The Description and Bionomics of *Tropidea cole blepharoneurae*
Buffington and Condon, New Species (Hymenoptera: Figitidae: Zaeucoilini), Parasitoid of *Blepharoneura* Loew Fruit Flies (Tephritidae)

Author(s): Matthew L. Buffington and Marty Condon
Published By: Entomological Society of Washington
DOI: [http://dx.doi.org/10.4289/0013-8797.115.4.349](http://dx.doi.org/10.4289/0013-8797.115.4.349)
THE DESCRIPTION AND BIONOMICS OF TROPIDEUCOILA BLEPHARONEURAE BUFFINGTON AND CONDON, NEW SPECIES (HYMENOPTERA: FIGITIDAE: ZAEUCOILINI), PARASITOID OF BLEPHARONEURA LOEW FRUIT FLIES (TEPHRITIDAE)

MATTHEW L. BUFFINGTON AND MARTY CONDON

(MLB) Systematic Entomology Lab, USDA, c/o Smithsonian NMNH, 10th & Constitution Ave NW, Washington DC 20013, USA. (e-mail: matt.buffington@ars.usda.gov); (MC) Department of Biology, Cornell College, 600 First Street West, Mount Vernon, Iowa 52314-1098, U.S.A. (e-mail: Mcondon@cornellcollege.edu)

Abstract.—Tropideucoila blepharoneurae, a new species of Zaeucoilini, is described from Peru. Specimens were reared from numerous species of the tephritid genus Blepharoneura feeding on species of Gurania (Cucurbitaceae). Prior to the discovery of this species, it was hypothesized that species of Tropideucoila were restricted to Agromyzidae hosts; this new species is remarkable for its host association with Tephritidae. To support the inclusion of this new species in Tropideucoila, we performed a total evidence phylogenetic reconstruction of the Zaeucoilini; this new species was recovered (with strong branch support) within Tropideucoila.

Key Words: Peru, Gurania acuminata, Gurania spinulosus, Gurania lobata, host plant, parasitoid, phylogeny

DOI: 10.4289/0013-8797.115.4.349

Tropideucoila was established by Ashmead (1903), based on the type species T. rufipes Ashmead. The genus was expanded considerably by Kieffer (1907), who added six more species, some of which were originally described in Trisseucoela Kieffer while another in Rhabdeucoela Kieffer. Tropideucoila has never been formally revised; Buffington (2009) provided a redescription of the genus, recovered the genus phylogenetically among the Zaeucoilini, and hypothesized based on phylogenetic inference that species within the genus were restricted to attacking Agromyzidae hosts. The only other two genera Buffington (2009) suggested could be confused with Tropideucoila were Marthiella Buffington and Penteucoila Weld, but a key to genera in the same work provides clear diagnostic characters to separate these genera.

Specimens reared by MC were sent to MB for identification. While at first glance this species appeared to be a Dettmeria Borgmeier or possibly a Lopheucoila Weld (due to size and association with Tephritidae), once the specimens were run through the key of Buffington (2009), it was clear the species belonged to Tropideucoila, and possessed all of the synapomorphies of the genus: orbital furrows present, originating at torulus; mesoscutal keel present, well developed; parapsidal ridges and parapsidal hair lines present; scutellar plate medium in size, often with two
tubercles bearing setae anterior to the midpit; no large conical projection present on plate; R₁ vein of wing incomplete. It should be noted that there is an error in the key of Buffington (2009): at couplet 9, the choice arriving at 11 should include ‘parapsidal ridges present’; as published, this key couplet arrives at 10 (Dicerataspis and Moneucoela). Having examined all of the major collections of Tropideucoila summarized in Buffington (2009), it was clear that this was a new species, much larger than typical Tropideucoila, and having a biology inconsistent with other known Tropideucoila hosts: Tephritidae. We provide here a description of this species, Tropideucoila blepharoneurae Buffington and Condon, and provide an overview of the biology of the species. Our goal is to bring to light a rather a-typical species of Tropideucoila, possibly the first of many such species awaiting description and biological study.

MATERIALS AND METHODS

List of depositories

UNMSM- Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos Lima, Perú.

USNM -National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA.

Rearing protocols.—We collected flowers from inflorescences of two species of vines (Gurania acuminata Cogn., G. spinulosa (Poepp. and Endl.) (= G. lobata L.) (Cucurbitaceae), growing along the perimeter of a ~ 1km long airstrip (S 12.5, W 70.1) at Los Amigos Biological Station (CICRA-Centro de Investigación y Capacitación Río Los Amigos) in Madre Dios, Peru. Recently fallen flowers were also collected. Gender and maturation stage of each flower was noted, and individual flowers and fruit were placed in labeled containers and checked daily for emergence of larvae, which pupate after emerging from plant parts. Each puparium was either placed in an individually labeled container for rearing or preserved in ethanol. Flies and parasitoids were reared to adulthood in USDA-approved containment facilities at Cornell College.

Specimen illustration and observation.—The digital illustration (Fig. 1) was generated by Taina Litwak (scientific illustrator, Systematic Entomology Lab, USDA) from camera lucida pencil sketches of specimens, using scanning electron micrographs for reference to surface sculpture. Digital painting was done using the Adobe CS4 package (San Jose, CA). A Hitachi TM3000 desktop scanning electron microscope was used for generating SEM images; specimens were photographed uncoated at ‘analysis’ voltage, running in ‘compo’ mode. The resulting images were edited in Adobe CS4. Light microscope images of wing interreference patterns (WIP) where captured following methods illustrated in Buffington and Sandler (2012). All images are available from the Morphbank collection under accession number 822901.

Descriptive format.—Diagnoses focus on easily recognized gross morphologies, and closely related species are distinguished. Terminology for all descriptive characters, as well as phylogenetic characters, follow Buffington (2009) and Buffington and Sandler (2012); surface sculpture terminology follows that of Harris (1979).

Phylogenetic analysis.—Morphological character coding is based on Buffington (2009). Tropideucoila blepharoneurae was coded for the entire matrix based on SEM images as well as whole mounted specimens; characters that could not be interpreted were coded as ‘?’. Molecular sequence data was generated by the Scheffer Laboratory (Systematic Entomology Laboratory, Beltsville, MD) following the protocols reported in
Buffington et al. (2012). Hosts (flies in the genus *Blepharoneura*) were identified by extracting DNA from fly puparia and sequencing mtDNA COI (cytochrome oxidase subunit I) following protocols outlined in Condon et al. (2008). Alignment of the resulting data (28S D2 and 28S D3) followed methods outlined in Buffington (2009). The original sequences are accessioned under KC589701-KC589702 on GenBank; the final phylogenetic matrix is available from Treebase (http://treebase.org) under Study ID number S13913.

Following the protocol in Buffington (2009), the two diglyphosematines, *Disorygma pacifica* (Yoshimoto) and *Gronotoma micromorpha* (Perkins), were chosen as outgroup terminals. The matrix was analyzed via maximum parsimony using PAUP* (Swofford 2002), employing 10000 replicate searches of TBR under implied weights using a K value of 2 (Goloboff 1993, with branches of maximum length zero collapsed and steepest descent set to ‘off.’ For bootstrap analyses (Felsenstein 1985), a simple addition sequence was employed, with *Gronotoma micromorpha* as the reference taxon, followed by 1000 bootstrap replicates, with each employing 100 TBR swapping replications.

**SYSTEMATIC TREATMENT**

*Tropideucoila blepharoneurae*, Buffington and Condon, new species  
Diagnosis.—The overall size of this new species (4.7–5.5 mm, n = 40) is the easiest character used to distinguish this
species from other *Tropideucoila* (ranging from 1.75–2.7 mm, n = 115). The incomplete R₁ in the forewing immediately sets this species apart from other *Tropideucoila*. This is the only *Tropideucoila* species known to parasitize Tephritidae. This new species can be separated from *Marthiella* by having distinct parapsidal ridges on the mesoscutum and four points protruding from the posterior aspect of the scutellum; this new species can be separated from *Penteucoila* by lacking a single
spine overhanging the scutellar plate (distinct spike present in *Penteucoila*). The species can also be confused with species of *Dettmeria* and *Lopheucoila*, but can be distinguished from both of these genera by the morphology of the scutellar plate: in *Tropideucoila*, there are two distinct tubercles at the midpoint of the plate; *Dettmeria* lacks tubercles, and the surface of the plate is smooth; *Lopheucoila* possess a small, single tooth at the anterior margin of the glandular release pit on the plate, which slightly overhangs the plate (similar to *Acantheucoela* and *Penteucoila*).

Description.—Adult females and males: 4.7–5.5 mm; all shiny black with reddish-brown legs Fig. 1.
**Head:** Nearly glabrous with a few scattered setae along lower face, clypeus and inner orbits of compound eyes (Fig. 2A). Ocellar hair patch present, bisecting line between anterior and lateral ocellus (Fig. 2A). Ventral 1/4 of lower face with admedial clypeal furrows converging toward clypeus. Orbital furrows originating from lateral aspect of torulus, terminating at malar sulcus (Fig. 2A). Malar sulcus simple. Malar space smooth with a few scattered setae. Genal carina running from malar space to dorsal margin of compound eye (Fig. 2B); gena smooth with occasional scallop sculpturing.

**Antennae:** Female: 11 flagellomeres, moniliform, non-clavate, sub-equal in length; flagellomeres 6–11 wider than 1–5; rhinaria present on all flagellomeres (Fig. 2C). Male: 13 flagellomeres, moniliform, non-clavate, sub-equal in length; rhinaria present all flagellomeres; flagellomere 1 modified, slightly longer than 2, curved outward, excavated laterally (Fig. 2D).

**Pronotum:** Pronotal plate wide, with sparse setae along most of dorsal margin; dorsal margin crested, bifurcate, densely setose; pronotal fovea open (Fig. 3B). Pronotal triangle, pronotal impression, present, both distinct. Lateral pronotal carina absent. Lateral part of pronotum (ventral to pronotal impression) smooth and glabrous (Fig. 2F).

**Mesoscutum:** Distinctly sculptured, setose. Mesocutal keel complete, tapering toward middle. Parapsidal ridges and parapsidal hair lines present, distinct, setae forming thin longitudinal line. Parascutal impression broad, aligned anteriorly with pronotal impression. Notauli absent (Fig. 2E).

**Mesoscutum:** Distinctly sculptured, setose. Mesoscutal keel complete, tapering toward middle. Parapsidal ridges and parapsidal hair lines present, distinct, setae forming thin longitudinal line. Parascutal impression broad, aligned anteriorly with pronotal impression. Notauli absent (Fig. 2E).

**Wings:** Forewing hyaline, with base of wing slightly darkened; medially glabrous, more setose distally; R₁ incomplete, not reaching anterior margin of wing, reduced to knob at junction with R₁+Sc; marginal cell slightly longer than deep; apical hair fringe present, short (Fig. 3D); wing interference pattern distally striatiform, antero-basally absent, central posterior region galactiform (Fig. 3E). Hindwing basally darkend, distally hyaline; interface
from dark to hyaline areas set off by stout, long setae; posterior margin of hindwing deeply curved, setose (Fig. 3D).

Legs: Fore and mid coxa sub-equal in size, hind coxa twice the size of either fore or mid coxa (Fig. 1). Fore coxa variously setose; mid and hind coxa with anterior and posterior dorsoventral setal bands. Femora and tibiae sparsely setose, tibiae with more appressed setae; tarsomeres covered in dense appressed setae. Length of hind tarsomere 1 equal to 0.5–0.7x the combined length of remaining hind tarsomeres.

Metasoma: Female: Sub-equal in size to mesosoma (Fig. 1). Crenulate ring not visible. Base of syntergum with with dense setae laterally, glabrous at extreme venter and dorsally; remainder of metasoma glabrous. Micropunctures present on posterior 1/2 of syntergum and on remaining terga. Terga posterior to syntergum abruptly directed ventrally, resulting in a 90 degree angle between syntergum and remaining terga. Male: as in female.

Type material.—Holotype, female. PERU Madre de Dios, Los Amigos Biological Station Lat 12°33’32.70”S Lon 70°6’20.54”W 270m; Collected from plants along airstrip Bwsp-576 = ‘109-8a’, ‘14x = p’, ex. Gurania acuminata male flower 109-8, fly pupated 14.X.08. USNM ENT 00764890. HOLOTYPE Tropideucoila blepharoneurae Buffington & Condon; deposited in the Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos (UNMSM). Paratypes, 18 females, 20 males. Same data as holotype with various individual plant numbers. USNM ENT numbers 00764899-00764908; 00764891-00764894; 00764885-00764866. Deposited in USNM and UNMSM.

Other material.—COSTA RICA: Alajuela, Chiles de Aquas Zarcas, Café, 300m, XI-1989, R. Cespedes (1 female; USNM ENT 00764869); Linda Vista, VI-VIII.1993, P. Hanson, MT (1 female, USNM ENT 00764868; La Selva, III.1993, P. Hanson, MT (1 female, USNM ENT 00764867). Deposited in USNM.

Etymology.—Species name refers to the genus of the tephritid host of this new species, Blepharoneura.

Biology.—Putative parasitoid of at least ten species of Blepharoneura sp. (Tephritidae); the species limits within this system are currently the focus of other research projects (Scheffer et al. in prep.). Blepharoneura sp3 reared from both male and female flowers of Gurania acuminata; sp21, sp30 reared from male flowers of G. acuminata and G. spinulosa; sp10 (= B. perkinsi Condon and Norrbom), reared from female flowers of G. spinulosa; sp2, sp28 reared from male flowers of G. acuminata; sp4 (= B. atomaria (Fabr.)), sp8, sp12, nsp1, reared from male flowers of G. spinulosa. With the exception of Blepharoneura nsp1 (newly discovered in this 2008 collection), host species identification follows the protocol outlined in Condon et al. (2008). Almost all parasitized puparia (89%, n = 90 flowers) were reared from flowers picked directly from the plants, indicating that Tropideucoila blepharoneurae attacks either larvae or eggs within flowers. These records suggest that T. blepharoneurae is a generalist, attacking multiple species of Blepharoneura in flowers of both sexes of two species of plant; however, the parasitoid attacks flies in female flowers of G. acuminata (~ 27%; n = 4/15) and male flowers of G. spinulosa (11%; n = 66/601) more frequently than flies in male G. acuminata flowers (~ 3%; n = 19/635) and female G. spinulosa (~ 1%; 1/88). Such differences in rates of attack may play a role in the evolution of host-use by Blepharoneura.

Discussion.—Phylogeny: A single tree of length 1083 was obtained from the parsimony analysis. A monophyletic Tropideucoila was recovered with a bootstrap support value of 94% (Fig. 4).
Though *Tropideucoila blepharoneurae* looks strikingly different from other species of *Tropideucoila*, the phylogenetic position of the species (Fig. 4) is firmly within *Tropideucoila*. We have interpreted this as the result of this species attacking a relatively large host species with respect to other *Tropideucoila* species, resulting in allometrically linked morphological distinctions. We lack data to sufficiently understand the evolutionary position of this species within *Tropideucoila*, however, given this species distinct morphology and host preference, it's possible there are two major lineages of *Tropideucoila*: one associated with Agromyzidae, and the other associated with Tephritidae.

**Future research:** A complete species level revision of *Tropideucoila* will certainly help elucidate the morphological plasticity present within species of the genus. Buffington (2009) set the stage for such a study by delineating the genus relative to other zaeucoelines and provided an overview of species and where holotypes for each species are located.

**Acknowledgments**

We thank the Instituto Nacional de Recursos Naturales- Intendencia Forestal y de Fauna Silvestre del Perú for authorizing collections (Autorización N°110-2008-INRENA-IFFS-DCB) and exportation of specimens (Permiso N° 011832-AG-INRENA). We are grateful for collaboration from Gerardo Lamas (Entomology) and Betty Millán (Herbarium) of the Museo
de Historia Natural de la Universidad Nacional Mayor de San Marcos, and Eric Cosio of the Pontificia Universidad Católica del Perú. We thank Luz Maria Huerto Santillan, Matthew Lewis, and Cornell College students for field assistance, and Sonja Scheffer and Matthew Lewis for molecular work. This research was supported in part by NSF grants to Condon: NSF DEB-0330845, NSF DEB-0949361.

**LITERATURE CITED**


