MORPHOLOGY, SYSTEMATICS, EVOLUTION

Systematics and Identification of Afrotropical Toxorhynchitinae (Diptera: Culicidae)

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ABSTRACT I define two new species groups of Afrorhynchus from the Afrotropical Region and examine the taxonomic structure of the genus in the region. Keys are provided for the identification of adult males and females of all known Afrotropical Toxorhynchites.

KEY WORDS Toxorhynchites, Afrorhynchus, systematics, identification keys

The Toxorhynchitinae are currently considered a monotypic subfamily, with the only genus, Toxorhynchites, distributed in tropical and temperate areas. Within the genus, four subgenera are now recognized (WRBU 2001): Ankylorhynchus Lutz, 1904 and Lynchiella Lahille, 1904 in the Americas; Toxorhynchites Theobald, 1901, widely distributed in the Old World, including Africa; and Afrorhynchus Ribeiro, 1991, endemic to the Afrotropical Region. The first-described Afrotropical toxorhynchitines were Toxorhynchites brevipalpis, Tx. lutescens, Tx. phytophagus (Theobald 1901a, 1909) and Tx. conradti (Grinberg 1907), followed by the description of Tx. barbipes, Tx. viridibasis, Tx. evansae, Tx. erythrurus (Edwards 1913, 1935, 1936, 1941), and Tx. aeneus (Evans 1926). The next important contributions to the knowledge of the Afrotropical Region representatives of the genus were made by Van Someren (1946, 1948), with the description of Tx. nairobiensis, Tx. kaimosi, and Tx. ruwenzori. At the beginning of the second half of the last century, the first Malagasy toxorhynchite, Tx. pauliani, was described by Doucet (1951), making a total of 13 species known from the region. Since then, with the exception of the works of Hopkins (1952) on larvae and Mattingly (1969) on eggs, little attention was paid to the systematics of the toxorhynchitines, and no new Afrotropical species were described until the nineties. The influential works of Belkin (1962) in the South Pacific and Steffan and Evenhuis (1985) in the Far East and Australasia led to studies of the Afrotropical Toxorhynchites, and descriptions of five species and one subspecies from the continent (Ribeiro 1991), one new species from the island of São Tomé (Ribeiro 1992/93), two new species from Angola (Ribeiro 1992a), three other species and one subspecies from the collections of several European museums (Ribeiro 2005), and five other species from Madagascar, to be added to Tx. pauliani (Ribeiro 2004).

Here, I define two new species groups of Afrorhynchus in the Afrotropical Region, examine the taxonomic structure of the genus in the same region, and propose an identification key for adult males and females of all known Afrotropical Toxorhynchites. The studies reported in this article are based on specimens from the collections of the Department of Medical Entomology, IHMT (Lisbon, Portugal), the Natural History Museum (London, United Kingdom), the Institut Pasteur de Paris (Paris, France), the Muséum National d’Histoire Naturelle (Paris, France), the Musée Royal de l’Afrique Centrale (Tervuren, Belgium), and the IRD, ex-ORSTOM, (Montpellier, France) (Ribeiro 1991a, b, 1992, 1992/93, 2004, 2005).

The morphological terminology and abbreviations adopted are basically those of Harbach and Knight (1980, 1981), whereas the format adopted is that of Ribeiro (1991a).

Species Groups in Subgenus Afrorhynchus

Besides the already established Malagasy Pauliani Group, two other groups are here defined in the Afrotropical Region species of Afrorhynchus.

Erythrurus Group nov.

This group is typified by Toxorhynchites (Afrorhynchus) erythrurus (Edwards 1941) and may be defined as follows. MF: Without scales on postspiracular and subspiracular areas; mesokatepisternum without patch of white scales at lower angle, below the golden scales; with five to 11 mesokatepisternal setae each side; mesepimeron bare at lower 1/5–1/4; caudolateral tufts well developed, orange, orange red, or red. M: Vestiture of fourth palpomere characteristic, with dorso- medial and ventrolateral pectens of four to 15 stout, erect setae on each palpus; ratio of width of dorsal aedeagal bridge to length of aedeagus 0.12–0.18; lobes of tergum IX with 18–40 setae each; gonostylus with...
7–13 sensilla trichoidea; ratio of length of gonostyly to length of gonostyly 0.34–0.37. The group includes the following eight species mainly distributed in the West African Subregion of Chapin (1932): *Tx. erythrurus* (Edwards 1941), *Tx. aeneus* (Evans 1926), *Tx. nairobiensis* (Van Someren 1946), *Tx. kainosi* (Van Someren 1946), *Tx. angolensis* Ribeiro 1992/93, *Tx. heleae* Ribeiro 1992/93, and *Tx. nigeriensis* and *Tx. wolfsi* Ribeiro (Ribeiro 2005).

**Lutescens Group Edwards 1941 (s.str.)**

This group is typified by *Toxorhynchites (Afrorhynchus) lutescens* Theobald, 1901, and may be defined as follows. MF: Without scales on postspiracular and subspiracular areas; mesokatepisternum with a distinct patch of white scales at lower angle, below the golden scales; without mesokatepisternal setae or, at most, with one or two such setae; mesepimeron clothed with flat scales, without obvious bare areas; caudolateral tufts rather small, inconspicuous, golden, orange, or reddish. M: Fourth palpomere without pectens, with two to six short, stout decumbent setae dispersed among the scales; ratio of width of dorsal aedeagal bridge to length of aedeagus 0.12–0.14; lobes of tergum IX with 11–25 setae each; gonostylus with four to six short, stout decumbent setae dispersed among the scales; ratio of length of gonostylar claw to length of gonostylus 0.29–0.34. The group includes the following six species: *Tx. ruwenzori* (Van Someren 1946), *Tx. helenae* Ribeiro (Ribeiro 2005); and *Tx. madagascarensis*, *Tx. brunhesi*, *Tx. grjebinei*, and *Tx. fontenillei* described recently (Ribeiro 2004).

**Identification Key to the Afrotropical Toxorhynchites**

Separate identification keys were already proposed for the Brevipalpis Group of subgenus *Toxorhynchites* (Ribeiro 1992/93); the Afrotropical Region species of subgenus *Afrorhynchus* (Ribeiro 2005); and the Mal-
agasy Pauliani Group, also in *Afroryhnchus* (Ribeiro 2004).

Here, I present a unified identification key to the adults of all known species and subspecies of toxorhynchitines in the Afrotropical Region, including subgenera, species groups, and subgroups.

1. **MF:** Mesokatepisternum densely clothed with white scales; scales on coxae all white; pale scales on abdomen white; laterotergite densely scaled; caudalateral tufts on abdominal terga white, yellowish, pale orange, brown, or black. **M:** Midungues unequal, one of them stronger and toothed; gonostylus slender, not widened at middle; gonostylar claw pointed and short, \(<0.20\) of gonostylus; dorsal aedeagal bridge very narrow, at most \(\approx1/10\) of aedeagus; paraproct without transverse unsclerotized band. Subsaharan Africa, ...Subgenus *Toxorhynchites*, Group *Brevipalpis* ...

2. **MF:** Mesokatepisternum with a patch of golden or golden brown scales below, usually also above; fore coxae, at least, all, or almost all golden-scaled; pale scales on abdomen golden; laterotergite with few or no scales; caudalateral tufts on abdominal terga yellow, orange or red, never white, brown, or black. **M:** Midungues small, equal, and simple; gonostylus noticeably widened at middle; gonostylar claw blunt-tipped and long, from \(\approx0.25\) to \(0.37\) of gonostylus; dorsal aedeagal bridge wider, 0.12 or more of aedeagus; paraproct appearing divided by a transverse, unsclerotized band. Afrotropical Region, including Madagascar: ...

2(1). **Males**

3. Hind femur without row of long, thin setae; first hind tarsomere without long setae; gonocoxite without exceptionally strong setae on the inner side. **Brevipalpis** Subgroup ...

4. Hind femur and first hind tarsomere with a row of long setae on about the distal half, beneath; inner aspect of gonocoxite with one to four exceptionally long and strong setae. ...Phytophagus Subgroup ...

5(4). **Tuft of tergum VI all or almost all black; lobes of tergum IX with \(\approx16\) setae each.** *br. conradi* Tuft of tergum VI all or almost all white; lobes of tergum IX with eight to 10 setae. *br. abyssinicus*

6(3). Caudalateral tuft of tergum VIII black, as that of tergum VII. *evansae*

7(6). Tuft of tergum VI all or almost all white. ...7

8(7). Lobes of tergum IX with \(\approx23\) setae; interlobar space narrow. *barbipes* Lobes of tergum IX with 11–16 setae; interlobar space wide. *dendo*

9(7). No white scales on postpronotum; long setae on first hind tarsomere coarse, most of them on the distal half of the segment. ...Rickenbachi* Postpronotum with at least a few white scales below; long setae on first hindtarsomere dense, either extending along all the tarsomere or more evident only at basal half ...

10(9). Mesokatepisternum with a few brownish scales in middle, among the white scales; second and third abdominal terga mainly metallic green above, with golden reflections; lobes of tergum IX each with 18 or 19 setae. *camaronis*

Mesokatepisternum without darker scales in middle; second and third terga dark purple, with violet or blue reflections; lobes of tergum IX with at most 16 setae ...

11(10). Scales on mesonotum with intense blue green reflections; with a patch of metallic light blue green scales on supra-alar area; sterna V and VI almost all dark purple, with inconspicuous apicolateral white patches; lobes of tergum IX with 11–16 setae. *phytophagous*

Scales on mesonotum with golden reflections; without patch of metallic light blue green scales on supra-alar area; sterna V and VI with well developed lateral patches of white scales; lobes of tergum IX with approximately seven setae. *lewisi*

12(2). Caudalateral tuft of tergum VIII black, as that of tergum VII. *evansae*

Tuft of tergum VIII orange, yellow or white, never black. ...13

13(12). First tarsomeres of fore and midlegs all white. ...Rickenbachi* First tarsomeres of fore and midlegs all dark or, at most, white at base only ...

14(13). Fifth tarsomere of midleg either all white or, at least, with white basal markings ...

15(14). Fourth and fifth tarsomeres of midleg white at base and obviously dark apically. ...Barbipes* Fourth and fifth tarsomeres of midleg all white ...

16(14). Third tarsomere of midleg all or almost all white. *rodhaini*

Third tarsomere of midleg dark ...

17(16). Distal one-third or more of tuft of tergum VI black; mesokatepisternum with \(\approx20\) ...

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(1) The male of *Tx. rodhaini* is not known.

(2) The female of *Tx. brevipalpis abyssinicus* is not known.
strong setae; radiomedial cross vein (rm) index $\approx 2.5$. 

**phytophagus**

Tuft of tergum VI all or almost all white; mesokatepisternum with $\approx 10$ weak setae; rm index 1.5–2. 

**dundo**

18(16). Second foretarsomere all dark 

19(18). Tuft of tergum VI white on basal one-third or more. 

20(18). Tuft of tergum VI all or almost all white. 

**br. brevipalpis**

Tuft of tergum VI black on about distal half or more. 

21(20). Tuft of tergum VI all or almost all black. 

MF: Mesepimeron bare at lower one-fifth 

**br. conradii** in part 

22(1). MF: Mesepimeron bare at lower one-fifth to one-fourth; M: Fourth palpomere with stout erect setae in a dorsomedial and a ventrolateral pecten; lobes of tergum IX with 18–40 setae each. 

Mainly West African Subregion... Erythrurus Group. 

23(22). Males 

24(23). Mesoposnotum with a small patch of green golden scales in middle; second hind tarsomere white-scaled at base; with well developed caudolateral tuft on tergum V. 

**wolfsi**

Mesoposnotum without scales; second hind tarsomere dark; without tuft on tergum V. 

25(24). Fourth palpomere with rows of only four specialized setae above and five below; hind tibia dark; lobes of tergum IX unusually flat, with $\approx 20$ setae each. 

**nairobiensis**

Fourth palpomere with rows of 7–15 specialized setae above and below; hind tibia with postmedian white ring; lobes of tergum IX round, with 23–40. 

26(25). Postpronotum with patches of golden scales in middle and behind, blue green scales above, and white scales below; second midtarsomere purple; ratio of gonostylar claw to gonostylus 0.370–0.375. 

Postpronotum not as above, without white scales; second midtarsomere with pale scaling below; gonostylar claw ratio 0.33–0.35. 

27(26). First and third midtarsomeres pale-scaled beneath; rm index 2; with two lower mesepimeral setae each side; lobes of tergum IX with 28–30 setae. 

**kainosi**

First and third midtarsomeres purple, without pale markings; rm index 3; one lower mesepimeral seta each side; lobes of tergum IX with 23–24 setae. 

28(26). Fourth palpomere with rows of 15 specialized setae above and 14 setae beneath; postpronotum clothed with golden scales. 

**erythrurus**

Fourth palpomere with seven to nine setae on each such rows; postpronotum clothed with brown scales with intense blue green reflections. 

29(28). With two lower mesepimeral setae each side; tergum II mainly purple, with admixture of greenish golden scales; sternum II golden; lobes of tergum IX with 38–40 setae each; with two cercal setae. 

**angolensis**

With one lower mesepimeral seta; tergum II extensively green-scaled proximally, purple distally; sternum II purple in middle; lobes of tergum IX with 31 or 32 setae; with three cercal setae. 

30(23). Postpronotum with a patch of white scales. 

**kainosi**

Postpronotum entirely or mainly golden, with or without blue green reflections, but without white scales. 

31(30). Hind tibia dark purple, without white markings. 

**nairobiensis**

Hind tibia with postmedian patch or ring of white scales. 

32(31). Scales on midcoxa all golden; second tarsomere of foretarsus pale beneath. 

**aeneus**

Midcoxa with patch of silvery white scales at base; second tarsomere of foretarsus dark. 

**erythrurus**

33(22). MF: Without postspiracular scales; rm index 2–3; caudolateral tufts inconspicuous. 

Mainly East and South African Subregion... Lutescens s.str. Group. 

34(33). Males. 

35(34). Golden scales on mesokatepisternum restricted to the lower portion of the sclerite. 

[3] The male of *Tx. aeneus* is not known. 

[4] The females of *Tx. angolensis, Tx. helenae, Tx. nigeriensis,* and *Tx. wolfsi* are not known. 

[5] The females of *Tx. viridibasis volticaeus* and *Tx. zairensis* are not known. 

[6] The male of *Tx. lemureae* and the females of *Tx. fontenillei* and *Tx. pauliani* are not known.
A patch of golden scales also present on the upper portion of mesokatepisternum, at base of the prealar knob. 36(35).

Postpronotum golden green; tergum II metallic green; caudalateral tufts well developed, orange red. v. viridibasis Postpronotum creamy white below, golden above; tergum II coppery purple; caudalateral tufts inconspicuous, yellow. ruwenzori

37(35).

Tergum III with abundant metallic green scales; caudalateral tufts well developed, orange red. v. voltaicus. Tergum III purple, almost devoid of green scales; caudalateral tufts small, inconspicuous, golden. 38

38(37).

Hind tibia purplish, without white ring; tergum II golden with green and purple scales. capelai Hind tibia with postmedian white ring; tergum II coppery or purplish golden, without green scales. 39

39(38). Without mesokatepisternal setae; sterna II–VI golden; distal portion of paraproct gently curved, as usual. lutescens With two mesokatepisternal setae; sterna with purple gloss distally, not entirely golden; distal portion of paraproct bent at right angle. zairensis

40(34). Postpronotum white-scaled below, with narrow line of golden scales above. ruwenzori Postpronotum entirely or mainly golden-scaled. 41

41(40).

Hind tibia dark purple, without white markings. capelai Hind tibia with postmedian patch or ring of white scales. 42

42(41). Scales on prealar area silvery white; second midtarsomere dark. v. viridibasis With golden scales on prealar area; second midtarsomere white. lutescens

43(33).

Males. 44

Females(7). 48

44(43).

Mean number of setae of both lobes of tergum IX 22–25. 45 Mean of the setae of both lobes of tergum IX 11–22. 46

45(44).

Scutum clothed with light green scales; midfemur yellow, with a dark patch at about middle of hind surface. pauliani Scutum clothed with golden brown scales, greenish scutal scales restricted to the prescutellar area; midfemur dark above and at distal half, without patch of dark scales behind. fontenillei 46

46(44).

Mean number of setae of both lobes of tergum IX 12.5–14.5; mean number of sensilla trichodea of both gonostyles 6.5–10; midfemur violaceous and golden, without defined line of blue scales in front. grjebinei

Mean number of setae of both lobes of tergum IX 13.5–25; mean number of sensilla trichodea of both gonostyles 9–18; midfemur with or without line of blue scales in front. 47

47(46).

Scutum with brownish scales with metallic reflections; midfemur with line of metallic blue scales in front, usually well developed; mean number of setae of both lobes of tergum IX 13.5–18; mean number of gonostylar sensilla 9–13.5. madagascariensis Scutal scales brown, golden and silvery, without obvious metallic green reflections; blue scales on midfemur, if present, few in number and sparse; mean number of setae of both lobes of tergum IX 17.5 or more; mean number of gonostylar sensilla 13–18. brunhesi 48(43). Upper surface of second palpomere mainly with whitish scales, dark scales present only at tip; foretarsomerites II–IV pale-scaled, slightly darker at joints. lemuriae Upper surface of palpus with purple and golden scales; at least foretarsomerites III and IV dark. 49

49(48). Front surface of midfemur usually with well developed line of metallic blue scales. madagascariensis Midfemur without line of blue scales, at most a few sparse blue scales present. brunhesi grjebinei

References Cited


(1) With the exception of Tx. lemuriae, females cannot be identified with certainty.


Theobald, F. V. 1901. A monograph of the Culicidae or mosquitoes, vol. I. The Trustees, British Museum (Natural History), London, United Kingdom.


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