Mosquitoes of the Ryukyu Archipelago
(Diptera: Culicidae)\(^1\)

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ABSTRACT. Mosquito species occurring in the Ryukyu Archipelago are enumerated. \textit{Anopheles ohamai} is provisionally treated as a subspecies of \textit{An. saperoi}. \textit{An. nigerrimus} is deleted from the fauna of the Archipelago.

INTRODUCTION

The senior author of this paper presented a short speech on the mosquito fauna of the Ryukyu Archipelago at the 23rd Annual Meeting of the Japan Society of Sanitary Zoology, publishing "A List of the Family Culicidae of the Ryukyu Islands" (Tanaka, 1971a, 1971b). In preparation of this list, he largely utilized Hara's mimeographed paper, "A List of Mosquito Fauna of Japan" (1966). However, Hara's list has been found inaccurate, especially in distribution of species within the Ryukyus, thus causing several erroneous distribution records in Tanaka's list. This paper is a replacement and enlargement of the speech of 1971, being essentially a list of species occurring in the Archipelago, including corrections of and additions to the list of 1971, synonyms from this region, brief accounts of larval habitats and geographical distributions. The first record of each species from the Ryukyu Archipelago is also shown as far as we could trace it; there may well exist earlier records than those we found for some of the commonest species such as \textit{C. tritaeniorhynchus}, \textit{Aedes albopictus}, \textit{Ae. vexans nipponii}, etc.

The Ryukyu Archipelago is here defined as a series of more than 100 islands situated between Kyushu and Taiwan, extending about 1000 km from 24° to 30° N, and 123° to 130° E. Tokara Gunto, composed of more than 10 very small islands scattered between Yakushima and Amami Oshima, may be a part of the Ryukyu Archipelago. However, mosquitoes have not been surveyed in this Gunto, and it is not considered in this paper. Daitō Shoto\(^3\), about 400 km east of Okinawa Is., consisting of 3 small islands of upheaved coral-reef, may belong to a different geographical category, thus, it is not included in the Ryukyu Archipelago. Osumi Shoto, including Yakushima (Is.) and

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\(^3\)K. Mizusawa personally attempted a survey during 4–6 Sept. 1967 on Minami Daitō Is., the largest island (31 km\(^2\)) of the three, obtaining 4 species: \textit{Mansonia uniformis}, \textit{Culex pipiens quinquefasciatus}, \textit{Aedes albopictus} and \textit{Armigeres subalbatus}.
Tanegashima (Is.) off southern Kyushu, is also not included, because it appears geographically more closely related to the mainland of Kyushu.

The Ryukyu Archipelago is divided into 4 groups of islands from the north to south: Amami Gunto, Okinawa Gunto, Miyako Gunto and Yaeyama Gunto; the last 2 occasionally combined as Sakishima Gunto. The area of and the number of species recorded from the total Ryukyu Archipelago, together with those of these 4 groups and Palaeartctic Japan (from Hokkaido to Kyushu) are shown in Table 1. Species composition of the total Ryukyu Archipelago is demonstrated in a diagram (Fig. 1).

While zoogeography of the Ryukyu Archipelago may well be one of the more fascinating subjects in this field, detailed discussions on the zoogeography of mosquitoes will be done elsewhere. Here we will give only a rough and partial sketch of it. Endemic species are Anopheles saperot, Urandentia ohamai, U. yaeyamana, Heimannia sp., Culex tuberiis, C. ryukyensis, Aedes atristimulis, Ae. iriomotensis and Toxorhynchites yamadai. Semiendemic species are Aedes watasei, Ae. riversi and Ae. nobukonis; the distributions of these 3 species outside the Archipelago are limited to only one to a few localities of the southern and western coastal regions of the Kyushu District. A rather high percentage of endemic species is thought to be one of the characteristics of the Ryukyu fauna. However, future discoveries seem likely to decrease rather than increase this percentage. Mosquito fauna of the eastern coastal region of East Asia including the Ryukyus may be characterized by richness of species and strong northwards invasion of southern species, bringing a high percentage of species common to the Oriental and Palaeartctic Regions to both the Ryukyus and Palaeartctic Japan. For an explanation of it, approaches from geological history should primarily be considered; however, aerial currents may be one of the important additional factors. Overseas migration of mosquitoes has recently been confirmed; for instance, 3 females of Culex tritaeniorhynchus were captured on a weather-ship located on the Pacific Ocean at 29°N, 135°E, 560 km east of Amami Oshima, or 780 km from Okinawa Is. (Asahina & Turuoka, 1969, 1970; Asahina 1970). The aerial currents prevailing in this region must have allowed northwards migration of southern species, and relatively high temperature and rich rain fall brought by the warm Japan oceanic current may have enabled them to have established there, contributing to the enrichment of the mosquito fauna of this region. The general character of the mosquito fauna of the Ryukyu Archipelago is Oriental as clearly seen in Fig. 1. Apparent richness of tropical elements in temperate Japan and its vicinity makes the boundary between the Oriental and Palaeartctic Regions in this area rather obscure. But, closer examination of the mosquito faunae of Amami Gunto and Ōsumi Shotō will give some light to this problem. Two tropical genera (Mimomyia and Malaya) and 5 Oriental species recorded from Amami Gunto do not reach Ōsumi Shotō; Heimannia, an Oriental genus (Mattingly, 1962), though occurring in Korea, was found on Amami Oshima, but not in Ōsumi Shotō; on the other hand, 7 Palaeartctic species of Ōsumi Shotō do not reach Amami Gunto. Essentially Palaeartctic elements in Amami Gunto are only 3; the Amami population of one of them (Aedes nipponicus) appears morphologically distinct from the populations of Palaeartctic Japan and Korea, and the remaining 2 species are distributed
further south. Ryukyuan subspecies downsi of Ae. flavopictus is spread throughout the Archipelago including Amami Gunto while the nominate subspecies occurs in Korea and temperate Japan including Ōsumi Shotō. "Percentages of affinity" (Masamune, 1931) of mosquito faunae between the neighbouring groups of islands are shown beneath.

Kyushu mainland-Ōsumi  Ōsumi-Amami  Amami-Okinawa  Okinawa-Yaeyama

82.08  55.30  79.61  84.57

The above examples appear to show that a greater faunal discontinuity exists between Ōsumi Shotō and Amami Gunto than between other areas of this region, suggesting that it is the boundary separating the Oriental and Palaeartic Regions. This coincides with the Watase Line (Okada, 1924, after Tokuda, 1941) which has been substantiated by the distributions of mammals, birds, reptiles, amphibians, terrestrial snails and several groups of insects (after Tokuda, 1941).

Table 1. The numbers of mosquito genera, subgenera and species.

<table>
<thead>
<tr>
<th>Area (km²)</th>
<th>Genera</th>
<th>Subgenera</th>
<th>Species</th>
<th>% of total species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Ryukyu Arch.</td>
<td>3,436</td>
<td>13</td>
<td>24</td>
<td>63</td>
</tr>
<tr>
<td>Amami Gunto</td>
<td>1,237</td>
<td>12</td>
<td>18</td>
<td>37</td>
</tr>
<tr>
<td>Okinawa Gunto</td>
<td>1,334</td>
<td>11</td>
<td>19</td>
<td>44</td>
</tr>
<tr>
<td>Miyako Gunto</td>
<td>227</td>
<td>4</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>Yaeyama Gunto</td>
<td>638</td>
<td>12</td>
<td>23</td>
<td>57</td>
</tr>
<tr>
<td>Palaearctic Japan</td>
<td>368,425</td>
<td>10</td>
<td>24</td>
<td>63</td>
</tr>
</tbody>
</table>
LIST OF SPECIES

1. *Anopheles (Cellia) minimus* Theobald, 1901, Mon. Cul. I: 186 (F);
Pokfulam, Hong Kong.
*Anopheles formosaensis* I Tsuzuki, 1902; ---Miyasaki, 1903; Yaeyama
Tiere 25: 542).

During 5 years of surveys on the Ryukyu Archipelago starting in 1970,
we found this species only in November and December, 1971, and obtained
more than 100 larvae from a streamlet between Mt. Banna and Mt. Maeshi, Ishigaki
Is. This species was the primary vector of malaria on Miyako and Yaeyama,
but appears to have been successfully controlled.

Distr. Ryukyu Arch. (Miyako and Yaeyama Gunto). Throughout the Oriental
Region including Taiwan, excepting most parts of Malaya and Borneo.

2. *Anopheles (Cellia) tesseillatus* Theobald, 1901, Mon. Cul. I: 175 (F);
Taipan, Straits Settlements. ---Miyagi, Iha & Kishimoto, 1969,
Trop. Med., Nagasaki 11: 33 (F); Haneji and Ishikawa, Okinawa
Is.; Ōtomì and Sonae, Iriomote Is.
The species seems to be very rare in the Ryukyu Arch., no record exists
other than that of Miyagi et al. (1969).
Distr. Ryukyu Arch. (Okinawa and Yaeyama Gunto). Throughout the Oriental
Region including Taiwan. Moluccas.

(M, L) (*aitkeni* var.); Marianbarie, Bengal Terai. ---Kanda & Kami-
mura, 1967, Japan. J. Sanit. Zool. 18: 108 (M, F, P. L); Amami
Ōshima and Tokunoshima, Amami Gunto.
Amami Gunto is the northern limit of the range of this species. It has
not been found in Okinawa and Yaeyama Gunto.
(Bengal and Assam).

4. *Anopheles (Anopheles) saperoi* Bohart et Ingram, 1946
Subsp. *saperoi* Bohart et Ingram, 1946, J. Wash. Acad. Sci. 36: 46
(F, L. E); Chizuka (= Kijoka), Okinawa Is.
No. 4: 9 (M, F, L) (as species) (mimeographed); Ishigaki Is.
Endemic species. Reid (1968) placed this species in the "albotaeniatus
group," but resemblance in the male genitalia and especially larvae suggests
that *saperoi* will be more closely allied to *koreicus*.

*Anopheles ohamai* was treated as a synonym of *saperoi* by Teller and Gentry
(1955); it was regarded as a distinct species by Ohama (1955) and Bohart (1959);
Sasa and Kamimura (1971) suggested the necessity of restudying its status.
The differentiating characteristics indicated by Ohama (L.c.) and Bohart (L.c.)
are: 1) the pale subcostal spot on vein c is shorter than the pale apical mark
in *saperoi*, as long as it in *ohamai*; 2) larval seta 3-C 4-7 branched in *saperoi*,
3-5 in *ohamai*; 3) 4-C is longer in *saperoi* than in *ohamai*. We examined 2 males,
5 females and 6 larvae of *saperoi* from Okinawa Is., and 2 males and 3 larvae
of *ohamai*; the 2 males of *ohamai* from Ishigaki Is. and the 3 larvae of *ohamai*
from Iriomote Is. All the 4 males of these 2 species have the subcostal spot
of the same length as the apical mark; 1 female of saperoi also has the spot as long as the apical mark; the subcostal spot is definitely shorter in 3 females and intermediate in 1 female. The male of saperoi has more developed pale spots or marks on the wing as often seen in species of this genus. Ohama and Bohart's discussion did not include the male of saperoi and our material lacks the female of ohamai. But the above facts suggest that difference in the size of the subcostal spot will be due to sexual dimorphism and also individual variation to some extent. The larval seta 3-C is 4-7 branched in saperoi and 3-6 branched in ohamai in the specimens we studied. This cannot be considered as a specific difference. We also could not find any significant difference between saperoi and ohamai. Thus, saperoi and ohamai cannot be discriminated by these 3 characters. As to the male genitalia, we examined 2 specimens of saperoi and 1 of ohamai (genitalia of another male were missing). They agree quite well with each other; including the characteristic lobes of tergum IX. Thus, saperoi and ohamai are considered as conspecific. However, we found some minor differences which were not mentioned by previous authors, viz., male hind tarsomere I is 1.19-1.21 times length of tibia in saperoi, 1.12-1.16 in ohamai; larval seta 3-VIII is 11-13 branched in 11 cases of saperoi; 8-10 branched in 2 cases of ohamai. Here we provisionally treat ohamai as a subspecies of saperoi until further material allows us to revise this status along with reevaluation of the above 2 differences.

Subsp. saperoi appears to be restricted to the northern mountain region of Okinawa Is. We obtained it at Mt. Onishi and Yona, 2 larvae were found on a rapid streamlet in the dark woods of Mt. Onishi. Subsp. ohamai, according to Ohama (1947a), was fairly common in that time; the larvae breed exclusively on mountain streamlets but have never been found associated with minimus. At present, ohamai appears very rare, the latest specimen we examined is a larvae, Iriomote Is., 17 XI 1965, M. Sasa leg., which Dr. Kamimura, Toyama Prefectural Hlth. Inst., kindly permitted us to study. Reisen et al. (1971) recorded saperoi from Misawa and Yokota AB, Honshu, Itazuke AB, northern Kyushu, and Osan and Kwang-Ju AB in Korea. It may be a misidentification or mislabeling.


Common throughout the Archipelago.
Hara (1961) listed nigerrimus in an enumeration of additional mosquito species to the Japanese fauna without giving any collection data; then in "A List of Mosquito Fauna of Japan" (1966), he gave Amami Ōshima and Okinawa as its distribution. Through the courtesy of Dr. Okada, Juntendo University, we were permitted to study 3 females from Ariya, Amami Ōshima, in Hara's collection preserved in Juntendo University. These 3 are all the specimens of Anopheles from the Ryukyu Archipelago occurring in this collection, and
2 of them are labeled as "Anoph. nigerr." and "Anoph. nige.", respectively, apparently by Hara's handwriting; the 3rd specimen has no label. There were no specimens of Anopheles from Okinawa. We identified these 3 specimens as sinensis. Excluding Hara, no one has found nigerrimus from the Archipelago. According to Harrison (1972), there are no confirmed records of the "nigerrimus subgroup" north or northeast of Vietnam. Thus, we feel it reasonable to delete nigerrimus from the Ryukyuan fauna.


6. Anopheles (Anopheles) lesteri Baisas and Hu, 1936
   Manila 16: 229 (F, P, L, E) (hyrcanus var.); Santa Mesa of Manila.

   Harrison (1973) recorded this species from Iriomote Is. We examined the
   following specimens from Amami, Okinawa, Ishigaki, Iriomote and Yonaguni Is.
   Amami Oshima: 1 F with associated Le4 and Pe,5 Nishinakama, 10 VII 1970,
   rice field, Mizusawa & Nishikawa leg.; 1 M with associated Le and Pe, Yuwan,
   26 VII 1974, ground pool, Saugstad leg. Okinawa Is.: 1 M with associated Le
   1 M, 2 FF with 3 associated LLe and PPe, Mashiki, Ginowan, 7 XI 1970, Ent.,
   25 IV 1971, grassy stream, Mizusawa & Nishikawa leg.; 2 FF, Mt. Banna, 19 XI
   1971, marsh, Tanaka & Mizusawa leg.; 1 M, 1 F, 2 PPe, Mt. Omoto, 14 XII 1972,
   ground pool, Mizusawa & Imamura leg. Iriomote Is.: 1 F, Uehara, 29 X 1971,
   net, Mizusawa, Shonaga & Kikuchi leg.; 1 F, Yashi-gawa, 18 XI 1971, net,
   Mizusawa leg. Yonaguni Is.: 2 FF nr. Sonai, 23 XI 1971, net, Mizusawa leg.;
   1 M, L.c., stream, Mizusawa leg.

   The characteristic serrate margin of the pupal trumpet is constant in
   specimens from Utoma, Okayama Pref., Western Honshu and the Ryukyu Archipelago.
   In the Hokkaido population, it is not distinctly serrate and apparently similar
   to that of sineroides. These 2 species are, however, easily separated by
   the shape of abdominal setae 9-II-VII. Paired dark spots near the trumpet
   bases indicated by Ohmori (1959) as a specific character, were constantly
   found in the specimens we examined from Hokkaido, Honshu and Okinawa Is.,
   and 1 female from Amami Oshima; they are lacking in specimens from Yaeyama
   and 1 male from Amami Oshima.

   An. sinensis has been thought to be a malaria vector in Japan, but more
   attention should be paid to An lesteri as suggested by Otsuru (1949) and
   Kamimura (1968), though malaria is no longer a serious problem in this region.

4 Larval exuviae (sing. - Le; pl. - LLe)
5 Pupal exuviae (sing. - Pe; pl. - PPe)


**Uranotaenia stonei** Bohart, 1946, J. Wash. Acad. Sci. 36: 47 (M, F, L); Chizuka, Okinawa Is.

A fresh water crab-hole species. Bohart (1946) obtained this species from a rock hole. The records of this species from Ishigaki and Iriomote Is. by Bohart (1959) seem to be erroneous. They may be either *U. ohamae* or *yaeyamana*. This will be clarified by Mr. E. L. Peyton.

Distr. Ryukyu Arch. (Okinawa Gunto). Hong Kong.

8. **Uranotaenia (Pseudoficalbia) ohamae** Tanaka, Mizusawa et Saugstad, 1975, Mosq. Syst. 7: 27 (M, F, L); Ishigaki and Iriomote Is.

A fresh water crab-hole species. Common.

Distr. Ryukyu Arch. (Yaeyama Gunto).

9. **Uranotaenia (Pseudoficalbia) yaeyamana** Tanaka, Mizusawa et Saugstad, 1975, Mosq. Syst. 7: 31 (M, F, L); Ishigaki and Iriomote Is.

A fresh water crab-hole species. Less common than *ohamae*.

Distr. Ryukyu Arch. (Yaeyama Gunto).


Common throughout the Archipelago except for Miyako Gunto. Larvae occur chiefly in tree holes, occasionally in small artificial containers. The population of the Ryukyu Arch. is characterized by the pale pleura. Contrarily, specimens from Palaearctic Japan appear identical in the pleural colour with Malayan specimens, which Mr. E. L. Peyton, Principal Investigator, Medical Entomology Project, Smithsonian Institution, kindly sent us for comparison.


11. **Uranotaenia (Pseudoficalbia) nivipleura** Leicester, 1908, Cul. Malaya: 219 (M, F); Selangor, Malaya; Singapore. ---Bohart & Ingram, 1946, U. S. Navmed 1055: 57 (M); Chizuka, Okinawa Is.

Very rare in the Archipelago. We obtained only 2 females: 1 F, Yona, Okinawa Is., 11 IX 1970, Tanaka & Mizusawa leg; 1 F, Mt. Banna, Ishigaki Is., 12 V 1970, net, Mizusawa & Nishikawa leg. The female of Yona, Okinawa Is., was captured on a naked knee of a man in a room in the evening, but it is unlikely that it feeds on man.


**Uranotaenia nanseica** Bohart et Ingram, 1946, U. S. Navmed 1055: 56 (M); Chizuka and Hedo, Okinawa Is.
Common in Yaeyama, less so in Okinawa Is.; the larvae are found in shaded shallow stream pools, and are characterized by *Aedes*-type sinuous actions and greatly modified antennal setae.


13. *Uranotaenia* (*Uranotaenia*) *macfarlanei* Edwards, 1914, Bull. Ent. Res. 5: 127 (F); Hong Kong. ---Bohart & Ingram, 1946, U. S. Navmed 1055: 55 (M, F, L); Chizuka, Okinawa Is. Very common in Yaeyama, less so in Okinawa Is. The most favorite larval habitat is a leafy shaded stream pool or a blocked stream. Their actions are *Anopheles*-like. We found that the male lacked the posterior smaller claw on the mid tarsus; this character appears not to have been reported by any previous author. Mr. Peyton, Medical Entomology Project, kindly informed me that topotypical specimens of this species also did not have the posterior claw on the mid tarsus.


Rare in the Archipelago. We also examined 1 female specimen from Okinawa (Nago, 19 II 74, light trap) through the courtesy of Dr. Kishimoto, Okinawa Inst. Poll. Hlth.

Belkin (1962) stated that the typical *elegans* from Queensland, Australia, was markedly different from specimens of all the other areas including Southeast Asia, and erected 2 species from the *elegans* complex of the South Pacific. Species of Southeast Asia may be different from typical *elegans* and also species of the South Pacific, however, there is no other available name for the species of this area. Here then, we follow Mattingly (1957). Ryukyu an specimens appear to have the patterns of pale scales on the scutum and abdomen more developed than in those of the other areas.


Apparently rare.

Distr. Ryukyu Arch. (Amami, Okinawa and Yaeyama Guntō). Throughout the Oriental Region including Taiwan.

16. *Mansonia* (*ansonioides*) *uniformis* (Theobald, 1901), Mon. Cul. 2: 180 (F) (*Panoplates*); Quilon, Travancore, S. India; Taiping, Perak. ---Mochizuki, 1913, Fukuoka Ikadaigaku Zasshi 7: 32 (F); Naha, Okinawa Is.

Apparently not rare. Adult females are easily obtained by human bait.


Common in Iriomote Is., rather rare in other parts of the Archipelago.


Not common; adults are captured by light trap.


Common throughout the Archipelago except for Miyako Gunto; the larvae occur chiefly in tree holes and occasionally in artificial containers.

Distr. Ryukyu Arch. (Amami, Okinawa and Yaeyama Gunto). Japan (Honshu, Shikoku, Kyushu). Throughout the Oriental Region including Taiwan, excluding Celebes.


This is a unique species of this genus in the Ryukyu Arch. Detailed description and discussions will be given in a later paper.

Distr. Ryukyu Arch. (Amami Gunto).


Apparently rare in the Archipelago.


There is no confirmed record of this species from Palaearctic Japan.

22. *Culex (Lutzia) halifaxii* Theobald, 1903, Mon. Cul. 3: 231 (F); Dindings, Straits Settlements.  
*Culex vorax* (Edwards, 1921); ---Bohart & Ingram, 1946, U. S. Navmed 1055: 70 (M, F, L); Okinawa Is. and Theya Is., Okinawa Gunto.  
Common throughout the Archipelago.  

Apparently rare in Okinawa Is., more common in Iriomote Is., Yaeyama Gunto.  
Specimens examined. 3 MM, 1 F, with 2 (M & F) associated PPe and LLe, 4 LL (K-0684), Itokawa-rindo, Iriomote Is., 14 IV 1971, tree hole, Mizusawa & Nishikawa leg.; 1 M, 2 FF, with 3 associated PPe and LLe, 57 LL (K-0698 and K-0699), near Sonai, Iriomote Is., 20 V 1971, tree hole, Mizusawa & Nishikawa leg.; 1 L (K-1236), Ôhara, Iriomote Is., 22 IX 1972, tree hole, Mizusawa leg.; 1 L (K-1238), Itokawa-rindo, Iriomote Is., 24 IX 1972, tree hole, Mizusawa leg.  

Common throughout the Archipelago except for Miyako Gunto. Larvae are found most frequently in rock pools and blocked streams, occasionally in ground pools. The adults are known as amphibian biters.  

Apparently rare throughout the Archipelago. Sirivanakarn (1972) recorded this species from Iriomote Is.; we also obtained 4 larvae from this island (Itokawa-rindo, 6 XII 1972, ground pool, Saugstad, Mizusawa & Imamura leg.). Prof. Y. Wada, Department of Medical Zoology, Nagasaki University School of Medicine, kindly informed us that he obtained this species on Amami Island. The larvae are found in shaded blocked streams, and rock or ground pools along streams.  

Common in both Iriomote and Ishigaki Islands, Yaeyama Gunto.


27. *Culex (Lophoceraomyia) infantulus* Edwards, 1922, Ind. J. Med. Res. 10: 287 (M); Hong Kong. ---Bohart & Ingram, 1946, U. S. Navmed 1055; 73 (M, F, L, E); Nago, Naha, Nahasoni, Chizuka and Hedo, Okinawa Is. Very common throughout the Archipelago except for Miyako Gunto. The larvae are found most frequently in blocked streams, rock pools, ground pools, and occasionally in crab holes.


Very common in Ishigaki and Iriomote Islands. The larvae are found usually in tree holes, occasionally in rock holes or ground pools.

Reisen et al. (1971) recorded this species from Yokota AB, Honshu, Japan. This is undoubtedly a misidentification or mislabeling.


29. *Culex (Lophoceraomyia) rubithoracis* (Leicester, 1908), Cul. Malaya: 119 (M, F) (*Lophoceratomyia*); Kuala Lumpur, Malaya. ---Intermill, 1967, Dist. Abund. Mosq. Okinawa: 2; Okinawa Is. This species was also recorded from Amami Gunto by Kamimura (1968), but has not been found on Yaeyama Gunto.


30. *Culex (Lophoceraomyia) tuberis* Bohart, 1946, Proc. Biol. Soc. Wash. 69: 42 (M, L); Chizuka, Okinawa Is. Endemic species. Bohart obtained this species from a rock hole in Okinawa Is. We collected many larvae from fresh water crab holes on Ishigaki and Iriomote Islands, together with *Uranotaenia ohama* and *U. yaeyamana*. The larvae and reared adults are identical with Bohart's description. It may be the same situation as the case with *Uranotaenia jacksoni (= stonel*) which Bohart obtained from a very deep, narrow rock hole, whereas we found it only in crab holes.

Distr. Ryukyu Arch. (Okinawa and Yaeyama Gunto).
Distr. Ryukyu Arch. (Yaeyama Gunto). Oriental Region including Taiwan, excluding Indochina. Palau and Caroline Islands.


Endemic species. Common throughout the Archipelago except for Miyako Gunto. The larvae are found in a wide variety of breeding places, such as ground pools, blocked streams, tree holes, crab holes and artificial containers; frequently in turbid water.
Reisen et al. (1971) recorded this species from Itazuke, northern Kyushu; this record needs substantiation.
Distr. Ryukyu Arch. (Amami, Okinawa and Yaeyama Gunto).

Common in brackish water ground pools in Yaeyama Gunto. The male has 25-31 modified setae on the 3rd segment of the palpus, the setae are blunt-tipped and different in shape from usually pointed ones of Culiciomyia. Distr. Ryukyu Arch. (Okinawa, Miyako and Yaeyama Gunto). Korea. Coastal regions throughout the Oriental Region, and of east Africa, Madagascar, northern Australia and Pacific islands.

As to the identification of this species, we here follow Sirivanakarn (1975).

Very common throughout the Archipelago. The primary vector of Japanese B encephalitis. Sagiyama virus was isolated from this species in Okinawa (Hurlbut & Nibley, 1964). Larvae are found most frequently in rice fields and in association with *Anopheles sinensis*. McDonald & Savage (1972) reported the remarkable drop of the population of this species as well as that of *Anopheles sinensis* through changes in agriculture in Okinawa Is.


Apparently rare in the Archipelago. Kamimura (1968) recorded this species from Amami Guntô, and Intermill (1968) from Okinawa Is.


Not rare in Yaeyama Guntô, but not found in other parts of the Archipelago. The larvae are found in ponds or rice fields.


39. *Culex (Culex) pipiens* Linne, 1758

Subsp. *quinquefasciatus* Say, 1823, J. Acad. Nat. Sci. Philad. 3: 10 (A) (as species); Mississippi River.

*Culex fatigans* Wiedemann, 1828; ---Hatori, 1919, J. Med. Ass. Formosa No. 205: 1057; Shika, Ishigaki Is. (misprinted as *Culex fatigaui*).

Very common throughout the Archipelago; a primary vector of Bancroftian filariasis. The Okinawa strain of Japanese B encephalitis was experimentally transmitted to mice by this subspecies (Hode, 1946).

Reisen et al. (1971) recorded *quinquefasciatus* from Misawa, Tachikawa and Yokota AB, Honshu, and Itazuke, Kyushu. These records should be restudied.


Kamimura (1968) recorded this species from Amami Guntô.


Common throughout the Archipelago.

42. *Culex (Culex) sinensis* Theobald, 1903, Mon. Cul. 3: 180 (gelidus var.) (F); Shaohyling, China. ---Bohart & Ingram, 1946, U. S. Navmed 1055: 80 (M, F, L); Nago, Chizuka and Hentona, Okinawa Is.

Sasa et al. (1968) recorded this species from Amami Guntō, and Bohart (1959) obtained 1 adult from Ishigaki Is. Apparently not common through the Archipelago.


Health Section, Okinawa Pref. (1931) reported the occurrence of this species in Okinawa, Tokashiki & Aguni Is., Okinawa Guntō; Miyako Is. & Yaeyama Guntō (Taketomi Vill.), but they did not give a full scientific name. Except in Amami Ôshima, this species appears not very common in the Ryukyu Arch.
Distr. Ryukyu Arch. (Amami, Okinawa, Miyako and Yaeyama Guntō). Japan (Hokkaido, Honshu, Shikoku, Kyushu). Korea. Throughout the southern Palaearctic Region and the Oriental Region including Taiwan.


Up to now, this species has been found only on Kuroshima, a small flat heart-shaped island, 4.1 km wide, 3.2 km long, situated between Ishigaki and Iriomote Is., the 2 major islands of the Yaeyama Guntō. The larvae were found in ground pools. Iyengar (1954) showed that this species was the principal vector of *Wuchereria bancrofti* in New Caledonia (after Belkin, 1962).


The species common in Amami Ôshima, Amami Guntō, and also Ishigaki and Iriomote Is., Yaeyama Guntō, but very curiously it has not been found from Okinawa Guntō. A similar distribution pattern is seen also in *Tripteroides bambusa*. Larvae are found most frequently in rock holes, and often in tree holes and various types of relatively small artificial containers. Knight (1968) assigned the Ryukyuan population to subsp. *shintienensis* Tsai and
Lien, 1950. Miyagi (1971) synonymized shintienensis with japonicus. The situation, however, appears more complicated. The southern population has some different characteristics from the northern population, and the populations of Amami, Yaeyama and Taiwan are not always consistent in both adult and larval characters. Here we treat provisionally all of them as japonicus. Detailed discussions will be published later.


46. Aedes (Finlaya) togoi (Theobald, 1907), Mon. Cul. 4: 379 (F) (Culicicola); Osaka. --Bohart & Ingram, 1946, U. S. Navmed 1055: 66; Naha, Shimabaru, Bolo Point and Kin, Okinawa Is.

Common throughout the Archipelago. Larvae are found chiefly in brackish water. Health Section, Okinawa Prefecture (1931) reported the occurrence of this species in Okinawa, Ie and Tokashiki Is., Okinawa Gunto; Irabu Is., Miyako Gunto; and Yaeyama Gunto (Ishigaki, Ohama, Taketomi and Yonaguni Villages), but they did not give a full scientific name for this species. This species has been known as a natural vector of Brugia malayi (not occurring in this Archipelago), and also a good experimental vector of Wuchereria bancrofti, Dicrofilaria immitis, etc.


47. Aedes (Finlaya) aureostriatus (Doleschall, 1857)


Common in Amami and Okinawa Is., rather rare in Yaeyama Gunto; larvae are found in tree holes and fern stumps.

Ae. aureostriatus aureostriatus was described from Amboina. We have not seen any typical or topotypical specimens, but examined 5 males, 3 females and 3 larval exuviae from Philippines. Adults of subsp. okinawanus differ from these Philippine specimens in that the scutal golden stripes are markedly narrower and paler, the mesepimeron bears 3-9 bristles on its mid anterior portion and also often 1-2 additional bristles on its lower posterior part, and the pale basal bands of the abdominal terga and the pale articular bands of the hind tarsus are less developed. Subsp. taiwanus is identical with okinawanus in scaling, but it has no mid and lower mesepimeral bristles as in specimens from Philippines. All the specimens of aureostriatus we obtained from Yaeyama Gunto agree with taiwanus. Though Bohart (1959) recorded okinawanus from Yaeyama Gunto, it will be taiwanus. Larvae also show some differences in their chaetotaxy among these 3 subspecies.

48. *Aedes (Finlaya) nipponicus* LaCasse et Yamaguti, 1948, Mosq. F. Japan
Korea, part II: 79 (M, F, L) (*niveus* ssp.); Maizuru, Yodo and
Wakayama, Honshu; Fukuoka, Nagasaki and Kagoshima, Kyushu. ---Kami-

This may be essentially a palaeartic species, and in the Archipelago,
has been recorded only from Amami Guntô, the northernmost islands in the
Ryukyus. Specimens of Amami Ōshima, however, appear morphologically distinct
from those from Palaeartic Japan and Korea. Detailed discussions will be
published later. Larvae occur in tree holes. In the original description,
the localities (should be type localities) of this species were shown by dots
on a map. The names of these localities should be interpreted from another
map. Stone *et al.* (1959: 167) appear to have partly misread in this proce-
dure; Sasabo (correctly Sasebo) should be replaced by Nagasaki and Nara must
be deleted.

Distr. Ryukyu Arch. (Amami Guntô). Japan (Hokkaido, Honshu, Shikoku,
Kyushu). Korea.

49. *Aedes (Finlaya) watasei* Yamada, 1921, Annot. Zool. Japon. 10: 64 (F);
Amami Guntô.

We have found this species throughout the Archipelago except for Miyako
Guntô. Bohart (1953) recorded *Ae. (F.) feegradei* from Okinawa and Ishigaki
Is. The original description of *Ae. (F.) feegradei* Barraud, 1934, is identi-
tical with specimens of *watasei*. At present, we consider Bohart's *feegradei*
as *watasei*. Synonymity between Burmese *feegradei* and Japanese *watasei*
will be studied later.

Distr. Ryukyu Arch. (Amami, Okinawa and Yaeyama Guntô). Japan (Kyushu).

(M, F) (*Finlaya albocincta*); Solon, Western Himalayas. ---Bohart,
1959, Mosq. News 19: 196 (F); Iriomote Is.

Since Bohart (1959), no one has obtained this species from the Ryukyu
Archipelago. Larvae have been found in tree holes in the Himalayas (Barraud,
1934) and Yunnan (Chow and Mattingly, 1951).

Distr. Ryukyu Arch. (Yaeyama Guntô). China (Yunnan). India (Western
Himalayas).

51. *Aedes (Geoskusea) baisasi* Knight and Hull, 1951, Pac. Sci. 5: 197 (M,
F); Palawan, Samar, and Mindanao Is., Philippines. ---Tanaka,
Saugstad & Mizusawa, 1974, Japan. J. Sanit. Zool. 24: 308 (M, F,
P, L); Iriomote Is.

Immature stages of this Philippine species had not been previously known.
We obtained all stages at Komi and along the River Maira, Iriomote Is. The
larvae are found in brackish water crab holes.


52. *Aedes (Stegomyia) aegypti* (Linne, 1762), in Hasselquist's Reise nach
Palästina: 470 (A) (*Culex*); Egypt.

*Stegomyia fasciata* (Fabricius, 1805); ---Nohizuki, 1913, Fukuoka Ika-
dai gaku Zasshi 7: 60; Naha, Okinawa Is.

According to Yamada (1916), the species appeared common in Okinawa Is.
at that time; it also has been said as common in Okinawa, Miyako and Yaeyama
at or before World War II (Hatori, 1919; Miyao, 1931; Saigo, 1940; Iwata, 1943). According to Dr. Kishimoto, Okinawa Inst. Poll. Hlth. (personal communication), the species has not been found in the Ryukyus since 1958. Reisen (1970a, b) and Reisen & Basio (1972) reported that this species had been obtained by ovitraps at Kadena AB and Naha AB, Okinawa Is. on 1-11 Sept. 1970. This material needs a restudy. Tanaka (1971b) recorded 11 males and 13 females from Kabira, Ishigaki Is. collected by Dr. M. Nishikawa, former member of our project, on April 30, 1970. These may be the latest record in the Archipelago. This species as well as Ae. albopictus has been believed to be a vector of dengue fever in this area.

Distr. Ryukyu Arch. (Okinawa and Yaeyama Guntô). Cosmotropical.


Very common throughout the Archipelago. The larvae occur in natural containers including tree holes, bamboo and fern stumps, leaf-axils, etc., and various types of small artificial containers in human dwelling areas. It has been known as a vector of dengue fever. Hatori (1919) recorded Stegomyia scutellaris from Fukai, Ishigaki Is., but it is uncertain whether his species is albopictus or rivensi.


54. Aedes (Stegomyia) flavopictus Yamada, 1921

Subsp. downsii Bohart et Ingram, 1946, J. Wash. Acad. Sci. 36: 51 (M, F, L) (as species); Chizuka, Shana Wan, Hentona and Hedo, Okinawa Is.

Bohart (1953) treated downsii as a subspecies of flavopictus. Huan (1972) erected it again to a species. Some of the characteristics considered as specific by her, however, appear to be due to local or individual variation. At present, we have checked only a part of our collection. Until further study is accomplished, we retain here subspecies status for downsii.


Very common throughout the Archipelago excepting Miyako Guntô. Habits of this species are similar to those of Ae. albopictus and flavopictus downsii. We obtained this species from Cape Sata, southern extremity of the mainland of Kyushu. This may be the first record of this species from the main islands of Japan. Specimens examined: 2 FF, 30 VIII 1969, biting, Mizusawa & Yoshii; 14 MM, 29 FF, l. c., reared from larvae, tree hole, Mizusawa & Yoshii.

Distr. Ryukyu Arch. (Amami, Okinawa and Yaeyama Guntô). Japan (Kyushu: Cape Sata, Tsushima and Yakushima).

56. Aedes (Aedimorphus) vexans (Meigen, 1830)

Subsp. nipponii (Theobald, 1907), Mon. Cul. 4: 337 (F) (Culicada nipponii); Karuizawa (misprinted as Karnizana), Honshu, Japan. ---Bohart & Ingram, 1946, U. S. Navmed 1055: 69 (Adult, L); Miyazato, Haba, Kadena and China, Okinawa Is.
Common throughout the Archipelago. Larvae are found usually in unshaded ground pools or rice fields. The Okinawan strain of Japanese B encephalitis virus was experimentally transmitted to mice by this species (*vexans vexans*) (Hodes, 1946), and Sagiyama virus was isolated from this species in Okinawa (Hurlburt & Nibley, 1964).


*Found only on Iriomote Is., Yaeyama Gunto. The larvae were found in ground pools ("Swamp" in the original description is erroneous). Adults bite man, being found in jungles but not common.*

**Distr.** Ryukyu Arch. (Yaeyama Gunto).


*It is very curious that this species was found abundant only during October to November, 1971, in an area at the upper limit of a mangrove forest of Iriomote Is., Yaeyama Gunto. A hundred females were easily obtained by human bait, but all efforts made in 3 succeeding years have been unsuccessful in obtaining not only the male and immature stages, but also additional female specimens.*

**Distr.** Ryukyu Arch. (Yaeyama Gunto).

59. *Aedes (VerraZZina) nobukonis* Yamada, 1932, In Icon. Ins. Japon.: 228 (F); Omura, Kyushu, Japan.


*Since Bohart (1956), this species has not been found in the Archipelago. Nagahana and Toyama (1954) recorded their specimens from Okinoshima (Is.), off western Honshu, as "Aedes nobukonis?"*  
**Distr.** Ryukyu Arch. (Yaeyama Gunto). Japan (Kyushu, Okinoshima).

60. *Armigeres (Armigeres) subalbatus* (Coquillett, 1898), Proc. U. S. Nat. Mus. 21: 302 (F) (Culex); Japan.


*Common throughout the Archipelago.*  


Kamimura (1968) recorded this from Amami Gunto; we made mosquito surveys twice on Amami Oshima but failed to obtain this species. In Yaeyama
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Guntô this is fairly common; the coloration of the adult from this area is different from specimens from palearctic Japan; the population of Yaeyama may deserve to be treated as a distinct subspecies. This species has not been collected in Okinawa Is., this curious distribution pattern is shared with Aedes (Pinlaya) japonicus.


62. Malaya genurostris Leicester, 1908, Cul. Malaya: 258 (M); Malaya.
   ---Bohart & Ingram, 1946, U. S. Navmed, 1055: 54 (Harpagomyia)
   (M, F, L); Nago, Shana Wan, Chizuka and Hedo, Okinawa Is.
   Common; larvae are found in leaf axils of Alocasia macrorrhiza.
   Distr. Ryukyu Arch. (Amami, Okinawa and Yaeyama Guntô). Taiwan.

63. Toxorhynchites (Toxorhynchites) yamadai (Ouchi, 1939)
   Subsp. yamadai (Ouchi, 1939), J. Shanghai Sci. Inst. Sect. III, 4:
   223 (M) (Megarhinus); Mt. Yuwan, Amami Oshima.
   Subsp. yaeyamae Bohart, 1956, Bull. Brooklyn Ent. Soc. 51: 29 (M, F,
   L) (as species); east fork of Nakara River and Shirahama, Iriomote Is.;
   Yarabu Peninsula, Ishigaki Is.
   Synonymity between yamadai and yaeyamae was suggested by Sasa and
   Kamimura (1971); Tanaka (1971) treated yaeyamae as a subspecies of yamadai.
   We obtained all stages of yamadai from Amami Oshima and yaeyamae from Ishigaki
   and Iriomote Is. The adults and larvae are identical with each other in all
   respects, with the one exception that the posterior pronotal lobe of the
   adult has a broader dark-scaled dorsal area in yamadai and a narrow dark-
   scaled dorsal margin in yaeyamae. Gentry (1957) recorded Toxorhynchites sp.
   from Okinawa Is., it may likely be this species, but we have not seen any
   specimens from this island. Until sufficient specimens from Okinawa Is. are
   available, we treat provisionally yaeyamae as a subspecies of yamadai.
   Distr. Subsp. yamadai: Ryukyu Arch. (Amami Guntô). Subsp. yaeyamae:
   Ryukyu Arch. (Yaeyama Guntô).

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Asia. - XVI. Genus Aedes Meigen, Subgenus Aedimorphus Theobald in

of the subgenus Verrallina of the genus Aedes (Diptera: Culicidae).


LITERATURE CITED, OTHER THAN ABOVE


Fig. 1
Mosquitoes of the Ryukyu Archipelago 63 spp.