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A REVIEW OF THE GENUS *MULGRAVEA* WITH DESCRIPTIONS OF FOUR NEW SPECIES FROM BHUTAN (DIPTERA: DROSOPHILIDAE)

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ABSTRACT. The genus *Mulgravea* of the family Drosophilidae is reviewed. Four new species are described from Bhutan, a previously unexplored country in the Oriental Region. A key to species of *Mulgravea* is given.

The genus *Mulgravea* was established by Bock (1982) with *M. minima* from Queensland, Australia as its type species. Since then many species described under other genera have been transferred to it. Ten species of *Mulgravea* are known from the world (Okada, 1987; 1988; Kumar & Gupta, 1992). We add four new species from Bhutan.

The known species of *Mulgravea* are reviewed in this paper and descriptions and figures are given of the four new species recently collected from Bhutan, a small mountainous and previously unexplored country in the Oriental region.

Genus *Mulgravea* Bock, 1982

Mulgravea Bock, 1982. Australian J. Zool., Suppl., 89: 122. Type species: *Mulgravea minima* Bock, 1982.

Thyreocephala Okada, 1985. Kontyu, 53: 338. Type species: *Lissocephala asiatica* Okada, 1964.

Diagnosis: Head broader than thorax; Postvertical and anterior reclinate orbital setae vestigial; ocellar setae outside ocellar triangle; facial carina vestigeal; acrostichal setulae in traces only in front of dorsocentral setae; anal vein absent.

Key to the known species of *Mulgravea*

1. Acrostichal setulae in 2 rows. 2
- Acrostichal setulae in 4-6 rows. 3
2. Frons granulous. ..... ***vittata*** Okada
- Frons not granulous 4
3. Wing hyaline; scutellum black. ..... ***trimaculata*** (Okada)
- Wing fuscous; scutellum black on lateral margins. .. ***viridifrons*** (Okada)
4. Arista with 3 dorsal branches. ..... ***corpusculata*** (Takada & Momma)
- Arista with 6 or more dorsal branches. 5
5. Anterior dorsocentrals larger than posterior dorsocentrals. ***minima*** Bock
- Anterior dorsocentrals either equal or smaller than posterior dorsocentrals. 6

6. Cercus with setigerous plate ventrally; surstylus slender and curved.....7
- Cercus without setigerous plate ventrally; surstylus not slender and curved. 8
7. 5X-index about 2.5. 9
- 5X-index about 3. 5. 10
8. Tergites 2-5 in male with light median areas; C-index about 1.5 ..... ***indersinghi*** (Takada & Momma)
- Tergites 2-5 in male without light median areas; C-index about 1.1. ..... ***ranipoolensis*** Kumar & Gupta
9. First flagellomere black. 11
- First flagellomere yellow. ..... ***bhutanica,*** sp. nov.
10. Anterior and posterior dorsocentrals equal. .... ***parasiatica*** (Takada & Momma)
- Anterior dorsocentrals smaller than posterior dorsocentrals. 12
11. Palpus orange yellow..... 13
- Palpus black. ..... ***detriculata,*** sp. nov.
12. Katepisternum shining yellow; anepisternum yellow..... .....***peniglobosa,*** sp. nov.
- Katepisternum dark brown; anepisternum with a ventral brown stripe. .....***spinisterna,*** sp. nov.
13. Abdominal tergites uniformly brownish black. ..... ***asiatica*** (Okada)
- Abdominal tergites not uniformly black, 2T and 6T yellow..... .....***neoasiatica*** (Takada & Momma)

1. *Mulgravea detriculata*, sp. nov. (Figs. 1, A-E)

Diagnosis: Arista branches 6-7/3-4 besides terminal bifurcation; antenna with pedicle yellow and first flagellomere black; 5X-index 2.3; Katepisternum brown, anepisternum with a ventral brown stripe; abdominal tergites completely brown; oviscapt with 3 marginal ovisensilla.

Description: Male and female: Average body length: male, 1.4-1.5 mm; female, 1.7-1.8 mm.

Head: Arista with 6-7 dorsal and 3-4 ventral branches in addition to terminal bifurcation. Antenna with pedicel yellow, first flagellomere black. Frons shining black. Facial carina reduced. Clypeus brown. Vibrissa and subvibrissal seta nearly equal. Palpus black, with single apical seta. Gena glossy black, greatest width of gena 0.14 the greatest diameter of eye. Eyes dark red. Anterior reclinate orbital obscure; length ratio between proclinate and posterior reclinate orbitals 5:4.

Thorax: Acrostichal setulae in traces of 2 rows. Scutum shining yellow with two large black spots above wing articulation and in between two small faint basal spots. Scutellum yellow with marginal black spots laterally. Anterior dorsocentral setae smaller than posterior dorsocentrals; distance between anterior and posterior dorsocentrals 0.7 the distance between two anterior dorsocentrals. Basal scutellar setae parallel; apical scutellars convergent, directed upward. Anepisternum with a brown stripe. Katepisternum

brown, with 2 katepisternal setae. Legs yellow, distal portion of femora somewhat darker, more dark at middle, mid coxa dark brown. Apical seta on fore and mid tibiae; preapical seta on all three tibiae. Wings (Fig. 1E) slender, with two large faint patches. Average wing vein indices: C-index 1.5; 4V-index 2.1; 4C-index 1.45; 5X-index 2.3. C_3 fringe 0.5. Halter stem little darker, knob whitish yellow.

Abdomen (Fig. 1C): First tergite yellowish, the remaining tergites uniformly brown in male; in female last three tergites enclosing yellowish small area laterally.

Periphallic organs (Fig. 1A): Epandrium dark brown, ventrally forming a small narrow process bearing 2 unequal setae, upper portion with 4 large setae. Cercus separated from epandrium, highly sclerotised ventrally and with a darker plate having 5 large setae and caudoventrally with a finger-like process. Surstylus elongate and curved, narrowing ventrally, upper portion with 3 small setae, lower portion with stout black prensisetae arranged in two sets of upper 3-4 and lower 11-12, and a few fine setae and microtrichiae.

Phallic organs (Fig. 1B): Aedeagus broadened distally, basal apodeme nearly as long as aedeagus. Hypandrium with a pair of paramedian spines; hypandrial apodeme triangular.

Oviscapt (Fig. 1D): Yellowish, medially swollen, apically narrow and terminating into a large peg and with about 3 marginal and one small lateral ovisensilla, and with 3-4 subapical trichoid ovisensilla.

Holotype: Male, BHUTAN: Phuntsholing, 22.X.1993, Coll. A. De & J. P. Gupta. Deposited in the Department of Zoology, Banaras Hindu University, Varanasi, India. *Paratypes:* 8M, 17F, same locality and collectors as holotype. In the Department of Zoology, B.H.U., Varanasi, India.

Relationships: This species closely resembles *M. asiatica* (Okada, 1964) in general morphology, but clearly differs from it in having head without much lateral prolongation (head extremely broadened in male *asiatica*), anterior dorsocentrals smaller than posterior dorsocentrals (equal in *asiatica*), and oviscapt with 3 marginal ovisensilla (large number of ovisensilla in *asiatica*).

Etymology: Named after its detritus feeding habit.

Distribution: Bhutan.

2. *Mulgravea bhutanica*, sp. nov. (Figs. 1, F-I)

Diagnosis: Arista branches 6/3 besides terminal bifurcation; antenna with pedicel and first flagellomere yellow; 5X-index 2.65; Katepisternum brown, anepisternum with a ventral brown stripe; abdominal tergites 2-4 completely brown; epandrium ventrally narrowing into a small process bearing 2 unequal setae; surstylus with two sets of prensisetae, upper one with 6 and lower with 10.

Description: Male: Average body length 1.6- 1.7 mm.

Head: Arista with 6 dorsal and 3 ventral branches in addition to small terminal bifurcation. Antenna with pedicel and first flagellomere yellow. Frons including ocellar triangle glossy brownish black. Facial carina vestigial, brownish black. Clypeus brown, Vibrissa and subvibrissal seta nearly equal. Palpus brown, with single apical seta. Gena black; greatest width of gena 0.16 the greatest diameter of eye. Eyes dark red. Anterior reclinate orbital obscure; Length ratio between proclinate and posterior reclinate orbitals 5:4.

Thorax: Acrostichal setulae in traces of 2 rows. scutum yellow, with two large black spots above wing articulation. Scutellum yellow, with two small marginal brown spots laterally. Anterior dorsocentral setae smaller than posterior dorsocentrals; distance between anterior and posterior dorsocentrals 0.5 the distance between two anterior dorsocentrals. Basal scutellar setae nearly parallel; apical scutellars convergent and somewhat directed upward. Anepisternum with a narrow brown stripe ventrally. Katepisternum dark brown, with two katepisternal setae. Legs yellow, distal portion of mid and hind femora little darker, mid coxa dark brown. Apical seta on fore and mid tibiae, preapical seta on all three tibiae. Wings (Fig. 1I) slender, with two faint large brownish patches. Approximate wing vein indices: C-index 1.6; 4V-index 2.0; 4C-index 1.4; 5X-index 2.65. C_3 fringe 0.6. Halter yellow, stem and knob with dark dorsal surface.

Abdomen (Fig. 1H): First tergite yellowish, 2-4 tergites completely brown, 5th tergite with narrow sublaterally interrupted apical dark band, 6th tergite completely yellow and the terminal tergite with a median dark brown spot.

Periphallic organs (Fig. 1F): Epandrium dark brown, ventrally narrowing into a small process bearing 2 unequal setae, upper portion with 4 large setae. Cercus separated from epandrium, lower portion more sclerotised, ventrally with a darker plate bearing 3 large and 4- 5 small marginal setae and a finger-like process, upper portion with about 8 setae. Surstylus elongate and curved, narrowing ventrally, with stout black prensisetae in two sets, upper one with 6 and lower with about 10 and a few fine setae.

Phallic organs (Fig. 1G): Aedeagus pale yellow, swollen apically; basal apodeme little longer than aedeagus. Hypandrium with a pair of paramedian spines; hypandrial apodeme triangular.

Holotype: Male, BHUTAN: Phuntsholing, 22.X.1993, Coll. A. De & J. P. Gupta. Deposited in the Department of Zoology, Benaras Hindu University, Varanasi, India. *Paratypes:* 4M, same locality and collectors as holotype. In the Department of Zoology, B.H.U., Varanasi, India.

Relationships: This species somewhat resembles *M. neoasiatica* (Takada & Momma, 1975) in general morphology of male terminalia, but distinctly differs from it in having epandrium narrowing into a small process (epandrium truncated ventrally in *neoasiatica*), surstylus with two sets of

prensisetae (3 sets of prensisetae in *neoasiatica*), first flagellomere yellow (black in *neoasiatica*), and katepisternum dark brown (small black spot in *neoasiatica*).

Etymology: Named after the country.

Distribution: Bhutan.

3. *Mulgravea peniglobosa*, sp. nov. (Figs. 2, A-E)

Diagnosis: Arista branches 7-8/4 besides terminal bifurcation; antenna with pedicel yellow, first flagellomere brown basally, yellowish apically; C-index 1.85; katepisternum shining yellow; abdominal tergites 1-3 completely brown; ventral finger-like process of cercus with 3 small setae; surstylus with two sets of prensisetae, upper one with 2-3 and lower with 9-10.

Description: Male and female: Average body length: male 1.6-1.7 mm; female 1.8-2.0 mm.

Head: Arista with 7-8 dorsal and 4 ventral branches in addition to small terminal bifurcation. Antenna with pedicel shining yellow, first flagellomere brown basally, yellowish apically. Frons including the ocellar triangle glossy black. Facial carina yellow, vestigial. Clypeus brown. Vibrissa and subvibrissal seta equally large. Gena black, glossy; greatest width of gena 0.2 the greatest diameter of eye. Eyes dark red. Anterior reclinate orbital obscure; length ratio between proclinate and posterior reclinate orbitals 5:4.

Thorax: Acrostichal setulae in traces of 2 rows. Scutum shining yellow, with two large black spots above wing articulation. Scutellum yellow, with two black marginal spots laterally. Anterior dorsocentral setae smaller than posterior; distance between anterior and posterior dorsocentral setae 0.33 the distance between two anterior dorsocentrals. Basal scutellars nearly parallel; apical scutellars convergent and directed gently upward. Katepisternum shining yellow, with two katepisternal setae. Legs yellow, fore femora with black ring at middle, mid coxa dark brown. Apical seta on fore and mid tibiae; preapical seta on all three tibiae. Wings (Fig. 2D) slender, with two large dark patches, one in anterior and another in posterior halves. Approximate wing vein indices: C-index 1.85; 4V-index 2.2; 4C-index 1.4; 5X-index 3.5. C_3 fringe 0.5. Halter stem and knob brown dorsally.

Abdomen (Fig. 2E): 1-3 tergites brown, the remaining tergites enclosing yellow area laterally.

Periphallic organs (Fig. 2A): Epandrium dark brown, broader at upper end, ventrally with a small process bearing two unequal setae, and with 6-7 scattered large setae on upper portion. Cercus separated from epandrium, lower portion highly sclerotised, ventrally with a large dark quadrate plate bearing 5 marginal setae and a finger-like process bearing 3 small setae, upper portion with 7 setae. Surstylus elongate and curved, narrowing ventrally, with prensisetae in two sets, upper one with 2-3 and lower with 9-10 and with 4-5 large setae and 4 microtrichiae.

Phallic organs (Fig. 2B): Aedeagus pale yellow, globular apically; basal apodeme nearly as long as aedeagus. Hypandrium with a pair of paramedian spines. Hypandrial apodeme triangular.

Oviscapt (Fig. 2C): Yellowish, fusiform, terminating into large peg, with 5 upper marginal small setae and 5 marginal ovisensilla besides 2 lateral ovisensilla.

Holotype: Male, BHUTAN: Phuntsholing, 25.X.1993, Coll. A. De and J. P. Gupta. Deposited in the Department of Zoology, Banaras Hindu University, Varanasi, India. *Paratypes:* 13 M, 10F, same locality and collectors as holotype. In the Department of Zoology, B.H.U., Varanasi, India.

Relationship: This species superficially resembles *M. minima* Bock (1982), but differs from it in having shining yellow katepisternum (dark brown in *minima*), C-index 1.8 (2.4 in *minima*), anterior dosocentrals smaller than posterior dorsocentrals (anterior dorsocentrals larger than posterior dorsocentrals in *minima*), surstylus with two sets of prensisetae (single row of small black prensisetae in *minima*) and in the abdominal colour pattern.

Etymology: Based on its globular shape of aedeagus.

Distribution: Bhutan.

4. *Mulgravea spinisterna*, sp. nov. (Figs. 2, F-I)

Diagnosis: Arista branches 8-9/3 besides terminal bifurcation; antenna with pedicel yellow, first flagellomere dark brown; C-index 1.5; katepisternum dark brown, anepisternum with a ventral brown stripe; abdominal tergites 2-4 completely brown; abdominal sternites with spine-like large setae; aedeagus expanded distally; surstylus with a single row of 19-20 small prensisetae.

Description: Male: Average body length 1.65 mm.

Head: Arista with 8-9 dorsal and 3 ventral branches in addition to a small terminal bifurcation. Antenna with pedicel yellow; first flagellomere dark brown. Frons glossy brownish black. Facial carina yellowish, vestigial. Clypeus brown. Vibrissa and subvibrissal seta nearly equal. Palpus dark brown, with single apical seta. Gena black; greatest width of gena 0.2 the greatest diameter of eye. Eyes dark red. Length ratio between proclinate and posterior reclinate orbitals 5:4.

Thorax: Acrostichal setulae in traces of two rows. Scutum yellow with two large black spots above wing articulation. Scutellum yellowish, with marginal black spots laterally. Distance between anterior and posterior dorsocentral setae 0.4 the distance between two anterior dorsocentrals. Basal scutellar setae nearly parallel; apical scutellars convergent and directed upward. Katepisternum dark brown, with two katepisternal setae. Legs yellow, distal portion of mid and hind femora little dusky, mid coxa dark brown. Apical seta on fore and mid tibiae; preapical seta on all three tibiae. Wings (Fig. 2I) slender, with two faint large patches. Approximate wing vein indi-

ces: C-index 1.5; 4V-index 2.0; 4C-index 1.4; 5X-index 3.5. C_3 fringe 0.7. Halter yellow, stem and knob brownish dorsally.

Abdomen (Fig. 2H): First tergite yellowish, 2-4 tergites completely brown, 5th tergite brownish medially, 6th tergite completely yellow and terminal tergite dorsally black.

Periphallic organs (Fig. 2F): Epandrium dark brown, broadened dorsally and narrowing ventrally, with 6 upper large setae and 2 lower unequal setae. Cercus separated from epandrium, upper portion with 10-12 setae, lower portion with a highly sclerotised ventral plate, with 7-8 small setae and with a finger-like process. Surstylus elongate, narrow and curved, with 19-20 small stout prensisetae arranged in a row, 4 relatively larger additional prensisetae at middle and 5 long setae.

Phallic organs (Fig. 2G): Aedeagus expanded distally, basal apodeme smaller than aedeagus. Hypandrium with a pair of short paramedian spines; hypandrial apodeme broader than long.

Holotype: Male, Bhutan: Phuntsholing, 26.X.1993, Coll. A. De and J. P. Gupta. Deposited in the Department of Zoology, Banaras Hindu University, Varanasi, India. *Paratypes:* 1M, same locality and collectors as holotype. In the Department of Zoology, B.H.U., Varanasi, India.

Relationships: This species closely resembles *M. parasiatica* (Takada & Momma, 1975) in general morphology but clearly differs from it in having surstylus with 19-20 small stout prensisetae arranged in a single row (about 8 small stout prensisetae in *parasiatica*), anterior dorsocentrals smaller than posterior dorsocentrals (equal in *parasiatica*), hypandrial apodeme somewhat triangular basally (basally rounded in *parasiatica*), and by the marked variation in the shape of aedeagus.

Etymology: Named because of the presence of spine-like large setae on sternites.

Distribution: Bhutan.

5. *Mulgravea asiatica* (Okada)

Lissocephala asiatica Okada, 1964, Kontyu, 32: 106.
Zygothrica asiatica: Okada; 1965, Kontyu, 33: 337.
Thyreocephala asiatica: Okada, 1985, Kontyu, 53: 339.
Mulgravea asiatica: Okada, 1987, Kontyu, 55: 187.

General morphology and female terminalia as figured and described by Okada (1964); male terminalia described by Okada (1965) .

Distribution: Japan (Amami Is., Ryukyus), Myanmar (= Burma), Taiwan, Malaysia, Indonesia, Sri Lanka.

6. *Mulgravea neoasiatica* (Takada & Momma)

Lissocephala neoasiatica Takada & Momma, 1975. J. Fac. Sci. Hokkaido Univ., (VI) 20 (1): 26.
Thyreocephala neoasiatica: Okada, 1985. Kontyu, 53: 339.
Mulgravea neoasiatica: Okada, 1987. Kontyu, 55: 187.

General morphology and terminalia as figured and described by Takada & Momma (1975).

Distribution: Malaysia.

7. *Mulgravea parasiatica* (Takada & Momma)

Lissocephala parasiatica Takada & Momma, 1975. J. Fac. Sci. Hokkaido Univ., (VI) 20: 24.
Thyreocephala parasiatica: Okada, 1985. Kontyu, 53: 339.
Mulgravea parasiatica: Okada, 1987. Kontyu, 55: 187.

General morphology and terminalia as figured and described by Takada & Momma (1975).

Distribution: Malaysia.

8. *Mulgravea indersinghi* (Takada & Momma)

Lissocephala indersinghi Takada & Momma, 1975. J. Fac. Sci. Hokkaido Univ., (VI) 20: 24.
Thyreocephala indersinghi Okada, 1985. Kontyu, 53: 339.
Mulgravea indersinghi Okada, 1987, Kontyu, 55: 187.

General morphology and terminalia as figured and described by Takada & Momma (1975).

Distribution: Malaysia.

9. *Mulgravea corpusculata* (Takada & Momma)

Lissocephala corpusculata Takada & Momma, 1975. J. Fac. Sci. Hokkaido Univ., (VI) 20: 26.
Thyreocephala corpusculata: Okada, 1985. Kontyu, 53: 339.
Mulgravea corpusculata: Okada, 1987. Kontyu, 55: 187.

General morphology and terminalia as figured and described by Takada & Momma (1975).

Distribution: Malaysia.

10. *Mulgravea minima* Bock

Mulgravea minima Bock, 1982. Australian J. Zool., Suppl., 89: 122.
Thyreocephala bimaculata Okada, 1985. Kontyu, 53: 339.

General morphology and terminalia as figured and described by Bock (1982).

Distribution: Australia (Queensland), Papua New Guinea.

11. *Mulgravea trimaculata* (Okada)

Thyreocephala trimaculata Okada, 1985. Kontyu, 53: 340.
Mulgravea trimaculata: Okada, 1987. Kontyu, 55: 187.

General morphology and terminalia as figured and described by Okada (1985).

Distribution: Papua New Guinea.

12. *Mulgravea viridifrons* (Okada)

Thyreocephala viridifrons Okada, 1985. Kontyu, 53: 341.
Mulgravea viridifrons: Okada, 1987. Kontyu, 55: 187.

General morphology and terminalia as figured and described by Okada (1985).

Distribution: Malaysia.

13. *Mulgravea vittata* Okada

Mulgravea vittata Okada, 1988. Ent. Scand. Suppl., 30: 128.

General morphology and terminalia as figured and described by Okada (1988).

Distribution: Sri Lanka.

14. *Mulgravea ranipoolensis* Kumar & Gupta

Mulgravea ranipoolensis Kumar & Gupta, 1992. Senckenbergiana Biol., 72: 45.

General morphology and terminalia as figured and described by Kumar & Gupta (1992).

Distribution: India.

Acknowledgments

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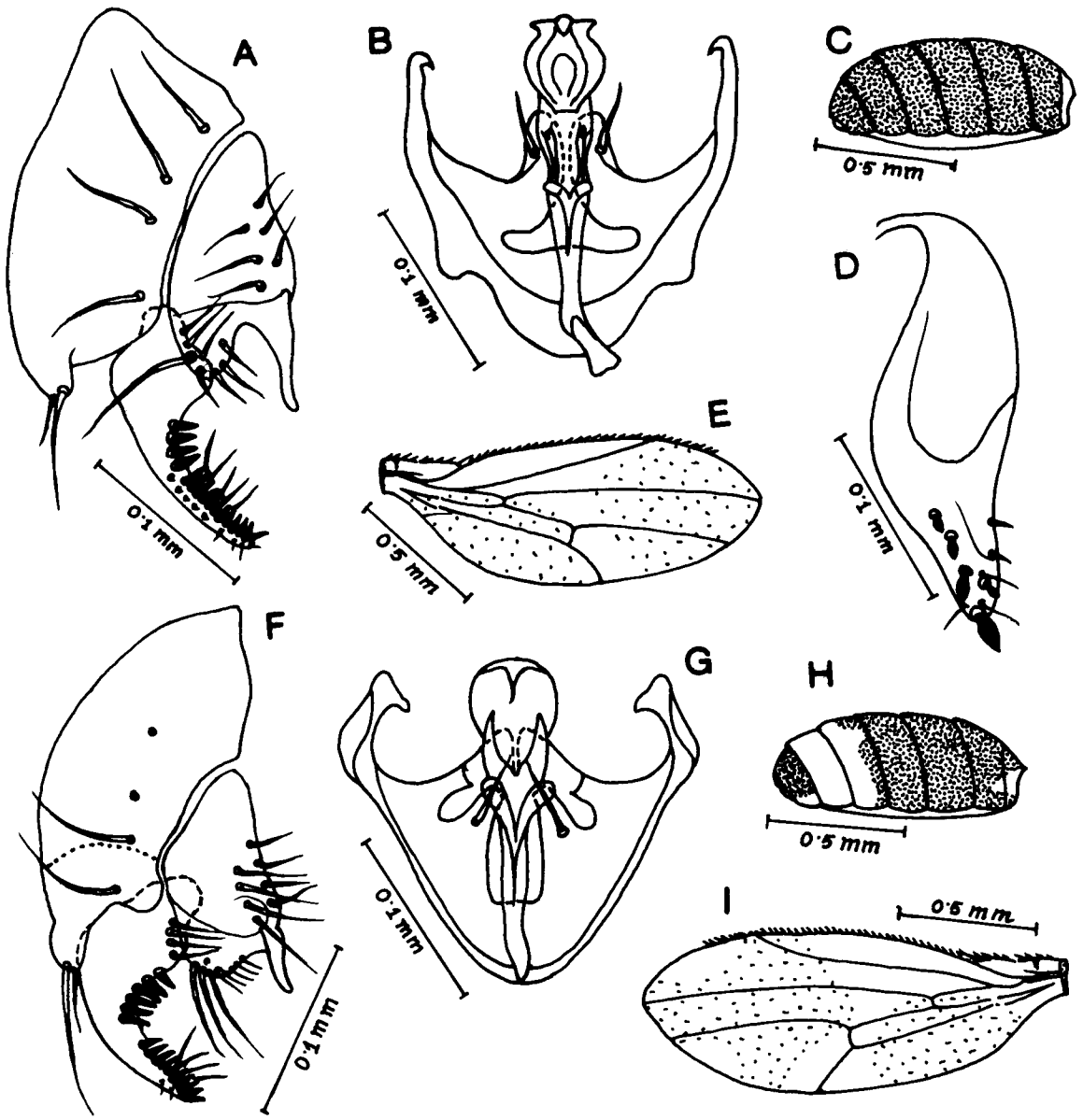
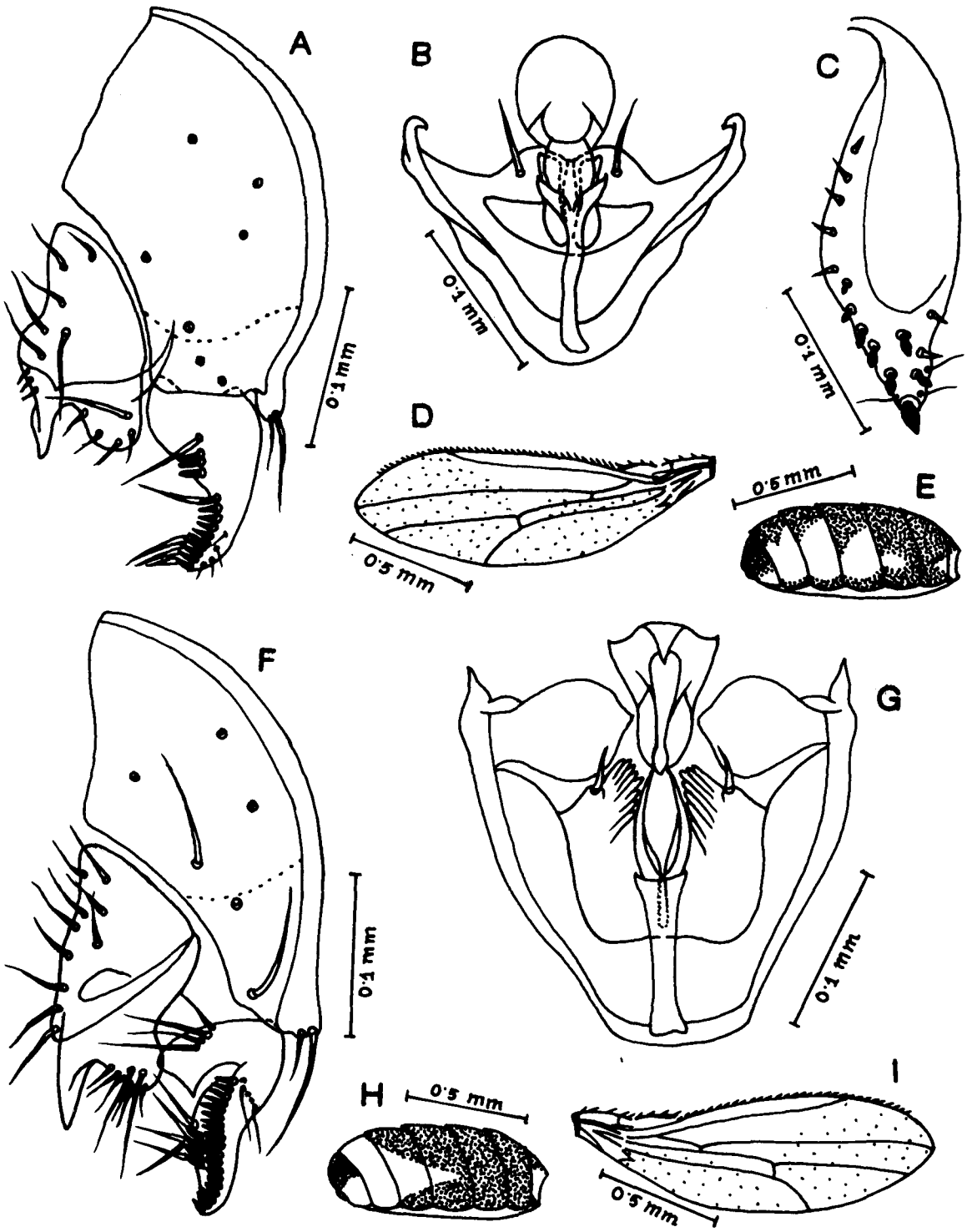


Figs. 1 A-E. *Mulgravea detriculata,* sp. nov.: A, periphallic organs; B, phallic organs; C, male abdomen; D, oviscapt; E, male wing.

Figs. 1 F-I. *Mulgravea bhutanica,* sp. nov.: F, periphallic organs; G, phallic organs; H, male abdomen; I, male wing.



Figs. 2 A-E. *Mulgravea peniglobosa,* sp. nov.: A, periphallic organs; B, phallic organs; C, oviscapt; D, male wing; E, male abdomen.

Figs. 2 F-I. *Mulgravea spinisterna,* sp. nov.: F, periphallic organs; G, phallic organs; H, male abdomen; I, male wing.