



Pictorial Keys to the Species of the Subgenera *Albuginosus* and *Aedimorphus* (Grjebinei and Apicoannulatus Groups) of the Genus *Aedes* Meigen in the Afrotropical Region (Diptera: Culicidae)

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Abstract

Nine species of the subgenus *Albuginosus*, one species of the subgenus *Aedimorphus* Grjebinei Group and two species of the subgenus *Aedimorphus* Apicoannulatus Group of the genus *Aedes* Meigen in the Afrotropical Region are treated in three pictorial keys based on diagnostic morphological features.

Key words: Culicidae, mosquitoes, identification key, Africa

Introduction

Precise and simple keys are essential tools for the accurate identification of species of mosquitoes, and correct identifications are necessary for the management and control of vector species, including prevention of epidemics of infectious diseases. The purpose of this paper is to provide pictorial keys to species of the subgenera *Albuginosus* and *Aedimorphus* (Grjebinei and Apicoannulatus Groups), and thus, to facilitate their accurate identification.

Edwards (1941) divided the genus *Aedes* Meigen into nine subgenera in his “Mosquitoes of the Ethiopian Region”. Reinert (1987) removed *Aedes marshallii* (Theobald) from the Apicoannulatus Group of the subgenus *Aedimorphus* Theobald and defined a new subgenus, *Albuginosus*, for that species and its relatives. Reinert included nine species, previously assigned to the subgenus *Aedimorphus*, in *Albuginosus*. Reinert (1987: 307) noted in the introduction that “Adults of *Ae. grjebinei* also were not available for examination, but there is no doubt this species should be included in *Albuginosus* based on the information provided in the original description.” After a critical study of all known specimens, it is apparent that *Ae. grjebinei* should not be included in the subgenus *Albuginosus* because it bears thoracic characters of *Aedimorphus*, and we hereby assign it to its own group (Grjebinei) within *Aedimorphus*.

To assist entomologists and other field workers in the identification of mosquitoes from Africa and to clarify the taxonomic status of *Ae. grjebinei*, we provide three pictorial keys as add-ons to the keys of Huang (2001). A few additional characters, indicated by double asterisks (**), were added as needed to facilitate identification. Images of diagnostic morphological structures of the adult head, thorax, legs and wing are also included in the supplemental pictorial keys.

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 the 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) classification of the genus *Aedes*, retaining both *Albuginosus* and *Aedimorphus* as subgenera of the genus *Aedes*.

Result and Discussion

Huang (2001) published a key to the *Aedes* mosquitoes of the Afrotropical Region. This paper is openly available from the websites of the Biodiversity Heritage Library (<http://www.biodiversitylibrary.org/>) and Walter Reed Biosystematics Unit (http://wrbu.si.edu/wrbupubs_chron.html). It includes pictorial keys for *Aedes (Albuginosus)* (Appendix 1), the *Aedes (Aedimorphus)* Grjebinei Group (Appendix 2), and the *Aedes (Aedimorphus)* Apicoannulatus Group (Appendix 3) in the Afrotropical Region. These keys are formatted so they can be merged with the keys of Huang (2001). The following steps should be followed when using the key of Huang (2001) to merge the supplemental keys:

(1) A Pictorial Key to the Species of the *Aedes (Albuginosus)* in the Afrotropical Region (Diptera: Culicidae) (Appendix 1). From Page 34 of 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 43 (on the left side – Thorax. Subspiracular area with scales, and ** Head. Pedicel with a patch of white broad overlapping scales on mesal surface), to key out to *Albuginosus*. Using Appendix 1, the supplemental key, add Page 43A (1st page), Page 43B (2nd page), Page 43C (3rd page), Page 43D (4th page A and 4th page B), Page 43E (5th page A and 5th page B), to key out to *Aedes (Albuginosus)*, for nine species.

(2) A Pictorial Key to the Species of the *Aedes (Aedimorphus)* Grjebinei Group in the Afrotropical Region (Diptera: Culicidae) (Appendix 2). From Page 34 of Huang (2001) key, with “**Part 3. Key to Subgenera of *Aedes***”, **ADULTS**, follow the key to Page 35, to Page 40, to Page 42b, to Page 43, then (on the right side, replace with Page 43A (1st page) - Thorax. Subspiracular area without scales, and ** Head. Pedicel with a patch of white broad overlapping scales on mesal surface), and to Page 43 B (2nd page), to key out to **Grjebinei Group**. Using Appendix 2, the supplemental key, add Page 43A (1st page), Page 43B (2nd page), to key out to *Aedes (Aedimorphus)* **Grjebinei Group**, for one species.

(3) A Pictorial Key to the Species of the *Aedes (Aedimorphus)* Apicoannulatus Group in the Afrotropical Region (Diptera: Culicidae) (Appendix 3). From Page 34 of 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 (Thorax. Subspiracular area without scales), to Page 46b, to Page 47a (** Head. Pedicel with few setae and scales on mesal surface), to key out to **Apicoannulatus Group**. Using Appendix 3, the supplemental key, add Page 47A (1st page), to key out to *Aedes (Aedimorphus)* **Apicoannulatus Group**, for two species.

The subgenus *Albuginosus* is characterized by having the subspiracular area with scales, and pedicel with a patch of white broad overlapping scales on mesal surface. It is represented by nine species: (1) *Ae. (Alb.) capensis* Edwards, 1924, (2) *Ae. (Alb.) gilliesi* Van Someren, 1962, (3) *Ae. (Alb.) haworthi* Edwards, 1923, (4) *Ae. (Alb.) kapretwae* Edwards, 1941, (5) *Ae. (Alb.) kennethi* Muspratt, 1956, (6) *Ae. (Alb.) marshallii* (Theobald, 1901), (7) *Ae. (Alb.) ngong* Van Someren, 1950, (8) *Ae. (Alb.) stokesi* Evans, 1929, and (9) *Ae. (Alb.) teesdalei* Van Someren, 1954. The *Aedes (Aedimorphus)* **Grjebinei Group** is briefly characterized by having the subspiracular area without scales, and pedicel with a patch of white broad overlapping scales on mesal surface. It is represented by only one species: *Ae. (Aed.) grjebinei* Hamon, Taufflieb & Maillot, 1957. The *Aedes (Aedimorphus)* **Apicoannulatus Group** is characterized by having the subspiracular area without scales, and pedicel with few setae and scales on mesal surface. It is represented by two species: *Ae. (Aed.) apicoannulatus* (Edwards, 1912), and *Ae. (Aed.) simulans* (Newstead and Carter, 1911).

Remarks

Reinert *et al.* (2009) placed these two species of the *Aedes (Aedimorphus)* **Apicoannulatus Group** in their new

genus, *Elpeytonius* Reinert, Harbach & Kitching, 2009. Although Reinert *et al.* (2004, 2006, 2008, 2009) substantially revised the classification of the tribe Aedini, and some of their conclusions are warranted, we do not fully accept herein their classification because their results were based on partial treatments of several groups. Consequently, a large number of species remains without subgeneric placement. Thus, the new reclassification of the genus *Aedes* proposed by Reinert *et al.* (2004, 2006, 2008, 2009) is incomplete and needs comprehensive taxonomic analysis (Huang and Rueda 2014).

Medical Importance

Brottes *et al.* (1966) isolated the Bunyamwera Virus from a mixed pool of *Ae. capensis*, *Ae. kummi* Edwards, *Ae. mutilus* Edwards, *Ae. simulans*, and *Ae. tarsalis* group of species in Cameroun. Berge (1975) isolated the Middleburg Virus from *Ae. marshallii* in Natal, South Africa. *Aedes stokesi* was considered to be a potential vector of Yellow Fever Virus in the Ivory Coast (Cordellier and Geoffroy 1974), in the lowlands of Arba-Minch District of Ethiopia (Ardoin *et al.* 1976), and in Senegal (Cornet *et al.* 1978).

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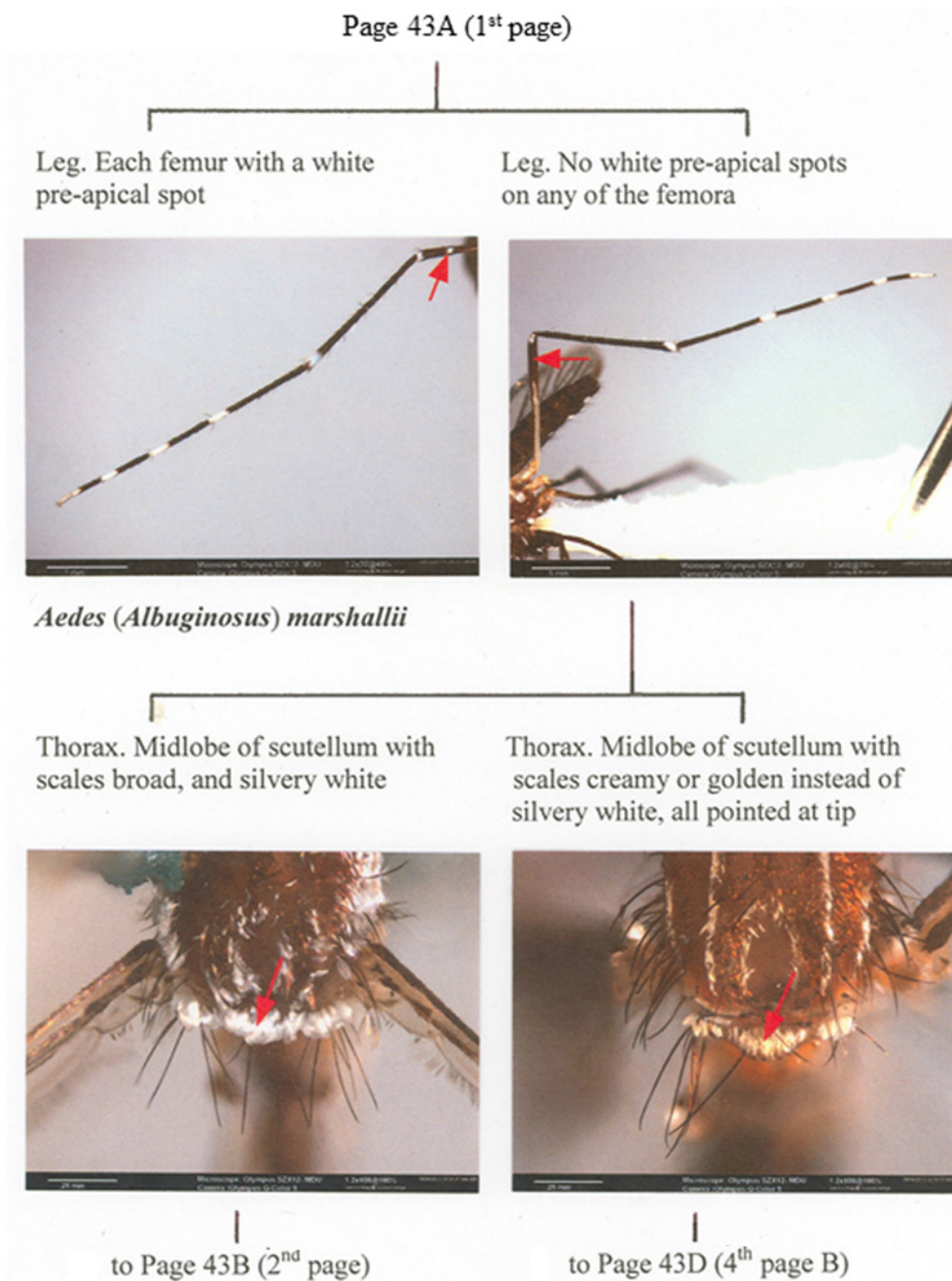
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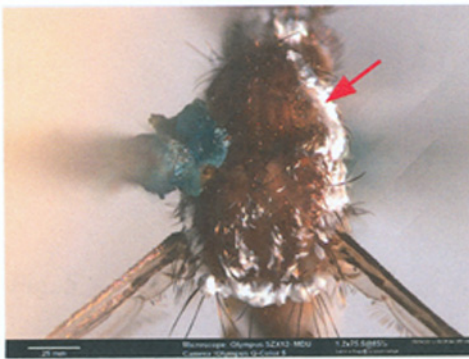
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(add Page 43A) 1st page

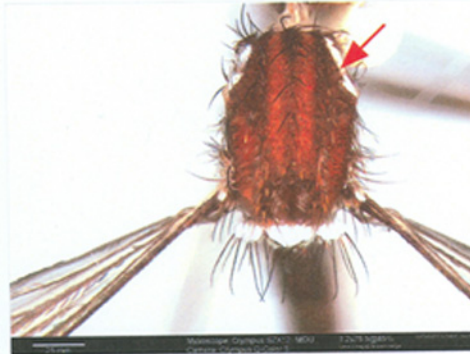


Page 43B (2nd page)

Thorax. Scutum with broad lateral margins of broad white scales from anterior margin to the prescutellar area



Thorax. Scutum without broad lateral margins of broad white scales from anterior margin to the prescutellar area



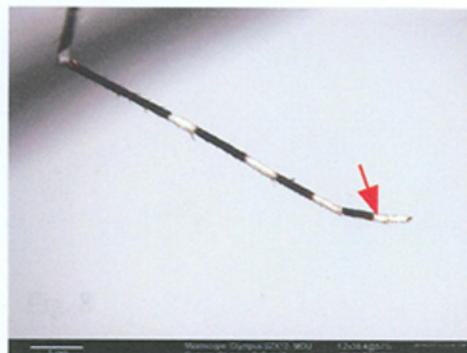
to Page 43C (3rd page)

Leg. Hindtarsomere 4 all white



Aedes (Albuginosus) kennethi

Leg. Hindtarsomere 4 with apical white band



Aedes (Albuginosus) teesdalei

Page 43C (3rd page)

Thorax. Scutum with long stripe of silvery broad scales on lateral prescutal area, extending over scutal angle



Thorax. Scutum with short stripe of silvery broad scales on lateral prescutal area, reaching to scutal angle



to Page 43D (4th page A)

Thorax. Posterior dorsocentral lines distinct, composed of silvery broad scales



Aedes (Albuginosus) ngong

Thorax. Posterior dorsocentral lines indistinct, composed of golden or pale narrow scales



Aedes (Albuginosus) haworthi

Page 43D (4th page A)

Thorax. Scutum with a pair of small white spots of broad scales in the middle area, and posterior dorsocentral white line present



Aedes (Albuginosus) capensis

Thorax. Scutum without a pair of small white spots of broad scales in the middle area, and without posterior dorsocentral white line



Aedes (Albuginosus) stokesi

(4th page B)

Thorax. Scutum with a small spot of broad white scales on lateral prescutal area



to Page 43E (5th page A)

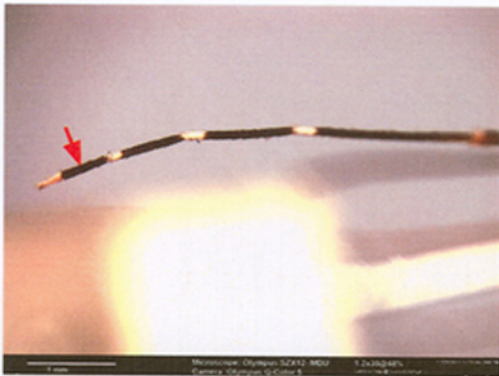
Thorax. Scutum with narrow stripe of broad white scales on the anterior part of lateral prescutal area, and with narrow yellowish scales on the posterior part of lateral prescutal area



to Page 43E (5th page B)

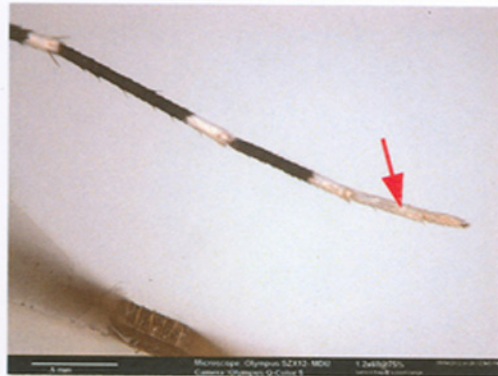
(5th page A)

Leg. Hindtarsomere 4 all dark



(5th page B)

Leg. Hindtarsomere 4 not all dark
(all white, or with a narrow dark
ring in middle)



Aedes (Albuginosus) gilliesi

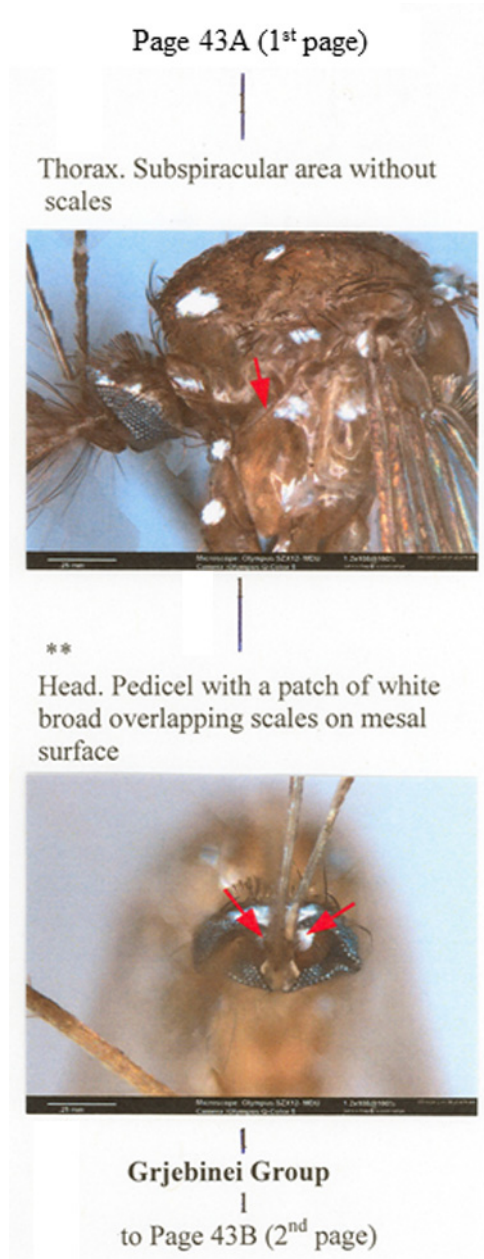
OR



Aedes (Albuginosus) kapretwae

APPENDIX 2. A Pictorial Key to the Species of *Aedes (Aedimorphus)* Grjebinei Group in the Afrotropical Region (Diptera: Culicidae).

(add Page 43A) 1st page



1

** 1
Head. Vertex with a pair of
wedge-shaped patches of broad, flat
scales on eye margins



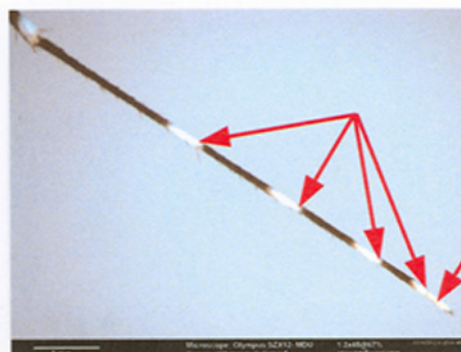
** 2
Thorax. Scutellum with broad white
scales on all lobes



** 3
Leg. Hindfemur without a white
pre-apical spot



** 4
Leg. Hindtarsomeres 1-4 with apical
white bands, tarsomere 5 all white



Aedimorphus (in part)
Grjebinei Group
Aedes grjebinei

APPENDIX 3. A Pictorial Key to the Species of *Aedes* (*Aedimorphus*) Apicoannulatus Group in the Afrotropical Region (Diptera: Culicidae).

(add Page 47A) 1st page

Page 47A (1st page)

