

## Drosophilidae Associated with Flowers in Papua New Guinea

### III. Zingiberales

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**Synopsis** Twelve new species of *Drosophila* which are associated with flowers of three families of the order Zingiberales in Papua New Guinea are described. Eight of these belong to the subgenus *Scaptodrosophila* and one each to the subgenera *Drosophila* and *Hirtodrosophila*. For two of them, the subgenus is uncertain. In the three papers of this series we have now described 29 new species of the family which frequent flowers. Of these, 20 (70%) belong to the subgenus *Scaptodrosophila*. Of the eight new *Scaptodrosophila* species, four were reared from flowers or decayed inflorescences. *D. (Sc.) parapunctipennis* DUDA was reared from flowers of the giant ginger, *Nicolaia eliator*.

The first two papers in this series (CARSON & OKADA, 1980; OKADA & CARSON, 1980) have dealt with the systematics and ecology of drosophilid associates of the well-known plant genera *Colocasia* and *Alocasia*, belonging to the family Araceae. The inflorescences of *Alocasia* were shown to have 14 associated species; 12 of these have been referred to the subgenus *Scaptodrosophila*. CARSON and OKADA (1981) have reported that this subgenus appears to be exuberantly speciated in New Guinea. BOCK and PARSONS (1981) record the fact that 60 of 110 *Drosophila* species from Australia belong to *Scaptodrosophila*.

By and large, the breeding niches of most of these *Scaptodrosophila* species are unknown. Following the clues provided by the *Alocasia* work, we made a special point of studying various kinds of inflorescences available in the forests of Morobe Province, Papua New Guinea during the latter half of 1977. This survey revealed that a number of indigenous *Drosophila* species are associated with flowers and that most of these belong to subgenus *Scaptodrosophila*. In this paper, we describe 12 new species of flower-associated Drosophilidae. All are associated with inflorescences of three host families, Zingiberaceae, Marantaceae and Musaceae of the order Zingiberales. Eight of the newly described species belong to the subgenus *Scaptodrosophila*.

### Material and Methods

The observations recorded here were made in the latter half of 1977 along an altitudinal transect in Morobe Province, Papua New Guinea. The area extended from the summit of Mt. Kaindi (2200 m) and the Bulldog Road (2200 m) to near sea level at Lae.

When flowering plants were located, individual inflorescences were approached and any specimens present were aspirated and preserved. Preadult stages were observed by bringing flowers to the laboratory and dissecting them under a stereoscopic microscope. Flowers containing eggs, larvae or pupae were placed in glass jar partly filled with sterile damp sand and covered with a fine nylon mesh screen. Imagoes reared from such material were identified and preserved.

### Descriptions of New Species

#### *Drosophila serripaenula* n. sp.

(Fig. 1A-D)

♂, ♀. Body about 2 mm in length. Eye black, with fine thick pile. Antenna yellowish orange, 2nd joint brown above. Arista with 3 upper and 3 lower rather short branches and a small fork. Palpus yellowish orange, with a few setae below. Ocellar triangle subshining black, anteriorly sharply pointed. Ocellars inside triangle made by ocelli. Periorbits subshining black. Frons mat black, pruinose, anteriorly much narrower than median length. Face mat grayish brown; carina low. Cheek very narrow, grayish brown. Anterior reclinate orbital 2/3 proclinate, at middle between proclinate and posterior reclinate, which is as long as proclinate. Second oral as long as vibrissa, succeeding orals gradually shorter. Thorax entirely glossy black, with fine gray pubescency. Humerals 2, subequal. Prescutellars slightly shorter than anterior dorsocentrals. Acrostichal hairs in 6 rows. Anterior dorsocentrals 3/4 posteriors; length distance of dorsocentrals 3/5 cross distance. Sterno-index 0.8. Lateral scutellars somewhat convergent, as long as apicals, which are nearer to each other than to laterals. Legs yellow. Male fore metatarsus (Fig. 1D) short, protruded apically beyond base of 2nd tarsal joint, ending in 2 long stout bristles; mid and hind metatarsi as long as the rest of tarsal joints. Female fore metatarsus as long as succeeding 3 tarsal joints, normal. Wing hyaline, cells C and R<sub>1</sub> fuscous; R<sub>4+5</sub> and M somewhat convexed anteriorly. C-index 2.3; 4V-index 2.5; 4C-index 1.3; 5x-index 3.0; Ac-index 3.5. C1-bristles 2, unequal; C3-fringe 2/7. Halter yellowish brown. Abdominal tergites glossy black, caudal margins gray; 1st tergite medially and laterally yellow.

Periphallalic organs (Fig. 1A) yellowish brown. Surstylus with about 12 long black teeth. Phallic organs (Fig. 1B) yellowish brown. Penis envelope elongate, apically with a few serrations, thus the specific name. Ovipositor (Fig. 1C) dark brown, with several long bristles. Testis bright yellow, with 3 outer and 3 inner

coils. Spermatheca pale; ventral receptacle small, once folded. Mouth hook of 2nd instar larva with a tooth below; that of 3rd with several pointed teeth.

Holotype ♂ (82821), allotype ♀, and 1♂ paratype, Mt. Kaindi, Wau, Papua New Guinea, 25.VIII.1977, ex ginger flowers (M. S. CARSON); 1♂ and 1♀ paratypes, same locality, 5. IX. 1977, ex same flowers (H. L. CARSON). Types in Bishop Museum.

Relationships. Slender aedeagus and modified male fore tarsus resemble those of some Hawaiian drosophilids.

*Drosophila latipaenula* n. sp.

(Fig. 1E-G)

♂. Body about 2 mm in length. Eye grayish black, with thick pile. Antenna black, 2nd joint anteriorly brown. Arista with 3 upper and 2 lower long branches and a large fork. Palpus orange brown, with a few short setae below. Ocellar triangle and periorbit subshining black. Frons velvety black, anteriorly narrower than median length. Face yellowish gray, laterally concaved. Carina silvery white, well developed, slant to buccal margin. Cheek very narrow, brownish black. Clypeus grayish brown. Anterior reclinate orbital half proclinate, very thin, slightly nearer to posterior reclinate than to proclinate, which is slightly shorter than posterior reclinate. Vibrissa long, 2nd oral as long as vibrissa, succeeding orals shorter. Thorax entirely subshining black, with gray pubescency. Pre-scutellars seemingly absent. Acrostichal hairs in about 6 rows. Anterior dorso-centrals 3/5 posteriors; length distance of dorso-centrals 1/3 cross distance. Sterno-index 0.4. Legs yellowish gray. Fore metatarsus (Fig. 1E) as long as 2nd tarsal joint and apically with a large dorsal bristle. Mid and hind metatarsi as long as successive 3 and 4 tarsal joints, respectively. Wing hyaline;  $R_{2+3}$  nearly straight;  $R_{4+5}$  and M parallel. C-index 2.0; 4V-index 2.3; 4C-index 1.4; 5x-index 2.5; Ac-index 4.0. Cl-bristles 2; C3-fringe 2/5. Halter yellow. Abdominal tergites subshining black.

Peripheral organs (Fig. 1F) brownish black. Surstylus with about 13 black teeth. Phallic organs (Fig. 1G) yellowish brown; penis envelope broad and flat, thus the specific name.

Holotype ♂ (90533), 3♂ paratypes, 5.IX.1977, ex ginger flowers (M. S. CARSON). Types in Bishop Museum.

Relationships. This species resembles the foregoing species, *D. serripaenula*, in having stout bristle on fore metatarsus, but differs in having broad penis envelope.

*Drosophila (Hirtodrosophila) kaindiana* n. sp.

(Fig. 1H-J)

♂, ♀. Body 1.5–2.0 mm in length. Eye dark red to purple red, bare. An-

Holotype ♂ (C210.27), 1♂ paratype, Mt. Kaindi, Wau, 2200 m, 3.XII.1977, at mercury vapor light (GAGNÉ); allotype ♀, same locality as holotype, 2000 m, 14.X.1977, reared ex flowers of *Alpinia* (CARSON). Types in Bishop-Museum.

Relationships. This species resembles *D. junae* GROSSFIELD in BOCK, 1976, from Queensland, in the shape of male genitalia, but differs in having only one lower branch of arista, darker body and not expanded aedeagus.

*Drosophila (Scaptodrosophila) cominsiae* n. sp.

(Fig. 1K M)

♂, ♀. Body about 2.5 mm in length. Eye castaneous red, with sparse pile. Arista with 3 upper and 2 lower branches and a large fork. Palpus yellowish gray, with a few short setae below. Ocellar triangle small, black. Periorbit grayish white. Frons mat velvety black, anteriorly orange brown, 1/3 as broad as head width. Clypeus yellowish brown. Carina high, flat above. Face gray. Cheek 1/7 as broad as the greatest diameter of eye. Anterior reclinate orbital at middle between proclinate and posterior reclinate. Second oral 2/3 vibrissa. Mesoscutum and scutellum mat brown; thoracic pleura mat yellowish gray. Humeral 2. Acrostichal hairs in 8 rows. Prescutellars weak. Anterior dorsocentrals 2/5 posteriors; length distance of dorsocentrals 1/5 cross distance. Lateral scutellars divergent, as long as apicals, which are equally apart from each other and from laterals. Sterno-index 0.7. Legs yellowish gray. Metatarsi as long as the rest of tarsal joints. Wing hyaline;  $R_{2+3}$  straight;  $R_{4+5}$  and M parallel. C-index 2.2; 4V-index 1.6; 4C-index 1.0; 5x-index 1.4; Ac-index 2.5. C3-fringe 2/5-1/2. Halter yellowish brown, knob darker. Abdominal tergites yellowish brown, with dark broad medially contiguous caudal bands.

Periphallalic organs (Fig. 1K) and phallic organs (Fig. 1L) pale yellow. Epandrium tapering below. Ovipositor (Fig. 1M) pale yellow.

Holotype ♂ (C218.10), allotype ♀, 10♂, 8♀ paratypes, Bulolo back road, 730 m, 11.XI.1977, ex flowers of *Cominsia* (CARSON). Types in Bishop Museum.

Relationships. This species resembles *D. metatarsalis* OKADA et CARSON in having tapering epandrium, but differs in having metatarsi not longer than the rest of tarsal joints.

1♂ 1♀ paratype per in NS 107.

*Drosophila (Scaptodrosophila) lagomorpha* n. sp.

(Fig. 2A-C)

♂, ♀. Body about 2.5 mm in length. Eye red, with thick pile. Antenna yellowish brown, 3rd joint gray. Arista with 3 upper and 2 lower long branches and a large fork. Palpus yellow, with prominent setae below. Ocellar triangle small, black. Periorbit gray. Frons golden brown, anteriorly orange, as broad as median length. Carina narrow, high and long. Face yellowish gray. Cheek

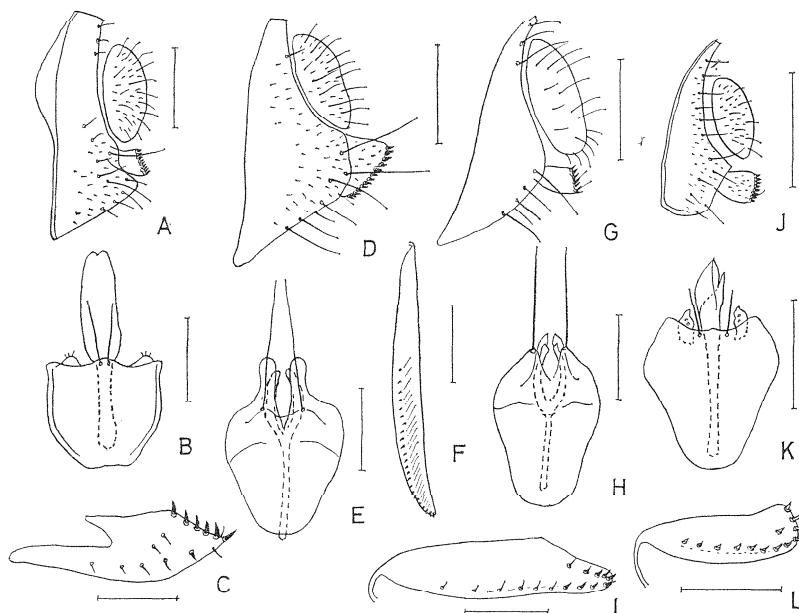


Fig. 2. A-C, *Drosophila (Scaptodrosophila) lagomorpha*; D-F, *D. (Sc.) phryniae*; G-I, *D. (Sc.) paraphryniae*; J-L, *D. (Sc.) paracentralis*. A, D, G, J, Peripheralhallic organs; B, E, H, K, phallic organs; C, F, I, L, ovipositor. Scales 0.1 mm.

index 2.3; 4V-index 1.7; 4C-index 0.9; 5x-index 1.3; Ac-index 3.0. C1-bristle 1; C3-fringe 3/5. Halter yellowish orange. Abdominal tergites dark orange brown, with caudal narrow black bands; caudal segments yellowish orange.

Peripheralhallic organs (Fig. 2D) pale yellow. Surstylus with about 10 black teeth in a somewhat convex row. Phallic organs (Fig. 2E) pale brown. Ovipositor (Fig. 2F) deep brown, very slender.

Holotype ♂ (C213.12), allotype ♀, 1♂ paratype, Headshump, near Bulolo, 15.IX.1977, ex flowers of *Phrynium* (CARSON). Types in Bishop Museum.

Relationships. This species resembles *D. cancellata* MATHER from Australia in the structure of ♂ genitalia, but differs in having no whitish longitudinal stripes on mesoscutum. Flat scaly bristles on ♂ fore tarsi are characteristic.

### *Drosophila (Scaptodrosophila) paraphryniae* n. sp.

(Fig. 2G-I)

♂, ♀. Body about 2.5 mm in length. Eye bright red, with pile. Antenna yellowish brown, anteriorly darker. Arista with 3 upper and 2 lower long branches and a large fork. Palpus yellow, with a few long setae below. Ocellar triangle and periorbit grayish yellow. Frons golden brown, anteriorly orange; anteriorly

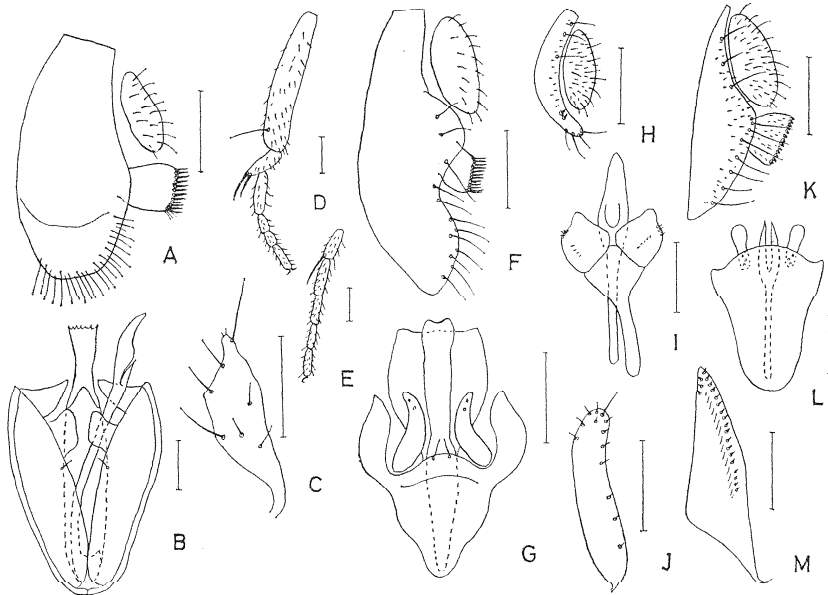


Fig. 1. A-D, *Drosophila serripaenula*; E-G, *D. latipaenula*; H-J, *D. (Hirtodrosophila) kaindiana*; K-M, *D. (Scaptodrosophila) cominsiae*. A, F, H, K, Peripheralhallic organs; B, G, I, L, phallic organs; D, E, fore leg; C, J, M, ovipositor. Scales 0.1 mm.

tenna with 2nd joint orange brown, 3rd darker. Arista with 3 upper and 1 lower distal branches and a large fork. Palpus black. Ocellar triangle black. Periorbit grayish black. Frons mat pruinose gray, anteriorly  $3/7$  as broad as head width and as broad as median length. Clypeus black. Face flat, grayish white. Carina very short, low. Cheek yellowish gray,  $1/8$  as broad as the greatest diameter of eye. Anterior reclinate orbital  $2/3$  proclinate, just lateral to proclinate; posterior reclinate longer than proclinate. Mesoscutum and scutellum subshining orange brown, with dark patch behind humerus. Thoracic pleura orange brown, with dark patches. Humerals 2. Acrostichal hairs in 8 rows. Anterior dorsocentrals  $2/3$  posteriors; length distance of dorsocentrals half cross distance. Lateral scutellars divergent, longer than apicals, which are equally apart from each other and from laterals. Sterno-index 0.8. Legs yellowish gray. Fore metatarsus as long as succeeding 3 tarsal joints; mid and hind metatarsi as long as the rest of tarsal joints. Mid and hind knees and tarsi a little darker. Wing hyaline;  $R_{2+3}$  gently curved to costa,  $R_{4+5}$  and M parallel. C-index 3.6; 4V-index 2.3; 4C-index 0.8; 5x-index 2.3; Ac-index 2.3. Cl-bristles 2, unequal; C3-fringe  $1/5$ . Halter yellowish gray. Abdominal tergites almost entirely mat black.

Peripheralhallic organs (Fig. 1H) and phallic organs (Fig. 1I) pale yellow. Surstylus absent. Ventral fragma elongate. Ovipositor (Fig. 1J) yellow.

yellow, about 1/8 as broad as the greatest diameter of eye. Clypeus gray yellow. Anterior reclinate orbital half posteriors, slightly nearer to proclinate than to posterior reclinate. Second oral weak, 1/4 vibrissa. Mesoscutum and scutellum subshining orange brown, pruinose. Thoracic pleura somewhat paler. Humerals 2, subequal. Acrostichal hairs in 6 rows. Anterior dorsocentrals 2/5 posteriors; length distance of dorsocentrals half cross distance. Sterno-index 0.8; median sternopleural merely slightly shorter than anteriors. Legs yellow, rather thick. Fore metatarsus as long as succeeding 3 tarsal joints; mid and hind as long as the rest of tarsal joints. Third and 4th tarsal joints of fore leg in both sexes each with 2 stout black teeth apically below, like lagomorphous double incisors, thus the specific name. Wing hyaline;  $R_{2+3}$  straight;  $R_{4+5}$  and M parallel. C-index 2.0; 4V-index 2.2; 4C-index 1.4; 5x-index 2.2; Ac-index 3.0. Cl-bristles 2, unequal; C3-fringe 2/7. Halter grayish yellow. Abdominal tergites yellowish brown, with narrow dark caudal bands.

Periphallic organs (Fig. 2A) yellowish. Surstylus with about 10 black teeth in a slightly concaved row. Phallic organs (Fig. 2B) pale yellow. Paramere seemingly absent. Ovipositor (Fig. 2C) brown.

Holotype (C211.81), allotype ♀, 7♂, 5♀ paratypes, Wau, 24-26. XI. 1977, ex spiny ginger flowers (CARSON). Types in Bishop Museum.

Relationships. This species resembles *D. specensis* BOCK from Queensland in body coloration and the shape of epandrium, but differs in having large aedeagus and no parameres.

### *Drosophila (Scaptodrosophila) phryniae* n. sp.

(Fig. 2D-F)

♂, ♀. Body about 2 mm in length. Eye red brown, with pile. Antenna brown. Arista with 2 upper and 2 lower long branches and a large fork. Palpus yellowish brown, with a few setae below. Ocellar triangle small, grayish brown. Ocellars inside triangle made by ocelli. Periorbits grayish brown, short. Frons mat golden brown, with several frontal hairs, anteriorly narrowing and narrower than median length. Face pale gray. Cheek pale brown, very narrow. Clypeus pale brown. Anterior reclinate orbital 2/5 posterior reclinate, at middle between proclinate and posterior reclinate. Second oral 2/5 vibrissa. Mesoscutum and scutellum mat dark brown. Thoracic pleura paler. Humerals 2, long. Acrostichal hairs in 8 rows. Anterior dorsocentrals 3/5 posteriors; length distance of dorsocentrals 2/5 cross distance. Sterno-index 0.7; median sternopleural long. Lateral scutellars divergent; apicals slightly longer than laterals, equally apart from each other and from laterals. Legs yellowish orange. Each of 2nd to 4th tarsal joints of ♂ fore leg with about 2 flat scaly bristles ventrally. Fore metatarsus as long as the rest of tarsal joints; mid and hind longer than the rest of tarsal joints. Wing slightly fuscous anteriorly.  $R_{2+3}$  nearly straight;  $R_{4+5}$  and M parallel. C-

much narrower than median length, posteriorly slightly broader. Face pale brown. Carina very high, rather short. Cheek very narrow, yellowish white. Clypeus pale yellowish brown. Anterior reclinate orbital long, 3/5 posterior reclinate, at middle between proclinate and posterior reclinate. Second oral 1/5 vibrissa. Ocellars inside triangle made by ocelli. Mesoscutum and scutellum mat orange brown, thoracic pleura paler. Humerals 2, long. Acrostichal hairs in 8 rows. Anterior dorsocentrals 3/5 posteriors; length distance of dorsocentrals 2/5 cross distance. Sterno-index 0.7; median sternopleural as long as posteriors. Lateral scutellars divergent; apicals slightly longer than laterals, equally apart from each other and from laterals. Legs yellowish orange. Fore metatarsus as long as the rest of tarsal joints; mid and hind longer than the rest of tarsal joints. Wing slightly fuscous along costa distally.  $R_{4+5}$  and M slightly convergent. C-index 2.8; 4V-index 1.7; 4C-index 0.9; 5x-index 1.6; Ac-index 2.5. C1-bristle 1; C3-fringe 4/7. Halter yellowish orange. Abdominal tergites dark orange brown, with caudal black obscurely demarcated bands.

Periphallic organs (Fig. 2G) pale yellow. Epandrium tapering below; surstylus with about 7 black teeth. Phallic organs (Fig. 2H) pale yellow, with well developed submedian spines. Ovipositor (Fig. 2I) pale yellow.

Holotype ♂ (C209.1), allotype ♀, 1♂, 1♀ paratypes, 1.XII. 1977, ex flowers of *Phrynium* (CARSON). Types in Bishop Museum.

Relationships. This species resembles the foregoing species, *D. phryniae*, in body coloration and male genitalia, but differs in having fewer surstylus teeth, wider range of C3-fringe and no scaly tarsal bristles in ♂.

### *Drosophila (Scaptodrosophila) paracentralis* n. sp.

(Fig. 2J L)

♂, ♀. Body about 1.2 mm in length. Eye bright red, with dense fine pile. Antenna orange brown. Arista with 4 upper and 2 lower long branches and a large fork. Palpus yellowish orange, with about 3 black setae below. Ocellar triangle yellowish brown. Periorbit mat yellowish gray. Frons golden brown, anteriorly narrowly orange, much broader than median length. Face yellowish gray; carina long, orange above. Cheek yellowish gray, 1/8 as broad as the greatest diameter of eye. Clypeus orange. Anterior reclinate orbital 1/4 proclinate, just behind it; posterior reclinate longer than proclinate. Vibrissa strong, 2nd oral 1/3 vibrissa. Mesoscutum and scutellum mat orange brown, the latter comparatively large. Thoracic pleura orange brown. Anterior dorsocentrals slightly shorter than posteriors, close to suture; cross distance of dorsocentrals equaling length distance. Humerals 2. Prescutellars rather weak. Acrostichal hairs in 6 rows. Lateral scutellars somewhat divergent, as long as apicals, which are equally apart from each other and from laterals. Sterno-index 0.5. Legs orange brown; metatarsi as long as succeeding 3 tarsal joints. Wing hyaline, broad;  $R_{2+3}$  nearly



teeth. Phallic organs (Fig. 3B) yellowish brown. Ovipositor (Fig. 3C) pale yellowish brown.

Holotype ♂ (C'12'), Lae, 30. VIII. 1977, ex flowers of *Heliconia*, thus the specific name (CARSON); 11♂, 3♀ paratypes, Lae, 27-29. IX. 1977, by sweeping (CARSON, OKADA); allotype ♀, Wau, 20. IX. 1977, by sweeping (OKADA). Types in Bishop Museum, 3♂, 3♀ paratypes in National Science Museum, Tokyo.

Relationships. This species resembles superficially *D. (D.) annulipes* DUDA in striped mesoscutum and annulated legs.

*Drosophila (Scaptodrosophila) anthia* n. sp.

(Fig. 3D-E)

♂. Body about 2.2 mm in length. Eye light red, with pile. Antenna with 2nd joint orange, 3rd gray. Arista with 3 upper and 2 lower branches and a large fork. Palpus yellowish orange, with a few setae below. Ocellar triangle black, small. Periorbit mat orange yellow. Frons mat orange yeollw, somewhat dark laterally and anteriorly; anteriorly 1/3 as broad as head width, narrower than median length; posteriorly wider. Face yellowish gray. Carina broad and high. Cheek yellowish white, 1/10 as broad as the greatest diameter of eye. Anterior reclinate orbital 1/3 proclinate, at middle between proclinate and posterior reclinate. Second

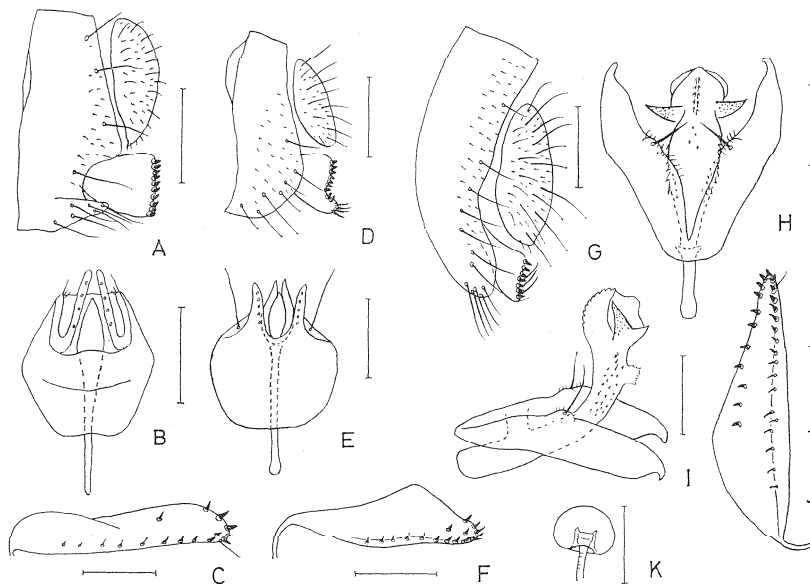


Fig. 3. A-C, *Drosophila (Scaptodrosophila) heliconiae*; D, E, *D. (Sc.) anthia*; F, *D. (Sc.) paranthia*; G-K, *D. (D.) niveifrons*. A, D, G, Peripheral phallic organs; B, E, H, I, phallic organs; C, F, J, ovipositor; K, spermatheca. Scales 0.1 mm.

*Drosophila (Drosophila) niveifrons* n. sp.

(Fig. 3G-K)

♂, ♀. Body about 2-2.5 mm in length. Eye dark red, with pile. Antenna with 2nd joint orange brown, 3rd grayish brown. Palpus orange, with 2 black setae below. Ocellar triangle black. Periorbit grayish orange. Frons orange yellow, anteriorly orange, almost entirely silver white in front view; anteriorly 1/3 as broad as head width, as broad as median length, caudally wider. Face yellow. Carina high and long. Anterior reclinate orbital small, 1/4 proclinate, at middle between proclinate and posterior reclinate, posterior reclinate longest. Second oral weak. Mesoscutum mat pale orange brown, with median narrow paler stripe. Scutellum darker. Thoracic pleura paler. Humerals 2. Acrostichal hairs in 8 rows. Anterior dorsocentrals 2/3 posteriors; length distance of dorsocentrals 2/3 cross distance. Lateral scutellars convergent; apicals slightly longer than laterals, equally apart from each other and from laterals. Sterno-index 0.6. Legs yellow; metatarsi as long as 3 succeeding tarsal joints. Wing hyaline;  $R_{2+3}$  convex anteriorly at middle;  $R_{4+5}$  and M parallel. C-index 3.0; 4V-index 1.4; 4C-index 0.8; 5x-index 1.5; Ac-index 1.8. C3-fringe about 1/2 or slightly more. Halter yellowish orange, dark at the base of knob. Abdominal tergites mat orange brown, with faint narrow medially contiguous dark caudal bands.

Periphallial organs (Fig. 3G) and phallic organs (Fig. 3H-I) pale yellow; aedeagus mediolaterally with numerous fine teeth. Ovipositor (Fig. 3J) orange yellow. Spermatheca (Fig. 3K) pale yellowish brown.

Holotype ♂, (24870), allotype ♀, 5♂, 5♀ paratypes, Lac, 10 m, 14. X. 1979 (stock: KITAGAWA); 2♂ paratypes, same place as above, 28. IX. 1977, reared ex torch ginger flowers (CARSON). Types in Bishop Museum, 2♂, 2♀ paratypes in National Science Museum, Tokyo.

Relationships. This species belongs to the *nasuta* subgroup of the *immigrans* group, resembling *D. pallidifrons* WHEELER in having numerous small bristles on aedeagus, but differing from the latter in having entirely silvery shining ♂ frons and well developed dorsal cylindrical expansion of aedeagus.

**Observations on Ecology and Life History**

Zingiberales is a large order of monocotyledonous plants consisting of six families (78 genera, 1400 species) of tropical and subtropical perennials. Most are herbaceous but a few have woody tendencies. *Drosophila* species have been found to be associated with members of three of these families, Zingiberaceae, Marantaceae, and Musaceae.

A number of genera of Zingiberaceae, referred to in English as "ginger," are distributed in both hemispheres but are predominantly Asiatic. There are about 200 species known from New Guinea. Between 1900 and 2200 m altitude on Mt.

Table 1. Drosophilidae associated with torch ginger, *Nicolaia elatior*. Botanical Garden, Lae, Papua New Guinea. August, September, and November, 1977.

	Specimens collected from inflorescence	Specimens reared from inflorescence
<i>D. (Sc.) anthia</i> OKADA et CARSON	4	—
<i>D. (Sc.) paranthia</i> OKADA et CARSON	3	1
<i>D. (Sc.) parapunctipennis</i> DUDA	21	13
<i>D. (Sc.) paracentralis</i> OKADA et CARSON	16	—
<i>D. (D.) sulphurigaster</i> DUDA	10	8
<i>D. (D.) niveifrons</i> OKADA et CARSON	1	4
<i>D. (D.) hypocausta</i> OSTEN-SACKEN	11	—
<i>D. (So.) ananassae</i> DOLESCHALL	16	2
<i>D. (So.) bipectinata</i> DUDA	6	2
<i>D. (So.) eugracilis</i> BOCK et WHEELER	2	1
<i>D. (So.) pseudotakahashii</i> MATHER	19	—
<i>Styloptera maculata</i> CARSON et OKADA	1	—
<i>Dettopsomyia formosa</i> LAMB	1	1
<i>Zaprionus argentostrigatus</i> (BOCK)	1	—
	112	32

of this plant had many flowers in all stages of development from young buds to decayed remnants. As shown in Table 1, 112 specimens of Drosophilidae belonging to 14 species were collected directly from these flowers. Eight of these species (32 specimens) were reared from the isolated inflorescences. Of particular interest is the presence of the very spectacular *Scaptodrosophila* species, *D. parapunctipennis* DUDA. In addition to the specimens caught on torch ginger, *D. (Sc.) paracentralis* was attracted in considerable numbers to traps baited with fermenting banana.

Marantaceae consists of about 25 genera and 300 species. The plants are distributed in both hemispheres but are predominant in the American tropics. At Bulolo, at an altitude of 730 m, *Cominsia gigantea* forms massive clumps growing in wet places in the tree plantations along the Bulolo Back Road. On November 11, 1977 H. L. and M. S. CARSON found two species of drosophilids associated with the white flowers of this species. There were 10♀♀ and 6♂♂ of *Dettopsomyia alba* CARSON et OKADA and 13♀♀ and 18♂♂ of *D. (Sc.) cominsiae*. The white portion of the recently opened flowers, as well as older brown decayed flowers, contained many drosophilid larvae. The eggs of the two species are easily distinguished, and collapsed chorions of both species were numerous in the decayed brown flower-remnants. The long-filamented eggs of *Drosophila cominsiae* were most numerous in the more decayed material whereas *Dettopsomyia alba* appears to oviposit on fresher material. Fourteen to eighteen days after collection of the flowers, specimens of *D. alba* began eclosing; from about 20 flowers a total of 48 specimens were obtained. Handling of the material in the laboratory was made difficult by the presence of numerous lepidopterous larvae which were also tunneling in the tube of the flowers.

straight;  $R_{4+5}$  and M parallel. C-index 1.2; 4V-index 3.0; 4C-index 2.5; 5x-index 2.6; Ac-index 3.7. C1-bristles 2, unequal. C3-fringe 1/2. Halter orange brown. Abdominal tergites yellowish brown, with dark medially interrupted caudal bands, which are especially broad in ♂, and a large dark spot on each lateral margin in ♀.

Periphallalic organs (Fig. 2J) pale yellowish brown. Surstylus with about 8 black teeth. Phallic organs (Fig. 2K) pale yellowish gray; paramere black. Ovipositor (Fig. 2L) pale yellow.

Holotype ♂ (92837), allotype ♀, 9♂, 3♀ paratypes, Lae, 27-29. IX. 1977, ex flowers of torch ginger (OKADA). 1♂ paratype, Keravat, Rabaul, New Britain, 25. I. 1974 (S. SHINONAGA). Types in Bishop Museum, 2♂, 2♀ paratypes in National Science Museum, Tokyo.

Relationships. This species is closely allied to *D. dorsocentralis* OKADA from Ryukyus, thus the specific name, and is distinguished from the latter in shorter and broader paramere and truncate ovipositor.

*Drosophila (Scaptodrosophila) heliconiae* n. sp.

(Fig. 3A-C)

♂, ♀. Body about 3 mm in length. Eye purplish red, bare. Antenna with 2nd joint yellowish gray, darker above, 3rd joint darker. Arista with 4 upper and 3 lower long branches and a large fork. Palpus yellowish gray, with about 3 setae below. Ocellar triangle black. Periorbit yellowish white. Frons yellow, medio-anteriorly brown, with many frontal hairs, anteriorly slightly narrower than median length. Face yellowish white. Carina rounded below. Cheek whitish, about 1/6 as broad as the greatest diameter of eye. Clypeus yellowish gray. Anterior reclinate orbital nearly as long as proclinate, just outside proclinate; posterior reclinate slightly longer than proclinate. Ocellars very long. Vibrissa strong, 2nd oral 1/4 vibrissa. Mesoscutum mat yellowish gray, with 4 black longitudinal stripes, lateral pair narrower and not extending before suture; another broad black stripe above humerus, reaching base of wing. Humerus yellowish white. Scutellum mat yellowish gray, with 2 black broad longitudinal stripes. Thoracic pleura paler, with 2 black longitudinal stripes, lower one narrower and shorter. Humeral 2, long, subequal. Acrostichal hairs in 8 rows. Anterior dorsocentrals half posteriors; length distance of dorsocentrals 1/3 cross distance. Sterno-index 0.8; median sternopleural as long as anteriors, but thinner. Lateral scutellars divergent, as long as apicals, which are equally apart from each other and from laterals. Legs yellow, with black annuli, one on femora, 2 on tibiae. Metatarsi much longer than the rest of tarsal joints. Wing slightly fuscous on anterior half.  $R_{2+3}$  straight;  $R_{4+5}$  and M parallel. C-index 1.7; 4V-index 3.0; 4C-index 2.0; 5x-index 2.0; Ac-index 3.5. C1-bristle 1; C3-fringe 5/6. Halter yellowish white. Abdominal tergites yellowish brown, with broad black caudal bands, which are broadened laterally.

Periphallalic organs (Fig. 3A) yellow. Surstylus darker, with about 10 black

oral slightly shorter than vibrissa. Mesoscutum mat yellowish orange, with narrow faint pale longitudinal stripes medially and along dorsocentral lines. Scutellum pale, with faint dark lateral patches. Thoracic pleura paler than mesoscutum, pruinose. Humerals 2. Prescutellars long. Acrostichal hairs in 8 rows. Anterior dorsocentrals half posteriors; length distance of dorsocentrals  $1/3$  cross distance. Lateral scutellars convergent, apicals equally apart from each other and from laterals. Sterno-index 1.0; median sternopleural long. Legs yellow. Fore metatarsus as long as succeeding 3 tarsal joints; mid metatarsus longer than the rest of tarsal joints; hind metatarsus as long as the rest of tarsal joints. Wing hyaline;  $R_{2+3}$  straight;  $R_{4+5}$  and M parallel. C-index 2.3; 4V-index 2.0; 4C-index 1.1; 5x-index 1.4; Ac-index 2.7. C3-fringe  $7/10$ . Halter yellowish orange, base of knob brown. Abdominal tergites mat orange yellow, caudal tergites darker.

Periphallalic organs (Fig. 3D) and phallic organs (Fig. 3E) pale yellow.

Holotype ♂ (C219.22), Lae, 10 m, 6. XI. 1977, ex torch ginger flowers (CARSON). Type in Bishop Museum.

Relationships. This species somewhat resembles *D. lebanonensis* WHEELER in the shape of periphallalic organs, but entirely differs from the latter in body coloration and phallic organs.

***Drosophila (Scaptodrosophila) paranthia* n. sp.**

(Fig. 3F)

♀. Body 1.5–2 mm in length. Eye dark red, with pile. Antenna with 2nd joint orange brown, 3rd gray. Arista with 4 upper and 2 lower branches and a small fork. Palpus orange brown, with about 3 long setae below. Ocellar triangle gray. Periorbit orange gray. Frons orange yellow, laterally dark, anteriorly slightly narrower than median length, about  $1/3$  as broad as head width. Face yellow; carina white, very short. Cheek narrow, yellow. Anterior reclinate orbital  $1/5$  proclinate, at middle between proclinate and posterior reclinate. Vibrissa long, 2nd oral about  $1/3$  vibrissa. Mesoscutum and scutellum orange brown, subshining. Thoracic pleura paler. Humerals 2. Acrostichal hairs in 8 rows. Lateral scutellars slightly divergent, as long as apicals, which are equally apart from each other and from laterals. Legs yellow. Metatarsi as long as the rest of tarsal joints. Wing hyaline, veins yellow.  $R_{2+3}$  straight;  $R_{4+5}$  and M parallel. C-index 2.0; 4V-index 1.8; 4C-index 1.0; 5x-index 2.0; Ac-index 3.0. C3-fringe  $1/2$ . Halter orange brown, knob darker. Abdominal tergites subshining orange brown, with indistinct caudal dark bands.

Ovipositor (Fig. 3F) yellow, with yellow teeth.

Holotype ♀ (C219.22), Lae, 6. XI. 1977, ex torch ginger flower (CARSON); 1 ♀ paratype, same place as above, 29. IX. 1977 (CARSON). Types in Bishop Museum.

Relationships. This species resembles the foregoing species, *D. anthia*, in general coloration, but differs in having body subshining and C3-fringe smaller.

Kaindi a number of *Alpinia* and *Riedelia* were found growing along the forest trails. Of the latter genus, the common species at the higher altitudes were *R. subulicalyx* VAL, *R. geluensis* VAL, and *R. monticola* VAL. The latter species and *R. urceolata* VAL were the commonest species found at the lower elevation. Resting and courting on all of these species were two very unusual but similar species of uncertain subgeneric affinity, *D. serripaenula* and *D. latipaenula*. The former was found alone at the lower elevation whereas near the summit of Mt. Kaindi and along the Bulldog Road both species occur. Inasmuch as the species were not recognized as different until examination of pinned specimens, it is not known if they are differentially distributed on the species of *Riedelia*. A number of *Riedelia* flowers of various species were examined. Although eggs were not found, individual flowers, especially *R. monticola* at the higher elevation, were often found to contain a single drosophilid larva. *Riedelia* flowers frequently do not open and how the egg or larva gains access to the interior is not known. Attempts to rear specimens from bagged flowers removed to the laboratory yielded no imagoes. Initial collections were discarded as negative after about 30 days. One small inflorescence of the purple-leaved *Riedelia urceolata* with about a dozen flowers was kept within a plastic bag in the laboratory for a period of 45 days. At this time it was noted that one *D. serripaenula*-like fly had emerged and 3 more puparia had been formed. Each of these was embedded within the tissue of the flower. Dissection of these puparia revealed the leg bristle characteristic of these two species. In another instance, a nylon bag of yellow *R. monticola* flowers was placed inside a shell vial and suspended near the base of the plant near the collecting site. Dissection after 45 days in the forest yielded two large larvae and one puparium. We conclude from these observations that one or both of these drosophilids breed on these ginger flowers and have an extraordinarily long sojourn as larvae within the individual flower.

*Drosophila (Hirtodrosophila) kaindiana* was reared from the large white flowers of a tall species of *Alpinia* growing along a forest trail at about 2200 m altitude on Mt. Kaindi. Two other specimens of this species were taken at light traps at the summit of Mt. Kaindi by Dr. Wayne C. GAGNÉ.

On November 25, 1981 a large white *Alpinia* came into bloom near the laboratory at Wau at 1250 m. Fifty-two specimens of *D. (Sc.) lagomorpha* were taken at these flowers. When the very fresh flower was examined by looking down inside with the binocular microscope, a large number of small drosophilid larvae could be observed. At a slightly later stage, when the white portion of the flower had become a mere brown remnant, larvae could still be seen. It is inferred that these larvae were of the species *D. (Sc.) lagomorpha* but direct proof by rearing imagoes was not accomplished.

The final observations of drosophilids at ginger flowers to be reported here were made in the Botanical Garden at Lae. A large flowering clump of the giant "torch ginger" *Nicolaia elatior* (JACK) HORANINOW was located. The inflorescences

In a site near Bulolo (Headshump Forest, 910 m) and on Mt. Missim (1570 m) clumps of *Phrynium macrocephalum* were located and two new *Scaptodrosophila* species were found. Collections at both sites yielded small numbers of a small dark species, *D. (Sc.) phryniae*. At the Mt. Missim site the large yellow species *D. (Sc.) paraphryniae* was found in substantial numbers (5♀♀ and 5♂♂ on Oct. 2, 1977 and 6♀♀ and 5♂♂ on Dec. 1, 1977). Flowers of this material yielded, after 30 and 31 days, 3♂♂ and 1♀ of *D. (Sc.) paraphryniae*.

It should be noted that the flowers of several species of *Calathea*, a genus of Marantaceae from Panama, serve as a breeding site for various species of *Drosophila* (PIPKIN *et al.*, 1966). These authors also report that a series of *Drosophila* species were associated with and reared from the flowers of several species of *Heliconia* (Musaceae). We describe here *D. (Sc.) heliconiae* collected from *Heliconia* flowers in ornamental plantings at the Lae Botanical Garden.

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### Literature Cited

- BOCK, I. R., & P. A. PARSONS, 1981. Species of Australia and New Zealand. In M. ASH-BURNER, H. L. CARSON & J. N. THOMPSON (eds.), *The Genetics and Biology of Drosophila* 3: 291-308. Academic Press, London.
- CARSON, H. L., & T. OKADA, 1980. Drosophilidae associated with flowers in Papua New Guinea. I. *Colocasia esculenta*. *Kontyû, Tokyo*, 48: 15-29.
- & ——— 1981. Drosophilidae of New Guinea. In J. L. GRESSITT (ed.), *Biogeography and Ecology of New Guinea*: 675-687. Dr. W. JUNK, Hague.
- OKADA, T., 1982. A Revision of the Genera *Dettoposomyia* LAMB and *Styloptera* DUDA. *Kontyû, Tokyo*, 50: 270-282.
- & H. L. CARSON, 1980. Drosophilidae associated with flowers in Papua New Guinea. II *Alocasia* (Araceae). *Pacif. Ins.*, 22: 217-236.
- PIPKIN, S. B., R. L. RODRIGUES, & J. LEÓN, 1966. Plant host specificity among flower-feeding neotropical *Drosophila* (Diptera: Drosophilidae). *Amer. Nat.*, 100: 135-156.

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