THE RAFFLES BULLETIN OF ZOOLOGY 2002 **50**(2): 317-326

A REVISION OF MALE ADULT *ABLABESMYIA* (DIPTERA: CHIRONOMIDAE: TANYPODINAE) FROM JAPAN, WITH A DESCRIPTION OF *A. PRORASHA*, NEW SPECIES, AND A KEY TO ADULT MALE SPECIES OF THE GENUS

Tadashi Kobayashi

Institute for Environment and Social Welfare Research, Aza Sunaba 135-3, Aramata, Kurobe City, Toyama Prefecture 938-0001, Japan
Home: Mita 3-4-303, Tama-Ku, Kawasaki, Kanagawa Prefecture 214-0034, Japan

Kohei Kubota

Graduate School of Agriculture and Agricultural Life Sciences, The University of Tokyo, Yayoi 1-1-1, Bunkyo-Ku, Tokyo 113-8657, Japan

ABSTRACT. – *Ablabesmyia* (Chironomidae: Tanypodinae) from Japan are reviewed, and divided into three species including a new species, *A. prorasha*, and a key to species given.

KEY WORDS. – Japan, Chironomidae, Tanypodinae, *Ablabesmyia*, new species, taxonomy.

INTRODUCTION

Adult males belonging to the genus *Ablabesmyia* are distinctly pigmented and can be readily recognized by the leg bands and the characteristic cochleariform or lanceolate megaseta. This is one of the most difficult genera in the subfamily Tanypodinae to classify to species due to the variability of characters. The species are almost impossible to recognize without recourse to slide preparation of the male genitalia as been noted by Roback (1971: 355). All the *Ablabesmyia* species recorded or described and all specimens obtained, including the type specimens, from many places in Japan are reviewed. The meristic examination of Japanese species led the authors to the conclusion that in Japan three species can be recognized within the genus, i.e. *A. monilis* (Linnaeus, 1759), *A. longistyla* Fittkau, 1962, and *A. prorasha*, new species. The key to the species, and a list of synonyms will contribute to a more accurate taxonomic classification of this genus in Japan and adjacent areas.

Genus *Ablabesmyia* was established by Johannsen, 1905, based on *Tipula monilis* Linnaeus, 1758. The present genus had been included in Group A of Edwards (1929) and Johannsen (1946) as a subgenus under the genus *Pentaneura*. Freeman (1955) and Roback (1959) considered this group a subgenus of the genus *Pentaneura*, using the name *Ablabesmyia*, too. Later, Fittkau (1962) gave it a full generic status, again, on the basis of the hypopygial structures and other characters. According to Ashe & Cranston (1990), six species of *Ablabesmyia* are distributed in the Palaearctic region, i.e. *longistyla* Fittkau, 1962, *moniliformis* Fittkau, 1962, *monilis* (Linnaeus, 1758), *nilotica* (Kieffer, 1923), *phatta* (Egger, 1963), and *pictipes* (Kieffer, 1923). The new name *moniliformis* was given by Fittkau (1962) to the Japanese species heretofore treated as *Pentaneura monilis* (Linnaeus, 1758) by Tokunaga (1937) since Fittkau considered the Japanese species different from the European species. However, Tokunaga (1937) does not mention details of the aedeagal structure in his text. Moreover, his illustration of the male hypopygium (plate 4: 80) does not clearly show the structure of the aedeagal complex. Therefore, it can not be unequivocally decided whether the name *moniliformis* is appropriate or not. So the present authors assume that is why the name has not been used by Japanese researchers with only two exceptions in Yamamoto (1989, 2000). Among the remaining five species of the genus, *longistyla*, *monilis* and *phatta* have most often been recorded and described in the Palaearctic region (e.g. Laville, H. & B. Serra-Tosio, 1996).

In the Nearctic region 18 species have been reviewed and described by Roback (1971): *A. (Karelia) illinoensis* (Malloch, 1915), *A. (K.) alaskaensis* Roback, 1971, *A. (K.) peleensis* (Walley, 1926), *A. (K.) philosphagnos* Beck & Beck, 1966, *A. (K.) pulchripennis* (Lundbeck, 1898), *A. (K.) cinctipes* (Johannsen, 1946), *A. (Ablabesmyia) mallochi* (Walley, 1925), *A. (A.) tarella* Roback, 1971, *A. (A.) aspera* (Roback, 1959), *A. (A.) rasha* Roback, 1971, *A. (A.) johannseni* (Roback, 1959), *A. (A.) rhamphe* Sublette, 1964, *A. (A.) janta* (Roback, 1959), *A. (A.) parajanta* Roback, 1971, *A. (A.) basalis* (Walley, 1925), *A. (A.) hauberi* Beck & Beck, 1966, *A. (A.) monilis* (Linnaeus, 1758), and *A. (A.) annulata* (Say, 1823).

According to Roback (1971) and Murray & Fittkau (1989), four subgenera, *Ablabesmyia* (*Asayia*) Roback, *A.* (*Karelia*) Roback, *A.* (*Sartaia*) Roback, and *A.* (*Ablabesmyia*)

Table 1. Distribution of the three species.

Prefecture	H-form *A. longistyla*	S-form *A. monilis*	T-form *A. prorasha*, new species	Total
Hokkaido	6	6	1	13
Kanagawa	19	3	27	49
Gifu	1	1	–	2
Aichi	–	3	–	3
Yamaguchi	1	–	–	1
Ehime	3	–	–	3
Saga	1	2	–	3
Nagasaki	7	5	1	13
Miyazaki	9	10	1	20
Total	47	30	30	107
	44%	28%	28%	100%

Johannsen are recognized within the genus in the Palaearctic region. However only *A.* (*Ablabesmyia*) was found in our studies, for all our specimens and the descriptions on the genus reexamined possess the following characteristics: mesal band on tibia of fore leg central (Fig. 1), wing spots separate, costa ending before tip of M_{1+2} (Fig. 2) and subterminal seta of gonostylus expanded apically (Fig. 3).

Presently in Japan, seven species have been recorded or described: *A. amamisimplexa* Sasa, 1990, *A. jogancornua* Sasa & Okazawa, 1991, *A. monilis* (Linnaeus, 1758), *A. longistyla* Fittkau, 1962, *A. tomotertia* Sasa, 1993, *A. yufucomplexa* Sasa & Suzuki, 1991, and *A. moniliformis* Fittkau, 1962.

Throughout our studies on *Ablabesmyia*, we have recognized only a few morphological-forms belonging to the genus as mentioned in the discussion, we analyzed these forms, primarily by means of features of the male genitalia, and have accordingly revised the taxonomy.

GENERIC DIAGNOSIS OF MALE IMAGINES

The characteristics of this genus have been comprehensively reviewed most recently by Murray & Fittkau (1989)(Figs. 1-5, 7-12, 14). In addition, the present authors found a row of minute SCf (sensilla campaniformis) along the frontal edge of scutum in all specimens (Fig. 6).

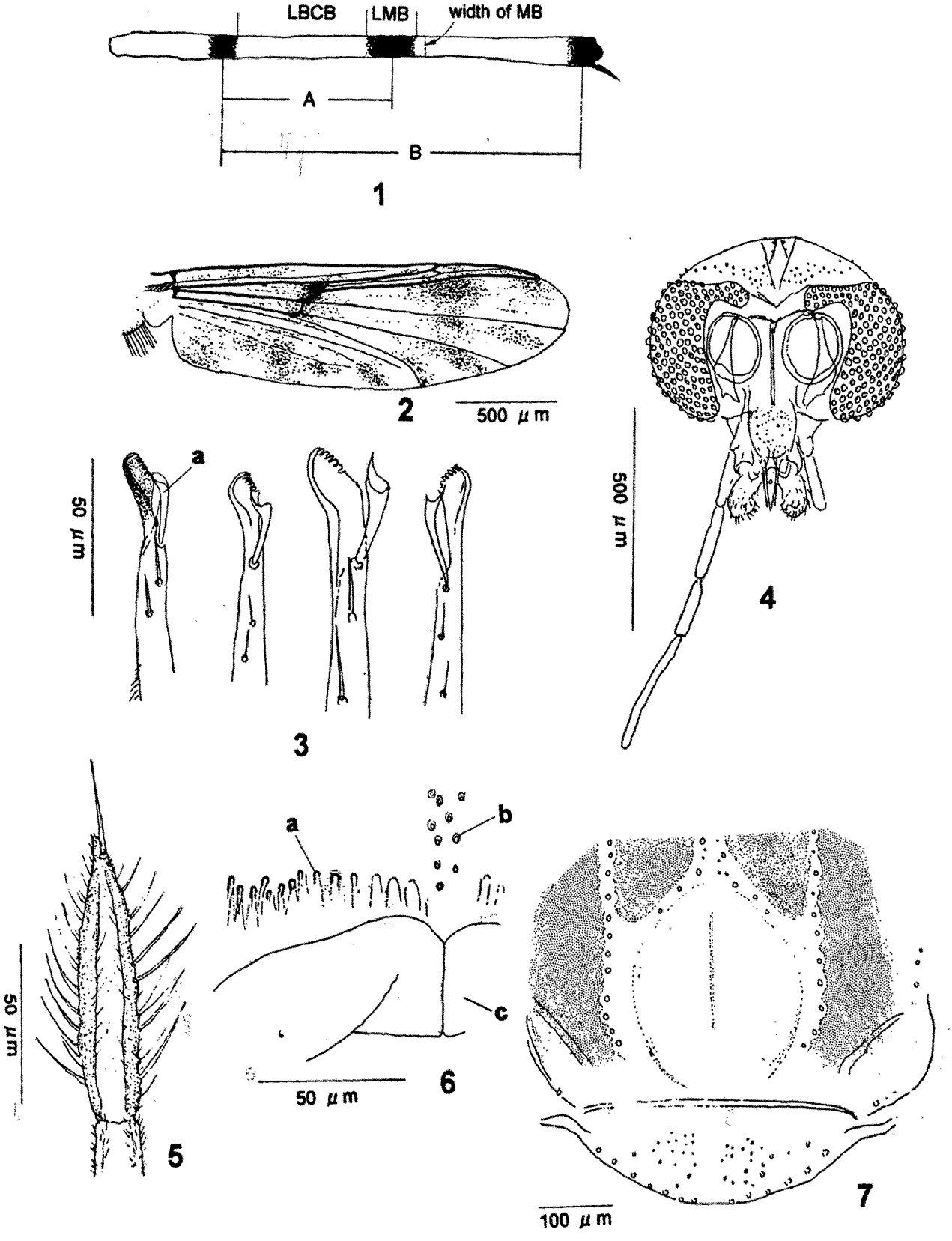
Roback (1971) recognized the aedeagal complex as consisting of four paired parts (the abbreviations in the parentheses are assigned by the present authors) (Fig. 13):

a) dorsal lobes (DL) – these are the triangular lobes bearing outwardly curved brush-like setae, which lie above the blades and each lobe being attached at its base to the base of AB and always shorter than AB. It is pad-like in *A. phatta*.
b) lateral filaments (LF) – these lie between the base of the blades and the inner corner of the gonocoxite. They arise from a membranous base.
c) aedeagal blades (AB) – these are median sclerotized rods which lie on each side of the midline. They may be straight, curved or sinuate, and sometimes in everted position.
d) lateral lobes (LL) – these are membranous or semi-sclerotized lobes which lie laterad of the blades. They are attached near the base of the blades, and of the lateral filaments. In some species they cannot be discerned, but in others they are very distinctive.

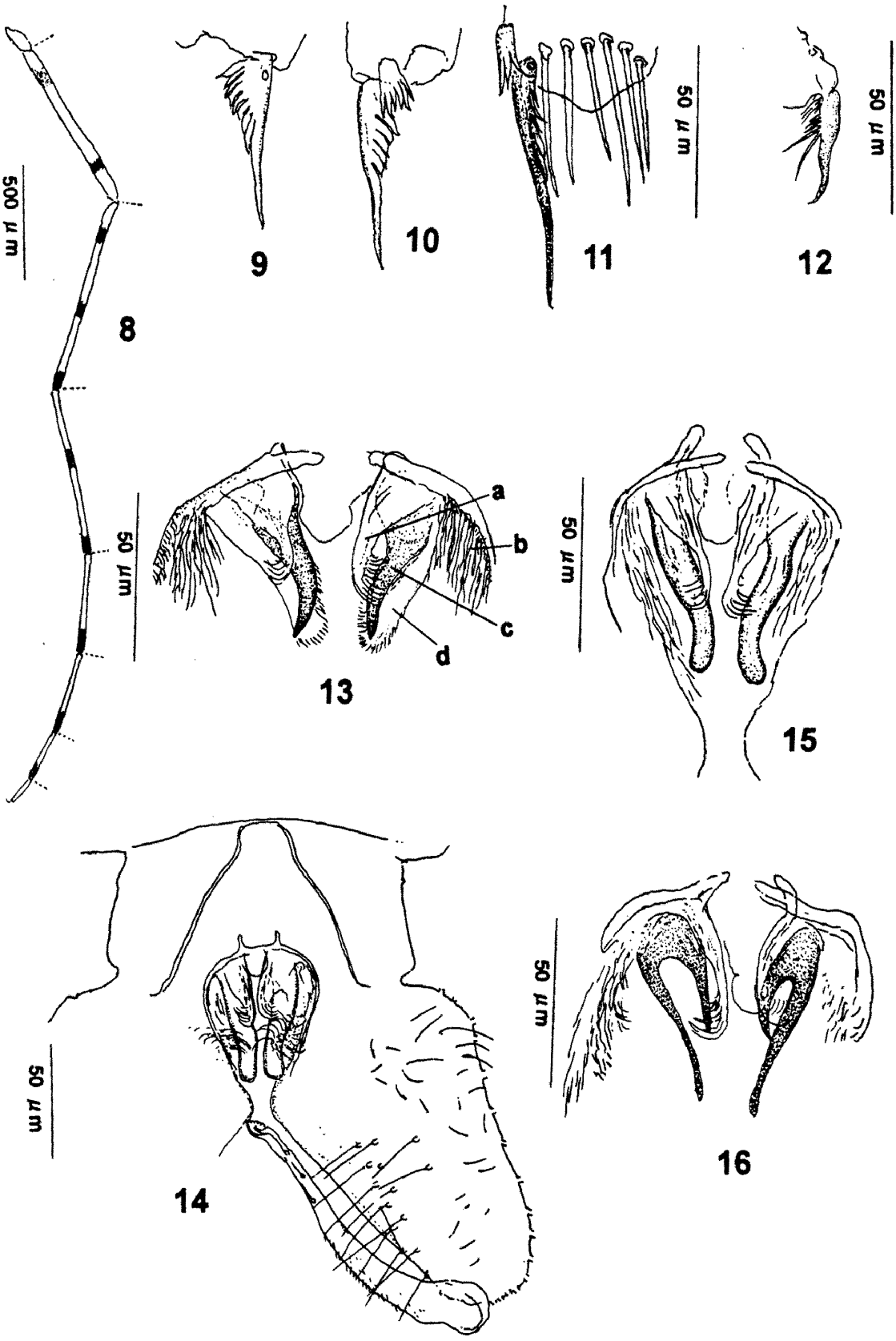
MORPHOLOGICAL ANALYSIS

While it is easy to identify adult *Ablabesmyia* by their conspicuous and characteristic leg bands (Fig. 8) and cohclear iform or lanceotale shaped megaseta of gonostylus, it is one of the most difficult groups in the subfamily Tanypodinae to identify at the species level due to being very similar structurally in general and due to the variability of the characters of the aedeagal complex in which characters necessary for identification are concentrated. However in the genus, the aedeagal complex offers the most reliable characters for differentiation of species. It is almost impossible to separate the species without recourse to slide preparation of the genitalia (Roback, 1959, 1971).

We examined one hundred and five male adults of *Ablabesmyia* collected by light trap (6 watt black light), sweeping net, and by rearing from Hokkaido, Honshu and Kyushu (Table 1). All of them were cleared with 10% KOH and some slides were mounted in Berlese mountant (Pinder, 1983), the rest were mounted in Euparal. In addition to these, some specimens from Sasa's collection deposited in the National Institute of Environmental Studies were reexamined. Some general characters and leg proportions were measured at first. Only the structures of the aedeagal complex enable us to divide the specimens available to us into three forms. They are abbreviated by us temporarily as follows based on the structure of AB: H (horn-like)-form (Fig. 13C), T (tongue-like)-form (Figs. 14, 15) and S (swan-



Figs. 1-7. 1. Diagrammatic front tibia (cf. Roback (1971). LBCB: length of basal clear band; LMB: length of medial band); 2. Wing; 3. Apical parts of gonostyli; 4. Head; 5. Last segment of antenna; 6. Anterior part of scutum. a: sensory organs; b: acrostichals; c: antepronotal lobe; 7. Posterior area of scutum.



Figs. 8-16. 8. Front leg; 9. Tibial spur of front leg (P_1); 10. Tibial spurs of mid leg (P_2); 11. Tibial spurs and comb of hind leg (P_3); 12. Claw of front leg; 13. Aedeagal complex of H-form. a: DL (dorsal lobe), b: LF (lateral filaments), c: AB (aedeagal blade), d: LL (lateral lobe); 14. Hypopygium (T-form); 15. Aedeagal complex of T-form; 16. Aedeagal complex of S-form.

neck-like)-form (Fig. 16). Then we measured and statistically evaluated features of the aedeagal complex as shown in Fig. 17.

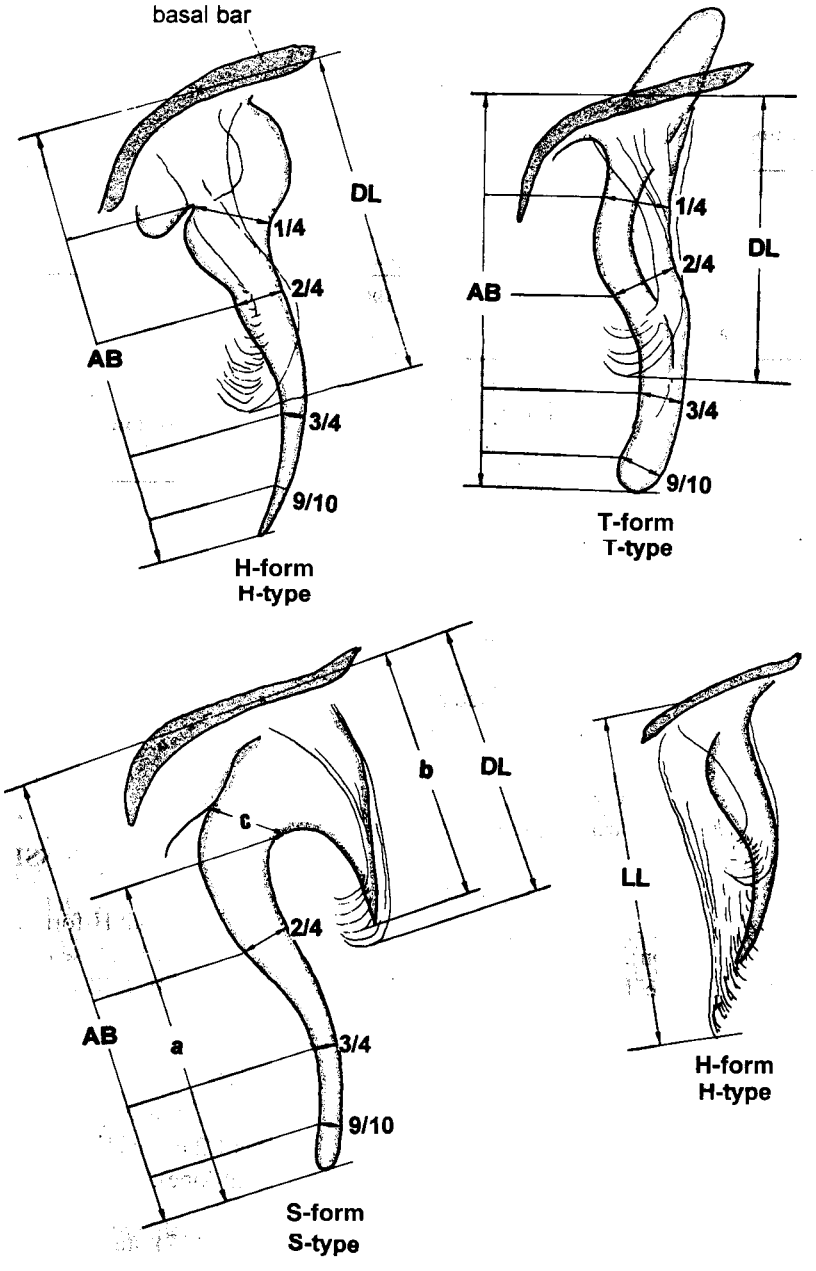
All linear measurements are given in μm, with the values presented as means followed by total ranges and SD in parentheses. Terminology and abbreviations follow mainly Sæther (1980) and Roback (1971).

Female adult and immature stages are not analyzed here, because of the small number of specimens we have, and the impossibility to associate the three male forms with the female adults and the immature specimens.

RESULTS

Meristic data of general characters and leg proportions are given in the Tables 2-4. Definite differences were never found among the three forms. S-form has the greatest wing length and highest AR (antennal ratio: ratio of length of apical flagellomere plus elongated penultimate one divided by combined length of the more basal flagellomeres) among the three forms, but the differences are small (Table 2).

Regarding the position of medial band (MB) on tibia, A/B, LMB/width of MB and LMB/LBCB defined by Roback (1971) (Fig. 1) are very similar (Table 3) among H, T and



17

Fig. 17. Diagrammatic AB (aedeagal blade). **AB**: Length of AB; **DL**: Length of DL (dorsal lobe); **LL**: Length of LL (lateral lobe). **1/4, 2/4, 3/4, 9/10**: Width of main blade at the specific length of divided AB, measured at right angle to axis of main blade. On S-form. **a**: Length of main blade; **b**: Length of basal blade; **c**: Width of main lobe at diverging point of main blade from basal blade.

Table 2. General characters (in μm).

	Range Average (SD) Number examined		
	H-form *A. longistyla*	S-form *A. monilis*	T-form *A. prorasha*, new species
AR	1.70-2.23 1.90 (0.18) 10	1.76-2.33 2.08 (0.16) 10	1.86-2.31 2.03 (0.15) 10
Wing length	1590-2900 2167 (310) 44	1760-2880 2430 (263) 29	1720-2730 2059 (211) 30
Length of coxite	155-265 198 (23) 45	180-250 244 (23) 30	175-255 198 (16) 30
Length of stylus	155-270 190 (25) 45	180-250 215 (17) 30	160-260 183 (19) 30
Coxite/stylus	0.84-1.14 1.04 (0.06) 45	0.95-1.16 1.04 (0.04) 30	0.98-1.22 1.09 (0.05) 30

Table 3. Proportions of front tibial bands.

	Range (number examined) Average		
	A/B	LMB/LBCB	LMB/width
H-form *A. longistyla*	0.49-0.55(6) 0.51	0.18-0.28(6) 0.23	1.60-2.67(6) 2
S-form *A. monillis*	0.49-0.53(4) 0.51	0.23-0.33(4) 0.26	1.60-3.25(4) 2.21
T-form *A. prorasha*, new species	0.49-0.52(5) 0.51	0.24-0.28(5) 0.26	1.75-2.67(5) 2.15

S-forms, so the position and size of band are not usable for separation of species. LR_1 (frontal leg ratio) and AR (antennal ratio) related with wing lengths also do not compose clusters in the graphs in spite of being divided into three clusters by the structure of the aedeagal complex as mentioned later (Figs. 18, 19). Any distinction could not be recognized between these forms on the feature of the tibial spurs (Figs. 9-11). After all, no remarkable differences to separate species were recognized among the specimens except those of the aedaegal complex. The aedeagal blade (AB) and dorsal lobe (DL) are always present and clear, lateral lobe (LL) could be discerned depending on forms and often confused with lateral filaments (LF) (cf. The Discussion). AB and DL were usually most conspicuous among the four parts of the aedeagal complex.

Length of gonocoxite, gonostylus and specifically located sites of the aedeagal complex were measured as given in Figs. 17, 20 to analyze their structure, and their proportions are given in the Table 5. The relation between length of AB and width of apex of AB (9/10) proves that the specimens are divided into three clusters (Fig. 21). AB of H-form is slender and tapering toward apex, sinuate or sometimes curved inwards or outwards. T-form's AB is not tapering, but parallel-sided (Figs. 14, 15, 17, 22), and somewhat looks membranous, while AB of T and H-forms have not basal blade, S-form has long, slender and sinuate main blade with conspicuous basal blade. Some specimens in each form (13% of H-form, 7% of S-form and 3% of T-form) have everted AB (Fig. 22). The reason why some AB are everted has not been understood, but it is neither an artifact nor a characteristic for discerning species as stated in Sublette (1964: 114). Discernable LL was found in 78% of H-form, 13% of S-form and 80% of T-form (Fig. 13).

DISCUSSION

It is unquestionable that H-form is *A. longistyla* and S-form is *A. monilis*, mainly because of the aedeagal structures. H-form has simple AB 1.48 times of DL (1.08-2.09, n=40, SD=0.21); according to Fittkau (1962) in European *longistyla* also AB is 1.5 times of DL. S-form has swan-neck-like AB, main blade sinuate, 1.62 times (1.27-2.71times, n=29, SD=0.25) of basal blade (according to Fittkau (1962: 431) basal blade is 1/2 of main blade, which means main lobe 2.0 times of basal lobe).

Fittkau (1962: 427) states gonostylus of *A. longistyla* is slightly longer than its gonocoxite, so gives it the specific name '*longistyla*'. However, the relative length of gonostylus of H-form is not as longer as that of the European species (Table 2). The ratio of length of H-form gonocoxite divided by length of gonostylus is 1.04 (0.84-1.14, n=46, SD=0.06),

Table 4. Legs proportions (in μm).

	n=10 (ti and ta1); n=5 (spur) Range and average, and SD in the parentheses								
	P1				P2			ti spurs	
	ti	ta1	LR1	ti spur	ti	ta1	LR2	inner	outer
H-form	890-1260	710-900	0.68-0.89	41-67	710-1240	600-920	0.72-0.92	57-79	32-44
A. longistyla	1004 (115)	790 (33)	0.79 (0.05)	58 (10)	956 (173)	749 (108)	0.79 (0.07)	68 (10)	37 (5)
S-form	840-1220	710-990	0.79-0.87	53-68	750-1100	630-900	0.76-0.90	63-80	27-48
A. monilis	1057 (112)	877 (96)	0.83 (0.02)	59 (6)	933 (125)	765 (94)	0.82 (0.04)	73 (7)	35 (9)
T-form	790-1020	660-820	0.80-0.88	51-63	760-940	600-700	0.73-0.81	60-65	27-37
A. prorasha, new species	906 (67)	755 (61)	0.83 (0.02)	56 (5)	865 (61)	666 (35)	0.77 (0.03)	63 (2)	33 (5)

Table 4 (Continued). Legs proportions (in μm).

	P3			ti spurs		comb's
	ti	ta1	LR2	inner	outer	bristle
H-form	830-1510	750-1300	0.79-0.90	61-81	27-43	5-10
A. longistyla	1161(830)	987 (987)	0.85 (0.03)	71 (8)	35 (6)	7 (2)
S-form	980-1400	850-1150	0.79-0.91	60-76	24-49	5-8
A. monilis	1192 (159)	1037 (123)	0.87 (0.04)	70 (6)	32 (10)	6 (1)
T-form	900-1180	770-980	0.83-0.87	57-71	24-36	6-7
A. prorasha, new species	1056(96)	896 (76)	0.85 (0.01)	63 (6)	32 (5)	7 (0.5)

while the ratio in European *longistyla* is 0.9 based upon figure 396 in Fittkau (1962).

Ablabesmyia phatta was not found in our studies; nevertheless it has been often recorded in the Palaearctic region as well as *monilis* and *longistyla*. According to Fittkau (1962), *A. phatta* has a strong seta at the base of middle tibial outer and inner spur respectively, frontal tibia with long beard. Subterminal megaseta of gonostylus is pointed at tip; with strong and uniserial acrostichal setae, AR at least 2.5, DL pad-like, and AB spine-like and pointed apically. Wing length of *phatta* usually over 4 mm, while ones of the specimens examined 2.9mm at most, AR 1.90 (1.70-2.23, n=10, SD=0.18) in H-form, 2.00 (1.86-2.31, n=10, SD=0.15) in T-form and 2.08 (1.76-2.33, n=10, SD=0.16) in S-form respectively, and pad- like DL was not found in all forms except three specimens of H-form and three of S-form. None of the specimens examined has a seta at the base of the middle tibial spurs (Figs. 10); subterminal megaseta of gonostylus of all forms is expanded apically. It is also impossible to use the bulge of gonocxite for separating species, because of its continuous inter- and intraspecific variation, although a very weak bulge was recognized in 29% of H-form, in 40% of S-form and in 33% of T-form.

Finally, the question remains as to the identity of the T-form. Its AB is approximately parallel-sided (Figs. 14, 15, 22), and does not taper toward apex; moreover, it appears membranous, and lacks basal blade. This species appears to be closely related to *A. basalis* (Walley, 1925) and *A. rasha* Roback, 1971 in having parallel-sided AB. However, DLs of *A. basalis* and *A. rasha* are very short, and lack toothbrush-like end that DL of T-form has. Besides, AB of *A. basalis* is clearly different from that of T-form, because of AB of the former possess a basal blade.

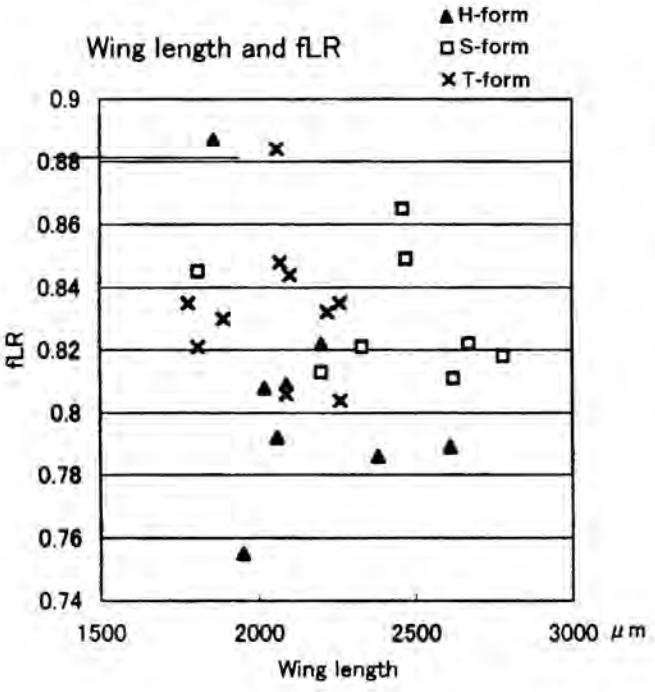
The characteristics of *A. rasha* Roback (1971), are very similar to those of T-form except for the following three points: length of fore tibial spur (44 μm in *A. rasha*, and 58(51-63) μm in T-form), LMB/width of MB (2.2-2.5 in *A. rasha*, and 2.15 in the T-form), and the structure of DL. Therefore, the authors examined the holotype of *A. rasha* (AMNH 620), courtesy of Dr. D. Grimaldi of the American Museum of Natural History. As a result, it was found that DL of *A. rasha* was very short due to lack of toothbrush-like end (Fig. 23). Roback (1971) reported that length of DL in *A. rasha* was 19-22 μm, while that in T-form was 30-52 μm (40 μm on average of 29) because the latter had a toothbrush-like end, while the former did not. This is the major difference between *A. rasha* and T-form. Consequently, this led us to conclude that T-form is a new species that we call *A. prorasha*.

Ablabesmyia prorasha, new species

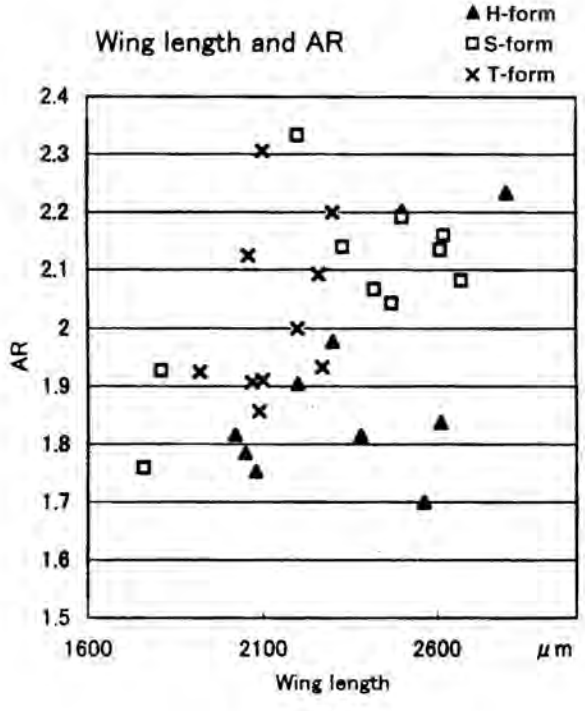
(Figs. 15, 17 (T-form))

Material examined. – Holotype – male, Japan, Kanagawa Prefecture, Ikuta (35° 36' N, 139° 32' E; 60 m in altitude), by light trap (a six-watt black light), 10 May.2000, slide mounted in Berlese mountant, deposited in the Natural History Museum and Institute, Chiba, Japan (No. CBM-ZI 88407).

Paratypes – 2 males (No. CBM-ZI 88408 and 9), as holotype.



18



19

Figs. 18, 19. 18. Relations between wing length and LR_1 (showing no correlation between them, and impossibility to divide into groups); 19. Relations between wing length and AR (showing no correlation between them, and impossibility to divide into groups).

Etymology. – Named after similarity to *A. rasha* Roback, 1971.

Diagnosis. – Separable from *A. rasha* by the feature of AB and lack of DL (conf. the Rusults).
Wing length, AR, length of coxite, length of stylus and ratio of coxite/stylus are given in Table 2; legs proportions in Table 4; proportions of AB in Table 5.
Synonyms are listed in the Synonymy (see later).

We have reviewed all *Ablabesmyia* species recorded from Japan and reexamined type specimens as much as possible and found they can be divided into three species mentioned above. The key to species based on adult male and the list of synonyms are as follows.

KEY TO ADULT MALES OF JAPANESE *ABLABESMYIA*

1. AB sinuate with a basal blade, main blade about 70 μm long.....*A. monilis*
– AB straight, curve or sinuate, without basal blade.....2
2. AB tapering toward apex, about 40 μm long.....*A. longistyla*
– AB parallel sided, round apex, about 60 μm long.....*A. prorasha*, new species

SYNONYMY (including a species from Korea)

A. longistyla Fittkau, 1962
A. amamisiplex Sasa, 1990: 134. NEW SYNOMYM
A. jogancornua Sasa, 1991: 64. NEW SYNONYM
A. longistyla – Sasa, Suzuki & Sakai, 1998: 125.
A. monilis – Sasa, 1990: 135; 1991: 65; Sasa & Okazawa, 1992: 208 (not Linnaeus, 1758).

A. monilis (Linnaeus, 1758)
A. monilis - Sasa, Suzuki & Sakai, 1998: 126; Sasa & Kawai, 1987: 55.
A. tomotertia Sasa, 1993: 58. NEW SYNONYM
A. yufucomplexa Sasa & Suzuki, 1991: 99. NEW SYNONYM

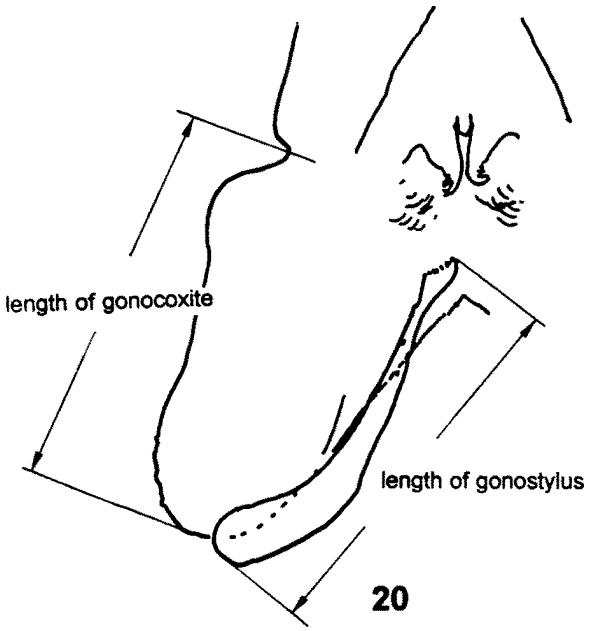
A. prorasha, new species
A. monilis – Sasa, 1993: 133; Sasa & Suzuki, 1997: 340; Ree & Kim, 1981: 180 (not Linnaeus, 1758).

ACKNOWLEDGMENTS

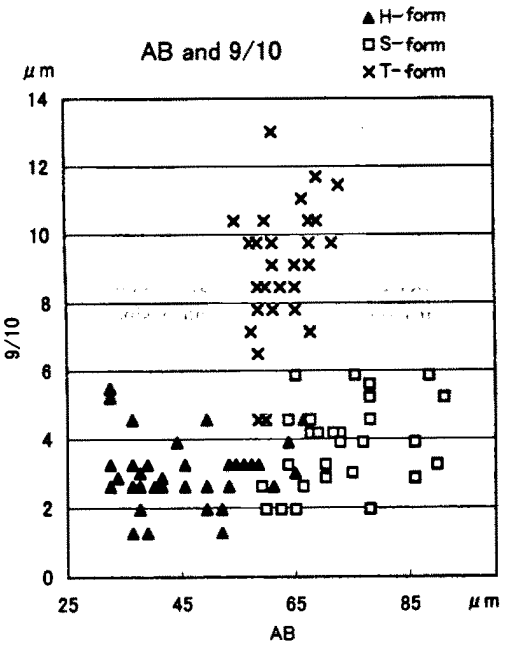
We wish to express our gratitude to Professor Dr. James E. Sublette for reading of the manuscript, and also Emeritus Professor of the Tokyo University Dr. Manabu Sasa, Dr. Hiroshi Suzuki of Nagasaki University, Dr. Shigeo Kondo of Aichi Medical University and Dr. Kazuo Endo of Obihiro Animal Husbandry College for their generous of loan of specimens.

Table 5. Proportions of AB (in μm) (cf. Fig. 17).

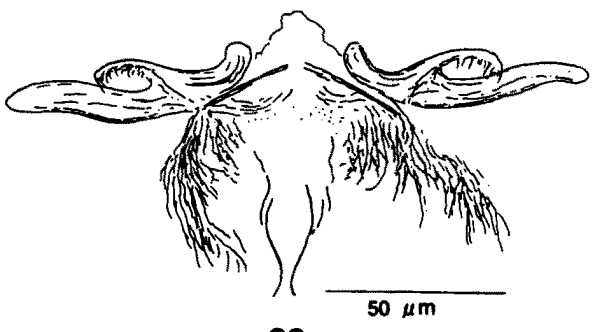
		Range Average (SD)										
	n	AB	DL	AB/DL	LL	1/4	2/4	3/4	9/10	a	b	c
H-form	46	33-66	18-51	1.08-2.09	28-75	6.5-26.5	4.6-11.7	2.0-8.5	1.3-5.5	–	–	–
A. longistyla		46 (10)	31 (8)	1.48 (0.21)	51 (15)	10.8 (3.5)	7.4(1.9)	4.7 (1.4)	3.1 (0.9)	–	–	–
S-form	30	59-91	31-56	1.24-2.50	64-73	–	4.6-13.7	2.0-7.8	2.0-5.9	34-66	22-55	7-14
A. monilis		73 (8)	43 (7)	1.71 (0.27)	70 (4.0)	–	7.8 (2.5)	4.5 (1.3)	3.8 (1.2)	48 (8.4)	46 (7)	11(3)
T-form	26	55-73	30-52	1.18-2.12	32-71	6.5-16.9	3.9-21.5	5.9-15.0	4.6-13.0	–	–	–
A. prorasha, new species		63 (5)	40 (6)	1.60 (0.18)	61 (8)	12.3 (2.9)	12.1 (3.4)	10.8 (2.6)	8.9 (1.9)	–	–	–



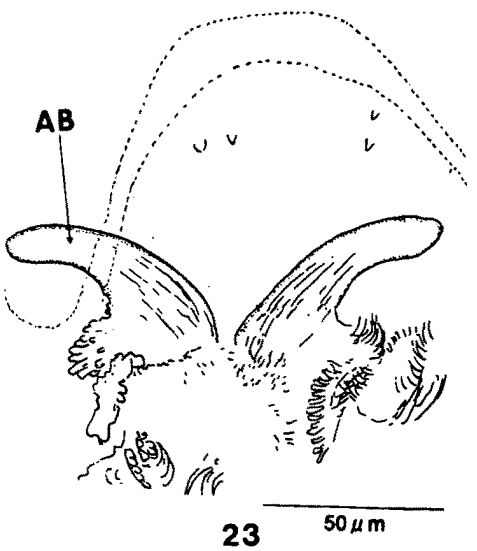
20



21



22



23

Figs. 20-23. 20. Diagrammatic hypopygium; 21. Relations between AB and 9/10 (showing division into three groups, H-form, S-form and T-form); 22. Aedeagal complex everted of T-form; 23. Aedeagal complex of *A. rasha* (Holotype).

LITERATURE CITED

Ashe, P. & P. S. Craston, 1990. Family Chironomidae. In: Soós, A. (ed.), *Catalogue of Palaearctic Diptera, Psychodidae-Chironomidae, 2*. Akadémiai Kiadó, Budapest. Pp. 113-355.

Edwards, F. W., 1929. British non-biting midges (Diptera, Chironomidae). *Transactions of the Royal Entomological Society of London,* **77**(Pt. 2): 279-430.

Fittkau, E.,1962. Die Tanypodinae (Diptera, Chironomidae). Die Tribus Anatopyniini, Macropelopiini und Pentanurini. *Abhandlung zur Larvalsystematik der Insekten,* **6**: 1-435.

Freeman, P., 1955. A study of the Chironomidae (Diptera) of Africa south of the Sahara. Part 1. *Bulletin of the British Museum (Natural History) Entomology,* **4**(1): 1-67.

Johannsen, O. A., 1905. Aquatic nematocerous Diptera. In: Needham, J. G., K. J. Morton & O. A. Johannsen (eds.), May Flies and Midges of New York. *Bulletin of New York State Museum,* **86**: 328-441.

Johannsen, O. A., 1946. Revision of the North American species of the genus Pentaneura (Tendipedidae, Chironomidae, Diptera). *Journal of the New York Entomological Society,* **54**(4): 267-287.

Laville, H. & B. Serra-Tosio, 1996. Additions and corrections to the French chironomid (Diptera) inventory since 1990. *Annales de Limnologie,* **32**(2): 115-121.

Murray, D. A. & E. Fittkau, 1989. The adult males of Tanypodinae (Diptera; Chironomidae) of The Holarctic region – Keys and diagnoses. In: Wiederholm, T. (ed.), Chirnomidae of the Holarctic region – Keys and diagnoses. Part 3. Adult males. *Entomologica scandinavica* Supplement, **34**: 37-124.

Pinder, L. C. V., 1989. The adult males of Chironomidae (Diptera) of the Holarctic region – Introduction. In: Wiederholm, T. (ed.), Chirnomidae of the Holarctic region – Keys and diagnoses. Part 3. Adult males. *Entomologica scandinavica* Supplement, **34**: 5-9.

Ree, H. I. & H. S. Kim, 1981. Studies on Korean Chironomidae (Diptera) 1. Taxonomical Study on Adults of Chironomidae. *Proceedings of the college of Natural Sciences,* **6**(1): 123-226.

Roback, S. S., 1959. The subgenus Ablabesmyia of Pentaneura (Diptera; Tendipedidae; Pelopiinae). *Transactions of the American Entomological Society,* **85**: 113-135, Pls. 1-17.

Roback, S. S., 1971. The subfamily Tanypodinae in Northern America. *Monographs of the Academy of Natural Sciences of Philadelphia,* **17**: 1-410.

Sæther, O. A., 1980. Glossary of chironomid morphology terminology (Diptera: Chironomidae). *Entomologica scandinavica* Supplement, **14**: 1-51.

Sasa, M., 1990. Studies on the chironomid midges (Diptera, Chironomidae) of the Nansei Islands, southern Japan. *Japanese Journal of Experimental Medicine,* **60**(3): 111-165.

Sasa, M., 1993. Studies on the chironomid midges (Yusurika) collected in Toyama and other area of Japan, 1993 (Pt. 3). In: Some characteristics water quality and aquatic organisms in the chief lakes in Toyama Prefecture. (Lake Nawagaike). *Research Report from Toyama Prefectural Environmental Pollution Research Center,* **1993**: 55-62.

Sasa, M. & H. Suzuki, 1991. The chironomids of the Joganji River and other places. Pt. 5. Studies on the chironomids of the Aso National Park, Kyushu. *Research Report from Toyama Prefectural Environmental Pollution Research Center,* **1991**: 93-100.

Sasa, M. & H. Suzuki, 1997. Studies on the Chironomidae (Diptera) collected from the Ogasawara Islands, southern Japan. *Medical Entomology and Zoology,* **48**(4): 315-343.

Sasa, M., H. Suzuki & T. Sakai, 1998. Studies on the Chironomid Midges Collected on the Shore of Shimanto River in April 1998. *Tropical Medicine,* **40**(3): 99-147.

Sasa, M. & K. Kawai, 1987. Studies on chironomid midges of Lake Biwa. *Lake Biwa Study Monographs,* **3** (Diptera, Chironomidae). Lake Biwa Research Institute, Otsu. Pp. 1-119.

Sasa, M. & T. Okazawa, 1992. Studies on the chironomid midges (Yusurika) of Toga-Mura, Toyama. Part 3. The subfamilies Diamesinae and Tanypodinae. *Research Report from Toyama Prefectural Environmental Pollution Research Center,* **1992**: 205-230.

Sublette, J. E., 1964. Chironomidae (Diptera) of Louisiana_. Systematics and immature stages of some lentic chironomids of Wet-Central Louisiana. *Tulane Studies in Zoology,* **11**(4): 109-150.

Tokunaga, M., 1937. Chironomidae from Japan **IX**. *The Philippine Journal of Science,* **62**(1): 21-65.

Yamamoto, M., 1989. Chironomidae. In: Hirashima, Y. (ed.), A checklist of Japanese Insects. *Kyushu Univ*ersity *Press*: 732-745.

Yamamoto, M., 2000. Chironomidae (Diptera) found in the Garden of the Imperial Palace, Tokyo. *Memories of the National Science Museum,* Tokyo, **36**: 381-395 (in Japanese).