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## Two new species of *Simulium* (*Gomphostilbia*) (Diptera: Simuliidae) from Peninsular India with keys to Peninsular Indian members of the genus *Simulium*

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### Abstract

Two new species of black flies, *Simulium* (*Gomphostilbia*) *peteri* sp. nov. and *S. (G.) takaokai* sp. nov., are described on the basis of reared adult, pupal and larval specimens collected from Peninsular India. These two new species are placed in the *batoense* species group within the subgenus *Gomphostilbia*. *S. (G.) peteri* sp. nov. is distinguished in the female by having a medium-sized round opening of the sensory vesicle and a large basal tooth on the claw, in the male by 12 vertical columns in the upper eye large facets, in the pupa by a ventral pair of 2 gill filaments somewhat thicker than the other filaments and in the larva by 5 hypostomal bristles per side lying parallel to the lateral margin. *S. (G.) takaokai* sp. nov. is characterized in the pupa by having the eight gill filaments with a medium-long common basal stalk and in the larva by the labral fan with 38 main rays and 4 hypostomal bristles on each side. Keys to 13 black fly species reported from Peninsular India are provided for females, males and pupae.

**Key words:** *Simulium*, Diptera, Simuliidae

### Introduction

Next to the mosquitoes, black flies (Simuliidae) receive major focus due to their wide distribution and potential as vectors in transmitting agents of lethal diseases. Many species of female black flies are haematophagous and are central to the transmission of the parasitic nematode *Onchocerca volvulus*, the causative organism of human onchocerciasis (river blindness), in tropical Africa, Central America, South America and Yemen where 30 million people are infected. Larval black flies constitute a vital component of aquatic habitats, which can be employed as bioindicators for the quality of these habitats because of their high sensitivity to environmental degradation (Harwood & James, 1979). Scientists debate whether global warming will lead to distribution extensions, increase in abundance and further spread of vector species and the disease agents they transmit (Githeko et al., 2000; Brower, 2001). Hence there is a need to analyze the taxonomy, ecology and molecular biology of black flies at a global level.

The total number of 2,163 black fly species (2,151 living and 12 fossils) belong to 26 genera and 37 subgenera of the family Simuliidae (Adler & Crosskey, 2014). Among them, 10 subgenera (*Asiosimulium* Takaoka & Choochote, *Byssodon* Enderlein, *Daviesellum* Takaoka & Adler, *Eusimulium* Roubaud, *Gomphostilbia* Enderlein, *Montisimulium* Rubtsov, *Nevermannia* Enderlein, *Simulium* Latreille s. str., *Wallacellum* Takaoka, and *Wilhelmia* Enderlein) have been reported from the Oriental Region. Seven of nine species-groups of *Gomphostilbia*, three of five species-groups of *Nevermannia* and 10 of 24 species-groups of *Simulium* s. str., are present in the Oriental Region (Takaoka, 2012). In India, black flies are grouped under 59 named and 13 unnamed species in seven subgenera: 2 species of *Eusimulium* Roubaud, 10 species (8 named and 2 unnamed) of *Gomphostilbia* Enderlein, 4 species of *Montisimulium* Rubstov (2 named and 2 unnamed), 10 species (8 named and 2 unnamed) of *Nevermannia* Enderlein, 44 species (37 named and 7 unnamed) of *Simulium* Latreille and 1 species of *Wilhelmia* Enderlein (Adler & Crosskey, 2014). Ten species of *Gomphostilbia* have been reported: *S. (G.) fidum* and *S. (G.)*

9. Ventral plate without teeth on posterolateral margins ..... *S. (S.) gravelyi*  
 - Ventral plate with teeth on posterolateral margins ..... 10  
 10. Mid tibia brownish black ..... *S. (S.) nilgiricum*  
 - Mid tibia yellowish gray, gradually darkened apically ..... *S. (S.) gurneyae*  
 11. Ventral plate with teeth on posterolateral margins ..... *S. (S.) palniense*  
 - Ventral plate without teeth on posterolateral margins ..... 12  
 12. Hind femur yellowish gray on basal 1/3, gradually becoming darker apically ..... *S. (S.) striatum*  
 - Hind femur black, with base yellow ..... *S. (S.) grisescens*

## Pupae

1. Grapnel-like hooklets present on the last abdominal segment (*Gomphostilbia*) ..... 2  
 - Grapnel-like hooklets absent on the last abdominal segment ..... 4  
 2. Gill with medium-long common basal stalk ..... *S. (G.) takaokai* **sp. nov.**  
 - Gill with short common basal stalk ..... 3  
 3. Gill with eight filaments of almost same thickness ..... *S. (G.) pattoni*  
 - Gill with eight filaments, of which 2 filaments of ventral pair somewhat thicker than others ..... *S. (G.) peteri* **sp. nov.**  
 4. Cocoon with anterodorsal projection (*Nevermannia*) ..... *S. (N.) aureohirtum*  
 - Cocoon without anterodorsal projection (*Simulium* s. str.) ..... 5  
 5. Gill with 3 inflated filaments ..... *S. (S.) nodosum*  
 - Gill with 6, 8 or 10 slender filaments ..... 6  
 6. Gill with 6 filaments ..... 7  
 - Gill with 8 or 10 filaments ..... 10  
 7. Cocoon wall-pocket-shaped ..... 8  
 - Cocoon shoe-shaped ..... 9  
 8. Two filaments of ventral pair much thinner than those of middle pair; cocoon with anterodorsal margin not produced anteriorly beyond apex of ventrolateral margin ..... *S. (S.) gurneyae*  
 - Two filaments of ventral pair as thick as those of middle pair; cocoon with anterodorsal margin much produced anteriorly beyond apex of ventrolateral margin ..... *S. (S.) nilgiricum*  
 9. Dorsal surface of abdominal segment 7 with spine-combs ..... *S. (S.) palniense*  
 - Dorsal surface of abdominal segment 7 without spine-comb ..... *S. (S.) gravelyi*  
 10. Gill with 8 filaments; cocoon with anterolateral window on each side ..... *S. (S.) novolineatum*  
 - Gill with 10 filaments; cocoon shoe-shaped ..... 11  
 11. Cocoon loosely and elaborately woven, comparatively more so near anterior end where large interspaces between strands are formed in a pretty pattern ..... *S. (S.) lineothorax* & *S. (S.) striatum*  
 - Cocoon not elaborately woven, with anterior end having a few irregular interspaces in web ..... *S. (S.) grisescens*

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## References

- Adler, P.H. & Crosskey, R.W. (2014) *World blackflies (Diptera: Simuliidae): a comprehensive revision of the taxonomic and geographical inventory [2014]*. Available from: <http://www.clemson.edu/cafls/biomia/pdfs/blackflyinventory.pdf> (accessed 5 September 2014)
- Adler, P.H., Currie, D.C. & Wood, D.M. (2004) *The Black Flies (Simuliidae) of North America*. Cornell University Press, Ithaca, New York, USA, xv + 941 pp.
- Anbalagan, S., Dinakaran, S. & Krishnan, M. (2010) Redescription of *Simulium palniense* Puri, 1933 (Diptera: Simuliidae) from the Palni hills of South India. *Journal of Entomological Research*, 34 (2), 171–174.
- Anbalagan, S., Dinakaran, S. & Krishnan, M. (2011) *Black flies of India: with a special aspect of onchocerciasis*. APH Publishing Corporation, New Delhi, India, 167 pp.
- Brower, V. (2001) Report Vector-borne diseases and global warming: are both on an upward swing. *European Molecular Biology Organization Journal*, 21, 755–757.
- Choochote, W., Takaoka, H., Fukuda, M., Otsuka, Y., Aoki, C. & Eshima, N. (2005) Seasonal abundance and daily flying

- activity of black flies (Diptera: Simuliidae) attracted to human baits in Doi Inthanon National Park, northern Thailand. *Medical Entomology and Zoology*, 56, 335–348.
- Datta, M. (1992) An overview of the Simuliidae (Diptera) of West Bengal, India. *Journal of Bengal Natural History Society, New Series*, 11, 41–62.
- Githeko, A.K., Lindsay, S.W., Confalonieri, U.E. & Patz, J.A. (2000) Climate change and vector-borne diseases: a regional analysis. *Bulletin of the World Health Organization*, 78, 1136–1147.
- Harwood, R.F. & James, M.T. (1979) *Entomology in Human and Animal Health. 7th Edition*. Macmillan Publications Company, New York, 548 pp.
- Ishii, Y., Choochote, W., Bain, O., Fukuda, M., Otsuka, Y. & Takaoka, H. (2008) Seasonal and diurnal biting activities and zoonotic filarial infections of two *Simulium* species (Diptera: Simuliidae) in northern Thailand. *Parasite*, 15, 121–129. <http://dx.doi.org/10.1051/parasite/2008152121>
- Takaoka, H. (2012) Morphotaxonomic revision of *Simulium* (*Gomphostilbia*) (Diptera: Simuliidae) in the Oriental Region. *Zootaxa*, 3577, 1–42.