

An Annotated List of *Culicoides* Biting Midges in Yaeyama Islands in the Southwestern Part of Japan (Diptera: Ceratopogonidae)

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Abstract: Species of *Culicoides* biting midges (Diptera: Ceratopogonidae) in Yaeyama Islands were listed. In total, 36 species were included in the list, in which *C. palpifer* Das Gupta and Ghosh was new to Japan and *C. cylindratus* Kitaoka, *C. malayae* Macfie and *C. sasai* Kitaoka were new to the islands. Taxonomic and biological notes for some species were also given.

Key words: *Culicoides*, Ceratopogonidae, list, distribution, Yaeyama Islands

INTRODUCTION

Yaeyama Islands is located in the extreme southwestern part of the Ryukyu Archipelago and consists of three main islands of Ishigaki, Iriomote and Yonaguni, including three small ones of Kuroshima, Kohama and Hateruma. Kitaoka (1977) collected 23 species of *Culicoides* biting midges in Yaeyama Islands and Henna et al. (1991) did 25 species. These two reports included 29 species in total, but several species were added to the Yaeyama *Culicoides* fauna and the taxonomic status was changed in some species. Herewith reported is a list of *Culicoides* species in Yaeyama Islands with taxonomic and biological notes.

Synonyms in the list are after Kitaoka (1984a, b) and Wirth and Hubert (1989), unless otherwise stated. Asterisks before localities in the distribution indicate that the distribution in Yaeyama Islands was confirmed by examining specimens which were mainly collected by the light trap.

Subgenus *Trithecoides* Wirth and Hubert, 1959

1) *C. anophelis* Edwards, 1922

Distribution: *Ishigaki Is., Kuroshima Is., Kohama Is., *Iriomote Is., Hateruma Is., *Yonaguni Is.; Taiwan, Mainland China, Southeast Asia.

Characters of specimens from Yaeyama Islands agree with the description by Wirth and Hubert (1989) excepting that sensilla coeloconica are sometimes present on antennal segment

9 in addition to segments 3 and 11–15 and parameres of male genitalia separate, not fused at the mid-portion.

C. anophelis is a parasitic biting midge on anopheline mosquitoes (Wirth and Hubert, 1959). I. Miyagi found in a cowshed in Ishigaki Island that *Anopheles sinensis* Wiedemann and *An. minimus* Theobald were commonly parasitized by females of *C. anophelis*. He also observed that anopheline females are weakened by the parasitization and often fail to oviposit.

Arnaud (1956) stated "This species has the remarkable habit of obtaining its blood meal by feeding on the abdomen of engorged *Anopheles* mosquitoes". However, Wirth and Hubert (1989) cited references indicating that females of *C. anophelis* feed on haemolymph, but not on engorged blood, of mosquitoes. Some females of *C. anophelis* collected from anophelines at a cowshed in Ishigaki Is. had mature eggs. Both females and males are attracted by light.

2) *C. matsuzawai* Tokunaga, 1950

Distribution: Hokkaido, Honshu, Shikoku, Kyushu, Yakushima Is., *Iriomote Is.; Taiwan, Mainland China, Primorskii Siberia.

This identification of specimens from Iriomote Is. is tentative. McDonald & Lu (1972) recorded the female of *C. matsuzawai* from Taiwan. But the female of *C. flaviscutatus* in Southeast Asia is very similar to that of *C. matsuzawai*, both of which have yellow mesonotum and entirely dark hind femur. Wirth & Hubert (1959) mentioned that the wing of female has a faint or narrow apical pale marking in *C. flaviscutatus* Wirth and Hubert but a distinct one in *C. matsuzawai*. However, the difference in wing pattern is slight and seems to be within a range of variation. On the contrary, male genitalia is quite different in the two species, and for this reason, examination of males is required for exact identification of species. The distribution of *C. matsuzawai* in Iriomote Island of Japan and in Taiwan needs further confirmation, because males from these two areas have not been examined so far.

3) *C. palpifer* Das Gupta and Ghosh, 1956

Distribution: *Iriomote Is. (new record to Japan); Taiwan, Mainland China, Southeast Asia, India, New Guinea, New Britain, Solomon Islands.

C. palpifer is newly recorded from Japan. This species belongs to the *macfieii* group, of which members are characterized by mandible with 7 curved teeth (the distal ones largest) and three spermathecae (one large and 2 subequal small ones) with broad unsclerotized openings to ducts. *C. palpifer* can easily be separated from *C. humeralis* Okada, another Japanese member of the group, by the coloration of mesonotum; the former species has uniformly yellow mesonotum and the latter has yellow mesonotum with dark areas on anterior margin.

4) *C. paraflavescens* Wirth and Hubert, 1959

Distribution: *Ishigaki Is., Kohama Is., *Iriomote Is., Yonaguni Is.; Taiwan, Mainland China, Southeast Asia, Sri Lanka.

Subgenus *Culicoides* Latreille, 1809

5) *C. cylindratus* Kitaoka, 1980

Distribution: Kyushu, Amami-Oshima Is., Okinawa Is., *Ishigaki Is. (new distribution); Taiwan.

Kitaoka (1980) described *C. cylindratus* based on specimens collected in Amami-Oshima Is. This species is allied to *C. aterinervis* Tokunaga but can be separated from it by cylindrical palp 3. The species reported as *C. aterinervis* from Okinawa Is. (McDonald et al., 1973) and from Taiwan (McDonald and Lu, 1972) is *C. cylindratus* (Kitaoka, 1980).

C. cylindratus is also allied to *C. indianus* Macfie in Southeast Asia and India, and Wirth and Hubert (1989) stated that it can be separated from *C. indianus* by subapical pale band on the hind femur, but this character is not diagnostic and further studies are needed.

6) *C. dubius* Arnaud, 1956

Distribution: Hokkaido, Honshu, Kuroshima Is., Iriomote Is., Yanaguni Is.; Taiwan.

Arnaud described *C. dubius* based on the specimens collected from Hokkaido. There was some confusion in classification and this species was called *C. arcuatus* Winnertz in the past in Japan (Arnaud, 1956). The distribution of *C. dubius* is interrupted by a wide area from Kyushu to Miyako Is. Although specimens in Yaeyama Islands were not available for examination, the female from Hokkaido and Honshu is identical with that from Taiwan excepting the smaller size of the latter, as McDonald and Lu (1972) indicated. However, males from Yaeyama and Taiwan are not known and need to be examined for exact identification.

7) *C. lungchiensis* Chen and Tsai, 1962

= *C. megaforticeps* Kitaoka, 1973

Distribution: Honshu, Kyushu, Tsushima Is., Yakushima Is., Hateruma Is.; Taiwan, Mainland China.

This species was first described as a subspecies of *C. peregrinus* Kieffer.

8) *C. malayae* Macfie, 1937

Distribution: Yakushima Is., *Iriomote Is. (new distribution); Taiwan, Southeast Asia.

9) *C. nipponensis* Tokunaga, 1955

Distribution: Hokkaido, Honshu, Amami-Oshima Is., Okinawa Is., *Ishigaki Is., Hateruma Is., *Iriomote Is., *Yonaguni Is.; Primorskii Siberia, Korea, Mainland China, Taiwan.

The species Arnaud (1956) reported as *C. peregrinus* Kieffer is *C. nipponensis* (Kitaoka, 1984a). The wing pattern is different in the two species.

10) *C. peregrinus* Kieffer, 1910

= *C. judicantus* Bezzi, 1917

= *C. esmoneti* Salm, 1918

= *C. philippinensis* Kieffer, 1921

= *C. quadratus* Tokunaga, 1951 (Y. Wada confirmed this synonymy by examining the holotype preserved at Entomological Laboratory, Kyoto Prefectural University.)

Distribution: Amami-Oshima Is., Okinawa Is., *Ishigaki Is., Kuroshima Is., Kohama Is., *Iriomote Is., Hateruma Is., Yonaguni Is.; Taiwan, Mainland China, Southeast Asia, India, Sri Lanka, Micronesia, New Guinea, Australia.

Wing with proximal pale spot at mediocubital fork is diagnostic to this species.

11) *C. sumatrae* Macfie, 1934

= *C. amamiensis* Tokunaga, 1937

= *C. kagiensis* Tokunaga, 1937

= *C. assimilis* Delfinado, 1961

Distribution: Kyushu, Yaku Is., Amami-Oshima Is., Tokunoshima Is., *Ishigaki Is., *Iriomote Is., Yonaguni Is.; Taiwan, Mainland China, Southeast Asia, Sri Lanka.

The wing pattern of *C. sumatrae* is similar to that of *C. nipponensis* Tokunaga, but sensillae of palp 3 are in a pit in *C. sumatrae* and scattered in *C. nipponensis*.

Subgenus *Avaritia* Fox, 1955

12) *C. actoni* Smith, 1929

= *C. okumensis* Arnaud, 1956

= *C. imperceptus* Das Gupta, 1962

Distribution: Honshu, Kyushu, Yaku Is., Amami-Oshima Is., Tokunoshima Is., Okinawa Is., Miyako Is., *Ishigaki Is., Kohama Is., *Iriomote Is., Yonaguni Is.; Taiwan, Mainland China, Southeast Asia, India, Australia.

Characters of the specimens from Yaeyama Islands agree well with those by Wirth and Hubert (1989) excepting that sensilla coeloconica of antennae are sometimes present on segment 11 in addition to segments 3 and 12–15.

13) *C. albifascia* Tokunaga, 1937

Distribution: Iriomote Is.; Taiwan, Mainland China.

Tokunaga (1937) described *C. albifascia* based on a female collected at Mt. Arisan in Taiwan, and Tokunaga (1962) supplemented his original description after examining a newly collected female from Iriomote Is., which is the only record of this species in Japan. McDonald and Lu (1972) recorded *C. albifascia* from Mt. Arisan in high altitude in Taiwan and Lee (1978) from Tibet (alt., 1,200–2,900m) in Mainland China, while Iriomote where Tokunaga (1962) collected *C. albifascia* is an oceanic island. In addition to the difference of locality, there is some discrepancy in the description between Tokunaga (1937) and Tokunaga (1962). Therefore, the species of Tokunaga (1962) from Iriomote Is. may be different from true *C. albifascia*.

14) *C. brevipalpis* Delfinado, 1961

Distribution: Amami-Oshima Is., Okinawa Is., *Ishigaki Is., Kuroshima Is., Kohama Is.,

*Iriomote Is., Hateruma Is., *Yonaguni Is.; Taiwan, Southeast Asia.

One female from Ishigaki Is. was found to have three spermathecae instead of two.

15) *C. brevitarsis* Kieffer, 1917

= *C. robertsi* Lee and Reye, 1953

= *C. superfulvus* Das Gupta, 1962

Distribution: Niijima Is., Kyushu, Takarajima Is., Amami-Oshima Is., Okinawa Is., Miyako Is., *Ishigaki Is., Kuroshima Is., Kohama Is., *Iriomote Is., Hateruma Is., *Yonaguni Is.; Taiwan, Southeast Asia, Australia.

16) *C. dumdumi* Sen and Das Gupta, 1959

Distribution: *Iriomote Is.; Sabah, India.

C. pungens in Southeast Asia is closely related to this species, but has still more reduced pale wing markings and darker halteres (Wirth and Hubert, 1989).

17) *C. flavipunctatus* Kitaoka, 1975

Distribution: *Ishigaki Is. (new distribution), *Iriomote Is., Yonaguni Is.; Southeast Asia.

18) *C. hui* Wirth and Hubert, 1961

Distribution: *Iriomote Is. (new distribution), Yonaguni Is.; Taiwan, Mainland China, Southeast Asia.

19) *C. jacobsoni* Macfie, 1934

= *C. buckleyi* Macfie, 1937

= *C. kitaokai* Tokunaga, 1955

= *C. unisetiferus* Tokunaga, 1959

Distribution: Honshu, Kyushu, Tsushima Is., Yakushima Is., Amami-Oshima Is., Tokunoshima Is., Okinawa Is., *Ishigaki Is., Kohama Is., *Iriomote Is., Hateruma Is.; Taiwan, Mainland China, Southeast Asia, New Guinea.

20) *C. maculatus* (Shiraki, 1913)

= *C. tainana* Kieffer, 1916

= *C. kii* Tokunaga, 1937

= *C. sigaensis* Tokunaga, 1937

= *C. kyotoensis* Tokunaga, 1937

= *C. suborientalis* Tokunaga, 1951

Distribution: Hokkaido, Honshu, Shikoku, Kyushu, Tsushima Is., Amami-Oshima Is., Okinawa Is., Ishigaki Is., Iriomote I., Yonaguni Is.: Taiwan, Mainland China, Southeast Asia.

C. maculatus is a variable species and there was some confusion in identification in the past. We do not have specimens from Yaeyama Islands that can confidently be referred to as *C. maculatus*.

21) *C. wadai* Kitaoka, 1980

Distribution: *Ishigaki Is., *Iriomote Is., Yonaguni Is.; Taiwan, Southeast Asia, Australia.

C. wadai is much allied to *C. suzukii* Kitaoka, but both are distinct species. The former species is found only in Amami-Oshima Is, while the latter widely from Yaeyama Islands to Australia. *C. wadai* was erroneously reported from Yaeyama Islands as *C. suzukii* by Kitaoka (1977).

Subgenus *Oecacta* Poey, 185122) *C. clavipalpis* Mukerji, 1931

= *C. candidus* Sen and Das Gupta, 1959

Distribution: Hokkaido, Honshu, *Ishigaki Is., *Iriomote Is. (new distribution), Hateruma Is.; Korea, Taiwan, Southeast Asia.

23) *C. dryadeus* Wirth and Hubert, 1972

Distribution: Mikura Is., Chikuzen-Okinoshima Is., Meshima Is., *Iriomote Is.; Taiwan, Southeast Asia, India.

This is a coastal species. Larvae breed in tree holes (Kitaoka, 1977).

24) *C. insularis* Kitaoka, 1980

Distribution: Sado Is., Mikura Is., Chikuzen-Okinoshima Is., Fukue Is., Kuchinoshima Is., Nakanoshima Is., Amami-Oshima Is., *Yonaguni Is.; Mainland China.

The species Kitaoka (1977) recorded from Yonaguni Is. as *C. pampangensis* Delfinado is *C. insularis*. This is a coastal species.

25) *C. iriomotensis* Kitaoka, 1975

Distribution: *Ishigaki Is., *Iriomote Is.

This species is known only from Yaeyama Islands. Larvae breed in tree holes (Kitaoka, 1977).

26) *C. kibunensis* Tokunaga, 1937

= *C. ponkikiri* Kono and Takahasi, 1940

= *C. sitinohensis* Okada, 1941

Distribution: Hokkaido, Honshu, Shikoku, Kyushu; Korea, Mainland China.

There was some confusion in the identification of *C. kibunensis*. *C. arnaudi* Wirth and Hubert is very similar to *C. kibunensis*, but they are distinct species (Wada, 1990). *C. kibunensis* was reported from Okinawa Is. by McDonald et al. (1973) and from Ishigaki Is. and Iriomote Is. by Henna et al. (1991), but it seems to be *C. arnaudi*. The species recorded by Tokunaga (1955) from Korea as *C. odiatus* Austen was confirmed to be *C. kibunensis* by examining specimens that were used for his record.

27) *C. komiensis* McDonald, Bolinguit and Lu, 1973

Distribution: Okinawa Is., *Ishigaki Is., *Iriomote Is.

28) *C. longidens* Arnaud, 1956

= *C. paucidentatus* Kitaoka, 1973

Distribution: Amami-Oshima Is., Okinawa Is., Iriomote Is.; Korea.

29) *C. okinawensis* Arnaud, 1956

Distribution: Amami-Oshima Is., Okinawa Is., Miyako Is., *Ishigaki Is., Kohama Is., *Iriomote Is.; Taiwan, Southeast Asia.

30) *C. oxystoma* Kieffer, 1910

= *C. kiefferi* Patton, 1913

= *C. mesopotamiensis* Patton, 1920

= *C. pattoni* Kieffer, 1921

= *C. housei* Causey, 1938

= *C. punctigerus* Tokunaga, 1951

= *C. alatus* Das Gupta and Ghosh, 1956

Distribution: Honshu, Kyushu, Amami-Oshima Is., Okinawa Is., Miyako Is., *Ishigaki Is., Kohama Is., *Iriomote Is., Hateruma Is., Yonaguni Is.; Korea, Taiwan, Mainland China, Southeast Asia, India, Iran.

31) *C. peliliouensis* Tokunaga, 1936

= *C. ejercitoi* Delfinado, 1961

= *C. subdubius* Tokunaga, 1962

Distribution: *Ishigaki Is. (new distribution), Iriomote Is., Yonaguni Is.; Taiwan, Southeast Asia, Micronesia.

32) *C. sasai* Kitaoka, 1975

Distribution: Kyushu, Amami-Oshima Is., *Ishigaki Is. (new distribution).

33) *C. toshiokai* Kitaoka, 1975

Distribution: *Ishigaki Is., *Iriomote Is., Hateruma Is.

This species is known only from Yaeyama Islands. Larvae breed in tree holes.

34) *C. verbosus* Tokunaga, 1937

= *C. yaeyamaensis* Kitaoka, 1975

Distribution: Okinawa Is., *Ishigaki Is., *Iriomote Is., Hateruma Is., Yonaguni Is.; Taiwan.

35) *C. wakuensis* McDonald, Bolinguit and Lu, 1973

= *C. chaetocellaris* Kitaoka, 1973

Distribution: Amami-Oshima Is., Okinawa Is., Iriomote Is.

Subgenus *Beltranmyia* Vargas, 1953

- 36) *C. arakawae* (Arakawa, 1910)
 = *C. sugimotonis* Shiraki, 1913
 = *C. alboguttatus* Kieffer, 1921
 = *C. shimai* Sasaki, 1928
 = *C. daleki* Smith and Swaminath, 1932
 = *C. micropunctatus* Tokunaga, 1951

Distribution: Throughout Japan including Ishihgaki Is., Kohama Is., Iriomote Is., Hateruma Is. and Yonaguni Is.; Korea, Taiwan, Mainland China, Southeast Asia, India.

Wirth and Hubert (1989) used *Meijerehelea* as the subgeneric name of *C. arakawae* in their monograph on *Culicoides* of Southeast Asia.

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