

AEDINE MOSQUITO SPECIES (DIPTERA: CULICIDAE: AEDINI) OCCURRING IN THAILAND WITH THEIR CURRENT GENERIC AND SUBGENERIC STATUS, AND NEW COUNTRY RECORDS

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Abstract. A list of the currently valid generic and species-level taxa of tribe Aedini in Thailand is provided. Its purpose is to enable entomologists, public health personnel and mosquito control workers to more quickly become familiar with recent formal taxonomic changes within the tribe. New country records of four species of *Armigeres* are reported.

INTRODUCTION

Harrison *et al* (1990) provided the most recent list of mosquito species (Culicidae) occurring in Thailand. Because recent publications on tribe Aedini have resulted in generic and/or subgeneric changes to mosquito species occurring in Thailand, we provide here an updated listing of these species. Genera *Ayurakitia* Thurman and *Verrallina* Theobald were resurrected to generic rank by Reinert (1999, 2000a). Genus *Ochlerotatus* was resurrected from synonymy in the composite genus *Aedes* Meigen and the included subgenera and species were transferred to it (Reinert, 2000b). The new subgenus *Bruceharrisonius* was described in *Ochlerotatus* Lynch Arribalzaga by Reinert (2003a). *Heizmannia thelmae* Mattingly was transferred from subgenus *Mattinglyia* Lien to subgenus *Heizmannia* Ludlow (Reinert, 2003b). Further extensive revision and modification of Aedini was provided by Reinert *et al* (2004) and involved the development of phylogenetic relationships resulted from cladistic analyses of 172 morphological characters

of eggs, fourth-instar larvae, pupae, females and genitalia, and males and genitalia, and 119 aedine species from all genera and subgenera of the tribe recognized at the time.

The current classification that resulted from the phylogenetic analyses, restricts genus *Aedes* Meigen to species in the former subgenus *Aedes* which includes only taxa outside of Thailand. *Alanstonea* Mattingly, *Bothaella* Reinert, *Christophersiomysia* Barraud, *Diceromyia* Theobald, *Edwardsaedes* Belkin, *Fredwardsius* Reinert, *Isoaedes* Reinert, *Lorrainea* Belkin, *Neomelaniconion* Newstead, *Paraedes* Edwards, *Scutomyia* Theobald, and *Stegomyia* Theobald, all formerly subgenera of *Aedes*, are now recognized as genera. Former subgenera of *Ochlerotatus* Lynch Arribalzaga, *ie*, *Finlaya* Theobald, *Kenknightia* Reinert, *Mucidus* Theobald, and *Rhinoskusea* Edwards, also have full generic status. *Downsiomyia* Vargas was elevated to generic rank from synonymy with *Finlaya* and includes the species formally in the Niveus Group. Genus *Tanakaius* Reinert, Harbach and Kitching was described as new by Reinert *et al* (2004). *Armigeres* Theobald, *Ayurakitia* Thurman, *Heizmannia* Ludlow, *Udaya* Thurman, *Verrallina* Theobald, and *Zeugomyia* Leicester are still recognized as genera and their subgeneric classifications remain unchanged. Adhering to the *International Code of Zoological*

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Nomenclature (International Commission on Zoological Nomenclature, 1999), the terminations of some species names were changed to agree in gender with newly recognized genera.

Twenty-six genera and 162 species/subspecies of Aedini are currently recognized in Thailand, but only 129 species are now classified in one or other of the genera. In this country, species previously included in subgenera *Bruceharrisonius* Reinert (2 species), *Finlaya* Theobald (19 species), and *Ochlerotatus* (1 species) of *Ochlerotatus*, and 9 species of subgenus *Aedimorphus* Theobald and 2 species of subgenus *Canacraedes* Edwards of *Aedes* cannot be placed in a currently recognized genus and are regarded as *incertae sedis* (a Latin term meaning 'of uncertain taxonomic position') within Aedini. These species are indicated in the list below as belonging to genus (subgenus) of authors, eg *Aedes* (*Aedimorphus*) *sensu auctorum*. The *incertae sedis* generic-level designations are not to be interpreted as having formal status. They are merely temporary repositories for the species listed below them. As an example, *Aedes* (*Aedimorphus*) *vexans* Meigen is a valid species of uncertain generic and subgeneric placement that was previously placed in subgenus *Aedimorphus* of *Aedes*. Once the phylogenetic relationships of *incertae sedis* species have been analyzed, they will be retained in their current genera, assigned to new genera, or placed in genera resurrected from synonymy with the genera in which they were previously assigned. However, we emphasize that until such studies have been accomplished, *incertae sedis* species should continue to be cited with their accustomed generic and subgeneric affiliations. Studies are currently underway to resolve the taxonomy of the *incertae sedis* taxa.

Abbreviations used for genera (2 letters) and subgenera (3 letters) follow Reinert (2001) and Reinert *et al* (2004).

SPECIES WITH TAXONOMICALLY VALID GENERIC AND SUBGENERIC PLACEMENT

Tribe Aedini Belkin, 1962

Genus *Alanstonea* Mattingly, 1960

As. treubi (De Meijere, 1910)

Genus *Armigeres* Theobald, 1901

Subgenus *Armigeres* Theobald, 1901

Ar. (Arm.) aureolineatus (Leicester, 1908)

Ar. (Arm.) bhayungi Thurman and Thurman, 1958

Ar. (Arm.) confusus Edwards, 1915

Ar. (Arm.) foliatus Brug, 1931

Ar. (Arm.) jugraensis (Leicester, 1908)

Ar. (Arm.) kesseli Ramalingam, 1987

Ar. (Arm.) kuchingensis Edwards, 1915

Ar. (Arm.) malayi (Theobald, 1901)

Ar. (Arm.) maximus Edwards, 1922

Ar. (Arm.) moultoni Edwards, 1914

Ar. (Arm.) subalbatus (Coquillett, 1898)

Ar. (Arm.) theobaldi Barraud, 1934

Subgenus *Leicesteria* Theobald, 1904

Ar. (Lei.) annulipalpis (Theobald, 1910)

Ar. (Lei.) annulitarsis (Leicester, 1908)

Ar. (Lei.) balteatus Macdonald, 1960

Ar. (Lei.) cingulatus (Leicester, 1908)

Ar. (Lei.) dentatus Barraud, 1927

Ar. (Lei.) digitatus (Edwards, 1914)

Ar. (Lei.) dolichocephalus (Leicester, 1908)

Ar. (Lei.) flavus (Leicester, 1908)

Ar. (Lei.) inchoatus Barraud, 1927

Ar. (Lei.) longipalpis (Leicester, 1904)

Ar. (Lei.) magnus (Theobald, 1908)

Ar. (Lei.) omissus (Edwards, 1914)

Ar. (Lei.) pectinatus (Edwards, 1914)

Ar. (Lei.) pendulus (Edwards, 1914)

Ar. (Lei.) traubi Macdonald, 1960

Ar. (Lei.) vimoli Thurman and Thurman, 1958

Genus *Ayurakitia* Thurman, 1954

Ay. griffithi Thurman, 1954

Ay. peytoni (Reinert, 1972)

Genus *Bothaella* Reinert, 1973

Bo. eldridgei (Reinert, 1973)

Bo. helenae (Reinert, 1973)

Genus *Christophersiomyia* Barraud, 1923

Cr. annulirostris (Theobald, 1905)

Cr. ibis (Barraud, 1931)

Cr. thomsoni (Theobald, 1905)

Genus *Diceromyia* Theobald, 1911

Di. franciscoi (Mattingly, 1959)

Di. iyengari (Edwards, 1923)

Di. pseudonummata (Reinert, 1973)

Di. scanloni (Reinert, 1970)

Di. whartoni (Mattingly, 1965)

- Genus *Downsiomyia* Vargas, 1950
Do. albolateralis (Theobald, 1908)
Do. alboniveus (Barraud, 1934)
Do. ganapathi (Colless, 1958)
Do. harinasutai (Knight, 1978)
Do. inermis (Colless, 1958)
Do. leonis (Colless, 1958)
Do. litorea (Colless, 1958)
Do. mikrokopion (Knight and Harrison, 1988)
Do. niveoides (Barraud, 1934)
Do. novonivea (Barraud, 1934)
Do. pexa (Colless, 1958)
Do. pseudonivea (Theobald, 1905)
Do. subnivea (Edwards, 1922)
Do. vana (Colless, 1958)
- Genus *Edwardsaedes* Belkin, 1962
Ed. imprimens (Walker, 1860)
- Genus *Finlaya* Theobald, 1903
Fl. flavipennis Giles, 1904
Fl. poicilia Theobald, 1903
- Genus *Fredwardsius* Reinert, 2000
Fr. vittatus (Bigot, 1861)
- Genus *Heizmannia* Ludlow, 1905
 Subgenus *Heizmannia* Ludlow, 1905
H. (Hez.) aureochaeta (Leicester, 1908)
H. (Hez.) chengi Lien, 1968
H. (Hez.) communis (Leicester, 1908)
H. (Hez.) complex (Theobald, 1910)
H. (Hez.) covelli Barraud, 1929
H. (Hez.) demeilloni Mattingly, 1970
H. (Hez.) macdonaldi Mattingly, 1957
H. (Hez.) mattinglyi Thurman, 1959
H. (Hez.) persimilis Mattingly, 1970
H. (Hez.) propinqua Mattingly, 1970
H. (Hez.) proxima Mattingly, 1970
H. (Hez.) reidi Mattingly, 1957
H. (Hez.) scanloni Mattingly, 1970
H. (Hez.) scintillans Ludlow, 1905
H. (Hez.) taiwanensis Lien, 1968
H. (Hez.) thelmae Mattingly, 1970
 Subgenus *Mattinglyia* Lien, 1968
H. (Mat.) achaetae (Leicester, 1908)
H. (Mat.) catesi (Lien, 1968)
- Genus *Isoaedes* Reinert, 1979
Ia. cavaticus (Reinert, 1979)
- Genus *Kenknightia* Reinert, 1990
Ke. dissimilis (Leicester, 1908)
Ke. harbachi (Reinert, 1990)
- Genus *Lorrainea* Belkin, 1962
Lo. amesii (Ludlow, 1903)
Lo. fumida (Edwards, 1928)
- Genus *Mucidus* Theobald, 1901
Mu. laniger (Wiedemann, 1820)
Mu. quasiferinus (Mattingly, 1961)
- Genus *Neomelanicion* Newstead, 1907
Ne. lineatopenne (Ludlow, 1905)
- Genus *Paraedes* Edwards, 1934
Pr. ostentatio (Leicester, 1908)
Pr. thailandensis (Reinert, 1976)
- Genus *Rhinoskusea* Edwards, 1929
Rh. longirostris (Leicester, 1908)
- Genus *Scutomyia* Theobald, 1904
Sc. albolineata (Theobald, 1904)
- Genus *Stegomyia* Theobald, 1901
St. aegypti (Linnaeus, 1762)
St. albopicta (Skuse, 1895)
St. annandalei Theobald, 1910
St. craggi Barraud, 1923
St. desmotes Giles, 1904
St. gardnerii imitator Leicester, 1908
St. malayensis (Colless, 1962)
St. malikuli (Huang, 1973)
St. novalbopicta (Barraud, 1931)
St. patriciae (Mattingly, 1954)
St. perplexa Leicester, 1908
St. pseudalbopicta Borel, 1928
St. seatoi (Huang, 1969)
St. w-albus Theobald, 1905
- Genus *Tanakaius* Reinert, Harbach and Kitching, 2004
Ta. togoi (Theobald, 1907)
- Genus *Udaya* Thurman, 1954
Ud. argyrurus (Edwards, 1934)
- Genus *Verrallina* Theobald, 1903
 Subgenus *Harbachius* Reinert, 1999
Ve. (Har.) indecorabilis Leicester, 1908
Ve. (Har.) yusafi (Barraud, 1931)
 Subgenus *Neomacleaya* Theobald, 1907
Ve. (Nma.) adusta (Laffoon, 1946)
Ve. (Nma.) andamanensis (Edwards, 1922)
Ve. (Nma.) atria (Barraud, 1928)
Ve. (Nma.) clavata (Barraud, 1931)
Ve. (Nma.) cretata (Delfinado, 1967)
Ve. (Nma.) cyrtolabis (Edwards, 1928)
Ve. (Nma.) gibbosa (Delfinado, 1967)
Ve. (Nma.) hispida (Delfinado, 1967)
Ve. (Nma.) incerta (Edwards, 1922)
Ve. (Nma.) latipennis (Delfinado, 1967)

- Ve. (Nma.) notabilis* (Delfinado, 1967)
Ve. (Nma.) phnoma (Klein, 1973)
Ve. (Nma.) protuberans (Delfinado, 1967)
Ve. (Nma.) pseudodiurna (Theobald, 1910)
Ve. (Nma.) sohni (Reinert, 1974)
Ve. (Nma.) torosa (Delfinado, 1967)
Ve. (Nma.) unca (Theobald, 1901)
Ve. (Nma.) vallistris (Barraud, 1928)
 Subgenus *Verrallina* Theobald, 1903
Ve. (Ver.) butleri (Theobald, 1901)
Ve. (Ver.) dux (Dyar and Shannon, 1925)
Ve. (Ver.) lugubris (Barraud, 1928)
 Genus *Zeugomyia* Leicester, 1908
Ze. gracilis Leicester, 1908

INCERTAE SEDIS SPECIES WITH
 PROVISIONAL GENERIC AND
 SUBGENERIC PLACEMENT

- Genus *Aedes* Meigen, 1818, *sensu auctorum*
 Subgenus *Aedimorphus* Theobald, 1903, *sensu auctorum*
Ae. (Adm.) alboscuteatus (Theobald, 1905)
Ae. (Adm.) caecus (Theobald, 1901)
Ae. (Adm.) culicinus Edwards, 1922
Ae. (Adm.) mediolineatus (Theobald, 1901)
Ae. (Adm.) orbitae Edwards, 1922
Ae. (Adm.) pallidostratus (Theobald, 1907)
Ae. (Adm.) pampangensis (Ludlow, 1905)
Ae. (Adm.) pipersalatus (Giles, 1902)
Ae. (Adm.) vexans vexans (Meigen, 1830)
 Subgenus *Canraedes* Edwards, 1929, *sensu auctorum*
Ae. (Can.) indonesiae Mattingly, 1958
Ae. (Can.) kohkutensis Mattingly, 1958
 Genus *Ochlerotatus* Lynch Arribalzaga, 1891, *sensu auctorum*
 Subgenus *Buceharrisonius* Reinert, 2003, *sensu auctorum*
Oc. (Brh.) christophersi (Edwards, 1922)
Oc. (Brh.) greenii (Theobald, 1903)
 Subgenus *Finlaya* Theobald, 1903, *sensu auctorum*
Oc. (Fin.) albotaeniatus (Leicester, 1904)
Oc. (Fin.) assamensis (Theobald, 1908)
Oc. (Fin.) chrysolineatus (Theobald, 1907)

- Oc. (Fin.) elsiae* (Barraud, 1923)
Oc. (Fin.) feegradei (Barraud, 1934)
Oc. (Fin.) formosensis (Yamada, 1921)
Oc. (Fin.) harveyi (Barraud, 1923)
Oc. (Fin.) jugraensis (Leicester, 1908)
Oc. (Fin.) khazani (Edwards, 1922)
Oc. (Fin.) lophoventralis (Theobald, 1910)
Oc. (Fin.) macfarlanei Edwards, 1914
Oc. (Fin.) prominens (Barraud, 1923)
Oc. (Fin.) pseudotaeniatus (Giles, 1901)
Oc. (Fin.) pulchriventer (Giles, 1901)
Oc. (Fin.) reinerti (Rattanaarithikul and Harrison, 1988)
Oc. (Fin.) saxicola Edwards, 1922
Oc. (Fin.) shortii (Barraud, 1923)
Oc. (Fin.) simlensis (Edwards, 1922)
Oc. (Fin.) uncinatus (Edwards, 1922)
 Subgenus *Ochlerotatus* Lynch Arribalzaga, 1891, *sensu auctorum*
Oc. (Och.) vigilax (Skuse, 1889)

DISCUSSION

Harrison *et al* (1990) compiled a list of mosquitoes occurring in Thailand which included several new country records and the elimination of incorrect records. They noted that the inclusion of *Hz. (Hez.) taiwanensis* needed confirmation. Mattingly (1970) indicated that he was unsure of records of *Hz. (Hez.) indica* (Theobald) from Thailand. *Zeugomyia gracilis* was reported for the first time from southern Thailand by Benjaphong and Rattanaarithikul (1991). *Armigeres (Lei.) cingulatus* is a valid species (see Thurman, 1959) and not a synonym of *Ar. (Lei.) longipalpis* as indicated in Stone and Knight (1977). Thurman (1959, pages 97 and 100) stated that only records of *Ar. cingulatus* by Barraud (1927), Borel (1930), and Edwards (*in* Barraud, 1934) were synonymous with *Ar. longipalpus*.

New country records for Thailand reported here include the following four species of *Armigeres* that were examined by one of us (RR): *Ar. confusus*, *Ar. foliatus*, *Ar. pendulus* and *Ar. traubi*.

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