Taximetrical Analyses of Costal Chaetotaxy of the Genus
Drosophilella DUDA, with Description of a New Species
from Sri Lanka (Diptera, Drosophilidae)

Toyoji OKADA

Synopsis

OKADA, T. 1986—Taximetrical analyses of costal chaetotaxy of the genus
Drosophilella DUDA, with description of a new species from Sri Lanka
The costal chaetotaxy of the genus Drosophilella DUDA is taximetrically
analysed in relation to other diagnostic characters and the host plants. A
new species, D. zeylanica, is described from Sri Lanka. This species is found
to have the chaetotaxy common among the family Drosophilidae but unique
in the genus.

Through courtesy of Mr. R. DANIELSSON of the Zoological Museum,
Lund, I was able to study a series of drosophilid specimens of the Lund
Collection from Sri Lanka, in which I have found a new species of the
genus Drosophilella DUDA. The relationships of the species of this genus
including the new species are taximetrically analysed with special regard
to the types of costal chaetotaxy classified after HACKMAN & VÄISÄNEN
(1985).

I thank Mr. DANIELSSON for providing me with material.

Drosophilella zeylanica n. sp.
(Fig. 1A–F)

♂. Body (Fig. 1A) 1.8 mm in length. Head (Fig. 1B) black. Eye
dark red, with pile. Antenna brownish black, antennal bases widely
separated. Arista twice as long as antenna, merely pubescent. Palpus
yellow. Ocellar triangle grayish black. Ocellars outside triangle made
by ocelli. Periorbit grayish brown. Postverticals short. Frons mat
black, quadrate, broader than long. Face yellowish gray. Carina large,
broad and flat. Cheek yellowish gray, 1/3 as broad as greatest diameter
of eye. Clypeus large, swollen, mat grayish black. Anterior reclinate
orbital minute. Second oral small. Thorax entirely mat black. Humerals
2. Acrostichal hairs in 6 rows. Anterior dorsocentrals 1/5 as long as
posteriors; length distance of dorsocentrals subequal to cross distance.
Lateral scutellars nearly parallele, as long as apicals, which are nearer
Fig. 1. *Drosophilella zeylanica* n. sp., ♂. A, Body; B, head; C, fore leg; D, costal chaetotaxy, lower figure ventral aspect of costa; E, periphallic organs; F, phallic organs. c, surstylus; e, aedeagus, g, epandrium. Scales 0.1 mm.

to each other than to laterals. Legs fuscous; femora black; metatarsi as long as 3 succeeding tarsal joints, 2nd joint of fore leg (Fig. 1C) apically prolonged and with 2 black stout bristles. Wing hyaline, costal fringe thick and heavy (Fig. 1D). C-index 1.7; 4V-index 2.8; 4C-index 1.6; 5x-index 3.0; Ac-index 1.7. Cl-bristle 1; C3-fringe 3/5. Halter yellowish gray. Abdominal tergites mat black. Abdominal sternites pale, without protuberance on 6th sternite. Periphallic organs (Fig. 1E) black; epandrium caudoanteriorly elongate, subbasally without upper process; cercus elliptical; surstylus apparently fused to epandrium, distally with 4 black teeth. Phallic organs (Fig. 1F) black, elongate; aedeagus without basal upper process.


Relationships. This species resembles *D. seminigra* DUDA in having large carina, widely separated antennal bases, and six rows of acrostichal hairs, but differs from the latter by having longer arista, darker thoracic pleura and stronger costal bristles.

Remarks. Although unknown to be associated with flowers, this
species is thought to be pistilicolous in larval habit by reason of the absence of subbasal dorsal processes of epandrium and aedeagus, which is characteristics of the known pistilicolous species.

Costal chaetotaxy

HACKMAN and VÄISÄNEN (1985) made a thorough investigation of costal chaetotaxy in as many as 875 species of Diptera belonging to 128 families. They classified the arrangement of the costal setae (macrotrichia) in several types. All of the species of Drosophilidae they studied belong to B₂ type: Amiota, Leucophenga, Scaptomyza, Drosophila (Idiomyia), in which “Setae are dimorphous, a subdorsal row of spinulæ and a subventral row of hairs or bristles”. The terms spinulæ and spines they used should be better replaced by the terms heavy bristles and heavy long bristles, because the costal setae are cuticular appendages (IMMS) and not cuticular processes which have no alveoles.

My cursory examination of costal chaetotaxy of Drosophilidae has proved B₂ type also in the genera Stegana, Erima, Microdrosophila,

Fig. 2. Costal chaetotaxy of Drosophilidae species. B₀, B₁, B₂, chaetotaxy types; left figure for each species, ventral aspect of costa at middle part of wing. Solid circle, heavy bristles; open circle, weaker bristles. Scale 0.1 mm.
Nesiodrosophila, Hypselothryrea, Tambourella, Mycodrosophila, Paramycopanomphalus, Jeannelopsis, Zaprius and Liodrosophila. On the other hand, in the genus Drosophilella (Fig. 2), typical B\(_3\) type is found only in zeylanica, atypical B\(_3\) type with subdorsal row of heavy bristles partially intermittent with weaker bristles in alocasiae and xenalocasiae, typical B\(_1\) type with homomorphous two rows of weaker bristles in colocasiae and iskandari, and atypical B\(_1\) type with three rows of homomorphous weaker bristles (designated here B\(_s\) type) is found in toshioaki, baechlili, and bogneri.

Hackman and Väisänen (1985) suggested that usual steps of evolutionary changes of costal chaetotaxy in Diptera are B\(_3\) \(\rightarrow\) B\(_1\) \(\rightarrow\) B\(_s\), but they recognized reverse steps in some cases, e.g., B\(_2\) \(\rightarrow\) B\(_1\) in Agromyzidae. Likewise, Drosophilella seem to have taken reverse steps B\(_2\) \(\rightarrow\) B\(_1\) \(\rightarrow\) B\(_s\), I (Okada, 1986) have estimated three routes of distribution in Drosophilella species: Alocasia route, Colocasia route and Homalomena route. It is concluded for the time being that the species of Alocasia route are B\(_3\) type, those of Colocasia route are B\(_1\) type and those of Homalomena route are B\(_s\) type (Table 1). The route leading to D. zeylanica is not clear because the host plant is unknown.

<table>
<thead>
<tr>
<th>Synhospitalic couple</th>
<th>Costal chaetotaxy</th>
<th>Distribution route</th>
<th>Distribution area</th>
</tr>
</thead>
<tbody>
<tr>
<td>stamenicola pistilicola</td>
<td>B(_3) (typical)</td>
<td>?</td>
<td>Sri Lanka</td>
</tr>
<tr>
<td>alocasiae xeyalocasiae</td>
<td>B(_2) (atypical)</td>
<td>Alocasia</td>
<td>Taiwan etc.</td>
</tr>
<tr>
<td>monococica diconica</td>
<td>B(_1)</td>
<td>Colocasia</td>
<td>Borna</td>
</tr>
<tr>
<td>colocasiae iskandari</td>
<td>B(_1)</td>
<td>Colocasia</td>
<td>Indonesia</td>
</tr>
<tr>
<td>stamenicola pistilicola</td>
<td>B(_1)</td>
<td>Colocasia</td>
<td>New Guinea</td>
</tr>
<tr>
<td>baechlili bogneri</td>
<td>B(_0)</td>
<td>Homalomena</td>
<td>Malaysia</td>
</tr>
<tr>
<td>? toshioaki</td>
<td>B(_0)</td>
<td>Homalomena</td>
<td>Philippines</td>
</tr>
</tbody>
</table>

**Taximetrical analyses**

The relationships of the species of the genus Drosophilella including D. zeylanica are analysed taximetricaly by S\(_{nm}\) proximity analysis and UPGMA cluster analysis, with special regard to the costal chaetotaxy. D. seminigra is excluded from the analyses because of insufficient information about male genitalia. Eighteen diagnostic characters are used, of which 17 ("A"-"T" ad "A"-"K") are as used in Toda and Okada (1983) and one, "H'", is newly adopted: paramere present (H'=0) or absent (h'=1). The character state A corresponds to the type B\(_2\) of costal chaetotaxy, and state a to the types B\(_1\) and B\(_s\).
Costal Chaetotaxy of *Drosophilella*

From the original $n \times t$ (character) matrix (Table 2), the dendrogram of relationships of the species (Fig. 3) is obtained.

**Table 2. Original $n \times t$ (character) matrix.**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>A'</th>
<th>B</th>
<th>C</th>
<th>C'</th>
<th>D</th>
<th>D'</th>
<th>E</th>
<th>E'</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>H'</th>
<th>I</th>
<th>I'</th>
<th>J</th>
<th>K</th>
<th>K'</th>
</tr>
</thead>
<tbody>
<tr>
<td>zeylanica</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
</tr>
<tr>
<td>alocasiae</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>NC</td>
<td>NC</td>
</tr>
<tr>
<td>xenalocasiae</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>stamenicola</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>pistilicola</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>monoconica</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>diconica</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>colorasiae</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>iskandari</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>toshikai</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>NC</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>baechlii</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>NC</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>NC</td>
<td>NC</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>bogneri</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>NC</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NC</td>
<td>NC</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Fig. 3.** A dendrogram of the relationships of the *Drosophilella* species, $B_0, B_1, B_2$, chaetotaxy types; alphabetical signs, character states derived from the original $n \times t$ matrix; numerical figures, order of key couplets; $S_{sw}$, simple matching similarity coefficient.
The species of B₀ type costal chaetotaxy: toshiokai, baechlii and bogneri, make a major cluster. Another major cluster is divided into zeylanica (B₂ type) and a group of the remaining species (B₁ and B₂ types). The latter group is subdivided into stamenicolas species (aloaciasiae, stamenicola, monoconica, colocasiae) and pistilicolous species (xenalocasiae, pistilicola, diconica, iskandari).

From the dendrogram a key to species of the genus Drosophilella is automatically constructed as below.

Key to species of the genus Drosophilella

1. Costal chaetotaxy B₁ or B₂ type; arista pubescent (a'); male cercus ventrally not prolonged (E') ........................................... 2
   - Costal chaetotaxy type B₂; arista plumose (A'); male cercus ventrally prolonged (e') .................................................. 10
2. Costal chaetotaxy type B₂; conical process of male 6th abdominal sternite absent (D'); paramere present (h') ..................... zeylanica
   - Conical process of male 6th abdominal sternite present (d'); paramere absent (H') .......................................................... 3
3. Basal process of aedeagus present (h); stalk of ejaculatory apodeme broader than long (i); ovipositor narrow especially distally (k) . 4
   - Basal process of aedeagus absent (H); stalk of ejaculatory apodeme longer than broad (I); ovipositor broad, black-like (K) ...... 7
4. Surstylus present (G) ...................................................................... 5
   - Costal chaetotaxy type B₁; surstylus absent (g) ....................... 6
5. Costal chaetotaxy type B₂; costal bristles strong at least partially (A); stout teeth of 2nd tarsal joint of fore leg four or more (C); female anal lobe crescent (j) ........................................... aloaciasiae
   - Costal chaetotaxy type B₁; costal bristles fine (a); stout teeth of 2nd tarsal joint of fore leg two (c); female anal lobe triangular (J) ........................................................... stamenicola
6. Caudoventral corner of epandrium rectangular (F) ... monoconica
   - Caudoventral corner of epandrium acute-angular (f) .... colocasiae
7. Costal chaetotaxy type B₂; costal bristles strong at least partially (A); male cercus oblong (E); surstylus absent (g) ............
   .................................................................................. xenalocasiae
   - Costal chaetotaxy type B₁; costal bristles fine (a); male cercus oval (e); surstylus present (G) ........................................... 8
8. Tarsal joints of fore leg compressed (b); caudoventral corner of epandrium acute-angular (f) ........................................... pistilicola
   - Tarsal joints of fore leg elongated (B) ........................................ 9
9. Caudoventral corner of epandrium rectangular (F) ...... diconica
Costal Chaetotaxy of Drosophilella

- Caudoventral corner of epandrium acute-angular (f) .... iskandari
10. Basal process of aedeagus absent (H); paramere absent (H');
ovipositor narrow especially distally (k) and segmented (k') ....
.............................................................. (toshiokai
- Basal process of aedeagus present (h); paramere present (h');
ovipositor broad, blade-like (K) and not segmented (K') .... 11
11. Surstylus absent (g) .................................. baechlii
- Surstylus present (G) .................................... bogneri

摘 要

岡田豊日（東京都）——前縁脈剛毛配置型を中心としたタロイモショウジョウバエ属
Drosophilella の分類と 1 種の記載。

Lund 博物館所蔵のスリランカのショウジョウバエ標本中に、タロイモショウジョウバ
エ属の 1 新種を発見記載した。本種を含めて同属の種の前縁脈剛毛型を中心とした数
量分類を行い、それと寄主植物との関連を考察した。

Literature cited

HACKMAN, W. and R. Väisänen, 1985. The evolution and phylogenetic significance of
OKADA, T. 1986. Estimation of the routes of synhospitolic distribution of the genus
Drosophilella DUDA (Diptera, Drosophilidae), with descriptions of three new
32–39.
TODA, M. J. and T. OKADA, 1983. Ecological studies of floricolous Drosophilella in
Burma with descriptions of three new species from Burma and the Philippines

Author’s address: Toyohi OKADA, Gotokuji 2-30-18, Setagaya-ku, Tokyo 154, Japan.

ADDENDUM (ERRATA)

p. line for read
32 1.... Routes Drosophila bogneri Routes Drosophilella bogneri
33 27