DESCRIPTIONS OF FOUR NEW SPECIES OF DROSOPHILIDAE OF THE BONINS, WITH TAXOMETRICAL ANALYSES OF THE SCAPTOMYZA SPECIES (DIPTERA)

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My drosophilid survey in the Bonin Islands in June 1972 added new material to the previous records (Kikkawa and Peng, 1938; Wheeler and Takada, 1964; Okada, 1971). The present work describes four new species including those which have been left unnamed due to insufficiency of material. Furthermore, an attempt is made to taxometrically determine the taxonomic positions of two new aberrant species of the genus *Scaptomyza* Hardy.

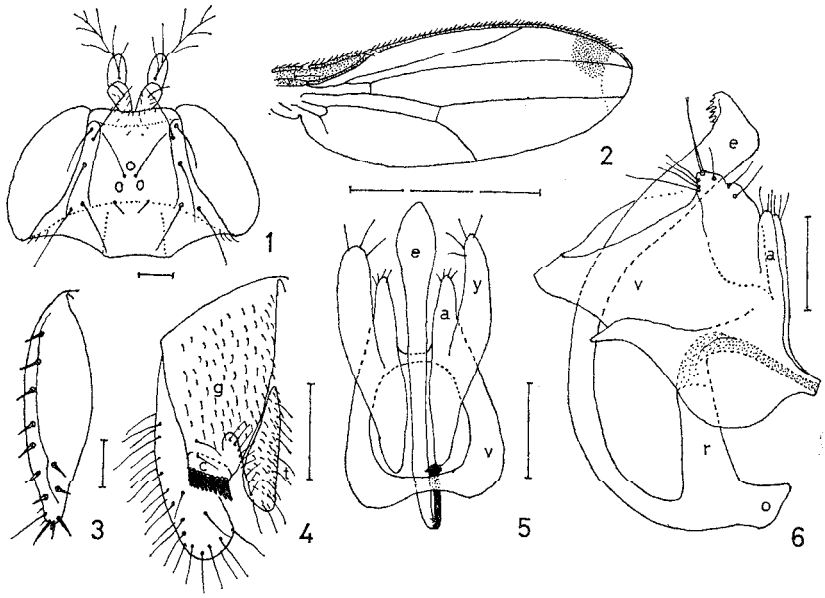
My hearty thanks are due to the members of the expedition, Mr. K. Suzuki and Mr. N. Watanabe of Tokyo Metropolitan University, and to Mr. H. Kôno and Mr. O. Iwahashi of the Ogasawara Branch Office of Tokyo Municipal Government, for their kind helps during the survey. The financial support was defrayed with the Scientific Research Funds from the Ministry of Education.

Chymomyza fenestrata sp. n. Figs. 1–6

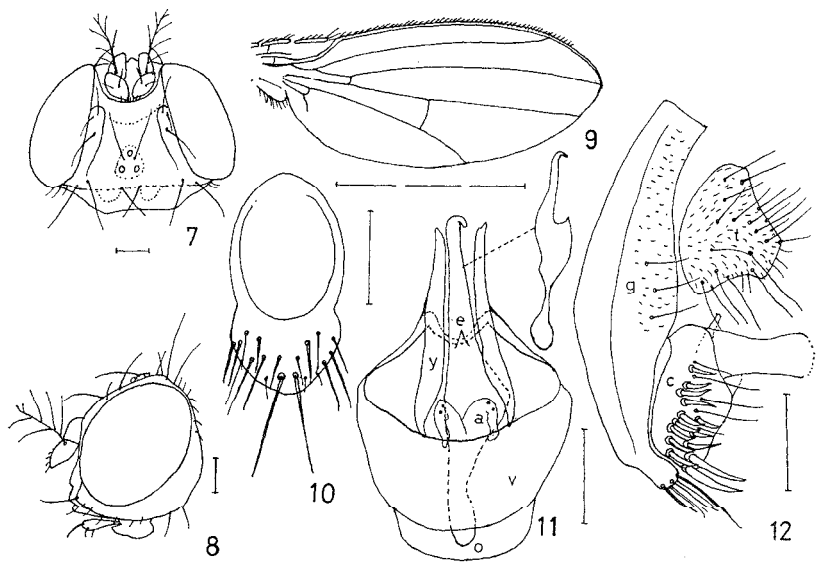
♂, ♀. Body about 3 mm in length. Eye (Fig. 1) orange red, bare. Antenna orange grey, third joint slightly longer and darker than the second. Arista with about three dorsal and two ventral branches besides a moderate fork. Palpus pale yellow, with a few short setae below. Ocellar triangle brownish black, subshining; periorbits glossy orange grey. Front subshining orange brown, somewhat purplish, anteriorly as broad as length down middle, posteriorly half as broad as head width. Face flat, dark brown, with carina undeveloped. Clypeus dark brown. Cheek yellow, very narrow. Anterior reclinate orbital as long as proclinate, situated before proclinate; posterior reclinate longer than other orbitals. Vibrissa strong, second oral half as long as vibrissa.

Thorax uniformly orange brown, subshining. Acrostichal hairs in six rows. Anterior dorsocentrals half as long as posteriors; distance between anterior and posterior pairs half distance between anterior pair. Humeral one. Anterior scutellars convergent, half as long as posteriors, which are nearer to anteriors than to each other. Sterno-index 0.8. Legs orange grey, fore and hind femora swollen, distal two-thirds of femur to metatarsus of fore leg black, tibiae of mid and hind legs fuscous. Preapicals prominent on hind tibia, apicals on mid tibia. Wing (Fig. 2) hyaline, apically milky white, subapically with a round black marking extending from costa below to cell R_{4+5}. Costa and costal cell black, R_{2+3} straight, R_{4+5} and M parallel. C-index 1.3; 4V-index 2.3; 4C-index 1.6; 5x-index 3.0; Ac-index 5.0. C1-bristles two, subequal in size; C3-fringe on basal five-sixths. Haltere white. Abdominal tergites glossy black, 1st tergite and anterior half of 2nd tergite orange brown. Abdominal sternites pale.

Periphallic organs (Fig. 4): Anal plate pale, small, oblong. Clasper small, as long as broad, with a straight row of about ten long black teeth. Phallic organs (Figs. 5, 6) generally brownish black. Aedeagus elongate, dorsally curved, apically somewhat swollen and with a few ventral serrations; apodeme very short, dorsoventrally flattened. Vertical rod well developed. Anterior parameres finger-like, fused to hypandria, apically with a few sensilla. Hypandrium with several long hairs apically. Egg-guide lobe (Fig. 3) pale



Figs. 1–6. *Chymomyza fenestrata* sp. n. 1. Head; 2. Wing; 3. Egg-guide; 4. Periphallic organs; 5. Phallic organs (ventral aspect); 6. *ibid.* (lateral aspect, left side ventral). a. anterior paramere; c. clasper; e. aedeagus; g. genital arch; o. apodeme of aedeagus; r. vertical rod of aedeagus; t. anal plate; v. ventral fragma; y. hypandrium. Scales 0.1 mm, for wing 1.0 mm.



Figs. 7–12. *Scaptomyza* (*Bunostoma*) *boninensis* sp. n. 7, 8. Head; 9. Wing; 10. Egg-guide; 11. Phallic organs (ventral aspect) with attached figure of aedeagus (lateral aspect, right side ventral); 12. Periphallic organs. Signs and scales as in Figs. 1–6.

yellow, apically narrowing, with about seven marginal and two discal long pointed yellowish teeth, basal isthmus very short.

Holotype: ♂, Okimura, Hahajima, 11–14 VII 1972, collected on the windowglass in a house (Okada).

Paratypes: 3♀, collected together with the holotype; 1♂, at fruit trap (Okada).

Relationships: Resembles *C. fuscimana* (Zetterstedt) in having glossy orange brown thorax, black abdominal tergites, ventrally rounded genital arch, long black clasper teeth, and bristly egg-guide teeth, but differs in having distinctly black costal cell, larger black wing marking, longer C3-fringe, and apically not bilobed aedeagus.

Scaptomyza (Bunostoma) boninensis sp. n. Figs. 7–12

Scaptomyza sp. I, Okada, 1971: 69 [Chichijima].

♂, ♀. Body about 2.5 mm in length. Head (Figs. 7, 8) slightly broader than thorax. Eye dark red, with thick piles. Antenna with second joint dark brown, third yellow. Arista with three dorsal and two ventral long branches besides a small fork. Palpus brownish black, with a long terminal and a few shorter ventral setae. Ocellar triangle black. Periorbits shining brown. Clypeus pale brown. Face flat, greyish white, paler at eye margins. Carina short and narrow. Front pale to dark brown, anteriorly orange brown and slightly broader than length down middle, posteriorly broadened and slightly more than half as broad as head width. Occiput brown, slunt caudoventrally. Anterior reclinate orbital small, outside and shortly behind proclinate. Vibrissa long, other orals shorter.

Mesonotum subshining dark brown, caudally darker. Scutellum brownish black, broader than long. Thoracic pleura yellow, with black patch on pteropleura. Humeral one, strong. Acrostichal hairs in two rows. Anterior dorsocentrals slightly longer than half posteriors, which are equally apart from each other and from anteriors. Anterior scutellars convergent, longer than posteriors. Sterno-index 0.4. Legs uniformly yellowish brown. Preapicals on mid and hind tibiae, apicals on mid. Wings (Fig. 9) hyaline, crossveins clear. R_{2+3} gently curved to costa at apex; R_{4+5} and M parallel. C-index 3.0; 4V-index 2.0–2.5; 4C-index 0.9; 5x-index 2.0; Ac-index 2.0. C1-bristles two; C3-fringe on basal three-sevenths. Abdominal tergites mat brownish black.

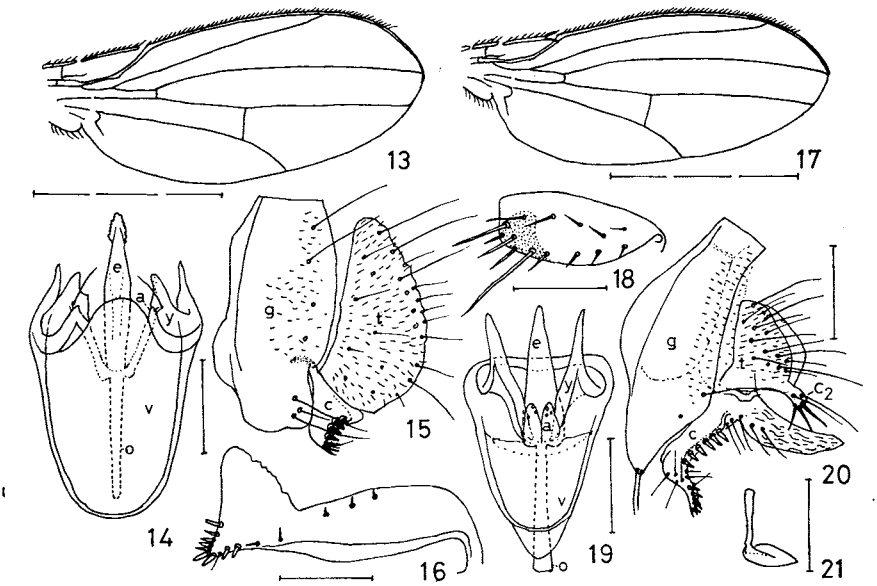
Periphallic organs (Fig. 12): Genital arch yellowish brown, much narrowing below, apically rounded and with a few strong bristles. Clasper large, broader than long, yellowish brown, distally with about fifteen stout black pointed teeth in irregular rows, apical two teeth very strong. Anal plate yellow, conical, without paralobe. Phallic organs (Fig. 11): Aedeagus yellowish brown, elongate, apically curved ventrally, ventromedially with a hook-like process. Apodeme of aedeagus dorsoventrally expanded. Anterior parameres small, conical, with a few sensilla distally. Hypandria elongate, yellowish brown, basally contiguous with the apodeme of aedeagus, dorsally connected to each other by a short bar. Ventral fragma quadrate. Ejaculatory apodeme pale brown, plate elliptical and slightly shorter than the stalk. Egg-guide lobes (Fig. 10) fused to become a glossy brown convexed elliptical plate, which is basally pale, distally with several strong setae, the apical pair of setae strongest.

Holotype: ♂, Okimura, Hahajima, 9–14 VII 1972 (Okada).

Paratypes: 1♀, Oomura, Chichijima, 26 III–4 IV 1970 (Iwahashi); 1♂, 2♀, collected together with the holotype.

Relationships: Much elongate aedeagus, two ventral branches of arista, two rows of acrostichal hairs, one humeral, long posterior scutellars, fused egg-guide lobes, and no paralobe of male anal plate are the features characteristic of the subgenus *Bunostoma*, but different from general *Bunostoma* species in having genital arch not extending below clasper and mesonotum not deep black.

Remarks: The occurrence of a *Bunostoma* species in the islands far from the known distribution areas of this subgenus, Hawaii, Samoa, Marquesas, and Australia, is remarkable. The fact may suggest a new evidence of the Oriental origin of the Hawaiian



Figs. 13–16. *Drosophila* (*Hirtodrosophila*) *apicohispida* sp. n. 13. Wing; 14. Phallic organs (ventral aspect); 15. Periphallic organs; 16. Egg-guide. Figs. 17–21. *Scaptomyza* (*Boninoscaptomyza*) *hexasticha* subgen. and sp. n. 17. Wing; 18. Egg-guide; 19. Phallic organs (ventral aspect); 20. Periphallic organs; 21. Ejaculatory apodeme. c_2. paralobe or secondary clasper. Other signs and scales as in Figs. 1–6.

"scaptoid" species *sens.* Throckmorton (1966:336).

Subgenus ***Boninoscaptomyza*** n.

Head as broad as thorax. Arista with ventral branches below fork. Humerals two. No presutural dorsocentrals. Acrostichal hairs in six rows. Posterior scutellars as long as anteriors. Male anal plate with paralobe. Egg-guide lobes weakly sclerotized, without stout teeth.

Resembles the subgenus *Parascaptomyza* Duda especially in the features of male and female genitalia, but distinctly different in having six rows of acrostichal hairs (at most four in *Parascaptomyza*) and two long humerals (one).

Type species: *Scaptomyza hexasticha* sp. n.

Scaptomyza* (*Boninoscaptomyza*) *hexasticha sp. n. Figs. 17–21

Scaptomyza sp. II, Okada, 1971: 69 [Hahajima].

♂, ♀. Body about 1.5 mm in length. Eye dark red, with thick piles. Antenna yellowish orange, third joint darker. Arista with three dorsal and one ventral branches besides a terminal fork. Palpus yellow, with a few strong setae distally below. Ocellar triangle glossy black, periorbits greyish brown. Occiput black. Front dark velvety orange, anteriorly somewhat narrower than length down middle, posteriorly wider. Face grey, carina narrow but high. Cheek broad, greyish white, caudally black. Clypeus pale yellow. Anterior reclinate orbital two-thirds as long as proclinate, much nearer to proclinate than to posterior reclinate, which is longer than proclinate. Second oral half as long as vibrissa.

Mesonotum subshining dark brown or yellowish brown. Thoracic pleura somewhat fuscous. Lower humeral slightly shorter than upper. Anterior dorsocentrals two-thirds

as long as posteriors; distance between anterior and posterior pairs half distance between anterior pair. Anterior scutellars convergent, posteriors nearer to each other than to anteriors. Sterno-index 0.5. Legs yellow, shaggy, ultimate tarsal joints large and black. Metatarsi of fore and mid legs as long as three succeeding tarsal joints taken together, that of hind leg as long as four. Preapicals well developed on all tibiae. Wing (Fig. 17) hyaline, long. R_{2+3} weakly curved to costa apically, R_{4+5} and M parallel. C-index 2.5; 4V-index 2.0; 4C-index 1.0; 5x-index 1.5; Ac-index 2.7. C1-bristles two, strong; C3-fringe on basal one-third. Haltere yellowish orange. Abdominal tergites subshining brownish black.

Periphallic organs (Fig. 20): Genital arch with upper half pale and pubescent; lower half black, apically narrowly pointed and with a few strong bristles. Clasper black, much broader than long, distally concaved, with a marginal row of about six stout black teeth and several smaller teeth below, dorsally with a pale blade-like process. Anal plate black, oval, pubescent and setigerous; paralobe club-shaped, with a tuft of a few stout setae. Phallic organs (Fig. 19) mostly pale brown. Aedeagus rod-shaped, distally narrowing; apodeme of aedeagus as long as aedeagus. Anterior paramere small, conical, distally with a few sensilla. Ventral fragma triangular. Hypandrium narrowly prolonged caudally. Ejaculatory apodeme (Fig. 21) black, with plate elliptical and slightly shorter than the stalk. Egg-guide lobe (Fig. 18) pale, distally with a black patch, apically broadly truncate, with about ten marginal and five discal black bristles, two apical bristles being very long. Basal isthmus minute.

Holotype: ♂, Kômoridani, Hahajima, 26 III 1971 (Suzuki).

Paratypes: 1♂, 1♀, Okimura, Hahajima, 11–13 VII 1972 (Okada).

Remarks: The six rows of acrostichal hairs as found in this species (as a subgeneric character) is uncommon in the genus *Scaptomyza*, hitherto known only in a few Hawaiian species of the subgenera *Trogloscaptomyza* Frey, *Alloscaptomyza* Hackman, and *Tantalia* Malloch. This may give another evidence to the Oriental origin of the Hawaiian scaptoid species.

Drosophila* (*Hirtodrosophila*) *apicohispida sp. n. Figs. 13–16

Drosophila (*Hirtodrosophila*) sp., Okada, 1971:69 [Chichijima; Hahajima].

♂, ♀. Body about 2.5 mm in length. Eye oval, relatively small, roughly pilose. Antenna dark greyish brown, third joint elongate and with long hairs anteriorly. Arista with six dorsal and one ventral long branches besides a large fork. Palpus dark brown, with a long stout apical seta. Front flat, mat greyish brown, anteriorly broader than length down middle, posteriorly three-fifths as broad as head width. Ocellar triangle black; periorbits paler than front. Clypeus greyish brown. Face flat, greyish yellow, carina undeveloped. Cheek yellowish grey, narrow. Anterior reclinate orbital minute, nearer to proclinate than to posterior reclinate, which is slightly longer than proclinate. Vibrissa strong, other orals fine.

Mesonotum dark yellowish brown, subshining, caudally darker. Scutellum dark brown. Thoracic pleura dark yellow, with a diffuse broad black longitudinal stripe above. Sternopleura black. Humerals two, subequal. Anterior scutellars divergent, as long as posteriors, which are nearer to each other than to anteriors. Anterior dorsocentrals half as long as posteriors; distance between anterior and posterior pairs half distance between anterior pair. Sterno-index 0.4. Acrostichal hairs in eight rows. Legs yellowish grey, coxa distally and femora proximally black. Wings (Fig. 13) slightly fuscous, crossveins clear. R_{2+3} straight, R_{4+5} and M nearly parallel, costa extending slightly beyond tip of R_{4+5}. C-index 1.5; 4V-index 1.5; 5x-index 2.0; Ac-index 3.5. C3-fringe on basal half. Haltere yellowish brown. Abdominal tergites mostly dark greyish brown, second to fifth

tergites anterosubmedially and caudolaterally yellow.

Periphallic organs (Fig. 15): Genital arch pale brown, paler below, pubescent and setigerous, ventrally truncate. Anal plate large, brownish black, setigerous and pubescent, broad below. Clasper yellowish brown, proximally narrowing, apically with a concave row of about five black teeth. Phallic organs (Fig. 14): Aedeagus greyish yellow, slender, straight, vertically compressed, apically finely tuberculated. Apodeme of aedeagus slender, slightly shorter than aedeagus. Anterior paramere conical, fused to hypandrium, apically with a few sensilla. Submedian spine of hypandrium strong. Ventral fragma longer than broad, mediodistally roundly protruded. Egg-guide lobe (Fig. 16) orange brown, proximally brownish, apically pointed, with about five upper and five lower black teeth near apex, and several smaller teeth along ventral margin. Basal isthmus short but thick.

Holotype: ♂, Okimura, Hahajima, 25 VIII 1970 (Okada).

Paratype: 1♀, Sakaiura, Chichijima, 21 VIII 1970 (Okada).

Relationships: Somewhat resembles *D.* (*H.*) *pseudonokogiri* Okada in the shape of phallic and periphallic organs and egg-guide, but differs in having body and legs not unicolorously black and acrostichal hairs in eight rows (six in *pseudonokogiri*).

Taxometric analysis of the *Scaptomyza* species

In order to objectively assume the taxonomic positions of the two new and aberrant species of the genus *Scaptomyza*, *boninensis* and *hexasticha*, in the genus, they are treated as OTU's together with hitherto known thirteen subgenera of this genus and compared over ten subgeneric characters listed below. As a procedure, MCD (mean character difference) proximity analysis and UVGA (unweighted variable group method using arithmetic average) and WVGA (weighted variable group method using arithmetic average) cluster analyses are applied.

Subgeneric characters	Character states		
	0	0.5	1
1. Ventral branches of arista	0	1	2~3
2. Head width compared to thorax width	subequal		larger
3. Maximum number of rows of acrostichal hairs	2	4	6
4. Presutural dorsocentral bristles	absent		present
5. Humerals	2	4	6
6. Posterior scutellars compared to anteriors	much shorter		subequal
7. Paralobes or secondary clasper	undeveloped		well developed
8. Tertiary clasper	absent		present
9. Sclerotization of egg-guide lobes	weak		strong
10. Distal fusion of egg-guide lobes	none		complete

These subgeneric characters and character states are mostly adopted from Hackman (1959), and supplementarily from Hackman (1962), Hardy (1965), Throckmorton (1966), and Wheeler and Takada (1966). The original data matrix (character × OTU) is shown in Table 1.

The resulted phenograms by UVGA and WVGA (Fig. 22) show their clustering sequences slightly different from each other, especially in the position of *Mesoscaptomyza*. The UVGA phenogram is found to be strikingly coincident with the "hypothetic phylogenetic diagram" of Hackman (1959:27). This seems to suggest superiority of UVGA to WVGA in this case, though CPCC between the original and the derived matrices in WVGA (+0.771) is slightly higher than that in UVGA (+0.763).

The subgenus *Euscaptomyza* Séguy, which was recently shifted by Tsacas (1972) to a subgenus of *Scaptomyza* from a distinct genus, was not considered in this analysis. This

Table 1. Original data matrix (Character × OTU).

OTU	Character 1	2	3	4	5	6	7	8	9	10
1. *Bunostoma* Malloch	1	0	0.5	0	0	1	0	0	0	1
2. *Trogloscaptomyza* Frey	0	0	1	1	0	1	0	0	0	0.5
3. *Rosenwaldia* Malloch	0.5	0	0.5	1	0	0.5	0	0	0	0.5
4. *Alloscaptomyza* Hackman	0.5	1	1	0	0	1	0	0	0	0
5. *Tantalia* Malloch	0.5	0	1	0	0	0.5	0	0	0	0.5
6. *Mesoscaptomyza* Hackman	1	0	0	0	0	0	0.5	0.5	0.5	0
7. *Metascaptomyza* Hackman	0.5	0	0.5	0	0	0	1	0	0	0
8. *Macroscaptomyza* Frey	0.5	0	0	1	0.5	NC	1	0	0	0
9. *Parascaptomyza* Duda	1	0	0.5	1	0	1	1	0	0	0
10. *Dentiscaptomyza* Takada	1	0	0.5	0	1	1	0.5	1	1	0
11. *Exalloscaptomyza* Hardy	1	0	0.5	0	1	1	0	0	1	1
12. *Hemiscaptomyza* Hackman	1	0	0.5	0	1	0.5	0	0	1	0
13. *Scaptomyza* Hardy (subgen.)	1	0	0.5	0	1	1	0	0	1	0
14. "*boninensis*"	1	0	0	0	0	1	0	0	0	1
15. "*hexasticha*"	0.5	0	1	0	1	1	1	0	0	0

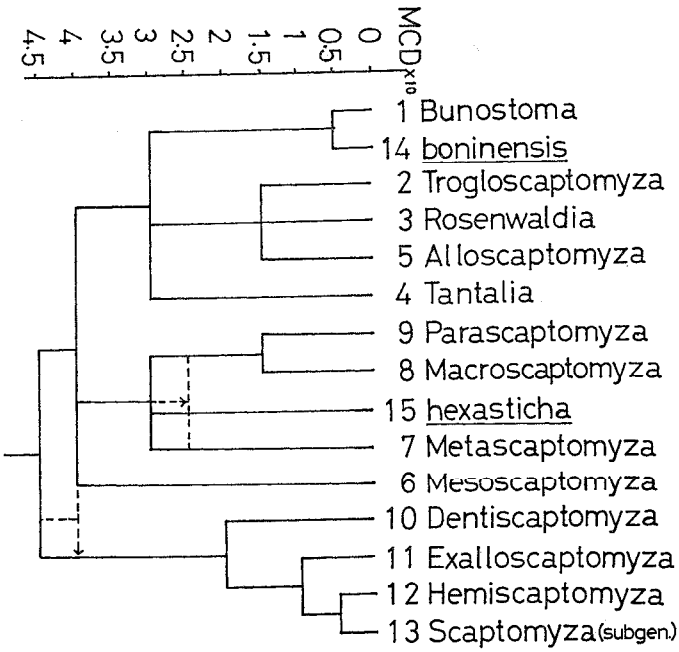


Fig. 22. MCD-phenograms showing taxonomic positions of *Scaptomyza boninensis* and *S. hexasticha* among hitherto known thirteen subgenera of *Scaptomyza* obtained by UVGA and WVGA (dotted lines) analyses.

subgenus shows the character states of ten items to be 1 0 1 0 1 0 0 0 1 0, which are closest to that of *Hemiscaptomyza* (Table 1), MCD between the two subgenera being only 0.1.

S. boninensis is clustered with *Bunostoma* at the least distance, and is reasonably assorted to *Bunostoma*. *S. hexasticha* is clustered with *Parascaptomyza-Macroscaptomyza* cluster and *Metascaptomyza* at an equal distance. The distance is, however, remote enough to include *S. hexasticha* in a new distinct subgenus, *Boninoscaptomyza*.

Summary

A new subgenus, *Boninoscaptomyza*, of the genus *Scaptomyza* is established and four new species, *Chymomyza fenestrata*, *Scaptomyza* (*Bunostoma*) *boninensis*, *S.* (*Boninoscaptomyza*) *hexasticha*, and *Drosophila* (*Hirtodrosophila*) *apicohispida*, of the family Drosophilidae are described from the Bonin Islands. The taxonomic positions of *S. boninensis* and *S. hexasticha* are analysed with aid of a taxometric procedure. Connections between these two new *Scaptomyza* species and the Hawaiian "scaptoids" are discussed.

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