

REDESCRIPTION OF *CULICOIDES ORIENTALIS* (DIPTERA: CERATOPOGONIDAE)

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Abstract. The type-series of *Culicoides orientalis* lodged in the British Museum (Natural History), is comprised of specimens from Malaysia (5♀), India (3♀) and Java (1♂, 23♀). The collection from Java is of a different species than the females from Malaysia and India and is identified as *C. maculatus*. The ♂ of *C. orientalis* is described for the first time, from specimens from Malaysia and New Guinea, and a redescription of the female, based on Macfie's original series from Malaysia and India supplemented by specimens from New Guinea, is presented. A ♀ specimen is designated as lectotype.

The recognition of some incongruities in the literature and a need to determine the identity of related species in the subgenus *Avaritia* in Australia prompted my examination of the original type-series of *Culicoides orientalis* Macfie. Through the courtesy of Dr Richard P. Lane and the Trustees of the British Museum (Natural History), I have been able to study in detail the complete series from the Malay States (5♀), India (3♀) and East Java (23♀, 1♂) available to Macfie (1932) for his original description of *C. orientalis*. Of them only 8 females from Malay States and India and the single male from Java (Djawa) were cleared and mounted on slides. The 23 females from Java were preserved in alcohol. It is considered most likely that the original description by Macfie was based primarily on the slide-mounted specimens (8♀, 1♂) and, at the most, supplemented from unmounted females from Java.

The genitalia of the single male from Java have been remounted to reveal the presence of fine hairs distally on the parameres and spiculae on the posterior membrane before the aedeagus, both of which were recorded as lacking in the description. However, 10 females of the alcohol preserved series from Java have now been mounted and those, together with the male specimen bearing the same collection data, are clearly of a distinct species from the other type-series specimens from the Malay States and India; these are identified as *Culicoides maculatus* Shiraki, 1913.

This paper presents a redescription of *C. orientalis* based on the original series from Malay States and India and other specimens from Ipoh, Malaysia and Urimo, NE New Guinea. Some interpretations of the literature on *C. orientalis*, particularly as regards the male, are also presented. Measurements were taken using a calibrated eyepiece. The following abbreviations are used to indicate depository institutions throughout this work: BMNH, British Museum (Natural History), London; ANIC, Australian National Insect Collection, Canberra; SPHTM, School of Public Health and Tropical Medicine, Sydney.

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***Culicoides (Avaritia)² orientalis* Macfie**

FIG. 1-11

Culicoides orientalis Macfie, 1932: 490 [♀ Malay States, India; fig. wing. ♂ (= *C. maculatus* Shiraki) Java; fig. 9th tergite, paramere, aedeagus].—Causey, 1938: 408 [Siam; diagnostic characters ♀ and ♂; fig. incomplete ♂ genitalia species identity questionable].—Sen & Das Gupta, 1959: 627 [India; ♂ only (= *C. brevitarsis* Kieffer) fig. wing, genitalia].—Tokunaga, 1959: 254 [Wum, New Guinea; ♀ fig. wing, antenna, palp, spermathecae; Hollandia, Neth. New Guinea; ♂ (= *C. actoni* Smith) fig. wing, genitalia].—Tokunaga, 1962: 514 [Papua, New Guinea, New Britain, New Ireland, Solomon Is; ♀ fig. wing. ♂ (?= *C. fragmentum* Tokunaga) fig. genitalia].—Tokunaga, 1963: 140 (New Britain; distribution record).—Delfinado, 1961: 656 [Philippines; ♀ and ♂ diagnostic characters; ♀ wing illus. (♂ identity questionable)].

Distinguishing characters

Female separable on wing characters from all species of the subgenus *Avaritia* by the shape of the 3rd dark costal marking that extends transversely across cell R_5 ; proximal margin sloped back behind to form an angular "heel" near vein M_1 , distal margin deeply indented about halfway back by proximal extension of terminal pale spot. Allied species examined from Australia, Papua New Guinea, SE Asia and Japan that possess a large terminal pale patch in cell R_5 are also separable from *C. orientalis* on the following characters: distal pale area of cell R_2 reduced to less than 0.3 (*C. brevitarsis* Kieffer, *C. actoni* Smith); hirsute eyes (*C. actoni*); weakly contrasted wing pattern (*C. actoni*, *C. maculatus*, *C. brevipalpis* Delfinado); discontinuity of fuscous strip along distal $\frac{1}{2}$ of vein M_2 (*C. boophagus* Macfie, *C. suzukii* Kitaoka); vein Cu_1 pale bordered (*C. boophagus*); and fuscous areas on predominantly pale wing forming small discrete spots (*C. flavipunctatus* Kitaoka, *C. fragmentum* Tokunaga, *C. dikhros* Tokunaga). I have been unable to obtain specimens of the closely related *C. suborientalis* for comparison.

Male wing pattern of *C. orientalis* comparable with female wing pattern but pale areas normally more expansive. Genitalia closely similar to those of near relatives but differing subtly in distribution of spiculae on posterior membrane (absent in *C. brevipalpis*, *C. brevitarsis*, *C. fragmentum*), presence or absence of terminal hairs on parameres (absent in *C. actoni*, *C. brevitarsis*), and form of the aedeagus and extent of sclerotization of the peg (strongly sclerotized in *C. brevitarsis*, *C. maculatus*).

Redescription

♀ (FIG. 1-5, 10). *Head*. Eyes bare, centrally contiguous for a distance of about 2 facets (FIG. 1). Antennae (FIG. 2) light brown with flagellomeres III-XV in proportions 12:9:8:9:9:10:11:15:15:16:16:25 (1 unit = 3.1 μ), antennal ratio 1.14, sensory pits on segments III, XI-XV. Palpal (FIG. 3) segments II and III medium brown in color, IV and V lighter; I-V in proportions 6:17:18:10:9; III scarcely swollen with a small rounded subterminal sensory pit about $\frac{1}{2}$ the width of the segment in diameter. Mouthparts 0.7 of head height; mandible with 12-15 teeth ($n=8$). *Thorax*. Dark brown scutum lacking conspicuous pale

2. Following Wirth 1973.

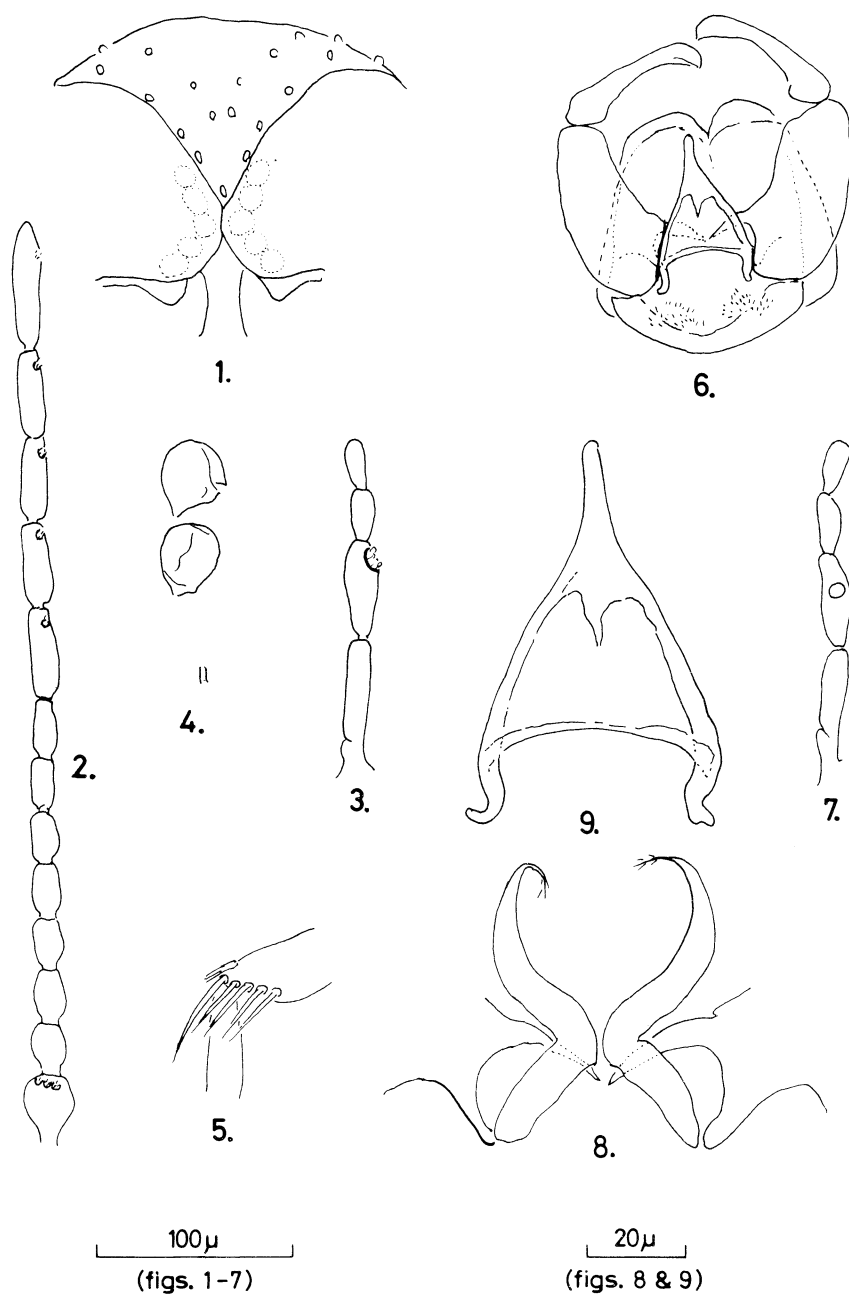


FIG. 1-9. *Culicoides orientalis*. 1, ♀ (Urimo, NE New Guinea), interorbital area. 2-5, ♀ (Malay States): 2, antenna; 3, palpus; 4, spermathecae (rudimentary not shown); 5, hind tibial comb. 6-9, ♂ (Urimo, NE New Guinea): 6, genitalia (parameres not shown); 7, palpus; 8, parameres; 9, aedeagus.

patches; scutellum dark brown, paling to medium brown laterally. *Legs*. Medium brown with faint paling on all femoral bases, fore and mid femora pale subapically, knees brown; all tibiae basally pale and hind weakly paled apically; tarsomeres paling to light brown terminally; hind tibial comb with 5 spines (FIG. 5), the 1st longer than the rest. Tarsi normal, IV on all legs subcylindrical. *Wing* (FIG. 10). Length 0.88 mm (0.75–0.90 mm, $n=14$), costal ratio 0.6; pattern clearly contrasting as figured; macrotrichia confined to distal $\frac{1}{3}$. Cells R_1 and R_2 subequal, basal $\frac{1}{2}$ of R_1 and distal $\frac{1}{2}$ of R_2 pale. First costal dark area nearly as broad as 2nd at the wing margin, both distinctly broader than 3rd; 3rd dark costal marking irregularly transverse across cell R_5 , distal margin deeply indented medially by a backward extension of the terminal pale spot, proximal margin sloping back from the costal margin towards vein M_1 to form a posterior basal "heel"; central dark patch in cell M_1 extending basad relative to the "heel"; dark strip along vein M_2 usually expanded at wing margin. Distal pale spots in cells R_5 , M_1 , M_2 and M_4 broadly abutting wing margin; proximal pale patch in cell M_1 centered basad from line drawn between R_5 and center of pale patch in cell M_4 . Haltere knob slightly fuscous, stem pale. *Abdomen*. Two ovoid functional spermathecae (FIG. 4), subequal with short necks, body dimensions 13×11 and 12×10 units, (1 unit = 3.1μ) the 3rd rudimentary, irregular, tubelike, sclerotized ring short, tubular.

♂ (FIG. 6–9, 11). *Head*. Eyes bare. Palpal segments (FIG. 7) in proportions 6:17:18:11:9, III slightly swollen with tiny rounded sensory pit. *Wing* (FIG. 11). Relatively elongate 0.86 mm ($n=3$), costal ratio 0.62. Macrotrichia limited to wing tip margin, 3rd costal dark area distally indented but base of central dark area in cell M_1 about level with "heel" of 3rd costal dark marking (not basad as in ♀). *Genitalia* (FIG. 6, 8, 9). Sternum 9 with broad deep excavation, posterior membrane spiculate in front with distinct bare central distal gap; tergum 9 tapered, lacking apicolateral processes but with pair of rounded relatively hyaline apical flanges; medial notch deep. Basistyle of medium length, slender, with dorsal root moderately long and stout, ventral root slender, curved and elongate; dististyle of normal proportions. Sides of aedeagus (FIG. 9) smoothly curved converging distally to end in a parallel-sided terminal arm about $\frac{1}{5}$ total length of the organ and with a rounded tip. Basal arms narrow and curved; about $\frac{1}{4}$ total length; basal arch sclerotized as is a backwardly directed internal medial extension from the base of the terminal arm. Parameres (FIG. 8) angled (110°) beyond straight basal $\frac{1}{3}$, distal arm relatively stout basally, curved and abruptly tapering, bearing very fine hyaline hairs at the tip.

Specimens used in redescription. Original type-series in BMNH: 5♀, MALAY STATES, S.T. Stanton (B.M. 1932.99.1–5); the ♀ mounted on slide numbered B.M. 1932.99.1 designated as lectotype. 2♀, INDIA, Dhawar, R. Newstead (B.M. 1932.99.7 & 8); 1♀, India, no other data (B.M. 1932.99.6). Previously unstudied material: 1♂, MALAYSIA, Ipoh, 11.II.1978, S. Kitaoka; 1♂, 8♀, PNG: NEW GUINEA (NE), Urimo, light trap, 5–6.XII.1977, B. Kadeu; 1♂ (78.0604.54) and 3♀ (78.0604.56, 58 & 59), Urimo, lodged in BMNH and 1♂, Ipoh and 5♀, Urimo (in ANIC).

It should be noted again that the collection from E Java, Tosari, Dr K. Fredericks (B.M. 1931.554) comprising 1♂ (slide mount) and 23♀ (originally in alcohol) of Macfie's (1932) series (10♀ recently mounted) are of a different species identified as *C. maculatus* Shiraki, 1913, representing the most southerly record and first of the species from Indonesia.

Other specimens examined. MALAYSIA: 15♀, Ipoh, 31.V.1978, light trap, C.S. Shauta; 1♀, Kuala Pilah, 25.XII.1970, M. Shiba (all in ANIC). PNG: NEW GUINEA (NE): 2♀, Bainyik, I.1959, W. Peters; 1♀, same data except 10.III.1959; 1♀, Maprik (no other data); 4♀, same locality, 7–14.III.1959, W. Peters; 3♀, same locality, IV.1958, Malaria Control Section; 4♀, Moro, Finisterre Range, 1800 m, XI.1964, at light, R. Pullen; 2♀, Madang Distr, Mur Vill, 12.VI.1959, B. McMillan; 21♀, Nineia, 450 m, IX–X.1961, at lamp in rest house, 2000 h, McMillan; 3♀, Sio, 13.X.1960, light trap, McMillan; 1♀, Yambi, 19.IV.1958, light trap, Mal. Cont. Sect. (all in

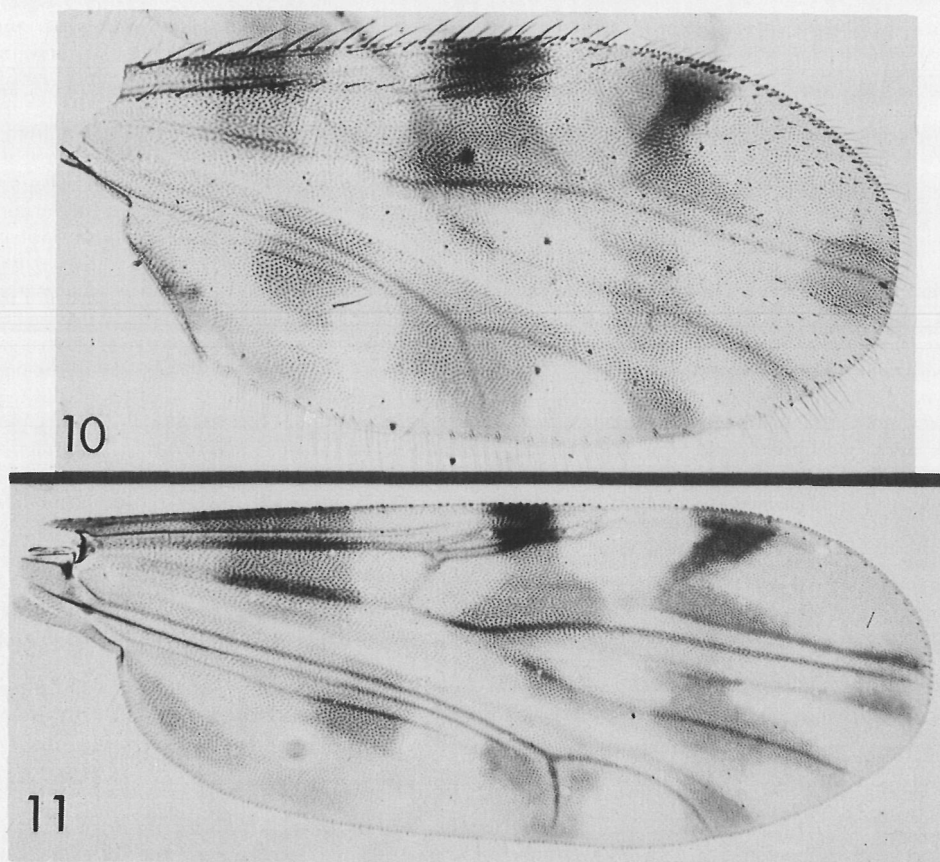


FIG. 10-11. *Culicoides orientalis*: 10, ♀ wing (lectotype); 11, ♂ wing (Urимо, NE New Guinea).

SPHTM). BISMARCK ARCH: NEW HANOVER: 2 ♀, Metrankan, 26.VIII.1958, aspirated at light in rest house, 2330 h, McMillan; 2 ♀, Ungat, 27.VIII.1958, biting at 1200 h, McMillan; NEW IRELAND: 17 ♀, Pronobus, 31.VII-16.VIII.1958, McMillan (all in SPHTM); NEW BRITAIN: 1 ♀, Keravat, 19.III.1958, A. Catley (all in SPHTM).

DISCUSSION

Macfie's (1932) description of the male of *C. orientalis* is based on a single slide-mounted specimen collected (E Java, Tosari, R. Fredericks) in association with 23 females (preserved in alcohol). The E Java specimens possess a wing pattern distinctly different from that of slide-mounted females from Malaysia and India upon which the original description of the female of *C. orientalis* is most likely based. In addition, fine, hyaline hairs adorning the tips of the parameres and spiculae on the posterior

membrane were not visible in the original mount. Consequently, there is confusion in subsequent literature concerning the male correlated with the *C. orientalis* females described by Macfie. My determination of the male specimen described by Macfie (1932) is *C. maculatus* Shiraki, 1913, and it is contended that the male corresponding to his described female has not previously been described.

Subsequent literature referred to below presents illustrations of 4 distinctly different males under the name of *C. orientalis* Macfie. Causey's (1938) reference to "filiform ends" of the parameres and lack of spiculae illustrated for specimens from Thailand clearly indicate that he did not have males of *C. orientalis* for study. The terminalia and wing of specimens from India illustrated by Sen & Das Gupta (1959) are, I believe, of *C. brevitarsis*. Tokunaga (1959, 1962) presented illustrations of male terminalia of 2 distinctly different species under *C. orientalis* in his coverage of New Guinea fauna. The actual specimen [Hollandia, New Guinea, 23.VIII.1955, light trap, Gressitt (in Bishop Museum)] initially illustrated (Tokunaga 1959) proved on examination to be *C. actoni* on the basis of the wing pattern, distribution of spiculae on the membrane, form of the aedeagus and the parameres; it is not *C. brevitarsis* (syn. *C. robertsi* Lee & Reye) as subsequently stated (Tokunaga 1960). The male terminalia later illustrated (Tokunaga 1962) lack fine hairs apically on the parameres (present on *C. orientalis* sensu stricto) and coincides accurately with the previously unrecognized male of *C. fragmentum* except for the presence of spiculae on the posterior membrane. Delfinado (1961) did not illustrate the male but listed as a diagnostic character for *C. orientalis*, "parameres with simple pointed tips," and therefore had male(s) of some other species before her. Dr Macfie's uncertainty about differentiation of his *C. orientalis* female from closely similar species is also evident from the literature. Macfie (1937) under *C. orientalis* wrote of "considerable range of variation" in color, wing adornment, and antennal proportions within a long series of female specimens from Malaysia, stating, "They may be a separate species." Later Buckley (1938: 135), in a footnote referring in part to *C. orientalis* and attributed to Dr Macfie, stated, "More than a single species may be included under these names, but it would be inadvisable, I think, to attempt to separate them until the range of variability of the species is better known, and in some cases, males are available for examination." Macfie's (1932) illustration of the distinctive wing pattern of the female of *C. orientalis* is accurate and those subsequent authors who have figured the wing (Tokunaga 1959, 1962; Delfinado 1961) have not erred.

Despite some confusion over the true identity of *C. orientalis* reflected in the literature, it is certain the species is widespread in Asia and New Guinea. The northern range of the species in Indochina is not precisely limited. McDonald & Lu (1972) did not record *C. orientalis* from Taiwan, whereas Ratanaworabhan (1975) recorded it as occurring in the Chiang Mai Valley, Thailand, with illustration of the female. Wirth (1973) listed the species from Thailand and Vietnam and Delfinado (1961) gave records from the islands of Luzon and Mindanao in the Philippines. The southern limit seems more clearly defined, however. The species is widespread and ap-

parently abundant on the main island of New Guinea (Papua New Guinea and Irian Jaya), the associated Gazelle Peninsula and the Solomon Is, but extensive surveys under way have not revealed its occurrence in Australia.

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