The *Drosophila polychaeta* and the *D. quadrisetata* Species-Groups (Diptera: Drosophilidae) from Yunnan Province, Southern China

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**ABSTRACT** Three new and four known species of the *Drosophila polychaeta* and the *D. quadrisetata* species-groups are reported from Yunnan Province, southern China. An evolutionary process of the *virilis-repleta* Radiation is discussed on the basis of the recent information from southern China.

**INTRODUCTION**

The present paper deals with three new and four known species of the *Drosophila polychaeta* and the *D. quadrisetata* species-groups from Yunnan Province, southern China, both of which belong to the *virilis* section of the subgenus *Drosophila*.

Most of specimens described here were collected at watersides, by using traps baited with fermenting bananas. All the holotypes and a part of paratypes are deposited in the Kunming Institute of Zoology, Academia Sinica, Kunming, China, and the remaining paratypes in the Biological Laboratory, Hokkaido University of Education, Sapporo, Japan.

**DROSOPHILA POLYCHAETA SPECIES-GROUP**

*D. polychaeta* species-group, Sturtevant, 1942, Univ. of Texas Publ., 42: 13-31

- *Drosophila (Drosophila) daruma* Okada


Distribution. Korea, Japan, Malaya, Borneo, India; China: Taiwan, Guangdong, Yunnan (n. loc.).

Remarks. This species is relatively common in southern and middle parts of Yunnan Province, but has not been collected in its northern districts.

- *Drosophila (Drosophila) latifshahi* Gupta et Ray-Chaudhuri

*Drosophila (Scaptodrosophila) latifshahi* Gupta et Ray-Chaudhuri, 1970 [1]: 67


Distribution. India, Bangladesh; China: Guangdong, Yunnan (n. loc.).

Remarks. *D. latifshahi* is a dominant species of waterside drosophilids, in Simao and Xishuang-banna districts.

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Accepted July 21, 1989
Received May 31, 1989
\textit{Drosophila (Drosophila) polychaeta}

Patterson et Wheeler

(Figs. 1–6)


Patterson and Wheeler [3] described this species based on the laboratory strain from Texas, but did not refer to its genitalia. The present specimens are supposed to belong to a native population of \textit{D. polychaeta}, and the description of the male and female genitalia is made below, together with its diagnostic characters.

**Diagnosis.** Brown species with 3 pairs of postsutural dorsocentral bristles. Palpus with ca. 2 moderate and ca. 18 short bristles. C-index ca. 1.96, C3-fringe ca. 0.93. Epandrium fused to cercus at middle; anteroventral corner sharply pointed; caudoventral corner rounded (Fig. 1). Spermatheca unsclerotized.

Periphallic organs (Figs. 1–3): Epandrium brown, darker on lower margin, pubescent except in upper portion and ventral margin, with ca. 30 bristles on lower half. Surstylus distally constricted into two parts; upper part flap-shaped, with tiny thorn-like spines in somewhat regular rows; lower part nearly quadrate, with ca. 4 primary teeth and ca. 2 bristles on distal margin, and with ca. 5 bristles at caudoventral corner. Cercus oval, ventrally narrowing, entirely pubescent with ca. 53 long bristles and tuft of ca. 11 short bristles at lower apex. Decasternum pale brown, Y-shaped in ventral view, medially with small dark patches.

Phallic organs (Figs. 4, 5): Aedeagus T-shaped in lateral view, proximally broadened; aedeagal apodeme short, ca. 1/4 as long as aedeagus. Anterior paramere oval, without sensilla; posterior paramere absent. Vertical rod dark brown. Novasternum nearly triangular, without submedian spines. Ventral fragma laterally flattened, distally conveved in middle.

♀ reproductive organs (Fig. 6): Lobe of ovipositor pale orange, dorso-submedially expanded, with ca. 4 discal teeth, ca. 24 spine-like marginal teeth and 1 subterminal hair; ultimate marginal tooth darker than penultimate. Spermatheca very small, embedded in adipose tissue.

**Specimens examined.** China: 12 ♀, 13 ♂, Simao, 4. XI. 1987 (X. C. Liang).

**Distribution.** Neotropics, Micronesia, Hawaii,
North America, Europe; China (n. loc.): Yunnan.

**Origin.** *D. polychaeta* is cosmopolitan, but its extremely wide range of distribution is probably due to the propagation with man [4]. Fonseca [5] states that *D. polychaeta* is frequently collected on ships in British ports but does not establish its permanent population there. The origin of this species was unknown. The present collection was made in a natural subtropical forest remote from a human residence. This suggests that southern China might be the original distribution range of *D. polychaeta*.

**DROSOPHILA QUADRISETATA**

**SPECIES-GROUP**


This group is very small, and consisted of only three species: *D. potamophila* Toda et Peng and *D. beppii* Toda et Peng from southern China, and *D. quadrisetata* Takada, Beppii et Toda from northern Japan. The last species was previously included in the *polychaeta* species-group [6]. Three new species are added in this article.

**Drosophila (Drosophila) potamophila** Toda et Peng

**Drosophila (Drosophila) potamophila** Toda et Peng, 1989 [2]: 159.

**Specimens examined.** China: 1♂, 1♀, Simao, Yunnan Province, 4. XI. 1987 (X. C. Liang).

**Distribution.** China: Guangdong, Yunnan (n. loc.).

**Remarks.** This species is abundant in subtropical districts of Yunnan, but has not been collected in Kunming (center of Yunnan) and Dali (northern Yunnan) districts.

**Drosophila (Drosophila) karakasa**

Watabe et Liang, sp. nov. (Figs. 7–14)

**Diagnosis.** Small and yellowish brown species with cercus separated from epandrium. Palpus short, with short hairs but without stout bristles (Fig. 7). 4C-index ca. 7/9 and C3-fringe ca. 3/5. Surstylus rectangular, distally with ca. 7 primary teeth and ca. 7 short bristles (Fig. 9). Lobe of ovipositor brown, much darker on ventral margin, roundish at tip (Fig. 13). Spermatheca con-
shaped, with sparse horizontal stripes on basal half of outer capsule (Fig. 14).

♀, ♂. Body length, ♀ ca. 2.33 mm (range: 2.1–2.5), ♂ ca. 2.31 mm (2.1–2.5). Wing length, ♀ ca. 2.83 mm (2.6–3.0), ♂ ca. 2.73 mm (2.6–2.8).

Head: Eye red with thick piles. Second joint of antenna reddish brown; 3rd grayish brown. Antenna with ca. 4 (4–6) upper and ca. 2 (2–3) lower short branches in addition to terminal fork. Frons dark brown, ca. 0.54 (0.43–0.65) as broad as head, anteriorly with a few frontal hairs. Anterior reclinate orbital (Orb 2) ca. 0.44 (0.33–0.56) length of posterior reclinate orbital (Orb 1); procline orbital (Orb 3) ca. 0.63 (0.56–0.78) length of Orb 1. Face brown; carina somewhat low, narrow. Clypeus reddish brown. Cheek tannish brown, ca. 0.25 (0.20–0.31) as broad as maximum diameter of eye, with ca. 3 long bristles along lower margin. Second oral (Or 2) minute, ca. 0.29 (0.23–0.36) length of vibrissa (Or 1). Palpus brown, club-shaped, basally baring (Fig. 7).

Thorax: Mesoscutum yellowish brown, medially with a darker longitudinal stripe running to scutellum. Scutellum brown, paler on lateral sides. Lower humeral ca. 0.70 (0.55–0.86) length of upper one. Two extra pairs of dorsocentrals present in front of usual ones. Anterior acrostichal bristles present between 1st (anterior-most) dorsocentrals; posterior ones between 2nds; length and location of acrostichal bristles more or less variable. Relative lengths of dorsocentrals and acrostichal bristles to 4th (posterior-most) dorsocentral: 1st dorsocentral ca. 0.57 (0.51–0.62), 2nd ca. 0.57 (0.49–0.62), 3rd ca. 0.71 (0.65–0.79), anterior acrostichal bristle ca. 0.35 (0.29–0.43), posterior one ca. 0.53 (0.46–0.68). Length distance from 1st dorsocentral to 2nd ca. 0.57 (0.52–0.68), distance from 2nd to 3rd ca. 0.48 (0.44–0.55), distance from 3rd to 4th ca. 0.56 (0.52 0.64) across distance between 3rds. Acróstichal hairs (Ac) scarce, in 4 irregular rows. Anterior scutellars (SctA) nearly parallel and posterior ones (SctP) convergent; SctA ca. 1.07 (0.88–1.17) length of SctP. Sterno-index ca. 0.72 (0.64–0.76).

Legs light brown; preapicals on all three tibiae; apicals on fore and mid tibiae.

Wing hyaline, slightly fuscous. Veins dark brown; crossveins clear. R_{2+3} straight; R_{4+5} and M parallel. C, bristles 2, subequal. Number of small stout bristles on 3rd costa (3CFr) ca. 28 (24–33). Wing indices: C in ♀ ca. 3.10 (2.96–3.34) and in ♂ ca. 2.77 (2.50–3.11), 4\(\sqrt{\text{V}}\) ca. 1.64 (1.54–1.87), 4\(\sqrt{\text{C}}\) ca. 0.77 (0.70–0.86), 5\(\sqrt{\text{X}}\) ca. 1.57 (1.33–1.73), Ac in ♀ ca. 2.26 (2.17–2.36) and in ♂ ca. 2.64 (2.14–3.00), C3-fringe ca. 0.61 (0.52–0.67). Halteres white, basally brown.

Abdomens: Tergites brown, darker on middle and paler on lateral margin. Sternites brown, darker on posterior margin, nearly quadrate.

Periphalic organs (Figs. 8–10): Epandrium yellowish brown, darker on anterior margin, pubescent on posterior half, with ca. 9 bristles on lower half. Surstylus pale brown, marginally darker, somewhat swollen at caudodorsal corner. Decasternum translucent, heart-shaped. Cercus brown, slightly projecting at ventral apex, entirely pubescent, with ca. 17 long bristles and tuft of ca. 5 short bristles along lower margin.

Phallic organs (Figs. 11, 12): Aedeagus yellow, bilobed, ventrally broadened, apodeme dark brown, ca. 3/8 as long as aedeagus. Anterior paramere small. Vertical rod black, plate-shaped in ventral view. Novasternum pale brown, without submedian spines; ventral Igma narrow.

♀ reproductive organs (Figs. 13, 14): Lobe of ovipositor with ca. 3–5 discal teeth and ca. 17 short marginal teeth: first 2 marginal teeth darker and larger than others. Spermapheca grayish brown, slightly constricted in middle; introvert deep.

Holotype ♀, China: Xianquan, Dali district, Yunnan Province, 19. IX. 1988 (X. C. Liang).

Paratypes, China: 1 ♀, same data as holotype, 2 ♂, Dabochin, Dali district, Yunnan Province, 21. IX. 1988 (X.C. Liang).

Distribution: China: Yunnan; Dabochin, Xianguan.

Relationships. D. karakosae somewhat resembles the foregoing species, D. potamophila, in the general morphology and chaetotaxy, but clearly distinguishable from the latter by the diagnostic characters. The aedeagus of this species is very similar to that of four species of the D. robusta species-group: D. okadai Takada, D. neokadai Kaneko et Takada, D. gani Liang et Zhang and D. unimaculata Strobl [7].
*Drosophila (Drosophila) barutani*
Watabe et Liang, sp. nov.
(Figs. 15–20)

**Diagnosis.** Dull brown species with cerci close to epandrium at middle (Fig. 15). Third oral subequal to vibrissa. Palpus with ca. 3 moderate bristles. 4C-index ca. 5/9 and C3-fringe ca. 9/10. Surfistus arc-shaped, broadened at caudodorsal corner (Fig. 16). Lobe of ovipositor sharply pointed at tip; ultimate marginal tooth large, bristle-like (Fig. 19). Spermatheca hemispherical (Fig. 20).

♂, ♀. Body length, ca. 3.60 mm (3.4–3.8). Wing length, ca. 4.03 mm (3.9–4.1).

Head: Eye brownish red with thick piles. Second joint of antenna reddish brown; 3rd blackish brown. Arista ca. 4 (4–6) upper and ca. 2 (1–2) lower short branches in addition to terminal fork. Frans reddish brown, ca. 0.47 (0.46–0.48) as broad as head, anteriorly with a few frontal hairs. Orb 2 ca. 0.32 (0.31–0.34) length of Orb 1; Orb 3 ca. 0.40 (0.33–0.47) length of Orb 1. Face brown; carina broad. Clypeus dark red. Cheek reddish brown, ca. 0.28 (0.24–0.33) as broad as maximum diameter of eye, with ca. 3 long bristles along lower margin. Or 2 thin, ca. 0.16 (0.14–0.17) length of Or 1; Or 3 ca. 0.99 (0.92–1.11) length of Or 1. Palpus grayish brown, laterally flattened.

Thorax: Mesocutum brown, with 4 darker longitudinal stripes. Scutellum brown, lateral sides black. Lower humeral ca. 0.58 (0.55–0.59) length of upper one. Two extra pairs of dorsocentrals present. Anterior acrostichal bristles present between 1st dorsocentrals; posterior slightly below cross line between 2nds. Relative lengths of dorsocentrals and acrostichal bristles to 4th dorsocentral: 1st (anteriormost) dorsocentral ca. 0.66 (0.65–0.67), 2nd ca. 0.68 (0.62–0.74), 3rd ca. 0.86 (0.79–0.98), anterior acrostichal bristle ca. 0.58 (0.48–0.70), posterior one ca. 0.54 (0.52–0.57). Length distance from 1st dorsocentral to 2nd ca. 0.64 (0.60–0.71), distance from 2nd to 3rd ca. 0.55 (0.50–0.61), distance from 3rd to 4th ca. 0.58 (0.55–0.61) cross distance between 3rds. Ac
sarse, in 6 irregular rows. SctAs parallel and Sctps convergent; SctA ca. 0.97 (0.93–1.03) length of SctP. Sterno-index ca. 0.72 (0.52–0.84).

Legs dark brown; coxae and trochanters paler. Fore femur posteriorly with ca. 5 bristles. Preapicals on all three tibiae; apicals on fore and mid tibiae.

Wing nyamne, signy tuscous. Veins dark brown; crossveins clear. R₄₋₅ nearly straight; R₄₋₅ and M parallel. C₁ bristles 2, inner bristle ca. 5/9 length of outer one. Number of 3CFr ca. 38 (35–40). Wing indices: C a. 3.46 (3.04–3.70), 4V ca. 1.61 (1.56–1.70), 4C ca. 0.57 (0.53–0.62), 5X ca. 1.06 (1.00–1.17), A3 ca. 2.01 (1.82–2.20), C3-fringe ca. 0.90 (0.87–0.94). Haltere pale yellow; stalk anteriorly darker.

Abdomens: Tergites entirely dark brown. Sternites pale grayish brown, nearly quadrate; Sth slightly convexed posteriorly.

Perihallic organs (Figs. 15, 16): Epandrium brown, dorsally narrowing and ventrally broadened, posteriorly pubescent except lower portion, with ca. 12 bristles. Surstylus dark brown, distally with ca. 7 primary teeth on margin and ca. 3 bristles at caudoventral corner, medially with ca. 7 spine-like bristles on outer surface. Cercus dark brown, somewhat projecting ventrally, entirely pubescent, with ca. 38 long bristles and tuft of ca. 12 short bristles at lower apex.

Phallic organs (Figs. 17, 18): Aedeagus yellowish brown, much darker at distal portion, bilobed, concaved on distal margin; apodeme short, ca. 3/7 as long as aedeagus. Anterior paramere rudiment. Vertical rod brown, ventrally black. Novasternum narrow; ventral fragma handmill-shaped.

♀ reproductive organs (Figs. 19, 20): Lobe of ovipositor brown, marginally black, dorso-subapically swollen, with ca. 4 discal teeth and ca. 13 marginal teeth in regular row; ultimate marginal tooth prominent, ca. 3 times as long as penultimate. Spermatheca pale yellow, apically somewhat flattened, wrinkled on basal margin, without apical indentation; introvert deep, ca. 5/8 height of outer capsule.

Holotype ♂, China: Dabo chin, Dali district, Yunnan Province, 21. IX. 1988 (X. C. Liang).

Paratypes, China: 1 ♂, Xianguan, Dali district, Yunnan Province, 21. IX. 1988, (X. C. Liang); 1 ♀, same data as holotype.

Distribution. China: Yunnan; Dabo chin, Xianguan.

Relationships. D. barutani is somewhat similar to D. potamophila in the abdominal coloration and large value of C3-fringe, but easily distinguishable from the latter by the shapes of its aedeagus and ovipositor.

Drosophila (Drosophila) multidentata
watane et Zhang, sp. nov.
(Figs. 21–27)

Diagnosis. Dull brown species, with cercus fused to epandrium at submedian portion (Fig. 21). Or 2 ca. 4/9 length of Or 1. C3-fringe ca. 5/9. Lobe of ovipositor with many irregular teeth (Fig. 26). Spermatheca slender, with sparse oblique lines on basal 1/3 of outer capsule (Fig. 27).

♂. Body length, ca. 2.55 mm (2.4–2.8), ca. 2.85 mm (2.6–3.1). Wing length, ca. 3.18 mm (3.0–3.5), ca. 3.48 mm (3.2–3.8).

Head: Eye dark red with thick piles. Second joint of antenna dark brown; 3rd grayish brown. Antenna with ca. 4 (3–4) upper and ca. 1 lower branches in addition to short terminal fork. Frons dark brown, ca. 0.46 (0.42–0.49) as broad as head, medially with black cuneiform line. Orb 2 ca. 0.36 (0.25–0.46) length of Orb 1; Orb 3 ca. 0.52 (0.42–0.79) length of Orb 1. Face reddish brown; carina very high, wider below. Clypeus blackish brown. Cheek brown, ca. 0.26 (0.23–0.31) as broad as maximum diameter of eye, with ca. 3 long and ca. 11 short bristles along lower margin. Or 2 thin, ca. 0.44 (0.23–0.61) length of Or 1; Or 3 minute. Palpus brown, small, club-shaped, with 1 somewhat long bristle at tip.

Thorax: Mesoscutum brown, medially darker; scutellum dark brown. Lower humeral ca. 0.61 (0.44–0.69) length of upper one. Anterior acrostical bristles present below cross line between 1st dorsocentrals; posterior below cross line between 2nds. Relative lengths of dorsocentrals and acrostical bristles to 4th dorsocentral: 1st dorsocentral (anteriormost) ca. 0.46 (0.39–0.52), 2nd ca. 0.51 (0.39–0.58), 3rd ca. 0.68 (0.60–0.79), anterior acrostical bristle ca. 0.33 (0.24–0.44), posterior one ca. 0.42 (0.37–0.44). Length distance from 1st
dorsocentral to 2nd ca. 0.55 (0.44–0.74), distance from 2nd to 3rd ca. 0.45 (0.39–0.48), distance from 3rd to 4th ca. 0.51 (0.46–0.56) cross distance between 3rds. Ac in 6 irregular rows; a few acrostical hairs in rows of dorsocentrals somewhat longer than other hairs. SctAs slightly and SctPs heavily convergent; SctA ca. 0.96 (0.86–1.05) length of SctP. Sterno-index ca. 0.73 (0.52–0.96).

Legs brown; fore tarsi darker. Fore femur posteriorly with ca. 2–3 long bristles. Preapicals on all three tibiae; apicals on fore and mid tibiae.

Wing hyaline, slightly fusco. Veins dark brown; crossveins clear. R_{1+3} nearly straight; R_{4+5} and M parallel. C_{1} bristles 2, subequal. Number of 3CFr ca. 24 (17–28). Wing indices: C ca. 3.54 (3.12–4.20), 4V ca. 1.69 (1.52–1.78), 4C ca. 0.68 (0.60–0.77), 5X ca. 1.22 (1.00–1.50), Ac ca. 2.00 (1.67–2.13), C3-fringe ca. 0.56 (0.43–0.65). Halteres white; stalk grayish brown.

Abdomens: Tergites grayish brown, darker in middle; sternites brown, each with ca. 26–34 bristles.

Periphallus organs (Figs. 21–23): Epandrium brown, darker on anterior margin, posteriorly pubescent, with ca. 15 bristles on lower half and ca. 2 bristles along ventral margin. Surstylus brown, darker on upper half, distally narrowing, slightly projecting at caudodorsal corner, with ca. 6 primary teeth and ca. 2 bristles. Decasternal dark brown, paler on lower portion. Cercus blackish brown, with ca. 34 long bristles and tuft of ca. 23 pale yellow bristles along ventral margin.

Phallic organs (Figs. 24, 25): Aedeagus yellow, bilobed, submedially broadened; apodeme dark brown, ca. 1/3 as long as aedeagus. Anterior paramere pale yellow, hemispherical. Vertical rod black, recurved dorsally. Novasternum pale yellow, darker on lateral margin, without submedian spines; ventral fragma slightly concaved at middle.
has resulted in the establishment of a new species-group, the quadriseta group. This group is closely related to the polychaeta group in the external morphology and to the robusta group in the male genitalia. Toda and Peng [2] consider that the quadriseta group occupies a systematic position between these two species-groups. Similarly, geographical information on the distribution of these three groups has made it possible to trace the evolutionary process. Most of the polychaeta group flies are distributed from the tropics to the subtropics of the East Asia, whereas the robusta group flies in its temperate zone [1, 2, 4, 8]. The distribution range of the quadriseta group overlaps with that of the polychaeta group and that of the robusta group. Of six quadriseta group species, D. potamophila and D. beppui are distributed in the subtropics and the remaining four species in the temperate forest [2, 6, 8]. In particular, in northern Yunnan, the present three new species are sympatric to D. neokadai and D. gani of the robusta species-group [9].

These information from southern China, including the discovery of D. polychaeta in a natural forest of Simao, strongly supports the Throckmorton's hypothesis: the polychaeta group first emerged in the Old World tropics and then the robusta group in the temperate forest of the East Asia probably through the emergence of the quadriseta group in its subtropics.

ACKNOWLEDGMENTS

The authors are grateful to Prof. Osamu Kitagawa (Tokyo Metropolitan University) and to Dr. Masanori J. Toda (Hokkaido University) for their interest and advice during this study. This work was supported by Grants-in Aid for Overseas Scientific Survey from the Ministry of Education, Science and Culture, Japan (Nos. 62041085, 63043060).

REFERENCES


THE VIRILIS-REPLETA RADIATION IN THE OLD WORLD

The virilis-repleta Radiation, which might have occurred during the Oligocene to early Miocene, is one of the main lineages in the evolution of the genus Drosophila. Throckmorton [4] considers that first the polychaeta group might have emerged in the Old World tropics and then several groups, e.g., the robusta, the virilis and the melanica species-groups, might have diverged adaptively in its temperate forest. However, the phylogenetic relationship among these species-groups, especially between the polychaeta group and other groups, was still open to question, mainly due to insufficient information from China.

The recent Drosophila-survey in southern China


