
Vector status	Unknown.
Immature habitat	Variable estuarine habitats with <i>Salicornia</i> , filamentous algae, peaty mud and/or sand (Lee & Reye 1963; Kettle & Elson 1976; Reye 1972; Kay 1973).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Cell r_2 dark to apex; cell r_3 with 1 pale spot distal to poststigmatic, usually truncate basally. Distal ring of 4-6 SCo present on flagellomere 12. 3rd palpal segment no more than 1.5 times as long or as wide as 2nd segment and bearing a shallow, often irregular or divided pit.

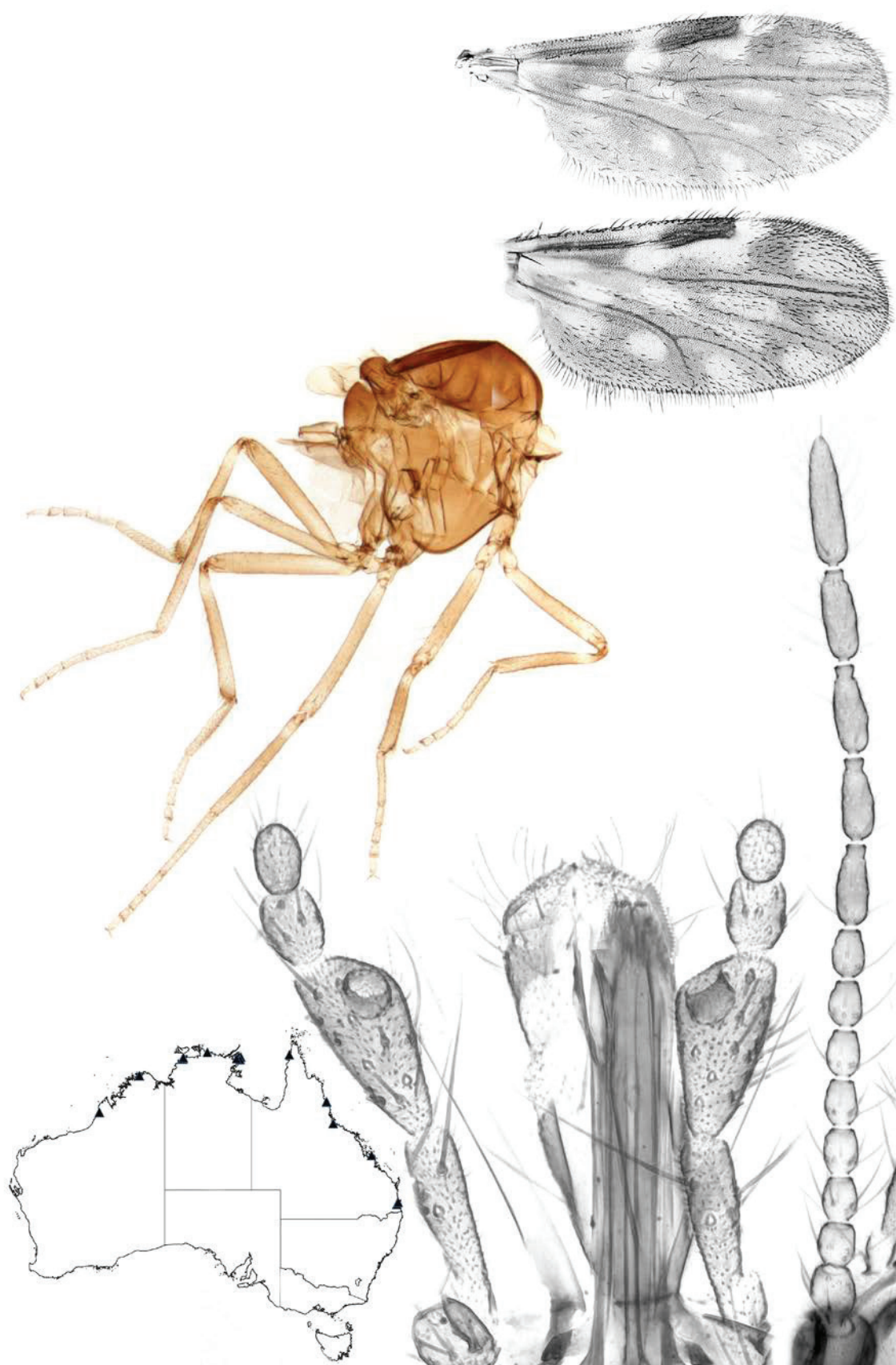


C. marmoratus

Culicoides ornatus

Culicoides ornatus Taylor 1913: 73 (Queensland)

Synonyms	Nil.
Distribution	Coastal northern WA, NT, and Qld south to Brisbane. Also in New Guinea and widespread in SE Asia.
Hosts	Human, flying fox, birds (Reye & Lee 1962).
Vector status	Unknown.
Immature habitat	Mangrove forest mud (Shivas et al 2022).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: cell r_2 dark to apex; cell r_3 with 1 pale spot distal to poststigmatic, centre point equidistant between poststigmatic pale spot and cell apex. Distal ring of 4-6 SCo present on flagellomere 12; 4-6 SCh present on all 5 distal flagellomeres. Haltere with stem and knob entirely pale.

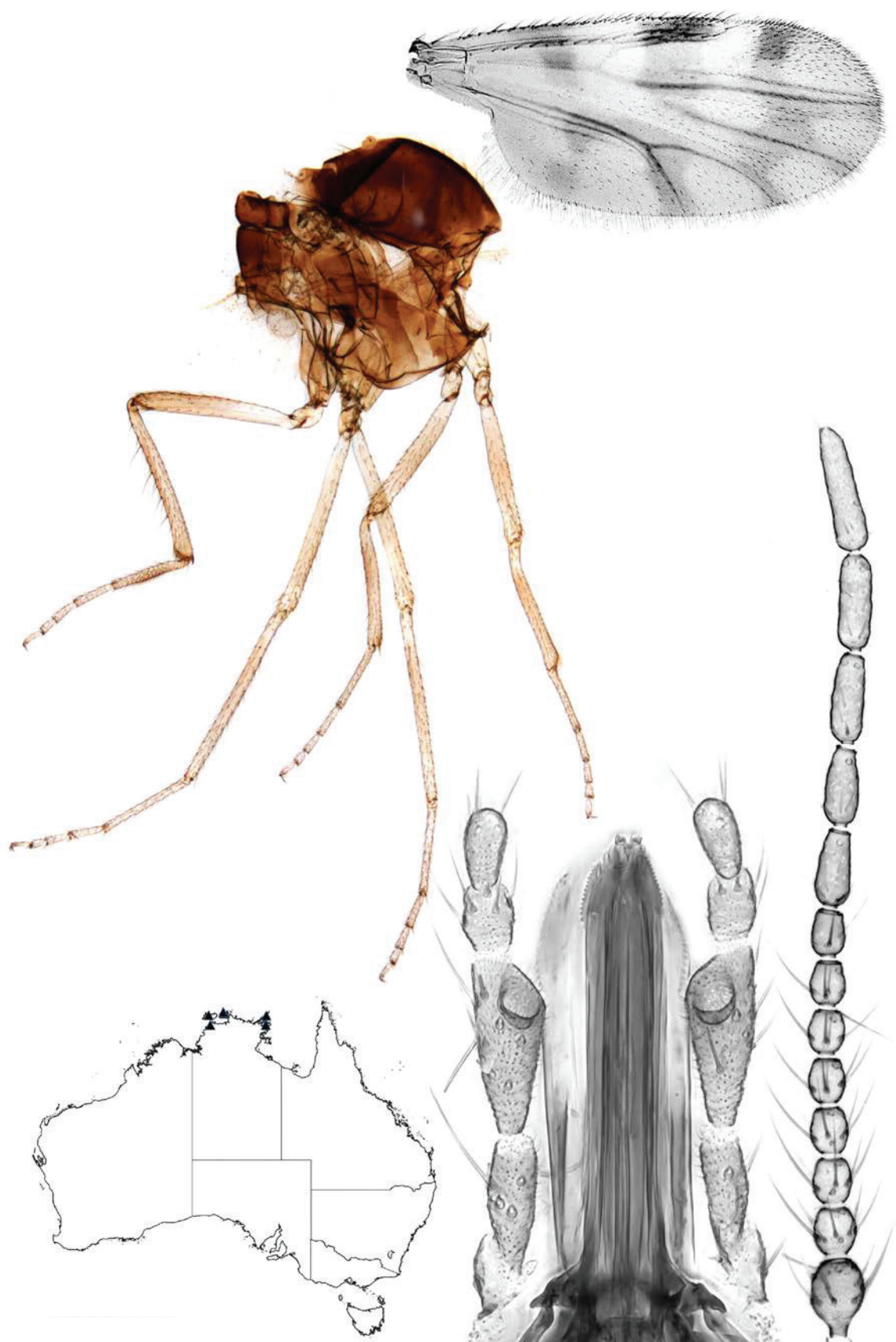


C. ornatus

Culicoides pangkorensis

Culicoides pangkorensis Wirth & Hubert 1989: 326 (Malaysia)

Synonyms	Nil.
Distribution	Northern NT. Widespread in SE Asia.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Seasonal subcoastal swamps (Reye unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 not included in pale marking; apical pale marking in cell r_3 reaching wing margin; vein M-Cu with base covered by pale marking. Hind tibia dark to base.

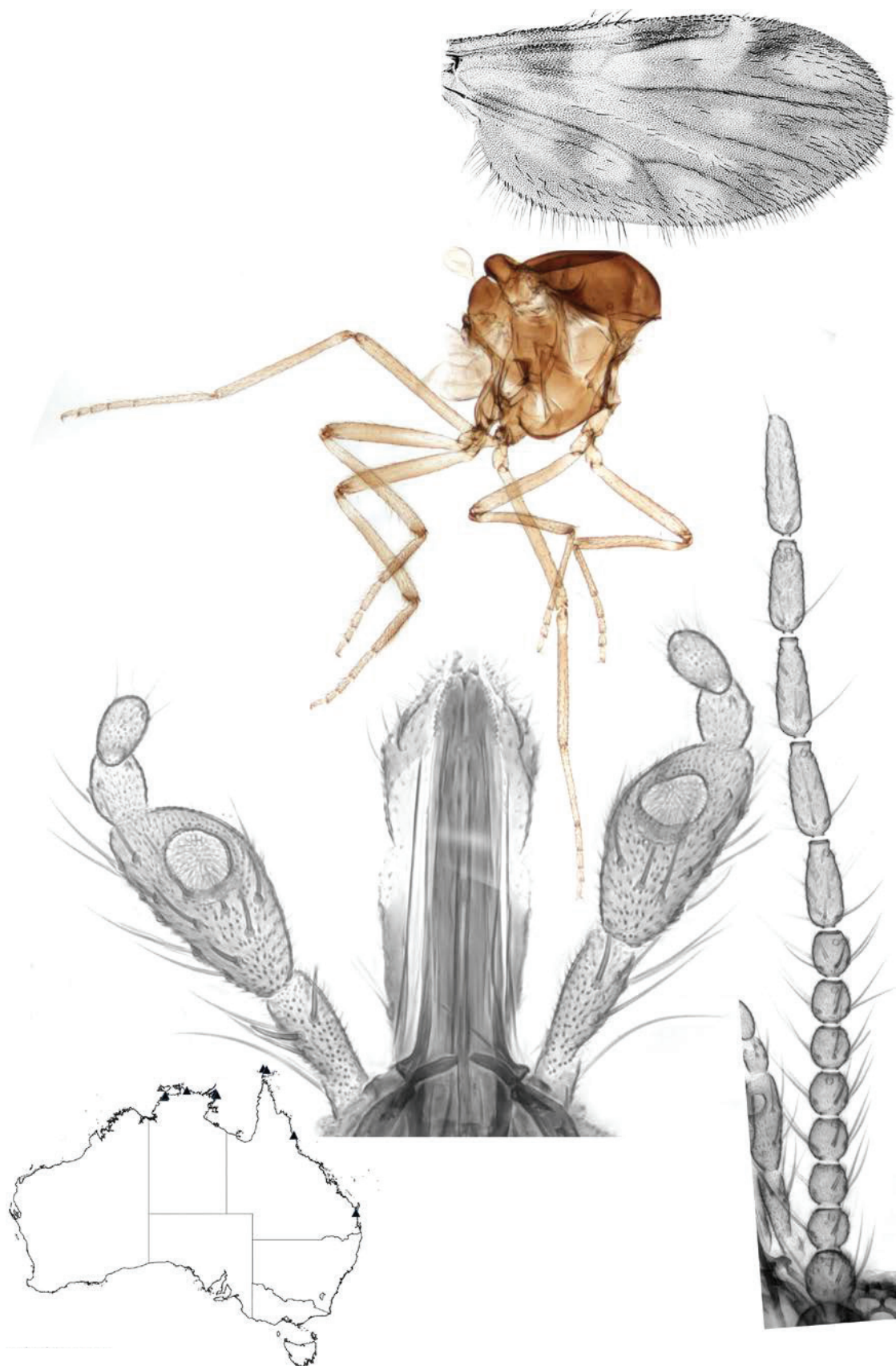


C. pangkorensis

Culicoides papuensis

Culicoides papuensis Tokunaga 1962: 513 (PNG)

Synonyms	Nil.
Distribution	Northern WA, NT and Qld. Widespread in SE Asia and Papua New Guinea.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Mangrove forest [Shivas et al 2022].
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 not included in pale marking; apical pale marking in cell r_3 reaching wing margin; vein M-Cu with base covered by dark marking and medial section covered by pale marking. 3rd palpal segment with rounded pit. Basal 8 flagellomeres compressed and individually much shorter than any of the distal 5 flagellomeres.

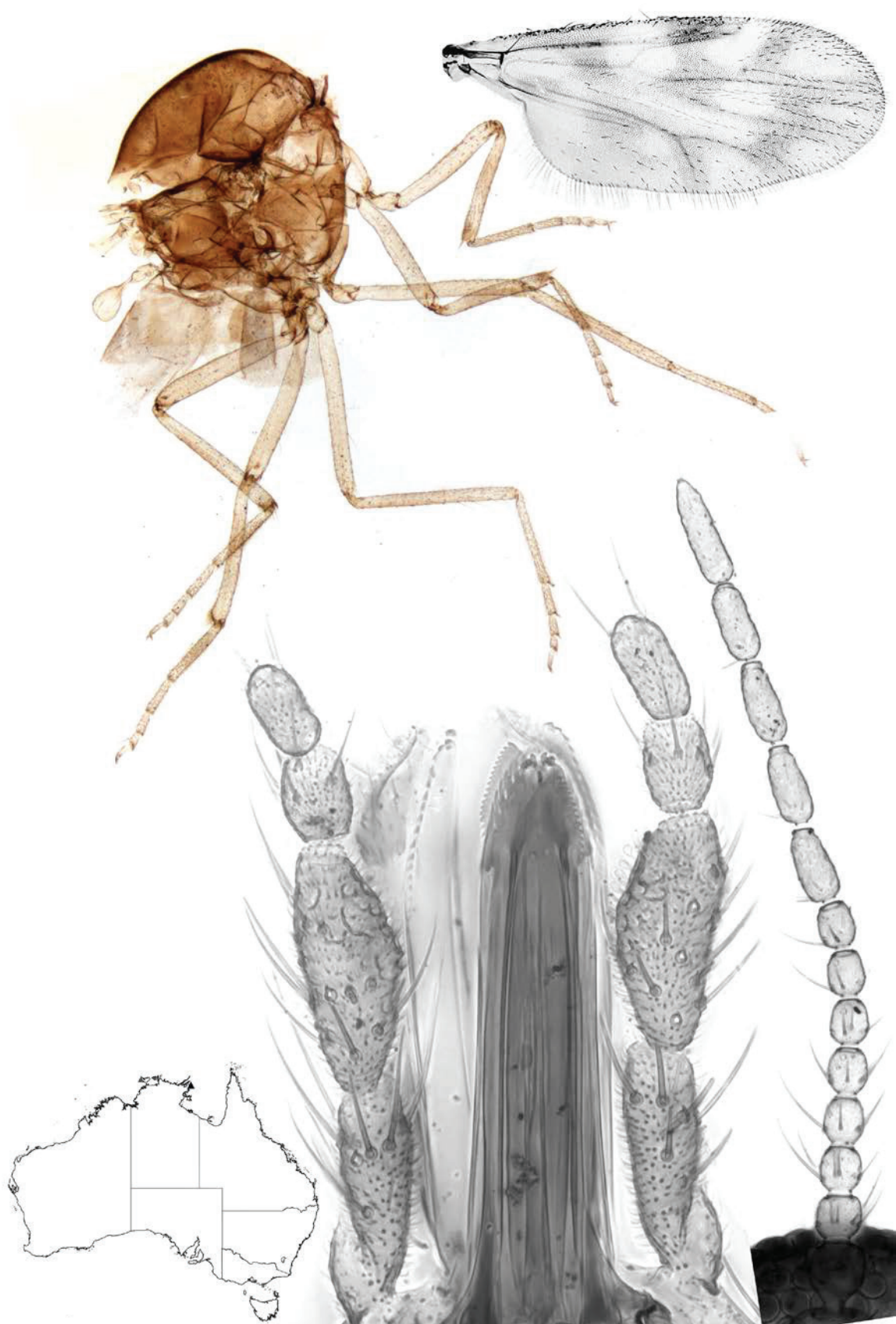


C. papuensis

Culicoides peliliouensis

Culicoides peliliouensis Tokunaga in Tokunaga & Esaki 1936: 55 (Palau)

Synonyms	<i>ejercitoi</i> Delfinado 1961: 643
Distribution	Known from a single male specimen collected near Nhulunbuy, northern NT. Widespread in southern Asia and the western Pacific.
Hosts	Reported as a major pest of humans in Micronesia.
Vector status	Unknown.
Immature habitat	Mangrove forest [Dorsey 1948].
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 not included in pale marking; apical pale marking in cell r_3 reaching wing margin; vein M-Cu with base covered by dark marking and medial section covered by pale marking. 3rd palpal segment lacking a pit.

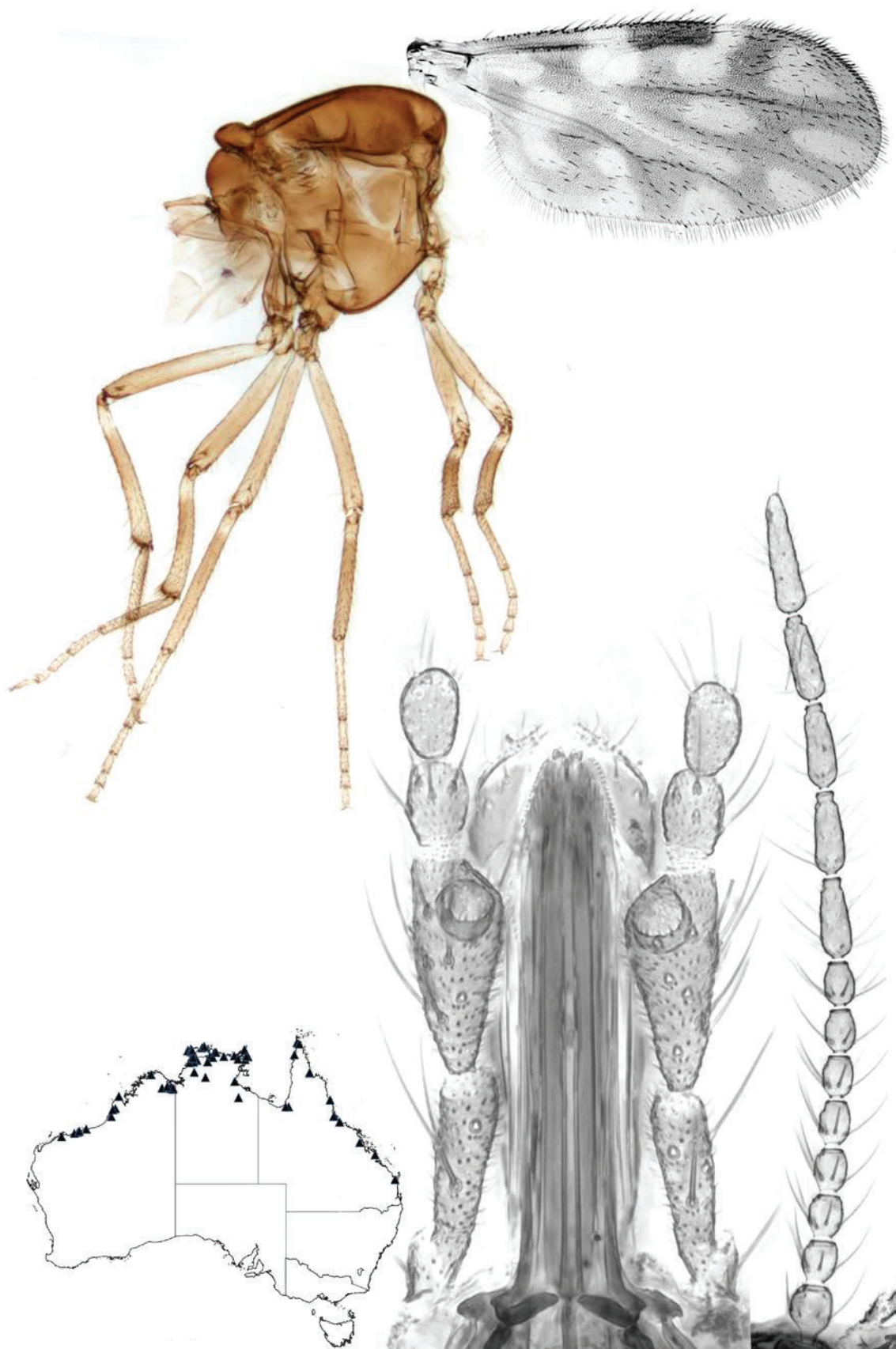


C. peliliouensis

Culicoides Ornatus Group sp no 6

Culicoides Ornatus Gp sp no 6 Dyce et al 2007:52

Synonyms	Nil.
Distribution	Coastal Qld, NT and northern WA. Records from Victoria reported by Mee et al (2021) require confirmation as this is well outside the known distribution for this species.
Hosts	Bovids, horse, marsupial (Muller et al 1981); unlikely to feed on humans (Shivas et al 2022).
Vector status	Unknown.
Immature habitat	Mangrove forest (Shivas et al 2022).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; cell r_3 with 1 pale spot distal to poststigmatic, usually truncate basally. 3rd palpal segment clavate (widening towards apex) and no more than 1.5 times as long or as wide as 2nd segment and bearing a relatively deep, round pit.

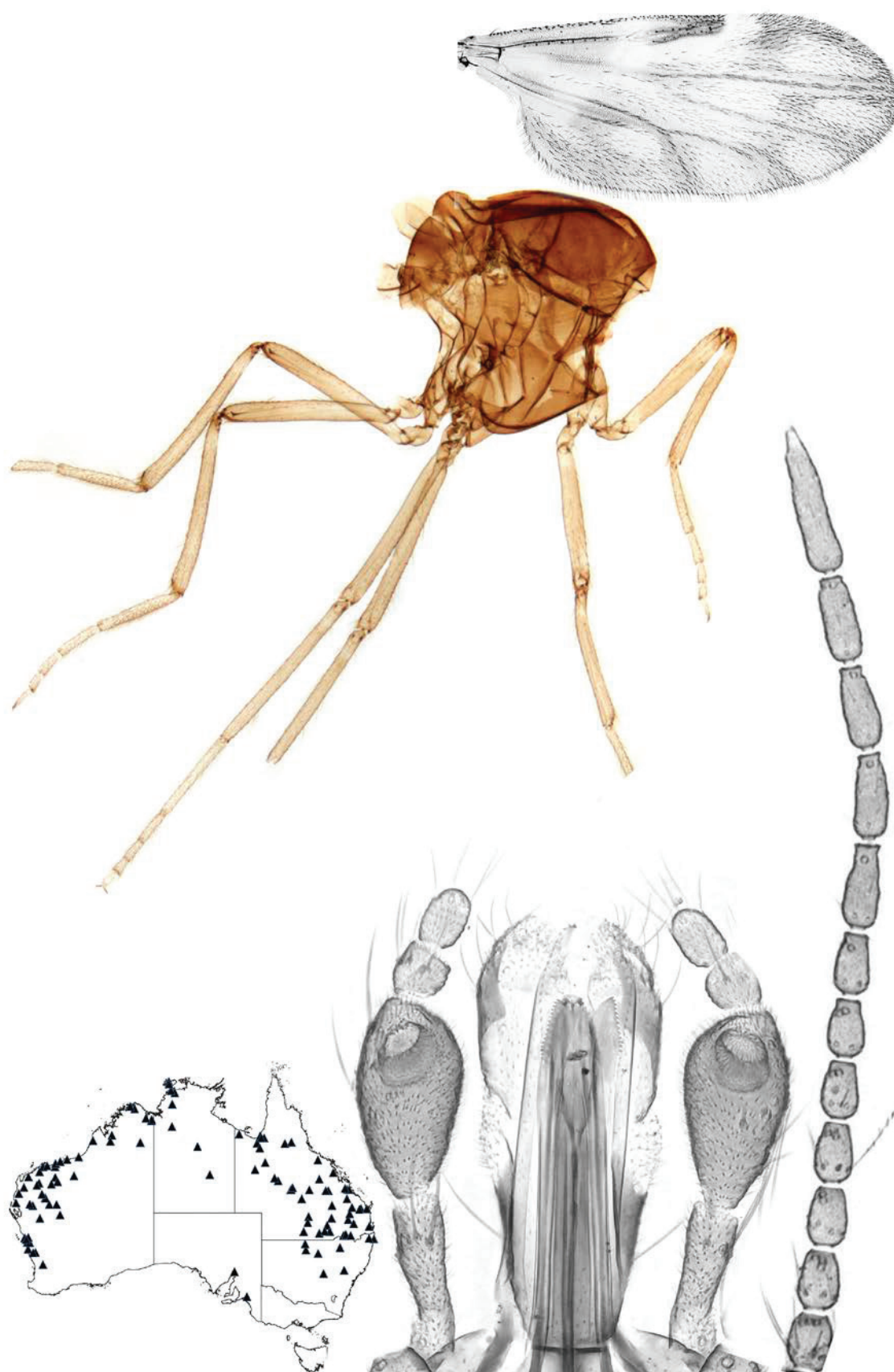


C. Ornatus Gp sp no 6

Culicoides Ornatus Group sp no 8

Culicoides Ornatus Gp sp no 8 Dyce et al 2007:53

Synonyms	Nil.
Distribution	Widespread in WA, NT, Qld and NSW, southeastern SA
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Mineralised seepage, bore drains (Dyce & Murray unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; cell r_3 with 1 pale spot distal to poststigmatic, 3rd palpal segment widest near middle and more than twice width of 2nd segment. Flagellomeres 4-7 longer than wide; SCh present on all 5 distal flagellomeres.

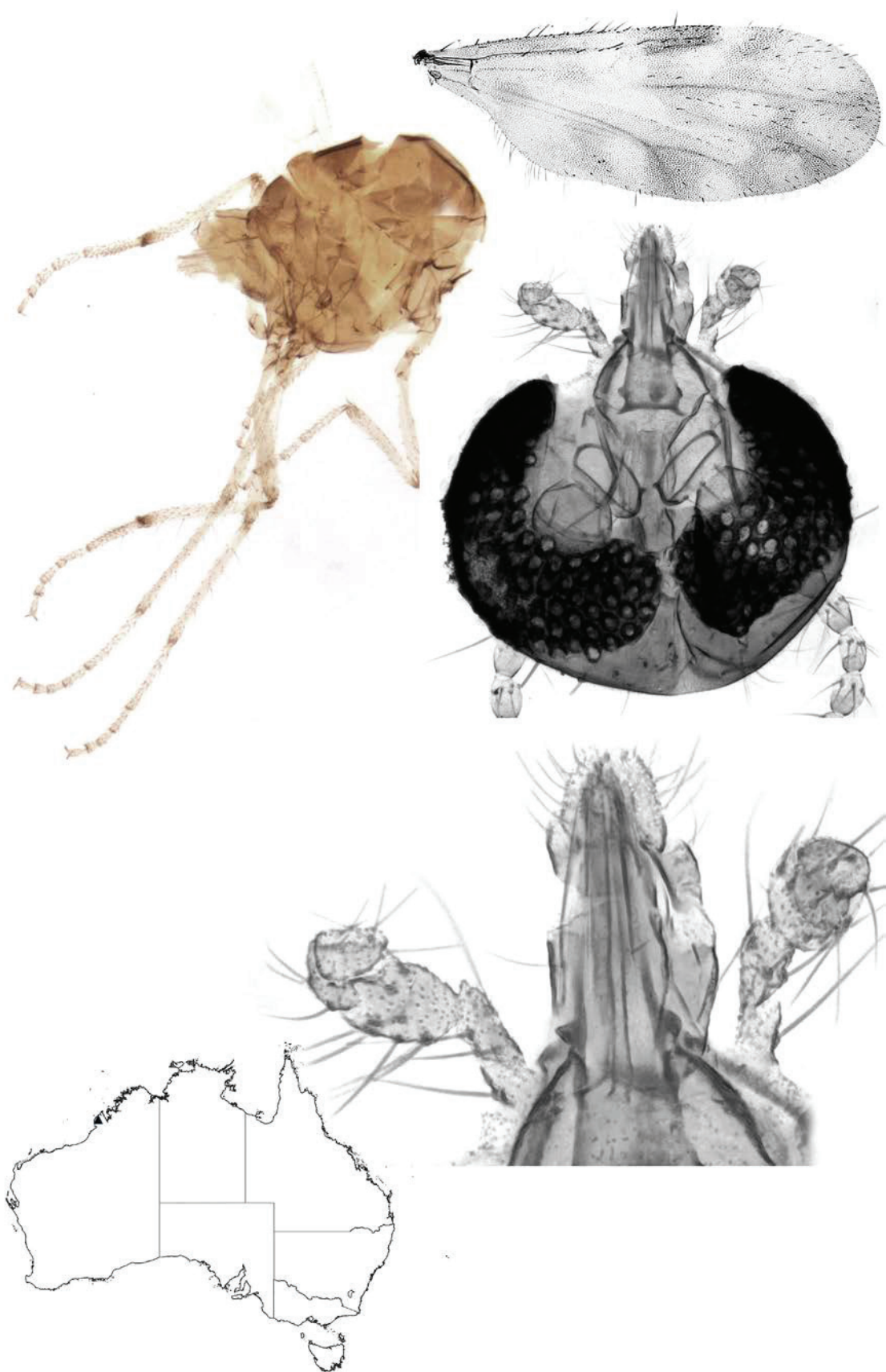


C. Ornatus Gp sp no 8

Culicoides Ornatus Group sp no 9

Culicoides Ornatus Gp sp no 9 Dyce et al 2007:54

Synonyms	Probably not synonymous with the species reported as <i>Culicoides Ornatus Gp sp no 9</i> by Shivas et al (2022).
Distribution	Known from Broome, WA.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; cell r_3 with 1 pale spot distal to poststigmatic, reaching wing margin. Proboscis and palpus short, not reaching 5th or 6th antennal flagellar segment respectively.

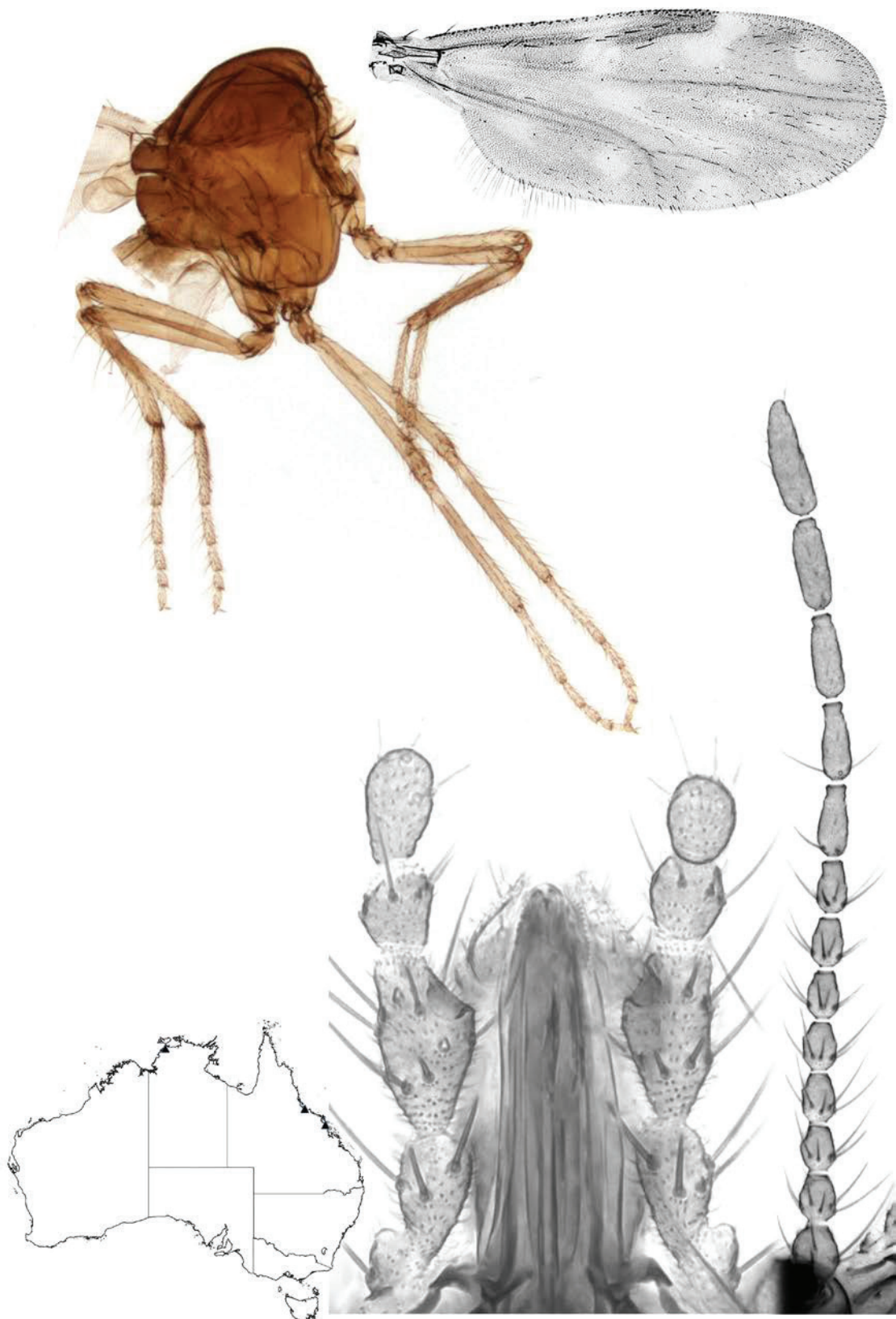


C. Ornatus Gp sp no 9

Culicoides Ornatus Group sp no 10

Culicoides Ornatus Gp sp no 10 Dyce et al 2007:54

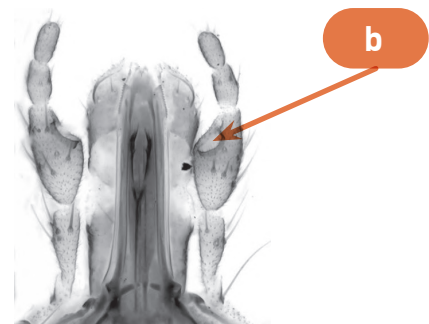
Synonyms	Possibly synonymous with the species reported as <i>Culicoides Ornatus Gp sp no 9</i> by Shivas et al (2022).
Distribution	Known from Mackay and Townsville, Qld. Specimens from Darwin may also belong to this species.
Hosts	Unknown but unlikely to feed on humans (Shivas et al 2022).
Vector status	Unknown.
Immature habitat	Mangrove forest (Shivas et al 2022).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; cell r_3 with 1 pale spot distal to poststigmatic, not reaching wing margin; proboscis and palpus short, not reaching 5th or 6th antennal flagellar segment respectively.



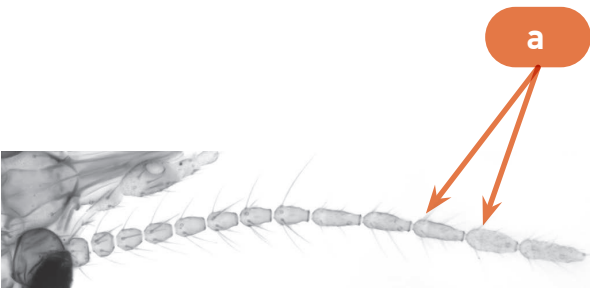
C. Ornatus Gp sp no 10

Key to female specimens of Australian species of the Purus Group

1	Palpal pit elongate, teardrop shaped or ovoid (a);	<i>C. purus</i>
	Palpal pit circular (b)	2



2	Flagellomeres 11 and 12 without SCH (a)	<i>C. queenslandae</i>
	Flagellomeres 11 and 12 with SCH (b)	<i>C. capricorniae</i>



Culicoides Purus Group

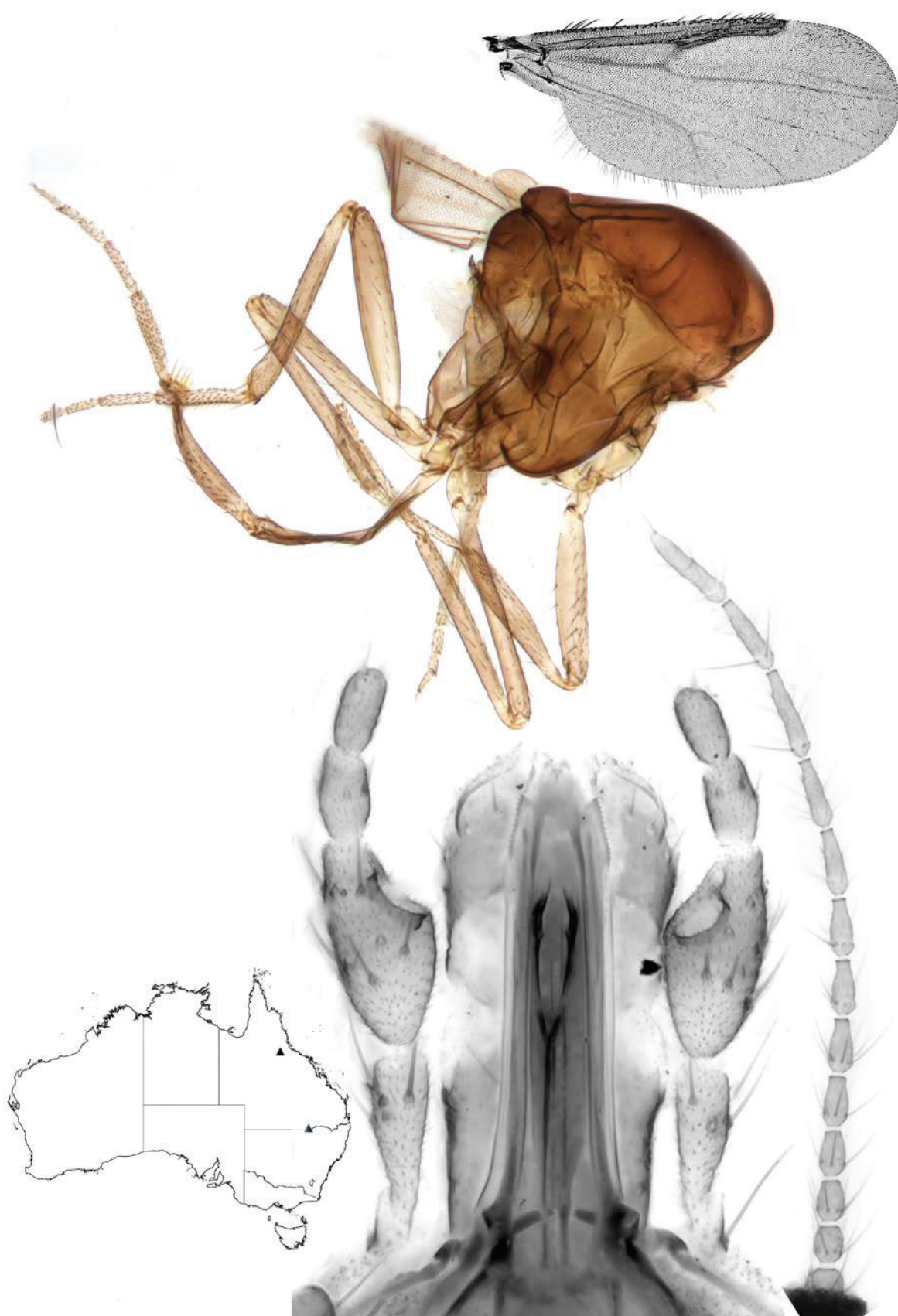
Culicoides Purus Gp Dyce & Wirth 1997:576

Nominate species	<i>Culicoides purus</i> Lee and Reye, 1963: 352. (NSW).
Synonyms	Nil.
Distribution	Eastern Australia, New Guinea and eastern Indonesia.
Number of species worldwide	6.
Number of species in Australia	4, 1 of which is only known as a male.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Tree holes.
Diagnosis	Female specimens can be distinguished from all other subgeneric groups present in Australia by the following suite of characters: Wing without pale markings poststigmatic or over r-m cross-vein. Basal antennal flagellomeres 4-7 vase shaped, narrowed subapically, at least twice as long as wide. Tibial comb with 4 spines.

Culicoides capricorniae

Culicoides capricornae Dyce & Wirth 1997: 586

Synonyms	Nil.
Distribution	Known only from 2 localities in inland Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing without marking over r-m cross-vein. Legs unbanded; tibial comb with 4 spines. Antennal flagellar segments 4-7 vasiform more than twice as long as wide with subapical constriction. SCh present on flagellomeres 11 and 12; SCo absent from flagellomeres 3 and 4. Palpal pit circular.



C. capricorniae

Culicoides purus

Culicoides purus Lee & Reye 1963: 352 (NSW)

Synonyms	Nil.
Distribution	Widespread but uncommon in NSW, Qld and northern NT.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Tree holes (Lee & Reye 1963; Kettle & Elson 1980).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing without pale marking over r-m cross-vein. Legs unbanded; tibial comb with 4 spines. Antennal flagellar segments 4-7 vasiform more than twice as long as wide with subapical constriction; SCo present on flagellomeres 3 and 4. Palpal pit elongate.

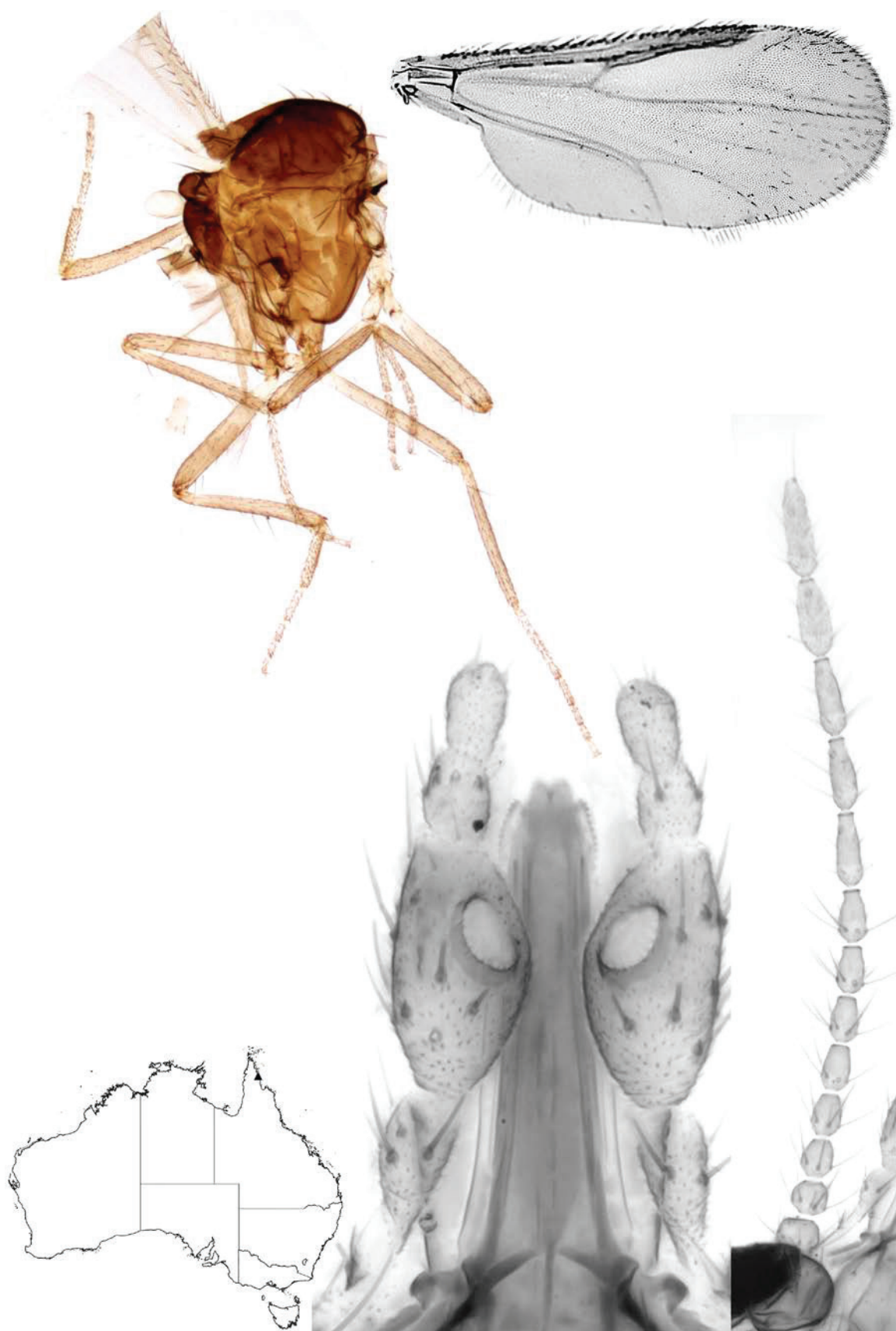


C. purus

Culicoides queenslandae

Culicoides queenslandae Dyce & Wirth 1997: 589 (Qld)

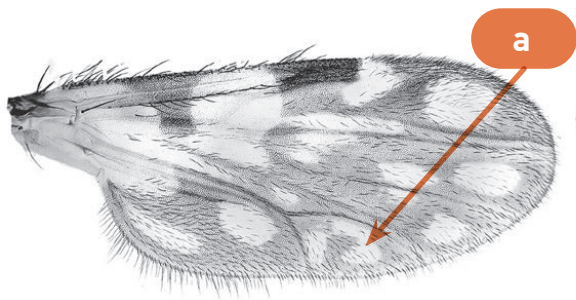
Synonyms	Nil.
Distribution	Known only from Iron Range in northern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing without pale marking over r-m cross-vein. Legs unbanded; tibial comb with 4 spines. Antennal flagellar segments 4-7 vasiform more than twice as long as wide with slight subapical constriction; SCh absent from flagellomeres 11 and 12.



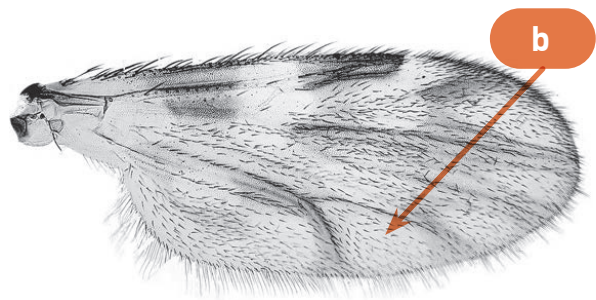
C. queenslandae

Key to females of species in the Shermani group

1	Cell m_4 with C-shaped pale spot (a)	<i>C. rabauli</i>
	Cell m_4 with simple, rounded pale spot (b)	2

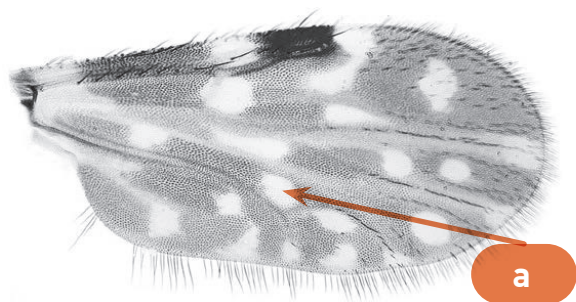


C. rabauli

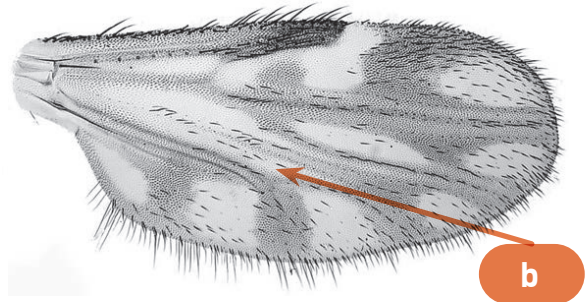


C. mackerassi

2	Small rounded pale spot immediately anterior to fork of M-Cu vein (a)	3
	No rounded pale spot immediately anterior to fork of M-Cu vein (b)	4



C. ardleyi



C. Shermani Gp sp no 1

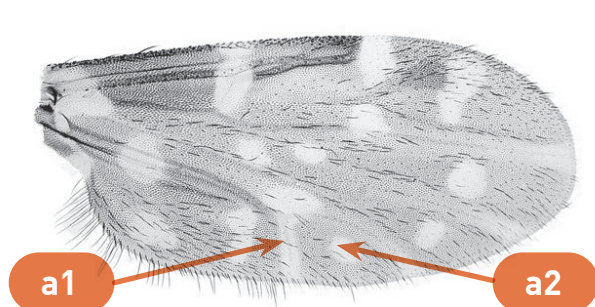
3

Vein CuA entirely included in pale marking (a1); Cell m_4 with single pale spot (a2)

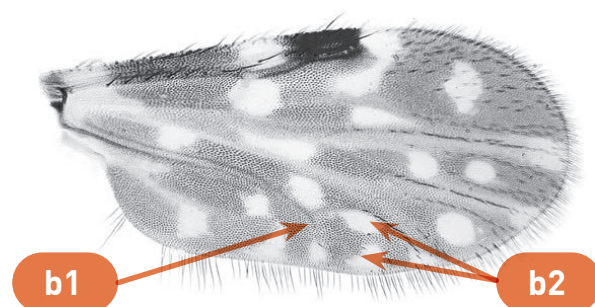
C. interrogatus

Vein CuA with pale marking at apex (b1); Cell m_4 with 2 pale spots (b2)

C. ardleyi



C. interrogatus



C. ardleyi

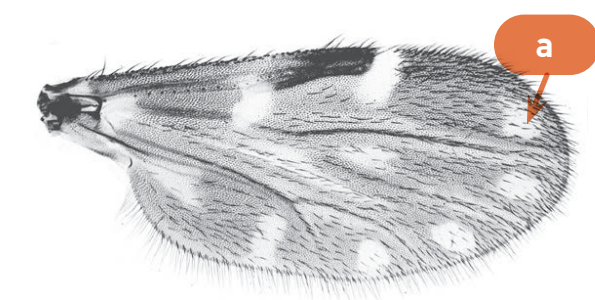
4

(2) Wing with at least one distinct pale spot in cell r_3 apical to post stigmatic spot (a)

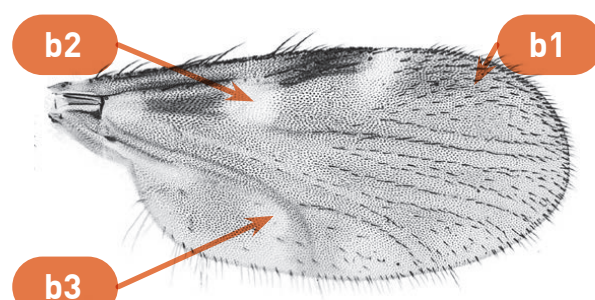
5

Wing pattern weak or absent, pale spots may be present over r-m cross-vein (b2), in posterior of wing (b3) or post stigmatic (b4) but not apical to post stigmatic spot in cell r_3 (b1)

8



C. shermani



C. moreensis

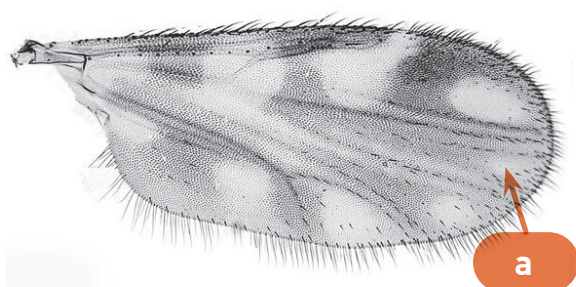
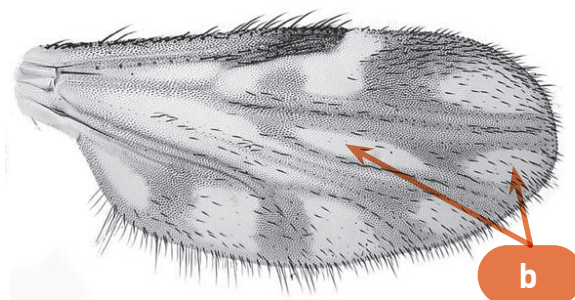
5

Cell m_1 with single pale spot, at wing margin (a)

Shermani Gp sp no 2

Cell m_1 with two pale spots (b)

6

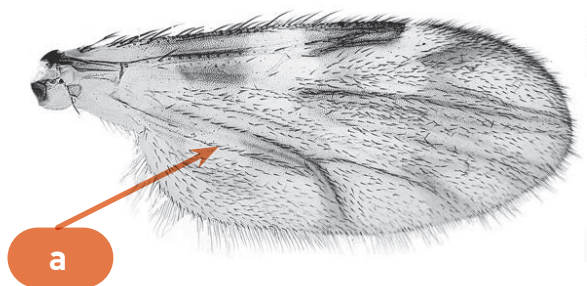
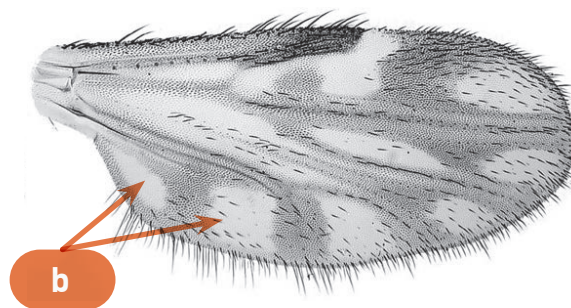
*C. Shermani* Gp sp no 2*C. Shermani* Gp sp no 1

6

Anal cell with subbasal pale marking touching vein M-Cu (a)

*C. mackerassi*Anal cell with basal and apical pale markings only, neither of which touch vein M_1 (b)

7

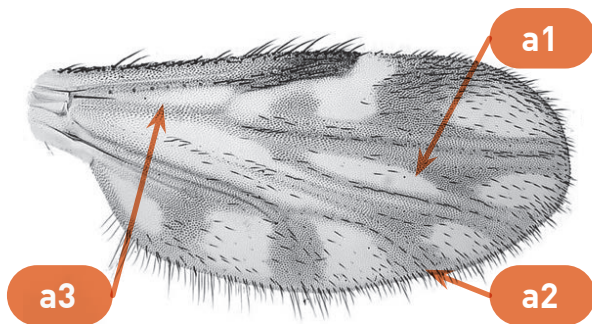
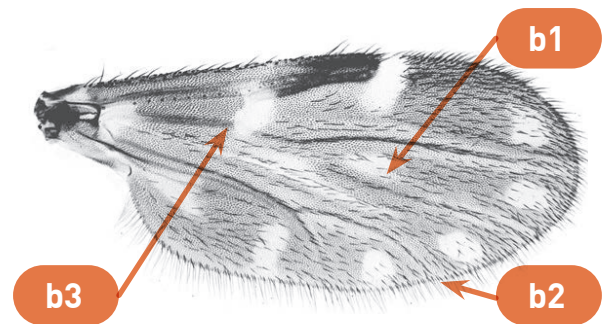
*C. mackerassi**C. Shermani* Gp sp no 1

7

Basal pale marking in cell m_1 elongate (a1), extending to level of apex of vein M_{3+4} (a2); pale marking over r-m cross-vein elongate, extending towards base of wing (a3)

Shermani Gp sp no 1

Basal pale marking in cell m_1 ovoid (b1), not extending to level of apex of vein M_{3+4} (b2); pale marking over r-m cross-vein transverse or rounded, not extending towards base of wing (b3)

C. shermani*C. Shermani* Gp sp no 1*C. shermani*

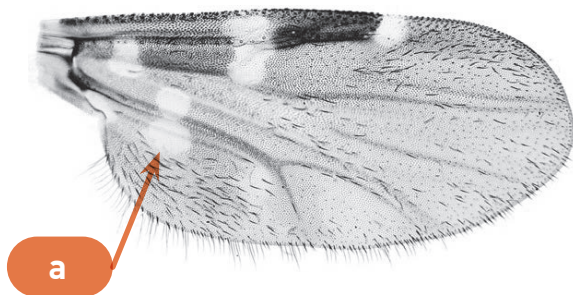
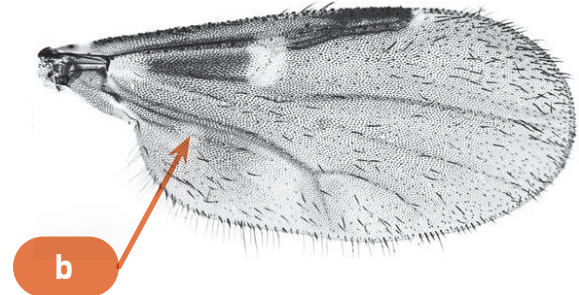
8

(4) Pale marking over medial part of vein M-Cu extending into cell m_2 (a)

C. dryadeus

Pale marking over medial part of vein M-Cu absent or not extending into cell m_2 (b)

9

*C. dryadeus**C. neomelanesiae*

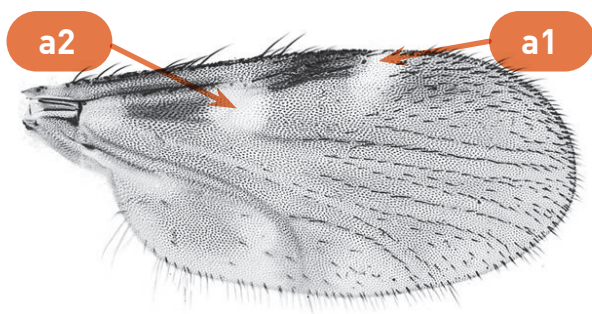
9

Poststigmatic pale spot (a1) prominent, almost as large as pale spot over r-m cross-vein (a2)

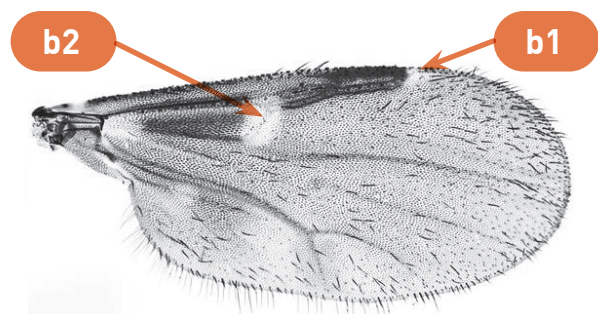
C. moreensis

Poststigmatic pale spot (b1) inconspicuous, less than half size of pale spot over r-m cross-vein (b2)

C. neomelanesiae



C. moreensis



C. neomelanesiae

Culicoides Shermani Group

Culicoides Shermani Gp Wirth & Hubert 1989:335

Nominate species	<i>Culicoides shermani</i> Causey, 1938: 404.
Synonyms	Nil.
Distribution	Australia, New Guinea, widespread in Asia and in Africa where it is known as the Neavei Group.
Number of species worldwide	Borkent & Dominiak (2020) list 22 species in the Shermani Group and 9 in the Neavei Group.
Number of species in Australia	Ten.
Hosts	Largely unknown. One species is known to feed on sheep.
Vector status	Unknown.
Immature habitat	Tree holes or limb crotches.
Diagnosis	A very diverse group with no strong female characters to group all species together while separating them from all other groups. Female specimens can be distinguished from most other subgeneric groups present in Australia by the following suite of characters: Wing with cell r_2 dark to apex; pale spots distinct in most species. SCh present on distal 5 flagellomeres.

Culicoides ardleyi

Culicoides ardleyi Tokunaga 1962: 474 (PNG)

Synonyms	Nil.
Distribution	Eastern Qld and NSW.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Apex of vein CuA covered by small rounded pale spot; 2 pale spots present in cell m ₄ .

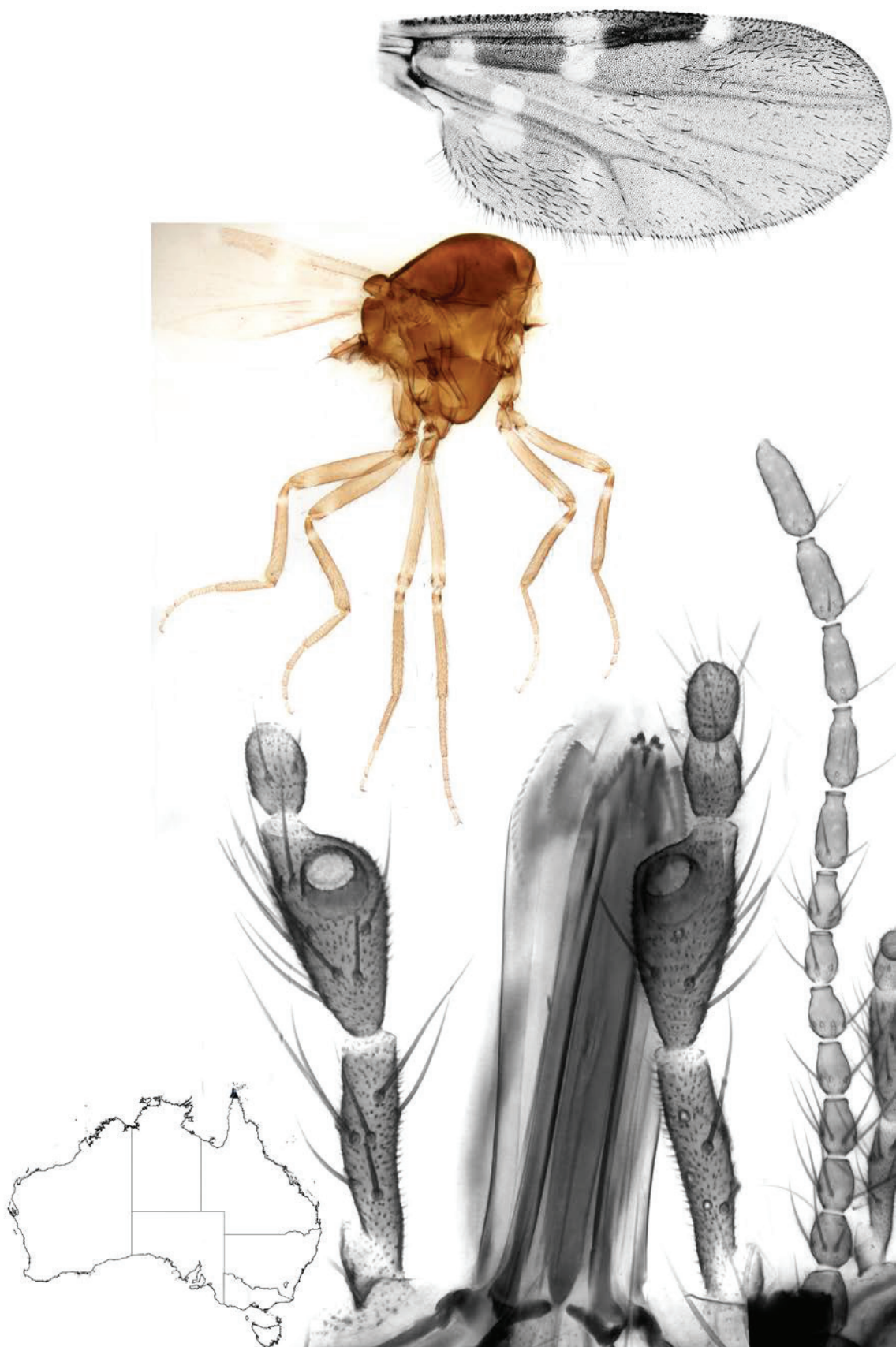


C. ardleyi

Culicoides dryadeus

Culicoides dryadeus Wirth & Hubert 1972: 41 (Malaysia)

Synonyms	Nil.
Distribution	Northern tip of Cape York Peninsula. PNG, widespread in SE Asia.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cells r_3 , m_1 , m_2 and m_4 without pale markings; prominent pale marking over medial section of vein M-Cu.

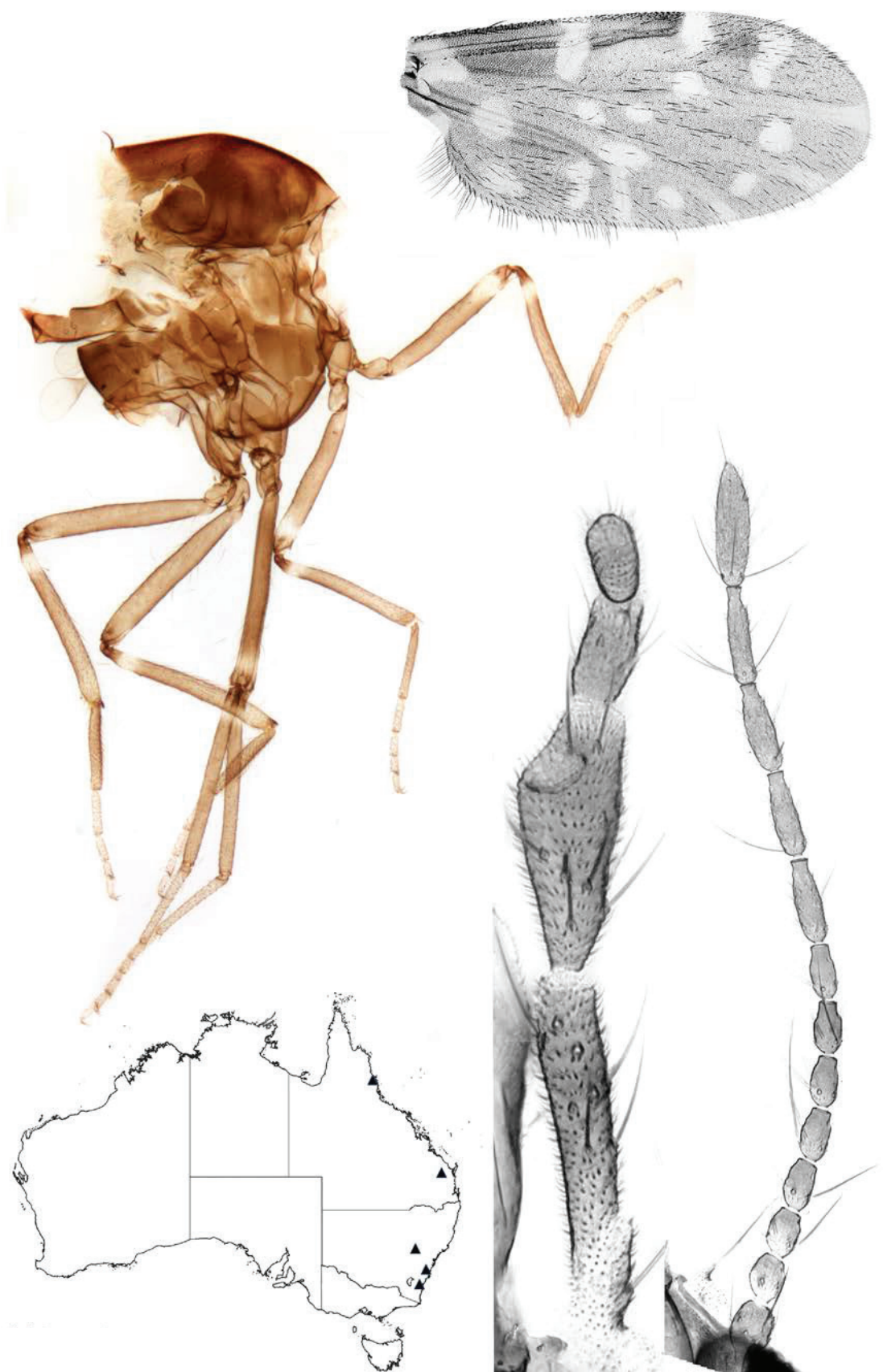


C. dryadeus

Culicoides interrogatus

Culicoides interrogatus Lee & Reye 1963: 358 (NSW)

Synonyms	Nil.
Distribution	Widespread but uncommon in Qld and NSW.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Wet tree flux (Kettle & Elson 1975).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with vein M-Cu almost entirely covered by an elongate pale marking; small, round pale spot covering vein M ₁ immediately posterior to poststigmatic pale spot.

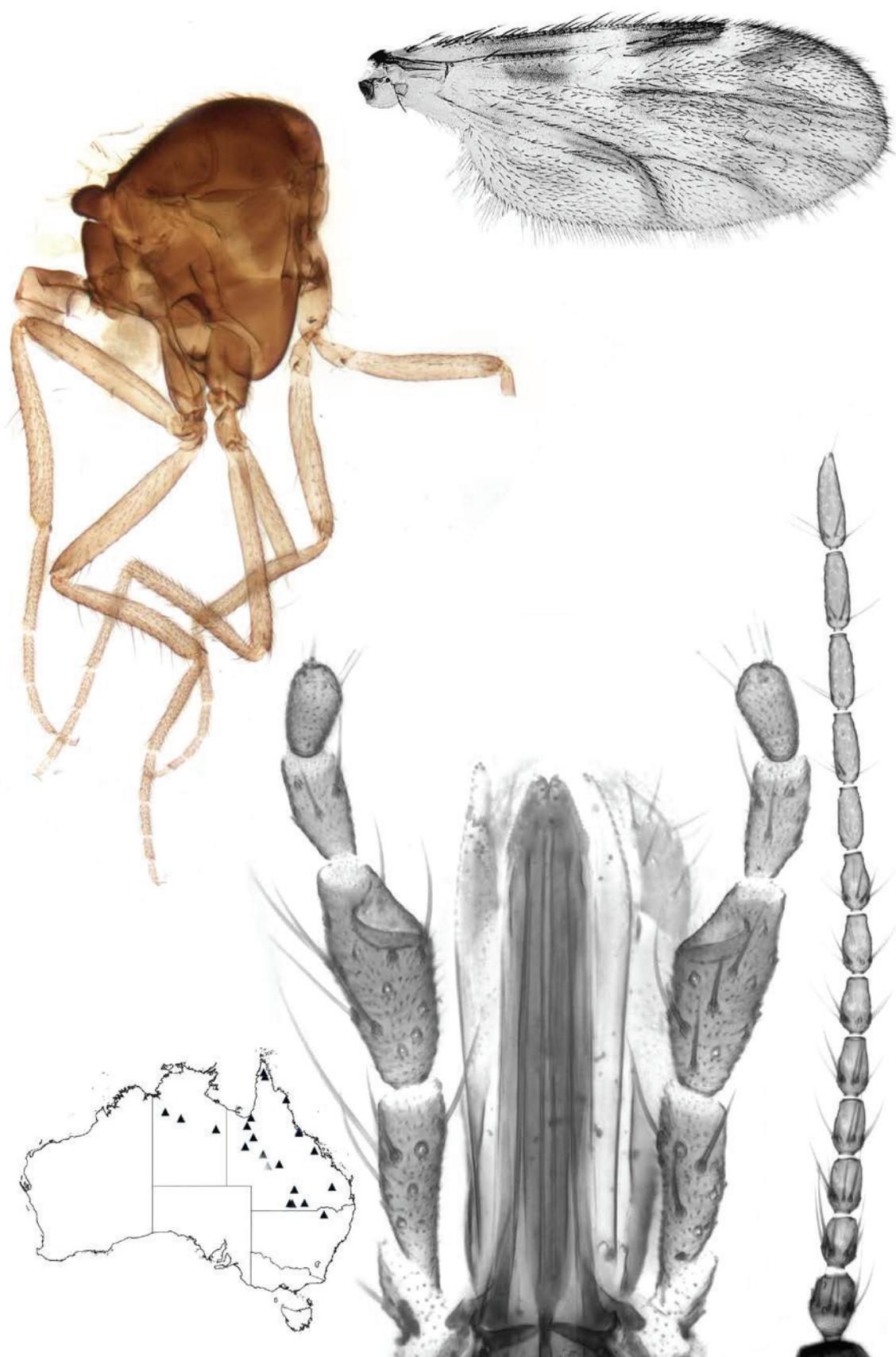


C. interrogatus

Culicoides mackerassi

Culicoides mackerrasi Lee & Reye 1963: 355 (NSW)

Synonyms	Nil.
Distribution	Inland NT, widespread but uncommon in Qld and northern NSW.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Tree holes (Dyce & Murray 1967).
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; pale marking centred over r-m cross-vein; basal pale spot in cell m_1 crossing vein M_2 to merge with pale spot in cell m_2 ; dark subapical marking in cell r_3 oblique and usually darker than most other dark spots on the wing; wing blade often covered in dense macrotrichea (hairs). Fore tibia dark to base.

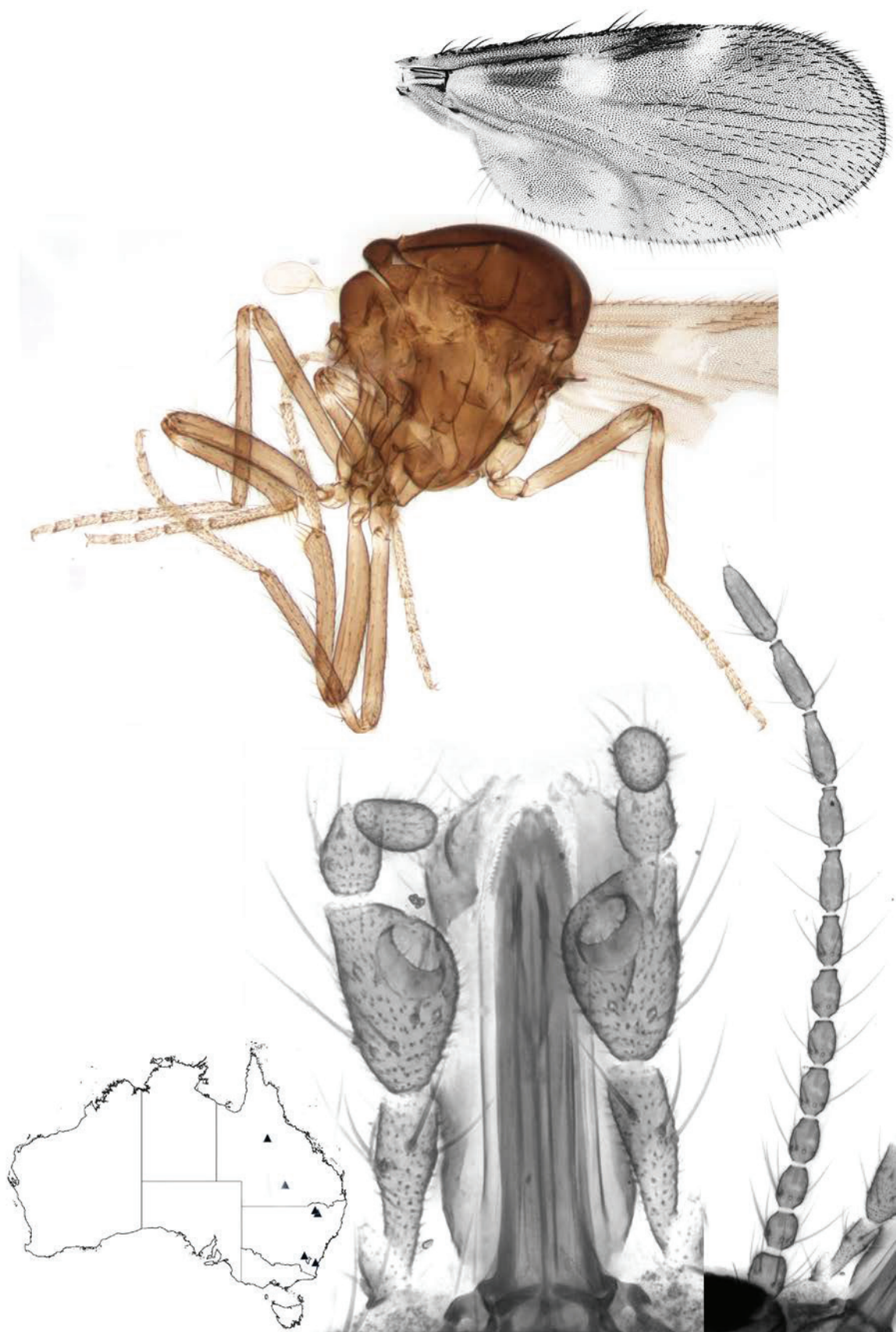


C. mackerassi

Culicoides moreensis

Culicoides moreensis Lee & Reye 1955: 239 (NSW)

Synonyms	Nil.
Distribution	Widespread but uncommon in Qld and NSW.
Hosts	Sheep (Muller & Murray 1977).
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; apical pale spot in cell r_3 absent; poststigmatic pale spot of similar size to pale spot over r-m cross-vein. 3rd palpal segment with distinct rounded pit. 3-5 SCh present on all 5 distal flagellomeres.

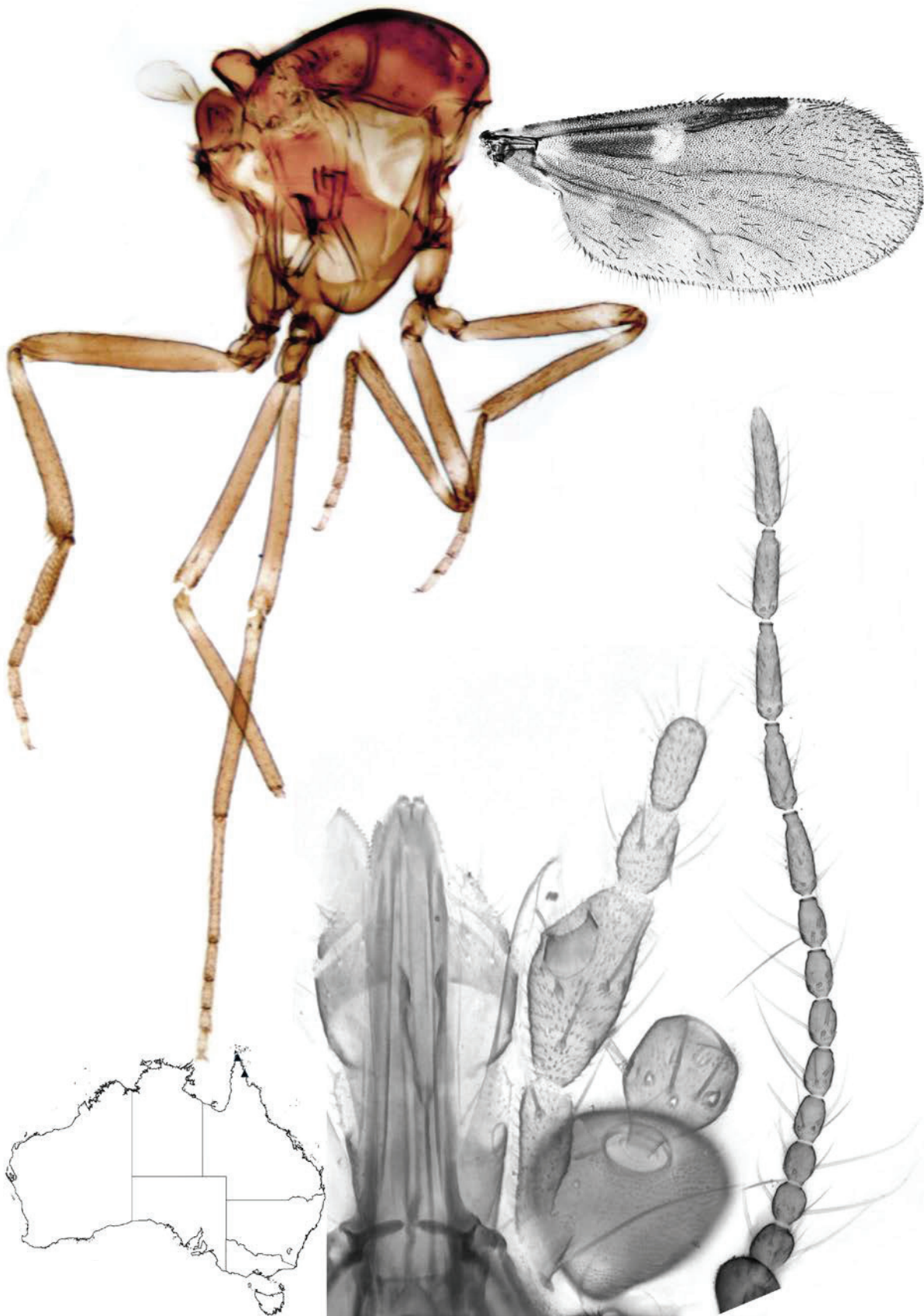


C. moreensis

Culicoides neomelanesiae

Culicoides neomelanesiae Tokunaga 1963: 123 (PNG)

Synonyms	Nil.
Distribution	Northern tip of Cape York Peninsula, Torres Strait and Papua New Guinea.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; apical pale spot in cell r_3 absent; poststigmatic pale spot distinctly smaller and less conspicuous than pale spot over r-m cross-vein. 3rd palpal segment with distinct rounded pit. 3-5 SCh present on all 5 distal flagellomeres.



C. neomelanesiae

Culicoides rabauli

Culicoides rabauli Macfie 1939: 367 (PNG)

Synonyms	<i>angularis</i> Lee & Reye 1953: 384
Distribution	SE South Australia, Victoria, eastern NSW and Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Tree holes and rock pools (Lee & Reye 1953; Dyce & Murray 1966; Kettle & Elson 1976).
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Wing with c-shaped pale marking in cell m_4 ; apical pale marking in cell r_3 not closer than its own diameter to apex of cell.

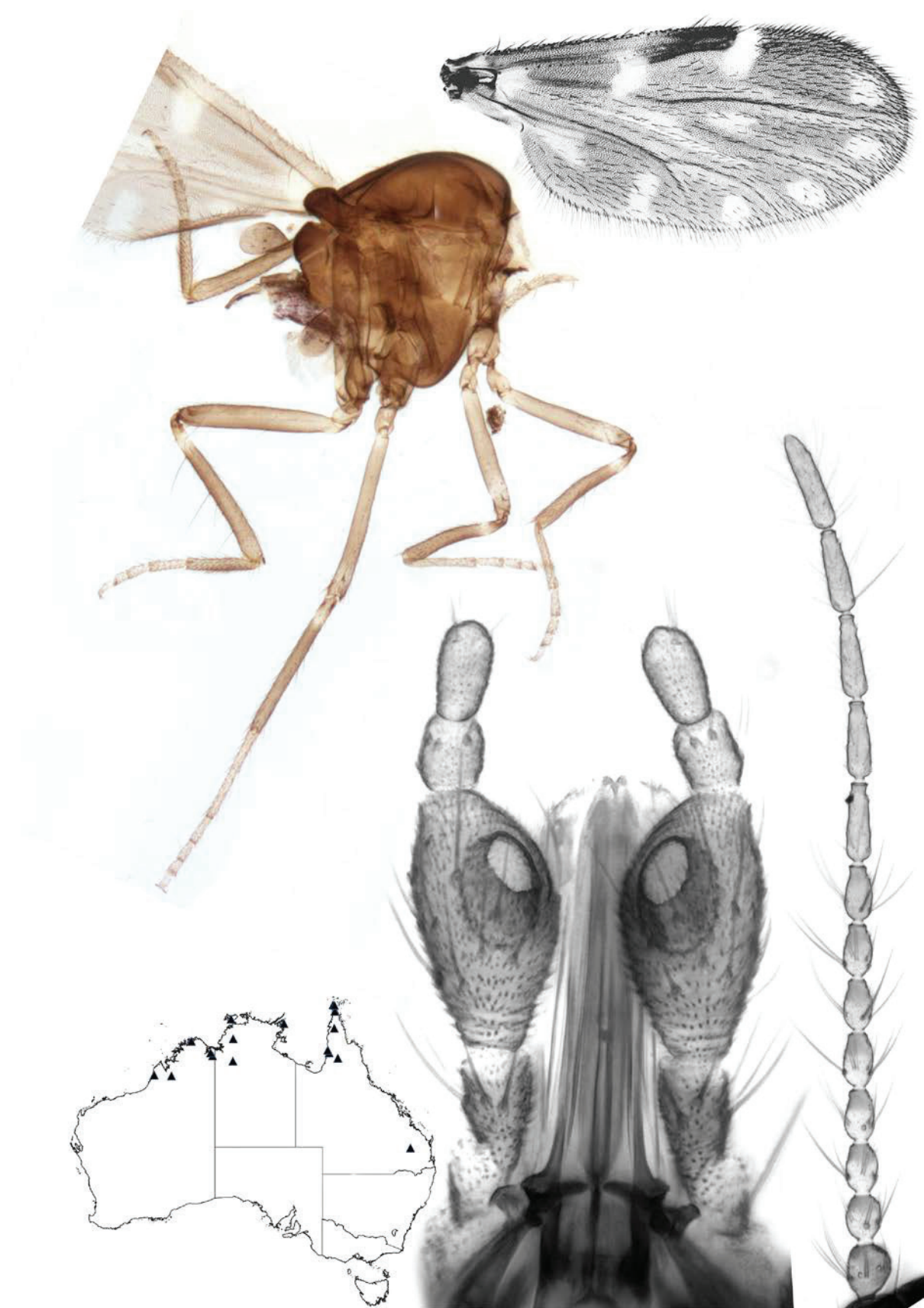


C. rabauli

Culicoides shermani

Culicoides shermani Causey 1938: 404 (Thailand)

Synonyms	Nil.
Distribution	Uncommon in northern WA, NT and Qld. Records from southern Qld require confirmation. Widespread in southern Asia, west to the Middle East.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Tree holes (Dyce unpublished).
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Wing with apical pale spot in cell r_3 compact, round or ovoid, and located near apex of cell; cell r_3 with 1 pale spot in addition to poststigmatic; compact pale spot between front of M-Cu fork and M_2 crease absent. Mid tibia with subbasal pale band.

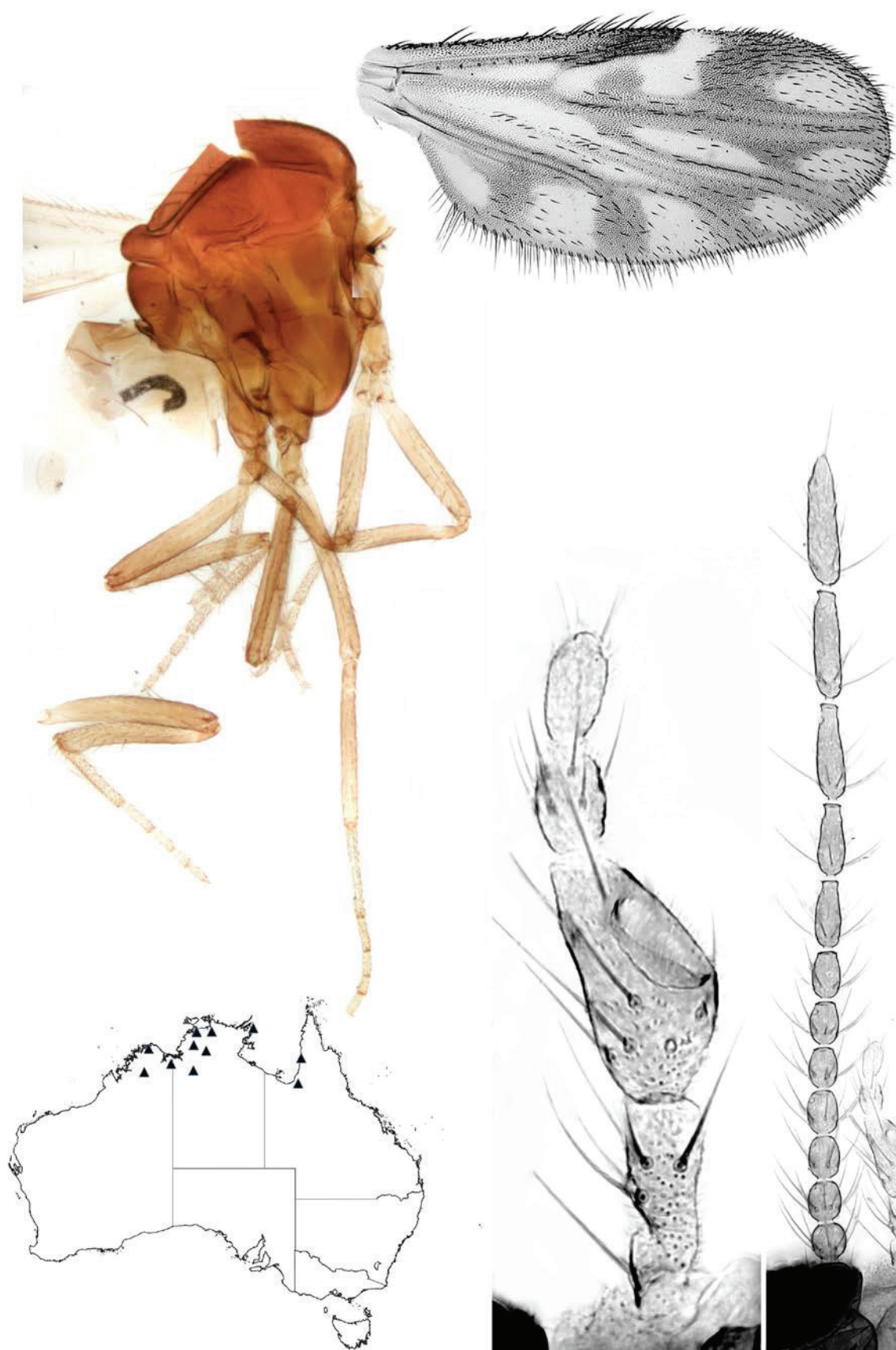


C. shermani

Culicoides Shermani Group sp no 1

Culicoides Shermani Gp sp no 1 (Dyce et al 2007:57)

Synonyms	Nil.
Distribution	Northern Qld, NT and WA.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Tree holes (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; apical pale spot in cell r_3 not centred near apex of cell, at most 1.5 times its own length from cell r_2 ; basal pale marking in anal cell not crossing vein M-Cu subbasally to join with basal pale marking in cell m_2 ; pale spot over r-m cross-vein elongate and extending towards base of wing. Fore femora unbanded.

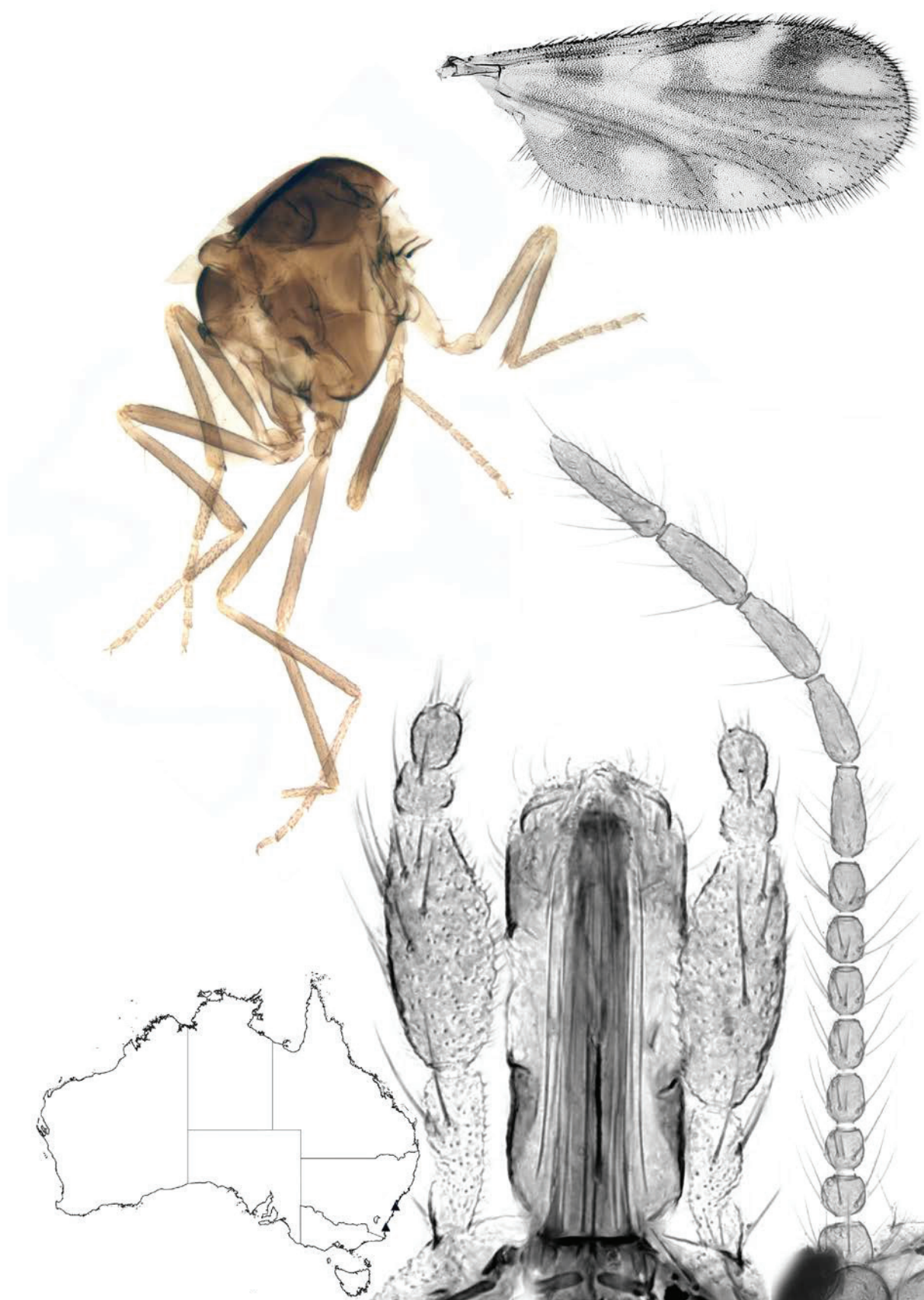


C. Shermani Gp sp no 1

Culicoides Shermani Group sp no 2

Culicoides Shermani Gp sp no 2 (Dyce et al 2007:57)

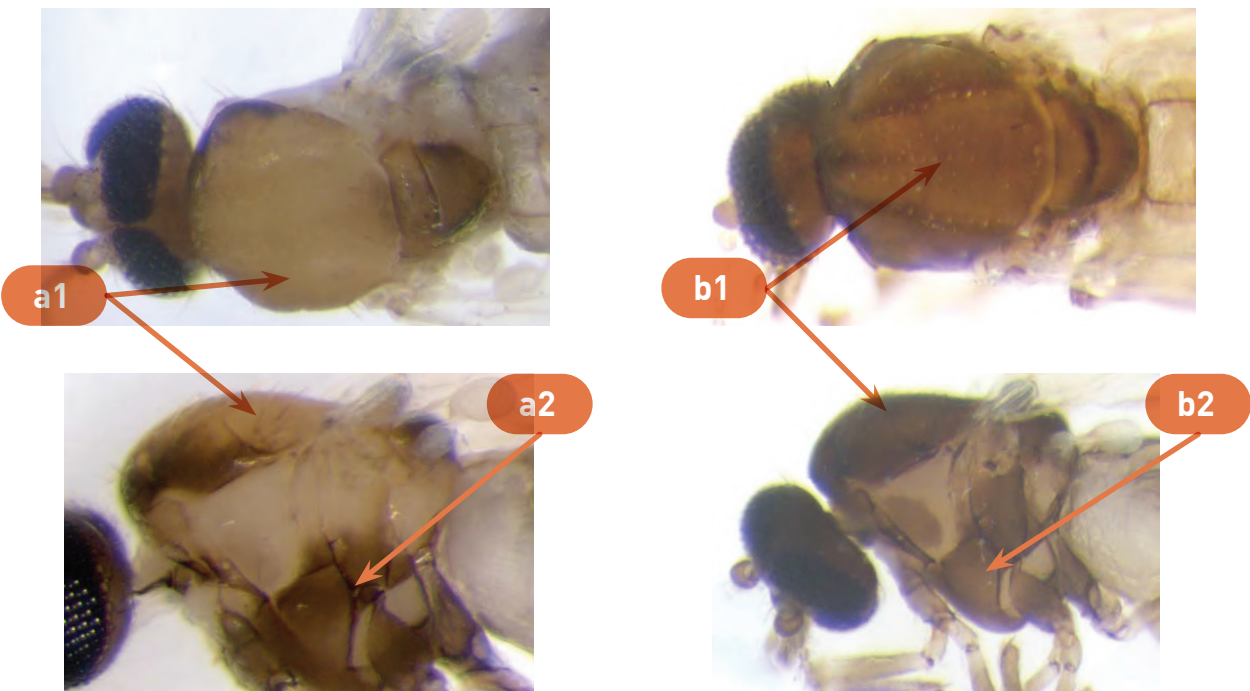
Synonyms	Nil.
Distribution	Known from southern coastal NSW.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; cell m_1 with 1 pale spot; poststigmatic pale spot reaching vein M_1 . 3rd palpal segment without pit.



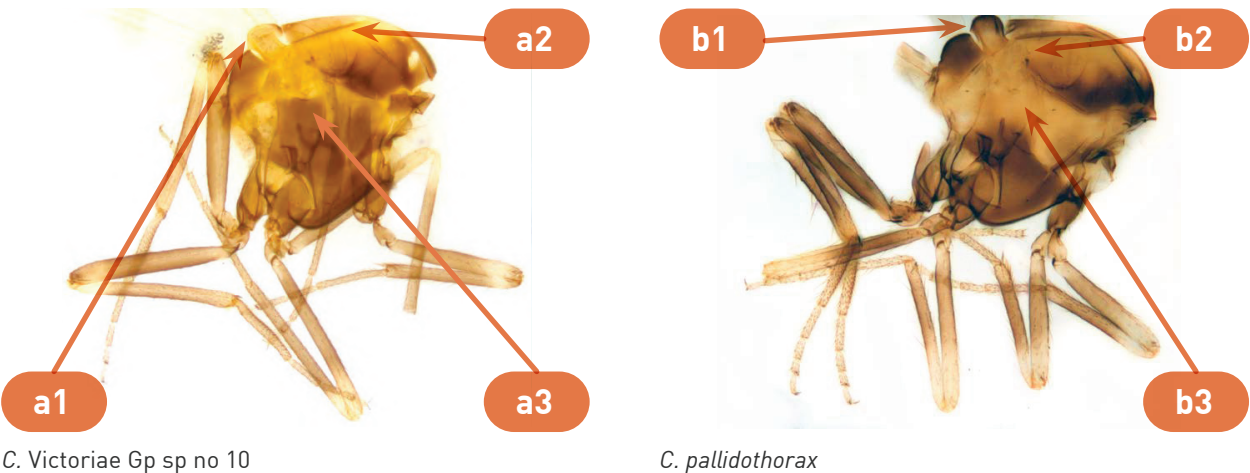
C. Shermani Gp sp no 2

Key to females of Australian species in the Victoriae Group

1	Scutum, excepting anterior and lateral margins, yellow (a1), distinctly paler than lower pleuron (a2) 2
	Scutum brown (b1), not paler than lower pleuron (b2) 3



2	Scutellum (a1) yellow, concolorous with scutum (a2); dorsal half of anepimeron dark (a3) NQld Victoriae Gp sp no 10
	Scutellum (b1) brown, darker than scutum (b2); dorsal half of anepimeron pale (b3) <i>C. pallidothorax</i>



C. Victoriae Gp sp no 10

C. pallidothorax

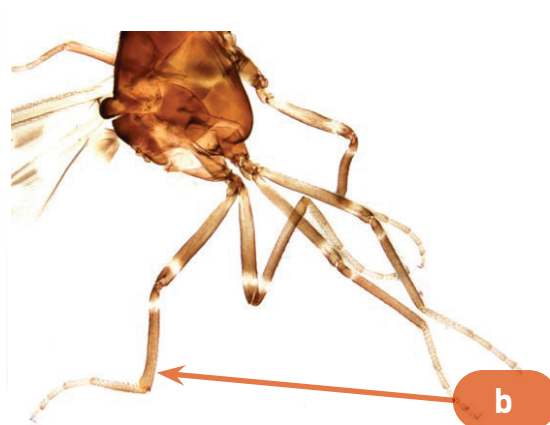
3

Apex of hind tibiae darker than remainder of segment (a)

C. waringi

Apex of hind tibiae concolorous or paler than remainder of segment (b)

4

*C. waringi**C. multimaculatus*

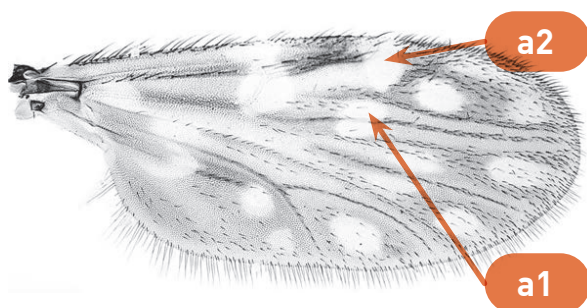
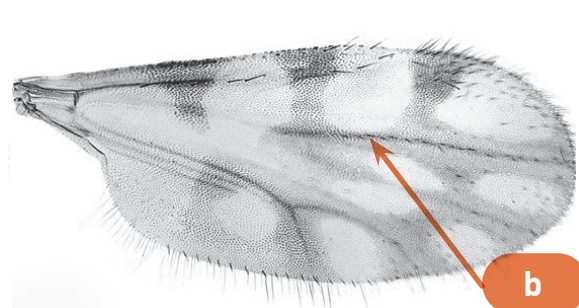
4

Cell r_3 with pale marking (a1) present immediately posterior to poststigmatic pale spot (a2)

5

Cell r_3 without pale marking present immediately posterior to poststigmatic pale spot (b)

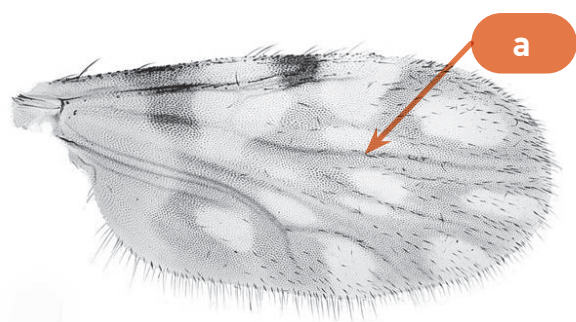
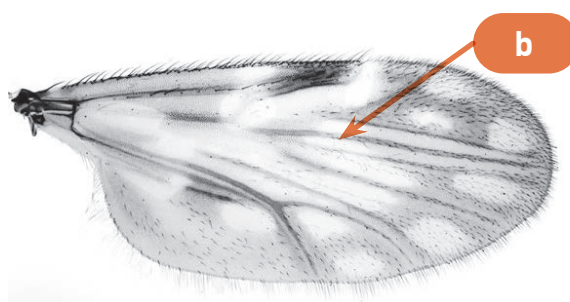
11

*C. mcmillani**C. pallidothorax*

5

Vein M_1 entirely dark (a) NQld*C. Victoriae* Gp sp no 12Subbasal part of vein M_1 included in pale marking (b)

6

*C. Victoriae* Gp sp no 12*C. Victoriae* Gp sp no 14

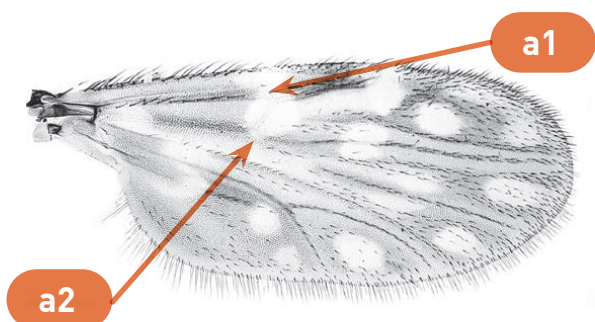
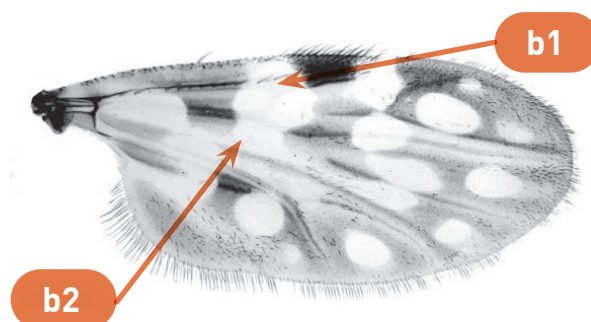
6

Pale spot over r-m cross-vein constricted over vein R_s (a1) and narrowly crossing vein M to barely encroach into cell m_2 (a2)

7

Pale spot over r-m cross-vein not constricted over vein R_s (b1) and broadly crossing vein M to join pale area in base of cell m_2 (b2)

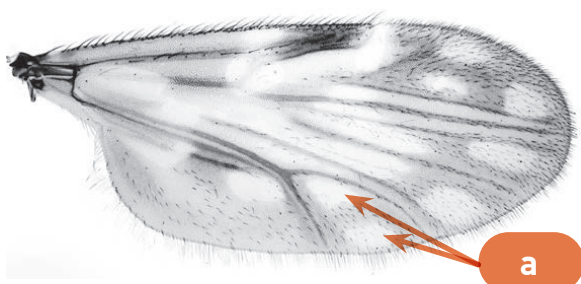
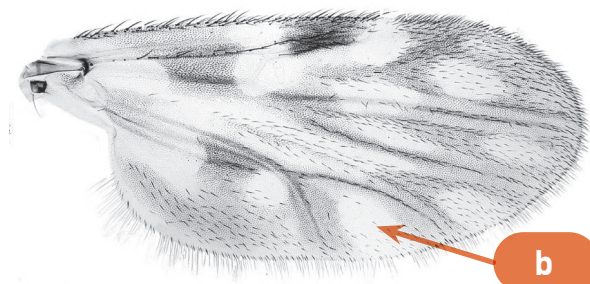
9

*C. mcmillani**C. multimaculatus*

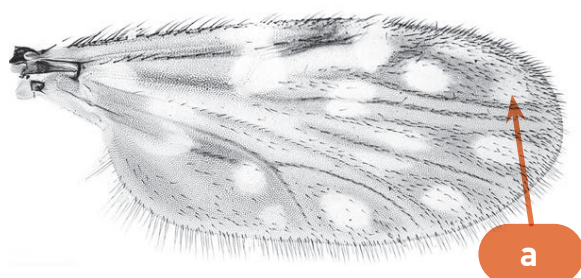
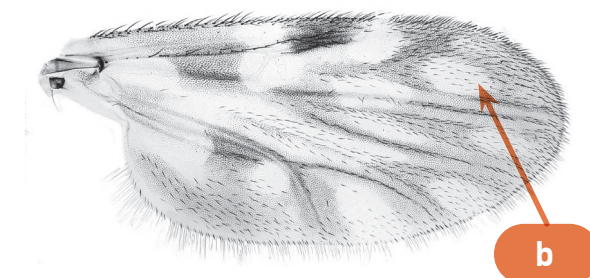
7

Cell m_4 with 2 pale spots (a) inland WA*C. Victoriae* Gp sp no 14Cell m_4 with 1 pale spot (b)

8

*C. Victoriae* Gp sp no 14*C. cuniculus*

8

Apical pale spot in cell r_3 almost reaching apex of cell (a)*C. mcmillani*Apical pale spot in cell r_3 not closer than its own diameter to apex of cell (b)*C. cuniculus**C. mcmillani**C. cuniculus*

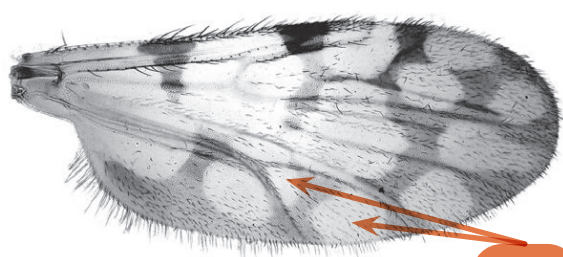
9

[6] Cell m_4 with 2 pale spots (a1), scutellum (a2) paler than scutum (a3)

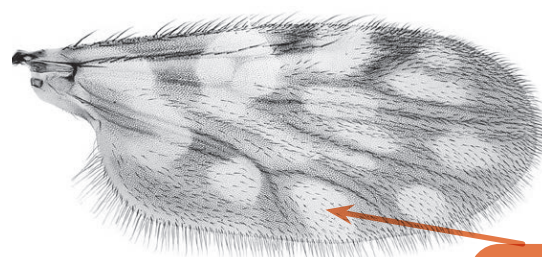
C. Victoriae Gp sp no 15

Cell m_4 with 1 pale spot (b1); scutellum (b2) not paler than scutum (b3)

10

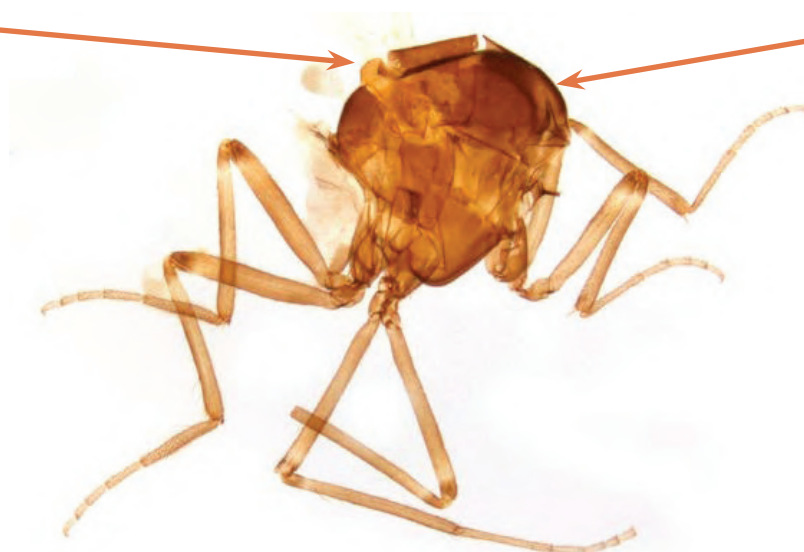


a1



b1

a2



a3

C. Victoriae Gp sp no 15

b4



b3

C. victoriae

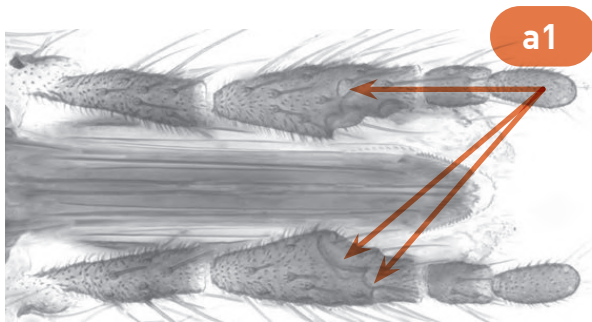
10

Third palpal segment with divided pit (a1); wing cell r_3 with 3 pale spots distal to poststigmatic pale spot (a2) and with dark marking over base of vein M-Cu (a3)

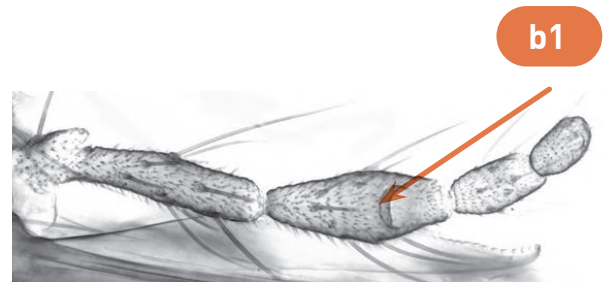
C. multimaculatus

Third palpal segment with single rounded pit (b1); if cell r_3 with 3 pale spots distal to poststigmatic pale spot (a2), then base of vein M-Cu included in pale marking (b2)

C. Victoriae complex



C. multimaculatus



C. multimaculatus



C. Victoriae

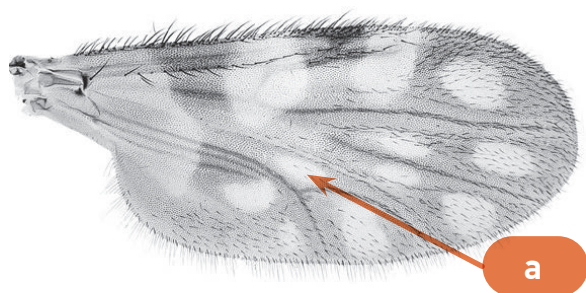
11

[5] Cell m_2 with small ovoid pale spot immediately anterior to M-Cu fork (a)

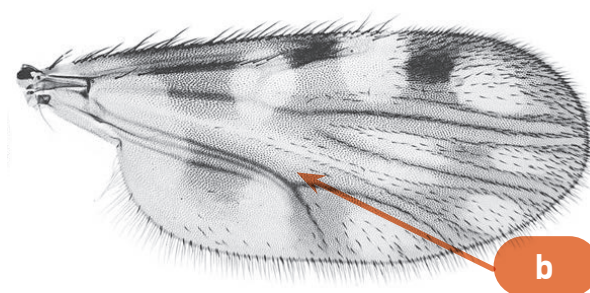
C. henryi

Cell m_2 without small ovoid pale spot immediately anterior to M-Cu fork (b)

12



C. henryi



C. bundyensis

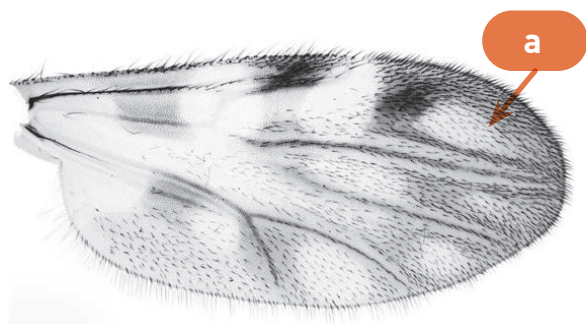
12

Apical pale spot in cell r_3 not reaching wing margin (a)

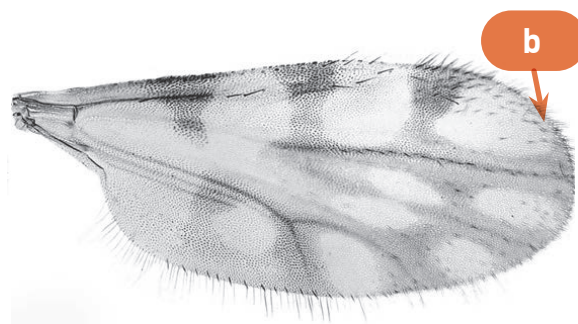
13

Apical pale spot in cell r_3 reaching wing margin (b)

15



C. Victoriae Gp sp no 8



C. Victoriae Gp sp no 6

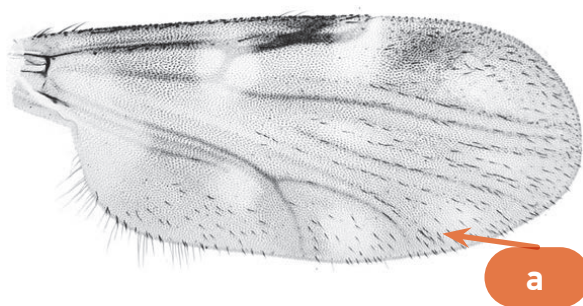
13

Apical pale spot in cell m_2 (a) less distinct than poststigmatic pale spot; SCo absent from flagellomeres 5 and 7

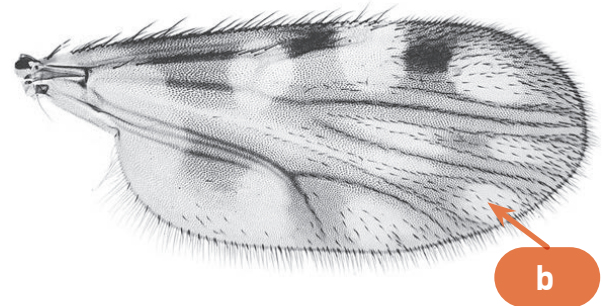
C. Victoriae Gp sp no 2

Apical pale spot in cell m_2 (b) as distinct as poststigmatic pale spot; SCo present on flagellomeres 5 and 7

14



C. Victoriae Gp sp no 2



C. bundyensis

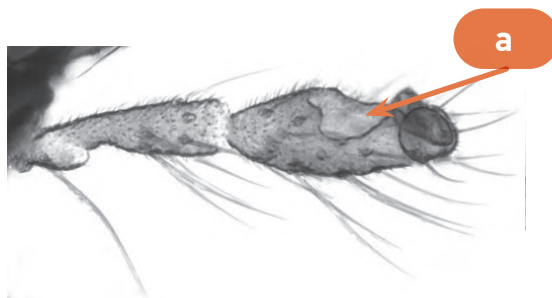
14

SCo present on flagellomere 2; palpal pit large and irregular but with distinct lateral and apical margin (a); large species, wing length greater than 1.5mm; southwestern WA

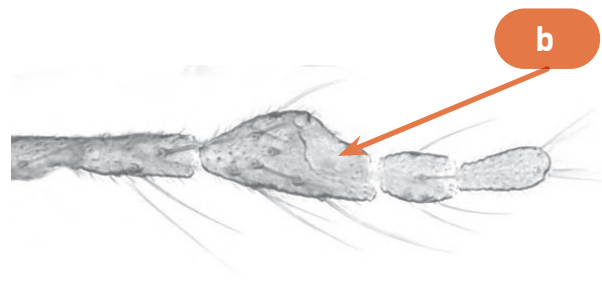
C. Victoriae Gp sp no 8

SCo absent from flagellomere 2; palpal pit with indistinct lateral margin and no apical margin (b); small to medium-sized species, wing length about 1mm

C. Bundyensis complex (pt)



C. Victoriae Gp sp no 8



C. bundyensis

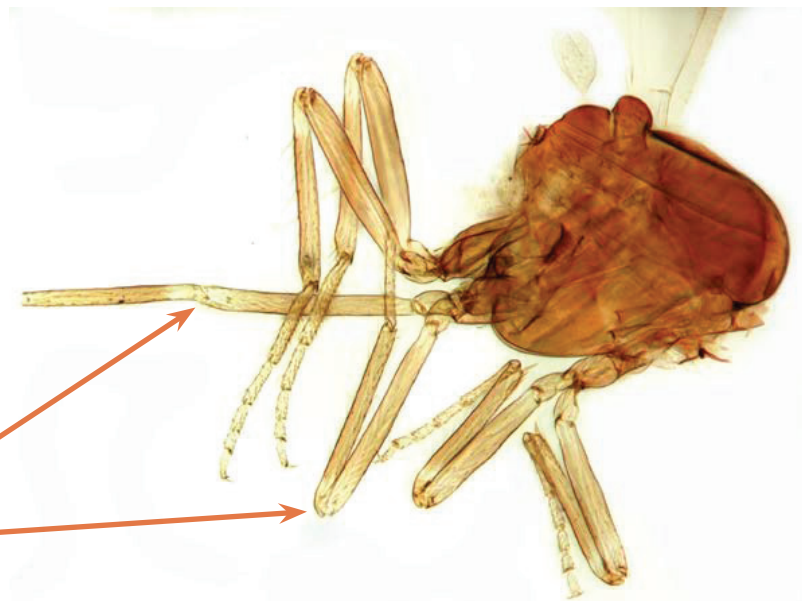
15

[12] Mid knees paler than femora and tibia (a)

16

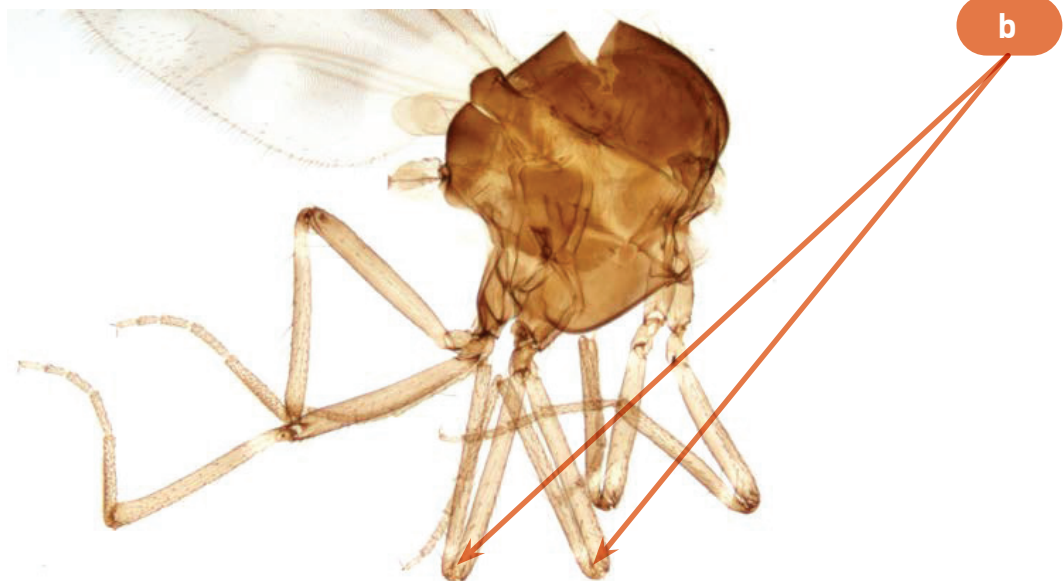
Mid knees as dark as femora and tibia (b)

19



a

C. Victoriae Gp sp no 6



b

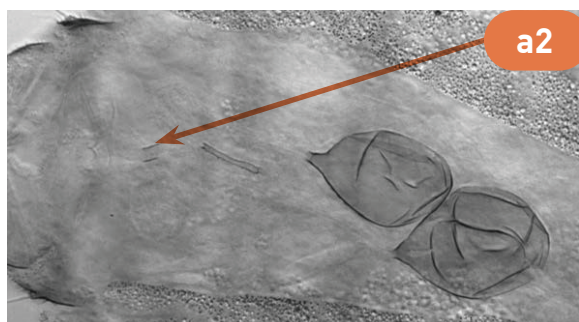
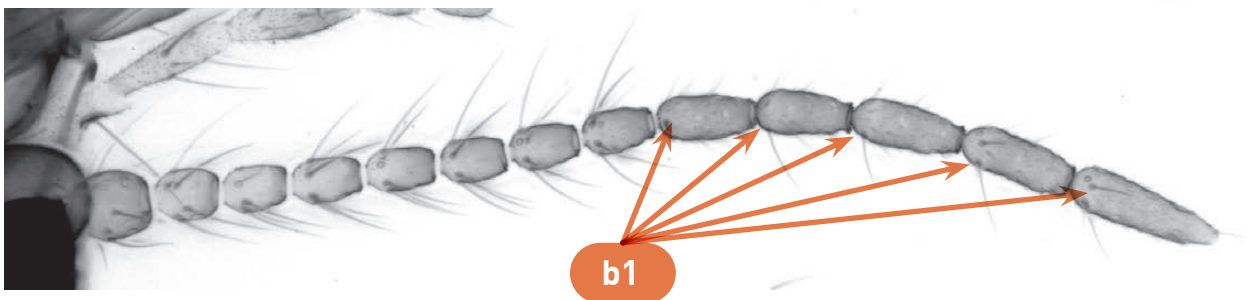
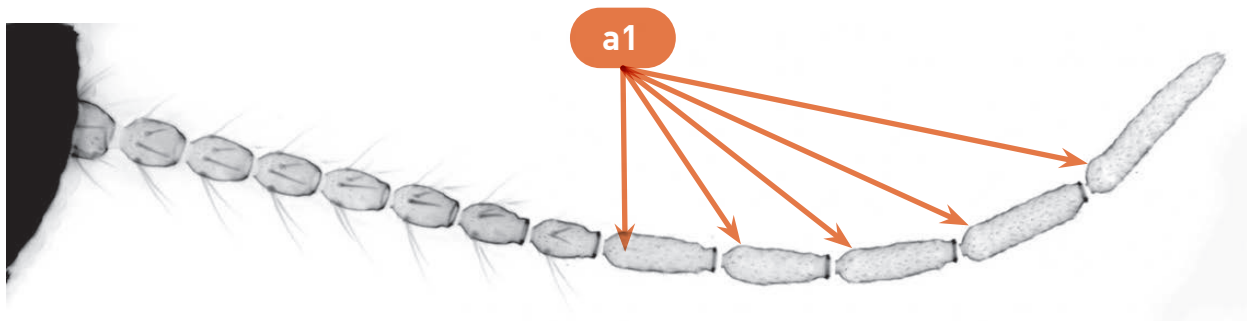
C. bundyensis

16

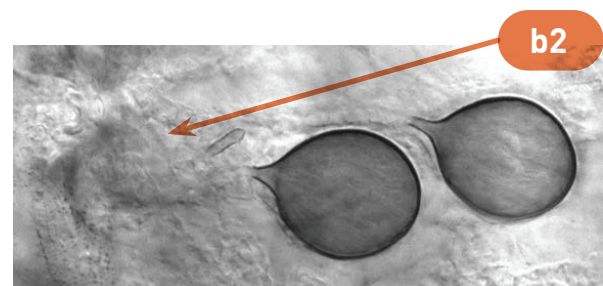
SCh absent from distal 5 flagellar segments (a1); spermathecal duct with sclerotized ring (a2)

17

At least 1 SCh present on some of the distal 5 flagellar segments (b1); spermathecal duct without sclerotized ring (b2)

18

C. Victoriae Gp sp no 3



C. Victoriae Gp sp no 7

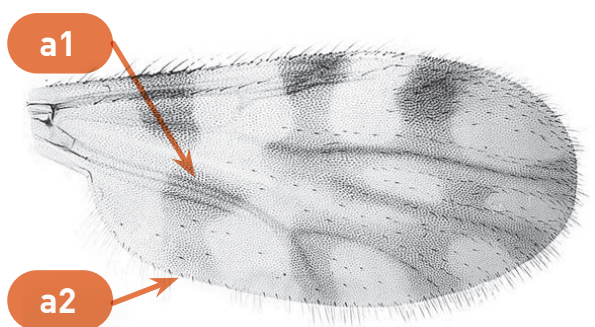
17

Anterior edge of dark marking over M-Cu vein (a1) at least as broad as posterior edge (a2) NQld

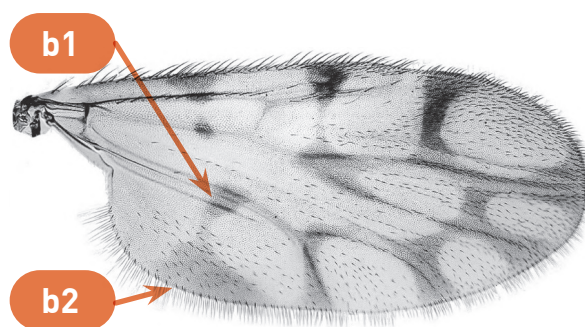
C. Victoriae Gp sp no 3

Anterior edge of dark marking over M-Cu vein (b1) much narrower than posterior edge (b2)

C. fulbrighti (pt)



C. Victoriae Gp sp no 3



C. fulbrighti

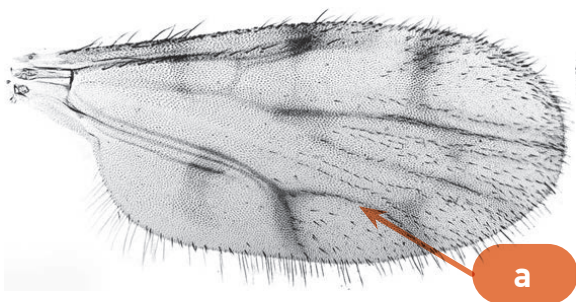
18

(16) Distal pale spot in cell m_4 crossing vein M_{3+4} (a)

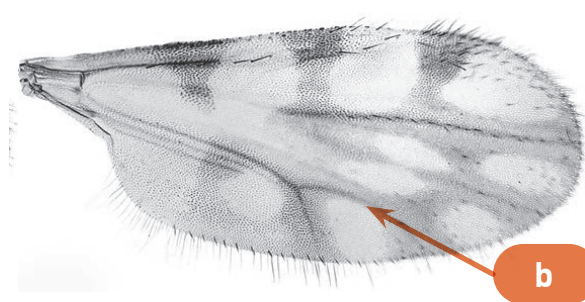
C. Victoriae Gp sp no 7

Distal pale spot in cell m_4 not crossing vein M_{3+4} (b)

C. Victoriae Gp sp no 6



C. Victoriae Gp sp no 7



C. Victoriae Gp sp no 6

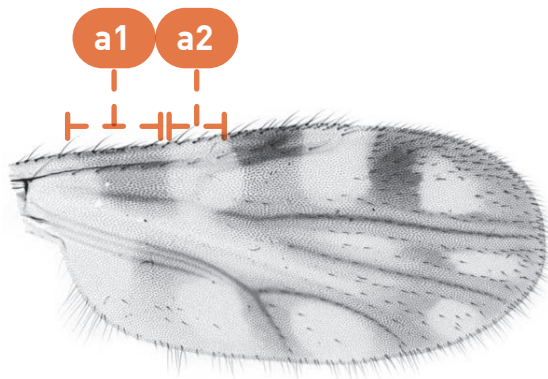
19

(15) Basal dark marking on costa (a1) equal to or greater than width of anterior margin of pale spot over r-m cross-vein (a2)

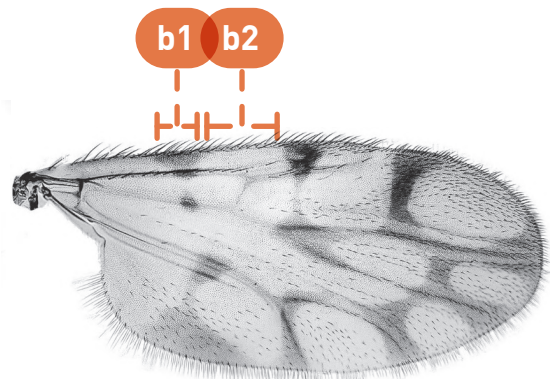
C. bundyensis (pt)

Basal dark marking on costa (b1) less than half width of pale spot over r-m cross-vein (b2)

20



C. bundyensis



C. fulbrighti

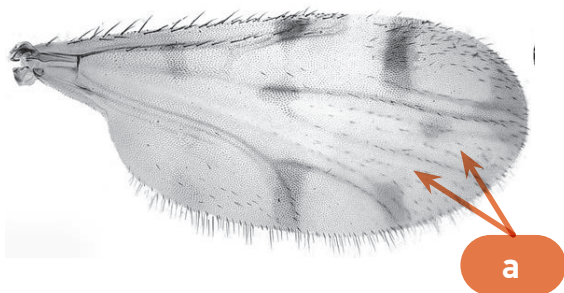
20

Single SCh present on flagellomeres 9-11; apical pale markings in cells m_1 and m_2 fused with subapical markings NQld

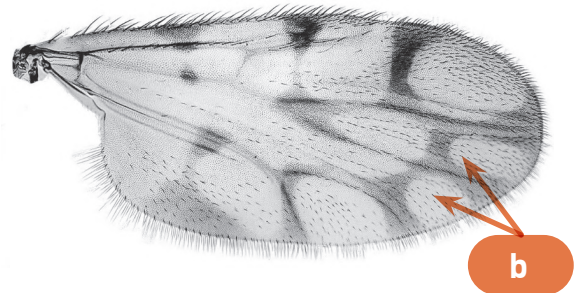
C. Victoriae Gp sp no 5

SCh absent from flagellomeres 9-11; apical pale markings in cells m_1 and m_2 separated from subapical markings

C. fulbrighti (pt)



C. Victoriae Gp sp no 5



C. fulbrighti

Culicoides victoriae Group

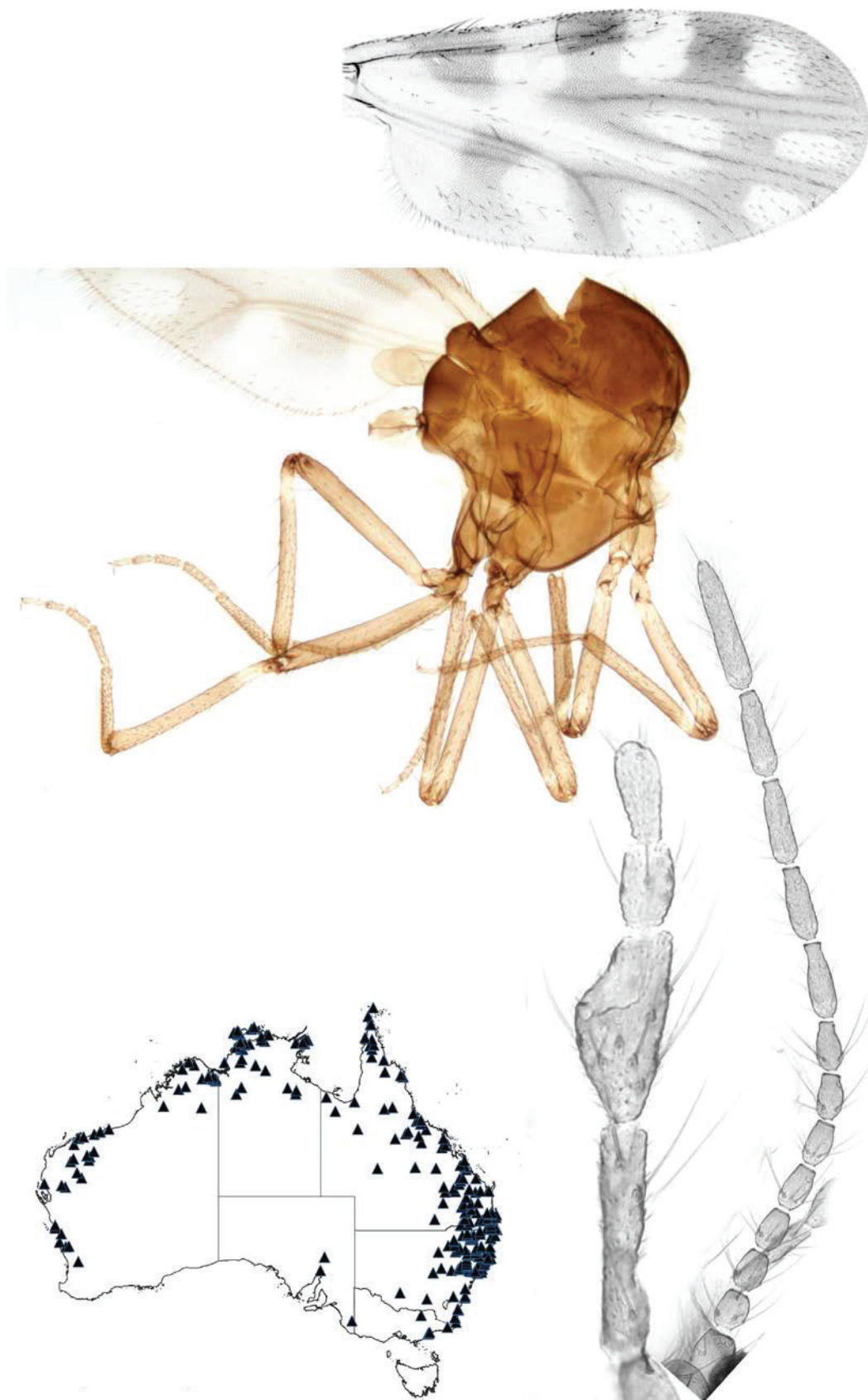
Culicoides Victoriae Gp Dyce unpublished

Nominate species	<i>Culicoides victoriae</i> Macfie 1941:67
Synonyms	Nil.
Distribution	Australia and New Guinea.
Number of species worldwide	Endemic to the Australasian region with 19 described and 15 undescribed species.
Number of species in Australia	19 including 10 undescribed.
Hosts	Where known, mammalian, including large mammals.
Vector status	Mostly unknown. One of the cryptic species of <i>C. bundyensis</i> is believed to be a vector of <i>Onchocerca sweetae</i> (Spratt et al 1978) and Wongorr virus has been isolated from <i>C. pallidothorax</i> (Standfast et al 1984).
Immature habitat	The diversity of this group is reflected in the diversity of immature habitat, ranging from margins of ground water bodies, tidal pools, floating algal mats, <i>Pandanus</i> leaf axils and tree holes (Dyce & Murray 1966; Hagen & Kettle 1990, Dyce & Murray unpublished data).
Diagnosis	This is a diverse and variable group with few female characters that define and separate the group from other groups. The following suite of characters help to define the group: Wing with cell r_2 pale apically; pale spots always distinct and with well defined edges in most species. SCo always present on flagellomeres 9-13; SCh present on distal 5 flagellar segments of most species.

Culicoides bundyensis

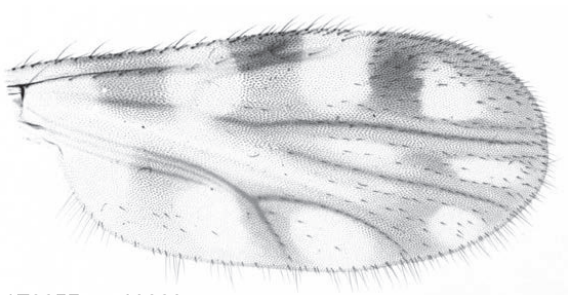
Culicoides bundyensis Lee & Reye 1955: 239 (NSW)

Synonyms	Nil.
Distribution	Widespread and common in all states excepting Tasmania.
Hosts	Sheep, cattle, marsupial, buffalo (Kay 1973; Muller & Murray 1977; Muller et al. 1981).
Vector status	Vector of <i>Onchocerca sweetae</i> , a nematode parasite of water buffalo (Spratt et al 1978).
Immature habitat	Margins of fresh groundwater ponds and small streams (Debenham 1979, Dyce & Murray unpublished data).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 not included in pale marking; vein M-Cu with base covered by pale marking; dark marking apical to poststigmatic pale spot in cell r_3 quadrate due to truncate basal margin of distal pale marking. Mid knee dark.
Notes	Dyce et al (2007) listed several variants of this species. DNA analysis of populations of this species suggests the existence of several potential cryptic species (Gopurenko, unpublished data), so the term C. Bundyensis Complex is preferred when referring to this group.

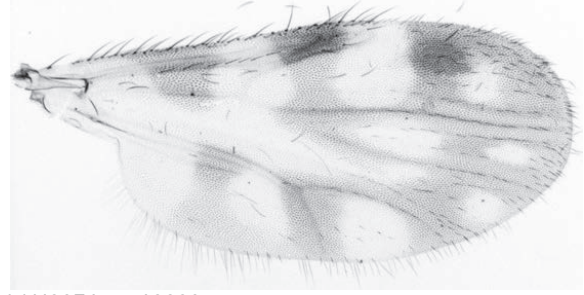


C. Bundyensis Complex

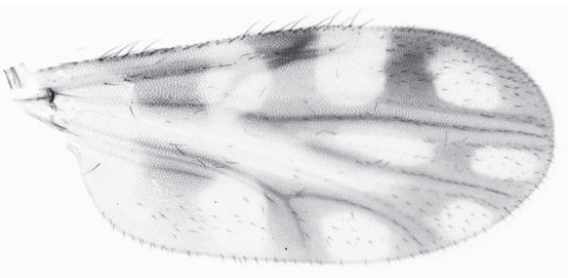
Genetic clades of *C. bundyensis*



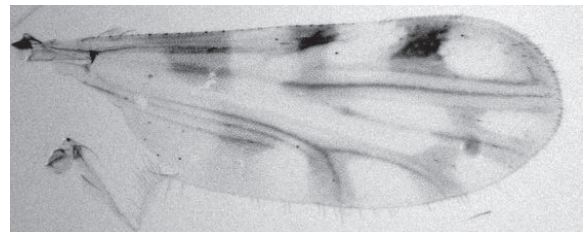
AAT9957 ww10808



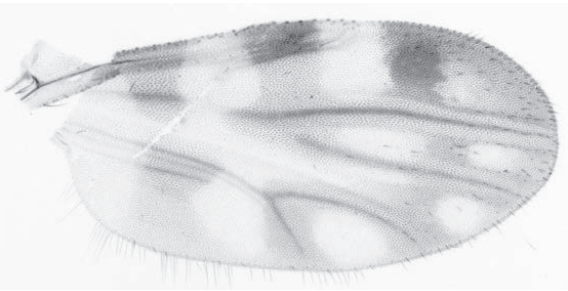
AAU0974 ww10903



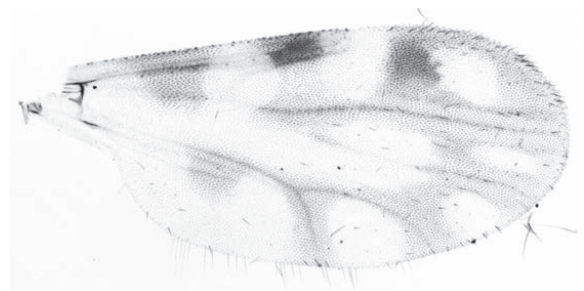
ACE8604 ww10801



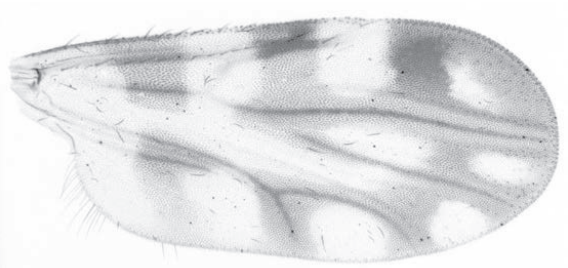
ACT3696 ww15679 male



ACE9727 ww10857



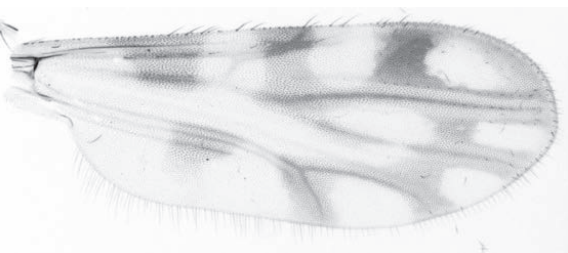
AAT9953 ww10797 ACT5100



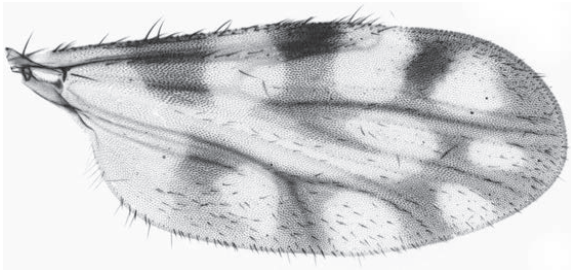
ABY9477 ww10778



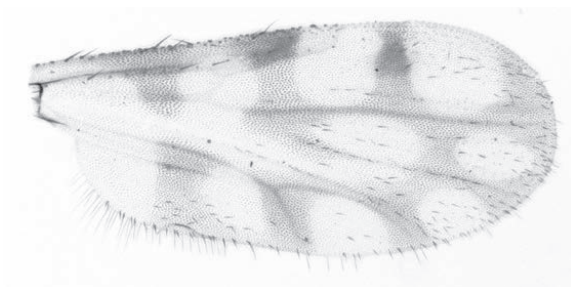
ACT5099 ww10765 (?= Vic#2) AAZ1011



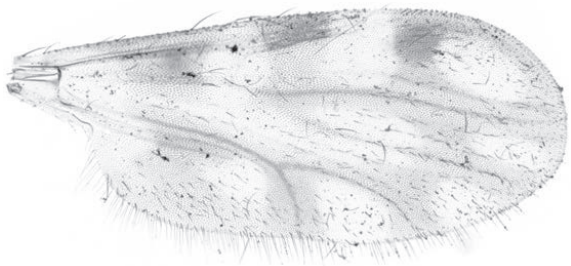
AAW4542 ww10879 male



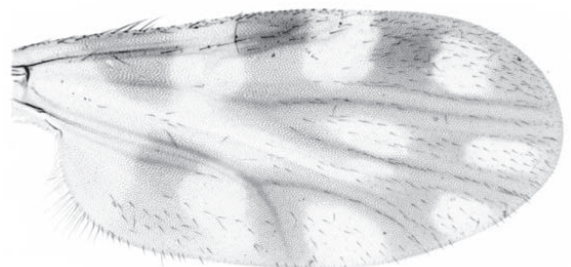
AAT9956 ww04969



AAT9956 ww10904



AAW4540 ww10751 ACI4674

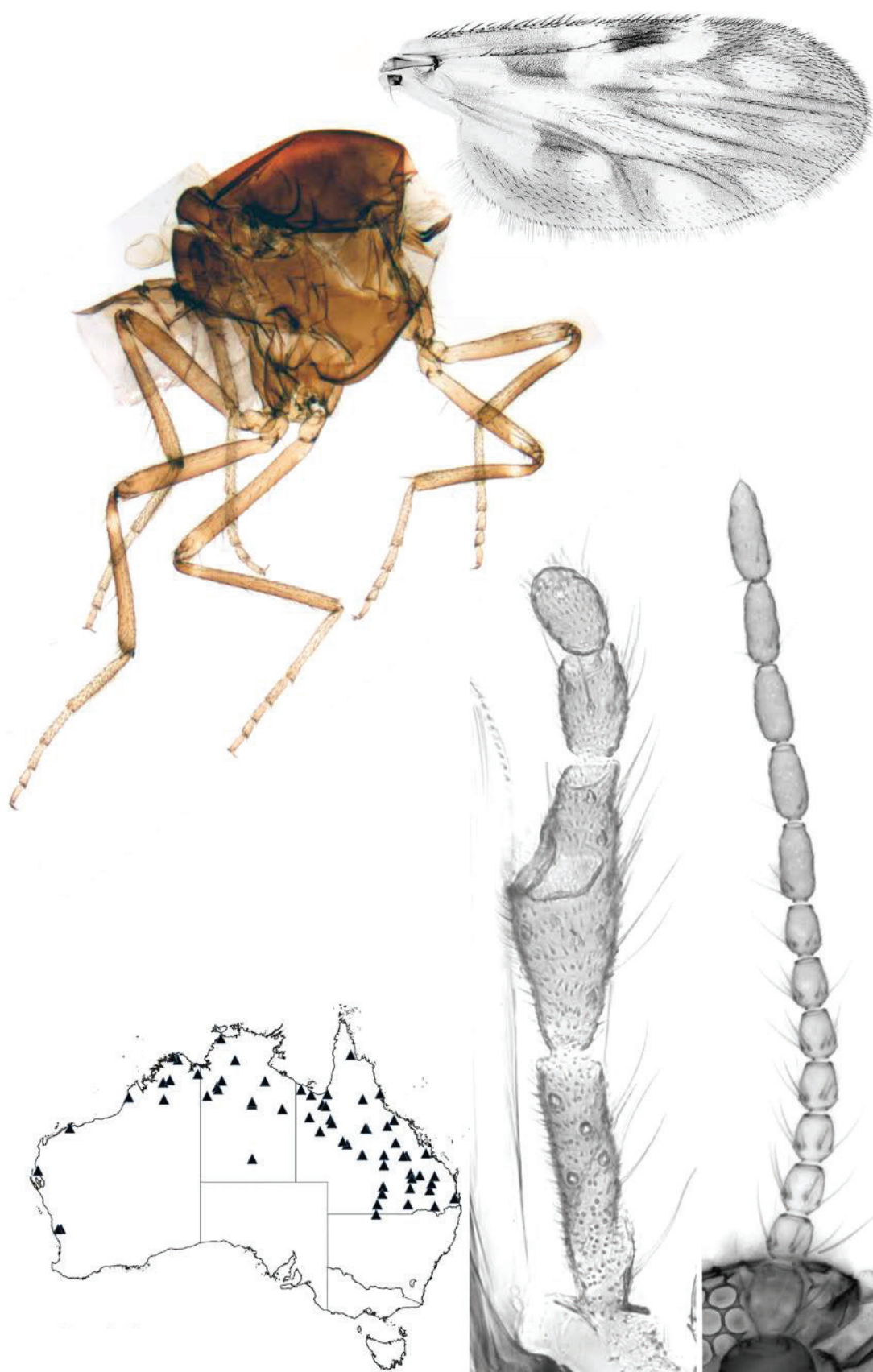


AAT9954 ww10749

Culicoides cuniculus

Culicoides cuniculus Lee & Reye 1953: 388 (Qld)

Synonyms	Nil.
Distribution	Widespread in Qld, NT and WA, also in northern NSW. Usually in dry country.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 included in pale marking; cell m_4 with single pale spot; apical spot in cell r_3 bilobed and closer than its own diameter to apex of cell.

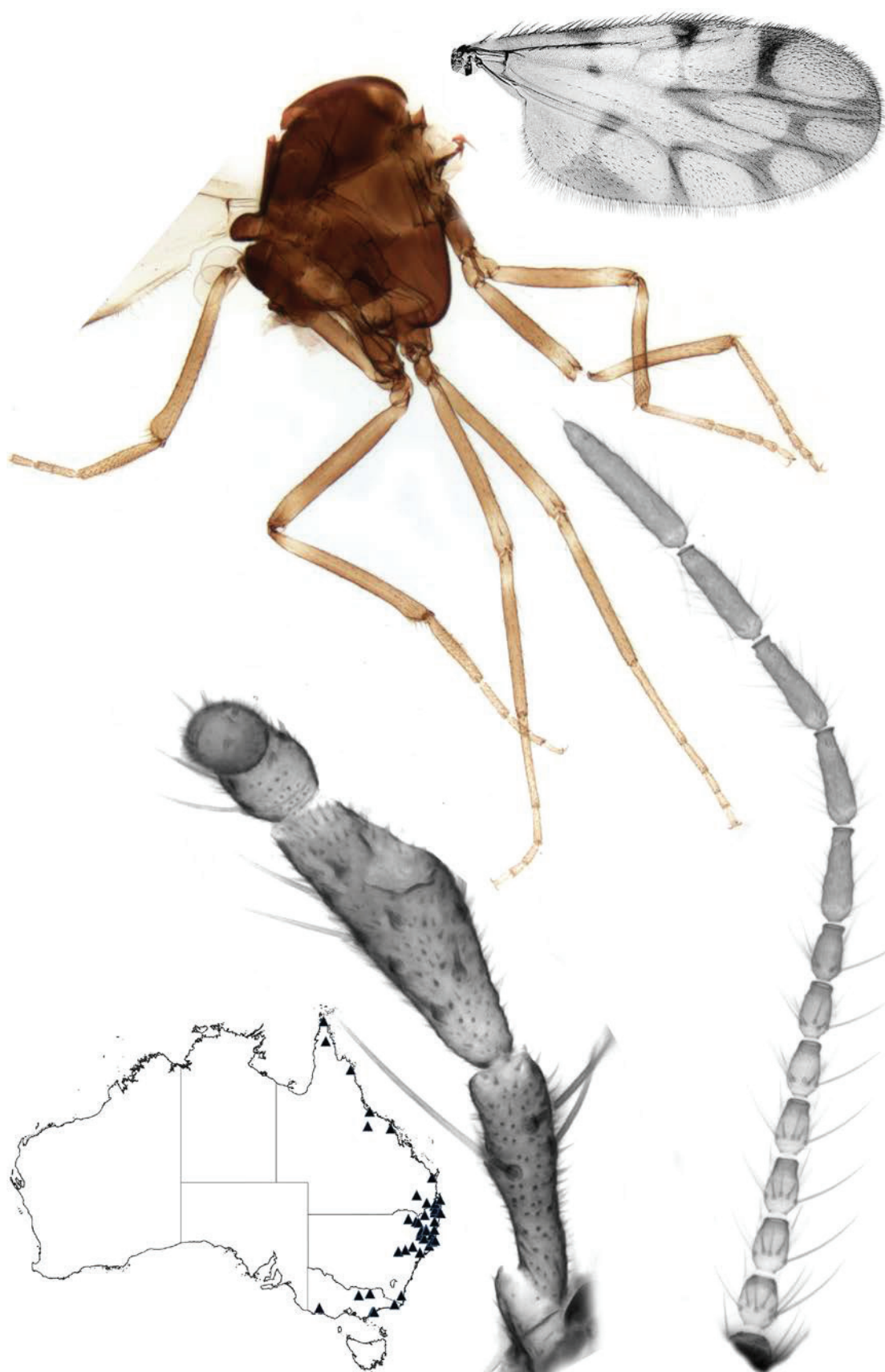


C. cuniculus

Culicoides fulbrighti

Culicoides fulbrighti Lee & Reye 1963: 361 (NSW)

Synonyms	Nil.
Distribution	Eastern Qld and NSW, Victoria.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Shaded margins of fresh groundwater pools (Dyce & Murray unpublished data).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; poststigmatic pale spot reaching or crossing vein M_1 ; mid femora with subapical pale band and mid tibia with subbasal pale band.

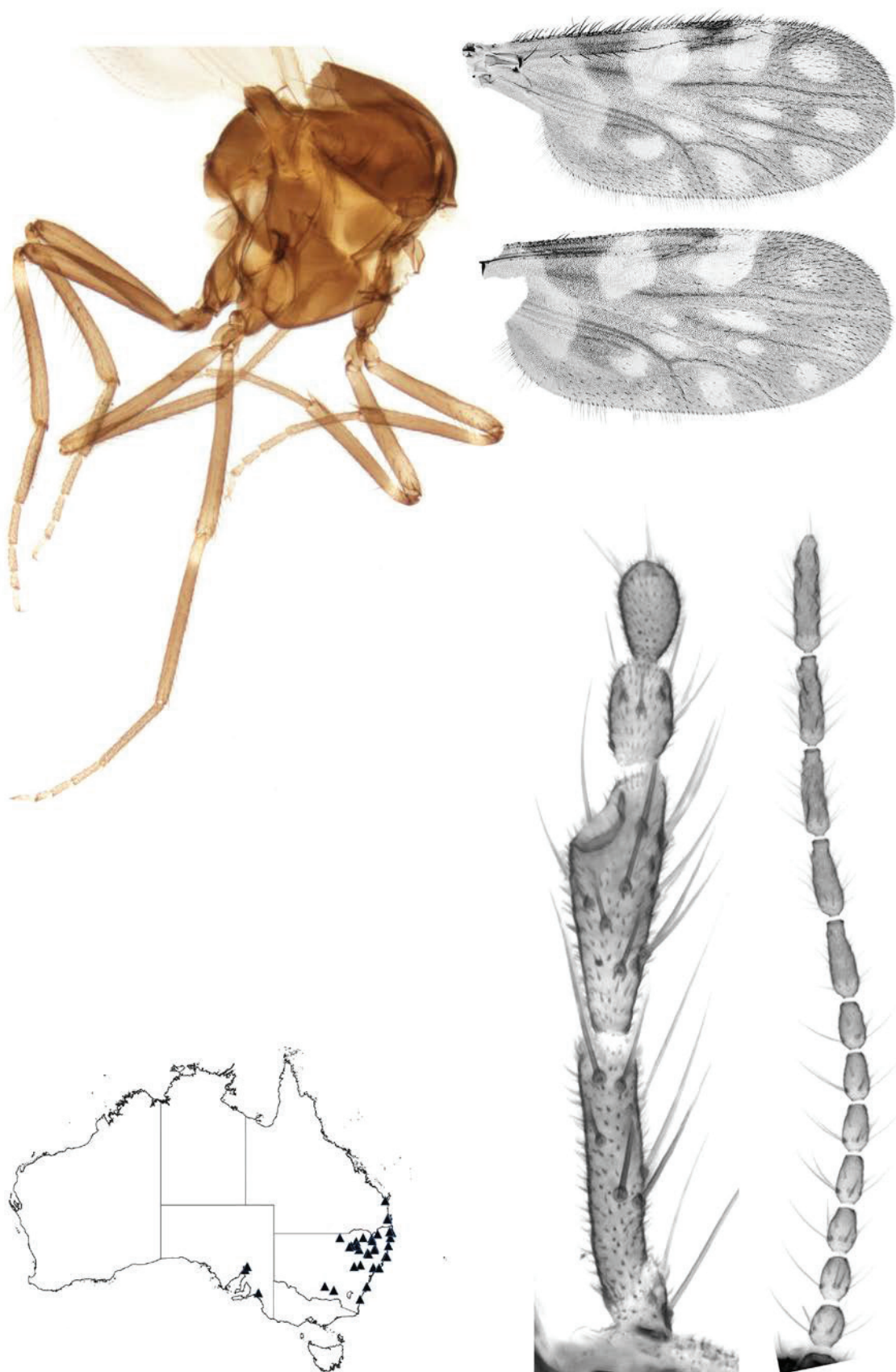


C. fulbrighti

Culicoides henryi

Culicoides henryi Lee & Reye 1963: 360 (Queensland)

Synonyms	Nil.
Distribution	SE Qld and SA, coastal NSW. Records from inland NSW require confirmation.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Algal mats in tidal pools, estuarine muddy sand; Dark peaty mud in mangroves (Dyce & Murray 1966; Hagen & Kettle 1990).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 not included in pale marking; compact pale spot between front of M-Cu fork and M_2 crease present; hind tibia dark to apex.

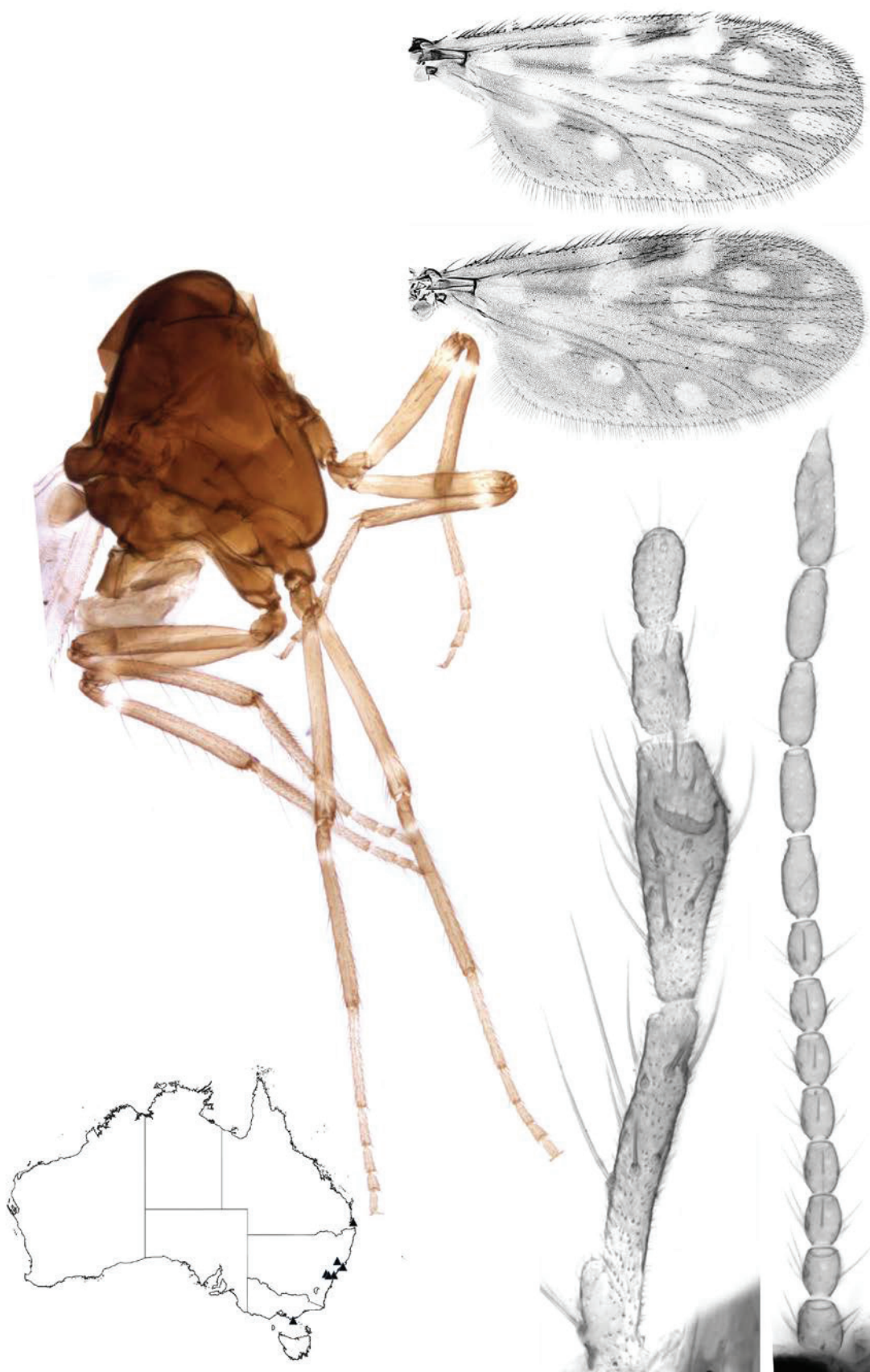


C. henryi

Culicoides mcmillani

Culicoides mcmillani Lee & Reye 1953: 391 (NSW)

Synonyms	Nil.
Distribution	Uncommon in Victoria, eastern NSW and south-eastern Qld.
Hosts	Largely unknown but apparently includes humans (Reye 1992).
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 included in pale marking; anal cell with 2 apical pale spots; base of basal pale spot in cell m_1 level with base of pale spot over vein M_1 ; distal pale marking in cell r_3 usually arc-shaped, parallel to margin of the wing. 3rd palpal segment at least twice as long as wide.

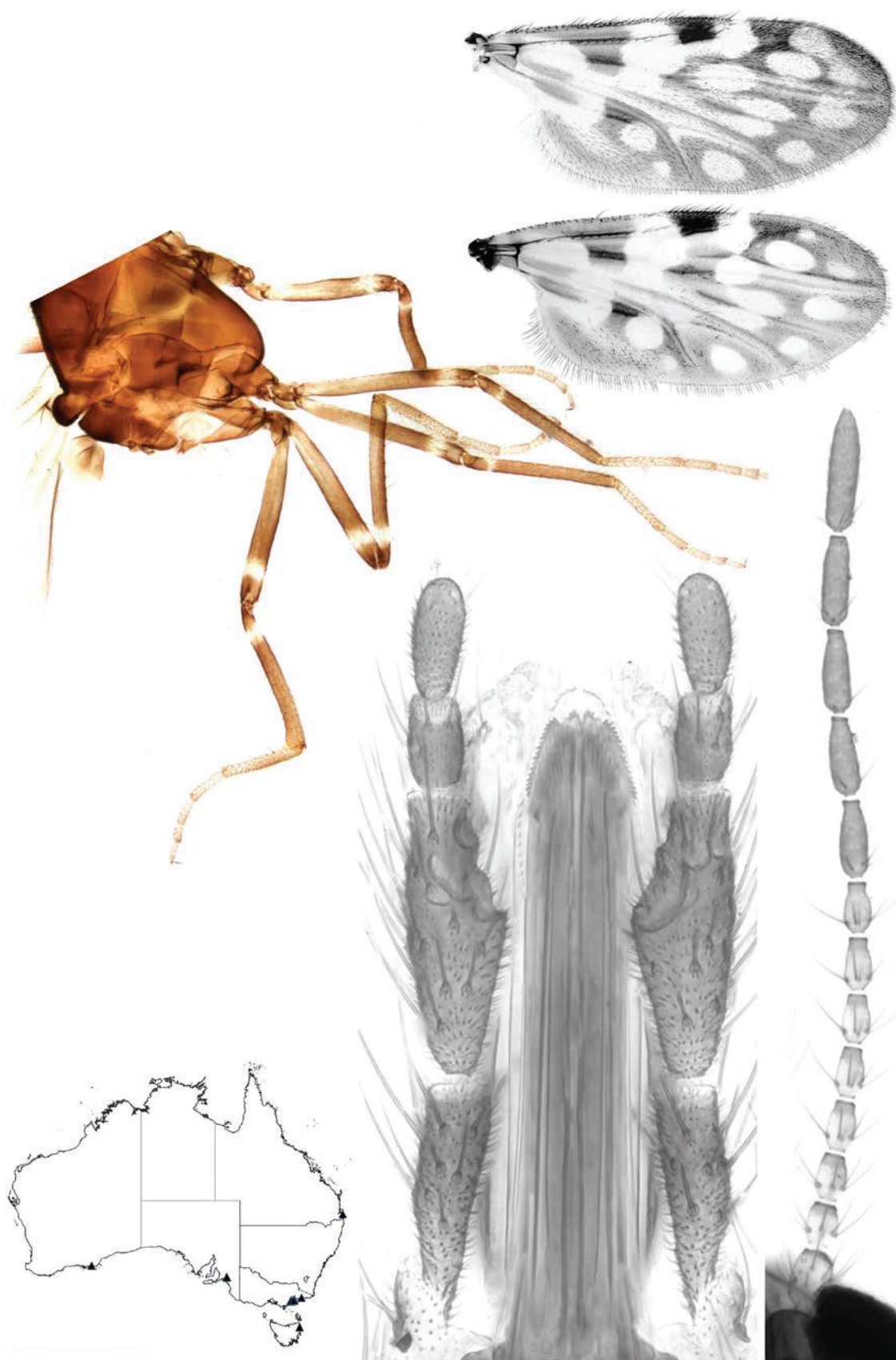


C. mcmillani

Culicoides multimaculatus

Culicoides multimaculatus Taylor 1918: 169 (Victoria)

Synonyms	Nil.
Distribution	Victoria, south-eastern SA, southern WA.
Hosts	Largely unknown but includes humans (Reye 1992).
Vector status	Unknown.
Immature habitat	Ultrasaline foreshore dune lake margins, organic peaty ooze (Dyce & Murray unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: cell r_2 pale apically; vein M_1 included in pale marking; base of vein M-Cu covered by pale marking; 3 distinct pale spots in apex of cell r_3 ; base of vein M_4 covered by pale marking; hind femora with strong subapical pale band.

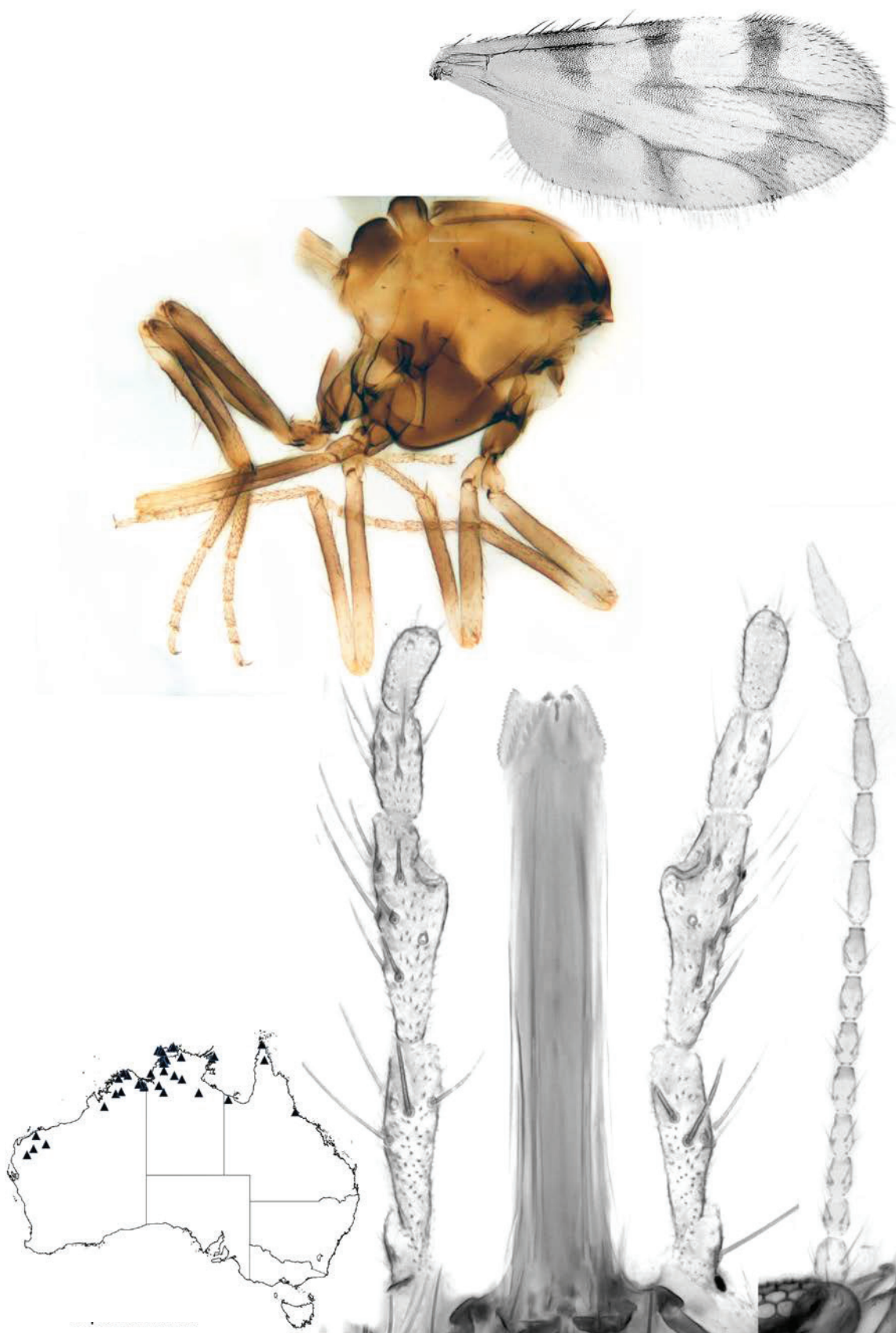


C. multimaculatus

Culicoides pallidothorax

Culicoides pallidothorax Lee & Reye 1963: 362 (NT)

Synonyms	Nil.
Distribution	Top End of NT and WA. Qld records require confirmation.
Hosts	Buffalo, marsupial (Muller et al 1981).
Vector status	Wongorr virus has been detected in this species (Standfast et al 1984).
Immature habitat	Pandanus leaf axils (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Thorax with scutum predominately yellow, contrasting with lower pleuron; scutellum dark brown; dorsal part of epimeron pale.

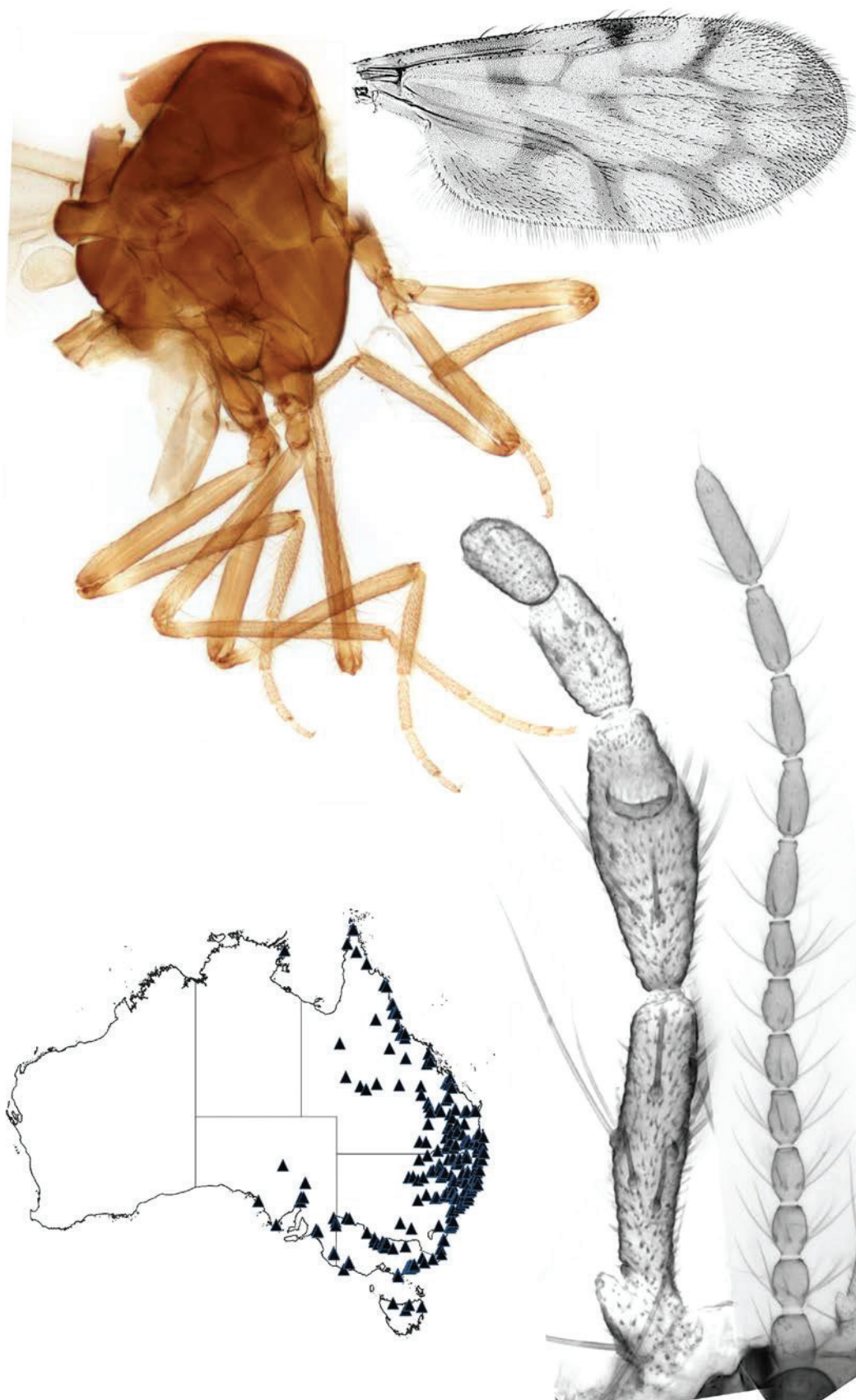


C. pallidothorax

Culicoides victoriae

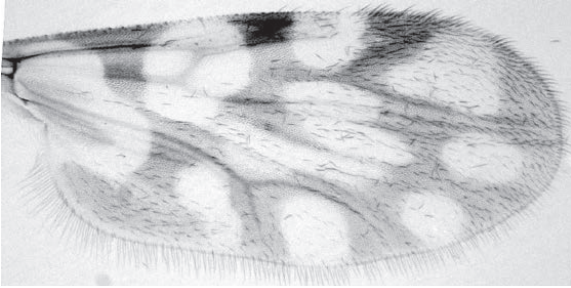
Culicoides victoriae Macfie 1941: 67 (Victoria)

Synonyms	<i>magnimaculatus</i> Lee & Reye 1953:388.
Distribution	Widespread and common in southeastern SA, Victoria, Tasmania and eastern NSW and Qld. Also present but uncommon in southwestern WA and northeastern NT.
Hosts	Marsupials, cattle, human (Kay 1973; Muller & Murray 1977, Lee et al 1963).
Vector status	Unknown.
Immature habitat	Margins of fresh water streams to ultrasaline foreshore dune lakes (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 included in pale marking; dark marking apical to poststigmatic pale spot narrow, oblique, forming a shape of the figure 7.
Notes	Dyce et al (2007) listed several variants of this species. DNA analysis of populations of this species supports the existence of several potential cryptic species (Mee et al 2020; Gopurenko unpublished data).

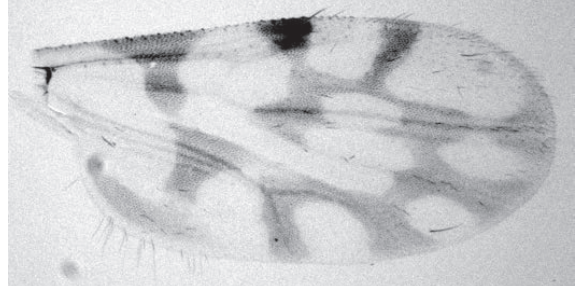


C. victoriae

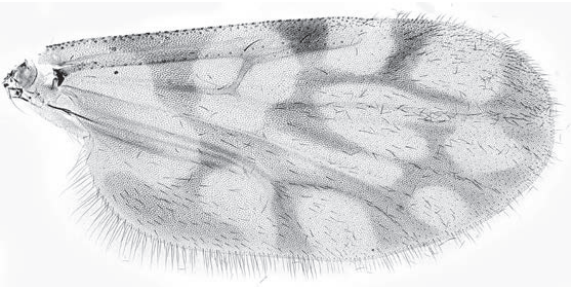
Victoriae complex



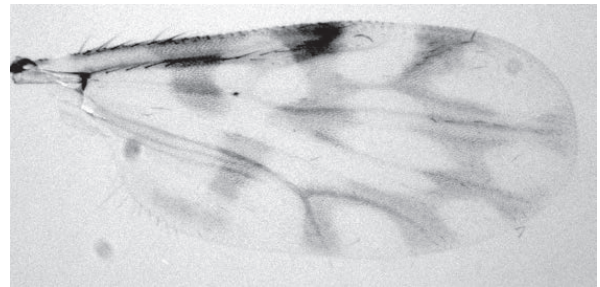
AAU2703 ww21563F2



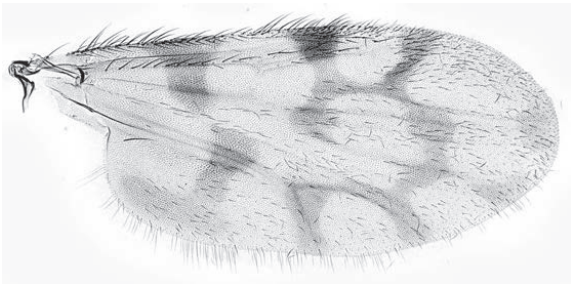
ACK4356 ww12601



AAU2703 ww25284



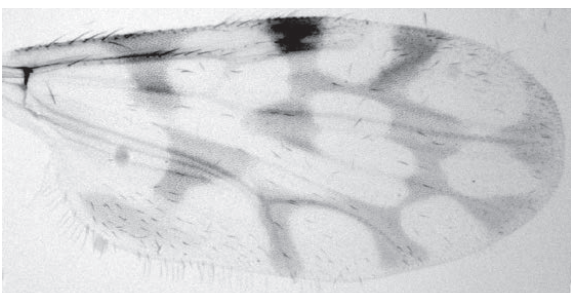
ADB6527 ww21571



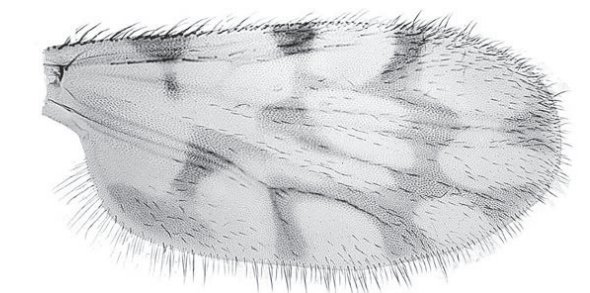
AAY9598 ww21543



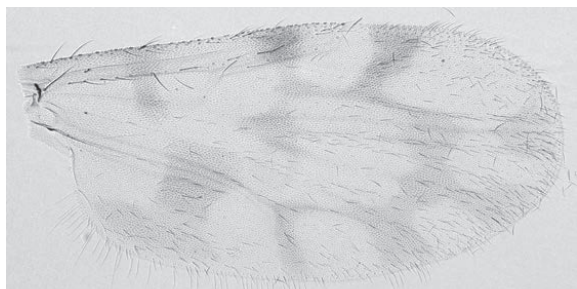
atlas 240



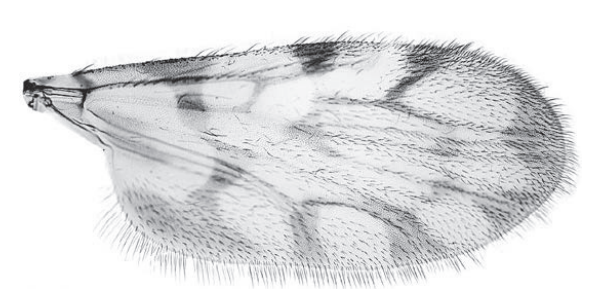
AAY9598 ww21543



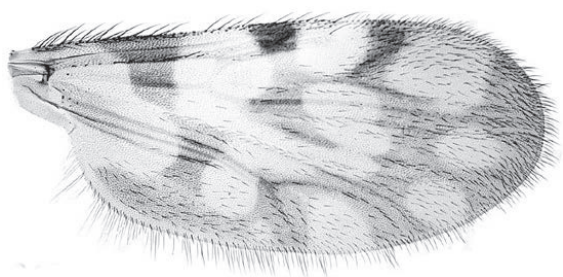
atlas 241



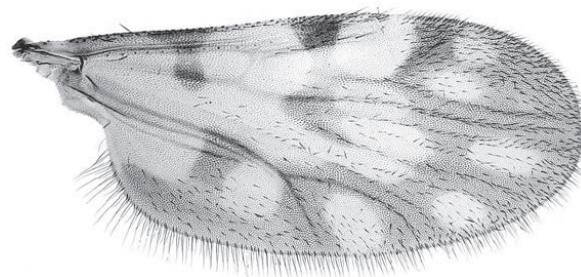
AAZ1010 ww11836



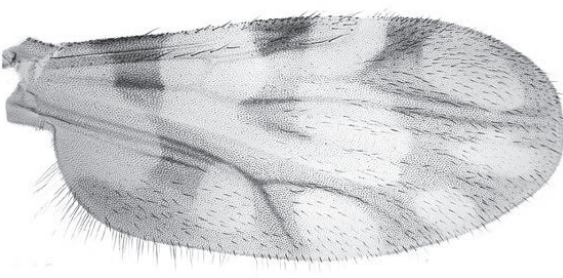
AAZ1010 ww11836



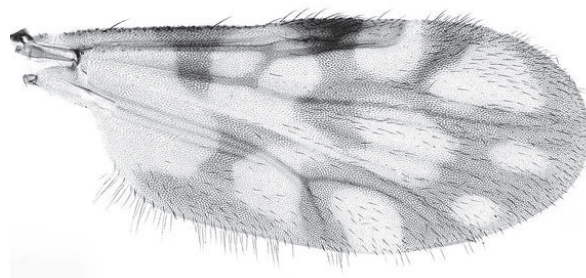
atlas 243



atlas 248



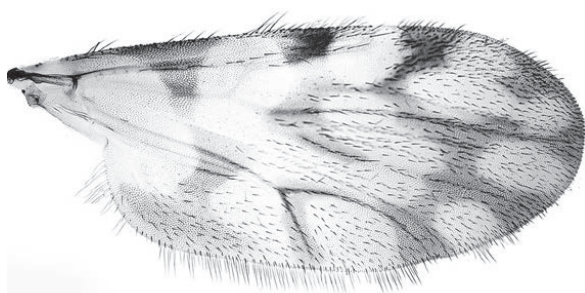
atlas 244



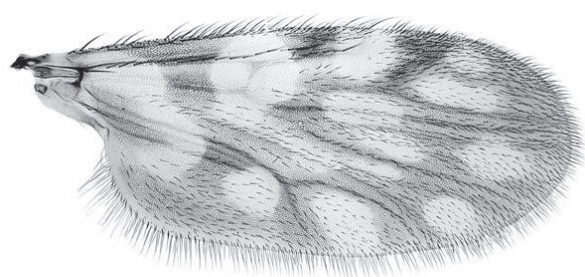
atlas 249



atlas 245



atlas 246

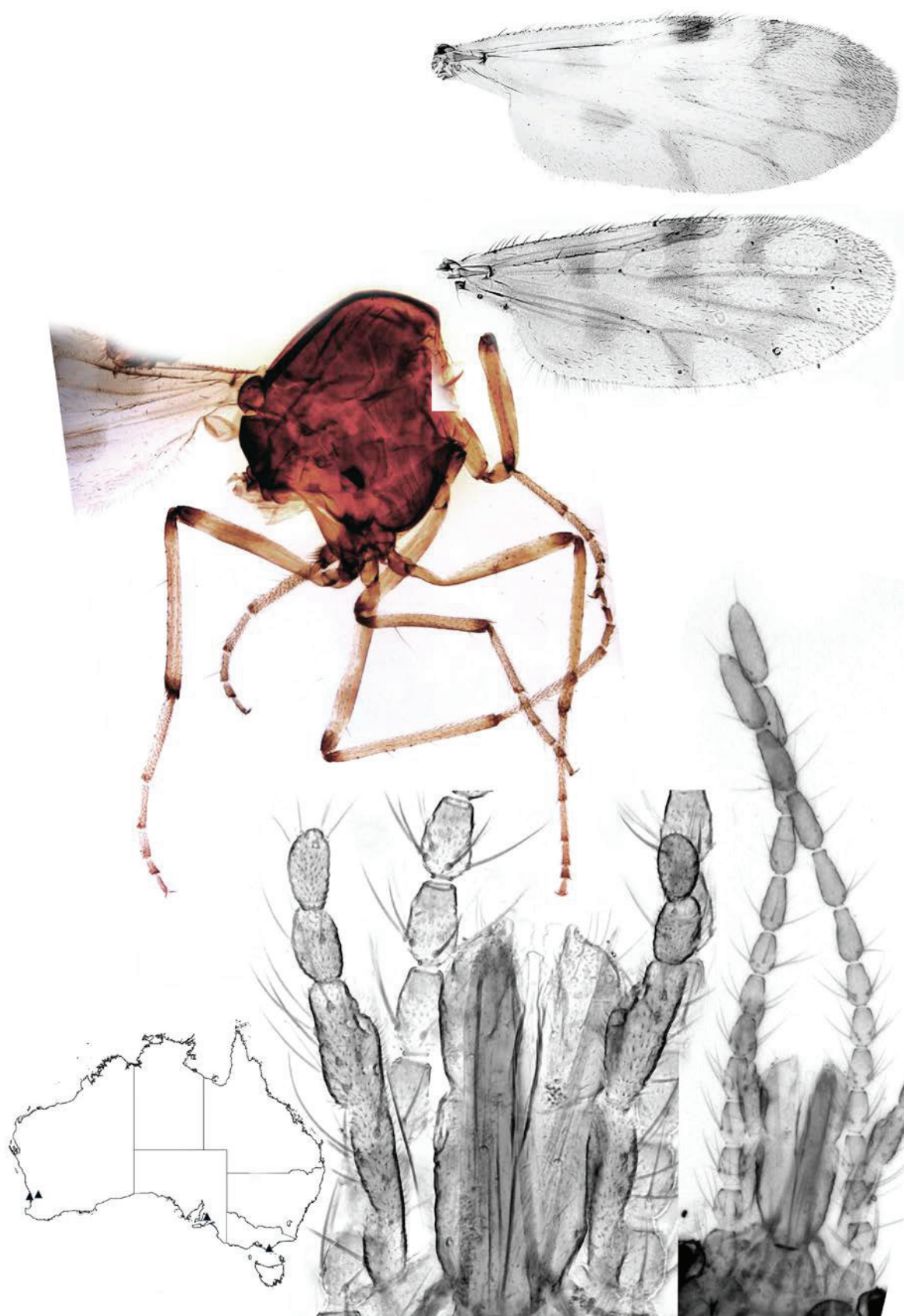


atlas 247

Culicoides waringi

Culicoides waringi Lee & Reye 1955: 240 (WA)

Synonyms	Nil.
Distribution	Uncommon in coastal Victoria, south-eastern SA and southwestern WA.
Hosts	Dyce & Murray (1967) speculated that this species does not feed on blood.
Vector status	Unknown.
Immature habitat	Floating filamentous algal mats, samphire flats and drains (Dyce & Murray 1967).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; very large species; vein M_1 included in pale marking; apex of hind tibia darker than remainder of segment.

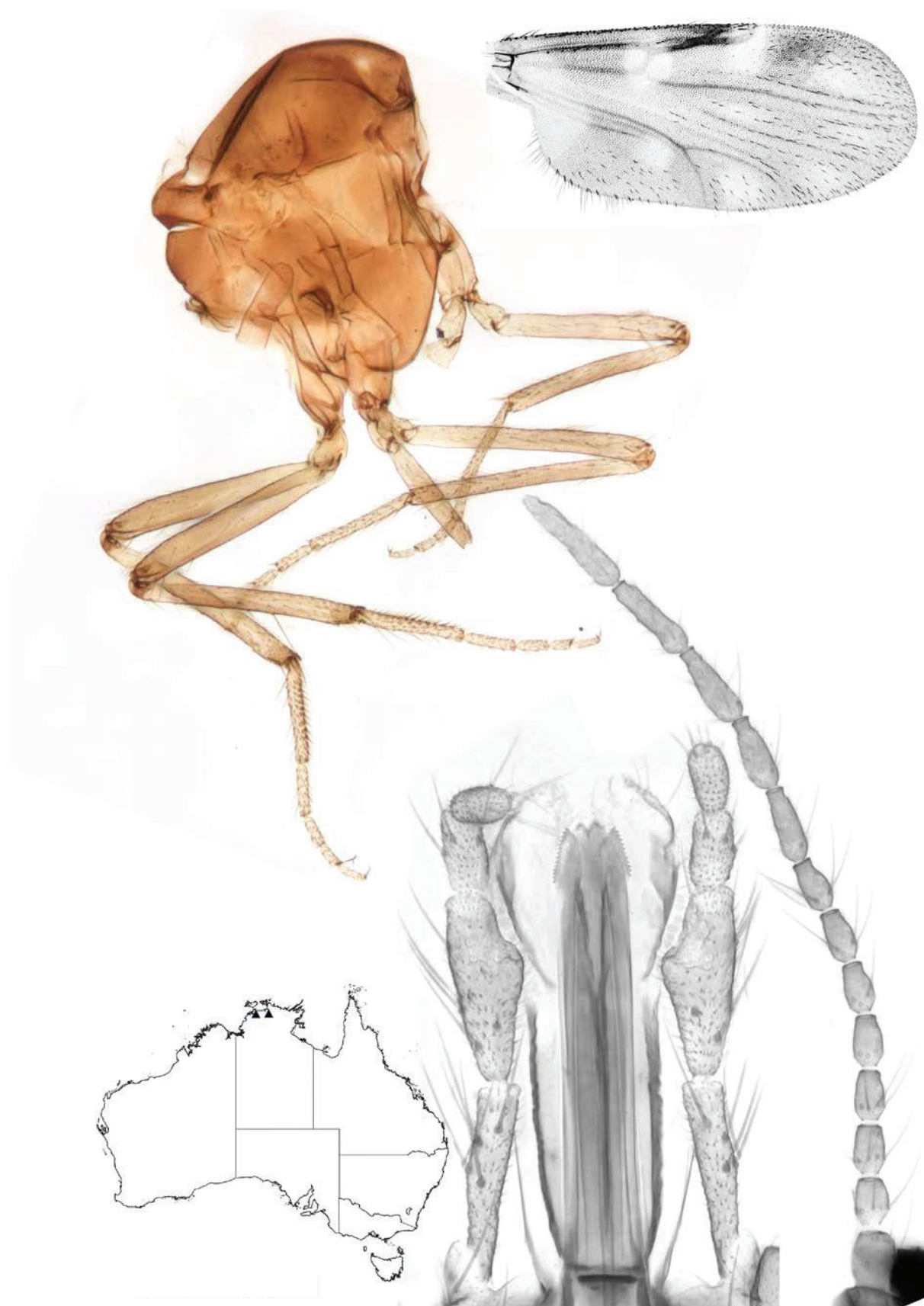


C. waringi

Culicoides Victoriae Group sp no 2

Culicoides Victoriae Gp sp no 2 Dyce et al 2007:59

Synonyms	Nil.
Distribution	Top End of NT.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 not included in pale marking; compact pale spot between front of M-Cu fork and M_2 crease absent; apical pale spot in cell r_3 not reaching wing margin. Mid tibia with subbasal pale band.

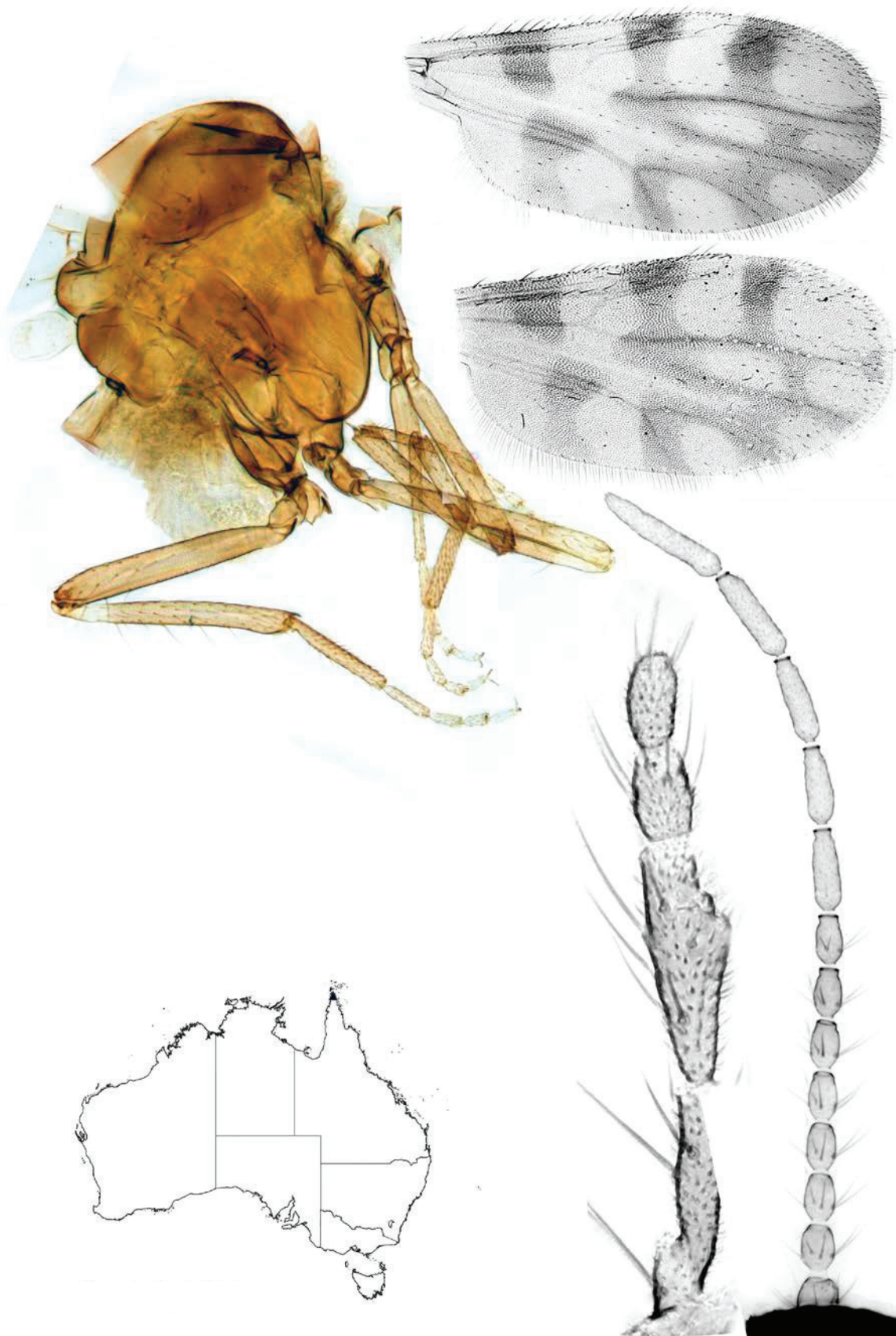


Victoriae Gp sp no 2

Culicoides Victoriae Group sp no 3

Culicoides Victoriae Gp sp no 3 (Dyce et al 2007:60)

Synonyms	Nil.
Distribution	Cape York Peninsula.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 not included in pale marking; vein M-Cu with base covered by pale marking. Mid knee pale. SCh absent from distal 5 flagellar segments; spermathecal neck with sclerotized ring.



Victoriae Gp sp no 3

Culicoides Victoriae Group sp no 5

Culicoides Victoriae Gp sp no 5 Dyce et al 2007:61

Synonyms	Nil.
Distribution	Known only from the Atherton Tablelands of northern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; pale markings on wing expansive with single marking covering most of cells M_1 , M_2 and anal cell.



Victoriae Gp sp no 5

Culicoides Victoriae Group sp no 6

Culicoides Victoriae Gp sp no 6 Dyce et al 2007:61

Synonyms	Nil.
Distribution	Northern NT and WA. Qld records require confirmation.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 not included in pale marking; vein M-Cu with base covered by pale marking; cell m_2 dark with 2 pale spots in apical half. Mid knee pale. At least 1 SCh present on all 5 distal flagellar segments. Spermathecal neck without sclerotized ring.



Victoriae Gp sp no 6

Culicoides Victoriae Group sp no 7

Culicoides Victoriae Gp sp no 7 Dyce et al 2007:61

Synonyms	Nil.
Distribution	Northern NT.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 not included in pale marking; vein M-Cu with base covered by pale marking; cell m_2 with large pale area extending from base of cell to level with apex of vein M_4 . Mid knee pale.



Victoriae Gp sp no 7

Culicoides Victoriae Group sp no 8

Culicoides Victoriae Gp sp no 8 Dyce et al 2007:61

Synonyms	Nil.
Distribution	Southwestern WA.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 not included in pale marking; vein M-Cu with base covered by pale marking; dark marking apical to poststigmatic pale spot in cell r_3 quadrate. Mid knee not pale. Palpal pit with strong apical margin.

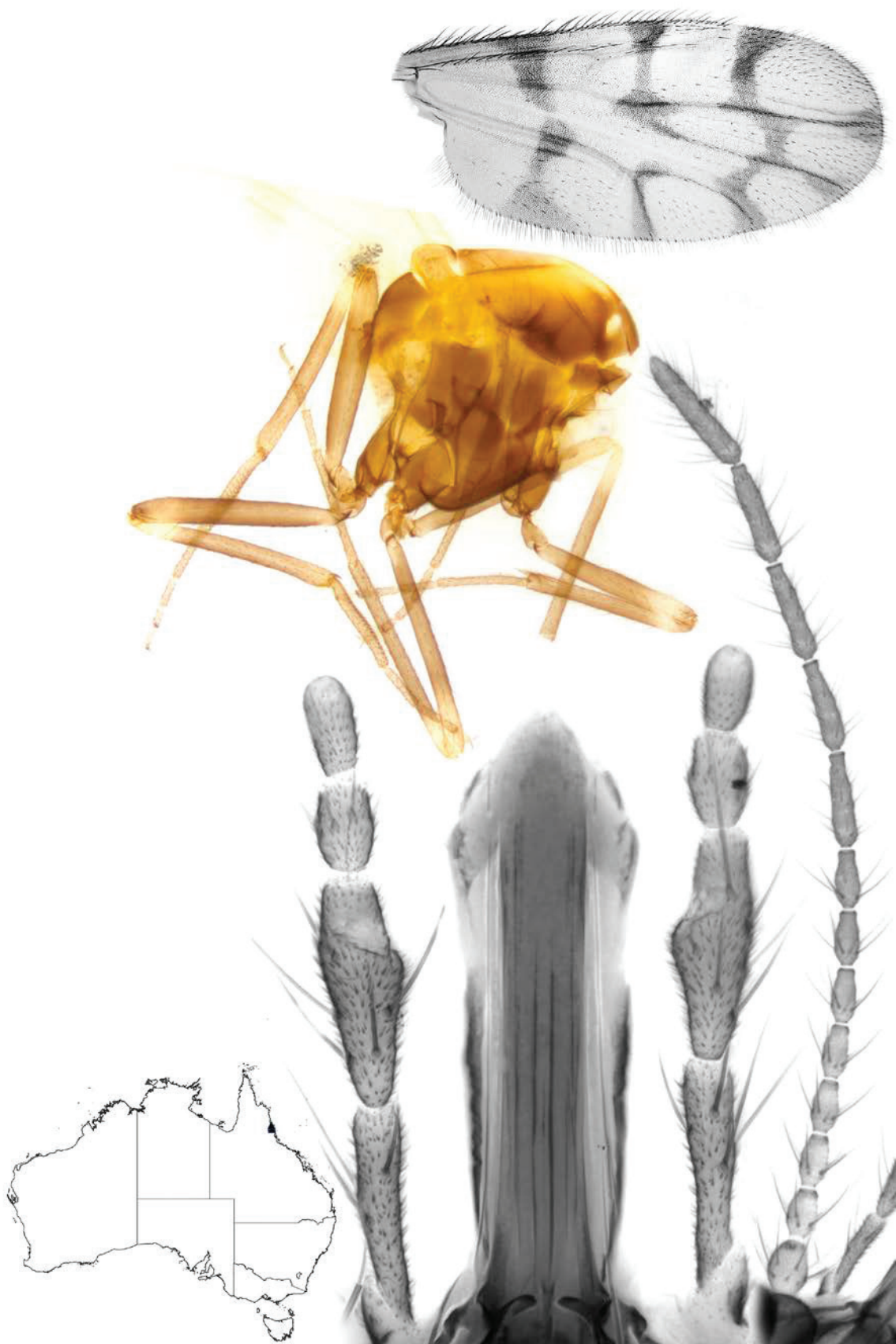


Victoriae Gp sp no 8

Culicoides Victoriae Group sp no 10

Culicoides Victoriae Gp sp no 10 Dyce et al 2007:62

Synonyms	Nil.
Distribution	Rainforest in northeastern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Scutum and scutellum predominately yellow, contrasting with lower pleuron; dorsal part of epimeron dark.

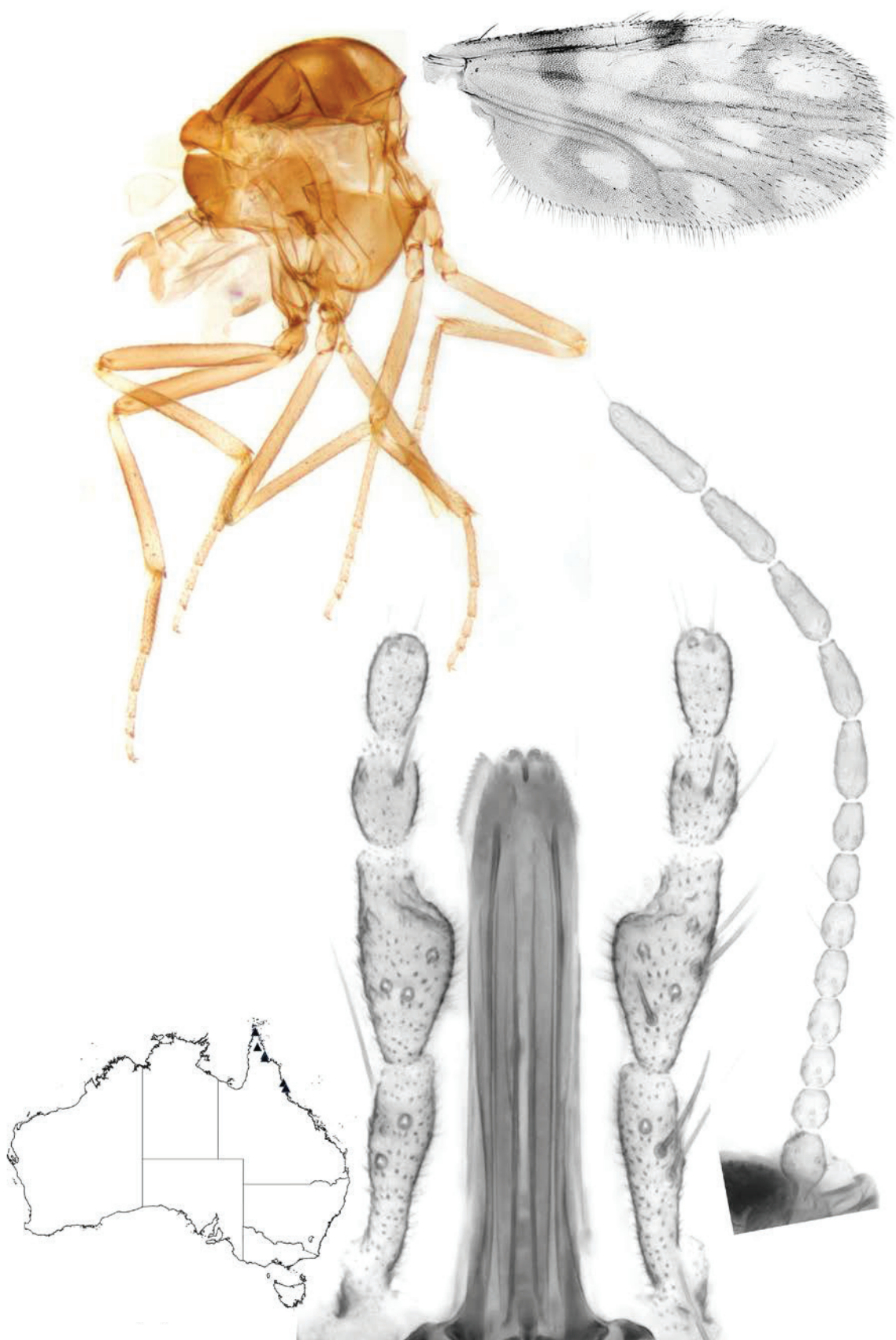


Victoriae Gp sp no 10

Culicoides Victoriae Group sp no 12

Culicoides Victoriae Gp sp no 12 Dyce et al 2007:63

Synonyms	Nil.
Distribution	Northern Qld as far south as Innisfail.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 not included in pale marking; discrete ovoid marking between poststigmatic pale spot and vein M_1 .

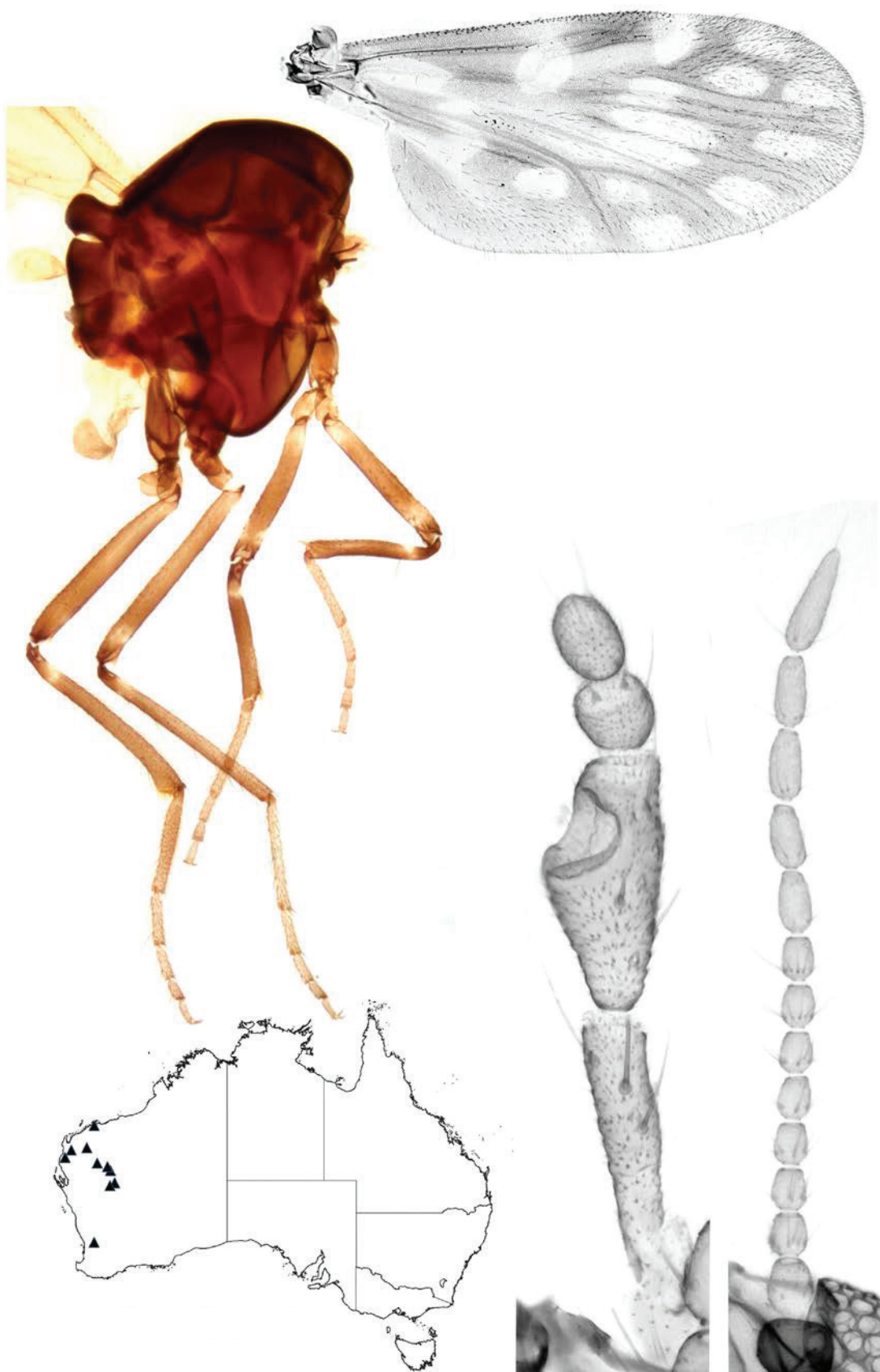


Victoriae Gp sp no 12

Culicoides Victoriae Group sp no 14

Culicoides Victoriae Gp sp no 14 Dyce et al 2007:64

Synonyms	Nil.
Distribution	Drier areas of southern WA as far north as the Pilbara region.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 included in pale marking; 3 distinct pale spots in apex of cell r_3 ; 2 pale spots in cell m_4 with basal spot ovoid or triangular; base of basal pale spot in cell m_1 level with base of pale spot over vein M_1 .

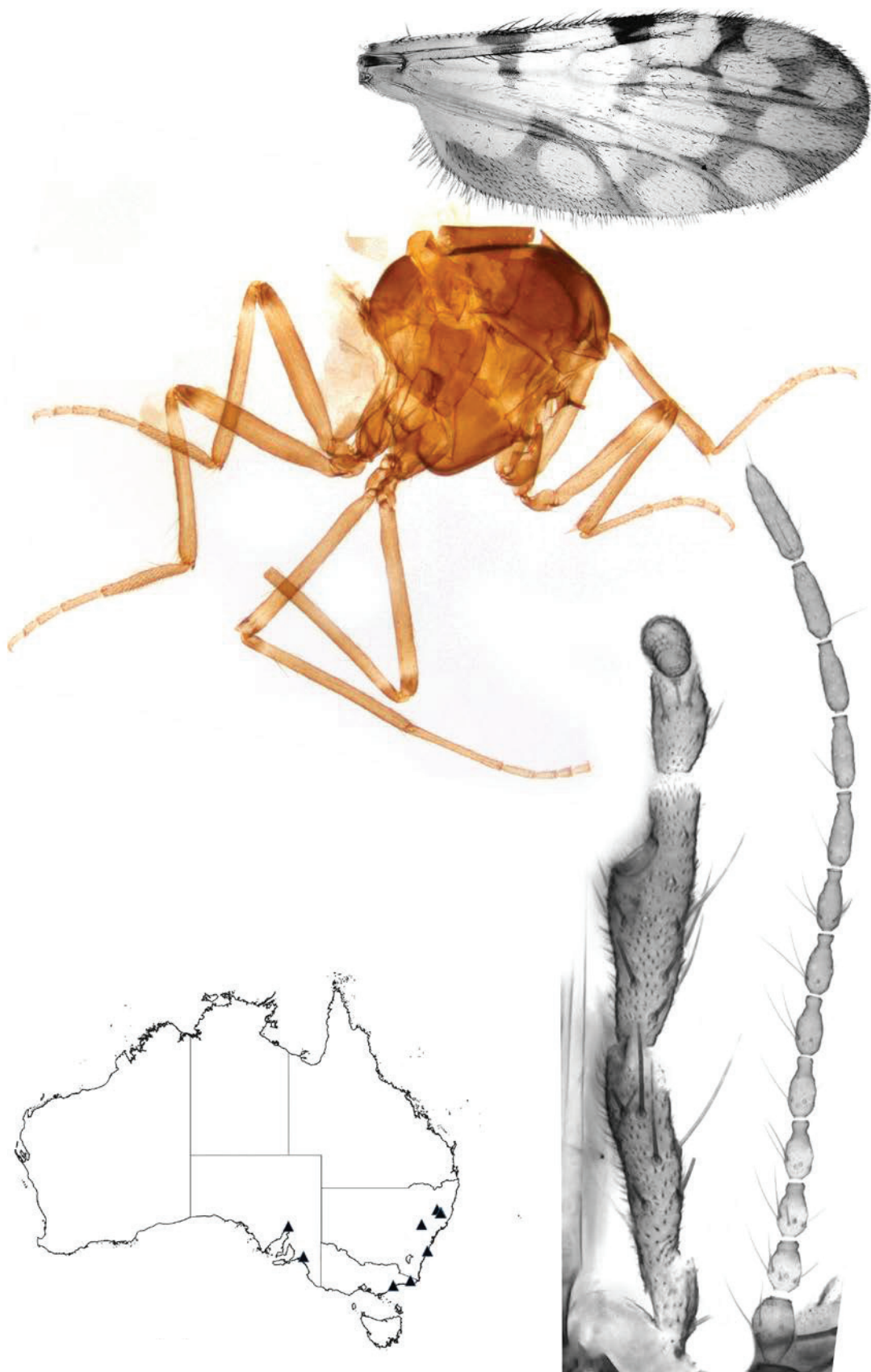


Victoriae Gp sp no 14

Culicoides Victoriae Group sp no 15

Culicoides Victoriae Gp sp no 15 Dyce et al 2007:65

Synonyms	Nil.
Distribution	Eastern NSW, Victoria, south-eastern SA.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 pale apically; vein M_1 included in pale marking; base of vein M-Cu covered by pale marking; 3 distinct pale spots in apex of cell r_3 ; base of vein M_4 covered by pale marking. Hind femora with subapical pale band weak or absent.



Victoriae Gp sp no 15

Key to female specimens belonging to the Williwilli Group

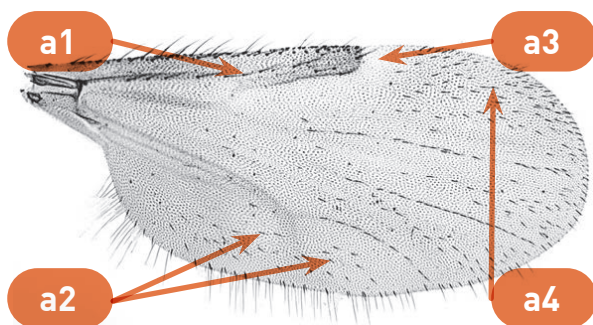
1

Wing pattern weak or absent, pale spots may be present over r-m cross-vein (a1), in posterior of wing (a2) or post stigmatic (a3) but not apical to post stigmatic spot in cell r_3 (a4)

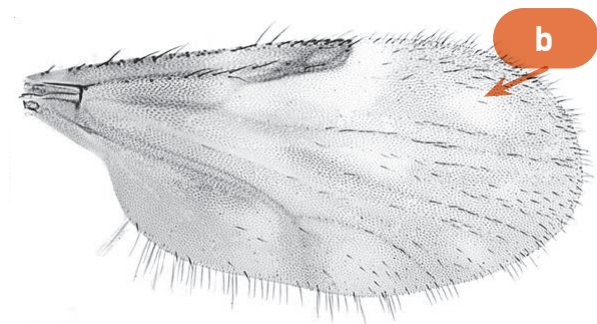
2

Wing with at least one distinct pale spot in cell r_3 apical to post stigmatic spot (b)

4



C. Williwilli Gp sp no 4



C. Williwilli Gp sp no 3

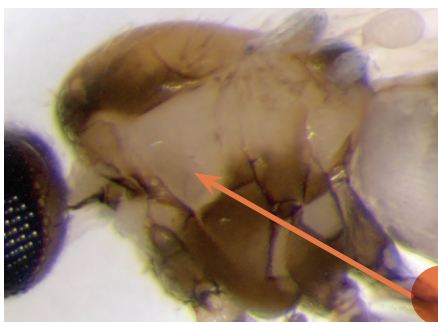
2

Anepisternite with at most a very pale marking along anterior edge (a)

C. Williwilli Gp sp no 4

Anepisternite yellow with distinctly dark, ovoid marking along anterior edge (b)

3



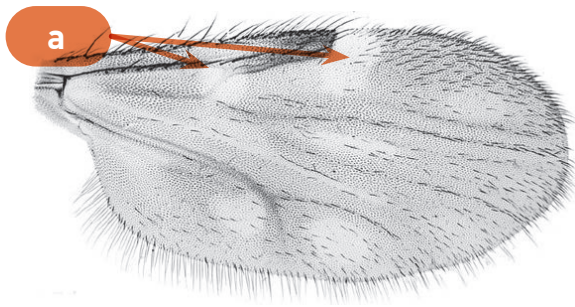
3

Wing with pale marking poststigmatic and over r-m cross-vein (a)

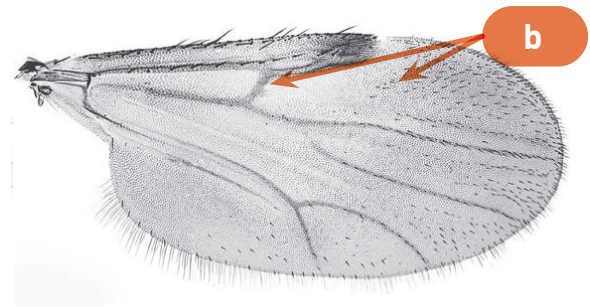
C. austropalpalis (pt)

Wing without pale marking poststigmatic and over r-m cross-vein (b)

C. smeei



C. austropalpalis



C. smeei

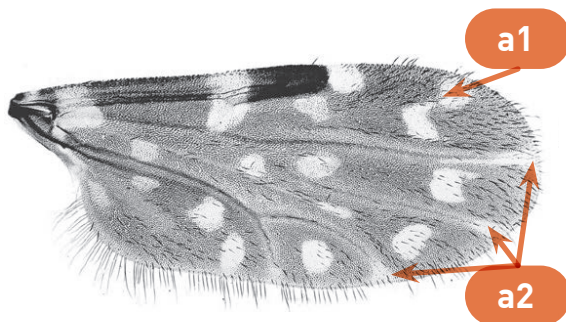
4

(1) Distal pale marking in cell r_3 zigzag shaped (a1); small pale markings present over the apices of veins M_1 , M_2 and M_{3+4} (a2)

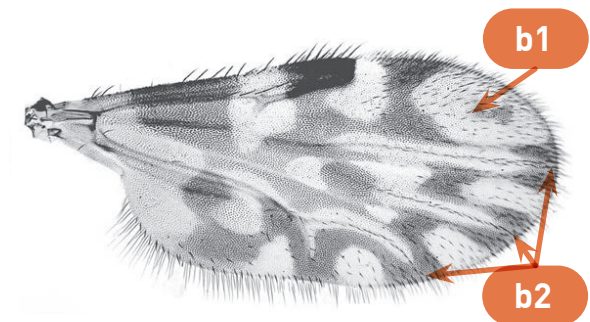
C. sigmoidus

Distal pale marking in cell r_3 ovoid (b1); apices of veins M_1 , M_2 and M_{3+4} not included in pale spots (b2)

5



C. sigmoidus



C. williwilli

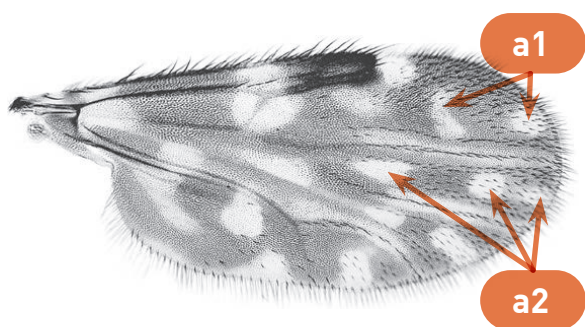
5

Cell r_3 with 2 pale markings distal to poststigmatic (a1); cell m_1 with 3 pale spots (a2)

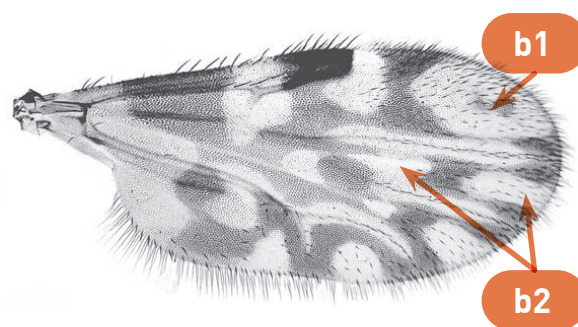
6

Cell r_3 with 1 pale marking distal to poststigmatic (b1); cell m_1 with 2 pale spots (b2)

8



C. narrabeenensis



C. williwilli

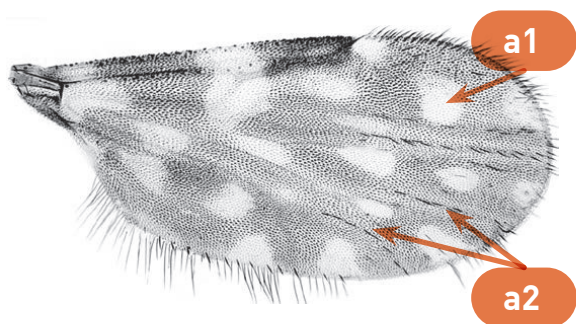
6

Subapical pale marking in cell r_3 rounded (a1); Medial part of veins M_2 and M_{3+4} not included in pale marking (a2)

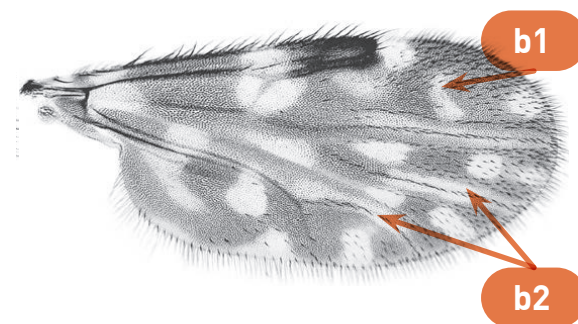
***C. Williwilli* Gp sp no 19**

Subapical pale marking in cell r_3 crescent or hourglass-shaped (b1); Medial part of veins M_2 and M_{3+4} often included in pale marking (b2)

7



C. Williwilli Gp sp no 19



C. narrabeenensis

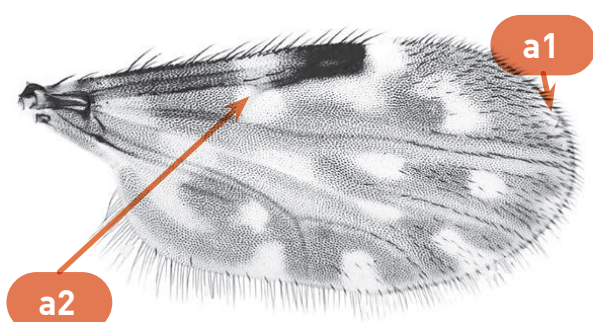
7

Apical pale spot in cell r_3 narrow, strip-like (a1); pale marking over r-m cross-vein narrowed over vein R_s (a2)

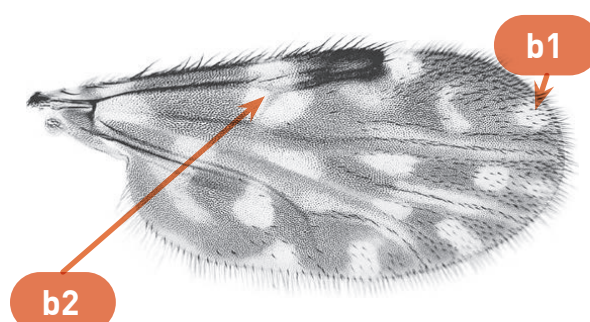
C. Williwilli Gp sp no 18

Apical pale spot in cell r_3 rounded (a1); pale marking over r-m cross-vein broad and rounded (a2)

C. narrabeenensis



C. Williwilli Gp sp no 18



C. narrabeenensis

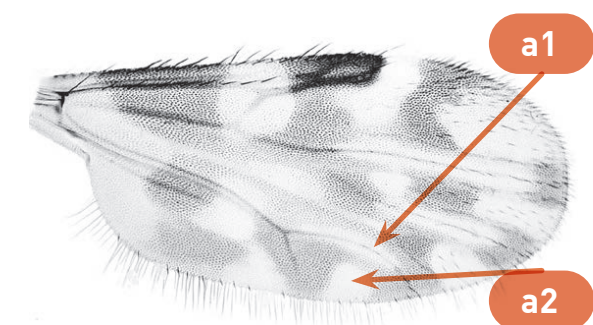
8

Elongate pale stripe running along medial part of vein M_{3+4} (a1) which is not joined to the pale marking in cell m_4 (a2)

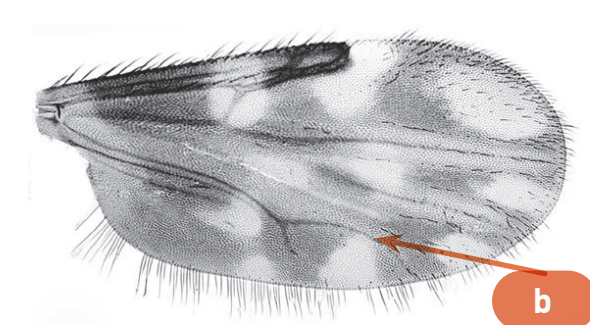
9

Medial part of vein M_{3+4} either entirely included in dark marking or, at most, partially covered by pale marking in cell M_4 (b)

10



C. Williwilli Gp sp no 7



C. Williwilli Gp sp no 6

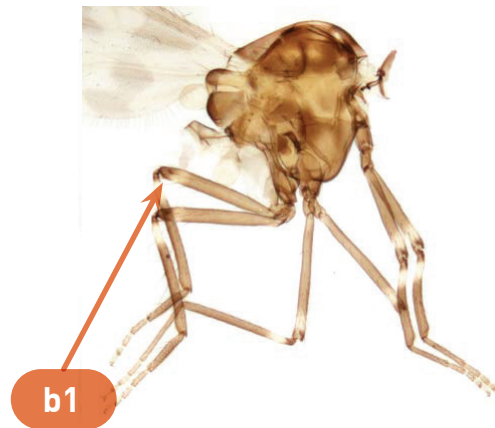
9

Hind femora dark to apex (a1); apical pale spot in cell r_3 often containing small dark marking (a2); SCo present on flagellar segment 3

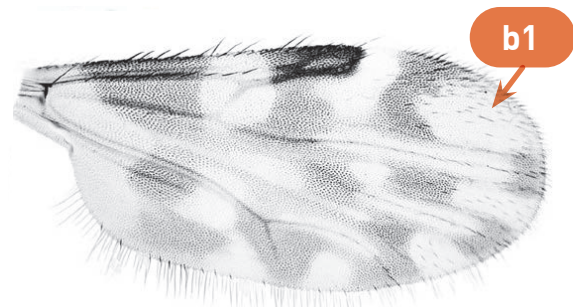
C. williwilli

Hind femora with subapical pale band (b1); apical pale spot in cell r_3 never containing small dark marking (b2); SCo absent from flagellar segment 3

C. Williwilli Gp sp no 7



C. williwilli



C. Williwilli Gp sp no 7

10

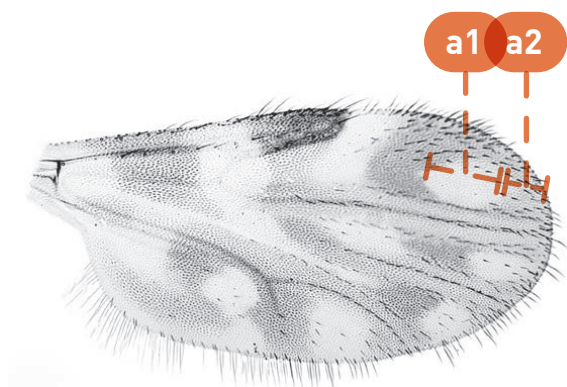
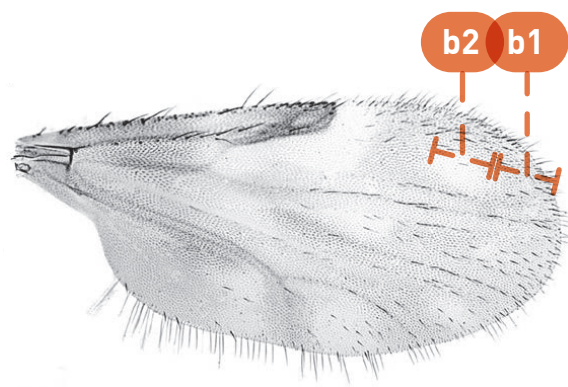
(8) Apical pale spot in cell r_3 closer than its own diameter (a1) to apex of the cell (a2)

11

Apical pale spot in cell r_3 distant from apex of the cell (b2) by at least its own diameter (b1)

15

(Nattaiensis complex*)

*C. pseudopalpalis**C. Williwilli Gp sp no 3*

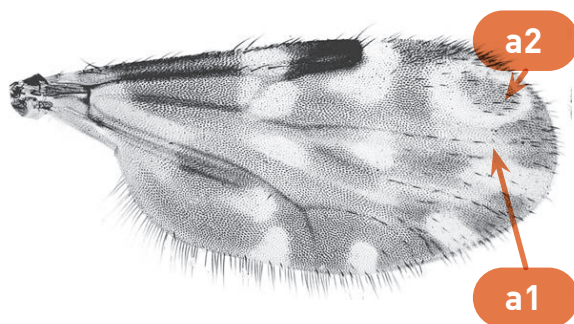
11

Apical pale spot in cell m_1 crossing vein M_1 to join pale marking in cell r_3 (a1); apical pale spot in cell r_3 often containing discrete dark marking (a2)

C. Williwilli Gp sp no 9

Apical pale spot in cell m_1 ovoid, not crossing vein M_1 (b1); apical pale spot in cell r_3 never containing dark marking (b2)

12

*C. Williwilli Gp sp no 9**C. Williwilli Gp sp no 6*

*Molecular data indicates the presence of multiple cryptic species within this complex.

12

Base of vein M-Cu included in pale marking (a)

13

Base of vein M-Cu not included in pale marking (b)

14

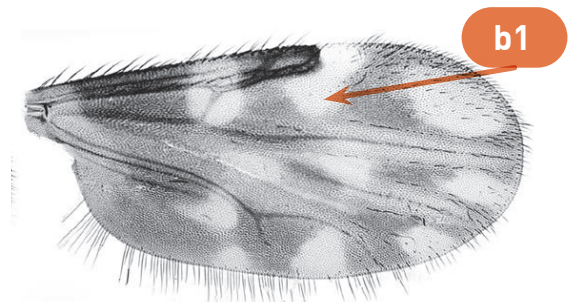
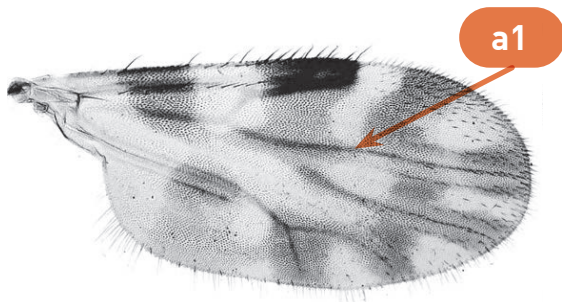
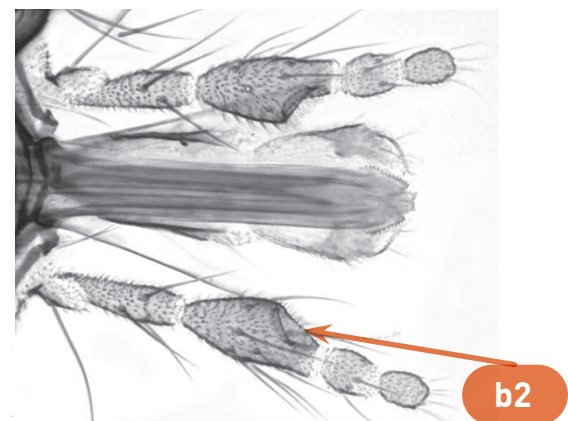
*C. Williwilli Gp sp no 6**C. pseudopalpalis*

13

Poststigmatic pale spot linear or sinuate, twice as long as wide and reaching or crossing vein M_1 (a1); 3rd palpal segment without well-defined pit (a2)

C. yasumatsui

Poststigmatic pale spot bilobed, little longer than wide and distant from vein M_1 (b1); 3rd palpal segment with well-defined round pit (b2)

C. Williwilli Gp sp no 6*C. yasumatsui**C. Williwilli Gp sp no 6*

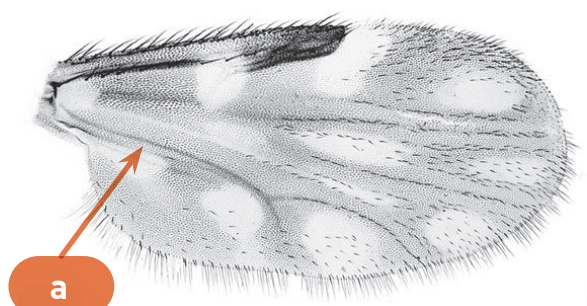
14

(12) SCo absent from flagellar segment 12; No part of vein M-Cu included in pale marking (a)

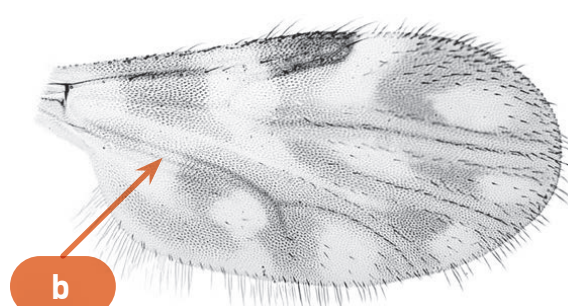
C. austropalpalis

SCo present on flagellar segment 12; Vein M-Cu partially included in pale marking (b)

C. pseudopalpalis



C. austropalpalis



C. pseudopalpalis

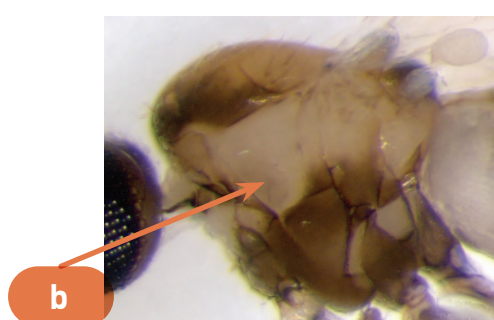
15

(10) Anepisternite with distinctly dark, ovoid marking along anterior edge (a)

16

Anepisternite yellow with at most a very pale marking along anterior edge (b)

17



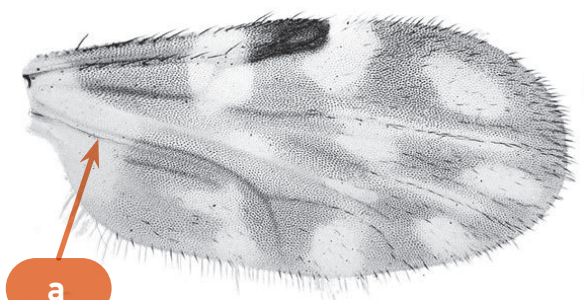
16

Base of vein M-Cu included in pale marking over base of wing (a)

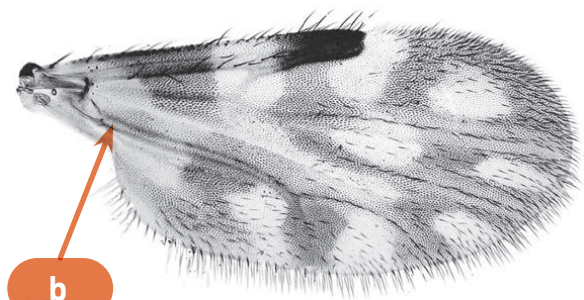
C. nattaiensis

Base of vein M-Cu covered by small dark marking (b)

*C. Williwilli Gp sp no 1**



C. nattaiensis



C. Williwilli Gp sp no 1

17

Flagellomeres 2-7 with 2 SCo; Base of wing with large, distinct pale marking extending from costa (a1) to anal corner (a2)

*C. Williwilli Gp sp no 2**

Flagellomeres 2-7 with 1 SCo; Base of wing with smaller, less distinct pale marking which barely reaches the costa and does not extend to the hind wing margin or anal corner (b)

*C. Williwilli Gp sp no 3**



C. Williwilli Gp sp no 2



C. Williwilli Gp sp no 3

*Molecular data indicates the presence of multiple cryptic species within this complex.

Culicoides Williwilli Group

Culicoides Williwilli Gp Wirth & Hubert 1989:385

Nominate species	<i>Culicoides williwilli</i> Lee & Reye 1955: 234.
Synonyms	Nil.
Distribution	Australia, New Guinea, Pacific, SE Asia.
Number of species worldwide	19 described and 23 undescribed species.
Number of species in Australia	8 described and 9 undescribed.
Hosts	Where known, hosts are predominately avian although some species have been reported to also feed on mammals, including livestock.
Vector status	<i>C. austropalpalis</i> has been shown to be refractory to infection with BTV (Standfast et al 1978; Duchemin et al 2021) but is considered a potential vector of Wallal virus (Hooper et al 1999).
Immature habitat	Margins of fresh groundwater pools and streams.
Diagnosis	This is a diverse and variable group with few female characters that define and separate this group from other groups. The following suite of characters help to define the group: Wing with cell r_2 dark to apex; pale spots distinct in most species; cell m_4 with a single pale spot. SCh absent from distal 5 flagellomeres in most species; SCo present on at least flagellomeres 3, 8, 10 and 12 in all species excepting <i>C. austropalpalis</i> . Thorax of many species with large pale markings.

Culicoides austropalpalis

Culicoides austropalpalis Lee & Reye 1955: 240 (NSW)

Synonyms	Described as <i>palpalis</i> Lee & Reye 1953: 380, but preoccupied by <i>palpalis</i> Macfie 1948: 78
Distribution	Widespread and common in all states.
Hosts	Avian, horse, bovid, marsupial (Muller et al. 1981, Kay et al 1978).
Vector status	Unlikely vector of bluetongue virus (Duchemin et al 2021). Potential vector of kangaroo blindness caused by Wallal virus (Hooper et al 1999).
Immature habitat	Margins of freshwater ponds, streams, bore drains (fresh to mineralised) (Lee & Reye 1953; Lee 1956; Kettle & Elson 1976).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; apical pale spot in cell r_3 closer than its own diameter from apex of the cell; cell m_1 with 2 pale spots; base of wing with large pale area extending from costa to anal cell which may be interrupted by dark marking over M-Cu; base of costa included in pale marking. 3rd palpal segment at least twice as long and as wide as 2nd segment and bearing large pit. SCo absent from flagellomeres 12 and 13.



C. austropalpalis

Culicoides narrabeenensis

Culicoides narrabeenensis Lee & Reye 1963: 357 (NSW)

Synonyms	Nil.
Distribution	Northern WA and NT, Qld, NSW and Victoria.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Vegetated margins of freshwater ponds and ditches (Lee & Reye 1962; Kettle & Elson 1976).
Diagnosis	Can be separated from all Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; cell m_1 with 3 pale spots; ovoid pale marking in cell m_4 ; medial part of vein M_1 included in pale marking; subapical pale marking in cell r_3 crescent or hourglass- shaped; apical pale spot in cell r_3 rounded; pale marking over r-m cross-vein broad and rounded.

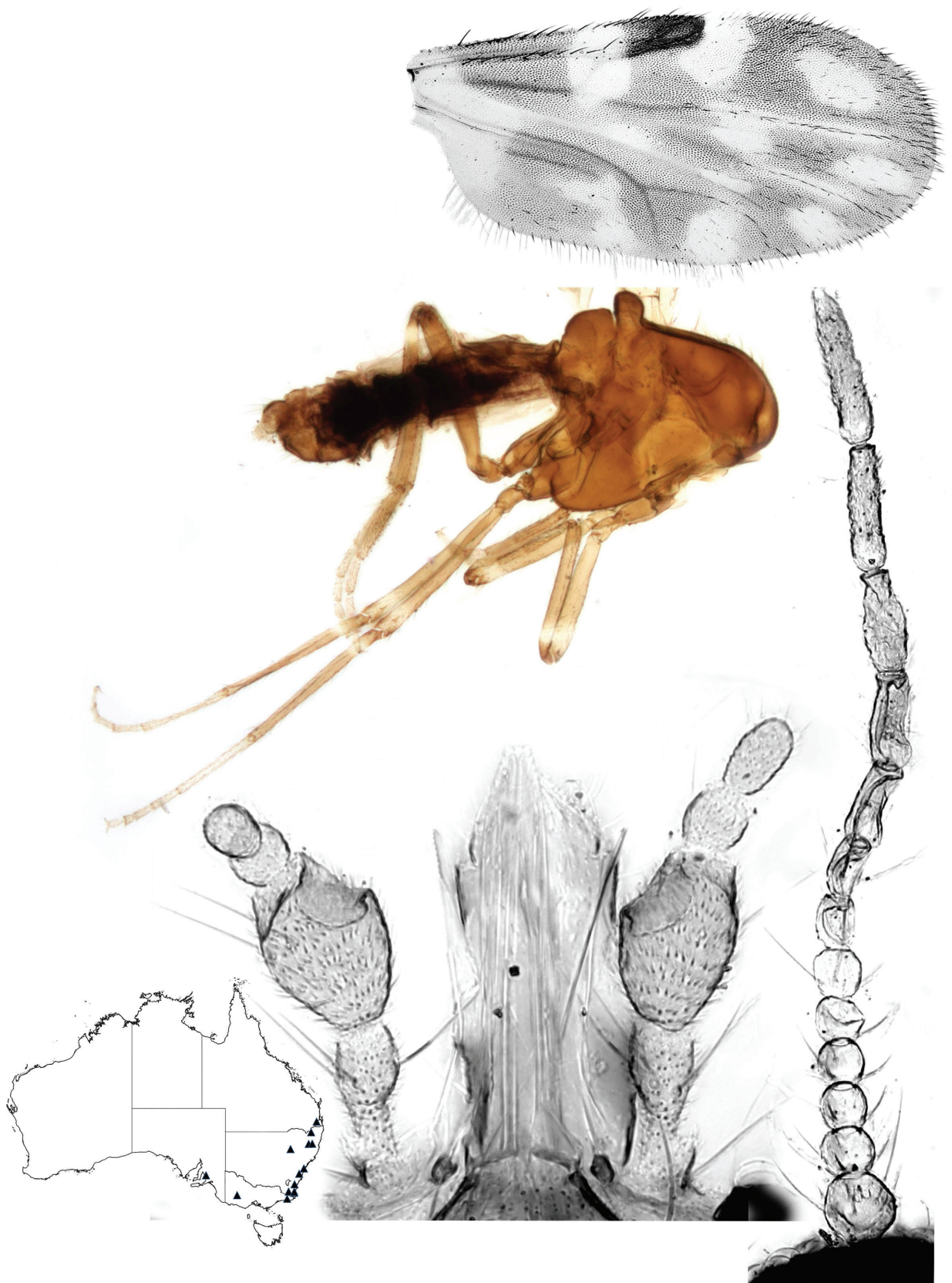


C. narrabeenensis

Culicoides nattaiensis

Culicoides nattaiensis Lee & Reye 1955: 237 (NSW)

Synonyms	Nil.
Distribution	SE Qld, eastern NSW, Vic and southeastern SA.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Margins of fresh groundwater (Dyce unpublished).
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; base of vein M-Cu included in pale spot; medial part of vein M_4 included in pale marking; apical pale spot in cell r_3 not reaching wing margin. SCo present on 1(3,5,6)8,10,12. Female <i>C. nattaiensis</i> , Williwilli Gp sp nos 1, 2 and 3 are difficult to separate. Additionally, DNA analysis has revealed the existence of a large number of potential cryptic species within this complex (Gopurenko unpublished data).

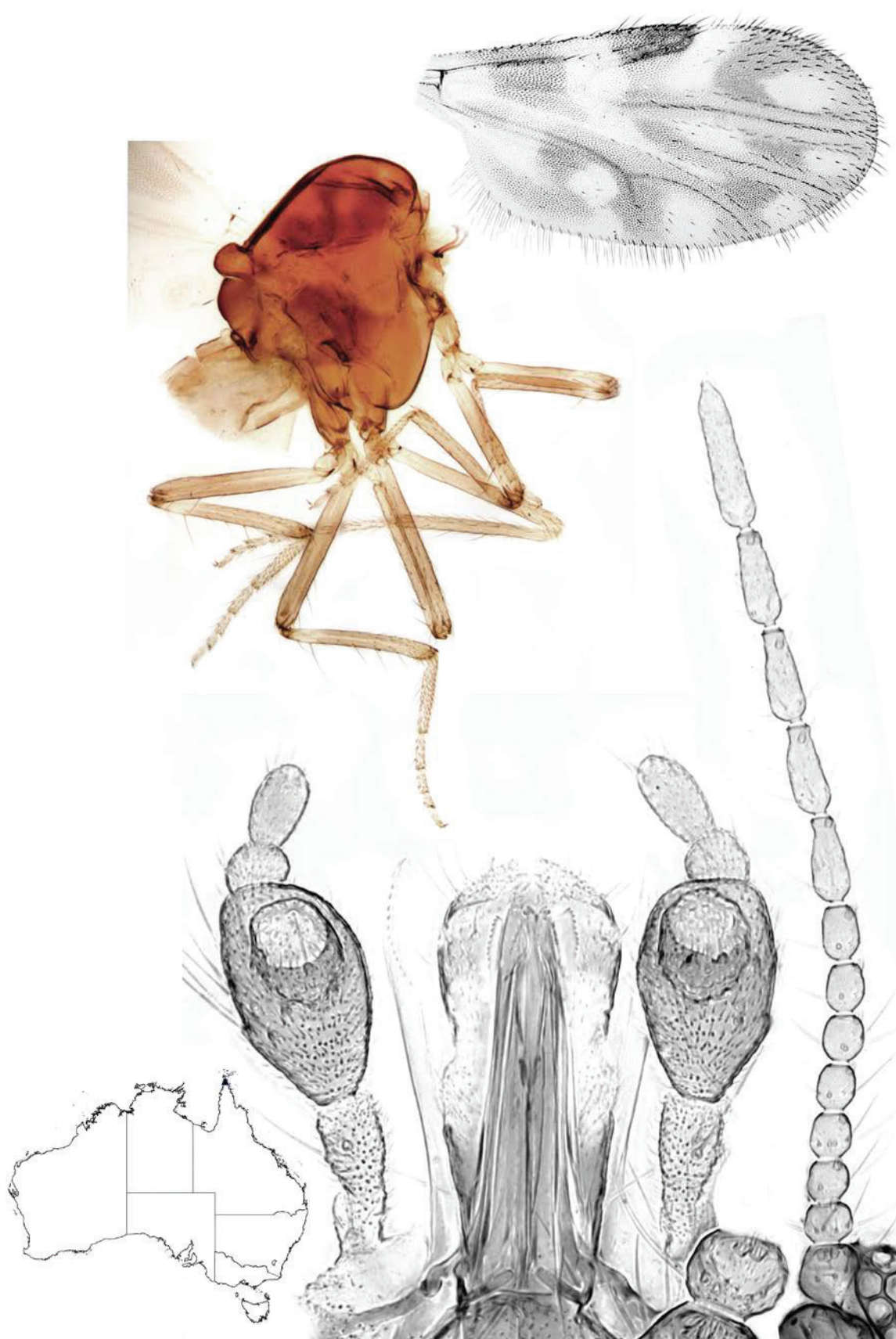


C. nattaiensis

Culicoides pseudopalpalis

Culicoides pseudopalpalis Wirth & Hubert 1989: 394

Synonyms	Nil.
Distribution	Northern tip of Cape York Peninsula. Widespread in SE Asia.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; apical pale spot in cell r_3 closer than its own diameter from apex of the cell; cell m_1 with 2 pale spots; base of wing with large pale area extending from costa to anal cell may be interrupted by dark marking over M-Cu; base of costa included in pale marking. 3rd palpal segment at least twice as long and as wide as 2nd segment and bearing large pit; SCo present on flagellomere 12.

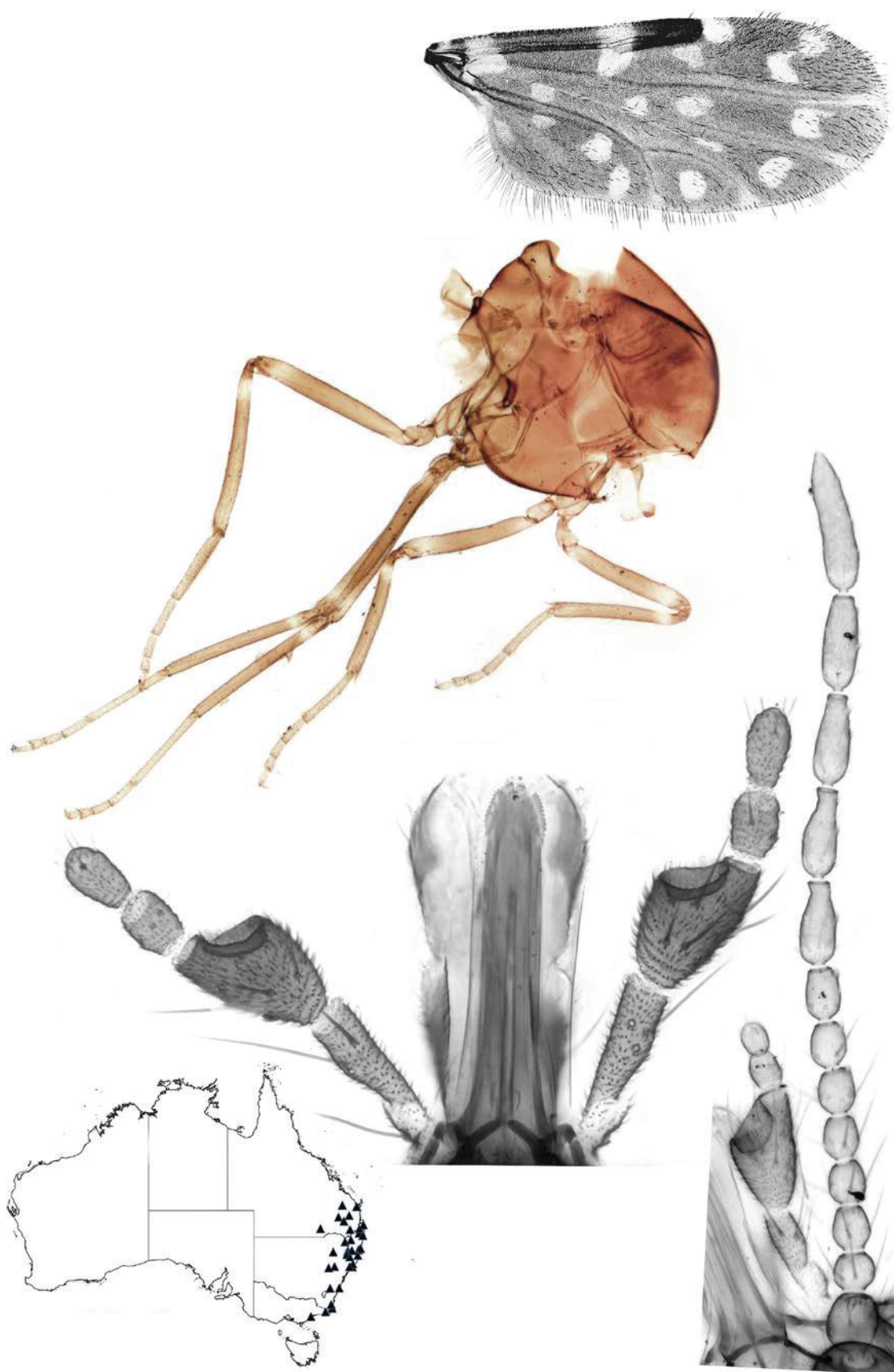


C. pseudopalpis

Culicoides sigmoidus

Culicoides sigmoidus Lee & Reye 1963: 359 (ACT)

Synonyms	Nil.
Distribution	SE Qld, eastern NSW, Victoria.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with apex of veins M ₁ , M ₂ , M ₄ and M-Cu covered by a small pale marking; apical marking in cell r ₃ sigmoidal.

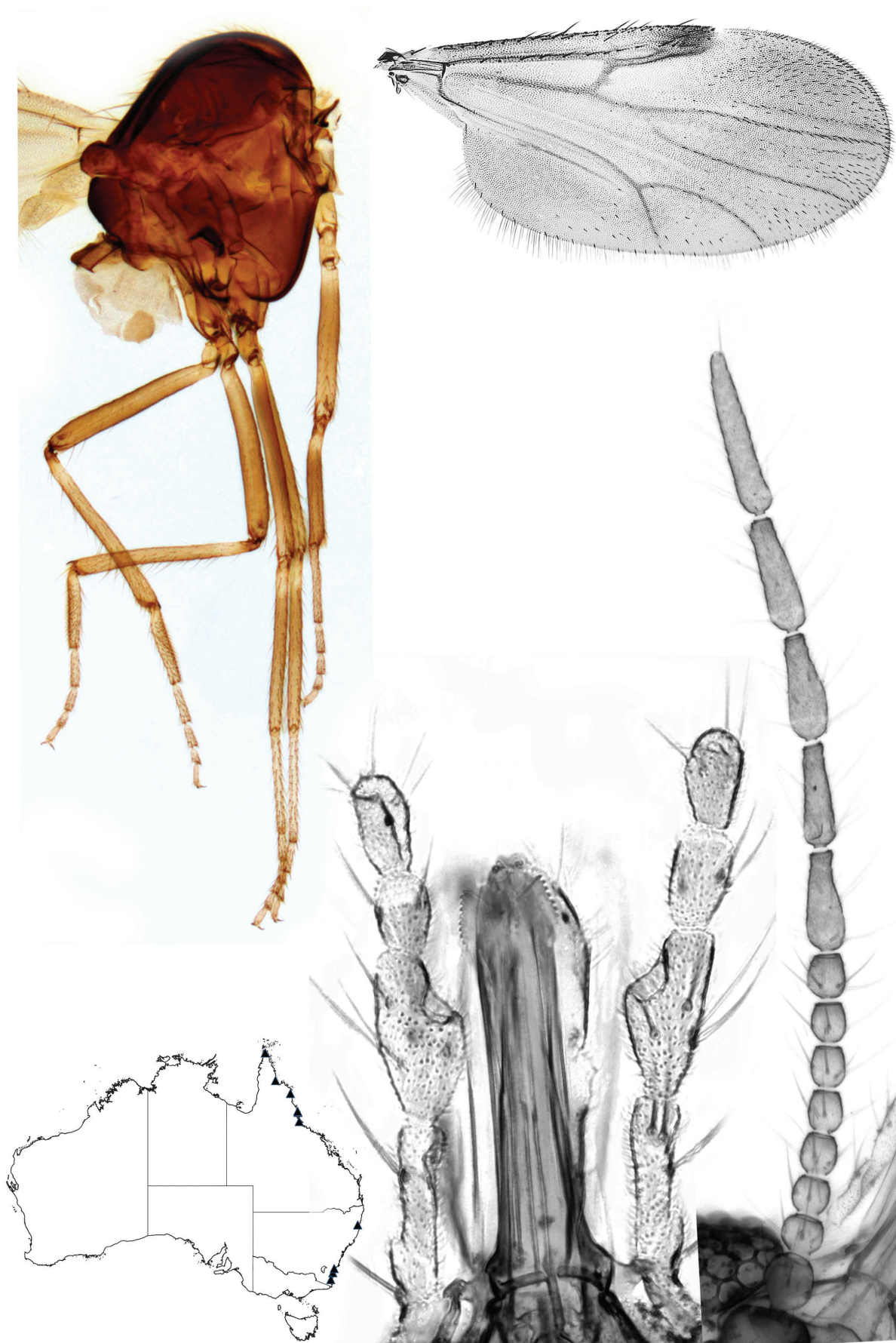


C. sigmoidus

Culicoides smeei

Culicoides smeei Tokunaga 1960: 73

Synonyms	Nil.
Distribution	NSW and Northern Qld.
Hosts	Avian, bovids, marsupials (Kay et al 1978).
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing without markings over r-m cross-vein. Tibial comb with 4 spines; fore knee contrastingly dark against adjacent pale bands. Thorax with anepisternite with dark marking. DNA analysis reveals a difference between Qld and NSW populations suggesting the presence of a potential cryptic species.

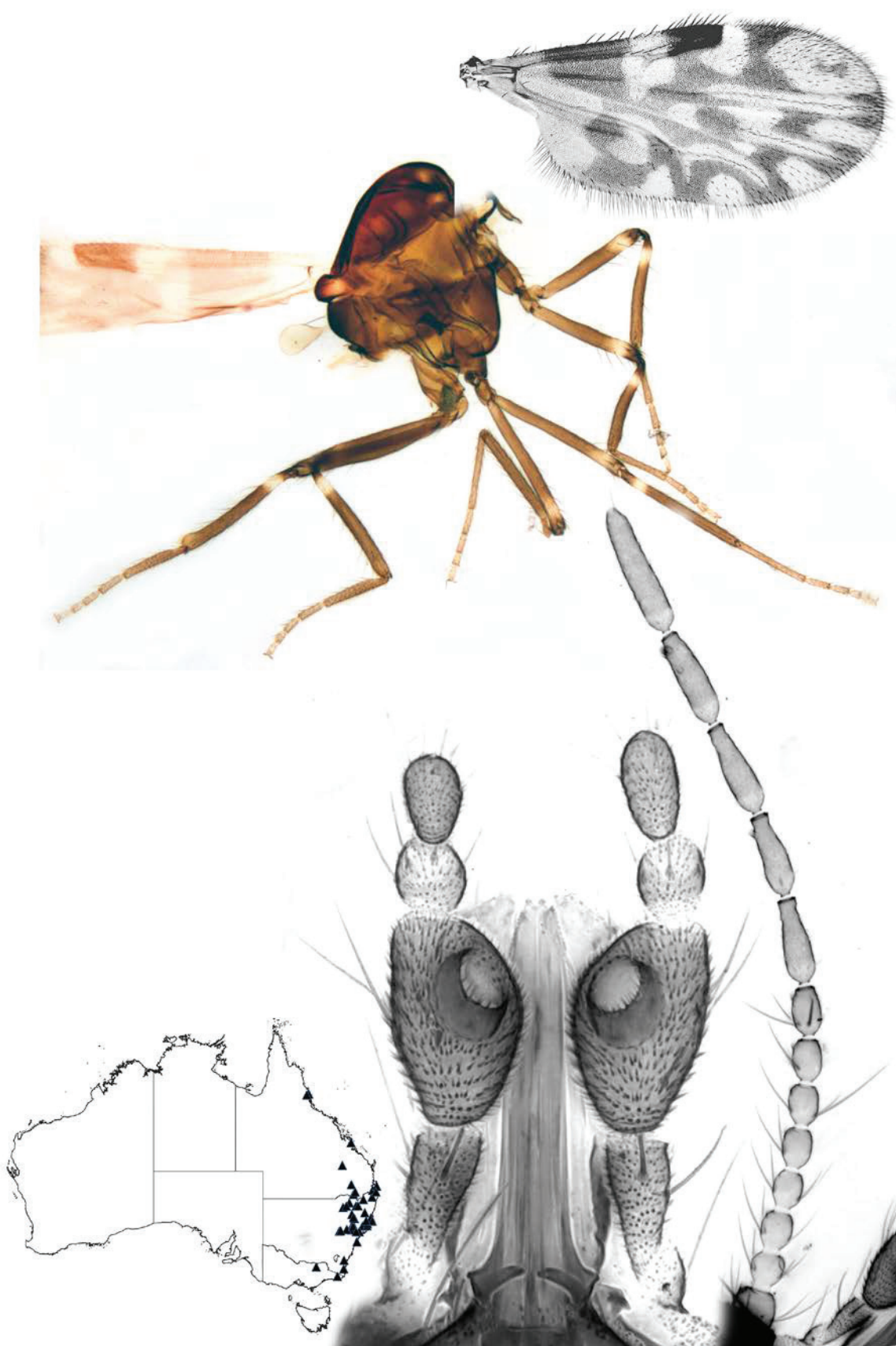


C. smeei

Culicoides williwilli

Culicoides williwilli Lee & Reye, 1955: 234 (NSW)

Synonyms	Nil.
Distribution	Eastern Qld, eastern NSW, Victoria.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; base of vein M-Cu included in pale spot; medial part of vein M_4 included in pale marking; cell r_3 with pale marking present immediately posterior to poststigmatic pale spot. Hind femora dark to apex.

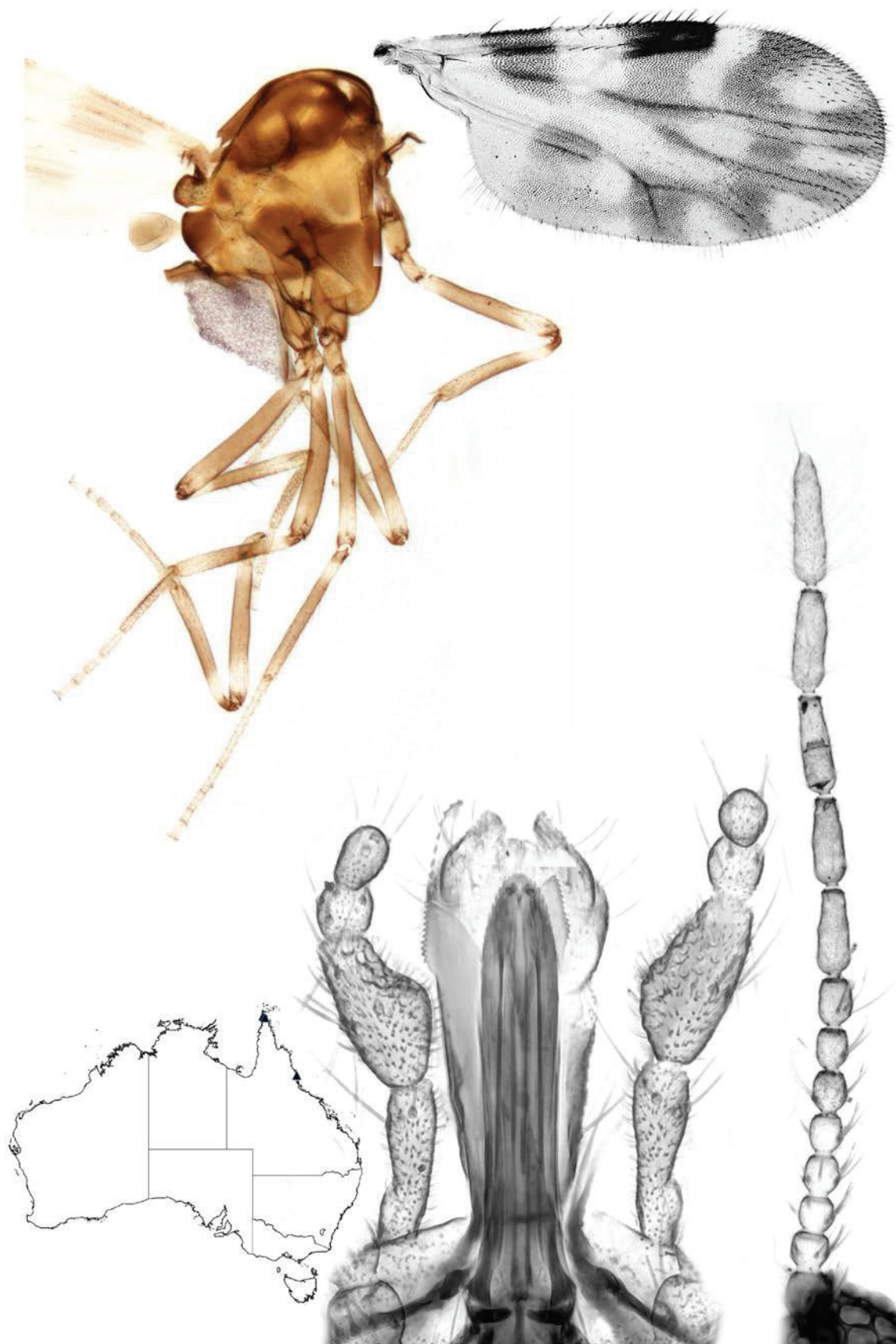


C. williwilli

Culicoides yasumatsui

Culicoides yasumatsui Tokunaga 1941: 113 (Micronesia)

Synonyms	<i>lingensis</i> Tokunaga 1963: 129
Distribution	Northern Qld. Also in SE Asia, PNG, Solomon Is, Vanuatu.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; cell m_1 with 2 pale spots; base of vein M-Cu included in pale spot; vein M_4 not included in pale markings; poststigmatic pale spot reaching vein M_1 . 3rd palpal segment without pit.

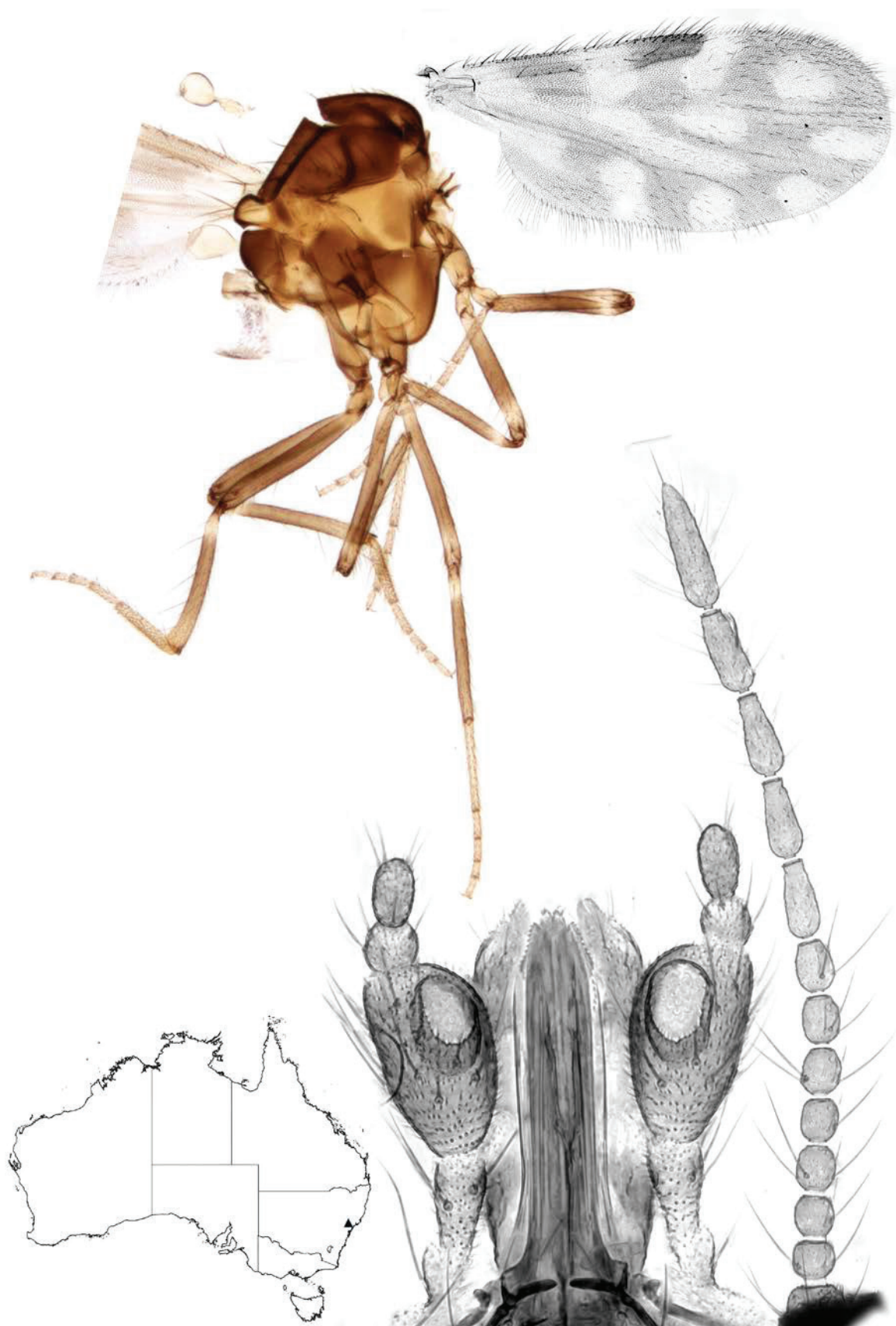


C. yasumatsui

Culicoides Williwilli Group sp no 1

Culicoides Williwilli Gp sp no 1 Dyce et al 2007:68

Synonyms	Nil.
Distribution	NSW and Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; base of vein M-Cu covered by small dark marking; medial part of vein M_4 not included in pale marking; apical pale spot in cell r_3 distant from wing margin. 3rd palpal segment distinctly swollen medially. Pale markings evident on scutum; anepisternite with distinctly dark, ovoid marking along anterior edge. SCo present on 1-8,10,12. Female Williwilli Gp sp no 1, 2 and 3 are difficult to separate. Additionally, DNA analysis has revealed the existence of a large number of potential cryptic species within this complex.

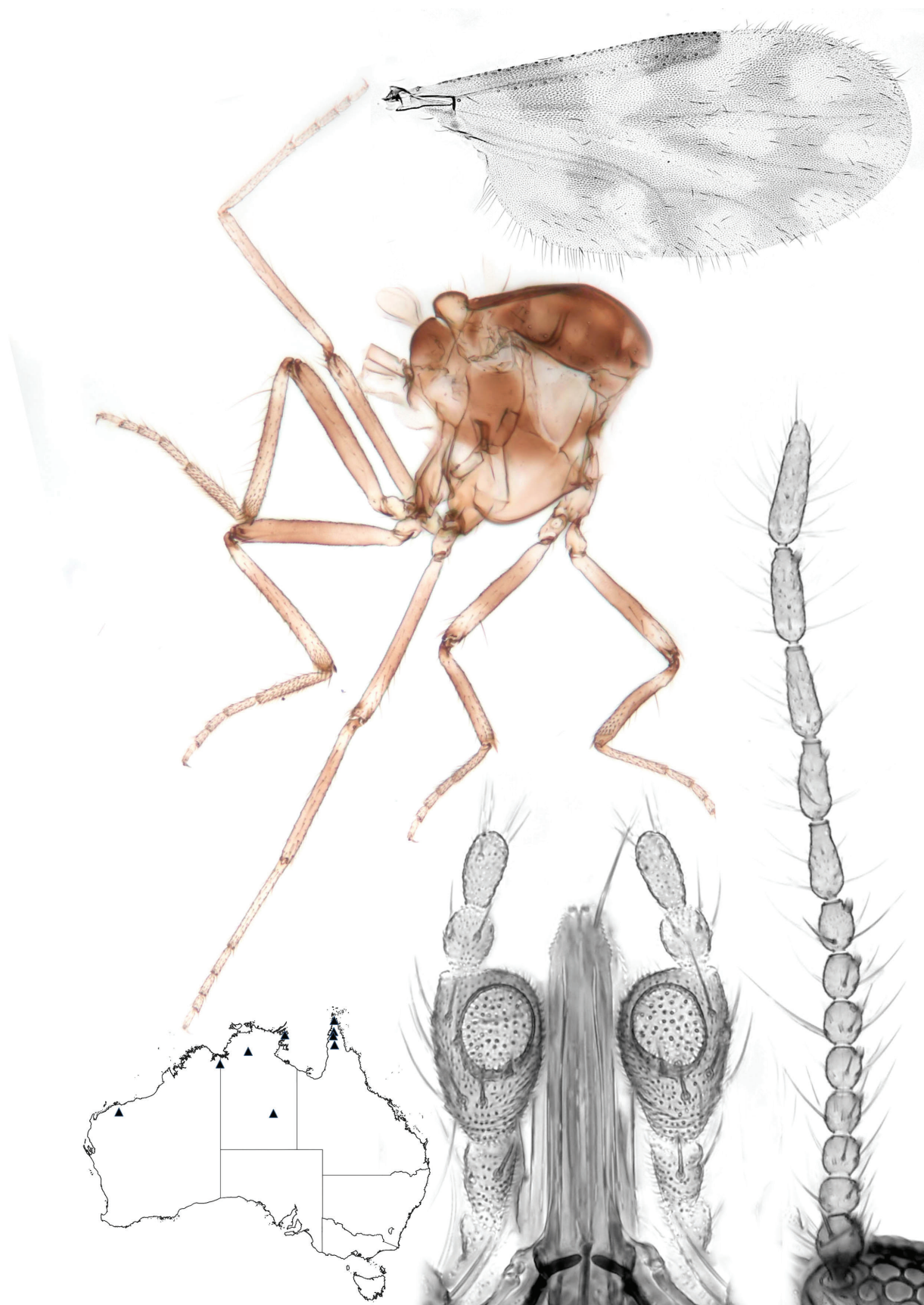


C. Williwilli Gp sp no 1

Culicoides Williwilli Group sp no 2

Culicoides Williwilli Gp sp no 2 Dyce et al 2007:68

Synonyms	Nil.
Distribution	Across northern Australia south to Pilbara and Central Australia.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; base of vein M-Cu included in pale spot; medial part of vein M_4 not included in pale marking; apical pale spot in cell r_3 distant from wing margin. Pale markings evident on scutum. SCo present on 1-8,10,12. Female Williwilli Gp sp no 1, 2 and 3 are difficult to separate. Additionally, DNA analysis has revealed the existence of a large number of potential cryptic species within this complex.

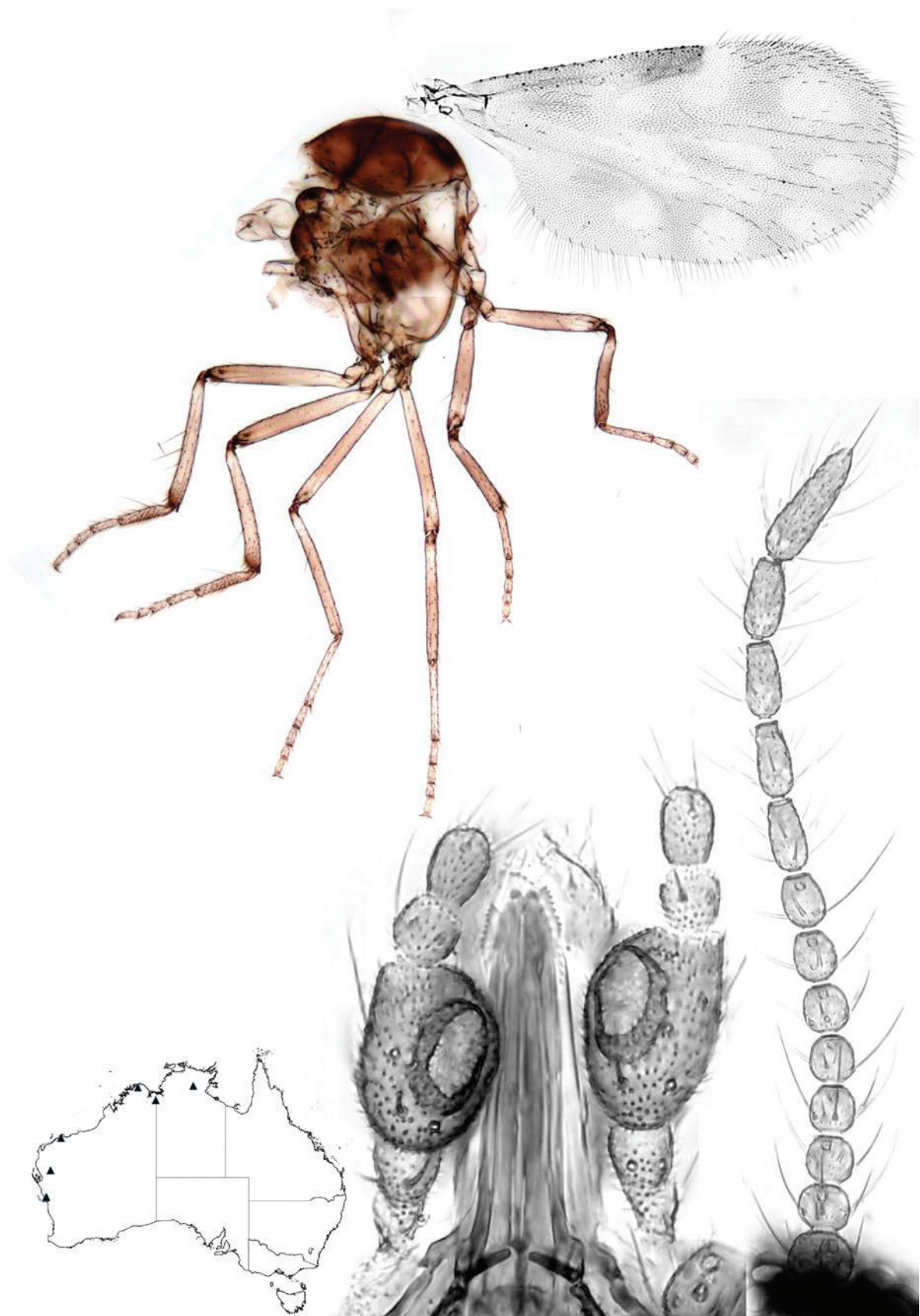


C. Williwilli Gp sp no 2

Culicoides Williwilli Group sp no 3

Culicoides Williwilli Gp sp no 3 Dyce et al 2007:69

Synonyms	Nil.
Distribution	Top End of NT, Kimberley, Pilbara and Gascoyne regions of WA.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; base of vein M-Cu not included in pale spot; medial part of vein M_4 not included in pale marking; apical pale spot in cell r_3 distant from wing margin. 3rd palpal segment markedly swollen. Pale markings evident on scutum. SCo present on 1-8,10,12. Female Williwilli Gp sp no 1, 2 and 3 are difficult to separate. Additionally, DNA analysis has revealed the existence of a large number of potential cryptic species within this complex.

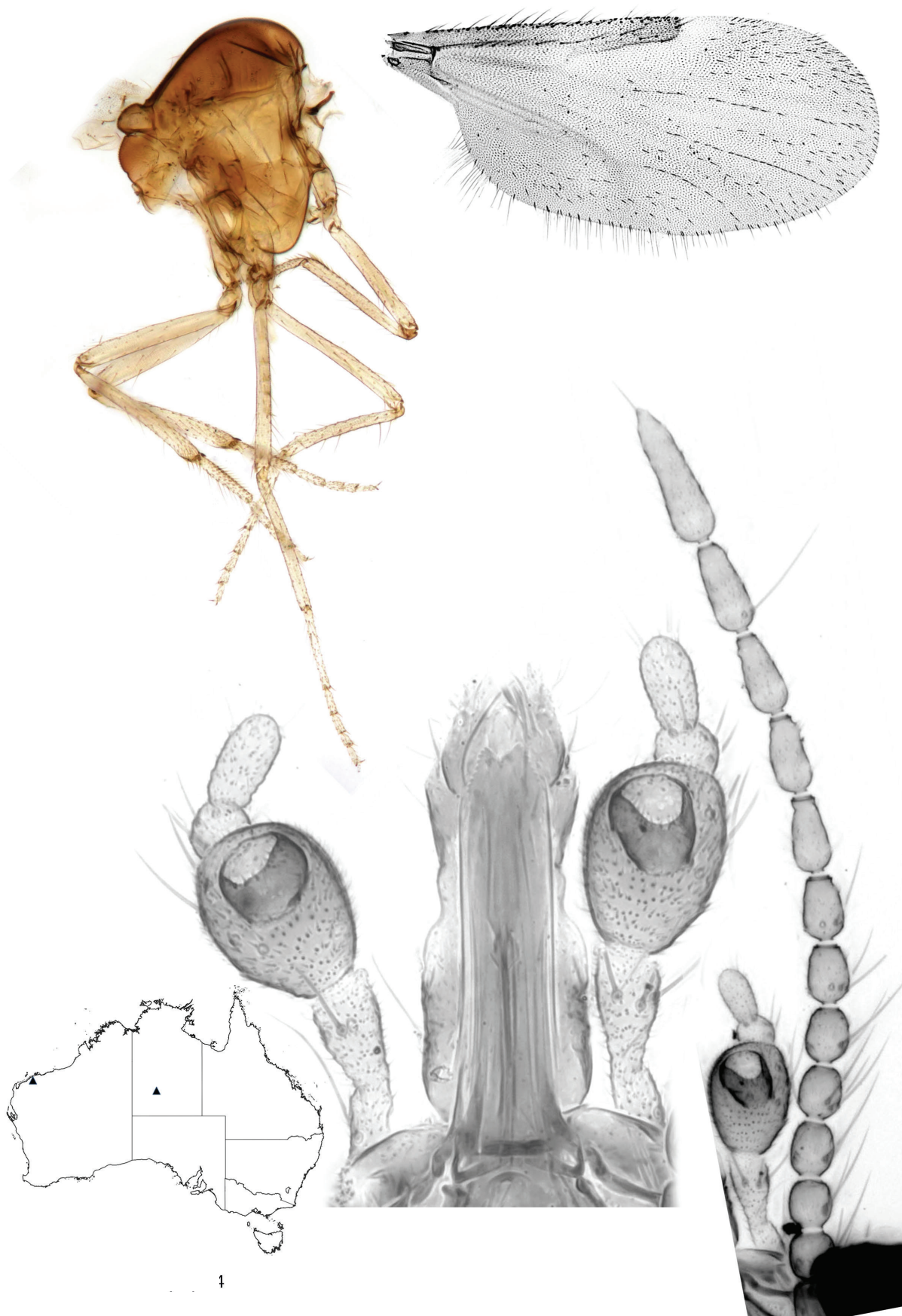


C. Williwilli Gp sp no 3

Culicoides Williwilli Group sp no 4

Culicoides Williwilli Gp sp no 4 Dyce et al 2007:69

Synonyms	Nil.
Distribution	Central Australia and Pilbara region of WA.
Hosts	Unknown, palpal morphology suggests avian.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing without pale markings distal to poststigmatic pale spot. Tibial comb with 4 spines; fore knee contrastingly dark against adjacent pale bands; anepisternite entirely pale. SCo present on 1-8,10,12.



C. Williwilli Gp sp no 4

Culicoides Williwilli Group sp no 6

Culicoides Williwilli Gp sp no 6 Dyce et al 2007:70

Synonyms	Nil.
Distribution	Rainforest areas of northern Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; cell m_1 with 2 pale spots; base of vein M-Cu included in pale spot; vein M_4 not included in pale markings; poststigmatic pale spot not reaching vein M_1 ; apical pale spot in cell r_3 not crossing vein M_1 .

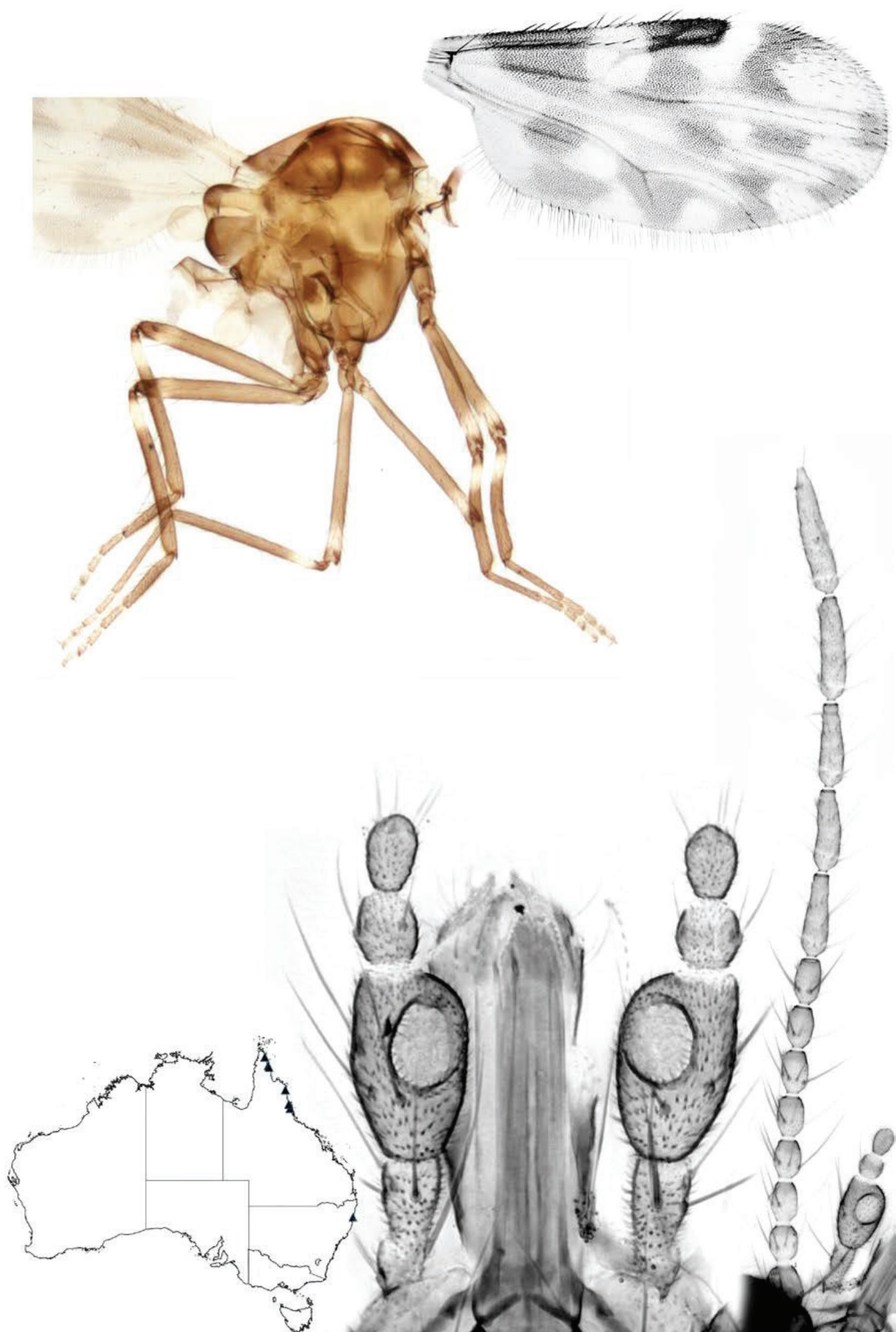


C. Williwilli Gp sp no 6

Culicoides Williwilli Group sp no 7

Culicoides Williwilli Gp sp no 7 Dyce et al 2007:70

Synonyms	Nil.
Distribution	Rainforest habitat in NSW and Qld.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; base of vein M-Cu included in pale spot; medial part of vein M_4 included in pale marking; cell r_3 with pale marking present immediately posterior to poststigmatic pale spot. Hind femora with subapical pale band.



C. Williwilli Gp sp no 7

Culicoides Williwilli Group sp no 9

Culicoides Williwilli Gp sp no 9 Dyce et al 2007:71

Synonyms	Nil.
Distribution	Eastern Victoria and NSW.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; cell m_1 with 2 pale spots; base of vein M-Cu included in pale spot; vein M_4 not included in pale markings; poststigmatic pale spot not reaching vein M_1 ; apical pale spot in cell r_3 crossing vein M_1 .

Antennae, palpus and thorax of specimens in hand are unsuitable for photography

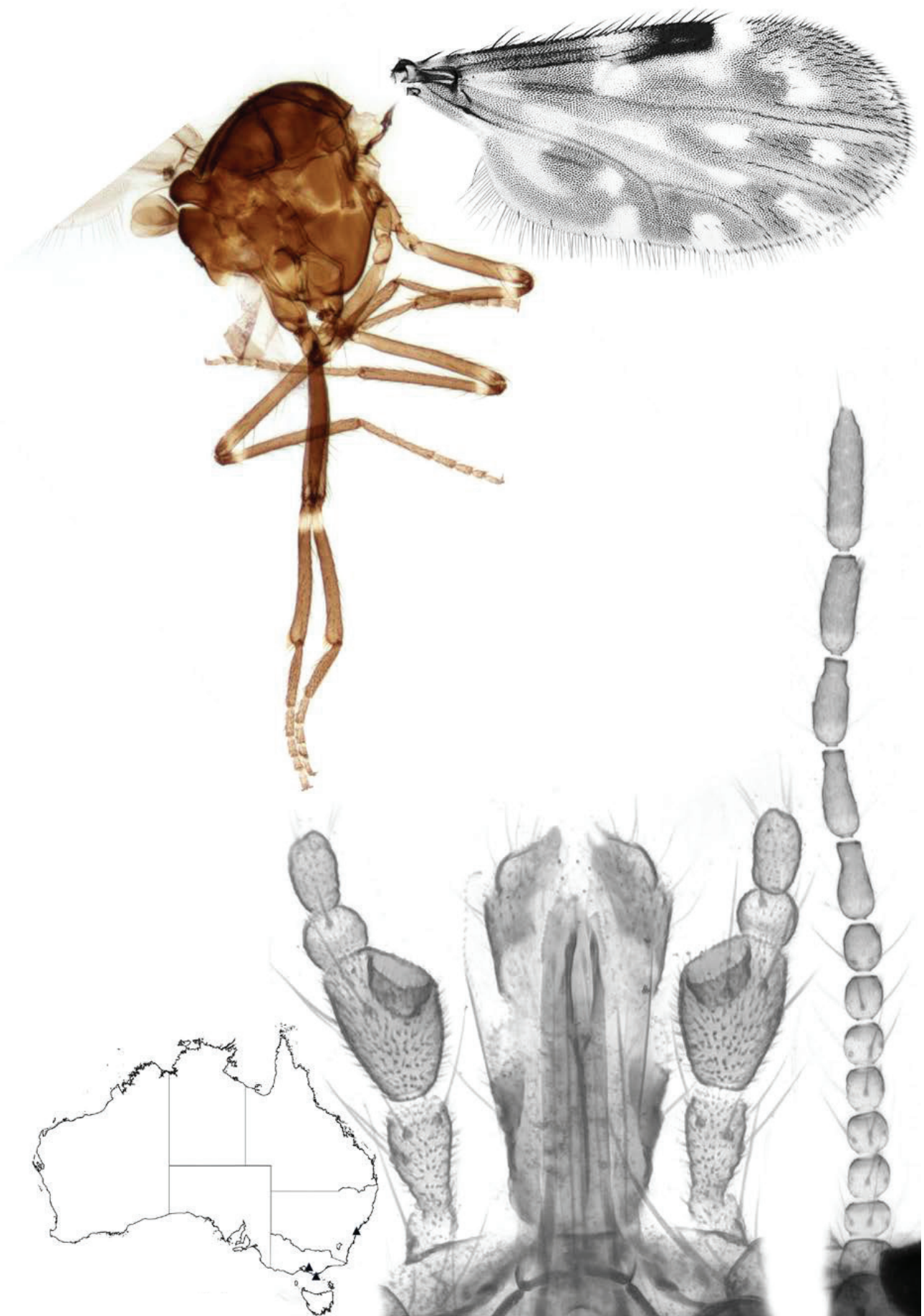


C. Williwilli Gp sp no 9

Culicoides Williwilli Group sp no 18

Culicoides Williwilli Gp sp no 18 Dyce et al 2007:74

Synonyms	Nil.
Distribution	Eastern NSW and Victoria.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; cell m_1 with 3 pale spots; ovoid pale marking in cell m_4 ; medial part of vein M_1 not included in pale marking; base of vein M included in pale spot; subapical pale marking in cell r_3 crescent-shaped; apical pale spot in cell r_3 narrow, strip-like; pale marking over r-m cross-vein narrowed over vein Rs.

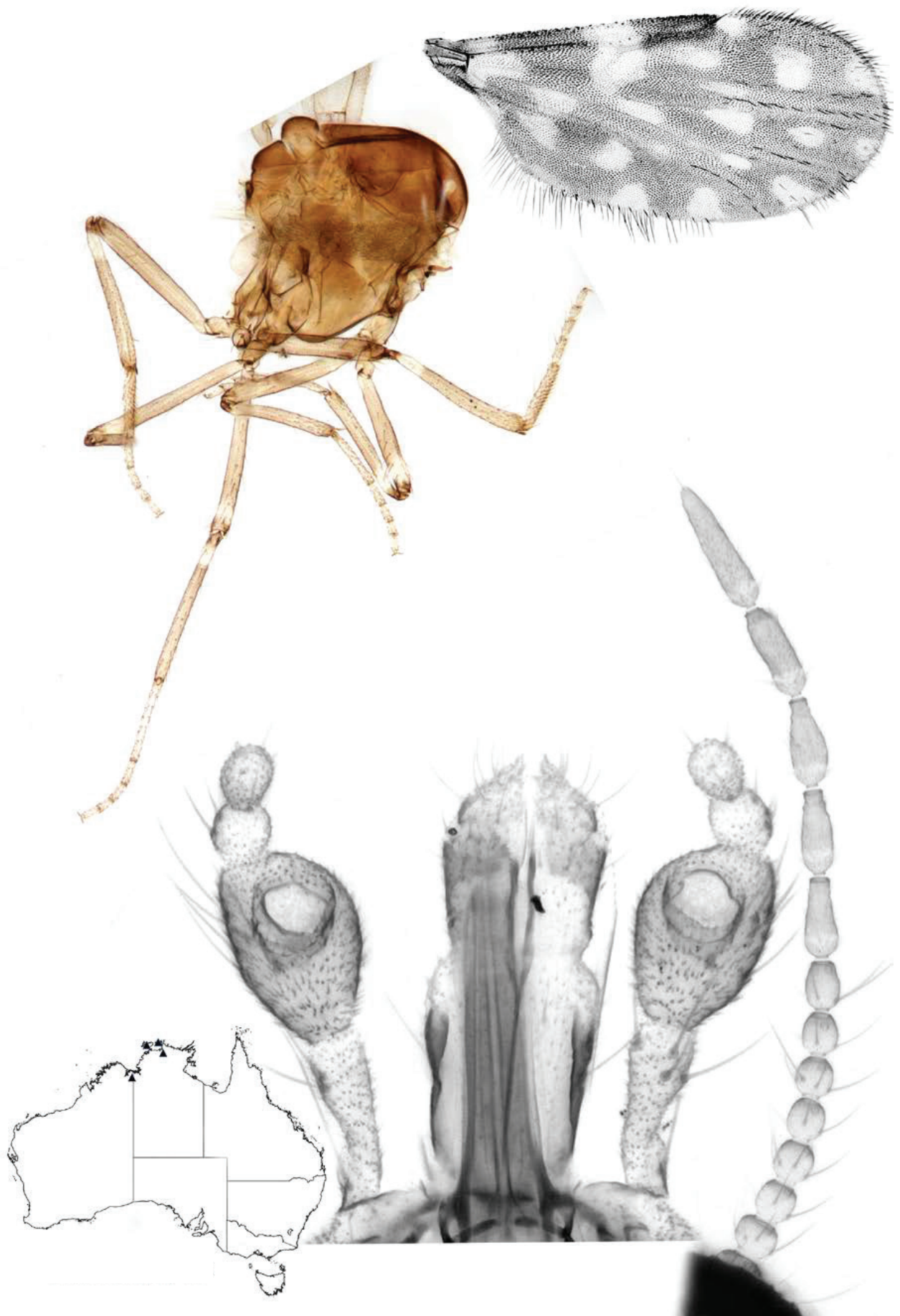


C. Williwilli Gp sp no 18

Culicoides Williwilli Group sp no 19

Culicoides Williwilli Gp sp no 19 (Dyce et al 2007:74)

Synonyms	Nil.
Distribution	Top End of NT.
Hosts	Unknown.
Vector status	Unknown.
Immature habitat	Unknown.
Diagnosis	Can be separated from all other Australian species of <i>Culicoides</i> by the following suite of characters: Wing with cell r_2 dark to apex; cell m_1 with 3 pale spots; ovoid pale marking in cell m_4 ; medial part of vein M_1 not included in pale marking; base of vein M included in pale spot; subapical pale marking in cell r_3 rounded.



C. Williwilli Gp sp no 19

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Appendix

Subgeneric group	Species	S Co distribution
<i>Avaritia</i>	<i>C. actoni</i>	1,10-13
<i>Avaritia</i>	<i>C. minimus</i>	1,11-13
<i>Avaritia</i>	<i>C. boophagus</i>	1,9-13
<i>Avaritia</i>	<i>C. wadai</i>	1,9-13
<i>Avaritia</i>	<i>C. brevipalpis</i>	1,9-13
<i>Avaritia</i>	<i>C. asiana</i>	1,9-13
<i>Avaritia</i>	<i>C. brevitarsis</i>	1,10-13
<i>Avaritia</i>	<i>C. imicola</i>	1,10-13
<i>Avaritia</i>	<i>C. nudipalpis</i>	1,10-13
<i>Avaritia</i>	<i>C. jacobsoni</i>	1,9-13
<i>Avaritia</i>	<i>C. #Avaritia</i> sp no 2	1,9-13
<i>Avaritia</i>	<i>C. dumdumi</i>	1,9-13
<i>Avaritia</i>	<i>C. flavipunctatus</i>	1,9-13
<i>Avaritia</i>	<i>C. fulvus</i>	1,9-13
<i>Avaritia</i>	<i>C. obscurus</i>	1,9-13
<i>Avaritia</i>	<i>C. obsoletus</i>	1,9-13
<i>Avaritia</i>	<i>C. orientalis</i>	1,9-13
<i>Avaritia</i>	<i>C. tainanus</i>	1,9-13
<i>Drymodesmyia</i>	<i>C. loughnani</i>	1,9-13
<i>Haemophoructus</i>	<i>C. calcaratus</i>	1,5,7,9-13

Cont'd

Subgeneric group	Species	SCo distribution
<i>Hoffmania</i>	<i>C. novaguineanus</i>	1, 9-13
<i>Hoffmania</i>	<i>C. peregrinus</i>	1, 9-13
<i>Hoffmania</i>	<i>C. sumatrae</i>	1, 9-13
<i>Marksomyia</i>	<i>C. zentae</i>	1{2-6}7, 9-13
<i>Marksomyia</i>	<i>C. kayi</i>	1{6,7}8-13
<i>Marksomyia</i>	<i>C. dycei</i>	1{6-8} 9-13
<i>Marksomyia</i>	<i>C. marksii</i>	1{8} 9-13
<i>Marksomyia</i>	<i>C. parvimaculatus</i>	1, 9-13
<i>Meijerehelea</i>	<i>C. arakawae</i>	1-12
<i>Meijerehelea</i>	<i>C. guttifer</i>	1-3{4-8}9-12
<i>Meijerehelea</i>	<i>C. histrio</i>	1-12
<i>Monoculicoides</i>	<i>C. sonorensis</i>	1{4}5-8
<i>Remmia</i>	<i>C. oxystoma</i>	1, 6-8
Antennalis Gp	<i>C. #Antennalis Gp sp 1</i>	1, 9-13
Antennalis Gp	<i>C. #Antennalis Gp sp 2</i>	1{8}9-13
Antennalis Gp	<i>C. #Antennalis Gp sp 3</i>	1{3}5, 7, 9-13
Antennalis Gp	<i>C. #Antennalis Gp sp 4</i>	1, 5, 7, 9-13
Antennalis Gp	<i>C. #Antennalis Gp sp 5</i>	1{4}5-7{8}9-13
Antennalis Gp	<i>C. #Antennalis Gp sp 6</i>	1{7}9-13

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Subgeneric group	Species	S Co distribution
Antennalis Gp	<i>C. #Antennalis</i> Gp sp 7	1[4]5(6)7,9-13
Antennalis Gp	<i>C. #Antennalis</i> Gp sp 8	1,9-13
Antennalis Gp	<i>C. #Antennalis</i> Gp sp 9	1[2,5,7]9-13
Antennalis Gp	<i>C. #Antennalis</i> Gp sp 10	1,8-13
Antennalis Gp	<i>C. #Antennalis</i> Gp sp 11	1,9-13
Antennalis Gp	<i>C. #Antennalis</i> Gp sp 14	1,5,7,9-13
Antennalis Gp	<i>C. antennalis</i>	1,9-13
Antennalis Gp	<i>C. gladysae</i>	1,9-13
Antennalis Gp	<i>C. mykityowyczi</i>	1[7]9-13
Bancrofti Gp	<i>C. bancrofti</i>	1,9-13
Bancrofti Gp	<i>C. hornsbyensis</i>	1-13
Clavipalpis Gp	<i>C. #Clavipalpis</i> Gp sp 1	1,5-8
Clavipalpis Gp	<i>C. #Clavipalpis</i> Gp sp 19	1,6-8
Clavipalpis Gp	<i>C. #Clavipalpis</i> Gp sp 2	1,3-8
Clavipalpis Gp	<i>C. #Clavipalpis</i> Gp sp 6	1,5-8
Clavipalpis Gp	<i>C. #Clavipalpis</i> Gp sp 8	1-8
Clavipalpis Gp	<i>C. #Clavipalpis</i> Gp sp 9	1-8
Clavipalpis Gp	<i>C. #Clavipalpis</i> Gp sp 10	1,6-8
Clavipalpis Gp	<i>C. #Clavipalpis</i> Gp sp 11	1-8
Clavipalpis Gp	<i>C. #Clavipalpis</i> Gp sp 13	1,5-8,10

Cont'd

Subgeneric group	Species	S Co distribution
Clavipalpis Gp	<i>C. #Clavipalpis Gp sp 14</i>	1,5-8
Clavipalpis Gp	<i>C. bunrooensis</i>	1 2 3-8
Clavipalpis Gp	<i>C. clavipalpis</i>	1 5 6-8
Clavipalpis Gp	<i>C. marginalis</i>	1-8
Clavipalpis Gp	<i>C. notatus</i>	1 2,3,4 5-8
Clavipalpis Gp	<i>C. parviscriptus</i>	1 2,3,4 5-8
Coronalis Gp	<i>C. #Coronalis Gp sp 1</i>	1,5-8
Coronalis Gp	<i>C. coronalis</i>	1,5-8
Immaculatus Gp	<i>C. shivasi</i>	1-8
Immaculatus Gp	<i>C. immaculatus</i>	1-8
Kusaiensis Gp	<i>C. kusaiensis</i>	1,3,5,7,9-12
Kusaiensis Gp	<i>C. leei</i>	1 2 3 4 5,7,9-12
Melanesiae Gp	<i>C. #Melanesiae Gp sp 1</i>	n/a
Melanesiae Gp	<i>C. #Melanesiae Gp sp 3</i>	n/a
Melanesiae Gp	<i>C. leanderensis</i>	1 2 3,5 6 7 8 9-13
Melanesiae Gp	<i>C. melanesiae</i>	1 3 5 7 9-13
Molestus Gp	<i>C. #Molestus Gp sp 1</i>	1 5-7 9-12
Molestus Gp	<i>C. #Molestus Gp sp 2</i>	1 2 3-8
Molestus Gp	<i>C. #Molestus Gp sp 3</i>	1 2,3 5-8

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Subgeneric group	Species	S Co distribution
Molestus Gp	<i>C. #Molestus Gp sp 4</i>	1-12
Molestus Gp	<i>C. #Molestus Gp sp 5</i>	1(3)5-8
Molestus Gp	<i>C. #Molestus Gp sp 6</i>	1,5-8
Molestus Gp	<i>C. #Molestus Gp sp 7</i>	1(2)3-8
Molestus Gp	<i>C. molestus</i>	1,5-8
Molestus Gp	<i>C. subimmaculatus</i>	1,3(4)5-8
Molestus Gp	<i>C. submagnesianus</i>	1(3)5-8
Ornatus Gp	<i>C. #Ornatus Gp sp 3</i>	n/a
Ornatus Gp	<i>C. #Ornatus Gp sp 6</i>	1(2)3,4(6)9-12
Ornatus Gp	<i>C. #Ornatus Gp sp 8</i>	1-12
Ornatus Gp	<i>C. #Ornatus Gp sp 9</i>	1,10-12
Ornatus Gp	<i>C. #Ornatus Gp sp 10</i>	1(9)11-12
Ornatus Gp	<i>C. circumbasalis</i>	1-12
Ornatus Gp	<i>C. cordiger</i>	1-13
Ornatus Gp	<i>C. flumineus</i>	1-12
Ornatus Gp	<i>C. longior</i>	1,2(3-8)9-12
Ornatus Gp	<i>C. marmoratus</i>	1(2-3)4(5-8)9-12
Ornatus Gp	<i>C. ornatus</i>	1(2-9)10-12
Ornatus Gp	<i>C. pangkorensis</i>	1-7(8)9-12(13)
Ornatus Gp	<i>C. papuensis</i>	1-13

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Subgeneric group	Species	S Co distribution
Ornatus Gp	<i>C. peliliouensis</i>	1(2-4)5-7(8)9-13
Purus Gp	<i>C. capricornae</i>	1,9-13
Purus Gp	<i>C. dubiosum</i>	n/a
Purus Gp	<i>C. elizabethae</i>	1,9-13
Purus Gp	<i>C. purus</i>	1-3(4)(5)(7)9-13
Purus Gp	<i>C. queenslandae</i>	1,9-13
Shermani Gp	<i>C. #Shermani Gp sp 1</i>	1,3-13
Shermani Gp	<i>C. ardleyi</i>	1,5-8
Shermani Gp	<i>C. dryadeus</i>	1,9-13
Shermani Gp	<i>C. interrogatus</i>	1,9-13
Shermani Gp	<i>C. mackerrasi</i>	1(3)5(6)7,9-12
Shermani Gp	<i>C. morensis</i>	1(2-3)(5)(7)9(10)11-12(13)
Shermani Gp	<i>C. neometanesiae</i>	1(4-6)(8)9-13
Shermani Gp	<i>C. rabauli</i>	1(2)3(4-8)9-13
Shermani Gp	<i>C. shermani</i>	1-5(6)7(8)9(10)11-13
Victoriae Gp	<i>C. #Victoriae Gp sp 2</i>	1,3,5-7,9-13
Victoriae Gp	<i>C. #Victoriae Gp sp 3</i>	1,9-13
Victoriae Gp	<i>C. #Victoriae Gp sp 5</i>	1,9-13
Victoriae Gp	<i>C. #Victoriae Gp sp 6</i>	1(3-8)9-13

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Subgeneric group	Species	S Co distribution
Victoriae Gp	<i>C. #Victoriae Gp sp 7</i>	1[5]6-13
Victoriae Gp	<i>C. #Victoriae Gp sp 8</i>	1-3,5,7,9-13
Victoriae Gp	<i>C. #Victoriae Gp sp 10</i>	1,9-13
Victoriae Gp	<i>C. #Victoriae Gp sp 12</i>	1,9-13
Victoriae Gp	<i>C. #Victoriae Gp sp 14</i>	1[2-8]9-13
Victoriae Gp	<i>C. #Victoriae Gp sp 15</i>	1[7,8]9-13
Victoriae Gp	<i>C. bundyensis</i>	1[3][5-8]9-13
Victoriae Gp	<i>C. cuniculus</i>	1[7]9-13
Victoriae Gp	<i>C. fulbrighti</i>	1,9-13
Victoriae Gp	<i>C. henryi</i>	1[8]9-13
Victoriae Gp	<i>C. mcmillani</i>	1[5][7]9-13
Victoriae Gp	<i>C. multimaculatus</i>	1[5][7]9-13
Victoriae Gp	<i>C. pallidothorax</i>	1[2-6]7[8]9-13
Victoriae Gp	<i>C. victoriae</i>	1[3,5-7]9[10]11-13
Victoriae Gp	<i>C. waringi</i>	1[9]10-11[12]13
Williwilli Gp	<i>C. #Williwilli Gp sp 1</i>	1-8,10,12
Williwilli G	<i>C. #Williwilli Gp sp 2</i>	1-8,10,12
Williwilli Gp	<i>C. #Williwilli Gp sp 3</i>	1-8,10,12
Williwilli Gp	<i>C. #Williwilli Gp sp 4</i>	1-8,10,12
Williwilli Gp	<i>C. #Williwilli Gp sp 6</i>	1,8,10,12

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Subgeneric group	Species	SCo distribution
Williwilli Gp	<i>C. #Williwilli Gp sp 7</i>	1,5-8,10,12
Williwilli Gp	<i>C. #Williwilli Gp sp 9</i>	1,3,5,7,8,10,12
Williwilli Gp	<i>C. #Williwilli Gp sp 18</i>	1-8,10,12
Williwilli Gp	<i>C. #Williwilli Gp sp 19</i>	1-8,10,12
Williwilli Gp	<i>C. austropalpalis</i>	1-11
Williwilli Gp	<i>C. narrabeenensis</i>	1-8,10,12
Williwilli Gp	<i>C. nattaensis</i>	1, {3, 5, 6} 7, 8, 10, 1
Williwilli Gp	<i>C. pseudopalpalis</i>	1-12
Williwilli Gp	<i>C. sigmoidus</i>	1{2-4}5-12
Williwilli Gp	<i>C. smeei</i>	1,8,10,12
Williwilli Gp	<i>C. williwilli</i>	1{3-4}5{6}7-8,10,12
Williwilli Gp	<i>C. yasumatsui</i>	1{6-7}8,10,12