

Compilation of morphological and molecular data, a necessity for taxonomy: The case of *Hormogaster abbatissae* sp. n. (Annelida, Clitellata, Hormogastridae)

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Abstract

Conflict among data sources can be frequent in evolutionary biology, especially in cases where one character set poses limitations to resolution. Earthworm taxonomy, for example, remains a challenge because of the limited number of morphological characters taxonomically valuable. An explanation to this may be morphological convergence due to adaptation to a homogeneous habitat, resulting in high degrees of homoplasy. This sometimes impedes clear morphological diagnosis of species. Combination of morphology with molecular techniques has recently aided taxonomy in many groups difficult to delimit morphologically. Here we apply an integrative approach by combining morphological and molecular data, including also some ecological features, to describe a new earthworm species in the family Hormogastridae, *Hormogaster abbatissae* sp. n., collected in Sant Joan de les Abadesses (Girona, Spain). Its anatomical and morphological characters are discussed in relation to the most similar Hormogastridae species, which

are not the closest species in a phylogenetic analysis of molecular data. Species delimitation using the GMYC method and genetic divergences with the closest species are also considered. The information supplied by the morphological and molecular sources is contradictory, and thus we discuss issues with species delimitation in other similar situations. Decisions should be based on a profound knowledge of the morphology of the studied group but results from molecular analyses should also be considered.

Keywords

Species description, earthworm, morphological characters, molecular data, integrative taxonomy, homoplasy

Introduction

Traditional methods for identifying earthworm species and their phylogenetic relationships (i.e., the study of their morpho-anatomical features) have been limited by high levels of homoplasy. The structural simplicity of earthworms, the low degree of variability and the overlap of diagnostic characters among species, the absence of a fossil record and their adaptation to life in the soil, are the principal factors responsible for the difficulties in recognizing species. DNA sequence data has however facilitated the distinction of closely related species and may be the solution to understanding the true level of biodiversity within morphologically-difficult groups, such as earthworms.

Some degree of controversy has arisen on how to describe and delimit species, but discrete morphological features remain the most used criterion. Others are in favour of molecular-based descriptions (e.g., Cook et al. 2010) who justify species descriptions based solely on DNA sequences, even ignoring morphological data, but they also recognize that in cases with incomplete molecular databases—as for most taxa—, this alternative alone is not viable. Species descriptions including both morphological and DNA-based data are imperative for a more universal taxonomy. There are many authors in favor of this integrative taxonomy, consisting in a multidisciplinary approach including morphological, molecular, ecological and geographical data. This type of approach can include complex procedures therefore using multi-gene genetic distances, analyses such as General Mixed Yule-Coalescent (GMYC) models or Automatic Barcode Gap Discovery (ABGD) analyses and weighting of the established hypotheses with complementary data such as morphological, geographical or ecological (see Puillandre et al. 2012 and included references).

Hormogastridae includes middle to large-sized earthworms, currently comprising 27–29 species and subspecies that are exclusively distributed in the western Mediterranean (Díaz Cosín et al. 1989, Cobolli Sbordoni et al. 1992, Blakemore 2004, 2008), where they play a very important ecological role (Bouché 1972). The highest abundance of species seems to be located in the NE Iberian Peninsula, where more than a dozen species have been described.

The taxonomy of this group, as in other earthworm families, has been based until now solely on morphological features. The first species described are *Hormogaster redii* Rosa, 1887 and *Hormogaster pretiosa* Michaelsen, 1899. Subsequently, other species

were added to the group by different authors, including Cognetti (1914), Zicsi (1970), Bouché (1970), Álvarez (1971, 1977), Díaz Cosín et al. (1989), and Rota (1993) but most were described by Qiu and Bouché (1998), including eleven new species from Spain presenting very subtle morphological differences. The known species are grouped in four genera, *Hormogaster* Rosa, 1887 (22-24 species and subspecies), *Hemigastrodrilus* Bouché, 1970 (one or two subspecies), *Vignysa* Bouché, 1970 (two species) and *Xana* Díaz Cosín et al., 1989 (one species).

Omodeo (1956) provided the first revision of the family in 1956, and later on Omodeo and Rota (2008) presented additional considerations on their evolution in an article including different Mediterranean areas. Cobolli Sbordoni et al. (1992) provided the first phylogenetic hypothesis of the family using allozymes, but that seminal work lacks a comprehensive sampling in NE Spain, where most of the hormogastrid diversity concentrates (Qiu and Bouché 1998). More recently, Novo et al. (2009, 2010) used DNA sequence data from multiple markers to detect cryptic diversity within *Hormogaster elisae* in the central area of the Iberian Peninsula. These studies highlight, among other aspects, the morphological stasis present in this group, whose anatomy seems to have adapted to the dry soils of this region.

During a collecting trip for the phylogenetic study of Novo et al. (2011), 22 hormogastrid specimens were collected near Sant Joan de les Abadesses (Girona, Spain). The specimens were assigned to *Hormogaster*, but were thought to represent a new species here described as *Hormogaster abbatissae* sp. n. Its description, including its relationship to other the closely related hormogastrid species are the initial objectives of this paper. The description we provide is complemented with a molecular analysis of different genes in the closest species, GMYC species delimitation and ecological data. This study resembles the first example to describe a new earthworm species by combining all these different data sources (Blakemore and Kupriyanova 2010, see also Blakemore 2010, Blakemore et al. 2010 and for lumbricids Blakemore and Grygier 2011 and Blakemore 2012) and also other studies on different taxa (e.g. Chullasorn et al. 2011, Heethoff et al. 2011, Hart et al. 2012). However, this is the first work to do so for an hormogastrid. Contradictory results between morphological and molecular data are found, and whether a particular data set should be favored over the remaining sources is discussed.

We expect that this example, combining molecular and morphological data and including ecological features, goes beyond the specific interest of a new earthworm species description and could be applied to other groups with comparable taxonomic problems.

Material and methods

Specimens were collected by hand and fixed in the field in ca. 96% EtOH, with subsequent alcohol changes. Once in the laboratory, specimens were preserved at -20 °C.

The studied material includes 22 specimens (five mature specimens, four semi-mature specimens with tubercula pubertatis and/or clitellum draft and 13 immatures

or fragments) collected between Ripoll and Sant Joan de les Abadesses, road C26, km 210 in a little forest near the Ter river (42°13'30.0"N, 2°14'57.5"E). Mean annual temperature is 14.3 °C and mean annual precipitation is 724 mm, as indicated by the nearest weather station (in the airport of Girona, 55km away: <http://www.aemet.es/es/serviciosclimaticos/datosclimatologicos/valoresclimatologicos?l=0367&k=cat>)

Specimens have been deposited in the Oligochaete Cryo collection of the *Departamento de Zoología y Antropología Física, Universidad Complutense de Madrid* (DZAF, UCM), Spain.

Specimens of nearly all other hormogastrid species were examined for comparison (list of specimens in Novo et al. 2011). Morphological characters include those features traditionally used for hormogastrids and other earthworms. Only the distantly related species *H. lleidana* Qiu & Bouché, 1998 and *H. multilamella* Qiu & Bouché, 1998 were not examined, and thus their information was limited to the published descriptions (Qiu and Bouché 1998). All the specimens are deposited in the earthworm criocollection of Complutense University of Madrid (DZAF, UCM).

Molecular data generation follow Novo et al. (2011, 2012). Phylogenetic inference and GMYC analyses discussed here are based on data published in those papers. Nine molecular regions of specimens SAN1, 2, 3, 4, 7, 8, 9, 10 were included: mitochondrial regions of cytochrome *c* oxidase subunit I (COI), 16S rRNA and tRNA Leu, Ala, and Ser, two nuclear ribosomal genes (complete 18S rRNA and a fragment of 28S rRNA) and two nuclear protein-encoding genes (histones H3 and H4). GeneBank accession numbers for the paragenotypes, following Chakrabarty (2010) for the mitochondrial markers, analyzed here are shown in Table 1.

We constructed networks with SplitsTree4 v.4.11.3 (Huson and Bryant 2006) for the mitochondrial genes (16S-tRNA, COI), including the phylogenetically closest species of *H. abbatissae* sp. n., in order to visualize in more detail the relationships and genetic distances among them. Default settings were used. We analysed 41 sequences of each gene including hormogastrids close to *H. abbatissae* sp. n. and *Hormogaster elisae* Álvarez, 1977 from Sigüero and *Aporrectodea trapezoides* (Dugés 1828) as more distant outgroups (see Table 2). Uncorrected pairwise differences were calculated between these species with Arlequin 3.5 (Excoffier et al. 2005).

Table 1. Paragenotypes of *Hormogaster abbatissae* sp. n. with GenBank accession numbers. The holotype SAN 11 was not sequenced in order to preserve the specimen intact.

Paragenotype	COI	16S-tRNA
SAN1	JN209553	JN209358
SAN2	HQ621990	HQ621884
SAN3	JN209557	JN209360
SAN4	JN209555	JN209361
SAN7	JN209556	JN209362
SAN8	JN209559	JN209363
SAN9	JN209558	JN209364
SAN10	JN209554	JN209359

Table 2. Species represented in the network corresponding to the closest relatives of *H. abbatissae*, according to the phylogenetic study by Novo et al. (2011). More distantly related species appear in bold. GenBank accession numbers of the used sequences are shown for each gene.

Species	Locality	Region, Country	Coordinates	N	COI	16S
<i>H. sylvestris</i>	Montmajor	Barcelona, Spain	42°01'43.3"N, 001°42'43.7"E	2	JN209552, HQ621981	JN209286, HQ621874
<i>H. pretiosa nigra</i>	Quillan	Aude, France	42°52'48.8"N, 002°10'12.0"E	1	HQ621988	HQ621882
<i>H. catalaunensis</i>	El Brull	Barcelona, Spain	41°48'04.9"N, 002°20'51.6"E	1	HQ621973	HQ621866
<i>H. gallica</i>	Banyuls Sur Mer	Pyrénées-Orientales, France	42°28'08.0"N, 003°09'08.2"E	1	HQ621974	HQ621867
<i>H. arenicola</i>	Biosca	Lleida, Spain	41°51'04.6"N, 001°19'40.4"E	8	JN209493- JN209499, HQ621972	JN209208- JN209214, HQ621865
<i>H. riojana</i>	Alesanco	La Rioja, Spain	42°26'21.7"N, 002°50'18.4"W	10	JN209477- JN209485, HQ621970	JN209196- JN209204, HQ621862
<i>H. ireguana</i>	Torreçilla en Cameros	La Rioja, Spain	42°13'54.7"N, 002°37'35.2"W	8	JN209486- JN209492, HQ621994	JN209394- JN209400, HQ621888
<i>H. elisae</i>	Siguero	Madrid, Spain	41°11'06.1"N, 03°37'07.4"W	1	EF653894.1	GQ409710.1
<i>A. trapezoides</i>	San Román	Asturias, Spain	43°15'20.9"N, 005°05'10.3"W	1	JF313607	HQ621864

Results

Taxonomic results

Phylum Annelida Lamarck, 1802

Subphylum Clitellata Michaelsen, 1919

Class Oligochaeta Grube, 1850

Order Haplotaxida Michaelsen, 1900

Family Hormogastridae Michaelsen, 1900

Genus *Hormogaster* Rosa, 1887

Type-species *Hormogaster redii* Rosa, 1887

***Hormogaster abbatissae* Novo & Díaz Cosín, sp. n.**

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http://species-id.net/wiki/Hormogaster_abbatissae

Hormogaster abbatissae Novo, 2010: 249 (eprints.ucm.es/12304/1/T32615.pdf) and

Novo and Díaz Cosín, in press: (<http://www.ucm.es/info/zoo/invertebrados/PDF/>

Novo%20et%20al%20%28en%20prensa%29%20When%20morphology%20and%20molecules%20clash.pdf) – nomina nuda superceded by current publication.

Material examined. *Holotype.* Adult (Catalog # SAN11 DZAF, UCM), 42°13'30.0"N, 2°14'57.5"E, from a small patch of forest near the Ter river, road C26, Km 210, between Ripoll and Sant Joan de les Abadesses, Girona (Spain), leg. M. Novo, D. Díaz Cosín, R. Fernández, December 2006.

Paratypes. 21 specimens (Catalog # SAN1-10, 12-22 DZAF, UCM), same collecting data as holotype.

Other material examined. 16 *Hormogaster* species and several subspecies included in the study by Novo et al. (2011).

Morphological description. *External morphology* (Figure 1). Length of the mature specimens: 103–130 mm. Maximum diameter (pre-clitellar, clitellar, post-clitellar): 8, 11, 9 mm. Number of segments: 239–270. Weight (fixed specimens): 3.45–4.98 g.

Colour: Anterior pink in live animals, with darker clitellum and grey-bluish posterior (Supplementary Figure S.1B). Specimens are grey-bluish when preserved in ethanol, with beige clitellum (Supplementary Figure S.1D).

Prostomium proepilobitic 1/3. Segments 1 and 2 showing longitudinal lines. Chaetae closely paired, quite lateral, visible along the body as two faint blue lines; intersetal ratio at segment 50, *aa*: 50, *ab*: 1.5, *bc*: 9, *cd*: 1, *dd*: 52. Nephridial pores in a row, between chaetae *b* and *c*. Spermathecal pores at intersegments 8/9, 9/10 and 10/11, at the level of chaetae *cd*.

Male pores opening near the 15/16 as elongated fissures at the level of *ab*, showing heart-shaped porophores of variable developmental degree that can cover practically all width of the segment 15 and ½ of 16 in mature specimens. Female pores in 14 more or less at the same level as the male ones.

Clitellum saddle-shaped extending over 14,15–27. Tubercula pubertatis in (20) 21,22–26,27 appearing frequently as a continuous line in 21–27. Papillae with variable position, frequently situated at *ab* chaetae in segment 27, although more variable in other segments within the pre-clitellar and clitellar area.

Internal anatomy. Funnel-shaped and strongly thickened septa in 7/8, 8/9 and 9/10, also in 6/7 and 10/11, less thickened though. Last pair of hearts in 11. Three globular strongly muscular gizzards in 6, 7 and 8 of shining appearance. Not apparent Morren's glands, although in transverse sections of the oesophagus at segments 10 to 14 some thickened blood vessels can be detected, but never the lamellae typically showed by this glands.

Lack of well-differentiated posterior gizzard, although the esophagus is a bit dilated at 15–16, but its wall is not especially muscular and its lumen does not exhibit a reinforcement similar to that in the anterior gizzards. In segments 17–25, 26, the gut shows folds in the wall of every segment, forming what has been called a stomach in some earthworms. Typhlosole begins in 20, 21 and presents 15 lamellae, being the two lateral ones very small that therefore could be unnoticed. Number of lamellae gradually decreases, showing three from segment 80 to 140–150, and one until 160–170 where the typhlosole ends. Therefore the last 70 to 100 segments lack the typhlosole.

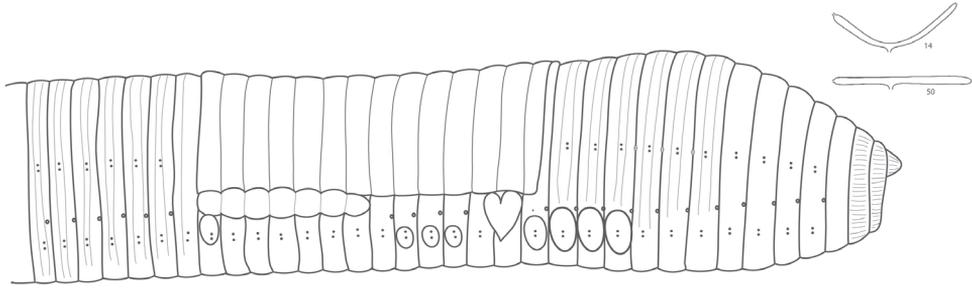


Figure 1. External morphology of *H. abbatisae*. An illustration of nephridial bladders in segments 14 and 50 is shown in the upper right corner.

Fraying testes and iridescent seminal funnels in 10 and 11. Two pairs of granular appearing seminal vesicles in 11 and 12 frequently showing black bodies. Ovaries and female funnels in 13; big ovarian receptacles in 14.

Three pairs of spermathecae in segments 8, 9 and 10 included into septa 8/9, 9/10 and 10/11 the ones in 8 being the smallest. Spermathecae with the appearance of flattened sacks, dish or flying saucer showing irregular borders inside the body wall under some of the muscular fascicles. They can be divided internally into interconnected lobes that in fact do not represent independent spermathecae but simple multicameral spermathecae that open to the exterior by a unique pore.

Anterior nephridial bladders V-shaped with widely open branches, being one of them shorter. They flatten towards the posterior section of the body, until the extent of showing appearance of an elongated sausage.

In some of the specimens, the sexual chaetae in 11 and 12 present well developed follicles that go into the body as a projection where various chaetae simultaneously appear.

Distribution. Known only from its type locality.

Habitat. Specimens were collected in a small forest patch dominated by *Populus alba*, *Acer pseudoplatanus* and *Rosa canina*, which develops in a slope at the edge of a meadow. The soil was covered with abundant leaf litter (Supplementary Figure S1. A), and it is characterized by 13.57% of coarse sand, 9.62% fine sand, 6.27% coarse silt, 32.37% fine silt, and 38.18% clay, constituting a clay loam soil, carbon (C): 4.48%, nitrogen (N): 1.32%, C/N: 3.39, pH: 7.09.

Etymology. The specific epithet derives from *abbatissa*, Latin for abbess, as the species is dedicated to the abbess Emma, the first Abbess head of the Monastery of Sant Joan de les Abadesses, founded in 885 AC by her father, the Count of Barcelona, Guifré el Pilós. The Monastery was run by nuns until the year 1,017 when the female community was expelled, presumably for disorderly conduct, and replaced by monks.

Molecular characters. Sequences from COI (8 individuals), 16S-tRNA (8 ind.), histone H3 (4 ind.), histone H4 (4 ind.), 28S rRNA (2 ind.) and 18S rRNA (1 ind.) were analysed with additional hormogastrid species. Phylogenetic analyses of the molecular data shows robust support for the monophyly of *Hormogaster abbatisae* sp. n., which is the sister species of *H. sylvestris* Qiu & Bouché, 1998 (Figure 2), described in

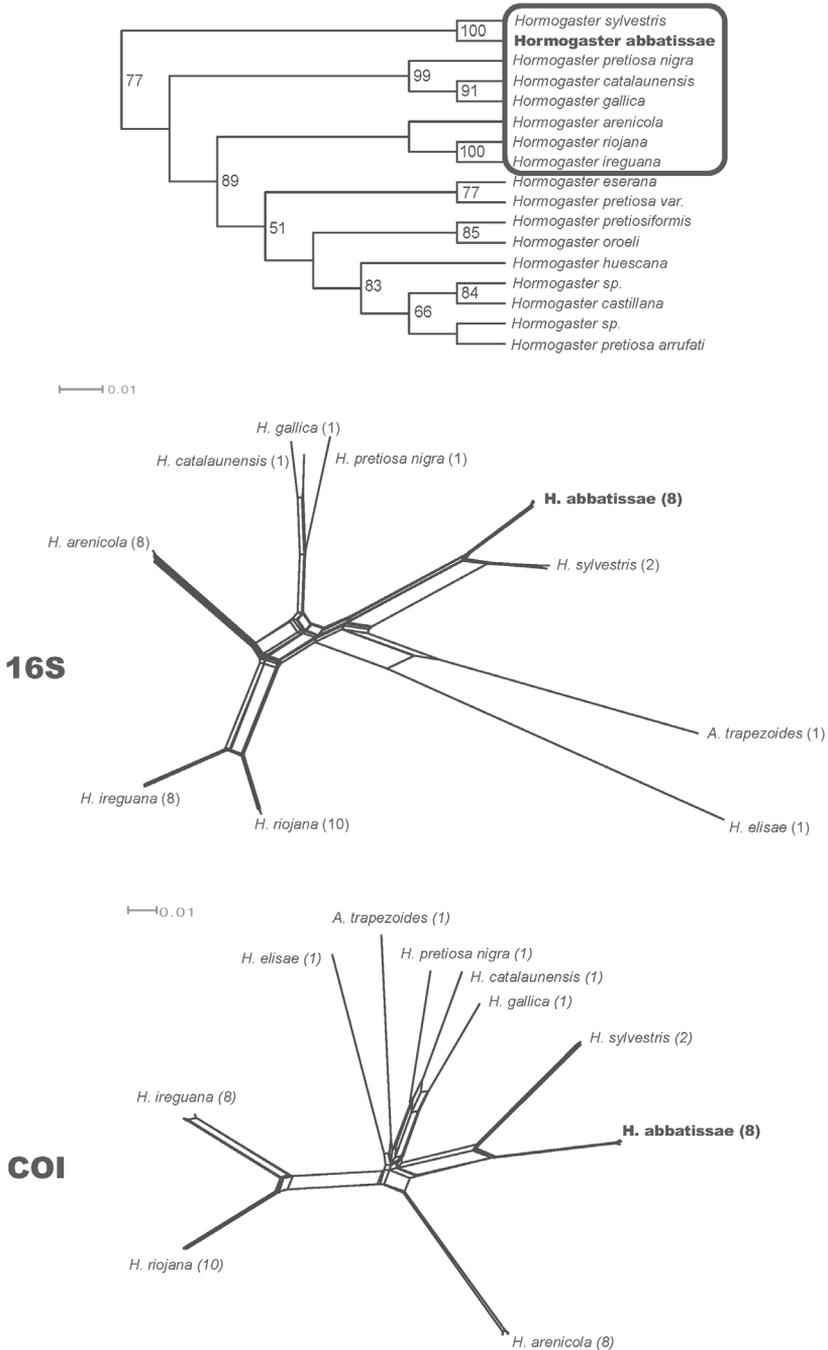


Figure 2. Top, part of the parsimony tree recovered by Novo et al. (2011), showing the clade where *H. abbatissae* was placed (in that work it is named *sp. n.*). Bottom, network representation for 16S-tRNA and COI recovered by SplitsTree4 of the closest species (surrounded by a black square in the tree above) and *Hormogaster elisae* and *Aporrectodea trapezoides* as distant references. The number of specimens used is indicated in parenthesis.

the nearby locality of Montmajor (Barcelona, Spain). This clade forms the sister group to almost all other *Hormogaster* species from the NE Iberian Peninsula (see Novo et al. 2011 for details). This latter clade from the NE Iberian Peninsula splits into two groups, the first clade including *H. gallica* Rota, 1994 from Banyuls-sur-Mer (S of France), *H. catalaunensis* Qiu & Bouché, 1998 from El Brull (Barcelona, Spain) and *H. pretiosa nigra* Bouché, 1970 from Quillan (S of France). Its sister clade includes other *Hormogaster* species from the NE Iberian Peninsula, including *H. riojana* Qiu & Bouché, 1998 and related species (Figure 2).

Uncorrected pairwise distances for 16S-tRNA and COI are shown in Table 3 for the sister species *Hormogaster abbatissae* sp. n. and *H. sylvestris* and the morphologically-close *H. riojana* as well as its sister species *H. ireguana* Qiu & Bouché, 1998. *Hormogaster elisae* is included as a distant relative, even though it belongs to a possible new genus (see Novo et al. 2011).

The networks recovered by Splitstree4 for the COI and 16S genes including morphological and molecular closest species are shown in Figure 2.

GMYC analyses performed by Novo et al. (2012) identified *H. abbatissae*, *H. riojana* and *H. sylvestris* as different species.

Ecological characters. Soil characteristics in the localities where *H. abbatissae* sp. n., *H. riojana* and *H. sylvestris* occur are shown in Table 4. Differences in soil texture were detected: *H. sylvestris* and *H. riojana* inhabit Silt-loamy soils, whereas *H. abbatissae* sp. n. inhabits Clay-loamy soils. *Hormogaster abbatissae* sp. n. inhabits soils with a higher content in organic matter. Comparisons with the remaining species of the family were provided by Novo et al. (2012).

Table 3. Mean values of uncorrected pairwise differences in percentage obtained for 16S-tRNA (above the diagonal) and COI (below the diagonal, in bold) genes. Values of intraspecific differences are shown in the diagonal for the species that include more than one sequence type.

	<i>H. abbatissae</i>	<i>H. sylvestris</i>	<i>H. riojana</i>	<i>H. ireguana</i>	<i>H. elisae</i>
<i>H. abbatissae</i>	0.10/0.05	4.01	11.92	12.86	17.88
<i>H. sylvestris</i>	11.71	0.46/0.25	11.89	12.76	16.29
<i>H. riojana</i>	17.80	17.36	0/0.09	4.32	17.18
<i>H. ireguana</i>	16.11	18.58	9.53	0.33/0.03	17.72
<i>H. elisae</i>	18.42	19.68	18.52	19.48	-

Table 4. Soil characteristics in the sampling localities of *H. sylvestris* (Montmajor MAJ), *H. abbatissae* sp. n. (San Joan de les Abadesses, SAN) and *H. riojana* (Alesanco, ALE). CSand: coarse sand, FSand: fine sand, TSand: total sand, CSilt: coarse silt, FSilt: fine silt, TSilt: total silt, Tex: textural class, SL: Silt loam, CL: Clay loam, C: percentage of carbon, N: percentage of nitrogen, C/N carbon/nitrogen relationship.

	CSand	FSand	TSand	CSilt	FSilt	TSilt	Clay	Tex	C	N	C/N	pH
MAJ	11.71	6.50	18.22	6.88	69.02	75.90	5.88	SL	2.98	0.83	3.6	7.39
SAN	13.57	9.62	23.18	6.27	32.37	38.64	38.18	CL	4.48	1.32	3.4	7.09
ALE	9.24	25.12	34.36	55.38	1.86	57.24	8.40	SL	1.63	0.30	5.33	7.33

Discussion

Most species within the genus *Hormogaster* are very similar morphologically, with the clitellum, tubercula pubertatis, spermathecae and typhlosole, in addition to size or colour, being the key morphological characters traditionally used for species diagnosis. Table 5 includes a comparison of the characters of *H. abbatissae* sp. n. with those of its closest congeners, showing a large degree of overlap in the distribution of these characters and their states. In this case we have a species that appears the closest morphologically, *H. riojana*, collected in Alesanco, a locality ca. 420 km from Sant Joan de les Abadesses, that can be distinguished by the body and clitellum colour, shape of the tubercula pubertatis and the number of spermathecae (although *H. riojana* specimens with three pairs of spermathecae have been reported by Novo 2010). This could lead to consider *H. abbatissae* sp. n. a variety of *H. riojana*. Nevertheless, as shown by the phylogenetic and phylogeographic analyses of molecular data (see Figure 2), *H. riojana* appears distantly related to *H. abbatissae* sp. n.

The sister group of *H. abbatissae* sp. n. is *H. sylvestris* (Figure 2), collected in Montmajor, 50 km away from Sant Joan de les Abadesses. These two species, closely related phylogenetically and biogeographically, are easily distinguished by their tubercula pubertatis (generally starting in more anterior segments and finer in *H. abbatissae* sp. n.), clitellum (shorter and saddle shaped in *H. abbatissae* sp. n. and annular in *H. sylvestris*), spermathecae (three pairs in *H. abbatissae* sp. n. and two pairs in *H. sylvestris*) and typhlosole (15 lamellae in *H. abbatissae* sp. n. and 13 in *H. sylvestris*). To these characters we can add other more variable characters such as colour, length, weight and number of segments (*H. sylvestris* is longer, heavier and with a higher number of segments). Of all these characters, the presence of three pairs of spermathecae in *H. abbatissae* sp. n. is the most conspicuous trait. It is therefore the combination of the morphological information and the phylogenetic position of the species, as derived from the molecular data, which aids in the global taxonomy of the group and serves to assess the degree of homoplasy in characters thought to be of taxonomic importance.

Some characters, such as the presence of Morren's glands or the existence of a posterior gizzard, can be difficult to observe and of subjective interpretation. Morren's glands seem to be absent because although an enrichment of blood vessels is detected in the oesophageal wall of some segments 10 – 14, the lamellae that define this organ were never observed. Likewise, the presence of a posterior gizzard is difficult to determine, as the gut thickens in segments 15 – 19 in the members of some species. However, in *H. abbatissae* sp. n. there is neither strong musculature, nor the thickening and hard covering of the lumen as observed in the gizzards of earthworms.

Regarding the molecular characters, Novo et al. (2009, 2010) proposed the presence of five cryptic species within the *H. elisae* complex, which resulted to be separated by genetic divergences between 9.41 – 18.31% for cytochrome *c* oxidase subunit I (Kimura 2-parameter distances, whose values are slightly higher than the uncorrected distances, used here). Also Hebert et al. (2003) reported comparable divergences for the same marker between 11.3%, for congeneric species of various animal groups and

Table 5. Comparison of the morphological characters of *H. abbatissae* sp. n. with those in the morphologically closest species. N. segments: number of segments. N. typhlosole lamellae: number of typhlosole lamellae. Size, weight and number of segments are for adult specimens. For complete information of the rest of the species within Hormogastridae, see Qiu and Bouche (1998).

	<i>H. abbatissae</i>	<i>H. gallica</i>	<i>H. riojana</i>	<i>H. sylvestris</i>	<i>H. ireguana</i>
Colour	Grey-bluish	Dark brownish	Dark brownish	Colourless	Brownish-grey
Clitellum	14, 15–27 (28) Saddle shaped, beige	(13) 14–28 (29,30)* Saddle shaped	13,14, 17–27,28 Saddle shaped, dark	15–28 Annular	13–27 Annular
Tubercula pubertatis	(20) 21,22–26,27 Fine band	(22, 23) 24 – 27 Fine and short band	(20)21–27 Fine band	22–27 Wide band	19–26 Linear band
Intersetal ratio	50:1.5:9:1:52	69:1.3:8.8:1:66	55:1:13:1:65	50:2:10:1:50	120:1:20:1:100
Length	103–130	165–190	125–185	180–220	100
N. segments	239–270	250–433	243–278	350–420	223
Weight (g)	3.45–4.98	9.2–17		13.6–15.3	
Spermathecae (pores)	8,9,10 (8/9,9/10,10/11)	9, 10 (9/10,10/11)	9, 10 (9/10,10/11)	9, 10 (9/10,10/11)	8, 9, 10 (8/9,9/10,10/11)
Appearance	Simple, Multicameral	Multiple, sessile, in a ring	Simple, Multicameral	Simple, Multicameral	Simple
N. typhlosole lamellae	15 (2 very small)	13	15	13	19
Morren gland	Absent	Absent	Absent	Absent	Absent
Posterior gizzard	15? 16 17? Very weak	14–16? Weak	15–16 Weak	16 Weak	14–15 Weak
Other characters		Carinated anterior segments			

15.7% between annelid species. It is evident, though that strict phenetic distances cannot be used for delimiting taxonomic boundaries, as other studies have shown that the same marker may have within species divergences much larger than the ones proposed by Hebert et al. (2003) (e.g., Barber et al. 2006, Boyer et al. 2007). This has been debated for earthworms by Chang and James (2011), who proposed that differences among species are indeed clade-specific, but they propose the existence of a consensus for COI (Kimura-corrected) distances: values under 9% normally indicate the same species, while values above 15% most probably indicate different species and values between 9-15% can be ambiguous. The species pairs *Hormogaster abbatissae* sp. n. and *H. sylvestris* as well as *H. riojana* and *H. ireguana* present COI uncorrected divergences within this ambiguity range (11.71% and 9.53%, respectively). The latest species were described by Qiu and Bouché (1998) based on morphology. Therefore, it seems that in this case distances need to be treated cautiously, thus reinforcing the critiques of their use for species delimitation (DeSalle et al. 2005, Hickerson et al. 2006, Whitworth et al. 2006). However, distances seem to be conservative in hormogastrid's case and our data suggest that divergence below the level proposed by Chang and James (2011) may correspond to different species. Anyway it is clear the necessity of morphological data to verify the status of two lineages that present a divergence value

within this range. Moreover, in the present case, these species are known to appear only in their type locality and therefore barcoding gap (ABGD) cannot be calculated with accuracy. Species delimitation with GMYC has been recently implemented in earthworms by Fernández et al. (2012) and particularly in hormogastrids by Novo et al. (2012). In both cases an overestimation of the species number, when compared with morphology, was detected. The marked genetic structure and scarce dispersion capacity of the studied earthworms could be the cause for this overestimation, being these factors particularly evident in *H. elisae*'s case, with various cryptic species. A GMYC analysis shows *H. abbatissae* sp. n. as a different entity from *H. sylvestris*. Whether the GMYC method is overestimating in this particular case is unknown but *H. abbatissae* sp. n., *H. riojana* and *H. sylvestris* are well-separated when combining morphology, phylogenetic analyses and network information.

After examining its morphology, phylogenetic placement and additional data such as GMYC and soil characteristics, it is evident that *H. abbatissae* sp. n. constitutes a new hormogastrid taxon not phylogenetically related to those species that show closest morphological similarities. Morphological and molecular data supply different signals thus clashing in the case of *H. abbatissae* sp. n. The question arising in this case is what should taxonomists do when different data sources provide conflict? The answer to this question is not straightforward. On the one hand, these animals can present a morphological stasis, as shown in *H. elisae* (Novo et al. 2009, 2010). On the other hand, molecular techniques rely on limited information, in this case based on a group of specific genes and depend on specific algorithms. This decision should thus be based on a profound knowledge of the morphological variability and peculiarities of the studied group, and an understanding of the strengths and weakness of the applied molecular analyses (used genes, sampling scheme, algorithms, etc.) that could lead to different decisions depending on the study case.

In this particular case, phylogeny is robust because it is based on a great amount of data, combining mitochondrial and nuclear genes (COI, 16S-rRNA, H3, H4, 28S, 18S) with different phylogenetic signal and including individuals representing most of the species in the family. Also we know that living conditions in the soil induce cryptic speciation processes in earthworms (King et al. 2008, Novo et al. 2009, 2010, James et al. 2010, Buckley et al. 2011, Dupont et al. 2011 – but see rebuttals of these “cryptic” genetic cladograms by Blakemore et al. 2010 and Blakemore 2010, 2011) and in many occasions the most important morphological characters used for earthworm species delimitations overlap showing a poor discrimination capacity (Fernández et al. 2012). Therefore, morphological characters should be applied cautiously by earthworm taxonomists in case of conflict with other data source.

Regarding ecological factors, some important differences are detected for texture and organic matter among soils of *H. abbatissae* sp. n., *H. sylvestris* and *H. riojana*. However, it should be considered that a single locality is known per species and that the discovery of other populations may show a higher ecological range.

In summary, this study evidences the need of complementing the morphological data with molecular characters data in taxonomy, especially in groups with limited

morphological characters and rampant convergence in their functional morphology, perhaps due to strong selective pressure due to habitat restriction. This study also proves that in case of rather small genetic divergence (within the range of uncertainty), morphology can be also helpful to conclude complementing molecular sources. We propose to establish the new species *Hormogaster abbatissae* sp. n. Given the existence of species closely-related phylogenetically (*H. sylvestris*) and an unrelated but morphologically similar species (*H. riojana*), a more exhaustive sampling effort in NE Spain could provide new diversity to help evaluate this situation. As indicated by Sites and Crandall (1997), species descriptions are not facts, but hypothesis established when certain criteria available in a specific moment are fulfilled and they can be accepted or rejected when new data are available.

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Appendix

Supplementary figure. (doi: 10.3996/zookeys.242.3996.app) File format: Adobe PDF file (pdf).

Explanation note: Sampling area of *H. abbatissae* (A), alive specimen (B), fixed specimens (D) and their spermathecae from one side of the body (C) numbered from anterior to posterior.

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Description of a new Brazilian *Paraportanus* and key to the species of the genus (Insecta, Hemiptera, Cicadellidae, Portanini)

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Abstract

Paraportanus longispinus, a new leafhopper species from Roraima and Amazonas States, North Brazil, is described and illustrated. The new species can be recognized by the male genital features, especially the distal third of ventral margin of the pygofer with a dentiform short process; plates distinctly longer than pygofer, extending posteriorly beyond pygofer by approximately 1/3 of their length and aedeagus with one pair of spiniform process long crossed and directed ventrally. A checklist and key to males of all known *Paraportanus* species is provided.

Keywords

Auchenorrhyncha, Xestocephalinae, leafhopper, taxonomy, Amazonian

Introduction

The South American genus *Paraportanus* Carvalho & Cavichioli, 2009 is known from ten species (see checklist) from Brazil (Acre, Amazonas, Minas Gerais, Mato Grosso, Maranhão, Pará, Rondônia and Roraima states) and Peru. Among the Portanini, *Paraportanus* species can be recognized by the usually strongly produced male pygofer carrying a pair of strongly pronounced spiniform processes on the posteroventral margin, subgenital plates triangular narrowing to apex and connective Y-shaped with very short stem.

In the present paper, a new *Paraportanus* species from Roraima and Amazonas States (North Brazil) is described and a checklist and key to all known species is provided.

Material and methods

Techniques for preparation of male genital structures follow Oman (1949). The dissected genital parts are stored in microvials with glycerin and attached below the specimens, as suggested by Young and Beirne (1958). The descriptive terminology adopted herein follows mainly Young (1968, 1977), except for the facial areas of the head (Hamilton 1981).

Label data are given inside quotation marks with a reversed virgule (\) separating lines on the labels and a semicolon separating labels of a specimen.

The specimens studied belong to the Coleção Entomológica Pe. J. S. Moure, Departamento de Zoologia, Universidade Federal do Paraná (DZUP; Curitiba) and Instituto Nacional de Pesquisa da Amazônia (INPA; Manaus).

Results

Checklist of *Paraportanus* species

- P. bicornis* (Carvalho & Cavichioli, 2003)
- P. bimaclatus* (Carvalho & Cavichioli, 2003)
- P. cinctus* (Carvalho & Cavichioli, 2003)
- P. eburatus* (Kamer, 1964)
- P. elegans* (Kramer, 1961)
- P. facetus* (Kramer, 1961)
- P. filamentus* (DeLong, 1980)
- P. jenniferae* Carvalho & Cavichioli, 2009 (type species),
- P. longicornis* (Osborn, 1923)
- P. longispinus* sp. n.
- P. variatus* (Carvalho & Cavichioli, 2003)

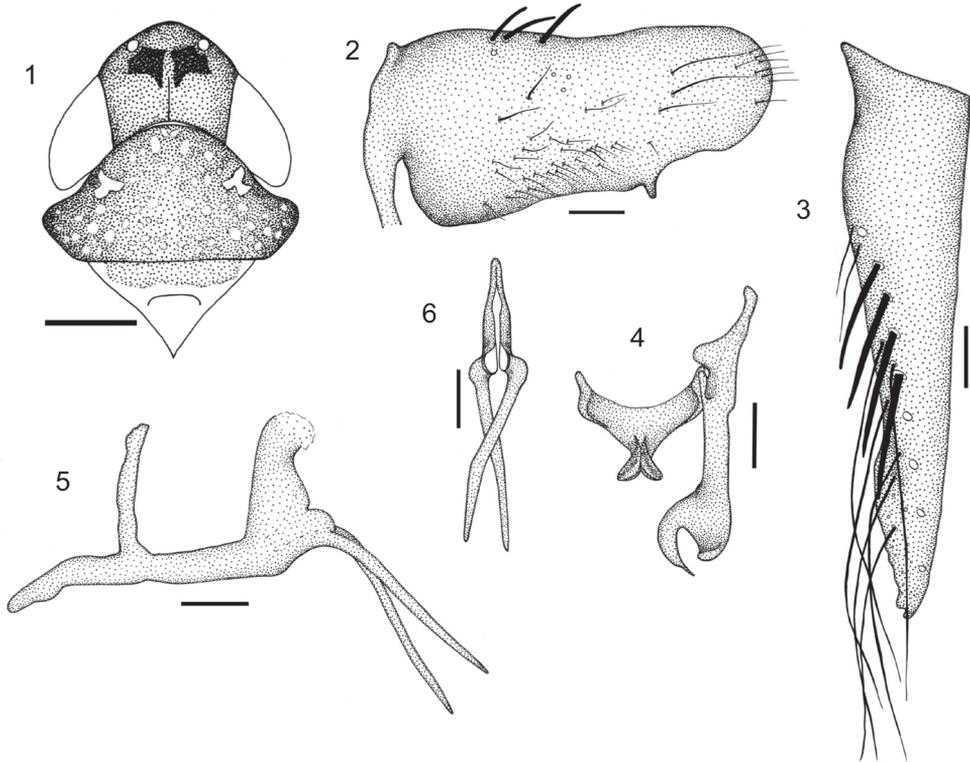
Paraportanus longispinus sp. n.

urn:lsid:zoobank.org:act:A852D16B-61DC-460E-9B08-83CFD0A60099

http://species-id.net/wiki/Paraportanus_longispinus

Figs 1–7

Description. Length 5 mm from apex of head to apex of forewings at rest. Crown (Fig. 1) strongly produced anteriorly; anterior margin rounded in dorsal view; ocelli located on anterior margin, equidistant from the anterior angles of the eyes and coronal suture, the latter half length of crown.



Figures 1–6. *Paraportanus longispinus*, sp. n., male holotype: **1** head, pronotum and mesonotum, in dorsal view **2** pygofer, in lateral view **3** subgenital plates, in ventral view **4** connective and style, in dorsal view **5** aedeagus, in lateral view **6** apex of aedeagus, in posterior view. Scales 0,15 m

Pronotum (Fig. 1) convex, wider than head; lateral margins subangulate in dorsal view; with dorsopelural carinae; posterior margin straight. Forewings with three closed anteapical cells; median cell as long as the external; third and fourth apical cell sub-retangular. Others characters as in description generic (Carvalho and Cavichioli 2009).

Color of body light yellow with opaque areas on crown and pronotum. Crown light brown with pair of large black maculae between ocelli (Fig. 1); face with vertical brown stripe on laterofrontal suture, broader adjacent antenna. Forewings light yellow semi-hyaline with white maculae at apex.

Male genitalia with pygofer (Fig. 2) in lateral view, strongly produced posteriorly; posterior margin broadly rounded; distal third of ventral margin with short dentiform process; macrosetae distributed mostly on proximal third of dorsal margin, some smaller setae on ventral margin to apex. Subgenital plates (Fig. 3), elongate, distinctly longer than pygofer, extending posteriorly approximately 1/3 their length, triangular with lateral margin sinuate; ventro laterally with diagonal row of macrosetae over distal two thirds and several long fine setae. Connective (Fig. 4) Y-shaped with arms broadly divergent; stem very short with strong median keel. Styles (Fig. 4) with apical apophysis strongly curved. Aedeagus (Fig. 5) in lateral view, narrow basally; shaft expanded distally, abruptly curved dorsally and laterally compressed; a



Figure 7. *Paraportanus longispinus* sp. n., male holotype in lateral view.

pair of long spiniform processes subapically on ventral margin (Fig. 6) crossed and directed ventrally; gonopore apical.

Female genitalia. The abdominal VII sternite, in ventral view, with anterior margin straight; posterior margin weakly sinuate, with a small rounded tooth medially.

Material examined. Male holotype, “Brasil: Roraima / Rio Uraricoera / Ilha de Maracá 02–13.V.1987; J. A. Rafael, J. E. B. Brasil & L. S. Aquino, *leg.*; DZUP” (DZUP). Paratypes: 4 males, same data as holotype (DZUP). 3 males, “Manaus – AM (2°25'S, 60°O) / Brasil 13.XI.1985 (Biological Dynamics of Forest Fragments Project) / 80 Km de Manaus / Bert Klein, *leg.* / Malaise”; *Ibdem.* 3 males, 01.IV.1985; *Ibdem.* 18.II.1987; *Ibdem.* 1 male, 1 female, 18.IX.1985; *Ibdem.* 1 male, 03.XII.1985; *Ibdem.* 1 male, 17.IX.1985; *Ibdem.* 1 male, 14.I.1985; *Ibdem.* 1 male, 10.XII.1985; *Ibdem.* 1 male, 24.IX.1985; *Ibdem.* 1 male, 19.IX.1985; *Ibdem.* 1 female, 04.XII.1985; *Ibdem.* 1 male, 11.XII.1985; *Ibdem.* 1 male, 12.XII.1985; *Ibdem.* 1 male, 24.IX.1985; *Ibdem.* 1 male, 25.IX.1985; *Ibdem.* 1 female, 11.XI.1987; *Ibdem.* 1 male, 25.II.1987; *Ibdem.* 1 female, 07.XI.1985; *Ibdem.* 1 male, 1 female, 18.IX.1985; *Ibdem.* 1 male, 12.XI.1985; *Ibdem.* 3 males, 2 females, 24.IX.1985; *Ibdem.* 1 male, 11.XII.1985; *Ibdem.* 1 male, 1 female, 25.IX.1985; *Ibdem.* 1 female, 18.XI.1985; *Ibdem.* 1 female, 10.XI.1985; *Ibdem.* 1 male, 28.I.1987; *Ibdem.* 1 male, 21.I.1987; *Ibdem.* 1 female, 25.II.1987 (INPA).

Etymology. The specific name is named for the long pair of spiniform processes of the aedeagus.

Remarks. *Paraportanus longispinus* can be distinguished from the other known species of the genus by the following combination of features: (1) crown with two maculae between ocelli (Fig. 1); (2) distal third of ventral margin of pygofer with short dentiform process (Fig. 2); (3) aedeagus with a pair of long spiniform process, crossed and directed ventrally (Figs 5, 6). The male genitalia of the new species are similar to those of *P. facetus* (Kramer) but differ from this species in having the processes of the aedeagus longer and crossed.

Key to males of *Paraportanus* (modified from Carvalho and Cavichioli 2009 to include *P. longispinus* sp. n.)

- 1 Style with apical portion slightly tapered and twisted 2
 – Styles with apical portion enlarged and bifid (Fig. 4) 4
 2 Pygofer with posterior margin truncate with long robust spiniform process ..
 *P. filamentus*
 – Pygofer with posterior margin angled without such process 3
 3 Crown orange with two black subtriangular spots between ocelli ... *P. cinctus*
 – Crown brown with orange spots *P. bimaculatus*
 4 Aedeagus with pair of lamellar processes 5
 – Aedeagus with pair of spiniform processes 7
 5 Connective with lamellar process at confluence of ventral arms; pygofer with
 spiniform process elongate, curved dorsally, exceeding posterior-dorsal angle.... 6
 – Connective not as above; pygofer with spiniform process short and stout,
 curved dorsally, not exceeding posterior-dorsal angle *P. eburatus*
 6 Crown and pronotum light brown, with minute stramineous spots
 *P. longicornis*
 – Crown orange with pair of dark brown transverse bands behind ocelli; pronotum
 with stramineous spots and distinct pair of orange spots centrally *P. elegans*
 7 Pygofer with elongate spiniform process at ventral posterior angle; aedeagus
 with pre-apical processes short *P. jenniferae*
 – Pygofer without elongate spiniform process at posteroventral angle; aedeagus
 with pre-apical processes short or elongated (Fig. 5) 8
 8 Aedeagus with a pair of short processes 9
 – Aedeagus with a pair of long processes (Fig. 5)..... 10
 9 Pygofer, in side view, with the apical margin angulate with short and robust
 dentiform process pre-apically, directed medially. Scutellum brown, white
 apically *P. variatus*
 – Pygofer, in side view, with the apical margin truncate without process. Scutel-
 lum brown with two white spots on lateral margin *P. bicornis*
 10 Pygofer with posterior margin broadly rounded with dentiform process (Fig.
 2)..... *P. longispinus* sp. n.
 – Pygofer with posterior margin narrowly rounded without dentiform process
 *P. facetus*

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Neoethilla, a new genus for the first record of the Ethillini from the New World (Diptera, Tachinidae, Exoristinae)

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Abstract

New genus *Neoethilla* **gen. n.**, is described to include two New World nominal species formerly recognized as valid species in *Winthemia* Robineau-Desvoidy: *Exorista ignobilis* van der Wulp and *Winthemia antennalis* Coquillett. *Winthemia antennalis* is proposed as a junior synonym of *Exorista ignobilis* **syn. n.** *Neoethilla ignobilis* **comb. n.** is removed from the Winthemiini and placed in the tribe Ethillini (Exoristinae) based on a study of the external features of adults, male terminalia, female reproductive system, and egg morphology. The small tribe Ethillini, not hitherto known from the New World, currently comprises fourteen genera worldwide. The phylogeny and systematics of the Ethillini and their relationships with related tribes are discussed and documented by descriptions and illustrations of relevant character states.

Keywords

Ethillini, *Exorista ignobilis* van der Wulp, Nearctic Region, Neotropical Region, *Winthemia antennalis* Coquillett, new genus, new synonymy, phylogeny, systematics, Winthemiini

Introduction

Van der Wulp (1890) described *Exorista ignobilis* from Guerrero, Mexico, based on a single male. The species was subsequently moved to *Winthemia* Robineau-Desvoidy, 1830, by Reinhard (1931) and has continued to be treated as a valid species of *Winthemia* to the present day (Guimarães 1972). However, Reinhard (1931) misidentified the species; he did not examine the holotype of *E. ignobilis* but instead relied on notes taken of it by J.M. Aldrich in 1929. Based on these notes, Reinhard (1931) misidentified three specimens from Chile and Argentina as *Winthemia ignobilis* and redescribed the species from this material. Aldrich (1934) himself accepted the identifications of Reinhard (1931) and included the species under the same combination in his faunal treatment of the Tachinidae of Patagonia and South Chile. Cortés and Hichins (1969) also recognized a Chilean species of *Winthemia* as *W. ignobilis*. Although the identities of these specimens from Chile and Argentina have yet to be clarified, we suspect that everything once called *W. ignobilis* from these countries is *W. reliqua* Cortés & Campos, 1971.

A second nominal species, *Winthemia antennalis*, was later described by Coquillett (1902) based on a single female from Los Angeles County, California, United States. Coquillett (1897) had earlier misidentified this single specimen as *Winthemia nigrifacies* (Bigot, 1889) in his key to the species of *Winthemia* of America north of Mexico. Tothill (1912) continued the placement of this species in *Winthemia* in his key to the North American species of the genus, as did Reinhard (1931) in his revision of the “American” species of *Winthemia*. This classification was also followed by Sabrosky and Arnaud (1965) in the *Catalog of the Diptera of America north of Mexico*. Guimarães (1972), however, removed *W. antennalis* from *Winthemia* in his revision of the *Winthemia* of America north of Mexico. Without further explanation, he wrote in his abstract: “*Winthemia antennalis* Coquillett does not belong in this genus and its correct placement has not been determined” (Guimarães 1972: 27). Sabrosky (1973) apparently agreed, as he did not include *W. antennalis* in his paper on the identification of *Winthemia* species of America north of Mexico.

Winthemia antennalis was again treated as a *Winthemia* species, albeit provisionally, by Wood (1987). Wood (1987: 1210) explained this placement in a footnote: “Although arrangement of postpronotal bristles is different from other species of *Winthemia*, the male terminalia and unembryonated planoconvex egg suggest a relationship, which may ultimately be resolved by additional study of the tribe Winthemiini”. Recently, O’Hara and Wood (2004) maintained this classification and listed *W. antennalis* under *Winthemia* in their catalogue of the Tachinidae of America north of Mexico.

The enigmatic placement and identity of *E. ignobilis* and *W. antennalis* became a topic of discussion among us when several specimens provisionally identified as *W. antennalis* were collected in the Gila National Forest of New Mexico, United States, during the field meeting of the North American Dipterists Society in 2007. Upon

further study we have determined that *W. antennalis* Coquillett is a junior synonym of *E. ignobilis* van der Wulp and that this taxon belongs not to the Winthemiini but to the Ethillini, a tribe hitherto unknown from the New World. We discuss below the characteristics of the Ethillini and propose a new genus for the single known New World species of this tribe.

Materials and methods

Specimens

Male terminalia of *Neoethilla ignobilis* were dissected following the method described in detail by O'Hara (2002), then dehydrated with ethanol and critical point dried. After examination, the terminalia were rehydrated and preserved in glycerine in a plastic microvial pinned below the specimen (cf. Cerretti and Shima 2011). One egg, almost entirely exposed but still attached to the ovipositor of a dried female of *N. ignobilis* from Plymouth, Massachusetts (CNC), was removed by tilting it carefully with a pin and then mounted on a micropin. After ESEM examination the egg was glued on a tag and pinned below the source specimen. Male terminalia, pinned specimens and egg were examined, uncoated, with a Hitachi TM1000 environmental scanning electron microscope (ESEM); male terminalia were also slide mounted and examined with a Leica DMLS. Figures 1a–e were prepared from composites of images captured using a Canon EOS 40D Digital SLR camera body, with a Canon MP-E 65mm 1–5X macro lens, mounted on a Kaiser RS1 copy stand (for further details see O'Hara 2012); figures 5a–c were prepared from composites of images captured with a Nikon Digital Sight DS-L1, DS-5M mounted on a Leica DMLS. Specimens examined are preserved in the following collections (acronyms used in the text):

- BMHN** Natural History Museum [formerly British Museum (Natural History)], London, United Kingdom (N. Wyatt).
- CNC** Canadian National Collection of Insects, Agriculture and Agri-Food Canada, Ottawa, Canada.
- MZUR** Museum of Zoology, Università degli Studi di Roma "La Sapienza", Rome, Italy (A. Vigna Taglianti).
- USNM** National Museum of Natural History [formerly United States National Museum], Smithsonian Institution, Washington, United States (N.E. Woodley).

Label data of the holotypes of *E. ignobilis* and *W. antennalis* are cited verbatim with the end of lines and labels indicated by the following symbols: /, end of a line and beginning of the next; //, end of a label and beginning of the next (from top to bottom on the same pin).

Terminology

Morphological terminology generally follows McAlpine (1981), except for the antenna and a few details of thoracic chaetotaxy for which we are following Stuckenberg (1999) and Tschorsnig and Richter (1998), respectively. Measurements and ratios of the head follow Cerretti (2010).

Systematics

Neoethilla gen. n.

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<http://species-id.net/wiki/Neoethilla>

Figs 1a–f, 2a–b, 4a–d, 5a–e

Type species: *Exorista ignobilis* van der Wulp, 1890, by present designation.

Etymology. The compound name *Neoethilla* refers to the New (Latin, *neo*) World distribution and to the suspected close relationship of this genus with the Old World genus *Ethilla* Robineau-Desvoidy, 1863.

Description. This generic description is based on a redescription of the single included species, *N. ignobilis*.

Length: 5.5–7.5 mm.

Colour: Head mainly black, covered with grey microtomentum. Palpus black to brown (usually paler in female). Thorax and legs entirely black. Abdomen mainly black but reddish yellow laterally (Fig. 1a–b). Tegula and basicosta black.

Head (Figs 1a–e, 2a): Large in dorsal view, about as wide as thorax; higher than long in lateral view. Compound eye densely covered with long ommatrichia (Fig. 1c–f). Frons at its narrowest point $2/3$ – $6/7$ (σ ♀) as wide as eye in dorsal view (no significant sexual dimorphism in examined specimens). Frontal vitta (= interfrontal area) clearly widening anteriorly. Outer (= lateral) vertical seta not differentiated from postocular setae in male, well developed in female. Ocellar seta absent (Figs 1c–d, 2a) or very small; ocellar triangle with several short, proclinate setulae (Fig. 2a). Fronto-orbital plate of male with about three irregular rows of fine, mediocline setae lateral to frontal setae. Seven to 10 frontal setae. Two or 3 upper (= dorsal) reclinate orbital setae, often not clearly differentiated from frontal setae. Proclinate orbital setae absent in male, 2 in female (Fig. 1a–b). Parafacial covered with proclinate, short, fine setae (Fig. 1a–b, 1e–f). Facial ridge straight in profile, with only a few setae above vibrissa on about $1/5$ – $1/4$ of its length. Vibrissa arising at about level of lower facial margin. Face concave; lower facial margin not visible in profile. Antenna slightly shorter than facial ridge. Postpedicel 3.0–3.5 times as long as pedicel. Arista bare, thickened on basal $2/5$ – $1/2$. First aristomere not longer than wide (usually shorter); second aristomere 1–2 times as long as wide. Genal dilation well developed. Gena in profile very narrow, about 0.10–0.15 times as high as compound eye (height measured in the same vertical

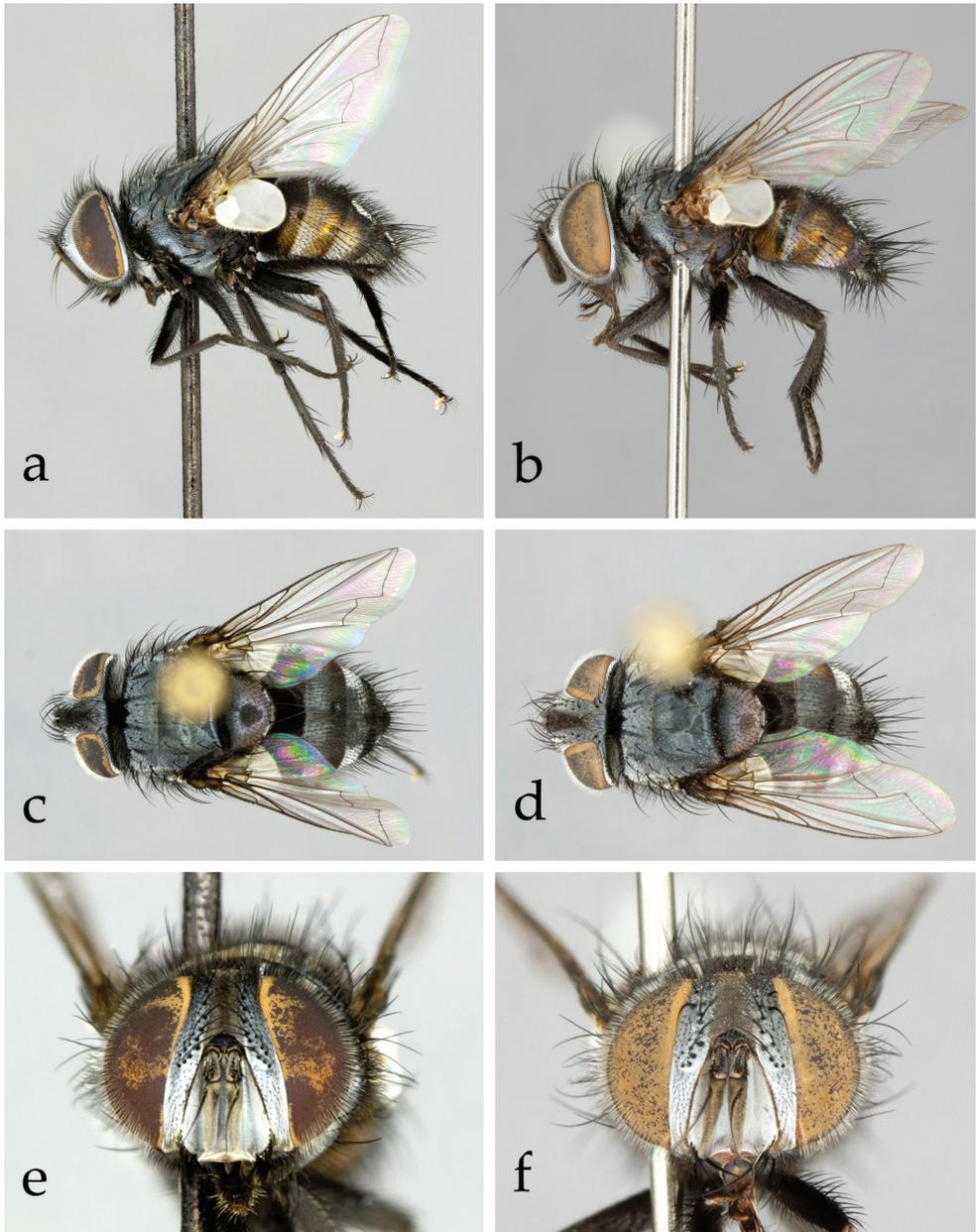


Figure 1. *Neoethilla* gen. n. *ignobilis* (New Mexico) **a–d** habitus **a** male in lateral view **b** female in lateral view **c** male in dorsal view **d** female in dorsal view **d–e** head in frontal view **d** male **e** female.

plane as height of head). Postocular setae fine, relatively long and slightly bent anteriorly. Occiput flat, with 1–2 rows of black setulae behind postocular row. Prementum not more than 2 times as long as wide; palpus well developed, apically covered with setulae, often strongly clavate in female.

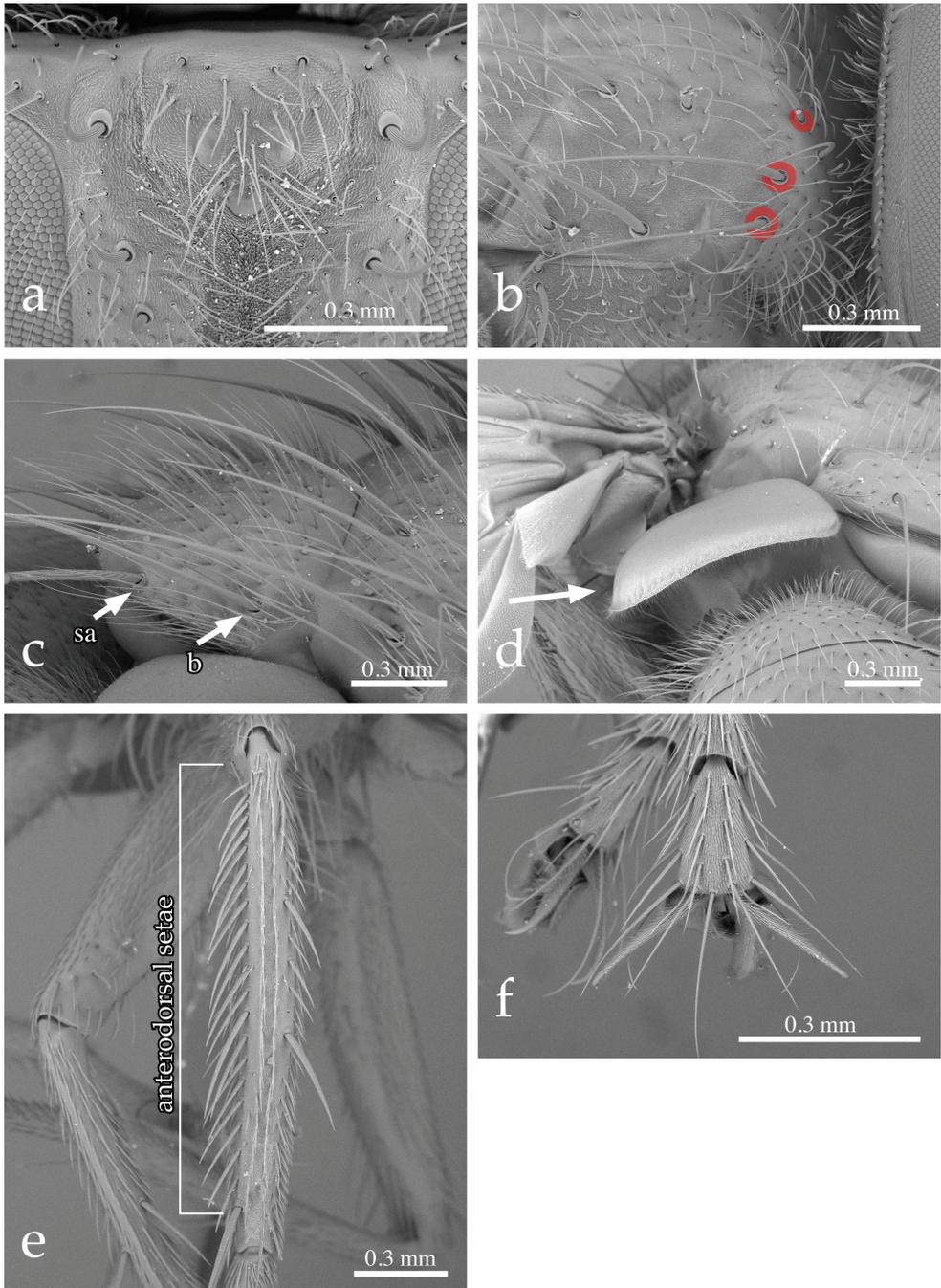


Figure 2. *Neothilla* gen. n. *ignobilis* (male, New Mexico) **a** vertex in anterodorsal view **b** right postpronotum and part of presutural portion of scutum in laterodorsal view [circles indicate basal postpronotal setae] **c** scutellum in laterodorsal view [b = basal scutellar seta; sa = subapical scutellar seta] **d** lower calypter in posterior view **e** left hind tibia in dorsal view **f** fore claws.

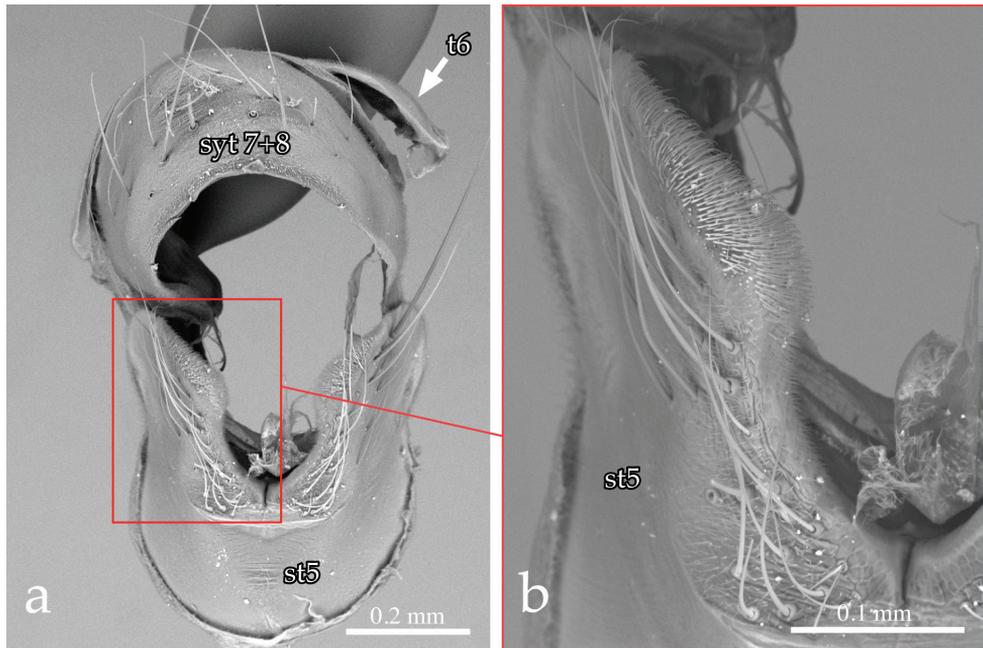


Figure 3. *Neoethilla* gen. n. *ignobilis* (male, New Mexico) [st5 = sternite 5; syt7+8 = syntergite 7+8; t6 = tergite 6] **a** sternite 5 and syntergite 7+8 **b** detail of left lobe of sternite 5.

Thorax (Figs 1a–d, 2b–d): Postpronotum with 4 setae; 3 strongest, basal, arranged in a line (Fig. 2b). Scutum with 2–3 posthumeral setae, 1 + 3 supra-alar (first post-sutural supra-alar seta at most as long as a notopleural seta), 0–1 + 3 intra-alar, 3 + 4 dorsocentral, 3 + 3 acrostichal setae. General hair-like setulae of scutum fine, relatively long and erect. Prosternum laterally setose. Proepisternal depression bare. Two katapisternal setae (the posterior one larger). Katepimeron setulose along its length. Anepimeral seta at most half as long as posterior katapisternal seta. Scutellum wider than long, covered with long, fine, erect setulae. Three pairs of marginal scutellar setae (basal, subapical, apical) (Figs 1c–d, 2c); basal and subapical setae about equal in size; apical pair shorter, crossed and sub-horizontal. Scutellum without discal setae. Anterior and posterior lappets of metathoracic spiracle unequal in size.

Legs: Preapical anterodorsal seta of fore tibia about as long and stout as preapical dorsal seta. Mid tibia with 1 anterodorsal seta. Hind tibia with a row of moderately spaced, comb-like anterodorsal setae (Fig. 2e); 2 dorsal preapical setae. Preapical posteroventral seta of hind tibia not differentiated. Claws about as long as fifth tarsal segment in male (Fig. 2f), considerably shorter in female.

Wing (Figs 1a–d, 2d): Bend of vein M usually obtuse. Cell r_{4+5} open. Section of M between crossveins r-m and dm-cu longer than section between dm-cu and bend of M. Section of M between dm-cu and bend of M shorter than post-angular section of M. Vein R_{4+5} with a single setula at base dorsally and 0–1 ventrally.

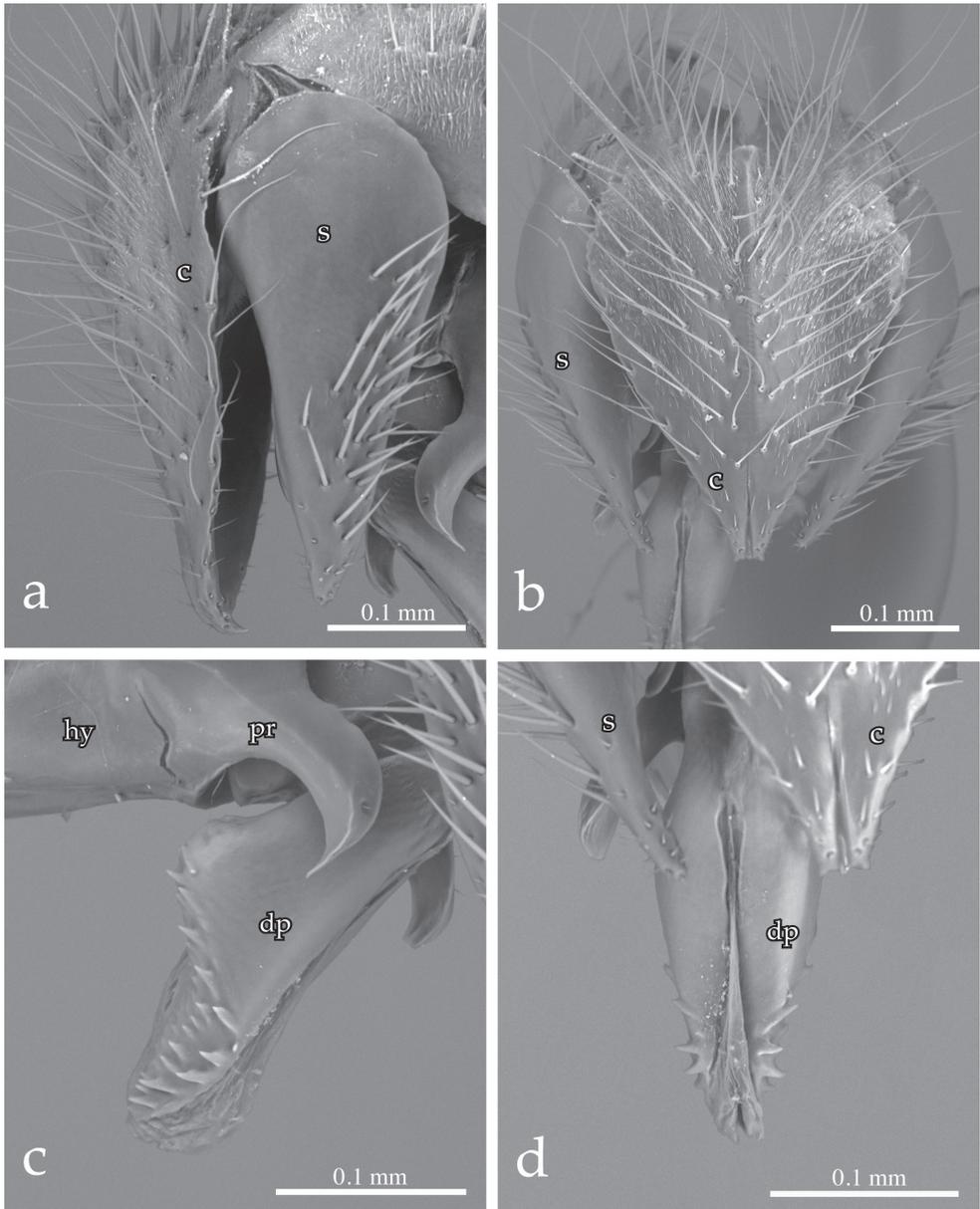


Figure 4. *Neoethilla* gen. n. *ignobilis* (male, New Mexico) [**c** = cerci; **hy** = hypandrium; **dp** = distiphallus; **pr** = pregonite; **s** = surstylus] **a** cerci and right surstylus in lateral view **b** epandrial complex in posterior view **c** distiphallus and pregonite in left lateral view **d** distiphallus in dorsal view.

Lower calypter large and strongly convex, especially along its lateral and posterior margins (Fig. 2d).

Abdomen (Fig. 1a–d): Syntergite 1+2 with mid-dorsal depression extending to hind margin. Tergites 1+2 and 3 with a pair of fine median marginal setae, sometimes

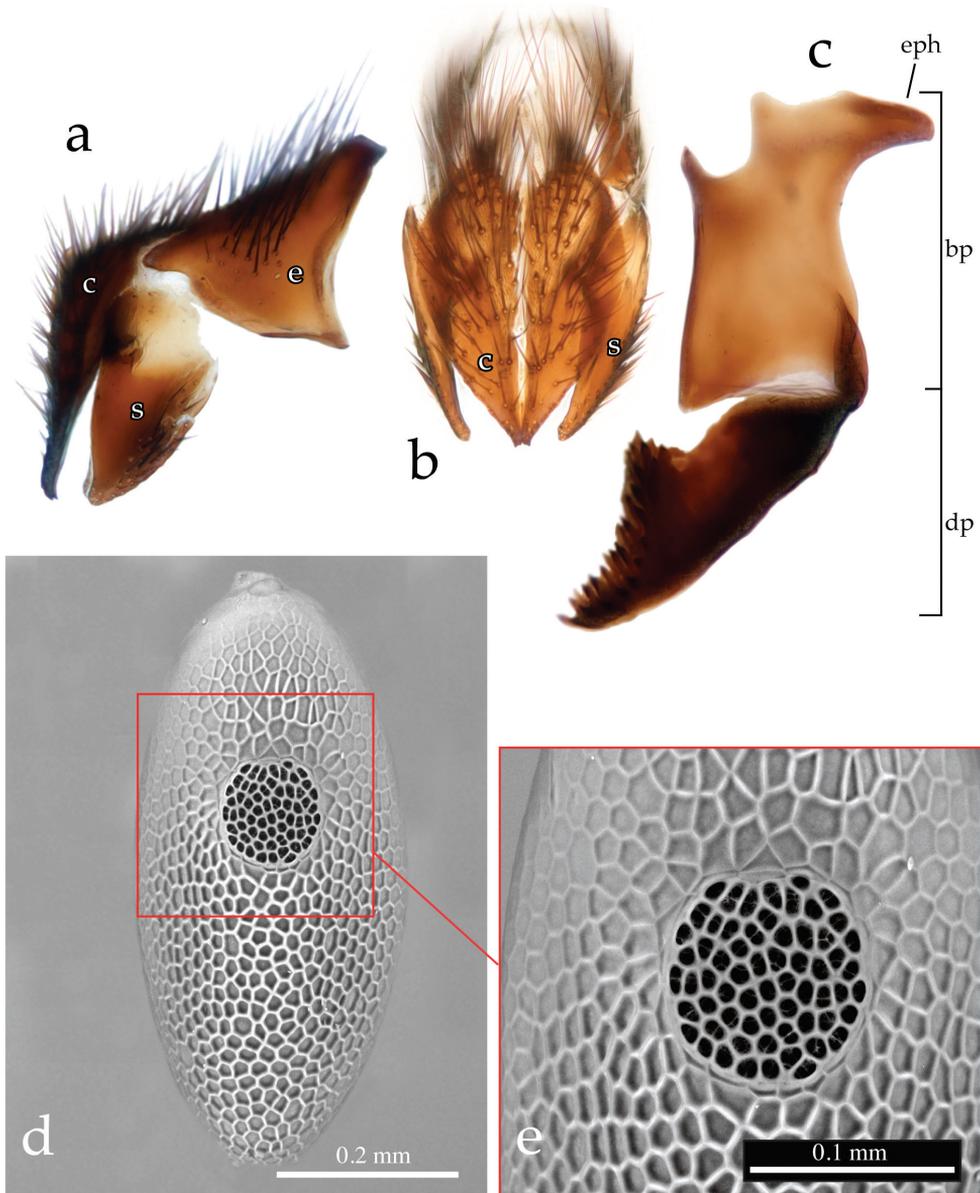


Figure 5. *Neoethilla* gen. n. *ignobilis* **a–c** terminalia (male, Idaho) [**c** = cerci; **bp** = basiphallus; **dp** = distiphallus; **e** = epnadrium; **eph** = epiphallus] **a** epandrial complex in lateral view **b** epandrial complex in posterior view **c** phallus in lateral view **d–e** egg in dorsal view (Massachusetts) **d** habitus **e** detail of *operculum*.

not differentiated from the general abdominal setae, and a pair of lateral setae; tergite 4 with a row of marginal setae; tergite 5 with scattered weak setae. Tergites 3 and 4 without median or lateral discal setae.

Male terminalia (Figs 3a–b, 4a–d, 5a–c): Sternite 5 with deep median cleft, outer lobe almost truncate along posterior margin (Fig. 3a–b). Tergite 6 large, plate-like

(not divided into two sclerites nor indentate on posterior edge), bare; tergite 6 separated from tergite 5 and segment 7+8 by membrane. Cerci (Figs. 4a–b, 5a–b) almost flat, wide in posterior view (sub-ovoid), not fused medially (i.e., longitudinal medial suture complete), distally very slightly divided (Figs 4b, 4d, 5b). Surstylus long, wide and sub-triangular in lateral view, distal tip sometimes slightly bent posteriorly (Figs 4c, 5a). Posterior half of lateral surface of surstylus with several stout setae. Pregonite and postgonite not fused. Pregonite strongly recurved and pointed. Processi longi long, slender and well separated from each other. Epiphallus stout, well sclerotized, attached to basal portion of basiphallus (Fig. 5c). Connection between basiphallus and distiphallus strongly sclerotized (Fig. 5c). Lateroventral sclerites of distiphallus well developed, strongly sclerotized with robust spines lateroventrally (Figs 4a–b, 5c).

Female terminalia. Ovipositor short, not telescopic as in *Winthemiini*.

Egg. Plano-convex macrotype unembryonated; long-oval in dorsal view; anterodorsally operculate (Fig. 5d–e). Dorsal, convex surface of egg characterized by a strong polygonal micro-sculpturing.

Remarks. *Neoethilla* is superficially similar to *Winthemia* because it has an enlarged compound eye covered with thick and long ommatrichia and parafacial covered with fine setulae. Moreover, *Neoethilla* and *Winthemia* both have a short first postsutural supra-alar seta, a comb-like row of anterodorsal setae on hind tibia and a fully setulose katepimeron. *Neoethilla* is distinguishable from *Winthemia* (i) in having the three strongest basal setae of postpronotum arranged in a line, (ii) in lacking the lateral scutellar setae and (iii) in having processi longi of male terminalia long, slender and well separated from each other. Females of *Neoethilla* have a short ovipositor and a dorsally operculate plano-convex egg. These characters, together with the strongly convex lower calypter, suggest that *Neoethilla* has an ethilline affiliation. Within this tribe the new genus is characterized by the following combination of character states: (i) parafacial fully setulose, (ii) gena very narrow (0.10–0.15 times as high as compound eye), (iii) ocellar setae absent or very reduced, (iv) three strongest basal postpronotal setae arranged in a line, and (v) lateral scutellar setae missing.

Included species and examined specimens

Neoethilla ignobilis (van der Wulp, 1890), comb. n.

http://species-id.net/wiki/Neoethilla_ignobilis

Exorista ignobilis van der Wulp, 1890: 71. Type material examined: holotype ♂ (BMNH): HOLO- / TYPE [disc with red border] // ♂ // Amula, / Guerrero, / 6000 ft. / Aug. H.H.Smith. // B.C.A. Dipt.II. / *Exorista* / *ignobilis*, / v.d.W. // Central America. / Pres. by / F.D.Godman. / O.Salvin. / 1903-172. // HOLOTYPE / of *Exorista* / *ignobilis* Wulp / designated 1998 / D.M. Wood.

Winthemia antennalis Coquillett, 1902: 115, **syn. n.** Type material examined: holotype ♀ (USNM): Los Angeles / Co., CAL. // JULY // Collection / Coquillett // Type / No 6222 / U.S.N.M. [red label] // *Winthemia* / *antennalis* / Coq.

Other material examined. UNITED STATES. *Arizona*: 1 ♂, Cochise County, Chiricahua Mountains, 1760 m, 31°52'26.1"N, 109°13'55.8"W, 18.VIII.2007, P. Cerretti leg. (MZUR). 1 ♂, [Cochise County], Chiricahua Mountains, Ash Spring, 1860m, 31°52.3'N, 109°14.7'W, 20–21.IX.2004, J.E. O'Hara leg. (CNC). 3 ♀♀, [Cochise County], Huachuca Mountains, Ramsey Canyon, 1680 m, 2.V.1967, D.M. Wood leg. (CNC). 1 ♂, Cochise County, [Huachuca Mountains], Ida Canyon, 1800 m, 31°23.5'N 110°19'W, 22–24.X.2001, G. & M. Wood leg. (CNC). 1 ♂, Coconino County, 2 km w. Sunset Crater National Monument, 2100 m, 23–24.VII.1982, J.E. O'Hara leg. (CNC). *California*: 2 ♂♂, [Riverside County], Elsinore, 13.VII.1931 (CNC). *Idaho*: 1 ♂, Craters of the Moon National Monument, 8.VII.1965, D.S. Horning Jr. leg. (CNC). *Maryland*: 1 ♂, Calvert County, Port Republic, 21.VIII.2001, D.M. Wood leg. (CNC). *Massachusetts*: 1 ♀ (with egg), Plymouth County, Onset, 29.VI–6.VII.1983, W.J. Morse leg. (CNC). *New Mexico*: 1 ♂, Grant County, 21 km n. Silver City, Cherry Creek Campground, 2100 m [not 2250 m or 7400' as printed on some labels from this locality], 32°54.8'N 108°13.6'W, 16–19.VIII.1982, J.E. & W.M. O'Hara leg. (CNC). 1 ♂, same data except 14–16.VIII.1983, J.E. O'Hara leg. (CNC). 1 ♂, same data except 26.V.1991 (CNC). 2 ♂♂, same data except 16.IX.1994 (CNC). 2 ♂♂, same data except 15–16.VIII.1999 (CNC). 2 ♂♂, Grant County, n. Silver City, Gomez Peak (hilltop), 2200 m, 32°50'N 108°17'W, 23.IX.2004, J.E. O'Hara leg. (CNC). 1 ♂, same data except 24.IX.2004 (CNC). 1 ♂, same data except 27.VIII.2006 (CNC). 1 ♂, same data except 9.VIII.2007 (CNC). 1 ♂, same data except 4.V.2010 (CNC). 1 ♂, same data except 11.X.2010 (CNC). 8 ♂♂, same data except 9.VIII.2011 (CNC). 6 ♂♂, same locality, 12.VIII.2007, P. Cerretti leg. (MZUR). 5 ♂♂, Grant County, n. Silver City, Eighty Mountain (hilltop), 2275 m, 32°50.9'N 108°18.0'W, 26.VIII.2006, J.E. O'Hara leg. (CNC). 1 ♂, same data except 15.VIII.2007 (CNC). 3 ♂♂, same locality, 15.VIII.2007, D.M. Wood leg. (CNC). 1 ♀, Grant/Sierra County, 63 km e. Silver City, Emory Pass, 2500 m, 32°54'N 107°45'W, 12.VIII.2007, G.& M. Wood leg. (CNC). 3 ♂♂, Torrance Co., 14 km s. Cedarvale, North Peak (hilltop), 2250 m, 34°16.4'N 105°43.5'W, 7.VIII.2007, J.E. O'Hara leg. (CNC). *South Carolina*: 1 ♂, Oconee Co., Sumter [as "Sumpter"] National Forest, Hunt Camp, 1.V.1997, M. Wood leg. (CNC).

Distribution. Neotropical: Mexico (Guerrero); Nearctic: widespread in continental United States (O'Hara and Wood 2004).

Discussion

The Ethillini are a small tribe of Exoristinae formerly thought to be exclusively Old World in distribution. Most Ethillini share a number of character states with several members of Winthemiini but the relationships between these tribes remain unclear as they have not been investigated with a rigorous cladistic approach. The tribe can be defined by the following character states:

(1) Lower calypter strongly convex (Fig. 2d) – this is a very rare condition in the Tachinidae (as well as in other Calypttratae) and could arguably be considered apomor-

phic. Excluding *Mycteromyiella* Mesnil, 1966 and *Calliethilla* Shima, 1979, whose systematic placements in Ethillini are questionable (see also Crosskey 1984; Shima 1979; Cerretti 2012), all the other ethilline taxa share this character state. Interestingly, a very convex lower calypter is also present in a few species of *Winthemia*. This could easily be interpreted as convergence if not for the fact that Winthemiini also share other character states with Ethillini (see below),

(2) katepimeron usually entirely covered with fine setulae – within the subfamily Exoristinae this character state is shared with practically all known Winthemiini, a few *Exorista* and the exoristine genus *Crassicornia* Kugler, 1980 (cf. Cerretti et al. 2012; Cerretti 2012). Important exceptions exist for *Atylomyia* Brauer, 1898 and a few *Amnonia* Kugler, 1971 where the katepimeron is often entirely bare, and

(3) female ovipositor short (i.e., non-telescopic) – this could be a plesiomorphic condition compared to the long and telescopic one present in all Winthemiini.

In addition to the above states, all examined female ethillines have a macrotype plano-convex egg of white color. All the Exoristinae, most Phasiinae and the Eutheriini also have a plano-convex egg, or at least traces of a primitive planoconvex shape. This type of egg thus represents a plesiomorphic condition for Ethillini. It is worth noting that Ethillini show two reproductive strategies (Tschorsnig 1988): females with a short ovisac that lay unincubated eggs and females with a long ovisac in which eggs are stored until embryogenesis is complete (*Paratryphera*-group, see below).

Worldwide the following genera fall well within the above limits: *Amnonia*, *Atylomyia*, *Ethilla*, *Ethylloides* Verbeke, 1970, *Gynandromyia* Bezzi, 1923, *Nemorilloides* Brauer & Bergenstamm, 1891, *Neoethilla* gen. n., *Paratryphera* Brauer & Bergenstamm, 1891, *Phorocerosoma* Townsend, 1927, *Prosethilla* Herting, 1984, and *Zelindopsis* Vileeneuve, 1943. As mentioned above, *Calliethilla* and *Mycteromyiella* have a questionable ethilline affiliation because of the lack of the distinctive convex lower calypter.

The grasshopper parasitoids *Gynandromyia* and *Phorocerosoma* and the genus *Zelindopsis* (*Phorocerosoma*-group) share the following: postpronotum with five setae, with the three basal strongest arranged in a triangle; female sternites 4–6 very large and exposed from the ventrolateral margins of the corresponding tergites; and egg surface dorsally smooth with two aeropilar areas, irregular in shape. The number and disposition of postpronotal setae are exactly the same as in nearly all the Winthemiini, and the egg characteristics are shared with several other Exoristinae. However, the features of the female abdominal sternites appear to be unique within the Exoristinae and may represent a strong apomorphy in support of the monophyly of this group of ethilline genera. Interestingly, males of *Mycteromyiella* share with males of several species of the *Phorocerosoma*-group the presence of distinctive spots of setulae and microtrichia on the ventral side of abdominal tergites 4 and 5, and also its members are parasitoids of Phasmatodea (Shima 1976), which are currently considered the living sister-group of the Orthoptera (cf. Grimaldi and Engel 2005).

All the remaining ethilline genera (Ethillini s. str.) share the following, probably derived, character states:

- (1) postpronotum with the three strongest, basal, setae arranged in a line (Fig. 2b),
- (2) male tergite 6 bare, wide and not indented antero-medially,
- (3) male segment 7+8 very wide and platiform (cf. Tschorsnig 1985), and
- (4) egg distinctly operculate (Tschorsnig 1988) (Fig. 5d–e).

The presence of operculate eggs is a very rare condition in tachinids. In most Exoristini an operculum is delineated by a line at the anterior end of the egg (cf. Wood 1972; Cerretti 2010), in Eutherini an oval “window” is situated on the dorsal surface of the egg immediately in front of its posterior end (Herting 1966), while in Ethillini s. str. an operculum is situated on the dorsal surface of the egg in its anterior half or in the middle (cf. Tschorsnig 1988; Tschorsnig and Richter 1998). Such substantial differences in the shape and position of the operculum in these groups suggest that the three types may have evolved independently and thus be non-homologous. Based on the four states listed here we consider the Ethillini s. str. to be a monophyletic lineage.

Finally, two probably monophyletic groups may be identified within Ethillini s. str. (cf. Tschorsnig 1985; Cerretti 2010). The first is the *Paratryphera*-group, composed of *Amnonia*, *Atylomyia* and *Paratryphera*. These taxa share the following character states:

- (1) long ovisac for storing fully embryonated eggs,
- (2) pregonite and postgonite at least partly fused basally,
- (3) connection between male sternite 6 and segment 7+8 on right side very narrow,
- (4) intermedium (cf. Tschorsnig 1985) not differentiated,
- (5) epiphallus light-colored and attached to apical portion of basiphallus,
- (6) ventrolateral sclerites of distiphallus greatly reduced, and
- (7) dorsal connection between basiphallus and distiphallus almost membranous.

The second probably monophyletic group within Ethillini is the *Ethilla*-group, composed of *Ethilla*, *Nemorilloides*, *Prosethilla* and *Neoethilla* gen. n. These taxa share the following character states:

- (1) short ovisac, females lay unembryonated eggs,
- (2) pregonite and postgonite not fused,
- (3) connection between male sternite 6 and segment 7+8 on right side very wide,
- (4) intermedium very large,
- (5) epiphallus massive and attached to basal portion of basiphallus (Fig. 5c),
- (6) ventrolateral sclerites of distiphallus heavily sclerotized and covered with spinulae (Figs 4c–d, 5c), and
- (7) dorsal connection between basiphallus and distiphallus heavily sclerotized (Fig. 5c).

We transfer the New World species *Exorista ignobilis* van der Wulp to the Ethillini and assign it to the new genus *Neoethilla* based on its distinctive characteristics. *Neoethilla* may share a sister-group relationship with *Prosethilla*, as evidenced by its

lack of lateral marginal setae on the scutellum and similar egg morphology (operculum, microsculpture and shape very similar in these genera, judging from figures of *Prosethilla* by Tschorsnig (1988)). *Neoethilla* is clearly distinguishable from *Prosethilla* by its very large compound eye that occupies most of the head in lateral view (gena very narrow, compared to 1/3 or more of vertical eye height in *Prosethilla*), parafacial entirely covered with fine setulae (as in *Winthemia*), and ocellar setae not (or just slightly) differentiated from other setulae on the ocellar triangle.

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A new species of *Schrankia* Hübner, 1825 from China (Lepidoptera, Erebidae, Hypenodinae)

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Abstract

A new species of the genus *Schrankia* Hübner, 1825, *S. pelicano* **sp. n.** is described from Sichuan, China. A diagnostic comparison is made with *Schrankia taenialis* (Hübner, [1809]) and *Schrankia separatalis* (Herz, 1904); illustrations of the male holotype and its genitalia are provided. A checklist of the genus with synonyms is given.

Keywords

Lepidoptera, Erebidae, *Schrankia*, new species, China

Introduction

Schrankia Hübner, 1825 is a widespread genus of Erebidae, being distributed in the Northern hemisphere, the Oriental and Australasiatic regions. It is represented by three species in Europe (Fibiger et al. 2010, Sinev 2008), three species in Africa and a single species on the Seychelles (Hacker 2004), twelve species in eastern and south-eastern Asia (Kononenko et al. 1998, Kononenko and Han 2007, Inoue 1979, Sugi 1982, Holloway 2008, Galsworthy 1997, Kendrick 2002). A considerable number of species live in Australasiatic region (Holloway 1977, Robinson 1975, Evenhuis 2007); three

species in Central America one of which, *S. macula* (Druce, 1891), also inhabits North America (Lafontaine and Schmidt 2010); there are only two valid taxa remaining in Hawaii after the remarkable revisionary work of Medeiros et al. (2009). The European taxon, *S. intermedialis* Reid, 1972 is treated by Fibiger et al. (2010) as an interspecific hybrid of *S. costastrigalis* and *S. taenialis*. The genus has been reported twice from Hong Kong (Galsworthy 1997, Kendrick 2002) but has not been mentioned in any Chinese literature (Chen et al. 1991, Chen 1999, Li-zhong 2005); this is the first record of the genus from south-west China.

Systematic part

Genus *Schrankia* Hübner, 1825

<http://species-id.net/wiki/Schrankia>

Figs 3, 8

Type-species. *Pyralis taenialis* Hübner, [1809]

Remarks. The genus *Schrankia* is characterized by the slender body and narrow, weakly sclerotized wings, light-brown ground color of the forewing and abdomen, long, straight labial palps, which are three to four times as long as the diameter of the eye (Zimmerman 1958) and the absence of ocelli. In the male genitalia (Fig. 8), uncus long, slightly curved; valva elongated with acute apex, bearing three well-developed processes in the middle; juxta X-shaped, composed of two well-sclerotized, bent bars; aedeagus thin, elongated, slightly curved with club-like caecum. The externally often confusingly similar species of the genus *Hypenodes* (type-species *H. humidalis* Doubleday, 1850) have a smaller and thinner body, narrow wings, grey or brownish forewing ground color, upcurved labial palps; ocelli also are absent. The configuration of the male genitalia is very uniform throughout the genus, having a very simple, long, narrow valva with small and thin processes at the base, and a short, wide aedeagus with a tapered caecum.

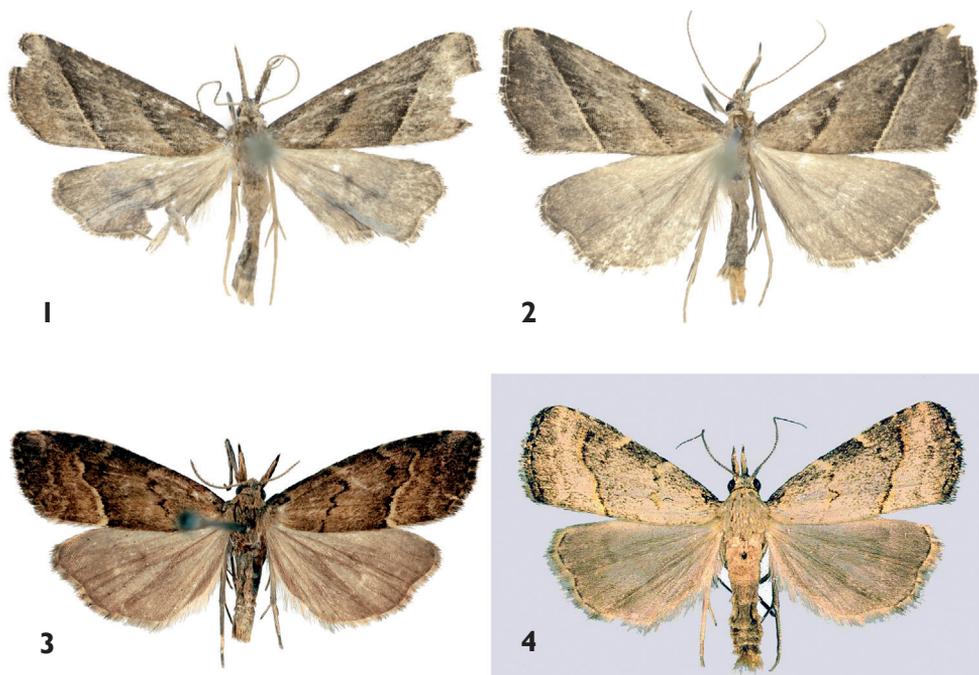
Schrankia pelicano sp. n.

[urn:lsid:zoobank.org:act:033BC935-14EC-4A82-B753-15C530773B3D](http://species-id.net/wiki/Schrankia_pelicano)

http://species-id.net/wiki/Schrankia_pelicano

Figs 1, 2, 5–7

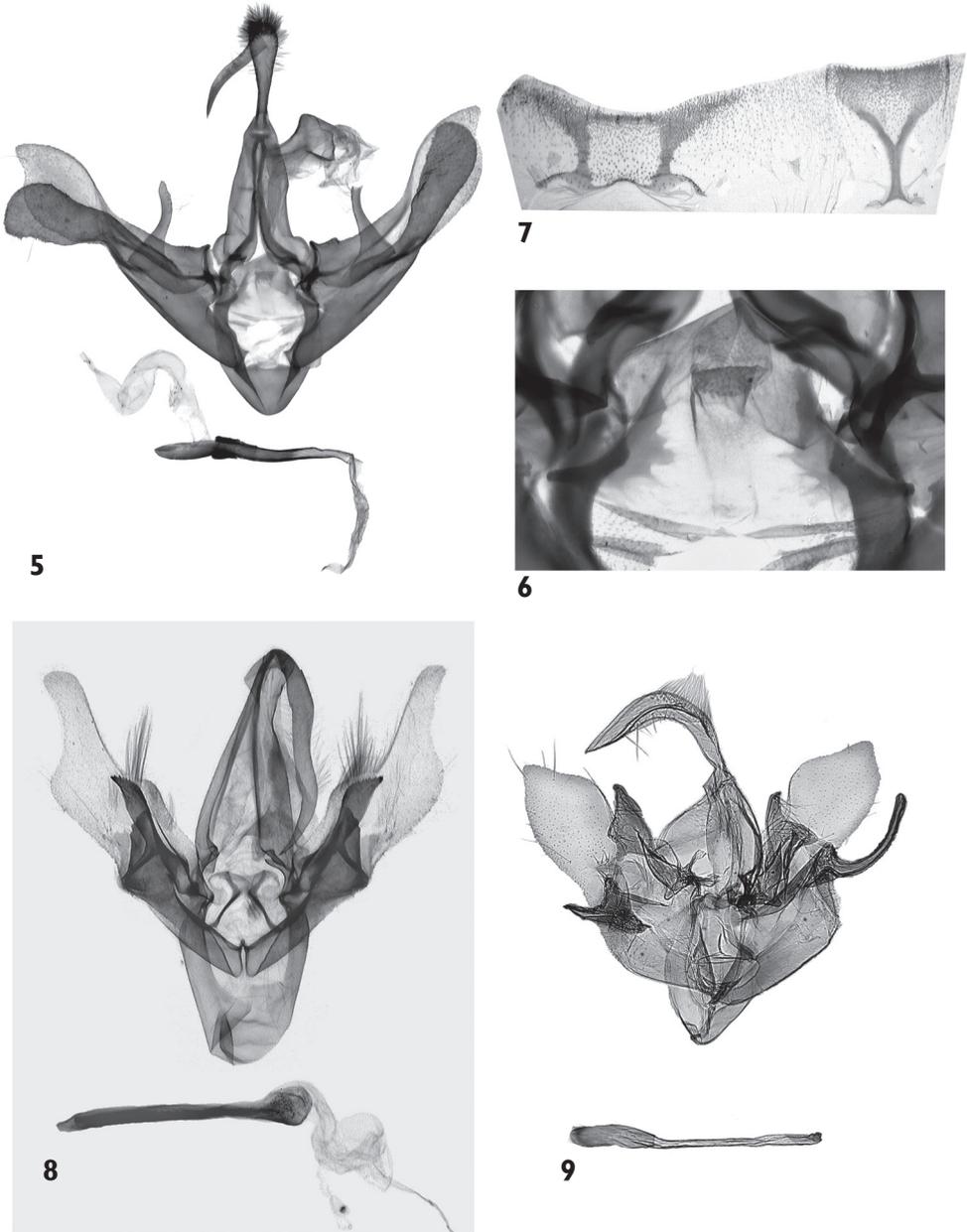
Type material. Holotype male. China, Sichuan, N29°52.808', E102°50.240', near Ying Jing, bamboo forest, 700 m, 4.IV.2011, leg. Floriani; slide No.: OP1429m (coll. O. Pekarsky, deposited in the HNHM Budapest). **Paratypes.** China, Sichuan: 4 ♂♂, with same data as the holotype (coll. A. Saldaitis, Vilnius); 1 ♂ (coll. O. Pekarsky); 1 ♂ (coll. W. Speidel, Munich).



Figures 1–4. Adults. **1–2** *Schrankia pelicano* sp. n. **1** holotype male, China **2** paratype male, China **3** *S. taenialis* male, Hungary **4** *S. separatalis* male, Korea.

Etymology. The species name refers to the resemblance of the opened male genitalia to a pelican.

Diagnosis. The new species possesses a number of the diagnostic characters of the genus *Schrankia* (e.g., absence of ocelli; long, straight palpi; wide valval base; presence of medial complex of processes; thin, elongated aedeagus). The autapomorphic features of *S. pelicano* are the very long palpi, being much longer than in other species of *Schrankia*, the biarticulate uncus, the extremely large sacculus, which is almost equal in size and similar in shape to the distal half of the valva. Considering the diagnostic characters mentioned previously, the new species is placed into *Schrankia*, but its generic position could change through a much needed revision of the entire genus. Among *Schrankia*, the new species is closest to the Oriental group of species known from Korea and Japan, *S. separatalis*, *S. dimorpha*, *S. kogii*, *S. masuii* and *S. seinoi*. This species-group is characterized by the flat, thin, weakly sclerotized (almost transparent) distal half of valva, which has a rounded apex, wider and more strongly sclerotized haunch-like valval base, the well-developed apical saccular projection, and the less broadened caecum. The numerous autapomorphic features of the male genitalia of the new species (Figs 5–7) make it difficult to determine its closest relative within *Schrankia*. The comparison is provided here with *S. taenialis* (Fig. 8), the type-species of the genus and *S. separatalis* (Fig. 9), the most similar representative of the Oriental group of species. *S. pelicano* is similar externally to *S. taenialis* and *S. separatalis* (Fig. 4) but has longer labial palpi, narrower, more elongated forewing with a less acute apex and straight,



Figures 5–9. Male genitalia. **5–7** *Schrankia pelicano* sp. n., holotype, China, slide No. OP1429m **5** clasper apparatus and aedeagus with vesica inverted **6** juxta (medially enlarged) **7** 8th abdominal segment **8** *S. taenialis* Hungary, slide No. 10059 RL **9** *S. separatalis* Korea, slide V. Kononenko.

almost parallel crosslines without undulations or dentations. The male genitalia of *S. pelicano* differ from those of the related species by the long and narrow, subapically constricted valva, very large sacculus, digitiform ampulla, and basally clavate uncus

with a long, narrow, acute distal part. *S. taenialis* (Fig. 8) has a narrow valva with an acute apex, a large and broad ampulla and a long uncus. The genitalia of *S. separatalis* have, in comparison with *S. pelicano*, short and wide valva with small sacculus and much thicker, continuously curved uncus having half-cylindrical cross-section (Fig. 9).

Description. Male (Figs 1, 2). Wingspan 16–17 mm, length of forewing 8 mm. Head, thorax and abdomen ochreous grey; ocelli absent; tongue well developed; palpi very long (almost 5 times longer than diameter of eye), straight, 2nd segment (with appressed scales) about 2.8 times longer than 3rd segment, which is porrect; antenna with fine ciliation ventrally along full length, basal joint without pectination. Forewing elongate, narrow with acute apex, outer margin with rounded termen; ground color grey brown; costa straight with five milk-white patches; basal line barely visible, semi-circular; antemedial line black, straight, oblique, curved upward near costa; postmedial line black, straight, oblique, extending from 2/3 from base on hind margin of wing to 9/10 from base on costal margin, edged on outer side by narrow yellow postmedial fascia; subterminal line faint, pale, irregular, parallel to outer margin of wing; terminal line black, most prominent between wing veins; cilia yellow at base with dark medial line, grey distally. Hindwing ochreous grey, discal spot grey, terminal line black; cilia pale yellow at base, grey distally. Abdomen slender, long. Female unknown.

Male genitalia (Figs 5–7). Uncus biarticulate, consisting of clavate and setose main part and long, narrow, subapically curved, bill-like extension with pointed tip; tegumen narrow, as long as vinculum; scaphium well sclerotized, distally dilated; subscaphium membranous; juxta large, triangular, wider at base, weakly sclerotized (almost transparent), with two narrow, strongly sclerotized lateral plates with serrated inner edges (Fig. 6); vinculum strong, cup shaped. Valva elongated, conspicuously constricted subapically; cucullus almost rounded with acute tip; corona absent; sacculus very large, elongated, with very long, heavily sclerotized, distally dilated saccular extension, almost as long as distal half of valve; clavus unspecialised; clasper/ampulla complex large, sclerotized, setose, cuneate with broad base and finely pointed apex. Aedeagus tubular, thin and gracile, finely undulate. Vesica relatively short (shorter than aedeagus), thinly tubular (as broad as average width of aedeagus), with fine granulose scobination throughout.

Distribution. The species is known only from the type-locality, South-West China, Province Sichuan.

Checklist of *Schrankia*

Europe

S. taenialis (Hübner, [1809]) TL: Europe

syn. *albistrigatis* Haworth, 1809 [TL: Britain]

S. costastrigalis (Stephens, 1834) TL: Witlesea Mere, Swaffham, Norfolk

syn. *exsularis* Meyrick, 1888 TL: New Zealand, Taranaki

syn. *triangulalis* Hudson, 1923

- syn. *costistrigalis* Dannehl, 1925 [TL: Italy]
 syn. *lugubralis* Dannehl, 1925 TL: South Tirol, Italy
 syn. *monotona* Lempke, 1949 [TL: Holland]
 syn. *unicolor* Lempke, 1949 [TL: Holland]
 syn. *virgata* Lempke, 1966 [TL: Holland]
 syn. *hartigi* Berio, 1991 TL: Sardinia
S. balneorum (Alphéraky, 1880) TL: N. Caucasus
 syn. *bosporella* Budashkin & Klyuchko, 1990 TL: Crimea

Africa

- S. solitaria* Fletcher, 1961 TL: Ruwenzori, Mahoma River [Uganda]
S. microscopica (Berio, 1962) TL: Aldabra Islands [Seychelles]
S. namibiensis Hacker, 2004 TL: Namibia, Brandberg, Am Königstein
S. scoparioides Hacker, 2004 TL: Namibia, Brandberg, Hungarob-valley

Asiatic region

- S. obstructalis* (Walker, [1866]) TL: Sarawak [Malaysia]
S. croceipicta (Hampson, 1893) TL: Ceylon, Pundaloya
 syn. *croceipicta aegrota* Berio, 1962; 179, TL: Seychelles, Mahe B., Vallon
S. aurantilineata (Hampson, 1896) TL: Ceylon
S. separatalis (Herz, 1904) TL: Korea
 syn. *squalida* Wileman & South, 1917; 28, TL: Japan
S. dimorpha Inoue, 1979 TL: Kagawa Pref., Shinoe, Fudodaki [Japan]
S. kogii Inoue, 1979 TL: Hokkaido, Shintoku, Kuttari
S. masuii Inoue, 1979 TL: Kagawa Pref., Shinoe, Oyashiki [Japan]
S. seinoi Inoue, 1979 TL: Amami-Oshima Is., Sumiyoson [Japan]
S. bilineata Galsworthy, 1997 TL: Hong Kong
S. pelicano sp. n. TL: China, Sichuan
S. bruntoni Holloway, 2008 TL: Ulu Temburon, Brunei
S. dusunorum Holloway, 2008 TL: Sabah, Ulu Dusun, 30mls W of Sandakan [Malaysia]
S. spiralaedeagus Holloway, 2008 TL: Sarawak, Gunong Mulu Nat. Park [Malaysia]

Australasiatic region

- S. calligrapha* Snellen, 1880 TL: New Hebrides, Aneityum, Red Crest, 3 km NE of Anelgauhat
S. taona (Tams, 1935) TL: Samoa, Savaii
S. capnophanes (Turner, 1939) TL: Tasmania, Mt. Wellington
S. dochmographa Fletcher, 1957 TL: Solomon Is., Rennell I., Hutuna
S. fururoa Robinson, 1975 TL: Fiji, Rotuma, Fururoa
S. vitiensis Robinson, 1975 TL: [Fiji]
S. boisea Holloway, 1977 TL: New Caledonia, Port Boise
S. cheesmanae Holloway, 1977 TL: New Hebrides, Aneityum, Red Crest, 3 km NE of Anelgauhat

- S. daviesi* Holloway, 1977 TL: Norfolk Is., N. Mission Road
S. erromanga Holloway, 1977 TL: New Hebrides, Erromango I., Nouankao Camp
S. karkara Holloway, 1977 TL: New Guinea, Karkar I., Dampier I.
S. nokowula Holloway, 1977 TL: New Hebrides, Sanot, Mt. Tabwemasana, Nokowula
S. nouankaoa Holloway, 1977 TL: New Hebrides, Erromango I., Nouankao Camp
S. tabwemasana Holloway, 1977 TL: New Hebrides, Santo, Mt. Tabwemasana, Nokowula
S. tamsi Holloway, 1977 TL: Samoa, Upolu I., Mt. Vaea

Neotropical region

- S. macula* (Druce, 1891) TL: Panama, Chiriqui
S. flualis (Schaus, 1916) TL: Panama, Trinidad River
S. musalis (Schaus, 1916) TL: Panama, Trinidad River

Oceanian region

- S. altivolans* (Butler, 1880) TL: Hawaii, Mauna Loa
syn. *simplex* (Butler, 1881) TL: Hawaii
syn. *oxygramma* (Meyrick, 1899) TL: Kaua, Kaholuamano [Hawaii]
syn. *sarothrura* (Meyrick, 1899) TL: Hawaii, Ola
syn. *arrhecta* (Meyrick, 1904) TL: Hawaii, Mt. Waimea
S. howarthi Davis & Medeiros, 2009 TL: Hawaii

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Taxonomic and faunistic studies on the genus *Harutaeographa* (Lepidoptera, Noctuidae, Orthosiini) with description of a new species

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Abstract

Description of a new *Harutaeographa* Yoshimoto, 1993 species, *Harutaeographa shui* **sp. n.** from China's Sichuan province, is given. *Harutaeographa yangzisherpani transformis* Hreblay & Ronkay, 1999 is combined as a synonym of *Harutaeographa yangzisherpani yangzisherpani* Hreblay & Ronkay, 1999. Additional distributional data for *Harutaeographa pallida* Yoshimoto, 1993, and *Harutaeographa cinerea* Hreblay & Ronkay, 1998 are provided. A checklist of the genus *Harutaeographa* and a key to the *Harutaeographa fasciculata* (Hampson, 1894) species-group, based on external characters and genitalia, are presented.

Keywords

Orthosiini, new species, *Harutaeographa*, distribution

Introduction

This paper contributes additional taxonomic, genitalic and faunistic information on the taxonomy of the genus *Harutaеographа* Yoshimoto, 1993 to what was previously provided in Chen (1999), Hacker and Ronkay (1996), Hampson (1894, 1906), Hreblay and Ronkay (1998, 1999), Hreblay et al. (1998), Kononenko et al. (1998), Ronkay and Ronkay (2000), Ronkay et al. (2001, 2010), and Yoshimoto (1993, 1994). The genus *Harutaеographа* is typical of the tribe *Orthosiini* within the Himalayan Noctuidae and contains 37 species and 3 subspecies distributed mostly in the Southeast Asian and Himalayan regions. Except for a few Western-Himalayan and Central-Asian species inhabiting semi-dry areas, most members of this genus are associated with the Himalayan monsoonic forest belt. Flight periods generally extend through March and April, but some Southern-Himalayan species are on the wing during the colder November to February period.

Materials and methods

The specimens of *Harutaеographа* preserved in the collections of Alessandro Floriani (Milan, Italy), Balázs Benedek (Törökbálint, Hungary), Gottfried Behounek (Grafing, Germany)/Zoologische Staatssammlung, Munich (Germany), Danny Nilsson (Kalvehave, Denmark) and Nature Research Centre (Vilnius, Lithuania) were examined. The specimens examined were collected in China and Nepal using ultraviolet light traps and occasionally sugar ropes. Seventeen genitalic slides were prepared and 27 photographs were made. Examination of morphology: after maceration, male and female genitalia were dissected and mounted in euparal on glass slides. Dissection of genitalia follows Lafontaine (2004). Photographs of genitalia were made using a Wild M3Z microscope and Canon EOS 350D camera.

Abbreviations of the material depositories:

AFM	Alessandro Floriani (Milan, Italy);
BBT	Balázs Benedek (Törökbálint, Hungary);
BMNH	Natural History Museum, London (United Kingdom);
DNK	Danny Nilsson (Kalvehave, Denmark);
HNHM	Hungarian Natural History Museum, Budapest (Hungary);
MNHU	Museum für Naturkunde Leibniz Institute for Research on Evolution and Biodiversity, Berlin (Germany);
NHM	Naturhistorisches Museum Wien (Austria);
NRCV	Nature Research Centre (Vilnius, Lithuania);
NSMT	National Science Museum Tokyo (Japan);
ZFMK	Zoological Forschungsinstitut und Museum Alexander Koenig, Bonn (Germany);
ZMH	Zoological Museum of Helsinki (Finland);
ZSM	Zoologische Staatssammlung, Munich (Germany).

Systematic accounts

Key to *Harutaeographa* species related to *Harutaeographa fasciculata* based on external characters

- 1 Forewings dark brown with black pattern or patches of dark scales.....2
 Forewings light brown, orbicular stigma whitish (Figs 10, 11).....
 *H. fasciculata* (Himalaya: Sikkim, N.India; Nepal)
- 2 Wingspan of forewings 37–42 mm, forewings narrow, cilia golden yellow (Figs 6, 7) *H. shui* (China: Sichuan)
 Wingspan of forewings 42–48 mm, forewings wide, cilia dark brown (Figs 8, 9).....*H. odavissa* (China: Shaanxi, Hubei, Sichuan)

Key to *Harutaeographa* species related to *Harutaeographa fasciculata* based on genital characters

- 1 Valva at apex widening, clasper curved, ductus bursae straight.....2
 – Valva not widening at apex, clasper almost straight, ductus bursae curved at base (Figs 17, 23)..... *H. fasciculata*
- 2 Uncus short, apical part of cucullus a boot-shaped plate with short blunt apex, ampula long, curved at apex, almost perpendicular to costa, both anterior and posterior parts of corpus bursae almost equal in size (Figs 15, 21)..
 *H. shui* sp. n.
- Uncus 1/3 longer than in *H. shui*, apical part of cucullus boot-shaped with short acute apex, ampula slightly curved at apex, posterior part of corpus bursae longer and narrower than anterior part (Figs 16, 22)..... *H. odavissa*

Harutaeographa shui Benedek & Saldaitis, sp. n.

urn:lsid:zoobank.org:act:C3F72129-2643-4234-84F6-ABEA933B13A8

http://species-id.net/wiki/Harutaeographa_shui

Figs 6, 7, 15, 21

Type material. Holotype: male (Fig. 6), China, Sichuan, 29°43.105'N, 02°36.195'E, near Siping, 1600 m, 27.iii.2011, Floriani leg., in the collection of ZSM; (slide No. JB1792m).

Paratypes: 3 males, with the same data as the holotype, 1 male, from the same locality, but 02.iv.2011, 1 female (Fig. 7), China, W. Sichuan, road Menghugang/Kangding, 29°49.955'N, 102°02.827'E, 1500 m, 19.iv.2010, leg. Chen Gun, in the AFM, BBT, and ZSM collections. Slide No. JB1793f.

Etymology. The specific name refers to the Shu Kingdom, which is now Chengdu, the capital of China's Sichuan province.

Diagnosis. *Harutaeographa shui* in general appearance is similar to *H. fasciculata* (Hampson, 1894) (Figs 10, 11), but is smaller and has more oblong forewings. Despite

this superficial resemblance to *H. fasciculata*, based on genital morphology the new species is more closely related to *Harutaeographa odavissa* Ronkay, Ronkay, Gyulai & Hacker, 2010 (Figs 8, 9). These species are easily distinguishable externally by forewing shape, coloration and pattern. The male genitalia differ from those of *H. odavissa* (Fig. 16) by its shorter uncus, smaller tegumen, remarkably broader and apically more elongate cucullus, and the configuration of the clasper-ampulla complex. The structure of aedeagus and vesica are similar to those of *H. odavissa* (Fig. 16), but *H. shui* (Fig. 15) has a slightly more curved aedeagus, differently configured vesica, and longer subterminal cornuti field. The female genitalia of the new species differ from those of *H. odavissa* (Fig. 22) in having a shorter ovipositor, shorter apophyses, and shorter and weaker ductus bursae.

Description. Wingspan 37–42 mm, length of forewing 17–20 mm. Head, front and thorax chocolate brown with some copper shine; male antenna bipectinate, female antenna narrow ciliate; forewings richly decorated with dark coppery-brown patterns distinctly marked with black scales, outer margin and cilia lighter golden yellow; hindwings with intensive dark suffusion, especially wide on outer margin, discal spot, and well-marked postmedial fascia; cilia with copper shine. **Male genitalia** (Fig. 15): uncus short, evenly broad; tegumen small and low; vinculum strong, narrow, V-shaped; valva finely arcuate; cucullus broad with apex elongate; sacculus weak, less sclerotized; clasper and ampulla robust outside and turned at middle; aedeagus rather long, gently arcuate; vesica with two subbasal coils and a small rasp-plate at base near carina, two small bunches of stronger cornuti in subbasal coils, and a long brush-like cornuti field on arcuate subterminal area. **Female genitalia** (Fig. 21): ostium nearly evenly truncated; ductus bursae narrow, somewhat wider and less sclerotized posteriorly; appendix bursae relatively small and rounded, weakly sclerotized; corpus bursae elongated, mesially constricted, with anterior and posterior parts subequal.

Bionomics and distribution. The new species is known only from Siping and Kangding areas of Sichuan Province (China), on the eastern edge of Tibetan plateau, where a few specimens were collected at the end of March – beginning of April at altitudes ranging from 1500 to 1600 m. It was attracted to light during cold (2–4 °C) nights in small river valleys. The habitat is mountain virgin mixed forest dominated by various broad-leaved trees, rhododendrons and bamboos (Fig. 27).

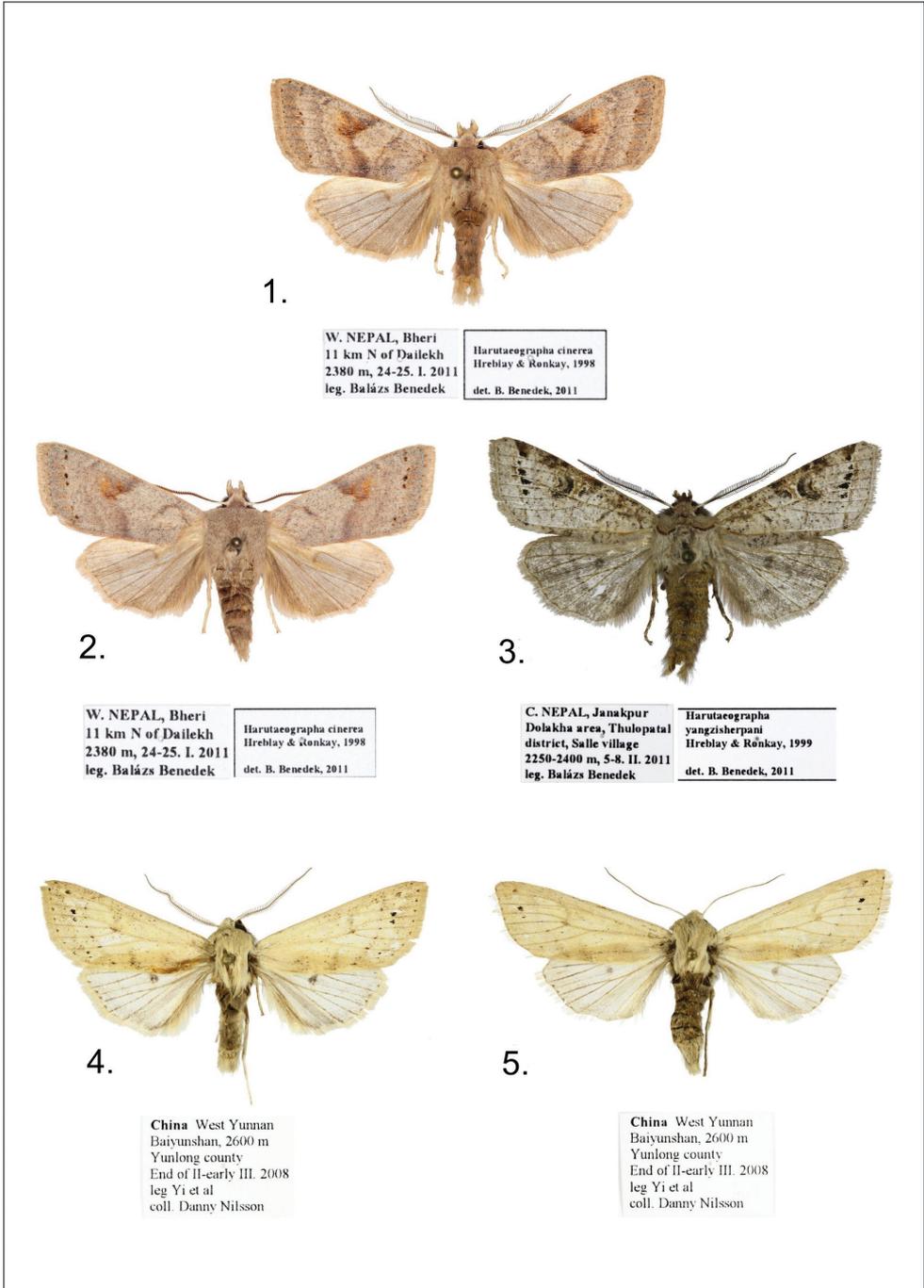
Harutaeographa monimalis (Draudt, 1950)

http://species-id.net/wiki/Harutaeographa_monimalis

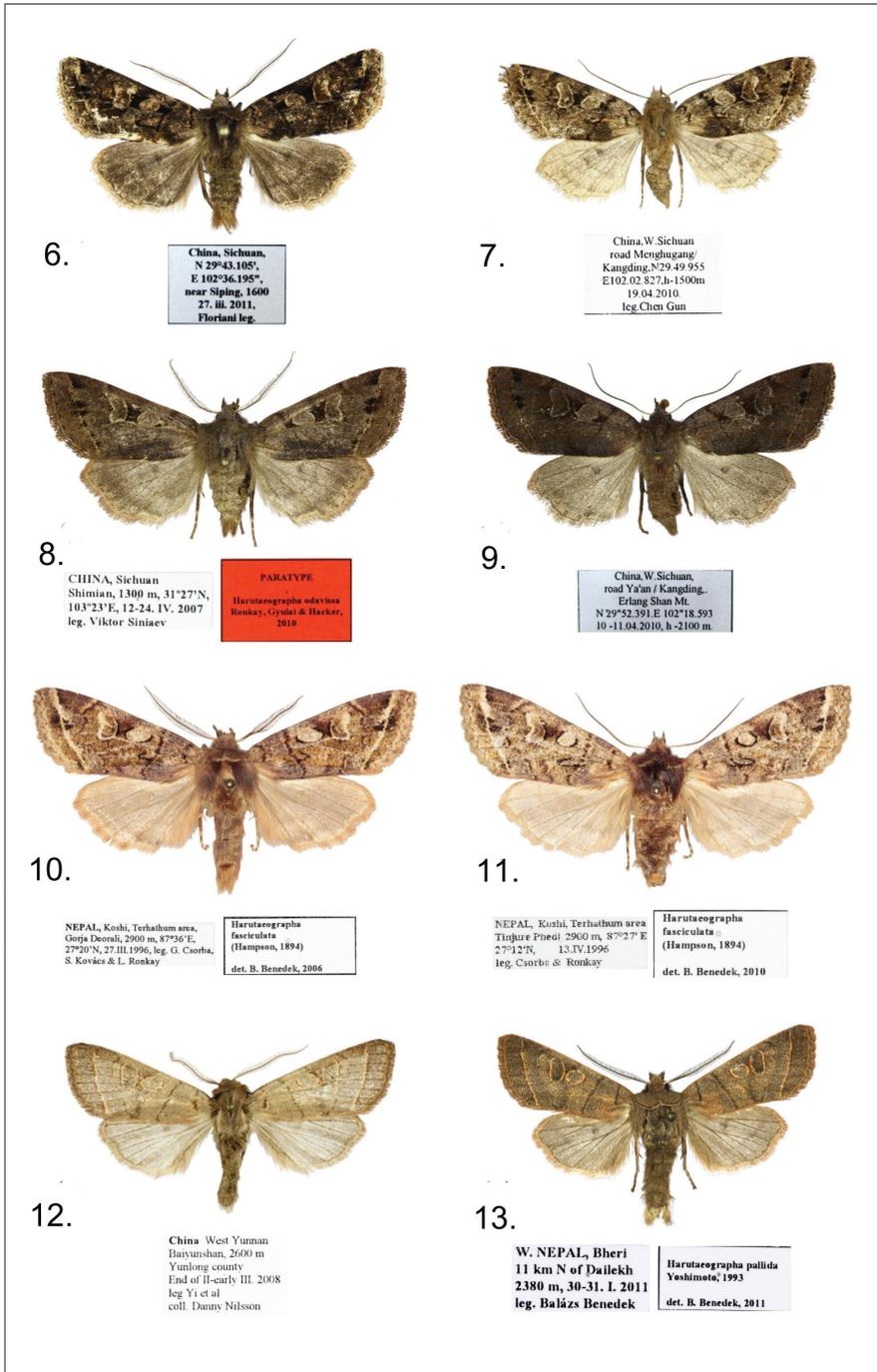
Figs 4, 5, 18, 24

Material examined. 1 male, 1 female, China, W. Yunnan, Baiyunshan, 2600 m, Yulong county, end of ii - early iii.2008, leg. Yi et al, in the collection of DNK; slide Nos JB1851m (Fig. 18); JB1852f.

Diagnosis. Male genitalia. Uncus small, elongated; tegumen short; juxta long, tongue-shaped, more or less quadrangular; vinculum short and heavily sclerotised,



Figures 1–5. *Harutaecographa* ssp. adults. **1** *H. cinerea*, male, West-Nepal, Bheri (BBT) **2** *H. cinerea*, female, West-Nepal, Bheri (BBT) **3** *H. yangzisherpani yangzisherpani*, male, Nepal, Janakpur (BBT) **4** *H. monimalis*, male, China, W. Yunnan (DNK) **5** *H. monimalis*, female, China, W. Yunnan (DNK)



Figures 6–13. *Harutaegerapha* ssp. adults. **6** *H. shui*, male, holotype, China, Sichuan (GBG/ZSM) **7** *H. shui*, female, paratype, China, Sichuan (AFM) **8** *H. odavissa*, male, paratype, China, Sichuan (BBT) **9** *H. odavissa*, female, China, Sichuan (BBT) **10** *H. fasciculata*, male, Nepal, Koshi (BBT) **11** *H. fasciculata*, female, Nepal, Koshi (BBT) **12** *H. pallida*, male, China, W. Yunnan (DNK) **13** *H. pallida*, male, West-Nepal, Bheri (BBT)

U-shaped; sacculus broad, with more or less parallel margins. Clasper relatively large, thumb-like, with elongated and heavily sclerotised base; clasper fused with relatively small and evenly curved ampulla. Valvae more or less symmetrical, broad, armed with strong, finger-shaped ventral process and large, broad digitus; cucullus broad and strong, more or less rhomboidal in shape. Aedeagus relatively long, straight and broad; vesica evenly helicoid in shape, everted ventrally, covered with a row of fine spiculi from basal part of vesica along to terminal segment where it merges into a stouter cluster of longer spines forming a brush-like structure. **Female genitalia** (Fig. 24): Ostium bursae wide, rounded; ductus relatively short; appendix bursae helicoid with three coils; corpus bursae constricted mesially with both anterior and posterior sections broadly elliptical.

Note. This is the first new report of this species known previously only by its holotype specimen collected by Dr. H. Höne in 1935 (coll. ZFMK, Bonn).

***Harutaeographa yangzisherpani transformis* Hreblay & Ronkay, 1999, syn. nov.**

http://species-id.net/wiki/Harutaeographa_yangzisherpani_transformis

Figs 3, 19

Material examined. 2 males, Nepal, Janakpur, Dolakha area, Thulopatal district, Salle village, 2250–2400 m, 27°35.998'N, 86°09.775'E 5–8.ii.2011, leg. Balázs Benedek, in the collection of BBT; slide No. JB1807m (Fig. 19).

Note. The genitalia of *H. yangzisherpani yangzisherpani* Hreblay & Ronkay, 1999 from Nepal exactly match those of *Harutaeographa yangzisherpani transformis* Hreblay & Ronkay from N. Vietnam pictured in Esperiana, 1999. The very slight genital differences between *H. yangzisherpani yangzisherpani* Hreblay & Ronkay, 1999 and *H. yangzisherpani transformis* Hreblay & Ronkay, 1999, suggest that they representing the same taxon and it is not reasonable to separate them as subspecies. Thus, *H. yangzisherpani transformis* Hreblay & Ronkay, 1999 is combined here as a synonym of *H. yangzisherpani yangzisherpani* Hreblay & Ronkay, 1999. It is first report of this species from Nepal.

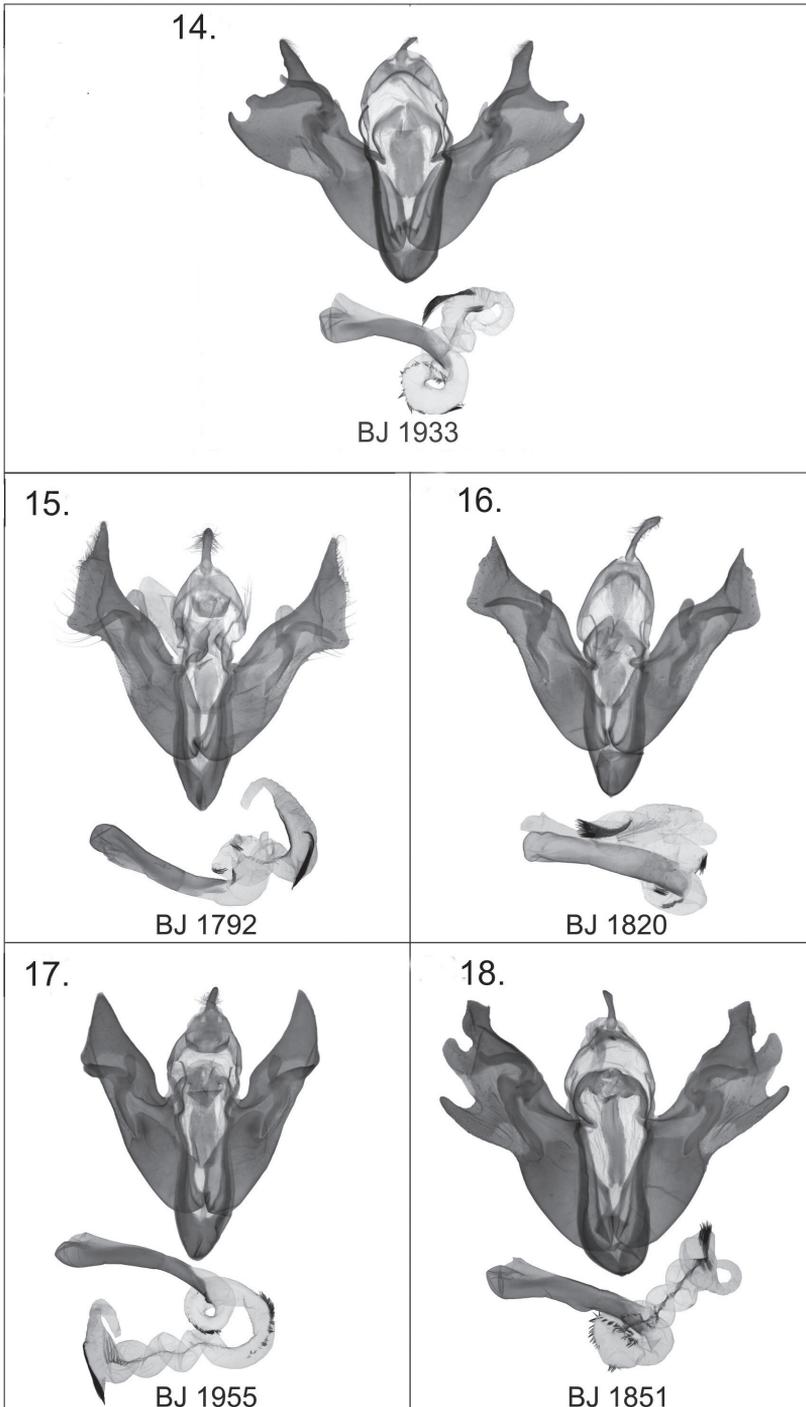
***Harutaeographa pallida* Yoshimoto, 1993**

http://species-id.net/wiki/Harutaeographa_pallida

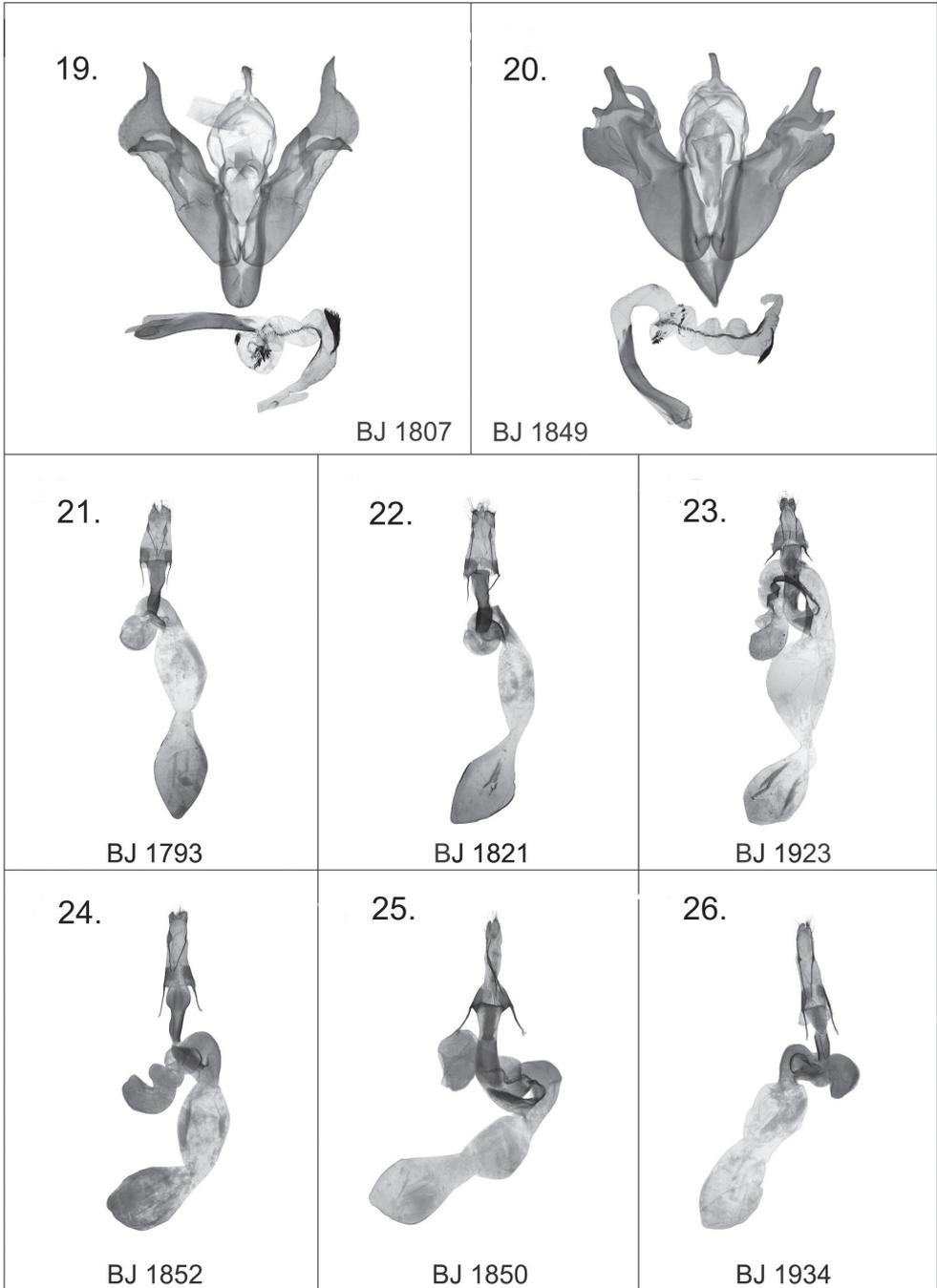
Figs 12, 13, 20, 25

Material examined. 1 female, West-Nepal, Bheri, Dailekh area, 11 km N of Dailekh, 2380 m, 24–25.i.2011, 1 male, West-Nepal, Bheri, Dailekh area, 11 km N of Dailekh, 2380 m, 30–31.i.2011, 2 males, Nepal, Janakpur, Dolakha area, Thulopatal district, Salle village, 2250–2400 m, 5–8.i.2011, leg. Balázs Benedek, 3 males, 1 female, China, W. Yunnan, Baiyunshan, 2600 m, Yunlong county, end of ii - early iii.2008, leg. Yi et al, in the collections of BBT and DNK; slide Nos JB1849m, JB1850f, (Figs 20, 25).

Notes. These specimens, which are paler in colour than those from Nepal, are the first to be reported from China.



Figures 14–18. *Harutaecographa* ssp. male genitalia. **14** *H. cinerea*, male, prep. BJ1933m **15** *H. shui*, male, holotype, prep. BJ1792m **16** *H. odavisa*, male, paratype, prep. BJ1820m **17** *H. fasciculata*, male, prep. BJ1955m **18** *H. monimalis*, male, prep. BJ1851m



Figures 19–26. *Harutaecographa* ssp. male and female genitalia. **19** *H. yangzisherpani yangzisherpani*, male, prep. BJ1807m **20** *H. pallida*, male, prep. BJ1849m **21** *H. shui*, female, paratype, prep. BJ1793f **22** *H. odavissa*, female, prep. BJ1821f **23** *H. fasciculata*, female, prep. BJ1923f **24** *H. monimalis*, female, prep. BJ1852f **25** *H. pallida*, female, prep. BJ1850f **26** *H. cinerea*, female, prep. BJ1934f



Figure 27. *Harutaegrapha shui*, type locality, China, Sichuan near Siping.

***Harutaegrapha cinerea* Hreblay & Ronkay, 1998**

http://species-id.net/wiki/Harutaegrapha_cinerea

Figs 1, 2, 14, 26

Material examined. long series of both sexes from the following localities: West-Nepal, Bheri, Dailekh area, 11 km N of Dailekh, 2380 m, 24–25.i.2011, West-Nepal, Bheri, Dailekh area, 13 km N of Dailekh, 2425 m, 26–27.i.2011, West-Nepal, Bheri, Dailekh area, 12 km N of Dailekh, 2600 m, 29.i.2011, West-Nepal, Bheri, Dailekh area, 11 km N of Dailekh, 2380 m, 30–31.i.2011, Nepal, Janakpur, Dolakha area, Thulopatal district, Salle village, 2250–2400 m, 5–8.ii.2011, leg. Balázs Benedek, in the collection of BBT.

Note. Little information has been available for this species due to insufficient collecting during its very early flight period (Hreblay and Ronkay 1998; Hreblay and Ronkay 1999). At the end of January–beginning of February in 2011 *H. cinerea* was one of the most frequently encountered noctuid species at light and sugar ropes at elevations between 2300–2600 m and is presumably widespread in Nepal.

Checklist of the genus *Harutaeographa****Harutaeographa adusta* Hreblay & Ronkay, 1999**

Holotype: coll. M. Hreblay, HNHM. Type locality: Thailand, Changwat Chiang Mai, Mt. Doi Inthanon. Distribution: Indochina, Thailand.

***Harutaeographa akos* Hreblay, 1996 [1997]**

Holotype: ZMH. Type locality: Tadjikistan, Gissar-Gebirge, Romit. Distribution: Tadjikistan (Gissar Mts.).

***Harutaeographa babai* Sugi & Sakurai, 1994**

Holotype: NSMT. Type locality: Nepal, Dhaulagiri, Jomsom. Distribution: Nepal; Himalaya.

***Harutaeographa bidui bidui* Hreblay & Plante, 1996 [1997]**

Holotype: coll. M. Hreblay, HNHM. Type locality: N. Pakistan, 5 km S Rattu. Distribution: Himalaya: N. Pakistan (Karakorum, Prov. Gilgit & Baltistan, Rattu, Prov. Jammu & Kashmir, Deosai Mts.).

***Harutaeographa bidui kaghanensis* Hreblay & Ronkay, 1999**

Holotype: coll. Hreblay, HNHM. Type locality: Pakistan, Prov. NW-Frontier, Kaghan valley, Khanian. Distribution: Pakistan (Prov. NW-Frontier, Kaghan valley, Khanian).

***Harutaeographa bicolorata* Hreblay & Ronkay, 1998**

Holotype: coll. Hreblay, HNHM. Type locality: Nepal, Ganesh Himal, 1 km E Gandrang. Distribution: Himalaya: Nepal (Ganesh Himal).

***Harutaeographa brahma* Hreblay & Ronkay, 1998**

Holotype: coll. Hreblay, HNHM. Type locality: Nepal, Ganesh Himal, 2 km W Thangjet. Distribution: Himalaya: Nepal (Ganesh Himal).

***Harutaeographa brumosa* Yoshimoto, 1994**

Holotype: NSMT. Type locality: Nepal, Janakpur, Jiri. Distribution: Himalaya: Nepal (Janakpur, Jiri, Terhathum distr.).

***Harutaeographa caerulea caerulea* Yoshimoto, 1993**

Holotype: NSMT. Type locality: Nepal, Mt. Phulchouki. Distribution: Himalaya: Nepal (Katmandu Valley, Godavari).

***Harutaeographa caerulea rubrigrappa* Hreblay & Ronkay, 1999**

Holotype: coll. Hreblay, HNHM. Type locality: Thailand, Changwat Chang Mai, Mt. Doi Phahompok, 18 km NW Fang. Distribution: Indochina: Thailand (Chiang Mai).

***Harutaeographa castanea* Yoshimoto, 1993**

Holotype: NSMT. Type locality: Nepal, Godavari. Distribution: Himalaya: Nepal (Kathmandu Valley, Godavari).

***Harutaeographa castaneipennis* (Hampson, 1894)**

Holotype: BMNH. Type locality: India, Kashmir, Narkundah. Distribution: Himalaya: N.India (Prov. Jammu & Kashmir).

***Harutaeographa cinerea* Hreblay & Ronkay, 1998**

Holotype: coll. G. Ronkay. Type locality: Nepal, Ganesh Himal, near Slya. Distribution: Nepal (Ganesh Himal, Slya).

***Harutaeographa craspedophora* (Boursin, 1969)**

Holotype: coll. Vartian, NHM. Type locality: Afghanistan, Paghman-Gebirge, 20 km NW Kabul. Distribution: Afghanistan (Paghman Mts.).

***Harutaeographa diffusa* Yoshimoto, 1994**

Holotype: NSMT. Type locality: Nepal, Janakpur, Jiri. Distribution: Himalaya: Pakistan; Nepal.

***Harutaeographa elphinia* Hreblay & Ronkay, 1999**

Holotype: HNHM. Type locality: Vietnam, Prov. Lao Cai, Mt. Fan-si-Pan, 7 km SW Sa Pa. Distribution: Indochina, Vietnam (Prov. Lao Cai, Tonkin).

***Harutaecographa eriza* (Swinhoe, 1901)**

Holotype: BMNH. Type locality: W. India, Punjab, Himachal Pradesh, Kulu. Distribution: Himalaya; Pakistan; India (Prov. Punjab).

***Harutaecographa fasciculata* (Hampson, 1894)**

= *H. fusciculata* nec Hampson, 1894

Holotype: BMNH. Type locality: Sikkim (India). Distribution: Himalaya: Sikkim, N. India; Nepal; North Vietnam (Fansipan Mts).

***Harutaecographa ferrosticta* (Hampson, 1894)**

Holotype: BMNH. Type locality: Kashmir, Narkundah. Distribution: Himalaya: Pakistan; N. India (Prov. Jammu & Kashmir).

***Harutaecographa ganeshi* Hreblay & Ronkay, 1998**

Holotype: coll. G. Ronkay. Type locality: Nepal, Ganesh Himal, 2 km W Gholjong. Distribution: Himalaya: Nepal (Ganesh Himal, Gholjong).

***Harutaecographa izabella* Hreblay & Ronkay, 1998**

Holotype: coll. Hreblay, HNHM. Type locality: Nepal, Annapurna Himal, 1 km E Ghorepani. Distribution: Nepal.

***Harutaecographa kofka* Hreblay, 1996 [1997]**

Holotype: BMNH. Type locality: N. India, Muktesar, Naini-Tal. Distribution: Himalaya: Pakistan; N. India; Nepal.

***Harutaecographa loeffleri* Ronkay, Ronkay, Gyulai & Hacker, 2010**

Holotype: coll. P. Gyulai, HNHM. Type locality: Burma, Chun state, Mindat camp. Distribution: Myanmar (Chun state, Mindat camp, Chun state, Natmataung Nationalpark, Mt. Victoria).

***Harutaecographa maria* Hreblay & Ronkay, 1999**

Holotype: coll. Hreblay, HNHM. Type locality: Pakistan, Prov. Jammu & Kashmir, Naltar valley, 5 km E Naltar. Distribution: Himalaya: Pakistan (Prov. Jammu & Kashmir, Karakorum).

***Harutaeographa marpha* Hreblay & Ronkay, 1999**

Holotype: coll. Hreblay, HNHM. Type locality: Nepal, Dhaulagiri Himal, 6 km NW Marpha. Distribution: Nepal; Himalaya.

***Harutaeographa monimalis* (Draudt, 1950)**

Holotype: ZFMK. Type locality: China, Yunnan. Distribution: China (Prov. Yunnan).

***Harutaeographa odavissa* Ronkay, Ronkay, Gyulai & Hacker, 2010**

Holotype: HNHM. Type locality: China, Shaanxi, Taibaishan. Distribution: China (Prov. Shaanxi, Taibaishan, Tsinling Mts., Prov. Hubei, Daba Shan, Prov. Sichuan, Daxue Shan, Gongga Shan, Volong Reserve, Siguliang Shan, Qingcheng Shan).

***Harutaeographa orias orias* Hreblay, 1996 [1997]**

Holotype: BMNH. Type locality: Prov. W. Bengal, Darjeeling. Distribution: Himalaya: N.India (Prov. Sikkim, Prov. W. Bengal, Darjeeling).

***Harutaeographa orias yoshimotoi* Hacker & Hreblay, 1996 [1997]**

Holotype: coll. Hacker, ZSM. Type locality: N. India, Himachal Prad., Rohtang. Distribution: Pakistan (Prov. Kashmir), Himalaya: N. India (Himachal Pradesh, Rohtang Pass, Prov. Sikkim); Nepal; Indochina; Thailand (Prov. Chiang Mai, Doi Phahompok)

***Harutaeographa pallida* Yoshimoto, 1993**

Holotype: HNSMT, Tokyo (Japan). Type locality: Nepal, Godavari. Distribution: Himalaya: N. India (Prov. Sikkim); Nepal (Katmandu Valley, Godavari, Solu Khumbu Himal, Ganesh Himal); China (Prov. Yunnan).

***Harutaeographa pinkisherpani* Hreblay & Ronkay, 1998**

Holotype: coll. G. Ronkay. Type locality: Nepal, Ganesh Himal, 2 km SW Haku. Distribution: Himalaya: Nepal (Ganesh Himal, Haku).

***Harutaeographa rama* Hreblay & Plante, 1996 [1997]**

Holotype: coll. Hreblay, HNHM. Type locality: N.Pakistan, 10 km SW Astor, Rama. Distribution: Himalaya: Pakistan (Jammu & Kashmir).

***Harutaegrapha rubida* (Hampson, 1894)**= *H. bipuncta* Yoshimoto, 1993

Holotype: BMNH. Type locality: Sikkim. Distribution: Himalaya: Nepal; N.India (Sikkim).

***Harutaegrapha saba* Hreblay & Plante, 1996 [1997]**

Holotype: coll. M. Hreblay, HNHM. Type locality: N.Pakistan, 10 km SW Astor, Rama. Distribution: Pakistan; Afghanistan.

***Harutaegrapha seibaldi* Ronkay, Ronkay, Gyulai & Hacker, 2010**

Holotype: coll. H. Seibald, Wien (Austria). Type locality: Burma, Chun state, Mindat camp. Distribution: Myanmar (Chun state, Mindat camp, Chun state, Natmataung Nationalpark, Mt. Victoria).

***Harutaegrapha shui* Benedek & Saldaitis, 2012**

Holotype: ZSM. Type locality: China, Sichuan, 29°43.105'N, 102°36.195'E, near Siping. Distribution: China (Sichuan).

***Harutaegrapha siva* Hreblay, 1996 [1997]**

Holotype: BMNH. Type locality: N. India, Simla. Distribution: Himalaya: N. India.

***Harutaegrapha stangelmaieri* Ronkay, Ronkay, Gyulai & Hacker, 2010**

Holotype: coll. Becher/Stumpf (Germany). Type locality: China, Prov. Yunnan, Daxue Shan Mts. Distribution: China (Prov. Yunnan, Daxue Shan Mts).

***Harutaegrapha stenoptera* (Staudinger, 1892)**

Holotype: MNHU. Type locality: Ussuri, Amur. Distribution: Russia: (SE Siberia, Amur, Ussuri, Primorje); Korea; China (Shaanxi).

***Harutaegrapha yangzisherpani yangzisherpani* Hreblay & Ronkay, 1999**= *H. yangzisherpani transformis* Hreblay & Ronkay, 1999

Holotype: coll. Hreblay, HNHM. Type locality: Thailand, Changwat Chiang Mai, Mts. Doi Inthanon. Distribution: Thailand, Vietnam; Nepal.

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