A New Species of the Genus *Aedes (Aedes)* from Japan, with Synonymical Notes on Japanese Species of the Subgenus *Aedes* (Diptera, Culicidae)[1]

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ABSTRACT

Aedes (Aedes) sasai, a new species, is described. *Ae. (Ae.) asanumai*, *Ae. (Ae.) pseudoesoensis*, and *Ae. (Ae.) rossicus* of Hara (1958) from Japan (*nec* Dolbeshkin *et al.*, 1930) are treated as synonyms of *Ae. (Ae.) esoensis*.

INTRODUCTION

In the course of our general revision of mosquitoes of Japan including the Ryukyu and Ogasawara Islands, and Korea, it was revealed that relatively large taxonomical changes would be necessary for species of the subgenus *Aedes*. We believe it better to present a special paper on these changes prior to completion of the project.

Eight species of this subgenus have been recorded as occurring in Japan, including the Ryukyu Islands (*cf.* Stone *et al.*, 1959; Stone 1961). *Ae. ishigakiensis* Bohart, 1956, one of the two species of Oriental stock of these eight, was transferred to the subgenus *Neomacleaya* by Delfinado (1968). Reinert (1973) treated *nobukonis* Yamada, 1932, as a member of *Neomacleaya*. Our study supports this view. The taxonomic status of the remaining 6 palaearctic species were reexamined, resulting in the following findings. *Ae. esoensis* Yamada, 1921, and *yamadai* Sasa *et al.*, 1950, are valid; the species previously known as *cinereus* is an undescribed species; *asanumai* Sasa *et al.*, 1950, *pseudoesoensis* Yamaguti and Tamaboko, 1954, and *rossicus* of Hara (1958) are not distinct from *esoensis*. Thus, the subgenus *Aedes* of Japan is now represented by but 3 species.

Aedes (Aedes) sasai sp. nov.
(Figs. 1,2,3a,3e; Table 1)

Aedes (Aedes) cinereus Meigen; Sasa, 1948, Nisshin Igaku 35 (4): 176 (male-G) ---Rubeshibe, Hokkaidô (misidentification); Sasa and Asanuma, 1948, Ka o Shiraberu Hito no Tameni: 71 ---Hokkaidô; Sasa, 1948, Japan. Med. J. 1 (6); 531; Sasa and Takahasi, 1949, Japan. Med. J. 2(1): 54 --- Rubeshibe, Hokkaidô; Sasa, Asanuma, Kano and Hayashi, 1949, Sôgô Igaku

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6 (23): 1228 ---Oze; Sasa, Kano and Takahasi, 1950, Japan. J. Exp. Med. 20: 634; Asanuma, Kano and Takahasi, 1952, Bull. Hokkaidô Hlth. Inst., 3: 40 ---Hokkaidô; Sato, 1959, J. Hokkaido Gakugei Univ. Sec. II B, 10 (2): 348 ---Tenninkyô, Hokkaidô; Sato and Tomita, 1962, J. Hokkaido Gakugei Univ. Sec. II B, 13 (1): 148, 156 ---Wakoto and Kawayu, Hokkaidô; Kurihara, 1963, Japan, J. Sanit. Zool. 14 (4): 197 ---Rubeshibe, Hokkaidô; Sato and Tatewaki, 1967, Rep. Taisetsuzan Inst. Sci., Hokkaido Univ. Educ. No. 6: 12 ---Ginsendai, Daisetsu Mts., Hokkaidô; Sato and Ito, 1969, Seibutsu Kyozai No. 6: 29-38 ---Rubeshibe, Hokkaidô; Sasa and Kamimura, 1971, Progr. Sanit. Zool.: 21 ---Hokkaidô, northeastern Honshû.

A blackish brown, medium- to rather large-sized mosquito with unornamented scutum and dark legs; the larva typical of the subgenus.

FEMALE. Wing length: 4.3-4.8 mm. *Head.* Eyes narrowly separated above. Vertex with a pair of large patches of dark broad scales anteriorly and a triangular patch of pale yellow, narrow curved scales posteromedially, apex of this patch extending onto interocular space; dark erect scales covering posterior 2/3 of vertex; eye margin heavily covered with pale yellow, rather narrow scales; tempora covered with pale yellow, broad scales, a broad stripe of dark broad scales within the pale scaled area; 5-7 mesoanteriorly directed vertical bristles, most mesal bristles bronze-yellow, others dark, 5 or more anteriorly directed temporal bristles finer than vertical bristles. Clypeus blackish brown, rounded at apex. Antenna longer than proboscis; pedicel testaceous, infuscate on inner side and bearing small scales and setae; flagellomere I with rather dark scales, 1.2-1.5 times as long as II. Proboscis excluding labella as long as or slightly shorter than fore femur, dark scaled. Palpus 1/4-1/5 as long as proboscis, dark scaled; segment III 1.5-1.8 times as long as II; IV papilliform. *Thorax.* Anterior pronotal lobe with integument brown to dark brown, covered with yellowish narrow curved scales and bearing many bristles; posterior pronotal lobe with integument dark brown above and pale brown below, covered with bronze-yellow narrow curved scales, those on lower posterior part almost white and often broader, 5-8 yellowish brown bristles along posterior margin, upper 1 or 2 bristles usually dark. Scutum with integument dark brown, covered with bronze-yellow narrow curved scales, those on margins somewhat paler; all scutal bristles present, dark bronze-brown. Scutellum covered with rather pale bronze-yellow narrow curved scales and bearing many dark bronze-brown bristles. Pleural integument mostly dark brown, partly pale; propleuron covered with pale ochreous broad scales; paratergite and postspiracular area with very pale yellowish, narrow curved or rather narrow scales, rather broad scales rarely found on postspiracular area; sternopleuron with two patches of pale broad scales; mesepimeron with a large patch of white broad scales covering upper 3/5; prealar knob, subspiracular area and metameron without scales; pleural bristles yellowish brown, more than 10 on propleuron, prealar knob, sternopleuron and upper mesepimeron respectively, 4-6 postspiraculars, no lower mesepimeral. *Wing.* Squama fringed with long hair-like scales; alula fringed with dark, rather narrow scales. Veins dark scaled. R_2 1.9-2.2 times as long

as r_{2+3}. Halter with stalk pale brown, and knob pale scaled, often partly dark scaled. *Legs.* Fore coxa with anterior surface covered with pale ochreous scales basally and dark scales apically; mid and hind coxae with a patch of pale ochreous scales. Femora with a rather indistinct apical pale fringe; fore femur pale scaled on posterior half of ventral surface; mid femur largely pale scaled on posterior surface; hind femur pale scaled on both anterior and posterior surfaces, the pale area narrowed toward apex; legs otherwise dark scaled. Claws equal, those of fore and mid tarsi with a subbasal sharp tooth, those of hind tarsus simple, rarely (6%) with a tooth. *Abdomen.* Terga dark scaled; I sometimes with scattered pale scales near base, laterotergite covered with pale scales; II-IV each with a small mediobasal white spot, the spot occasionally developed to a short band on III and IV, often reduced on IV; II-VII each with laterobasal white patches not reaching apical margin. Sterna mostly pale scaled, III-VII with progressively broader dark apical bands.

MALE. Wing length: 3.5-3.6 mm. Pedicel dark; flagellomeres XII and XIII together shorter than I-XI, XII shorter than XIII. Scales of lower anterior pronotal lobe, lower posterior pronotal lobe, paratergite and postspiracular area in general a little broader than in female. Pleural bristles generally fewer than in female, 2-4 postspiraculars. White spot of abdominal terga II-IV usually a little more developed than in female. Claws hairy, anterior claw of fore and mid tarsi longer than simple posterior claw and with a blunt-tipped median tooth, both claws equal and simple in hind tarsus. *Genitalia* (Fig. 1). Tergum IX transverse, well sclerotized, usually with a few bristles on apical margin laterad of lobes which are widely separated, rather broad, protrudent, well sclerotized and densely bristled on apical margin. Sternum IX rhomboidal, bearing 3-6 bristles. Basistyle 2.9-3.5 times as long as sternal basal width, bristled except at base and on mesal half of tergal surface proximad of insertion of dististyle, scaled on lateral and sternal surfaces, excavated and rugose on mesal side just basal to tergomesal lobe, with a group of long bristles on sternal mesal margin; apical conical part distad of insertion of dististyle 1/4 as long as basistyle (the shape similar to that in *esoensis*, wider than in *yamadai*); basal tergomesal lobe wide, square, with apical mesal angle protrudent, heavily bristled on tergal side; claspettoid moderately sclerotized, bifurcate, lateral branch narrow and bearing 2-8 setae apically, mesal branch wide and bearing 4-6 setae apically and laterally. Dististyle inserted at apical fourth of basistyle, 1/2 as long as basistyle, divided near base into two arms, lateral main arm a little broadened toward apical third, then abruptly narrowed and bifurcate, the mesal branch slightly broadened apically, rounded at apex which is surrounded by a comb of densely arranged short blunt teeth, those on lateral side of the branch (inner side of function) much wider, the lateral branch more slender, narrowed toward apex, with closely set blunt teeth at apex and on mesal margin; basal mesal arm reaching about middle of main arm, tapering toward apex (the shape similar to that of *yamadai*), bearing a number of small hairs. Paraproct strongly sclerotized, rod-shaped, without cercal setae; tergum X band-shaped, complete. Aedeagus bulb-shaped in tergal view, composed of a pair of strongly sclerotized lateral pieces connected by a narrow sternal band at base, a triangular dorsal plate at apex and a sternal flap at middle, leaving a narrow median slit at basal half of

sternal side; each lateral piece provided with 2 strong, hook-like incurved processes at apex, and 1 straight one sternally at middle; basal plate large.

4TH INSTAR LARVA (Fig. 2, Table 1). Width of head: 1.02-1.27 mm. *Head.* Moderately pigmented, 1.31-1.49 times as wide as long; labrum slightly concave at middle of apical margin; 1-C slender, longer than distance between bases, sometimes weakly barbed, rarely bifurcate at apex; 4- and 5-C on about same level; 6-C behind 7-C; 5-C a little mesocaudad of 6-C; 5-, 6- and 7-C on a straight line. *Antenna* 0.43-0.60 mm long, 3/5-2/3 as long as head, inwardly arcuate, infuscate except basal 1/5-2/5, rather finely and sparsely spinulate throughout; 1-A inserted at basal 0.36-0.48 ($\bar{x}$: 0.43), with 6-12 ($\bar{x}$: 9.1) strongly barbed branches, often with secondary branches, not quite reaching or just reaching apex of shaft; 2-A 1/4-1/3 as long as shaft. *Mentum plate* wider than long, with 24-28 ($\bar{x}$: 25.8) teeth. *Thorax.* Seta 1-P medium-sized, usually single; 2- and 3-P short; usually, 9-P double and 9-T triple; 6-T always single. *Abdomen.* Seta 12-I lacking; 7-I almost always single and as long as 6-I, but in one specimen 4 branched and about 2/3 as long as 6-I; 7-II of medium size, strongly barbed; 6-I and -II usually triple; 9-I, 8- and 12-II, 12-IV, 3- and 5-V, 10- and 12-VII usually double; 10-I, 8-, 10-, 11- and 14-III, 2-, 6-, 10- and 14-IV, 2-, 8-, 12- and 14-V usually single. Comb scales 12-16 ($\bar{x}$: 13.3), arranged in an irregular single or partly double row; individual scales with a single apical spine and a lateral fringe of fine spicules. *Siphon* with distinct acus, widest near base, tapering apically, with apex 0.54-0.62 of widest part; length 1.13-1.57 mm; index 3.4-4.4; pecten reaching apical 0.42-0.53 ($\bar{x}$: 0.47) of siphon, of 16-24 ($\bar{x}$: 20.7) teeth including 1-4 basal abortive ones, apical 2-4 teeth detached, each tooth with 2-4 ventral denticles, detached teeth larger with finer denticles; 1-S located beyond pecten at apical 0.29-0.37 ($\bar{x}$: 0.33) of siphon, most frequently 4 or 5 branched, shorter than width of siphon at insertion; 2-S shorter than apical pecten tooth, extending beyond apex of siphon; 2 subapical (1 subdorsal and 1 subventral, rarely one of them lacking) and 0 (42%) or 1 (58%) midsubdorsal accessory siphonal setae on each side, each seta dendritic, 3-7 branched. *Saddle* extending to ventral 1/3 of the segment; 1-X shorter than saddle; 2-X less than half length of 3-X; 4-X of 8-10 cratal and 4-2 precratal tufts (usually 12 in total, occasionally 11), the former with 3-10 branches, latter with 3-8. Gills about 3 times as long as saddle, dorsal gill usually somewhat longer than ventral one.

TYPE-LOCALITY. Umegashima spa, alt. 1000 m, in Akaishi Mountain Range, Shizuoka Pref., Honshû, Japan.

TYPE-SERIES. Holotype male (#2922, D-1156) with an associated genitalia slide, 30 V 1972, ground pool, K. Mizusawa and S. Hayashida leg. Paratypes: 10 males, 11 females, 2L-skins, 4LL (D-1156) with slides of associated 1P-skin, 1L-skin, genitalia (10 males), mouth parts (2 males, 2 females), wings (2 males, 2 females) and legs (2 males, 2 females), the collection data same as the holotype. The holotype is to be deposited in the National Science Museum, Tokyo, and the paratypes are to be distributed among the United States National Museum, Washington, D. C., National Science Museum, Tokyo, and British Museum (Natural History), London, after completion of the project.

SPECIMENS EXAMINED OTHER THAN THE TYPES. 2 males (A-1683) with slides of associated genitalia, wings and legs: Rubeshibe, Hokkaidô, 12 V 1966, S. Sato leg.; 3 males, 1 female (A-1684) with slides of genitalia (3 males), wings (2 males, 1 female) and legs (1 female): Rubeshibe, Hokkaidô, 29 V 1966, S. Sato leg.; 24 males, 7 females, 22 L-skins, 22LL (D-1540-1543) with slides of associated 9P-skins, 9L-skins, genitalia (24 males) and mouthparts (4LL): Kamikôchi, alt. 1550 m, in Hida Mountain Range, Nagano Pref., Honshû, 13 VI 1973, ground pool, V. A. Robinson leg.; 22 females, 7L-skins, 10LL (D-1158) with slides of genitalia (3 females), mouth parts (3 females, 2LL), wings (3 females) and legs (3 females): Umegashima spa, in Akaishi Mountain Range, Shizuoka Pref., Honshû, 31 V 1972, ground pool, K. Mizusawa and S. Hayashida leg.

DISTRIBUTION. Japan: Hokkaidô and Honshû.

BIOLOGICAL NOTES. Larvae are usually found in shaded ground pools in the woods. One of our larval collections of this species at the type locality, Umegashima, contained a single larva of *Ae. (Finlaya) japonicus;* the other 5 collections (1 at Umegashima, 4 at Kamikôchi) containing *Ae. sasai* exclusively. Sato (1959), Sato and Tomita (1962), and Sato and Tatewaki (1967) presented biological data in Hokkaidô, reporting that the larvae were found in ground pools formed by melted snow, and often found associated with *Ae. (Aedes) esoensis, Ae. (Ochlerotatus) communis* and *Ae. (Ochlerotatus) punctor.* They felt that the species was univoltine.

TAXONOMIC DISCUSSION. Since Sasa (1948), this species has been treated under the name *cinereus.* However, our comparison of Japanese specimens with those of *cinereus* from Germany, *geminus* from Germany and England, and *fuscus* from North America, indicates that it is unlikely that the Japanese species is conspecific with any of these species.

Among the species of the subgenus *Aedes, sasai* belongs to the group of *cinereus-geminus-fuscus* in having the apically bifurcate dististyle. The male genitalia of *sasai* are, in general, more robust and more deeply pigmented than in the other species. The dististyle (Fig. 3) of *sasai* is distinctly thicker, narrowest at the basal fork, then a little broadened toward the apical fork. In the other 3 species it is slender and tapers from the base to the apical fork, occasionally appearing broadest, though very slightly, in the middle, tapering to both basal and apical forks. The mesoapical branch of the dististyle of *sasai* is distinctly broader than the lateroapical branch and well rounded apically, the lateroapical branch is not rounded at apex; while these 2 apical branches are not markedly different from each other in *cinereus, geminus* and *fuscus.* The insertion of the lateroapical branch is tergolateral in *sasai;* the stem of the dististyle apparently retaining its thickness at this portion also, thus it shows a distinct, smoothly curved sternal line from the lateral margin of the dististyle through the base of the lateroapical branch toward the apex of the mesoapical branch. Such a clear curved line is not seen in the other 3 species. The basal tergomesal lobe (Fig. 3) of *sasai* is similar to that of *cinereus*, but slightly more developed; it is larger, distinctly more protrudent mesodistally and more heavily bristled than in *fuscus* and *geminus.* The mesal

branch of the claspettoid of *sasai* is more developed, it is broader, and the setae are distinctly stouter than in the other 3 species; the number of the setae varies from 4 to 6, while it is 3-4 in *cinereus* (after Natvig, 1948, and 2 specimens identified by Peus), 2-3 in *geminus* (5 topotypical specimens probably identified by Peus, and 2 specimens from England identified by us), 2-4 in *fuscus* (after Carpenter and LaCasse, 1955), constantly 3 in 3 specimens of *fuscus* we examined. The length of the lateral branch apparently does not differ among *cinereus*, *geminus* and *fuscus*, though individual variation occurs; in *sasai*, it is stouter and relatively shorter; in *fuscus*, it is more slender than in the other 3 species. It is very easy to discriminate *sasai* from *esoensis*, *yamadai* and *rossicus* in the male genitalia by the apical furcation of the dististyle.

The females of *sasai* may easily be distinguished from *cinereus*, *geminus* and *fuscus* by the laterobasal patches of pale scales of the abdominal terga. In *sasai*, these patches extend posteriorly and slightly mesally, narrowing apically, never reaching the apical margin. In *cinereus*, *geminus* and *fuscus* both sides of the abdominal terga are covered completely with pale scales forming a continuous broad longitudinal stripe through the terga; *rossicus* also has such a stripe (Gutsevich *et al.*, 1970). The dorsomedian part of abdominal terga II-IV of *sasai* usually has a small spot of pale scales that is not found in *cinereus* and *geminus*. *Ae. fuscus* is said to have complete basal bands; the 5 males and 5 females we examined were such examples. According to Peus (1970), however, specimens lacking such bands also exist; therefore, all intermediate cases may be found in this species. *Ae. sasai* is easily distinguished from *yamadai* by the dark body integument and scales; *yamadai* is a bright yellowish brown species, its abdominal terga are pale yellowish brown laterally and brown with a weak purplish tinge dorsally, there being neither spots nor bands. It is most difficult to separate the females of *sasai* from those of *esoensis*. Although *esoensis* is usually recognized as a brownish species, dark examples similar to *sasai* are occasionally found; the abdominal tergal basal bands in *esoensis* are, in fact, often conspicuous and complete (connected with the laterobasal spots), but examples lacking the bands are not rare. The only difference we found is the presence or absence of a patch of pale, moderately broad scales on the posterolateral surface of the fore coxa. All the 41 females of *sasai* we examined, excepting one specimen from Umegashima having 2 pale scales, lack scales on this part. Fully nourished examples of *esoensis* have a distinct patch of pale scales, but in small specimens (possibly undernourished, usually reared examples) the patch is very often reduced or lost. Thus, 100% discrimination is impossible. Sato and Tomita (1959) claimed that tergum IX takes the form of a fan without base in *sasai* (as *cinereus*), it being heart-shaped or saddle-shaped in *esoensis*. In fact, tergum IX of *sasai* is also concave at middle of the apical margin; thus, the difference indicated by them may be interpreted as the apical margin of tergum IX being narrowly concave in *sasai*, and more widely concave in *esoensis*. We examined genitalia slides of 13 females of *sasai* and 39 females of *esoensis* from various localities, finding that this difference is due to individual variation. There seems to be a tendency for the tergum to be shorter in *sasai*, but it is difficult to obtain accurate measurements because of its convexity and poor sclerotization.

Larvae of *sasai*, *cinereus*[2], *fuscus*, *esoensis* and *yamadai* are quite similar, and it is by far more difficult to separate them than the adults. Among these species, *sasai* will be most easily confused with *esoensis*. We could detect no definite differentiating characteristics.

The Umegashima population of *sasai* is characterized in the poorly developed spinulation on the antennal shaft; it is similar to *yamadai*, and distinctly finer and sparser than in *esoensis*, *cinereus* and *fuscus*. The Kamikochi population of *sasai*, however, shows all transitional cases from Umegashima-type to *esoensis*-type.

The pecten teeth may have some importance; in *sasai*, the teeth are more closely arranged and the number is larger than in the other 4 species, though the range of variation overlaps with each species except for *yamadai* (Table 2). The values for *cinereus*, *fuscus* and *yamadai* given in Table 2 should be revised with more material from various geographical areas.

The accessory siphonal setae are longer and more distinct in *sasai* than in *esoensis*. The number of these setae were used by Hara (1958) as definite specific characteristics for this group. It is evident, however, that he neglected both individual and local variations, and his knowledge on *esoensis* was based simply on LaCasse and Yamaguti (1950) who had overlooked the midsubdorsal accessory siphonal setae. Variations of these setae of *sasai* and *esoensis* from three areas are summarized in Table 3. This demonstrates a clinal variation in *esoensis*; the northern population having more setae than the southern population, this tendency also observed within the Hokkaidô population. Sato and Tomita (1962) reported that *sasai* (as *cinereus*) of Hokkaidô has usually 3 (rarely 4) pairs of the accessory setae. So the range of the setae in *sasai* should be from 1 to 4. Thus, in Hokkaidô, more than 80% of *esoensis* will be discriminated from *sasai*, and about 30% of *sasai* from *esoensis*; in Aomori, northern Honshû, only about 30% of *sasai* and *esoensis* will be separated from each other, and in Mt. Hakusan, central Honshû, the number of these setae loses all taxonomic value in regards to these 2 species. The accessory siphonal setae appear to serve reasonably effectively in distinguishing *sasai* from *cinereus* or *fuscus* (Table 4). On the subapical area of the siphon, 1 or 2 setae are always found in *sasai*, none in *cinereus*; 96% of *sasai* have 2 subapical setae, *fuscus* only 1 or none. The number of accessory setae on the median area of the siphon shows a different pattern of frequency by species, but this does not appear too reliable a character for the purpose of identification.

As to other body setae, *sasai* appears different from *yamadai* in that 2-P, 3-M, 6-T and 4-VIII are consistently single; they are double or triple in *yamadai*. For comparison of *sasai* with *cinereus* and *fuscus*, the number of branches of 11 selected setae, together with their arithmetic means and unoverlapped areas, or else modes, with their percentages are presented in

[2]Differences between *geminus* and *cinereus* were not given by Peus (1970). We lack adequate specimens to find different characters of these 2 species, so *cinereus* in this discussion on larvae may or may not include *geminus*.

Table 5. Combinations of the characters of these setae may furnish some aid to identification. Of course, some of these differences might change if more material of *cinereus* and *fuscus* were studied.

Aedes (Aedes) esoensis Yamada

Aedes (Aedes) esoensis Yamada, 1921, Annot. Zool. Japon. 10 (art. 6): 77 (male, male-G*, female). Type loc. Kanayama, Hokkaidô, Japan. Syntypes:3 males, 3 females in Inst. Med. Sci., Tokyo Univ.

Aedes (Aedes) asanumai Sasa, Kano *et* Takahasi, 1950, Japan J. Exp. Med. 20: 637 (male, male-G*). Type loc. Rubeshibe, Hokkaidô, Japan. A single type male with a genitalia slide in Inst. Med. Sci., Tokyo Univ. *Syn. nov.*

Aedes (Aedes) pseudoesoensis Yamaguti and Tamaboko, 1954, Acta Med. Okayama 8 (4): 418 (male, male-G*, female*, L*). Type loc. Mt. Hakusan, 1750-1900 m, Honshû, Japan. The type specimens were not designated.

Aedes (Aedes) rossicus Dolbeshkin, Gorickaja & Mitrofanova; Hara, 1958, Japan. J. Sanit. Zool. 9 (1): 23 (male-G*, L) (misidentification).

Ae. asanumai was described from a single male, based on the presence of an asetose lateral branch of the claspettoid, a different scaling of the vertex and the mesally narrowed, pale basal band of abdominal tergum V. Through the courtesy of Dr. Sasa, we examined this single type, together with its genitalia slide, finding that the asetose lateral branch was actually not a branch but a sclerotized part on the mesal wall of the basistyle extending from the base of the claspettoid. The scaling of the vertex of *asanumai* is identical with that of the male *esoensis*. The pale basal bands of the abdominal terga in *esoensis* are quite variable; in the most developed case, they are continuous with the laterobasal patch laterally and slightly broadened at middle; in the least developed case, they are entirely absent, all the intermediate cases occurring. Thus, *asanumai* is considered as an individual variation of *esoensis*.

As to *pseudoesoensis* known from Mt. Hakusan, Ishikawa Pref., Honshû, only Nakagawa (1956) decisively stated its synonymity with *esoensis* based on identity in the male genitalia. Unfortunately, this short article was published in a non-professional journal of entomology, and has been overlooked by most culicidologists, and only Tamaboko (1964) followed Nakagawa's view, using the name *esoensis* for his own *pseudoesoensis*. As stated by Nakagawa (*l.c.*), there is no difference in the male genitalia between these 2 species. Yamaguti and Tamaboko (1954) indicated, however, 7 characteristics of *pseudoesoensis* to differentiate it from *esoensis*: 1) the smaller body size; 2) the pale basal abdominal tergal bands which are not continuous with the lateral patches except for the 3rd and 4th terga; 3) the dorsal teeth of the cutting organ; 4) the apical denticulation of the dorsal labial plate; 5) the extent of the pecten; 6) the position of 1-S; 7) the number of the accessory siphonal setae.

We examined 29 males, 9 females and 39 larvae with 7 dissected mouth part slides of topotypical specimens of *pseudoesoensis*. These were compared with the following specimens of *esoensis:* 203 males, 403 females and 123 larvae with 7 dissected mouth part slides from Hokkaidô; 154 males, 103 females and 60 larvae with 5 dissected mouth part slides from Aomori; and 4 males, 12 females and 2 larvae from Oze.

We found wing length to vary from 2.9 to 5.0 mm in *esoensis* and 4.3 to 4.8 mm in *pseudoesoensis*. Width of the larval head is 1.01-1.25 mm in *esoensis* and 1.06-1.22 mm in *pseudoesoensis*. Both values of *pseudoesoensis* fall within the range of variation of *esoensis*. Since LaCasse and Yamaguti (1950), it has been believed that *esoensis* always has complete pale basal bands on the abdominal terga. In fact, these bands of *esoensis* are quite variable as already stated in discussions on *sasai* and *asanumai*, and in this respect *pseudoesoensis* is fairly close to the average type of *esoensis*. Regarding the dorsal teeth of the larval cutting organ, we checked 15 skin mount specimens of *esoensis* in addition to 12 slides of dissected mouth parts, and 5 skin mount larvae of *pseudoesoensis* in addition to 7 slides of dissected mouth parts. The lateral dorsal tooth has 0-2 and the mesal dorsal tooth 0-1 mesal denticles; the number of the accessory denticles on the mesal surface of the mandible varying from 0 to 6, the size of the denticles also varying; some of these denticles can, at times, also be interpreted as the basal denticles of the mesal dorsal tooth. No differences in these teeth and denticles were detected between those of *esoensis* and *pseudoesoensis*. It may be noteworthy that the teeth of *esoensis* illustrated by LaCasse and Yamaguti (1950) seem to be an atypical case. We could not find any specimen exactly identical with it, only 1 slide rather close to their figure. Concerning the apical denticulation of the dorsal labial plate, we studied 4 slides each of Hokkaidô and Aomori specimens of *esoensis*, and 5 slides of *pseudoesoensis*, finding no significant difference between them, though there was individual variation in the number of denticles from 4 to 6. The extent of the pecten and the position of 1-S are shown separately by areas in Table 6, the specimens from Hakusan representing *pseudoesoensis*. The differences appear clinal. The accessory siphonal setae show more distinct clinal variation as seen in Table 3. Besides these characteristics, we noticed that the number of pecten teeth, the gill index (gill length divided by saddle length) and the total number of the branches of 105 body setae also exhibit a clinal variation. These are summarized in Table 7. As seen above, there is no significant difference in the adult between *esoensis* and *pseudoesoensis*, and all the differences observed in the larvae appear to be clinal. Thus, it may be concluded that these 2 species are not only conspecific but are not even distinct subspecies.

Hara (1958) identified his specimens obtained at Tsuta spa, in Hakkôda Mts., Aomori Pref., Honshû, as *rossicus*, describing and illustrating male-G, female-G and the larva. In so doing, he remarked only on identical characteristics between *rossicus* and his specimens, and wholly neglected the different points. Both individual and local variations appear not to have been taken into his consideration. In addition, he did not have adequate knowledge of *esoensis*, as stated in the discussion on *sasai* of this paper.

These doubtlessly contributed to his misidentification. Hara's unique basis of this identification in the larva is in the midsubdorsal accessory siphonal setae. Sato (1959) and Hattori (1960) noted that larvae of *esoensis* from Hokkaidô were identical with Hara's *rossicus*. It is perfectly correct. The number of the midsubdorsal accessory siphonal setae is 2 in Hara's *rossicus*. True *rossicus* has 2 setae (Monchadskii, 1936; Gutsevich *et al.*, 1970). It can never be said, however, based on only this single character, that *rossicus* and his species are conspecific. Also, *esoensis* has such setae, varying in number from 1 to 5 in Hokkaidô, 1-3 in Aomori, and 1-2 in Hakusan; the 2 setose case is most frequent in both Hokkaidô and Aomori. Hara's *rossicus* larvae have 4 pairs of the subapical accessory siphonal setae, this being the most frequent (69%) type of *esoensis* in Hokkaidô, also being found in 22% of *esoensis* of Aomori. True *rossicus* entirely lacks these subapical setae (Monchadskii, 1936; Gutsevich *et al.*, 1970). No difference between *esoensis* and Hara's *rossicus* could be elucidated from the remainder of his discussion. Thus, the larva of Hara's *rossicus* appears to be nothing other than typical *esoensis*.

The single adult male specimen of Hara's *rossicus* has a *cinereus*-type claspettoid having a lateral branch as illustrated by him. This is the unique basis of his identification in the adult. It is true that the claspettoid of *rossicus* has a lateral branch (Stackelberg, 1937). However, the shape of the mesal branch of the claspettoid of true *rossicus* is different from that of Hara's figure, which is quite typical of *esoensis;* the basal mesal arm of the dististyle extends beyond middle of the dististyle in *rossicus,* while Hara's illustration shows a short broad arm which is quite the same as that of *esoensis;* the apical conical part of the basistyle distad of the insertion of the dististyle in *rossicus* appears a little longer and narrower than in *esoensis,* that of Hara's figure does not differ from that of *esoensis*. Including all the other respects, the male genitalia of Hara's specimen agree with those of *esoensis* except for the presence of a lateral branch in the claspettoid. We examined 134 male genitalia slides of *esoensis:* 61 examples from Hokkaidô, 55 from Aomori, 8 from Oze and 10 from Hakusan. Among these, 3(4.4%) from Hokkaidô and 1 (1.8%) from Aomori (3.0% in total) possessed a lateral branch on the claspettoid on only one side of the basistyle; the claspettoid of the other side being typical for *esoensis*. The shape of these claspettoids having a lateral branch is quite the same as Hara's figure. One of these 3 Hokkaidô specimens is an individually reared example. The larva has 5 midsubdorsal accessory siphonal setae on the left side, 3 on the right, and 4 subapical accessory setae on each side. It is clear that the male of Hara's *rossicus* is but a variation of *esoensis*. Hara also provided a key to the female genitalia, but it appears useless because of the failure to consider individual variation.

Gutsevich *et al.* (1970) combined *cinereus, esoensis* and *rossicus* into a single species, *cinereus,* and treated them as subspecies. Though it is uncertain to us what is implied in their word for subspecies, "podvid", it appears different from the generally accepted definition of local subspecies, since the distribution ranges of these 3 as given by them overlap with each

other in vast areas, *viz.*, *cinereus* spread out from Europe through Caucasus and Kazakhstan to the Far East of CCCP; *esoensis* from Kazakhstan through northeastern Kitai, the Far East of CCCP to Korea and Japan; *rossicus* from Europe (Czechoslovakia, Hungary, Ukraine, Chuvash and Ural) through Caucasus to Yakut. They claimed that intermediate forms occur among them, but in their discussion, it appears that there is confusion of intermediate characters with different combinations of characters. As discussed above, 3 species in the subgenus *Aedes* occur in Japan: *esoensis, sasai* and *yamadai*. If the principle of Gutsevich *et al. (l.c.)* is adopted, they should be a single species, *cinereus*. No intermediate forms are, however, found in the male genitalia of these 3 Japanese species; they are homogenous within species; 134 slides of *esoensis* from 10 localities, 40 of *sasai* from 3 localities, and 7 of *yamadai* from 3 localities were studied and there was no confusion in identification. The dististyle of *sasai* is of the *cinereus*-type, though distinguishable from *cinereus*, while the abdominal tergal scaling is of *esoensis*-type; *yamadai* is of *esoensis*-type in the dististyle, though different in the shape of the basal mesal arm, and is of *cinereus*-type in the abdominal scaling which is still distinguishable from *cinereus*. These cases are not intermediates but different combinations of characters. It is desirable that European and Siberian material be studied further for clarification of the status of *cinereus, geminus, rossicus* and continental *esoensis*.

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We express our deep appreciation to Dr. M. Sasa, the Institute of Medical Science, Tokyo University, for permission to examine the type specimens of *Aedes asanumai, esoensis, yamadai* and *nobukonis*, and also other specimens of the subgenus *Aedes*; to Dr. P. F. Mattingly, British Museum (Natural History), for specimens of *cinereus* and *geminus*; to Dr. A. Stone and Dr. C. W. Sabrosky, the United States National Museum, Mr. E. L. Peyton and Major J. F. Reinert, Medical Entomology Project, Smithsonian Institution, for specimens of *cinereus* and *fuscus*; to Prof. S. Sato, Asahikawa Branch, Hokkaido University of Education, for specimens of *sasai*; to Dr. M. Hasegawa and Mr. K. Hattori, Hokkaidô Health Institute, for specimens of *yamadai*; and to Dr. K. Kamimura, Health Institute of Toyama Prefecture, Dr. R. Tamaboko, the High School at the Faculty of Education, Kanazawa University, Dr. N. Yamaguti, Tokyo Women's Medical College, and Mr. S. Hayashida and Mr. Y. Imamura, Tokyo University of Agriculture, for information on habitats or aid in field work. We also thank Mr. M. Sawada, Mr. A. Yoshii, Dr. M. Nishikawa and Mr. A. Kato, former technicians of this department, and SP5 V. A. Robinson of this department, for their aid in field and laboratory work. We express our gratitude to LTC A. A. Hubert, the former chief of this department, for support and encouragement. The illustrations for this paper were prepared by Mr. S. Ohtawa and Mr. I. Yoshigaki of this department.

Additional Note

After the completion of this manuscript, we were permitted to examine Hara's slides of the male genitalia and the larva of his *rossicus* through

the courtesy of Dr. Kôtarô Okada, Biological Laboratory, Juntendo University. The examination of these slides convinced us that the above conclusion was correct.

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TABLE 1. CHAETOTAXY OF THE 4TH INSTAR LARVA OF *Aedes (Aedes) sasai* sp. nov.

HAIR No.	HEAD	THORAX			ABDOMEN							
		PRO-	MESO-	META-	I	II	III	IV	V	VI	VII	VIII
0	?	m(d)	-	-	-	1	1	1	1	1	1	1
1	1-2	1-2	2-4	1-4	2-4	2-5	4-8	4-8	5-8	5-11	3-8	3-6(b)
2	-	1	2-4	2-4	1-2	1-3	1	1-2	1-2	1	1	1-2
3	1	2-4	1	7-m	2-7	3-5	2-3	2-3	2-3	1-3	4-8	6-10(B)
4	6-11	2-4	2-4	3-7	m	6-m	2-5	1-3	5-9	3-6	2-3	1
5	3-9(B)	1(L,B)	1(L,B)	1	6-12	3-6	1-4	2-4	2-4	2-5	4-7	5-7(b)
6	4-9(B)	1(L,B)	4-8(L,B)	1	2-4(L,B)	2-3(L,B)	1(L,B)	1-2(L,B)	1(b)	1(b)	5-11	1-S
7	5-16(B)	2-3(L,B)	1(L,B)	6-9(L,B)	1(L,B)	3-7(B)	5-13(B)	8-13	7-12	3-6	1-3	3-7
8	1-3	1-3(B)	5-8(L,B)	m(d)	-	1-3	1-2	1	1-2	1-4	4-9	1-X
9	2-3	1-2	4-8(L,B)	2-5(L,B)	1-4	1	1	1	1	1	1-5	1-2
10	2-4	1	1(L,B)	1(L,B)	1-2	1	1-2	1-2	1	1	1-3	2-X
11	5-14	3-7	2-5	1-5	2-5	1-4	1-2	1-2	1-2	1-3	1-4	4-9(L)
12	5-9	1	1(L,B)	1	-	1-3	1-4	1-3	1-2	1-2	1-2	3-X
13	2-4	-	m(d)	m(d)	1-4	m(d)	2-4	2-4	2-4	m(d)	4-16	1(L)
14	1	2-5	m(d)	-	-	-	1-2	1-2	1-2	1-2	1-3	1-3
15	3-7	-	-	-	-	-	-	-	-	-	-	-

B: barbed; b: weakly barbed; d: dendritic; L: large sized; m: multiple (with more than ten branches).

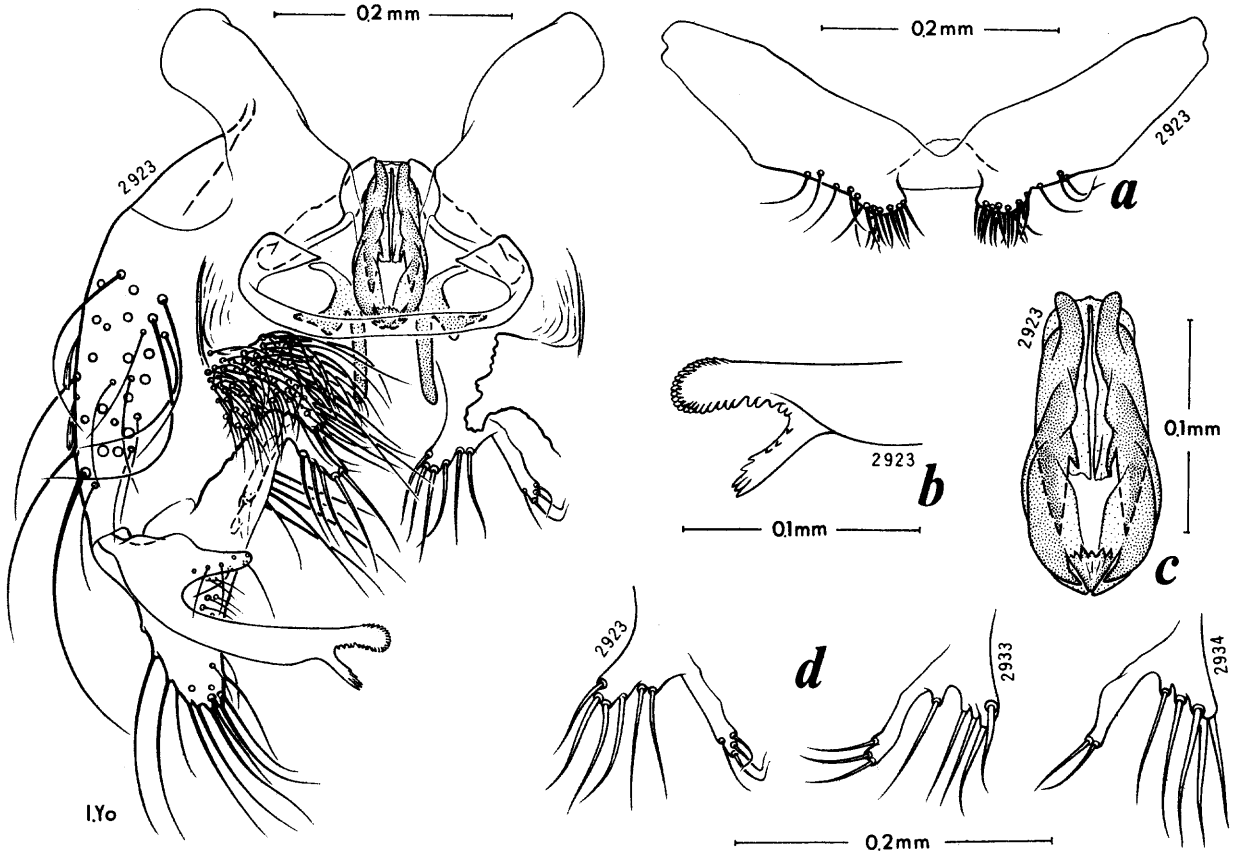

Fig. 1. *Aedes (Aedes) sasai* sp. nov., male genitalia. a, tergum IX; b, apex of dististyle (sternal aspect); c, aedeagus; d, variation of claspettoid.

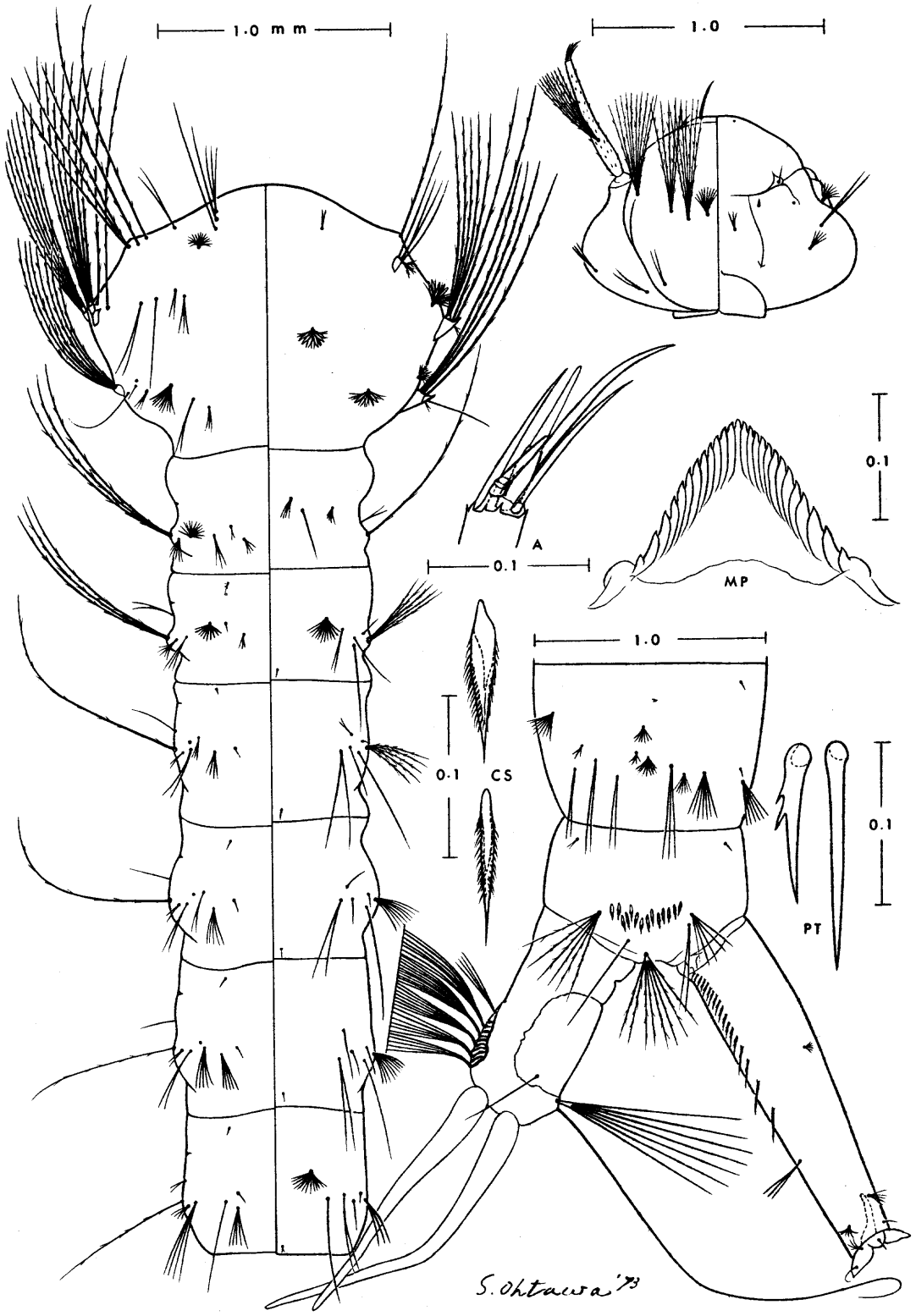

Fig. 2. *Aedes (Aedes) sasai* sp. nov., 4th instar larva. A, apex of antenna; CS, comb scales; MP, mentum plate; PT, pecten teeth.

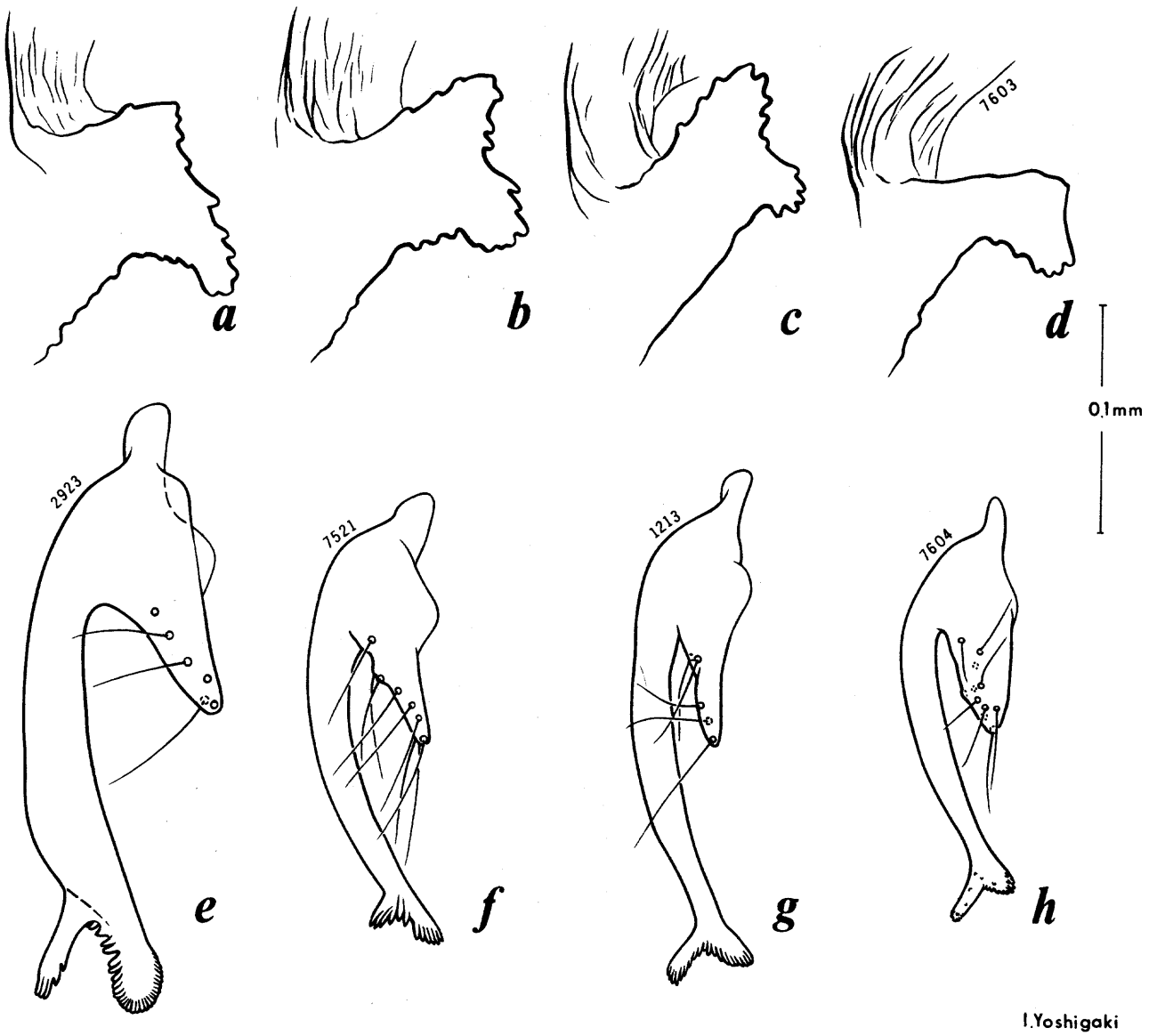

Fig. 3. Basal tergomesal lobes (a-d) and dististyles (e-h) of *Aedes (Aedes)* spp. a & e, *sasai* from Umegashima, Honshû; b & f, *cinereus* from Berlin-Wansee, Grosses Fenn, Germany; c & g, *geminus* from Kassel, Germany; d & h, *fuscus* from Springfield, Massachusetts.

ADDENDUM TO: Tanaka, K., K. Mizusawa and E. S. Saugstad. A New Species of the Genus *Aedes (Aedes)* from Japan, with Synonymical Notes on Japanese Species of the Subgenus *Aedes* (Diptera, Culicidae). Mosquito Systematics 7(1): 41-58. 1975.

Regretfully, Tables 2 through 7 became separated from the manuscript in my office with the result that they were omitted from the above reference. With sincere apologies for this serious error, I am publishing them here. — Editor's Note.

TABLE 2. THE PECTEN TEETH OF *Aedes (Aedes)* spp.

Species	Specimens examined	Range	$\bar{x}$	Range and percent distinguishable from *sasai*		Range & percent of *sasai* distinguishable from each species	
sasai	40	16-24	20.9	-	-	-	-
cinereus	8	13-18*	14.9	13-15	62.5%	19-24	83.9%
fuscus	10	12-16**	14.1	12-15	85.0	22-24	27.4
esoensis	32	10-19	13.9	10-15	85.3	20-24	64.5
yamadai	7	11-15	13.3	11-15	100.0	16-24	100.0

* 13-16, $\bar{x}$: 15.1, after Natvig, 1948.
** 12-21, after Carpenter and LaCasse, 1955.
Localities of the specimens examined: *sasai* - Honshû (Umegashima and Kamikôchi); *cinereus* - England; *fuscus* - Alabama, Delaware, Minnesota, Mississippi, New York and North Carolina; *esoensis* - Hokkaidô and Honshû (Aomori, Oze and Mt. Hakusan); *yamadai* - Hokkaidô.

TABLE 3. VARIATION OF THE NUMBER OF THE ACCESSORY SIPHONAL SETAE OF *Aedes (Aedes) sasai* AND *Ae. (Ae.) esoensis*.

Species	Specimens examined	Number of accessory siphonal setae								
		1	2	3	4	5	6	7	8	9
sasai (Honshû)	45	4%	28	68	-	-	-	-	-	-
esoensis (Hokkaidô)	32	-	-	3	5	17	30	39	5	2
esoensis (Aomori)	32	-	-	16	50	13	9	11	2	-
esoensis (Hakusan)	33	2	20	50	29	-	-	-	-	-

TABLE 4. VARIATION OF THE NUMBER OF THE SUBAPICAL AND MIDSUBDORSAL ACCESSORY SIPHONAL SETAE OF *Aedes (Aedes) sasai*, *Ae. (Ae.) cinereus* AND *Ae. (Ae.) fuscus*.

Species	Specimens examined	Subapical setae			Midsubdorsal setae		
		0	1	2	0	1	2
sasai	45	-	4%	96	32	68	-
cinereus	8	100	-	-	13	44	44
fuscus	10	30	70	-	-	70	30

TABLE 5. COMPARISON OF THE NUMBER OF BRANCHES OF SELECTED BODY SETAE OF *Aedes (Aedes) sasai*, *Ae. (Ae.) cinereus* AND *Ae. (Ae.) fuscus*.

Seta No.	*sasai* (29ex.)	*cinereus* (8ex.)	*fuscus* (10ex.)
2-P	1 (constant)	1-3 (1.9*; 2-3: 79%)	1-3 (1.9; 2-3: 82%)
1-M	2-4 (2.9; 2-3: 85%) 2: 38%)	4-8 (5.0; 5-8: 69%)	3-7 (4.8; 5-7: 70%)
6-T	1 (constant)	1-2 (1.8; 2: 80%)	1-2 (1.5; 2: 47%)
10-III	1-2 (1.1; 1: 93%)	2-3 (2.3; 3: 33%)	1-2 (1.8; 2: 78%)
11-III	1-2 (1.2; 1: 80%)	2-3 (2.3; 3: 33%)	1-3 (2.0; 3: 19%)
8-IV	1 (constant)	1-4 (2.1; 2-4: 80%)	1-3 (2.3; 2-3: 90%)
10-IV	1-2 (1.1; 1: 93%)	2-3 (2.3; 3: 31%)	1-2 (1.7; 2: 67%)
8-V	1-2 (1.1; 1: 88%)	2-4 (2.8; 3-4: 50%)	2-4 (2.6; 3-4: 50%)
10-V	1 (constant)	2-3 (2.2; 2-3: 100%)	1-2 (1.4; 2: 37%)
10-VI	1 (constant)	1-2 (1.9; 2: 94%)	1-2 (1.5; 2: 54%)
1-X	1-2 (1.2; 1: 78%)	1-3 (2.1; 3: 22%)	2-3 (2.6; 3: 58%)

* Arithmetic mean.

TABLE 6. CLINAL VARIATIONS OF THE EXTENT OF THE PECTEN AND THE POSITION OF 1-S OF THE LARVAE OF *Aedes (Aedes) esoensis* FROM 3 AREAS.

Areas	Specimens examined	Pecten from apex of siphon Range	$\bar{x}$	1-S from apex of siphon Range	$\bar{x}$
Hokkaidô	10	0.45-0.60	0.51	0.33-0.44	0.38
Aomori	10	0.40-0.50	0.46	0.29-0.39	0.34
Hakusan	10	0.38-0.50	0.44	0.29-0.37	0.33

TABLE 7. CLINAL VARIATIONS OF SELECTED CHARACTERISTICS OF THE LARVAE OF *Aedes (Aedes) esoensis* FROM 3 AREAS.

Areas	Specimens examined	Number of pecten teeth Range	$\bar{x}$	Gill index	Total number of branches of 105 body setae Average per larva
Hokkaidô	10	10-14*	12.6*	2.2-3.3	463.8
Aomori	10	11-16	14.1	2.6-3.8	455.6
Hakusan	10	13-19	14.9	3.4-4.1	376.0

* 11-16, $\bar{x}$: 13, after Sato and Tomita, 1962.