



## A pictorial key to the sections, groups, and species of the *Aedes* (*Diceromyia*) in the Afrotropical Region (Diptera: Culicidae)

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### Abstract

Nine species of the subgenus *Diceromyia* Theobald of genus *Aedes* Meigen in the Afrotropical Region are treated in a pictorial key based on diagnostic morphological features. Images of the diagnostic morphological structures of the adult head, thorax, abdomen, leg and wing are included. The medical importance of the Furcifer Group species in Africa was briefly reviewed.

**Key words:** Culicidae, mosquitoes, identification key, *Aedes*, Africa

### Introduction

Edwards (1941: 214) included five African species in his “Mosquitoes of the Ethiopian Region,” in the subgenus *Diceromyia* Theobald: (1) *Aedes* (*Diceromyia*) *adersi* (Edwards) (1917: 214), from Zanzibara; (2) *Aedes* (*Diceromyia*) *fascipalpis* (Edwards) (1912:19), from Tanzania; (3) *Aedes* (*Diceromyia*) *flavicollis* Edwards (1928: 269), from Lagos, Nigeria; (4) *Aedes* (*Diceromyia*) *furcifer* (Edwards) (1913: 48), from Sudan; and (5) *Aedes* (*Diceromyia*) *taylori* Edwards (1936: 55), from Gadau, Nigeria. In addition, De Meillon and Lavoipierre (1944: 57) described *Aedes* (*Diceromyia*) *zethus* (replacement name for *niveus* De Meillon 1943: 94) from Zambia; Wolfs (1958: 298) described *Aedes* (*Diceromyia*) *bananea* from Zaire; Ferrara (1974: 3) described *Aedes* (*Diceromyia*) *mefouensis* from Cameroon; and Huang (1986: 636) described *Aedes* (*Diceromyia*) *cordellieri* from Ivory Coast. Thus, the subgenus *Diceromyia* in the Afrotropical Region now consists of nine species.

To assist entomologists and other field workers in identification of mosquitoes from Africa, we provide a pictorial key as an add-on to the key of Huang (2001). A few additional characters, indicated by a double asterisks (\*\*), were added as needed to facilitate identification. Images of diagnostic morphological structures of the adult head, thorax, abdomen, leg and wing are also included in this supplemental pictorial key.

### Material and methods

This study is based on specimens in the mosquito collection of the Department of Entomology, National Museum of Natural History (USNM), Smithsonian Institution. Other specimens were borrowed from individuals and institutions noted in the acknowledgments. The terminology follows Harbach and Knight (1980, 1982) with the exception of “tarsal claws,” which is retained for “ungues.” Terminology for wing venation follows Belkin (1962). In this paper, we follow Edwards’ (1932) and Wilkerson *et al.* (2015) classification of the genus *Aedes*, retaining *Diceromyia* as subgenus of the genus *Aedes*.

## Result and discussion

Huang (2001) published a key to the *Aedes* Mosquitoes of the Afrotropical Region. The present paper includes a pictorial key for *Aedes (Diceromyia)* (Appendix 1) in the Afrotropical Region. This key is formatted so it can be merged with the key of Huang (2001). The following steps should be followed when using the key of Huang (2001) to merge the supplemental key:

A pictorial key to the sections, groups, and species of the *Aedes (Diceromyia)* in the Afrotropical Region (Diptera: Culicidae) (Appendix 1).

From Page 34 of the Huang (2001) key, with “**Part 3. Key to Subgenera of *Aedes*”, ADULTS**, follow the key to Page 35, then to Page 40, to Page 42b, to Page 44b, to Page 45 (Thorax. Postpronotum with all or most scales broad and flat), and then to Page 46a (\*\* Head. Pedicel with setae mixed with many broad, flat scales on mesal surface), to key out to *Diceromyia*. Using Appendix 1, the supplemental key, add Page 46aA (1<sup>st</sup> page), Page 46aB (2<sup>nd</sup> page), Page 46aC (3<sup>rd</sup> page A and 3<sup>rd</sup> page B), Page 46aD (4<sup>th</sup> page), Page 46aE (5<sup>th</sup> page), to key out to *Aedes (Diceromyia)*, for nine species.

**Classification.** The African subgenus *Diceromyia* can be further divided into two sections: (1) Section A is characterized by having the wing with broad dark scales mixed with broad white scales at least on anterior three veins (C, Sc and R). It is represented by three species-groups, the Adersi, Flavicolis, and Furcifer Groups. (2) Section B is characterized by having the wing with dark scales on all veins except for a small basal spot of white scales on costa. It is represented by two species-groups, the Fascipalpis and Zethus Groups. Thus, the African *Diceromyia* now consists of 5 species-groups. These five groups with their constituent nine species are indicated in Table 1.

**TABLE 1.** Classification of the subgenus *Diceromyia* of *Aedes* in the Afrotropical Region.

| GROUP          | SPECIES  |
|----------------|--|
| 1. ADERSI      | 1. <i>adersi</i> (Edwards)<br>2. <i>bananea</i> Wolfs                                    |
| 2. FLAVICOLLIS | 3. <i>flavicollis</i> Edwards<br>4. <i>mefouensis</i> Ferrara                            |
| 3. FURCIFER    | 5. <i>cordellieri</i> Huang<br>6. <i>furcifer</i> (Edwards)<br>7. <i>taylori</i> Edwards |
| 4. FASCIPALPIS | 8. <i>fascipalpis</i> (Edwards)  |
| 5. ZETHUS      | 9. <i>zethus</i> De Meillon and Lavoipierre  |

**Medical Importance.** Members of the Furcifer Group of *Aedes (Diceromyia)* have been incriminated as vectors of the yellow fever virus (YFV) in Africa, including Nuba mountains, Sudan (=Anglo-Egyptian Sudan) (Lewis, 1943), Burkino Faso (=Upper Volta) and Mali (Cordellier *et al.*, 1974), Gambia (Port and Wilkes, 1979), and Côte d'Ivoire (Digoutte, 1999). *Aedes furcifer* and *Ae. cordellieri* had head squash infection rates (HSIRs) by the indirect fluorescent antibody test of 29% and 3%, respectively, and *Ae. furcifer* transmitted the YFV in vitro at a transmission rate (TR) of 25%. This suggests that *Ae. furcifer* would be more important than *Ae. cordellieri* in YFV transmission between monkeys in West Africa (Jupp and Kemp, 2002).

Furcifer Group species are also known vectors of Chikungunya virus (CHIKV) in Zimbabwe (=Southern Rhodesia) (McIntosh *et al.*, 1964; Paterson and McIntosh, 1964) and South Africa (McIntosh *et al.*, 1977; Jupp, 1980). Several viruses such as YF, CHIK, Zika, dengue, Bouboui and Bunyamwera were isolated from Furcifer

Group species in Senegal (Cornet *et al.*, 1978, 1979; Diallo *et al.*, 2005, 2012, 2014a, b; Traoré-Lamizana *et al.*, 1990, 1996), and YFV in Burkino Faso (Baudon *et al.*, 1984, Robert *et al.*, 1993).

In Senegal, *Ae. furcifer* males were found infected with Zika virus (ZIKV) within a village, thus this species maybe involved in the transmission of this virus to humans. Using RT-PCR, ZIKV was also detected in *Ae. taylori* and other mosquito species in Senegal (Diallo *et al.*, 2014a). During the wet season of 2010, YFV was detected in field-collected mosquitoes in the Kédougou region in southeastern Senegal, including *Ae. furcifer* (52.2% of the infected pools), and *Ae. taylori* (6.0% of the infected pools). Spatially, YFV was detected from mosquitoes collected in all land cover classes, but mainly in forest canopies (49.2%). Human infection is likely mediated by *Ae. furcifer*, the only species found infected with YFV within villages. Villages containing YFV-infected mosquitoes were significantly closer to large forests (> 2 ha) than villages in which no infected mosquitoes were detected (Diallo *et al.* 2014b). Furthermore, in Senegal and Côte d'Ivoire, YFV was isolated from monkeys (as virus reservoirs), and from male mosquitoes, indicating vertical viral transmissions where YFV can survive from one rainy season to the next in *Aedes* eggs. Thus, there could be an increase in the number of human blood meals and the proportion of mosquito females apt to transmit the virus since they infect at a younger age (Digoutte, 1999). Robert *et al.* (1993) confirmed that *Ae. furcifer* is a major epidemic vector of the YFV, with the isolation of 25 virus strains from this species in Burkino Faso.

*Aedes furcifer*, which occurred abundantly in all land cover classes and landed frequently on humans in villages outside of houses, maybe the major bridge vector responsible for the spillover of sylvatic CHIKV to humans (Diallo *et al.*, 2012). *Aedes furcifer* was highly susceptible to both sylvatic and urban dengue 2 virus (DENV-2) strains. It is considered as one of the potential sylvatic vectors of DENV-2 in Senegal and other western parts of Africa (Diallo *et al.*, 2005).

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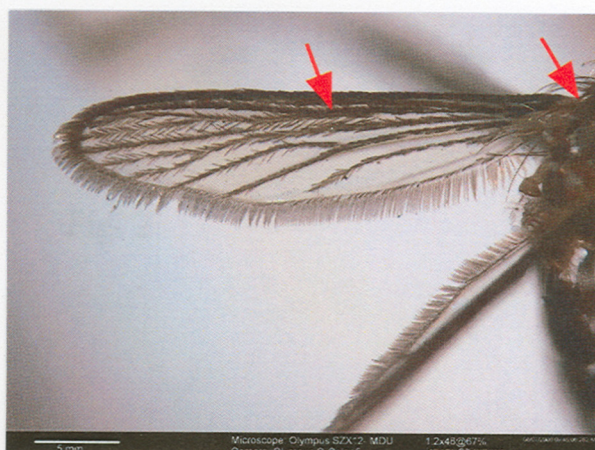
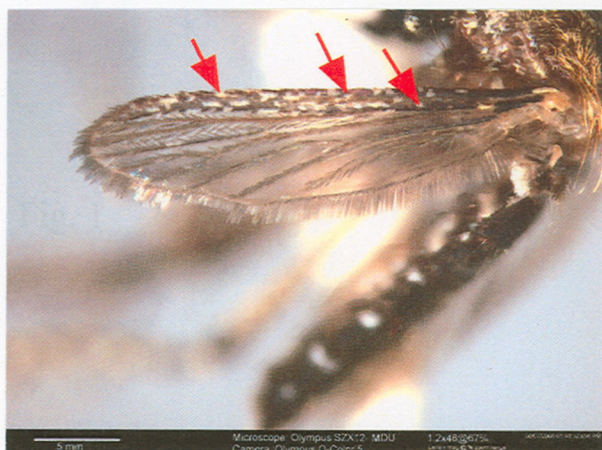
**APPENDIX 1.** A pictorial key to the sections, groups and species of *Aedes* (*Diceromyia*) in the Afrotropical Region (Diptera: Culicidae).

(add Page 46aA) 1<sup>st</sup> page

Page 46aA (1<sup>st</sup> page)

Wing. With broad dark scales mixed with broad white scales at least on anterior 3 veins (C, Sc and R)...SECTION A

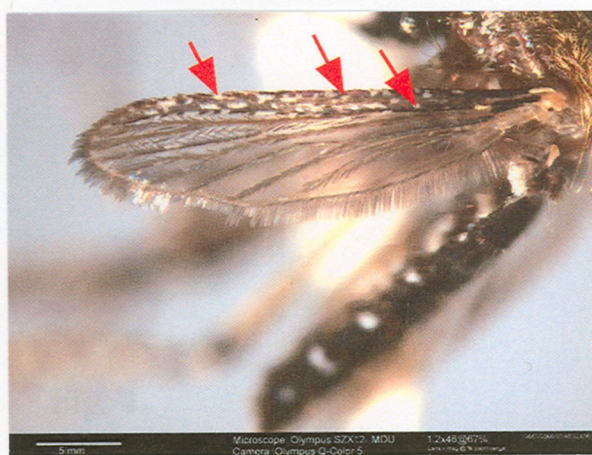
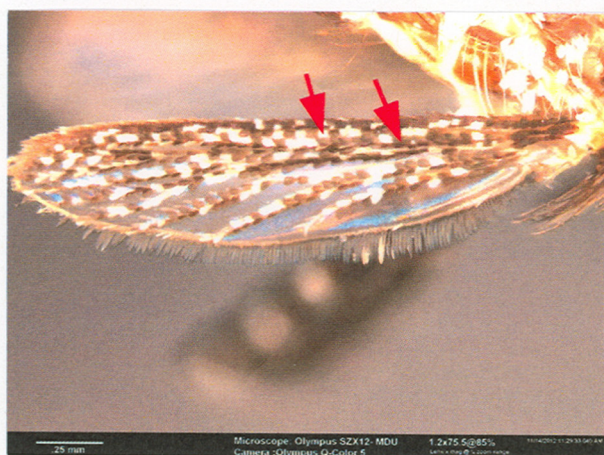
Wing. With dark scales on all veins except for a small basal spot of white scales on costa ...SECTION B



to Page 46aE (5<sup>th</sup> page)

Wing. With broad dark scales mixed with broad white scales on all veins

Wing. With broad dark scales mixed with broad white scales on anterior 3 veins (C, Sc and R)... Flavicollis Group



to Page 46aB (2<sup>nd</sup> page)

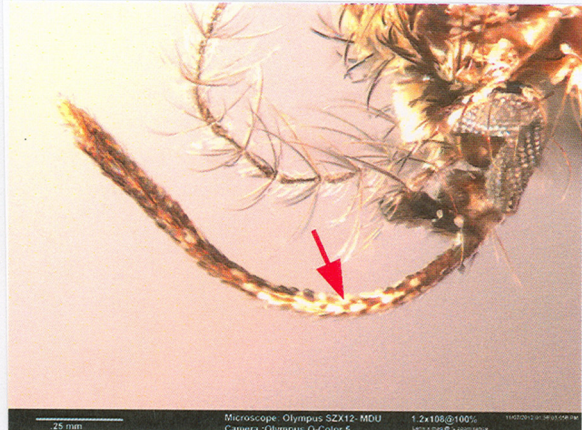
to Page 46aD (4<sup>th</sup> page)

Page 46aB (2<sup>nd</sup> page)

Head. Proboscis with a distinct white band...Furcifer Group



Head. Proboscis without a distinct white band...Adersi Group



to Page 46aC (3<sup>rd</sup> page B)

Abdomen. Terga II-VII with pale scales scattered on apicolateral and dorsomedian areas



*Aedes (Diceromyia) furcifer*

Abdomen. Terga II-VII no scattered pale scales on dorsomedian areas



to Page 46aC (3<sup>rd</sup> page A)

Abdomen. Terga II-VII with yellow scales scattered on apicolateral areas only



*Aedes (Diceromyia) cordellieri*

Abdomen. Terga II-VII no scattered pale or yellow scales on apicolateral and dorsomedian areas



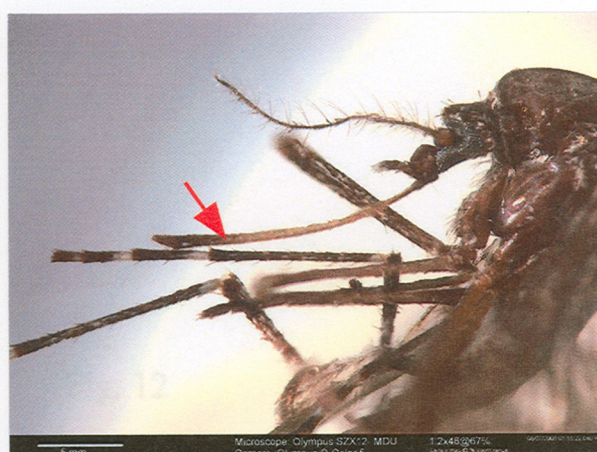
*Aedes (Diceromyia) taylora*

Head. Proboscis with numerous scattered pale scales on basal 0.60



*Aedes (Diceromyia) adersi*

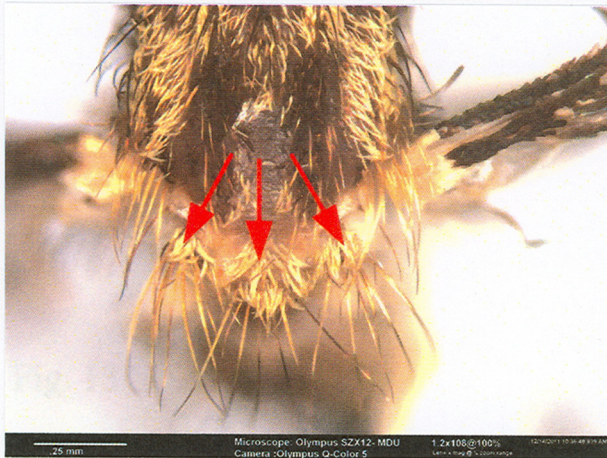
Head. Proboscis with all pale scales on basal 0.80



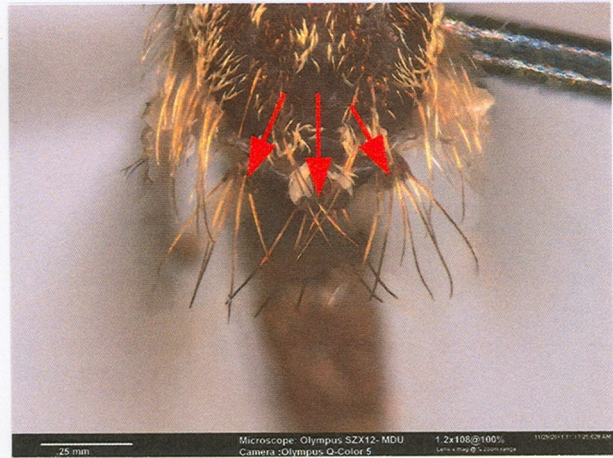
*Aedes (Diceromyia) bananea*



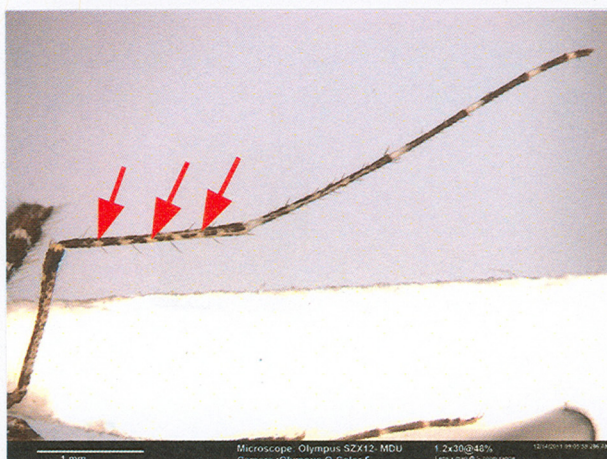
Thorax. Scutellum with narrow yellow scales on all lobes



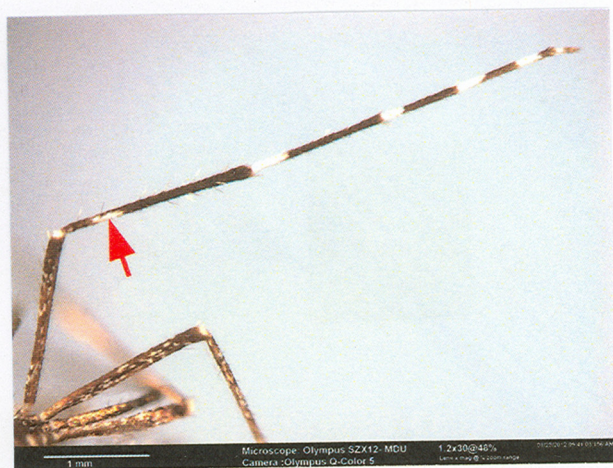
Thorax. Scutellum with broad scales on all lobes



Leg. Hindtibia sprinkled with yellow scales



Leg. Hindtibia all dark with a subbasal white stripe on ventral surface



*Aedes (Diceromyia) flavicollis*

*Aedes (Diceromyia) mefouensis*

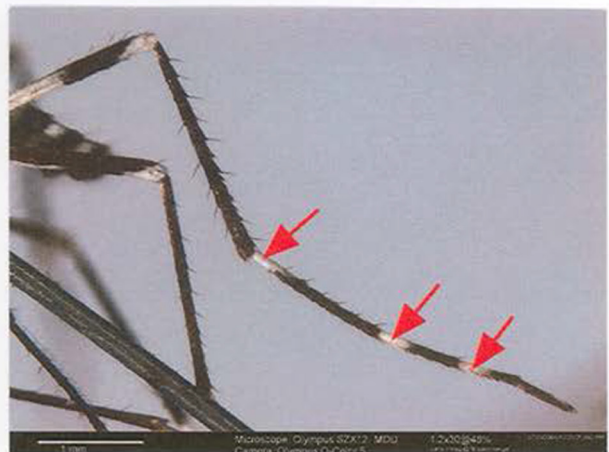
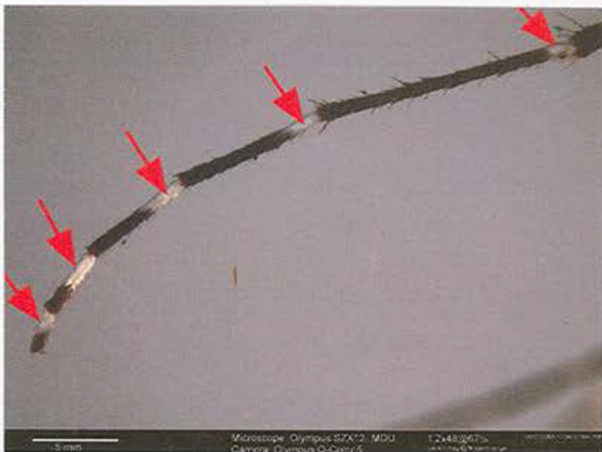
Head. Proboscis with scattered pale scales on about middle area...Fascipalpis Group

Head. Proboscis with all dark scales...Zethus Group



Leg. Hindtarsus with basal white band on tarsomeres 1-5

Leg. Hindtarsus with basal white band on tarsomeres 1-3, tarsomeres 4 and 5 all dark



*Aedes (Diceromyia) fascipalpis*

*Aedes (Diceromyia) zethus*