

THE MOSQUITO FAUNA OF THE RYUKYU ARCHIPELAGO  
WITH IDENTIFICATION KEYS, PUPAL DESCRIPTIONS  
AND NOTES ON BIOLOGY, MEDICAL IMPORTANCE AND DISTRIBUTION\*

by

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\*This investigation was partially supported by Grant-in-Aid for General Research (C), Project No. 60570178 from the Ministry of Education, Science and Culture of Japan.

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**ABSTRACT.** From 1975 to 1984, mosquito surveys were carried out in the Ryukyu Archipelago, Japan. Adults were collected by light traps, human-bait catches, sweeping catches and dry ice traps in the field. Larval collections were made by dipping at breeding sites. A total of 71 species of mosquitoes were found in the Archipelago. This paper includes identification keys to all taxa, notes on the bionomics, habits and distribution of each species occurring in the Archipelago. Detailed pupal descriptions of species are also provided.

## INTRODUCTION

The Ryukyu Archipelago extends between Japan proper, which belongs to the Palaearctic region, and Taiwan, which belongs to the Oriental region. The Archipelago is situated between 24° to 30° north latitude, and 123° to 132° east longitude (Fig. 1). The number of islands of the Archipelago is almost 100 and they consist of following 6 major island groups: Tokara, Amami, Okinawa, Miyako, Yaeyama and Daito Islands. The climate of the Archipelago can be classified as subtropical. The mean daily minimum for January, the coolest month, is 13.9°C in Amami Is., 15.8°C in Okinawa Is., 17.6°C in Yaeyama Is. and 16.9°C in Daito Is. The mean daily maximum for July, the warmest month, is 28.5°C in Amami Is., 28.3°C in Okinawa Is., 29.3°C in Yaeyama Is. and 28.2°C in Daito Is. The annual rainfall varies in different islands of the Archipelago from 1600 to 2500 mm with about 200 rainy days each year. The period from May to June is the most rainy, but the wet season is not well marked. The Archipelago lies within the typhoon belt of the East China sea, and the typhoon season is from July to October.

The Archipelago is an extremely interesting area from a zoogeographical standpoint and is a transitional zone where Oriental and Palaearctic species intermingle. The border line as shown in Fig. 1 is called zoogeographically, "the Watase line". It lies on the strait of Tokara between Osumi Is. in the Palaearctic region and Tokara Is. in the Oriental region.

The mosquitoes reported on the Archipelago by the Japanese before World War II were only several common species: *Anopheles sinensis*, *Culex quinquefasciatus*, *Cx. mimeticus*, *Armigeres subalbatus*, *Aedes albopictus*, *Ae. aegypti* and *Ae. togoi* (Anonymous, 1931). In 1945 and 1951, Bohart extensively studied the taxonomy and biology of Ryukyuan mosquitoes (Bohart, 1946, 1953, 1956, 1959; Bohart and Ingram, 1946a, 1946b). In recent years, Tanaka, Mizusawa and Saugstad carried out a taxonomic revision of the adults and 4th stage larvae of mosquitoes of Japan including the Ryukyu Archipelago and the Ogasawara Islands, and South Korea (Tanaka *et al.*, 1975b, 1979).

During our mosquito surveys on the Ryukyu Archipelago starting in 1975, we have described 2 new species, *Topomyia yanbarensis* from Okinawajima (Miyagi, 1976) and *Ae. daitensis* from Minami Daitojima (Miyagi and Toma, 1980b), and added 4 species, *Uranotaenia lateralis* (Miyagi and Toma 1979b), *Ae. lineatopennis* (Miyagi and Toma, 1977, 1978b, 1980a; Miyagi *et al.*, 1983a), *Cx. jacksoni* and *Ficalbia* sp. (Miyagi and Toma, 1980a), to the fauna.

This paper provides biological notes such as larval habitats and associated species and adult feeding habits for the 71 species based on our field observations. Keys to all species, pupal descriptions of 16 species, faunal notes and information on species of medical importance are also included.

## PLACE AND METHOD

The Ryukyu Archipelago is here defined as the Tokara Islands, Amami Islands, Okinawa Islands, Miyako Islands, Yaeyama Islands and Daito Islands.

During the period 1975 to 1984, extensive mosquito surveys were carried out to ascertain the mosquito fauna and its biology in the following islands of the Archipelago: Kuchinoshima(13 km<sup>2</sup>), Nakanoshima(27 km<sup>2</sup>), Takarajima(7 km<sup>2</sup>) in 1981 and 1982; Amami Oshima(818 km<sup>2</sup>) in 1975 and from 1979 to 1982; Okinawajima(1220 km<sup>2</sup>) from 1975 to 1981; Iheyajima(21 km<sup>2</sup>) in 1978; Izenajima(14 km<sup>2</sup>) in 1980; Minnajima(0.6 km<sup>2</sup>) in 1983 and 1984; Miyakojima(159 km<sup>2</sup>) in 1976 and from 1980 to 1983; Ishigakijima(221 km<sup>2</sup>) from 1975 to 1980; Iriomotejima(284 km<sup>2</sup>) from 1976 to 1982; Kuroshima (10 km<sup>2</sup>) in 1975; Yonagunijima(28 km<sup>2</sup>) from 1977 to 1981; Kita Daitojima(13 km<sup>2</sup>) in 1979 and Minami Daitojima(31 km<sup>2</sup>) in 1976 and 1979(Fig. 1). We had no chance to survey Tokunoshima, Kumejima and Haterumajima.

Collections were made in the forest, base of mountains, open and urban areas. Wooden boxes(20x20x20 cm<sup>3</sup>) and artificial containers such as earthen jars, tin cans and glass vials had been placed as oviposition traps beforehand in Okinawajima, Ishigakijima, Iriomotejima and Yonagunijima. Larval collections were made with dippers, pipettes, siphons or small nets at breeding sites such as natural habitats (tree holes, leaf axils, bamboo stumps, bamboo internodes, crab holes, ground pools, rice paddies, rock pools, etc.) and artificial containers. A much higher percentage of species can be collected as immature stages than as adults. Individual rearings were essential to establish correlations between the immatures and the adults and the rearings were usually made from field-collected fourth-instar or third-instar larvae. Adult mosquitoes were collected by light traps, human-baited catches, sweeping catches and dry ice traps.

## MORPHOLOGY AND TERMINOLOGY

Figures show most morphological features and terminologies used. Those limited to certain species are shown in the illustrations for such species. The methods of presentation, terminology and abbreviation used in the descriptions mostly follow Belkin (1962), Huang (1972) and Bram (1967). Chaetotaxy, based on pupal skins which have been associated with adult specimens, and tables for the pupa follow Tanaka *et al.* (1979).

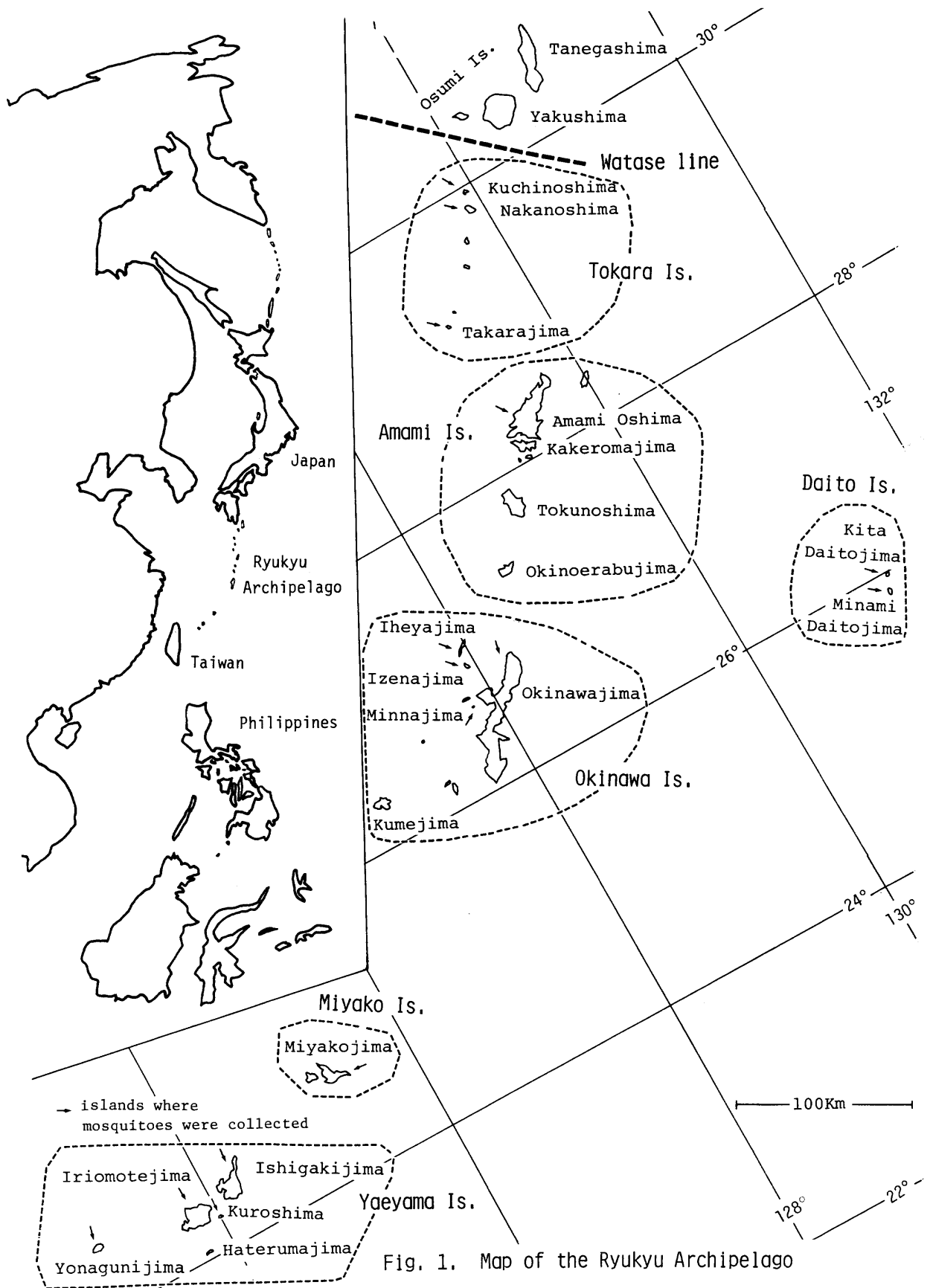
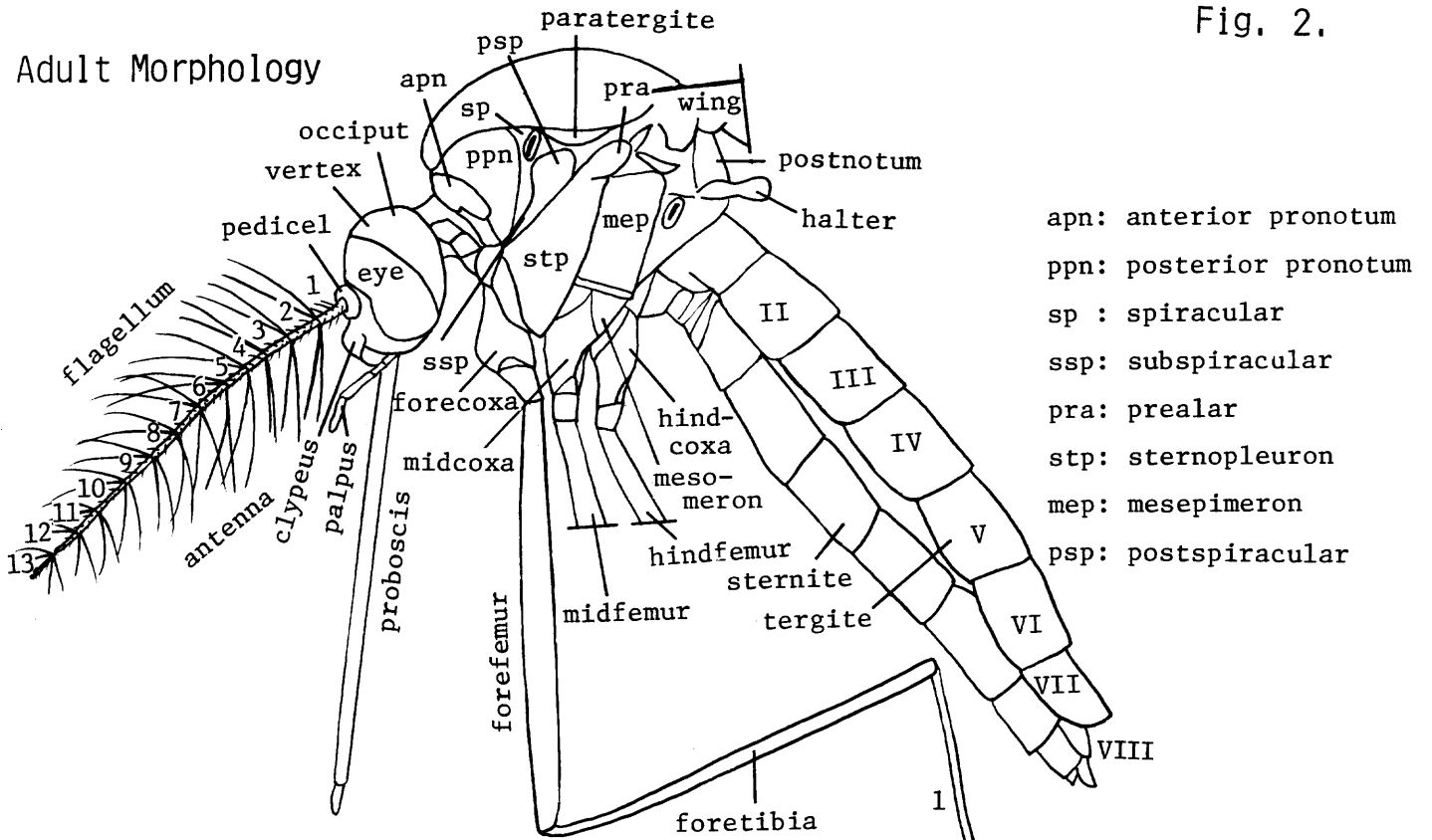


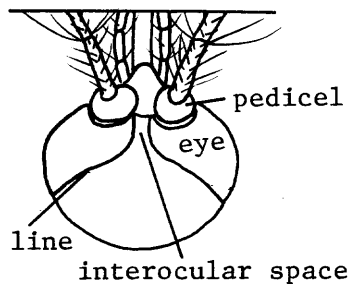
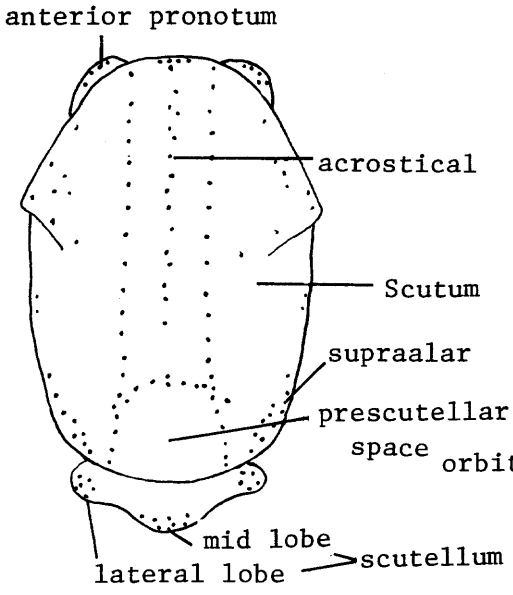
Fig. 1. Map of the Ryukyu Archipelago

Fig. 2.

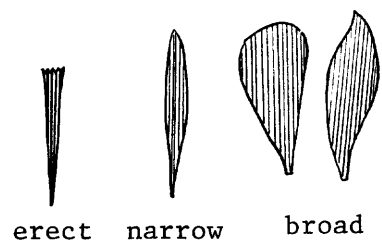
Adult Morphology



- apn: anterior pronotum
- ppn: posterior pronotum
- sp : spiracular
- ssp: subspiracular
- pra: prealar
- stp: sternopleuron
- mep: mesepimeron
- psp: postspiracular

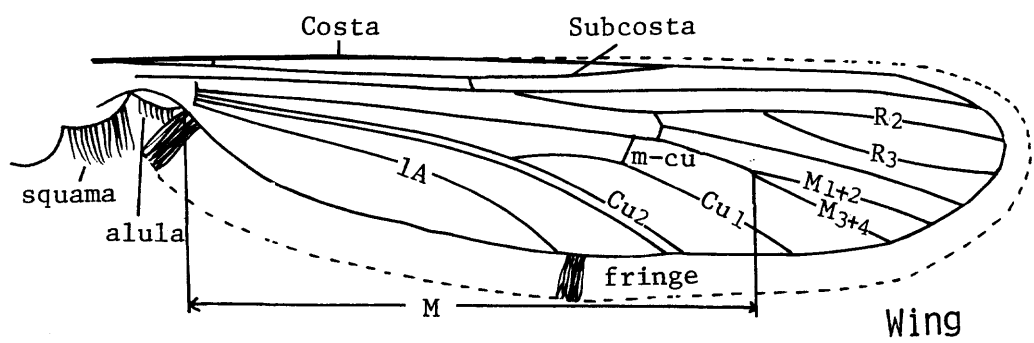


Head



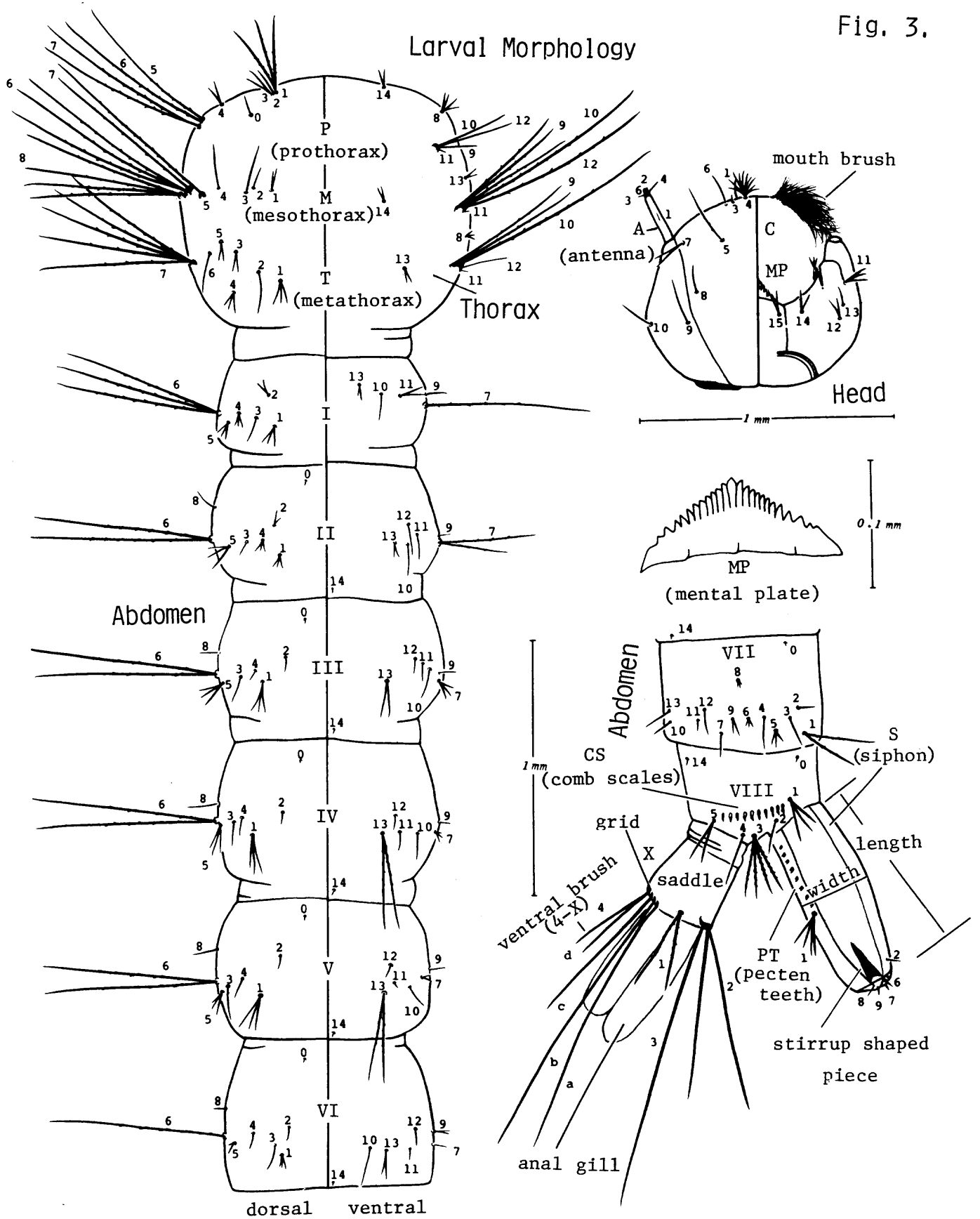
Scales

Thorax



Wing

Fig. 3.



## KEYS TO GENERA OF CULICIDAE IN THE RYUKYU ARCHIPELAGO

## ADULT

1. Palpus as long as proboscis in both sexes; abdomen without scales at least on sternites; scutellum rounded....*Anopheles*  
- Palpus shorter than proboscis in female(Fig. 4 A, 5 B, D); abdomen with scales on sternites and tergites; scutellum rounded or trilobed. .... 2
2. Large mosquito with coloration of bright blue, green and gold, with metallic luster; apical part of proboscis conspicuously bent downward and backward, more slender than basal half(Fig. 4 A,B); scutellum rounded..... *Toxorhynchites*  
- Medium to small-sized mosquito with coloration dull or metallic; apical part of proboscis not conspicuously bent downward and backward(but slightly so in *Armigeres*), and not slender; scutellum trilobed. .... 3
3. Apical part of proboscis swollen, upturned and hairy(Fig. 4 C), usually proboscis folded backward under body..... *Malaya*  
(one species, *Ml. genurostris*)  
- Apical part of proboscis sometimes swollen, but not upturned and hairy, proboscis not folded backward under body. .... 4
4. Scutum with double median longitudinal stripe of broad, flat, silvery scales; postspiracular setae absent; squama bare. .... *Topomyia*  
(one species, *To. yanbarensis*)  
- Without such combination of characters. .... 5
5. Fore and midfemora marked with two silvery spots on apical anterior surface(Fig. 4 D,E); vertex with scales showing brilliant metallic blue luster; spiracular setae present. ..  
..... *Tripteroides*  
(one species, *Tp. bambusa yaeyamensis*)  
- Fore and midfemora not marked with two silvery spots on apical anterior surface; vertex without scales showing brilliant metallic blue luster; spiracular setae absent. ..6
6. Vein 1A short(Fig. 4 F), reaching wing margin before or at about level of fork of  $Cu_1$  and  $Cu_2$  . .... *Uranotaenia*  
- Vein 1A long(Fig. 4 G), reaching wing margin beyond level of fork  $Cu_1$  and  $Cu_2$ . .... 7
7. Postnotum with a small patch of setulae..... *Heizmannia*  
(one species, *Hs. kana*)  
- Postnotum without setulae. .... 8
8. First tarsomere of foreleg longer than the last four tarsomeres combined; wing spotted. .... *Orthopodomyia*  
(one species, *Or. anopheloides*)



- First tarsomere of foreleg shorter than the last four tarsomeres combined; wing various. .... 9
- 9. Postspiracular setae absent. .... 10
- Postspiracular setae present. .... 13
- 10 Proboscis more or less swollen distally(Fig. 5 A,B); wing with very broad(Fig. 7 D) or broad scales. .... 11
- Proboscis not distinctly swollen distally; wing with narrow, or with both narrow and broad scales. .... 12
- 11. Wing with conspicuous pale and dark scales; scutellar scales broad; alula with broad scales. .... *Mimomyia*
- Wing with inconspicuous pale and dark scales; scutellar scales narrow, usually scanty; alula with fringe of narrow scales. .... *Ficalbia*  
(one species, *Fi. sp.*)
- 12. Hindtarsal claws not small; pulvilli absent or rudimental on all legs. .... *Coquillettidia*
- Hindtarsal claws very small and inconspicuous; pulvilli well developed at least on hindleg(Fig. 7 F). .... *Culex*
- 13. Dorsal wing scales black and white very numerous, all broad and strongly asymmetrical(Fig. 5 C). .... *Mansonia*  
(one species, *Ma. uniformis*)
- Wing scales black, normal in shape, if broad not asymmetrical. .... 14
- 14. Larger species; proboscis stout somewhat compressed and curved downward at apical half(Fig. 5 D); dark mosquitoes without pale bands on legs; postspiracular area and pedicel with pale scales. .... *Armigeres*  
(one species, *Ar. subalbatus*)
- Moderate-sized species; proboscis not curved downward and not compressed; pale scales of legs, postspiracular area and pedicel various. .... *Aedes*

## LARVA

- 1. Siphon not developed(Fig. 8 A). .... *Anopheles*
- Siphon distinctly developed(Fig. 14 A,B,C). .... 2
- 2. Large species(12-15 mm); mouth brushes reduced to about 10 broad flat and single filaments(Fig. 8 C); comb scales absent. .... *Toxorhynchites*
- Small to medium-sized species(3-9 mm); mouth brushes composed of numerous fine filament(except in subgenus *Lutzia* of *Culex* which is modified for predation); comb scales present. .... 3
- 3. Seta 4-X with a single pair of setae on grid(Fig. 9 A). .. 4
- Seta 4-X with 2 to several pairs of setae on grid. .... 6
- 4. Setae 5,6-P single; 6-M and 7-T stout spines(Fig. 8 D); comb

- scales in a row. .... *Tripteroides*  
(one species, *Tp. bambusa yaeyamensis*)
- Seta 5,6-P many branched; 6-M and 7-T never stout spines; comb scales in a row or a patch. .... 5
5. Comb scales less than 15, arranged in a row(Fig. 9 A); pecten teeth large, rounded apically(Fig. 9 A); seta 5-P many branched but not forms stout fan; 4-X 6,7 branched. ...  
..... *Topomyia*  
(one species, *To. yanbarensis*)
- Comb scales more than 20, arranged in a patch; pecten teeth moderate, not rounded apically; seta 5-P many branched and forms stout fan(Fig. 9 C); 4-X 1,2 branched. .... *Malaya*  
(one species, *Ml. genurostris*)
6. Siphon modified for piercing plant tissues, with sclerotized saw-toothed process at tip(Fig. 9 D). .... 14
- Siphon not so modified, without saw-toothed process. .... 7
7. Siphon with only one hair tuft. .... 8
- Siphon with at least three or more hair tufts. .... *Culex*
8. Antenna jointed and articulated freely and spiculate(Fig. 10 B); pecten teeth absent. .... *Mimomyia*
- Antenna not jointed and articulated; siphon with or without pecten teeth. .... 9
9. Pecten teeth absent. .... 10
- Pecten teeth present. .... 11
10. Siphon elongate; abdominal segments VII and VIII with large sclerotized plate covering most of the segment(Fig. 10 C); alternating large and small comb scales present.....  
..... *Orthopodomyia*  
(one species, *Or. anopheloides*)
- Siphon short; abdominal segments without sclerotized plates; alternating large and small comb scales absent. ...*Armigeres*  
(one species, *Ar. subalbatus*)
11. Abdominal segment VIII with small sclerotized plate(in *Ur. yaeyamana* and *Ur. jacksoni* very poorly sclerotized plate present)(Fig. 11 D); pecten teeth mostly scale-like(Fig. 10 E). .... *Uranotaenia*
- Abdominal segment VIII without large sclerotized plate; pecten teeth spine- or tooth-like(Fig. 12 B). .... 12
12. Seta 4-C conspicuous and multibranched. .... *Heizmannia\**  
(one species, *Hs. kana*)
- Seta 4-C small and usually less than 10 branched. .... 13
13. Seta 1-S arising at not more than one-eighth of the distance from base to apex. .... *Ficalbia\**  
(one species, *Fi. sp.*)
- Seta 1-S arising at more than one-eighth of the distance from base to apex. .... *Aedes*



- Wing with pale markings. .... 2
- 2. Palpi all dark. .... 3
- Palpi with some white scales. .... 4
- 3. Spiracular setae absent. .... *lindesayi japonicus*
- Spiracular setae present. .... *saperoi*  
   ssp. *saperoi* in Okinawa Is.  
   ssp. *ohamai* in Yaeyama Is.
- 4. Upper midcoxa without patch of pale scales (a few scales  
 occasionally present, but not forming a definite patch);  
 usually pale fringe spot at termination of vein Cu<sub>2</sub> absent  
 in females but present in 50% of males. .... *lesteri*
- Upper midcoxa with a distinct patch of pale scales; pale  
 fringe spot at termination of vein Cu<sub>2</sub> present in both sexes  
 .... *sinensis*

## LARVA

- 1. Seta 2-C 4-7 branched, separated by a distance about equal  
 to that between 2,3-C (Fig. 11 A). .... *bengalensis*
- Seta 2-C single, close together (Fig. 8 B). .... 2
- 2. Seta 1-P single or with 2 or 3 short branches at tip. .... 3
- Seta 1-P 4-14 branched. .... 4
- 3. Palmate setae small, leaflets pigmented uniformly. ....  
   *lesteri*
- Palmate setae large, leaflets pale basally and apically. ...  
   *sinensis*
- 4. Seta 3-C single; 8-C single or double.... *lindesayi japonicus*
- Seta 3-C 3-7 branched; 8-C 5-9 branched. .... *saperoi*  
   ssp. *saperoi* in Okinawa Is.  
   ssp. *ohamai* in Yaeyama Is.

KEYS TO SPECIES OF *TOXORHYNCHITES*

## ADULT

- 1. Lateral tufted setae of abdominal terga VI-VIII inconspicu-  
 ous. .... *manicatus*  
   ssp. *yamadai* in Amami Is.  
   ssp. *yaeyamae* in Yaeyama Is.
- Lateral tufted setae of abdominal terga VI-VIII conspicuous.  
 .... *Tx. sp.*

## LARVA

- 1. Setae 3,4-M and 5-7-M on different calli. .... *manicatus*  
   ssp. *yamadai* in Amami Is.  
   ssp. *yaeyamae* in Yaeyama Is.
- Setae 3-7-M on a common callus. .... *Tx. sp.*

KEYS TO SUBGENERA OF *URANOTAENIA*

## ADULT

1. Alula bare (Fig. 6 C); erect scales of vertex absent or very few; prealar area separated from sternopleuron by a suture (Fig. 6 C). . . . . *Uranotaenia*  
 - Alula with a few broad dorsomarginal scales; numerous erect scales of vertex present; prealar area not separated from sternopleuron by a suture. . . . . *Pseudoficalbia*

## LARVA

1. Setae 5,6-C very stout and spine- or spike-like (Fig. 10 D).. . . . . *Uranotaenia*  
 - Setae 5,6-C not stout, spine- or spike-like. . . . . *Pseudoficalbia*

KEYS TO SPECIES OF *URANOTAENIA* (*URANOTAENIA*)

## ADULT

1. Abdominal terga with apical or dorsoapical median pale markings. . . . . *macfarlanei*  
 - Abdominal terga without apical median pale markings (though with lateroapical markings on tergites). . . . . 2
2. Blackish species; scutum with a short stripe of flat broad bluish-white scales in front of wing base; male first fore-tarsomere thickened and with long setae at base; male antenna not strongly plumose. . . . . *lateralis*  
 - Brownish species; scutum without a short stripe of flat broad bluish-white scales in front of wing base; male legs without conspicuous setae; male antenna normally plumose. . . . . *annandalei*

## LARVA

1. Antenna with seta 1-A leaf-like and with two additional leaf-like setae apically; 4-6 comb scales. . . . . *annandalei*  
 - Antenna without large leaf-like setae; 6-10 comb scales. . . . . 2
2. Head light brown; pecten teeth present beyond 1-S. . . . . *lateralis*  
 - Head dark; pecten teeth not present beyond 1-S. . . . . *macfarlanei*

KEYS TO SPECIES OF *URANOTAENIA* (*PSEUDOFICALBIA*)

## ADULT

1. Scutum with a dark spot over wing base. ....  
     ..... *novobscura ryukyuana*
- Scutum without dark spot..... 2
2. Scutum with a stripe of pale scales along side margin before  
     level of wing root. .... *nivipleura*
- Scutum without stripe of pale scales along side margin  
     before level of wing root. .... 3
3. Abdominal terga without pale bands. .... *yaeyamana*
- Abdominal terga with pale bands. .... 4
4. Pleuron with a distinct dark patch covering posterior pro-  
     notal lobe, postspiracular area and upper sternopleuron. ...  
     ..... *ohamai*
- Pleuron with a rather indistinct dark patch covering post-  
     spiracular area and upper sternopleuron. .... *jacksoni*

## LARVA

1. Setae 5,9-IV,V long and stiff; 1,2-VIII on a common narrow  
     sclerotized callus(Fig. 11 D). .... 2
- Setae 5,9-IV,V short and not stiff; 1,2-VIII not on a common  
     narrow sclerotized callus. .... 4
2. Seta 5-III shorter than 5-IV, V; pecten teeth with 2  
     different shapes. .... 3
- Seta 5-III as long as 5-IV, V; all pecten teeth uniform in  
     shape. .... *ohamai*
3. Distance between tip of stirrup-shaped piece and seta 1-S  
     more than 2.5 times distance between seta 1-S and apical  
     pecten teeth detached on siphon; 1-S located at basal 0.61  
     (0.57-0.64) of siphon. .... *jacksoni*
- Distance between tip of stirrup-shaped piece and seta 1-S  
     less than 1.5 times distance between seta 1-S and apical  
     pecten teeth detached on siphon; 1-S located at basal 0.68  
     (0.63-0.71) of siphon. .... *yaeyamana*
4. Setae 6-I, II single; anal gills nearly as long as saddle;  
     pecten teeth present beyond 1-S. .... *novobscura ryukyuana*
- Setae 6-I, II 3-branched; anal gills more than 2 times  
     length of saddle; pecten teeth present not beyond 1-S. ....  
     ..... *nivipleura*

KEYS TO SPECIES OF *COQUILLETIDIA*

## ADULT

1. Wing scales mainly dark; purplish scales present on all or  
     some of abdominal terga. .... *crassipes*
- Wing scales all yellow; abdomen with yellowish scales. ....  
     ..... *ochracea*

## LARVA

1. Comb scales long, slender, sharply pointed(Fig. 9 E). . . . . *crassipes*  
 - Comb scales not so slender, apically pectinate(Fig. 9 B). . . . . *ochracea*

KEYS TO SPECIES OF *MIMOMYIA* (*ETORLEPTIOMYIA*)

## ADULT

1. Dorsal surface of abdomen largely pale except for a conspicuous broad median dark stripe; acrostichal setae present; second hindtarsomere with two well separated dark spots(Fig. 5 F). . . . . *luzonensis*  
 - Dorsal surface of abdomen largely dark with very small pale markings; acrostichals absent; second hindtarsomere with a broad dark band(Fig. 5 E). . . . . *elegans*

## LARVA

1. Head brown; comb scales forming single row; seta 1-C trifid (Fig. 10 B). . . . . *luzonensis*  
 - Head black; comb scales in double rows; seta 1-C simple. . . . . *elegans*

KEYS TO SUBGENERA OF *AEDEDES*

## ADULT

1. Scutum with white, yellowish-white or golden scales in lines or patches. . . . . 2  
 - Scutum with uniformly dark or yellowish scales, never in line or patches. . . . . 4
2. Legs without pale markings; scutum marked with golden scales along lateral margin(Fig. 6 D). . . . . *Neomelaniconion*  
 (one species, *Ae. lineatopennis*)  
 - Legs with pale markings; scutum with longitudinal golden or white stripes or patches. . . . . 3
3. Scutum with a median white or yellowish-white line, or with a pair of fine yellowish-white submedian lines(Fig. 6 E,F); scutellum with broad and flat scales; pedicel with white scales. . . . . *Stegomyia*  
 - Scutum with golden scales in lines or white patches(Fig. 7 A,B); scutellum with narrow curved golden scales(except *Ae. watasei* with broad yellowish-white scales and *Ae. albocinctus* with narrow white scales on scutellum); pedicel without white scales (except *Ae. albocinctus*, *Ae. japonicus* and *Ae. togoi* with white scales on pedicel). . . . . *Finlaya*

4. All hindtarsal segments with pale basal bands or patches. . . . . 5  
 - All hindtarsal segments without pale band. . . . . 6
5. Subspiracular area with scales; pedicel with conspicuous pale scales on inner surface. . . . . *Aedimorphus*  
 (one species, *Ae. vexans nipponii*)  
 - Subspiracular area without scales; pedicel with a very few inconspicuous dark scales on inner surface. . . . .  
 . . . . . *Ochlerotatus*  
 (one species, *Ae. vigilax*)
6. Erect scales on head few and confined to occiput; sternopleuron without minute setae; palpus of male distinctly short, about 0.2 length of proboscis. . . . . *Verrallina*  
 - Erect scales on head numerous, extending to orbital; sternopleuron with numerous minute setae; palpus of male short, about 0.5 length of proboscis. . . . . *Geoskusea*  
 (one species, *Ae. baisasi*)

## LARVA

1. Seta 12-I present. . . . . 2  
 - Seta 12-I absent. . . . . 7
2. Setae 1,2-VIII on a common callus. . . . . *Neomelaniconion*  
 (one species, *Ae. lineatopennis*)  
 - Setae 1,2-VIII not on a common callus. . . . . 3
3. Length of seta 6-C same or longer than siphonal length. . . 4  
 - Length of seta 6-C shorter than siphonal length. . . . . 5
4. Seta 2-X 10-16 branched; anal gills very short and rounded. . . . . *Geoskusea*  
 (one species, *Ae. baisasi*)  
 - Seta 2-X 3 branched; anal gills elongate. . . . .  
 . . . . . *Finlaya* (in part: *Ae. aureostriatus*)
5. Seta 5,6-C 3-15 branched. . . . . *Finlaya* (in part)  
 - Seta 5,6-C single. . . . . 6
6. Seta 7-C single or double; 5-P single; 2-X 3-5 branched. . . . .  
 . . . . . *Finlaya* (in part: *Ae. watasei*)  
 - Seta 7-C 6-10 branched; 5-P double; 2-X 9-13 branched. . . . .  
 . . . . . *Ochlerotatus*  
 (one species, *Ae. vigilax*)
7. Seta 5-C single; 5-C about on level of 7-C or cephalad of 7-C (Fig. 12 A). . . . . *Stegomyia*  
 - Seta 5-C 2-8 branched; 5-C distinctly caudad of 7-C (Fig. 12 C). . . . . 8
8. Seta 2-P single; 6-III 2,3 branched; 1,2-VIII on a common callus. . . . . *Aedimorphus*



- (one species, *Ae. vexans nipponii*)  
 - Seta 2-P 2,3 branched; 6-III single; 1,2-VIII not on a  
 common callus(Fig. 12 D). . . . . *Verrallina*

KEYS TO SPECIES OF *AEDES* (FINLAYA)

## ADULT

1. Tarsi not banded. . . . . *nishikawai*  
 - Tarsi banded. . . . . 2
2. Scutellum with narrow curved golden scales. . . . . 3  
 - Scutellum without narrow curved golden scales. . . . . 5
3. Paratergite with scales; palpi with apical white scales. ....  
 . . . . . *togoi*  
 - Paratergite without scales; palpi all dark. . . . . 4
4. Pedicel with scales; postspiracular area with scales. ....  
 . . . . . *japonicus*  
     *ssp. amamiensis* in Amami and Okinawa Is.  
     *ssp. yaeyamensis* in Yaeyama Is.  
 - Pedicel without scales; postspiracular area without scales..  
 . . . . . *aureostriatus*  
     *ssp. okinawanus* in Tokara, Amami and Okinawa Is.  
     *ssp. taiwanus* in Yaeyama Is.
5. Scutum with a large reniform spot of white slender scales at  
 anterior end and a transversely elongated patch of somewhat  
 longer white narrow scales to each wing base. .... *watasei*  
 - Scutum covered with narrow white scales over anterior 0.75..  
 . . . . . *albocinctus*

## LARVA

1. Seta 1-A usually single(1,2); 6-C single..... 2  
 - Seta 1-A 3-15 branched; 6-C branched. . . . . 3
2. Seta 6-C very long, more than twice as long as 5-C which is  
 3-6 branched; 5-P 3 branched. . . . . *aureostriatus*  
     *ssp. okinawanus* in Tokara, Amami and Okinawa Is.  
     *ssp. taiwanus* in Yaeyama Is.  
 - Seta 6-C as long as 5-C which is not branched; 5-P single...  
 . . . . . *watasei*
3. Pecten with distal large-sized teeth widely spaced, extend-  
 ing beyond siphonal seta(1-S) to near apex of siphon (Fig.  
 13 A). . . . . *japonicus*  
     *ssp. amamiensis* in Amami and Okinawa Is.  
     *ssp. yaeyamensis* in Yaeyama Is.  
 - Pecten with all same-sized teeth evenly spaced, not extending  
 beyond siphonal seta(1-S). . . . . 4

4. Comb scales about 30-170, arranged in a patch. .... 5  
 - Comb scales about 8-12, arranged in a row. .... *nishikawai*
5. Setae 4, 6-C about same-size; comb scales about 30, individual scales pointed at apex. .... *albocinctus*  
 - Seta 4-C smaller than 6-C; comb scales about 60-170, individual scales rounded at apex, evenly fringed with spicules. .  
 ..... *togoi*

#### KEYS TO SPECIES OF *Aedes* (*VERRALLINA*)

##### ADULT

1. Eye margin without pale scales; interocular space without scales. .... *iriomotensis*  
 - Eye margin with pale scales; interocular space covered with pale scales. .... 2
2. Interocular space covered with broad pale scales; mesepimeron without setae caudad of scale patch. .... *nobukonis*  
 - Interocular space with narrow curved pale scales; mesepimeron with a few to numerous fine setae caudad of scale patch (Fig. 7 C). .... *atriisimilis*

##### LARVA

1. Setae 5,6-C 2 branched; 1-A single or double; 2-X 3-4 branched. .... *nobukonis*  
 - Setae 5,6-C more than 3 branched; 1-A more than 3 branched; 2-X 5-7 branched. .... 2
2. Seta 5-C 5-8 branched; 6-C 5-7 branched; 7-C 11-16 branched; siphonal index 3.0-3.4; siphonal length 0.89-0.98 mm; 13-16 pecten teeth on basal 0.75. .... *atriisimilis*  
 - Seta 5-C 3-4 branched 6-C 3-4 branched; 7-C 5-7 branched; siphonal index 2.0-3.0; siphonal length 0.75-0.82 mm; 10-14 pecten teeth on basal 0.55. .... *iriomotensis*

#### KEYS TO SPECIES OF *Aedes* (*STEGOMYIA*)

##### ADULT

1. Scutum with a white or yellowish-white median stripe. .... 2  
 - Scutum with a pair of lateral curved white lines and also with a pair of submedian yellowish-white lines. .... *aegypti*
2. Scutum with a yellowish-white median stripe; scutellum with black scales only or black and white scales on lateral lobes; subspiracular area with scales; bands on tarsomeres incomplete in inner lateral part; halter with dark and pale scales  
 ..... *daitensis*

- Scutum with a white median stripe; scutellum with white scales on lateral lobes; subspiracular area with or without scales; bands on tarsomeres complete; halter with dark scales only. .... 3
- 3. White patches on pleuron forming distinct parallel transverse stripes; abdominal terga without dorsobasal bands; supraalar white line complete and well developed, with broad flat scales over wing root and toward scutellum. .... *riversi*
- White patches on pleuron not forming distinct parallel transverse stripes; abdominal terga with dorsobasal bands; supraalar white line incomplete or not clearly defined and with only narrow or broad scale patch over wing root. .... 4
- 4. Scutum with a patch of broad flat white scales on lateral margin just before level of wing root; hindtarsomere 4 with about basal 2/3 white scaled. .... *albopictus*
- Scutum with a patch of narrow curved yellowish scales on lateral margin just before level of wing root; hindtarsomere 4 with about basal 5/6 white scaled. .... *flavopictus*  
ssp. *downsi* in Tokara, Amami and Okinawa Is.  
ssp. *miyarai* in Yaeyama Is.

## LARVA

- 1. Comb scales with very strong basal denticles (Fig. 13 C); ventral brush with 5 pairs of setae (Fig. 13 B); seta 6-III 3-5 branched. .... *aegypti*
- Comb scales without very strong basal denticles; ventral brush with 4 pairs of setae; seta 6-III 2 branched. .... 2
- 2. Seta 6-C usually single; 1-VII 3.8(3.2-4.9) times as long as 5-VII. .... 3
- Seta 6-C usually double; 1-VII 3.0(2.0-4.0) times as long as 5-VII. .... 4
- 3. Seta 1-VII and 5-VIII usually 3(2-5) branched; apical spine of some comb scales usually split at tip. .... *riversi*
- Seta 1-VII usually double(2,3) and 5-VIII usually double(1,2); comb scales never split at tip. .... *daitensis*
- 4. Anal gills longer than 1-X. .... *albopictus*
- Anal gills as long as or shorter than 1-X. .... *flavopictus*  
ssp. *downsi* in Tokara, Amami and Okinawa Is.  
ssp. *miyarai* in Yaeyama Is.

KEYS TO SUBGENERA OF *CULEX*

## ADULT

- 1. Relatively large species (wing length, 5-7 mm); 4 or more strong, lower mesepimeral setae present; proboscis dark brown with variable ventral median band of pale scales;

- forefemur with a row of many pale spots of irregular outline on inner margin. .... *Lutzia*
- Moderately to small-sized species (wing length less than 5 mm); mesepimeral setae absent, or if present, 1 or 2 rather weak setae; ornamentation of proboscis and legs various. .... 2
2. Pleuron with distinct scale patches at least on the upper and lower sternopleuron and the anterior mesepimeron. ....  
..... *Culex*
- Pleuron without distinct scale patches. .... 3
3. Female. .... 4
- Male. .... 6
4. 1A index ( $1A/m-cu$ ) of wing greater than 1.00; abdomen with distinct pale band; lower mesepimeral setae always present..  
..... *Culiciomyia* (in part)
- 1A index less than 1.00; abdominal pale band and lower mesepimeral setae various. .... 5
5.  $R_2$  index ( $R_2/R_{2+3}$ ) of wing greater than 2.1; abdominal pale band absent. .... *Eumelanomyia* (in part)
- $R_2$  index less than 2.1; abdominal pale band various. ....  
..... *Lophoceraomyia* (in part)
6. Antenna with specialized scales and setae usually present on flagellomeres V-IX, always present on VII and VIII. ....  
..... *Lophoceraomyia*
- Antennae without specialized scales and setae. .... 7
7. Abdomen with pale basal band; palpus greater than or about equal to the length of the proboscis; palpus with characteristic ventrolateral linear series of lanceolate scales. ....  
..... *Culiciomyia*
- Abdomen without pale band; palpus approximately 0.5 to 0.75 the length of the proboscis; palpus without such scales. ...  
..... *Eumelanomyia*

## LARVA

1. Seta 7-II as strong as 7-I; mouth brushes thickened; anal saddle longer than siphon. .... *Lutzia*
- Seta 7-II much shorter and weaker than 7-I; mouth brushes normal; anal saddle shorter than siphon. .... 2
2. Seta 4-X with usually 4 pairs of setae (8 setal tufts); saddle with markedly strong apical spicules. ... *Culiciomyia*
- Seta 4-X with 5 to 7 pairs of setae (more than 10 setal tufts) and sometimes additional unpaired setae proximad; saddle without markedly strong apical spicules. .... 3
3. Seta 3-P always single and thickness of 1-P. .... *Culex*
- Seta 3-P single or branched and thinner than 1-P and usually less than 0.5 length of 1-P. .... 4

4. Seta 4-P less than 0.2 length of 3-P...*Eumelanomyia*(in part)  
 - Seta 4-P greater than length of 3-P. .... 5
5. Setae 6-IV and 2-X single. ....*Eumelanomyia*  
 - Setae 6-IV and 2-X 2-5 branched. .... *Lophoceraomyia*

KEY TO SPECIES OF *CULEX* (*LUTZIA*)\*

## ADULT

1. Abdominal terga II, III with very narrow apical bands; terga  
 IV-VIII usually with entirely yellow scales and sometimes V  
 with broad apical yellow bands. .... *fuscanus*  
 - Abdominal terga II-VII usually with narrow pale apical bands  
 .... *halifaxii*

\*It is not presently possible to distinguish the larvae of these species.

KEYS TO SPECIES OF *CULEX* (*CULEX*)

## ADULT

1. Proboscis without pale band; one or 2 lower mesepimerals  
 present; tarsi not pale banded. .... 2  
 - Proboscis ringed with a distinct pale band; lower mesepime-  
 ral absent; tarsi with basal pale bands. .... 4
2. Abdominal terga without distinct pale band and patch;  
 pleuron with distinct dark spots on postspiracular, sterno-  
 pleuron and mesepimeron areas. .... *fuscocephala*  
 - Abdominal terga with a distinct pale basal band; pleuron  
 without distinct dark spot. .... 3
3. Anterior surface of all femora and tibiae with a distinct  
 median longitudinal pale stripe. .... *vagens*  
 - Anterior surface of all femora and tibiae unicolored,  
 without longitudinal pale stripe. .... *quinquefasciatus*
4. Wing with striking pattern of pale spots. .... 5  
 - Wing without pale spots. .... 6
5. Mesonotal scales predominantly brown. .... *jacksoni*  
 - Mesonotal scales predominantly pale. .... *mimeticus*
6. Abdominal terga with pale apical bands, or both apical and  
 basal bands. .... 7  
 - Abdominal terga with only pale basal bands. .... 8
7. Wings with pale scales scattered among dark scales, particu-  
 larly on costa and subcosta. .... *bitaeniorhynchus*

- All wing veins without pale scales. .... *sinensis*
- 8. Scutum densely covered with distinct silver scales, which are continued posteriorly through the prescutellar space and on the scutellum..... *whitmorei*
- Scutum densely covered with brown or golden, or pale beige scales. .... 9
- 9. Anterior surface of fore and midfemora with speckling of pale scales. .... *sitiens*
- All legs without speckling of pale scales. .... 10
- 10. Proboscis with accessory pale scale patches proximad to the median pale band on the ventral surface; most of the erect scales of vertex dark brown; mesonotal scales narrow, fine, predominantly dark brown. .... *tritaeniorhynchus*
- Proboscis without accessory pale scales on the ventral surface; erect scales of vertex pale beige or yellowish-white in center; mesonotal scales coarse, predominantly pale beige. .... *pseudovishnui*

## LARVA

- 1. Seta 1-C fine, rapidly tapering to a filamentous point. .. 2
- Seta 1-C robust, gradually tapering to bluntly rounded point or very broad. .... 4
- 2. Siphonal index less than 4:1. .... *quinquefasciatus*
- Siphonal index more than 5:1. .... 3
- 3. Setae 5,6-C 2,3 branched; 6-III, V, VI single.....
- ..... *fuscocephala*
- Setae 5,6-C 4-6 branched; 6-III, V, VI double..... *vagens*
- 4. Seta 1-C long and cylindrical, lightly pigmented; pecten inconspicuous, restricted to the basal 0.1 of the siphon. ..
- ..... 5
- Seta 1-C short, darkly pigmented; pecten obvious, extending through approximately the basal 0.3 of the siphon. .... 6
- 5. Lateral teeth of the mentum robust, distinctly separated; seta 4-P fine, short, about 0.2 of the length of 1-3-P.....
- ..... *sinensis*
- Lateral teeth of the mentum extremely narrow and compact; seta 4-P pectinate, long, about 0.5 of the length of 1-3-P..
- ..... *bitaeniorhynchus*
- 6. Comb scales less than 15. .... 7
- Comb scales more than 20. .... 8
- 7. Seta 1-S double, strongly barbed, more than twice as long as siphon diameter; 5-C double; 5-VIII 2,3 branched. ....
- ..... *whitmorei*
- Seta 1-S 3-6 branched, not barbed, not more than twice as long as siphon diameter; 5-C 3,4 branched; 5-VIII 4-8

- branched. .... *pseudovishnui*
8. Comb scales paddle-shaped evenly fringed with fine spicules. .... 9  
 - Comb scales thorn-shaped, apical spine stronger than lateral spicules. .... 10
9. Seta 1-C very short and stout(Fig. 13 D); anal gills bulbous (Fig. 13 E). .... *sitiens*  
 - Seta 1-C more slender; anal gills elongate. ....  
 .... *tritaeniorhynchus*
10. Siphon with 1-4 simple strong spines; seta 5-C usually 6(4-7), 6-C usually 3(3,4) branched. .... *jacksoni*  
 - Siphon without simple strong spines; seta 5-C usually 3(3,4), 6-C usually 2(2,3) branched. .... *mimeticus*

KEYS TO SPECIES OF *CULEX* (*CULICIOMYIA*)

## ADULT

1. Pleuron pale, with a distinct velvety black spot on upper part of mesepimeron. .... *nigropunctatus*  
 - Pleuron with a brown stripe across upper part. .... 2
2. Pleuron with distinctly dark brown pattern which stretches from *apn* across the prealar and terminates at upper mesepimeron; another dark brown pattern present on the middle sternopleuron; last segment of male palpus with many long setae. .... *pallidothorax*  
 - Pleuron with a faint stripe across upper part and a small faint dark spot at anterior corner of sternopleuron; last segment of palpus with few setae. .... *ryukyensis*

## LARVA

1. Siphon with false joint beyond the middle due to lack of sclerotization(Fig. 14 A). .... *nigropunctatus*  
 - Siphon without false joint beyond the middle. .... 2
2. Siphon tapering gradually to a narrow and somewhat upturned apex, with microsculpture consisting of small, elongate tubercles largely confined to apex(Fig. 14 B); 11 to 21 pecten teeth .... *ryukyensis*  
 - Siphon conspicuously swollen towards middle, very narrow at apex, without microsculpture(Fig. 14 C); 4-10 pecten teeth. .... *pallidothorax*

KEYS TO SPECIES OF *CULEX* (*LOPHOCERAOMYIA*)

## ADULT

1. Pedicel with distinct nipple-like spicules; palpus without basal finger-like process ..... 2
- Pedicel without nipple-like spicules; palpus with basal finger-like process. .... 3
  
2. Forecoxa with yellowish pale scales; postnotal integument light brown; lower mesepimeral seta absent. .... *tuberis*
- Forecoxa with gray scales anteriorly; postnotal integument dark brown; lower mesepimeral seta usually present. ....  
..... *bicornutus*
  
3. Abdomen without pale basal band. .... *rubithoracis*
- Abdomen with pale basal band. .... 4
  
4. Scutal integument yellowish-brown; posterior pronotal lobe unscaled. .... *infantulus*
- Scutal integument reddish-brown; posterior pronotal lobe with hair-like scales. .... *cinctellus*

## LARVA

1. Comb scales with small stout apical spine, laterally fringed with spicules. .... *bicornutus*
- Comb scales without apical spine, evenly fringed with fine spicules. .... 2
  
2. Seta 7-1 single. .... *rubithoracis*
- Seta 7-1 double. .... 3
  
3. Seta 6-C single; 1-VII double. .... *tuberis*
- Seta 6-C double; 1-VII more than 5 branched. .... 4
  
4. Seta 5-C double; 14-P 2 or 3 branched. .... *infantulus*
- Seta 5-C 3 or 4 branched; 14-P single. .... *cinctellus*

KEYS TO SPECIES OF *CULEX* (*EUMELANOMYIA*)

## ADULT

1. Acrostical setae absent; lower mesepimeral setae absent. ...  
..... *brevipalpis*
- Acrostical and lower mesepimeral setae present. .... 2
  
2. Female. .... 3
- Male. .... 4
  
3.  $M_{3+4}$  index( $M/M_{3+4}$ ) of wing less than 3.4;  $M_{1+2}$  index( $M/M_{1+2}$ ) of wing less than 2.6. .... *okinawae*
- $M_{3+4}$  index( $M/M_{3+4}$ ) of wing greater than 3.5;  $M_{1+2}$  index ( $M/M_{1+2}$ ) of wing greater than 2.7(Fig. 4G).....  
..... *hayashi ryukyuanus*
  
4. Clasper of male genitalia large and the basal half narrow,



- the apical half expanded, ending in a broad truncate, recurved apex; subapical lobe of sidepiece(basimere) with 9 rods, the distal one with heavy denticles(Fig. 7 E). . . . .  
 . . . . . *okinawae*  
 - Clasper small and slender; 4 distal rods of subapical lobe finely denticulate(Fig. 4 H). . . . . *hayashii ryukyuanus*

## LARVA

1. Seta 1-S shorter than siphon diameter at insertion; siphon long(more than 1.7 mm in length), brown; pecten restricted to the basal 0.2 of the siphon. . . . . *brevipalpis*  
 - Seta 1-S longer than siphon diameter at insertion; siphon not long(less than 1.5 mm in length), usually pale yellowish brown; pecten extending through the basal 0.23 of the siphon . . . . . 2
2. Seta 2-X 2-5 branched; 6-III, V, VI 3 branched. . . . .  
 . . . . . *hayashii ryukyuanus*  
 - Seta 2-X single; 6-III, V, VI 2 branched. . . . . *okinawae*

Fig. 4 .

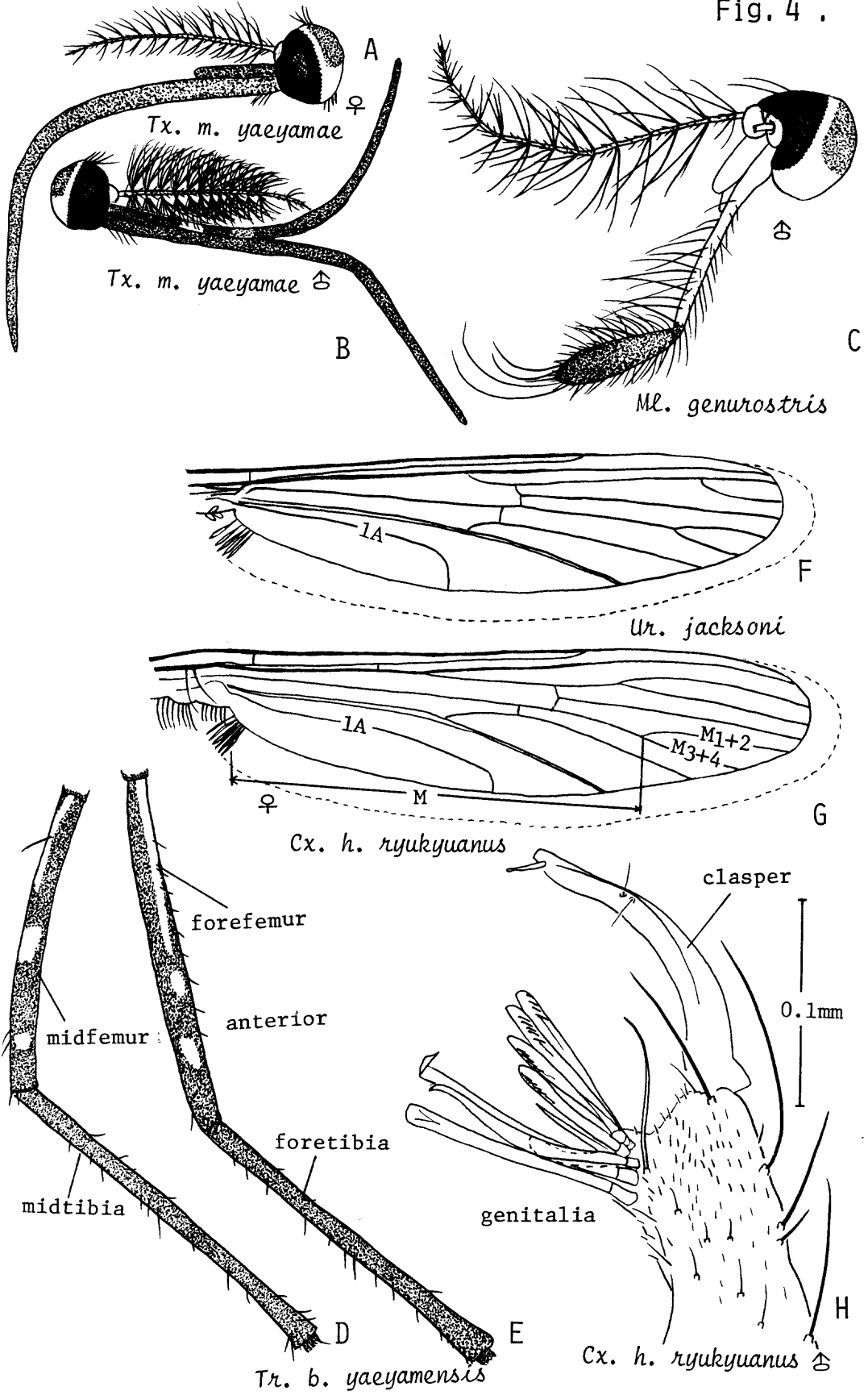


Fig. 5.

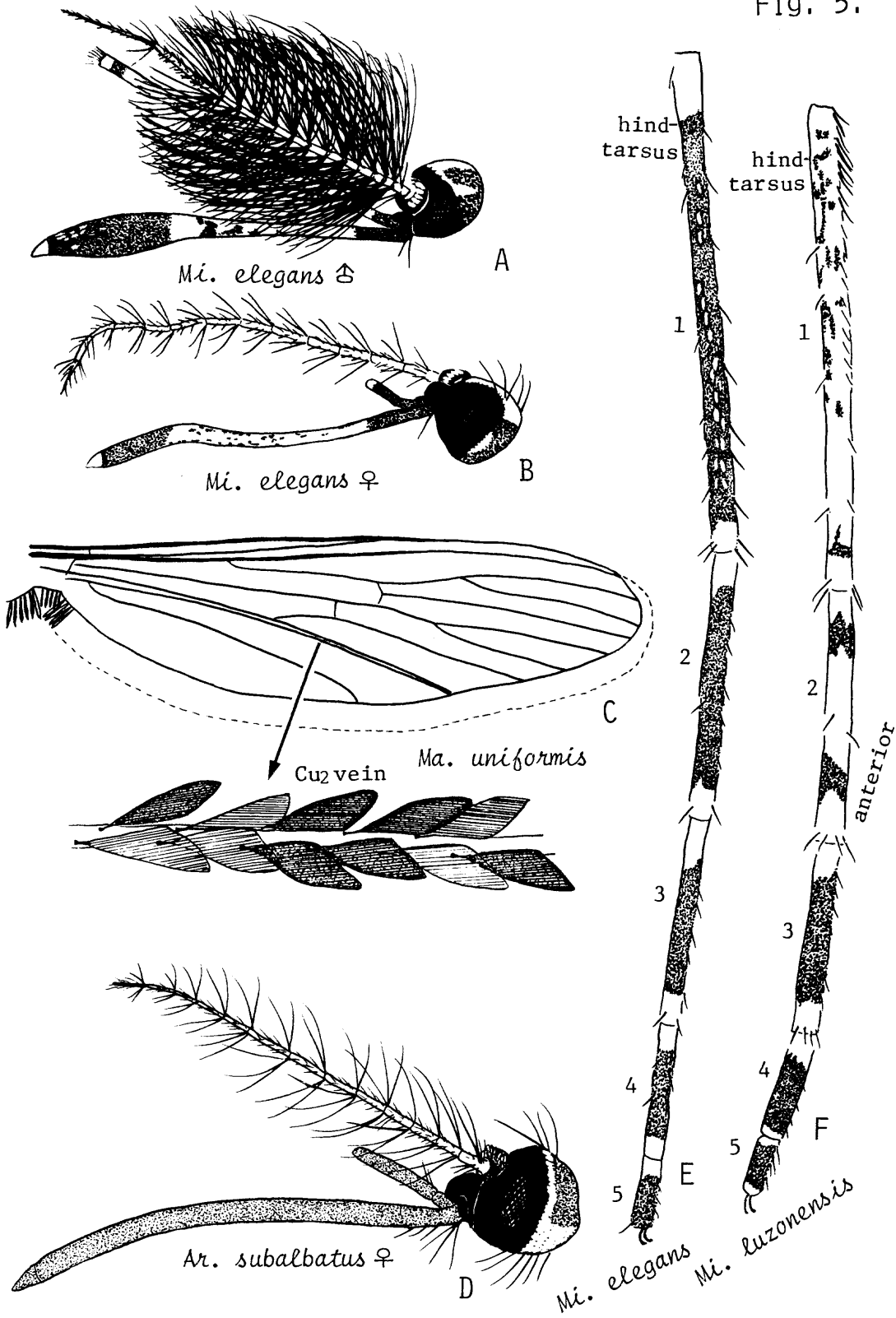


Fig. 6.

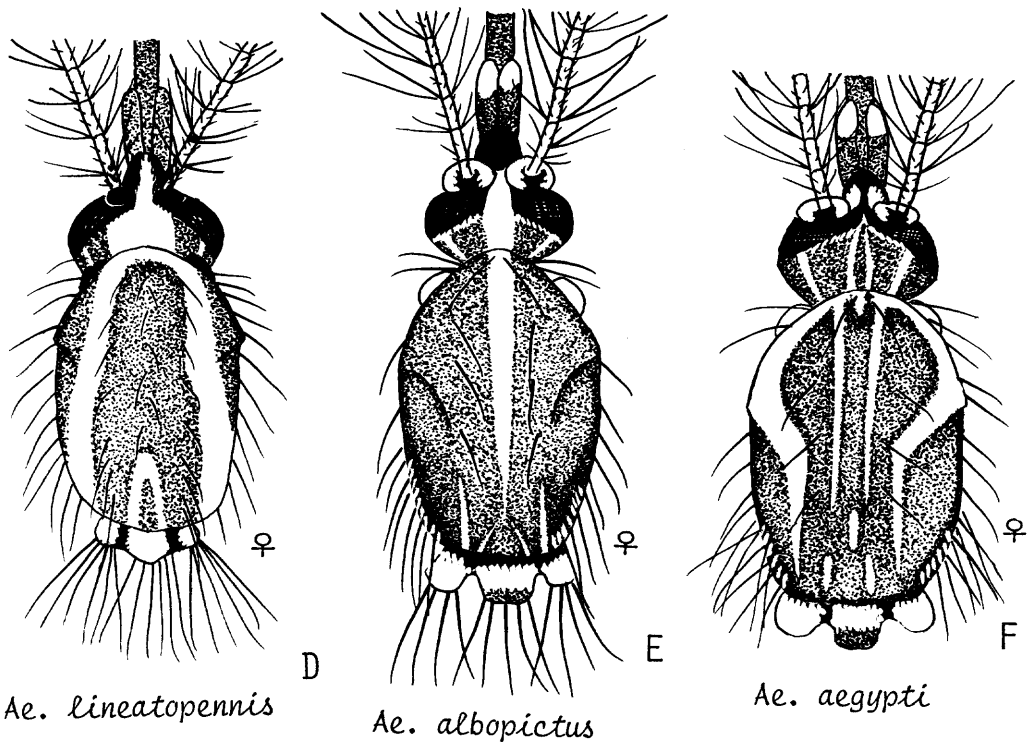
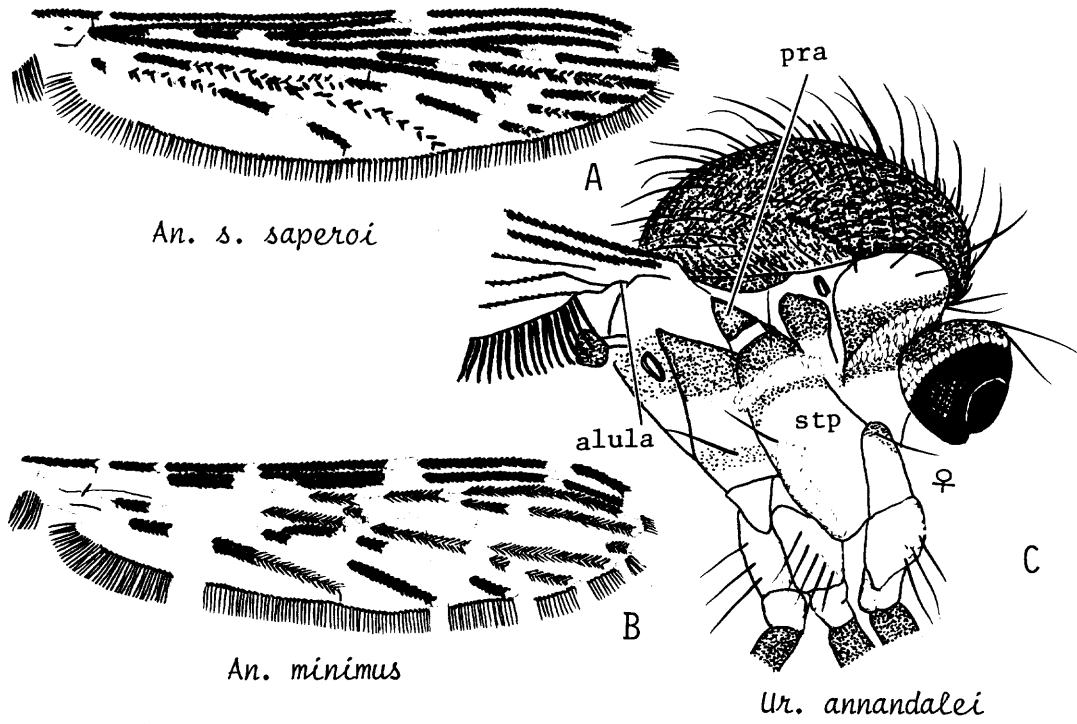


Fig. 7.

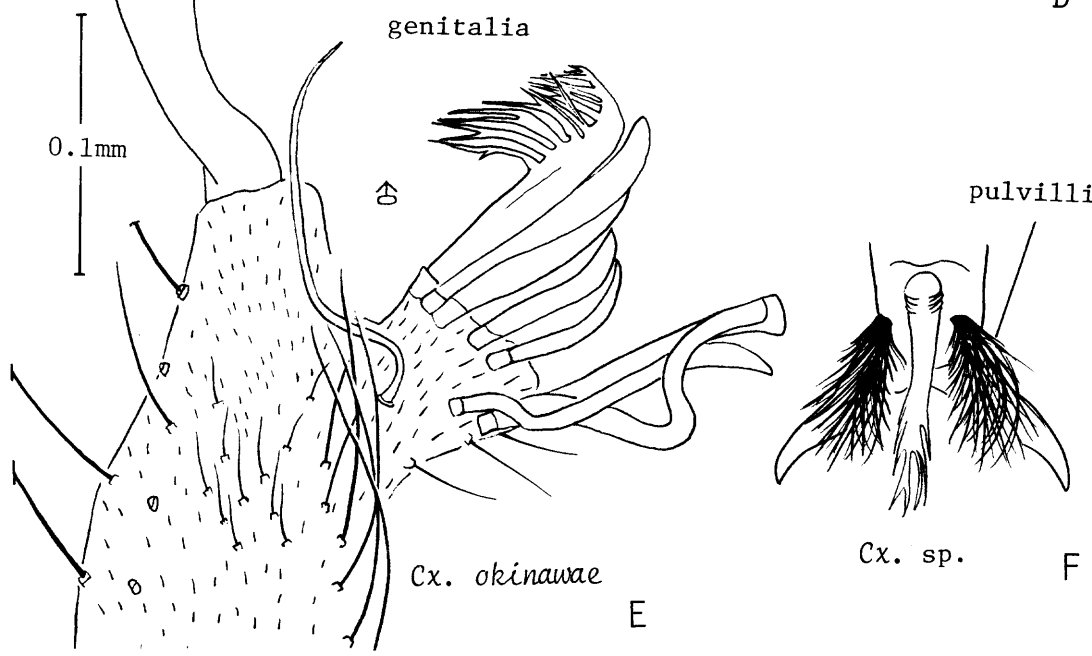
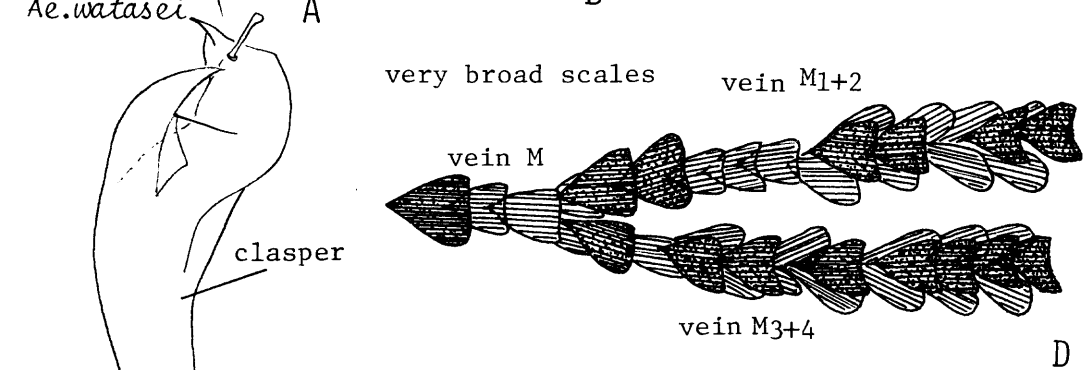
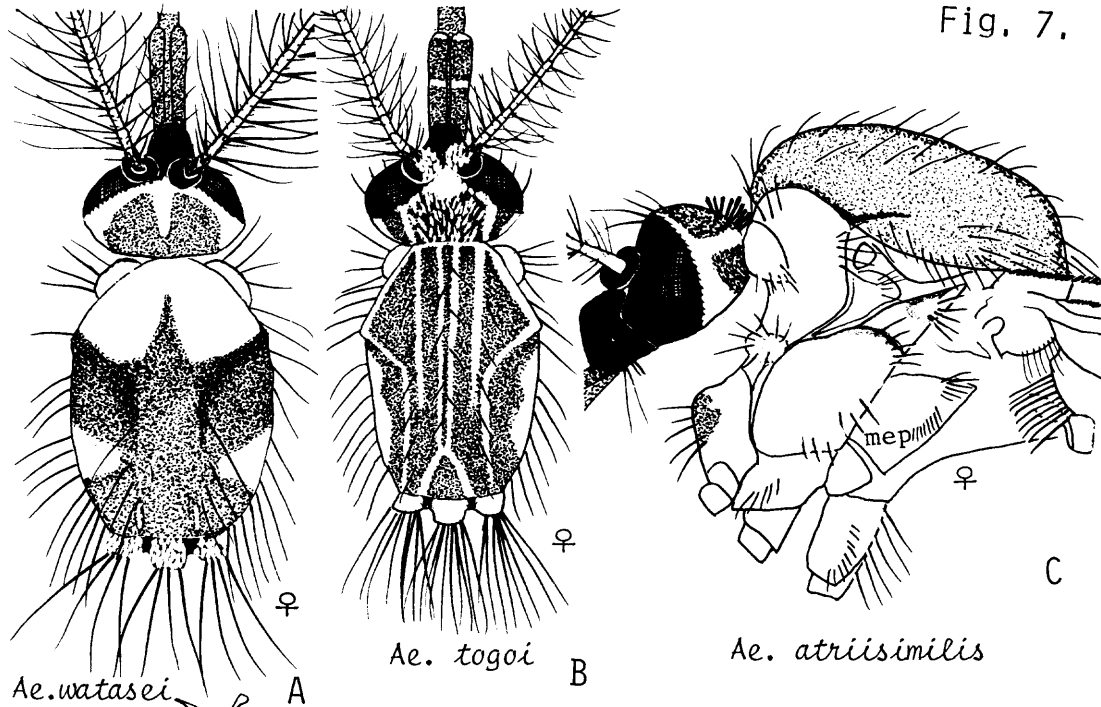


Fig. 8.

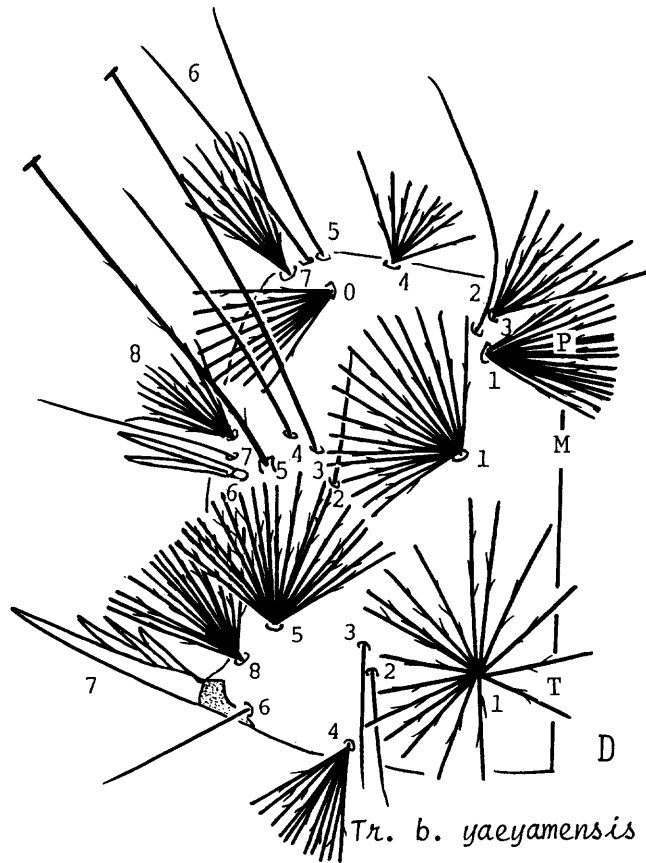
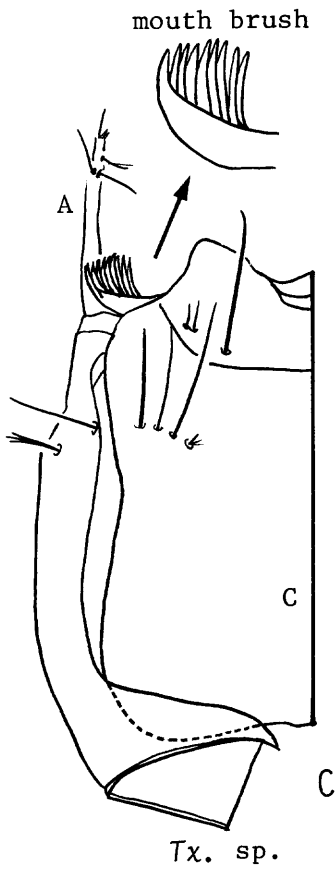
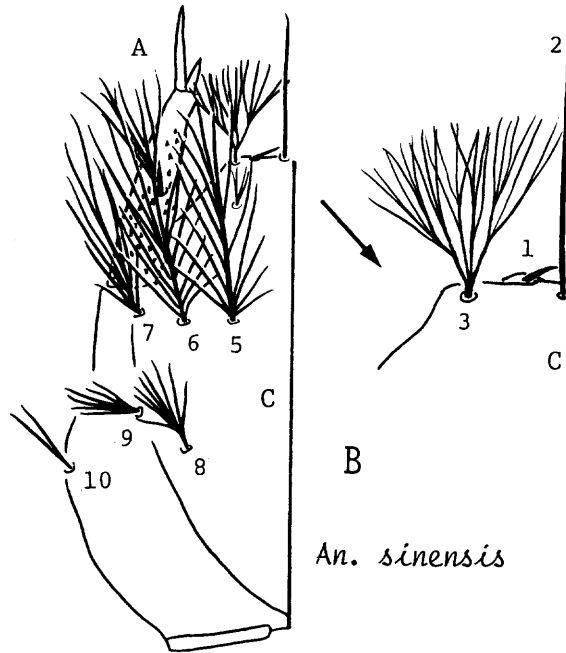
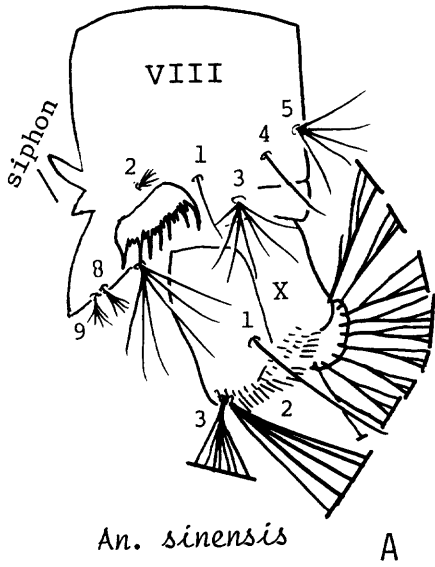


Fig. 9

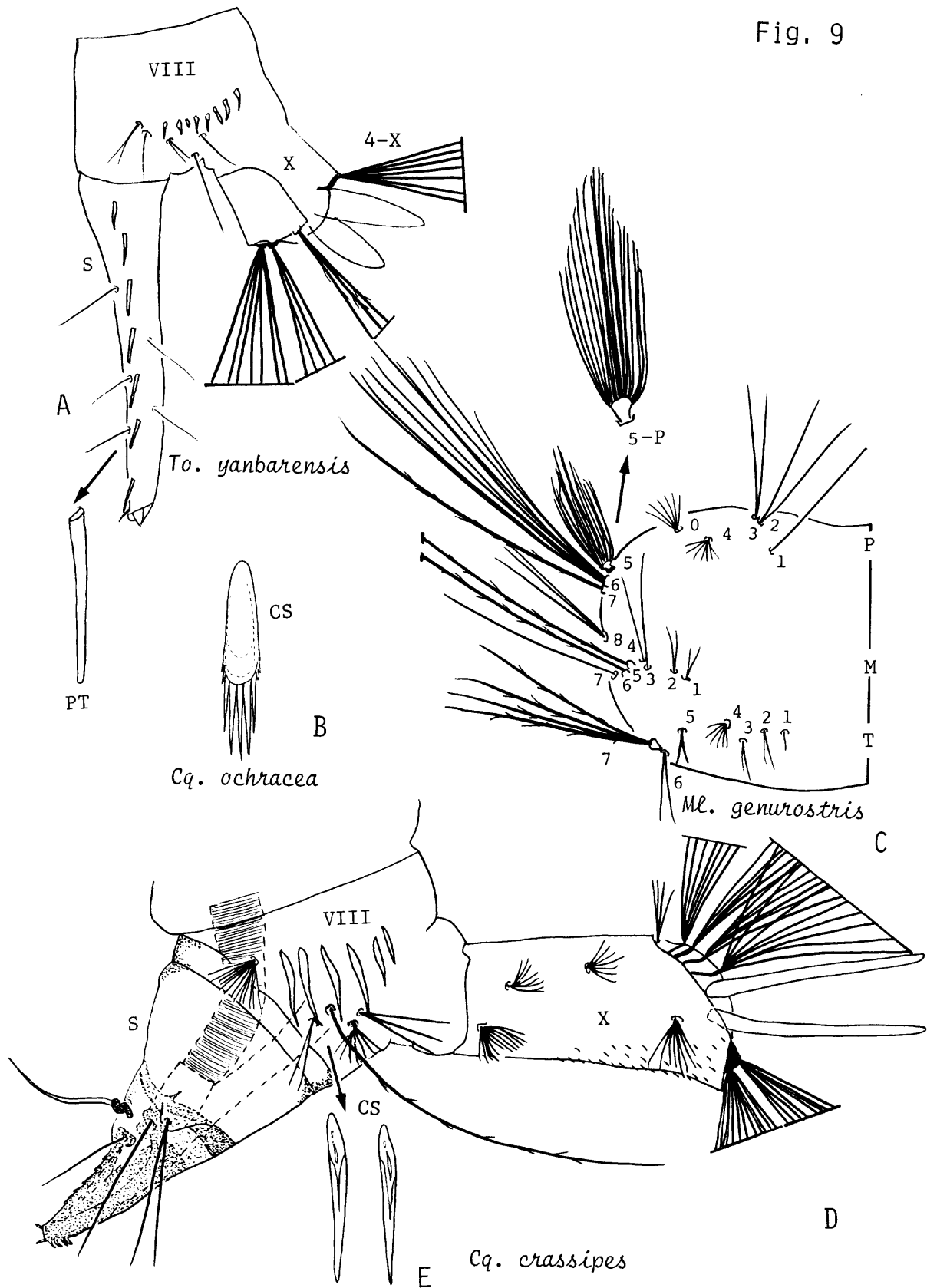


Fig. 10.

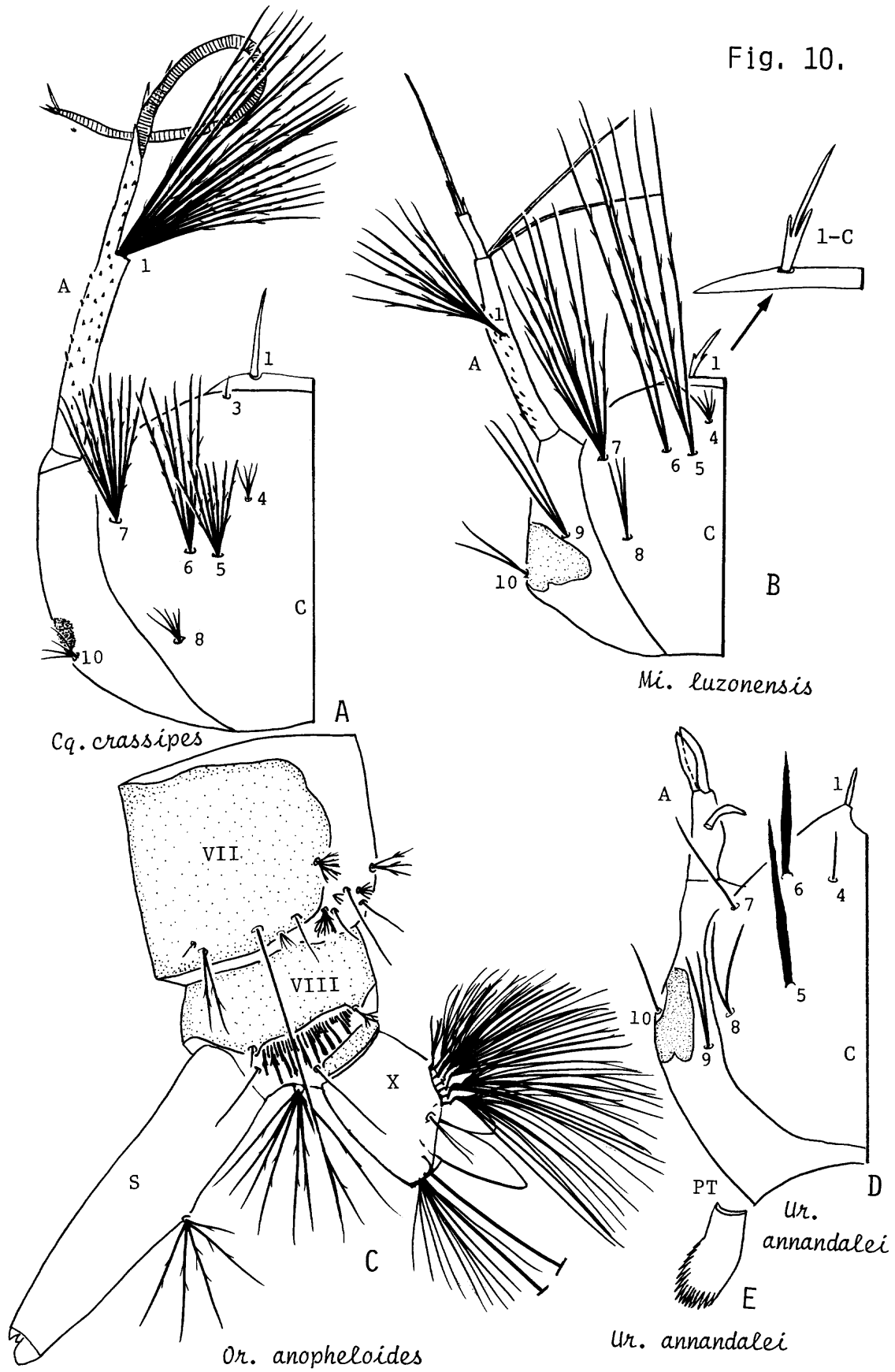




Fig. 11.

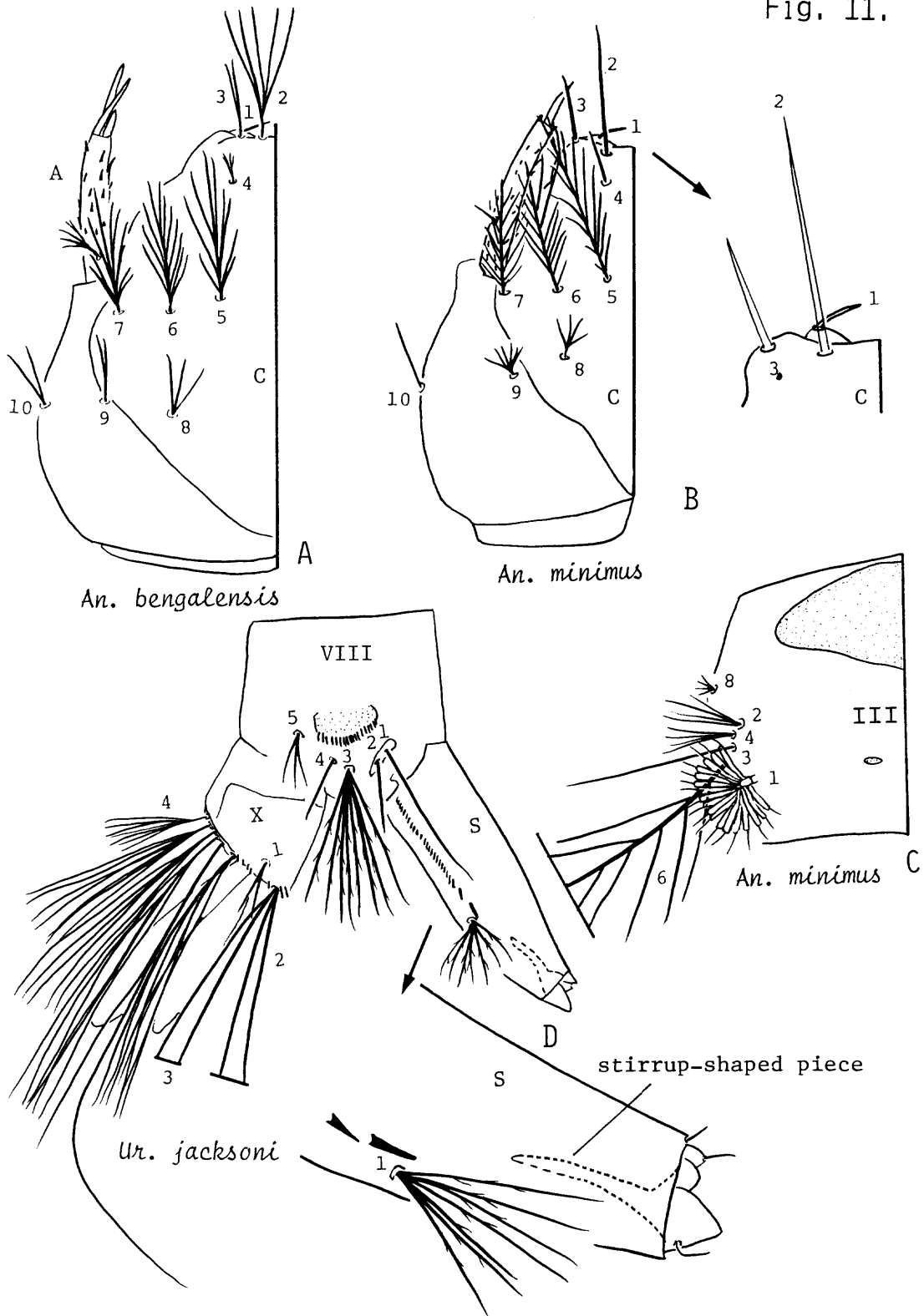


Fig. 12.

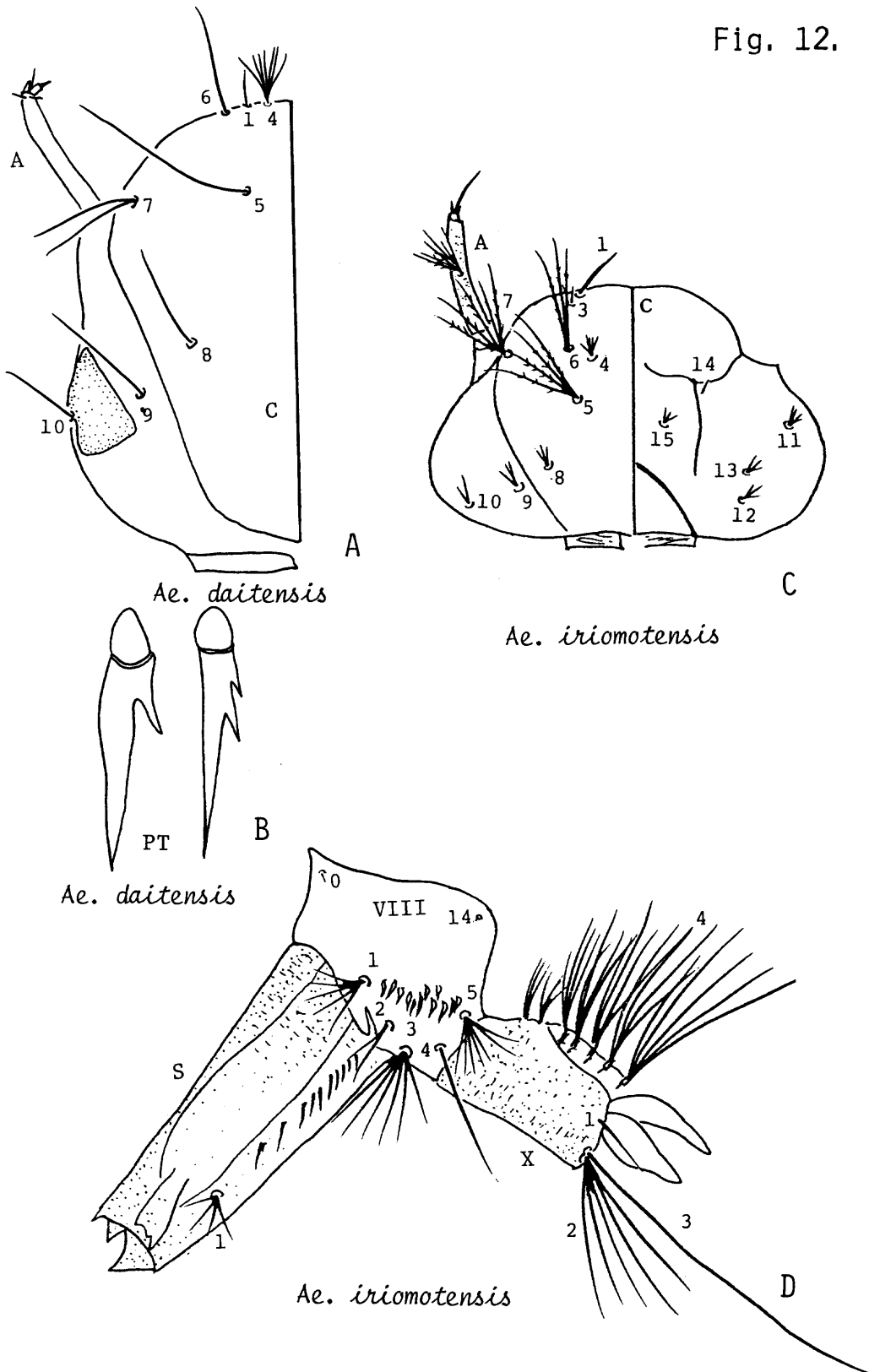
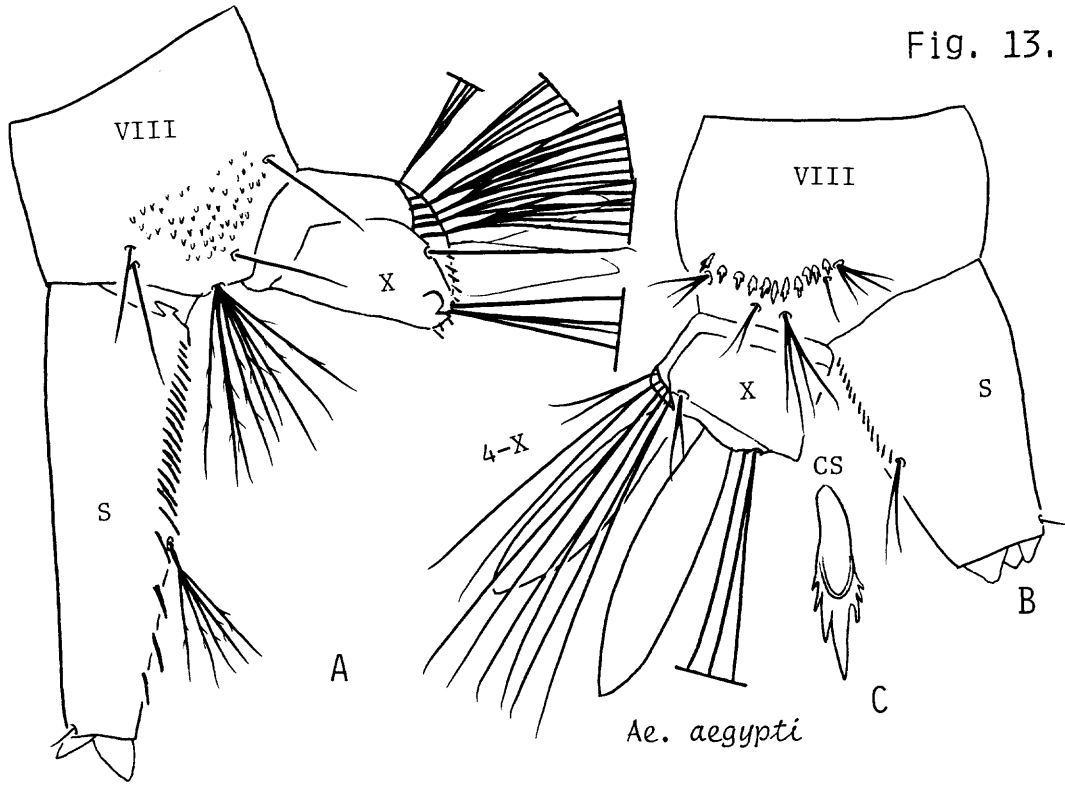
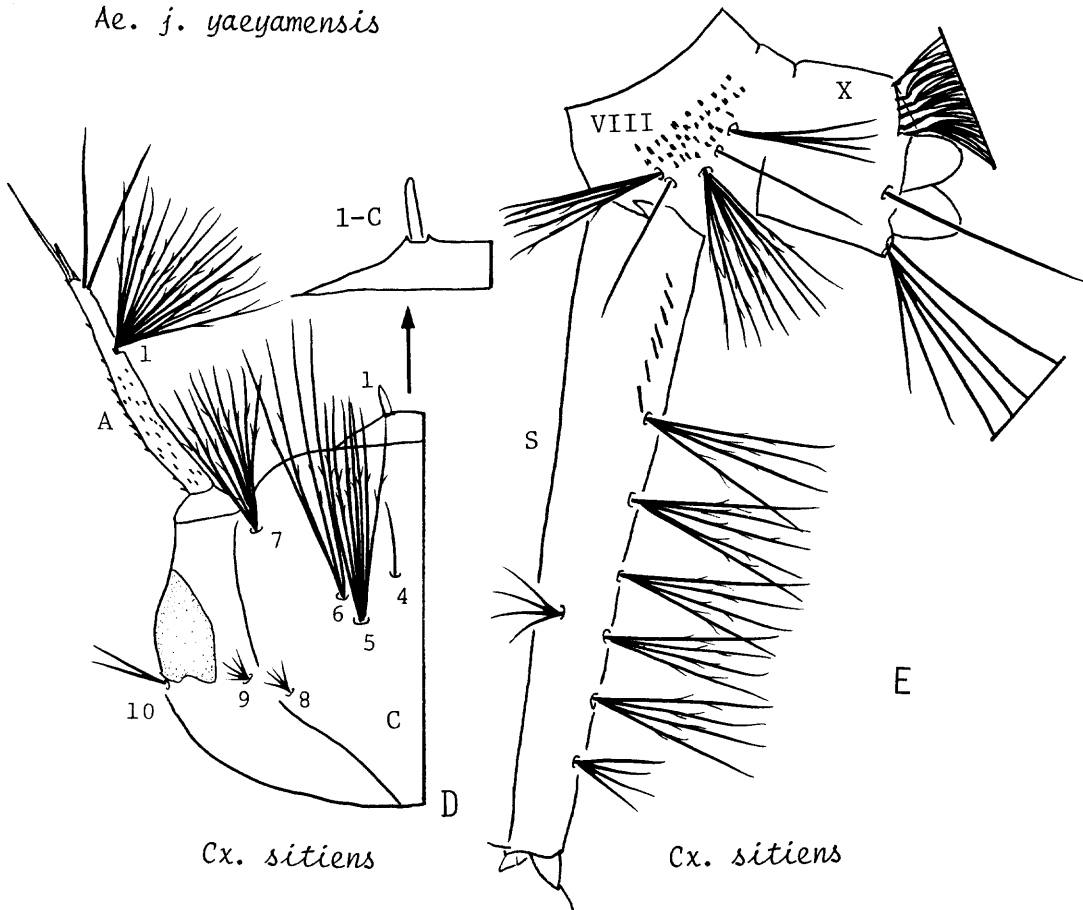


Fig. 13.



*Ae. j. yaeyamensis*

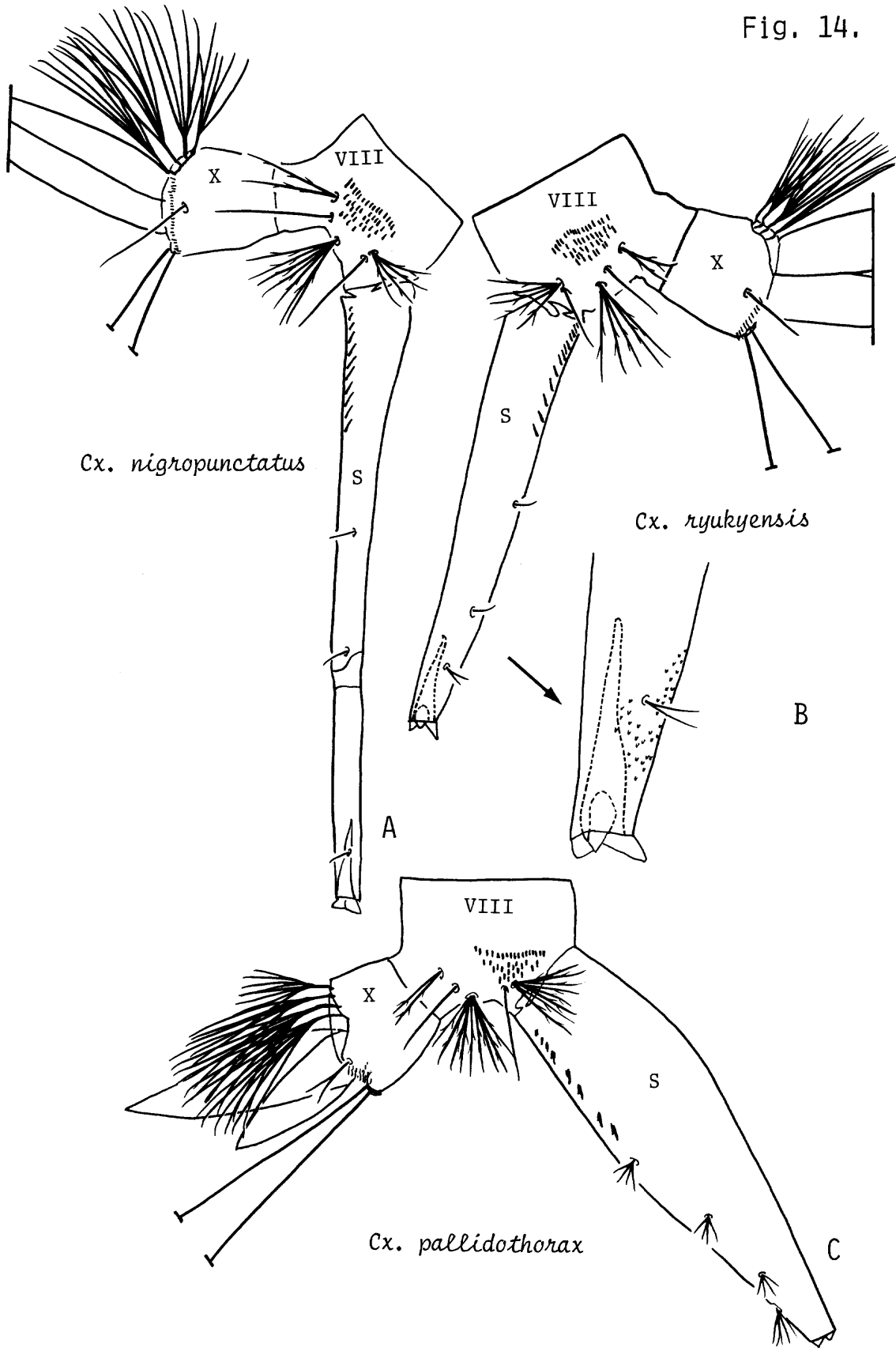
*Ae. aegypti*



*Cx. sitiens*

*Cx. sitiens*

Fig. 14.



## LIST OF MOSQUITO SPECIES

The list of mosquito species occurring in the Ryukyu Archipelago includes notes on biology, abundance, evidence of man-biting habits and distribution, and also includes descriptions of the pupae of some species. Most of the information on taxonomic status and distribution follows Knight and Stone(1977), Knight(1978), Tanaka *et al.*(1979) and Ward (1984).

*Anopheles (Anopheles) bengalensis* Puri  
1930. Indian J. Med. Res. 18:955(M,L: as var.). Type-loc.: Marianbarie, Bengal Terai, India.

Notes. Amami Oshima is the northern limit of distribution in this species. It has not been found in Tokara, Okinawa, Miyako, Yaeyama and Daito Islands. The immatures have been found in streams and rock pools at the base of mountains. Adults reared from the larvae were studied for identification. Feeding habits of the female are not known.

The species is reported from the Oriental region (including Taiwan).

*Anopheles (Anopheles) lindesayi* Giles  
1900. Handbook: 166(A; as *lindesaii*). Type-loc.: Bakloh, India.

Subsp. *japonicus* Yamada  
1918. J. Hyg. Infect. Dis., Tokyo 13:689(F; as sp.). Type-loc.: Kanayama, Hokkaido, Japan.

Notes. The immatures have been commonly found in small pools in the rocky beds of mountain streams and in stagnant pools of wells. Adults reared from the larvae were examined. Feeding habits of the females are not known. The morphological features of adult specimens indicated by Tanaka *et al.*(1979) are different slightly from specimens of Nakanoshima at hand. We have some doubt as to the treatment of the Japanese population of *An. l. japonicus* as a subspecies of *An. l. lindesayi*(Miyagi *et al.*,1983b).

This subspecies is reported from Palaeartic Japan, Korea and North China.

*Anopheles (Anopheles) saperoi* Bohart and Ingram  
1946. J. Wash. Acad. Sci. 36:46(F,L,E). Type-loc.: Chizuka, Okinawajima, Ryukyu Arch., Japan.

Subsp. *saperoi* Bohart and Ingram

Notes. *Anopheles s. saperoi* is the endemic subspecies, restricted to the northern mountain area of Okinawajima. It was commonly found throughout year. The immatures have been collected from streams with *Cx. h. ryukyuanus* and sometimes with *Ur. annandalei* and *Ur. macfarlanei*. The females have a special preference for human blood and feed readily upon humans during day in the forest

(Toma and Miyagi, 1981b).

#### Description of pupa

Abdomen: 2.83-3.83 mm. Trumpet: 0.32-0.46 mm. Paddle: length 0.75-0.89 mm, width 0.50-0.66 mm. Complete chaetotaxy as figured in Fig. 15 and recorded in Table 1. Cephalothorax. Setae 1,3-C 1-3 branched, 5-C 2-6 branched, 7-C usually single(1,2), 8-C usually single or double(1-4). Trumpet. Moderately pigmented; index 0.89-1.31, average 1.10; meatus 0.14-0.33 length of trumpet. Metanotum. Setae 10, 11-C 1-4 branched, 12-C single or double. Abdomen. Seta 1-I dendritic; 1,3-III, 1,5,11-IV-VI, 1, 5, 7-VII strong, pigmented; 1-III 2-4 branched; 3-III usually single(1,2); 9-III small, pigmented, average 0.50(0.29-0.70) length of 9-IV; 1-IV, V 2-6 branched; 5-IV 4-9 branched; 9-IV pigmented, average 0.61(0.44-0.78) length of 9-V; 11-IV-VI usually single; 5-V, VII 3-8 branched; 9-V pigmented, average 0.96(0.86-1.31) length of 9-VI; 1-VI, VII single or double; 5-VI 3-9 branched; 9-VI pigmented, average 0.88(0.67-0.93) length of 9-VII, 0.18-0.31 length of segment VI; 9-VII pigmented 0.22-0.32 length of segment VII; 9-VIII pigmented, flattened, 5-19 branched. Paddle. Ovoid, 1.24-1.50 as long as wide; lateral fringe changing from small spines to filaments gradually at 0.53-0.61 of distance from base to seta 1-P; paddle fringe not extending mesad of seta 1-P; 1-P 0.09-0.15 length of paddle.

#### Subsp. *ohamai* Ohama

1947. Rec. Publ. Hlth. Dept. Yaeyama Prov. Gov. 9 (mimeographed) (M,L). Type-loc.: Ishigakijima, Ryukyu Arch., Japan.

Notes. *Anopheles s.ohamai* is restricted to the base of mountains and the forest area of Iriomotejima. We have never found this subspecies in Ishigakijima, the type-locality of this species. The immatures have been collected from streams with *Cx. h.ryukyuanus* and sometimes with *An. minimus*, *Ur. macfarlanei*, *Ur. annandalei*, *Cx. infantulus* and *An. sinensis*. The females feed readily on humans during daytime in the forest.

Tanaka *et al.* (1979) provisionally treated *An. s.ohamai* as a subspecies of *An. s.saperoi*. The important differentiating characteristic indicated by Ohama(1949) and Bohart(1959) is that *An. s.ohamai* has the pale costal spot beyond the middle of the wing about as large as the subcostal spot, instead of smaller. We have examined about 500 adult specimens of *An. saperoi* collected from Okinawajima and Iriomotejima throughout a year. We could not find any distinct differences between the specimens from Okinawajima and from Iriomotejima. *Anopheles saperoi* shows marked seasonal variation in the size of the pale subcostal spot. These morphological variations will be due to water temperature in the breeding streams of the immature stages (Toma and Miyagi, 1981a). The pupae of Iriomotejima do not differ distinctly from these of Okinawajima. It is very possible *An. s.saperoi* from Okinawajima and *An. s.ohamai* from Ishigakijima are identical morphologically and the results of the hybridization experiments between these subspecies may explain conspecific features. Until further studies are accomplished, we prefer to retain them as a distinct

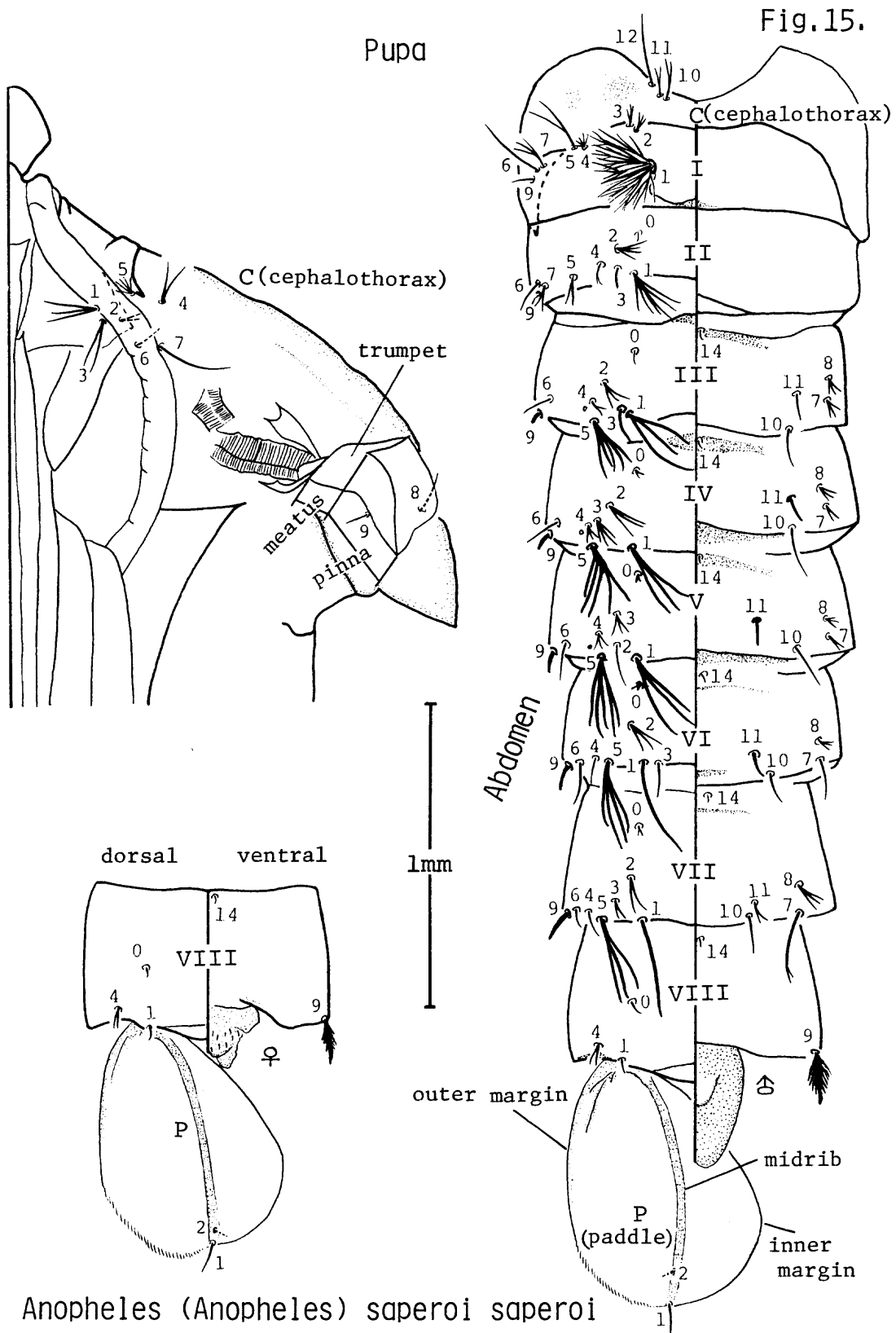


Table 1. Chaetotaxy of the pupa of Anopheles (Anopheles) saperoi saperoi

SETA NO.	CEPHALO- THORAX	ABDOMEN								PADDLE		
		I	II	III	IV	V	VI	VII	VIII			
0	-	-	1-3	1,2	1-3	1,2	1-3	1-3	1,2	1-3	1,2	-
1	1-3	50-150	3-9	2-4	2-6	2-6	2-6	1,2	1,2	1	-	1
2	1-4	1-4	3-7	2-5	2-4	1,2	1,2	2-4	2-4	2-4	-	(1-3)
3	1-3	2-5	1	1 (1,2)	2-5	1-4	1-4	1,2	1-4	1-4	-	-
4	2,3 (1-4)	3-7	1-3 (1-4)	1-4	1-4	1-4	1-4	1	1	1 (1,2)	1-3	-
5	2-6	1-3	1-3	5-10 (2-13)	4-9	3-8	3-8	3-9	3-8	3-8	-	-
6	1-3	1 (1,2)	1 (1,2)	1 (1-3)	1	1 (1,2)	1	1	1	1 (1-3)	-	-
7	1 (1,2)	1-5	1-3	1-4	1-4	1-4	1-4	1	1-4	1-4	-	-
8	1,2 (1-4)	-	-	1-4	1-4	1-4	1-4	1-4	1-4	1-4	-	-
9	1,2	1 (1,2)	1	1	1	1	1	1	1	1	5-19	-
10	1-4	-	-	1-3	1 (1,2)	1	1	1 (1,2)	1	1,2	-	-
11	1-4	-	-	1 (1,2)	1 (1,2)	1 (1,2)	1 (1,2)	1 (1,2)	1 (1,2)	1-3	-	-
12	1,2	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	1	1	1	1	1	1	1	1	-

Specimens examined: 20 from Yona and Gaiya, Okinawajima



subspecies for the present.

*Anopheles (Anopheles) sinensis* Wiedemann  
1828. Aussereurop. Zweifl. Ins. 1:547(M,F). Type-loc.: Canton, China.

Notes. This is very common species in the Archipelago and the larvae breed commonly in rice paddies, fallows and swamps. The adults are zoophilic and have been collected by light traps, dry ice traps in cow sheds and human-baited catches. *Anopheles sinensis* has been thought to be a former malaria vector in Japan proper and Okinawajima. This species is a new record in Kuroshima.

This species is reported from Japan, Korea, China and the Oriental region (including Taiwan).

*Anopheles (Anopheles) lesteri* Baisas and Hu  
1936. Mon. Bull. Bur. Hlth. Philipp., Manila 16:229(F,P,L,E; *hyrcanus* var). Type-loc.: Santa Mesa of Manila, Philippines.

Notes. This species is apparently common in the Archipelago. The immatures have been collected from fallows and rice paddies. This species can be easily separated from *An. sinensis* only in the egg stage. The larvae of this species have been collected commonly in rice paddies at the base of mountains on Okinawajima, Ishigakijima, Iriomotejima and Yonagunijima.

This species is reported from Korea, South China, Palaeartic Japan (except Shikoku) and the Oriental region (including Taiwan).

*Anopheles (Cellia) minimus* Theobald  
1901. Mon. Cul. 1:186(F). Type-loc.: Pokfulam, Hong Kong.

Notes. The immatures have been found in streams at the base of mountains and in forested areas with *Ur. annandalei* and *Ur. macfarlanei* on Ishigakijima and with *An. s. ohamai* in Iriomotejima. The habitat of this species in Miyakojima is different from that in the Yaeyama Islands and is limited to streams produced from wells in open areas. At the base of mountains in Ishigakijima and Iriomotejima, many adults were collected by light traps and human- and cow-baited net traps (Miyagi and Toma, 1978a).

This species is recorded from the Oriental region (including Taiwan).

*Anopheles (Cellia) tessellatus* Theobald  
1901. Mon. Cul. 1:175(F). Type-loc.: Taipang, Perak, Malaya.

Notes. The adults have been occasionally collected by light traps and dry ice traps (Miyagi *et al.* 1969). The species seems to be rare and the immatures have not been collected in the Archipelago.

This species is reported from the Oriental region (including

Taiwan) and New Guinea.

*Toxorhynchites (Toxorhynchites) manicatus* (Edwards)  
1921. Ann. Mag. Nat. Hist. (9) 8:630 (F; *Megarhinus*). Type-  
loc.: Toa Tsui Kutsu, Taiwan.

Subsp. *yamadai* (Ouchi)  
1939. J. Shanghai Sci. Inst. (3)4:223(M; *Megarhinus*). Type-  
loc.: Mt. Yuwan, Amami Oshima, Ryukyu Arch., Japan.

Notes. The immatures have been found in tree holes, artificial containers in the forest and at the base of mountains with *Or. anopheloides*, *Ae. a. okinawanus*, *Ae. riversi*, *Ae. f. downsi* and *Ur. n. ryukyuana*. Like all members of this genus, larvae are predacious and feed upon other mosquito larvae. Overwintering of this subspecies is possible in the larval stage (Wada *et al.*, 1976). It was treated as a subspecies of *Tx. manicatus* by Tanaka *et al.* (1979).

It is reported from Amami Oshima, Tokunoshima and Kakeromajima.

Subsp. *yaeyamae* Bohart  
1956. Bull. Brooklyn Entomol. Soc. 51:29(M,F,P,L). Type-  
loc.: Nakara river, Iriomotejima, Ryukyu Arch., Japan.

Notes. The immatures have been most frequently collected from tree holes and artificial containers in association with *Trp. b. yaeyamensis*, *Or. anopheloides*, *Ae. a. taiwanus*, *Ae. riversi* and *Cx. bicornutus* in forests on Ishigakijima and Iriomotejima. They have also been taken from bamboo stumps. Tanaka *et al.* (1979) were the first to consider *yaeyamae* as a subspecies of *Tx.m.manicatus*.

This subspecies is not known elsewhere.

#### Redescription of pupa

Abdomen: 6.15-7.67 mm. Trumpet: 0.90-1.08 mm. Paddle: length 1.60-2.00 mm, width 1.13-1.35 mm. Complete chaetotaxy as figured in Fig. 16 and recorded in Table 2. Cephalothorax. Uniformly strongly pigmented, darker caudad middorsally; setae largely concolorous with integument; seta 1-C strongly developed, distinctly darker, usually single(1-3); 2,3-C close together toward mid-ventral line; 6,7-C far forward, close to 4,5-C; 8,9-C close together; 3,4,7-C 1-4 branched; 6-C 1-3 branched; 8-C single or double; 9-C usually single(1-3). Trumpet. Bright orange brown, lighter distad; index 3.25-4.40, average 3.85. Metanotum. Seta 10-C 1-4 branched; 11-C single or double; 12-C 1-5 branched. Abdomen. Strongly pigmented, larger setae darker than integument; seta 1-I dendritic; 1-IV-VI long and single; 9-I-VII small, ventral in position; 9-VIII at caudolateral angle small; 5-IV long and usually single, rarely branched; 5-V, VI long, subequal and single; 6-III,IV small, single inserted in a depressed area; 6-V, VI long, subequal, single inserted in a depressed area; 6-VII 2-5 branched. Paddle. Uniformly strongly pigmented, mid-rib brighter and darker; distal about 0.3 of outer margin with

Fig. 16.

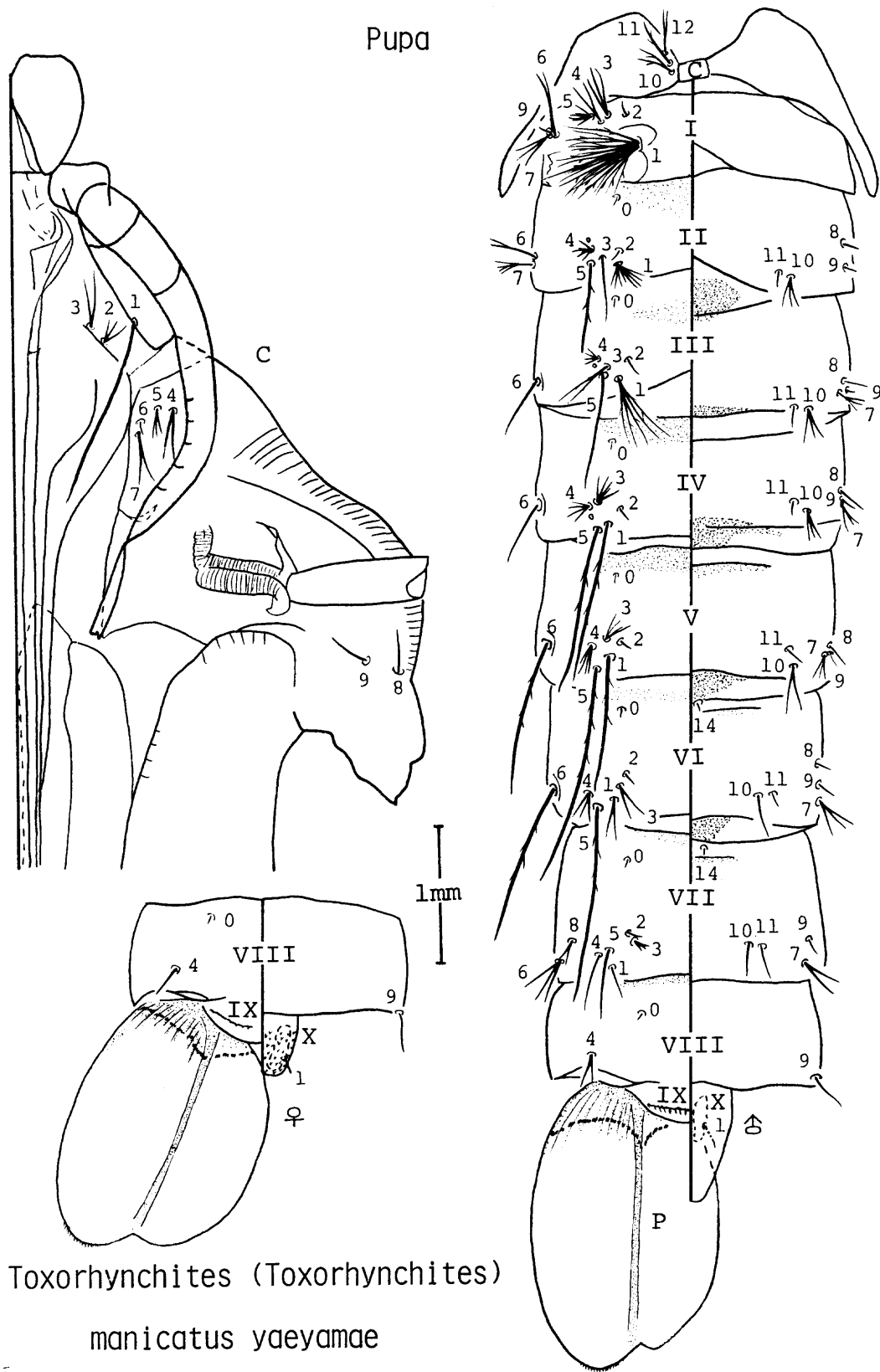


Table 2. Chaetotaxy of the pupa of Toxorhynchites (Toxorhynchites) manicatus yaeyamae

SETA NO.	CEPHALO- THORAX	ABDOMEN											
		I	II	III	IV	V	VI	VII	VIII	X			
0	-	-	1	1	1	1	1	1	1	1	1	-	-
1	1 (1-3)	40-102	5-19	4-12	1 (1,2)	1 (1,2)	1	1,2	1-3	1-3	1-3	-	1-5
2	2-5	1	1	1	1	1	1	1	1	1	1	-	-
3	1-4	2-12	1-4	1-4	3-10	2-5	1-6	1-6	1-4	1-4	1-4	-	-
4	1-4	1-5	3-8	2-9	4-9	2-7	1-4	1-4	1	1,2	1,2	-	-
5	1-6	3-9	1,2	1 (1,2)	1 (1,2)	1	1	1	1 (1,2)	1 (1,2)	1 (1,2)	-	-
6	1-3	1-4	1-3	1 (1,2)	1	1	1	1	1	2-5	2-5	-	-
7	1-4	2-9	1-6	2-6	2-6	2-5	2-6	2-6	1-4	1-4	1-4	-	-
8	1,2	-	1	1	1	1	1	1 (1,2)	1-4	1-4	1-4	-	-
9	1 (1-3)	1	1	1	1	1	1	1	1	1	1	1	-
10	1-4	-	2-5	2-5	2-6	1-5	1	1	1 (1,2)	1 (1,2)	1 (1,2)	-	-
11	1,2	-	1	1	1	1	1	1	1	1	1	-	-
12	1-5	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	1	1	1	1	1	-	-

Specimens examined: 8 from Ishigakijima

numerous long fine spicules.

*Toxorhynchites* (*Toxorhynchites*) sp. Gentry  
1957. Mosq. News, 12:83(L).

Notes. This species is very similar in all stages to *Tx. towadensis* from Kyushu (Yakushima) and belongs to a different group from *Tx. manicatus*. It needs to be studied both morphologically and genetically. This species is not common and so far as we are aware, its distribution is limited to the northern part of Okinawajima (Toma and Miyagi, 1981b). The immatures have been frequently found in wooden traps located in deep mountain and tree holes. They were associated with *Or. anopheloides* and *Ae. a. okinawanus* in deep forest and with *Ae. albopictus*, *Ae. f. downsi*, *Ae. riversi* and *Ae. a. okinawanus* at the base of mountains.

*Tripteroides* (*Tripteroides*) *bambusa* (Yamada)  
1917. Zool. Mag., Tokyo 29:61 (M, F, P, L, E; *Rachinotomyia*). Type-loc.: Tokyo, Japan.

Subsp. *yaeyamensis* Tanaka, Mizusawa and Saugstad  
1979. Contr. Am. Entomol. Inst. 16:481 (M, F). Type-loc.: Mt. Banna, Ishigakijima, Ryukyu Arch., Japan.

Notes. The immatures of this subspecies have been most frequently found in bamboo stumps, tree holes and artificial containers. They have been frequently found in association with *Ae. aureostriatus*, *Or. anopheloides*, *Ae. riversi* and *Cx. bicornutus* in forests and at the base of mountains. Adult females were collected by daytime human-baited catches and sweeping catches.

According to Tanaka *et al.* (1979), the Ryukyu (Ishigakijima and Iriomotejima) population of *Tp. b. yaeyamensis* has been separated as a subspecies from *Tp. b. bambusa* of Palaearctic Japan primarily on the yellowish brown scutum, paratergite, lower end of sternopleuron and apex of mesomeron. The morphological features of this subspecies in Nakanoshima, Tokara Islands were somewhat intermediate between *Tp. b. bambusa* from Saga prefecture, Kyushu and *Tp. b. yaeyamensis* from Ishigakijima. Until further studies on morphology and hybridization experiments have been conducted, we consider that the specimens from Tokara Is. are identical with *Tp. b. yaeyamensis*. It is very curious that *Tp. bambusa* has not been found on Okinawa and Amami Islands.

*Malaya genurostris* Leicester  
1908. Cul. Malaya : 258 (M). Type-loc.: Malaya.

Notes. The immatures have been collected from the water in leaf axils of *Alocasia macrorrhiza* throughout the Archipelago. They have been often associated with *Ae. f. miyarai* and *Ar. subabatus* on Yaeyama Is. This species is a typical Oriental element and Nakanoshima is the northernmost record for distribution of this species. It is certain that this species can overwinter in

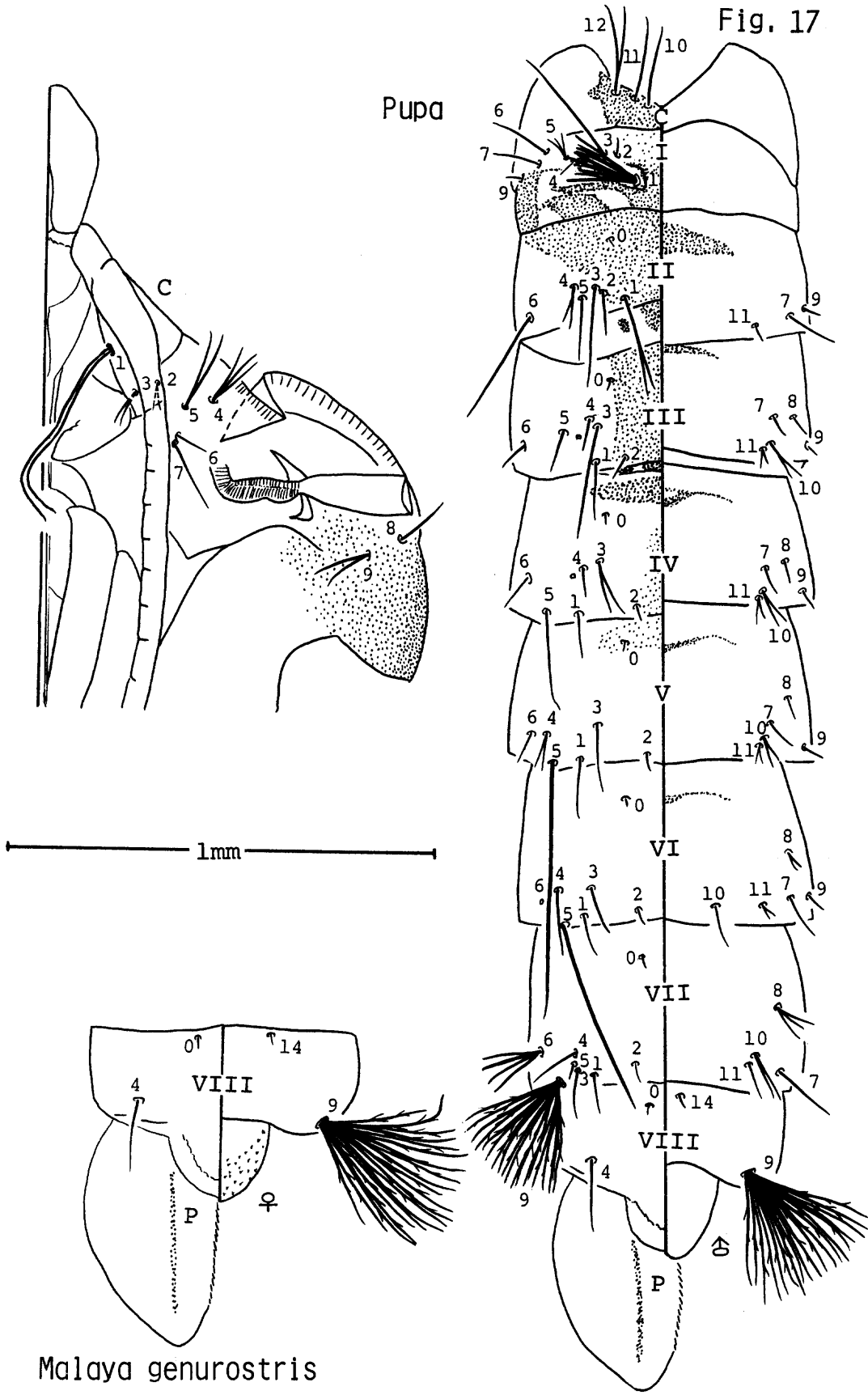


Table 3. Chaetotaxy of the pupa of Malaya genurostris

SETA NO.	CEPHALO- THORAX	ABDOMEN										
		I	II	III	IV	V	VI	VII	VIII			
0	-	-	1	1	1	1	1	1	1	1	1	
1	2	37-62	1-4	1-3	1,2	1,2	1,2	1,2	1	1	1	-
2	1-4	1 (1-3)	1 (1,2)	1	1	1	1	1	1	1	1	-
3	1-4	1	1	1	1-3	1-3	1-3	1-3	1,2	1,2	1	-
4	1-3	1	1-3	1,2	1,2	1-3	1-3	1-3	1-3	1-3	1,2	1
5	1-3	2-4	1	1 (1,2)	1	1	1	1	1	1	1	-
6	1-3	1,2	1	1 (1,2)	1,2	1	1,2	1	0 (0,1)	2-5	2-5	-
7	1,2	1,2	1,2	1,2	1 (1,2)	1-3	1-3	1-3	1,2	1	1	-
8	1 (1,2)	-	-	1,2	1 (1,2)	1,2	1 (1,2)	1,2	1-3	2-4	2-4	-
9	1-3	1 (1,2)	1 (1,2)	1	1	1 (1,2)	1	1	1	17-25	17-25	17-25
10	1,2	-	-	1,2	1-3	1,2	1-3	1,2	1 (1,2)	1-3	1-3	-
11	1	-	1	1-3	1,2	1,2	1,2	1,2	1-3	1-3	1-3	-
12	1-4	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	1

Specimens examined: 15 from Iriomotejima

the larval stage. We have never observed the adult females of this species in nature, but they obtain their food from ants of the genus *Cremastogaster* (Barraud, 1934; Miyagi, 1981). This species is a new record in Kuroshima, Yaeyama Islands.

This species is reported from the Oriental (including Taiwan) and Australian regions.

#### Redescription of pupa

Abdomen: 2.13-2.68 mm. Trumpet: 0.26-0.30 mm. Paddle: length 0.49-0.54 mm, width 0.27-0.33 mm. Complete chaetotaxy as figured in Fig. 17 and recorded in Table 3. Cephalothorax. Seta 1-C extremely long, distinctly darker, double; 2,3-C 1-4 branched, 4,5,6-C 1-3 branched; 7-C single or double. Trumpet. Index 2.76-3.41, average 3.01. Metanotum. Seta 10-C single or double; 11-C single; 12-C 1-4 branched. Abdomen. Seta 1-I dendritic, 37-62 branched; 1-II 1-4 branched; 1-III 1-3 branched; 1-IV, V single or double; 1-VI, VII usually single (1,2); 5-I-IV, VII shorter than 5-V, VI; 5-V, VI very long, darker, single; 5-V longer than 5-VI; 6-II single, longer than 6-I, III-V, VII; 6-VI usually represented only by a puncture; 9-VII, VIII 17-25 branched. Paddle. 1.64-2.00 as long as wide, extremely lightly pigmented, practically invisible in mounts; midrib poorly developed; marginal spicules not evident except on internal margin.

#### *Topomyia* (*Suaymyia*) *yanbarensis* Miyagi

1976. Trop. Med. 17:202(M,F,P,L). Type-loc.: Yona, Okinawajima, Ryukyu Arch., Japan.

Notes. Immatures have been commonly found in the water accumulating in newly cut bamboo stumps and in erect bamboo internodes bored by cerambycid beetles. The larva prey upon small crustacea in the water accumulating in the bamboos. Immature larvae were usually found singly in the breeding site without any associated mosquitoes. The adults are not attracted to light traps and never feed on humans in the laboratory. This species overwinters in the larval stage and is distributed throughout the Archipelago except Ishigakijima, Iriomotejima and Yonagunijima. It is a typical Oriental element and the peculiar habitat of the mosquito may make it possible for the species to extend its northern distribution (Mogi *et al.*, 1981; Mogi and Suzuki, 1983).

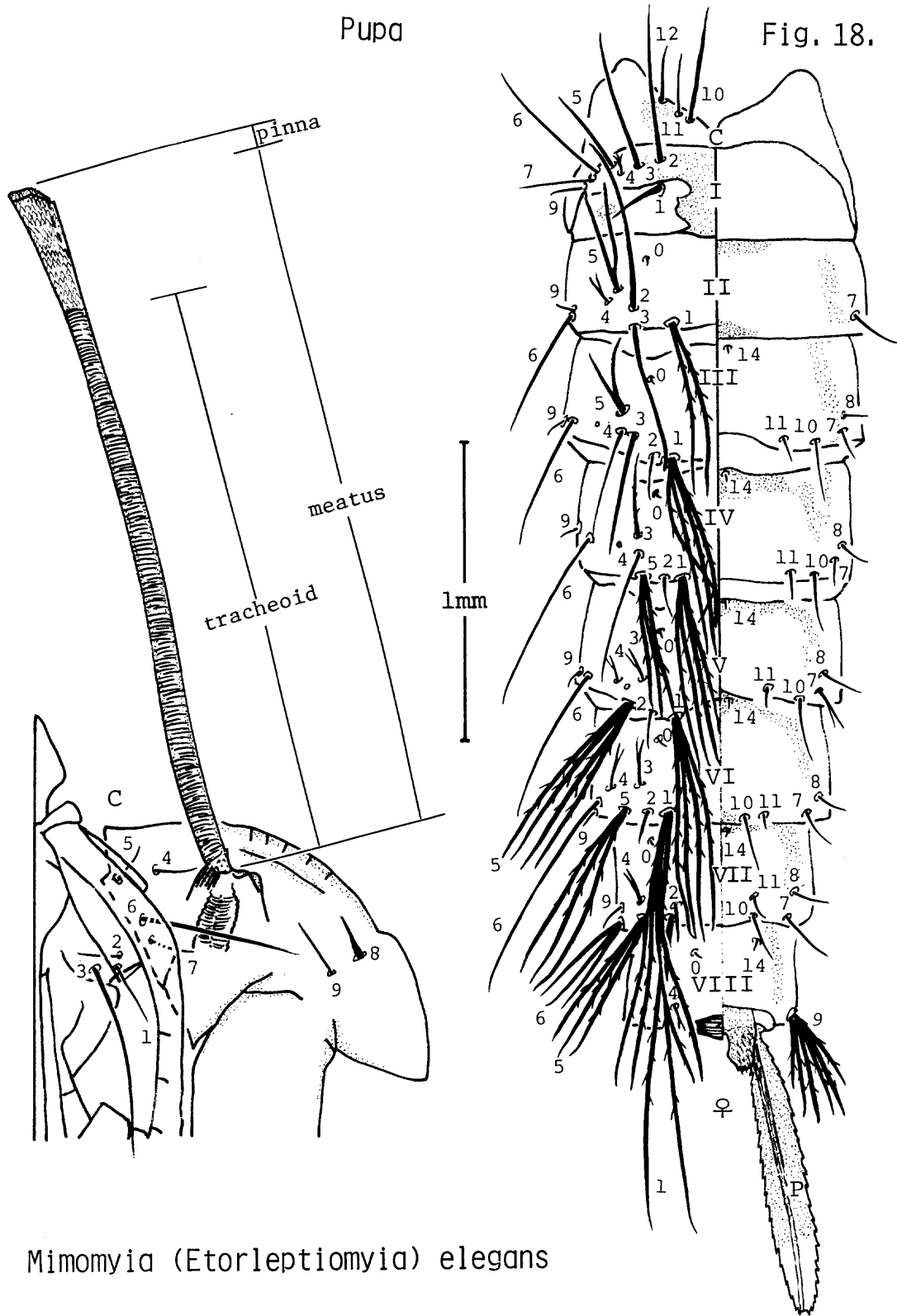
This species is reported from Palaearctic Japan (Kyushu) and Taiwan.

#### *Mimomyia* (*Etorleptomyia*) *elegans* (Taylor)

1914. Trans. R. Entomol. Soc. Lond. 1913:703(F; *Dixomyia*). Type-loc.: Townsville, Queensland, Australia.

Notes. This species is rare in the Archipelago. The immatures of this species have been obtained from fallows with vegetation. We have collected many larvae and pupae of *Mi. elegans* in fallows at Yona, on the northern part of Okinawajima during





*Mimomyia (Etorleptomyia) elegans*

Table 4. Chaetotaxy of the pupa of Mimomyia (Etorleptomyia) elegans

SETA NO.	CEPALO_		ABDOMEN								
	THORAX		I	II	III	IV	V	VI	VII	VIII	
0	-		-	1	1	1	1	1	1	1	1 (1,2)
1	1		1	2 (2,3)	4,5 (4-6)	4,5 (4-6)	4-6	4-6	2,3 (2-4)	-	-
2	1 (1,2)		1	1	1	1	1	1 (1,2)	1	-	-
3	1		1	1	1	1 (1,2)	2 (1-3)	1-3	-	-	-
4	1 (1,2)		2-4	2 (1,2)	1	1	1-3 (1-4)	1,2	1-3	1,2	1,2
5	1 (1,2)		1,2	2 (1,2)	2 (1-3)	3-5	3-5	3-5	3-5	-	-
6	1		1 (1,2)	1	1 (1,2)	1	1 (1,2)	1 (1,2)	2-4	-	-
7	1 (1,2)		1,2	1	1 (1,2)	1	1,2 (1-3)	1 (1,2)	1 (1,2)	1 (1,2)	-
8	1		-	-	1	1	1	1 (1,2)	1 (1,2)	-	-
9	1 (1-3)		1	1	1	1	1	1	1	1	6-12
10	1 (1-3)		-	-	1 (1,2)	1 (1,2)	1 (1,2)	1 (1,2)	1 (1,2)	1 (1,2)	-
11	1		-	-	1 (1,2)	1	1	1	1	1	-
12	1,2		-	-	-	-	-	-	-	-	-
14	-		-	-	1	1	1	1	1	1	1

Specimens examined: 13 from Yona, Okinawajima

September 1979. Adults have been collected by light traps. Belkin (1962) stated that typical *Mi. elegans* from Queensland, Australia, was markedly different from specimens seen from other areas, including Southeast Asia. Mattingly (1957) and Tanaka *et al.* (1979) also discussed variability in this species.

This species is reported from the Oriental and Australian regions.

#### Redescription of pupa

Abdomen: 2.33-3.38 mm. Trumpet: 2.21-2.60 mm. Paddle: length 0.90-1.13 mm, width 0.10-0.12 mm. Complete chaetotaxy as figured in Fig. 18 and recorded in Table 4. Cephalothorax. Moderately pigmented; setae 3,8-C blackish; 1,8-C single; 3,6-C single, long. Trumpet. Index about 20.1-25.4; tracheoid about 0.79-0.85; apical portion slightly widened, diagonally truncate, and slit for about 0.53-0.67 its length; basal 0.05-0.18 without tracheoid but with some small sharp spicules on one surface. Metanotum. Seta 10-C usually single(1-3), long, blackish; 11-C single. Abdomen. Setae 1,3,5-I, 1,2,5-II, 1,2,3,5-III, IV, 1,2,5-V, VI, 1,2,5,6-VII, 9-VIII blackish; 3-II lighter; caudolateral corner of segment VIII with 1-3 small spicules. Terminal segments. Female postgenital lobe sharply produced, spicules strong apically; male genital lobe extending to about 0.20-0.24 of paddle, apex sharply produced. Paddle. Long, about 4.7 to 5.9 times as long as its greatest breadth; very dark on basal 0.55 to 0.78, lighter distad, midrib slightly darker; marginal spicules very strong; seta 1-P not developed.

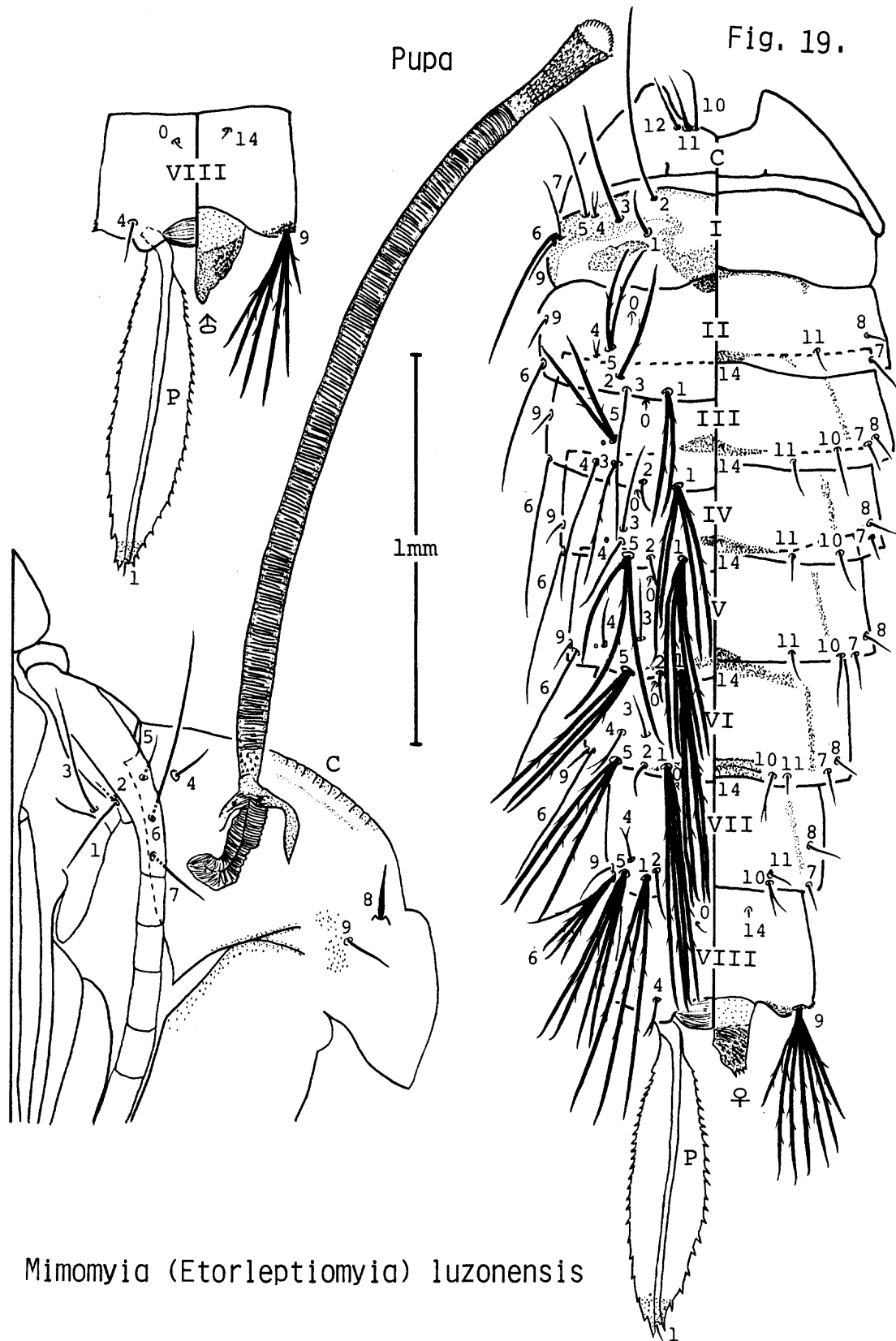
*Mimomyia (Etorleptiomyia) luzonensis* (Ludlow)  
1905. *Canad. Entomol.* 37:101(F; *O'Reillia*). Type-loc.: Bayambang, Luzon, Philippines.

Notes. This is a common species throughout the Archipelago. Immatures have been collected from rice paddies and fallows with *An. sinensis*, *Mi. elegans*, *Ma. uniformis*, *Cq. crassipes*, *Cx. bitaeniorhynchus*, *Cx. pseudovishnui*, *Cx. tritaeniorhynchus*, and *Cx. hali-faxii*. Engorged females of *Mi. luzonensis* have been collected by light traps in cow sheds. This species is a new record in Miyakojima.

This species is reported from the Oriental region (including Taiwan).

#### Redescription of pupa

Abdomen: 1.89-2.73 mm. Trumpet: 1.99-2.22 mm. Paddle: length 0.78-0.91 mm, width 0.11-0.20 mm. Complete chaetotaxy as figured in Fig. 19 and recorded in Table 5. Cephalothorax. Setae 3,8-C blackish; 1,8-C single; 3,6-C single, long. Trumpet. Index about 4.1-7.8; tracheoid about 0.80-0.85; apical portion slightly widened, diagonally truncate, and slit for about 0.72-0.82 its length; basal 0.03-0.07 without tracheoid but with some small sharp spicules on one surface. Metanotum. Setae 10, 12-C usually single(1,2); 11-C single, blackish. Abdomen. Setae 1,3,5,-I,



*Mimomyia (Etorleptomyia) luzonensis*

Table 5. Chaetotaxy of the pupa of Mimomyia (Etorleptomyia) luzonensis

SETA NO.	CEPHALO- THORAX	ABDOMEN								PADDLE	
		I	II	III	IV	V	VI	VII	VIII		
0	-	-	1 (1,2)	1 (1,2)	1	1	1	1	1	1	-
1	1	1	2 3-5	4,5	3-5	4,5	3,4	3,4	3,4	3,4	1
2	1	1	1	1	1	1	1	1	1	1	-
3	1	1	1	1 (1,2)	1 (1-3)	1-3	1-3	-	-	-	-
4	1,2	1-4	1	1 (1,2)	1 (1-4)	1-3	1-3	1-3	1-3	1-3	-
5	1-3	1	1,2	3 (2,3)	3,4	3,4	3,4	4,5	4,5	4,5	-
6	1	1	1	1	1	1	1	1	3,4	3,4	-
7	1 (1-3)	1-3	1	1 (1,2)	1 (1-4)	1 (1,2)	1 (1,2)	1 (1-4)	1 (1,2)	1	-
8	1	-	1	1	1	1	1	1	1 (1,2)	1	-
9	1 (1,2)	1	1	1	1	1	1	1	1	1	5-8
10	1 (1,2)	-	1 (1,2)	1	1 (1,2)	1	1-4	1-4	1-4	1,2	-
11	1	-	1	1	1	1	1	1	1	1	-
12	1 (1,2)	-	1	-	-	-	-	-	-	-	-
14	-	-	1	1	1	1	1	1	1	1	1

Specimens examined: 16 from Ishigakijima

1,2,5-II, 1,3,5-III, 1,5-IV-VI, 1,5,6-VII, 9-VIII blackish; 3-II lighter; caudolateral corner of segment VIII with 1-4 small spicules. Terminal segments. Female postgenital lobe sharply produced, spicules particularly strong; male genital lobe extending to about 0.22-0.23 of paddle, apex sharply produced. Paddle. Long, about 4.1 to 7.8 times as long as its greatest breadth, without pigmentation on basal 0.84-0.94, darker distad; seta 1-P single.

*Ficalbia* sp. Miyagi and Toma  
1980a. Jpn. J. Sanit. Zool. 31:81(M).

Notes. Three adult males were collected by light traps at Funaura, Iriomotejima, in July 1978 (Miyagi and Toma, 1980a). The larvae have not been collected. On the basis of examination of this limited material, we believe it belongs to the genus *Ficalbia* as it has the following characters: palpus about 0.5 length of proboscis; wing with anterior fork cell 1.4 times as long as its stem; wing with inconspicuous pale and dark markings; alula with fringe of narrow scales; scutellum with a few scales. Until additional specimens from Iriomotejima are available, we provisionally treat this species as *Ficalbia* sp.

*Mansonia* (*Mansonioides*) *uniformis* (Theobald)  
1901. Mon. Cul. 2:180 (F; *Panoplites*). Type-loc.: Quilon, Travancore, India.

Notes. This is one of the common mosquito species in the Archipelago but the immature stages of this species are difficult to find since they are attached to the roots of aquatic plants in fallows. The adults are commonly collected with human-baited net traps, light traps and dry ice traps. This species is a new record in Miyakojima. *Mansonia uniformis* is an important vector of *Brugia malayi* and *Wuchereria bancrofti* in many countries of Southeast Asia.

This species is reported from Palaearctic Japan (except Hokkaido), the Oriental (including Taiwan), Australian and Ethiopian regions.

#### Redescription of pupa

Abdomen: 2.88-3.45mm. Trumpet: 0.84-1.05 mm. Paddle: length 1.00-1.15 mm, width 0.33-0.49 mm. Complete chaetotaxy as figured in Fig. 20 and recorded in Table 6. Cephalothorax: setae 1-3-C single; 6,7-C single or double. Trumpet. Index 5.21-6.21; light yellowish, slightly darkened on tracheoid and much darker on sclerotized apical process, which is strongly curved; apical process about 0.39 of total length; tracheoid on outer surface from base to a little less than middle part. Metanotum. Seta 10-C single; 11-C 1-3 branched; 12-C 1-4 branched. Abdomen. Setae 1-II-VII and 5-IV-VII thickened, long; 10-II with or without setae; 9-II-VI single, small; 9-VII, VIII longer than 9-II-VI; 9-VII single, thickened; 9-VIII single or double. Paddle. 2.35-3.03

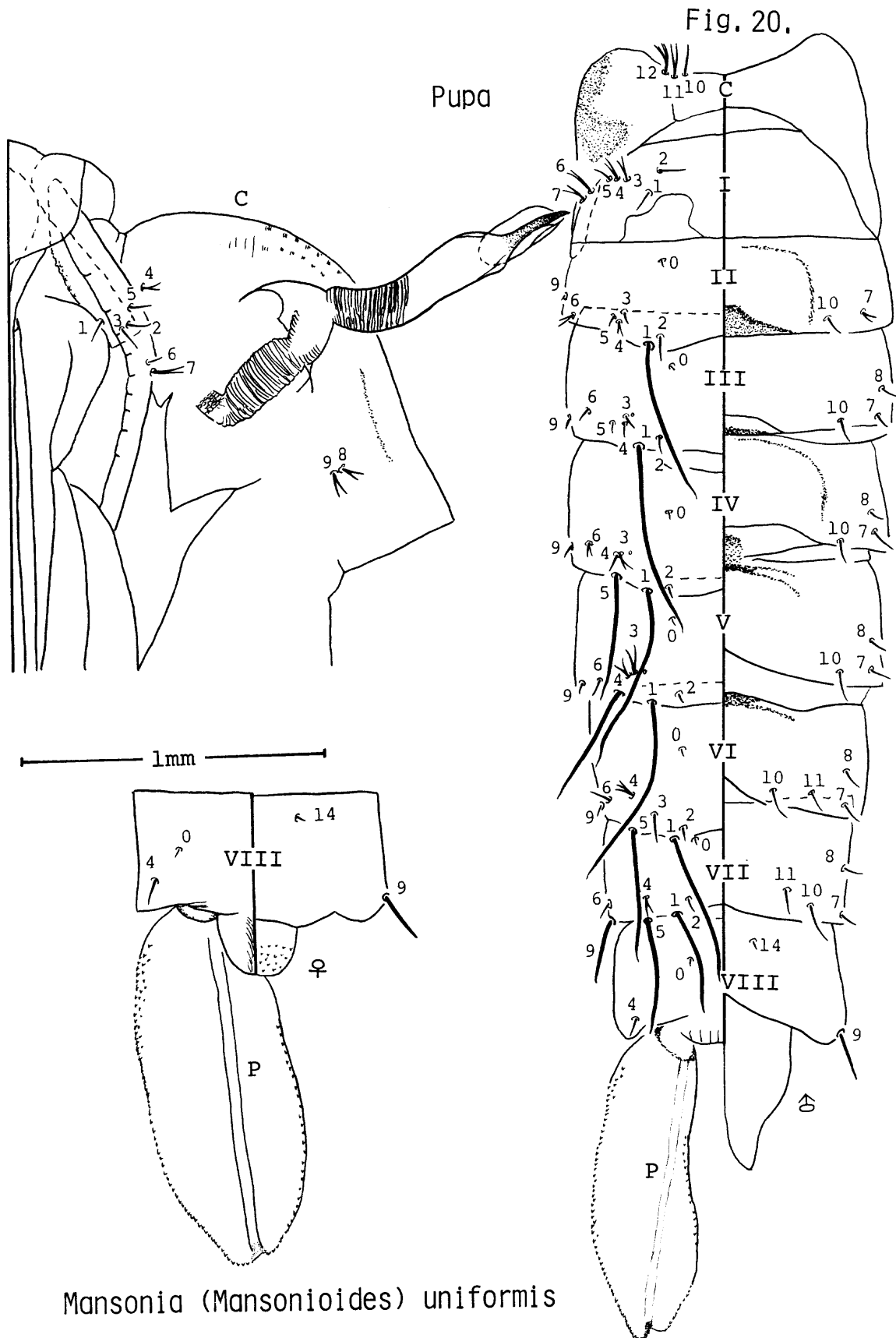


Table 6. Chaetotaxy of the pupa of Mansonia (Mansonioides) uniformis

SETA NO.	CEPHARO- THORAX	ABDOMEN								
		I	II	III	IV	V	VI	VII	VIII	
0	-	-	1	1,2	1	1	1	1	1	1
1	1	1-3	1	1	1	1	1	1	1	-
2	1	1	1	1	1,2	1	1	1	1	-
3	1	1-3	1-3	1-3	1,2	1-3	1,2	1,2	-	-
4	1-4	1,2	1-3	1-3	1,2	2-5	1-4	1-4	1-3	1-4
5	1,2	1	1	1	1	1	1	1	1	-
6	1-3	1-3	1-3	1,2	1,2	1,2	1,2	1,2	1	-
7	1-3	2-4	1-3	1,2	1,2	1-3	1-3	1-3	1-3	-
8	1,2	-	-	1	1,2	1,2	1,2	1,2	1-3	-
9	2,3	-	1	1	1	1	1	1	1	1,2
10	1	-	0-2	1,2	1,2	1	1,2	1,2	1	-
11	1-3	-	-	-	-	-	1	1	1,2	-
12	1-4	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	1

Specimens examined: 4 from Iriomotejima



as long as wide, uniformly lightly pigmented; marginal spicules small and sparse.

*Coquillettidia (Coquillettidia) crassipes* (Van der Wulp)  
1881. Bijd. Fauna Midden-Sumatra. Dipt.:9(F;*Culex*). Type-loc.: Soeroelangoen, Sumatra.

Notes. Immatures are difficult to find since they attach to the roots of aquatic plants in fallows. Like *Ma. uniformis*, the adults have been collected from human-baited net traps, light traps, sweeping catches and dry ice traps. Three female specimens collected from light traps in Minami Daitojima, are somewhat different in coloration from *Cq. crassipes* collected from Iriomotejima but it may be just variation of this species (Miyagi, 1977). This is a typical Oriental element and Amami Oshima is the northernmost record of this species.

This species is reported from the Oriental (including Taiwan) and Australian regions.

*Coquillettidia (Coquillettidia) ochracea* (Theobald)  
1903. Mon. Cul. 3:263(F;*Taeniorhynchus*). Type-loc.: Kuala Lumpur, Malaya.

Notes. The immatures are difficult to find but the adults are readily collected from human bait and light traps in Ishigakijima and Iriomotejima. This species is known to occur throughout the Archipelago but it is apparently rare in Okinawajima because the swamp areas are now smaller in extent.

This species is reported from Palaeartic Japan (Honshu) and the Oriental region.

*Uranotaenia (Pseudoficalbia) novobscura* Barraud  
1934. Fauna Brit. India, Diptera 5:84(M,F,L), Type-loc.: Sukna, Darjeeling District, India.

Subsp. *ryukyuana* Tanaka, Mizusawa and Saugstad  
1979. Contr. Am. Entomol. Inst. 16:465(M,F,L). Type-loc.: Okinawajima, Ryukyu Arch., Japan.  
*Uranotaenia bimaculata*: Yamada, 1932:229(in part); Ryukyus.

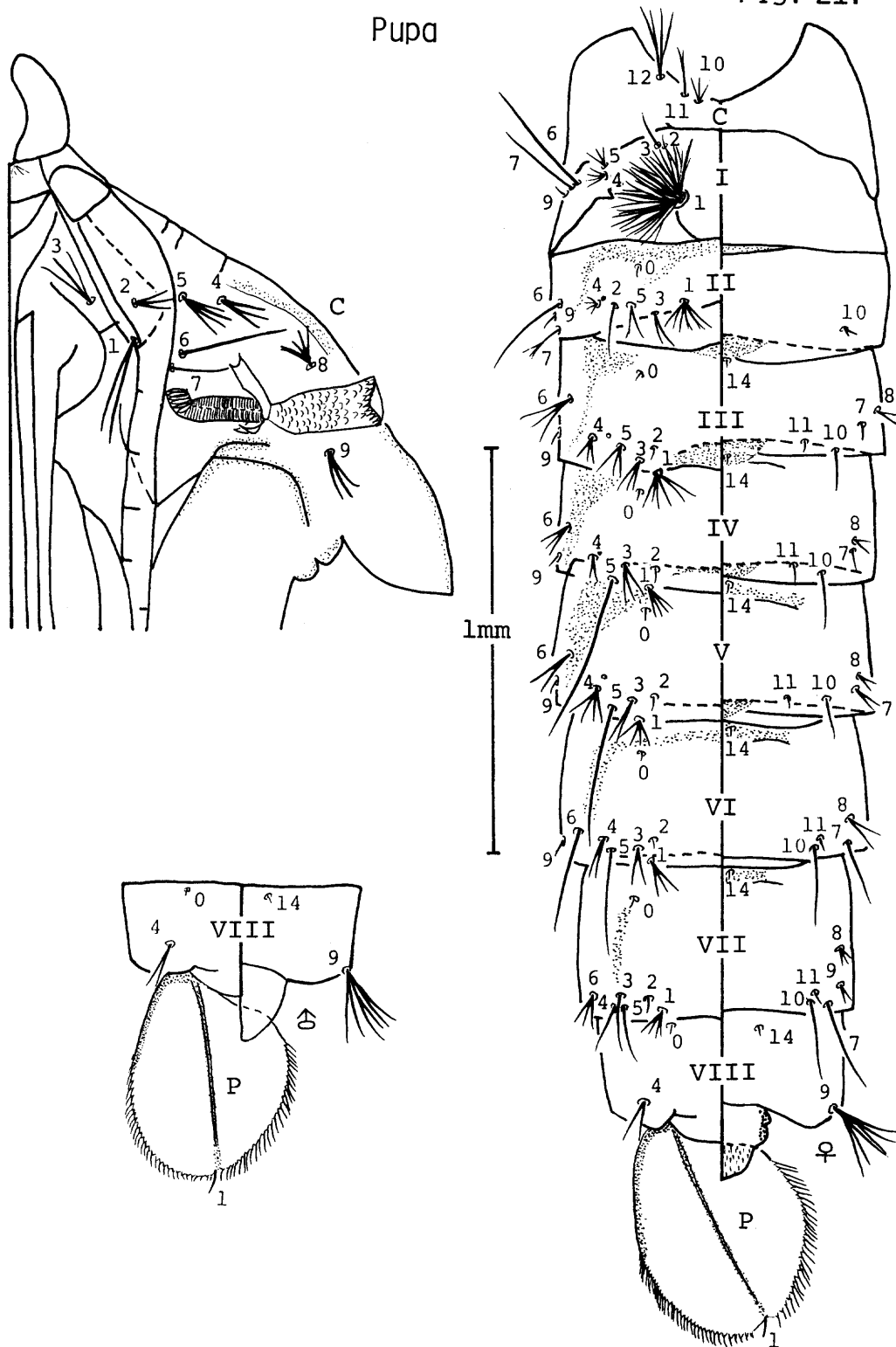
Notes. Nomenclature of *Ur. bimaculata* was discussed by Peyton (1977) and the population of Ryukyu Archipelago was treated as a subspecies of *Ur. novobscura* by Tanaka *et al.* (1979). This species is very common on Amami, Okinawa and Yaeyama Islands. The immatures have been collected mainly with *Or. anopheloides*, *Ae. aureostriatus*, *Ae. flavopictus*, *Ae. riversi* and *Ae. albopictus* in artificial containers, bamboo stumps and tree holes in the forest and mountain foothills.

#### Description of pupa

Abdomen: 2.20-2.98 mm. Trumpet: 0.29-0.33 mm. Paddle: length

Fig. 21.

Pupa



*Uranotaenia (Pseudoficalbia) novobscura ryukyana*

Table 7. Chaetotaxy of the pupa of *Uranotaenia (Pseudoficalbia) novobscura ryukyuana*

SETA NO.	CEPHALO- THORAX	ABDOMEN								PADDLE	
		I	II	III	IV	V	VI	VII	VIII		
0	-	-	1	1	1	1	1	1	1	1	-
1	1,2	70-130	6-19	3-11	3-10	1-6	2-7	2-7	2-7	-	1 (1,2)
2	1-5	1	1	1 (1,2)	1 (1-3)	1 (1,2)	1	1	1	-	-
3	2-5	1 (1,2)	1-5	1-6	1-7	1-4	1-4	1	1 (1-4)	-	-
4	1-5	1-8	2-7	1-4	1-5	1-8	1-4	1-4	1,2	2-4	-
5	3-8	1-6	1-5	1-6	1 (1,2)	1 (1,2)	1 (1-3)	1-3	1-3	-	-
6	1	1	1	1-4	1-4	1-4	1,2	2-6	-	-	-
7	1 (1,2)	1-4	1-4	1-4	1 (1,2)	1-4	1	1	-	-	-
8	2-10	-	-	1-4	1-3	1-3	1-3	1-4	-	-	-
9	1-4	1	1	1 (1,2)	1	1	1	1,2 (1-4)	2-11	-	-
10	1-5	-	1-3	1 (1-3)	1	1	1 (1,2)	1 (1,2)	-	-	-
11	1-5	-	-	1 (1,2)	1	1 (1,2)	1	1	-	-	-
12	1-5	-	-	-	-	-	-	-	-	-	-
14	-	-	-	1	1	1	1	1	1 (1,2)	-	-

Specimens examined: 15 from Yona, Okinawajima

0.50-0.56 mm, width 0.35-0.45 mm. Complete chaetotaxy as figured in Fig. 21 and recorded in Table 7. Cephalothorax. Seta 1-C single or double, 2-C, 4-C 1-5 branched, 3-C 2-5 branched, 5-C 3-8 branched, 6-C single, strong, darkly pigmented, longer than 7-C, 7-C usually single(1,2), 8-C 2-10 branched, 9-C 1-4 branched. Trumpet. Moderately pigmented; index 3.00-3.75, average 3.31. Metanotum. Setae 10, 11, 12-C 1-5 branched. Abdomen. Seta 1-I dendritic; 5-IV, V usually single(1,2), strong, long, darkly pigmented, about length of succeeding segment on IV, V; 5-VI usually single(1-3), shorter than 5-IV, V; 6-I, II single; 6-III-V 1-4 branched; 6-VI single or double, longer; 6-VII 2-6 branched, small; 9-VIII 2-11 branched, strong, pigmented. Paddle. Darkly pigmented at base and on basal about 0.35 of outer margin; midrib darkly pigmented to apex; outer margin has a long fine terminal filament, inner margin with a fringe of longer filamentous spicules; 1-P usually single(1,2).

*Uranotaenia (Pseudoficalbia) jacksoni* Edwards

1935. Bull. Entomol. Res. 26:130(M). Type-loc.: Hong Kong.

Notes. The immatures have been found in association with *Cx. tubercis* in fresh water crab holes and artificial containers located along the stream banks in forests of the northern part of Okinawajima and Iheyajima. Many adults were also collected by sweeping around the breeding places. This species is reported from Hong Kong.

*Uranotaenia (Pseudoficalbia) nivipleura* Leicester

1908. Cul. Malaya:219(M,F). Type-loc.: The Gap, Selangor, Malaya.

Notes. This species is very rare in the Archipelago. We have collected the larvae only three times from bamboo stumps with *Ur. n. ryukyana*, *Ae. f. downsi* and *Ae. a. okinawanus* at the base of mountains in Okinawajima. We did not find this species on Ishigakijima and Iriomotejima. The adults reared from the immatures were identical with the description of *Ur. nivipleura* of Peyton (1977).

This species is reported from the Oriental region (including Taiwan).

*Uranotaenia (Pseudoficalbia) ohamai* Tanaka, Mizusawa and Saugstad  
1975. Mosq. Syst. 7:27(M,F,L). Type-loc.: Yashigawa, Iriomotejima, Ryukyu Arch., Japan.

Notes. This species is endemic and common in the Yaeyama Islands but not known elsewhere. The immatures have been usually collected from fresh water crab holes in the forest with *Cx. tubercis*, *Ur. yaeyamana*, *Ur. macfarlanei*, *Cx. infantulus*, *Cx. bicornutus* and *Cx. ryukyensis*. They have been rarely collected in brackish water crab holes. The adults have been collected by light traps and sweeping.

*Uranotaenia (Pseudoficalbia) yaeyamana* Tanaka, Mizusawa and Saugstad 1975. Mosq. Syst. 7:27(M,F,L). Type-loc.: Funaura, Iriomotejima, Ryukyu Arch., Japan.

Notes. This species is common in Yaeyama Is. The immatures have been collected from fresh water crab holes in the forest with *Cx. tubercis* and *Ur. ohamai*, and also from brackish water crab holes with *Cx. tubercis*, *Ae. baisasi* and *Ur. ohamai*. The adults have been collected by light traps and sweeping around the crab holes. The feeding habits of this species as well as other species of the subgenus *Pseudoficalbia* are unknown.

This species is also reported from Taiwan.

*Uranotaenia (Uranotaenia) annandalei* Barraud 1926. Indian J. Med. Res. 14:343(M,F). Type-loc.: Golaghat, Assam, India.

Notes. This species is not common in Okinawa and Yaeyama Islands but breeds in many types of habitats such as stream pools, rock pools and artificial containers. In Okinawajima, We found *Ur. annandalei* with *An. s. sapiro*, *Ur. macfarlanei* and *Cx. h. ryukyuanus* in streams and with *Ae. albopictus*, *Ae. f. downsi* and *Ae. riversi* in artificial containers located along the banks of streams. On Iriomotejima, they were collected with *An. minimus*, *Ur. macfarlanei* and *Cx. h. ryukyuanus* in streams, and with *Ae. j. yaeyamensis*, *Cx. infantulus*, *Cx. bicornutus* and *Cx. ryukyensis* in rock pools in the forest.

This species is reported from Taiwan, India, Nepal, Burma and China.

*Uranotaenia (Uranotaenia) macfarlanei* Edwards 1914. Bull. Entomol. Res. 5:127(F). Type-loc.: Hong Kong.

Notes. Like *Ur. ohamai*, *Ur. macfarlanei* is rare in the Okinawa and the Yaeyama Islands. The habitats of this species are same as *Ur. macfarlanei*.

This species is reported from the Oriental region (including Taiwan).

#### Redescription of pupa

Abdomen: 1.60-2.34 mm. Trumpet: 0.32-0.38 mm. Paddle: length 0.48-0.55mm, width 0.35-0.39 mm. Complete chaetotaxy as figured in Fig. 22 and recorded in Table 8. Cephalothorax. Seta 1-C 4-6 branched; 2-C 2-7 branched; 3,5-C 4-8 branched; 6-C single; 7-C 1-3 branched. Trumpet. Index 4.71-5.08; uniformly strongly pigmented; tracheoid to about 0.4; pinna about 0.19. Metanotum. Seta 10, 11-C 2-4 branched; 12-C 2-5 branched. Abdomen. II-VIIIth integument with spicules; seta 1-I dendritic, 42-58 branched; 1-II 5-11 branched; 1-III 6-9 branched; 1-IV, V 4-8 branched; 1-VI 4-6 branched; 1-VII 3-5 branched; 5-II single; 5-III 4-12 branched; 5-IV, V 5-9 branched; 5-VI 3-7 branched; 5-VII 2-6 branch-

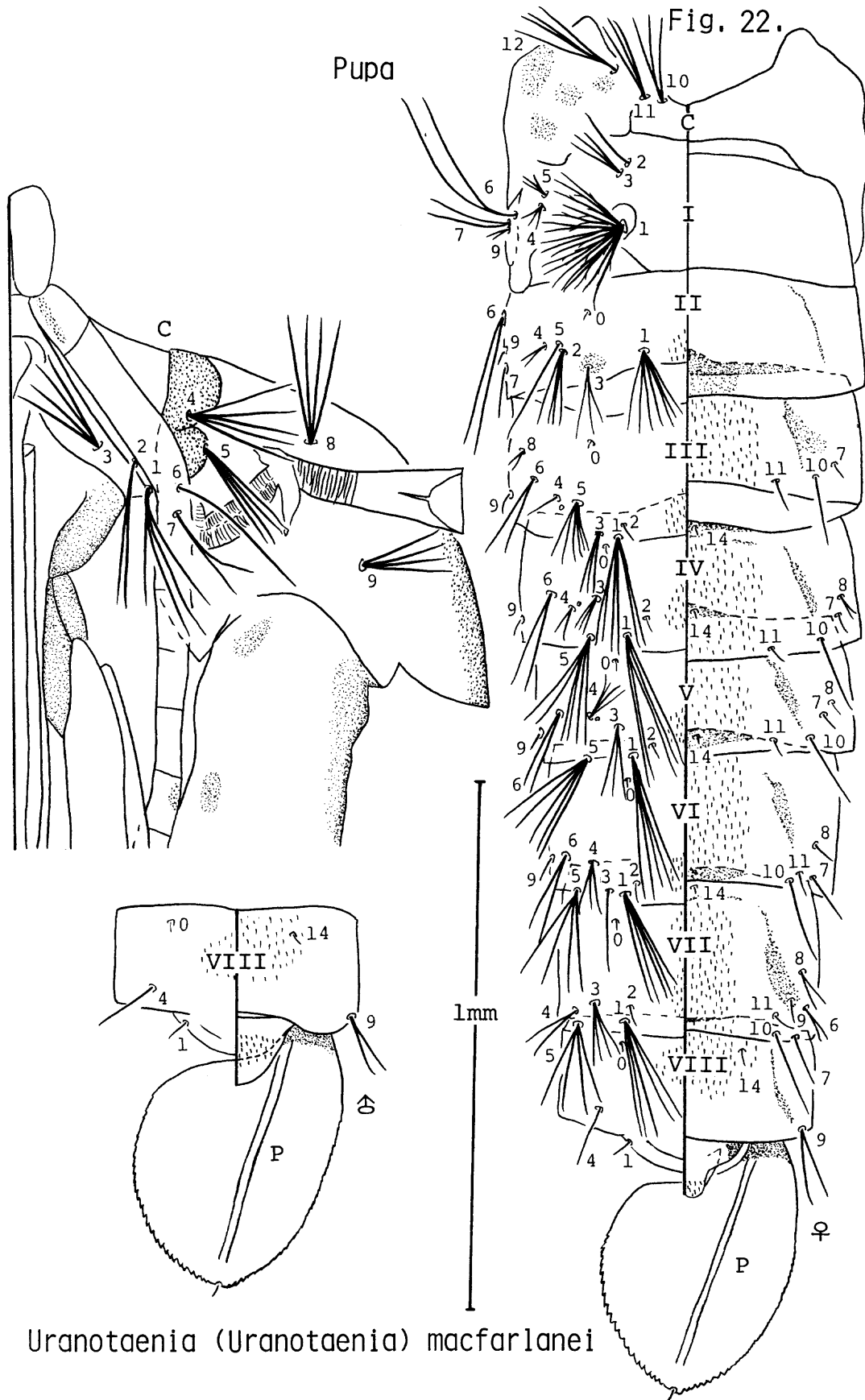


Table 8. Chaetotaxy of the pupa of Uranotaenia (Uranotaenia) macfarlanei

SETA NO.	CEPHALO- THORAX		ABDOMEN								VIII	IX	
	I	II	III	IV	V	VI	VII	VIII	IX				
0	-	-	1	1	1	1	1	1	1	1	1	1	-
1	4-6	42-58	5-11	4-8	4-8	4-6	3-5						1
2	2-7	1	4-6	1	1	1	1	1	1	1	1	1	-
3	4-8	3, 4	3-6	3-6	2-4	1-3	2-5						-
4	5-8	2-6	1-4	1-3	3-7	2, 3	1-4						-
5	4-8	1-6	1	5-9	5-9	3-7	2-6						-
6	1	2, 3	1-3	2-4	1-4	2-4	1-3						-
7	1-3	1-3	1	1	1-4	1	1						-
8	3-8	-	1-3	1-3	1, 2	1-3	2-4						-
9	3-6	1-3	1	1	1	1	1, 2					2-4	-
10	2-4	-	1	1	1	1	1						-
11	2-4	-	1	1	1	1	1						-
12	2-5	-	-	-	-	-	-						-
14	-	-	-	1	1	1	1					1	-

Specimens examined: 7 from Iriomotejima

ed; 6-I longer than 6-II-VII, double or triple; 6-II, VII 1-3 branched; 6-III, V 1-4 branched; 6-IV, VI 2-4 branched; 9-VIII longer than 9-I-VII, 2-4 branched. Paddle. Lightly pigmented, 1.29-1.45 as long as wide; external margin with distinct serrations apically, apical distinct serrations gradually changing to small teeth; internal margin with distinct serrations on distal 0.6; seta 1-P single, minute.

*Uranotaenia (Uranotaenia) lateralis* Ludlow

1905. *Canad. Entomol.* 37:385(F; *caeruleocephala* var.). Type-loc.: Cotabato, Mindanao, Philippines.

Notes. This Oriental species is rare on the Yaeyama Islands. Immatures have been collected from small shallow ground pools near the seacoast at Komi, Iriomotejima. They are found in association with *Cx. fuscocephala*, *Cx. tritaeniorhynchus*, *Cx. pseudo-vishnui*, *Cx. sitiens*, *Cx. halifaxii*, *Cq. crassipes*, *Ma. uniformis* and *An. sinensis*. The adults have been collected by light traps.

This species is reported from the Oriental and Australian regions.

*Orthopodomyia anopheloides* (Giles)

1903. In: Wyville Thomson, *J. Trop. Med.* 6:315(M, F, L; *Mansonia*). Type-loc.: Dehra Dun, India.

Notes. The immatures of this species were commonly found in tree holes in the Archipelago with *Cx. ryukyensis*, *Ae. aureostriatus* and *Ae. watasei*. The adult of this species never bites humans in the forest. This species overwinters in the 4th larval stage, and pupation and emergence begin from late February on Okinawajima (Toma and Miyagi, 1981b).

This species is reported from Palaearctic Japan (except Hokkaido) and the Oriental region (incl. Taiwan).

*Heizmannia (Heizmannia) kana* Tanaka, Mizusawa and Saugstad

1979. *Contrib. Am. Entomol. Inst.* 16:249(F). Type-loc.: Mt. Yuwan, Amami Oshima, Ryukyu Arch., Japan.

Notes. This species appears to be very rare in Amami Oshima. We did not collect this species. According to Eshita and Kurihara (1979) the adult females readily bite humans in the jungles of Mt. Yuwan. Nothing is known of the larval habitats.

This species is not known elsewhere.

*Aedes (Ochlerotatus) vigilax* (Skuse)

1889. *Proc. Linn. Soc. N. S. W.* 3:1731(F; *Culex*). Type-loc.: Gosford, Kiama and National Park, New South Wales, and Brisbane, Queensland, Australia.

Notes. This species is a typical Oriental element and is very rare in the Archipelago. Immatures have been rarely found



from ground pools near the seashore at Kuroshima, Yaeyama Is. We have examined the larval specimens collected by Nagano, April 1972 (Tanaka *et al.*, 1975a).

This species is reported from the Oriental (including Taiwan) and Australian regions.

*Aedes (Finlaya) albocinctus* (Barraud)

1924. Indian. J. Med. Res. 11:1002(M,F; *Finlaya*). Type-loc.: Solon, Western Himalayas, India.

Notes. With some hesitation, we have identified the single specimen at hand as *Ae. albocinctus* which was first recorded from Iriomotejima by Bohart (1959). This species is very rare in the Archipelago. We have collected only one female from daytime human-baited catches at Komi in the mountain forest of Iriomotejima on October 14, 1977. This is the only collection record for the species in the Archipelago since Bohart (1959).

This species is reported from China, Taiwan and India.

*Aedes (Finlaya) aureostriatus* (Doleschall)

1857. Naturuk. Tijdschr. Ned.-Ind., 14:385(F; *Culex*). Type-loc.: Amboina Island.

Subsp. *okinawanus* Bohart

1946. Proc. Biol. Soc. Wash. 59:39(M,F,L; as sp.). Type-loc.: Okuma, Okinawajima, Ryukyu Arch., Japan.

Notes. This subspecies is very common at the base of mountains and forest areas of Amami Oshima and Okinawajima. The immatures have been primarily reared with *Ur. n. ryukyuana*, *Ae. riversi*, *Ae. f. downsi* and *Or. anopheloides* collected from tree holes, bamboo stumps and artificial containers. They overwinter in the 4th larval stage, and the female bites humans during the day in the forest.

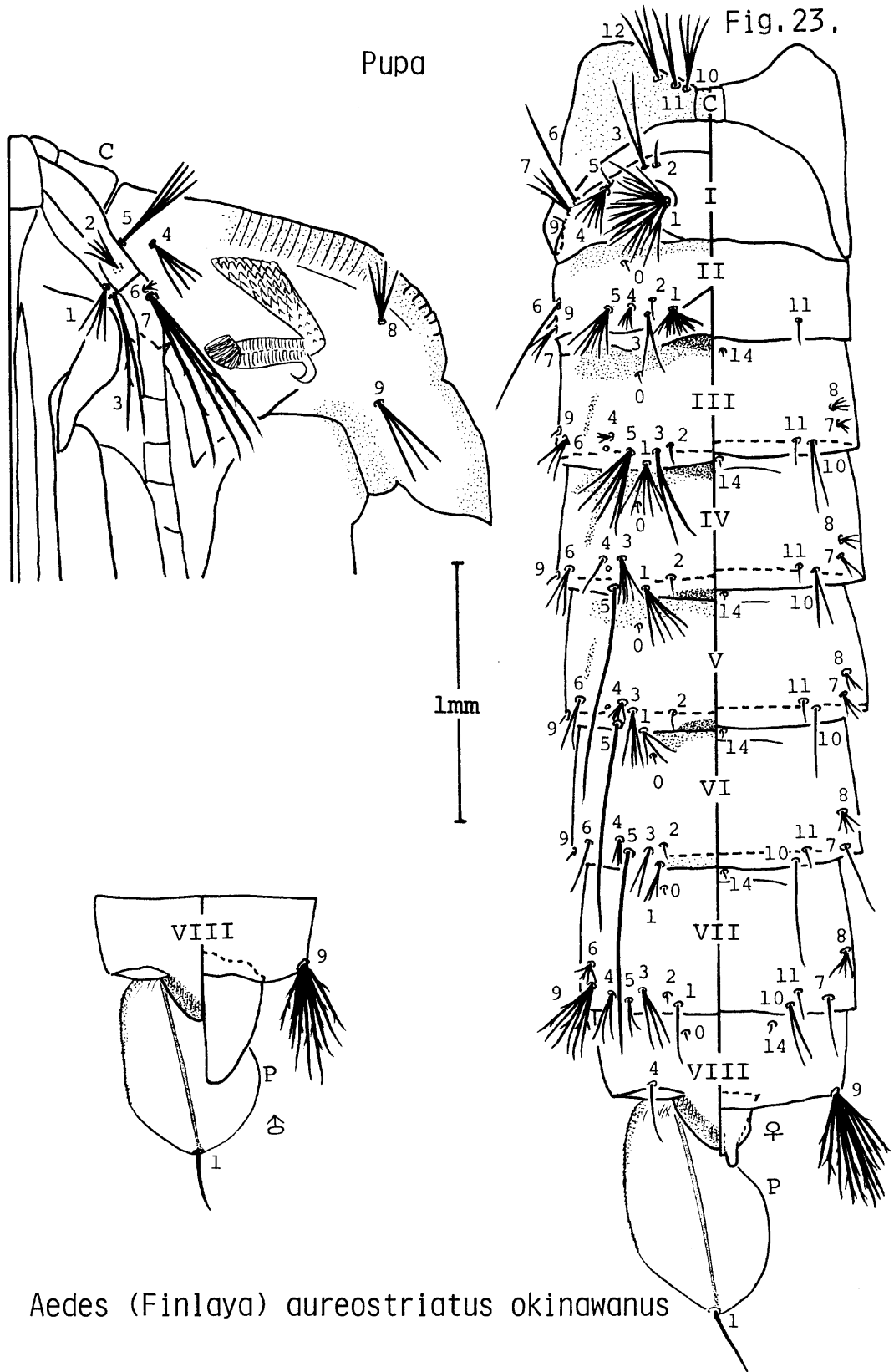
It is reported from Yakushima, Kyushu, Japan.

#### Redescription of pupa

Abdomen: 2.85-3.65 mm. Trumpet: 0.49-0.52 mm. Paddle: length 0.69-0.85 mm, width 0.45-0.60 mm. Complete chaetotaxy as figured in Fig. 23 and recorded in Table 9. Cephalothorax. Seta 3-C usually single or double(1-4), blackish; 7-C 2-6 branched, blackish. Trumpet. Moderately pigmented; index 3.8-5.0, average 4.4. Metanotum. Seta 11-C 1-4 branched, blackish; 12-C 1-6 branched, blackish. Abdomen. Seta 1-I dendritic; 9-VII 2-6 branched, blackish; 4-VIII usually single or double(1-4); 9-VIII 9-16 branched, blackish; 1-4, 7-I, 3,6-II, 3-III, 5-IV-VI blackish. Paddle. Ovoid; with minute serrations along basal 0.64 of outer margin; seta 1-P long, single; index 1.35-1.63, average 1.44.

Subsp. *taiwanus* Lien

1968. Trop. Med. Nagasaki. 10:223(M,F,P.L). Type-loc.: Mashihshih, Taiwu, Pingtung Hsien, Taiwan.



*Aedes (Finlaya) aureostriatus okinawanus*

Table 9. Chaetotaxy of the pupa of Aedes (Finlaya) aureostriatus okinawanus

SETA NO.	CEPHALO-THORAX	ABDOMEN										PADDLE	
		I	II	III	IV	V	VI	VII	VIII				
0	-	-	1	1	1	1	1	1	1	1	1	1	-
1	2-6	130-160	15-40	4-6	2-4	1-4	1-3	1-3	1-4	1-3	1-3	1-3	1
2	2-5	1 (1,2)	1	1	1	1	1	1	1	1	1	1	-
3	1,2 (1-4)	1-3	1-4	1-6	3-8	1-4	1-3	1-3	1-3	1-6	1-6	1-6	-
4	3-9	4-12	2-8	1-5	1-4	2-10	1-5	1-5	1-5	1-5	1-5	1-5	1,2 (1-4)
5	2-5	1-3	4-8	4-8	1 (1,2)	1 (1,2)	1	1	1	1-3	1	1-3	-
6	1-5	1	1 (1,2)	2-4	2,3 (2-4)	1-3	1,2	1,2	1,2	2-8	2-8	2-8	-
7	2-6	2-5	2-6	1-7	2-6	2-6	1	1	1	1-3	1-3	1-3	-
8	4-7	-	-	2-6	1-6	2-5	3-6	3-6	3-6	2-5	2-5	2-5	-
9	1-4	1	1	1	1	1	1	1	1	2-6	2-6	2-6	9-16
10	3-8	-	-	2-5	1-4	1 (1,2)	1	1	1	1-3	1-3	1-3	-
11	1-4	-	1	1	1	1	1	1	1	1	1	1	-
12	1-6	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	1	1	1	1	1	1	1	1	1	1

Specimens examined: 15 from Yona, Okinawajima

Notes. This subspecies is very common on Yaeyama Is. The habitats are same as *Ae. a. okinawanus*. Tanaka *et al.* (1979) treated the population of *Ae. aureostriatus* from Yaeyama Is. as well as that of Taiwan as *Ae. a. taiwanus*. However, we have not found clear morphological distinctions between populations from Okinawa Is. and from Yaeyama Is. We have not seen specimens of the *aureostriatus* group from Taiwan and the Philippines.

This subspecies is reported from Taiwan.

*Aedes (Finlaya) japonicus* (Theobald)

1901. Mon. Cul. 1:358(F; *Culex*). Type-loc.: Tokyo, Japan.

Subsp. *amamiensis* Tanaka, Mizusawa and Saugstad

1979. Contrib. Am. Entomol. Inst. 16:312(M,F,L). Type-loc.: Mt. Yuwan, Amami Oshima, Ryukyu Arch., Japan.

Subsp. *yaeyamensis* Tanaka, Mizusawa and Saugstad

1979. Contrib. Am. Entomol. Inst. 16:313(M,F,L). Type-loc.: near Yonehara, Ishigakijima, Ryukyu Arch., Japan.

Notes. This species is very common in Amami and Yaeyama Islands as well as mainland Japan, but very rare in Okinawa. We have collected larvae of this species only twice on June 5, 1976 at Yona and December 15, 1979 at Ada, Okinawajima. Immatures have been collected from rock pools, tree holes and artificial containers at the base of mountains. Tanaka *et al.* (1979) treated *Ae. j. japonicus* from mainland Japan, *Ae. j. amamiensis* from Amami Oshima, *Ae. j. yaeyamensis* from Yaeyama Is. and *Ae. j. shintiensis* from Taiwan as different subspecies.

This species is reported from Palaearctic Japan, Korea, Taiwan.

*Aedes (Finlaya) nishikawai* Tanaka, Mizusawa and Saugstad

1979. Contr. Am. Entomol. Inst. 16:356(F,M,L). Type-loc.: Mt. Yuwan, Amami Oshima, Ryukyu Arch., Japan.

Notes. Immatures have been collected from tree holes at the base of mountains and forests on Amami Oshima. Several females have been collected by biting catches in Nakanoshima.

This species is not known elsewhere.

*Aedes (Finlaya) togoi* (Theobald)

1907. Mon. Cul. 4:379(F; *Culicelsa*). Type-loc.: Osaka, Japan

Notes. This species is very common in the Archipelago. The immatures have been found in rock holes and artificial containers near the seashore. The adults have been collected by light traps and human-baited catches near the seashore. This species is a new record in Minnajima and Kuroshima.

This species is known from Palaearctic Japan, Taiwan, China, Korea, Malaysia, Thailand and the Pacific northwest coast of Canada and the USA.

*Aedes (Finlaya) watasei* Yamada

1921. Annot. Zool. Jap. 10:64(F). Type-loc.: Omura, Kyushu, Japan.

Notes. This species is common in the Archipelago. The immatures have been mainly found in tree holes, bamboo stumps, and artificial containers with *Ae. aureostriatus*, *Or. anopheloides*, *Ae. riversi* and *Ae. flavopictus* in forests and at the base of mountains. The females will feed upon humans in the laboratory but not in nature.

This species is reported from Palaearctic Japan (Kyushu).

## Redescription of pupa

Abdomen: about 2.5-3.0 mm. Trumpet: about 0.5-0.7 mm. Paddle: length about 0.7-0.8 mm, width about 0.5-0.6 mm. Complete chaetotaxy as figured in Fig. 24 and recorded in Table 10. Cephalothorax. Moderately pigmented; seta 5-C long and pigmented, single. Metanotum. Seta 10-C single or double; 11, 12-C double. Abdomen. Seta 1-I dendritic, 8-20 branched; 3-II, III pigmented, single, longer than 3-IV-VII; 5-IV-VI pigmented, single, longer than 5-I-III, VII, VIII; 9-I-VI single; 9-VII double or triple; 9-VIII pigmented, 4-11 branched. Paddle. Ovoid; 1-P single; index about 1.2-1.3.

*Aedes (Geoskusea) baisasi* Knight and Hull

1951. Pacif. Sci. 5:197(M,F). Type-loc.: Iwahig Penal Colony, Palawan, Philippines.

Notes. The immatures have been found in brackish water crab holes. In Yaeyama Is., they are often associated with *Cx. tubensis* and *Ur. yaeyamana*. Adults have been collected by light traps and sweeping near the seashore. Gravid females were often collected by sweeping near crab holes but the feeding habits of the adult are not known. Ecological studies of Mogi *et al.* (1984) estimated absolute populations of immatures of *Ae. baisasi* and other crab hole mosquitoes on Iriomotejima. This species is a new record in Amami Oshima, Minnajima and Miyakojima.

This species is reported from the Philippines.

## Description of pupa

Abdomen: 2.38-3.08 mm. Trumpet: 0.41-0.48 mm. Paddle: length 0.69-0.77 mm, width 0.54-0.60 mm. Complete chaetotaxy as Fig. 25 and recorded in Table 11. Cephalothorax. Seta 1-C 2 or 3 branched; 2-C, 9-C 1-3 branched; 3-C 2-4 branched; 5-C 3-5 branched. Metanotum. Seta 10-C 4-8 branched; 11-C pigmented, single, 12-C 2-5 branched. Abdomen. Seta 1-I pigmented, dendritic, 125-190 branched; 6,7-I,II pigmented; 1-II 12-32 branched; 1-III 3-10 branched; 2-I-VI single; 5-IV-VI strong, pigmented, single; 6-I, IV 1-3 branched; 6-II, IV single or double; 6-III, VII 1-4 branched; 9-VII 1-3 branched; 9-VIII strong, pigmented, 3-5 branched. Paddle. Ovoid, 1.17-1.33 as long as wide; seta 1-P single.

Fig.24.

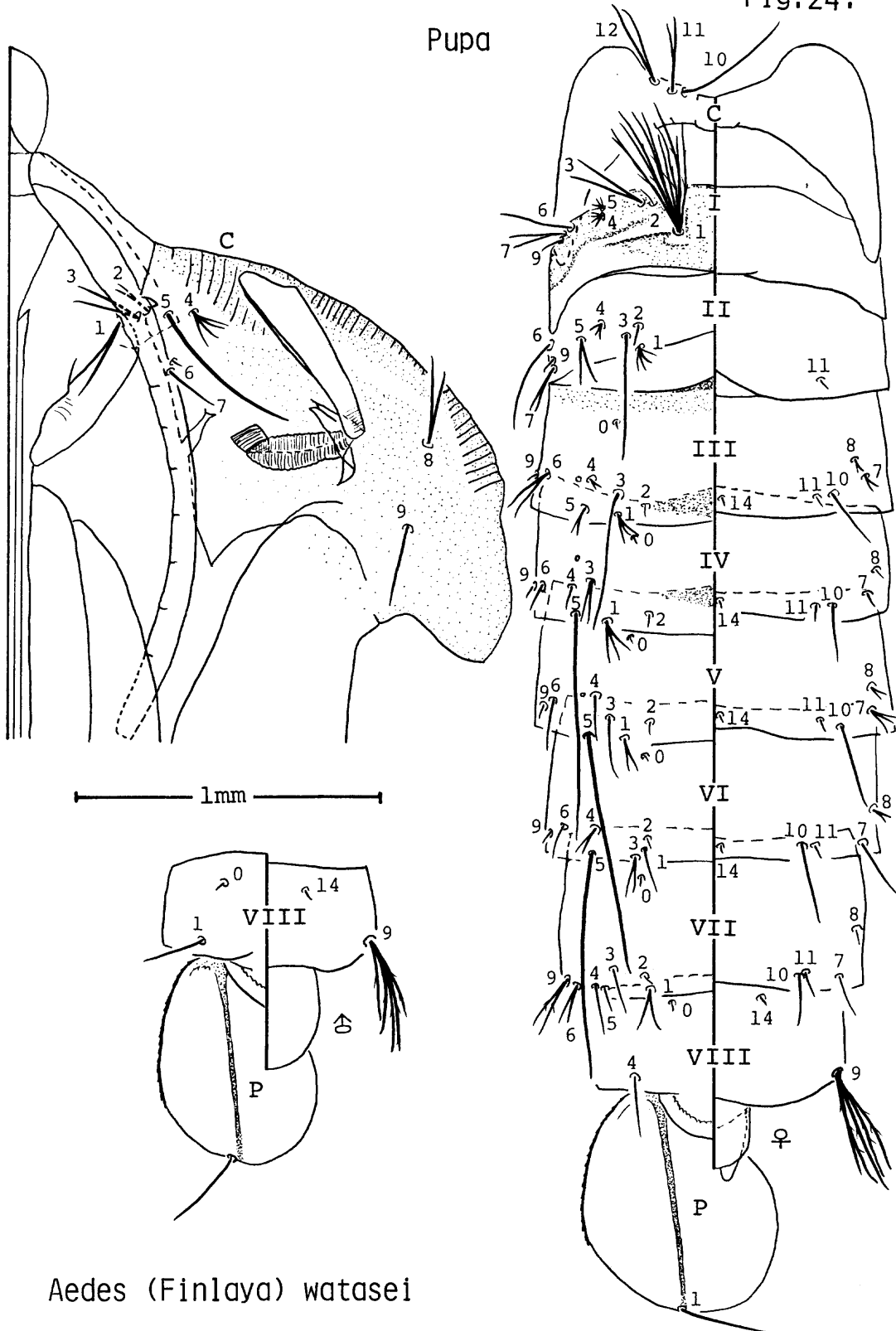


Table 10. Chaetotaxy of the pupa of Aedes (Finlaya) watasei

SETA NO.	CEPHALO- THORAX	ABDOMEN										PADDLE	
		I	II	III	IV	V	VI	VII	VIII				
0	-	-	1	1	1	1	1	1	1	1	1	1	-
1	2	8-20	4,5	3,4	3,4	2,3	1-3	1-3	2	2	1-3	2	1
2	2	1	1	1	1	1	1	1	1	1	1	1	-
3	1,2	2,3	1	1	2-4	1,2	1-3	1-3	1,2	1,2	1-3	1,2	-
4	2-6	4,5	2-5	2,3	1,2	1-3	2,3	2,3	1	1	2,3	1	-
5	1	3-5	2,3	2,3	1	1	1	1	1,2	1,2	1	1,2	-
6	1	1,2	1	1,2	1,2	1	1,2	1,2	1,2	1,2	1,2	2,3	-
7	1,2	2,3	2,3	1-3	1	2,3	1	1	1	1	1	1	-
8	2	-	-	2,3	1,2	1-3	2,3	2,3	1,2	1-3	2,3	1,2	-
9	1	1	1	1	1	1	1	1	1	1	1	2,3	-
10	1,2	-	-	1	1	1	1	1	1	1	1	1	-
11	2	-	1,2	1	1	1	1	1	1	1	1	1	-
12	2	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	1	1	1	1	1	1	1	1	1	-

Specimens examined: 2 from Yona, Okinawajima

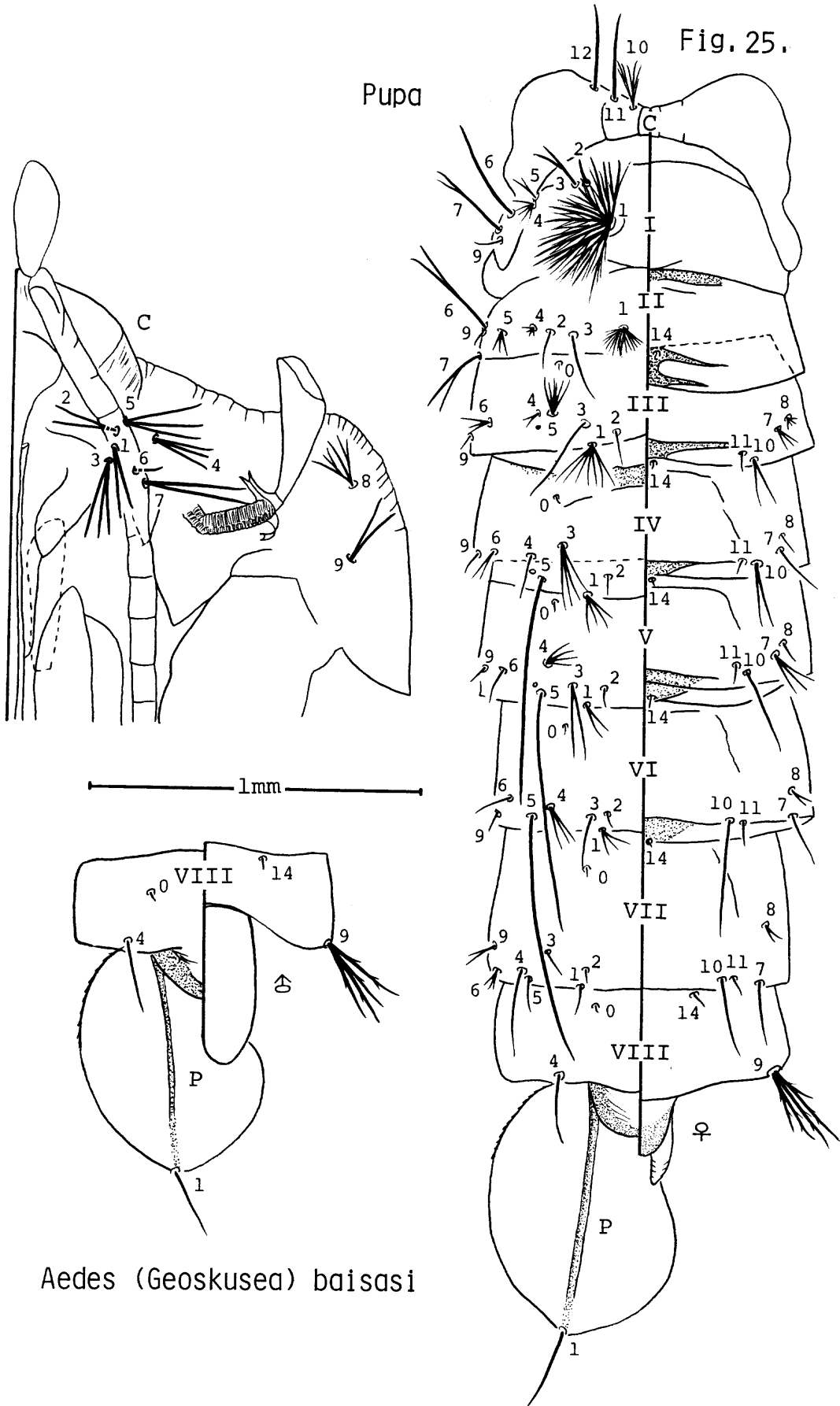




Table 11. Chaetotaxy of the pupa of Aedes (Geoskusea) baisasi

SETA NO.	CEPHALO- THORAX	ABDOMEN								PADDLE	
		I	II	III	IV	V	VI	VII	VIII		
0	-	-	1	1	1	1	1	1	1	1	-
1	2,3	125-190	12-32	3-10	2-4	2-4	2-4	2-4	2-4	1-3	1
2	1-3	1	1	1	1	1	1	1	1	(1,2)	-
3	2-4	1-3	1,2	1	2-5	1,2	1	1,2	(1,2)	1,2	-
4	1-4	4-6	2-7	1-4	1,2	2-5	1-6	1	1	1	-
5	3-5	1-3	2-6	3-7	1	1	1	1	1	(1,2)	-
6	1,2	1-3	1,2	1-4	1-3	1,2	1	1,2	1	1-4	-
7	2,3	1,2	1-3	1-4	1	1-4	1	1-4	1	1	-
8	4-6	-	-	1-6	1	1	1-3	1-3	1-3	1-3	-
9	1-3	1	1	1	1	1	1	(1,2)	1	1-3	3-5
10	4-8	-	-	1-3	1-3	1	1	1	1	1	-
11	1	-	-	1	1	1	1	1	1	1	-
12	2-5	-	-	-	-	-	-	-	-	-	-
14	-	-	-	1	1	1	1	1	1	1	1

Specimens examined: 14 from Minnajima

*Aedes (Stegomyia) aegypti* (Linnaeus)  
1762. In: Hasselquist's, Reise nach Palaestina: 470(A; *Culex*).  
Type-loc.: Egypt.

Notes. *Aedes aegypti* as well as dengue epidemics were recorded frequently in the past in the Yaeyama and Okinawa Islands (Miyao, 1931; Saigo, 1940). We made special efforts to locate this species on every island, but were unsuccessful. The latest record of the species in the Archipelago on April 30, 1970 at Kabira, Ishigakijima was mentioned by Tanaka *et al.* (1975b).

This species is widely distributed in tropical, subtropical and warm temperate regions.

*Aedes (Stegomyia) albopictus* (Skuse)  
1894(1895). Indian Mus. Notes 3:20(F; *Culex*). Type-loc.: Calcutta, West Bengal, India.

Notes. This is a domestic mosquito and very common throughout the Archipelago. The immatures have been collected from artificial containers, tree holes and bamboo stumps near human dwellings and at the base of mountains. The adults readily bite humans who are adjacent to their breeding sites. *Ae. albopictus* has not been collected in remote mountain forests where *Ae. riversi* is predominant (Miyagi and Toma, 1981a; Toma *et al.*, 1983). There are clearly two population peaks of adults in the year, one in July, the other in September (Toma *et al.*, 1982). It is a new record in Minnajima.

This species is reported from Palaeartic Japan (except Hokkaido), the Oriental (including Taiwan), Malagasy and Australian regions; Hawaiian Islands and Micronesia.

*Aedes (Stegomyia) flavopictus* Yamada  
1921. Annot. Zool. Jap. 10:52(M,F). Type-loc.: Shiba, Tokyo, Japan.

Subsp. *downsi* Bohart and Ingram  
1946. J. Wash. Acad. Sci. 36:51(M,F,L; as sp.). Type-loc.: Chizuka, Okinawajima, Ryukyu Arch., Japan.

Notes. This subspecies is common at the base of mountains, especially in bamboo forests. The immatures have been collected from bamboo stumps, artificial containers and tree holes with *Ae. riversi*, *Cx. ryukyensis*, *Or. anopheloides* and *Ae. a. okinawanus*. The adults feed on human in the vicinity of their breeding places. Nakanoshima is the northernmost distribution of this subspecies. The population of Palaeartic Japan was treated as a different subspecies, *Ae. f. flavopictus* (Tanaka *et al.*, 1979).

This subspecies is not known elsewhere.

Subsp. *miyarai* Tanaka, Mizusawa and Saugstad  
1979. Contrib. Am. Entomol. Inst. 16: 390(M,F,L). Type-loc.:

Mt. Banna, Ishigakijima, Ryukyu Arch., Japan.

Notes. Tanaka *et al.* (1979) treated the population of *Ae. flavopictus* from Yaeyama Is. as a different subspecies, *Ae. f. miyarai*. Immatures have been frequently collected in leaf axils of taro plants with *Ml. genurostris*. It has also been collected from bamboo stumps, artificial containers and tree holes.

*Aedes (Stegomyia) riversi* Bohart and Ingram  
1946. J. Wash. Acad. Sci. 36: 50(M,F,L). Type-loc.: Chizuka, Okinawajima, Ryukyu Arch., Japan.

Notes. This species is very similar to *Ae. albopictus* morphologically as well as biologically. It is common at the base of mountains and forests in the Archipelago, but very few have been found near human dwellings. The immatures have been commonly collected from artificial containers discarded in the forest. They have been also found in tree holes and bamboo stumps. The adult females readily bite man in the forest.

This species is reported from Palaearctic Japan (Kyushu).

*Aedes (Stegomyia) daitensis* Miyagi and Toma  
1980. Mosq. Syst. 12:428(M,F,P,L,E). Type-loc.: Zaisho, Minami Daitojima, Ryukyu Arch., Japan.

Notes. This is the endemic species in Minami and Kita Daitojima. According to Miyagi and Toma (1980b), this species is apparently a member of the Western Pacific *Scutellaris* subgroup and easily distinguished from other members of the subgroup in the Ryukyu Archipelago by yellowish-white narrow scales over the wing root and markings on tarsomeres 1-5 and on the scutellum.

The principal habitat of the immatures of this species is tree holes. They are also found in artificial containers with *Ae. albopictus* in the forest. The females readily bite man in the forest.

This species is not known elsewhere.

*Aedes (Aedimorphus) vexans* (Meigen)  
1830. Syst. Besch. Zweifl. Ins. 6:241(F; *Culex*). Type-loc.: Berlin, Germany.

Subsp. *nipponii* (Theobald)  
1907. Mon. Cul. 4:337 (F; *Culicada* ; as sp.). Type-loc.: Karnizana, Japan.

Notes. This subspecies is common throughout the Archipelago. The immatures have been collected frequently from temporary ground pools and fallows. The adults have been collected by light traps and human-baited net traps. It is a new record in Minnajima.

This subspecies is reported from Palaearctic Japan, Sakhalin Is., Siberia, Korea and China.

*Aedes (Verrallina) atriisimilis* Tanaka and Mizusawa  
1973. Bull. Natl. Sci. Mus. Tokyo 16:625 (M,F,L). Type-loc.:  
Itokawa-rindo, Iriomotejima, Ryukyu Arch., Japan.

Notes. This is an endemic species and is found only in Iriomotejima. The immatures have been found rarely in small ground pools in the forest. The adults bite man in the forest and have been collected by light traps and sweeping in the forest. This species is not known elsewhere.

#### Description of pupa

Abdomen: 2.55-3.10 mm. Trumpet: 0.47-0.60 mm. Paddle: length 0.70-0.78 mm, with 0.68-0.71 mm. Complete chaetotaxy as figured in Fig. 26 and recorded in Table 12. Cephalothorax. Setae 3,6-C single. Trumpet. Moderately pigmented; index 4.7-6.1, average 5.1. Metanotum. Seta 10-C 4-7 branched; 11-C usually single(1,2), blackish. Abdomen. Seta 1-I dendritic; 6-VII 1-3 branched; 9-VII single; 4-VIII 1,2 branched; 9-VIII 1-5 branched. Paddle. Ovoid; with minute serrations along basal 0.58 of outer margin; tiny spicules along apical 0.32 of outer and apical 0.28 of inner margins; seta 1-P moderately long, single; index 1.09-1.22, average 1.17.

*Aedes (Verrallina) iriomotensis* Tanaka and Mizusawa  
1973. Bull. Natl. Sci. Mus. Tokyo 16:633(F). Type-loc.: Funaura,  
Iriomotejima, Ryukyu Arch., Japan.

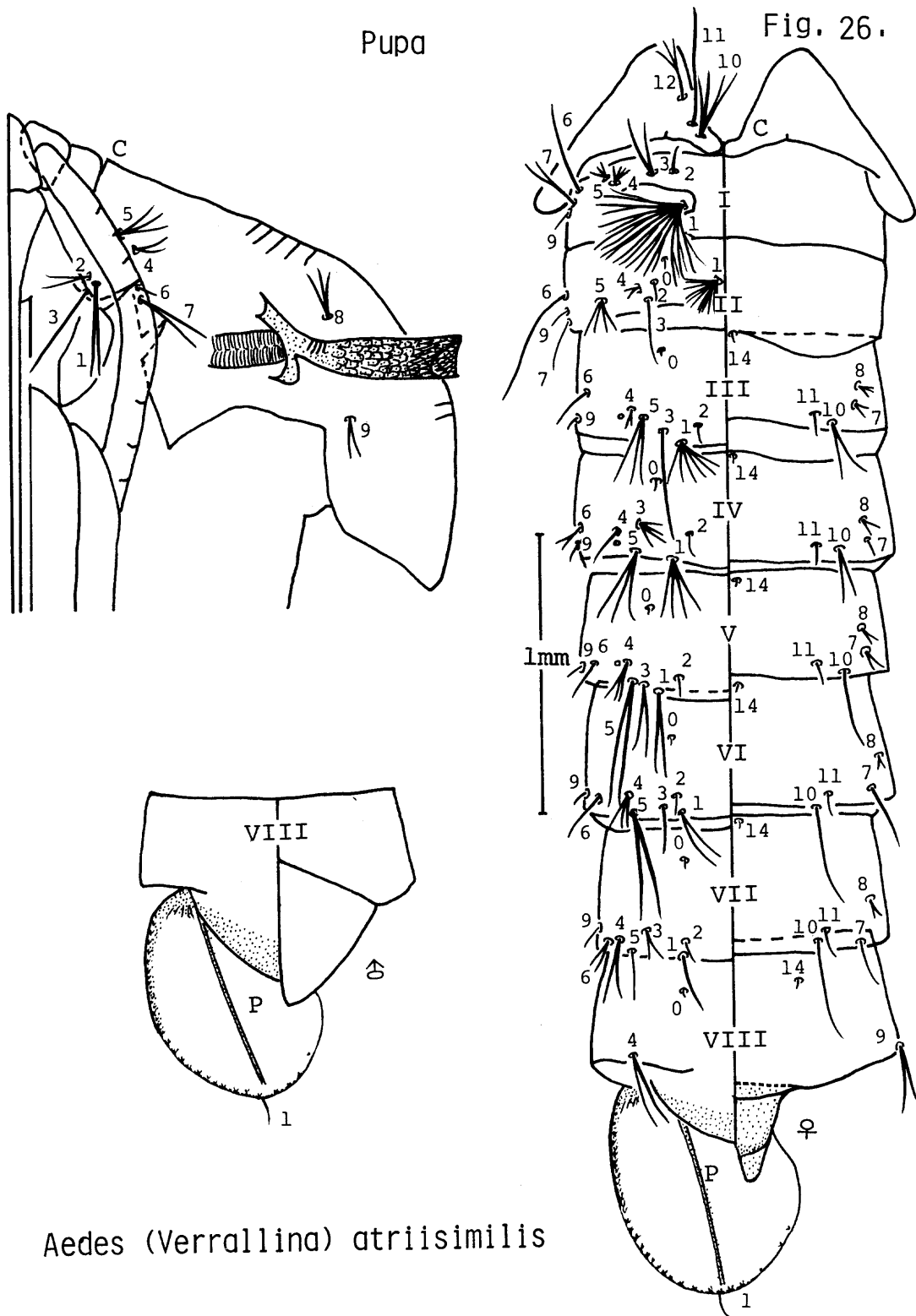
Notes. This species is endemic to Iriomotejima. The immatures have been rarely found in ground pools in the forest (Miyagi and Toma, 1980a). This is the predominant species of *Aedes* on the island and was collected by daytime and nighttime human-baited catches in the forest. The specialized mating behavior of this species was observed by Miyagi and Toma (1981b, 1982). The males do not swam and remain for some time in the vicinity of the breeding sites where they encounter young females by chance through random flights. As soon as the female emerges from the pupal skin, many males begin a darting flight and struggle over the female. Then one of the males commences copulation end to end. Descriptions of the male, larva and pupa of this species were made by Miyagi and Toma (1979a).

This species is not known elsewhere.

*Aedes (Verrallina) nobukonis* Yamada

1932. Iconogr. Insect. Jap. 2:228(F). Type-loc.: Omura, Kyushu,  
Japan.

Notes. This species is very rare in the Archipelago. The immatures have been collected once in temporary ground pools in the forest of Iriomotejima. The adults have been collected by daytime human-baited catches at Komi, Iriomotejima during July,



*Aedes (Verrallina) atrisimilis*

Table 12. Chaetotaxy of the pupa of Aedes (Verrallina) atrisimilis

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SETA NO.	ABDOMEN										PADDLE	
	CEPAHLO- THORAX	I	II	III	IV	V	VI	VII	VIII			
0	-	-	-	1 (1,2)	1	1	1	1	1	1	1	-
1	2 (1-3)	70-100	17-30	3-9	3-5	1-3	2 (2,3)	1 (1,2)	-	-	1	1
2	2 (1,2)	1	1	1 (1,2)	1	1	1	1	-	-	1	-
3	1	1-3	1	1	3-7	1,2	1 (1,2)	2,3 (1-3)	-	-	-	-
4	1-3	3-6	1-5	1-3	1,2	2-5	1-5	1,2	1,2	1,2	-	-
5	1-4	2-5	2-5	2-4	1-4	2 (1,2)	2 (1,2)	1 (1,2)	-	-	-	-
6	1	1,2	1	1-3	1-3	1-3	1	1-3	-	-	-	-
7	1-3	1-3	1-3	1-3	1-3	1-5	1	1 (1,2)	-	-	-	-
8	2-5	-	-	1-4	1-3	1-3	1-3	1-3	-	-	-	-
9	1-3	1	1	1 (1,2)	1	1	1	1	2,3 (1-5)	1	-	-
10	4-7	-	-	1-3	1-3	1	1	1 (1,2)	-	-	-	-
11	1 (1,2)	-	-	1	1	1	1	1	-	-	-	-
12	1-4	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	1	1	1	1	1	1	1	-

Specimens examined: 20 from Iriomotejima

1978.

This species is reported from Palaearctic Japan (Kyusyu).

*Aedes (Neomelanicion) lineatopennis* (Ludlow)

1905. *Canad. Ent.* 37:133(F; *Taeniorhynchus*). Type-loc.: Camp Gregg, Bayambang, Pangasinan, Luzon, Philippines.

Notes. This species is apparently an Oriental element and Miyakojima is the northernmost distribution of the species. Immatures have been found in shallow, grassy, fresh water pools in fallows, together with *Ae. vexans nipponii*, *An. sinensis* and *Cx. tritaeniorhynchus*. A very few adults have been collected by light traps. Throughout the Southeast Asian countries, this is one of the common mosquitoes and is known as cattle biter. *Aedes lineatopennis* is uncommon in the Archipelago. It is a new record in Miyakojima.

This species is reported from the Oriental (including Taiwan) and Australian regions; eastern and southern Africa, Nigeria, Gold Coast and Upper Volta.

*Armigeres (Armigeres) subalbatus* (Coquillett)

1898. *Proc. U. S. Natl. Mus.* 21:302(F; *Culex*). Type-loc.: Japan.

Notes. This species is very common in the Archipelago. The immatures have been collected from polluted water of artificial containers around human dwellings. They are also found in tree holes, bamboo stumps and leaf axils of taro plants. The adults have been collected by light traps and human-baited catches in the shade during the day. This species is a new record in Minnajima.

This species is reported from Palaearctic Japan (except Hokkaido) and the Oriental region (including Taiwan).

*Culex (Lutzia) fuscans* Wiedemann

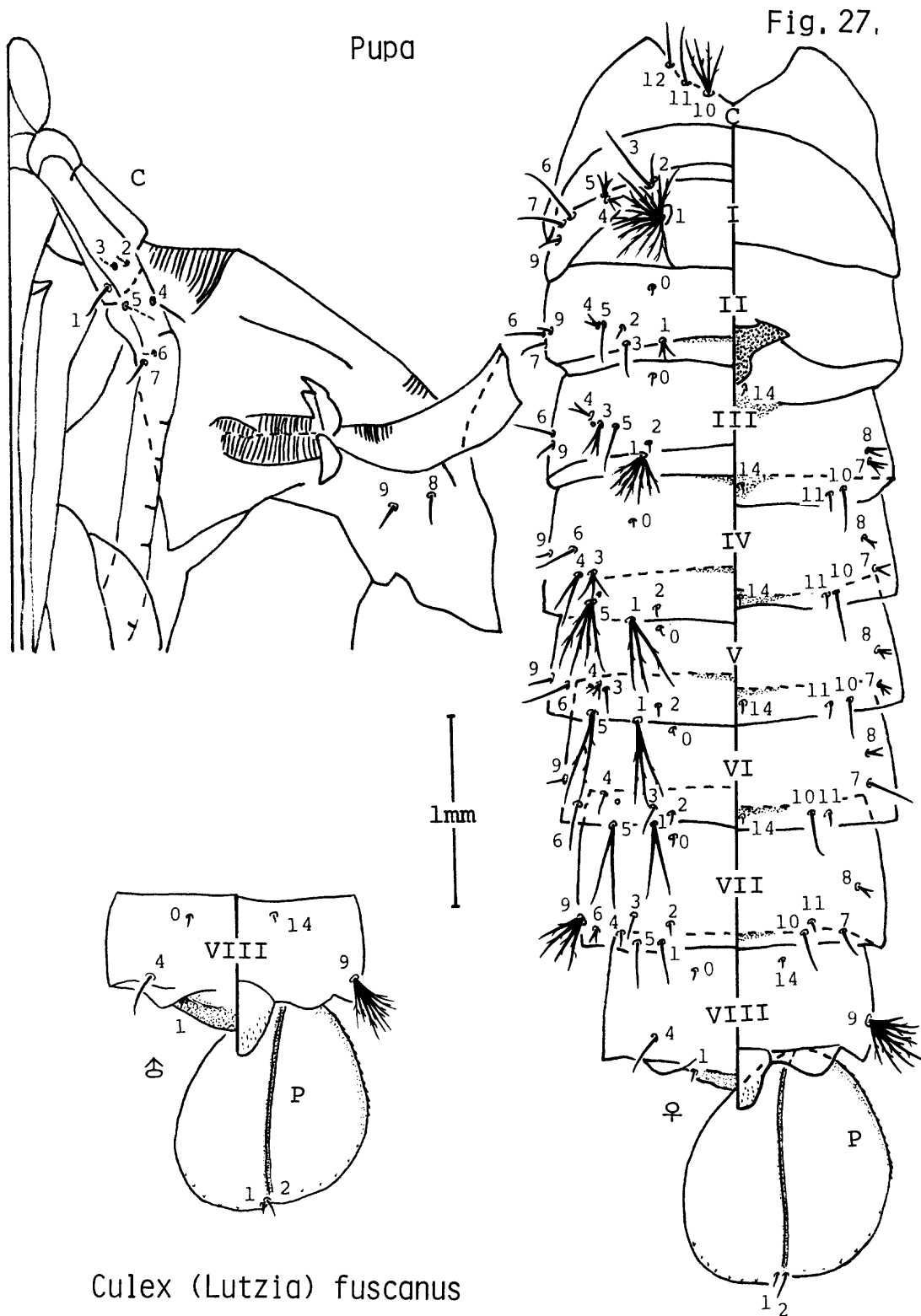
1820. *Dipt. Exot.* :9(M,F). Type-loc.: India.

Notes. This species was not observed in April, was uncommon in May, and was abundant from June to August. The immatures have been collected from artificial containers with *Cx. quinquefasciatus* and *Cx. halifaxii*. They are predaceous on the larvae of other mosquitoes as well as chironomid larvae. The adults have been collected by light traps. This is a new record in Minnajima and Miyakojima.

This species is reported from U.S.S.R, China, Korea, the Oriental region (including Taiwan) and some of the Pacific islands.

#### Redescription of pupa

Abdomen: 4.38-5.45 mm. Trumpet: 0.96-0.10 mm. Paddle: length 1.09-1.23 mm, width 0.98-1.09 mm. Complete chaetotaxy as figured in Fig. 27 and recorded in Table 13. Cephalothorax. Moderately pigmented; setae 1-9-C single. Trumpet. Moderately pigmented; index 3.59-4.50, average 3.99. Metanotum. Seta 10-C 3-6 branch-



*Culex (Lutzia) fuscans*



Table 13. Chaetotaxy of the pupa of Culex (Lutzia) fuscus

SETA NO.	CEPHALO-THORAX	ABDOMEN								PADDLE	
		I	II	III	IV	V	VI	VII	VIII		
0	-	-	1	1	1	1	1	1	1	1	-
1	1	25-65	3,4 (1-5)	5-11	3-7	2-4	2	(2,3)	1	(1,2)	1
2	1	1	1	1	1	1	1	1	1	1	1 (1-3)
3	1	1	1	1-5	2-7	1 (1,2)	1	1	1	1	-
4	1	2-6	1-4	1-5	1-3	1-3	1	(1,2)	1	(1-3)	1
5	1	1-8	1 (1,2)	1 (1,2)	2-6	2-5	2	(2,3)	1	(1,2)	-
6	1	1 (1,2)	1 (1,2)	1 (1,2)	1 (1,2)	1	1	2,3 (2-4)	1	2,3 (2-4)	-
7	1	1 (1,2)	1 (1,2)	2-8	1-3	1-5	1	(1,2)	1	1	-
8	1	-	-	1-5	1-4	1-3	1-3	(1-3)	2	(1,2)	-
9	1	1 (1,2)	1	1	1	1	1	1	4-8	8-12	-
10	2-7	-	-	1 (1,2)	1 (1,2)	1	1	1	1	(1,2)	-
11	1 (1,2)	-	-	1 (1,2)	1	1	1	1	1	1	-
12	1 (1,2)	-	-	-	-	-	-	-	-	-	-
14	-	-	-	1	1	1	1	1	1	1	-

Specimens examined: 12 from Minnajima

ed; 11,12-C usually single(1,2). Abdomen. Seta 1-I dendritic, 25-65 branched; 1-II usually 3 or 4 branched(1-5); 1-III 5-11 branched; 1-IV 3-7 branched; 1-V 2-4 branched; 1-VI usually double(2,3); 1-VII usually single(1,2); 2,3-I,II single; 2-III-VII single; 5-I 1-8 branched; 5-II,III usually single(1,2); 5-IV 2-6 branched; 5-V 2-5 branched; 5-VI usually double(2,3); 5-VII usually single(1,2); 9-I usually single(1,2); 9-II-VI single; 9-VII 4-8 branched; 9-VIII 8-12 branched. Paddle. Ovoid; 1-P single; 2-P usually single(1-3); index 1.07-1.17, average 1.13.

*Culex (Lutzia) halifaxii* Theobald

1903. Mon. Cul. 3:231(F). Type-loc.: Dindings, Malaya.

Notes. This species is common in the Archipelago from May to July. The immatures have been collected from artificial containers. The chief prey of the larva is *Cx. quinquefasciatus*. This species is a new record in Minnajima and Izenajima.

This species is reported from U.S.S.R., China, Nepal, Palaeartic Japan, Korea, the Oriental (including Taiwan) and Australian regions.

Redescription of pupa

Abdomen: 4.50-5.38 mm. Trumpet: 0.80-0.96mm. Paddle: length 0.46-0.54 mm, width 0.41-0.45 mm. Complete chaetotaxy as figured in Fig. 28 and recorded in Table 14. Cephalothorax. Moderately pigmented; setae 1,3-C usually single(1,2); 2,4-9-C single. Metanotum. Seta 10-C 3-7 branched; 11,12-C single. Abdomen. Seta 1-I dendritic, 31-64 branched; 1-II 3-7 branched; 1-III 5-9 branched; 1-IV double or triple; 1-V usually single(1,2); 1-VI, VII single; 2-I-VII single; 5-I 1-5 branched; 5-II, VI, VII single; 5-III, IV 1-3 branched; 9-I single or double; 9-II-VI single; 9-VII 2-6 branched; 9-VIII 5-10 branched. Paddle. Ovoid; 1-P usually single(1,2); 2-P single; index 1.02-1.27, average 1.17.

*Culex (Eumelanomyia) brevivalpis* (Giles)

1902. Handb. 2nd ed.:384 (M,F; *Stegomyia*). Type-loc.:Shanjahanpur, India.

Notes. This species is rare in the Archipelago. We have collected the immatures from artificial containers in the forest, Iriomotejima, with *Tx. m. yaeyamae*, *Ur. n. ryukyuana*, *Or. anophe- loides*, *Ae. a. taiwanus*, *Ae. riversi* and *Ae. f. miyarai*.

This species is reported from the Oriental region (including Taiwan), New Guinea and the Bismarck Archipelago.

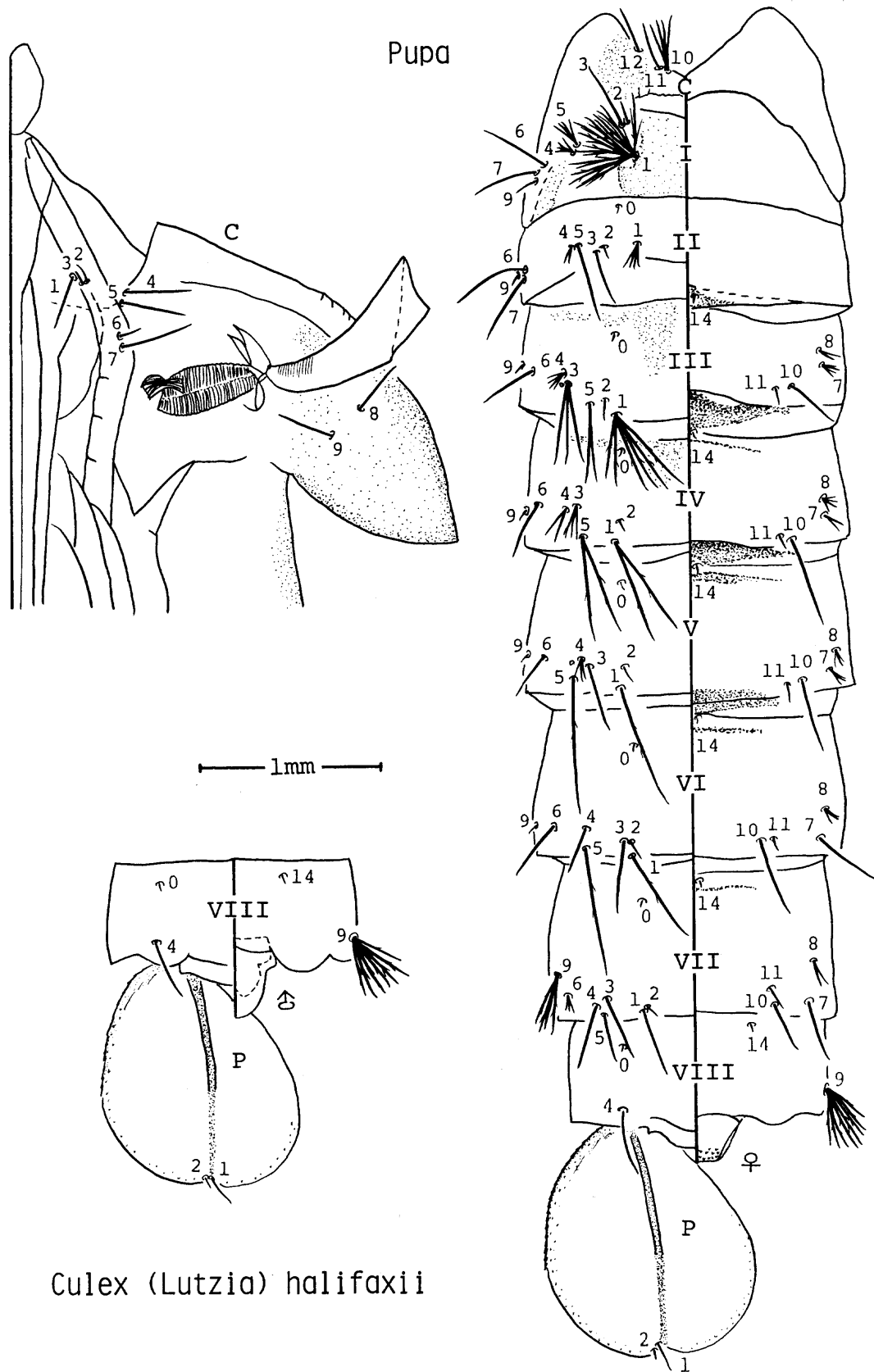
*Culex (Eumelanomyia) hayashii* Yamada

1917. Zool. Mag. Tokyo, 29:67(M,F,P,L,E). Type-loc.:Tokyo, Japan.

Subsp. *ryukyuanus* Tanaka, Mizsusawa and Saugstad

1979. Contrib. Am. Entomol. Inst. 16:190(M,F,L). Type-loc.:

Fig. 28.



*Culex (Lutzia) halifaxii*

Table 14. Chaetotaxy of the pupa of Culex (Lutzia) halifaxii

SETA NO.	CEPHALO- THORAX	ABDOMEN								PADDDLE		
		I	II	III	IV	V	VI	VII	VIII			
0	-	-	1	1	1 (1,2)	1	1	1	1	1 (1,2)	1	-
1	1 (1,2)	31-64	3-7	5-9	2,3	1 (1,2)	1	1	1	1	-	1 (1,2)
2	1	1	1	1	1	1	1	1	1	1	-	1
3	1 (1,2)	1-3	1 (1,2)	1-3	3-5	1 (1,2)	1	1	1	1	-	-
4	1	2-5	1-3	2-5	1-3	2-4	1,2	1	1	1	1	-
5	1	1-5	1	1-3	1-3	1 (1,2)	1	1	1	1	-	-
6	1	1 (1-4)	1	1 (1,2)	1 (1,2)	1	1	1	1	2-4	-	-
7	1	1 (1,2)	1-4	2-7	1-4	2-4	1	1	1	1	-	-
8	1	-	-	1-4	3-5	2-4	2-4	2-4	1-4	1-4	-	-
9	1	1,2	1	1	1	1	1	1	1	2-6	5-10	-
10	3-7	-	-	1	1	1	1	1	1	1	-	-
11	1	-	-	1	1	1	1	1	1	1	-	-
12	1	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	1	1	1	1	1	1	1	1	-

Specimens examined: 12 from Ozato, Okinawajima

near Shirahama, Iriomotejima, Ryukyu Arch., Japan.

Notes. This subspecies is common in the Archipelago. Immatures have been found most frequently in streams and blocked streams, occasionally rock pools in the forest and at the base of mountains. They have been associated with *An. s. sapersoi* in Okinawajima and with *An. s. ohamai* and *An. minimus* in Iriomotejima. The adults are known to feed on amphibians. It is a new record in Miyakojima.

This species is reported from Palaeartic Japan, U.S.S.R., China, Korea and Taiwan.

*Culex (Eumelanomyia) okinawae* Bohart  
1953. Proc. Entomol. Soc. Wash. 55:187(M,F,P,L). Type-loc.: East Taira, Okinawa, Ryukyu Arch., Japan.

Notes. This species is common in the Archipelago. The immatures of this species are morphologically very similar to those of *Cx. h. ryukyuanus* and have been collected from tree holes, artificial containers, ground pools and rock pools at the base of mountains and in forests. They are usually never associated with *Cx. h. ryukyuanus* which breed in stream pools. The adults fed on frogs and have been collected by sweeping around stream banks in the mountains. Amami Oshima is the northernmost distribution of this species.

This species is known from Taiwan and Philippines.

*Culex (Lophoceraomyia) cinctellus* Edwards  
1922. Indian J. Med. Res. 10:287(M; nom. nov. for *taeniata* Leicester, non Wiedemann 1828).

Notes. This species is found on the Yaeyama Islands. The immatures have been collected from fallows in open areas and artificial containers and tree holes in the forest. The adults have been commonly collected by light traps. The feeding habits of the adult is not known.

This species is reported from the Oriental region.

*Culex (Lophoceraomyia) infantulus* Edwards  
1922. Indian J. med. Res. 10:287(M). Type-loc.: Hong Kong.

Notes. This species is very common throughout the Archipelago. The immatures have been collected from tree holes, ground pools, rock and ground pools along streams and fresh water crab holes at the base of mountains and in forests. Adults, including gravid females, were collected resting on damp vegetation and rocks along streams in forest.

This species is reported from Palaeartic Japan and the Oriental region (including Taiwan).

*Culex (Lophoceraomyia) bicornutus* (Theobald)

1910. Rec. Indian Mus. 4:25(M: *Lophoceratomyia*). Type-loc.: Dawna hills, near Kawkareik, Lower Burma.

Notes. This species is very common but found only in Yaeyama Islands. The immatures have been usually collected from tree holes and artificial containers; occasionally from ground pools and rock pools in the forest and at the base of mountains.

This species is reported from the Oriental region.

*Culex (Lophoceraomyia) rubithoracis* (Leicester)

1908. Cul. Malaya: 119(F;M; *Lophoceratomyia*). Type-loc.: Kuala Lumpur, Malaya.

Notes. This species is rare in Amami and the Okinawa Islands and no specimens have been collected from the Yaeyama Islands. The immatures have been found in rice paddies. The adults have been collected by light traps in Minami Daitojima and Iheyajima.

This species is reported from Palaeartic Japan (except Hokkaido) and the Oriental region (including Taiwan).

*Culex (Lophoceraomyia) tuberis* Bohart

1946. Proc. Biol. Soc. Wash. 59:42(M,L). Type-loc.: Chizuka, Okinawa, Ryukyu Arch., Japan.

Notes. This species is common in Okinawa and Yaeyama Islands. The immatures have been found in fresh water crab holes, occasionally in brackish water crab holes and artificial containers located along the banks of streams in the forest. On Okinawajima, they were usually associated with *Ur. jacksoni* in fresh water crab holes. In the Yaeyama Islands, they were usually associated with *Ur. ohamai* in fresh water crab holes and *Ur. ohamai* and *Ae. baisasi* in brackish water crab holes.

This species is reported from Thailand.

#### Redescription of pupa

Abdomen: 2.55-2.98 mm. Trumpet: 0.55-0.71 mm. Paddle: length 0.66-0.72 mm, width 0.47-0.55 mm. Complete chaetotaxy as figured in Fig. 29 and recorded in Table 15. Cephalothorax. Setae 1-C, 3-C, 5-C, 7-C, 9-C strong, pigmented; 1-C 2-4 branched; 3-C 1-3 branched; 5-C 2-4 branched; 7-C usually single(1,2), 9-C 1-3 branched. Metanotum. Seta 10-C single or double; 11-C strong, pigmented, 1-3 branched; 12-C 1-4 branched. Abdomen. Seta 1-I pigmented, dendritic, 120-210 branched; 3-I, II, III strong, pigmented, single or double; 6-I, II strong, usually single; 7-I strong; 5-IV-VI strong, pigmented, single or double; 5-IV shorter than 5-V; 5-V as long as 5-VI; 6-IV-VI single or double; 9-VII, VIII strong, pigmented, 1-4 branched. Paddle. Ovoid with pointed apex, 1.28-1.44 as long as wide; setae 1,2-P single.

Fig. 29.

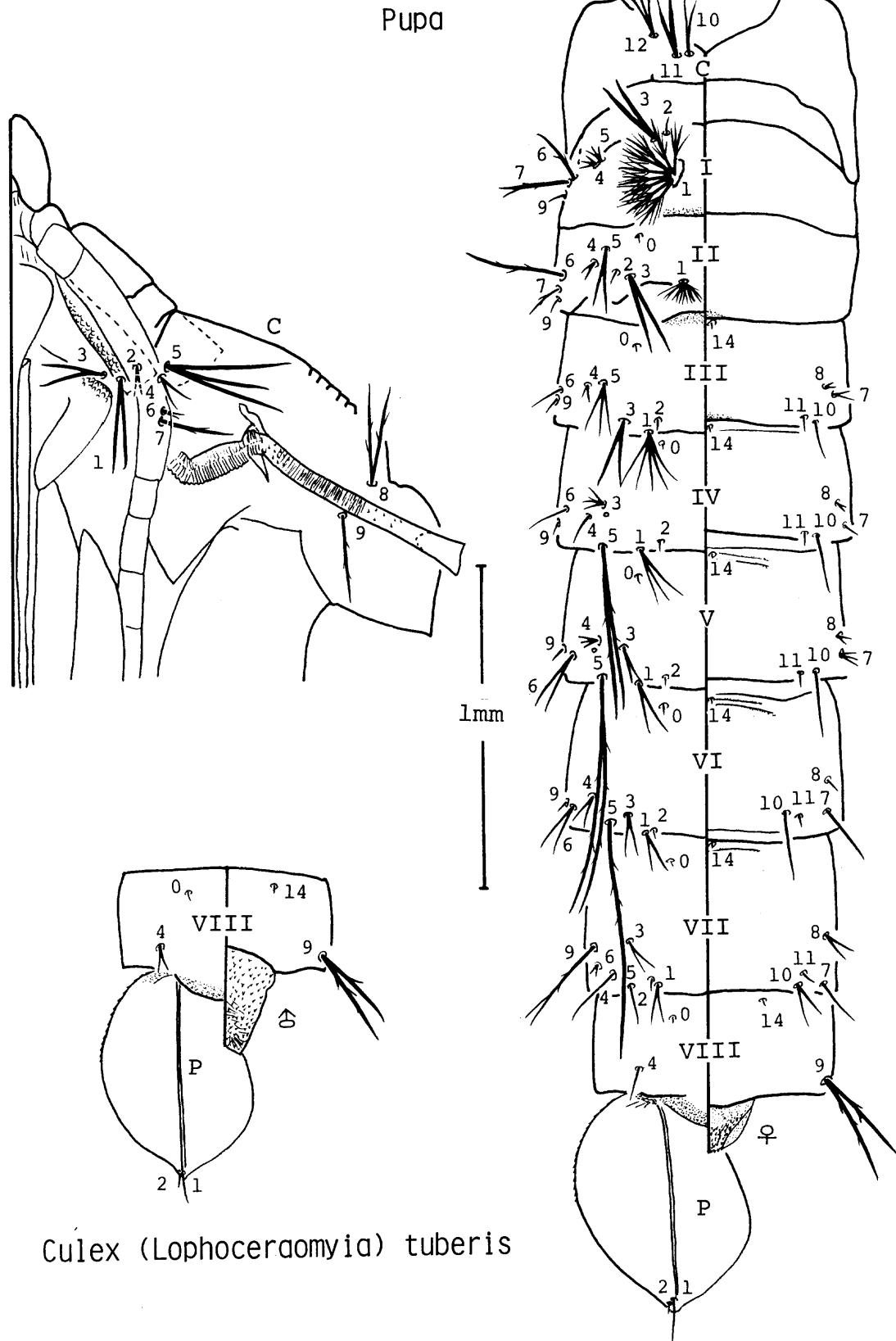


Table 15. Chaetotaxy of the pupa of Culex (Lophoceraomyia) tubervis

SETA NO.	CEPHALO- THORAX	ABDOMEN								PADDLE	
		I	II	III	IV	V	VI	VII	VIII		
0	-	-	-	1	1	1	1	1	1	1	-
1	2-4	120-210	10-25	3-6	2-5	2	1,2	1,2	1,2	1,2	1
2	1-4	1	1	1	1	1	1	1	1	1	1
3	1-3	1,2	1,2	1,2	2-4	1,2	1-3	1,2	1,2	1,2	-
4	1-4	1-4	1-3	1-3	1 (1-4)	1-4	1-3	1,2	1,2	1,2	1,2
5	2-4	2-6	2-4	1-5	1,2	1,2	1,2	1,2	1	1	-
6	1-3	1 (1,2)	1 (1,2)	1-4	1,2	1,2	1,2	1,2	1-4	1-4	-
7	1 (1,2)	1-3	1	1-3	1-3	1-5	1	1	1	1	-
8	1,2	-	-	1-4	1-3	1,2	1-3	1-4	1-4	1-4	-
9	1-3	1	1	1	1	1	1	1	1-4	1-4	1-4
10	2,3	-	-	1 (1,2)	1,2	1	1	1	1,2	1,2	-
11	1-3	-	-	1	1	1	1	1	1,2	1,2	-
12	1-4	-	-	-	-	-	-	-	-	-	-
14	-	-	-	1	1	1	1	1	1	1	1

Specimens examined: 15 from Ishigakijima



*Culex (Culiciomyia) nigropunctatus* Edwards  
1926. Bull. Entomol. Res. 17:121(nom. nov. for *annulata* Theobald,  
1907, Mon. Cul. 4:230(M,F; *Culiciomyia*). Type-loc.: Kuching,  
Borneo.

Notes. This is an Oriental species and Yaeyama Is. is the northernmost distribution of this species. Immatures have been commonly collected from rice paddies, swamps, ground pools and artificial containers in the open areas. They have been often found associated with *Ae. v. nipponii*, *Cx. tritaeniorhynchus*, *Cx. sitiens*, *Cx. fuscocephala* and *Cx. pseudovishnui*. The adults have been collected by light traps and human-baited net traps.

This species is reported from the Oriental region (including Taiwan) and Micronesia.

*Culex (Culiciomyia) pallidothorax* Theobald  
1905. J. Econ. Biol. 1:32(M,F). Type-loc.: India.

Notes. The immatures have been commonly found in artificial containers, tree holes and rock pools together with *Cx. ryukyensis* at the base of mountains and in forests. This is a new record in Minnajima.

This species is reported from Palaeartic Japan (except Hokkaido), the Oriental region (including Taiwan) and New Guinea.

*Culex (Culiciomyia) ryukyensis* Bohart  
1946. Proc. Biol. Soc. Wash. 59:41(M,F,L). Type-loc.: Chizuka,  
Okinawajima, Ryukyu Arch., Japan.

Notes. This species is very common throughout the Archipelago except for Miyakojima. Nakanoshima is the northernmost distribution of this species. The immatures breed in various habitats such as bamboo stumps, tree holes, artificial containers, rock pools, fresh water crab holes and ground pools at the base of mountains and in the forests. They have been frequently associated with *Or. anopheloides*, *Ae. albopictus*, *Ae. riversi*, *Ae. flavopictus* and *Ae. aureostriatus*. Adults have been collected by light traps. The adults, including gravid females have also been collected in the forest by sweeping but they have never been observed to feed on humans.

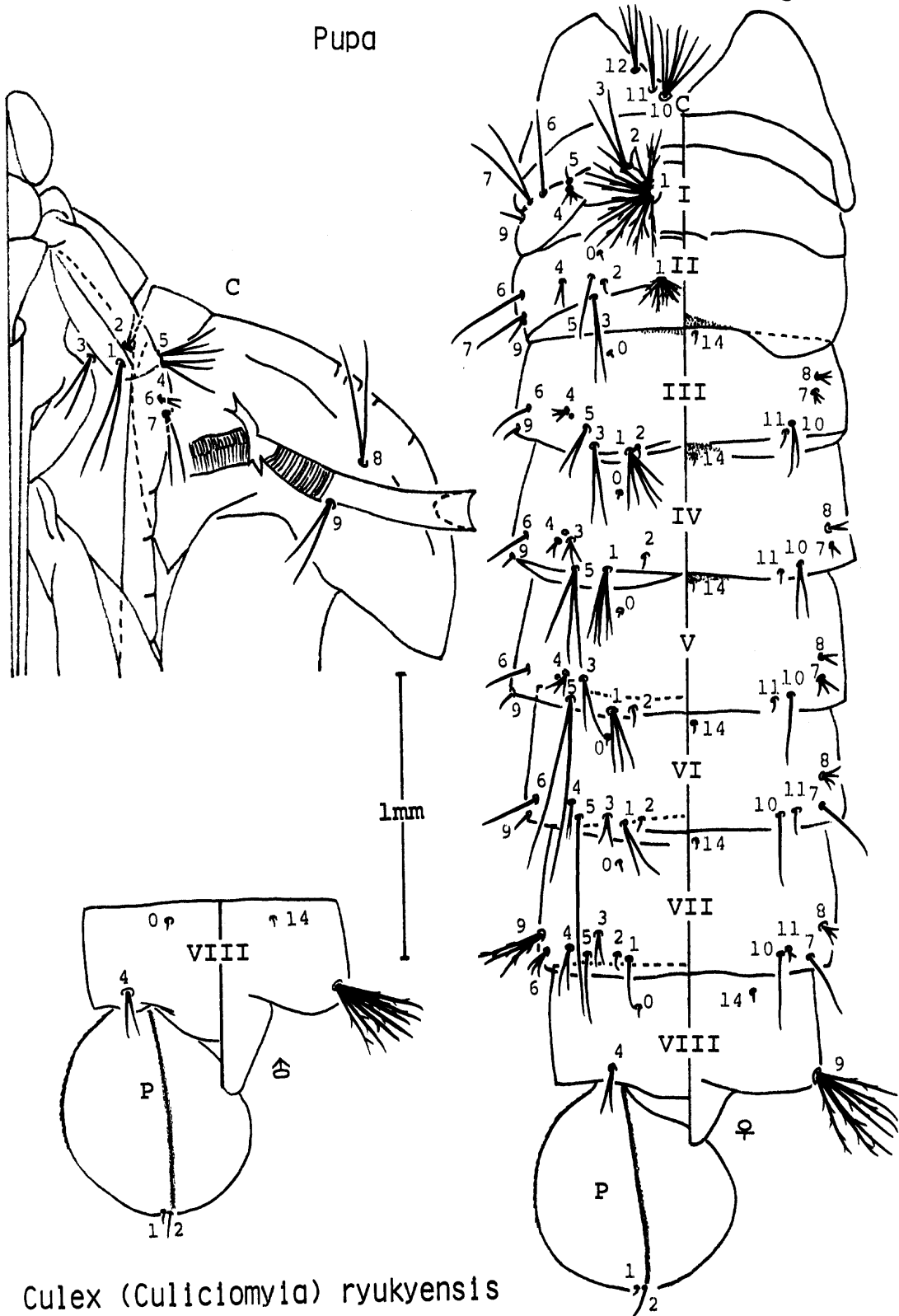
This species is not reported elsewhere.

#### Description of pupa

Abdomen: 3.08-3.33 mm. Trumpet: 0.79-0.85 mm. Paddle: length 0.78-0.84 mm, width 0.66-0.70 mm. Complete chaetotaxy as figured in Fig. 30 and recorded in Table 16. Cephalothorax. Moderately pigmented; seta 1-C double or triple; 7-C usually double(2,3); 8-C usually double(1-3); 9-C usually double(1,2). Trumpet. Moderately pigmented; index 7.13-8.10, average 7.67. Metanotum. Seta 10-C 5-8 branched; 11-C usually double(2,3); 12-C usually triple(2-5). Abdomen. Seta 1-I dendritic, 90-130 branched; 2-I usually single(1,2); 3-I usually double(1,2); 1-II 20-50 branched; 1-

Fig. 30.

Pupa



*Culex (Culiciomyia) ryukyensis*

Table 16. Chaetotaxy of the pupa of Culex (Culicomyia) ryukyensis

SETA NO.	CEPHALO-THORAX		ABDOMEN						PADDLE		
	I	II	III	IV	V	VI	VII	VIII			
0	-	1	1	1	1	1	1	1	1	1	-
1	2,3	20-50	3-10	3-8	3	1-3	1-3	1-3	1	1	1
2	2 (2,3)	1	1	1	1	1	1	1	1	1	1
3	2 (1-3)	2 (1,2)	2 (1,2)	2-8	2 (1-3)	1,2	2 (1,2)	2 (1,2)	2	2	-
4	3 (2-4)	1-4	2-5	2 (1-4)	2-7	1-3	2 (1,2)	2 (1,2)	2	2	-
5	2-4 (1-3)	1 (1,2)	2 (1-3)	3 (2-4)	2 (1,2)	1 (1,2)	1 (1,2)	1	1	1	-
6	2 (1-4)	1	1	1	1	1	1	2-5	1	1	-
7	2 (2,3)	1,2	2-6	2 (1-3)	3-5	1	1	1	1	1	-
8	2 (1-3)	-	3 (1-4)	2 (1,2)	1-3	2-5	2-4	2-4	2	2	-
9	2 (1,2)	1	1	1	1	1	3 (3-5)	3 (3-5)	3	3	5-9
10	5-8	-	2 (1,2)	2 (1,2)	1 (1,2)	1	1	1	1	1	-
11	2 (2,3)	-	1	1	1	1 (1,2)	2 (1-5)	2 (1-5)	2	2	-
12	3 (2-5)	-	-	-	-	-	-	-	-	-	-
14	-	-	1	1	1	1	1	1	1	1	-

specimens examined: 12 from Yona, Okinawajima

III 3-10 branched; 1-IV 3-8 branched; 1-V usually triple(2-4); 1-VI, VII 1-3 branched; 5-I usually single(1-3); 5-II usually single(1,2); 5-III usually double(1-3); 5-IV usually triple(2-4); 5-V usually double(1,2), long; 5-VI usually single(1,2), long; 5-V, VI longer than 5-I-IV, VII; 9-I-VI single, small; 9-VII usually triple(3-5); 9-VIII 5-9 branched. Paddle. Ovoid; 1,2-P single; index 1.12-1.23, average 1.17.

*Culex (Culex) bitaeniorhynchus* Giles

1901. J. Bombay Nat. Hist. Soc. 13:607(A). Type-loc.: Travancore, India.

Notes. This species is very common in the Archipelago. The immatures have been collected from rice paddies, fallows in open areas and rock pools in the mountain forest especially in association with green algae. They are often associated with *An. sinensis*, *Ae. v. nipponii*, *Cx. tritaeniorhynchus*, *Cx. pseudovishnui*, *Cx. mimeticus*, *Cx. infantulus* and *Cx. fuscocephala*. Adults have been collected by light traps and human-baited catches.

This species is reported from Palaeartic Japan, the Oriental (including Taiwan) and African regions.

*Culex (Culex) fuscocephala* Theobald

1907. Mon. Cul. 4:420(F). Type-loc.: Peradeniya, Ceylon.

Notes. This species has never been found on Okinawa and Amami Islands but is very common on the Yaeyama Islands. The immatures have been frequently collected from rice paddies and fallows in association with *An. sinensis*, *Cx. tritaeniorhynchus*, *Cx. nigropunctatus*, *Cx. bitaeniorhynchus*, *Cx. sitiens* and *Cx. pseudovishnui*. They have also been taken from artificial containers located in open fields. The adults, including engorged females, have been collected commonly by light traps in cow sheds and human-baited net traps. In Thailand, *Cx. fuscocephala* is considered to be an efficient vector of Japanese encephalitis (Muangman *et al.*, 1972).

This species is reported from the Oriental (including Taiwan) region.

*Culex (Culex) mimeticus* Noe

1899. Boll. Soc. Entomol. Ital. 31:240(F). Type-loc.: Grassano in Basilicata, Italy.

Notes. This species is common throughout the Archipelago except for the Daito Islands. The immatures has been collected from rice paddies and fallows in association with *An. sinensis*, *Cx. bitaeniorhynchus*, *Cx. tritaeniorhynchus* and *Cx. pseudovishnui*. The adults have been collected by light traps. Small numbers of females were collected by daytime biting collections and dry ice traps in the forest. It is a new record in Izenajima.

This species is reported from Palaeartic Japan and the Oriental region (including Taiwan).

*Culex (Culex) jacksoni* Edwards

1934. In: Barraud, Fauna Brit. India, Diptera 5: 452(M,F,L).  
Type-loc.: Shonson Hill, Hong Kong.

Notes. This species is very rare in the Archipelago. Several immatures were collected with *An. sinensis*, *Cx. bitaeniorhynchus* and *Cx. mimeticus* from small ground pools in an open area at Kin, Okinawajima, March 17, 1980. One male and 3 females reared from the larvae were examined for identification. This species is a new record in the Archipelago.

This species is reported from Kyushu, Palaeartic Japan (Mogi, 1978), Korea and the Oriental region (including Taiwan).

*Culex (Culex) quinquefasciatus* Say

1823. J. Acad. Nat. Sci. Philad. 3:10(A; as sp.). Type-loc.: Mississippi River, United States.

Notes. This species is very common throughout the Archipelago. The immatures have been collected from artificial containers and ground pools with polluted water in urban to rural areas. The larvae were commonly preyed upon by those of *Cx. halifaxii* and *Cx. fuscianus*. This is the prevalent domestic mosquito, biting humans at night. Adults were collected throughout the year by light traps and a few fed and gravid females were found even in the winter season. There were clearly two population peaks of adults during the year, one in May and the second in October (Toma *et al.*, 1978b).

This species is reported from Palaeartic Japan (except Hokkaido) and is cosmopolitan.

*Culex (Culex) pseudovishnui* Colless

1957. Ann. Trop. Med. Parasit. 51:88(M,F,L). Type-loc.: Singapore.

Notes. This species is not so common as *Cx. tritaeniorhynchus* in the Archipelago. We have never found this species in the Tokara and the Daito Islands. The immatures have been collected from rice paddies and fallows in association with *Cx. tritaeniorhynchus*, *Cx. bitaeniorhynchus* and *Cx. fuscocephala*. Adults have been collected by light traps in cow sheds and human-baited net traps. This species is a new record in Minnajima and Izenajima.

This species is reported from Palaeartic Japan (except Hokkaido), the Oriental region (including Taiwan) and Indonesia (West Irian and Mollucas).

*Culex (Culex) sinensis* Theobald

1903. Mon. Cul. 3:180(F; *gelidus* var.). Type-loc.: Shaohyling, China.

Notes. This species is not common in the Archipelago. In the Yaeyama Islands, the females are often attracted to human-baited

net traps in the field but we have never found the immatures.

This species is reported from Palaeartic Japan (except Hokkaido), Korea, China, U. S. S. R. (Maritime Province) and the Oriental region (including Taiwan).

*Culex (Culex) sitiens* Wiedemann

1828. *Aussereurop. Zweifl. Ins.* 1:542(F). Type-loc.: Sumatra.

Notes. This species is commonly found in coastal open areas. The immatures have been collected from ground pools, rock pools and fallows with brackish water. They are often found with *An. sinensis*, *Cx. nigropunctatus*, *Cx. fuscocephala* and *Ae. togoi*.

This is an Oriental (including Taiwan) species with an extensive range covering the Ethiopian, Palaeartic (excluding Japan) and the Australasian regions and the islands of the Central and South Pacific.

*Culex (Culex) tritaeniorhynchus* Giles

1901. *J. Bombay Nat. Hist. Soc.* 13:606(A). Type-loc.: Travancore, India.

Notes. This species is very common in the Archipelago. The immatures have been most frequently collected from rice paddies and fallows associated with *An. sinensis*, *Ae. v. nipponii* and *Cx. bitaeniorhynchus*. They have been also often taken from containers with clean water. The adults are zoophilic, collected in cow and pig sheds. They have been also collected by human-baited net traps, light traps, dry ice traps and sweeping.

This species is reported from Palaeartic Japan, Micronesia, the Middle East, the Oriental (including Taiwan) and Ethiopian regions.

*Culex (Culex) vagans* Wiedemann

1828. *Aussereurop. Zweifl. Ins.* 1:545(M,F). Type-loc.: China.

Notes. This species is very rare in the Archipelago. The immatures have been collected from fallows in association with *An. sinensis* (Toma *et al.*, 1978a). This species was reported to be naturally as well as experimentally infected with *Wuchereria bancrofti* (Bohart, 1946).

This species is reported from Palaeartic Japan, Siberia and the Oriental region (including Taiwan).

*Culex (Culex) whitmorei* (Giles)

1904. *J. Trop. Med.* 7:367 (F; *Taeniorhynchus*). Type-loc.: Camp Stotsenburg, Pampanga, Philippines.

Notes. This species has not been collected in the Archipelago except on Amami Oshima where it is scarce. The immatures have been collected from ground pools and rice paddies while adults collections by light and dry ice traps in cow sheds.

This species is reported from Palaearctic Japan, the maritime provinces of U. S. S. R. and the Oriental (including Taiwan) and Australian regions.

#### DISTRIBUTION AND LARVAL ASSOCIATION

The distribution of mosquitoes occurring in the Ryukyu Archipelago is shown in Table 17. Frequencies of the larval associations for mosquitoes collected from artificial containers at the base of mountains and forests in Okinawajima, tree holes in Okinawajima and Iriomotejima, bamboo stumps in Okinawajima and crab holes in Iriomotejima, Ryukyu Archipelago are shown in Tables 18-22, respectively.

#### MOSQUITOES MEDICAL IMPORTANCE

In the Ryukyu Archipelago, only a few cases of Japanese encephalitis and bancroftian filariasis presently occur. But in the past, other serious mosquito-borne diseases such as malaria and dengue have occurred in the Archipelago. From the zoogeographical and climatic aspects, possibilities exist for the introduction and establishment of these mosquito-borne diseases. Vector biology and pest mosquito species in the Archipelago will be discussed briefly.

*Anopheles minimus* is one of the most important vectors of malaria in Asian countries and was the primary vector of malaria in the Miyako and the Yaeyama Islands before and after World War II (1946-48). A great amount of DDT was used as a residual spray for malaria eradication in Yaeyama Is. from 1957 to 1962. Soon afterwards, populations of *An. minimus* as well as malaria cases decreased suddenly in the Archipelago and no new indigenous malaria cases have been reported since 1962. At present, *An. minimus* is very common in Ishigakijima and Iriomotejima and their immatures are found commonly in streams at the base of mountains. The females feed upon cattle in the pastures.

*Anopheles sapersoi* is an endemic species in Okinawajima and Iriomotejima. Its importance as a malaria vector was not known, but judging from the biology of this mosquito and epidemiological information on the malaria epidemics among the evacuees in the northern part of Okinawajima from 1946 to 1948 (Fukuchi, 1973), *An. sapersoi* seemed to be an important vector. Experimental infection of *Plasmodium vivax* in *An. s. ohamai* from Ishigakijima was reported by Ohama (1968).

*Anopheles sinensis* and *An. lesteri* have also been thought to be former malaria vectors in the Archipelago. The populations of these mosquitoes are much reduced now, because of the decrease of rice fields in the Archipelago.

Recently, the chance of imported malaria cases from tropical areas into the Archipelago has been increasing (Asato and Hasegawa, 1981). Imported malaria and the possibilities of transmission in the Archipelago are important problems which should not be ignored.

*Culex quinquefasciatus* is the most common and widespread





Table 17(continued).

Distribution  Species	Ryukyu Archipelago														Oriental r.(incl.Taiwan)	Palaeartic Japan								
	Tokara Is.		Amami Is.		Okinawa Is.				Miyako Is.		Yaeyama Is.			Daito Is.										
	Nakanoshima	Takarajima	Kuchinoshima	Amami Oshima	Tokunoshima	Okinawajima	Itheyajima	Izenajima	Minnajima	Kumejima	Miyakojima	Ishigakijima	Iriomotejima	Kuroshima			Haterumajima	Yonagunijima	Kita Daitojima	Minami Daitojima				
<i>Ae. baisasi</i>				⊙					⊙	⊙	○	○			○			+						
<i>aegypti</i>						●				●	●	●	●						+					
<i>albopictus</i>	○	○	○	○	●	○	○	○	⊙	●	○	○	○	○	●	○	○	○	+	+				
<i>f. downsi</i>	○			○	●	○				●														
<i>f. miyarai</i>												○	○											
<i>riversi</i>	○	○		○	●	○	○				○	○	●		○					+				
<i>daitensis</i>																	○	○						
<i>v. nipponii</i>	○			○	●	○	○		⊙		○	○	○		●	○		○		+				
<i>atriisimilis</i>												○												
<i>iriomotensis</i>												○												
<i>nobukonis</i>											●	○								+				
<i>lineatopennis</i>											⊙	○	○			○				+				
<i>Ar. subalbatus</i>	○	○	○	○	●	○	○	○	⊙	●	○	○	○	○	○	○	○	○	○	+	+			
<i>Cx. fuscans</i>						○			⊙		⊙	○	○				○	○		+				
<i>halifaxii</i>	○			○	●	○	○	⊙	⊙		○	○	○	●	●	○		○		+	+			
<i>brevipalpis</i>						●						●	○								+			
<i>h. ryukyuanus</i>				○	●	○				⊙	○	○	●											
<i>okinawae</i>				○		○						○	○								+			
<i>cinctellus</i>												●	○			⊙					+			
<i>infantulus</i>				○		○						○	○			○					+	+		
<i>bicornutus</i>												○	○			○					+			
<i>rubithoracis</i>				●		○	○											○			+	+		
<i>tuberis</i>						○						○	○									+		
<i>nigropunctatus</i>												○	○			○						+		
<i>pallidothorax</i>				●		○			⊙			●			○							+	+	
<i>ryukyensis</i>	○			○	●	○	○		⊙			○	○			○								
<i>bitaeniorhynchus</i>		○		○	●	○	○			●	○	○	○			○						+	+	
<i>fuscocephala</i>												○	○										+	
<i>mimeticus</i>	⊙			○	●	○	○	⊙		●	○		○										+	+
<i>jacksoni</i>						⊙																	+	+
<i>quinquefasciatus</i>	○	○		○	●	○	○	○	⊙	●	○	○	○	○	○	○	○	○	○	○	○	+	+	
<i>pseudovishnui</i>				○	●	○	○	⊙			○	○	○			○							+	+
<i>sinensis</i>				○		●					?	●	○										+	+
<i>sitiens</i>						○					●	○	○										+	
<i>tritaeniorhynchus</i>	○	○	⊙	○	●	○	○	○	⊙		○	○	○		●	○	○	○	○	○	○	+	+	
<i>vagans</i>				○		●	○									○							+	+
<i>whitmorei</i>				○		●						●	●										+	+

○; collection by authors, ●; collection by others,  
 ⊙; new record by authors, ?; uncertain, +; distribution

Table 18. Larval associations for mosquitoes collected in artificial containers at the base of mountain and forest in Okinawajima, Ryukyu Archipelago

Artificial containers: 377 collections at base of mountain (93 collections in forest)*	<i>An. sinensis</i>	<i>Tx. sp.</i>	<i>Ur. n. ryukyuanus</i>	<i>Ur. jacksoni</i>	<i>Ur. annandalei</i>	<i>Or. anopheleoides</i>	<i>Ae. okinawanus</i>	<i>Ae. watasei</i>	<i>Ae. albopictus</i>	<i>Ae. f. downsi</i>	<i>Ae. riversi</i>	<i>Ar. subalbatus</i>	<i>Cx. halifaxii</i>	<i>Cx. okinawae</i>	<i>Cx. infantulus</i>	<i>Cx. tubercis</i>	<i>Cx. pallidotho.</i>	<i>Cx. ryukyensis</i>	<i>Cx. quinque.</i>
<i>An. sinensis</i>																			
<i>Tx. sp.</i>	2* (1)																		
<i>Ur. n. ryukyuanus</i>	(9)																		
<i>Ur. jacksoni</i>	(2)																		
<i>Ur. annandalei</i>																			
<i>Or. anopheleoides</i>																			
<i>Ae. a. okinawanus</i>																			
<i>Ae. watasei</i>																			
<i>Ae. albopictus</i>																			
<i>Ae. f. downsi</i>																			
<i>Ae. riversi</i>																			
<i>Ar. subalbatus</i>																			
<i>Cx. haliifaxii</i>																			
<i>Cx. okinawae</i>																			
<i>Cx. infantulus</i>																			
<i>Cx. tubercis</i>																			
<i>Cx. pallidothorax</i>																			
<i>Cx. ryukyensis</i>																			
<i>Cx. quinque.</i>																			

\* Larval association in the forest is shown in parenthesis.

Table 19. Larval associations for mosquitoes collected in tree holes at the base of mountain and forest in Okinawajima, Ryukyu Archipelago

Tree holes: 48 collections at base of mountain (152 collections in forest)*	Tx. sp.	Ur. n. ryukyana	Or. anopheleoides	Ae. a. okinawanus	Ae. watasei	Ae. albopictus	Ae. f. downsi	Ae. riversi	Ar. subalbatus	Cx. halifaxii	Cx. okinawae	Cx. pallidothorax	Cx. ryukyensis
Tx. sp.	0 (3)*	0 (4)	2 (45)	4 (39)	0 (6)	8 (0)	0 (3)	0 (3)			0 (4)		0 (3)
Ur. n. ryukyana			6 (17)	16 (16)	2 (5)	8 (0)	8 (3)	10 (4)	1 (0)	5 (0)	0 (3)	1 (0)	4 (2)
Or. anopheleoides		0 (4)	0 (4)	10 (116)	0 (25)	2 (0)	5 (10)	15 (15)		5 (0)	0 (16)	0 (1)	4 (6)
Ae. a. okinawanus			1 (2)	1 (2)	5 (29)	10 (0)	16 (15)	16 (18)	1 (0)	12 (0)	0 (8)	1 (1)	12 (8)
Ae. watasei					0 (1)	5 (0)	4 (8)	6 (9)		1 (0)		0 (1)	1 (2)
Ae. albopictus							8 (0)	11 (0)	1 (0)	2 (0)			3 (0)
Ae. f. downsi								12 (10)	1 (0)	4 (0)	0 (2)	1 (0)	6 (0)
Ae. riversi										3 (0)	0 (2)		6 (2)
Ar. subalbatus													
Cx. halifaxii													
Cx. okinawae													
Cx. pallidothorax												1 (0)	10 (0)
Cx. ryukyensis													0 (0)

\* Larval association in the forest is shown in parenthesis.

Table 20. Larval associations for mosquitoes collected in tree holes at the base of mountain and forest in Iriomotejima, Ryukyu Archipelago

Tree holes: 12 collections at base of mountain (33 collections in forest)*	Tx. m. yaeyamae	Tp. b. yaeyamensis	Ur. n. ryukyuanana	Or. anopheloides	Ae. a. taiwanus	Ae. j. yaeyamensis	Ae. watasei	Ae. albopictus	Ae. f. miyagai	Ae. riversi	Ar. subalbatus	Cx. halifaxii	Cx. infantulus	Cx. bicornutus	Cx. nyukyensis	Cx. quinquefasciatus
Tx. m. yaeyamae	0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tp. b. yaeyamensis	(5)	(7)	1	1	0	0	1	0	0	1	0	0	0	0	0	0
Ur. n. ryukyuanana	(1)	(10)	(8)	(8)	1	0	2	0	0	0	0	0	0	0	0	0
Or. anopheloides			(1)	(1)	1	(1)	(1)	0	0	0	0	0	0	0	0	0
Ae. a. taiwanus			0	0	1	0	0	0	0	0	0	0	0	0	0	0
Ae. j. yaeyamensis			(1)	(1)	(8)	(1)	(1)	0	0	0	0	0	0	0	0	0
Ae. watasei			0	0	(1)	0	0	0	0	0	0	0	0	0	0	0
Ae. albopictus			0	0	0	0	0	1	0	0	0	0	0	0	0	0
Ae. f. miyagai			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ae. riversi			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ar. subalbatus			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cx. halifaxii			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cx. infantulus			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cx. bicornutus			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cx. nyukyensis			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cx. quinquefasciatus			0	0	0	0	0	0	0	0	0	0	0	0	0	0

\* Larval association in the forest is shown in parenthesis.

Table 21. Larval associations for mosquitoes collected in cut bamboos at the base of mountain and forest in Okinawajima, Ryukyu Archipelago

Bamboo stumps: 74 collections at base of mountain (7 collections in forest)*	<i>Ur. n. ryukyuana</i>	<i>Ur. nivipleura</i>	<i>Or. anopheloides</i>	<i>Ae. a. okinawanus</i>	<i>Ae. watasei</i>	<i>Ae. albopictus</i>	<i>Ae. f. downsi</i>	<i>Ae. riversi</i>	<i>Ar. subalbatus</i>	<i>Cx. ryukyensis</i>
<i>Ur. n. ryukyuana</i>	2 (0)*	2 (0)		11 (0)	1 (0)	5 (0)	34 (1)	8 (0)	6 (0)	
<i>Ur. nivipleura</i>				2 (0)			2 (0)	2 (0)		
<i>Or. anopheloides</i>							2 (0)			
<i>Ae. a. okinawanus</i>					1 (0)	3 (0)	12 (0)	5 (1)	5 (0)	1 (0)
<i>Ae. watasei</i>							1 (0)		1 (0)	
<i>Ae. albopictus</i>						1 (0)	6 (0)	4 (0)	2 (0)	
<i>Ae. f. downsi</i>							27 (5)	8 (0)	8 (0)	
<i>Ae. riversi</i>								1 (0)	2 (0)	
<i>Ar. subalbatus</i>										
<i>Cx. ryukyensis</i>										2 (0)

Table 22. Larval associations for mosquitoes collected in crab holes at the base of mountain and forest in Iriomotejima, Ryukyu Archipelago

Crab holes: 15 collections at base of mountain (22 collections in forest)*	<i>Ur. ohamai</i>	<i>Ur. yaeyamana</i>	<i>Ur. macfarlanei</i>	<i>Ae. baisasi</i>	<i>Cx. infantulus</i>	<i>Cx. bicornutus</i>	<i>Cx. tuberos</i>	<i>Cx. ryukyensis</i>
<i>Ur. ohamai</i>	0 (2)*	2 (4)	0 (1)	3 (0)	0 (1)	0 (1)	3 (15)	0 (2)
<i>Ur. yaeyamana</i>				1 (0)			2 (4)	
<i>Ur. macfarlanei</i>					0 (1)		0 (1)	0 (1)
<i>Ae. baisasi</i>				7 (0)			4 (0)	
<i>Cx. infantulus</i>							0 (1)	0 (1)
<i>Cx. bicornutus</i>							0 (1)	
<i>Cx. tuberos</i>							2 (1)	0 (2)
<i>Cx. ryukyensis</i>								0 (2)

\* Larval association in the forest is shown in parenthesis.

mosquito in the Archipelago and the only domestic species biting at night. Filariasis due to *Wuchereria bancrofti* had been a serious health problem until 15 years ago in the Archipelago. However, owing to improvements of general sanitary conditions, the disease has disappeared spontaneously in the formerly notorious endemic foci in the Archipelago (Sasa, 1976; Sasa *et al.*, 1977).

*Aedes togoi* and *Ma. uniformis* are well known as important vectors of Malayan filariasis (*Brugia malayi*) in Korea and Malaya. In the Archipelago, these mosquitoes are common and readily attack large animals such as cattle and pigs but are not so vicious man-biters.

*Culex tritaeniorhynchus* is well known as the main vector of Japanese encephalitis. Recently, the population of this species has rapidly decreased because the main larval habitats such as rice paddies have been reduced in area. The decline of human cases in the Archipelago is probably associated with both the extension of immunization among children and the decrease of vector population density. The bionomics of *Cx. pseudovishnui* is very similar to *Cx. tritaeniorhynchus* and it may be a vector of Japanese encephalitis virus in Japan as well as the Oriental region. However, its role as a carrier of this disease or other related viruses has not yet been definitely established.

Epidemics of dengue or dengue-like fever have been reported from time to time in the Archipelago (Miyao, 1931). *Ae. aegypti* was considered the principal vector and *Ae. albopictus* seemed to be of secondary importance at that time. *Aedes aegypti* has not been found in spite of our recent extensive surveillances. At present, *Ae. albopictus* is the most common and vicious daytime biter around human dwellings in the Archipelago. *Aedes riversi* is also very common in forests at the base of mountains. Other species of the subgenus *Stegomyia* (*Ae. f. downsi*, *Ae. f. miyarai* and *Ae. daitensis*) are known to occur in the Archipelago. These are also vicious daytime biters but localized and restricted within the forest areas.

*Aedes iriomotensis* is an endemic species of Iriomotejima. The females are common and vicious biters in the forest but immatures are rarely found in temporary ground pools in the forest.

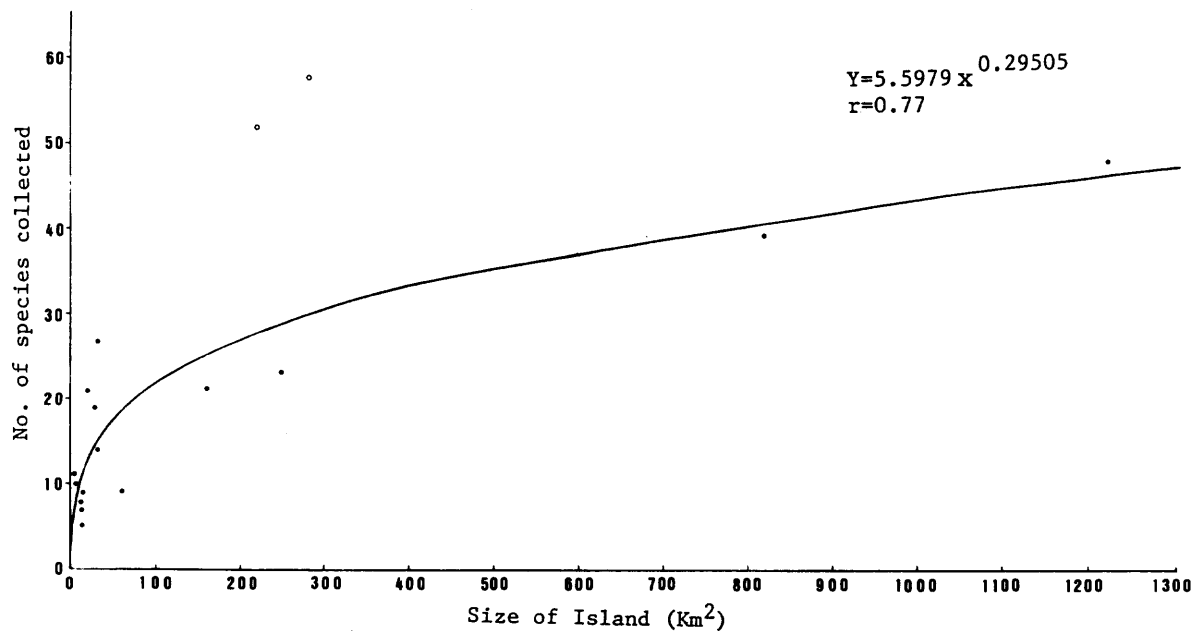
#### FAUNAL NOTES

The numbers of mosquitoes genera and species on each Island and geographical distribution of mosquitoes in the Ryukyu Archipelago are indicated in Table 23 and Fig. 32 respectively.

The known mosquito fauna is well-balanced and northern Oriental in character, but there is an admixture of southern Palaearctic species. All 3 subfamilies are represented: the Anophelinae by 7 species in one genus, the Toxorhynchitinae by 2 species in one genus, and the Culicinae by 62 species in 15 genera. Of the total of 71 known species 28 (39.4 %) occur in the Oriental region and the Archipelago: *An. bengalensis*, *An. minimus*, *An. tessellatus*, *Tx. manicatus*, *Ml. genurostris*, *Mi. elegans*, *Mi. luzonensis*, *Cq. crassipes*, *Ur. jacksoni*, *Ur. nivipleura*, *Ur. yaeyamana*, *Ur. annandalei*, *Ur. macfarlanei*, *Ur. lateralis*, *Ae.*

Table 23. The numbers of mosquito genera and species

	Area <sub>2</sub> (Km <sup>2</sup> )	Genera	Species	% of total species
Ryukyu Archipelago	3589	15	71	100.0
Tokara Is.	89	9	20	28.2
Nakanoshima	27		19	
Takarajima	7		10	
Kuchinoshima	13		5	
Amami Is.	1237	13	39	54.9
Amami Oshima	818		39	
Tokunoshima	248		23	
Okinawa Is.	1415	12	49	67.6
Okinawajima	1220		48	
Iheyajima	21		21	
Izenajima	14		9	
Minnajima	0.6		11	
Kumejima	59		9	
Miyako Is.	225	7	21	29.6
Miyakojima	159		21	
Yaeyama Is.	579	13	61	85.9
Ishigakijima	221		52	
Iriomotejima	284		58	
Kuroshima	10		10	
Haterumajima	13		7	
Yonagunijima	28		27	
Daito Is.	44	7	14	19.7
Kita Daitojima	13		8	
Minami Daitojima	31		14	
Palaeartic Japan	374054	12	68	



Symbol o in the figure shows Ishigakijima in the Yaeyama Is.

Fig. 31. Relationship between the size of Islands in the Ryukyu Archipelago and number of species collected

*aegypti*, *Ae. vigilax*, *Ae. albocinctus*, *Ae. baisasi*, *Ae. lineatopennis*, *Cx. fuscatus*, *Cx. brevivalpis*, *Cx. okinawae*, *Cx. cinctellus*, *Cx. bicornutus*, *Cx. tuberis*, *Cx. nigropunctatus*, *Cx. sitiens* and *Cx. fuscocephala*. On the other hand, 28(39.4 %) species occur throughout the Oriental and Palaeartic Japan: *An. lindesayi*, *An. sinensis*, *An. lesteri*, *Tp. bambusa*, *Ma. uniformis*, *Cq. ochracea*, *Ur. novobscura*, *Or. anopheloides*, *Ae. togoi*, *Ae. albopictus*, *Ae. vexans*, *Ar. subalbatus*, *Cx. halifaxii*, *Cx. hayashii*, *Cx. infantulus*, *Cx. rubithoracis*, *Cx. pallidothorax*, *Cx. bitaeniorhynchus*, *Cx. mimeticus*, *Cx. quinquefasciatus*, *Cx. pseudovishnui*, *Cx. tritaeniorhynchus*, *Cx. vagans*, *Cx. whitmorei*, *Cx. sinensis*, *To. yanbarensis*, *Ae. aureostriatus* and *Cx. jacksoni*, which last 3 species are known to occur only in Kyushu, southern part of the Palaeartic Japan. Only 5(7.0 %) species, *Ae. japonicus*, *Ae. watasei*, *Ae. flavopictus*, *Ae. riversi* and *Ae. nobukonis* are known to occur in the Archipelago as well as the Palaeartic Japan. Endemic species are 10 (14.1 %) as follows: *An. saperoi*, *Ur. ohamai*, *Hs. kana*, *Ae. nishikawai*, *Ae. daitensis*, *Ae. atriisimilis*, *Ae. iriomotensis*, *Cx. ryukyensis*, *Toxorhynchites* sp. and *Ficalbia* sp.

As shown in Fig. 31, there is a high correlation between the size of an island and the number of species reported. The relationship between the size X and the number Y is represented by the equation  $Y=5.5979X^{0.29505}$ , which is obtained by the method of least squares, and the coefficient of correlation, r, is 0.77. The Y values corresponding to the X values in Ishigakijima and Iriomotejima are apparently far from the curved line. The reason is considered that they locate near Formosa and are mountainous with heavily wooded and with a greater abundance of water, wild and domestic animals for their size.

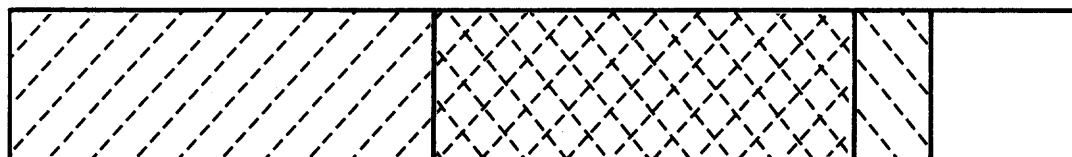
Tanaka *et al.* (1979) proposed many subspecies in accordance with geographical and minor morphological differentiations. As

Species occurring in Oriental region 56 spp.(78.9%)

Species occurring both Orient and Palaeartic Japan  
28 spp.(39.4%)

Species occurring in Palaeartic Japan  
33 spp.(46.5%)

Endemic species  
10 spp.(14.1%)



Species occurring in the Ryukyu Archipelago 71 spp.

Fig. 32. General character of the mosquito fauna of the Ryukyu Archipelago



to taxonomic treatment of subspecies, we here provisionally followed Tanaka *et al.* (1979). We suggest hybridization experiments and comparison of the isozymes may yield information of broad application to the puzzling features of island speciation among mosquitoes.

#### ACKNOWLEDGEMENT

We are indebted to Dr. Atsuo Sato, Professor, Department of Medical Zoology, Faculty of Medicine, Kagoshima University and Dean Masamitsu Otsuru, Department of Parasitology, Faculty of Medicine, University of the Ryukyus, for their generous encouragement and cooperation in this research. We wish to thank Dr. Ronald A. Ward, Department of Entomology, Walter Reed Army Institute of Research, for critically reviewing the manuscript. Thanks are also due to Dr. Sigeo Iha, Department of Environment and Health, Okinawa Prefecture, Dr. Masao Hoshino, Director, Research Institute of Tropical Agriculture, College of Agriculture, University of the Ryukyus, Dr. Hiroshi Suzuki, Institute of Tropical Medicine, Nagasaki University and Mr. Hiroshi Kimura, Ishigaki Branch Office of Naha Quarantine Station, for warmhearted understanding for carrying out field collections. Our great indebtedness should be expressed to the members of Gajan (mosquito) Research Team in Okinawa: Mr. S. Sakamoto, Mr. S. Nakamura, Miss Y. Tokuyama, Mr. H. Otake, Mr. S. Kusunoki, Miss. S. Hoshino, Mr. H. Higa, Mr. H. Miyajima, Mr. O. Teruya, Miss. T. Saito, Mr. M. Otake, Mr. K. Mitsuda and Mr. S. Kamiyama, for their kindness in various ways.

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