2010

Revision of the Genus Erythromelana Townsend, 1919 (Diptera: Tachinidae) with Notes on their Phylogeny and Diversification

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REVISION OF THE GENUS *ERYTHROMELANA* TOWNSEND, 1919 (DIPTERA: TACHINIDAE) WITH NOTES ON THEIR PHYLOGENY AND DIVERSIVICATION

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science

By

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2010
Wright State University

WRIGHT STATE UNIVERSITY

SCHOOL OF GRADUATE STUDIES

November 10, 2010

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ABSTRACT

Inclan Luna, Diego Javier. M.S., Department of Biological Sciences, Wrigth State University, 2010. Revision of the Genus *Erythromelana* Townsend, 1919 (Diptera: Tachinidae) with notes on their phylogeny and diversification

The neotropics harbor an enormous diversity of tachinid flies, yet the fauna remains poorly known. The tribe Blondeliini is particularly diverse in this region and desperately needs taxonomic attention. Here, I present a revision of the neotropical genus *Erythromelana* Townsend including the redescription of three previously described species and the description of 11 new species. Two species previously assigned into this genus, are resurrected as distinct genera. *Erythromelana* species are widely distributed from southern Mexico to northern Argentina, with the Andes being a hotspot of diversity. *Erythromelana* are specialized on geometrids in the genus *Eois*, which mainly feed on plants in the genus *Piper*. I constructed a morphological database (N=210), and used these data along with DNA sequence data to define taxa and infer phylogenetic relationships. The phylogeny, biology and patterns of diversity of *Erythromelana* are examined.

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INTRODUCTION

Insects account for a large portion of all biodiversity in the planet, but their ecology, taxonomy, behavior, and diversity are still poorly known. With biodiversity loss being a global problem, cataloging and describing species is one of the most important stages in the effort of conserving insect biodiversity. The present study focused on the revision of one small tropical genus of parasitic flies, *Erythromelana* Townsend (Diptera: Tachinidae). Specifically, I first discuss larger issues of insect diversity and then the specific focal taxon are introduced. Then I include a methods section in which I describe the procedures and analyses employed in this study, and finally I present the revisionary results and discussion of the biology and evolution of the genus.

Insect Diversity

In the quarter millennium since the publication of *Systema Naturae* by Carl Linnaeus (1707-1778), the first use of the binomial system of nomenclature in animals, many species have been described. In this Linnaean era, taxonomists have successfully discovered and named over a million species of animals (Zhang and Shear 2007). However many, probably the majority, remain to be named. Insect diversity represents the biggest gap in our knowledge of animal diversity (Winston 1999). Among all these described species, a majority belong to the class Insecta. Estimates of the total number of described species of insects vary; recent estimates include 720,000 (May 1997), 865,000 (Nielsen and Mound 1997), 917,000 (Brown 2001b), 959,000 (Hammond 1992), and 963,000 species [including insects and myriapods] (WCMC 2000). This diversity of species has been classified into 32 orders and about 939 families (Daly et al. 1998).

However, Gaston (2000) and Samways (2005) estimate that only ~10% of worldwide insects have been described. Estimates of the total number of insect species, including those yet to be described, are highly debated among scientists. In general, estimates of the world's animal species range from five to 30 million, 97% of which are invertebrates (Zhang and Shear 2007), most of which remain undescribed (Zhang and Shear 2007). Erwin (1982, 1997) predicted that the world's arthropods alone may comprise 30 million species based on his research of the specificity of beetles on trees. In contrast to Erwin's calculations, more recently researchers have estimated that world insect diversity ranges from two (Nielsen and Mound 1997), four (May 1997) eight (Hammond 1992, WCMC 2000) to 10 million species (May 1990, Gaston 1991, Gaston & Hudson 1994). In the end, taxonomists are faced with the necessity of describing and naming a huge proportion of the world insect diversity (~50 to 90%), whether the total insect richness is two or 30 million.

The ambitious project of describing and cataloging each one of the insect species on earth is a great taxonomic challenge. Stork (1997) reported that about 15,000 new species are described each year, with averages of 6,000 to 8,000 over the last 230 years. If this low rate of species description continues, 90 to 120 years will be necessary to describe all insect species, even if we consider a conservative number of 3,000,000 as the total of number of insect species (Stork 1997). The magnitude of this problem increases in the tropical regions, where insect diversity reaches its maximum levels (Samways 1994, Gaston 2000). In terms of density of insect species, almost 55% of global insects live in less than 7% of the world land surface, the tropical forests (Samways 1994).

Gaston and Hudson (1994) suggested that Neotropical insect diversity alone ranges from 1.5 to 16 million. Pitifully, less than 20% of tropical insect diversity has been described (Godfray et al. 1999). One exception is the taxonomic advance in the order Lepidoptera. About 90% of the worldwide Lepidoptera are already described and only 20% of the tropical species remain undescribed (Robbins et al. 1996, Robbins & Opler 1997). Lepidoptera, especially butterflies, are a good example of the potential achievements of many scientists combining their knowledge and effort working on this taxonomic challenge. However, there is an evident loss of worldwide taxonomic expertise, and relatively little is known taxonomically about many other orders (Samways 2005). The current research is focused on one of the poorest known major insect groups in terms of diversity: the order Diptera.

Diptera

The order Diptera ("true flies") is one of the most diverse orders of insects. This group represents 10-15% of the world's biodiversity (Brown 2005, Yeates et al. 2007) and contains approximately 157,000 described species (Thompson 2008). Estimate of the total diversity of Diptera suggest that this order may contain a minimum of 1,000,000 (Brown 2001a) to 1,700,000 species (Stork 1997). These estimates indicate than 90% of Diptera species remain undescribed. Again, the biggest gap of described species is for the Neotropical region. This is one of the richest biogeographic regions, but it only represents 15% of currently described Diptera (Brown 2001a, Amorin et al. 2002). Dipteran species have been classified into about 11,600 genera, 154 families, 22-32 superfamilies, 8-10

infraorders and 2 suborders (Oosterbroek & Courtney 1995, Yeates & Wiegmann 1999, Thompson 2008).

True flies are one of the most anatomically varied and ecologically diverse groups of insects (Yeates et al. 2007). An example of this diversity is the parasitoid Diptera. The common feature of the parasitoid lifestyle is that their larval stages usually feed in the body of a single host, typically killing it (Godfray 1994). Lawton (1994) stated that there are two principal reasons to study parasitoids: First, parasitoids can be used as a general models to reveal the course of the natural evolution of species; and second, studying parasitoids is useful and applicable to biological control of pests in agriculture. Similarly, Godfray (1994) emphasized that parasitoids play an important role in the regulation of populations in natural and agricultural ecosystems. For example, a study of the structure of tropical host-parasitoid in a community of leaf miners in Costa Rica showed that more than 30% of their mortality was due to parasitoids (Memmott et al. 1994). In Diptera, species with parasitoid life-styles comprise about 11% of the order (e.g., some species of Sarcophagidae, Conopidae, Pipunculidae, Phoridae, Bombylidae, Acroceridae) and ~20% of all parasitoid insect species (Godfray 1994, Freener & Brown 1997). Documenting and describing the diversity of dipteran parasitoids, especially in the Neotropics, represents a special need in order to fill the gap in our knowledge of parasitoid insect diversity, and has great potential for applications in programs of biological control (e.g. Suazo et al. 2006 & Suazo et al. 2008). These are the principal reasons for why the main goal of the present study is focused on the family Tachinidae, the most successful group of Dipteran parasitoids.

Tachinidae

The parasitic family Tachinidae is one of the most diverse families of Diptera (Belshaw 1993, Irwin et al. 2003). Tachinidae also represent the largest group of non-hymenopteran parasitoids (Belshaw 1994) including about 10,000 described species worldwide, classified in ~1,500 genera (Brown 2001a, Irwin et al. 2003, O'Hara 2008). The Tachinidae family is currently divided in four subfamilies, the Phasiinae, Dexiinae, Exoristinae and Tachininae, where the Exoristinae and Tachininae are the most species richness subfamilies (O'Hara 2008). Tachinids are well represented in all zoogeographic zones. Approximately 16 to 32% of the described species are from the Palearctic region, 29% are Neotropical, 14% are Nearctic, 10% are Afrotropical, 8% are Australasian, and 7% are from the Oriental region (Guimarães 1971, Irwin et al. 2003, O'Hara 2008). However, only the tachinids of the Paleartic and Neartic regions are well known, with about 90% of their species documented (Stireman et al. 2006). In contrast, the Neotropics appear to possess a highly diverse fauna and the current number of described species in this region represents only a small fraction of the true richness (Stireman et al. 2006, O'Hara 2008). This is despite the fact that in terms of described species, the family Tachinidae is the largest family of Diptera in the Neotropical region (Amorin et al. 2002). Conservative evaluations suggest that total neotropical tachinid biodiversity is at least twice the currently number of described species (Stireman et al. 2006). In summary, the neotropics probably harbors the greatest diversity of tachinids of any biogeographic realm, yet it remains one of the most poorly known faunas.

The purpose of the present study is the revision of the genus *Erythromelana*, which belongs to the tribe Blondeliini in the subfamily Exoristinae. The tribe Blondeliini was initially proposed and described by Mesnil (1939) based mostly on European species. Some of the principal characters that Mesnil (1939) used to define the tribe are the presence of setae on the prosternum, prealar bristle smaller than the first postsutural dorsocentral bristle (sometimes even absent), wing vein M forming an obtuse angle, subapical scutellar setae divergent and the apical setae very small or absent. However, these morphological characteristics are not present in all the current genera classified as Blondeliini. For example, the oriental genus *Hygiella* Mesnil is placed in the Blondeliini, even when specimens of this genus have a bare prosternum, well-developed apical scutellar setae, and convergent subapical scutellar setae (Crosskey 1977). Similarly, the new world genera *Chaetonodexodes* Townsend and *Thelyoxynops* Townsend are placed in the Blondeliini, even when these genera have non-divergent subapical scutellar setae (Wood 1985). These examples illustrate the complexity of this tribe, which Wood (1985) described as a group of relatively "heterogeneous assemblage of nondescript" tachinids. Additionally, there are no distinctive characteristics of male genitalia, females, or first instars that unite this tribe (Wood 1985). As a result, it has been suggested that the current Blondeliini may not form a monophyletic group (Crosskey 1977, Wood 1985).

The tribe Blondeliini is distributed nearly worldwide, but is most diverse in the New World, where it represents about 10% of the North America tachinids and probably a larger percentage of the neotropical fauna (Wood 1985). There have been few attempts to assemble the New World Blondelini by Sabrosky and Arnaud (1965), focusing on the

Nearctic fauna; Guimarães (1971) focusing on the South America fauna; and the most recent by Wood (1985), focusing on the fauna of North and Central America and the West Indies. However, the lack of consensus on the definition of the Blondeliini has led to an "arbitrary and intuitive" placement of several particular genera from the New World (Wood 1985). Some examples of this conflictive arrangement of genera into this tribe are all the genera previously assigned to tribes Admontiini, Ophirionini, Calodexiini, and some Erythrocerini among others (Wood 1985). In summary, the diversity and morphological homogeneity of the Blondeliini make this group one of the most taxonomically difficult of all Tachinidae, where the Neotropical region is particularly species rich and is in desperate need of taxonomic attention.

Our poor knowledge of global and tropical insect diversity, the current taxonomic challenge in orders like Diptera, and our lack of understanding of parasitoids are all important reasons to study tachinid taxonomy; especially in a group like the Exoristine tribe Blondeliini, which is in urgent need of taxonomic revision. Therefore, the present study helps to address our poor understanding of Neotropical tachinids with revision of the tachinid genus *Erythromelana*, by focusing on three major areas. First, I conducted a taxonomic revision of the tachinid genus *Erythromelana,* identifying and describing all species belonging to this genus for which material was available and revising the genus as a whole. Second, I used morphological and some molecular data to assess the phylogenetic relationships at the species and genus level; and third, I explored the factors that may have been involved in the diversification of the *Erythromelana* species.

Revision of the genus *Erythromelana*

Charles Henry Tyler Townsend (1863-1944) originally described the genus *Erythromelana* in 1918 (Townsend 1919). Townsend spent most of his life studying Neotropical insects, especially in Peru and Brazil, where he described and published about 3,000 new names of species and/or genera, principally of Diptera (Toma & Nihei 2006). Townsend worked as a Director of Entomology Stations for the Peru government from 1909 to 1914 (Toma & Nihei 2006). During this period he collected many Peruvian specimens that later have been used as types to describe new species and genera. Specifically, in 1911, Townsend collected one female and one male specimen from the Huascaray Ridge at ~215 meters in altitude in the Jaen Province of Peru; that later, in 1918, were utilized as genotypes to describe the genus *Erythromelana* and the species *Erythromelana jaena* (Townsend 1919).

No change was made in the genus *Erythromelana* until 1985 (e.g. see Guimarães 1971) when Wood published an important revision of the tribe Blondeliini. In this revision, Wood described the genus *Erythromelana* as medium size flies, characterized by the following traits: eyes large and haired or bare, parafacial bare and extremely narrow, postgena and gena narrow, pospronotum with two bristles, abdominal mid-dorsal depression not extending to hind margin, and broad variability in the abdominal color from fully yellow to black-silver. As result of this revision, Wood (1985) included in the genus *Erythromelana* the genera: *Minthomyia* Townsend 1920, *Euptilodegeeria* Townsend 1931, and *Myiodoriops* Townsend 1935. He further included the species *Myiodoriops marginalis* (Townsend) 1935, *Anisia nigrithorax* (Wulp) 1890, *Anisia*

obscurifrons (Wulp) 1890, and *Hypostena obumbrata* (Wulp) 1890 in the genus *Erythromelana* (Table 1). However, the scope of Wood's revision was the Blondeliini of North and Central America and the West Indies, and no similar work has been done for the Blondeliini of South America (with the exception of the South American type specimens that Wood considered in his revision). As a result, several Neotropical species of *Erythromelana* that have remained undescribed were studied in the current revision of this genus.

Table 1. Included species in the genus *Erythromelana* Townsend by Wood (1985).

Species	Author	Year
Erythromelana jaena	Townsend	1919
Erythromelana marginalis	(Townsend)	1935
Erythromelana nigrithorax	(Wulp)	1890
Erythromelana obscurifrons	(Wulp)	1890
Erythromelana obumbrata	(Wulp)	1890

A continuing caterpillar-parasitoid biological inventory project in the eastern Andes of Ecuador by Lee Dyer and collaborators has reared a great number of Lepidoptera and parasitoid species (e.g., Stireman et al. 2009). One focus of this project is the interactions between species in the plant genus *Piper*, their specialist geometrid herbivores in the genus *Eois,* and the parasitoids of *Eois*. After seven years of collecting data, this project has reared more than 100 morphospecies of *Eois* feeding on 40 species of *Piper* (Rodriguez-Castañeada et al. 2008, 2010). From these *Eois* species, 28 *Erythromelana* parasitoid specimens were reared, most of which were not previously described (Stireman et al. 2009). An understanding of the species limits, diversity, and relationships of *Erythromelana* complement the ecological and systematic work of other

researchers on their *Eois* hosts and *Pipper* host plants, providing an opportunity to create detailed systematic perspective of a tri-trophic community. In addition, the present study represents an important contribution to our better understanding of the genus *Erythromelana* and its relationship to other genera of Blondeliini tribe.

Phylogeny of *Erythromelana*

Although the family Tachinidae is one of the largest described families of Diptera and represents the biggest clade of non-hymenopteran parasitoids, most of the higher level relationships within the family remain unknown. Classifications based on morphological characters show that of the four subfamilies (Exoristinae, Dexiinae, Phasiinae, and Tachininae) only the Dexiinae can be defined by a synapomorphy, their hinged aedeagus (Tschorsnig 1985, Wood 1987). Therefore, the monophyly of the remaining subfamilies remain unclear (Wood 1987). Despite recent advances in genetic data and phylogenetic analysis, only two studies have used molecular techniques to test higher level associations in the Tachinidae family. Specifically, Stireman (2002) and Tachi and Shima (2010) have provided support for the monophyly of the Exoristinae. Given the morphological complexity of tachinids, there is a special need for molecular analysis to confirm the phylogenetic relationships among this group. Morphological analyses of the tribe Blondeliini have suggested that this group is probably polyphyletic (Crosskey 1977, Wood 1985), where studies using molecular techniques but limited numbers of taxa have reconstructed the Blondeliini as a monophyletic tribe (Stireman 2002, Tachi & Shima 2010). However, in these studies the position of *Phyllophilopsis* Townsend (Stireman 2002) and *Trigonospila* Pokorny (Tachi & Shima 2010) among the

Blondeliini is still in debate. Therefore, the Blondeliini is a clear example of the need of studies that integrate morphological and molecular analysis in order to reconstruct an accurate phylogeny of this tribe. Specifically, the position of the genus *Erythromelana* in the Blondeliini remains unknown, given that the only two previous studies involving this tribe have not included this genus in their analysis. In this study, I reconstructed a morphological and molecular phylogeny of *Erythromelana* species. In addition, I assessed the position of the genus *Erythromelana* among the Blondeliini.

Diversification of *Erythromelana*

Despite the importance and diversity of the family Tachinidae, the ecology of most species in the family is poorly known or unknown. Specifically, we know little about the forces involved in the rapid radiation and the processes of speciation and diversification of this family. Given the parasitoid lifestyle of tachinids, associations with particular host may play a role in species divergence. On the other hand, geographic separation may also be important. Nonetheless, there are few studies suggesting that sympatric speciation could be a mode of species diversification. For example, Smith et al. (2006) found that species in the apparently generalist genus *Belvosia*, actually represent many different cryptic species specialized on different hosts or groups of hosts. Therefore, host specificity may have played an important role in the diversification of these species of *Belvosia*. However, it is unclear if the speciation actually occurred *in situ* or if the species are now in secondary contact following geographic isolation. In the present study, I present a preliminary evaluation of the diversification of the genus *Erythromelana* based on 28 reared records and locality information from 582 specimens.

In general, I evaluated the likely roles of host associations versus geographic distributions in the diversification process of *Erythromelana* species.

OBJECTIVES

(1) Revision of the genus *Erythromelana*

The revision of the genus *Erythromelana* consists of four goals:

1) Redescribe and define the genus *Erythromelana*.
2) Identify and redescribe all the described species corresponding to the genus *Erythromelana*, including the synonymized genera/species included in the taxonomic revision of the tribe Blondeliini by Wood (1985).
3) Describe the *Erythromelana* species reared in an international collaborative caterpillar-parasitoid biological inventory project in the eastern Andes of Ecuador and from the material available from loans of the National Museum of Natural History (NMNH), the British Natural History Museum (BNHM), the National Biodiversity Institute of Costa Rica (INBIO) and the Canadian National Collection of Insects (CNC).
4) Create the first taxonomic key for identification of the species of *Erythromelana*.

(2) Phylogeny reconstruction of the genus *Erythromelana*

The reconstruction of the *Erythromelana* phylogeny consists of four goals:

1) Verify whether the *Erytromelana* species form a monophyletic clade.
2) Validate if the *Erythromelana* genus belongs to the Blondeliini.
3) Construct a morphological phylogenetic hypothesis of *Erythromelana*.
4) Construct a molecular phylogeny of *Erythromelana* and closely related genera in the Blondelini.

(3) Diversification of the species in the genus *Erythromelana*

The evaluation of the diversification of the *Erythromelana* species consists of two goals:

1) Evaluate the tri-trophic relationships among *Erythromelana* species their Lepidoptera host and their host plants.
2) Examine the geographic distribution of the *Erythromelana* species based on locality data and evaluate likely modes of diversification.

METHODS

The following sections describe in detail the procedures that I followed revising the genus *Erythromelana*. In summary, I started with the collection of specimens, which were initially sorted into morphospecies groups. Next, I dissected male and female terminalia for each morphospecies group to confirm the identity and composition of each group, and then, when necessary, I reorganized the morphospecies groups into new ones. Representatives of each one of the *Erythromelana* species was photographed and illustrated. In addition, I collected detailed information on 97 morphological traits for individual specimens, including continuous and discrete characters. I used this database (1) for a principal component analysis (PCA) to evaluate species morphological differences, (2) for the redescription of species and the description of the new species, and (3) to reconstruct phylogenetic relationships of *Erythromelana* species based on morphological characters. Additionally, I reconstructed the phylogenetic relationships at species and genus level based on molecular data from 13 specimens. Finally, I evaluated the rearing records and locality data of the *Erythromelana* species in order to assess the patterns of diversification of this genus.

Collection of specimens

This revision is based on the study of a collection of 581 adult specimens. Included among these specimens was material from: (1) reared specimens, (2) museum specimens, and (3) hand and trap collected specimens. The reared specimens were associated with a caterpillar-parasitoid biological inventory project in the eastern Andes

of Ecuador (see Stireman et al. 2009). From this project, 28 *Erythromelana* specimens were from different *Eois* hosts (see Rodriguez-Castañeada et al. 2008). In addition to these reared specimens, I obtained seven *Erythromelana* specimens collected by hand and pan traps in Ecuador and Costa Rica from Dr. J. Stireman. Finally, I acquired 547 *Erythromelana* specimens loaned from museum and personal collections (listed bellow). For all these specimens, I assigned a unique sequential number to each specimen in order to maintain an individual identity for each one of the analysis performed in this study. This collection of specimens included representatives from 11 different countries: Mexico, El Salvador, Trinidad, Costa Rica, Venezuela, Colombia, Ecuador, Peru, Bolivia, Argentina and Brazil. Included in these specimens were two primary types, 17 paratypes, and two lectotypes.

Codes used in the text for the museums and private collections from which I have borrowed material appear below with their names and respective curators.

BNHM	Natural History Museum, Departement of Entomology, London, UK; N.P. Wyatt.
CNC	Canadian National Collection of Insects, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada; J.E. O'Hara.
DMW	Private collection of D.M. Wood, Ottawa, Ontario, Canada.
JOS	Private collection of J.O. Stireman, Dayton, Ohio, USA.
INBio	National Biodiversity Institute of Costa Rica, Department of Entomology, Santo Domingo de Heredia, Costa Rica; M. Zumbado.

NMNH National Museum of Natural History, Department of Entomology, Smithsonian Institution, Washington, USA; N.E. Woodley.

PCE Private collection of P. Cerretti, Verona, Italy.

Reared material

All the reared specimens that I used in this study were collected from a collaborative caterpillar-parasitoid biological inventory in the eastern Andes of Ecuador (see Stireman et al. 2009). Specifically, the material was collected within 10 kilometers of the Yanayacu Biological Station & Center for Creative Studies (YBS). This station is located at 2,200m in the Quijos Valley, Napo Province, in the northeastern Ecuadorian Andes (00 36' S, 77 53' W). YBS is part of one of the largest intact altitudinal gradients in the eastern Andes from 250 to 5000m. The cloud forest reserve at YBS is one of the few remaining habitats of this type in the Ecuadorian Andes (see www.yanayacu.org).

Examination and illustration

Adult specimens were examined with a Nikon SMZ1000 stereoscopic microscope equipped with an ocular micrometer and a digital Nikon Coolpix 8800 camera. Color images were taken using the digital camera mounted on the stereoscopic microscope. To create images with a greater depth field, 30 to 50 pictures of each specimen/structure were taken at different focal points, and then pictures were compiled into a single image using the image stacking software CombineZM. Finally, Adobe Photoshop CS2 9.0 was used to digitally edit all the images. I used the same procedure for male and female terminalia pictures, with the only exception that the terminalia were held in a depression

slide with glycerin while the pictures were taken. The depression slide preparation has the advantage that the terminalia can be oriented with the use of a needle or moving the cover slip. Line drawings were made based on digital pictures, which were placed in Adobe Illustrator CS2 12.0.1 for digital drawing. Each drawing was compared to the original specimen/terminalia in order assess the accuracy of the drawing and make corrections when it was needed. Finally, scale bars are shown wherever size information was recorded.

Terminology and species descriptions format

Descriptions and redescriptions of the *Erythromelana* species were made following the format from Winston (1999) that includes: (1) a heading containing the scientific name, author and date; and (2) the main body that consist of the etymology, diagnosis, taxonomic discussion, ecology, and distribution. For the etymology section, I followed the terminology and rules of the fourth edition of the International Code of Zoological Nomenclature (ICZN) (2000). Specifically, the new species were named giving priority to distinguishing features, geographic areas of collections, or in honor of a particular collector or researcher. For the taxonomic descriptions, I mostly followed the terminology used in the Manual of Central America Diptera (Cumming and Wood 2009). In addition, I used the terms proposed by O'Hara (1989) for the male abdominal sternum 5 as shown in Fig 9. The cerci in posterior view exhibit a variety of different shapes across species. I followed the terms used in the description of the cerci by Wood (1987). Specifically, I divided the cerci in three main regions: (1) upper lobes, (2) medial section, and (3) apical cleft as shown in Fig 11.

Identification and grouping of specimens

A many of the specimens used in this study were previously classified at least at the genus level. However, there were a significant number of specimens that were not sorted to genus from the CNC, NMNH, and JOS collections. I classified these specimens using the original descriptions of the *Erythromelana* genus and species by Wulp (1890), Townsend (1919, 1920, 1931, and 1935), and Wood as a reference (1985). Additionally, I identified some of the specimens using the key of the Central America Tachinidae (Wood, in prep.), and/or by comparison with identified specimens.

After all the specimens were classified at the genus level, they were grouped into morphospecies based on morphological traits. Once I had the preliminary groups, I dissected the female and male terminalia of several members each group in order to confirm the identity of each morphospecies (see section on dissection of male and female terminalia). If the genitalia suggested the existence of cryptic species I proceeded to separate specimens into new groups based on genitalia morphology. Note that for the morphospecies in which the group was classified based on male terminalia, I was not always able to match their respective female. Therefore, there are some females for which identification to the species level was not possible and this is noted in the discussion section of the description of each species. After the confirmation of each morphospecies groups, I compared them with the type specimens assigned to *Erythromelana* housed in the NMNH and with the type specimens that I borrowed from the BNHM. At this point, I was able to identify all the current described species and the new species. After the analysis and description of the *Erythromelana* species, I assigned

the respective types and returned the specimens to their original collections. The final depository of each individual specimen is indicated in the description section of each species.

Dissection of male and female terminalia

Male genitalia of tachinids provide one of the best characters for taxonomic studies at the species level (O'Hara 1989). Initially, I dissected and examined one to three sets of male and female terminalia for each one of my preliminary *Erythromelana* morphospecies groups. Once I confirmed the identity of each group, I dissected more individuals depending on the availability of specimens for each morphospecies group. Dissections were performed according to the procedure described by O'Hara (2002). Briefly, this procedure involves the removal of the abdomen of an adult specimen, partial clearing of the abdomen in 10% of NaOH, dissection of genitalia, reattachment of the abdomen to the specimen, extra clearing of the genitalia in 100% lactic acid, and finally storage of the genitalia in a microdish with glycerine (O'Hara 1989, 2002). After the dissection, I characterized and measured the shape of the male and female terminalia structures as is explained in the following section.

Morphological characterization and measurements

After the final identification of the specimens in morphospecies groups, I proceeded with the morphological characterization of each group. This characterization included the creation of a database based on continuous and discrete characters for individual specimens. I evaluated a total of 210 specimens, including 80 females and 130

males. Additionally, I dissected the terminalia from 100 specimens, including 30 females and 70 males. For each specimen, I recorded a total of 97 variables including 30 continuous and 67 discrete variables. Twenty-five percent of these variables correspond to the head, 42 percent to the thorax, eight percent to the abdomen, and 25 percent to the terminalia. Additionally, I transformed the continuous variables into ratios in order to control for differences in overall body size, which can vary widely within tachinid species (O'Hara 2002). I used this information for a principal component analysis (PCA), for the redescription of species and the description of the new species, and for the reconstruction of the phylogeny of the species. Specifically for the species descriptions section, I reported the measurements separately for each sex using the mean for continuous variables and the median for discrete variables using the symbol "$\overline{x}$ "and the letter "m" respectively. In addition, I used the letter "N" to show the number of specimens that I used for the calculation of the mean and the median.

In the following section, I present the list and description of all the continuous and discrete variables that I recorded in this study and a list of the ratios that I calculated for the continuous variables. The numbers in brackets and parenthesis represent the sequential number of the variable and the number assigned to a particular state of the character, respectively.

Continuous variables:

All the following structures were measured through the stereoscope with an ocular micrometer. Measurements were taken in base of 10 units from the micrometer, which was calibrated using a 1mm slide micrometer allowing the conversion of the measurements to mm.

[1] *Body total length* was measured in profile from the pedicel to tip of the abdomen excluding abdominal setae.

Head

[2] *Ommatrichia length* was measured from the back of the head using a white background to see the contrast of the setae. For each individual, the measurement was the average of two-three setae taken from the center region of the right eye.

[3] *Head height*, [4] *eye height*; [5] *pedicel length*, and [6] *flagellum length* were measured in profile as shown in Fig. 2.

[7] *Parafacial width* was measured in profile at the narrowest point.

[8] *Facial ridge setae height* was measured in profile and it was evaluated from the vibrissal seta until the uppermost seta on the facial ridge as shown in Fig. 2.

[9] *Palpus length* was measured in profile as shown in Fig 2. For specimens in which measurement was not possible because the palpus was not visible, NA was reported.

[10] *Head width* was measured in frontal view as shown in Fig. 1.

[11] *Frontal vitta* (FV) and [12] *vertex width* were measured in frontal view at their narrowest point as shown in Fig 1.

Thorax

[13] *Thorax total length* was measured in dorsal view, at the center of the thorax from the anterior edge of the prescutum to the posterior edge of the scutum.

[14] *Ultimate fore-tarsomere length* was measured in profile at the center of the right fore-tarsomere.

[15] *Fore-claw length* was measured in profile from the right fore-claw.

[16] *Wing length* was measured in profile at the right wing from the end of the basicosta to the wing apex.

[17] *Percentage of setae on wing vein R4+5* was calculated as the proportion the distance between base of R4+5 and cross vein r-m on the right wing.

Male terminalia:

[18] *Sternite 5 basal plate length*, [19] *apical lobe length*, and [20] *S5 total length* were measured as shown in the Fig. 9.

[21] *Cerci* and [22] *surstylus length* were measured in profile.

The cerci were divided in three sections: [23] *upper lobe length*, [24] *medial section length*, and [25] *apical cleft length*, which were measured in posterior view as shown in Fig. 11.

Female terminalia:

[26] *Sternite 5 width* and [27] *length* were measured.

[28] *Sternite 6* and [29] *sternite 7 length* were measured at the center of each sternite.

[30] *Tergite 10* and [31] *cercus length* were measured.

***Discrete variables**:*

The following discrete characters were recorded:

Head:

[32] *Fronto-orbital plate (FOP) color*: (1) dull silver, (2) dull silver and black, and (3) black.

[33] *FOP pruinescence*: (0) absent and (1) golden pruinosity present.

[34] *Vertex color*: (1) dull silver, (2) dull siver and black, and (3) black.

[35] *Vertex pruinescence*: (0) absent and (1) golden pruinosity present.

[36] *Palpi color*: (1) brown, (2) yellow, (3) black, (4) brown with black at bases, and (5) brown-yellowish.

[37] *Ommatrichia*: (0) bare, (1) well developed, and (2) poorly developed.

[38] *Ommatrichia density*: (0) sparse, (1) dense.

[39] *Fronto-orbital seta*: Number of setae on right and left sides

[40] *Inner-orbital seta*: Number of setae on right and left sides

[41] *Outer-orbital seta*: Number of setae on right and left sides

[42] *Subvibrissal seta*: Number of setae

[43] *Ocellar seta*: (0) absent, (1) medioclinate, (2) lateroclinate, (3) proclinate, and (4) reclinate.

[44] *Arista microtrichia*: (1) pubescent, microtrichia length no more than the widest point of the arista, (2) plumose, microtrichia longer than width of arista.

Thorax:

[45] *Postpronotum setae*: Number of setae

[46] *Postpronotum seate alignment*: (1) forming a triangle, (2) in a line.

Setae on *presutural scutum*: [47] number of *acrostichal*, [48] *dorsocentral*, [49] *intra-alar*, and [50] *supra-alar setae*.

Seate on *postsutural scutum*: [51] number of *acrostichal*, [52] *dorsocentral*, [53] *intra-alar*, and [54] *supra-alar setae*.

[55] *1st supra-alar setae on postsutural scutum*: (0) absent, (1) smaller than 2nd supra-alar setae.

[56] *Katepisternum*: Number of setae

Scutellum setae: (0) absent, (1) present for [57] *basal*, [58] *discal*, [59] *lateral,* [60] *subapical*, and [61] *apical setae*.

[62] *Tibia color*: (1) yellow, (2) yellowish with black, (3) black.

Setae on *mid tibia*: Number of well developed setae on [63] *anterodorsal*, [64] *dorsal*, [65] *posterodorsal*, [66] *posterior*, [67] *posteroventral*, and [68] *ventral sections*.

Setae on *hind tibia*: Number of well developed setae on [69] *posterodorsal* and [70] *anteroventral* sections.

Wing cell color: (1) hyaline, (2) light fumose, and (3) dark fumose for: [71] c, [72] sc, [73] r1, [74] r2+3, [75] r4+5, and [76] dm cells.

[77] *R4+5 dorsally with setae* on (1) only at the base, (2) more that half way between the base and the cross with the vein r-m.

[78*] Number of setae at the base of R4+5* the right wing

[79] *M1 vein ending at wing apex*: (1) separately or (2) with R4+5.

Abdomen:

[80] *Abdomen color* in dorsal view: (1) fully yellow, (2) mostly yellow, (3) mostly black, (4) fully black, and (5) equally yellow and black.

[81] If *abdomen mostly yellow, dorsally with black on*: (1) t1+2; (2) t3; (3) t4; (4) t5; (5) t1+2, t3, and t4; (6) t3 and t4; (7) t1+2 to t5; and (8) t1+2, t4, and t5.

[82] If *abdomen mostly black; dorsally with yellow* on: (1) t1+2; (2) t3; (3) t4; (4) t5; (5) t1+2, t3, and t4; (6) t3 and t4; (7) t1+2 to t5; and (8) t1+2, t4, and t5.

[83] *White pruinescence forming apical bands on*: (0) absent, (1) 1/3 t3, t4, & ½ t5; (2) 1/3 t3, t4 & 2/3 t5; (3) 1/4 t3, t4 & 1/3 t5; (4) 1/2 t3, t4, & 4/5 t5; and (5) 1/4 t3 & t5.

[84] *Discal setae on*: (0) absent, (1) t3 to t5, (2) t5, (3) t3 & t4, and (4) t3.

[85] *Median marginal setae on*: (1) t1+2 to t5, and (2) t3 to t5.

[86] *Sex patches*: (0) absent, (1) on ventral t4 and t5.

Male Terminalia:

[87] *Setae on apical lobes of the sternite 5*: (1) one long bristle on each lobe, (0) absent.

[88] *Shape of apical lobes of the sternite 5*: (1) pointed lobes, (2) rounded lobes.

[89] *Surstyli internally with setae*: (0) absent, (1) small, (2) medium, (3) large.

[90] *Surstyli with a few small setae like spines at anterior side of the tip*: (1) present, (0) absent.

[91] *Surstyli shape*: (0) rectangular, (1) triangular shape

[92] *Cerci with a dorsal depression or twist* (1) present (0) dorsally flat.

[93] *Cerci shape in profile* forming a: (1) slightly carinate, (2) medium carinate, (3) strongly carinate, or (0) almost straight.

[94] *Pregonite shape*: (0) straight, (1) curved

Female terminalia:

[95] *Sternite 5 setae*: (1) with two pairs of well developed setae on posterior edge, (2) several well developed setae covering at least distal ¼ of the sternite, and (3) only one pair of well developed setae in the center of the sternite.

[96] *Sternite 8*: (0) absent, (1) present.

[97] *Tergite 8*: (1) dorsally with a distinctive narrow lobe, (0) dorsally without a lobe

Ratios:

In order to adjust measurements to control for size differences, the continuous variables were transformed into ratios. In addition, for the phylogenetic analysis, ratios were converted into discrete values as states. In order to transform the continuous values, I plotted in a histogram of the distribution of each ratio, and then I arbitrarily divided each ratio into subgroups that represent a specific range of their distribution. When possible, I attempted to divide states based on discontinuities or apparent troughs in the distributions. Finally, I assigned a discrete value to each one of the subgroups. In the next section, I present the list of each ratio followed, in brackets, by the number of the continuous variable involved in the calculation of the ratio and then, in parentheses, by the number of the states and their respective distribution.

Head:

Head height to body length [3 to 1]: (1) $X \leq 0.25$ and (2) $X > 0.25$

Head width to body length [10 to 1]: (1) X≤0.27, (2) 0.27<X≤0.3, and (3) X>0.3

Eye height to head length [4 to 3]: (1) X≤0.84, (2) 0.84<X≤0.88, and (3) X>0.88

Frontal vitta to vertex [11 to 12]: (1) X≤0.15, (2) 0.15<X≤0.32, and (3) X>0.32

Vertex to head width [12 to 10]: (1) X≤0.16 and (2) X>0.16

Parafacial wide to head width [7 to 10]: (1) X≤0.02 and (2) X>0.02

Facial ridge length to head height [8 to 3]: (1) X≤0.14, (2) 0.14<X≤0.18, and (3) X>0.18

Palpus length to head height [9 to 3]: (1) X≤0.29, (2) 0.29<X≤0.33, and (3) X>0.33

Pedicel length to flagellum length [5 to 6]: (1) X≤0.26, (2) 0.26<X≤0.32, and (3) X>0.33

Flagellum length to head height [6 to 3]: (1) X≤0.45, (2) 0.45<X≤0.5, and (3) X>0.5

Thorax:

Thorax length to body length [13 to 1]: (1) X≤0.34, (2) 0.34<X≤0.38, and (3) X>0.38

Fore-claw length to last fore-tarsomere length [15 to 14]: (1) X≤1 and (2) X>1

Wing length to body length [16 to 1]: (1) X≤0.85, (2) 0.85<X≤0.95, and (3) X>0.95

Male terminalia:

Sternite 5 basal plate length to sternite 5 apical lobe length [18 to 19]: (1) X≤0.8 and (2) X>0.8

Sternite 5 basal plate length to sternite 5 length [18 to 20]: (1) X≤0.42 and (2) X>0.42

Cercus length to sternite 5 length [21 to 20]: (1) X≤0.55, (2) 0.55<X≤0.75, and (3) X>0.75

Surstyli length to cercus length [22 to 21]: (1) X≤0.60, (2) 0.60<X≤0.66, and (3) X>0.66

Cercus upper lobes length to cercus length [23 to 21]: (1) X≤0.30, (2) 0.30<X≤0.40, and (3) X>0.40

Cercus medial section length to cercus length [24 to 21]: (1) X≤0.25, (2) 0.25<X≤0.45, and (3) X>0.45

Female terminalia:

Sternite 5 width to sternite 5 length [26 to 27]

Sternite 6 length to sternite 5 length [28 to 27]

Sternite 7 length to sternite 5 length [29 to 27]

Tergite 10 length to sternite 5 length [30 to 27]

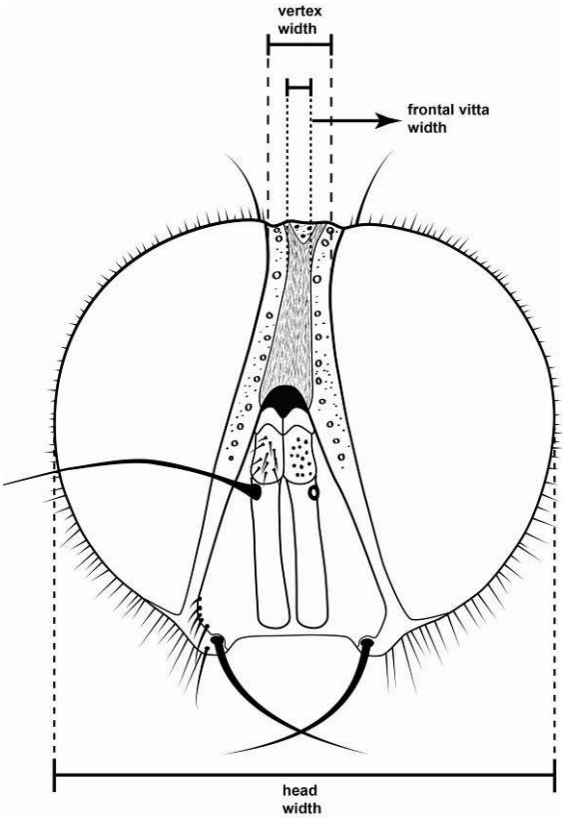


Figure 1. Frontal view of the head of male *E. leptoforceps*, showing head measuremns taken for descriptive purposes.

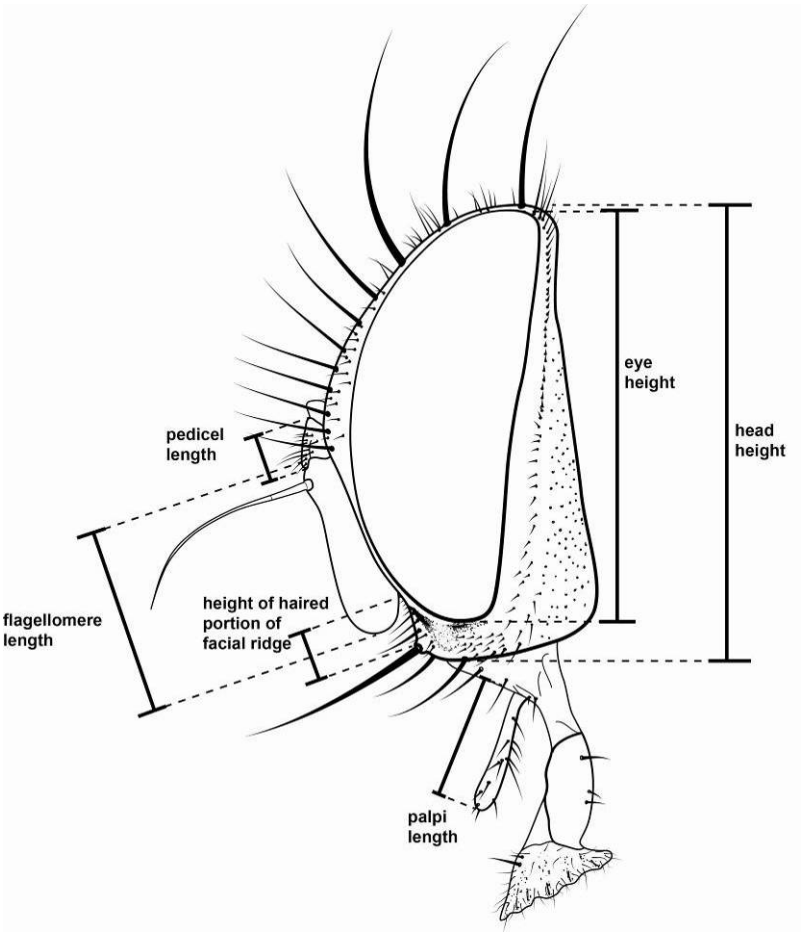


Figure 2. Lateral view of the head of male *E. leptoforceps*, showing head measuremns taken for descriptive purposes.

Citation of specimen label data

For the citation of label information, I followed the format of O'Hara (2002). In summary, the data of each type specimen were cited exactly as they appear on the label, where each line is separated by a diagonal slash (/) and information on each individual label is enclosed in parenthesis. Additional information that did not appear on the label was enclosed within brackets. Finally, the depository collection is ceted in parenthesis. Data on paratype and other matherial examined were cited as country, locality, date, collector, number and sex of specimens, and depository.

Distribution maps

Maps were created using SimpleMappr (2010), which uses coordinates in decimal degrees as latitude and longitude to create point distribution maps. The coordinates were based on the locality from the label information of each specimen. For specimens in which the labels did not include coordinates, I entered the locality information into Google Earth to get the approximately latitude and longitude of each location. All the coordinates were transformed to decimal degrees in order to interface with each map. Once the maps were created with SimpleMappr, I downloaded the maps as a scalable vector graphics (.svg) files. Finally, I exported the svg files to Adobe Illustrator to produce the final figures.

Principal Component Analysis (PCA)

I performed a principal component analysis (PCA) of morphological characters in order to explore whether *Erythromelana* species and sepecies groups could be easily distinguished morphologically. In summary, increasing distance between specimens in the PCA ordination space is an indicator of greater compositional dissimilarity. Therefore, I interpreted a cluster of specimens in the PCA ordination as preliminary evidence of the existence of species, subspecies, and/or genus groups. Notice that I used this analysis as an exploratory technique to detect some of the patterns in species composition, and the final grouping of species were not based exclusively on this analysis.

I performed the PCA analysis on two different data sets, which were arranged to explore differences: (1) among genera and (2) within the genus. Therefore, the first matrix contained information from four different genera, where the second data set included information of only *Erythromelana* specimens. In the first data set, I included information on 62 variables from 197 specimens, which correspond to 67♀ and 102♂ *Erythromelana*, 2♀ and 10♂ *Euptilodegeeria*, and 6♀ and 5♂ *Myiodoriops* specimens. Additionally, I incorporated 2♀ and 3♂ *Phyllophilopsis pallidicornis* as a control of a known genus, related to but distinct from *Erythromelana*. One goal of the analysis of this data set was to determine if taxa formerly assigned to these genera should be considered members of *Erythromelana* (e.g., in the absence of DNA data). In the second data set, I included information on 45 variables from 169 specimens, which correspond to 67♀ and 102♂ *Erythromelana* specimens. Note that all the information used in these two data sets only incorporated information of non-terminalic structures. For complete data sets, see Appendix 1 and 2.

I calculated the PCA using the function "prcomp" in the statistical software R (R Development Core Team 2010). In order to standardize the continuous and discrete variables, in the "prcomp" function, a scaling was done by dividing each column by their root-mean-square. The resulting PCA ordination was plotted using the function "ordiplot" in the statistical package *vegan* in R (Oksanen et al. 2007). Simultaneously, I plotted the 95% CI for each group using the function "ordiellipse" in the *vegan* package (Oksanen et al. 2007). I exported the PCA figures into scalable vector graphics (.svg)

files using the function "devSVG" from the package *RSvgDivice* in R (Luciani 2009). Finally, I exported the svg files to Adobe Illustrator to produce the finals figures.

PHYLOGENETIC ANALYSIS

Morphologic phylogeny

After identification of all of the species of *Erythromelana,* I compiled a matrix of morphological characters for each recognized species. This matrix was based only on characters from the male because of the difficulty associating females with their respective male species (see species description section). I included a total of 56 characters in the matrix, from which 43 and 13 corresponded to external and terminalia morphology respectively. Based on the collection of male specimens from each species, I calculated the mean and the median for the continuous and discrete variables respectively. Next, I transformed all the continuous variables into discrete states as was explained in the morphological characterization section. I evaluated a total of 17 *Erythromelana* species including one species, *E. cryptica*, that was divided into four groups based on their locality records. In addition, I included three different species belonging to two genera: *Euptilodegeeria obumbrata*, *Euptilodegeeria* sp. nov. and *Myiodoriops marginalis*. *E. obumbrata* was used as the outgroup species. For the complete data set, see Appendix 3.

A parsimony analysis of the matrix was performed using the package of programs for inferring phylogenies PHYLIP ver. 3.69 (*PHYL*ogeny *I*nference *P*ackage) for

Windows (Felsenstein 2005). In PHYLIP, I first used the SEQBOOT program to produce 1,000 data sets from my original matrix by bootstrap resampling. Next, I used the PARS program that based on the bootstrap data sets, finds the tree that requires the minimum number of changes using a multistate discrete-characters parsimony method (Felsenstein 2005). From the default settings in PARS, I changed the following parameters: First, on the Jumble option (J), I selected a random odd number and I set the seed to 100; this allowed the program to try 100 different orders of species in constructing the trees and printing the best trees among all 100 runs for each data set. Second, on the Outgroup option (O), I specified the position in the data set of *E. obumbrata* as the outgroup species. Third, on the Threshold option (T), I set a threshold number of six. As a result, when the number of steps counted in a character was higher than six, it was taken to be the threshold value rather than the actual number of steps; therefore, this option allows one to reduce the noise in the tree by de-weighting characters that are highly homoplasious. Fourth, on the weights option (W), I emphasized the information from the terminalia characters by giving a weight of two, which indicates that terminalia characters were counting twice in the analysis. Finally, on the Multiple data sets option (M), I set the program to read the 1,000 data sets from the bootstrap. Once I had the out file from PARS, I used the CONSENSE program to compute the consensus tree. The consensus tree includes at each node the number of times each group has occurred across data sets and parsimony searches. I used the software MEGA4 (Tamura et al. 2007) to explore and edit the final tree. Finally, I exported the three to Adobe Illustrator to produce the final figures.

Molecular phylogeny

DNA was extracted from the right metathoracic leg of 16 specimens that were kept in alcohol after collection and from 50 pinned-dried specimens. DNA extractions were made using the Puregene Core Kit A (QIAGEN Sciences Inc., Germantown, MD, USA) following the manufacturer's protocols. I amplified the mitochondrial gene CO1 using the primers LepF1 (5'-ATTCAACCAATCATAAAGATATTGG-3'), LepR1 (5'-TAAACTTCTGGATGTCCAAAAAATCA-3'). For the PCR amplification, I followed the general procedure described in Smith et al. (2006) and Stireman (2002). In particular, I performed the PCRs in 30 µl reactions volumes using a thermocycling profile of one cycle of 2 min at 94°C; 36 cycles of 30 sec at 94°C, 60 sec at 45°C, and 60 sec at 72°C; and a final cycle of 6 min at 72°C. The PCR products were sent to the sequencer UAGC (The University of Arizona Genetics Core) where the samples were run through an Applied Biosystems 3730XL DNA Analyzer in 96-well format. COI sequences were recovered for 13 specimens corresponding to five males and eight females as shown in the Appendix 4. These sequences were manually aligned and edited using CodonCode Aligner 3.5 (CodonCode Corporation, Dedham. MA, USA). In addition to these *Erythromelana* specimens, I incorporated 12 Blondeliini species sequences from which ten were obtained from the GenBank database (Benson et al 2000). All the new sequences that I used in this study were uploaded at the GenBank database and their respective codes are reported in the Appendix 4. Using these 25 sequences, I reconstructed the tree by conducting a Maximum Likelihood search using PHYML (Guindon & Pascual 2003). In PHYML, the statistical analysis was based on 500 bootstrap resampling. Next, I used MEGA4 (Tamura et al. 2007) to reconstruct and edit

the phylogenetic tree. In MEGA5, I set *Calolydella* sp. Wood01 as the outgroup species. Finally, I exported the tree to Adobe Illustrator to produce the final figures.

DIVERSIFICATION

I examined the diversification patterns of the *Eryhtomelana* specimens based on rearing records of 28 specimens and locality information of 554 specimens. Specifically, I evaluated the role of host associations and geographic distributions in the diversification process of the *Erythromelana* species. All the information that I used for the hosts associations were obtained from the YBS caterpillar-parasitoid biological inventory (see Reared material study site section). From this inventory, I constructed a database with the information of the 28 *Erythromelana* reared species, their caterpillar host and their feeding host plant. The information for the caterpillars and plant hosts included taxonomical identification to species level for a few specimens, whereas for most of the specimens the identification was based on morphospecies groups. Using this host database, I assessed how host-specific *Erythromelana* species appear to be. For the geographic distributions, I used the information provided in the level of each specimen to construct the distribution maps for each species (see Distribution maps section). Next, I evaluated the distribution maps to see which species do or do not overlap in their distribution. I correlated these distribution patterns with the altitudinal information in order to see if altitude might act as a geographical barrier to isolate species. Finally, I compared the results from the host associations and the geographic distributions to evaluate the role of these forces in the speciation process in *Erythromelana*.

RESULTS

PRINCIPAL COMPONENT ANALYSIS (PCA)

PCA by genera

Projections of the 62 external morphological variables onto the first two principal axes are shown in Figure 3. Mapping generic associations of specimens onto a principal component ordination shows a clear division of the four genera examined. Separation of specimens along the first axis (PC1) was generated by contrasts in the number of setae on various body sclerites, particularly the presence or absence of abdominal discal setae, the number of katepisternal setae, the number of supra-alar setae on postsutural scutum, the number of posterodorsal setae on the mid tibia, and the number of setae at the base of the R4+5 wing vein. Separation of specimens along the second axis (PC2) was mainly the result of contributions from the number of acrostichal setae on postsutural scutum, the number of anterodorsal and posterodorsal setae on the mid tibia, color of the sc and r1 wing cells, and the number of inner orbital setae.

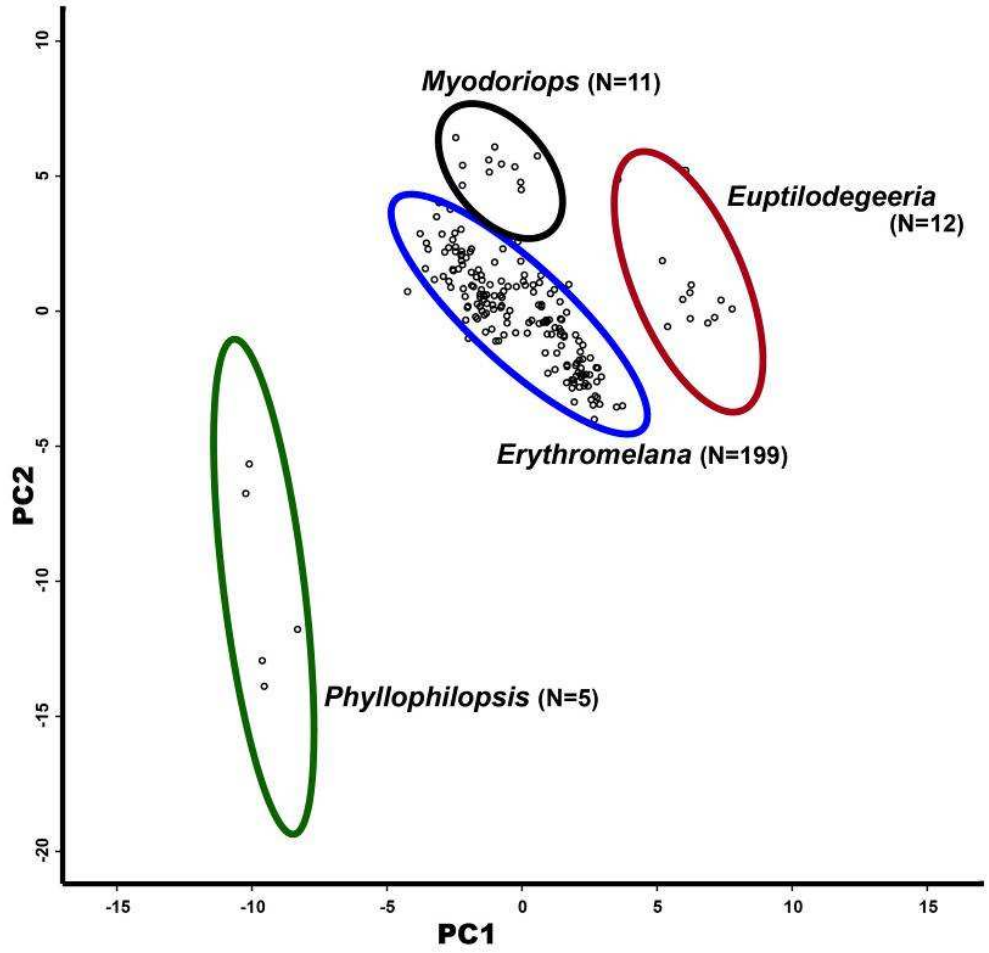


Figure 3. Principal component ordination of 227 specimens based on the analysis of 62 morphological variables. Ellipses show the 95% CI for the *Erythromelana*, *Euptilodegeeria*, *Myodoriops*, and *Phyllophilopsis* genera. The number after each genus represents the number of specimens evaluated.

Specimens plotted in the PCA ordination clearly show separation into the four different genera (Fig. 3). Specimens of the genus *Phyllophilopsis* that were used as a known control for a distinct genus of Blondeliini are clearly grouped on inferior left-quadrant of the ordination plot. Similarly, specimens of the genera *Euptilodegeeria* and *Myodoriops* are clustered in the superior right-quadrant of the plot. This suggests that the genus *Euptilodegeeria* and *Myodoriops* previously assigned to *Erythromelana* genus

(Wood 1985) are truly distinct genera. However, the genus *Euptilodegeeria* and *Myodoriops* are morphologically closely related to *Erythromelana* given the multivariate proximity of these genera to *Erythromelana* relative to *Phyllophilopsis* specimens. *Phyllophilopsis* differs from *Erythromelana* specimens in the presence of 14-17 frontal setae in males, no inner orbitals in males, no acrostichal seta on postsutural scutum, scutellum with apical seta, setae on the arista longer than the wifth of the arista, no antereodorsal seta on mid tibia, and four setae on postereodorsal mid tibia. Specimens in the *Euptilodegeeria* genus differed from *Erythromelana* specimens principally by the presence of small first supra-alar seta on postsutural scutum, R4+5 dorsally haired to cross vein r-m, abdominal discal setae on T3 and T4, and the presence of sex patches on the ventral T4 and T5 of males. Finally, specimens in the *Myodoriops* genus differed from *Erythromelana* specimens in their relatively wider parafacial, three inner orbital setae, scutum with three presutural and postsutural acrostichal setae, postsutural scutum with a small first supra-alar seta, and M vein ending in the R4+5 vein.

PCA of *Erythromelana*

Projections of the 45 morphological variables onto the first two principal axes are shown in Figure 4. Mapping species associations of *Erythromelana* specimens onto a principal component ordination shows a clear division of the two species groups. Separation of specimens along the first axis (PC1) was generated by contrasts in the number of setae on various sclerites, particularly the number of supra-alar setae on the postsutural scutum, the presence of abdominal discal setae, the number of katepisternal setae, the number of discal scutellar setae, and the number of acrostichal setae on the

postsutural scutum. Separation of specimens along the second axis (PC2) was mainly the result of contributions from the number of frontal setae, the ratio of the flagellum length to the head height, abdominal coloration, tibia coloration, and the presence of ocellar setae.

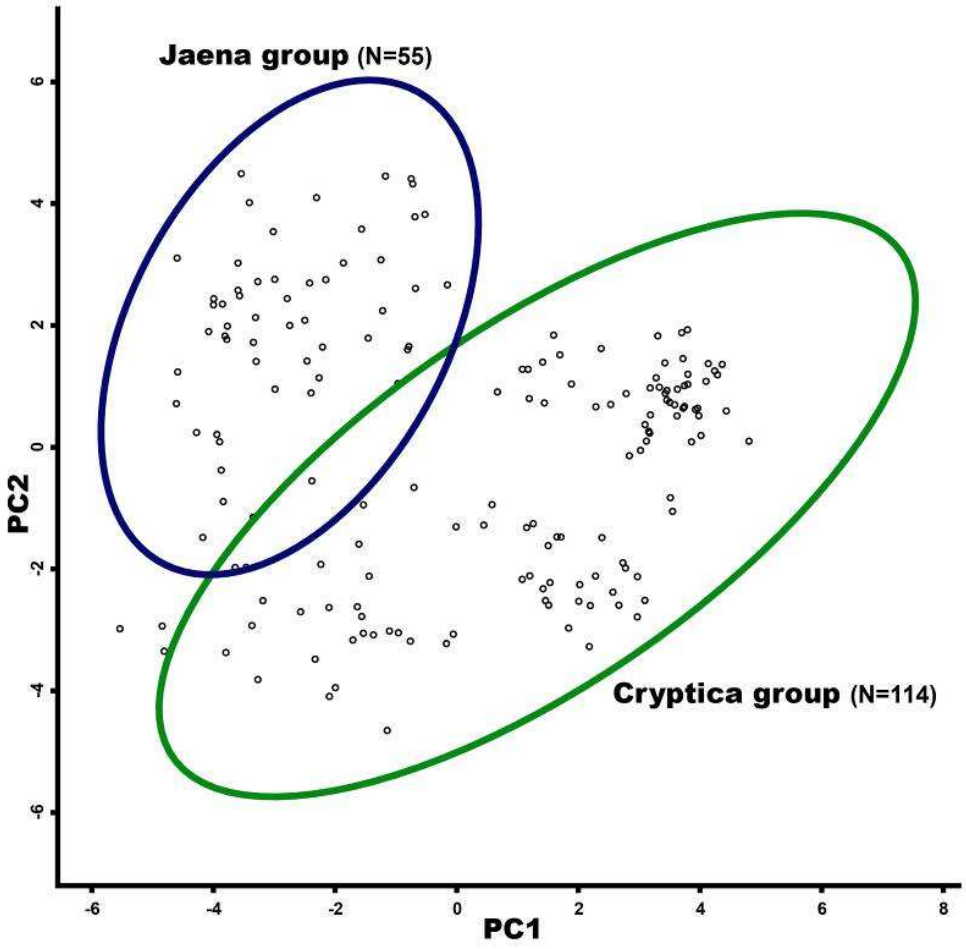


Figure 4. Principal component ordination of 169 specimens based on the analysis of 45 morphological variables. Ellipses show the 95% CI for *E. jaena* species group and *E. cryptica* species group. The number after each genus represents the number of specimens evaluated in each group.

The PCA ordination of *Erythromelana* specimens shows a relatively clear separation of two species groups (Fig. 4), although there is slight overlap in the 95% confidence intervals. Specimens morphologically similar to *E. jaena* are grouped on the superior left-quadrant of the ordination plot, and specimens similar to *E. cryptica* sp. nov. are clustered in the lower and superior right-quadrants. This suggests that *Erythromelana* species can be morphologically separated into two main species groups, which are referred here as the *E. jaena* and *E. cryptica* species groups (see species description section). In general, most of the species in the *E. jaena* group have a bright yellow abdomen (except on *E. leptoforceps* and *E. nigrithorax*), 2 katepisternal setae (except by 3 on *E. eois,* and rarely 3 in *E. ecuadoriana*), and the first postsutural supra–alar absent. In contrast, most of the species in the *E. cryptica* group have the abdomen mostly black with yellow laterally (rarely mostly yellow in *E. woodi*), 3 katepisternal setae (except on *E. distincta* and rarely *E. woodi*), and first postsutural supra–alar present (rarely absent in *E. cryptica*, absent in *E. convexiforceps*, *E. woodi*, and *E. distincta*). Individual species do not form clear, identifiable clusters in the PCA ordination. One reason for this overlapping of species is that this PCA analysis only includes non-terminalic structures and within the species groups, most *Erythromelana* can only be separated by differences in male terminalia. Similar results have been found in other Diptera, such as *Pseudexechia* (Mycetophilidae) flies, where a PCA analysis of 59 non-terminalic characters showed broad overlap between species in the ordination plot and only species groups were identified (Kjærandsen 2009). Morphologically cryptic species have been commonly found across Tachinidae (e.g., *Belvosia*, Smith et al 2006; *Winthemia*, *Anoxynops*, *Lespesia*, Smith et al. 2007) and many other insect groups (e.g., Butterflies,

Burns et al. 2008; Beetles, Monaghan et al 2005; Wasps, Molbo et al. 2003), where separation of species has required molecular techniques and/or terminalia characters. Therefore, the presence of cryptic species found in this analysis reinforces the importance of incorporating the study of terminalic characters and molecular data as is shown in the next following sections.

REVISION OF THE GENUS *ERYTHROMELANA*

Erythromelana Townsend 1919

DIAGNOSIS

Species of the genus *Erythromelana* are widely distributed throughout the Neotropical region. In general, members of this genus are medium size flies 6.7mm long, with large eyes, narrow and bare parafacial, and a small postgena and gena. With fairly narrow bodies, long wings, blackish thorax, long legs, and the abdomen ranging from all orange to all black, not strongly banded.

Erythromelana can be recognized among the Blondeliini by a combination of characters. On the head, the fronto-orbital plate of female bears 2 proclinate outer orbital setae, which are absent in the male. The inner orbital and vertical setae are well differentiated from the frontal setae and ocellar setae may be present or absent. The eyes are sparsely to densely haired. The arista is extremely long and it's thickened only at the base. The parafacial is extremely narrow and always bare. The lower margin of the face

extends to the level of the vibrissa, which are located at the extreme anteroventral corner of the head. These two traits, the extremely narrow parafacial and anteroventrally located vibrissae, serve to distinguish *Erythromelana* from most other genera of Blondeliini (though not from genera like *Anoxynops* Townsend, *Euptilodegeeria* Townsend, *Myodoriops* Townsend, *Phyllophilopsis* Toensend, *Trigonospila* Pokorny).

The chaetotaxy of the thorax of *Erythromelana* is somewhat variable. Generally, the genus can be characterized by the following traits: prosternum setose, postpronotum with 2 or 3 setae, katepisternum with 2 or 3 setae, first postsutural supra–alar small or absent, scutellum with apical setae absent, lateral setae shorter than subapical setae; wings equal or larger than body size, vein R4+5 setose only at the base, and vein R1 setose or bare.

On the abdomen, the mid-dorsal depression does not extend to the hind margin of T1+2 and discal seta, if present, are only found on T5. The male terminalia resemble of a number of other Blondellini (e.g., *Euptilodegeeria* Townsend). The apical lobes of sternite 5 may be rounded or pointed apically bearing 1 or 2 long well developed seta in some species (as in *Lixophaga* Townsend). The pregonite is slightly curved anteriorly and tapered to a narrow rounded tip. The postgonite almost parallel–sided and paddle-like with a broadly rounded apex. The shape of the cerci is variable and useful in differentiating many species. In lateral view, the shape varies from straight to slightly concave along anterior margin and from slightly concave to strongly carinate on posterior surface, ending in a nearly truncate or rounded tip. In posterior view, they are slightly to

abruptly constricted on the apical 1/3; with relatively long upper lobes; medial section and apical cleft dorsally flat or with a slightly depression on the medial section, sometimes producing an internal twist in the apex; and usually with a short well defined apical cleft. In the female, the fifth sternite is rectangular–shaped and either covered with well developed setae on more than posterior 2/3, or with 2 pairs of well developed setae close to posterior margin. Sternite 7 bears a distinctive medial lobe on the anterior margin. Sternite 8 is small, and usually difficult to distinguish from the surrounding membrane. Tergites 6 and 7 are each present as separate lateral sclerites.

REDESCRIPTION

Redescribed from 104 males (including the holotype *E. jaena*) and 68 females, unless otherwise noted as "N".

Length: 5.4–8.4mm ($\bar{x}$ = 6.7mm) in male, 5.0–7.3mm ($\bar{x}$ = 6.1mm) in female.

Head: Parafacial brown in ground color covered with silver or dull silver pruinescence. Fronto-orbital plate and vertex black in ground color covered with dull silver pruinescence (which could appear grayish from certain angles), usually with a faint golden pruinescence (visible only in lateral view). Frontal vitta usually entirely black, sometimes fading to dark–brown toward the antennae. Pedicel black and first flagellomere black covered with fine microtrichia, appearing grayish. Arista long, with minute setae, black with brown on basal 1/3 or less, thickened only on basal 1/4 or less. Eye sparsely to densely haired, ommatrichia about as long as 2-7 eye facets. Eye 0.83–0.97 head height in male, 0.77–0.92 in female. Vertex width 0.12–0.24 head width in male, 0.13–0.32 in female. Frontal vitta width 0.14–0.50 vertex width in male, 0.20–0.57

in female. Length of first flagellomere 0.36–0.59 head height in male, 0.35–0.60 in female. Pedicel length 0.19–0.38 length of first flagellomere in male, 0.22–0.37 in female. Fronto–orbital plate with 5–12 medioclinate frontal setae in male, 3–7 in female; 2 reclinate inner orbital setae (rarely with 1 extra small seta) in both sexes, rarely with only 1 seta in females; female with 2 proclinate outer orbital setae, male without outer orbitals. Vertex with 1 reclinate inner and 1 lateroclinate outer vertical seta, the latter varied from barely to well differentiated from the row of postocular setae in both sexes. Inner orbital and vertical setae usually about twice the length of frontal setae. Ocellar setae proclinate or absent. Parafacial bare and extremely narrow with the narrowest point equal to or narrower than the basal width of the palpus in both sexes. Facial ridge with hairs on basal 1/4 or less, and lower margin of face descending to the level of vibrissa. Subvibrissal ridge short, usually with 3 or fewer setae; postgena narrow, with a distinct but small genal dilation. Palpus coloration varied from fully yellow to brown-yellowish with black at bases; usually sparsely haired with base usually bare, but varied from just apically to fully dorsally bare; rectilinear, or slightly medially curved inward; usually almost uniform in width, but sometimes slightly to substantially broadened at the apices.

Thorax: Shiny black in ground color; presutural scutum with thin white pruinescence, postsutural scutum with much sparser pruinescence revealing underlying black ground color. In dorsal view only the presutural scutum appears grayish; whereas in lateral view the postsutural scutum appears grayish as well. Faint white pruinose stripes on presutural scutum leaving 4 or 5 black vittae; the inner 2 or 3 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae. Prosternum with several hair-like setae in middle.

Postpronotum with 2 setae, rarely with 1 small additional seta (*E. woodi* sp. nov. usually with 3 setae); Proepisternum bare. Katepisternum with 2 or 3 setae. Scutum with 1 or 2 presutural acrostichal setae, rarely with 1 additional small seta; postsutural acrostichal setae varied from 1 to 3, rarely with 1 or 2 additional small setae; 2 presutural dorsocentral setae, occasionally with 1 additional small seta; 2 or 3 postsutural dorsocentral setae, usually with 1 or 2 additional small setae; 1 presutural intra–alar setae, occasionally with 1 additional small seta; 3 postsutural intra–alar setae; 1 presutural supra–alar setae, rarely with 1 additional small seta; and 2 or 3 postsutural supra–alar setae, first postsutural supra–alar small or absent. Scutellum with a pair each of well developed divergent subapical and basal setae; a pair of moderately developed lateral setae, shorter than subapicals and curved medially; discal setae usually absent, sometimes with 1 hair–like pair; and without apical setae.

Legs usually entirely black, rarely with dark yellowish on medial section of the front and hind tibiae. Tarsal claws longer than 5th tarsomere in male and shorter than 5th tarsomere in female (although shorter in both males and females of *E. ecuadoriana* sp. nov.). Mid tibia with 1 anterodorsal seta, 2 posterodorsal setae, and 1 ventral seta. Hind tibia with anterodorsal setae uneven in length and not closely spaced; 2 well developed posterodorsal setae, rarely with 1 or 2 additional shorter seta; anteroventral setae varied from 2 to 9 well developed setae. Upper and lower calypteres brown–yellowish. Wings length usually subequal to body length or longer. Wings varied from completely hyaline to dark or light fumose on cells c, sc, r_1, r_{2+3}, and r_{4+5}. Wing vein R_{4+5} dorsally setose only at base, and R1 dorsally setose on about apical half on *E. ecuadoriana* and *E. distincta* sp.

nov. Vein M smoothly curved at bend and ending at wing margin anterior to wing tip separately from vein R_{4+5}.

Abdomen: Coloration varied from fully yellow to fully black, but several species with abdomen mostly black with yellow laterally on T_{1+2} to T_4. Transverse bands of sparse white pruinosity sharply demarcated on specimens with black abdomen, almost invisible to naked eye on specimens with yellow abdoment. Mid-dorsal depression of syntergite 1+2 not extending to hind margin. One pair of median marginal setae on T_{1+2} and T_3; a row of median marginals on T_4 and T_5; 1 pair of lateral marginal setae on T_{1+2} and T_3; and discal setae present as an irregular row on T5, or absent. Sternites completely overlapped by tergites.

Male terminalia: Sternite 5 with median cleft smoothly U or V-shaped; inner margin with minute setae; apical lobe rounded or pointed apically with a single long well developed seta present, rarely with 2 setae, or absent. Sternite 5 usually slightly concave on anterior margin of basal plate. Hypandrial arms separated. Pregonite curved anteriorly and tapered to a narrow rounded tip, with setae along posterior margin. Postgonite short and paddle like, almost parallel–sided with rounded apex. Epiphallus small, usually hard to see between the pregonites. Surstyli with small hairs externally and internally (with well developed setae on internal surface of *E. distincta*), or completely bare. Surstyli, in lateral view, varied in shape from almost straight to slightly concave on anterior or posterior margins; usually ending in a broad rounded apex, occasionally truncate. Surstyli and cerci usually subequal in length, sometimes cerci shorter than surstyly. Cerci, in

lateral view, varied from straight to slightly concave along anterior margin and from slightly concave to strongly carinate on posterior margin, ending in a nearly truncate or rounded apex. When a carina is present on the posterior margin of the cerci, it ends abruptly or gradually producing and right or obtuse angle, respectively. In posterior view, cerci slightly to abruptly constricted on apical 1/3; dorsal inner margin of the cerci on the medial section rarely with small pointed processes; upper lobe length varied from shorter, subequal to longer than the medial section or apical cleft; medial section and apical cleft dorsally flat or with a slight depression on the medial section, extended to an internal twist in the apical cleft of *E. cryptica* sp. nov., *E. catarina* sp. nov., *E. convexiforceps* sp. nov., and *E. distincta* sp. nov.; apical cleft slightly to well defined; and apex of the cerci linear or curved, with tips pointing distally or directed medially, respectively.

Female Terminalia: Sternite 5 rectangular–shaped, middle of anterior margin slightly concave, covered with well developed setae on more than posterior 2/3, or with 2 pairs of well developed setae near the posterior margin. Sternite 5 usually about twice as long as wide. Sternite 6 with several well developed setae on posterior corners.T_6 well developed, present as two lateral sclerites, with well developed setae along posterior margin. Sternite 7 with a distinctive elongate medial lobe on the anterior margin, with several small setae on posterior corners. Tergite 7 present as two lateral sclerites, with small setae along posterior margins. Sternite 8 usually small and bare, difficult to distinguish from the surrounding membrane; sometimes absent. Tergite 8 bare, well developed laterally, strongly narrowed dorsally, joining at the ventral end with the postgenital plate; dorsally with a distinctive narrow lobe on the medial section of the

anterior margin on *E. distincta*. Tergite 10 between the cerci, small and bare, usually rhomboid shape. Postgenital plate with several small setae on posterior tip. Cercus usually slightly narrowed at bases, with several setae apically.

Host: Twenty eight *Erythromelana* specimens were reared from *Eois* spp. caterpillars (Lepidoptera: Geometridae), and one specimen from an unknown pyralid larva (Lepidoptera: Pyralidae) (although see species diversification section). These specimens were reared from caterpillars that were collected in a 10 kilometers radio from YBS (Napo, Ecuador) on host plants in the genus *Piper* or related genera (*Piperaceae*), and one specimen on *Siparuna pyricarpa* (Monimiaceae).

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

The genus *Erythromelana* is widely distributed in the Neotropical region, from southern Mexico to northern Argentina (Map 1). Specimens have been collected from ten different countries: Mexico, El Salvador, Costa Rica, Venezuela, Colombia, Ecuador, Peru, Bolivia, Argentina and Brazil. There is a large geographical gap between the specimens collected in Mexico and those collected in Costa Rica as well as the specimens collected in southern Brazil and the specimens collected along the Andes Mountains. These disjunct distributions are probably largely due to the limited collecting effort in the Neotropical region in general. Species occur on lowland tropical to montane tropical forest including both low elevations (e.g., Santa Catarina, Brazil, 300–500m) and high elevations (e.g., Napo, Ecuador 2000–2600m). In particular, all the species with a yellow abdomen appear to occur only in the Andes Mountains, a region that is probably contains

more species of *Erythromelana* than any other area of the Neotropics, and which may be a center for their diversification. Specimens have been collected/reared throughout the year.

Map 1. Known distributions of the genus *Erythromelana*.

Taxonomic changes

In the original description of *Erythromelana*, Townsend (1919) described the genus from a single species, *E. jaena*. Therefore, his definition of the genus was limited to the variation of two specimens in this single species. Specifically, Townsend described the absence of ocellar setae and abdominal discal setae. In this broader revision of the genus, these two characters vary; ocellar setae may be absent to well-developed and abdominal setae may be present or absent on T5. Additionally, in Wood's (1985)

revision of the Blondeliini of Central America and the West Indies, he included in his diagnosis of the genus that the pospronotum has only 2 setae and the wing vein R4+5 may be setose more than half way to crossvein r-m. In this revision, these two characters vary, with the postpronotum bearing 2 or 3 setae and the vein R4+5 setose only at base.

Species included in the genus *Erythromelana* (Species authorship, male & female described)

E. jaena Townsend, male

E. abdominalis (Townsend), male

E. leptoforceps sp. nov., male and female

E. nigrithorax (Wulp), male and female

E. curvifrons sp. nov., male and female

E. ecuadoriana sp. nov., male and female

E. eois sp. nov., male and female

E. cryptica sp. nov., male

E. catarina sp. nov., male

E. convexiforceps sp. nov., male

E. arciforceps sp. nov., male

E. napensis sp. nov., male

E. woodi sp. nov., male and female

E. distincta sp. nov., male and female

Nomen dubium

E. obscurifrons (Wulp), female.

Erythromelana obscurifrons was described from a single female, which in this study corresponds to one of the cryptic females in the *E. cryptica* species group. Females in this species group lack obvious morphological characters for their identification and separation and cannot be associated with their respective males. Given the difficulty of determining to which male this female belongs, I am designating the name as a *nomen dubium*.

ERYTHROMELANA SPECIES GROUPS

All of the species of *Erythromelana* identifed thus far can be roughly separated into two primary groups termed here the E. *jaena* and *E. cryptica* species groups. These groups are distinguished by a combination of non-terminalic and terminalic structures stated as follows:

E. jaena species group

Species belonging to this group share two synapomorphies of the male terminalia. Specifically, sternite 5 has the apical lobes broadly rounded, with only several small hair-like setae (sometimes similar in *E. woodi*) and the cerci are dorsally flat on the medial section in posterior view. In addition, most of the species have: bright yellow abdominal coloration (except *E. leptoforceps* and *E. nigrithorax*), 2 katepisternal setae (3 in *E. eois,*

and rarely in *E. ecuadoriana*); first postsutural supra–alar absent; sternite 5 of female covered with several well developed setae on more than posterior 2/3 (although similar in *E. woodi*); and cerci, in lateral view, slightly concave along posterior margin.

This group includes seven species, five with fully yellow abdomens, *E. jaena*, *E. abdominalis*, *E. curvifrons*, *E. ecuadoriana*, and *E. eois*; and two species with black and yellow abdomens, *E. leptoforceps* and *E. nigrithorax*.

***E. cryptica* species group**

Species in this group share two synapomorphies of the male terminalia. In contrast to the species in the *E. jaena* group, the apical lobe of the sternite 5 is usually pointed, with a long well developed seta (rarely absent in *E. woodi*); and a slight depression dorsally on the medial section, or a twist internally at the apical cleft of the cerci. Additionally, most of the species have: abdominal coloration mostly black with yellow laterally (rarely mostly yellow on *E. woodi*), 3 katepisternal setae (except *E. distincta* and rarely *E. woodi*), first postsutural supra–alar present (rarely absent in *E. cryptica*, absent in *E. convexiforceps*, *E. woodi*, and *E. distincta*), sternite 5 of female with 2 pairs of well developed setae close to the posterior margin (except *E. woodi*), and cerci, in lateral view, strongly carinate on medial section of the posterior margin (except *E. arciforceps*, *E. napensis*, and *E. woodi*).

This group includes seven species, all with black abdomens with yellow laterally, *E. cryptica*, *E. catarina*, *E. convexiforceps*, *E. arciforceps*, *E. napensis*, *E. distincta*, and *E. woodi*; the latter rarely with a predominantly yellow abdomen.

KEY TO *ERYTHROMELANA* SPECIES

Key to male species

1	Abdomen dorsally yellow, or mostly yellow (as in Fig. 5); first postsutural supra–alar absent	2
1'	Abdomen dorsally black, or mostly black (as in Fig. 50); first postsutural supra–alar present or absent	7
2(1)	Abdomen fully yellow	3
2'	Abdomen mostly yellow with black only on T1+2 or on T1+2 and T4 (as in Fig. 5)	4
3(2)	Vein R1 dorsally setose on about apical half, katepisternum with 2 or 3 setae	*E. ecuadoriana* sp. nov.
3'	Vein R1 dorsally bare, katepisternum with 3 setae	*E. eois* sp. nov.
4(2')	Abdomen mostly yellow with black on the anterodorsal margin and the mid-dorsal depression of T1+2; palpi nearly linear, dorsally sparsely haired (as in Fig. 6)	5
4'	Abdominal coloration as above, but also with black on on the posterodorsal margin of T4; palpi curved inward medially, dorsally bare (Fig. 77)	*E. woodi* sp. nov. (in part)
5(4)	Fronto-orbital plate not concave (as in Fig. 15); frontal vitta width about 1/4 the vertex width (as in Fig. 13); wings light or dark fumose on c, sc, r1, r2+3, and r4+5 cells	6
5'	Fronto-orbital plate slightly concave (Fig. 39); frontal vitta extremely narrow, the width about 1/7 the vertex width (Fig. 38); wings completely hyaline	*E. curvifrons* sp. nov.
6(5)	Hind tibia usually with 6 or more well developed anteroventral setae (rarely 5); and the apex of the cerci, in lateral view, ending in a truncate tip (Fig. 10)	*E. jaena* Townsend
6'	Hind tibia usually with 4 well developed anteroventral setae (rarely 5); and the apex of the cerci, in lateral view, ending in a rounded tip (Fig. 17)	*E. abdominalis* (Townsend)

7(1')	Katepisternum with 2 setae; first postsutural supra–alar absent	8
7'	Katepisternum with 3 setae; first postsutural supra–alar present or absent	11
8(7)	Ocellar setae absent; S5 of male with the apical lobe rounded, with several small hair-like setae (as in Fig. 9)	9
8'	Ocellar setae present, proclinate; S5 with the apical lobes pointed, each with a long well developed seta (as in Fig 56)	10
9(8)	Medial section of the cercus, viewed from the posterior, less than half of the cercus length, about 0.40 the cercus length (Fig. 24)	*E. leptoforceps* sp. nov.
9'	Medial section of the cercus, viewed from the posterior, more than half of the cercus length, about 0.60 the cercus length (Fig. 35)	*E. nigrithorax* (Wulp)
10(8')	Vein R1 dorsally setose; palpi almost straight, sparsely haired; surstyli ending in a very broad rounded apex (Fig. 69), internally with several well developed setae (Fig. 70); posterior margin of the cerci, in lateral view, strongly carinate (Fig. 69)	*E. distincta* sp. nov.
10'	Vein R1 dorsally bare; palpi slightly curved inward medially, dorsally bare; surstyli ending in a rounded tip (Fig. 80), internally with few small hair-like setae (Fig. 81); posterior margin of the cerci, in lateral view, slightly concave (Fig. 81)	*E. woodi* sp. nov. (in part)
11(7')	posterior margin of the cerci, in lateral view, strongly carinate (as in Fig. 60)	12
11'	posterior margin of the cerci, in lateral view, not strongly carinate, at most slightly concave (as in Fig. 63)	14
12(11)	First postsutural supra–alar usually present, rarely absent; the carina on the medial section of the posterior margin of the cerci, in lateral view, ending gradually, forming an obtuse angle before the apical tip (as in Fig. 54); apex of the cerci, in posterior view, curved, with tips pointing medially (as in Fig. 55).	13
12'	First postsutural supra–alar absent; the carina on the medial section of the posterior margin of the cerci, in lateral view, ending abruptly, forming a nearly right angle before the rounded apical tip (Fig. 60); apex of the cerci, in posterior view, linear, with tips directed distally (Fig. 61).	*E. convexiforceps* sp. nov.
13(12)	Apices of the cerci, in lateral view, ending in a nearly truncate tip (Fig. 54)	*E. cryptica* sp. nov.
13'	Apices of the cerci, in lateral view, ending in a rounded tip (Fig. 57)	*E. catarina* sp. nov.

14(11')	Palpi almost straight, sparsely haired (as in Fig. 6); first postsutural supra–alar present	15
14'	Palpi medially slightly curved inward, dorsally bare (Fig. 77); first postsutural supra–alar absent	*E. woodi* sp. nov. (in part)
15(14)	Apices of the cerci, in lateral view, ending in a nearly truncate tips (Fig. 63); in posterior view, with upper lobe length almost equal to the medial section length and to the apical cleft length (Fig. 64)	*E. arciforceps* sp. nov.
15'	Apices of the cerci, in lateral view, ending in a rounded tip (Fig. 66); in posterior view, with upper lobes longer than medial section and almost equal to the length of the apical cleft (Fig. 67).	*E. napensis* sp. nov.

Key to female species

1	Abdomen yellow or mostly yellow (as in Fig. 5); first postsutural supra–alar absent	2
1'	Abdomen black or mostly black (as in Fig. 50); first postsutural supra–alar present or absent	6
2(1)	Abdomen fully yellow	3
2'	Abdomen mostly yellow with black only on T1+2 or on T1+2 and T4 (as in Fig. 5)	4
3(2)	Vein R1 dorsally setose, katepisternum with 2 or 3 setae	*E. ecuadoriana* sp. nov.
3'	Vein R1 dorsally bare, katepisternum with 3 setae	*E. eois* sp. nov.
4(2')	Abdomen mostly yellow with black on the anterodorsal margin and the mid-dorsal depression of T1+2; palpi almost straight, sparsely haired (as in Fig. 6)	5
4'	Abdomen as above, but with black also on the posterodorsal margin of T4; palpi slightly curved inward medially, dorsally bare (Fig. 77)	*E. woodi* sp. nov. (in part)
5(4)	Fronto-orbital plate not concave (as in Fig. 15); frontal vitta width about 1/3 the vertex width; wings with light or dark fumose on c, sc, r1, r2+3, and r4+5 cells	Unknown female of *E. jaena* Townsend and *E. abdominalis* (Townsend)
5'	Fronto-orbital plate slightly concave(Fig. 39); frontal vitta extremely narrow, the width about 1/5 the vertex width; wings hyaline	*E. curvifrons* sp. nov.
6(1')	Katepisternum with 2 setae; first postsutural supra–alar absent	7
6'	Katepisternum with 3 setae; first postsutural supra–alar present or absent	9

7'(6)	Ocellar setae proclinate	8
7	Ocellar setae absent	*E. leptoforceps* sp. nov. and *E. nigrithorax* (Wulp) (see species description)
8(7')	Vein R1 dorsally setose; palpi almost straight, sparsely haired; S5 with 2 pairs of well developed setae close to posterior margin (Fig. 72); T8 dorsally with a distinctive narrow medial lobe on the anterior margin (Fig. 74).	*E. distincta* sp. nov.
8'	Vein R1 dorsally bare; palpi slightly curved inward medially, dorsally bare; S5 covered with several well developed setae on more than posterior 2/3 (as in Fig. 26); T8 strongly narrowed dorsally, without a lobe (as in Fig. 29)	*E. woodi* sp. nov. (in part)
9(6')	Palpi almost straight, sparsely haired(as in Fig. 50); S5 with 2 pairs of well developed setae close to posterior margin (as in Fig. 72)	Unknown female of *E. cryptica* sp. nov., *E. catarina* sp. nov., *E. convexiforxeps* sp. nov., *E. arciforceps* sp. nov., and *E. napensis* sp. nov.
9'	Palpi slightly curved inward medially, dorsally bare (Fig. 77); S5 covered with several well developed setae on more than posterior 2/3(as in Fig. 26)	*E. woodi* sp. nov. (in part)

***Erythromelana jaena* species group**

Erythromelana jaena Townsend 1919

(Figs. 5-11, Map 2)

TYPE MATERIAL

Holotype

One male, labelled: “Huascaray Rdge [Ridge]/ Pr [Province] Jaen Peru/ 7000 ft 21-IX”, “CHT Townsend/ coll”, “Type/ No./ U.S.N.M [red label]”, “Erythromelana/ jaena/ Det CHTT T.”.

OTHER MATERIAL EXAMINED

Nine male specimens. One male, labelled: “Ecuador: Napo Prov. [Province]/ Yanayacu Biological Station,/ S 00°35.9’ W 77°53.4, 2163m/ REARED/ Mayo [May]/ 14830[rearing record number]”, “Erythromelana/ jaena Townsend/ det. Inclan D.J.”, Terminalia and Puparium stored in glycerine in a microvial pinned below specimen (CNC); one male, labelled: “Ecuador, Napo [Province]/ 7 km. s. [south] Baeza/ 20-25- II. 79/ G. &M. Wood 2000m”, “Erythromelana/ jaena Townsend/ det. Inclan D.J.”, “DI11CA [specimen ID number]”, terminalia stored in glycerine in a microvial pinned below specimen (CNC); three males, same previus data exept ID number “DI05CA” terminalia stored in glycerine in a microvial pinned below specimen, “DI268CA” (CNC), and “DI07CA” terminalia stored in glycerine in a microvial pinned below specimen (NMNH); two males, same previus data exept date “28. III. 1983” and ID number “DI264CA” (CNC) and “DI02CA” terminalia stored in glycerine in a microvial pinned

below specimen (Ecuador); two males, same previus data exept location and date “8.5/ km E Papallacta/ 29. III. 1983” and ID number “DI256CA” (CNC) and “DI266CA” terminalia stored in glycerine in a microvial pinned below specimen (JOS).

RECOGNITION

This species is morphologically very similar to *E. abdominalis* and can be distinguished by differences in the male hind tibia setae and male genitalia. These species can be initially separated by differences in the number of anteroventral setae on the hind tibia, where *E. jaena* usually has 6 or more well developed setae and *E. abdominalis* usually has 4 setae. However, sometimes both species have 5 setae, making genitalic characters the only reliable way to distinguish these species. In lateral view, the cerci of *E. jaena* end in a wide truncate tip, where the cerci of *E. abdominalis* end in a narrower rounded point. The surstylus of *E. jaena* is markedly wider than the surstylus of *E. abdominalis*. In posterior view, the upper lobes of the cerci of *E. jaena* are notably thinner and longer than the upper lobes of *E. abdominalis*. I have not found characters to reliably separate females of these two species and their identity remains unknown (see discussion). The yellow abdomen of *E. jaena* and *E. abdominals* distinguish these species from *E. nigrithorax*, *E. leptoforceps* and all species in the *E. cryptica* species group that have a yellow with black abdomen. The remaining species in the *E. jaena* species group with yellow abdomens, *E. ecuadoriana*, *E. eois*, and *E. curvifrons*, can be separated from *E. jaena* and *E. abdominalis* by the presence of setae on R1, 3 katepisternal setae, and the concave fronto-orbital plate, respectively.

REDESCRIPTION

Redescribed from 7 males (including the holotype), unless otherwise noted as "N".

Length: 6.8–7.6mm ($\bar{x}$ = 7.08mm, N = 6) in male.

Head: Parafacial brown in ground color covered with dull silver pruinescence. Fronto-orbital plate and vertex black in ground color covered with dull silver pruinescence appearing grayish from certain angles. Vertex with faint golden reflections visible only in lateral view. Arista black with brownish on basal 1/4, thickened only on basal 1/6 (Figs. 6 and 8). Eye sparsely haired, ommatrichia about as long as 2 eye facets. Eye 0.85–0.90 ($\bar{x}$ = 0.87, N=6) head height. Vertex width 0.13–0.18 ($\bar{x}$ = 0.16, N=6) head width. Frontal vitta width 0.21–0.35 ($\bar{x}$ = 0.28, N=6) vertex width. Length of first flagellomere 0.38–0.45 ($\bar{x}$ = 0.41, N = 6) head height. Pedicel length 0.30–0.33 ($\bar{x}$ = 0.31, N=6) length of first flagellomere. Fronto–orbital plate with 6–12 (m = 8) medioclinate frontal setae; 2 reclinate inner orbital setae (usually with 1 extra small seta), without outer orbitals. Vertex with 1 reclinate inner and 1 lateroclinate outer vertical seta, the latter barely differentiated from the row of postocular setae. Ocellar setae usually absent; if present proclinate, but hardly differentiated from the adjacent setae. Parafacial bare and extremely narrow with the narrowest point almost equal to or slightly wider than the width of the palpus at the base. Parafacial width 0.02–0.04 ($\bar{x}$ = 0.03, N = 6) head width. Facial ridge with hairs on basal 1/4 or less. Height of haired portion of facial ridge 0.13–0.19 ($\bar{x}$ = 0.15, N = 6) head height. Palpus yellowish, distally sparsely haired with base usually bare, apices slightly broadened, length 0.30–0.33 ($\bar{x}$ = 0.31, N = 7) head height.

Thorax: Dorsocentral length 0.38–0.39 ($\bar{x}$ = 0.38, N = 6) total body length. In dorsal view, thorax shiny black in ground color, presutural and postsutural scutum with thin and sparser white pruinescence (almost invisible to naked eye) revealing underlying black color. In lateral view the presutural and postsutural scutum appears slightly grayish. Faint white pruinose stripes on presutural scutum leaving 4-5 black vittae; the inner 2-3 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae (Fig. 5). Postpronotum with 2 setae, rarely with 1 small additional seta. Katepisternum with 2 setae. Scutum with 1 presutural acrostichal seta, usually with 1 additional small seta; 2 postsutural acrostichal setae, usually with 1 additional small seta, rarely with 2 additional small setae; 2 presutural and 2 postsutural dorsocentral setae, usually with 1 or 2 additional small setae; 1 presutural and 3 postsutural intra–alar setae; 1 presutural supra-alar seta, rarely with 1 additional small seta; and 2 postsutural supra–alar setae, first postsutural supra–alar absent. Scutellum discal setae usually absent or with 1 small pair of hair–like setae.

Legs black, usually with front and hind tibiae yellowish (Fig. 7). Tarsal claws longer than 5th tarsomere in male. Fore claw length 0.93–1.17 ($\bar{x}$ = 1.02, N = 6) fore 5th tarsomere length in male. Hind tibia with 2 well developed posterodorsal setae; usually with 6 well developed anteroventral setae, but varied from 5 to 7. Wings usually dark fumose at sc, $r_{1,}$ and r_{2+3} cells; and light fumose at c, r_{4+5}, and dm cells. Wing vein R_{4+5} dorsally with 2-3 setae at base. Vein M smoothly curved at bend and ending at wing margin, close to wing tip and separately from vein R_{4+5}.

Abdomen: Bright yellow in dorsal view with a black transverse band on anterior 1/5 of T_{1+2}, and black on the mid-dorsal depression of $T_{1+2.}$ Transverse bands of sparse white pruinosity absent. Discal setae absent, 1 pair of median marginal setae on T_{1+2} and T_3, a row of median marginals on T_4 and T_5, and 1 pair of lateral marginal setae on T_{1+2} and T_3.

Male terminalia: Sternite 5 with median cleft smoothly U–shaped, inner margin with minute setae, apical lobe rounded apically, and anterior margin of basal plate slightly concave (Fig. 9). S_5 apical lobe length 0.60–0.67 ($\bar{x}$ = 0.64, N = 6) S_5 length. In lateral view, surstylus bare, slightly concave on anterior margin and almost straight along posterior margin. Surstylus and cercus subequal in length. Cerci almost straight along anterior margin and slightly concave on posterior margin, ending in nearly truncate tip forming a beak-like tip on anterior corner. In posterior view, cercus narrowly constricted on apical 1/3; upper lobe length longer than medial section length and more than double the apical cleft length; apical cleft well defined; and apex of the cerci linear, with rounded tips directed medially. Cercus upper lobe length 0.31–0.43 ($\bar{x}$ = 0.34, N = 6) cercus length, cercus medial section length 0.35–0.48 ($\bar{x}$ = 0.43, N = 6) cercus length. (Figs. 10 and 11).

Host: One specimen was reared from the caterpillar *Eois* sp. nr. *olivacea* (Lepidoptera: Geometridae). The caterpillar was collected from YBS (Napo, Ecuador) on the host plant *Piper baezanum* (Piperaceae). The third instar caterpillar was collected on 27th May 2006 and the fly was found 43 days later.

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

The holotype specimen was collected from northern Peru and the rest of the specimens from Ecuador (Map 2). *E. jaena* seems to occur at high elevations (Jaen, Peru, 2,150m; Napo, Ecuador, 2,000-2,600m). This suggest that this species is probably distributed across the Andes mountains, but how far north and south is unclear due to the lack of specimens collected from Colombia, Peru, Bolivia, and Chile. Specimens from Ecuador were collected from February to May, and the holotype from Peru was collected in September.

Map 2. Known distribution of *E. jaena*.

DISCUSSION

E. jaena and *E. abdominalis* can be separated based on differences in the male hind tibia setae and male genitalia. The number of anteroventral setae in males can be

used as a preliminary identification of this species; however, as mentioned in the recognition section, the number of setae varies and sometimes both species have 5 setae. This character is still important as it is the only external character that could be used to identify these species (when the number of seta is different than 5). I separated the *E. jaena* and *E. abdominalis* holotypes based on the presence of 4 and 6 anteroventral setae on the hind tibia respectively. I did not dissected the genitalia of the holotypes, the genitalia descriptions of these species are based on a series of specimens where I dissected the genitalia and associated differences with the number of antereoventral setae on their hind tibia. Specifically, the distinct shape of the cercus and surstylus allow the reliable separation of the males of these two species. In contrast, the descriptions of *E. jaena* and *E. abdominalis* females are not included in this revision because I could not find any reliable characters (including terminalia) to associate females with males. There appear to be differences in the shape and size of the female palpus, where one group of females has a male like palpus and the other group has a broader and larger palpus. I have sequenced mitochondrial DNA from these two different female morphospecies and the results suggest that these are two different species (see phylogenetic section). However, I still cannot associate which group of females correspond to *E. jaena* and *E. abdominalis* because I do not have sequence data for males (see phylogenetic section). Additionally, females can not be assigned to males based on geographical distribution because both species exhibit sympatric distributions (see previous section). Additional DNA sequence analysis of male specimens would be useful in associating males and females of these species.

Figure 5. Dorsal view of male *E. jaena*.

Figure 6. Frontal view of the head of male *E. jaena*.

Figure 7. Lateral view of male *E. jaena*.

Figure 8. Lateral view of the head of male *E. jaena*.

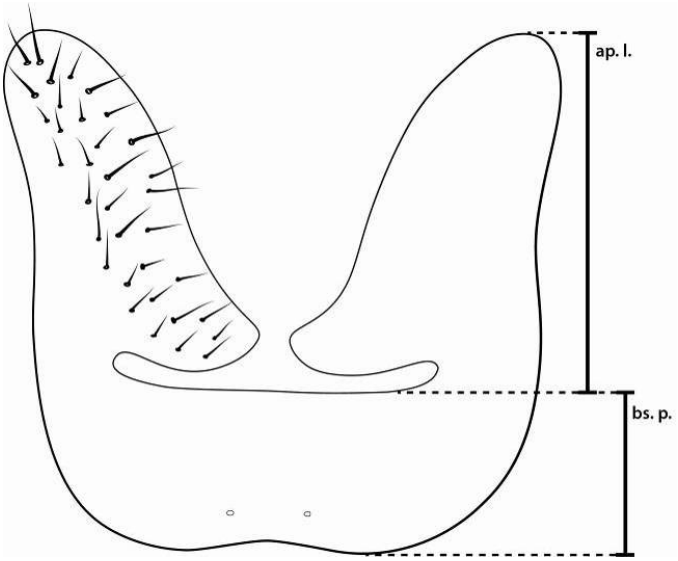


Figure 9. 5th sternite of male *E. jaena* (ap. l. apical lobe length, bs. p. basal plate length)

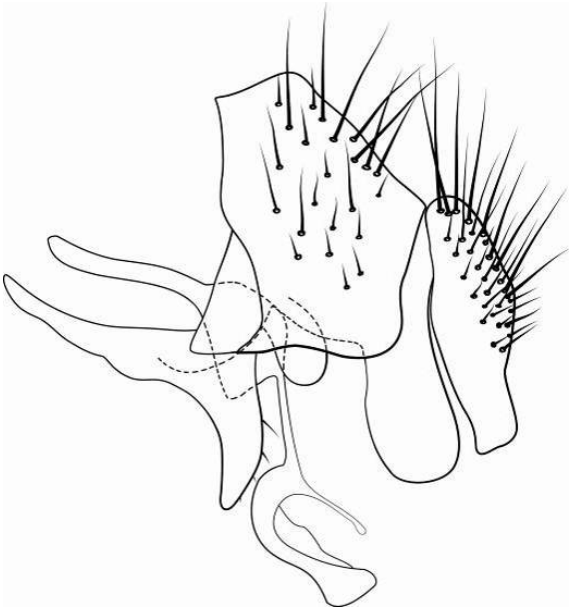


Figure 10. Lateral view of *E. jaena* male genitalia

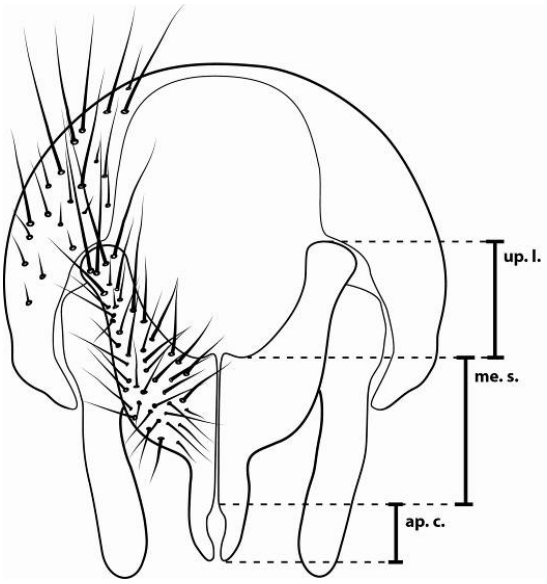


Figure 11. Epandrial complex in posterior view of male *E. jaena* (up. l. upper lobe length, me. s. medial section length, ap. c. apical cleft length).

Erythromelana abdominalis (Townsend)

(Figs. 12–18, Map 3)

TYPE MATERIAL

Holotype

One male, labelled: "R [River?] Charape Peru/ 4500 ft 12-IX-11", "CHT Townsend/ coll", "Type No./ 22235/ U.S.N.M [red label]", "Minthomyia/ abdominalis/ ♂/ Det CHTT T.".

OTHER MATERIAL EXAMINED

11 male specimens. One male, labelled: "Ecuador, Napo [Province]/ 7 km. s. [south] Baeza/ 20-25- II. 79/ G. &M. Wood 2000m", "Erythromelana/ abdominalis/ (Townsend)/ det. Inclan D.J.", "DI246CA [specimen ID number]", (CNC); five males, same previus

data exept ID number “DI01CA”, “DI08CA”, “DI09CA”, “DI04CA” terminalia stored in glycerine in a microvial pinned below specimen (CNC), and “DI272CA” (NMNH); one male, same previus data exept date “13-14. II. 1982” and ID number “DI03CA” (CNC); two males, same previus data exept locality and date “6 km S [South] Baeza/ 13. II. 1982” and ID numbers “DI259CA” (CNC) and “DI260CA” terminalia stored in glycerine in a microvial pinned below specimen (Ecuador); two males, same previus data exept location and date “7 km s [south] Baeza/ 28. III. 1983” and ID numbers “DI10CA” terminalia stored in glycerine in a microvial pinned below specimen (CNC) and “DI13CA” terminalia stored in glycerine in a microvial pinned below specimen (JOS).

RECOGNITION

This species is morphologically very similar to *E. jaena* and can be distinguished by differences in the male hind tibia setae and male genitalia. These species can be initially separated by differences in the number of anteroventral setae on the hind tibia where *E. abdominalis* usually has 4 well developed setae and *E. jaena* usually has 6 or more setae. However, sometimes both species have 5 setae, making genitalia characters the only reliable way to distinguish these species. The main distinction of between *E. abdominalis* and *E. jaena* in male genitalia is that the cerci in lateral view of this species end in a thin rounded tip rather than a wide truncate tip, respectively. Female unknown. Complete information on the recognition of *E. abdominalis*, and the distinction of this species from the remaining *Erythromelana* species as stated in the description of *E. jaena*.

REDESCRIPTION

Described from 8 males (including the holotype), unless otherwise noted as "N".

Length: 6.1–6.9mm ($\bar{x}$ = 6.47mm, N = 7) in male.

As described for *E. jaena* except as follows:

Head: Eye sparsely haired, ommatrichia about as long as 2-3 eye facets. Eye 0.84–0.90 ($\bar{x}$ = 0.88, N=7) head height. Vertex width 0.15–0.17 ($\bar{x}$ = 0.16, N=7) head width. Frontal vitta width 0.27–0.33 ($\bar{x}$ = 0.29, N=7) vertex width. Length of first flagellomere 0.36–0.43 ($\bar{x}$ = 0.40, N = 7) head height. Pedicel length 0.29–0.38 ($\bar{x}$ = 0.32, N=7) length of first flagellomere. Fronto–orbital plate with 6–9 (m = 8) medioclinate frontal setae; 2 reclinate inner orbital setae (rarely with 1 extra small setae). Ocellar setae proclinate, hardly differentiated from the adjacent setae. Parafacial bare and extremely narrow with the narrowest point almost equal to the palpus width at the base. Parafacial width 0.01–0.02 ($\bar{x}$ = 0.02, N=7) head width. Height of haired portion of facial ridge 0.11–0.20 ($\bar{x}$ = 0.14, N= 7) head height. Palpus length 0.28–0.33 ($\bar{x}$ = 0.31, N = 7) head height (Fig 13 and 14).

Thorax: Dorsocentral length 0.33–0.38 ($\bar{x}$ = 0.36, N=7) total body length. Faint white pruinose stripes on presutural scutum leaving 5 black vittae; the inner 3 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae (Fig. 12). Scutum with 1 presutural acrostichal seta, rarely with 1 additional small seta; 2 postsutural acrostichal setae, rarely with 1 additional seta; 2 presutural and 2 postsutural dorsocentral setae, rarely with 1 or 2 additional small setae. Scutellum discal setae usually with 1 small pair

of hair–like setae. Fore claw length 0.96–1.40 ($\bar{x}$ = 1.12, N = 7) fore 5th tarsomere length in male. Hind tibia usually with 4 well developed anteroventral setae, but varied from 3 to 5. Dorsal section of wing vein R_{4+5} usually with 2 setae at base.

Male terminalia: S_5 apical lobe length 0.61–0.64 ($\bar{x}$ = 0.62, N = 4) S_5 length (Fig. 16). In lateral view, surstylus almost straight with anterior and posterior margins parallel-sided. Surstylus slightly longer than cercus. Cerci straight along anterior surface, ending in a narrow round tip. In posterior view, cercus narrowly constricted on apical 1/3, upper lobe length almost equal to medial section length and more than double the apical cleft length. Cercus upper lobe length 0.28–0.44 ($\bar{x}$ = 0.38, N = 5) cercus length, cercus medial section length 0.39–0.50 ($\bar{x}$ = 0.44, N = 5) cercus length (Figs. 17 and 18).

Female Terminalia: Unknown

Host: Unknown

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

The holotype specimen collected from northern Peru and all other specimens from Ecuador (Map 3). *E. abdominalis* seems to occur at moderate to high elevations (Charape, Peru, 1,500m; Napo, Ecuador, 2,000-2,600m). This species, like *E. jaena*, is probably distributed along the Andes Mountains, but how far north and south is unclear due to the lack of specimens collected from Colombia, Peru, Bolivia, and Chile.

Specimens from Ecuador were collected in February and March, and the holotype from Peru was collected in September.

Map 3. Known distribution of *E. abdominalis*.

DISCUSSION

See discussion section of *E. jaena*.

Figure 12. Dorsal view of male *E. abdominalis*.

Figure 13. Frontal view of the head of male *E. abdominalis*.

Figure 14. Lateral view of male *E. abdominalis*.

Figure 15. Lateral view of the head of male *E. abdominalis*.

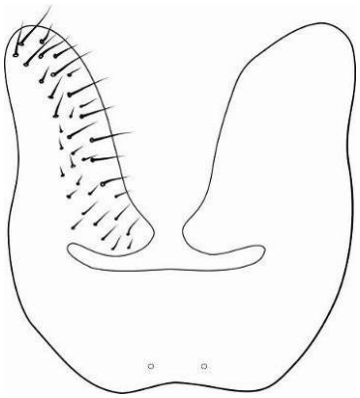


Figure 16. 5th sternite of male *E. abdominalis*.

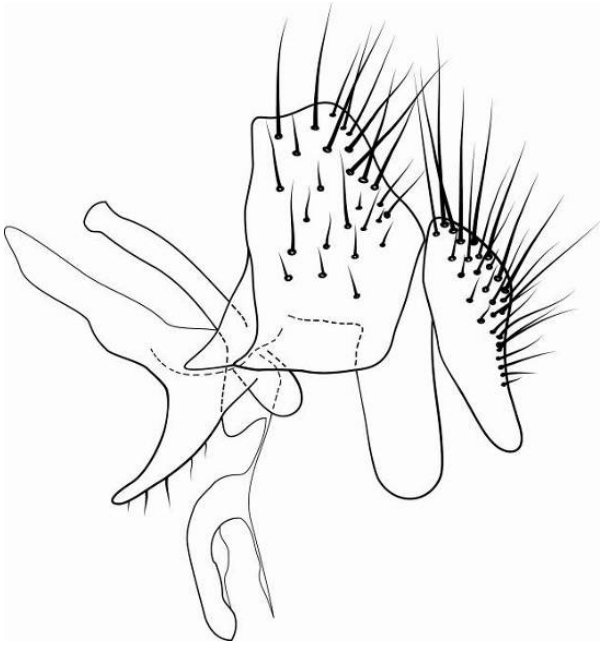


Figure 17. Lateral view of *E. abdominalis* male genitalia

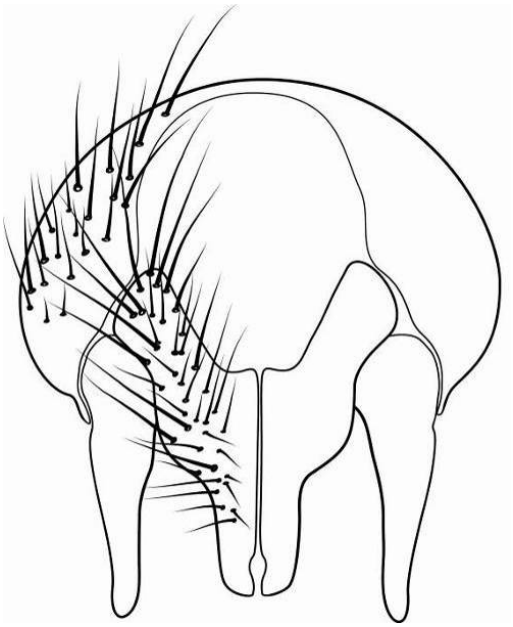


Figure 18. Epandrial complex in posterior view of male *E. abdominalis*.

Erythromelana leptoforceps Inclan sp. nov.

(Figs. 19–29, Map 4)

TYPE MATERIAL

Holotype

Male, labelled: " COSTA RICA Pnts [Puntarenas province]/ Monteverde, EBM [Estacion Biologica Monteverde]/ 20-30.VIII.1997/ D.M. Wood 1500m", "HOLOTYPE/ Erythromelana/ leptoforceps/ Inclan D.J. [red label]", "DI184MW [specimen ID]", (CNC).

Allotype

Female, labelled: " COSTA RICA Pnts [Puntarenas province]/ Monteverde, EBM [Estacion Biologica Monteverde]/ 20-30.VIII.1997/ D.M. Wood 1500m", "ALLOTYPE/

Erythromelana/ leptoforceps/ Inclan D.J. [red label]", "DI186MW [specimen ID]", (CNC).

Paratypes

30 males and 22 females. **Costa Rica:** one male, "COSTA RICA Pnts [Puntarenas province]/ Monteverde 1600m/ 18-24.VIII.1987/ G. & M. Wood", "PARATYPE/ Erythromelana/ leptoforceps/ Inclan D.J. [yellow label]", "DI180MW [specimen ID]", (CNC); one male and female, "COSTA RICA Pnts [Puntarenas province]/ Monteverde/ 20-25.VIII.1991/ D.M. Wood 1500m", "DI181MW [♂] [specimen ID]" and "DI188MW [♀] [specimen ID]" (CNC); one female, same as previus exept date "20-22.VIII.1993" and specimen ID "DI187MW", (CNC); one male, same as previus exept date " 22.VIII.1991" altitude "1842m" and specimen ID "DI182MW", (CNC); one male, same as allotype exept date "10-15.I.1998" and specimen ID "DI185MW", terminalia stored in glycerine in a microvial pinned below specimen (CNC); one male, "COSTA RICA Pnts [Puntarenas province]/ Monteverde, Cerro/ Amigos 1842m/ 2.IX.95 D.M. Wood", "DI183MW [specimen ID]", (CNC); three males and one female, "COSTA RICA PNTS [Puntarenas province]/ Monteverde NP [National Park] ~1600m/ 17-viii-10 Forest Clearing/ 10°15'N 84°32'W/ P. Cerretti", one male "JOS 810.7.2 [molecular barcoding]" (PCE), and female "JOS 810.7.1 [molecular barcoding]" (PCE); four males, same as previus expet "18-viii-10 Stream/ J.O. Stireman III", one male "JOS 810.6.1 [molecular barcoding]" (JOS), one male "JOS 810.4.1 [molecular barcoding]" (JOS); one male, " Quebrada Segunda Ref./ Nac. Fauna Silv. Tapanti,/ 1250m, Prov. Cartago,/ Costa Rica, R. Vargas, abr/ 1992, L-N 194000, 560000", "COSTA RICA INBIO/ CRI000/ 459612", terminalia stored in glycerine in a microvial pinned below specimen (INBio); one male,

same as previus exept “F.A. Quesada, Ago 1991/ L-N-194000, 559800”, “CRI000/ 551708”, (INBio); one female, “ COSTA RICA, Prov. Cartago, R./ Grande de Orosi, desde/ Administracion hasta Sendero La/ Pava. 1150-1600m. AGO 1996. R./ Guzman. L_N_192500_560400”, “CRI002/ 459482”, (INBio). **Brazil:** four males and one female, “Nova Teutonia”/ S.C.-BRAZIL/ Nov. 1970/ F. Plaumann”, “DI355CA [♂]”, “DI356CA [♂]”, “DI62CA [♂]” terminalia stored in glycerine in a microvial pinned below specimen, “DI63CA [♂]” terminalia stored in glycerine in a microvial pinned below specimen, and “DI361CA [♀]”, (CNC); four males and two females, same as previus exept “Nov. 1971”, “DI375CA [♂]”, “DI376CA [♂]”, “DI367CA [♂]”, “DI371CA [♂]” terminalia stored in glycerine in a microvial pinned below specimen, “DI370CA [♀]”, and “DI378CA [♀]”, (CNC); one male and one female, same as previus expet “Nov. 1969”, “DI380CA [♂]” and “DI381CA [♀]”, (CNC); one female, same as previus exept “Jan. 1970”, “DI363CA” terminalia stored in glycerine in a microvial pinned below specimen, (CNC); one female, same as previus exept “Dec. 1970”, “DI366CA”, (JOS); one male, same as previus exept “Aug. 1970”, “DI351CA”, (CNC); one male and one female, same as previus exept “Oct. 1970”, “DI358CA [♀]” (CNC), “DI352CA [♂]” terminalia stored in glycerine in a microvial pinned below specimen, (Ecuador); one female, same as previus exept “Oct. 1961”, “DI71CA”, (Ecuador); one female, same as previus exept “XII. 1971”, “DI377CA” terminalia stored in glycerine in a microvial pinned below specimen, (CNC); one female, same as previus exept “April 1960”, “DI385CA”, (CNC); one female, “Sao Paulo/ S.P., BRAZIL/ 3 Jan. 1965/ R. Inoue”, “DI384CA”, (CNC); one female, “Brasilien/ Nova Teutonia/ 27° 11’la 52° 23L/ Fritz Plaumann/ V 1968 [diagonal on label]/ 300-500m [diagonal on label]”, “ DI387CA”,

(CNC); one male, same as previus exept “20 II 1938”, “Brit. Mus./ 1939-66.”, “DI111BM”, (BNHM); one male “Nova Teutonia/ 27°11’S 52°23’W/ Brazil, 300-500m/ II – 1965/ Fritz Plaumann”, “Minthomyia/ Det. D.M. Wood 1968”, “DI383CA”, (CNC); one male, “BRAZIL: Santa Catarina:/ Nova Teutonia, 27°11’S/ 52°23’W, 300-500m, Feb/ 1969, F. Plaumann”, “COLLECTION OF/ PAUL H. ARNAUD, JR.”, “DI151NM”, (NMNH); one male, same as previus exept “Mar. 1969”, “DI162NM”, (NHNM); one female, same as previus exept “14 Mar. 1966”, “DI149NM”, (NMNH); three females, same as previus exept “Apr. 1966”, “DI143NM”, “DI141NM”, and “DI147NM”, (NMNH); one female, same as previus exept “ Jan. 1967”, “DI163NM”, (NMNH). **Peru:** one male, “Quincemil/ Cuzco, PERU/ 13-31. VIII. ‘62/ L.Pena. 780m.”, “DI230CA” terminalia stored in glycerine in a microvial pinned below specimen, (CNC). **Argentina:** one female, “ARGENTINA: Tuc./ Horco Molle, c. 12km./ W. of Tucuman. 700m./ Malaise trap/ 18-21.iii.1974. C.R. Vardy/ B.M. 1974-204”, “DI117BM”, (BNHM).

OTHER MATERIAL EXAMINED

Twenty four males and eight females. **Bazil:** one male: “BRAZIL: Santa Catarina:/ Nova Teutonia, 27°11’S/ 52°23’W, 300-500m/ Feb. 1966, F. Plaumann”, “COLLECTION OF/ PAUL H. ARNAUD, JR.”, “DI125NM”, (NMNH); 17 males, “Nova Teutonia”/ S.C.-BRAZIL/ Nov. 1970/ F. Plaumann”, “DI65CA”, “DI64CA”, “DI66CA”, “DI61CA”, “DI60CA”, “DI360CA”, “DI344CA”, “DI350CA”, “DI346CA”, “DI345CA”, “DI347CA”, “DI348CA”, “DI349CA”, “DI357CA”, “DI368CA”, “DI353CA”, “DI354CA”, (CNC); one female, same as previus exept “DI365CA”, (CNC); four males, same as previus exept “Nov. 1971”, “DI372CA”, “DI373CA”, “DI3374CA”,

"DI369CA", (CNC); one female, same as previus exept "DI379CA", (CNC); one male, same as previus exept "March 1970", "DI359CA", (CNC); one male, same as previus exept "April 1963", "DI67CA", (CNC); one female, same as previus exept "Oct. 1961", "DI72CA", (CNC); one female, same as previus exept "Sept. 1961", "DI70CA", (CNC); one female, same as previus exept "June 1970", "DI362CA", (CNC); one female, same as previus exept "Feb. 1970", "DI364CA", (CNC); one female, same as previus exept "Nov. 1969", "DI382CA", (CNC); one female, same as previus exept "III. 1968", "DI386CA", (CNC).

ETYMOLOGY

From the Greek *leptos* and the Latin *forceps*, meaning narrow cerci, in reference to the relatively narrow cerci (viewed from the posterior) of this species compared to those of its close relative, *E. nigrithorax* (Wulp).

RECOGNITION

This species is morphologically very similar to *E. nigrithorax* and can only be distinguished from it by differences in the male terminalia. The medial section of the cerci of *E. leptoforceps*, viewed from the posterior, is notably narrower than the cerci of *E. nigrithorax*. In addition, the base of sternite 5 is wider in *E. leptoforceps* than in *E. nigrithorax*. Females of these two species cannot be reliably separated morphologically (see discussion section). Here, the identity of females is assumed based on geographical distribution (see geographic distribution section). Male and female of both species can be distinguished from other species in the *E. jaena* species group by the black abdominal

color forming a vitta and transverse bands, in contrast to the yellow abdomen characteristic of the remaining species in the *E. jaena* group. Species in the *E. cryptica* species group share similar abdominal coloration patterns with *E. leptoforceps* and *E. nigrithorax*; however, most of them have three katepisternal setae whereas *E. leptoforceps* and *E. nigrithorax* have only two. There are only two species in the *E. cryptica* group that have two katepisternal setae, *E. distincta* and *E. woodi* (usually three, but varied from two to three), and they can be separated from *E. leptoforceps* and *E. nigrithorax* by the presence of setae on R_1 and small ocellar setae, respectively. Additionally, *E. woodi* usually has an irregular row of discal setae on T5, where the discal setae are absent from all species of the *E. jaena* species group.

DESCRIPTION

Described from 10 males and 6 females, unless otherwise noted as "N".

Length: 6.3–8.0mm ($\overline{x}$ = 6.24mm, N = 9) in male, 5.4–6.1mm ($\overline{x}$ = 5.78mm) in female.

Head: Parafacial brown in ground color covered with dull silver pruinescence. Fronto-orbital plate and vertex black in ground color covered with dull silver pruinescence (which could appear grayish from certain angles), with a faint golden reflections visible only in lateral view. Arista black with brown on basal 1/4, thickened only on basal 1/6 (Figs. 20 and 22). Eye moderately haired, ommatrichia about as long as 4-5 eye facets. Eye 0.89–0.93 ($\overline{x}$ = 0.91) head height in male, 0.90–0.92 ($\overline{x}$ = 0.92) in female. Vertex width 0.12–0.15 ($\overline{x}$ = 0.14) head width in male, 0.16–0.23 ($\overline{x}$ = 0.18, N = 5) in female. Frontal vitta width 0.27–0.33 ($\overline{x}$ = 0.30) vertex width in male, 0.30–0.44 ($\overline{x}$ = 0.39, N = 5)

in female. Length of first flagellomere 0.40–0.47 ($\bar{x}$ = 0.41, N = 9) head height in male, 0.39–0.48 ($\bar{x}$ = 0.43) in female. Pedicel length 0.26–0.34 ($\bar{x}$ = 0.30) length of first flagellomere in male, 0.26–0.31 ($\bar{x}$ = 0.28) in female. Fronto–orbital plate with 6–10 (m = 8) medioclinate frontal setae in male, 4–5 (m = 5) in female; 2 reclinate inner orbital setae (rarely with 1 extra small setae); female with 2 proclinate outer orbital setae, male without outer orbitals. Vertex with 1 reclinate inner and 1 lateroclinate outer vertical seta, the latter barely differentiated from the row of postocular setae on both sexes. Ocellar setae absent. Parafacial bare and extremely narrow with the narrowest point narrower than the width of maxillary palpus at base in both sexes. Parafacial width 0.01–0.03 ($\bar{x}$ = 0.02) head width in male, 0.01–0.02 ($\bar{x}$ = 0.01) in female. Facial ridge with hairs on basal 1/4 or less. Height of haired portion of facial ridge 0.11–0.18 ($\bar{x}$ = 0.14) head height in male, 0.11–0.18 ($\bar{x}$ = 0.13) in female. Palpus yellow, usually dark yellowish at base; distally sparsely haired with base usually bare; apices slightly to substantially broadened; length 0.24–0.32 ($\bar{x}$ = 0.23, N = 9) head height in male, 0.28–0.34 ($\bar{x}$ = 0.30) in female.

Thorax: Dorsocentral length 0.35–0.43 ($\bar{x}$ = 0.38) total body length in male, 0.38–0.44 ($\bar{x}$ = 0.41) in female. Shiny black in ground color; presutural scutum with thin white pruinescence, postsutural scutum with much sparser pruinescence and scutellum revealing underlying black ground color. In dorsal view, only the presutural scutum appears grayish; whereas in lateral view the postsutural scutum appears grayish as well, especially in the female. Faint white pruinose stripes on presutural scutum leaving 4 or 5 black vittae; the inner 2 or 3 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae (Figs. 19). Postpronotum with 2 setae, rarely with 1 small additional seta.

Katepisternum with 2 setae. Scutum with 1 presutural acrostichal seta, rarely with 1 additional small seta; 3 postsutural acrostichal setae, rarely with only 2; 2 presutural and 2 postsutural dorsocentral setae, occasionally with 1 and 2 additional small setae respectively; 1 presutural and 3 postsutural intra–alar setae; 1 presutural and 2 postsutural supra–alar setae, first postsutural supra–alar absent. Scutellum discal setae usually absent, but sometimes with 1 small hair–like pair of setae.

Legs black, rarely with front and hind tibiae dark yellowish (Fig. 21). Tarsal claws longer than 5th tarsomere in male and shorter than 5th tarsomere in female. Fore claw length 1.04–1.27 ($\bar{x}$ = 1.11) fore 5th tarsomere length in male, 0.79–0.94 ($\bar{x}$ = 0.88) in female. Hind tibia with 2 well developed posterodorsal setae, rarely with 1 additional shorter seta; usually 5 well developed anteroventral setae, but varied from 3 to 7. Wings usually dark fumose at r_1 and r_{2+3} cells; and light fumose at c, sc, r_{4+5}, and dm cells. Wing vein R_{4+5} dorsally with 1–4 setae at base. Vein M smoothly curved at bend and ending at wing margin anterior to wing tip separately from vein R_{4+5}.

Abdomen: Ovoid in female and more elongate in male. Mostly bright yellow in dorsal view with a narrow black vitta medially on T_{1+2} to T_5 merging with black transverse bands on anterior 1/4 of T_{1+2}, posterior 1/4 to 1/5 of T_3, posterior 2/3 of T_4, and usually 3/4 of T_5 (rarely full black or yellowish) in male. T_5 mostly yellow in female. Transverse bands of sparse white pruinosity not sharply demarcated (appearing almost invisible to naked eye) on anterior 1/4 of T_3 and T_4 and on anterior 1/3–1/2 of T_5. Mid-dorsal depression of T_{1+2} not reaching median marginal setae (Fig. 19). Discal setae absent, 1

pair of median marginal setae on T_{1+2} and T_3, a row of median marginals on T_4 and T_5 (usually 4 pairs of well developed setae on T_4 and T_5), and 1 pair of lateral marginal setae on T_{1+2} and T_3.

Male terminalia: Sternite 5 with median cleft smoothly U–shaped, inner margin with minute setae, apical lobe rounded apically, and anterior margin of basal plate slightly concave (Fig. 25). S_5 apical lobe length 0.61–0.67 ($\overline{x}$ = 0.64, N = 7) S_5 length. Surstylus bare, in lateral view almost straight. Surstylus and cercus almost subequal in length. Cerci in lateral view straight along anterior surface and slightly concave on posterior surface, ending in a nearly truncate tip. In posterior view, cercus narrowly constricted on apical 1/3; upper lobes length almost equal to medial section length and longer than the apical cleft length; and apex of the cerci linear, with rounded tips directed distally. Cercus upper lobe length 0.33–0.42 ($\overline{x}$ = 0.38, N = 7) cercus length, cercus medial section length 0.33–0.52 ($\overline{x}$ = 0.40, N = 7) cercus length. (Figs. 23 and 24).

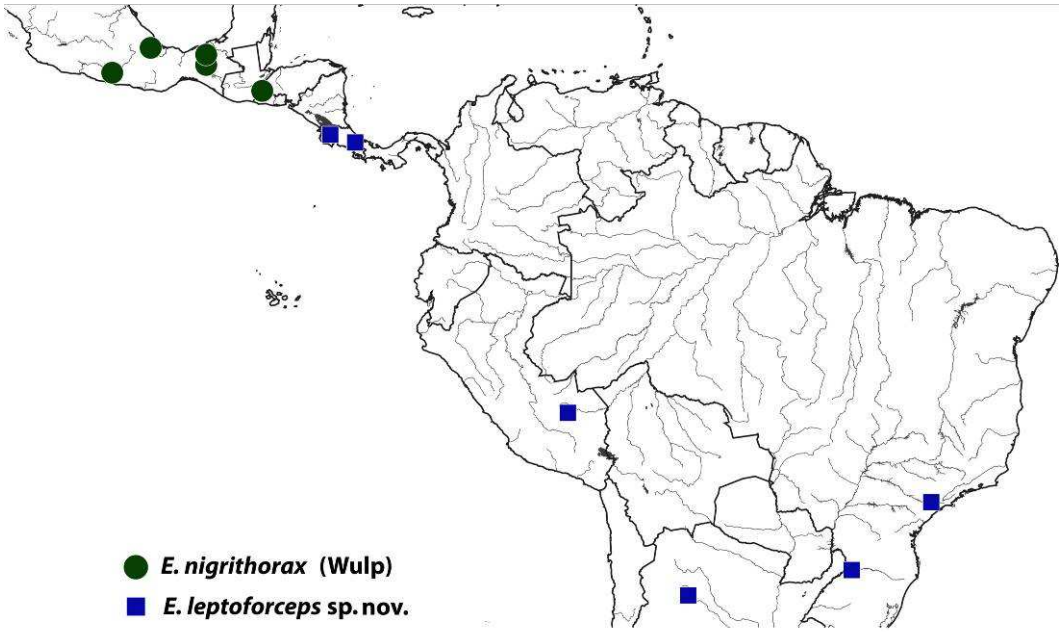
Female Terminalia: Sternite 5 rectangular–shaped, middle of anterior margin with a slightly concave curve, covered with well developed setae on more than posterior 2/3 (Fig. 26). S_5 about twice as long as wide. Width of S_5 0.51–0.56 ($\overline{x}$ = 0.54, N = 2) the length. S_6 with several well developed setae on posterior corners (Fig. 27).T_6 well developed, present as two lateral sclerites, uniform in width, with well developed setae along posterior margin. S_7 with a distinctive lobe on the medial section of the anterior margin, with several small setae on posterior corners (Fig. 28). T_7 present as two lateral sclerites, with small setae along posterior margins (Fig. 29). S_8 small and bare, almost

round, difficult to distinguish from the surrounding membrane. T_8 bare, well developed laterally, strongly narrowed dorsally, joining at the ventral end with the postgenital plate. T_{10} between the cerci, small and bare, rhomboid in shape (Fig. 29). Postgenital plate with several small setae on posterior tip. Cercus slightly clavate with several setae apically (Fig. 29).

Host: Unknown

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

Widely distributed, from Costa Rica in the north to northern Argentina in the south (Map 4). There is a large geographical gap between the specimens collected in Costa Rica and those collected in southern Brazil that is probably due to the lack of collecting effort between these two areas. This species seems to occur at both low elevations (e.g., Santa Catarina, Brazil, 300–500m) and moderately high elevations (e.g., Monte Verde, Costa Rica, 1500–1800m). However, we have sampled the tachinid fauna of the eastern Andes of Ecuador (2000–2600m) for several years and we have not collected it there, which suggests that it may not occur above ~2000m. Specimens from Brazil were collected throughout the year, but 57% were collected in November. Specimens from Costa Rica were collected from August to October, the specimen from Peru was collected in August, and the single specimen from Argentina was collected in March.



Map 4. Known distributions of *E. nigrithorax* (Wulp) and *E. leptoforceps*.

DISCUSSION

As mentioned above in the recognition section, *E. leptoforceps* and *E. nigrithorax* can be reliably separated based on differences in the shape of the cerci and S_5. In addition to these characters, there are two other differences in the male genitalia, (1) the shape of the surstylus is more rounded in *E. nigrithorax* and more rectangular in *E. leptoforceps*, and (2) the shape of the distiphallus, in general, varies between these two species (Figs. 23–34). However, the shapes of these structures vary intraspecifically such that some specimens exhibit intermediate states in the shape of surstylus and aedeagus. In contrast to males, it is extremely difficult to separate the females of these two species. There appear to be some slight differences between *E. leptoforceps* and *E. nigrithorax* in the shapes of sternites 5–7 and the cerci. However, variation in these structures is also present within these taxa. Therefore, females cannot be reliably separated at this time

based on genitalia or other characters. Here, I assigned females with males based primarily on their geographical distribution. The collection locality records of *E. nigrithorax* and *E. leptoforceps* suggests that these species exhibit allopatric or parapatric distributions (see previous section). Females used in the description of the species were collected in the same place and on the same dates as male specimens of the same species. Because of these circumstances, the female descriptions should be used with some caution. Additional study is needed to separate females confidently. In addition, collection of specimens from El Salvador, Honduras and Nicaragua, where these two species may coexist, would be useful in corroborating the separation of these species and assessing variation between and within species.

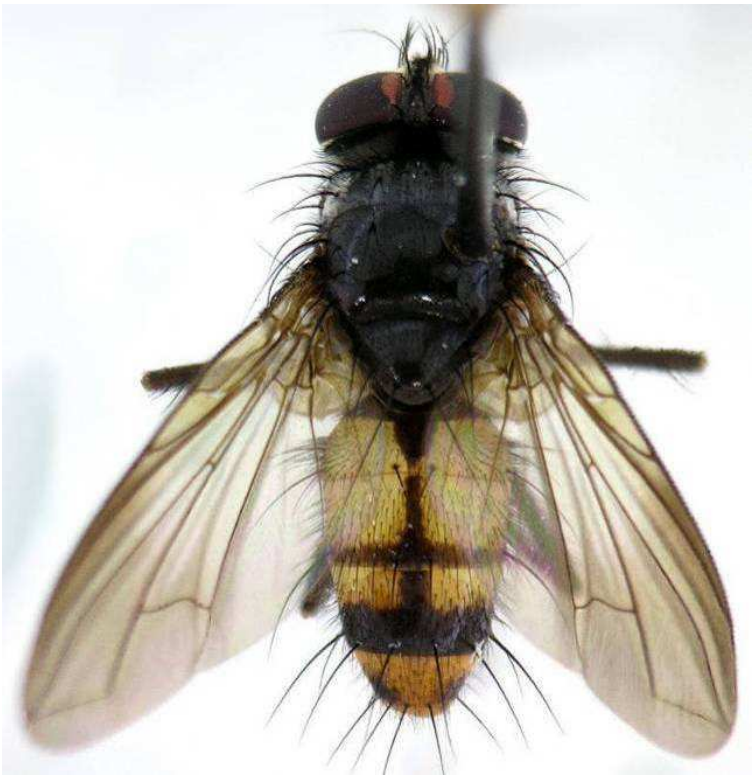


Figure 19. Dorsal view of male *E. leptoforceps*.

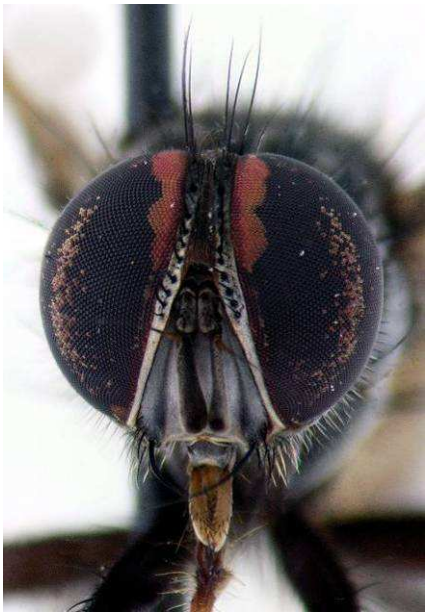


Figure 20. Frontal view of the head of male *E. leptoforceps*.

Figure 21. Lateral view of male *E. leptoforceps*.

Figure 22. Lateral view of the head of male *E. leptoforceps*.

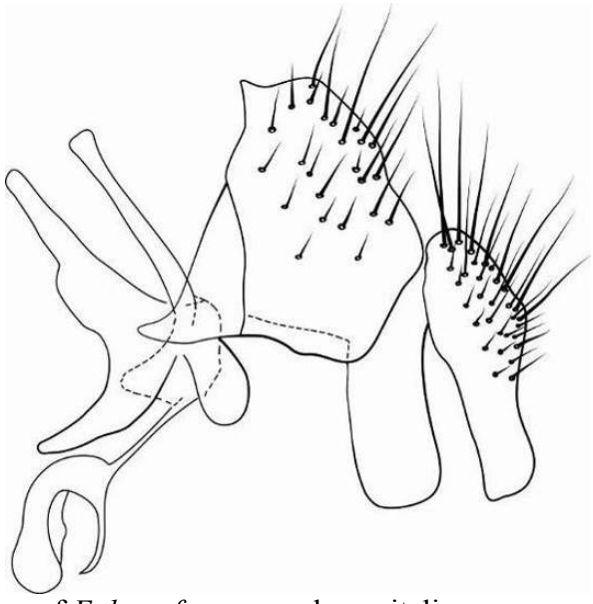


Figure 23. Lateral view of *E. leptoforceps* male genitalia.

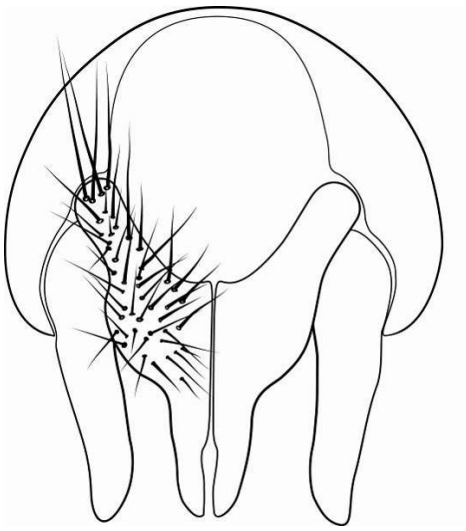


Figure 24. Epandrial complex in posterior view of male *E. leptoforceps*.

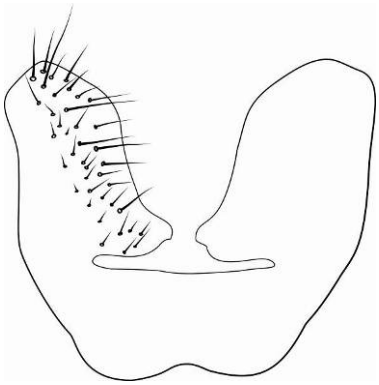


Figure 25. 5th sternite of male *E. leptoforceps*.

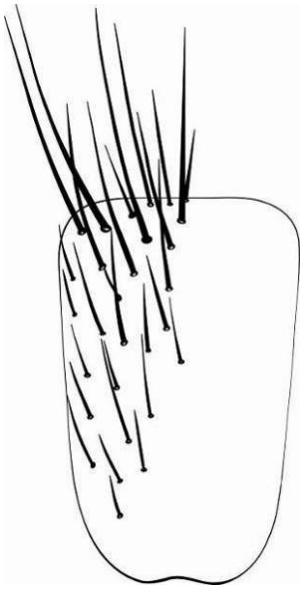


Figure 26. 5th sternite of female *E. leptoforceps*.

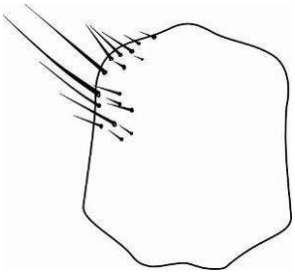


Figure 27. 6th sternite of female *E. leptoforceps*.

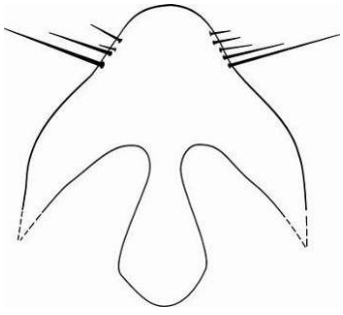


Figure 28. 7th sternite of female *E. leptoforceps*.

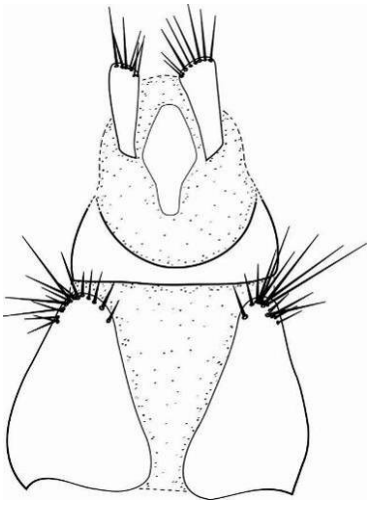


Figure 29. Dorsal view of female genitalia showing tergites 7–10 and cerci of *E. leptoforceps*.

Erythromelana nigrithorax (Wulp)

(Figs. 30–36, Map 4)

TYPE MATERIAL

Lectotype

One male, labelled: “LECTO-/ TYPE [purple label]”, “Teapa/ Tabasco. [Mexico]/ Feb H.H.S.”, “B.C.A.. Dipt. II./ Anisia/ nigrithorax,/ v.d.W.”, “Central America./ Pres. by/ F.D. Godman./ O. Savin./ 1903-172.”, “LECTOTYPE ♂/ of Anisia/ nigrithorax Wulp/ designated 1979/ D.M. Wood”, “ Erythromelana/ nigrithorax (Wulp)/ det. Inclan D.J.”, (BNHM).

Paralectotype

One female, labelled: “PARA-/ LECTO-/ TYPE [blue label]”, “♀”, “Atoyac,/ Vera Cruz. [Mexico]/ April H.H.S.”, “B.C.A.. Dipt. II./ Anisia/ nigrithorax,/ v.d.W.”, “Central America./ Pres. by/ F.D. Godman./ O. Savin./ 1903-172.”, “PARALECTOTYPE ♀/ of

Anisia/ nigrithorax Wulp/ designated 1979/ D.M. Wood", "Erythromelana/ nigrithorax (Wulp)/ det. Inclan D.J.", "DI110BM [specimen ID number]", (BNHM).

OTHER MATERIAL EXAMINED

Six male and four female specimens. One female, labelled: "MEXICO Chiapas/ 8.9 km E. Rayon/ 19. IX. 1991/ M. Wood 1500m", "Erythromelana/ nigrithorax (Wulp)/ det. Inclan D.J.", "DI59CA [specimen ID number]", terminalia stored in glycerine in a microvial pinned below specimen (CNC); six males and three females, same previus data exept location and date " MEXICO GRO. – jcn/ Chichihualco-Filo/ de Caballo roads/ 15. VII. 92 M.Wood" and ID numbers "DI58CA [♀]", "DI226CA [♀]", "DI49CA [♂]", "DI224CA [♂]", "DI225CA [♂]"terminalia stored in glycerine in a microvial pinned below specimen, "DI48CA [♂]" terminalia stored in glycerine in a microvial pinned below specimen (CNC), "DI50CA [♂]"terminalia stored in glycerine in a microvial pinned below specimen (INBio), and "DI57CA [♀]" terminalia stored in glycerine in a microvial pinned below specimen (JOS); one male, " 3-25-78/ monte Cristo/ El Salvador, CA [Central America]/ d.r. barger", " Urodexiini ?/ [D.R. Barger/ 78-4903]", "Erythromelana/ nigrithorax (Wulp)/ det. Inclan D.J.", "DI136NM [specimen ID number]", terminalia stored in glycerine in a microvial pinned below specimen (NMNH).

RECOGNITION

This species is morphologically very similar to *E. leptoforceps* and can only be distinguished from it by differences in the male genitalia. The medial section of the cerci of *E. nigrithorax* (Wulp), viewed from the posterior, is notably wider than the cerci of *E.*

leptoforceps. In addition, the base of sternite 5 is narrower in *E. nigrithorax* than in *E. leptoforceps*. Information on the recognition of *E. nigrithorax* female, and the distinction of this species from the remaining *Erythromelana* species is provided in the description of *E. leptoforceps*.

REDESCRIPTION

Redescribed from 5 males and 4 females (including the male lectotype and the female paralectotype), unless otherwise noted as "N".

Length: 5.2-7.8mm ($\bar{x}$ = 6.98mm) in male, 5.4-6.8mm ($\bar{x}$ = 6.35mm) in female.

As described for *E. leptoforceps* sp. nov. except as follows:

Head: Eye moderately haired, ommatrichia about as long as 4 eye facets. Eye 0.84-0.93 ($\bar{x}$ = 0.88) head height in male, 0.86-0.92 ($\bar{x}$ = 0.89) in female. Vertex width 0.12-0.16 ($\bar{x}$ = 0.14) head width in male, 0.15-0.17 ($\bar{x}$ = 0.16) in female. Frontal vitta width 0.27-0.41 ($\bar{x}$ = 0.33) vertex width in male, 0.33-0.45 ($\bar{x}$ = 0.39) in female. Length of first flagellomere 0.41-0.50 ($\bar{x}$ = 0.47) head height in male, 0.39-0.47 ($\bar{x}$ =0.42) in female. Pedicel length 0.27-0.31 ($\bar{x}$ =0.29) length of first flagellomere in male, 0.27-0.37 ($\bar{x}$ = 0.31) in female. Fronto-orbital plate with 7-11 (m = 10) medioclinate frontal setae in male, 4-6 (m = 6) in female. Parafacial width 0.01-0.02 ($\bar{x}$ = 0.02) head width in male and female. Height of haired portion of facial ridge 0.11-0.21 ($\bar{x}$ = 0.16) head height in male, 0.12-0.16 ($\bar{x}$ = 0.14) in female. Palpus brown-yellowish, apices slightly broadened; length 0.27-0.29 ($\bar{x}$ = 0.28) head height in male, 0.28-0.31 ($\bar{x}$ = 0.29) in female.

Thorax: Dorso-central length 0.34-0.42 ($\bar{x}$ = 0.37) total body length in male, 0.33-0.41 ($\bar{x}$ = 0.39) in female. Faint white pruinose stripes on presutural scutum leaving 4 black vittae on males and females, rarely 5 black vittae on females (Fig, 30). Postpronotum with 2 setae, usually with one small additional seta in males. Scutum with 2 presutural acrostichal seta, if only 1 setae usually accompanied by 1 additional small seta; 3 postsutural acrostichal setae. Scutellum discal setae usually composed of 1 pair of hair-like setae, sometimes absent.

Legs black (Fig. 32). Fore claw length 1.20-1.36 ($\bar{x}$ =1.21, N = 4) fore 5th tarsomere length in males, 0.73-0.95 ($\bar{x}$ = 0.85) in females. Hind tibia with only 2 well developed posterodorsal setae; usually 4-5 well developed anteroventral setae, but varied from 3 to 6. Wing vein R_{4+5} dorsally with 3 setae at base, but varied from 2-4 setae.

Abdomen: Mostly bright yellow in dorsal view with a narrow black vitta medially on T_{1+2} to T_5 merging with black transverse bands on anterior 1/4 of T_{1+2}, posterior 1/5 to 1/4 of T_3, posterior 2/3 of T_4, and usually ¾ of T_5 (rarely full black) in male (Fig. 30). Female similar to males, but black transverse bands on posterior 1/3 to all of T4, and fully black or yellow on T5. Transverse bands of sparse white pruinosity not sharply demarcated on anterior ¼ of T_3, 1/4 to 1/3 of T_4, and usually well differentiated on anterior 1/2 to all of T5.

Male terminalia: Sternite 5 apical lobe length 0.63-0.70 ($\overline{x}$ = 0.66, N = 4) S_5 length (Fig. 36). Surstylus slightly wider distally with a rounded tip. Cerci in lateral view with the anterior and posterior surface of the tip almost parallel sided. In posterior view, cercus upper lobe length shorter than medial section length and almost equal to the apical cleft length. Cercus upper lobe length 0.15-0.19 ($\overline{x}$ = 0.18, N = 4) cercus length, cercus medial section length 0.49-0.69 ($\overline{x}$ = 0.60, N = 4) cercus length (Figs. 34 and 35).

Female Terminalia: Sternite 5 rectangular shaped, usually with the posterior section slightly wider and anterior margin almost flat. Width of S_5 0.56-0.72 ($\overline{x}$ = 0.64, N = 2) the length. S_6 length 0.62-0.74 ($\overline{x}$ = 0.68, N = 2) S5 length. Cerci slightly curved medially.

Host: Unknown

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

E. nigrithorax has been collected primarily from southern Mexico with one specimen from El Salvador (Map 4). The gap between the specimens collected from Mexico and El Salvador suggest the presence of this species in Guatemala as well. The closely related species, *E. leptoforceps*, has been collected in Costa Rica, and it is not clear if or where these species meet. This species occurs at both low elevations (e.g., Teapa, Mexico, 100–300m) and high elevations (e.g., Monte Cristo, El Salvador, 1800-2300 m). Specimens from Mexico were collected in February, April, July, and September, and the specimen from El Salvador was collected in March.

DISCUSSION

See discussion section of *E. leptoforceps.*

Figure 30. Dorsal view of male *E. nigrithorax*.

Figure 31. Frontal view of the head of male *E. nigrithorax*.

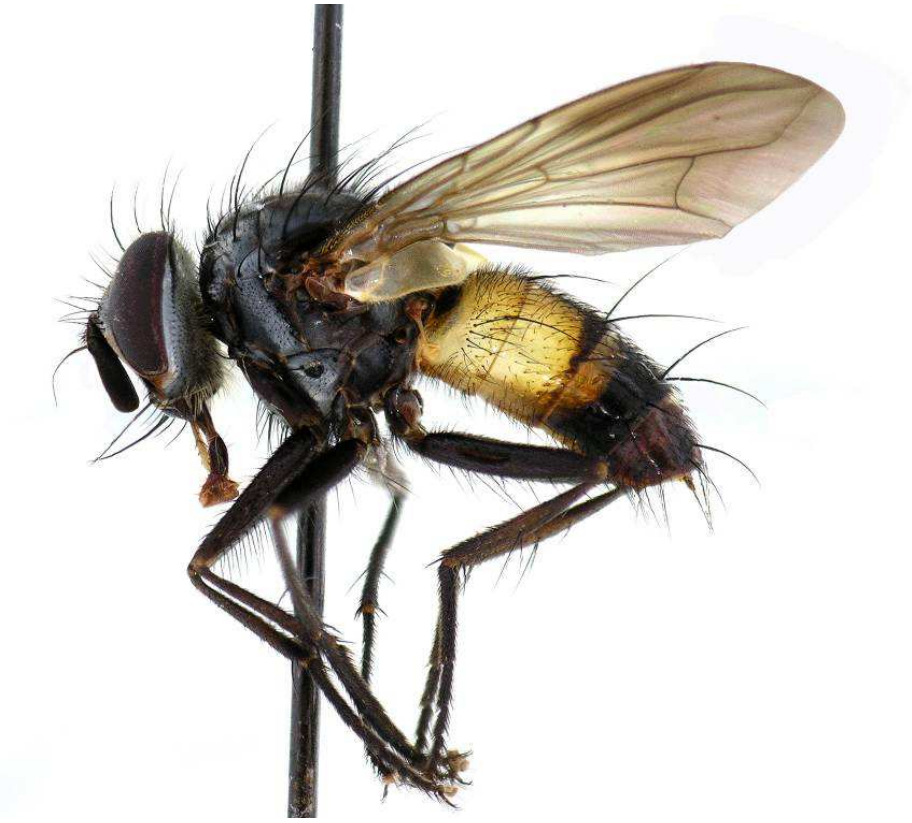


Figure 32. Lateral view of male *E. nigrithorax*.

Figure 33. Lateral view of the head of male *E. nigrithorax*.

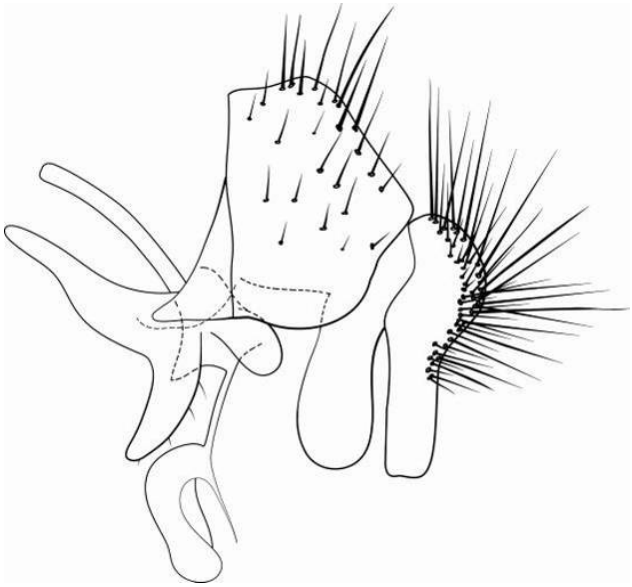


Figure 34. Lateral view of *E. nigrithorax* male genitalia.

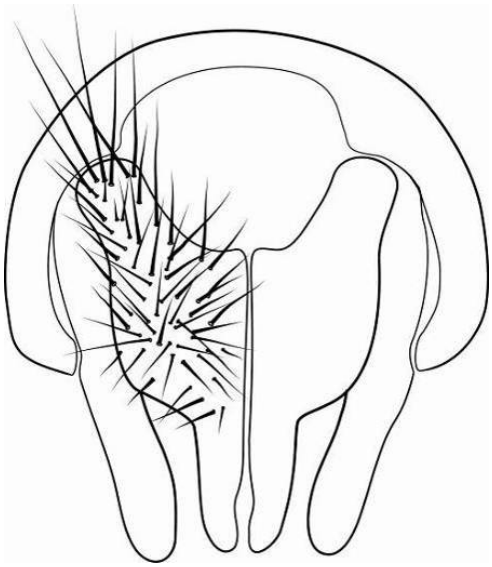


Figure 35. Epandrial complex in posterior view of male *E. nigrithorax*.

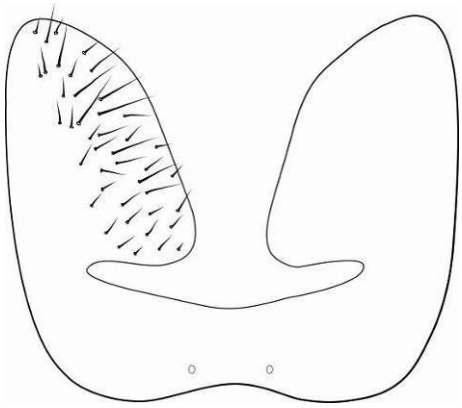


Figure 36. 5th sternite of male *E. nigrithorax*.

Erythromelana curvifrons Inclan sp. nov.

(Figs. 37-43)

TYPE MATERIAL

Holotype

Male, labelled: "Ecuador: Napo Prov. [Province]/ Yanayacu Biological Station,/ S 00°35.9' W 77°53.4, 2163m/ REARED/ January 2006/ 11280 [rearing record]", "HOLOTYPE/ Erythromelana/ curvifrons/ Inclan D.J. [red label]" (CNC). Puparium pinned below specimen.

Allotype

Female, labelled: "Ecuador: Napo Prov. [Province]/ Yanayacu Biological Station,/ S 00°35.9' W 77°53.4, 2163m/ REARED/ April 2006/ 14245 [rearing record]", "ALLOTYPE/ Erythromelana/ curvifrons/ Inclan D.J. [red label]" (CNC). Puparium pinned below specimen.

Paratype

Male, labelled: "Ecuador: Napo Prov. [Province]/ Yanayacu Biological Station,/ S 00°35.9' W 77°53.4, 2163m/ REARED/ January 2006/ 11279 [rearing record]", "PARATYPE/ Erythromelana/ curvifrons/ Inclan D.J. [yellow label]" (JOS). Puparium and terminalia stored in glycerine in a microvial pinned below specimen.

ETYMOLOGY

From the Latin *curvus* and *frons* meaning bent or curved forehead, in reference to the curvature of the frontal orbital plate compared to other *Erythromelana* species.

RECOGNITION

E. curvifrons is morphologically similar to the related species with yellow abdomen in the *E. jaena* species group (*E. jaena*, *E. abdominalis*, *E. ecuadoriana*, and *E. eois*). In general, this species can be separated from all the species in the *E. jaena* and *E. cryptica* species groups by the curvature of the fronto-orbital plate and the extremely narrow frontal vitta. Additionally, *E. curvifrons* can be distinguished from all the species in the *E. cryptica* species group by the yellow abdominal coloration.

DESCRIPTION

Described from 2 males and 1 female, unless otherwise noted as "N".

Length: 6.4–6.8mm ($\bar{x}$ = 6.6mm) in male, 6.5mm in female.

Head: Parafacial brown in ground color covered with dull silver pruinescence. Fronto-orbital plate and vertex black in ground color covered with silver pruinescence (which could appear grayish from certain angles) restricted mostly to the fronto-orbital plate, vertex with weak golden pruinescence visible only in lateral view. Arista black with brown-yellowish on basal 1/4, thickened only on basal 1/5 (Figs. 38 and 39). Eye moderately long-haired in male, sparser and shorter in female; ommatrichia about as long as 3 eye facets in male, 2 in female. Eye 0.89 ($\bar{x}$ = 0.89) head height in male, 0.90 in female. Vertex width 0.13–0.14 ($\bar{x}$ = 0.13) head width in male, 0.13 in female. Frontal vitta width 0.14–0.15 ($\bar{x}$ = 0.15) vertex width in male, 0.21 in female. Length of first flagellomere 0.41–0.43 ($\bar{x}$ = 0.42) head height in male, 0.42 in female. Pedicel length 0.28–0.29 ($\bar{x}$ = 0.28) length of first flagellomere in male, 0.26 in female. Fronto–orbital plate with 9–10 medioclinate frontal setae in male, 6–7 in female; 2 reclinate inner orbital

setae (rarely with 1 extra small setae); female with 2 proclinate outer orbital setae, male without outer orbitals. Vertex with 1 reclinate inner and 1 lateroclinate outer vertical seta, the latter barely differentiated from the row of postocular setae (especially in male). Ocellar setae absent. Parafacial bare and extremely narrow, the narrowest point almost equal to the width of the thickened section of the arista in both sexes. Parafacial width 0.01 head width in male and female. Facial ridge with hairs on basal 1/5 or less. Height of haired portion of facial ridge 0.13 ($\overline{x}$ = 0.13) head height in male, 0.08 in female. Palpus yellow; sparsely haired with base usually bare; almost uniform in width; length 0.28–0.31 ($\overline{x}$ = 0.30) head height in male.

Thorax: Dorsocentral length 0.38–0.40 ($\overline{x}$ = 0.39) total body length in male, 0.39 in female. Shiny black in ground color; presutural scutum with thin white pruinescence, postsutural scutum with much sparser pruinescence revealing underlying black ground color. In dorsal view only the presutural scutum appears slightly grayish; where in lateral view the postsutural scutum appears slightly grayish as well. Faint white pruinose stripes on presutural scutum leaving 4 black vittae; the inner 2 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae (Fig. 37). Postpronotum with 2 setae. Katepisternum with 2 setae. Scutum with 1 and 3 postsutural presutural acrostichal seta; 2 presutural dorsocentral setae, usually with 1 additional small setae; 2 postsutural dorsocentral setae, usually with 1 or 2 additional small setae; 1 presutural and 3 postsutural intra–alar setae; 1 presutural and 2 postsutural supra–alar setae, first postsutural supra–alar absent. Scutellum with discal setae usually absent or with 1 pair of small hair–like setae.

Legs black with front and hind tibiae yellowish (Fig. 40). Tarsal claws longer than 5th tarsomere in male and shorter than 5th tarsomere in female. Fore claw length 1.04–1.08 ($\bar{x}$ = 1.06) fore 5th tarsomere length in male, 0.67 in female. Hind tibia with 2 well developed posterodorsal setae, rarely with 1 additional small seta; usually with 4 or 5 well developed anteroventral setae. Wing vein R_{4+5} dorsally with 3 setae at base. Vein M smoothly curved at bend, ending at wing margin, almost at wing tip, separately from vein R_{4+5}.

Abdomen: Bright yellow with black on the anterodorsal margin and the mid-dorsal depression of T_{1+2}. Transverse white pruinose bands absent (Fig. 37). Discal setae absent, 1 pair of median marginal setae on T_{1+2} and T_3, a row of median marginals on T_4 and T_5, and 1 pair of lateral marginal setae on T_{1+2} and T_3.

Male terminalia: Sternite 5 with median cleft smoothly U–shaped, inner margin with minute setae, apical lobe rounded apically, and anterior margin of basal plate slightly concave (Fig. 43). S_5 apical lobe length 0.64 (N = 1) S_5 length. Surstylus in lateral view slightly concave on posterior margin. Surstylus and cercus almost subequal in length. In lateral view, cerci straight along anterior surface forming a nearly right angle with the end of the cercus; slightly concave on posterior surface forming a nearly round tip. In posterior view, cercus narrowly constricted on nearly apical 1/2; upper lobe length longer than medial section length and almost double than the apical cleft length; apical cleft well defined; and apex of the cerci linear, with rounded tips directed medially. Cercus upper

lobe length 0.39 (N = 1) cercus length, cercus medial section length 0.35 (N = 1) cercus length. (Figs. 41 and 42).

Host: Three specimens were reared from unknown geometrid caterpillars (probably *Eois sp*., Lepidoptera: Geometridae). Specifically, two males were reared from caterpillars that were collected from YBS (Napo, Ecuador) on an unknown host plant in the genus *Piper* (Piperaceae). The first and second instar caterpillars were collected on 6th January 2006 and the tachinid pupae were noticed 16 days later. Adult flies were observed 29 and 31 days after pupa were first observed, respectively. The single female was reared from a caterpillar that was collected from YBS on the host plant *Siparuna pyricarpa* (Monimiaceae). The second instar caterpillar was collected on 18th April 2006 and the fly pupa was noticed 19 days later, with the adult emerging 26 days later.

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

All the specimens were collected in the province of Napo, Ecuador at 2,000-2,600m. The presence of the specimens collected in high elevations, suggest that this species could be distributed more widely along the Andes Mountains in South America. The males were reared in January, and the female was reared in April (see host section).

DISCUSSION

Ideally the description of a species should be based on a long series of specimens. Here, I am describing this species based on two males and a single female because of the unique non-terminalic and terminalic features. As described in the recognition section, *E.*

curvifrons can be easily separated from other *Erythromelana* species based on the curvature of their fronto-orbital plate and their narrow frontal vitta. In addition, the male terminalia has a distinctive shape where the cerci, in lateral view, are straight along the anterior surface forming a nearly right angle with the end of the cerci; and the cerci, in posterior view, with upper lobe length longer than medial section length and almost double the apical cleft length. Therefore, I have no doubt that these specimens are distinct from the other *Erythromelana* species. However, given the few specimens examined in this description, it remains unknown how much variation exists among individuals of this species. Because of these circumstances, this description should be used with some caution. Additional study of a larger sample of specimens is needed to evaluate the variation in each character presented in this description.

Figure 37. Dorsal view of male *E. curvifrons*.

Figure 38. Frontal view of the head of male *E. curvifrons*.

Figure 39. Lateral view of male *E. curvifrons*.

Figure 40. Lateral view of the head of male *E. curvifrons*.

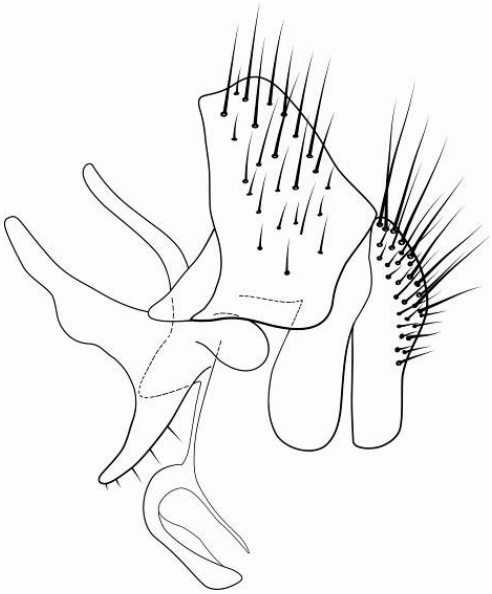


Figure 41. Lateral view of *E. curvifrons* male genitalia.

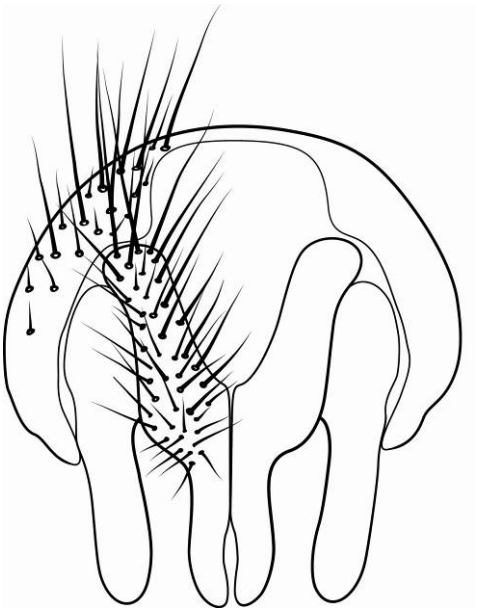


Figure 42. Epandrial complex in posterior view of male *E. curvifrons*.

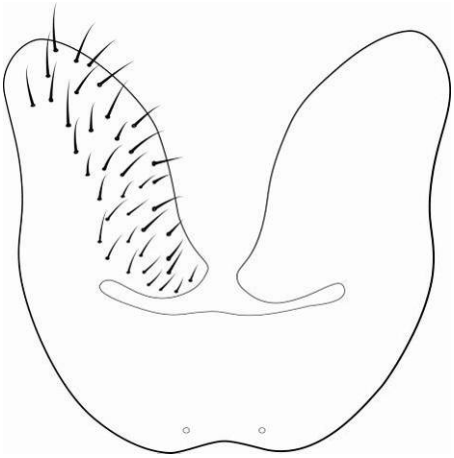


Figure 43. 5th sternite of male *E. curvifrons*.

Erythromelana ecuadoriana Inclan sp. nov.

(Figs. 44-46)

TYPE MATERIAL

Holotype

Male, labelled: “Ecuador: Napo Prov. [Province]/ Yanayacu Biological Station,/ S 00°35.9’ W 77°53.4, 2163m/ REARED/ Feb [February] 2009/ 37297 [rearing record]”, “HOLOTYPE/ Erythromelana/ ecuadoriana/ Inclan D.J. [red label]” (CNC). Puparium stored in glycerine in a microvial pinned below specimen.

Allotype

Female, labelled: “Ecuador: Napo [Province]/ 7 km. S [south] Baeza/ 20-25. II. 79/ G. & M. Wood 2000m”, “ALLOTYPE/ Erythromelana/ ecuadoriana/ Inclan D.J. [red label]” “DI06CA”, (CNC).

Paratype

Male, labelled: “Ecuador: Napo Prov. [Province]/ Yanayacu Biological Station,/ S 00°35.9’ W 77°53.4, 2163m/ Pan Traps/ 4-11 Feb 2008”, “PARATYPE/ Erythromelana/ ecuadoriana/ Inclan D.J. [yellow label]”, “DI03PT”, (JOS). Terminalia stored in glycerine in a microvial pinned below specimen.

ETYMOLOGY

Named after the country, Ecuador, where all known specimens have been collected.

RECOGNITION

E. ecuadoriana is morphologically similar to the related species with yellow abdomen in the *E. jaena* species group (*E. jaena*, *E. abdominalis*, *E. curvifrons*, and *E. eois*). In general, this species can be separated from most of the species in the *E. jaena* and *E. cryptica* species groups by the presence of a row of setae on about apical half of the vein R1. *E. distincta* is the only species that also have the R1 vein setose, but this species can be easily distinguished by the yellow and black abdominal coloration characteristic of most of the species in the *E. cryptica* species group. Additionally, this is the only *Erythromelana* species where tarsal claws are shorter than the 5th tarsomere in both males and females.

DESCRIPTION

Described from 2 males and 1 female, unless otherwise noted as "N".

Length: 5.6–6.1mm ($\bar{x}$ = 5.9mm) in male, 5.8mm in female.

Head: Parafacial brown in ground color covered with dull silver pruinescence. Fronto-orbital plate black in ground color covered with silver pruinescence, which appears grayish from certain angles. Vertex black with a faint golden reflections visible only in lateral view. Arista black with dark brown on basal 1/4, thickened only on basal 1/5 . Eye sparsely haired, ommatrichia about as long as 4 eye facets in male and female. Eye 0.83–0.84 ($\bar{x}$ = 0.83) head height in male, 0.84 in female. Vertex width 0.20–0.21 ($\bar{x}$ = 0.21) head width in male, 0.19 in female. Frontal vitta width 0.44–0.50 ($\bar{x}$ = 0.47) vertex width in male, 0.47 in female. Length of first flagellomere 0.56–0.59 ($\bar{x}$ = 0.58) head height in male, 0.47 in female. Pedicel length 0.19–0.22 ($\bar{x}$ = 0.21) length of first flagellomere in

male, 0.3 in female. Fronto–orbital plate with 5–6 (m = 6) medioclinate frontal setae in male, 4–5 in female; 2 reclinate inner orbital setae in male, 1 in female; female with 2 proclinate outer orbital setae, male without outer orbitals. Vertex with 1 reclinate inner and 1 lateroclinate outer vertical seta; the latter smaller than the inner setae, but well differentiated from the row of postocular setae in both sexes. Ocellar setae well developed, proclinate. Parafacial bare and extremely narrow, with the narrowest point narrower than the width of maxillary palpus at base in both sexes. Parafacial width 0.01–0.02 ($\bar{x}$ = 0.02) head width in male, 0.03 in female. Facial ridge with hairs on basal 1/4 or less. Height of haired portion of facial ridge 0.14–0.16 ($\bar{x}$ = 0.15) head height in male, 0.19 in female. Palpus yellow, usually dark yellowish at base; distally sparsely haired in female, dorsally almost bare in male; apices slightly broadened; length 0.35–0.36 ($\bar{x}$ = 0.35) head height in male, 0.35 in female.

Thorax: Dorsocentral length 0.35–0.38 ($\bar{x}$ = 0.37) total body length in male, 0.37 in female. Shiny black in ground color; presutural scutum with thin white pruinescence, postsutural scutum with much sparser pruinescence revealing underlying black ground color. In dorsal view only the presutural scutum appears grayish; where in lateral view the postsutural scutum appears grayish as well. Faint white pruinose stripes on presutural scutum leaving 4 black vittae in male, 5 in female; the inner 2 or 3 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae. Postpronotum with 2 setae. Katepisternum with 2-3 setae; the lower hair-like in male, absent in female. Scutum with 1 presutural acrostichal seta, with 1 additional small seta; 2 postsutural acrostichal setae in male, 1 in female; 2 presutural dorsocentral setae, with 1 additional small seta; 2

postsutural dorsocentral setae, with 1 or 2 additional small setae; 1 presutural and 3 postsutural intra–alar setae; 1 presutural and 2 postsutural supra–alar setae, first postsutural supra–alar absent. Scutellum with discal setae absent or with 1 pair of small hair–like setae.

Legs black, usually with the mid section of the tibiae dark yellowish. Tarsal claws shorter than the 5th tarsomere in male and female. Fore claw length 0.74–0.79 ($\bar{x}$ = 0.77) fore 5th tarsomere length in male, 0.77 in female. Hind tibia with 2 well developed posterodorsal setae, 5-7 well developed anteroventral setae. Wings usually dark fumose at sc, r_1 and r_{2+3} cells; and light fumose at c and r_{4+5} cells. Wing vein R_1 dorsally setose and vein R_{4+5} dorsally with 2–3 setae at base. Vein M smoothly curved at bend and ending at wing margin close to wing tip separately from vein R_{4+5}.

Abdomen: Completely bright yellow, white pruinosity transverse bands absent. Mid-dorsal depression of T_{1+2} not reaching median marginal setae. Discal setae absent, 1 pair of median marginal setae on T_{1+2} and T_3, a row of median marginals on T_4 and T_5, and 1 pair of lateral marginal setae on T_{1+2} and T_3.

Male terminalia: Sternite 5 with median cleft smoothly U–shaped, inner margin with minute setae, apical lobe rounded apically and pointing outward, and anterior margin of basal plate slightly concave (Fig. 46). S_5 apical lobe length 0.64 (N = 1) S_5 length. Surstylus bare, in lateral view, slightly concave on anterior and posterior margins, broadened distally and slightly spatulate in shape. Surstylus and cercus subequal in

length. Cerci, in lateral view, slightly concave on anterior and posterior margins, ending in a nearly rounded tip. In posterior view, cercus slightly constricted on apical 1/3; upper lobes shorter than length of medial section and almost equal in length to the apical cleft; apical cleft well defined; and apex of the cerci linear, with rounded tips directed medially. Cercus upper lobe length 0.32 (N = 1) cercus length, cercus medial section length 0.43 (N = 1) cercus length. (Figs. 44 and 45).

Host: A single male specimen was reared from an *Eois* sp caterpillar (Lepidoptera: Geometridae). Specifically, this male was reared from a caterpillar that was collected from YBS (Napo, Ecuador) on an unknown host plant in the genus *Piper* (Piperaceae). The second instar caterpillar was collected on 28th February 2009; the pupa was noticed 19 days later, and the adult fly was found 27 days later.

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

All specimens were collected in the vicinity of YBS in the province of Napo, Ecuador at 2,000-2,600m. The species may be more widespread at moderate to high elevations in the Andes Mountains in South America. All specimens were collected in February. Specifically, one male was reared (see host section), the other male was collected with a yellow pan trap, and the female was hand collected.

DISCUSSION

As described in the recognition section, *E. ecuadoriana* can be easily separated from other *Erythromelana* species based on the presence of setae on the R1 vein and the

yellow abdominal coloration. In addition, the male terminalia has a distinctive shape: Sternite 5 has the apical lobe rounded apically and pointing laterally; the surstyli, in lateral view, slightly spatulate in shape; and the cercus, in posterior view, has upper lobes that are shorter than the medial section and almost equal to the apical cleft in length. Given these unique characteristics, I feel confident in describing this species even though only two males and a single female are available for study. Given the small number of specimens, this description should be used with some caution (see discussion section of *E. curvifrons*).

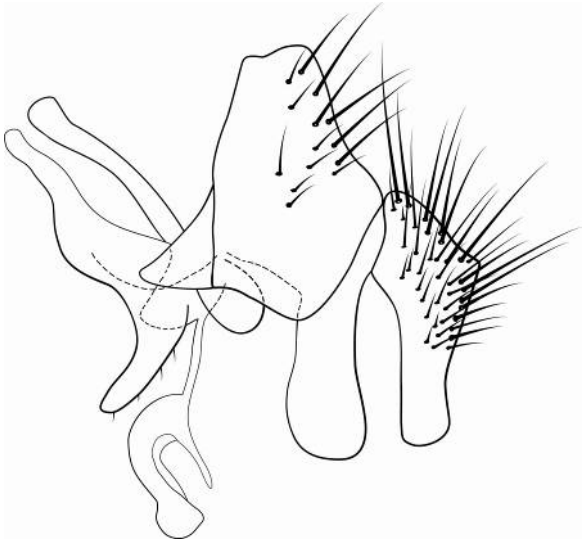


Figure 44. Lateral view of *E. ecuadoriana* male genitalia.

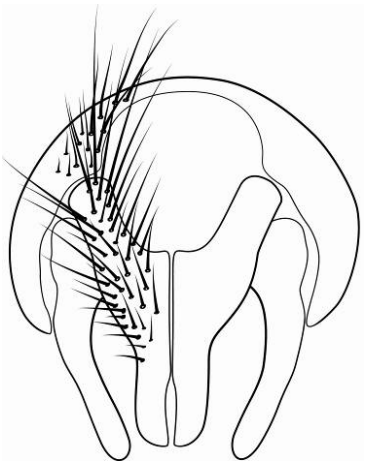


Figure 45. Epandrial complex in posterior view of male *E. ecuadoriana*.

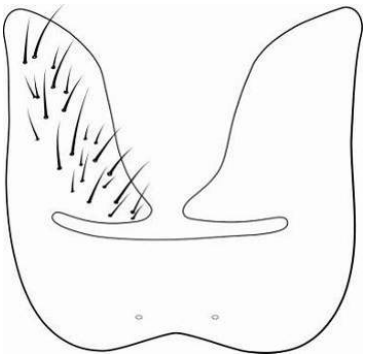


Figure 46. 5th sternite of male *E. ecuadoriana*.

***Erythromelana eois* Inclan sp. nov.**

(Figs. 47–49)

TYPE MATERIAL

Holotype

Male, labelled: "Ecuador: Napo Prov. [Province]/ Yanayacu Biological Station,/ S 00°35.9' W 77°53.4'/ 2163M [meters], 27-May-2 Jun 2005/ J.O. Stireman III",

"HOLOTYPE/ Erythromelana/ eois/ Inclan D.J. [red label]", "DI5+6+2a [specimen ID number]" (CNC). Terminalia stored in glycerine in a microvial pinned below specimen.

Allotype

Female, labelled: "Ecuador: Napo prov. [Province]/ Yanayacu Biological Station,/ S 00°35.9' W 77°53.4' 2163m/ REARED 26-viii-06/ J.O. Stireman III 16608[rearing record number]", "Allotype/ Erythromelana/ eois/ Inclan D.J. [red label]" (CNC). Puparium stored in glycerine in a microvial pinned below specimen.

OTHER MATERIAL EXAMINED

Female, labelled: "Ecuador: Napo Prov. [Province]/ Yanayacu Biological Station,/ S 00°35.9' W 77°53.4, 2163m/ REARED/ November 2005/ 9772[rearing record number]", "Erythromelana/ eois/ Inclan D.J." (CNC). Puparium pinned below specimen.

ETYMOLOGY

Named after the genus of its lepidopteran host, *Eois* (Lepidoptera: Geometridae).

RECOGNITION

E. eois is morphologically similar to the related species with yellow abdomens in the *E. jaena* species group (*E. jaena*, *E. abdominalis*, *E. ecuadoriana* and *E. curvifrons*). In general, this species can be separated from the species in the *E. jaena* group, by the presence of 3 katepisternal setae, and the long palpi that is bare anteroventrally. *E. ecuadoriana* is the only other species in the *E. jaena* group that sometimes possesses 3 katepisternal setae, but this species can be separated from *E. eois* by the presence of setae

on the vein R1. *E. eois* can be distinguished from all species in the *E. cryptica* species group by the complete yellow abdominal coloration.

DESCRIPTION

Described from 1 male and 2 females, unless otherwise noted as "N".

Length: 7.08mm in male, 6.2–6.8mm ($\bar{x}$ = 6.50mm) in female.

Head: Parafacial brown in ground color covered with dull silver pruinescence. Fronto-orbital plate and vertex black in ground color covered with dull silver pruinescence (which could appear grayish from certain angles), with a faint golden reflections visible only in lateral view. Arista black with dark brown on basal 1/5, thickened only on basal 1/6. Eye densely haired in male, sparsely in female; ommatrichia about as long as 4 eye facets in male, 3 in female. Eye 0.88 head height in male, 0.82–0.89 ($\bar{x}$ = 0.86) in female. Vertex width 0.18 head width in male, 0.20 ($\bar{x}$ = 0.20) in female. Frontal vitta width 0.48 vertex width in male, 0.33–0.45 ($\bar{x}$ = 0.39) in female. Length of first flagellomere 0.50 head height in male, 0.51–0.60 ($\bar{x}$ = 0.55) in female. Pedicel length 0.23 length of first flagellomere in male, 0.22–0.26 ($\bar{x}$ = 0.24) in female. Fronto–orbital plate with 8 medioclinate frontal setae in male, 4–5 (m = 4) in female; 2 reclinate inner orbital setae; female with 1 or 2 proclinate outer orbital setae, male without outer orbitals. Vertex with 1 reclinate inner and 1 lateroclinate outer vertical seta, the latter barely differentiated from the row of postocular setae (especially in male). Ocellar setae proclinate, almost reduced to a hair-like setae. Parafacial bare and extremely narrow with the narrowest point narrower than the width of maxillary palpus at base in both sexes. Parafacial width 0.02 head width in male, 0.01–0.02 ($\bar{x}$ = 0.02) in female. Facial ridge, in lateral view,

nearly straight (especially in female). Facial ridge with hairs on basal 1/4 or less. Height of haired portion of facial ridge 0.15 head height in male, 0.13–0.21 ($\overline{x}$ = 0.17) in female. Palpus yellow; sparsely covered with hair-like setae distally with dorsal section usually bare in males, and setae restricted to the lateral basal section in females; apices substantially broadened (especially in females); length 0.32 head height in male, 0.33–0.34 ($\overline{x}$ = 0.34) in female.

Thorax: Dorsocentral length 0.33 total body length in male, 0.35–0.37 ($\overline{x}$ = 0.36) in female. Shiny black in ground color; presutural scutum with thin white pruinescence, postsutural scutum with much sparser pruinescence revealing underlying black ground color. In dorsal view only the presutural scutum appears grayish; where in lateral view the postsutural scutum appears grayish as well. Faint white pruinose stripes on presutural scutum leaving 4 black vittae; the inner 2 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae. Prosternum often with several hair-like setae at middle. Postpronotum with 2 setae, rarely with 1 small additional seta. Katepisternum with 3 setae, the lower hair-like. Scutum with 2 presutural acrostichal seta, rarely with 1 additional small seta; 3 or 2 postsutural acrostichal setae; 2 presutural dorsocentral setae, rarely with 1 additional small seta; 3 postsutural dorsocentral setae; 1 presutural and 3 postsutural intra–alar setae; 1 presutural supra–alar setae, rarely with 1 additional small setae; 2 postsutural supra–alar setae, first postsutural supra–alar absent. Scutellum with 1 pair of small hair–like discal setae.

Legs black in male, rarely with front and hind tibiae dark yellowish in female. Tarsal claws longer than 5th tarsomere in male and shorter than 5th tarsomere in female. Fore claw length 1.14 fore 5th tarsomere length in male, 0.68–0.81 ($\bar{x}$ = 0.75) in female. Hind tibia with 2 well developed posterodorsal setae; anteroventral surface with 6 to 9 well developed setae. Wings usually dark fumose at r_1 and r_{2+3} cells; and light fumose at c, sc, r_{4+5}, and dm cells. Wing vein R_{4+5} dorsally with 1–4 setae at base. Vein M smoothly curved at bend and ending at wing margin close to wing tip separately from vein R_{4+5}.

Abdomen: Fully bright yellow in male and female. Transverse pruinose bands absent. Mid-dorsal depression of T_{1+2} not reaching median marginal setae. Discal setae absent, 1 pair of median marginal setae on T_{1+2} and T_3, a row of median marginals on T_4 and T_5, and 1 pair of lateral marginal setae on T_{1+2} and T_3.

Male terminalia: Sternite 5 with median cleft smoothly U–shaped, inner margin with minute setae, apical lobe rounded apically, and anterior margin of basal plate slightly concave (Fig. 49). S_5 apical lobe length 0.60 S_5 length. Surstylus bare, in lateral view almost straight ending in a rounded tip. Surstylus and cercus subequal in length. Cerci in lateral view slightly concave on anterior and posterior margins, ending in a broad round tip. In posterior view, upper lobe length slightly shorter than medial section length and slightly longer than the apical cleft length; apex of the cerci curved, with tips directed medially. Cercus upper lobe length 0.32 cercus length, cercus medial section length 0.41 cercus length (Figs. 47 and 48).

Female Terminalia: Sternite 5 rectangular–shaped, anterior margin slightly concave, covered with well developed setae on more than posterior 2/3. S_5 about twice as long as wide. Width of S_5 0.57 (N = 1) the length. S_6 with several well developed setae on posterior corners. T_6 well developed, present as two lateral sclerites with well developed setae along posterior margin. S_7 with a distinctive lobe on the medial section of the anterior margin, with several small setae on posterior corners. T_7 present as two lateral sclerites, with small setae along posterior margins. S_8 absent. T_8 bare, well developed laterally, strongly narrowed dorsally, joining ventrally with the postgenital plate. T_{10} between the cerci, small and bare, rhomboid in shape. Postgenital plate with several small setae on posterior tip. Cerci slightly narrow at bases, with several setae apically.

Host: Two female specimens were reared, one from an unknown geometrid (probably *Eois sp*.) and one from an *Eois* sp caterpillar (Lepidoptera: Geometridae). Specifically, the first female was reared from caterpillars that were collected from YBS (Napo, Ecuador) on the host plant *Piper schuppii* (Piperaceae). The third instar caterpillar was collected on the 20th of November 2005, the pupa was observed 14 days later, and the adult fly was observed 30 days later. The second female was reared from a caterpillar that was collected from the Arenillas cloud forest (Napo, Ecuador, 00°33.721S, 077°51.940W) on another unknown *Piper* species. The fourth instar caterpillar was collected on 19th Jun 2006 and the adult fly was found 68 days later.

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

All specimens were collected in the province of Napo, Ecuador at 2,000-2,600m. The male specimen was hand collected during the day, and the two females were reared (see host section). The male was collected in May, and the two females were reared in August and November.

DISCUSSION

As described in the recognition section, *E. eois* can be separated from other *Erythromelana* species based on their katepisternal and palpus setae, their unique palpus shape, and their abdominal coloration. In addition, the male terminalia has a distinctive shape. The cercus is not narrowly constricted on the apex as in other species in the *E. jaena* species group, and the medial section length is longer than the length of the upper lobes. Because of these unique characteristics, I am describing this species despite the small number of specimens available. As with other descriptions based on few specimens, this description should be used with some caution (see discussion section of *E. curvifrons*).

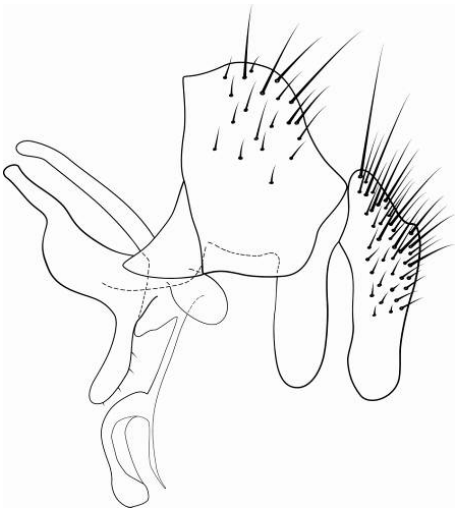


Figure 47. Lateral view of *E. eois* male genitalia.

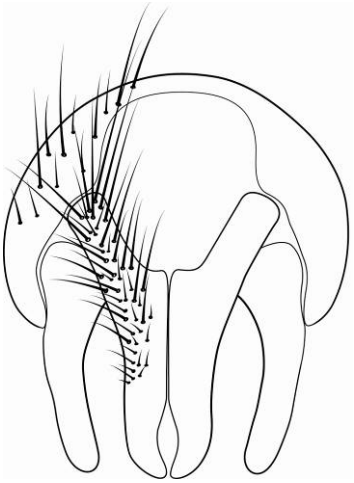


Figure 48. Epandrial complex in posterior view of male *E. eois*.

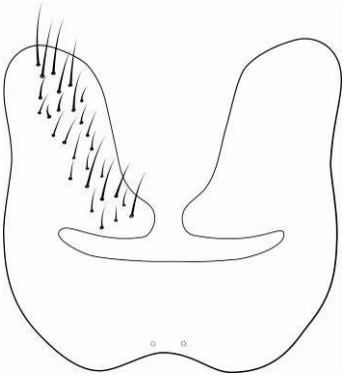


Figure 49. 5th sternite of male *E. eois*.

ERYTHROMELANA CRYPTICA SPECIES GROUP

Erythromelana cryptica Inclan sp. nov.

(Figs. 50–56, Map 5)

TYPE MATERIAL

Holotype

Male, labelled: "VENEZUELA Aragua/ Rancho Grande/ 18-27.II.1971/ G.&M. Wood 1100m", "HOLOTYPE/ Erythromelana/ cryptica/ Inclan D.J. [red label]", "DI477CA [specimen ID number]", (CNC). Terminalia stored in glycerine in a microvial pinned below specimen.

Paratypes

Sixteen males. **Venezuela:** Four males, same data as the Holotype exept "PARATYPE/ Erythromelana/ cryptica/ Inclan D.J. [yellow label]", and ID numbers "DI37CA" terminalia stored in glycerine in a microvial pinned below specimen (CNC), "DI472CA" terminalia stored in glycerine in a microvial pinned below specimen (CNC), and "DI476CA" terminalia stored in glycerine in a microvial pinned below specimen (CNC). **Ecuador:** two males, "ECUADOR, Napo [Province]/ 7 km. s. [South] Baeza/ 22. II. 79 2000m/ G. & M. Wood", "DI488CA" terminalia stored in glycerine in a microvial pinned below specimen (CNC), and "DI27CA" terminalia stored in glycerine in a microvial pinned below specimen (Ecuador); two males, same as previus data exept date "20-25.II.79", and ID numbers "DI16CA" terminalia stored in glycerine in a microvial pinned below specimen (CNC), and "DI20CA" terminalia stored in glycerine in a microvial pinned below specimen (JOS); one male "Ecuador: Napo prov. [Province]/ Yanayacu

Biological Station,/ S 00°35.9’ W 77°53.4’ 2163m/ REARED/ Sep [September] 2007/ 26213 [rearing record number]”, puparium and terminalia stored in glycerine in a microvial pinned below specimen (CNC). **Peru:** one male, “Oxipampa Peru/ 2-VIII 19”, “CHTTow’d/ coll”, “DI88NM” terminalia stored in glycerine in a microvial pinned below specimen (NMNH). **Bolivia:** one male, “ BOLIVIA Cbba [Cochabamba] Chapare/ Villa Tunari-Cochabamba/ road – km 365 – 1800m/ G. & M. Wood 3-10.XII.96”, “DI173MW” terminalia stored in glycerine in a microvial pinned below specimen (CNC). **Mexico:** two males, “MEXICO Chiapas/ Lagunas de Monte-/ bello 21.IX.1991/ D.M. Wood 1580m”, “DI52CA” terminalia stored in glycerine in a microvial pinned below specimen (CNC), and “DI51CA” terminalia stored in glycerine in a microvial pinned below specimen (CNC). **Costa Rica:** one male “Estacion Pitilla, 9km S. Santa Cecillia, P./ N. Guanacaste, Prov. Guanacaste, COSTA/ RICA, 700m. 9-14 Jul 1993, Gredy,/ Diego, Carlos, Estudiantes, L N/ 330200_380200 #2319”, “COSTA RICA INBIO/ CRI001/ 955711” terminalia stored in glycerine in a microvial pinned below specimen (INBio); one male, “COSTA RICA, Cartago, Send. [Sendero]/ Rancho Negro. Puente Dos Amigos/ hasta la Represa. 1400-1800m/ FEB 1997. R. Guzman./ L_N_186600_562000 #45462”, “COSTA RICA INBIO/ CRI002/ 536979” terminalia stored in glycerine in a microvial pinned below specimen (INBio); one male, “17 III”, “COSTA RICA/ La Suiza’ 24/ P. Schild”, “ALMelander/ Collection/ 1961”, “DI85NM” terminalia stored in glycerine in a microvial pinned below specimen (NMNH).

ETYMOLOGY

Derived from the Greek *kryptos*, meaning hidden, in reference to the morphological similarity of this species with others in the *E. cryptica* species group.

RECOGNITION

This species is morphologically very similar to *E. catarina, E. convexiforceps, E. arciforceps,* and *E. napensis,* and can only be distinguished from them by differences in the male genitalia. Therefore, females presently cannot be assigned to any of these these species (see Discussion). This species, as well as *E. catarina* and *E. convexiforceps*, can be separated from *E. arciforceps* and *E. napensis* by the presence, in lateral view, of a raised carina on the medial section of the posterior margin of the cerci. *E. cryptica* can be separated from *E. convexiforceps* by the more gradually ending of the carina on the posterior margin of the cerci, which forms an obtuse angle; and by the apices that, in posterior view, point medially (although see Discussion). Additionally, *E. cryptica* can be distinguished from *E. catarina* and *E. convexiforceps* by the nearly truncate apical tips of the cerci (in lateral view). The other species in the *E. cryptica* species group, *E. distincta* and *E. woodi*, can be separated from this species, in addition to *E. catarina, E. convexiforceps, E. arciforceps,* and *E. napensis*, by the presence of setae on wing vein R1 and the thin and dorsally bare palpi, respectively.

E. cryptica, as well as all the species in *E. cryptica* species group, can be separated from *E. jaena*, *E. abdominalis*, *E. curvifrons*, *E. ecuadoriana*, and *E. eois* by the mostly black abdominal color (although see discussion of *E. woodi*), in contrast to the

bright yellow abdomen of species in the *E. jaena* group. In addition, *E. cryptica*, *E. catarina, E. convexiforceps, E. arciforceps,* and *E. napensis*, can be separated from the *E. jaena* species group (except *E. eois*) by the presence of three katepisternal setae. Finally, all species in the *E. cryptica* species group can be separated from all the species in the *E. jaena* species group by the presence of a dorsal depression or twist in the cerci and by the presence of a long seta on the 5th sternite apical lobe (although see discussion of *E. woodi*).

DESCRIPTION

Described from 16 males, unless otherwise noted as "N".

Length: 6.0–8.3mm ($\bar{x}$ = 7.09mm) in male.

Head: Parafacial brown in ground color covered with silver pruinescence. Fronto-orbital plate and vertex black in ground color covered with dull silver pruinescence (which can appear grayish from certain angles), with a faint golden reflections visible only in lateral view. Arista black with dark brown on basal 1/4, thickened only on basal 1/4-1/5 (Figs. 51 and 53). Eye densely haired with long ommatrichia about as long as 5-7 eye facets. Eye 0.84–0.91 ($\bar{x}$ = 0.89) head height. Vertex width 0.13–0.16 ($\bar{x}$ = 0.14) head width. Frontal vitta width 0.19–0.33 ($\bar{x}$ = 0.25) vertex width. Length of first flagellomere 0.39–0.44 ($\bar{x}$ = 0.42) head height in male. Pedicel length 0.24–0.31 ($\bar{x}$ = 0.28) length of first flagellomere. Fronto–orbital plate with 5–11 (m = 8) medioclinate frontal setae, 2 reclinate inner orbital setae, outer orbital setae absent. Vertex with 1 reclinate inner and 1 lateroclinate outer vertical seta, the latter barely differentiated from the row of postocular

setae. Ocellar setae proclinate. Parafacial bare and extremely narrow with the narrowest point equal or narrower than the basal width of the palpus. Parafacial width 0.02–0.03 ($\bar{x}$ = 0.02) head width. Facial ridge with hairs on basal 1/4 or less. Height of haired portion of facial ridge 0.11–0.25 ($\bar{x}$ = 0.16) head height. Palpus dark yellowish, usually black at base; distally sparsely haired with dorsal base usually bare; almost uniform in width; length 0.26–0.36 ($\bar{x}$ = 0.31) head height.

Thorax: Dorsocentral length 0.32–0.41 ($\bar{x}$ = 0.36) total body length. Shiny black in ground color; presutural scutum with thin white pruinescence, postsutural scutum with much sparser pruinescence revealing underlying black ground color. In dorsal view only the presutural scutum appears grayish; where in lateral view the postsutural scutum appears grayish as well. Faint white pruinose stripes on presutural scutum leaving 4 black vittae, rarely 5; the inner 2 or 3 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae (Fig. 50). Postpronotum with 2 setae. Katepisternum with 3 setae. Scutum with 1 presutural and 1 postsutural acrostichal seta; 2 well developed presutural dorsocentral setae, rarely with 1 additional small setae; 2 well developed postsutural dorsocentral setae, usually with 2 additional small setae; 1 presutural and 3 postsutural intra–alar setae; 1 presutural supra–alar setae; 3 postsutural supra–alar setae, rarely with the first postsutural supra–alar absent. First postsutural supra–alar setae similar in length and stoutness to the first postsutural dorsocentral setae. Scutellum discal setae absent.

Legs black (Fig. 52). Tarsal claws longer than 5th tarsomere. Fore claw length 1.04–1.36 ($\bar{x}$ = 1.23) fore 5th tarsomere length. Hind tibia with 2 well developed

posterodorsal setae, rarely with 1 or 2 additional shorter seta; usually 3 or 4 well developed anteroventral setae. Wings usually light fumose at c, sc, r_1, r_{2+3}, r_{4+5}, and dm cells; rarely dark fumose at sc, and r_1 cells. Wing vein R_{4+5} dorsally with 2–4 setae at base. Vein M smoothly curved at bend and ending at wing margin anterior to wing tip separately from vein R_{4+5}.

Abdomen: Coloration varied, in dorsal view from fully black to mostly black with yellow. In dorsal view, T_{1+2} complete black, rarely with yellow on 1/3 of anterolateral sides; T3 with yellow on 3/4 of anterolateral sides, rarely full black; T4 with yellow on 1/3-1/2 of anterolateral sides, rarely fully black; T5 fully black. Transverse bands of sparse white pruinosity on anterior 1/3-1/4 of T_3 and T_4 and on anterior 2/3 of T_5. Mid-dorsal depression of T_{1+2} not reaching median marginal setae (Fig. 50). One pair of median marginal setae on T_{1+2} and T_3, a row of median marginals on T_4 and T_5, 1 pair of lateral marginal setae on T_{1+2} and T_3, and an irregular row of small discal setae on T5.

Male terminalia: Sternite 5 with median cleft smoothly V–shaped, inner margin with minute setae, apical lobe pointed apically with a single long well developed seta, and anterior margin of basal plate slightly concave (Fig. 56). S_5 apical lobe length 0.61–0.68 ($\bar{x}$ = 0.65) S_5 length. Surstylus internally and externally with several small setae, in lateral view slightly concave along anterior and posterior margins. Surstylus and cercus subequal in length. Cerci in lateral view slightly concave on anterior margin; in the medial section of the posterior margin not strongly carinate, with the carina ending gradually before the nearly truncate apices, forming an obtuse angle. In posterior view,

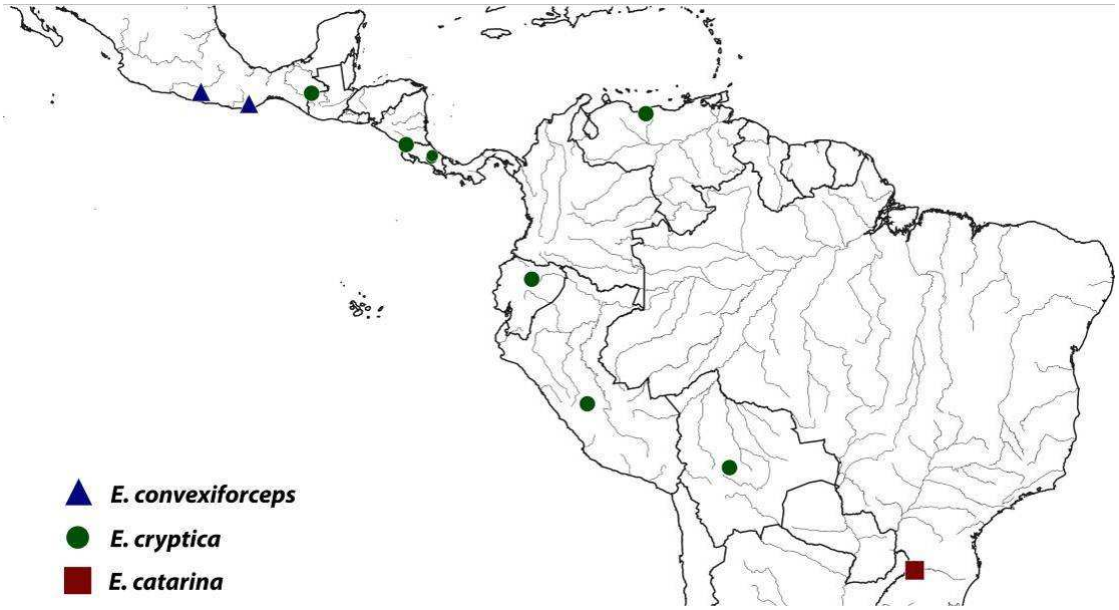
dorsal inner medial margin of the cerci with small pointed processes; cerci narrowed on apical 1/3; upper lobe length almost equal to the medial section and to the apical cleft length; apical cleft well defined and internally twisted; and apex of the cerci curved, with tips directed medially. Cercus upper lobe length 0.33–0.48 ($\bar{x}$ = 0.39) cercus length, cercus medial section length 0.28–0.40 ($\bar{x}$ = 0.32) cercus length (Figs. 54 and 55).

Host: A single male specimen was reared from an *Eois* sp nr. *nigricosta* caterpillar (Lepidoptera: Geometridae). This male was reared from a caterpillar that was collected from YBS (Napo, Ecuador) on the host plant *Piper hispidum* (Piperaceae). The third instar caterpillar was collected on 13th September 2007, the pupa was noticed 17 days later and the abult fly was recorded 38 days later.

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

E. cryptica exhibits one of the widest geographic distributions of all *Erythromelana* species. It has been collected from Mexico in the north to Bolivia in the south (Map 5). There is a large geographical gap among the specimens collected thus far. No specimens have been collected between Mexico and Costa Rica, and Venezuela and Ecuador, largely due to the lack of collecting efforts in these areas. This species seems to occur at both low elevations (e.g., Guanacaste, Costa Rica, 700m) and high elevations (e.g., Napo, Ecuador, 2000-2600m). Specimens have been collected throughout the year: 2 specimens from Mexico were collected in September; 3 specimens from Costa Rica were collected in February, March, and July; 5 specimens from Venezuela were collected in February; 4 specimens from Ecuador were collected in February and one specimen

was reared in September; 1 specimen from Peru was collected in August; and 1 specimen from Bolivia was collected in December.



Map 5. Known distributions of *E. cryptica, E. catarina* and *E. convexiforceps*.

DISCUSSION

As mentioned in the recognition section, I used male genitalia as the only character to identify this species. I have not found differences in female genitalia that allow me to match females with their respective male for most of the species in the *E. cryptica* species group, including *E. cryptica*, *E. catarina*, *E. convexiforceps*, *E. arciforceps*, and *E. napensis*. Additionally, males of these species exhibit overlapping geographical distributions making it impossible to separate females based on locality information. Consequently, future studies are needed to separate and describe the females of these species.

E. cryptica is one the most difficult species of *Erythromelana* to identify. This is due to the confusing variation evident among the several specimens that I have examined. I have found the shape of the cerci to be of the most important characters defining the species in the *E. cryptica* species group. However, in this species there is variation in the shape of the cerci and the surstylus. Specifically, the carina on the medial section of the posterior margin of the cerci (in lateral view) varies in shape and in the angle that it forms with the apical tip. This variation could represent the extremes of within species variation or possibly different species that vary slightly in cerci shape. I have excluded, for this species description, a few specimens that seem to present an extreme intraspecific variation, but not enough interspecific variation to be described as a different species. Therefore, future analysis of *E. cryptica* including a larger collection of specimens is needed in order to determine whether this species consists of multiple crytpic species or is just one phenotypically varied species.

Figure 50. Dorsal view of male *E. cryptica*.

Figure 51. Frontal view of the head of male *E. cryptica*.

Figure 52. Lateral view of male *E. cryptica*.

Figure 53. Lateral view of the head of male *E. cryptica*.

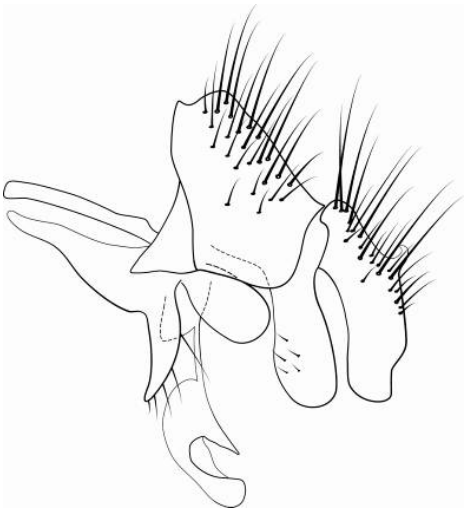


Figure 54. Lateral view of *E. cryptica* male genitalia.

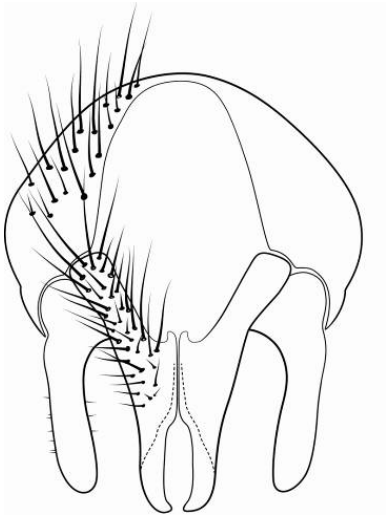


Figure 55. Epandrial complex in posterior view of male *E. cryptica*.

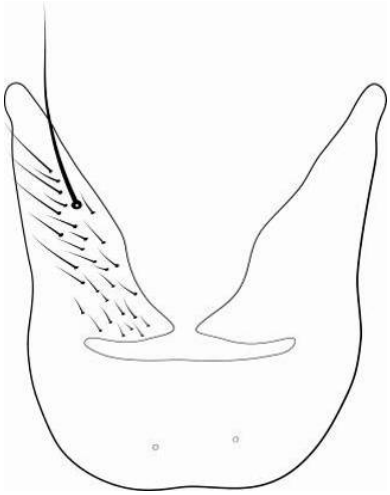


Figure 56. 5th sternite of male *E. cryptica*.

Erythromelana catarina Inclan sp. nov.

(Figs. 57–59, Map 5)

TYPE MATERIAL

Holotype

Male, labelled: "Nova Teutonia/ S. C. [Santa Catarina Province] – BRAZIL/ June 1970/ F. Plaumann", "HOLOTYPE/ Erythromelana/ catarina/ Inclan D.J. [red label]", "DI392CA [specimen ID number]", (CNC). Terminalia stored in glycerine in a microvial pinned below specimen.

Paratypes

Four males, same data as the holotype exept "PARATYPE/ Erythromelana/ catarina/ Inclan D.J. [yellow label]", "DI410CA" terminalia stored in glycerine in a microvial pinned below specimen (Ecuador); "II 1968", "DI460CA" terminalia stored in glycerine

in a microvial pinned below specimen (NMNH); “Oct. 1970”, “DI408CA” (CNC); and “Feb. 1971”, “DI452CA” (CNC).

ETYMOLOGY

Named after the Brazilian province, Santa Catarina, where all the specimens used in this description were collected.

RECOGNITION

This species is morphologically very similar to *E. cryptica, E. convexiforceps, E. arciforceps,* and *E. napensis,* and can only be distinguished from them by differences in the male genitalia. *E. catarina* can be separated from *E. convexiforceps* by the more gradually curved ending of the carina on the medial section of the posterior margin of the cerci (in lateral view) that forms an obtuse angle; the cercal apices that (in posterior view) are directed medially, and by the narrower and less truncate surstyli. Additionally, *E. catarina* can be distinguished from *E. cryptica* by the narrower and more rounded apical tips of the cerci (in lateral view). Female unknown (see Discussion of *E. cryptica*). See the recognition section of *E. cryptica* for the distinction between *E. catarina* and the other species in the *E. cryptica* and *E. jaena* species group.

DESCRIPTION

Described from 5 males, unless otherwise noted as “N”.

Length: 5.8–6.1mm ($\overline{x}$ = 5.9mm) in male.

As described for *E. cryptica* except as follows:

Head: Parafacial brown in ground color covered with dull silver pruinescence. Arista black with dark brown on basal 1/4, thickened only on basal 1/5. Eye densely haired with ommatrichia about as long as 4-5 eye facets. Eye 0.87–0.91 ($\bar{x}$ = 0.89) head height. Vertex width 0.16–0.17 ($\bar{x}$ = 0.17) head width. Frontal vitta width 0.24–0.31 ($\bar{x}$ = 0.27) vertex width. Length of first flagellomere 0.42–0.46 ($\bar{x}$ = 0.44) head height in male. Pedicel length 0.27–0.30 ($\bar{x}$ = 0.28) length of first flagellomere. Fronto–orbital plate with 5–7 (m = 7) medioclinate frontal setae. Vertex with 1 reclinate inner and 1 lateroclinate outer vertical seta, the latter varied from well to barely differentiated from the row of postocular setae. Ocellar setae proclinate. Parafacial width 0.02–0.03 ($\bar{x}$ = 0.02) head width. Height of haired portion of facial ridge 0.12–0.19 ($\bar{x}$ = 0.16) head height. Palpus dark yellowish with black at base, length 0.29–0.36 ($\bar{x}$ = 0.32) head height.

Thorax: Dorsocentral length 0.34–0.39 ($\bar{x}$ = 0.36) total body length. Faint white pruinose stripes on presutural scutum leaving usually 5 black vittae; the inner 3 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae. Scutum 2 well developed presutural dorsocentral setae; 2 well developed postsutural dorsocentral setae, usually with 1 or 2 additional small setae; 1 presutural and 3 postsutural supra–alar setae, first postsutural supra–alar setae small. Fore claw length 1.05–1.25 ($\bar{x}$ = 1.10) fore 5th tarsomere length. Hind tibia with 3 well developed anteroventral setae. Wings usually light fumose at c, sc, r_1, r_{2+3}, r_{4+5}, and dm cells.

Abdomen: Mostly black with yellow on laterals. In dorsal view, T_{1+2} complete black, T3 with yellow on 3/4 of antereolateral sides, T4 with yellow on 1/3 or less of antereolateral sides, T5 fully black. Transverse bands of sparse white pruinosity on anterior 1/3 or less of T_3 and T_4 and on anterior 2/3 of T_5. An irregular row of small discal setae on T5 (rarely with only 1-2 pairs of setae).

Male terminalia: S_5 apical lobe length 0.64–0.67 ($\overline{x}$ = 0.66) S_5 length. Surstylus, in lateral view, slightly concave along anterior margin and almost straight along posterior margin. Cerci in lateral view slightly concave on anterior margin; in the medial section of the posterior margin weakly carinate, with the carina ending gradually before the rounded apical tips, forming an obtuse angle. In posterior view, dorsal inner margin of the medial section of cerci with small processes pointing laterally. Cercus upper lobe length 0.30–0.45 ($\overline{x}$ = 0.36) cercus length, cercus medial section length 0.41–0.45 ($\overline{x}$ = 0.43) cercus length (Figs. 57-58).

Host: Unknown

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

All the specimens were collected at Nova Teutonia, Santa Catarina province, Brazil (Map 5). The elevation of this region (300-500m) suggests that *E. catarina* may occur only in low elevations. I examined a long series of specimens that were collected in different regions of South America above 1,000m and *E. catarina* was not present. However, in order to confirm if this species truly occurrs only at low elevations more

samples from a broader geographic range are needed. Two specimens were collected in February; and one specimen in June, October and November.

DISCUSSION

E. catarina was collected only from Santa Catarina (Brazil) where *E. arciforceps* was collected as well. These two species are morphologically very similar, but *E catarina* can be initially separated from *E. arciforceps* by differences in body size, where *E. catarina* is usually smaller than *E. arciforceps*. However, this distinction could vary making male genitalia the only reliable way to identify these species. See discussion section of *E. cryptica* for female notes.

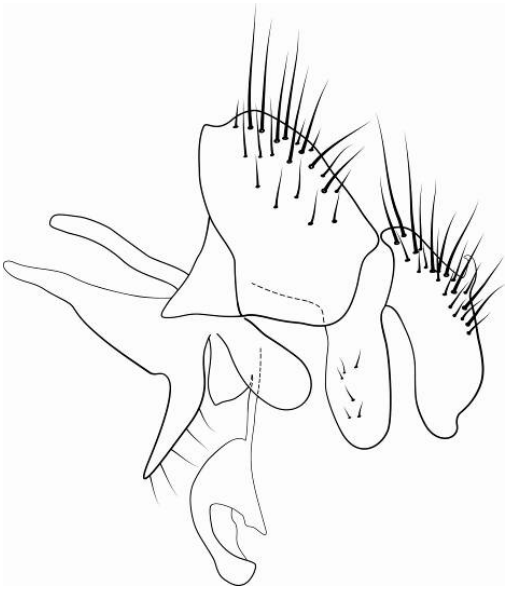


Figure 57. Lateral view of *E. catarina* male genitalia

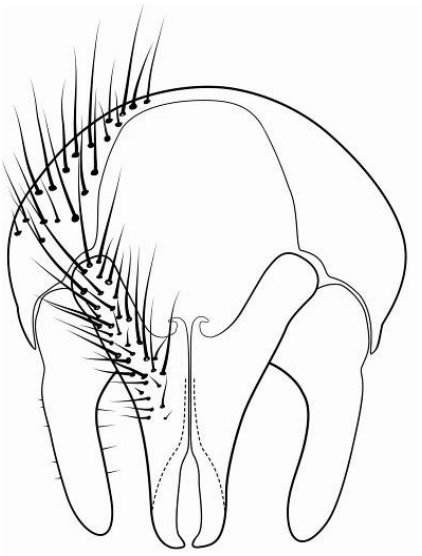


Figure 58. Epandrial complex in posterior view of male *E. catarina*.

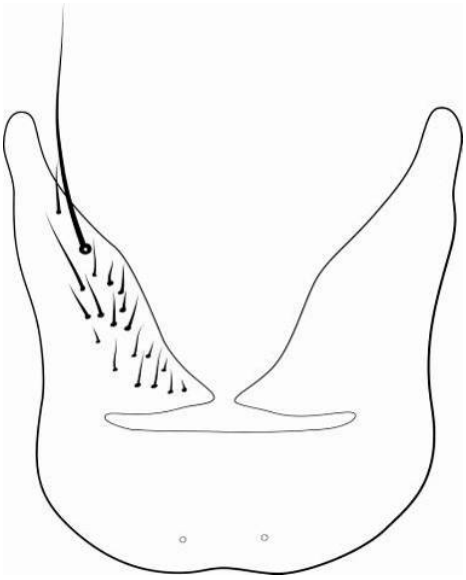


Figure 59. 5th sternite of male *E. catarina*.

Erythromelana convexiforceps Inclan sp. nov.

(Figs. 60–62, Map 5)

TYPE MATERIAL

Holotype

Male, labelled: “Mexico, Oax [Oxaca] 4.6 km/ S [South] Suchistepec/ 23.VII.1992/ D.M. Wood 2150m”, “HOLOTYPE/ Erythromelana/ convexiforceps/ Inclan D.J. [red label]”, “DI54CA [specimen ID number]” (CNC). Terminalia stored in glycerine in a microvial pinned below specimen.

Paratypes

Two males, labelled: “Omilteme,/ Guerrero,/ 8000 ft./ July. H.H. Smith.”, “CENT. AMERICA./ Press by/ F.D. Godman./ & O. Salvin./ B.M. 1903-172.”, “PARATYPE/ Erythromelana/ convexiforceps/ Inclan D.J. [yellow label]”, “DI119BM [specimen ID number]”, “DI118BM” terminalia stored in glycerine in a microvial pinned below specimen. (BNHM).

ETYMOLOGY

From the Latin *convexus* and *forceps*, meaning convex cerci, in reference to the highly convex posterior margin of the cerci (in lateral view) of this species.

RECOGNITION

This species is morphologically very similar to *E. cryptica, E. catarina, E. arciforceps,* and *E. napensis,* and can only be distinguished from them by differences in

the male genitalia. *E. convexiforceps* can be separated from *E. cryptica* and *E. catarina* by the abrupt ending of the carina on the medial section of the posterior margin of the cerci (in lateral view) that forms a nearly right angle; and by the rounded apical tips that (in posterior view) are directed distally. Additionally, this species can be distinguished from *E. cryptica* and *E. catarina* by the almost straight anterior margin of the surstyli (in lateral view) and their truncate apicies. Female unknown (see discussion of *E. cryptica*). See the recognition section of *E. cryptica* for the distinction of *E. convexiforxeps* from other species in the *E. cryptica* and *E. jaena* species groups.

DESCRIPTION

Described from 3 males, unless otherwise noted as "N".

Length: 7.0–7.3mm ($\bar{x}$ = 7.2mm) in male.

As described for *E. cryptica* except as follows:

Head: Arista black, thickened only on basal 1/4. Eye densely haired with large ommatrichia, each one about as long as 6-7 eye facets. Eye 0.90–0.92 ($\bar{x}$ = 0.91) head height. Vertex width 0.12–0.14 ($\bar{x}$ = 0.13) head width. Frontal vitta width 0.20–0.23 ($\bar{x}$ = 0.22) vertex width. Length of first flagellomere 0.39–0.41 ($\bar{x}$ = 0.40) head height in male. Pedicel length 0.27–0.28 ($\bar{x}$ = 0.27) length of first flagellomere. Fronto–orbital plate with 6–9 (m = 9) medioclinate frontal setae. Vertex with 1 reclinate inner and 1 lateroclinate outer vertical seta, the latter usually well differentiated from the row of postocular setae. Parafacial bare and extremely narrow with the narrowest point almost equal to the basal width of the palpus. Parafacial width 0.02–0.03 ($\bar{x}$ = 0.03) head width. Height of haired

portion of facial ridge 0.16–0.19 ($\bar{x}$ = 0.17) head height. Palpus length 0.30–0.33 ($\bar{x}$ = 0.31) head height.

Thorax: Dorsocentral length 0.37–0.38 ($\bar{x}$ = 0.37) total body length. Faint white pruinose stripes on presutural scutum leaving 4 black vittae; the inner 2 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae. Scutum with 1 presutural acrostichal seta, usually with 1 additional seta; 1 postsutural acrostichal seta; 2 well developed presutural dorsocentral setae; 1 presutural intra–alar setae, usually with 1 additional small seta; 1 presutural supra–alar setae, usually with 1 additional small setae; 2 postsutural supra–alar setae, first postsutural supra–alar seta absent. Fore claw length 1.18–1.41 ($\bar{x}$ = 1.30) fore 5th tarsomere length. Wings almost completely hyaline, with light fumosity at c, sc, r_1, and r_{2+3} cells. Wing vein R_{4+5} dorsally with 3 setae at base.

Abdomen: Mostly black with yellow laterally. In dorsal view, T_{1+2} with yellow on 3/4 of posterolateral sides; T3 with yellow on 3/4 to almost all anterolateral sides; T4 with yellow on 1/3 or less of anterolateral sides, rarely full black; T5 fully black. Transverse bands of sparse white pruinosity on anterior 1/3 or less of T_3 and T_4 and on anterior 2/3 or less of T_5 .

Male terminalia: S_5 apical lobe length 0.62–0.63 ($\bar{x}$ = 0.62) S_5 length (Fig. 62); apical lobe margins broadly rounded, not extended into narrow points. Surstylus, in lateral view, almost straight along anterior margin and slightly concave along posterior margin ending in a nearly truncate apex. Cerci in lateral view slightly concave on anterior margin; the

medial section of the posterior margin strongly carinate, with the carina ending abruptly before the rounded tips, forming a nearly right angle. In posterior view, dorsal inner margin of the cerci at the medial section with small pointed processes; upper lobe length longer than the medial section and the apical cleft. Apex of the cerci linear, with rounded tips directed distally. Cercus upper lobe length 0.42–0.52 ($\bar{x}$ = 0.47) cercus length, cercus medial section length 0.31–0.32 ($\bar{x}$ = 0.31) cercus length. (Figs. 60 and 61).

Host: Unknown

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

All specimens were collected in the states of Oaxaca (2150m) and Guerrero (2450m), Mexico (Map 5). The elevation of the collecting locations (2150-2450m) suggests that this species may occur only at higher elevations. I examined *E. cryptica* specimens that were collected in the same region of Mexico at lower elevations (1500m), but *E. convexiforceps* was not present. However, to confirm if this species is restricted to high elevations more samples are needed, particularly given the undersampled tachinid fauna of Mexico. All specimens were collected in July.

DISCUSSION

As mentioned above in the recognition section, *E. convexiforceps* exhibits a unique distinction in the shape of the surstyli and cerci. This species is distinguished by the abruptly end of the carina on the medial section of the posterior margin (in lateral view) of the cerci, which forms a nearly right angle with the apex of the cerci. Because of

this unique characteristic, I am describing this species despite having only three males available for examination. Given the few specimens examined in this study, this description should be used with some caution (see discussion of *E. curvifrons*). See the discussion section of *E. cryptica* for female notes.

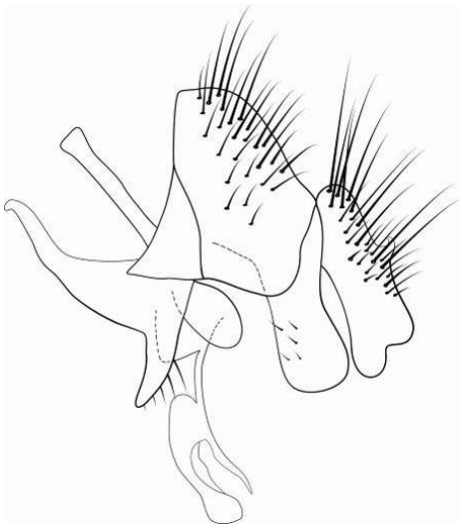


Figure 60. Lateral view of *E. convexiforceps* male genitalia.

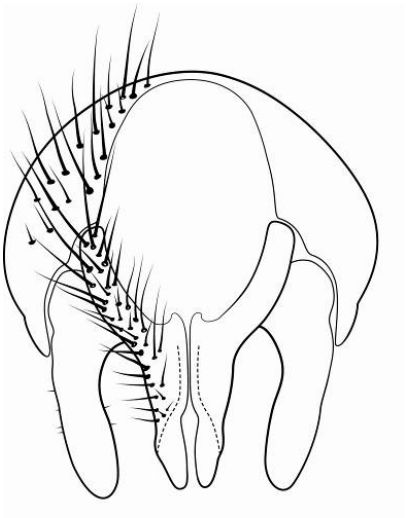


Figure 61. Epandrial complex in posterior view of male *E. convexiforceps*.

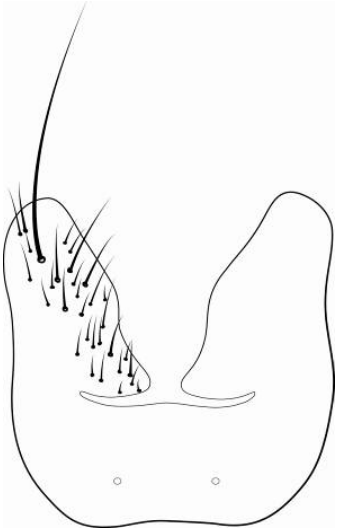


Figure 62. 5th sternite of male *E. convexiforceps*.

Erythromelana arciforceps Inclan sp. nov.

(Figs. 63–65, Map 6)

TYPE MATERIAL

Holotype

Male, labelled: "Nova Teutonia/ S. C. [Santa Catarina Province] – BRAZIL/ Nov. 1970/ F. Plaumann", "HOLOTYPE/ Erythromelana/ arciforceps/ Inclan D.J. [red label]", "DI412CA [specimen ID number]", (CNC). Terminalia stored in glycerine in a microvial pinned below specimen.

Paratypes

Five males. **Costa Rica:** one male, "San Luis, Monteverde, Prov. [Province] Punta, [Puntarenas]/ COSTA RICA. 1040m. nov [November] 1993, Z./ Fuentes, L N

250850_449250 #2443", " COSTA RICA INBIO/ CRI001/ 938508", "PARATYPE/ Erythromelana/ arciforceps/ Inclan D.J. [yellow label]", terminalia stored in glycerine in a microvial pinned below specimen (INBio). **Brazil:** two males, same as holotype exept ID numbers "DI397CA" terminalia stored in glycerine in a microvial pinned below specimen (NMNH), and "DI414CA" terminalia stored in glycerine in a microvial pinned below specimen (Ecuador); one male, " Brasilien/ Nova Teutonia/ 27°11'B. 52°23L/ Fritz Plaumann/ 20.3.1937", "DI120BM" terminalia stored in glycerine in a microvial pinned below specimen (BNHM); one male, same as previus exept date "II 1968" and ID number "DI455CA" terminalia stored in glycerine in a microvial pinned below specimen (CNC).

ETYMOLOGY

From the Latin *arcus* and *forceps*, meaning arced cerci, in reference to the arched shape of the cerci (in lateral view) of this species compared to relatively linear cerci of its close relative, *E. napensis.*

RECOGNITION

This species is morphologically very similar to *E. cryptica*, *E. catarina*, *E. convexiforceps* and *E. napensis* and can be only distinguished from them by differences in the male genitalia. The posterior margin of the cerci of *E. arciforceps*, in lateral view, is relatively rectilinear compared with the cerci of *E. cryptica*, *E. catarina*, and *E. conversiforceps*. *E. napensis* is the only species with similar cerci to *E. arciforceps*, but this species can be separated by the more spatulate surstyli (in lateral and posterior view)

and the curved cerci (in lateral view). Additionally, *E. arciforceps* can be distinguished from *E. napensis* by the cerci, in posterior view, by having the apical lobe length subequal to the medial section length (much longer in *napensis*), and by a realtively short apical cercal cleft (shorter than or equal to the midsection length). Female unknown (see discussion of *E. cryptica*). See recognition section of *E. cryptica* for the distinction between *E. arciforceps* and the other species in the *E. cryptica* and *E. jaena* species groups.

DESCRIPTION

Described from 6 males, unless otherwise noted as "N".

Length: 7.2–7.9mm ($\bar{x}$ = 7.67mm, N = 5) in male.

Head: Parafacial brown in ground color covered with dull silver pruinescence. Fronto-orbital plate and vertex black in ground color covered with dull silver pruinescence mostly on fronto-orbital plate (which could appear grayish from certain angles), withfaint golden reflections visible only in lateral view mostly on the vertex. Arista black with dark brown on basal 1/4, thickened only on basal 1/4 or less. Eye densely haired with large ommatrichia about as long as 5-6 eye facets. Eye 0.88–0.89 ($\bar{x}$ = 0.89, N = 4) head height. Vertex width 0.13–0.16 ($\bar{x}$ = 0.15, N = 4) head width. Frontal vitta width 0.20–0.27 ($\bar{x}$ = 0.24, N = 4) vertex width. Length of first flagellomere 0.39–0.42 ($\bar{x}$ = 0.40, N = 4) head height in male. Pedicel length 0.28–0.33 ($\bar{x}$ = 0.29, N = 4) length of first flagellomere. Fronto–orbital plate with 8-10 (m = 8) medioclinate frontal setae, 2 reclinate inner orbital setae, outer orbital setae absent. Vertex with 1 reclinate inner and 1

lateroclinate outer vertical seta, the latter slight to barely differentiated from the row of postocular setae. Ocellar setae proclinate. Parafacial bare and extremely narrow with the narrowest point equal to or narrower than the basal width of the palpus. Parafacial width 0.02–0.03 ($\bar{x}$ = 0.02, N = 4) head width. Facial ridge with hairs on basal 1/4 or less. Height of haired portion of facial ridge 0.14–0.18 ($\bar{x}$ = 0.16, N = 4) head height. Palpus dark yellowish, usually black at base; distally sparsely haired with dorsal base usually bare; almost uniform in width; length 0.27–0.33 ($\bar{x}$ = 0.30, N = 3) head height.

Thorax: Dorsocentral length 0.39–0.41 ($\bar{x}$ = 0.40, N = 4) total body length. Shiny black in ground color; presutural scutum with thin white pruinescence, postsutural scutum with much sparser pruinescence revealing underlying black ground color. In dorsal view only the presutural scutum appears grayish; whereas in lateral view the postsutural scutum appears grayish as well. Faint white pruinose stripes on presutural scutum leaving 4 black vittae, rarely 5; the inner 2 or 3 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae. Postpronotum with 2 setae. Katepisternum with 3 setae. Scutum with 1 presutural acrostichal seta; 1 or 2 postsutural acrostichal seta; 2 presutural dorsocentral setae, usually with 1 additional small setae; 2 postsutural dorsocentral setae, with 2 additional small setae; 1 presutural and 3 postsutural intra–alar setae; 1 presutural and 3 postsutural supra–alar setae, first postsutural supra–alar setae small. Scutellar discal setae absent.

Legs black. Tarsal claws longer than 5th tarsomere. Fore claw length 1.07–1.32 ($\bar{x}$ = 1.21, N = 4) fore 5th tarsomere length. Hind tibia with 2 well developed

posterodorsal setae, rarely with 1 or 2 additional shorter seta; usually 3 or 4 well developed anteroventral setae. Wings usually light fumose at c, sc, r_1, r_{2+3}, r_{4+5}, and dm cells. Wing vein R_{4+5} dorsally with 3–4 setae at base. Vein M smoothly curved at bend and ending at wing margin anterior to wing tip separately from vein R_{4+5}.

Abdomen: Mostly black with yellow on lateral sides. In dorsal view, T_{1+2} completely black, T3 with yellow on 4/5 of anterolateral sides, T4 with yellow on 1/3-1/2 of anterolateral sides, and T5 fully black. Transverse bands of sparse white pruinosity on anterior 1/3-1/4 of T_3 and T_4 and on anterior 2/3 of T_5. Mid-dorsal depression of T_{1+2} not reaching median marginal setae (Fig. 1). One pair of median marginal setae on T_{1+2} and T_3, a row of median marginals on T_4 and T_5, 1 pair of lateral marginal setae on T_{1+2} and T_3, and an irregular row of small discal setae on T5.

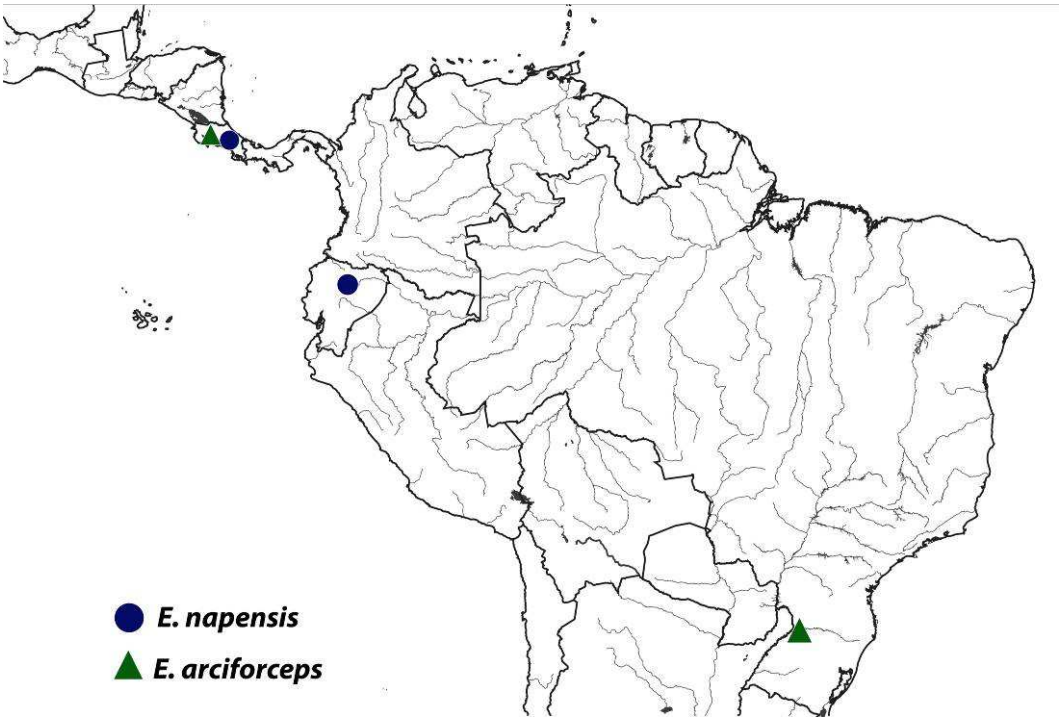
Male terminalia: Sternite 5 with median cleft smoothly V–shaped, inner margin with minute setae, apical lobe broadly pointed apically with a single, long, well developed seta. Anterior margin of basal plate slightly concave (Fig. 65). S_5 apical lobe length 0.57–0.62 ($\bar{x}$ = 0.59) S_5 length. Surstylus internally and externally with a few small setae. Surstylus, in lateral view, almost straight on basal 1/2 and convex on apical 1/2 of anterior margin, and very slightly concave along posterior margin. Surstylus and cercus subequal in length. Cerci, in lateral view, bent, strongly concave on anterior surface, slightly concave on posterior-apical margin, and ending in a broadly rounded tip. In posterior view, cercus narrowed on apical 1/3, upper lobe length almost equal to medial section length and longer than the apical cleft; apical cleft well defined with rounded tips

directed slightly medially. Cerci, in posterior view, with a depression on the medial section. Cercus upper lobe length 0.37–0.47 ($\bar{x}$ = 0.41) cercus length, cercus medial section length 0.33–0.44 ($\bar{x}$ = 0.39) cercus length (Figs. 63 and 64).

Host: Unknown

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

E. arciforceps is widely distributed, from Costa Rica in the north to southern Brazil in the south (Map 6). It is likely to be present throughout the intervening region, and the absence of this species between these countries clearly represent a lack of collecting effort in the Neotropical region. *E. arciforceps* seems to occur at low elevations (e.g., Santa Catarina, Brazil, 300–500m) and mid elevations (e.g., San Luis de Monteverde, Costa Rica, 1100m). We have sampled the tachinid fauna of the eastern Andes of Ecuador (2000–2600m) for several years and we have not collected it there, which suggests that it may not occur above ~2000m. Specimens from Brazil were collected throughout the year, 1 in February, 1 in March, 1 in October, and 2 in November. The single specimen from Costa Rica was collected in November.



Map 6. Known distributions of *E. arciforceps* and *E. napensis*.

DISCUSSION

As mentioned above in the recognition section, the genitalia of *E. arciforceps* is very distinct from the genitalia of *E. cryptica*, *E. catarina,* and *E. convexiforceps*, but is similar to the genitalia of *E. napensis*. This species is distinguished by the relatively rectilinear posterior margin of the cerci (in lateral view). In addition, this species is well differentiated from *E. napensis* by the spatulate shape of their surstyli, their bent cerci, and (in posterior view) by the wider and shorter apical cleft. These differences in the shape of the surstyli and cerci seem to be realtively constant; therefore, I have no doubt than *E. arciforceps* are truly different from these other *Erythromelana* species. See the discussion of *E. cryptica* for female notes.

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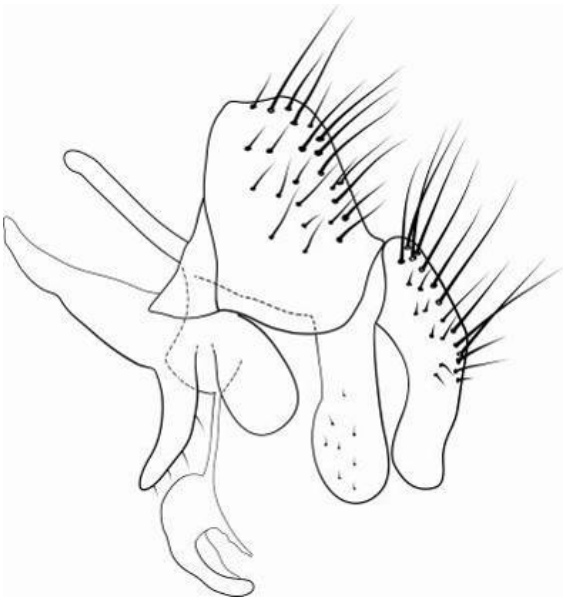


Figure 63. Lateral view of *E. arciforceps* male genitalia.

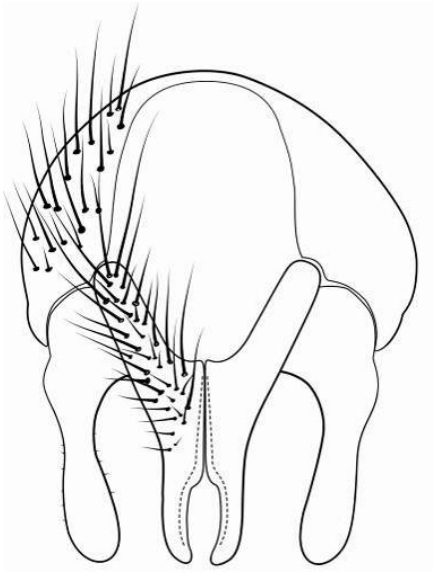


Figure 64. Epandrial complex in posterior view of male *E. arciforceps*.

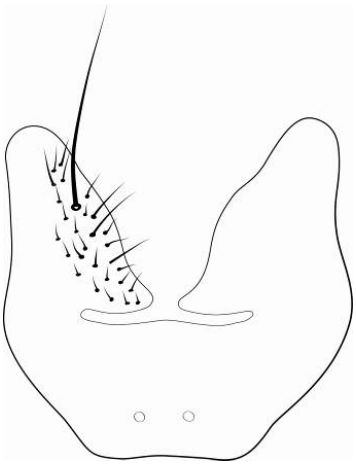


Figure 65. 5th sternite of male *E. arciforceps*.

***Erythromelana napensis* Inclan sp. nov.**

(Figs. 66–68, Map 6)

TYPE MATERIAL

Holotype

Male, labelled: "ECUADOR: Napo Prov. [Province]/ Yanayacu Biological Station,/ S 00°35.9' W 77°53.4, 2163m/ REARED [in red color]/ October 2005/ 8135 [rearing record]", "HOLOTYPE/ Erythromelana/ napensis/ Inclan D.J. [red label]" (CNC). Puparium and terminalia stored in glycerine in a microvial pinned below specimen.

Paratype

Male, labelled: "COSTA RICA, Cartago, Sect. [Sector] la/ Represa, al inicio del Send. [Sendero] Rancho/ Negro al Cruce del Rio Villegas./ 1780m. ABR [April] 1997. R. Guzman./ L_N_187750_560000 #46243", " COSTA RICA INBIO/ CRI002/ 550825",

"PARATYPE/ Erythromelana/ napensis/ Inclan D.J. [yellow label]" (INBio). Terminalia stored in glycerine in a microvial pinned below specimen.

ETYMOLOGY

Named after the Ecuadorian province, Napo, where the holotype specimen used in this description was reared.

RECOGNITION

This species is very similar to *E. arciforceps* and can only be distinguished from it by differences in the male genitalia. *E. napensis* can be separated from *E. arciforceps* by the shape, in lateral view, of their less spatulate surstyli, their relatively straight cerci, and the rounded cercal apices. Additionally, *E. napensis* can be distinguished from *E. arciforceps* by the cerci, in posterior view, by having the upper lobe length longer that the medial section length and almost equal to the apical cleft length; and by the apical cleft much narrower and longer than in *E. arciforceps*. See the recognition sections of *E. arciforceps* and *E. cryptica* for the distinction of *E. napensis* from the remaining *Erythromelana* species.

DESCRIPTION

Described from 2 males, unless otherwise noted as "N".

Length: 7.0mm ($\bar{x}$ = 7.0mm) in male.

As described for *E. arciforceps* except as follows:

Head: Parafacial brown in ground color covered with silver pruinescence. Eye 0.87–0.88 ($\bar{x}$ = 0.87) head height. Vertex width 0.15–0.17 ($\bar{x}$ = 0.16) head width. Frontal vitta width 0.25–0.33 ($\bar{x}$ = 0.29) vertex width. Length of first flagellomere 0.39–0.43 ($\bar{x}$ = 0.41) head height in male. Pedicel length 0.28–0.31 ($\bar{x}$ = 0.29) length of first flagellomere. Fronto–orbital plate with 7–9 (m = 9) medioclinate frontal setae. Vertex with 1 reclinate inner and 1 lateroclinate outer vertical seta, the latter barely differentiated from the row of postocular setae. Ocellar setae proclinate, usually as a small hair-like seta. Parafacial width 0.02 ($\bar{x}$ = 0.02) head width. Height of haired portion of facial ridge 0.16–0.17 ($\bar{x}$ = 0.16) head height. Palpus apically densely haired with dorsal base usually bare, length 0.28–0.36 ($\bar{x}$ = 0.32) head height.

Thorax: Dorsocentral length 0.40 ($\bar{x}$ = 0.40) total body length. Faint white pruinose stripes on presutural scutum leaving 4 black vittae; the inner 2 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae. Scutum with 1 postsutural acrostichal seta; 2 presutural dorsocentral setae; 2 postsutural dorsocentral setae, usually with 1 or 2 additional small setae. Scutellum discal setae absent, one specimen with only one apical seta. Fore claw length 1.11–1.21 ($\bar{x}$ = 1.16) fore 5th tarsomere length. Hind tibia with 2 well developed posterodorsal setae, rarely with 1 additional shorter seta; 3 well developed anteroventral setae. Wings completely hyaline. Wing vein R_{4+5} dorsally with 3 setae at base.

Abdomen: Mostly black with yellow laterally. In dorsal view, T_{1+2} completely black; T3 with yellow on 2/3 or less of anterolateral sides; T4 with yellow on 1/3 of anterolateral sides, or almost fully black; and T5 fully black.

Male terminalia: S_5 apical lobe length 0.65–0.66 ($\bar{x}$ = 0.65) S_5 length (Fig. 68). Surstylus, in lateral view, slightly concave along anterior and posterior margin. Cerci, in lateral view, slightly concave on anterior and posterior-apical margins, ending in a rounded apex. In posterior view, upper lobe length almost double than the medial section length and almost equal to the apical cleft length; apical cleft narrow and elongate, and apex of the cerci curved, with tips directed medially. Cercus upper lobe length 0.33–0.36 ($\bar{x}$ = 0.35) cercus length, cercus medial section length 0.25–0.30 ($\bar{x}$ = 0.28) cercus length (Figs. 66 and 67).

Host: A single male specimen was reared from an *Eois pallidicosta* Warren caterpillar (Lepidoptera: Geometridae). This male was reared from an *Eois* caterpillar that was collected from YBS (Napo, Ecuador) on an unknown species of *Piper* (Piperaceae). The third instar caterpillar was collected on 4th October 2005 and the pupa was observed 13 days later. The adult was noticed 31 days later.

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

E. napensis is distributed from Costa Rica in the north to Ecuador in the south (Map 6). Similar to *E. arciforceps*, nospecimens have been collected between Costa Rica and Ecuador exemplifying the lack of collecting effort between these two areas. This

species seems to occur at high elevations (e.g., Cartago, Costa Rica, 1800m; and Napo, Ecuador, 2000-2600m). However, there are only two location records for this species. More specimens are needed to evaluate the geographic distribution and altitude restrictions. The single specimen from Costa Rica was collected in April, and the specimen from Ecuador was reared in October (see Host section).

DISCUSSION

As mentioned above in the recognition section, the genitalia of *E. napensis* are quite similar to the genitalia of *E. arciforceps*. This species is well differentiated from *E. arciforceps* by the shape (in lateral view) of surstyli, the straight cerci with rounded cerci apices, and (in posterior view) by their longer and narrower apical cleft. Because of these unique characteristics, I am describing this species with only two males available. Given the limited specimens examined in this study, this description should be used with some caution (see discussion section of *E. curvifrons*). See the discussion section of *E. cryptica* for female notes.

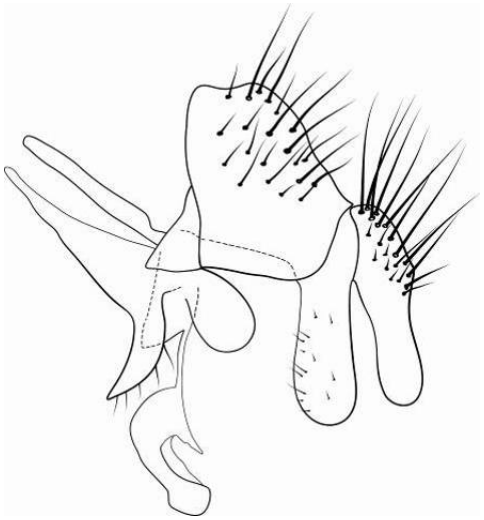


Figure 66. Lateral view of *E. napensis* male genitalia.

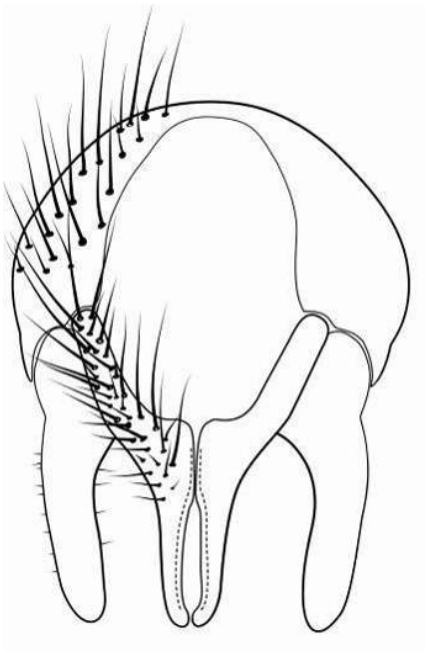


Figure 67. Epandrial complex in posterior view of male *E. napensis*.

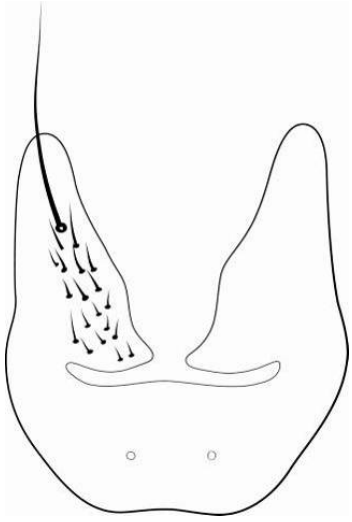


Figure 68. 5th sternite of male *E. napensis*.

Erythromelana distincta Inclan sp. nov.

(Figs. 69–75, Map 7)

TYPE MATERIAL

Holotype

Male, labelled: "VENEZUELA Aragua/ 11 km Rancho/ Grande 25.II.1971/ G.&M. Wood", "HOLOTYPE/ Erythromelana/ distincta/ Inclan D.J. [red label]", "DI280CA [specimen ID number]", (CNC). Terminalia stored in glycerine in a microvial pinned below specimen.

Allotype

Female, labelled: "VENEZUELA Aragua/ 11 km Rancho/ Grande 25.II.1971/ G.&M. Wood", "ALLOTYPE/ Erythromelana/ distincta/ Inclan D.J. [red label]", "DI46CA [specimen ID number]", (CNC).

Paratypes

Seventeen males and nineteen females. **Costa Rica:** one female, "COSTA RICA, Prov. [Province] Puntarenas, Send. [Sendero]/ a Trocha Acuaductos Tablas a 700m/ NO. de Cerro Chivo. 1680m./ 11DIC 1997. A. Picado./ L_S_322200_597800 #48784", "COSTA RICA INBIO/ CRI002/ 593459", "PARATYPE/ Erythromelana/ distincta/ Inclan D.J. [yellow label]" terminalia stored in glycerine in a microvial pinned below specimen (INBio). **Venezuela:** one male and one female, same as Holotype data exept date "18-27.II.1971" and ID numbers "DI38CA [♂]" terminalia stored in glycerine in a microvial pinned below specimen (CNC) and "DI47CA [♀]" terminalia stored in glycerine in a microvial pinned below specimen (CNC). **Ecuador:** one male, "Coca, Napo R. [River?]/

Napo [Province], ECUADOR/ .V1965/ 250m., L. Pena", "DI343CA" terminalia stored in glycerine in a microvial pinned below specimen (CNC). **Peru:** three males, "Avispas, Madre/ de Dios, PERU/ 10-20.IX.1962/ L.Pena. 400m.", "DI342CA" terminalia stored in glycerine in a microvial pinned below specimen (CNC); "DI341CA" (CNC); and "340CA" (CNC). **Brazil:** five males, "Nova Teutonia/ S.C. [Santa Catarina Province] – BRAZIL/ Nov. 1970/ F. Plaumann", "DI296CA" terminalia stored in glycerine in a microvial pinned below specimen (JOS); "DI290CA" (CNC); "DI289CA" (CNC); "DI288CA" (CNC); "DI324CA" (CNC). Seven females, same data as previus exept ID numbers "DI313CA" (CNC); "DI309CA" (CNC); "DI311CA" (CNC); "DI312CA" (CNC); "DI308CA" (CNC); "DI303CA" (CNC); "DI315CA" terminalia stored in glycerine in a microvial pinned below specimen (CNC). Three males, same as previus exept date "Dec. 1970" and ID numbers "DI383CA" (CNC); "DI282CA" (Ecuador); and "DI281CA" (INBio). One male, same data as previus exept date "XII 71" and ID number "DI328CA" (CNC). One female, same as previus data expet date "Aug. 1969" and ID number "DI335CA" (Ecuador). Two females, same as previus data exept date "Oct. 1970" and ID numbers "DI319CA" (CNC); and "DI306CA" (CNC). One female, same as previus data exept date "Dec. 1961" and ID number "DI334CA" (CNC). One female, same as previus data expet date "Sept. 1961" and ID number "DI333CA" (CNC). One female, same data as previus exept date "Jan. 1971" and ID number "DI330CA" (CNC). One fenale, "Brasilien/ Nova Teutonia/ 27°11'B 52°23'L/ Fritz Plaumann/ III 1960/ 300 500m", "DI388CA" (JOS). One male, "Nova Teutonia/ 27°11'S 52°23'W/ Brazil, 300-500m/ XII. 1964/ Fritz Plaumann", "DI339CA" (CNC). One female, same data as previus exept date "II 1965" and ID number "DI338CA" (CNC). Two males, "BRAZIL: Santa

Catarina/ Nova Teutonia, 27°11'S/ 52°23'W, 300-500m, 20/ Apr. 1966. F. Plaumann", "COLLECTION OF/ PAUL H. ARNAUD, JR.", "DI156NM" (NMNH); "DI158NM" (NMNH). One female, same data as previus exept date "Feb 1969" and ID number "DI142NM" (NMNH). One female, same data as previus exept date "11/ Apr. 1966" and ID number "DI160NM" (NMNH).

OTHER MATERIAL EXAMINED

Nineteen males and twenty females. One male, "BRAZIL: Santa Catarina/ Nova Teutonia, 27°11'S/ 52°23'W, 300-500m/ Feb. 1966. F. Plaumann", "COLLECTION OF/ PAUL H. ARNAUD, JR.", "DI156NM" (NMNH); "Erythromelana/ distincta/ Inclan D.I.", "DI164NM" (NMNH). Two females, same data as previus exept date "21 Apr. 1966" and ID numbers "DI161NM" (NMNH); and "DI165NM" (NMNH). One female, same data as previus exept date "20/ Apr. 1966" and ID number "DI157NM" (NMNH). Five males, "Nova Teutonia/ S.C. [Santa Catarina Province] – BRAZIL/ Nov. 1970/ F. Plaumann", "DI287CA" (CNC); "DI286CA" (CNC); "DI299CA" (CNC); "DI302CA" (CNC); and "DI295CA" (CNC). Three females, same information as previus exept ID numbers "DI304CA" (CNC); "DI305CA" (CNC); and "DI317CA" (CNC). Two males, same data as previus exept date "Dec. 1970" and ID numbers "DI284CA" (CNC); and "DI285CA" (CNC). Two females, same data as previus exept ID numbers "DI322CA" (CNC); and "DI314CA" (CNC). Two males, same data as previus expet date "Aug. 1970" and ID numbers "DI291CA" (CNC); and "DI298CA" (CNC). Two females, same data as previus exept ID numbers "DI328CA" (CNC); and "DI321CA" (CNC). Five males, same information as previus exept date "Oct. 1970" and ID numbers "DI300CA"

(CNC); “DI297CA” (CNC); “DI294CA” (CNC); “DI293CA” (CNC); and “DI292CA” (CNC). Three females, same data as previus exept ID numbers “DI307CA” (CNC); “DI310CA” (CNC); and “DI316CA” (CNC). One male, same data as previus exept date “June 1970” and ID number “DI301CA” (CNC). Two females, same data as previus expet date “May 1970” and ID numbers “DI320CA” (CNC); and “DI318CA” (CNC). One female, same data as previus exept date “Sept. 1969” and ID number “DI336CA” (CNC). One female, same data as previus exept date “Dec. 1969” and ID number “DI337CA” (CNC). Two males, same data as previus exept date “XII 71” and ID numbers “DI326CA” (CNC); and “DI327CA” (CNC). One female, same data as previus exept ID number “DI332CA” (CNC). One male, same data as previus exept date “ Nov. 1971” and ID numers “DI325CA” (CNC). Two females, same data as previus exept ID numbers “DI331CA” (CNC); and “DI329CA” (CNC).

ETYMOLOGY

Derived from the Latin *distinctus*, meaning apart or different, in reference to the surstylus and cerci of the male genitalia that are uniquely-shaped and well differentiated from all other *Erythromelana* species.

RECOGNITION

This species is easily distinguished from all other *Erythromelana* species by its black and yellow abdominal coloration and the present of setae on the dorsum of vein R1. *E. ecuadoriana* is the only other species that has setae on the vein R1, but this species can be easily separated by the bright yellow abdominal coloration. Additionally, the surstylus

of *E. distincta* is the broadest of all observed *Erythromelana* species and it is the only one bearing large internal setae.

DESCRIPTION

Described from 10 males and 6 females, unless otherwise noted as "N".

Length: 5.4–6.0mm ($\bar{x}$ = 5.60mm) in male, 5.3-6.4mm ($\bar{x}$ = 5.82mm) in female.

Head: Parafacial brown in ground color covered with silver pruinescence. Fronto-orbital plate and vertex black in ground color covered with dull silver pruinescence (which could appear grayish from certain angles), with a faint golden reflections visible only in lateral view (mostly on vertex). Arista black with dark brown on basal 1/3-1/4, thickened only on basal 1/4. Eye sparsely haired with short ommatrichia about as long as 2-3 eye facets in male and female. Eye 0.86–0.92 ($\bar{x}$ = 0.89) head height in male, 0.86-0.91 ($\bar{x}$ = 0.89) in female. Vertex width 0.19–0.24 ($\bar{x}$ = 0.22) head width in male, 0.20-0.23 ($\bar{x}$ = 0.22) in female. Frontal vitta width 0.30–0.50 ($\bar{x}$ = 0.40) vertex width in male, 0.32-0.42 ($\bar{x}$ = 0.38) in female. Length of first flagellomere 0.48–0.59 ($\bar{x}$ = 0.54) head height in male, 0.48-0.53 ($\bar{x}$ = 0.51) in female. Pedicel length 0.21–0.29 ($\bar{x}$ = 0.24) length of first flagellomere in male, 0.23-0.29 ($\bar{x}$ = 0.25) in female. Fronto–orbital plate with 5–7 (m = 6) medioclinate frontal setae in male, 4-5 (m = 5) in female; 2 reclinate inner orbital setae, usually the first pair large and well developed and the second pair small or reduce to a hair-like seta (specially in female); 2 proclinate outer orbital setae in female, absent in male. Vertex with 1 reclinate inner and 1 lateroclinate outer vertical seta, the latter well differentiated from the row of postocular setae. Ocellar setae proclinate. Parafacial bare and extremely narrow with the narrowest point equal or narrower than the basal width of

the palpus. Parafacial width 0.02 ($\bar{x}$ = 0.02) head width in male, 0.01-0.02 ($\bar{x}$ = 0.02) in female. Facial ridge with hairs on basal 1/4 or less. Height of haired portion of facial ridge 0.14–0.24 ($\bar{x}$ = 0.19) head height in male, 0.14-0.18 ($\bar{x}$ = 0.15) in female. Palpus yellowish, usually with dark brown-yellow base; distally sparsely haired with external lateral edges usually bare; almost uniform in width; length 0.28–0.38 ($\bar{x}$ = 0.31) head height in male, 0.31-0.36 ($\bar{x}$ = 0.33) in female.

Thorax: Dorsocentral length 0.33–0.39 ($\bar{x}$ = 0.37) total body length in male, 0.36-0.41 ($\bar{x}$ = 0.38) in female. Shiny black in ground color; presutural scutum with thin white pruinescence, postsutural scutum with much sparser pruinescence revealing underlying black ground color. In dorsal view only the presutural scutum appears grayish; whereas in lateral view the postsutural scutum appears grayish as well. Faint white pruinose stripes on presutural scutum leaving 4 black vittae, the inner 2 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae. Postpronotum with 2 setae, usually with one additional small setae. Katepisternum with 2 setae. Scutum with 1 presutural acrostichal seta; 1 postsutural acrostichal seta, rarely with one additional small seta; 2 well developed presutural dorsocentral setae, rarely with 1 additional small seta; 2 well developed postsutural dorsocentral setae, usually with 1 additional small seta; 1 presutural intra–alar seta, usually with 1 additional small seta; 3 postsutural intra–alar setae; 1 presutural supra–alar seta, usually with one additional small seta; 2 postsutural supra–alar setae, the first postsutural supra–alar absent. Scutellar discal setae usually present but hair-like.

Legs black. Tarsal claws longer than 5th tarsomere in male and shorter than 5th tarsomere in female. Fore claw length 1.00–1.15 ($\bar{x}$ = 1.09, N = 7) fore 5th tarsomere length in male, 0.73-0.92 ($\bar{x}$ = 0.83) in female. Hind tibia with 2 well developed posterodorsal setae, usually with 1 or 2 additional shorter seta; usually 3 or 4 well developed anteroventral setae. Wings usually light fumose on c, sc, r_1, r_{2+3}, and r_{4+5} cells; or dark fumose on sc, and r_1 cells. Wing vein R_1 dorsally setose on about apical half and vein R_{4+5} dorsally with 3–6 (m = 3) setae at base. Vein M smoothly curved at bend and ending at wing margin anterior to wing tip separately from vein R_{4+5}.

Abdomen: Mostly black with yellow on lateral sides. In dorsal view, T_{1+2} usually with yellow on 1/3 to all of posterolateral sides, rarely fully black; T3 with yellow on 3/4 to all of anterolateral sides; T4 with yellow on 1/3-1/2 of anterolateral sides, rarely fully black; T5 fully black. Transverse bands of sparse white pruinosity on anterior 1/3-1/4 of T_3 and T_4 and on anterior 2/3 of T_5. Mid-dorsal depression of T_{1+2} not reaching median marginal setae. One pair of median marginal setae on T_{1+2} and T_3, a row of median marginals on T_4 and T_5, 1 pair of lateral marginal setae on T_{1+2} and T_3, and an irregular row of small discal setae sometimes present, but usually absent on T5.

Male terminalia: Sternite 5 with median cleft almost V–shaped, inner margin with minute setae, apical lobe not strongly pointed apically with a single long well developed seta, and anterior margin of basal plate slightly concave (Fig. 71). S_5 apical lobe length 0.58–0.67 ($\bar{x}$ = 0.62, N = 5) S_5 length. Postgonite slightly spatulate with an extreme broad rounded tip. Surstyli externally with several small setae and internally with several large

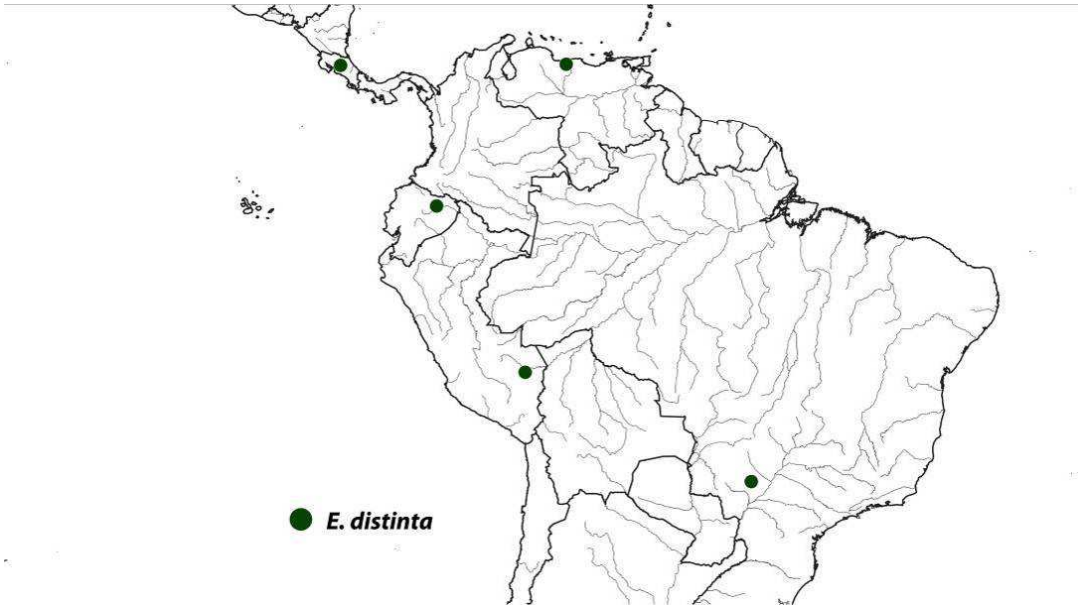
setae, in lateral view slightly concave along anterior and posterior margins resulting in a very broad spatulate apex. Cerci length slightly shorter than the surstyli length. Cerci in lateral view slightly concave on anterior surface, in the medial section of the posterior margin strongly carinate, with the carina ending before the rounded apices, forming an obtuse angle. In posterior view, cerci narrowed on apical 1/3, upper lobe length longer than the medial section length and almost equal to the sum of the medial section and the apical cleft length; apical cleft well defined and internally twisted; and apex of the cerci linear, with rounded tips directed distally. Cercus upper lobe length 0.45–0.55 ($\overline{x}$ = 0.50, N = 5) cercus length, cercus medial section length 0.24–0.32 ($\overline{x}$ = 0.27, N = 5) cercus length (Figs. 69-71).

Female Terminalia: Sternite 5 rectangular–shaped, anterior margin slightly concave, with 2 pairs of well developed setae close to posterior margin (Fig. 72). S_5 length about 1.5 the width. Width of S_5 0.67–0.86 ($\overline{x}$ = 0.67, N = 3) the length. S_6 with several well developed setae on posterior corners (Fig. 73). T_6 well developed, present as two lateral sclerites with well developed setae along posterior margin. S_7 with a distinctive lobe on the medial section of the anterior margin, with several small setae on posterior corners (Fig. 74). T_7 present as two lateral sclerites, with small setae along posterior margins. S_8 small, difficult to distinguish from the surrounding membrane. T_8 bare, dorsally with a distinctive narrow lobe on the medial section of the anterior margin, strongly narrowed dorsally, joining ventrally with the postgenital plate (Fig. 75). T_{10} between the cerci, small and bare, rhomboid in shape. Postgenital plate with several small setae on posterior tip. Cerci slightly narrow at bases, with several setae apically (Fig. 75).

Host: Unknown

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

E. distincta is widely distributed, from Costa Rica to southern Brazil (Map 7). Besides the specimens from Venezuela, Ecuador, and Peru, there is a large geographical gap between the specimens collected in Costa Rica and those collected in Brazil representing a substantial portion of the Neotropics that remains unsampled. There is a large collection of specimens from Nova Teutonia (Brazil) contrasting with the records for Costa Rica, Venezuela, Ecuador, and Peru that correspond to singletons or no more than four specimens. This species seems to occur only at low and mid elevations (Puntarenas, Costa Rica, 1600m; Araguas, Venezuela, 1100m; Napo, Ecuador, 250m; Avispas, Peru, 400m; and Santa Catarina, Brazil, 300-500m). We have sampled the tachinid fauna of the eastern Andes of Ecuador (2000–2600m) for several years and we have not collected it there, which suggests that it may not occur above ~2000m. Specimens from Brazil were collected throughout the year, but most were collected late in the year (1 in January, February, and March; 2 in May; 1 in June; 5 in August; 2 in September; 10 in October; 24 in November; and 14 in December). The single specimen from Costa Rica was collected in December, the four specimens from Venezuela were collected in February, the single specimen from Ecuador was collected in May, and the three specimens from Peru were collected in September.



Map 7. Known distributions of *E. distincta*.

DISCUSSION

E. distincta is the only species in the *E. cryptica* species group that have only two katepisternal setae and the discal setae on T5 are usually absent (although see discussion of *E. woodi*). This species is the only one that has a distinct character of the female genitalia distinguishing it from all other *Erythromelana* species: the distinctive narrow lobe on the dorsal anterior margin of T_8.

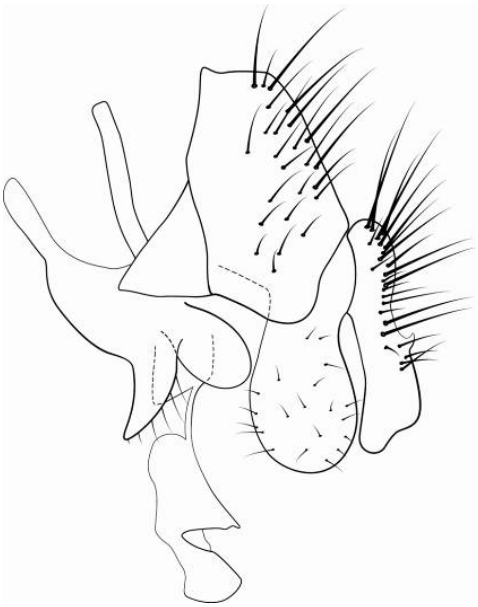


Figure 69. Lateral view of *E. distincta* male genitalia.

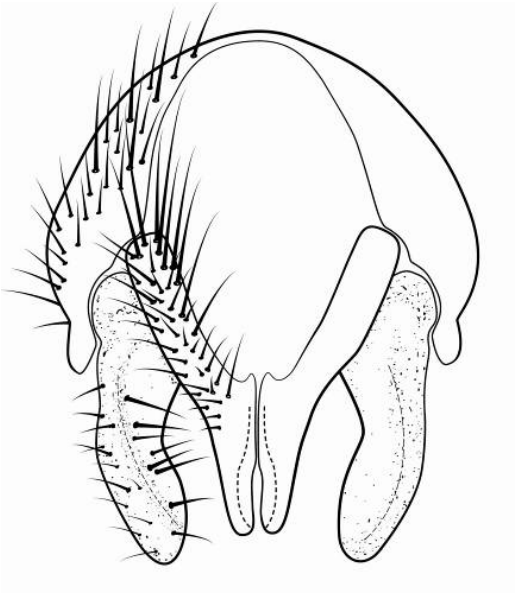


Figure 70. Epandrial complex in posterior view of male *E. distincta*.

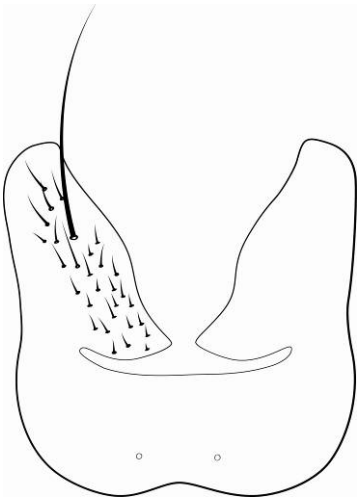


Figure 71. 5th sternite of male *E. distincta*.

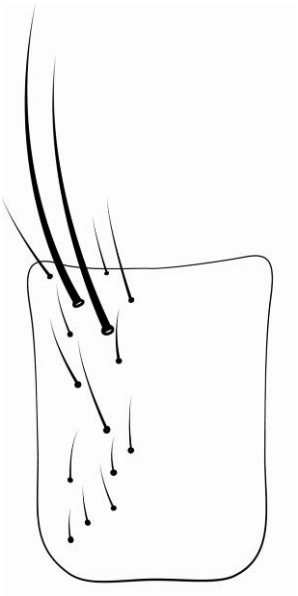


Figure 72. 5th sternite of female *E. distincta*.

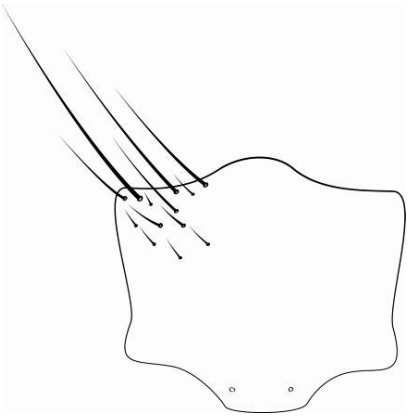


Figure 73. 6th sternite of female *E. distincta*.

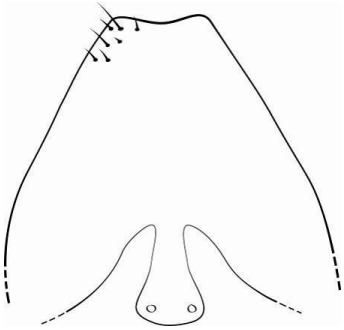


Figure 74. 7th sternite of female *E. distincta*.

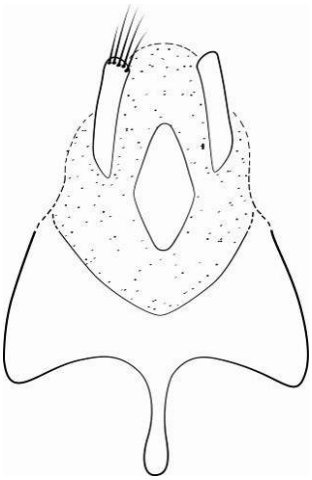


Figure 75. Dorsal view of female genitalia showing tergites 7–10 and cerci of *E. distincta*.

Erythromelana woodi Inclan sp. nov.

(Figs. 76–82, Map 8)

TYPE MATERIAL

Holotype

Male, labelled: "COSTA RICA Pnts [Puntarenas Province]/ Monteverde/ 28.VIII. 1993/ D.M. Wood 1842m", "HOLOTYPE/ Erythromelana/ woodi/ Inclan D.J. [red label]", "DI208MW [specimen ID number]", (CNC).

Allotype

Female, labelled: "COSTA RICA Pnts [Puntarenas Province]/ Monteverde 1600m/ 18-24.VIII. 1987/ G. & M. Wood", "ALLOTYPE/ Erythromelana/ woodi/ Inclan D.J. [red label]", "DI210MW [specimen ID number]", (CNC).

Paratypes

Five males and seven females. **Mexico:** one male, "MEXICO Oax [Oaxaca] 100/ km s [South] Tuxtepec/ 20.VIII.1984/ D.M. Wood", "PARATYPE/ Erythromelana/ woodi/ Inclan D.J. [yellow label]", "DI228CA [specimen ID number]" terminalia stored in glycerine in a microvial pinned below specimen (CNC). Two females, same data as previus exept ID numbers "DI55CA" terminalia stored in glycerine in a microvial pinned below specimen (CNC); and "DI227CA" (NMNH). One female, "MEXICO Oax [Oaxaca] 4.6 km/ S Suchistepec/ 23.VII.1992/ D.M. Wood 2150m", "DI56CA" (CNC). **Costa Rica:** one male, same data as the Holotype exept date "22.IX.1994" and ID number "DI207MW" (INBio). One female, "COSTA RICA Pnts/ Monteverde, Cerro/ Chomogo 1800m/ 1.IX.95 Blutler&Wood", "DI209MW" (CNC). **Ecuador:** one male,

"Ecuador: Cosanga, Napo./ 8km NW from Yanayacu B.S. [Biological Station]/ 05-XII-09 00°35.955'S/ ~6904ft 77°53.377'W/ Diego J. Inclan", "DI84EC-09" terminalia stored in glycerine in a microvial pinned below specimen (CNC). One female, "Ecuador: Mindo, Pichinca/ road to tarabita/ 24-XI-09 00°04.062'S/ ~4800ft 78°45.246'W/ Diego J. Inclan", "DI507ECU" (CNC). One female, "ECUADOR: Napo prov/ Yanayacu Biological Station/ S 00°35.9' W77°53.4' 2163m/ 5-vi-06 J.O. Stireman III", "sp jaena ab?"(JOS). **Bolivia:** two males, "BOLIVIA Cbba Chapare/ Villa Tunari-Cochabamba/ road – km 388 – 2200m/ G&M.Wood 3.XII.96", "DI205MW" (CNC); and "DI203MW" (Ecuador). One female, "BOLIVIA Cbba Chapare/ Villa Tunari-Cochabamba/ road – km 365 – 1800m/ G.&M.Wood 3-10.XII.96", "DI204MW" (CNC).

ETYMOLOGY

This species is named in honor of Dr. D. Monty Wood, who has immensely contributed to the systematics of the New World Tachinidae. In particular, his conspectus of the Neotropical Blondelliini (Wood 1985) was an important reference in the development of this revision. Dr. Wood has extensively collected tachinids in Central and South America including the holotype and nine paratypes of this species and several types of other *Erythromelana* species.

RECOGNITION

This species is easily recognized by the shape and the setal arrangement of the male and female palpi, and by having three postpronotal setae. *E. woodi* palpi are distinguished from all other *Erythromelana* species by being narrower and slightly

curved inward medially, with two distinctive setae on the external lateral sides, usually with one or two small setae at tip, and dorsally bare. See recognition section of *E. leptoforceps* for differences between this species and *E. woodi*, and see recognition section of *E. cryptica* for the distinction of *E. woodi* with other species in the *E. cryptica* species group and *E. jaena* species group.

DESCRIPTION

Described from 5 males and 6 females, unless otherwise noted as "N".

Length: 5.9–6.8mm ($\bar{x}$ = 5.28mm) in male, 5.2-6.6mm ($\bar{x}$ = 5.75mm) in female.

Head: Parafacial brown in ground color covered with dull silver pruinescence. Fronto-orbital plate and vertex black in ground color covered with dull silver pruinescence (which can appear grayish from certain angles), with a faint golden reflections visible only in lateral view (mostly on vertex). Arista fully black or with dark brown on basal 1/4, thickened only on basal 1/4 (Figs. 77 and 79). Eye sparsely haired with short ommatrichia about as long as 2-3 eye facets in male and female. Eye 0.88–0.89 ($\bar{x}$ = 0.89) head height in male, 0.89-0.90 ($\bar{x}$ = 0.90) in female. Vertex width 0.18–0.23 ($\bar{x}$ = 0.20) head width in male, 0.20-0.24 ($\bar{x}$ = 0.22) in female. Frontal vitta width 0.30–0.45 ($\bar{x}$ = 0.35) vertex width in male, 0.36-0.57 ($\bar{x}$ = 0.45) in female. Length of first flagellomere 0.40–0.54 ($\bar{x}$ = 0.49) head height in male, 0.48-0.54 ($\bar{x}$ = 0.52) in female. Pedicel length 0.24–0.35 ($\bar{x}$ = 0.27) length of first flagellomere in male, 0.23-0.30 ($\bar{x}$ = 0.26) in female. Fronto–orbital plate with 6–8 (m = 6) medioclinate frontal setae in male, 4-5 (m = 4) in female; 2 reclinate inner orbital setae, rarely with 1 additional small seta in male; 2 proclinate outer orbital setae in female, absent in male. Vertex with 1 reclinate

inner and 1 lateroclinate outer vertical seta; the latter barely differentiated from the row of postocular setae in male, well differentiated in female. Ocellar setae proclinate. Parafacial bare and extremely narrow with the narrowest point narrower than the basal width of the palpus. Parafacial width 0.01-0.02 ($\bar{x}$ = 0.01) head width in male, 0.01-0.02 ($\bar{x}$ = 0.02) in female. Facial ridge with hairs on basal 1/4 or less. Height of haired portion of facial ridge 0.12–0.20 ($\bar{x}$ = 0.16) head height in male, 0.12-0.19 ($\bar{x}$ = 0.16) in female. Palpus yellowish, usually with brown-yellow at base; narrow and medially slightly curved inward; almost uniform in width; setae mostly on internal lateral sides, dorsally bare, with two distinctive setae on external lateral sides, and usually with 1 or 2 small setae at tip; length 0.29–0.37 ($\bar{x}$ = 0.33) head height in male, 0.28-0.40 ($\bar{x}$ = 0.34) in female.

Thorax: Dorsocentral length 0.37–0.38 ($\bar{x}$ = 0.37) total body length in male, 0.34-0.37 ($\bar{x}$ = 0.39) in female. Shiny black in ground color; presutural scutum with thin white pruinescence, postsutural scutum with much sparser pruinescence revealing underlying black ground color. In dorsal view only the presutural scutum appears grayish; whereas in lateral view the postsutural scutum appears grayish as well. Faint white pruinose stripes on presutural scutum leaving 4 black vittae, the inner 2 vittae longer and thinner, almost 1/2 the width of each of the outer 2 vittae (Fig. 76). Postpronotum with 3 setae, usually the middle basal seta displaced antereolaterally forming a nearly right-angled triangle with outer and inner basal setae. Katepisternum with 3 setae, the lower as a hair-like seta or absent. Scutum with 2 presutural and 2 postsutural acrostichal seta; 2 well developed presutural dorsocentral setae; 2 well developed postsutural dorsocentral setae, usually

with 1 additional small seta; 1 presutural intra–alar seta, with 1 additional small seta; 3 postsutural intra–alar setae; 1 presutural supra–alar setae, usually with one additional small seta; 2 postsutural supra–alar setae, the first postsutural supra–alar absent. Scutellum discal setae absent.

Legs black (Fig. 78). Tarsal claws longer than 5th tarsomere in male and shorter than 5th tarsomere in female. Fore claw length 1.14–1.36 ($\bar{x}$ = 1.22, N = 4) fore 5th tarsomere length in male, 0.81-0.94 ($\bar{x}$ = 0.88, N = 5) in female. Hind tibia with 2 well developed posterodorsal setae, rarely with 1 additional shorter seta; usually 4 or 5 well developed anteroventral setae. Wings usually with dark fumose on sc, and r_1 cells; and light fumose on c, r_{2+3}, and r_{4+5} cells. Wing vein R_{4+5} dorsally with 2–5 (m = 3) setae at base. Vein M smoothly curved at bend and ending at wing margin anterior to wing tip separately from vein R_{4+5}.

Abdomen: Coloration varied from mostly yellow to mostly black. In dorsal view, T_{1+2} usually with yellow on 1/3 to all of posterolateral sides or black only on mid-dorsal depression, rarely fully yellow; T3 with yellow on 3/4 to all of anterolateral sides, rarely fully yellow; T4 with yellow on 1/3-2/3 of anterolateral sides, rarely with black only on posterior margin; T5 varied from fully black to fully yellow or mostly yellow with black only at the center of posterior margin. Black color usually forming a triangular shape on dorsal of T3, T4, and T5. Transverse bands of sparse white pruinosity on anterior 1/3-1/4 of T_3 and T_4 and on anterior 2/3 of T_5 on mostly black abdomens, and absent on mostly yellow abdomens. Mid-dorsal depression of T_{1+2} not reaching median marginal setae

(Fig. 76). One pair of median marginal setae on T_{1+2} and T_3; a row of median marginals on T_4 and T_5; 1 pair of lateral marginal setae on T_{1+2} and T_3; and usually with an irregular row of small discal setae present on T5, rarely absent.

Male terminalia: Sternite 5 with median cleft almost U–shaped; inner margin with minute setae; apical lobe truncate, not strongly pointing apically; usually with a single long well developed seta, but varied from absent to 2 medium size setae. Anterior margin of basal plate slightly concave (Fig. 82). S_5 apical lobe length 0.62–0.68 ($\bar{x}$ = 0.65, N = 3) S_5 length. Surstylus internally and externally with several small setae, in lateral view slightly concave along anterior and posterior margins. Surstylus and cercus subequal in length. Cerci narrow, in lateral view, slightly concave on anterior and posterior margins ending in a narrow rounded apex. In posterior view, cerci with a slight depression on the medial section extending towards the apical cleft, upper lobe length almost half the medial section length and almost equal to the apical cleft length, apical cleft weakly defined with rounded tips directed distally. Cercus upper lobe length 0.24–0.27 ($\bar{x}$ = 0.25, N = 3) cercus length, cercus medial section length 0.50–0.56 ($\bar{x}$ = 0.53, N = 3) cercus length (Figs. 80-81).

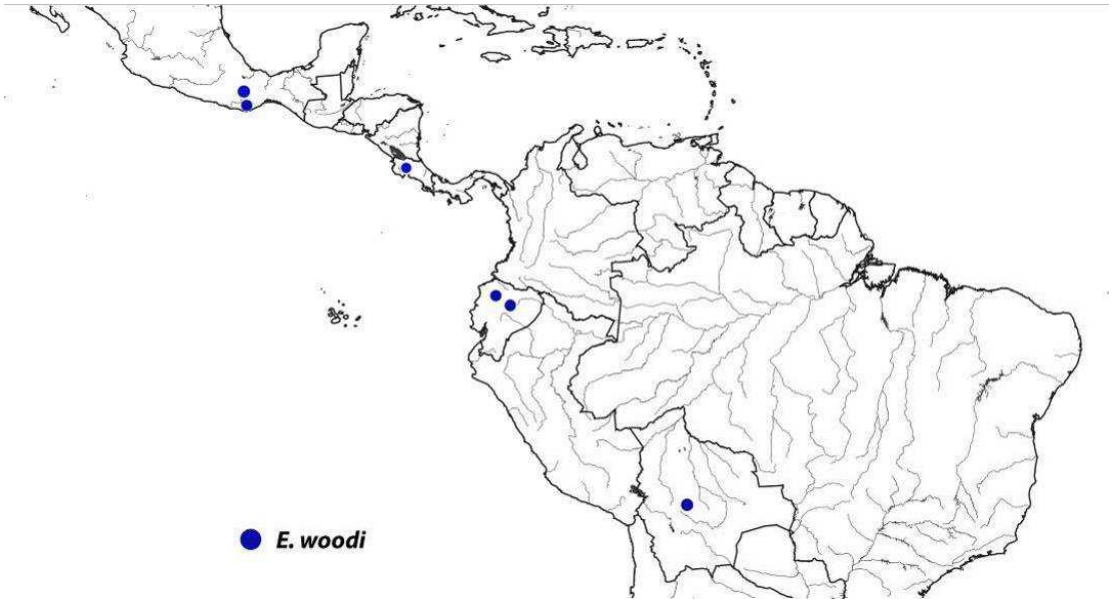
Female Terminalia: Sternite 5 rectangular–shaped, anterior margin slightly concave, covered with well developed setae on more than posterior 1/2. S_5 length about 1.5 the width. Width of S_5 0.66–0.76 ($\bar{x}$ = 0.71, N = 3) the length. S_6 with several well developed setae on posterior corners. T_6 well developed, present as two lateral sclerites with well developed setae along posterior margin. S_7 with a distinctive lobe on the medial section

of the anterior margin, with several small setae on posterior corners. T_7 present as two lateral sclerites, with small setae along posterior margins. S_8 small and bare, difficult to distinguish from the surrounding membrane. T_8 bare, well developed laterally, strongly narrowed dorsally, joining ventrally with the postgenital plate. T_{10} between the cerci, small and bare, almost rhomboid shape. Postgenital plate with several small setae on posterior tip. Cercus slightly narrow at bases, with several setae apically.

Host: Unknown

GEOGRAPHIC DISTRIBUTION AND SEASONAL OCCURRENCE

E. woodi exhibits one of the wider geographic distributions among *Erythromelana* species. It has been collected from Mexico in the north to Bolivia in the south (Map 8). As in records of the other *Erythromelana* species, the true distribution of this species remains unknown due to the lack of specimens collected between Mexico and Costa Rica, Costa Rica and Ecuador, and Ecuador and Bolivia. *E. woodi* seems to occur at high elevations, above the 1500m (e.g., Oax, Mexico, 2000-2500m; Monteverde, Costa Rica, 1600m; Napo, Ecuador, 2000-2600m; Mindo, Ecuador, 1500m; Cochabamba, Bolivia, 1800-2200m). Specimens have been collected from June throughout December. In Mexico one specimen was collected in July and three in August; in Costa Rica two specimens were collected in August and two in September; in Ecuador three specimens were collected in June, November and December; and in Bolivia three specimens were collected in December.



Map 8. Known distributions of *E. woodi*.

DISCUSSION

The coloration of the abdomen, the number of katepisternal setae, and the setae on the 5th sternite apical lobe are quite varied, but at this time I do not see other evidence to suggest that *E. woodi* represents more than one species. The abdominal coloration varies from specimens with the abdomen mostly black to mostly bright yellow. In general, specimens from higher elevations seem to have more yellow abdomens, but these specimens always retain small black posterodorsal markings usually on the of T3 and always in T4. Another character that varies is the number of katepisternal setae, usually there are three setae, but some specimens seem to have lost the lower seta and possess only two well developed setae. Of all the *Erythromelana* species, this is the only species in which I found that the number of katepisternal setae varies. Aside from this species, this character is a useful as an indicator to separate species (e.g. *E. leptoforceps* and *E. nigrothrax* from most of the species in the *E. cryptica* species group). The last character

that varies in this species is the setae on the S5 apical lobe. One characteristic of species in the *E. cryptica* species group is the presence of long, well developed seta on the S5 apical lobe, but males of *E. woodi* usually have one long seta or two medium size setae, and rarely this seta is absent. However, I have examined the genitalia of all these specimens and the shape of the surstylus and cerci are identical. Therefore, I am describing *E. woodi* as a unique species because I think that all these differences represent intraspecific variation and I do not see other evidence suggesting than more than one species is involved.

E. woodi is presents the most variation from the defined characters of the *E. cryptica* species group. As explained above, the abdominal coloration of some *E. woodi* specimens departs from the typical color of the *E. cryptica* species group. In addition, the male S5 usually has the long seta characteristic of this group, but sometimes it is absent as in the S5 of the *E. jaena* species group. Similarly, the female S5 in the *E. cryptica* species group is characterized by the presence of two pairs of well developed setae close to the apical margin, but the S5 of females of *E. woodi* is like the S5 of the species in *E. jaena* group that usually have several well developed setae on more than posterior 1/2. However, *E. woodi* has a slight dorsal depression on the medial section of the cerci that is characteristic of all the species in the *E. cryptica* species group (although in other species this depression makes a twist toward the apical cleft). Because of this character, I am grouping *E. woodi* in the *E. cryptica* species group.

Figure 76. Dorsal view of male *E. woodi*.

Figure 77. Frontal view of the head of male *E. woodi*.

Figure 78. Lateral view of male *E. woodi*.

Figure 79. Lateral view of the head of male *E. woodi*.

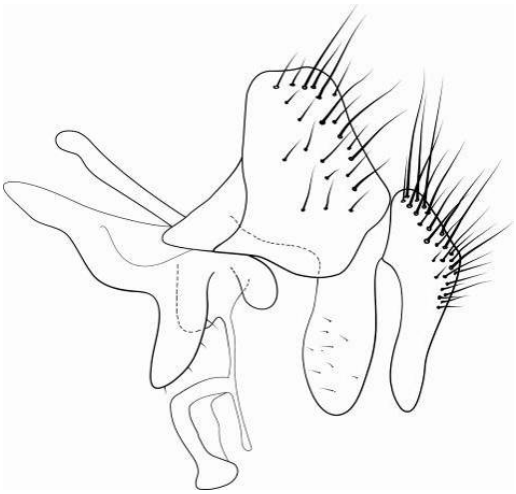


Figure 80. Lateral view of *E. woodi* male genitalia.

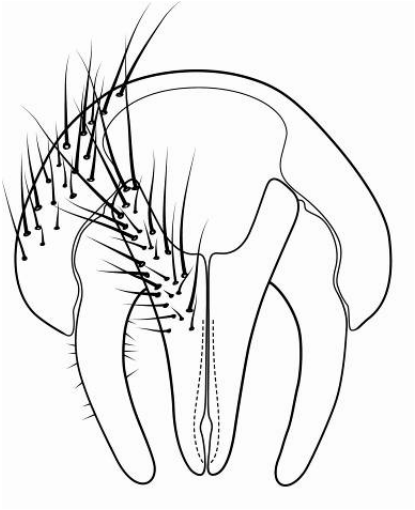


Figure 81. Epandrial complex in posterior view of male *E. woodi*.

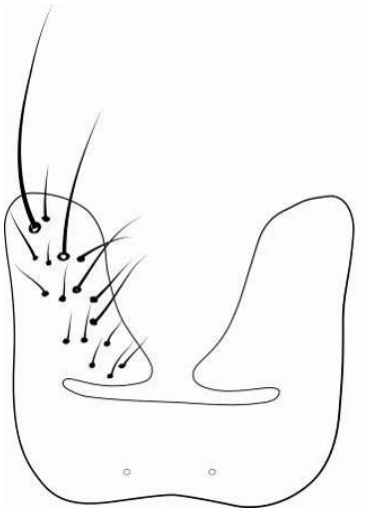


Figure 82. 5th sternite of male *E. woodi*.

PHYLOGENY RECONSTRUCTION OF THE GENUS *ERYTHROMELANA*

Phylogenetic analysis of morphological characters

The parsimony analysis resulted in a single most parsimonius cladogram (L=253); however, most of the ingroup nodes were supported by low bootstrap values (<70%) (Figure 83). The analysis supports the monophyly of the *Erythromelana* species relatively strongly, as the branch that separates this genus from *Myiodoriops* and *Euptilodegeeria* has a bootstrap value of 74 (Fig. 83). The genus *Myiodoriops* is separated from *Erythromelana* and *Euptilodegeeria* by six synapomorphies: 3 inner orbital setae; 2 subvibrisa setae; M vein ending with R4+5 vein at wing margin; cercus length more than 0.75 of the S5 length; cercus medial section length less or equal to 0.25 of the cercus length; and surstyli with a few small setae like spines on the anterior side of the apex. The genus *Euptilodegeeria* is separated from *Erythromelana* and *Myiodoriops* genera by four synapomorphies: R4+5 vein setose on more than half way to crossvein r-m; abdominal discal setae on T3 and T4; sex patches present ventrally on T4 and T5; and S5 basal plate length less than or equal to 0.42 of the S5 total length. Finally, the genera *Euptilodegeeria* and *Myiodoriops* are separated from the *Erythromelana* genus by two synapomorphies: pregonites strongly curved and surstyli triangular-shaped, narrowed toward the apex.

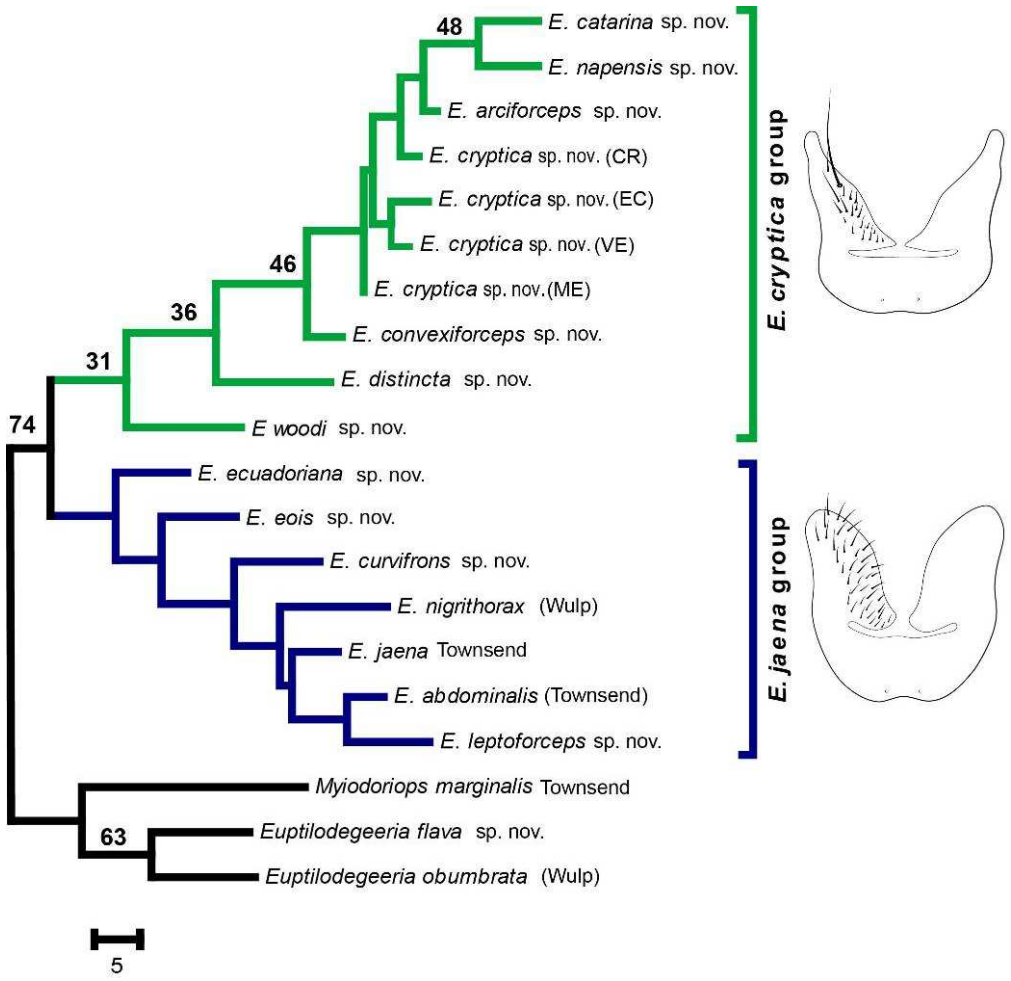


Figure 83. The most parsimonius tree based on the analysis of 56 morphological characters. The values above the branches refer to bootstrap values (from 1,000 replicates), only those greater than 30 are shown.

In this morphology-based phylogenetic reconstruction, two clusters of species within *Erythromelana* can be recognized, the *E. cryptica*, and *E. jaena* groups (see PCA section above), but these groups are supported by low bootstrap values (Fig. 83). There two synapomorphies in the male terminalia that divide these groups: Males in the *E. jaena* species group have the apical lobes of the sternite 5 rounded, with several small setae; and the cerci are dorsally flat on the medial section. In contrast, males in the *E. cryptica* species group have the apical lobe of the sternite 5 usually pointed, with a pair of

long, well-developed setae (rarely absent on *E. woodi*); and a slight dorsal depression on the medial section of the cerci. In particular, *E. woodi* appears intermediate in some ways, as some specimens lack the long setae on S5 and the abdominal coloration sometimes resembles the *E. jaena* species group. Thus, it's placement in the *E. cryptica* species group is a little tenuous. Additionally species relationships within these species groups remain unclear due to the low support of all these nodes.

The species *E. cryptica* was separated into four groups based on geographical location, (ME) Mexico, (CR) Costa Rica, (VE) Venezuela, and (EC) Ecuador, in order to analyze the morphological variation of these subgroups. In this analysis, *E. cryptica* is recovered as a paraphyletic group, but all branches are poorly supported by bootstrap analysis. All these specimens are united by a single synapomorphy in the male terminalia, where the cerci, in posterior view, are slightly carinate on the medial section of the posterior margin, and end in a nearly truncate tip. The main variation among these specimens is the wing coloration, the number of sucutal setae; and the ratios of head height and width to the body length, and pedicel length to flagellum length. Based on the genitalic synapomorphy of this species, I am considering the ME, CR, VE, and EC specimens as members of one species, *E. cryptica*, but it remains unclear whether the variation within this group is truly interspecific or intraspecific.

Phylogenetic analysis of molecular characters

Of the initial 66 specimens from which I extracted DNA, *COI* sequences of about 700 bp were only recovered for only 13 *Erythromelana* specimens, corresponding to five

males and eight females as shown in the Appendix 4. This low percentage of sequences recovered, is mostly due to the age of the samples that I used for DNA extraction because 91% and 64% of the sampled specimens were four and ten or more years old, respectively.

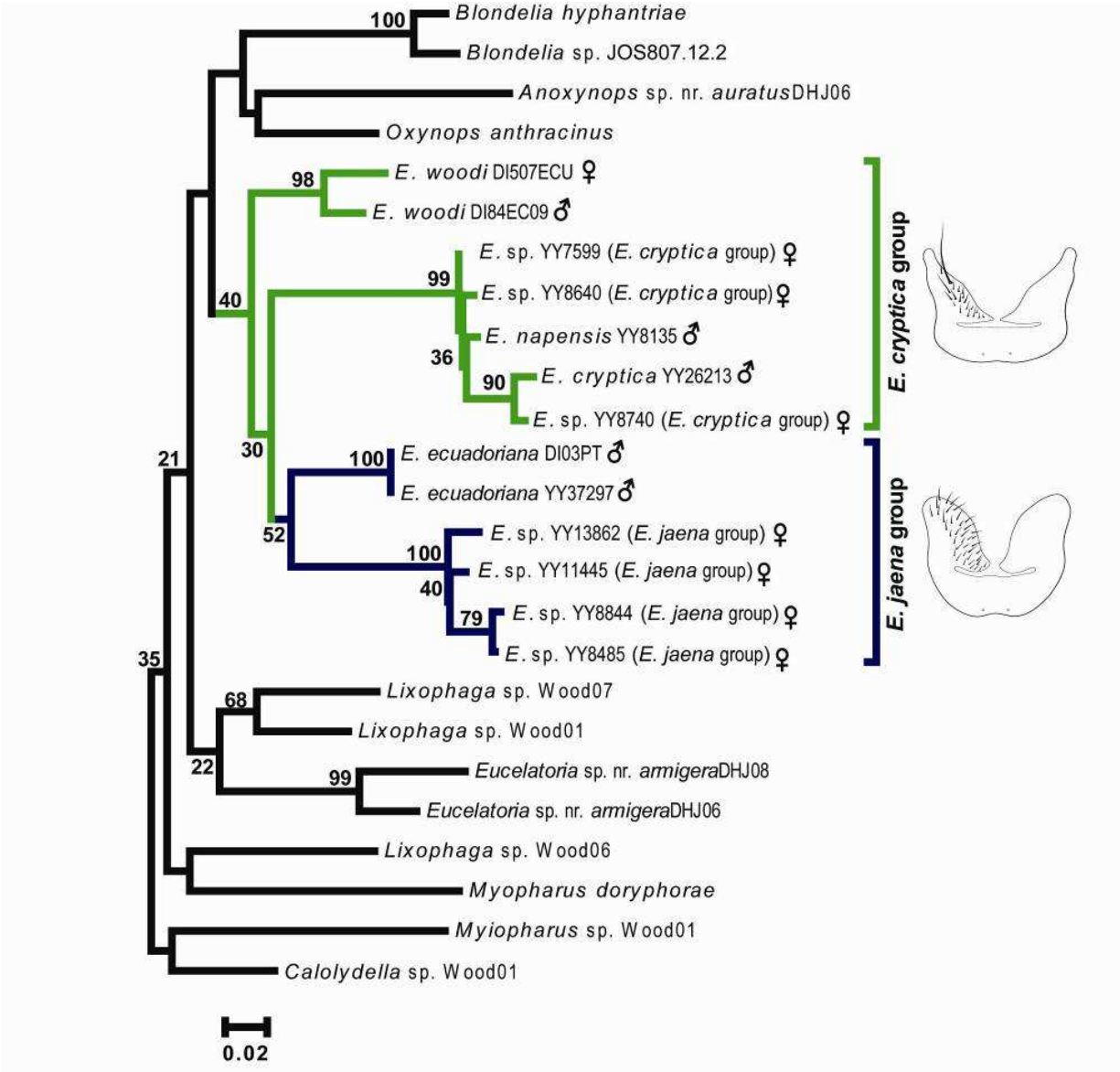


Figure 84. Maximum Likelihood tree for 12 Blondeliini and 13 *Erythromelana* COI sequences. The values above the branches refer to bootstrap values (from 500 replicates), only those greater than 20 are shown.

The maximum likelihood (ML) tree resulting from this analysis supports the monophyly of the genus *Erythromelana* (Fig. 84). However, bootstrap support for the genus is weak. *Erythromelana woodi* is placed as the most basal lineage of the genus, but this relationship is not strongly supported by a high bootstrap value. Three clusters of species within the genus can be recognized: *E. woodi*, *E. cryptica*, and *E. jaena*, although each of these groups are supported by low bootstrap values, 40, 30, and 52% respectively. The main difference between these relationships and those indicated by the morphological analysis is that the *E. cryptica* species group is monophyletic based on parsimony analysis of morphology and is recovered as paraphyletic in ML analyses of COI mtDNA sequences. However, in both analyses these groups are supported by low bootstrap values. Given this low bootstrap support and the lack of morphological characters that clearly separate *E. woodi* from the *E. cryptica* species group, I am considering *E. woodi* as a member of this species group.

The recognition of *Erythromelana* species based on COI mtDNA sequences depends on the percent divergence between lineages. Proponents of DNA barcoding have suggested a 3% COI divergence as the threshold for separation of Lepidoptera species (Hebert et al. 2003), but this threshold has been highly debated due to the greater intraspecific and lower interspecific variation observed in many several species (e.g. Whinnett et al. 2005, Meier et al. 2006). If a three percent divergence threshold is adopted to separate the 13 *Erythromelana* specimens sequenced in this study (using uncorrected "p" distances), seven species can be identified, four from the *E. cryptica* and three from the *E. jaena* species groups. For the *E. cryptica* species group, (1) *E. woodi*

DI84EC09 is 4.7% divergent from (2) *E. woodi* DI507ECU; (3) *E*. sp. YY7599, YY8640, and *E. napensis* YY8135 exhibit less than 1.5% sequence divergence from one another, and are 3.5% divergent from (4) *E. cryptica* YY26213 and *E.* sp. YY8740 (1.4% divergent). For the *E. jaena* species group, (5) *E. ecuadoriana* YY37297 is identical to DI03PT; (6) *E.* sp. YY13862 is 2.2% divergent from *E.* sp. YY11445; and (7) *E.* sp. YY8844 is almost identical (0.05%) to *E.* sp. YY8485. However, these "DNA species" are delineated by an arbitrary 3% COI divergence threshold and interpretations of these groups should be made with great caution.

The main distinction of these seven "DNA species" with the morphologically defined species involves the male and female of *E. woodi,* which morphologically are classified as a single species, but here are clearly different. Interestingly, I collected both of these specimens in the Ecuadorian Andes, but the female is from the western slope and the male is from the eastern slope (both at above 1,500m). In order to confirm this species divergence, more sequence data from males and females will be needed so that these molecular differences can be evaluated and correlated with morphological variation (see discussion section of *E. woodi* species description). In contrast to *E. woodi*, the DNA divergence of the species *E. ecuadoriana*, *E. napenis*, and *E. cryptica* corresponds to their classification based on morphological characters. This analysis indicates that *E*. sp. YY7599 and YY8640 are probably the females of *E. napensis*, and *E*. sp. YY8740 is likely a female of *E. cryptica*. However, as described in the species description of *E. cryptica*, females of the *E. cryptica* group (except on *E. distincta* and *E. woodi*) remain undescribed due to the lack of morphological characters to separate them and associate

them with their respective male species. Similarly, the two sets of females in the *E. jaena* species groups are morphologically similar to *E. jaena* and *E. abdominalis*, but there are differences in the shape of the palpi, where the specimens YY13862 and YY11445 have small and sparsely haired palpi and YY8844 and YY8485 have larger and apically almost bare palpi. However, I still cannot reliably associate which group of females correspond to *E. jaena* and *E. abdominalis* because I do not have any molecular sequence from males of these species. Given the moderate levels of sequence divergence within some the species recognized here (1-2%), it is possible that additional, morphologically cryptic species exist, but much more data would be needed to properly evaluate this possibility.

Within the outgroup Blondeliini included in our analysis, the genus *Erythromelana* appears to be closely related to a weakly supported cluster comprised of *Blondelia*, *Anoxynops*, and *Oxynops* (Fig. 84). It is unlikely that this genus is closely related to *Blondelia*, due to the presence of female piercer in this genus and distinctive male surstyli (Wood 1985). There are only two studies that have analyzed phylogenetic relationship of the Blondeliini, both including only a small number of taxa (Stireman 2002, Tachi & Shima 2010). These studies have suggested that the tribe is largely monophyletic, but relationships among genera within this group remain unknown. In order to assess and reconstruct the relationships and the position of *Erythromelana* within the Blondeliini more taxa and more data will be needed.

ERYTHROMELANA SPECIES RICHNESS AND DIVERSIFICATION

Despite the importance and diversity of tachinids, the ecology of most species in the family is poorly known or unknown (Stireman et al. 2006) and the genus *Erythromelana* is no the exception. Prior to this work, the only known information for this genus was restricted to the external morphology of three species; even their geographicdistribution and no host associations had been recorded in the literature. In this section, I use the available material (582 specimens) and host records (28) to evaluate potential modes of diversification of this genus.

Erythromelana host associations

After more than five years of inventorying caterpillars, the *Caterpillars and Parasitoids of the Eastern Andes in Ecuador* project has recorded more than 12,800 successful lepidopterans rearing events (Miller and Dyer 2009, Stireman et al. 2009). A total of 564 rearing events of adult tachinids have been obtained from 16 families of Lepidoptera, and preliminary identifications of these specimens suggest the existence of more than 200 tachinid species (Stireman et al. 2009; Stireman unpub. data.). Of these records, 28 *Erythromelana* specimens were reared from *Eois* spp. (Lepidoptera: Geometridae), and one specimen from an unknown pyralid larva (Lepidoptera: Pyralidae). Given the strong association of *Erythromelana* with *Eois* hosts, I suspect that this record may be an erroneous identification. Most of the caterpillars sampled at the site and day of collection of this pyralid-reared specimen were geometrids. The 28 *Erythomelana* specimens were reared from 24 caterpillars that were collected on host

plants in the genus *Piper,* two on the genus *Peperomia*, and one on the genus *Sarcorchachis* (*Piperaceae*); and a single specimen was reared from a caterpillar host in the genus *Siparuna* (Monimiaceae) (Table 2).

One problem in understanding insect diversity and host relationships of herbivores and parasitoids is the presence of large numbers of rare species (Novotny and Basset 2000). In the Ecuadorian lepidopteran and parasitoid inventory project mentioned above, with a total parasitism by tachinids of about 9% , more more than 50% of 150 morphospecies were represented by a single individual (Stireman et al 2009). In particular, *Erythromelana* appear to be extremely rare. From 5,810 successful *Eois* spp. rearing events with a total percent of parasitism of 8.2% (including Hymenoptera: *Braconidae* and *Ichneumonidae*), the percent of tachinid parasitism (e.g. *Eribella*, *Calolydella*, *Siphona*, *Eucelatoria*, *Phythomyptera*) is less than two percent, and the percent of *Erythromelana* parasitism is less than 0.5 percent. Additionally, I have sorted two years of monthly samples from malaise and pan traps that were located in the same area where these caterpillars were collected. Of over 2,000 individual tachinids collected from these traps only a single *Erythromelana* specimen was found. The extreme rarity of this species makes it difficult to analyze patterns of host associations given the limited sample size. Despite this, in the next section I provide a brief discussion of the *Erythromelana* host associations and what they suggest about the biology and diversification of this genus.

Table 2. *Erythromelana* species and morphospecies reared from areas surrounding YBS (Napo, Ecuador) with their respective caterpillar host-plants. (Specimen ID's represent unique numbers assigned to each rearing event).

***Erythromelana* parasitoids**		**Lepidoptera host**		**Host plant**	
Species	**Specimen ID**	**Family**	**Species**	**Family**	**Species**
E. curvifrons	14245	**Geometridae**	unknown	Monimiaceae	*Siparuna pyricarpa*
	11279		unknown	**Piperaceae**	*Piper* sp2
	11280		unknown		*Piper* sp2
E. jaena	14830		*Eois* sp.nr. *olivacea*		*Piper baezanum*
E. eois	16608		*Eois* spp.		*Piper* sp1
	9772		unknown		*Piper* cf. *schuppii*
E. ecuadoriana	10737		*Eois* spp.		*Sarcorhachis sydowi*
	37297		*Eois* spp.		*Piper* sp1
E. cryptica	26213		*Eois* sp.nr. *nigricosta*		*Piper hispidum*
	8740		*Eois* spp.		*Piper* sp3
E. napensis	8135		*Eois pallidicosta*		*Piper* sp1
	7599		*Eois pallidicosta*		*Piper* sp1
	8640		*Eois* spp.		*Piper baezanum*
E. sp. (*E. cryptica* group)	9763		*Eois* spp		*Piper* sp4
	9764		*Eois* spp		*Piper* sp4
	8512		*Eois pallidicosta*		*Piper* sp1
	8532		*Eois* spp.		*Piper baezanum*
	1813		*Eois* spp.		*Piper baezanum*
	7655		*Eois pallidicosta*		*Piper* cf schuppii
	12215		*Eois* spp.		*Piper baezanum*
	16758		*Eois* spp.		*Piper* sp4
	24562		*Eois* spp.		*Piper* sp3
E. sp. big palpi (*E. jaena* group)	10384		*Eois* spp.		*Peperomia* sp.
	8485		*Eois* spp.		*Peperomia* sp.
	8844		*Eois* spp.		*Piper* sp3
E. sp. small palpi (*E. jaena* group)	13861		*Eois pallidicosta*		*Piper* sp1
	13862		*Eois pallidicosta*		*Piper* sp1
	11445	Pyralidae	unknown		*Piper* cf. *schuppii*

Host specialization has been proven to be one of the major factors in species diversification (Schluter 2000). Specifically, specialization can increase genetic differentiation of populations by linking resource use and mate choice (e.g. Feder et al 1988, Hawthorne and Via 2001). Five *Erythromelana* species appear to be specialized on the genus *Eois* (Table 2). From these rearing records, *E. curvifrons* is the only species where the lepidopteran host genus remains unknown, although it is probably an *Eois* caterpillar or a closely related genus as it was identified as a Geometrid and was collected on the same host plant where *Eois* larvae usually feed. The specificity of *Erythromelana* species to particular *Eois* species remains unclear because most of the caterpillar records are identified only to genera. However, several *Erythromelana* species appear to

parasitize the same host species and it is likely that some parasitize several *Eois* species. For example, *E. napensis* and the two morphospecies, *E.* sp. *E. cryptica* group and *E. jaena* group specimens with small palpi, parasitize the same host species, *Eois pallidicosta* (Table 2). This suggests that *Erythromelana* are largely specialized on the genus *Eois*, but individual species probably use more than one *Eois* species. Therefore, it is unlikely that some form of host associated speciation by itself can explain the diversification of these *Erythromelana* species.

Shifts in host plant use have been suggested as an important mechanism of speciation in herbivorous insects (Bush 1975). Successful colonization of novel host plant species by phytophagous insects has been shown to result in a reduction in enemy attacks (e.g. Murphy 2004, Keeler and Chew 2008, Wiklund and Friberg 2008). *Eois* caterpillars have been reported to feed primarily on plants in the genus *Piper*, with recent colonizations of closely related genera in the Piperaceae (e.g. *Peperomia* and *Manekia*), and one species on *Siparuna pyricarpa* (Monimiaceae) (Strutzenberger et al. 2010). Here, *Erythromelana* seems to attack mostly *Eois* larvae that are feeding on *Piper* plants. *E. ecuadoriana* is the only species that have been reared from an *Eois* host that was feeding on *Sarcorhachis sydowi*. From a total of 23 *Eois* specimens reared from this host plant, only two parasitoids have been produced, one *Erythromelana* and one unknown parasitoid (probably a Hymenoptera parasitoid). This novel host plant may provide reduced parasitism in *Eois*, but the sample size is too small to test this hypothesis. Similarly, two specimens of the big papli *E. jaena* group morphospecies were reared from *Eois* larvae feeding on *Peperomia*, but I cannot speculate whether this host plant

shift is favored by enemy free space because there are only three successful rearing events of *Eois* from this host plant.

Host selection by parasitoids is regulated by a combination of olfactory, visual and chemosensory cues (Yamawaki and Kainoh 2005, Stireman et al. 2006). The parasitism of *Erythromelana* in *Eois* feeding on different host plants, suggest that this parasitoid is not restricted to cues from *Piper* host plants to locate their caterpillar host. It is likely that *Erythromelana* parasitoids are using a combination of visual host location, and chemosensory responses to recently damaged leaves and/or host frass. In general, more records of *Erythromelana* specimens from *Eois* feeding on different host plants need to be gathered to determine the significance of the tritrophic associations between *Erythromelana*, their *Eois* host caterpillars, and their piperaceous host plants.

Geographical patterns in *Erythromelana* richness

Species in the genus *Erythromelana* are broadly distributed across the Neotropical region. Specifically, specimens have been collected from ten different countries including Mexico, El Salvador, Costa Rica, Venezuela, Colombia, Ecuador, Peru, Bolivia, Argentina, and Brazil (Map 1). In general, the genus *Erythromelana* remains under sampled, as the fauna between Mexico and Costa Rica as well the fauna between southern Brazil and the Andes Mountains remains completely unknown. *Erythromelana* species occur in a variety of habitats ranging from lowland to montane tropical forest including both low elevations (e.g., Santa Catarina, Brazil, 300–500m) and high elevations (e.g., Napo, Ecuador 2000–2600m).

Given the parasitoid lifestyle of *Erythromelana*, their distribution could be associated in a tritrophic context corresponding to the distribution and diversity of their lepidopteran host and their host plants. The primary caterpillar host of *Erythromelana*, *Eois*, is widely distributed in the Neotropics, from Mexico to Argentina, where it comprises an important part of the geometrid fauna (Strutzenberger et al. 2010). *Eois* includes 205 Neotropical species, but estimates of the diversity of this genus suggest the existence of about 2,000 species in this region (Strutzenberger et al. 2010, Rodriguez-Castañeada et al. 2010). In particular, the bulk of *Eois* species diversity appears to occur in the Neotropical Montane regions (1,600-1,800m), where more than 500 species are estimated to occur (Rodriguez-Castañeada et al. 2010). Plants in the genus *Piper*, the predominant host of *Eois* caterpillars, exhibit similar patterns in their distribution and diversity. *Piper* species are widely distributed in the Neotropics, including about 700 described species (Jaramillo and Manos 2001). Similar to *Eois*, Pipers are highly diverse at mid elevations (1,600-1,800m), particularly in the Andes Mountains where there are at least 300 described species (Jaramillo and Manos 2001, Rodriguez-Castañeada et al. 2010). In summary, *Erythromelana*, *Eois*, and *Piper* genera are similarly distributed across the Neotropical region, and the Andes Mountains appear to be a hotspot of diversity in each of these genera.

Altitude appears to be a major factor in the distribution and diversification of *Erythromelana* species. *Erythromelana* species can be divided into species occurring only at low elevations (<1,000m), mid elevations (1,000-1,800m), and high elevations

(>1,800m). *E. catarina* appears to be restricted only to low elevations; where *E. convexiforceps*, *E. napensis*, *E. jaena*, *E. curvifrons*, *E. ecuadoriana*, and *E. eois* appear to be restricted only to high elevations. The species *E. arciforceps*, *E. distincta*, *E. leptoforceps*, and *E. nigrithorax* occur at both low and mid elevations; and *E. abdominals* and *E. woodi* occur at mid and high elevations. *E. cryptica* is the only species that have been collected in a wide range of elevations, from relatively low elevations in Costa Rica (700m) to high elevations in Ecuador (2,000-2600m). Overall, *Erythromelana* exhibits a lower species diversity in low elevations and higher diversity in mid and high elevations. The diversity of *Erythromelana* species across different altitudes correlates with the distribution of their caterpillar hosts. It has been estimated that the number of *Eois* species at low elevations is about 260 species, where in the high elevations it is about 570 species (Rodriguez-Castañeada et al. 2010).

Aside from differences in altitude, most of the *Erythromelana* species are found only in South America with a few species restricted only to Central America. For example, *E. convexiforceps* and *E. nigrithorax* have been collected only from southern Mexico and El Salvador. There are only two species, *E. woodi* and *E. cryptica*, that are widely distributed from Mexico to the Andes Mountains in South America. All the other species occur in South America, with *E. leptoforceps*, *E. napensis*, *E arciforceps*, and *E. distincta* found also in Costa Rica. This distribution suggests that *Erythromelana* probably originated in the Andes Mountains and expanded to Central America and the Amazon lowlands. The distribution and the position of *E. woodi* in the *Erythromelana* phylogeny (see Figs. 83, 84 and Map 8), suggests that this species may be the most basal

Erythromelana species that have dispersed from the Andes to Mexico radiating into the species found in Central America. This radiation of the genus could be related to the history of the rapid uplift of the Andes Mountains in South America and the Talamanca highlands in Central America. The current elevation of the Andes Mountains is the result of a rapid uplift that occurred during the last ten million years, whereas the Talamanca highlands rose within the last five million years (Hooghiemstra and van der Hammen 1998, Gregory-Wodzicki 2000, Grafe et al. 2002). These different uplift events, correlate with the diversification hypothesis that the Andes region is the center of diversity of *Erythromelana* and from there this genus radiated to Central America and the Amazon lowlands.

The Andes Mountains, with their great heterogeneity in high and low altitude ranges, represent one of the most biologically diverse regions on earth (Lomolino 2001, Molau 2004, Beck et al. 2008). Of the 14 *Erythromelana* species described in this revision, five species (*E. jaena*, *E.abdominalis*, *E.curvifrons*, *E. ecuadoriana*, and *E. eois*) appear to be restricted in distribution to the Andes Mountains. In addition, this Andean fauna includes all the species with yellow abdominal coloration. *E. woodi* is the only species that contains individuals ranging from mostly yellow to mostly black abdomens, but the specimens with mostly yellow abdomens are from the Andes and the specimens with black abdomens occur in Central America. In addition, the Andes Mountains with their varied topography and habitat heterogeneity could promote isolation of populations increasing the likelihood of differentiation among them. For example, I collected single female and male *E. woodi* specimens at approximately the

same latitude in Ecuador, but the female is from Mindo on the western slope and the male from is from YBS on the eastern slope of the Andes Mountains. These specimens are morphologically classified as a single species, but the molecular analysis suggests that they are probably different species (see phylogeny section Fig. 84). The lack of morphological differences between these specimens may represent the early geography-associated divergence of this species, where the eastern and western populations are isolated by the high Andean paramo. To confirm this hypothesis of the importance of geographic isolation in the Andes more specimens from these locations will be needed.

Species diversification summary

The five *Erythromelana* species of which I have rearing records (Table 2), suggest that species in this genus are specialized on caterpillars in the genus *Eois*, that primary feed on plants in the genus *Piper*. However, most *Erythromelana* species are probably not strictly specific on particular *Eois* species or *Piper* host plants. Therefore, it is unlikely that host-associated speciation by itself explains the diversificaton of these *Erythromelana* species. On the other hand, the distribution of *Erythromelana* species suggests that geographic separation of species (e.g., low vs. high elevation species, western vs. eastern Andean species, Central American vs. Andean species) is likely important in the diversification of this genus. However, large scale geographic isolation does not explain the relatively high diversity of species that coexist in the same habitat. For example, more than half of the known *Erythromelana* species (*E. jaena*, *E. abdominalis*, *E. eois*, *E. ecuadoriana*, *E. curvifrons*, *E. napensis*, *E. cryptica*, *E. woodi*) have been collected in the same location at YBS in Ecuador. I have host records for five

of these species, and they appear to broadly overlap in host use. Because of the absence of geographic and host differentiation, the factors that have led to divergence of these species remain mysterious. However, all of the hypotheses and ideas presented in this section are limited by the small number of rearing records, the lack of definitve host species identifications, and the bias in the relatively few collection sites used to estimate species distributions. Thus, conclusions and interpretations from this section should be viewed with some caution.

Appendix 1. Complete data set used for the PCA ordination by genera of 227 specimens based on the analysis of 62 morphological variables. The number of each variable corresponds to the sequential number of each character as stated on the method section.

Specimen ID	Genera	Sex	1	3 to 1	10 to 1	4 to 3	11 to 12	12 to 10	7 to 10	8 to 3	9 to 3	5 to 6	6 to 3	13 to 1	15 to 14	16 to 1	17	37	38	39	40	42	43	44	47
DI12CA	Euptilodegeeria	male	6.70	0.22	0.27	0.88	0.39	0.20	0.02	0.19	0.39	0.32	0.41	0.34	1.05	0.85	1	2	0	7	2	2	3	1	2
CR487039	Euptilodegeeria	male	7.50	0.23	0.29	0.85	0.30	0.18	0.03	0.21	0.37	0.28	0.41	0.35	1.09	0.85	0.75	2	0	9	2	2	3	1	3
CR546698	Euptilodegeeria	male	8.90	0.26	0.30	0.85	0.22	0.14	0.02	0.21	0.28	0.29	0.35	0.38	1.09	0.98	0.35	2	0	12	2	2	3	1	3
CR568485	Euptilodegeeria	male	6.90	0.26	0.32	0.89	0.32	0.20	0.03	0.36	0.35	0.23	0.49	0.31	1.20	0.86	0.75	1	1	8	2	2	3	1	2
DI106BM	Euptilodegeeria	male	6.50	0.25	0.31	0.88	0.25	0.20	0.02	0.20	0.31	0.34	0.43	0.39	1.35	0.86	0.75	1	1	9	2	1	3	1	2
DI98BM	Euptilodegeeria	male	6.90	0.24	0.31	0.87	0.30	0.19	0.03	0.21	0.35	0.34	0.39	0.35	1.27	0.88	0.75	1	1	9	2	2	3	1	3
DI105BM	Euptilodegeeria	male	7.00	0.23	0.28	0.87	0.24	0.17	0.03	0.22	0.34	0.34	0.43	0.35	1.88	0.90	0.75	1	1	10	2	1	3	1	3
DI109BM	Euptilodegeeria	male	7.10	0.24	0.29	0.87	0.26	0.19	0.03	0.19	0.36	0.34	0.41	0.38	1.26	0.92	0.75	1	1	10	2	1	3	1	3
DI104BM	Euptilodegeeria	male	6.60	0.24	0.30	0.89	0.26	0.19	0.03	0.19	0.30	0.34	0.44	0.33	1.24	0.92	0.75	1	1	10	2	1	3	1	3
DI97BM	Euptilodegeeria	male	7.10	0.24	0.29	0.86	0.30	0.19	0.03	0.22	0.44	0.32	0.44	0.38	1.56	0.90	0.75	1	1	9	2	1	3	1	3
DI107BM	Euptilodegeeria	female	6.10	0.27	0.33	0.85	0.32	0.25	0.03	0.22	0.34	0.36	0.40	0.43	0.77	0.95	0.75	1	1	6	2	2	3	1	3
DI108BM	Euptilodegeeria	female	7.00	0.24	0.30	0.85	0.28	0.24	0.03	0.26	0.35	0.33	0.42	0.37	0.94	0.87	0.75	1	1	5	2	1	3	1	3
DI240CA	Myiodoriops	male	5.50	0.26	0.32	0.85	0.30	0.23	0.03	0.08	0.26	0.37	0.38	0.38	1.12	0.87	0	2	0	7	3	2	3	1	3
DI243CA	Myiodoriops	male	5.20	0.27	0.33	0.87	0.26	0.22	0.04	0.10	0.27	0.36	0.40	0.39	1.18	0.90	0	2	0	6	3	2	3	1	3
DI73CA	Myiodoriops	male	5.80	0.24	0.30	0.86	0.28	0.21	0.05	0.13	0.25	0.32	0.41	0.37	1.33	0.83	0	2	0	5	3	2	3	1	3
DI241CA	Myiodoriops	male	5.50	0.25	0.31	0.87	0.29	0.20	0.04	0.13	0.27	0.33	0.40	0.38	1.24	0.87	0	2	0	6	3	3	3	1	3
DI131BM	Myiodoriops	male	5.10	0.25	0.30	0.87	0.25	0.21	0.04	0.16	0.30	0.31	0.46	0.37	1.36	0.84	0	2	0	8	3	2	3	1	3
DI130BM	Myiodoriops	female	5.00	0.26	0.33	0.85	0.43	0.25	0.02	0.15	0.28	0.28	0.44	0.40	0.88	0.90	0	2	0	6	3	1	3	1	3
DI134BM	Myiodoriops	female	4.50	0.27	0.35	0.85	0.40	0.26	0.03	0.12	0.31	0.29	0.39	0.40	0.76	0.89	0	2	0	7	3	1	3	1	3
DI124BM	Myiodoriops	female	5.10	0.26	0.33	0.83	0.30	0.27	0.04	0.15	0.27	0.31	0.44	0.41	0.67	0.84	0	2	0	5	3	1	3	1	3
DI236CA	Myiodoriops	female	4.53	0.28	0.35	0.87	0.29	0.27	0.04	0.16	0.27	0.36	0.40	0.40	0.82	0.81	0	2	0	5	3	1	3	1	3
DI239CA	Myiodoriops	female	3.90	0.29	0.34	0.88	0.28	0.27	0.04	0.09	0.27	0.35	0.41	0.38	0.80	0.81	0	2	0	4	2	1	3	1	3
DI74CA	Myiodoriops	female	4.20	0.29	0.36	0.83	0.33	0.24	0.04	0.12	0.28	0.30	0.45	0.43	0.64	0.83	0	2	0	5	3	1	3	1	3
DI215CA	Phyllophilopsis	female	5.40	0.26	0.34	0.94	0.37	0.21	0.02	0.11	0.31	0.23	0.49	0.41	0.67	0.96	0	2	0	3	2	1	3	2	3
DI216CA	Phyllophilopsis	female	6.00	0.25	0.32	0.92	0.33	0.22	0.03	0.15	0.30	0.22	0.49	0.42	0.75	0.92	0	2	0	4	2	0	3	2	2
DI212CA	Phyllophilopsis	male	8.00	0.23	0.28	1.06	0.33	0.11	0.02	0.14	0.26	0.23	0.48	0.34	1.28	0.91	0	2	0	17	0	1	3	2	3
DI214CA	Phyllophilopsis	male	7.20	0.24	0.29	0.93	0.46	0.11	0.02	0.12	0.26	0.23	0.45	0.38	1.24	0.92	0	2	0	15	0	0	3	2	3
DI211CA	Phyllophilopsis	male	7.50	0.24	0.28	0.94	0.36	0.11	0.03	0.13	0.26	0.20	0.47	0.34	1.25	0.89	0	2	0	14	0	0	3	2	3
CR357375	Erythromelana	female	5.80	0.29	0.36	0.88	0.35	0.19	0.02	0.12	0.37	0.24	0.45	0.40	0.80	0.93	0	1	0	4	2	1	3	1	1
CR415948	Erythromelana	female	6.20	0.27	0.33	0.88	0.35	0.20	0.03	0.17	0.37	0.27	0.45	0.39	0.75	0.95	0.5	1	1	5	2	1	3	1	1
DI171MW	Erythromelana	female	6.40	0.28	0.34	0.88	0.25	0.22	0.03	0.17	0.34	0.26	0.43	0.40	0.90	0.97	0	1	0	4	2	1	3	1	1
DI170MW	Erythromelana	female	6.80	0.26	0.33	0.88	0.32	0.23	0.03	0.16	0.34	0.29	0.43	0.40	0.79	0.99	0	1	0	5	1	1	3	1	1
CR138565	Erythromelana	female	5.70	0.29	0.36	0.90	0.30	0.20	0.02	0.15	0.35	0.26	0.42	0.43	0.89	0.97	0	1	0	4	2	1	3	1	1
DI422CA	Erythromelana	female	6.80	0.29	0.36	0.90	0.36	0.20	0.03	0.18	0.34	0.29	0.42	0.43	0.73	0.99	0	1	0	5	2	1	3	1	1
DI484CA	Erythromelana	female	6.00	0.27	0.33	0.88	0.32	0.22	0.03	0.15	0.35	0.28	0.45	0.37	0.76	0.93	0	1	0	5	2	1	3	1	1
DI439CA	Erythromelana	female	5.70	0.27	0.33	0.86	0.32	0.23	0.03	0.17	0.32	0.29	0.46	0.40	0.75	0.93	0	1	0	3	2	1	3	1	1
DI481CA	Erythromelana	female	7.30	0.27	0.33	0.89	0.35	0.19	0.03	0.14	0.33	0.26	0.44	0.39	0.80	0.96	0	1	0	4	2	1	3	1	1
DI391CA	Erythromelana	female	5.80	0.27	0.34	0.90	0.27	0.22	0.02	0.18	0.34	0.29	0.44	0.39	0.80	0.95	0	1	0	3	2	1	3	1	1
DI125BM	Erythromelana	female	5.00	0.29	0.36	0.82	0.44	0.28	0.06	0.14	0.29	0.26	0.48	0.44	0.60	0.90	0	2	0	5	2	1	3	2	1
DI126BM	Erythromelana	female	6.10	0.26	0.31	0.79	0.40	0.32	0.04	0.15	0.34	0.23	0.50	0.42	0.56	0.87	0	2	0	5	2	1	3	2	1
DI42CA	Erythromelana	female	6.20	0.27	0.34	0.89	3.10	0.20	0.02	0.14	0.36	0.31	0.43	0.37	0.77	0.94	0	1	0	6	2	1	3	1	1

Appendix 1. Continued

Specimen ID	Genera	Sex	51	48	52	49	50	54	55	56	58	61	45	46	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	83	84	85
DI12CA	Euptilodegeeria	male	2	2	4	2	2	3	1	3	0	0	3	2	3	1	0	2	0	0	1	2	2	2	3	3	2	2	2	2	0	1	2	2	0	1
CR487039	Euptilodegeeria	male	2	2	2	1	1	3	1	3	1	0	3	1	3	1	0	2	0	0	1	2	4	1	3	2	2	2	1	2	0	1	3	2	3	1
CR546698	Euptilodegeeria	male	2	2	2	1	2	3	1	2	1	0	3	2	3	1	0	2	0	0	1	2	4	3	3	3	3	2	2	2	0	1	3	2	1	1
CR568485	Euptilodegeeria	male	1	2	2	2	1	2	0	3	1	0	3	2	3	1	0	2	0	0	1	2	3	1	2	2	2	1	1	2	1	1	3	1	0	1
DI106BM	Euptilodegeeria	male	1	2	2	2	1	3	1	3	1	0	3	2	3	1	0	2	0	0	1	2	2	1	3	3	2	2	1	2	0	1	3	4	4	1
DI98BM	Euptilodegeeria	male	1	2	2	2	1	3	1	3	1	0	3	2	3	1	0	2	0	0	1	2	2	1	3	3	2	2	1	2	0	1	3	4	4	1
DI105BM	Euptilodegeeria	male	1	3	3	2	1	3	1	3	1	0	3	2	3	1	0	2	0	0	1	2	2	1	2	2	2	1	1	2	0	1	3	4	4	1
DI109BM	Euptilodegeeria	male	2	3	2	3	1	3	1	3	1	0	3	2	3	1	0	2	0	0	1	2	2	1	2	2	2	1	1	2	0	1	3	4	3	1
DI104BM	Euptilodegeeria	male	2	3	3	1	1	3	1	3	1	0	3	2	3	1	0	2	0	0	1	2	2	1	3	3	2	2	1	2	0	1	3	4	3	1
DI97BM	Euptilodegeeria	male	2	2	2	2	1	3	1	3	1	0	3	2	3	1	0	2	0	0	1	2	2	1	2	2	2	1	1	2	0	1	3	4	4	1
DI107BM	Euptilodegeeria	female	3	2	2	2	1	2	0	3	1	0	3	2	3	1	0	2	0	0	1	2	2	1	1	1	1	1	1	2	0	1	3	4	0	1
DI108BM	Euptilodegeeria	female	2	3	3	3	1	3	1	3	1	0	3	2	3	1	2	0	0	0	1	2	2	1	1	1	1	1	1	2	0	1	3	4	0	1
DI240CA	Myiodoriops	male	3	2	3	2	1	3	1	2	1	0	3	1	3	1	0	2	0	0	1	2	2	1	1	1	1	1	1	1	0	2	5	2	0	1
DI243CA	Myiodoriops	male	3	2	3	2	1	3	1	2	1	0	3	1	3	1	0	2	0	0	1	2	2	1	1	1	1	1	1	1	0	2	2	2	0	1
DI73CA	Myiodoriops	male	3	2	3	2	1	3	1	2	1	1	3	2	3	1	0	2	0	0	1	2	2	1	1	1	1	1	1	1	0	2	5	2	0	1
DI241CA	Myiodoriops	male	3	2	3	2	1	3	1	2	1	0	3	1	3	1	0	2	0	0	1	3	2	1	1	1	1	1	1	1	0	2	5	1	0	1
DI131BM	Myiodoriops	male	3	2	3	2	1	3	1	2	1	0	2	2	3	1	0	2	0	0	1	2	2	1	1	1	1	1	1	1	0	2	3	1	0	1
DI130BM	Myiodoriops	female	3	2	3	1	1	3	1	2	1	0	3	1	3	1	0	2	0	0	1	2	2	3	3	3	2	2	2	1	0	2	4	2	0	1
DI134BM	Myiodoriops	female	3	2	3	2	1	3	1	2	1	0	3	1	3	1	0	2	0	0	1	2	2	1	1	1	1	1	1	1	0	2	4	2	0	1
DI124BM	Myiodoriops	female	3	3	4	2	2	3	1	2	1	0	2	2	3	1	0	2	0	0	1	3	2	1	1	1	1	1	1	1	0	2	4	2	0	1
DI236CA	Myiodoriops	female	3	2	3	2	1	3	1	2	1	0	2	2	3	1	0	2	0	0	1	2	2	1	1	1	1	1	1	1	0	2	4	2	0	1
DI239CA	Myiodoriops	female	3	2	3	2	1	3	1	2	1	1	2	2	3	1	0	2	0	0	1	3	2	1	1	1	1	1	1	1	0	2	4	3	0	1
DI74CA	Myiodoriops	female	3	2	3	2	1	3	1	2	1	1	3	1	3	1	0	2	0	0	1	2	2	1	1	1	1	1	1	1	0	2	4	1	0	1
DI215CA	Phyllophilopsis	female	0	3	3	1	1	3	1	2	0	1	3	2	2	0	0	4	0	0	0	2	3	1	2	2	1	1	1	1	0	1	3	3	0	2
DI216CA	Phyllophilopsis	female	0	3	3	2	1	3	1	2	0	1	3	2	2	0	0	4	0	0	0	2	3	1	2	2	1	1	1	1	0	1	3	3	0	2
DI212CA	Phyllophilopsis	male	0	3	3	2	1	2	0	2	0	1	3	2	2	0	0	4	0	0	0	2	3	2	3	3	3	2	2	1	0	1	2	3	0	2
DI214CA	Phyllophilopsis	male	0	3	3	3	1	2	0	2	0	0	3	2	2	0	0	4	0	0	0	2	2	2	3	3	2	2	2	1	0	1	2	3	0	2
DI211CA	Phyllophilopsis	male	0	3	4	2	1	2	0	2	0	0	3	2	2	0	0	4	0	0	0	2	1	2	3	3	2	1	2	1	0	1	2	3	0	1
CR357375	Erythromelana	female	1	2	4	2	2	3	1	3	0	0	3	1	3	1	0	2	0	0	1	3	3	1	2	2	2	1	1	1	0	1	3	2	2	1
CR415948	Erythromelana	female	1	2	2	1	1	2	0	3	0	0	2	2	3	1	0	2	0	0	1	2	4	1	2	2	2	2	1	1	0	1	3	2	2	1
DI171MW	Erythromelana	female	1	2	4	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	2	2	2	1	0	1	4	2	2	1
DI170MW	Erythromelana	female	1	2	4	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	0	1	4	2	2	1
CR138565	Erythromelana	female	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	5	2	1	2	2	2	1	1	1	0	1	3	2	2	1
DI422CA	Erythromelana	female	1	2	4	2	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	4	4	2	3	3	3	2	2	1	0	1	3	2	2	1
DI484CA	Erythromelana	female	1	2	4	2	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	2	2	3	3	2	2	2	1	0	1	4	2	2	1
DI439CA	Erythromelana	female	1	2	4	2	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	2	1	2	1	0	1	3	2	2	1
DI481CA	Erythromelana	female	1	2	4	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	4	3	2	3	3	2	2	2	1	0	1	4	2	2	1
DI391CA	Erythromelana	female	1	2	4	2	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	2	2	2	1	0	1	3	2	2	1
DI125BM	Erythromelana	female	2	3	5	3	1	2	0	3	1	1	3	1	3	1	0	2	0	0	1	3	2	2	3	3	3	2	2	1	0	1	4	2	0	1
DI126BM	Erythromelana	female	2	2	3	3	2	2	0	3	1	0	3	1	3	1	0	2	0	0	1	3	2	1	2	2	2	1	1	1	0	1	4	2	0	1
DI42CA	Erythromelana	female	1	2	4	2	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	2	2	3	3	3	2	2	1	0	1	3	2	2	1

Appendix 1. Continued

Specimen ID	Genera	Sex	1	3 to 1	10 to 1	4 to 3	11 to 12	12 to 10	7 to 10	8 to 3	9 to 3	5 to 6	6 to 3	13 to 1	15 to 14	16 to 1	17	37	38	39	40	42	43	44	47
DI45CA	Erythromelana	female	5.90	0.29	0.36	0.91	0.30	0.19	0.02	0.14	0.34	0.28	0.46	0.41	0.73	0.97	0	1	0	5	2	1	3	1	1
DI504CA	Erythromelana	female	6.40	0.28	0.34	0.89	0.36	0.20	0.03	0.12	0.34	0.25	0.44	0.40	0.71	1.02	0	1	0	3	2	1	3	1	1
DI478CA	Erythromelana	female	6.60	0.30	0.36	0.88	0.43	0.18	0.03	0.15	0.37	0.23	0.45	0.41	0.82	0.99	0	1	0	4	2	1	3	1	1
DI175MW	Erythromelana	female	7.10	0.28	0.34	0.86	0.32	0.21	0.03	0.18	0.35	0.28	0.40	0.43	0.85	1.07	0	1	0	4	1	1	3	1	1
DI197MW	Erythromelana	female	5.60	0.29	0.36	0.90	0.33	0.21	0.02	0.13	0.34	0.27	0.43	0.39	0.75	0.95	0	1	0	5	2	1	3	1	1
DI196MW	Erythromelana	female	7.30	0.28	0.35	0.89	0.39	0.20	0.02	0.17	0.31	0.27	0.44	0.42	0.74	1.00	0	1	0	4	2	1	3	1	1
DI174MW	Erythromelana	female	6.40	0.26	0.52	0.88	0.35	0.14	0.02	0.16	0.35	0.30	0.45	0.38	0.82	0.92	0	1	0	4	2	1	3	1	1
DI195MW	Erythromelana	female	6.70	0.28	0.35	0.92	0.32	0.19	0.03	0.15	0.37	0.31	0.39	0.39	0.75	0.93	0	1	1	5	1	1	3	1	1
YY1813	Erythromelana	female	6.60	0.25	0.32	0.84	0.30	0.22	0.03	0.15	0.34	0.26	0.42	0.38	0.71	0.97	0	1	1	5	1	1	3	1	1
YY8640	Erythromelana	female	6.30	0.29	0.35	0.86	0.32	0.20	0.03	0.14	0.32	0.25	0.44	0.40	0.65	1.03	0	1	1	5	1	1	3	1	1
YY16758	Erythromelana	female	6.60	0.26	0.31	0.86	0.32	0.24	0.03	0.15	0.38	0.30	0.43	0.39	0.80	0.99	0	1	1	6	2	1	0	1	1
YY9763	Erythromelana	female	5.90	0.28	0.34	0.85	0.24	0.21	0.03	0.17	0.38	0.27	0.45	0.52	0.83	1.02	0	1	1	4	1	1	3	1	1
YY8740	Erythromelana	female	6.00	0.27	0.32	0.88	0.30	0.21	0.02	0.16	0.28	0.29	0.43	0.47	0.83	0.97	0.35	1	1	4	1	1	3	1	1
YY7599	Erythromelana	female	7.00	0.26	0.31	0.89	0.25	0.22	0.03	0.17	0.31	0.27	0.41	0.37	0.80	0.93	0	1	1	5	1	1	0	1	1
YY9764	Erythromelana	female	5.80	0.29	0.34	0.82	0.24	0.21	0.03	0.18	0.32	0.26	0.45	0.40	0.75	1.02	0	1	1	5	1	1	3	1	1
YY7655	Erythromelana	female	6.40	0.26	0.31	0.87	0.38	0.24	0.03	0.17	0.31	0.27	0.45	0.37	0.70	0.97	0	1	1	6	1	1	3	1	1
YY24562	Erythromelana	female	6.60	0.26	0.29	0.88	0.23	0.23	0.01	0.08	0.27	0.28	0.42	0.34	0.67	0.99	0	1	0	4	1	1	3	1	1
CR577875	Erythromelana	female	6.90	0.28	0.35	0.88	0.33	0.20	0.03	0.16	0.35	0.30	0.45	0.41	0.83	0.97	0	1	1	7	1	1	3	1	1
DI489CA	Erythromelana	male	5.90	0.27	0.32	0.89	0.29	0.15	0.03	0.15	0.35	0.31	0.40	0.36	1.11	0.97	0	1	1	7	2	1	3	1	1
DI25CA	Erythromelana	male	6.60	0.28	0.32	0.88	0.25	0.15	0.03	0.14	0.34	0.28	0.43	0.39	1.15	0.94	0	1	1	8	2	1	3	1	1
DI83NM	Erythromelana	male	7.10	0.26	0.31	0.88	0.29	0.15	0.02	0.20	0.33	0.26	0.46	0.39	1.25	0.86	0	1	1	9	2	1	3	1	1
DI473CA	Erythromelana	male	7.00	0.27	0.32	0.90	0.19	0.14	0.03	0.16	0.32	0.28	0.42	0.37	1.36	0.93	0	1	1	9	2	1	3	1	1
DI53CA	Erythromelana	male	7.00	0.26	0.26	0.90	0.25	0.17	0.03	0.14	0.33	0.30	0.40	0.39	1.19	0.94	0	1	1	8	2	1	3	1	1
DI501CA	Erythromelana	male	6.80	0.25	0.30	0.86	0.20	0.15	0.03	0.15	0.33	0.30	0.44	0.35	1.35	1.02	0	1	1	6	2	1	3	1	1
DI189MW	Erythromelana	male	6.90	0.27	0.32	0.89	0.25	0.15	0.03	0.17	0.29	0.26	0.45	0.37	1.16	0.87	0	1	1	7	2	1	3	1	1
DI190MW	Erythromelana	male	7.70	0.25	0.30	0.88	0.24	0.15	0.03	0.17	0.31	0.31	0.43	0.36	1.33	0.94	0	1	1	7	2	1	3	1	1
DI191MW	Erythromelana	male	7.00	0.26	0.31	0.88	0.25	0.15	0.03	0.17	0.31	0.25	0.44	0.37	1.19	0.96	0	1	1	8	2	1	3	1	1
DI178MW	Erythromelana	male	7.50	0.25	0.30	0.86	0.25	0.18	0.03	0.19	0.32	0.29	0.41	0.28	1.21	0.97	0	1	1	8	3	1	3	1	1
DI176MW	Erythromelana	male	6.20	0.26	0.31	0.88	0.27	0.16	0.02	0.16	0.34	0.32	0.39	0.38	1.45	1.00	0	1	1	8	2	1	3	1	1
DI497CA	Erythromelana	male	7.10	0.24	0.29	0.88	0.25	0.15	0.02	0.16	0.35	0.28	0.42	0.35	1.29	0.93	0	1	1	10	2	1	3	1	1
DI475CA	Erythromelana	male	6.10	0.30	0.35	0.98	0.21	0.13	0.02	0.14	0.28	0.26	0.42	0.42	1.26	0.98	0	1	1	8	2	1	3	1	1
DI474CA	Erythromelana	male	6.90	0.26	0.32	0.88	0.25	0.14	0.02	0.14	0.32	0.25	0.44	0.35	1.21	0.91	0	1	1	8	2	1	3	1	1
DI84NM	Erythromelana	male	5.90	0.27	0.32	0.87	0.23	0.14	0.03	0.15	0.30	0.29	0.44	0.41	1.15	1.00	0	1	1	8	2	1	3	1	1
DI87NM	Erythromelana	male	6.90	0.26	0.30	0.88	0.21	0.14	0.02	0.15	0.34	0.27	0.42	0.38	1.22	0.91	0	1	1	8	2	1	3	1	1
CR568018	Erythromelana	male	7.60	0.27	0.32	0.88	0.24	0.14	0.02	0.17	0.34	0.28	0.39	0.40	1.17	0.99	0	1	1	8	2	1	3	1	1
CR932348	Erythromelana	male	6.10	0.29	0.38	0.89	0.24	0.15	0.02	0.16	0.38	0.31	0.45	0.41	1.21	0.85	0	1	1	6	2	1	3	1	1
DI92MW	Erythromelana	male	6.60	0.26	0.32	0.87	0.29	0.13	0.03	0.17	0.35	0.28	0.42	0.39	1.15	0.97	0	1	1	7	2	1	3	1	1
DI94NM	Erythromelana	male	6.20	0.26	0.30	0.88	0.31	0.14	0.02	0.14	0.30	0.26	0.44	0.36	1.16	0.92	0	1	1	7	2	1	3	1	1
DI90NM	Erythromelana	male	7.40	0.26	0.31	0.86	0.24	0.15	0.03	0.16	0.31	0.30	0.41	0.39	1.18	0.95	0	1	1	9	2	1	3	1	1
CR110787	Erythromelana	male	7.10	0.28	0.33	0.88	0.27	0.13	0.03	0.14	0.30	0.28	0.40	0.41	1.40	1.01	0	1	1	7	2	1	0	1	1
YY8532	Erythromelana	male	6.30	0.28	0.33	0.87	0.25	0.15	0.03	0.16	0.29	0.34	0.37	0.39	0.87	0.95	0	1	1	8	2	1	0	1	1
DI392CA	Erythromelana	male	5.80	0.26	0.31	0.90	0.27	0.17	0.02	0.12	0.29	0.28	0.42	0.34	1.21	0.86	0	1	1	7	2	1	3	1	1
DI91NM	Erythromelana	male	6.60	0.26	0.30	0.87	0.27	0.15	0.03	0.19	0.32	0.29	0.40	0.37	1.36	0.92	0	1	1	8	2	1	3	1	1

Appendix 1. Continued

Specimen ID	Genera	Sex	51	48	52	49	50	54	55	56	58	61	45	46	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	83	84	85
DI45CA	Erythromelana	female	1	2	4	2	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	1	2	2	2	1	1	1	0	1	4	2	2	1
DI504CA	Erythromelana	female	1	2	4	2	1	3	1	4	0	0	2	2	3	1	0	2	0	0	1	5	3	1	2	2	2	1	2	1	0	1	2	2	2	1
DI478CA	Erythromelana	female	3	2	4	2	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	2	2	2	1	0	1	3	2	2	1
DI175MW	Erythromelana	female	1	2	4	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	2	2	3	3	3	2	2	1	0	1	2	0	2	1
DI197MW	Erythromelana	female	1	2	4	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	2	1	2	1	1	1	1	1	0	1	3	2	2	1
DI196MW	Erythromelana	female	1	2	4	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	4	2	2	2	2	1	1	1	0	1	4	2	2	1
DI174MW	Erythromelana	female	1	2	4	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	2	2	3	3	3	2	2	1	0	1	4	2	2	1
DI195MW	Erythromelana	female	2	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	4	2	2	2	1	1	1	1	0	1	3	2	2	1
YY1813	Erythromelana	female	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	2	1	2	2	2	1	1	1	0	1	4	1	2	1
YY8640	Erythromelana	female	1	2	4	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	1	3	3	2	1	1	1	0	1	4	2	2	1
YY16758	Erythromelana	female	1	2	3	1	1	2	0	3	0	0	3	1	3	1	0	2	0	0	1	2	3	1	3	3	3	1	1	1	0	1	4	2	2	1
YY9763	Erythromelana	female	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	2	1	1	1	1	1	1	1	0	1	4	1	2	1
YY8740	Erythromelana	female	1	2	3	1	1	2	0	3	0	0	2	2	3	1	0	2	0	0	1	2	3	1	1	2	1	1	1	1	0	1	3	1	2	1
YY7599	Erythromelana	female	1	2	3	1	1	3	1	3	0	1	2	2	3	1	0	2	0	0	1	2	3	1	2	2	1	1	1	1	0	1	4	1	2	1
YY9764	Erythromelana	female	1	2	2	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	1	1	1	1	1	1	1	0	1	4	2	2	1
YY7655	Erythromelana	female	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	1	3	3	3	2	2	1	0	1	4	2	2	1
YY24562	Erythromelana	female	1	2	2	1	1	2	0	3	0	0	2	2	3	1	0	2	0	0	1	2	4	1	1	1	1	1	1	1	0	1	3	2	2	1
CR577875	Erythromelana	female	1	2	3	1	1	3	1	3	0	0	3	1	3	1	0	2	0	0	1	2	3	1	2	2	2	1	1	1	0	1	4	2	2	1
DI489CA	Erythromelana	male	0	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI25CA	Erythromelana	male	0	2	3	1	1	3	1	3	0	0	2	2	2	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI83NM	Erythromelana	male	0	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	4	4	1	3	3	2	1	1	1	0	1	3	2	2	1
DI473CA	Erythromelana	male	2	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	1	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI53CA	Erythromelana	male	2	2	2	1	1	3	1	3	0	0	2	2	2	1	0	2	0	0	1	5	3	2	3	3	2	2	2	1	0	1	3	2	2	1
DI501CA	Erythromelana	male	1	2	3	1	1	2	0	3	0	0	2	2	2	1	0	2	0	0	1	2	3	2	2	3	2	2	2	1	0	1	3	2	2	1
DI189MW	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	1	3	3	2	2	2	1	0	1	3	2	2	1
DI190MW	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	3	1	2	2	2	2	1	1	0	1	3	2	2	1
DI191MW	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	5	3	1	2	2	2	1	1	1	0	1	3	2	2	1
DI178MW	Erythromelana	male	1	3	3	1	2	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI176MW	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	3	2	1	1	0	1	3	2	2	1
DI497CA	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI475CA	Erythromelana	male	1	2	3	2	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	3	2	3	3	2	2	2	1	0	1	3	2	2	1
DI474CA	Erythromelana	male	2	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI84NM	Erythromelana	male	2	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI87NM	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	1	1	1	2	3	2	3	3	3	2	2	1	1	1	3	2	2	1
CR568018	Erythromelana	male	2	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	1	4	2	3	3	2	2	2	1	0	1	3	2	2	1
CR932348	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	4	2	2	3	3	2	2	2	1	0	1	3	2	2	1
DI92MW	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	4	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI94NM	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI90NM	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	4	4	2	3	3	2	2	2	1	0	1	3	2	2	1
CR110787	Erythromelana	male	2	2	2	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	3	1	2	3	2	2	2	1	1	1	3	2	2	1
YY8532	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	1	1	2	1	1	1	1	0	1	3	1	2	1
DI392CA	Erythromelana	male	0	2	2	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI91NM	Erythromelana	male	1	2	4	1	1	3	1	3	0	0	3	1	3	1	0	2	0	0	1	2	3	2	3	3	3	2	3	1	0	1	3	2	0	1

Appendix 1. Continued

Specimen ID	Genera	Sex	1	3 to 1	10 to 1	4 to 3	11 to 12	12 to 10	7 to 10	8 to 3	9 to 3	5 to 6	6 to 3	13 to 1	15 to 14	16 to 1	17	37	38	39	40	42	43	44	47
DI500CA	Erythromelana	male	7.10	0.25	0.29	0.89	0.25	0.15	0.03	0.14	0.34	0.27	0.42	0.27	1.21	0.92	0	1	1	8	2	1	3	1	1
DI31CA	Erythromelana	male	6.50	0.25	0.28	0.83	0.35	0.22	0.04	0.22	0.34	0.29	0.46	0.36	1.08	0.92	0	1	1	6	2	1	3	1	1
DI206MW	Erythromelana	male	6.80	0.26	0.31	0.86	0.25	0.15	0.03	0.15	0.25	0.29	0.39	0.39	1.16	0.96	0	1	1	10	2	1	3	1	1
CR938508	Erythromelana	male	7.20	0.26	0.32	0.89	0.27	0.13	0.02	0.18	0.33	0.28	0.42	0.40	1.32	0.94	0	1	1	8	2	1	3	1	1
DI414CA	Erythromelana	male	7.90	0.26	0.30	0.88	0.26	0.16	0.03	0.18	0.30	0.28	0.39	0.41	1.07	0.96	0	1	1	9	2	1	3	1	1
DI120BM	Erythromelana	male	7.90	0.26	0.31	0.89	0.20	0.16	0.02	0.14	0.27	0.33	0.39	0.39	1.24	0.85	0	1	1	8	2	1	3	1	1
CR550825	Erythromelana	male	7.00	0.26	0.31	0.88	0.25	0.15	0.02	0.17	0.36	0.28	0.43	0.40	1.21	0.93	0	1	1	9	2	1	3	1	1
YY8135	Erythromelana	male	7.00	0.26	0.31	0.87	0.33	0.17	0.02	0.16	0.28	0.31	0.39	0.40	1.11	1.01	0	1	1	9	2	1	0	1	1
DI408CA	Erythromelana	male	5.90	0.28	0.33	0.89	0.27	0.16	0.03	0.19	0.33	0.27	0.42	0.37	0.92	0.90	0	1	1	7	2	1	3	1	1
DI460CA	Erythromelana	male	6.10	0.27	0.33	0.89	0.24	0.17	0.02	0.17	0.36	0.27	0.46	0.39	1.09	0.87	0	1	1	6	2	1	3	1	1
DI410CA	Erythromelana	male	5.80	0.27	0.32	0.87	0.27	0.16	0.02	0.14	0.30	0.29	0.45	0.37	1.05	0.90	0	1	1	5	2	1	3	1	1
DI452CA	Erythromelana	male	5.90	0.26	0.32	0.91	0.31	0.17	0.02	0.17	0.31	0.30	0.43	0.35	1.25	0.81	0	1	1	6	2	1	3	1	1
DI472CA	Erythromelana	male	6.90	0.26	0.32	0.90	0.20	0.14	0.02	0.16	0.28	0.26	0.44	0.36	1.36	0.88	0	1	1	7	2	1	3	1	1
DI37CA	Erythromelana	male	6.90	0.27	0.32	0.88	0.20	0.14	0.02	0.16	0.31	0.28	0.42	0.37	1.31	0.91	0	1	1	9	2	1	3	1	1
DI173MW	Erythromelana	male	7.30	0.25	0.29	0.88	0.25	0.15	0.03	0.15	0.33	0.31	0.39	0.37	1.28	1.00	0	1	1	8	2	1	3	1	1
CR955711	Erythromelana	male	6.00	0.30	0.35	0.90	0.27	0.14	0.02	0.11	0.27	0.27	0.42	0.41	1.18	0.97	0	1	1	6	2	1	3	1	1
DI477CA	Erythromelana	male	7.00	0.27	0.31	0.89	0.19	0.15	0.02	0.16	0.33	0.25	0.43	0.40	1.30	0.89	0	1	1	10	2	1	3	1	1
DI488CA	Erythromelana	male	7.70	0.24	0.29	0.86	0.28	0.16	0.03	0.25	0.36	0.30	0.43	0.37	1.29	0.91	0	1	1	10	2	1	3	1	1
DI476CA	Erythromelana	male	6.50	0.27	0.32	0.90	0.29	0.14	0.02	0.15	0.28	0.24	0.43	0.37	1.20	0.89	0	1	1	9	2	1	3	1	1
DI16CA	Erythromelana	male	8.00	0.24	0.29	0.91	0.24	0.15	0.03	0.12	0.32	0.29	0.39	0.34	1.21	0.90	0	1	1	8	2	1	3	1	1
CR536979	Erythromelana	male	7.00	0.26	0.32	0.88	0.20	0.13	0.02	0.17	0.30	0.26	0.42	0.38	1.24	0.90	0	1	1	8	2	1	3	1	1
DI27CA	Erythromelana	male	7.40	0.25	0.29	0.88	0.27	0.14	0.03	0.15	0.33	0.26	0.41	0.36	1.29	0.87	0	1	1	9	2	1	3	1	1
DI20CA	Erythromelana	male	6.90	0.24	0.30	0.90	0.27	0.15	0.02	0.15	0.28	0.31	0.39	0.34	1.14	0.90	0	1	1	8	2	1	3	1	1
DI36CA	Erythromelana	male	7.00	0.27	0.31	0.90	0.20	0.14	0.03	0.14	0.30	0.25	0.43	0.36	1.19	0.84	0	1	1	8	2	1	3	1	1
YY26213	Erythromelana	male	7.40	0.24	0.29	0.84	0.27	0.14	0.03	0.21	0.34	0.29	0.42	0.32	1.07	0.89	0	1	1	9	2	1	3	1	1
DI52CA	Erythromelana	male	6.80	0.25	0.31	0.91	0.21	0.14	0.02	0.16	0.35	0.31	0.41	0.35	1.04	0.84	0	1	1	7	2	1	3	1	1
DI85NM	Erythromelana	male	8.30	0.26	0.31	0.88	0.29	0.13	0.03	0.16	0.26	0.28	0.40	0.39	1.25	0.99	0	1	1	8	2	1	3	1	1
DI51CA	Erythromelana	male	6.30	0.28	0.32	0.89	0.33	0.15	0.03	0.16	0.29	0.28	0.41	0.36	1.35	0.91	0	1	1	8	2	1	3	1	1
DI118BM	Erythromelana	male	7.30	0.26	0.30	0.90	0.20	0.14	0.03	0.19	0.30	0.27	0.39	0.38	1.41	0.88	0	1	1	9	2	1	3	1	1
DI54CA	Erythromelana	male	7.00	0.25	0.31	0.92	0.23	0.12	0.02	0.16	0.33	0.28	0.40	0.37	1.18	0.93	0	1	1	6	2	1	3	1	2
DI164NM	Erythromelana	male	5.40	0.27	0.33	0.89	0.37	0.21	0.02	0.21	0.34	0.29	0.48	0.39	0.91	0.80	0	1	0	6	2	1	3	1	2
DI341CA	Erythromelana	male	5.50	0.26	0.32	0.90	0.42	0.22	0.02	0.14	0.38	0.26	0.54	0.35	0.87	0.82	0	2	0	5	2	1	3	1	2
DI342CA	Erythromelana	male	5.40	0.26	0.30	0.86	0.35	0.24	0.02	0.19	0.34	0.21	0.54	0.39	0.71	0.82	0	2	0	6	2	1	3	1	2
DI280CA	Erythromelana	male	5.60	0.27	0.32	0.89	0.39	0.20	0.02	0.24	0.28	0.23	0.59	0.36	0.85	0.84	0	2	0	6	2	1	3	1	2
DI343CA	Erythromelana	male	5.60	0.26	0.33	0.90	0.41	0.19	0.02	0.16	0.30	0.23	0.53	0.37	0.77	0.79	0	2	0	6	2	1	3	1	2
DI340CA	Erythromelana	male	5.70	0.25	0.31	0.89	0.50	0.20	0.02	0.17	0.30	0.24	0.52	0.36	0.71	0.79	0	2	0	7	1	1	3	1	2
DI296CA	Erythromelana	male	5.70	0.26	0.32	0.92	0.30	0.22	0.02	0.20	0.27	0.24	0.51	0.37	0.63	0.83	0	1	0	6	2	1	3	1	2
DI328CA	Erythromelana	male	5.50	0.25	0.32	0.87	0.45	0.23	0.02	0.19	0.29	0.26	0.55	0.33	0.86	0.76	0	1	0	7	2	1	3	1	2
DI38CA	Erythromelana	male	5.60	0.28	0.33	0.86	0.37	0.20	0.02	0.20	0.32	0.24	0.57	0.37	0.86	0.86	0	2	0	6	2	1	3	1	2
DI68CA	Erythromelana	male	6.00	0.28	0.33	0.87	0.44	0.23	0.02	0.19	0.31	0.23	0.52	0.38	0.73	0.77	0	1	0	6	2	1	3	1	2
DI313CA	Erythromelana	female	6.00	0.26	0.33	0.89	0.41	0.22	0.02	0.14	0.32	0.25	0.51	0.38	0.73	0.93	0	1	0	4	1	1	3	1	2
DI315CA	Erythromelana	female	5.80	0.27	0.33	0.91	0.35	0.21	0.02	0.17	0.31	0.26	0.51	0.39	0.80	0.90	0	1	0	5	1	1	3	1	2
DI306CA	Erythromelana	female	5.30	0.26	0.34	0.91	0.32	0.21	0.01	0.14	0.36	0.29	0.50	0.37	0.77	0.85	0	1	0	5	1	1	3	1	2

Appendix 1. Continued

Specimen ID	Genera	Sex	51	48	52	49	50	54	55	56	58	61	45	46	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	83	84	85
DI500CA	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI31CA	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	3	1	3	1	0	2	0	0	1	2	3	3	3	3	3	2	1	1	0	1	3	2	0	1
DI206MW	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	4	2	3	3	3	2	2	1	0	1	3	2	2	1
CR938508	Erythromelana	male	2	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	2	2	2	1	0	1	3	2	2	1
DI414CA	Erythromelana	male	1	2	2	1	1	3	1	3	0	0	2	2	2	1	0	2	0	0	1	2	4	1	2	2	1	1	1	1	1	1	3	2	2	1
DI120BM	Erythromelana	male	2	2	2	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	0	1	3	2	2	1
CR550825	Erythromelana	male	1	2	3	1	1	3	1	3	0	1	2	2	3	1	0	2	0	0	1	2	3	1	2	2	2	1	1	1	0	1	3	2	2	1
YY8135	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	3	1	1	1	1	1	1	1	0	1	3	2	2	1
DI408CA	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	2	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI460CA	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	4	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI410CA	Erythromelana	male	0	2	2	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	1	3	3	2	2	1	1	0	1	3	2	2	1
DI452CA	Erythromelana	male	1	2	2	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	3	2	3	3	3	2	2	1	0	1	3	2	0	1
DI472CA	Erythromelana	male	0	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	3	2	3	3	2	2	2	1	0	1	3	2	2	1
DI37CA	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	2	2	2	1	0	1	3	2	2	1
DI173MW	Erythromelana	male	1	2	2	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	0	1	3	2	2	1
CR955711	Erythromelana	male	1	2	3	1	1	2	0	3	0	0	2	2	3	1	0	2	0	0	1	2	3	1	3	2	2	2	2	1	0	1	3	2	2	1
DI477CA	Erythromelana	male	2	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	4	2	3	3	2	2	2	1	0	1	3	2	2	1
DI488CA	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	3	3	3	3	3	2	2	1	0	1	4	2	2	1
DI476CA	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	3	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI16CA	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	4	3	3	3	3	3	2	1	0	1	3	2	2	1
CR536979	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	4	3	2	3	3	2	2	2	1	0	1	3	2	2	1
DI27CA	Erythromelana	male	1	2	2	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	0	1	3	2	2	1
DI20CA	Erythromelana	male	1	2	2	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	3	3	3	3	2	2	1	0	1	3	2	2	1
DI36CA	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	4	2	3	3	2	2	2	1	0	1	3	2	2	1
YY26213	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	3	3	3	3	2	2	1	0	1	3	2	2	1
DI52CA	Erythromelana	male	1	2	3	1	1	3	1	3	0	0	2	2	3	1	0	2	0	0	1	2	3	1	3	3	2	2	1	1	0	1	3	2	2	1
DI85NM	Erythromelana	male	2	2	2	1	1	3	1	3	0	0	3	1	3	1	0	2	0	0	1	2	4	1	2	1	1	1	1	1	0	1	2	2	2	1
DI51CA	Erythromelana	male	1	2	2	1	1	2	0	3	0	0	2	2	3	1	0	2	0	0	1	2	4	1	2	2	2	1	1	1	0	1	3	2	2	1
DI118BM	Erythromelana	male	1	2	2	1	1	2	0	3	0	0	3	1	3	1	0	2	0	0	1	2	4	1	2	2	2	1	1	1	0	1	5	2	2	1
DI54CA	Erythromelana	male	1	2	2	1	1	2	0	3	0	0	2	2	3	1	0	2	0	0	1	2	3	1	1	2	2	1	1	1	0	1	3	2	2	1
DI164NM	Erythromelana	male	2	3	3	2	2	2	0	2	1	0	2	2	3	1	0	2	0	0	1	2	4	1	3	3	2	1	1	1	2	1	3	1	0	1
DI341CA	Erythromelana	male	1	2	3	2	1	2	0	2	0	0	2	2	3	1	0	2	0	0	1	3	4	2	3	3	2	2	1	1	2	1	3	2	0	1
DI342CA	Erythromelana	male	2	2	2	2	1	2	0	2	0	0	3	1	3	1	0	2	0	0	1	4	4	2	3	3	2	2	2	1	2	1	3	2	0	1
DI280CA	Erythromelana	male	1	2	2	1	1	2	0	2	1	0	3	1	3	1	0	2	0	0	1	2	3	2	3	3	2	2	1	1	2	1	2	1	0	1
DI343CA	Erythromelana	male	1	2	2	1	1	2	0	2	1	0	2	2	3	1	0	2	0	0	1	2	4	2	3	3	3	2	2	1	2	1	3	1	0	1
DI340CA	Erythromelana	male	2	2	2	1	1	2	0	2	1	0	2	2	3	1	0	2	0	0	1	2	3	1	2	3	3	2	1	1	2	1	3	1	0	1
DI296CA	Erythromelana	male	2	2	2	1	1	2	0	2	1	0	2	2	3	1	0	2	0	0	1	2	3	1	2	3	2	2	1	1	2	1	3	1	0	1
DI328CA	Erythromelana	male	2	2	2	1	1	2	0	2	1	0	3	1	2	1	0	2	0	0	1	2	4	1	3	3	2	2	1	1	2	1	3	1	0	1
DI38CA	Erythromelana	male	1	3	3	2	2	2	0	2	1	0	3	1	2	1	0	2	0	0	1	3	4	1	1	2	2	1	1	1	2	1	3	1	0	1
DI68CA	Erythromelana	male	2	2	3	2	2	2	0	2	0	0	2	2	2	1	0	2	0	0	1	4	4	1	1	3	2	1	1	1	2	1	3	1	0	1
DI313CA	Erythromelana	female	1	2	2	1	1	2	0	2	0	0	2	2	3	1	0	2	0	0	1	2	3	1	2	3	3	2	1	1	2	1	3	1	0	1
DI315CA	Erythromelana	female	1	2	2	1	1	2	0	2	0	0	3	1	3	1	0	2	0	0	1	2	3	2	3	3	3	2	1	1	2	1	3	1	0	1
DI306CA	Erythromelana	female	1	2	2	1	1	2	0	2	1	0	3	1	2	1	0	2	0	0	1	2	3	2	3	3	3	2	2	1	2	1	3	1	2	1

Appendix 1. Continued

Specimen ID	Genera	Sex	1	3 to 1	10 to 1	4 to 3	11 to 12	12 to 10	7 to 10	8 to 3	9 to 3	5 to 6	6 to 3	13 to 1	15 to 14	16 to 1	17	37	38	39	40	42	43	44	47
DI46CA	Erythromelana	female	5.40	0.28	0.34	0.88	0.40	0.22	0.02	0.15	0.33	0.23	0.53	0.38	0.92	0.82	0	2	1	5	2	1	3	1	2
DI47CA	Erythromelana	female	6.40	0.27	0.34	0.88	0.36	0.21	0.01	0.15	0.34	0.23	0.52	0.36	0.87	0.86	0	2	0	5	2	1	3	1	2
CR593459	Erythromelana	female	6.00	0.28	0.35	0.86	0.42	0.23	0.02	0.18	0.34	0.24	0.48	0.41	0.87	1.00	0.35	1	0	4	1	1	3	1	2
DI208MW	Erythromelana	male	5.90	0.28	0.33	0.89	0.33	0.18	0.01	0.20	0.32	0.26	0.51	0.38	1.14	0.76	0	2	0	6	2	1	3	1	2
DI207MW	Erythromelana	male	6.40	0.26	0.32	0.89	0.33	0.21	0.01	0.18	0.29	0.24	0.54	0.38	1.17	0.83	0	2	0	6	2	1	3	1	2
DI203MW	Erythromelana	male	6.40	0.26	0.32	0.88	0.30	0.23	0.02	0.12	0.37	0.26	0.52	0.37	1.21	0.88	0	2	0	8	2	1	3	1	2
DI205CA	Erythromelana	male	5.90	0.27	0.33	0.89	0.35	0.21	0.02	0.13	0.34	0.26	0.49	0.37	1.17	0.85	0	2	0	6	2	1	3	1	2
DI84EC09	Erythromelana	male	6.80	0.25	0.30	0.89	0.45	0.20	0.02	0.17	0.35	0.35	0.40	0.37	1.36	0.81	0	1	0	7	2	1	3	1	2
DI507ECU	Erythromelana	female	5.50	0.29	0.36	0.90	0.46	0.22	0.01	0.19	0.35	0.24	0.51	0.40	0.81	0.95	0	1	0	4	2	1	3	1	2
Jaena ab	Erythromelana	female	6.60	0.25	0.31	0.90	0.57	0.21	0.02	0.16	0.30	0.30	0.48	0.34	0.94	0.82	0	1	0	4	2	1	3	1	1
DI209MW	Erythromelana	female	5.80	0.28	0.35	0.90	0.45	0.20	0.02	0.16	0.40	0.25	0.55	0.41	0.88	0.93	0	2	0	4	2	1	3	1	2
DI210MW	Erythromelana	female	5.20	0.30	0.37	0.90	0.40	0.21	0.01	0.17	0.28	0.24	0.53	0.43	0.87	0.92	0	2	0	4	2	1	3	1	2
DI204MW	Erythromelana	female	5.90	0.28	0.36	0.89	0.36	0.24	0.01	0.12	0.37	0.23	0.54	0.39	0.88	0.90	0	2	0	4	2	1	3	1	2
DI56CA	Erythromelana	female	5.50	0.27	0.35	0.90	0.48	0.22	0.02	0.19	0.36	0.28	0.53	0.38	1.00	0.87	0	1	0	5	2	1	3	1	2
DI55CA	Erythromelana	female	6.10	0.26	0.33	0.90	0.46	0.22	0.02	0.15	0.31	0.29	0.51	0.38	0.81	0.92	0	1	0	5	2	1	3	1	2
CR459612	Erythromelana	male	7.00	0.27	0.31	0.91	0.33	0.14	0.02	0.13	0.27	0.28	0.38	0.39	1.27	0.96	0	2	0	8	2	1	0	1	1
DI380CA	Erythromelana	male	6.90	0.26	0.31	0.93	0.31	0.12	0.01	0.13	0.27	0.27	0.41	0.38	1.14	0.99	0	1	0	8	2	1	0	1	1
DI62CA	Erythromelana	male	7.20	0.27	0.31	0.89	0.31	0.15	0.02	0.17	0.24	0.32	0.40	0.35	1.04	0.94	0	1	0	8	2	1	0	1	1
DI63CA	Erythromelana	male	7.00	0.26	0.31	0.92	0.31	0.15	0.01	0.16	0.28	0.31	0.40	0.36	1.04	0.94	0	1	0	10	2	1	0	1	1
DI185MW	Erythromelana	male	8.00	0.26	0.30	0.89	0.27	0.12	0.02	0.16	0.25	0.31	0.40	0.38	1.11	0.89	0	1	1	10	2	1	0	1	1
DI370CA	Erythromelana	male	6.30	0.30	0.35	0.93	0.33	0.14	0.01	0.15	0.31	0.29	0.41	0.43	1.08	1.03	0	2	0	7	2	1	0	1	1
DI371CA	Erythromelana	male	6.30	0.27	0.32	0.93	0.33	0.12	0.02	0.13	0.30	0.34	0.41	0.39	1.18	1.02	0	2	0	9	2	1	0	1	1
DI352CA	Erythromelana	male	7.00	0.27	0.32	0.90	0.29	0.15	0.03	0.14	0.32	0.34	0.40	0.37	1.09	0.99	0	1	0	8	2	1	0	1	1
DI230CA	Erythromelana	male	5.50	0.27	0.31	0.89	0.27	0.17	0.03	0.11	0.28	0.26	0.47	0.36	1.05	0.91	0	2	0	6	2	1	3	1	1
DI111BM	Erythromelana	male	6.70	0.28	0.33	0.90	0.27	0.14	0.02	0.14	0.21	0.29	0.40	0.41	1.13	1.05	0	1	0	9	2	1	0	1	1
DI117BM	Erythromelana	female	5.40	0.29	0.35	0.92	0.20	0.16	0.01	0.13	0.28	0.28	0.46	0.42	0.80	0.98	0	1	0	4	2	1	0	1	2
DI363CA	Erythromelana	female	5.80	0.30	0.36	0.92	0.38	0.15	0.01	0.14	0.29	0.26	0.44	0.41	0.88	0.98	0	1	0	5	2	1	0	1	2
DI377CA	Erythromelana	female	5.90	0.30	0.36	0.91	0.34	0.06	0.01	0.15	0.30	0.26	0.44	0.38	0.83	0.97	0	1	0	5	2	1	3	1	1
DI387CA	Erythromelana	female	6.00	0.30	0.35	0.90	0.33	0.17	0.01	0.14	0.34	0.26	0.43	0.40	1.07	0.93	0	1	0	4	2	1	0	1	1
DI71CA	Erythromelana	female	6.10	0.30	0.36	0.92	0.37	0.18	0.01	0.11	0.29	0.31	0.39	0.42	0.94	1.03	0	1	0	5	2	1	3	1	1
DI348CA	Erythromelana	female	5.50	0.31	0.36	0.92	0.44	0.16	0.01	0.11	0.31	0.28	0.42	0.44	0.79	1.02	0	1	0	5	2	1	3	1	1
DI110BM	Erythromelana	female	5.40	0.30	0.36	0.92	0.33	0.15	0.01	0.12	0.28	0.27	0.42	0.41	0.87	0.85	0	1	0	4	2	1	0	1	1
DI58CA	Erythromelana	female	6.80	0.29	0.34	0.87	0.40	0.17	0.02	0.14	0.26	0.28	0.47	0.39	0.95	0.99	0	1	1	5	2	1	0	1	2
DI57CA	Erythromelana	female	6.40	0.31	0.36	0.86	0.45	0.17	0.02	0.15	0.30	0.33	0.40	0.41	0.87	1.02	0	1	1	6	2	1	0	1	2
DI59CA	Erythromelana	female	6.80	0.27	0.32	0.91	0.38	0.15	0.02	0.16	0.31	0.37	0.39	0.33	0.73	0.82	0	1	0	6	2	1	0	1	2
DI136NM	Erythromelana	male	7.40	0.26	0.31	0.89	0.35	0.15	0.01	0.13	0.28	0.27	0.50	0.35	1.36	0.89	0	1	1	11	2	1	0	1	2
DI50CA	Erythromelana	male	7.80	0.25	0.29	0.86	0.31	0.14	0.02	0.15	0.27	0.29	0.49	0.34	1.20	0.91	0	1	1	10	2	1	0	1	2
DI48CA	Erythromelana	male	7.40	0.27	0.30	0.87	0.31	0.15	0.02	0.18	0.29	0.29	0.49	0.37	1.04	0.84	0	1	1	9	2	1	0	1	2
DI49CA	Erythromelana	male	7.10	0.27	0.31	0.84	0.41	0.16	0.02	0.21	0.28	0.31	0.48	0.39	0.96	0.92	0	1	1	10	2	1	0	1	2
DI02CA	Erythromelana	male	6.80	0.27	0.31	0.87	0.24	0.16	0.03	0.13	0.30	0.31	0.38	0.37	1.17	0.90	0	1	1	9	2	1	3	1	2
DI266CA	Erythromelana	male	7.20	0.26	0.30	0.85	0.32	0.18	0.02	0.19	0.33	0.30	0.45	0.39	1.03	1.03	0	1	1	11	2	1	0	1	1
YY14830	Erythromelana	male	6.80	0.25	0.29	0.90	0.27	0.15	0.02	0.15	0.30	0.32	0.43	0.38	0.96	0.96	0	1	0	8	2	1	0	1	1
DI07CA	Erythromelana	male	6.90	0.27	0.31	0.88	0.21	0.13	0.02	0.13	0.31	0.31	0.39	0.38	0.93	0.93	0	1	0	8	2	1	3	1	1

Appendix 1. Continued

Specimen ID	Genera	Sex	51	48	52	49	50	54	55	56	58	61	45	46	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	83	84	85
DI46CA	Erythromelana	female	1	3	3	2	2	2	0	2	1	0	3	1	2	1	0	2	0	0	1	3	4	1	2	3	2	1	1	1	2	1	3	1	0	1
DI47CA	Erythromelana	female	2	3	3	2	2	2	0	2	1	0	3	1	3	1	0	2	0	0	1	3	4	1	2	3	3	1	1	1	2	1	3	1	0	1
CR593459	Erythromelana	female	1	3	2	1	1	2	0	2	1	0	2	2	3	1	0	2	0	0	1	2	3	2	3	3	2	2	2	1	2	1	5	2	0	1
DI208MW	Erythromelana	male	2	2	4	2	2	2	0	3	0	0	3	1	3	1	0	2	0	0	1	2	5	2	3	3	3	2	2	1	0	1	3	2	2	1
DI207MW	Erythromelana	male	1	2	3	2	1	2	0	3	0	0	3	1	3	1	0	2	0	0	1	2	4	2	3	3	2	2	2	1	0	1	5	2	2	1
DI203MW	Erythromelana	male	2	2	3	2	2	2	0	3	0	0	3	1	3	1	0	2	0	0	1	2	5	2	3	3	3	2	2	1	1	1	2	2	2	1
DI205CA	Erythromelana	male	2	2	4	2	2	2	0	3	0	0	3	1	3	1	0	2	0	0	1	3	4	1	3	3	3	3	1	1	0	1	2	2	2	1
DI84EC09	Erythromelana	male	2	3	3	2	2	2	0	2	0	0	3	1	3	1	0	2	0	0	1	2	5	2	3	3	3	2	2	1	0	1	2	0	0	1
DI507ECU	Erythromelana	female	2	3	3	2	2	2	0	3	0	0	3	1	3	1	0	2	0	0	1	2	5	2	3	3	2	2	2	1	1	1	2	0	2	1
Jaena ab	Erythromelana	female	1	3	3	2	2	2	0	2	0	0	3	1	3	1	0	2	0	0	1	2	5	1	2	2	1	2	1	1	1	1	1	0	0	1
DI209MW	Erythromelana	female	2	2	3	2	2	2	0	2	0	0	3	1	3	1	0	2	0	0	1	2	5	2	3	3	3	2	2	1	0	1	3	2	2	1
DI210MW	Erythromelana	female	2	3	3	2	2	2	0	3	0	0	3	1	3	1	0	2	0	0	1	2	5	1	3	3	3	1	1	1	1	1	3	2	2	1
DI204MW	Erythromelana	female	2	2	3	2	2	2	0	3	0	0	3	1	3	1	0	2	0	0	1	2	4	2	3	3	3	2	2	1	0	1	2	2	2	1
DI56CA	Erythromelana	female	3	2	3	1	1	2	0	3	1	0	3	1	3	1	0	2	0	0	1	2	5	1	2	2	2	1	1	1	0	1	3	3	2	1
DI55CA	Erythromelana	female	1	2	3	1	1	2	0	3	0	0	3	1	3	1	0	2	0	0	1	2	5	1	3	2	2	1	1	1	0	1	3	1	2	1
CR459612	Erythromelana	male	1	2	2	1	1	2	0	2	0	0	2	2	3	1	0	2	0	0	1	2	4	2	2	3	3	2	2	1	0	1	2	0	0	1
DI380CA	Erythromelana	male	3	2	2	1	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	4	1	2	3	3	2	2	1	0	1	5	3	0	1
DI62CA	Erythromelana	male	3	2	2	1	1	2	0	2	0	0	2	2	2	1	0	2	0	0	1	2	5	2	2	3	3	2	2	1	0	1	2	3	0	1
DI63CA	Erythromelana	male	3	2	2	1	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	4	2	2	3	3	2	2	1	0	1	2	3	0	1
DI185MW	Erythromelana	male	3	2	4	1	1	2	0	2	0	0	2	2	3	1	0	2	0	0	1	2	5	1	2	3	3	2	1	1	0	1	5	3	0	1
DI370CA	Erythromelana	male	2	2	2	1	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	5	3	3	3	3	3	2	1	0	1	5	3	0	1
DI371CA	Erythromelana	male	3	2	3	1	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	4	1	3	3	3	2	1	1	0	1	5	3	0	1
DI352CA	Erythromelana	male	3	2	2	1	1	2	0	2	1	0	3	2	2	1	0	2	0	0	1	2	4	1	3	3	2	2	1	1	0	1	2	3	0	1
DI230CA	Erythromelana	male	1	2	2	1	1	2	0	2	0	0	2	2	2	1	0	2	0	0	1	2	4	2	2	3	2	2	2	1	0	1	2	0	0	1
DI111BM	Erythromelana	male	2	2	2	1	1	2	0	2	0	0	2	2	2	1	0	2	0	0	1	2	4	2	2	3	3	2	2	1	0	1	2	0	0	1
DI117BM	Erythromelana	female	2	2	3	1	1	2	0	2	0	1	2	2	2	1	0	2	0	0	1	2	5	1	2	3	3	2	1	1	1	1	2	0	0	1
DI363CA	Erythromelana	female	3	2	4	1	1	2	0	2	0	0	2	2	2	1	0	2	0	0	1	2	4	2	2	3	3	2	2	1	0	1	2	0	0	1
DI377CA	Erythromelana	female	2	2	2	1	1	2	0	2	0	0	2	2	2	1	0	2	0	0	1	2	5	1	2	3	3	2	2	1	0	1	2	5	0	1
DI387CA	Erythromelana	female	3	2	2	1	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	3	1	2	3	3	2	2	1	0	1	2	5	0	1
DI71CA	Erythromelana	female	2	2	2	1	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	4	1	2	3	2	2	2	1	0	1	2	5	0	1
DI348CA	Erythromelana	female	3	2	2	1	1	2	0	2	0	0	2	2	2	1	0	2	0	0	1	2	4	2	2	3	3	2	2	1	0	1	2	5	0	1
DI110BM	Erythromelana	female	3	3	2	1	1	2	0	2	0	0	2	2	2	1	0	2	0	0	1	2	5	1	1	2	2	2	1	1	0	1	2	0	0	1
DI58CA	Erythromelana	female	3	2	3	1	1	2	0	2	1	0	2	2	2	1	0	3	0	1	0	2	3	1	1	2	2	1	1	1	0	1	5	2	0	1
DI57CA	Erythromelana	female	3	3	3	1	1	2	0	2	1	0	2	2	2	1	0	2	0	1	0	4	4	1	1	2	2	1	1	1	0	1	3	1	0	1
DI59CA	Erythromelana	female	3	3	3	1	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	5	1	1	2	2	1	1	1	0	1	2	3	0	1
DI136NM	Erythromelana	male	3	3	3	2	1	2	0	2	1	0	3	1	3	1	0	2	0	0	1	3	5	1	2	2	2	2	1	1	0	1	5	3	0	1
DI50CA	Erythromelana	male	3	3	3	1	2	2	0	2	1	0	3	1	2	1	0	2	0	0	1	2	4	1	2	2	2	2	1	1	0	1	2	3	0	1
DI48CA	Erythromelana	male	3	2	2	1	1	2	0	2	1	0	3	1	3	1	0	2	0	0	1	3	4	1	2	2	2	2	1	1	0	1	5	3	0	1
DI49CA	Erythromelana	male	3	3	4	1	1	2	0	2	1	0	3	1	3	1	0	2	0	0	1	3	6	1	2	2	2	1	1	1	0	1	5	2	0	1
DI02CA	Erythromelana	male	2	3	4	1	1	2	0	2	0	0	3	2	2	1	0	2	0	0	1	2	5	1	3	3	2	2	1	1	0	1	2	0	0	1
DI266CA	Erythromelana	male	3	2	3	1	1	2	0	2	1	0	3	2	2	1	0	2	0	0	1	2	5	1	2	3	3	2	1	1	0	1	2	0	0	1
YY14830	Erythromelana	male	2	3	4	1	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	6	2	2	2	1	2	1	1	0	1	2	0	0	1
DI07CA	Erythromelana	male	2	3	4	2	1	2	0	2	0	0	3	1	2	1	0	2	0	0	1	1	7	1	2	2	2	1	1	1	0	1	2	0	0	1

Appendix 1. Continued

Specimen ID	Genera	Sex	1	3 to 1	10 to 1	4 to 3	11 to 12	12 to 10	7 to 10	8 to 3	9 to 3	5 to 6	6 to 3	13 to 1	15 to 14	16 to 1	17	37	38	39	40	42	43	44	47
DI11CA	Erythromelana	male	7.20	0.27	0.31	0.85	0.35	0.15	0.03	0.16	0.32	0.33	0.38	0.38	1.08	1.07	0	1	1	8	2	1	3	1	2
DI05CA	Erythromelana	male	7.60	0.24	0.28	0.88	0.29	0.16	0.04	0.15	0.31	0.30	0.41	0.37	0.93	0.99	0	1	1	8	2	1	3	1	2
YY9772	Erythromelana	female	6.80	0.25	0.31	0.89	0.33	0.20	0.01	0.13	0.34	0.26	0.51	0.35	0.68	0.82	0	1	1	4	2	1	3	1	2
YY16608	Erythromelana	female	6.20	0.27	0.32	0.82	0.45	0.20	0.02	0.21	0.33	0.22	0.60	0.37	0.81	0.98	0	1	1	4	2	1	3	1	2
sp5+6+2a	Erythromelana	male	7.80	0.24	0.29	0.88	0.48	0.18	0.02	0.15	0.32	0.23	0.50	0.33	0.84	0.81	0	1	1	8	2	1	3	1	2
DI06CA	Erythromelana	female	5.80	0.26	0.31	0.84	0.47	0.19	0.03	0.19	0.35	0.31	0.47	0.37	0.77	0.97	0	1	0	4	1	1	3	1	2
YY37297	Erythromelana	male	5.60	0.29	0.33	0.84	0.44	0.20	0.17	0.16	0.35	0.19	0.59	0.38	0.65	0.95	0	1	1	5	2	1	3	1	2
sp5+6+2b	Erythromelana	male	6.10	0.26	0.29	0.83	0.50	0.20	0.02	0.14	0.36	0.22	0.56	0.35	0.62	1.03	0	1	1	6	2	1	3	1	2
DI95BM	Erythromelana	female	5.70	0.34	0.41	0.87	0.38	0.18	0.02	0.12	0.36	0.28	0.44	0.48	1.07	1.33	0	1	0	6	2	1	0	1	1
DI269CA	Erythromelana	female	6.10	0.28	0.34	0.89	0.39	0.17	0.01	0.11	0.40	0.35	0.40	0.40	0.79	0.93	0	1	0	5	2	1	0	1	2
YY10384	Erythromelana	female	6.10	0.30	0.34	0.87	0.29	0.16	0.01	0.11	0.34	0.30	0.44	0.42	0.93	1.07	0	1	0	5	2	1	2	1	1
YY8844	Erythromelana	female	5.30	0.33	0.34	0.77	0.23	0.15	0.01	0.09	0.28	0.36	0.35	0.38	1.17	1.11	0	1	0	5	2	1	0	1	1
YY8485	Erythromelana	female	5.50	0.31	0.36	0.87	0.40	0.15	0.01	0.16	0.36	0.28	0.43	0.40	0.75	1.02	0	1	0	5	2	1	3	1	2
DI14CA	Erythromelana	female	7.00	0.29	0.33	0.85	0.36	0.19	0.03	0.16	0.33	0.26	0.42	0.43	0.71	1.13	0	1	1	4	2	1	0	1	1
YY13861	Erythromelana	female	6.50	0.27	0.33	0.86	0.33	0.84	0.02	0.11	0.29	0.28	0.44	0.41	0.93	0.91	0	1	1	5	2	1	0	1	1
YY11445	Erythromelana	female	6.40	0.28	0.33	0.89	0.31	0.15	0.02	0.15	0.28	0.27	0.42	0.35	0.86	0.86	0	1	1	5	1	1	0	1	2
DI15CA	Erythromelana	female	6.60	0.28	0.33	0.85	0.33	0.19	0.03	0.17	0.33	0.30	0.44	0.38	0.71	0.96	0	1	1	7	2	1	3	1	2
DI13CA	Erythromelana	male	6.50	0.27	0.32	0.89	0.27	0.15	0.02	0.14	0.28	0.30	0.42	0.37	1.12	1.00	0	1	0	9	2	1	3	1	2
DI04CA	Erythromelana	male	6.90	0.25	0.28	0.89	0.33	0.16	0.02	0.20	0.29	0.29	0.40	0.34	1.24	0.83	0	1	0	7	2	1	3	1	1
DI08CA	Erythromelana	male	6.00	0.26	0.30	0.89	0.27	0.17	0.02	0.13	0.32	0.36	0.40	0.33	1.39	0.90	0	1	0	7	2	1	0	1	2
DI01CA	Erythromelana	male	6.90	0.25	0.28	0.86	0.31	0.17	0.02	0.17	0.33	0.31	0.41	0.37	1.08	0.90	0	1	0	8	2	1	3	1	2
DI03CA	Erythromelana	male	6.70	0.27	0.31	0.84	0.27	0.15	0.02	0.14	0.33	0.31	0.40	0.36	1.13	0.93	0	1	0	8	2	1	3	1	2
DI10CA	Erythromelana	male	6.20	0.26	0.29	0.89	0.27	0.17	0.02	0.11	0.30	0.38	0.36	0.37	0.96	0.87	0	1	0	8	2	1	3	1	1
DI09CA	Erythromelana	male	6.10	0.26	0.31	0.90	0.29	0.15	0.02	0.13	0.31	0.32	0.43	0.38	0.92	0.98	0	1	0	8	2	1	3	1	1
YY11280	Erythromelana	male	6.40	0.29	0.31	0.89	0.15	0.13	0.01	0.13	0.31	0.28	0.43	0.40	0.86	1.09	0	1	1	9	2	1	3	1	1
YY11279	Erythromelana	male	6.80	0.27	0.30	0.89	0.14	0.14	0.01	0.13	0.28	0.29	0.41	0.38	0.82	0.97	0	1	1	10	2	1	3	1	1
YY14245	Erythromelana	female	6.50	0.28	0.33	0.90	0.21	0.13	0.01	0.08	0.30	0.26	0.42	0.39	0.67	1.02	0	1	0	6	2	1	3	1	1

Appendix 1. Continued

Specimen ID	Genera	Sex	51	48	52	49	50	54	55	56	58	61	45	46	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	83	84	85
DI11CA	Erythromelana	male	3	2	3	2	2	2	0	2	0	0	3	1	3	1	0	2	0	0	1	2	6	2	2	2	2	2	2	1	0	1	2	0	0	1
DI05CA	Erythromelana	male	3	3	4	2	2	2	0	2	1	0	3	1	2	1	0	2	0	0	1	3	6	2	2	2	2	2	2	1	0	1	2	0	0	1
YY9772	Erythromelana	female	3	3	4	1	1	2	0	3	1	0	3	2	3	1	0	2	0	0	1	2	6	1	2	2	2	1	1	1	0	1	1	0	0	1
YY16608	Erythromelana	female	2	3	3	1	2	2	0	3	1	0	2	2	2	1	0	2	0	0	1	2	7	1	3	3	3	1	1	1	0	1	1	0	0	1
sp5+6+2a	Erythromelana	male	3	3	3	2	2	2	0	3	1	0	3	1	3	1	0	2	0	0	1	2	9	1	3	3	2	2	1	1	0	1	1	0	0	1
DI06CA	Erythromelana	female	1	2	4	2	1	2	0	2	0	0	3	1	3	1	0	2	0	0	1	3	6	1	2	2	2	1	1	1	2	1	1	0	0	1
YY37297	Erythromelana	male	2	3	4	2	1	2	0	3	1	0	2	2	3	1	0	2	0	0	1	2	7	1	3	3	3	1	1	1	2	1	1	0	0	1
sp5+6+2b	Erythromelana	male	2	4	3	2	2	2	0	3	0	0	2	2	2	1	0	2	0	0	1	2	5	1	3	3	2	1	1	1	2	1	1	0	0	1
DI95BM	Erythromelana	female	2	2	3	1	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	5	1	3	3	3	2	1	1	0	1	2	0	0	1
DI269CA	Erythromelana	female	3	2	4	1	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	6	1	1	3	2	2	1	1	0	1	1	0	0	1
YY10384	Erythromelana	female	2	3	3	2	1	2	0	2	1	1	2	2	3	1	0	2	0	0	1	3	6	1	1	1	1	1	1	1	0	1	1	0	0	1
YY8844	Erythromelana	female	2	2	4	1	2	2	0	2	1	0	2	2	3	1	0	2	0	0	1	2	5	1	1	1	1	1	1	1	0	1	2	0	0	1
YY8485	Erythromelana	female	3	3	4	1	1	2	0	2	1	0	2	2	3	1	0	2	0	0	1	2	5	1	1	1	1	1	1	1	0	1	2	0	0	1
DI14CA	Erythromelana	female	3	3	3	2	1	2	0	2	1	0	3	1	3	1	0	2	0	0	1	7	6	2	2	2	2	1	2	1	0	1	1	0	0	1
YY13861	Erythromelana	female	2	3	3	1	1	2	0	2	0	0	2	2	2	1	0	2	0	0	1	2	4	1	1	2	2	1	1	1	0	1	2	0	0	1
YY11445	Erythromelana	female	3	3	5	1	1	2	0	2	0	0	2	2	2	1	0	2	0	0	1	2	4	1	1	3	2	2	1	1	0	1	2	0	0	1
DI15CA	Erythromelana	female	3	3	3	2	1	2	0	2	0	0	2	2	2	1	0	2	0	0	1	3	5	1	3	3	2	2	1	1	0	1	2	0	0	1
DI13CA	Erythromelana	male	3	3	2	2	2	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	4	1	3	3	3	2	2	1	0	1	2	0	0	1
DI04CA	Erythromelana	male	3	3	4	1	1	2	0	2	1	0	3	1	2	1	0	2	0	0	1	2	5	1	3	3	2	2	2	1	0	1	2	0	0	1
DI08CA	Erythromelana	male	3	2	4	2	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	4	1	3	3	2	2	2	1	0	1	2	0	0	1
DI01CA	Erythromelana	male	2	2	4	2	1	2	0	2	1	0	3	1	2	1	0	2	0	0	1	2	3	1	3	3	2	2	2	1	0	1	2	0	0	1
DI03CA	Erythromelana	male	2	2	3	1	2	2	0	2	0	0	3	1	2	1	0	2	0	0	1	4	4	1	3	3	2	2	2	1	0	1	2	0	0	1
DI10CA	Erythromelana	male	2	2	3	1	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	4	1	3	3	2	2	2	1	0	1	2	0	0	1
DI09CA	Erythromelana	male	3	3	3	1	2	2	0	2	1	0	3	2	2	1	0	2	0	0	1	2	4	1	2	2	2	2	1	1	0	1	2	0	0	1
YY11280	Erythromelana	male	3	3	3	1	1	2	0	2	1	0	2	2	2	1	0	2	0	0	1	2	4	1	1	1	1	1	1	1	0	1	2	0	0	1
YY11279	Erythromelana	male	3	3	3	1	1	2	0	2	1	1	2	2	2	1	0	2	0	0	1	2	5	1	1	2	1	1	1	1	0	1	1	0	0	1
YY14245	Erythromelana	female	3	3	3	1	1	2	0	2	1	1	2	2	2	1	0	2	0	0	1	3	5	1	1	1	1	1	1	1	0	1	2	0	0	1

Appendix 2. Complete data set used for the PCA ordination by *Erythromelana* specimens of 169 specimens based on the analysis of 45 morphological variables. The number of each variable corresponds to the sequential number of each character as stated on the method section.

Specimen ID	Subspecie group	sex	1	3 to 1	4 to 3	11 to 12	12 to 10	7 to 10	8 to 13	9 to 3	6 to 3	15 to 14	16 to 1	37	38	39	40	43	44	47
CR357375	cryptica	female	0.29	0.36	0.88	0.35	0.19	0.02	0.12	0.37	0.45	0.80	0.93	1	0	4	2	3	1	1
CR415948	cryptica	female	0.27	0.33	0.88	0.35	0.20	0.03	0.17	0.37	0.45	0.75	0.95	1	1	5	2	3	1	1
DI171MW	cryptica	female	0.28	0.34	0.88	0.25	0.22	0.03	0.17	0.34	0.43	0.90	0.97	1	0	4	2	3	1	1
DI170MW	cryptica	female	0.26	0.33	0.88	0.32	0.23	0.03	0.16	0.34	0.43	0.79	0.99	1	0	5	1	3	1	1
CR138565	cryptica	female	0.29	0.36	0.90	0.30	0.20	0.02	0.15	0.35	0.42	0.89	0.97	1	0	4	2	3	1	1
DI422CA	cryptica	female	0.29	0.36	0.90	0.36	0.20	0.03	0.18	0.34	0.42	0.73	0.99	1	0	5	2	3	1	1
DI484CA	cryptica	female	0.27	0.33	0.88	0.32	0.22	0.03	0.15	0.35	0.45	0.76	0.93	1	0	5	2	3	1	1
DI439CA	cryptica	female	0.27	0.33	0.86	0.32	0.23	0.03	0.17	0.32	0.46	0.75	0.93	1	0	3	2	3	1	1
DI481CA	cryptica	female	0.27	0.33	0.89	0.35	0.19	0.03	0.14	0.33	0.44	0.80	0.96	1	0	4	2	3	1	1
DI391CA	cryptica	female	0.27	0.34	0.90	0.27	0.22	0.02	0.18	0.34	0.44	0.80	0.95	1	0	3	2	3	1	1
DI125BM	cryptica	female	0.29	0.36	0.82	0.44	0.28	0.06	0.14	0.29	0.48	0.60	0.90	2	0	5	2	3	2	1
DI126BM	cryptica	female	0.26	0.31	0.79	0.40	0.32	0.04	0.15	0.34	0.50	0.56	0.87	2	0	5	2	3	2	1
DI42CA	cryptica	female	0.27	0.34	0.89	3.10	0.20	0.02	0.14	0.36	0.43	0.77	0.94	1	0	6	2	3	1	1
DI45CA	cryptica	female	0.29	0.36	0.91	0.30	0.19	0.02	0.14	0.34	0.46	0.73	0.97	1	0	5	2	3	1	1
DI504CA	cryptica	female	0.28	0.34	0.89	0.36	0.20	0.03	0.12	0.34	0.44	0.71	1.02	1	0	3	2	3	1	1
DI478CA	cryptica	female	0.30	0.36	0.88	0.43	0.18	0.03	0.15	0.37	0.45	0.82	0.99	1	0	4	2	3	1	1
DI175MW	cryptica	female	0.28	0.34	0.86	0.32	0.21	0.03	0.18	0.35	0.40	0.85	1.07	1	0	4	1	3	1	1
DI197MW	cryptica	female	0.29	0.36	0.90	0.33	0.21	0.02	0.13	0.34	0.43	0.75	0.95	1	0	5	2	3	1	1
DI196MW	cryptica	female	0.28	0.35	0.89	0.39	0.20	0.02	0.17	0.31	0.44	0.74	1.00	1	0	4	2	3	1	1
DI174MW	cryptica	female	0.26	0.52	0.88	0.35	0.14	0.02	0.16	0.35	0.45	0.82	0.92	1	0	4	2	3	1	1
DI195MW	cryptica	female	0.28	0.35	0.92	0.32	0.19	0.03	0.15	0.37	0.39	0.75	0.93	1	1	5	1	3	1	1
YY1813	cryptica	female	0.25	0.32	0.84	0.30	0.22	0.03	0.15	0.34	0.42	0.71	0.97	1	1	5	1	3	1	1
YY8640	cryptica	female	0.29	0.35	0.86	0.32	0.20	0.03	0.14	0.32	0.44	0.65	1.03	1	1	5	1	3	1	1
YY16758	cryptica	female	0.26	0.31	0.86	0.32	0.24	0.03	0.15	0.38	0.43	0.80	0.99	1	1	6	2	0	1	1
YY9763	cryptica	female	0.28	0.34	0.85	0.24	0.21	0.03	0.17	0.38	0.45	0.83	1.02	1	1	4	1	3	1	1
YY8740	cryptica	female	0.27	0.32	0.88	0.30	0.21	0.02	0.16	0.28	0.43	0.83	0.97	1	1	4	1	3	1	1
YY7599	cryptica	female	0.26	0.31	0.89	0.25	0.22	0.03	0.17	0.31	0.41	0.80	0.93	1	1	5	1	0	1	1
YY9764	cryptica	female	0.29	0.34	0.82	0.24	0.21	0.03	0.18	0.32	0.45	0.75	1.02	1	1	5	1	3	1	1
YY7655	cryptica	female	0.26	0.31	0.87	0.38	0.24	0.03	0.17	0.31	0.45	0.70	0.97	1	1	6	1	3	1	1
YY24562	cryptica	female	0.26	0.29	0.88	0.23	0.23	0.01	0.08	0.27	0.42	0.67	0.99	1	0	4	1	3	1	1
CR577875	cryptica	female	0.28	0.35	0.88	0.33	0.20	0.03	0.16	0.35	0.45	0.83	0.97	1	1	7	1	3	1	1
DI489CA	cryptica	male	0.27	0.32	0.89	0.29	0.15	0.03	0.15	0.35	0.40	1.11	0.97	1	1	7	2	3	1	1
DI25CA	cryptica	male	0.28	0.32	0.88	0.25	0.15	0.03	0.14	0.34	0.43	1.15	0.94	1	1	8	2	3	1	1
DI83NM	cryptica	male	0.26	0.31	0.88	0.29	0.15	0.02	0.20	0.33	0.46	1.25	0.86	1	1	9	2	3	1	1

Appendix 2. Continued

Specimen ID	Subspecie group	sex	48	49	51	52	50	54	55	56	58	61	45	46	62	69	70	71	72	73	74	75	76	78	80	83	84
CR357375	cryptica	female	2	2	1	4	2	3	1	3	0	0	3	1	3	3	3	1	2	2	2	1	1	0	3	2	2
CR415948	cryptica	female	2	1	1	2	1	2	0	3	0	0	2	2	3	2	4	1	2	2	2	2	1	0	3	2	2
DI171MW	cryptica	female	2	1	1	4	1	3	1	3	0	0	2	2	3	2	3	2	3	3	2	2	2	0	4	2	2
DI170MW	cryptica	female	2	1	1	4	1	3	1	3	0	0	2	2	3	2	3	2	3	3	3	2	2	0	4	2	2
CR138565	cryptica	female	2	1	1	3	1	3	1	3	0	0	2	2	3	5	2	1	2	2	2	1	1	0	3	2	2
DI422CA	cryptica	female	2	2	1	4	1	3	1	3	0	0	2	2	3	4	4	2	3	3	3	2	2	0	3	2	2
DI484CA	cryptica	female	2	2	1	4	1	3	1	3	0	0	2	2	3	3	2	2	3	3	2	2	2	0	4	2	2
DI439CA	cryptica	female	2	2	1	4	1	3	1	3	0	0	2	2	3	2	3	2	3	3	2	1	2	0	3	2	2
DI481CA	cryptica	female	2	1	1	4	1	3	1	3	0	0	2	2	3	4	3	2	3	3	2	2	2	0	4	2	2
DI391CA	cryptica	female	2	2	1	4	1	3	1	3	0	0	2	2	3	2	3	2	3	3	2	2	2	0	3	2	2
DI125BM	cryptica	female	3	3	2	5	1	2	0	3	1	1	3	1	3	3	2	2	3	3	3	2	2	0	4	2	0
DI126BM	cryptica	female	2	3	2	3	2	2	0	3	1	0	3	1	3	3	2	1	2	2	2	1	1	0	4	2	0
DI42CA	cryptica	female	2	2	1	4	1	3	1	3	0	0	2	2	3	2	2	2	3	3	3	2	2	0	3	2	2
DI45CA	cryptica	female	2	2	1	4	1	3	1	3	0	0	2	2	3	2	3	1	2	2	2	1	1	0	4	2	2
DI504CA	cryptica	female	2	2	1	4	1	3	1	4	0	0	2	2	3	5	3	1	2	2	2	1	2	0	2	2	2
DI478CA	cryptica	female	2	2	3	4	1	3	1	3	0	0	2	2	3	2	3	2	3	3	2	2	2	0	3	2	2
DI175MW	cryptica	female	2	1	1	4	1	3	1	3	0	0	2	2	3	2	2	2	3	3	3	2	2	0	2	0	2
DI197MW	cryptica	female	2	1	1	4	1	3	1	3	0	0	2	2	3	3	2	1	2	1	1	1	1	0	3	2	2
DI196MW	cryptica	female	2	1	1	4	1	3	1	3	0	0	2	2	3	2	4	2	2	2	2	1	1	0	4	2	2
DI174MW	cryptica	female	2	1	1	4	1	3	1	3	0	0	2	2	3	2	2	2	3	3	3	2	2	0	4	2	2
DI195MW	cryptica	female	2	1	2	3	1	3	1	3	0	0	2	2	3	2	4	2	2	2	1	1	1	0	3	2	2
YY1813	cryptica	female	2	1	1	3	1	3	1	3	0	0	2	2	3	2	2	1	2	2	2	1	1	0	4	1	2
YY8640	cryptica	female	2	1	1	4	1	3	1	3	0	0	2	2	3	2	3	1	3	3	2	1	1	0	4	2	2
YY16758	cryptica	female	2	1	1	3	1	2	0	3	0	0	3	1	3	2	3	1	3	3	3	1	1	0	4	2	2
YY9763	cryptica	female	2	1	1	3	1	3	1	3	0	0	2	2	3	2	2	1	1	1	1	1	1	0	4	1	2
YY8740	cryptica	female	2	1	1	3	1	2	0	3	0	0	2	2	3	2	3	1	1	2	1	1	1	0	3	1	2
YY7599	cryptica	female	2	1	1	3	1	3	1	3	0	1	2	2	3	2	3	1	2	2	1	1	1	0	4	1	2
YY9764	cryptica	female	2	1	1	2	1	3	1	3	0	0	2	2	3	2	3	1	1	1	1	1	1	0	4	2	2
YY7655	cryptica	female	2	1	1	3	1	3	1	3	0	0	2	2	3	2	3	1	3	3	3	2	2	0	4	2	2
YY24562	cryptica	female	2	1	1	2	1	2	0	3	0	0	2	2	3	2	4	1	1	1	1	1	1	0	3	2	2
CR577875	cryptica	female	2	1	1	3	1	3	1	3	0	0	3	1	3	2	3	1	2	2	2	1	1	0	4	2	2
DI489CA	cryptica	male	2	1	0	3	1	3	1	3	0	0	2	2	3	2	3	2	3	3	3	2	2	0	3	2	2
DI25CA	cryptica	male	2	1	0	3	1	3	1	3	0	0	2	2	2	2	3	2	3	3	3	2	2	0	3	2	2
DI83NM	cryptica	male	2	1	0	3	1	3	1	3	0	0	2	2	3	4	4	1	3	3	2	1	1	0	3	2	2

Appendix 2. Continued

Specimen ID	Subspecie group	sex	1	3 to 1	4 to 3	11 to 12	12 to 10	7 to 10	8 to 13	9 to 3	6 to 3	15 to 14	16 to 1	37	38	39	40	43	44	47
DI473CA	cryptica	male	0.27	0.32	0.90	0.19	0.14	0.03	0.16	0.32	0.42	1.36	0.93	1	1	9	2	3	1	1
DI53CA	cryptica	male	0.26	0.26	0.90	0.25	0.17	0.03	0.14	0.33	0.40	1.19	0.94	1	1	8	2	3	1	1
DI501CA	cryptica	male	0.25	0.30	0.86	0.20	0.15	0.03	0.15	0.33	0.44	1.35	1.02	1	1	6	2	3	1	1
DI189MW	cryptica	male	0.27	0.32	0.89	0.25	0.15	0.03	0.17	0.29	0.45	1.16	0.87	1	1	7	2	3	1	1
DI190MW	cryptica	male	0.25	0.30	0.88	0.24	0.15	0.03	0.17	0.31	0.43	1.33	0.94	1	1	7	2	3	1	1
DI191MW	cryptica	male	0.26	0.31	0.88	0.25	0.15	0.03	0.17	0.31	0.44	1.19	0.96	1	1	8	2	3	1	1
DI178MW	cryptica	male	0.25	0.30	0.86	0.25	0.18	0.03	0.19	0.32	0.41	1.21	0.97	1	1	8	3	3	1	1
DI176MW	cryptica	male	0.26	0.31	0.88	0.27	0.16	0.02	0.16	0.34	0.39	1.45	1.00	1	1	8	2	3	1	1
DI497CA	cryptica	male	0.24	0.29	0.88	0.25	0.15	0.02	0.16	0.35	0.42	1.29	0.93	1	1	10	2	3	1	1
DI475CA	cryptica	male	0.30	0.35	0.98	0.21	0.13	0.02	0.14	0.28	0.42	1.26	0.98	1	1	8	2	3	1	1
DI474CA	cryptica	male	0.26	0.32	0.88	0.25	0.14	0.02	0.14	0.32	0.44	1.21	0.91	1	1	8	2	3	1	1
DI84NM	cryptica	male	0.27	0.32	0.87	0.23	0.14	0.03	0.15	0.30	0.44	1.15	1.00	1	1	8	2	3	1	1
DI87NM	cryptica	male	0.26	0.30	0.88	0.21	0.14	0.02	0.15	0.34	0.42	1.22	0.91	1	1	8	2	3	1	1
CR568018	cryptica	male	0.27	0.32	0.88	0.24	0.14	0.02	0.17	0.34	0.39	1.17	0.99	1	1	8	2	3	1	1
CR932348	cryptica	male	0.29	0.38	0.89	0.24	0.15	0.02	0.16	0.38	0.45	1.21	0.85	1	1	6	2	3	1	1
DI92MW	cryptica	male	0.26	0.32	0.87	0.29	0.13	0.03	0.17	0.35	0.42	1.15	0.97	1	1	7	2	3	1	1
DI94NM	cryptica	male	0.26	0.30	0.88	0.31	0.14	0.02	0.14	0.30	0.44	1.16	0.92	1	1	7	2	3	1	1
DI90NM	cryptica	male	0.26	0.31	0.86	0.24	0.15	0.03	0.16	0.31	0.41	1.18	0.95	1	1	9	2	3	1	1
CR110787	cryptica	male	0.28	0.33	0.88	0.27	0.13	0.03	0.14	0.30	0.40	1.40	1.01	1	1	7	2	0	1	1
YY8532	cryptica	male	0.28	0.33	0.87	0.25	0.15	0.03	0.16	0.29	0.37	0.87	0.95	1	1	8	2	0	1	1
DI392CA	cryptica	male	0.26	0.31	0.90	0.27	0.17	0.02	0.12	0.29	0.42	1.21	0.86	1	1	7	2	3	1	1
DI91NM	cryptica	male	0.26	0.30	0.87	0.27	0.15	0.03	0.19	0.32	0.40	1.36	0.92	1	1	8	2	3	1	1
DI500CA	cryptica	male	0.25	0.29	0.89	0.25	0.15	0.03	0.14	0.34	0.42	1.21	0.92	1	1	8	2	3	1	1
DI31CA	cryptica	male	0.25	0.28	0.83	0.35	0.22	0.04	0.22	0.34	0.46	1.08	0.92	1	1	6	2	3	1	1
DI206MW	cryptica	male	0.26	0.31	0.86	0.25	0.15	0.03	0.15	0.25	0.39	1.16	0.96	1	1	10	2	3	1	1
CR938508	cryptica	male	0.26	0.32	0.89	0.27	0.13	0.02	0.18	0.33	0.42	1.32	0.94	1	1	8	2	3	1	1
DI414CA	cryptica	male	0.26	0.30	0.88	0.26	0.16	0.03	0.18	0.30	0.39	1.07	0.96	1	1	9	2	3	1	1
DI120BM	cryptica	male	0.26	0.31	0.89	0.20	0.16	0.02	0.14	0.27	0.39	1.24	0.85	1	1	8	2	3	1	1
CR550825	cryptica	male	0.26	0.31	0.88	0.25	0.15	0.02	0.17	0.36	0.43	1.21	0.93	1	1	9	2	3	1	1
YY8135	cryptica	male	0.26	0.31	0.87	0.33	0.17	0.02	0.16	0.28	0.39	1.11	1.01	1	1	9	2	0	1	1
DI408CA	cryptica	male	0.28	0.33	0.89	0.27	0.16	0.03	0.19	0.33	0.42	0.92	0.90	1	1	7	2	3	1	1
DI460CA	cryptica	male	0.27	0.33	0.89	0.24	0.17	0.02	0.17	0.36	0.46	1.09	0.87	1	1	6	2	3	1	1
DI410CA	cryptica	male	0.27	0.32	0.87	0.27	0.16	0.02	0.14	0.30	0.45	1.05	0.90	1	1	5	2	3	1	1
DI452CA	cryptica	male	0.26	0.32	0.91	0.31	0.17	0.02	0.17	0.31	0.43	1.25	0.81	1	1	6	2	3	1	1

Appendix 2. Continued

Specimen ID	Subspecie group	sex	48	49	51	52	50	54	55	56	58	61	45	46	62	69	70	71	72	73	74	75	76	78	80	83	84
DI473CA	cryptica	male	2	1	2	3	1	3	1	3	0	0	2	2	3	1	3	2	3	3	3	2	2	0	3	2	2
DI53CA	cryptica	male	2	1	2	2	1	3	1	3	0	0	2	2	2	5	3	2	3	3	2	2	2	0	3	2	2
DI501CA	cryptica	male	2	1	1	3	1	2	0	3	0	0	2	2	2	2	3	2	2	3	2	2	2	0	3	2	2
DI189MW	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	2	3	1	3	3	2	2	2	0	3	2	2
DI190MW	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	3	3	1	2	2	2	2	1	0	3	2	2
DI191MW	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	5	3	1	2	2	2	1	1	0	3	2	2
DI178MW	cryptica	male	3	1	1	3	2	3	1	3	0	0	2	2	3	2	3	2	3	3	3	2	2	0	3	2	2
DI176MW	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	2	3	2	3	3	3	2	1	0	3	2	2
DI497CA	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	2	3	2	3	3	3	2	2	0	3	2	2
DI475CA	cryptica	male	2	2	1	3	1	3	1	3	0	0	2	2	3	3	3	2	3	3	2	2	2	0	3	2	2
DI474CA	cryptica	male	2	1	2	3	1	3	1	3	0	0	2	2	3	3	3	2	3	3	3	2	2	0	3	2	2
DI84NM	cryptica	male	2	1	2	3	1	3	1	3	0	0	2	2	3	2	3	2	3	3	3	2	2	0	3	2	2
DI87NM	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	2	3	2	3	3	3	2	2	1	3	2	2
CR568018	cryptica	male	2	1	2	3	1	3	1	3	0	0	2	2	3	1	4	2	3	3	2	2	2	0	3	2	2
CR932348	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	4	2	2	3	3	2	2	2	0	3	2	2
DI92MW	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	4	3	2	3	3	3	2	2	0	3	2	2
DI94NM	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	2	3	2	3	3	3	2	2	0	3	2	2
DI90NM	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	4	4	2	3	3	2	2	2	0	3	2	2
CR110787	cryptica	male	2	1	2	2	1	3	1	3	0	0	2	2	3	3	3	1	2	3	2	2	2	1	3	2	2
YY8532	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	2	3	1	1	2	1	1	1	0	3	1	2
DI392CA	cryptica	male	2	1	0	2	1	3	1	3	0	0	2	2	3	2	3	2	3	3	3	2	2	0	3	2	2
DI91NM	cryptica	male	2	1	1	4	1	3	1	3	0	0	3	1	3	2	3	2	3	3	3	2	3	0	3	2	0
DI500CA	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	3	3	2	3	3	3	2	2	0	3	2	2
DI31CA	cryptica	male	2	1	1	3	1	3	1	3	0	0	3	1	3	2	3	3	3	3	3	2	1	0	3	2	0
DI206MW	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	2	4	2	3	3	3	2	2	0	3	2	2
CR938508	cryptica	male	2	1	2	3	1	3	1	3	0	0	2	2	3	2	3	2	3	3	2	2	2	0	3	2	2
DI414CA	cryptica	male	2	1	1	2	1	3	1	3	0	0	2	2	2	2	4	1	2	2	1	1	1	1	3	2	2
DI120BM	cryptica	male	2	1	2	2	1	3	1	3	0	0	2	2	3	2	3	2	3	3	3	2	2	0	3	2	2
CR550825	cryptica	male	2	1	1	3	1	3	1	3	0	1	2	2	3	2	3	1	2	2	2	1	1	0	3	2	2
YY8135	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	3	3	1	1	1	1	1	1	0	3	2	2
DI408CA	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	2	2	3	2	3	3	3	2	2	0	3	2	2
DI460CA	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	4	3	2	3	3	3	2	2	0	3	2	2
DI410CA	cryptica	male	2	1	0	2	1	3	1	3	0	0	2	2	3	2	3	1	3	3	2	2	1	0	3	2	2
DI452CA	cryptica	male	2	1	1	2	1	3	1	3	0	0	2	2	3	3	3	2	3	3	3	2	2	0	3	2	0

Appendix 2. Continued

Specimen ID	Subspecie group	sex	1	3 to 1	4 to 3	11 to 12	12 to 10	7 to 10	8 to 13	9 to 3	6 to 3	15 to 14	16 to 1	37	38	39	40	43	44	47
DI472CA	cryptica	male	0.26	0.32	0.90	0.20	0.14	0.02	0.16	0.28	0.44	1.36	0.88	1	1	7	2	3	1	1
DI37CA	cryptica	male	0.27	0.32	0.88	0.20	0.14	0.02	0.16	0.31	0.42	1.31	0.91	1	1	9	2	3	1	1
DI173MW	cryptica	male	0.25	0.29	0.88	0.25	0.15	0.03	0.15	0.33	0.39	1.28	1.00	1	1	8	2	3	1	1
CR955711	cryptica	male	0.30	0.35	0.90	0.27	0.14	0.02	0.11	0.27	0.42	1.18	0.97	1	1	6	2	3	1	1
DI477CA	cryptica	male	0.27	0.31	0.89	0.19	0.15	0.02	0.16	0.33	0.43	1.30	0.89	1	1	10	2	3	1	1
DI488CA	cryptica	male	0.24	0.29	0.86	0.28	0.16	0.03	0.25	0.36	0.43	1.29	0.91	1	1	10	2	3	1	1
DI476CA	cryptica	male	0.27	0.32	0.90	0.29	0.14	0.02	0.15	0.28	0.43	1.20	0.89	1	1	9	2	3	1	1
DI16CA	cryptica	male	0.24	0.29	0.91	0.24	0.15	0.03	0.12	0.32	0.39	1.21	0.90	1	1	8	2	3	1	1
CR536979	cryptica	male	0.26	0.32	0.88	0.20	0.13	0.02	0.17	0.30	0.42	1.24	0.90	1	1	8	2	3	1	1
DI27CA	cryptica	male	0.25	0.29	0.88	0.27	0.14	0.03	0.15	0.33	0.41	1.29	0.87	1	1	9	2	3	1	1
DI20CA	cryptica	male	0.24	0.30	0.90	0.27	0.15	0.02	0.15	0.28	0.39	1.14	0.90	1	1	8	2	3	1	1
DI36CA	cryptica	male	0.27	0.31	0.90	0.20	0.14	0.03	0.14	0.30	0.43	1.19	0.84	1	1	8	2	3	1	1
YY26213	cryptica	male	0.24	0.29	0.84	0.27	0.14	0.03	0.21	0.34	0.42	1.07	0.89	1	1	9	2	3	1	1
DI52CA	cryptica	male	0.25	0.31	0.91	0.21	0.14	0.02	0.16	0.35	0.41	1.04	0.84	1	1	7	2	3	1	1
DI85NM	cryptica	male	0.26	0.31	0.88	0.29	0.13	0.03	0.16	0.26	0.40	1.25	0.99	1	1	8	2	3	1	1
DI51CA	cryptica	male	0.28	0.32	0.89	0.33	0.15	0.03	0.16	0.29	0.41	1.35	0.91	1	1	8	2	3	1	1
DI118BM	cryptica	male	0.26	0.30	0.90	0.20	0.14	0.03	0.19	0.30	0.39	1.41	0.88	1	1	9	2	3	1	1
DI54CA	cryptica	male	0.25	0.31	0.92	0.23	0.12	0.02	0.16	0.33	0.40	1.18	0.93	1	1	6	2	3	1	2
DI164NM	cryptica	male	0.27	0.33	0.89	0.37	0.21	0.02	0.21	0.34	0.48	0.91	0.80	1	0	6	2	3	1	2
DI341CA	cryptica	male	0.26	0.32	0.90	0.42	0.22	0.02	0.14	0.38	0.54	0.87	0.82	2	0	5	2	3	1	2
DI342CA	cryptica	male	0.26	0.30	0.86	0.35	0.24	0.02	0.19	0.34	0.54	0.71	0.82	2	0	6	2	3	1	2
DI280CA	cryptica	male	0.27	0.32	0.89	0.39	0.20	0.02	0.24	0.28	0.59	0.85	0.84	2	0	6	2	3	1	2
DI343CA	cryptica	male	0.26	0.33	0.90	0.41	0.19	0.02	0.16	0.30	0.53	0.77	0.79	2	0	6	2	3	1	2
DI340CA	cryptica	male	0.25	0.31	0.89	0.50	0.20	0.02	0.17	0.30	0.52	0.71	0.79	2	0	7	1	3	1	2
DI296CA	cryptica	male	0.26	0.32	0.92	0.30	0.22	0.02	0.20	0.27	0.51	0.63	0.83	1	0	6	2	3	1	2
DI328CA	cryptica	male	0.25	0.32	0.87	0.45	0.23	0.02	0.19	0.29	0.55	0.86	0.76	1	0	7	2	3	1	2
DI38CA	cryptica	male	0.28	0.33	0.86	0.37	0.20	0.02	0.20	0.32	0.57	0.86	0.86	2	0	6	2	3	1	2
DI68CA	cryptica	male	0.28	0.33	0.87	0.44	0.23	0.02	0.19	0.31	0.52	0.73	0.77	1	0	6	2	3	1	2
DI313CA	cryptica	female	0.26	0.33	0.89	0.41	0.22	0.02	0.14	0.32	0.51	0.73	0.93	1	0	4	1	3	1	2
DI315CA	cryptica	female	0.27	0.33	0.91	0.35	0.21	0.02	0.17	0.31	0.51	0.80	0.90	1	0	5	1	3	1	2
DI306CA	cryptica	female	0.26	0.34	0.91	0.32	0.21	0.01	0.14	0.36	0.50	0.77	0.85	1	0	5	1	3	1	2
DI46CA	cryptica	female	0.28	0.34	0.88	0.40	0.22	0.02	0.15	0.33	0.53	0.92	0.82	2	1	5	2	3	1	2
DI47CA	cryptica	female	0.27	0.34	0.88	0.36	0.21	0.01	0.15	0.34	0.52	0.87	0.86	2	0	5	2	3	1	2
CR593459	cryptica	female	0.28	0.35	0.86	0.42	0.23	0.02	0.18	0.34	0.48	0.87	1.00	1	0	4	1	3	1	2

Appendix 2. Continued

Specimen ID	Subspecie group	sex	48	49	51	52	50	54	55	56	58	61	45	46	62	69	70	71	72	73	74	75	76	78	80	83	84
DI472CA	cryptica	male	2	1	0	3	1	3	1	3	0	0	2	2	3	3	3	2	3	3	2	2	2	0	3	2	2
DI37CA	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	2	3	2	3	3	2	2	2	0	3	2	2
DI173MW	cryptica	male	2	1	1	2	1	3	1	3	0	0	2	2	3	2	3	2	3	3	3	2	2	0	3	2	2
CR955711	cryptica	male	2	1	1	3	1	2	0	3	0	0	2	2	3	2	3	1	3	2	2	2	2	0	3	2	2
DI477CA	cryptica	male	2	1	2	3	1	3	1	3	0	0	2	2	3	3	4	2	3	3	2	2	2	0	3	2	2
DI488CA	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	3	3	3	3	3	3	2	2	0	4	2	2
DI476CA	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	3	3	2	3	3	3	2	2	0	3	2	2
DI16CA	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	2	4	3	3	3	3	3	2	0	3	2	2
CR536979	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	4	3	2	3	3	2	2	2	0	3	2	2
DI27CA	cryptica	male	2	1	1	2	1	3	1	3	0	0	2	2	3	2	3	2	3	3	3	2	2	0	3	2	2
DI20CA	cryptica	male	2	1	1	2	1	3	1	3	0	0	2	2	3	2	3	3	3	3	3	2	2	0	3	2	2
DI36CA	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	2	4	2	3	3	2	2	2	0	3	2	2
YY26213	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	2	3	3	3	3	3	2	2	0	3	2	2
DI52CA	cryptica	male	2	1	1	3	1	3	1	3	0	0	2	2	3	2	3	1	3	3	2	2	1	0	3	2	2
DI85NM	cryptica	male	2	1	2	2	1	3	1	3	0	0	3	1	3	2	4	1	2	1	1	1	1	0	3	2	2
DI51CA	cryptica	male	2	1	1	2	1	2	0	3	0	0	2	2	3	2	4	1	2	2	2	1	1	0	3	2	2
DI118BM	cryptica	male	2	1	1	2	1	2	0	3	0	0	3	1	3	2	4	1	2	2	2	1	1	0	5	2	2
DI54CA	cryptica	male	2	1	1	2	1	2	0	3	0	0	2	2	3	2	3	1	1	2	2	1	1	0	3	2	2
DI164NM	cryptica	male	3	2	2	3	2	2	0	2	1	0	2	2	3	2	4	1	3	3	2	1	1	2	3	1	0
DI341CA	cryptica	male	2	2	1	3	1	2	0	2	0	0	2	2	3	3	4	2	3	3	2	2	1	2	3	2	0
DI342CA	cryptica	male	2	2	2	2	1	2	0	2	0	0	3	1	3	4	4	2	3	3	2	2	2	2	3	2	0
DI280CA	cryptica	male	2	1	1	2	1	2	0	2	1	0	3	1	3	2	3	2	3	3	2	2	1	2	3	1	0
DI343CA	cryptica	male	2	1	1	2	1	2	0	2	1	0	2	2	3	2	4	2	3	3	3	2	2	2	3	1	0
DI340CA	cryptica	male	2	1	2	2	1	2	0	2	1	0	2	2	3	2	3	1	2	3	3	2	1	2	5	1	0
DI296CA	cryptica	male	2	1	2	2	1	2	0	2	1	0	2	2	3	2	3	1	2	3	2	2	1	2	3	1	0
DI328CA	cryptica	male	2	1	2	2	1	2	0	2	1	0	3	1	2	2	4	1	3	3	2	2	1	2	3	1	0
DI38CA	cryptica	male	3	2	1	3	2	2	0	2	1	0	3	1	2	3	4	1	1	2	2	1	1	2	3	1	0
DI68CA	cryptica	male	2	2	2	3	2	2	0	2	0	0	2	2	2	4	4	1	1	3	2	1	1	2	3	1	0
DI313CA	cryptica	female	2	1	1	2	1	2	0	2	0	0	2	2	3	2	3	1	2	3	3	2	1	2	3	1	0
DI315CA	cryptica	female	2	1	1	2	1	2	0	2	0	0	3	1	3	2	3	2	3	3	3	2	1	2	3	1	0
DI306CA	cryptica	female	2	1	1	2	1	2	0	2	1	0	3	1	2	2	3	2	3	3	3	2	2	2	3	1	2
DI46CA	cryptica	female	3	2	1	3	2	2	0	2	1	0	3	1	2	3	4	1	2	3	2	1	1	2	3	1	0
DI47CA	cryptica	female	3	2	2	3	2	2	0	2	1	0	3	1	3	3	4	1	2	3	3	1	1	2	3	1	0
CR593459	cryptica	female	3	1	1	2	1	2	0	2	1	0	2	2	3	2	3	2	3	3	2	2	2	2	5	2	0

Appendix 2. Continued

Specimen ID	Subspecie group	sex	1	3 to 1	4 to 3	11 to 12	12 to 10	7 to 10	8 to 13	9 to 3	6 to 3	15 to 14	16 to 1	37	38	39	40	43	44	47
DI208MW	cryptica	male	0.28	0.33	0.89	0.33	0.18	0.01	0.20	0.32	0.51	1.14	0.76	2	0	6	2	3	1	2
DI207MW	cryptica	male	0.26	0.32	0.89	0.33	0.21	0.01	0.18	0.29	0.54	1.17	0.83	2	0	6	2	3	1	2
DI203MW	cryptica	male	0.26	0.32	0.88	0.30	0.23	0.02	0.12	0.37	0.52	1.21	0.88	2	0	8	2	3	1	2
DI205CA	cryptica	male	0.27	0.33	0.89	0.35	0.21	0.02	0.13	0.34	0.49	1.17	0.85	2	0	6	2	3	1	2
DI84EC09	cryptica	male	0.25	0.30	0.89	0.45	0.20	0.02	0.17	0.35	0.40	1.36	0.81	1	0	7	2	3	1	2
DI507ECU	cryptica	female	0.29	0.36	0.90	0.46	0.22	0.01	0.19	0.35	0.51	0.81	0.95	1	0	4	2	3	1	2
Jaena ab	cryptica	female	0.25	0.31	0.90	0.57	0.21	0.02	0.16	0.30	0.48	0.94	0.82	1	0	4	2	3	1	1
DI209MW	cryptica	female	0.28	0.35	0.90	0.45	0.20	0.02	0.16	0.40	0.55	0.88	0.93	2	0	4	2	3	1	2
DI210MW	cryptica	female	0.30	0.37	0.90	0.40	0.21	0.01	0.17	0.28	0.53	0.87	0.92	2	0	4	2	3	1	2
DI204MW	cryptica	female	0.28	0.36	0.89	0.36	0.24	0.01	0.12	0.37	0.54	0.88	0.90	2	0	4	2	3	1	2
DI56CA	cryptica	female	0.27	0.35	0.90	0.48	0.22	0.02	0.19	0.36	0.53	1.00	0.87	1	0	5	2	3	1	2
DI55CA	cryptica	female	0.26	0.33	0.90	0.46	0.22	0.02	0.15	0.31	0.51	0.81	0.92	1	0	5	2	3	1	2
CR459612	jaena	male	0.27	0.31	0.91	0.33	0.14	0.02	0.13	0.27	0.38	1.27	0.96	2	0	8	2	0	1	1
DI380CA	jaena	male	0.26	0.31	0.93	0.31	0.12	0.01	0.13	0.27	0.41	1.14	0.99	1	0	8	2	0	1	1
DI62CA	jaena	male	0.27	0.31	0.89	0.31	0.15	0.02	0.17	0.24	0.40	1.04	0.94	1	0	8	2	0	1	1
DI63CA	jaena	male	0.26	0.31	0.92	0.31	0.15	0.01	0.16	0.28	0.40	1.04	0.94	1	0	10	2	0	1	1
DI185MW	jaena	male	0.26	0.30	0.89	0.27	0.12	0.02	0.16	0.25	0.40	1.11	0.89	1	1	10	2	0	1	1
DI370CA	jaena	male	0.30	0.35	0.93	0.33	0.14	0.01	0.15	0.31	0.41	1.08	1.03	2	0	7	2	0	1	1
DI371CA	jaena	male	0.27	0.32	0.93	0.33	0.12	0.02	0.13	0.30	0.41	1.18	1.02	2	0	9	2	0	1	1
DI352CA	jaena	male	0.27	0.32	0.90	0.29	0.15	0.03	0.14	0.32	0.40	1.09	0.99	1	0	8	2	0	1	1
DI230CA	jaena	male	0.27	0.31	0.89	0.27	0.17	0.03	0.11	0.28	0.47	1.05	0.91	2	0	6	2	3	1	1
DI111BM	jaena	male	0.28	0.33	0.90	0.27	0.14	0.02	0.14	0.21	0.40	1.13	1.05	1	0	9	2	0	1	1
DI117BM	jaena	female	0.29	0.35	0.92	0.20	0.16	0.01	0.13	0.28	0.46	0.80	0.98	1	0	4	2	0	1	2
DI363CA	jaena	female	0.30	0.36	0.92	0.38	0.15	0.01	0.14	0.29	0.44	0.88	0.98	1	0	5	2	0	1	2
DI377CA	jaena	female	0.30	0.36	0.91	0.34	0.06	0.01	0.15	0.30	0.44	0.83	0.97	1	0	5	2	3	1	1
DI387CA	jaena	female	0.30	0.35	0.90	0.33	0.17	0.01	0.14	0.34	0.43	1.07	0.93	1	0	4	2	0	1	1
DI71CA	jaena	female	0.30	0.36	0.92	0.37	0.18	0.01	0.11	0.29	0.39	0.94	1.03	1	0	5	2	3	1	1
DI348CA	jaena	female	0.31	0.36	0.92	0.44	0.16	0.01	0.11	0.31	0.42	0.79	1.02	1	0	5	2	3	1	1
DI110BM	jaena	female	0.30	0.36	0.92	0.33	0.15	0.01	0.12	0.28	0.42	0.87	0.85	1	0	4	2	0	1	1
DI58CA	jaena	female	0.29	0.34	0.87	0.40	0.17	0.02	0.14	0.26	0.47	0.95	0.99	1	1	5	2	0	1	2
DI57CA	jaena	female	0.31	0.36	0.86	0.45	0.17	0.02	0.15	0.30	0.40	0.87	1.02	1	1	6	2	0	1	2
DI59CA	jaena	female	0.27	0.32	0.91	0.38	0.15	0.02	0.16	0.31	0.39	0.73	0.82	1	0	6	2	0	1	2
DI136NM	jaena	male	0.26	0.31	0.89	0.35	0.15	0.01	0.13	0.28	0.50	1.36	0.89	1	1	11	2	0	1	2
DI50CA	jaena	male	0.25	0.29	0.86	0.31	0.14	0.02	0.15	0.27	0.49	1.20	0.91	1	1	10	2	0	1	2

Appendix 2. Continued

Specimen ID	Subspecie group	sex	48	49	51	52	50	54	55	56	58	61	45	46	62	69	70	71	72	73	74	75	76	78	80	83	84
DI208MW	cryptica	male	2	2	2	4	2	2	0	3	0	0	3	1	3	2	5	2	3	3	3	2	2	0	3	2	2
DI207MW	cryptica	male	2	2	1	3	1	2	0	3	0	0	3	1	3	2	4	2	3	3	2	2	2	0	5	2	2
DI203MW	cryptica	male	2	2	2	3	2	2	0	3	0	0	3	1	3	2	5	2	3	3	3	2	2	1	5	2	2
DI205CA	cryptica	male	2	2	2	4	2	2	0	3	0	0	3	1	3	3	4	1	3	3	3	3	1	0	5	2	2
DI84EC09	cryptica	male	3	2	2	3	2	2	0	2	0	0	3	1	3	2	5	2	3	3	3	2	2	0	5	0	0
DI507ECU	cryptica	female	3	2	2	3	2	2	0	3	0	0	3	1	3	2	5	2	3	3	2	2	2	1	5	0	2
Jaena ab	cryptica	female	3	2	1	3	2	2	0	2	0	0	3	1	3	2	5	1	2	2	1	2	1	1	5	0	0
DI209MW	cryptica	female	2	2	2	3	2	2	0	2	0	0	3	1	3	2	5	2	3	3	3	2	2	0	3	2	2
DI210MW	cryptica	female	3	2	2	3	2	2	0	3	0	0	3	1	3	2	5	1	3	3	3	1	1	1	3	2	2
DI204MW	cryptica	female	2	2	2	3	2	2	0	3	0	0	3	1	3	2	4	2	3	3	3	2	2	0	5	2	2
DI56CA	cryptica	female	2	1	3	3	1	2	0	3	1	0	3	1	3	2	5	1	2	2	2	1	1	0	3	3	2
DI55CA	cryptica	female	2	1	1	3	1	2	0	3	0	0	3	1	3	2	5	1	3	2	2	1	1	0	3	1	2
CR459612	jaena	male	2	1	1	2	1	2	0	2	0	0	2	2	3	2	4	2	2	3	3	2	2	0	2	0	0
DI380CA	jaena	male	2	1	3	2	1	2	0	2	1	0	2	2	2	2	4	1	2	3	3	2	2	0	2	3	0
DI62CA	jaena	male	2	1	3	2	1	2	0	2	0	0	2	2	2	2	5	2	2	3	3	2	2	0	2	3	0
DI63CA	jaena	male	2	1	3	2	1	2	0	2	1	0	2	2	2	2	4	2	2	3	3	2	2	0	2	3	0
DI185MW	jaena	male	2	1	3	4	1	2	0	2	0	0	2	2	3	2	5	1	2	3	3	2	1	0	2	3	0
DI370CA	jaena	male	2	1	2	2	1	2	0	2	1	0	2	2	2	2	5	3	3	3	3	3	2	0	2	3	0
DI371CA	jaena	male	2	1	3	3	1	2	0	2	1	0	2	2	2	2	4	1	3	3	3	2	1	0	2	3	0
DI352CA	jaena	male	2	1	3	2	1	2	0	2	1	0	3	2	2	2	4	1	3	3	2	2	1	0	2	3	0
DI230CA	jaena	male	2	1	1	2	1	2	0	2	0	0	2	2	2	2	4	2	2	3	2	2	2	0	2	0	0
DI111BM	jaena	male	2	1	2	2	1	2	0	2	0	0	2	2	2	2	4	2	2	3	3	2	2	0	2	0	0
DI117BM	jaena	female	2	1	2	3	1	2	0	2	0	1	2	2	2	2	5	1	2	3	3	2	1	1	2	0	0
DI363CA	jaena	female	2	1	3	4	1	2	0	2	0	0	2	2	2	2	4	2	2	3	3	2	2	0	2	0	0
DI377CA	jaena	female	2	1	2	2	1	2	0	2	0	0	2	2	2	2	5	1	2	3	3	2	2	0	2	5	0
DI387CA	jaena	female	2	1	3	2	1	2	0	2	1	0	2	2	2	2	3	1	2	3	3	2	2	0	2	5	0
DI71CA	jaena	female	2	1	2	2	1	2	0	2	1	0	2	2	2	2	4	1	2	3	2	2	2	0	2	5	0
DI348CA	jaena	female	2	1	3	2	1	2	0	2	0	0	2	2	2	2	4	2	2	3	3	2	2	0	2	5	0
DI110BM	jaena	female	3	1	3	2	1	2	0	2	0	0	2	2	2	2	5	1	1	2	2	2	1	0	2	0	0
DI58CA	jaena	female	2	1	3	3	1	2	0	2	1	0	2	2	2	2	3	1	1	2	2	1	1	0	2	2	0
DI57CA	jaena	female	3	1	3	3	1	2	0	2	1	0	2	2	2	4	4	1	1	2	2	1	1	0	2	1	0
DI59CA	jaena	female	3	1	3	3	1	2	0	2	1	0	2	2	2	2	5	1	1	2	2	1	1	0	2	3	0
DI136NM	jaena	male	3	2	3	3	1	2	0	2	1	0	3	1	3	3	5	1	2	2	2	2	1	0	2	3	0
DI50CA	jaena	male	3	1	3	3	2	2	0	2	1	0	3	1	2	2	4	1	2	2	2	2	1	0	2	3	0

Appendix 2. Continued

Specimen ID	Subspecie group	sex	1	3 to 1	4 to 3	11 to 12	12 to 10	7 to 10	8 to 13	9 to 3	6 to 3	15 to 14	16 to 1	37	38	39	40	43	44	47
DI48CA	jaena	male	0.27	0.30	0.87	0.31	0.15	0.02	0.18	0.29	0.49	1.04	0.84	1	1	9	2	0	1	2
DI49CA	jaena	male	0.27	0.31	0.84	0.41	0.16	0.02	0.21	0.28	0.48	0.96	0.92	1	1	10	2	0	1	2
DI02CA	jaena	male	0.27	0.31	0.87	0.24	0.16	0.03	0.13	0.30	0.38	1.17	0.90	1	1	9	2	3	1	2
DI266CA	jaena	male	0.26	0.30	0.85	0.32	0.18	0.02	0.19	0.33	0.45	1.03	1.03	1	1	11	2	0	1	1
YY14830	jaena	male	0.25	0.29	0.90	0.27	0.15	0.02	0.15	0.30	0.43	0.96	0.96	1	0	8	2	0	1	1
DI07CA	jaena	male	0.27	0.31	0.88	0.21	0.13	0.02	0.13	0.31	0.39	0.93	0.93	1	0	8	2	3	1	1
DI11CA	jaena	male	0.27	0.31	0.85	0.35	0.15	0.03	0.16	0.32	0.38	1.08	1.07	1	1	8	2	3	1	2
DI05CA	jaena	male	0.24	0.28	0.88	0.29	0.16	0.04	0.15	0.31	0.41	0.93	0.99	1	1	8	2	3	1	2
YY9772	jaena	female	0.25	0.31	0.89	0.33	0.20	0.01	0.13	0.34	0.51	0.68	0.82	1	1	4	2	3	1	2
YY16608	jaena	female	0.27	0.32	0.82	0.45	0.20	0.02	0.21	0.33	0.60	0.81	0.98	1	1	4	2	3	1	2
sp5+6+2a	jaena	male	0.24	0.29	0.88	0.48	0.18	0.02	0.15	0.32	0.50	0.84	0.81	1	1	8	2	3	1	2
DI06CA	jaena	female	0.26	0.31	0.84	0.47	0.19	0.03	0.19	0.35	0.47	0.77	0.97	1	0	4	1	3	1	2
YY37297	jaena	male	0.29	0.33	0.84	0.44	0.20	0.17	0.16	0.35	0.59	0.65	0.95	1	1	5	2	3	1	2
sp5+6+2b	jaena	male	0.26	0.29	0.83	0.50	0.20	0.02	0.14	0.36	0.56	0.62	1.03	1	1	6	2	3	1	2
DI95BM	jaena	female	0.34	0.41	0.87	0.38	0.18	0.02	0.12	0.36	0.44	1.07	1.33	1	0	6	2	0	1	1
DI269CA	jaena	female	0.28	0.34	0.89	0.39	0.17	0.01	0.11	0.40	0.40	0.79	0.93	1	0	5	2	0	1	2
YY10384	jaena	female	0.30	0.34	0.87	0.29	0.16	0.01	0.11	0.34	0.44	0.93	1.07	1	0	5	2	2	1	1
YY8844	jaena	female	0.33	0.34	0.77	0.23	0.15	0.01	0.09	0.28	0.35	1.17	1.11	1	0	5	2	0	1	1
YY8485	jaena	female	0.31	0.36	0.87	0.40	0.15	0.01	0.16	0.36	0.43	0.75	1.02	1	0	5	2	3	1	2
DI14CA	jaena	female	0.29	0.33	0.85	0.36	0.19	0.03	0.16	0.33	0.42	0.71	1.13	1	1	4	2	0	1	1
YY13861	jaena	female	0.27	0.33	0.86	0.33	0.84	0.02	0.11	0.29	0.44	0.93	0.91	1	1	5	2	0	1	1
YY11445	jaena	female	0.28	0.33	0.89	0.31	0.15	0.02	0.15	0.28	0.42	0.86	0.86	1	1	5	1	0	1	2
DI15CA	jaena	female	0.28	0.33	0.85	0.33	0.19	0.03	0.17	0.33	0.44	0.71	0.96	1	1	7	2	3	1	2
DI13CA	jaena	male	0.27	0.32	0.89	0.27	0.15	0.02	0.14	0.28	0.42	1.12	1.00	1	0	9	2	3	1	2
DI04CA	jaena	male	0.25	0.28	0.89	0.33	0.16	0.02	0.20	0.29	0.40	1.24	0.83	1	0	7	2	3	1	1
DI08CA	jaena	male	0.26	0.30	0.89	0.27	0.17	0.02	0.13	0.32	0.40	1.39	0.90	1	0	7	2	0	1	2
DI01CA	jaena	male	0.25	0.28	0.86	0.31	0.17	0.02	0.17	0.33	0.41	1.08	0.90	1	0	8	2	3	1	2
DI03CA	jaena	male	0.27	0.31	0.84	0.27	0.15	0.02	0.14	0.33	0.40	1.13	0.93	1	0	8	2	3	1	2
DI10CA	jaena	male	0.26	0.29	0.89	0.27	0.17	0.02	0.11	0.30	0.36	0.96	0.87	1	0	8	2	3	1	1
DI09CA	jaena	male	0.26	0.31	0.90	0.29	0.15	0.02	0.13	0.31	0.43	0.92	0.98	1	0	8	2	3	1	1
YY11280	jaena	male	0.29	0.31	0.89	0.15	0.13	0.01	0.13	0.31	0.43	0.86	1.09	1	1	9	2	3	1	1
YY11279	jaena	male	0.27	0.30	0.89	0.14	0.14	0.01	0.13	0.28	0.41	0.82	0.97	1	1	10	2	3	1	1
YY14245	jaena	female	0.28	0.33	0.90	0.21	0.13	0.01	0.08	0.30	0.42	0.67	1.02	1	0	6	2	3	1	1

Appendix 2. Continued

Specimen ID	Subspecie group	sex	48	49	51	52	50	54	55	56	58	61	45	46	62	69	70	71	72	73	74	75	76	78	80	83	84
DI48CA	jaena	male	2	1	3	2	1	2	0	2	1	0	3	1	3	3	4	1	2	2	2	2	1	0	2	3	0
DI49CA	jaena	male	3	1	3	4	1	2	0	2	1	0	3	1	3	3	6	1	2	2	2	1	1	0	2	2	0
DI02CA	jaena	male	3	1	2	4	1	2	0	2	0	0	3	2	2	2	5	1	3	3	2	2	1	0	1	0	0
DI266CA	jaena	male	2	1	3	3	1	2	0	2	1	0	3	2	2	2	5	1	2	3	3	2	1	0	1	0	0
YY14830	jaena	male	3	1	2	4	1	2	0	2	1	0	2	2	2	2	6	2	2	2	1	2	1	0	1	0	0
DI07CA	jaena	male	3	2	2	4	1	2	0	2	0	0	3	1	2	1	7	1	2	2	2	1	1	0	1	0	0
DI11CA	jaena	male	2	2	3	3	2	2	0	2	0	0	3	1	3	2	6	2	2	2	2	2	2	0	1	0	0
DI05CA	jaena	male	3	2	3	4	2	2	0	2	1	0	3	1	2	3	6	2	2	2	2	2	2	0	1	0	0
YY9772	jaena	female	3	1	3	4	1	2	0	3	1	0	3	2	3	2	6	1	2	2	2	1	1	0	1	0	0
YY16608	jaena	female	3	1	2	3	2	2	0	3	1	0	2	2	2	2	7	1	3	3	3	1	1	0	1	0	0
sp5+6+2a	jaena	male	3	2	3	3	2	2	0	3	1	0	3	1	3	2	9	1	3	3	2	2	1	0	1	0	0
DI06CA	jaena	female	2	2	1	4	1	2	0	2	0	0	3	1	3	3	6	1	2	2	2	1	1	2	1	0	0
YY37297	jaena	male	3	2	2	4	1	2	0	3	1	0	2	2	3	2	7	1	3	3	3	1	1	2	1	0	0
sp5+6+2b	jaena	male	4	2	2	3	2	2	0	3	0	0	2	2	2	2	5	1	3	3	2	1	1	2	1	0	0
DI95BM	jaena	female	2	1	2	3	1	2	0	2	1	0	2	2	2	2	5	1	3	3	3	2	1	0	1	0	0
DI269CA	jaena	female	2	1	3	4	1	2	0	2	1	0	2	2	2	2	6	1	1	3	2	2	1	0	1	0	0
YY10384	jaena	female	3	2	2	3	1	2	0	2	1	1	2	2	3	3	6	1	1	1	1	1	1	0	1	0	0
YY8844	jaena	female	2	1	2	4	2	2	0	2	1	0	2	2	3	2	5	1	1	1	1	1	1	0	1	0	0
YY8485	jaena	female	3	1	3	4	1	2	0	2	1	0	2	2	3	2	5	1	1	1	1	1	1	0	1	0	0
DI14CA	jaena	female	3	2	3	3	1	2	0	2	1	0	3	1	3	7	6	2	2	2	2	1	2	0	1	0	0
YY13861	jaena	female	3	1	2	3	1	2	0	2	0	0	2	2	2	2	4	1	1	2	2	1	1	0	1	0	0
YY11445	jaena	female	3	1	3	5	1	2	0	2	0	0	2	2	2	2	4	1	1	3	2	2	1	0	1	0	0
DI15CA	jaena	female	3	2	3	3	1	2	0	2	0	0	2	2	2	3	5	1	3	3	2	2	1	0	1	0	0
DI13CA	jaena	male	3	2	3	2	2	2	0	2	1	0	2	2	2	2	4	1	3	3	3	2	2	0	1	0	0
DI04CA	jaena	male	3	1	3	4	1	2	0	2	1	0	3	1	2	2	5	1	3	3	2	2	2	0	1	0	0
DI08CA	jaena	male	2	2	3	4	1	2	0	2	1	0	2	2	2	2	4	1	3	3	2	2	2	0	1	0	0
DI01CA	jaena	male	2	2	2	4	1	2	0	2	1	0	3	1	2	2	3	1	3	3	2	2	2	0	1	0	0
DI03CA	jaena	male	2	1	2	3	2	2	0	2	0	0	3	1	2	4	4	1	3	3	2	2	2	0	1	0	0
DI10CA	jaena	male	2	1	2	3	1	2	0	2	1	0	2	2	2	2	4	1	3	3	2	2	2	0	1	0	0
DI09CA	jaena	male	3	1	3	3	2	2	0	2	1	0	3	2	2	2	4	1	2	2	2	2	1	0	1	0	0
YY11280	jaena	male	3	1	3	3	1	2	0	2	1	0	2	2	2	2	4	1	1	1	1	1	1	0	1	0	0
YY11279	jaena	male	3	1	3	3	1	2	0	2	1	1	2	2	2	2	5	1	1	2	1	1	1	0	1	0	0
YY14245	jaena	female	3	1	3	3	1	2	0	2	1	1	2	2	2	3	5	1	1	1	1	1	1	0	1	0	0

Appendix 3. Character matrix of 14 *Erythromelana* species including one species, *E. cryptica*, that was divided into four groups based on their locality records (CR Costa Rica, VE Venezuela, EC Ecuador, ME Mexico), and three different species belonging to two genera: *Euptilodegeeria obumbrata*, *Euptilodegeeria* sp. nov. and *Myiodoriops marginalis*. The number of each variable corresponds to the sequential number of each character as stated on the method section.

Species	3 to 1	10 to 1	4 to 3	11 to 12	12 to 10	7 to 10	8 to 3	9 to 3	5 to 6	6 to 3	13 to 1	15 to 14	16 to 1	18 to 20	21 to 20	22 to 21	23 to 21	24 to 21	37	39	40	41	42	43	47	51	48	52	49	50	55	56	58	45	62	70	72	73	74	75	76	77	78	79	80	83	84	86	87	88	89	92	90	93	94	91
E. cryptica CR	2	3	1	2	1	2	2	2	2	1	3	2	3	1	1	2	3	2	1	2	2	2	1	3	1	1	2	3	1	1	1	3	0	2	3	3	3	2	2	2	2	1	0	1	3	2	2	0	1	1	1	1	0	1	0	0
E. cryptica VE	2	3	1	2	1	1	2	2	1	1	2	2	2	1	1	1	2	2	1	2	2	2	1	3	1	1	2	3	1	1	1	3	0	2	3	3	3	3	2	2	2	1	0	1	3	2	2	0	1	1	1	1	0	1	0	0
E. cryptica EC	1	2	2	2	1	2	2	2	2	1	2	2	2	1	1	1	2	2	1	2	2	2	1	3	1	1	2	3	1	1	1	3	0	2	3	3	3	3	3	2	2	1	0	1	3	2	2	0	1	1	1	1	0	1	0	0
E. cryptica ME	2	3	1	2	1	2	2	2	2	1	2	2	2	1	1	1	3	2	1	2	2	2	1	3	1	1	2	3	1	1	1	3	0	2	3	3	3	3	2	2	1	1	0	1	3	2	2	0	1	1	1	1	0	1	0	0
E. catarina	2	3	1	2	2	1	2	2	2	1	2	2	2	1	1	2	2	2	1	1	2	2	1	2	1	1	2	2	1	1	1	3	0	2	3	3	3	3	3	2	2	1	0	1	3	2	2	0	1	1	2	1	0	2	0	0
E. arciforceps	2	3	1	2	1	2	2	2	2	1	3	2	2	1	1	2	3	2	1	2	2	2	1	3	1	2	2	2	1	1	1	3	0	2	3	3	3	3	2	2	2	1	0	1	3	2	2	0	1	1	1	1	0	0	0	0
E. napensis	2	3	2	2	1	1	2	2	2	1	3	2	3	1	1	2	2	2	1	2	2	2	1	2	1	1	2	3	1	1	1	3	0	2	3	3	2	2	2	1	1	1	0	1	3	2	2	0	1	1	2	1	0	0	0	0
E. convexiforceps	2	3	1	2	1	2	2	2	2	1	2	2	2	1	1	1	3	2	1	2	2	3	1	3	1	1	2	2	1	1	0	3	0	2	3	3	2	2	2	1	1	1	0	1	3	2	2	0	1	2	1	1	0	3	0	0
E. distincta	2	3	3	3	2	1	3	2	1	3	2	1	1	1	1	1	3	2	2	1	2	3	1	3	2	2	2	2	1	1	0	2	1	2	3	4	3	3	2	2	1	1	2	1	3	1	0	0	1	2	3	1	0	3	0	0
Eu. obumbrata	1	2	2	2	2	2	3	3	3	1	2	2	2	2	2	2	2	2	2	3	2	0	1	3	3	1	3	2	2	1	1	3	1	3	3	2	3	3	2	2	1	2	0	1	3	4	3	1	0	2	0	0	0	0	1	1
M. marginalis	2	3	2	2	2	2	1	1	3	1	2	2	2	1	3	3	3	1	0	1	3	0	2	0	3	3	2	3	2	1	1	2	1	3	3	2	1	1	1	1	1	1	0	2	3	2	0	0	0	2	2	0	1	0	1	1
E. leptoforceps	2	3	3	2	1	1	2	1	2	1	3	2	3	1	1	2	2	2	2	2	2	2	1	3	1	3	2	2	1	1	0	2	1	2	2	4	2	3	3	2	2	1	0	1	2	3	0	0	0	2	0	0	0	0	0	0
E. woodi	2	3	3	3	2	1	2	3	2	2	2	2	1	1	2	2	1	3	0	1	2	2	1	3	2	2	2	3	2	2	0	3	0	3	3	5	3	3	3	2	2	1	0	1	2	2	2	0	1	2	1	1	0	0	0	0
Eu. sp nov.	1	1	2	3	2	1	3	3	2	1	1	2	2	2	2	1	1	2	0	1	2	0	1	3	1	2	2	4	2	2	1	3	0	3	3	2	3	3	2	2	2	2	0	1	2	2	0	1	0	2	0	0	0	0	1	1
E. nigrithorax	2	3	2	3	1	1	2	1	2	2	2	2	2	1	2	2	1	3	1	3	2	2	1	0	2	3	3	3	1	1	0	2	1	3	3	4	2	2	2	2	1	1	0	1	2	2	0	0	0	2	0	0	0	0	0	0
E. jaena	2	3	2	2	1	2	2	2	2	1	2	2	3	1	2	2	2	2	2	2	2	2	1	0	2	2	3	4	2	1	0	2	1	3	2	6	2	2	2	2	1	1	0	1	1	0	0	0	0	2	0	0	0	0	0	0
E. ecuadoriana	2	3	1	3	2	2	2	3	1	3	2	1	3	1	2	1	2	2	2	1	2	3	1	3	2	2	3	3	2	1	0	3	0	2	2	5	3	3	2	1	1	1	2	1	1	0	0	0	0	2	0	0	0	0	0	0
E. eois	1	2	3	3	2	1	2	2	1	2	1	1	1	1	2	1	2	2	2	2	2	2	1	2	2	3	3	3	2	2	0	3	1	3	3	6	3	3	2	2	1	1	0	1	1	0	0	0	0	2	0	0	0	0	0	0
E. abdominalis	2	2	2	2	1	1	2	2	3	1	2	2	2	1	1	2	2	2	2	2	2	2	1	0	2	3	2	3	1	1	0	2	1	2	2	4	3	3	2	2	2	1	0	1	1	0	0	0	0	2	0	0	0	0	0	0
E. curvifrons	2	3	3	1	1	1	1	2	2	1	3	1	3	1	2	3	2	2	2	2	2	2	1	0	1	3	3	3	1	1	0	2	1	2	2	5	1	2	1	1	1	1	0	1	1	0	0	0	0	2	0	0	0	0	0	0

Appendix 4. GenBank accession numbers for 13 *Erythromelana* and 1 *Blondeli*a COI sequences.

Genus	Species	Specimen ID	GenBank accession number
Erythromelana	*cryptica*	YY26213male	HQ634211
Erythromelana	*napensis*	YY8135male	HQ634214
Erythromelana	*ecuadoriana*	DI03PTmale	HQ634215
Erythromelana	*ecuadoriana*	YY37297male	HQ634217
Erythromelana	*woodi*	DI507ECUfemale	HQ634219
Erythromelana	*woodi*	DI84EC09male	HQ634221
Erythromelana	sp / *cryptica* species group	YY8740female	HQ634212
Erythromelana	sp / *cryptica* species group	YY8640female	HQ634213
Erythromelana	sp / *cryptica* species group	YY7599female	HQ634218
Erythromelana	sp / *jaena* species group	YY8844female	HQ634216
Erythromelana	sp / *jaena* species group	YY11445female	HQ634220
Erythromelana	sp / *jaena* species group	YY8485female	HQ634210
Erythromelana	sp / *jaena* species group	YY13862female	HQ634222
Blondelia	sp	JOS807.12.2	HQ634223

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