



<http://dx.doi.org/10.11646/zootaxa.3750.5.9>

<http://zoobank.org/urn:lsid:zoobank.org:pub:EC9A05CD-5A99-43B9-9EF5-49DD43C66B84>

The genus *Leucophenga* (Diptera, Drosophilidae), part III: the *interrupta* species group from the Oriental region, with morphological and molecular evidence

JIA HUANG¹, TONG LI² & HONGWEI CHEN^{1,3}

¹Department of Entomology, South China Agricultural University, Wushan-lu 483, Tianhe, Guangzhou 510642, China

²Institute of Plant Protection, Henan Academy of Agricultural Science, Zhengzhou, 450002, China

³Corresponding author. E-mail: hongweic@scau.edu.cn

Abstract

A new species group, the *interrupta* group, is established within the genus *Leucophenga* based on two known and three new species, all of which are endemic to the Oriental region: *L. interrupta* Duda, 1924, *L. neointerrupta* Fartyal & Toda, 2005, *L. bifurcata* sp. nov., *L. quadrifurcata* sp. nov. and *L. retifoliacea* sp. nov. A key to the five species of the *interrupta* group is provided. Sixteen mtDNA *COI* sequences of the five species are analyzed; the molecular data are used as complementary evidence for the species boundaries defined by the morphological data.

Key words: DNA barcoding, *Leucophenga interrupta* species group, new species, Oriental region

Introduction

Leucophenga interrupta Duda, 1924 and *L. neointerrupta* Fartyal & Toda, 2005 have been reported from the Oriental region and assigned to the *L. ornata* species group (Okada 1990; Fartyal *et al.* 2005; Bächli 2013); however, they distinctly differ from the other species of the *ornata* group in having the wing usually clear on r–m and dm–cu crossveins and with broad, dark longitudinal stripe along anterodistal portion, and the aedeagus with strong processes basolaterally.

In the present study, three new species from Yunnan, China are described; they are morphologically similar to *L. interrupta* and *L. neointerrupta* in the wing color pattern and/or the aedeagus with basolateral processes. Thus, a new species group, namely the *interrupta* group, is established here, based on two known and three new species. One Afrotropical species, *Leucophenga denigrata* Bächli, 1971, shares the wing with broad, dark longitudinal stripe along anterodistal portion (fig. 38f in Bächli 1971), but its male terminalia has not been described. We provisionally refrain from assigning this Afrotropical species to the *interrupta* group to avoid further confusion. We analyze sixteen *COI* barcode sequences of the two known and three new species in order to evaluate morphological delimitation for these species.

Material and methods

Material and morphological terminology. All specimens examined were collected by sweeping on tussocks and tree trunks along streams in forest. The type specimens are deposited in Department of Entomology, South China Agricultural University, Guangzhou, China (SCAU). We followed Zhang & Toda (1992) and Chen & Toda (2001) for the definitions of measurements, indices and abbreviations, and Chen & Toda (1994) for the interpretation of the homology on the phallic organs in the genus *Leucophenga*.

Phylogenetic analyses. DNA extraction, gene amplification, sequencing and sequence alignment were made by the same methods as in Huang *et al.* (2013). A NJ (neighbor-joining) tree was constructed in MEGA 5 with K-2P distances, and a Bayesian tree was constructed in MrBayes 3.1.2 (Huelsenbeck & Ronquist 2001; Ronquist &

References

- Bächli, G. (1971) *Leucophenga* und *Paraleucophenga* (Diptera: Brachycera) Fam. Drosophilidae. *Exploration du Parc National de l'Upemba*, Fascicule 71, 1–192+38 plates, Bruxelles.
- Bächli, G. (2013) The database on Taxonomy of Drosophilidae. Available from: <http://taxodros.uzh.ch/> (accessed 20 November 2013)
- Bächli, G., Vilela, C. R., Andersson, S. & Saura, A. (2004) *The Drosophilidae (Diptera) of Fennoscandia and Denmark*. In: *Fauna Entomologica Scandinavica*. Vol. 39. Brill, Leiden, New York, pp. 362.
- Chen, H.W. & Aotsuka, T. (2003) A survey of the genus *Leucophenga* in Iriomote-jima of Japan (Diptera: Drosophilidae), with descriptions of three new species. *Canadian Entomologist*, 135, 143–158.
<http://dx.doi.org/10.4039/n02-054>
- Chen, H.W. & Toda, M.J. (2001) A revision of the Asian and European species in the subgenus *Amiota* Loew (Diptera, Drosophilidae) and establishment of species-groups based on phylogenetic analysis. *Journal of Natural History*, 35, 1517–1563.
<http://dx.doi.org/10.1080/002229301317067665>
- Chen, H.Z. & Toda, M.J. (1994) Six new species of the Drosophilidae (Diptera) from Eastern China. *Japan Journal of Entomology*, 62, 537–554.
- Duda, O. (1924) Beitrag zur Systematik der Drosophiliden unter besonderer Berücksichtigung der paläarktischen und orientalischen Arten (Dipteren). *Archiv Mecklenburgischer Naturforscher*, 90A, 172–234.
- Fartyal, R.S., Singh, B.K. & Toda, M.J. (2005) Review of the genus *Leucophenga* Mik (Diptera: Drosophilidae) in India, with descriptions of five new species from northern India. *Entomological Science*, 8, 405–417.
<http://dx.doi.org/10.1111/j.1479-8298.2005.00140.x>
- Guindon, S. & Gascuel, O. (2003) A simple, fast, and accurate algorithm to estimate large phylogenies by maximum likelihood. *Systematic Biology*, 52, 696–704.
- Huang, J., Li, T., Gao, J.J. & Chen, H.W. (2013) The genus *Leucophenga* (Diptera, Drosophilidae), part II: the *ornata* species group from the Oriental region with morphological and molecular evidence (I). *Zootaxa*, 3701 (2), 101–147.
<http://dx.doi.org/10.11646/zootaxa.3701.2.1>
- Huelsenbeck, J.P. & Ronquist, F. (2001) MRBAYES: Bayesian inference of phylogenetic trees. *Bioinformatics*, 17, 754–755.
<http://dx.doi.org/10.1093/bioinformatics/17.8.754>
- Li, T., Gao, J.J., Lu, J.M., Ji, X.L. & Chen, H.W. (2013) Phylogenetic relationship among East Asian species of the *Stegana* genus group (Diptera: Drosophilidae). *Molecular Phylogenetics and Evolution*, 66 (1), 412–416.
<http://dx.doi.org/10.1016/j.ympev.2012.09.004>
- Okada, T. (1956) *Systematic Study of Drosophilidae and allied families of Japan*. 1–183. Gihodo Co. Ltd., Tokyo.
- Okada, H. (1968) Addition to the fauna of the family Drosophilidae of Japan and adjacent countries (Diptera: Drosophilidae). *Kontyû, Tokyo*, 36, 303–323.
- Okada, H. (1990) A revision of the *Leucophenga ornata* species-group (Diptera: Drosophilidae) of the Oriental and adjacent regions. *Japan Journal of Entomology*, 58, 679–688.
- Posada, D. (2008) jModelTest: phylogenetic model averaging. *Molecular Biology Evolution*, 25, 1253–1256.
<http://dx.doi.org/10.1093/molbev/msn083>
- Ronquist, F. & Huelsenbeck, J.P. (2003) MrBayes 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics*, 19, 1572–1574.
<http://dx.doi.org/10.1093/bioinformatics/btg180>
- Su, Y.R., Lu, J.M. & Chen, H.W. (2013) The genus *Leucophenga* (Diptera, Drosophilidae), part I: the *abbreviata* species group from the Oriental region with morphological and molecular evidence. *Zootaxa*, 3637 (3), 361–373.
<http://dx.doi.org/10.11646/zootaxa.3637.3.8>
- Tamura, K., Peterson, D., Peterson, N., Stecher, G., Nei, M. & Kumar, S. (2011) MEGA5: molecular evolutionary genetics analysis using maximum likelihood, evolutionary distance, and maximum parsimony methods. *Molecular Biology and Evolution*, 28, 2731–2739.
<http://dx.doi.org/10.1093/molbev/msr121>
- Zhang, W.X. & Toda, M.J. (1992) A new species-subgroup of the *Drosophila immigrans* species-group (Diptera, Drosophilidae), with description of two new species from China and revision of taxonomic terminology. *Japanese Journal of Entomology*, 60, 839–850.