

Mosquitoes of the Tokara Archipelago, Japan¹Ichiro Miyagi², Takako Toma², Hiroshi Suzuki³ and Takao Okazawa⁴

ABSTRACT: Nineteen mosquito species belonging to nine genera are recorded from Kuchinoshima, Nakanoshima and Takarajima of Tokara Archipelago, Japan: *An. sinensis*, *An. lindesayi japonicus*, *Tr. bambusa yaeyamensis*, *Ml. genurostris*, *To. yanbarensis*, *Cq. ochracea*, *Or. anopheloides*, *Ae. nishikawai*, *Ae. togoi*, *Ae. albopictus*, *Ae. flavopictus downsi*, *Ae. riversi*, *Ae. vexans nipponii*, *Ar. subalbatus*, *Cx. ryukyensis*, *Cx. halifaxii*, *Cx. pipiens quinquefasciatus*, *Cx. tritaeniorhynchus* and *Cx. bitaeniorhynchus*. All of them are new records from the islands. Among them 13 species are widely distributed in the Ryukyu Islands and the Palaeartic Japan. Five species, *Tr. bambusa yaeyamensis*, *Ml. genurostris*, *Ae. nishikawai*, *Ae. flavopictus downsi* and *Cx. ryukyensis*, are an Oriental element and the northernmost records. *An. lindesayi japonicus* has not been found in the Ryukyu Archipelago and this is the southernmost record of the species. The distribution and habits of the species are also discussed.

INTRODUCTION

The Tokara Archipelago (Fig. 1), lying in the east China sea between the latitudes of 29-30° N and the longitudes of 129-130° W, is mainly composed of nine small islands: Kuchinoshima (13.30 km²), Nakanoshima (27.54 km²), Gajyajima (4.50 km²), Suwanosejima (22.5 km²), Tairajima (1.99 km²), Akusekijima (7.04 km²), Takarajima (7.0 km²), Kodakarajima (1.17 km²) and Yokoatejima (3.76 km²). The Archipelago represents an extremely interesting area from a zoogeographical standpoint. As is well known, the mosquito fauna of the northern Satsuma Islands (including Tanegashima and Yakushima) are in the same zoological zone as the mainland of Japan which belongs to the Palaeartic Region. On the other hand, the southern Ryukyus (Amami, Okinawa, Ishigaki, Iriomote and Yonaguni)

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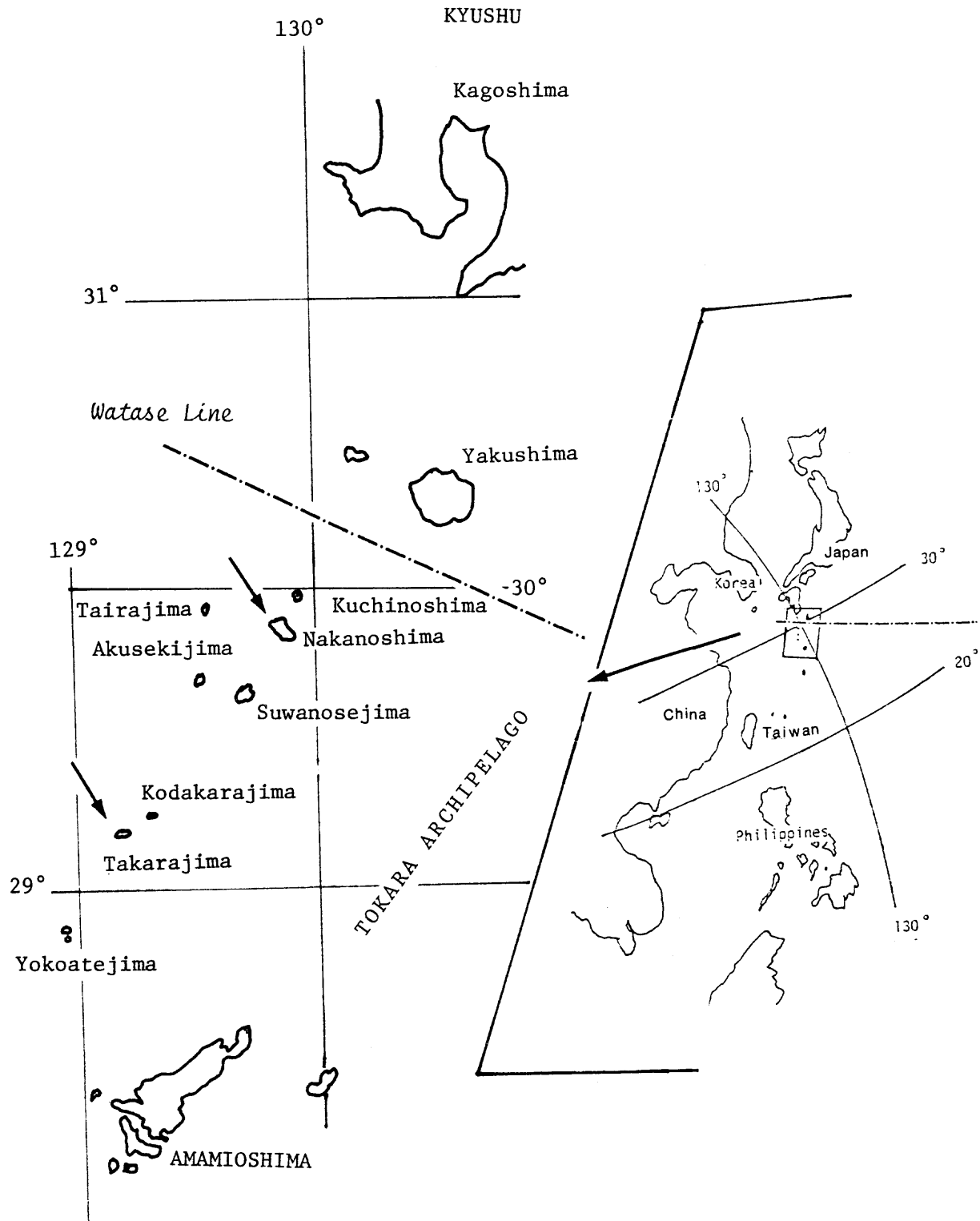


Fig. 1. Map of the Tokara Archipelago showing the islands collected mosquitoes (arrows) and "Watase Line" which is the boundary separating the Oriental and Palaeartic Regions.

belong to the Subtropical Region and the fauna are mainly represented by Oriental species (Kamimura 1968; Sasa et al. 1977; Tanaka et al. 1975, 1979; Miyagi and Toma 1980, 1981). The channel dividing the Satsuma Islands and Tokara Archipelago is called, zoogeographically, "the Watase Line" (Tokuda 1941). The nine islands situated between the Satsuma Islands and the Ryukyu Archipelago seem to be a transitional zone where oriental and palaeartic species intermingle. However, there seems to be no published record of the occurrence of mosquitoes on the Tokara Archipelago.

During a 2-year (1981-1982) medico-zoological survey in the Tokara Archipelago, extensive mosquito collections were made on Kuchinoshima, Nakanoshima and Takarajima using several conventional methods. The data presented on the following pages are derived from this survey.

RESULTS AND DISCUSSION

1. *Anopheles (Anopheles) sinensis* Wiedemann 1828

Specimens examined. KUCHINOSHIMA: 3 larvae, 14 August 1981, H. Suzuki. NAKANOSHIMA: 14 females, 13 males, 10 larvae 28-30 July 1981; TAKARAJIMA: 10 females, 5 males, 7 August 1981, light traps, I. Miyagi.

Notes. This is a very common species in the islands and breeds commonly in rice fields and marshes. Many adults were collected by light traps at cowsheds.

Distribution. Palaeartic Japan (Hokkaido to Kyushu, Yakushima), Tokara Arch. (Kuchinoshima, Nakanoshima, Takarajima), Ryukyu Arch. (Amami to Iriomote, Yonaguni), China, Taiwan, Hong Kong, Indochina, Thailand, Malaya, Sumatra, Assam.

2. *Anopheles (Anopheles) lindesayi japonicus* Yamada 1918

Specimens examined. NAKANOSHIMA: 10 larvae, 4 females, 5 males reared from larvae, 28-29 July 1981, 10 larvae, 4 females, 2 males reared from larvae, 6-8 August 1981.

Notes. The larvae were commonly found in small clear pools in the rocky beds of mountain streams and in stagnant pools of wells. A number of geographically separated forms have been named and are treated as subspecies (Reid 1968). According to Tanaka et al. (1979), "The Japanese population of *An. lindesayi* has been distinguished as subspecies *japonicus* primarily on the absence of a pale terminal spot on vein R_3 , the presence of a pale terminal spot on Cu_1 ," and also they stated many of the Japanese specimens usually have a pale spot at the end of R_{4+5} , M_{3+4} , Cu_2 and $1A$. The specimens at hand are identical with the redescription of *japonicus* by Tanaka et al. (1979), however, considerable variations were found. There is usually no terminal pale spot on Cu_1 and R_{4+5} . It is quite curious that in spite of extensive collecting (Miyagi and Toma 1980, 1981), forms of *An. lindesayi* have not been found in

the Ryukyus Archipelago, though it is common in both Taiwan and Palaeartic Japan (Tanaka et al. 1979). We have some doubt as to the treatment of the Japanese population of *japonicus* as a subspecies of *lindesayi*.

Distribution. Palaeartic Japan (Hokkaido to Kyushu, Yakushima, Tsushima), Tokara Arch. (Nakanoshima, Takarajima).

3. *Tripterooides (Tripterooides) bambusa yaeyamensis* Tanaka, Mizusawa and Saugstad 1979

Specimens examined. NAKANOSHIMA: 10 females, 23 males reared from larvae, 24 April 1982, H. Suzuki; 20 larvae, 15 May 1982, H. Suzuki; 11 females, 7 males, 1 July 1982, H. Suzuki.

Notes. This subspecies is very common in Nakanoshima but never found on Takarajima and Kuchinoshima. The larvae of this species were commonly found in tree holes, cut bamboos and artificial containers in the forest. Two females and 53 males feeding on wild flowers, *Patrinia villosa* Juss and *Eupatorium variabile* Makino were collected by H. Suzuki. The adult females were frequently feeding upon us in the forest.

According to Tanaka et al. (1975), the Ryukyu (Ishigaki and Iriomote) population of *Tp. bambusa* has been distinguished as subspecies *yaeyamensis* primarily on the yellowish brown scutum, paratergite, lower end of sternopleuron and apex of mesomeron. We have had an opportunity to compare our specimens with *Tp. bambusa yaeyamensis* but scutum, paratergite, postnotum and pleura are brown, somewhat intermediate between subspecies *bambusa* from Saga and *yaeyamensis* from Ishigaki. It is very curious that *Tripterooides bambusa* has not been found in Okinawa and Amami. Until further studies on morphology and biology have been conducted, we consider that the specimens from Tokara Is. are identical with *yaeyamensis*.

Distribution. Tokara Arch. (Nakanoshima), Ryukyu Arch. (Iriomote, Ishigaki and Yonaguni).

4. *Malaya genurostris* Leicester 1908

Specimens examined. NAKANOSHIMA: 2 larvae, 1 female reared from larva, 28 July 1981, I. Miyagi.

Notes. The larvae were collected from water in leaf axils of *Alocasia macrorrhiza*. This is a typical Oriental element and the northernmost record.

Distribution. Ryukyu Arch. (Amami, Okinawa and Yaeyama Gunto), Tokara Arch. (Nakanoshima), Taiwan, Philippines, Indonesia, South China, Malay, Singapore, Thailand, Burma, India, Ceylong, Maldive Is., New Guinea, Australia.

5. *Topomyia (Suaymyia) yanbarensis* Miyagi 1976

Specimens examined. NAKANOSHIMA: 1 male, 29 July 1981, I. Miyagi; 7 larvae, 22 October 1981, I. Miyagi. TAKARAJIMA: 3 females, 2 males reared from larvae, 3 August 1981, I. Miyagi.

Notes. On the basis of the male genitalia, our specimens are identical with the type specimens of *Topomyia yanbarensis*. The larvae were commonly found in water collections in internodes of living small bamboos. The larvae are predacious and the adult females are autogenous. This species is a typical Oriental element and since a part of the characteristic habitat of this species has been revealed by Miyagi (1976), this species was recorded from Taiwan (Miyagi and Toma 1981), Amami (Mogi et al. 1981), Kagoshima (Makiya et al. 1976) and Nagasaki (Mogi et al. 1981). The peculiar habitat of the species may make it possible to extend their northern distribution.

Distribution. Taiwan, Ryukyu Arc. (Okinawa, Amami), Tokara Arch. (Tokarajima, Nakanoshima), Kyushu (Kagoshima, Nagasaki).

6. *Coquillettidia ochracea* (Theobald) 1903

Specimens examined. NAKANOSHIMA: 1 female, 3 males, 6-8 August 1981, I. Miyagi.

Notes. The adults were collected from light traps operated at a pond (Sokonashi Ike).

Distribution. Palaeartic Japan (Honshu), Korea, Tokara Arch. (Nakanoshima), Ryukyu Arch. (Amami, Okinawa, Ishigaki, Iriomote), throughout Southeast Asian countries.

7. *Orthopodomyia anopheloides* (Giles) 1903

Specimens examined. NAKANOSHIMA: 1 larva, 1 August 1981, I. Miyagi; 6 larvae, 32 females, 48 males reared from larvae, 17 November 1981, H. Suzuki.

Notes. The larvae were collected from tree holes and artificial containers distributed in the forest of Nakanoshima.

Distribution. Palaeartic Japan (Honshu, Shikoku, Kyushu, Yakushima), Tokara Arch. (Nakanoshima), Ryukyu Arch. (Amami, Okinawa, Ishigaki, Iriomote), Oriental region.

8. *Aedes (Finlaya) nishikawai* Tanaka, Mizusawa and Saugstad 1979

Specimens examined. NAKANOSHIMA: 1 female, 30 July 1981, I. Miyagi; 1 female, 20 October 1982, T. Okazawa; 1 female, 1 July 1982, H. Suzuki.

Notes. Two females were collected at the forest of Nakanoshima by biting catches. The specimens agree well with the specimen of *Aedes (Finlaya)*

nishikawai from Amami and original description of *Ae. nishikawai* (Tanaka et al. 1979).

Distribution. Tokara Arch. (Nakanoshima), Ryukyu Arch. (Amami).

9. *Aedes (Finlaya) togoi* (Theobald) 1907

Specimens examined. KUCHINOSHIMA: 1 female, 14 August, H. Suzuki; NAKANOSHIMA: 5 females, 5 males, 29 July 1981, I. Miyagi; 8 larvae, 15 November 1981, H. Suzuki. TAKARAJIMA: 3 females, 10 males, 12 August 1981, I. Miyagi.

Notes. Many adults were collected by light traps and readily bit us in the forest. The larvae were found in artificial containers near the seashore. This species has become established on the northern coast of the State of Washington, U. S. A., and British Columbia, Canada (Belton 1980).

Distribution. Korea, Sakhalin, China, Palaearctic Japan (Hokkaido to Kyushu), Tokara Arch. (Kuchinoshima, Nakanoshima, Takarajima), Ryukyu Arch. (Amami to Ishigaki, Iriomote, Yonaguni), Taiwan, Thailand, Malaya, State of Washington, U. S. A., British Columbia, Canada.

10. *Aedes (Stegomyia) albopictus* (Skuse) 1894

Specimens examined. KUCHINOSHIMA: 6 larvae, 14 August 1981, H. Suzuki; NAKANOSHIMA: 5 larvae, 2 females, 1 male, 28-31 July 1981, I. Miyagi; TAKARAJIMA: 14 larvae, 18 females, 20 males reared from larvae, 3-5 August 1981, I. Miyagi.

Notes. This is one of the common mosquitoes in human dwelling areas in the islands.

Distribution. Palaearctic Japan (Hokkaido to Kyushu, Yakushima), Ryukyu Arch. (Amami to Yonaguni), Tokara Arch. (Kuchinoshima, Nakanoshima, Takarajima), Taiwan, Oriental region.

11. *Aedes (Stegomyia) flavopictus downsi* Bohart and Ingram 1946

Specimens examined. NAKANOSHIMA: 7 males and 5 females, 5 September 1982, T. Okazawa.

Notes. One female was collected biting at Nakanoshima and laid eggs in the laboratory. The specimens examined are offspring of the female. Three geographically separated forms have been named and they are treated as subspecies by Tanaka et al. 1979: *Aedes flavopictus flavopictus* Yamada, from mainland Japan, *Ae. flavopictus downsi* Bohart and Ingram, from Amami and Okinawa, and *Ae. flavopictus miyagai* Tanaka et al., from Yaeyama. Tanaka et al. (1979) discussed that differentiation of these subspecies. However, Huang (1972) treated *downsi* and *flavopictus* as separate species. Although our specimens are superficially damaged and detailed comparison is not possible, the male genitalia are identical with *Ae. flavopictus downsi* from Amami and Okinawa.

12. *Aedes (Stegomyia) riversi* Bohart and Ingram 1946

Specimens examined. NAKANOSHIMA: 10 larvae, 3 females, 2 males, 29 July 1981, I. Miyagi; 10 larvae, 14 November 1981, H. Suzuki; TAKARAJIMA: 5 females, 3 males, 3 August 1981, I. Miyagi; 12 females, 1 male reared from larvae, 1 July 1982, H. Suzuki.

Notes. The adult females of *Ae. riversi* readily bit us in the forest. The larvae were found in artificial containers and rock pools together with *Orthopodomyia anopheloides*, *Culex ryukyensis*, and sometimes with *Ae. albopictus*.

Distribution. Palaearctic Japan (Kyushu, Yakushima, Tsushima), Ryukyu Arch. (Amami to Iriomote, Yonaguni), Tokara Arch. (Nakanoshima, Takarajima).

13. *Aedes (Aedimorphus) vexans nipponii* (Meigen) 1830

Specimens examined. NAKANOSHIMA: 5 females, 18 males, 29 July 1981, I. Miyagi.

Notes. Many adults were collected by light traps at cowsheds.

Distribution. Palaearctic Japan (Hokkaido to Kyushu, Yakushima), Tokara Arch. (Nakanoshima), Ryukyu Arch. (Amami to Yonaguni), China.

14. *Armigeres (Armigeres) subalbatus* (Coquillett) 1898

Specimens examined. KUCHINOSHIMA: 1 female, 14 August 1981, H. Suzuki; NAKANOSHIMA: 2 females, 5 males, 28 July, I. Miyagi; TAKARAJIMA: 2 females, 3 males, 1 August 1981, I. Miyagi.

Notes. Adults were collected by light traps at Nakanoshima and very often came to bite at night in Takarajima.

Distribution. Palaearctic Japan (Honshu to Yakushima), Takara Arch. (Kuchinoshima, Nakanoshima, Takarajima), Ryukyus Arch. (Amami to Yonaguni), Thailand, Burma, India, Taiwan, Southchina, Indochina.

15. *Culex (Lutzia) halfaxii* Theobald 1903

Specimens examined. NAKANOSHIMA: 5 larvae, 2 females reared from larvae, 31 July 1981, I. Miyagi; 3 larvae, 23 November 1981, H. Suzuki.

Notes. The larvae were commonly found in artificial containers with *Aedes riversi* and rock pools with *Culex ryukyensis*.

Distribution. Palaearctic Japan (Hokkaido to Yakushima), Tokara Arch. (Nakanoshima), Ryukyu Arch. (Amami to Yonaguni), Oriental and Australian regions.

16. *Culex (Culiciomyia) ryukyensis* Bohart 1946

Specimens examined. NAKANOSHIMA: 5 females, 5 males, reared from larvae, 31 July 1981, I. Miyagi; 5 larvae, 1 female, 2 males reared from larvae, 14 November 1981, H. Suzuki.

Notes. The larvae were commonly found in rock pools and artificial containers in the forest. This species is somewhat similar to *Cx. kyotoensis* in general appearance but easily separated by the male genitalia (Bohart 1953). *Culex ryukyensis* appears endemic to the Ryukyu Archipelago and the present record is the northern limits of this species.

Distribution. Ryukyu Arch. (Amami to Yonaguni), Tokara Arch. (Nakanoshima).

17. *Culex (Culex) pipiens quinquefasciatus* Say 1823

Specimens examined. NAKANOSHIMA: 3 larvae, 5 females, 10 males, 30 July 1981, I. Miyagi; TAKARAJIMA: 2 females, 5 males, 12 August 1981, I. Miyagi.

Notes. Many adults of *Cx. pipiens* group were collected by light traps. The male genitalia of the examined specimens were identical with *Cx. quinquefasciatus* from Okinawa. This is an Oriental element and one of the common mosquitoes in the islands.

Distribution. Palaearctic Japan (Sikoku, Kyushu, Yakushima), Tokara Arch. (Nakanoshima, Takarajima), Ryukyu Arch. (Amami to Yonaguni), Cosmotropical.

18. *Culex (Culex) tritaeniorhynchus* Giles 1901

Specimens examined. NAKANOSHIMA: 10 larvae, 3 females, 2 males, 28 July 1981, I. Miyagi; 20 females, 16 males, 12 August 1981, I. Miyagi.

Notes. The larvae of the species were found in paddy field, swamps of Nakanoshima. Many adults were attracted by light traps in cowsheds.

Distribution. Palaearctic Japan (Hokkaido to Yakushima), Tokara Arch. (Nakanoshima, Takarajima), Ryukyu Arch. (Amami to Yonaguni), Southeast Asia.

19. *Culex (Culex) bitaeniorhynchus* Giles 1901

Specimens examined. TAKARAJIMA: 1 female, 3 males, 3 August 1981, I. Miyagi.

Notes. The female was collected by sweeping net in the forest.

Distribution. Palaearctic Japan (Hokkaido to Yakushima), Ryukyu Arch. (Amami to Yonaguni), Oriental, Australian and Ethiopian Regions.

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