



Systematics, Morphology and Biogeography

Description of a new and highly distinctive genus and species of Euptychiina (Lepidoptera: Nymphalidae: Satyrinae) from the Brazilian southern Amazon

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ABSTRACT

A new genus and species of Euptychiina (Satyrinae), *Cristalinaia vitoria* Mota, Zacca & Freitas **gen. et sp. nov.**, is described based on three specimens collected in the region of the Cristalino River, Alta Floresta, Mato Grosso, Brazil. This rare species is known only from this region, where it flies inside the dense bamboo patches typical of that area. The last instar larva and the pupa are described; the larva was observed feeding on mature leaves of the common bamboo *Guadua* aff. *paniculata* Munro. [urn:lsid:zoobank.org:pub:D61EDE8D-CAE9-41C6-B24D-BB789873566E](https://doi.org/10.1016/j.rbe.2019.05.004)

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Introduction

In the last decade, a good number of genera in the Neotropical subtribe Euptychiina (Nymphalidae: Satyrinae) have been more or less intensively studied, especially since the start of a large collaborative international effort that began in 2013 and has resulted in 50 publications on the ecology, natural history, taxonomy and evolution of this group (see details in <http://www.flmnh.ufl.edu/museum-voices/euptychiina/>). During the process, the immature stages have been described for several species (e.g., Freitas et al., 2016a,b; Freitas, 2017), new phylogenetic hypothesis have been proposed based on morphology and molecular data (Marín et al., 2017; Espeland et al., 2019), many small and large genera have been reorganized (e.g. Zacca et al., 2017, 2018), and new genera and species have been described from throughout the Neotropics (e.g. Barbosa et al., 2015, 2016; Freitas et al., 2015, 2018; Huertas et al., 2016; Nakahara et al., 2015, 2018, 2019; Zacca et al., 2014; Benmesbah et al., 2018). A number of new species have been identified based on integrative taxonomic approaches targeting cryptic species complexes in large genera, as in the genus *Ypthimoides* Forster, 1964 (Barbosa et al., 2015), while others are clearly distinct based on external morphology, as was the case with the genus *Moneuptychia* Forster, 1964, which increased

from 2 to 8 species in a decade (Freitas et al., 2015 and references therein).

However, in the great majority of the above cases, newly described species were part of cryptic complexes that remained unnoticed in museum drawers, as can easily be observed from lists of examined material, including the types. By contrast, the present study is outstanding by describing a taxon apparently not present in any of the major examined collections. Moreover, this new taxon was initially discovered from a single field-collected larva that was reared to adult, resulting in a highly distinctive satyrine not closely resembling any other known. Subsequent intensive field work in the same region resulted in only two additional specimens, which compose the type series of this new species. Molecular and morphological characters confirm that this new Euptychiina species is seemingly not closely related to any of the known described genera. Accordingly, the present paper describes this southern Amazonian taxon as a new genus and species, and discusses the relevance of the present finding for Euptychiina systematics and conservation of the region.

Material and methods

Study site

All three known individuals were collected in the region of the “Cristalino Lodge” (9°35'51”S, 55°55'52”W), located near the west banks of the Cristalino River, in the municipality of Alta Floresta,

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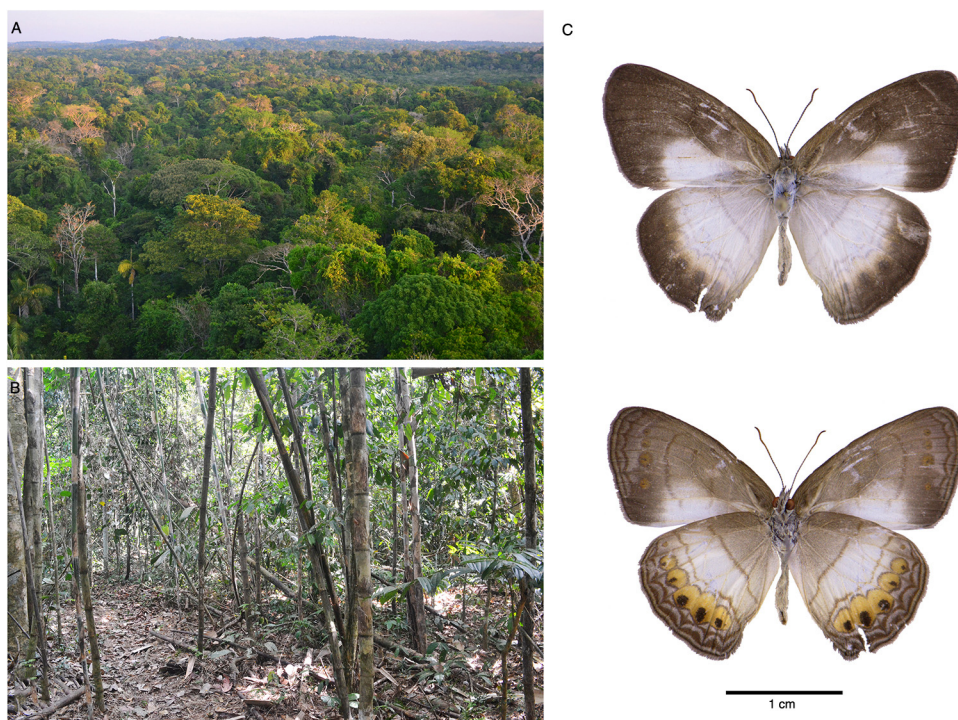


Fig. 1. Habitat and holotype of *Cristalinaia vitoria* gen. et sp. nov. in the type locality at Cristalino Lodge, Alta Floresta, Mato Grosso, Brazil. (A) A general view of the area; (B) a close view of the bamboo patch where the larva was found; (C) male holotype of *Cristalinaia vitoria* sp. nov. (dorsal above, ventral below).

northern Mato Grosso State (near the border with Pará State in northern Brazil) (Fig. 1A, B). The climate of the region is warm and wet, with average annual temperature of 24 °C and annual rainfall above 2400 mm, with a dry season lasting 3–5 months (Nimer, 1989). The vegetation in the region is transitional from ombrophilous to semideciduous (IBGE, 2004).

Morphological studies

The last instar collected in the field was reared in a 500 mL plastic container with fresh leaves of its bamboo hostplant offered *ad libitum*. Photographs of the larva and pupa were taken with a Nikon D3100, and of the last instar cephalic capsule and male genitalia using a Zeiss Stereo Discovery V.20 Stereomicroscope (Zeiss, Germany) in association with the AxioVision Rel.4.8 software for focus-stacking images.

One adult specimen had its abdomen detached and soaked in a heated test tube with 10% potassium hydroxide solution (KOH) for about 3–5 min in *bain marie* before dissection of the genitalia. Wing size was measured from base to apex on the forewing and base to outer margin on the hindwing using a ruler. The terminology for wing venation, wing pattern elements and genitalia follows Zacca et al. (2018). The following abbreviations are used throughout the text: FW – forewing; HW – hindwing; DW – dorsal wings; VW – ventral wings; DFW – dorsal forewing; VFW – ventral forewing; DHW – dorsal hindwing; VHW – ventral hindwing; * – specimen dissected. The taxonomic higher classification follows Lamas (2004) modified after Peña et al. (2006, 2010) and Wahlberg et al. (2009).

Specimens of different groups of Satyrini have been morphologically examined, photographed and/or dissected by all authors in more than 30 public and private collections (see e.g. Zacca et al., 2018), in addition to the original descriptions of Euptychiina genera (e.g. Forster, 1964). In addition, photographs of Neotropical butterfly type specimens taken by Gerardo Lamas and available in Warren et al. (2013) were also consulted and compared with the new taxon here described.

DNA sampling and analysis

Total DNA was extracted from two legs of adults (YPH-0835, BLU883 and BLU1055) using the DNeasy Blood & Tissue Kit protocol (QIAGEN, Düsseldorf, Germany). Total DNA (Deoxyribonucleic acid) was stored in TE buffer at –20 °C. The mitochondrial gene cytochrome c oxidase I (COI – 1498 bp), and the nuclear genes Glyceraldehyde-3-phosphate dehydrogenase (GAPDH – 691 bp) and Ribosomal Protein S5 (RpS5 – 610 bp) for most specimens, were amplified, purified and sequenced using standard techniques (see Barbosa et al., 2015; Silva-Brandão et al., 2005; Wahlberg and Wheat, 2008). The obtained sequences were deposited in GenBank (Benson et al., 2013) (see Table 1 for voucher numbers). All sequences were examined with the program FinchTV v. 1.4.0 (Geospiza, PerkinElmer Inc., Waltham, MA), and posteriorly aligned manually with sequences obtained previously and available on GenBank by using BioEdit v.7.2.4 (Hall, 2013). The final matrix comprised 81 specimens from 58 species of 34 genera (including three specimens from the new genus *Cristalinaia* gen. nov.). The phylogenetic relationships of the new species were estimated using a Maximum Likelihood (ML) analysis. Analyses were run using RAxML (Stamatakis et al., 2008) with 250 thorough searches for the maximum likelihood topology, followed by 1000 rapid bootstrap replicates with the data modeled according to the GTR+CAT model (Stamatakis et al., 2008) and partitioned by gene on the CIPRES portal (Miller et al., 2010).

Results

Cristalinaia Freitas, Barbosa & Zacca gen. nov.

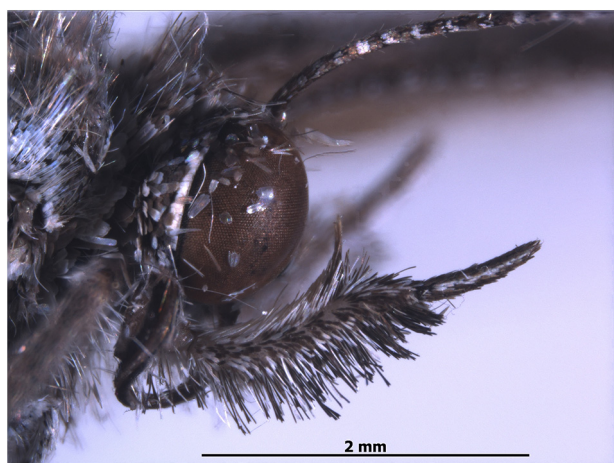
Type species. *Cristalinaia vitoria* Mota, Zacca & Freitas
 sp.n.urn:lsid:zoobank.org:act:C917EF80-C62A-4E41-8AA8-1CCD6637EB5Eurn:lsid:zoobank.org:act:0A7CC6EA-95F5-4179-AAF8-6220389C4B6D

Table 1
Species of Euptychiina with code, sampling site data and GenBank accession numbers for sequenced genes. *Cristalinaia gen. nov.* is in bold. Acronyms are explained in the Methods section.

Species	DNA voucher	Locality	COI	GAPDH	RPS5
<i>Oressinoma sorata</i>	CP06-89	Oxapampa, Peru	GQ357209	GQ357440	GQ357570
<i>Ypthima baldus</i>	NW98-5	Central Sulawesi, Palolo Valley, SE Berdikari, Indonesia	DQ338875	EU528416	EU528469
<i>Melanargia lachesis</i>	NW149-3	Languedoc, Aude, Villegly, France	GQ357222	GQ357463	GQ357593
<i>Karanasa bolorica</i>	NW166-10	E Pamir, Karateke district, Russia	GQ357246	GQ357504	GQ357630
<i>Erebia oeme</i>	EW24-7	Languedoc, Ariège 09, Ustou, Bois du Piéjau, France	DQ338780	EU141479	EU141375
<i>Maniola jurtina</i>	EW4-5	Sant Climent, N Spain, Spain	AY090214	EU141481	EU141376
<i>Pronophila thelebe</i>	CP03-70	Quebrada Siete Jeringas, Junín, Peru	DQ338859	EU528410	EU528461
<i>Paramacera xicaque</i>	CP15-08	Distrito Federal, Mexico	GQ357210	GQ357442	GQ357571
<i>Cyllopsis pertepida</i>	NW165-3	Guanajuato, Mexico	GQ357204	GQ357428	GQ357557
<i>Atlanteuptychia ernestina</i>	YPH-0191	Serra do Japi, Jundiá, São Paulo, Brazil	KP994863	KU340904	KU340937
<i>Atlanteuptychia ernestina</i>	EE001	Serra do Japi, Jundiá, São Paulo, Brazil	MG209749	MG546307	—
<i>Atlanteuptychia ernestina</i>	EE002	Serra do Japi, Jundiá, São Paulo, Brazil	MG209750	MG546308	—
<i>Atlanteuptychia ernestina</i>	NW136-14	São Luís do Paraitinga, São Paulo, Brazil	DQ338793	GU205947	GU206007
<i>Cristalinaia vitoria</i>	YPH-0835	Cristalino Lodge, Alta Floresta, Mato Grosso, Brazil	MK575530	—	—
<i>Cristalinaia vitoria</i>	BLU883	Cristalino Lodge, Alta Floresta, Mato Grosso, Brazil	MK575531	—	—
<i>Cristalinaia vitoria</i>	BLU1055	Cristalino Lodge, Alta Floresta, Mato Grosso, Brazil	MK575532	MK575543	MK575548
<i>Euptychia atlantica</i>	MGCL-LOAN-216	Reserva Serra Bonita, Camacan, Bahia, Brazil	KX833117	—	—
<i>Euptychia enyo</i>	CP06-73	Cordillera del Cóndor, Peru	GQ357205	GQ357430	GQ357559
<i>Euptychia mollina</i>	YPH-0154	Tapajós, Pará, Brazil	KP890210	KU340902	KU340935
<i>Inbio hilara</i>	LEP-14997	c. 6 km E Lita, Cachaco IM, Ecuador	KR818704	—	—
<i>Inbio hilara</i>	LEP-19587	—	MK575533	—	MK575549
<i>Euptychia sp.</i>	SN-2015	—	KR818703	—	—
<i>Chloreuptychia catharina</i>	CP01-68	Madre de Dios, Peru	GQ864749	GQ864942	GQ865413
<i>Hermeuptychia harmonia</i>	CP06-93	Oxapampa, Peru	GU205842	GU205955	GU206014
<i>Hermeuptychia pimpla</i>	CP04-10	Quebrada Siete Jeringas, Junín, Peru	GU205843	GU205956	GU206015
<i>Hermeuptychia maimoune</i>	YPH-0239	Rio Madeira, Porto Velho, Rondônia, Brazil	KR349479/KT880199	KR349475	KR349472
<i>Hermeuptychia fallax</i>	YPH-0368	Santa Teresinha, Bahia, Brazil	KU340868	—	KU340950
<i>Pindis squaminstriga</i>	NW165-5	Guanajuato, Mexico	GQ357211	GQ357445	GQ357574
<i>Godartiana armilla</i>	PM04-02	Brasília, Distrito Federal, Brazil	JQ392582	JQ392816	JQ392921
<i>Godartiana luederwaldti</i>	YPH-0200	Goiás, Goiás, Brazil	KT880201	KT880210	—
<i>Godartiana muscosa</i>	YPH-0319	Foz do Iguaçu, Paraná, Brazil	KT880203	KT880212	—
<i>Godartiana muscosa</i>	NW127-8	Serra do Japi, Jundiá, São Paulo, Brazil	DQ338582	GQ864974	GQ865443
<i>Amphidecta calliomma</i>	YPH-0355	—	MK575534	MK575544	MK575550
<i>Amphidecta calliomma</i>	YPH-0356	—	MK575535	MK575545	MK575551
<i>Amphidecta pignerator</i>	YPH-0308	Foz do Iguaçu, Paraná, Brazil	MK575536	MK575546	MK575552
<i>Zischkaia pacarus</i>	CP14-02	—	GQ864819	GQ865049	GQ865512
<i>Splendeuptychia itonis</i>	CP02-44	Madre de Dios, Peru	DQ338811	GQ357447	GQ357576
<i>Splendeuptychia hygina</i>	YPH-0317	Foz do Iguaçu, Paraná, Brazil	MK575537	—	—
<i>Splendeuptychia boliviensis</i>	CP02-48	Madre de Dios, Peru	GU205866	GU205980	GU206041
<i>Splendeuptychia libitina</i>	YPH-0318	Foz do Iguaçu, Paraná, Brazil	MK575538	MK575547	—
<i>Forsterinaria boliviana</i>	CP04-88	Quebrada Siete Jeringas, Junín, Peru	DQ338799	GQ357435	GQ357564
<i>Forsterinaria necys</i>	NW126-10	Ribeirão das Pedras, São Paulo, Brazil	GU205837	GU205950	—
<i>Forsterinaria quantius</i>	PM10-05	Serra do Rola Moça, Nova Lima, Minas Gerais, Brazil	JQ392596	JQ392829	JQ392934
<i>Forsterinaria itatiaia</i>	YPH-0453	Serra do Caparaó, Minas Gerais, Brazil	MK575539	—	—
<i>Forsterinaria itatiaia</i>	YPH-0454	Serra do Caparaó, Minas Gerais, Brazil	MK575540	—	—
<i>Sepona punctata</i>	YPH-0240	Abunã, Porto Velho, Rondônia, Brazil	KR349480	KR349476	—
<i>Sepona punctata</i>	YPH-0494	Conceição do Mato Dentro, Minas Gerais, Brazil	KR349482	—	—
<i>Sepona punctata</i>	YPH-0503	Reserva Trabijú, Pindamonhangaba, São Paulo, Brazil	KR349484	—	—
<i>Taygetis tripunctata</i>	YPH-0579	Aquidauana, Mato Grosso do Sul, Brazil	MK575541	—	MK575553
<i>Taygetina banghaasi</i>	LEP-00435	Filo de Chumbiriatza, Zamora-Chinchipe, Ecuador	JQ392633	JQ392854	JQ392964
<i>Harjesia obscura</i>	YPH-0238	Rio Madeira, Porto Velho, Rondônia, Brazil	KU340858	KU340905	KU340938
<i>Erichthodes antonina</i>	YPH-0325	Alagoas, Brazil	KU340864	KU340913	KU340946
<i>Prenda clarissa</i>	AVLF-1	São Francisco de Paula, Rio Grande do Sul, Brazil	HQ444284	—	—
<i>Taydebis peculiaris</i>	NW149-11	Campos do Jordão, São Paulo, Brazil	GQ864811	GQ865036	GQ865499
<i>Taydebis peculiaris</i>	YPH-0375	Campos do Jordão, São Paulo, Brazil	MK575542	—	—
<i>Nhambikuara mima</i>	MGCL-LOAN-550	Porto Velho, Rondônia, Brazil	MF489994	MF490009	MF490025
<i>Nhambikuara mima</i>	MGCL-LOAN-175	Ibateguara, Alagoas, Brazil	MF489993	—	—
<i>Nhambikuara cerradensis</i>	YPH-0572	Serra do Cipó, Santana do Riacho, Minas Gerais, Brazil	MF489984	MF490004	MF490017
<i>Nhambikuara cerradensis</i>	YPH-0573	Serra do Cipó, Santana do Riacho, Minas Gerais, Brazil	MF489985	MF490005	MF490018
<i>Nhambikuara cerradensis</i>	YPH-0574	Serra do Cipó, Santana do Riacho, Minas Gerais, Brazil	MF489986	MF490006	MF490019
<i>Nhambikuara cerradensis</i>	YPH-0575	Aquidauana, Mato Grosso do Sul, Brazil	MF489987	—	MF490020
<i>Nhambikuara cerradensis</i>	YPH-0576	Aquidauana, Mato Grosso do Sul, Brazil	MF489988	MF490007	MF490021
<i>Nhambikuara cerradensis</i>	MGCL-LOAN-134	Itirapina, São Paulo, Brazil	MF489995	—	—
<i>Splendeuptychia furina</i>	CP02-39	Madre de Dios, Peru	GU205868	GU205982	GU206043
<i>Splendeuptychia toynei</i>	LEP-10657	Los Encuentros-Zarza, Zamora-Chinchipe, Ecuador	MF489990	—	MF490023
<i>Splendeuptychia doxes</i>	MGCL-LOAN-386	Serra do Japi, Jundiá, São Paulo, Brazil	MF489992	—	—
<i>Splendeuptychia doxes</i>	BC-DZWII-092	Pq. Estadual Lago Azul, Campo Mourão, Paraná, Brazil	MF489991	—	MF490024
<i>Splendeuptychia doxes</i>	NW126-8	Atibaia, São Paulo, Brazil	GU205867	GU205981	GU206042
<i>Splendeuptychia doxes</i>	YPH-0172	Serra do Japi, Jundiá, São Paulo, Brazil	KR349478	KR349474	—
<i>Splendeuptychia latia</i>	MGCL-LOAN-500	Reserva Biológica de Una, Una, Bahia, Brazil	MF489996	—	—
<i>Paryphthimoides grimon</i>	CP10-01	Saibadela, Sete Barras, São Paulo, Brazil	DQ338806	GQ865015	GQ865483
<i>Cissia myncea</i>	CP01-58	Tampopata Research Center, Madre de Dios, Peru	GU205832	GU205944	GU206004
<i>Cissia myncea</i>	NW108-6	Picinguaba, Ubatuba, São Paulo, Brazil	DQ338581	GQ357427	GQ357556
<i>Magneuptychia moderata</i>	CP01-36	Madre de Dios, Peru	GU205847	GU205960	GU206019

Table 1 (Continued)

Species	DNA voucher	Locality	COI	GAPDH	RPS5
<i>Splendeptychia ashna</i>	CP01-19	Madre de Dios, Peru	GU205865	GU205979	GU206040
<i>Cissia similis</i>	DNA97-014	Orange Walk District, Belize	AY508529	—	—
<i>Cissia similis</i>	07-SRNP-14171	Area de Conservacion Guanacaste, Costa Rica	JQ538434	—	—
<i>Magneptychia ocytete</i>	CP01-32	Tambopata Research Center, Madre de Dios, Peru	GU205848	GU205961	GU206020
<i>Magneptychia pallega</i>	CP02-41	Albergue Posada Amazonas, Madre de Dios, Peru	GU205849	GU205962	GU206021
<i>Capronnieria galesus</i>	NW167-5	Pq. Nac. Serra do Itajai, Apiúna, Santa Catarina, Brazil	GU205826	GU205938	GU205998
<i>Archeptychia cluena</i>	NW149-9	Est. Biol. Boracéia, Salesópolis, São Paulo, Brazil	GQ864736	GQ864926	GQ865392

Fig. 2. Lateral view of the head of *Cristalinaia vitoria* gen. et sp. nov.

Diagnosis. *Cristalinaia* gen. nov. differs from all other genera of Euptychiina by the VHW ocelli with very broad orange ocellar rings, reduced black ocellar spots with no pupils (Fig. 1C) and the male 8th abdominal tergite strongly sclerotized, except by the unsclerotized antero-dorsal region (Fig. 4B, C). The female is unknown.

Etymology. The generic name is derived from the Cristalino River, a river of dark translucent waters near which the specimens were collected (the word “cristalino” is Portuguese for “crystal clear”, alluding to the translucent waters of the river). It also alludes to the Reserva Particular do Patrimônio Natural Cristalino (Cristalino Private Reserve) and to the “Fundação Ecológica Cristalino” (Cristalino Ecological Foundation), both founded by Vitoria da Riva Carvalho. The gender of the name should be considered feminine.

Cristalinaia vitoria Mota, Zacca & Freitas sp. nov. (Figs. 1–6).

Type material. Holotype male, deposited in the Museu de Zoologia da Universidade Estadual de Campinas (ZUEC), Campinas, São Paulo, Brazil (Fig. 1C). Labels on the holotype (five labels separated by transverse bars): /HOLOTYPE/BRAZIL, Mato Grosso, Alta Floresta, Cristalino Lodge, 9°35'41"S 55°55'52"W, 2.II.2016, 240–260 m, LLM 280, Luisa L. Mota leg., ex larva/DNA voucher – BLU 883/ZUEC LEP 10648/*Cristalinaia vitoria* Mota, Zacca & Freitas det. 2018/.

Paratypes. 2 males (1 dissected). BRAZIL – Mato Grosso: Alta Floresta, Cristalino Lodge, 9°35'41"S 55°55'52"W, 1 male, 20.IV.2016, LLM 509 (DNA voucher BLU 1055), ZUEC LEP 10650, 1 male, 3.VIII.2018, LLM 52.2018 (DNA voucher YPH 0835), ZUEC LEP 10649*, Luisa L. Mota leg. ZUEC.

Diagnosis. *Cristalinaia vitoria* sp. nov. superficially resembles several other species of Euptychiina (e.g. *Pareptychia* species, *Pseudeptychia* species, *Splendeptychia toynei* Willmott & Hall, 1995, *S. aurigera* (Weymer, [1911]), *S. triangula* (Aurivillius, 1929)) by the white ground color on the wings, but it can be easily distinguished from them by the incomplete median line and four tiny ocelli from M₁ to CuA₂ on the VFW, by the five VHW ocelli between M₁ to 2A that have a very broad orange ocellar ring and black ocellar

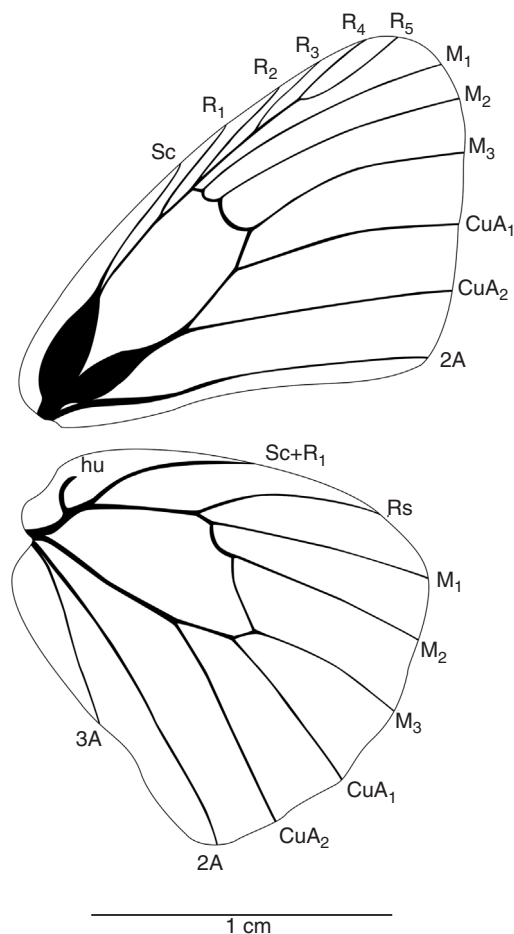


Fig. 3. Wing venation of *Cristalinaia vitoria* gen. et sp. nov. Sc, subcostal vein; R, radial vein; M, median vein; CuA, cubital vein; A, anal vein; h, humeral vein; +, fusion between veins.

spot in the distal half of ring plus a very small ocelli in Rs-M₁, and the broadened VHW reddish brown marginal line forming crescents in each cell.

Description. **Head:** Brown and glabrous eyes; antennae with 38 flagellomeres ($n = 1$), whitish short scales at base of each flagellomere; labial palpi covered by dark brown elongated scales mixed with creamy scales; third segment with short brown scales and creamy scales in lateral view, first and third labial palpi segments almost same length, second segment 1½ length of third segment (Fig. 2). **Thorax:** dark brown covered by whitish short scales and elongated filiform scales; coxae and femur covered by whitish short scales, tibia and tarsus covered by dark brown short scales and reduced spines; pair of tibial spurs at distal end of tibia. **Wings:** FW length: 16.5 mm (HT) – 17–19 mm (PT). **Venation** (Fig. 3): FW with subcostal and media-cubital veins dilated at mid-basal region (more than 10 times wider than mid-apical region of vein) and 2A slightly dilated at mid-basal region (about twice wider than mid-apical region of vein); discal cell half-length of wing length. HW with

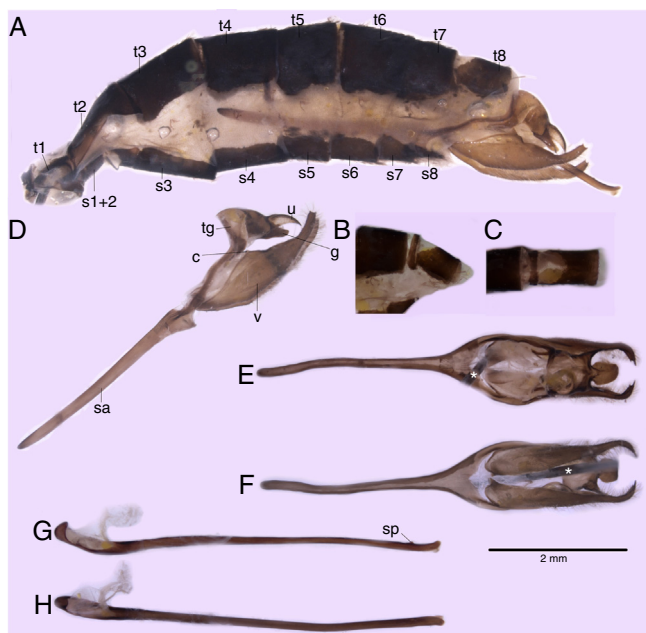


Fig. 4. Abdomen and male genitalia of *Cristalinaia vitoria* gen. et sp. nov.: (A) Abdomen (lateral); (B–C) 8th abdominal tergite: (B) lateral, (C) dorsal; (D–H) Male genitalia: (D) lateral, (E) dorsal, (F) ventral, (G) Phallus, lateral; (H) Phallus, dorsal. t, tergite; s, sternite; tg, tegumen; g, gnathos; u, uncus; v, valvae; c, costae; sa, saccus; sp, spine. The small white asterisk in E and F indicates the insect pin used for placing the genitalia in position.

developed humeral vein curved in direction to costal margin; discal cell 2/3 length of entire length of wing. **DFW**: ground color brown, whitish area between M_3 and inner margin from base to median region. **DHW**: ground color brown, whitish area between costal and inner margin from base to median region. Elements of ventral wings can be seen throughout transparency. **VFW**: similar to DFW; thin submedian line restricted to discal cell, irregular thin median line from costal margin to 2A, thin crenulated submarginal line from

costal margin to tornus, thin marginal line from costal margin to tornus; four tiny ocelli from M_1 to CuA_2 . **VHW**: thin submedian line from costal to inner margin, thin median line restricted to CuA_2 and inner margin, submarginal line crenulated from costal to inner margin, broad marginal line forming crescents in each cell (Fig. 1C); six ocelli from R_s to 2A, tiny ocellus in cell R_s-M_1 , ocelli from M_1 to 2A with a broad orange ocellar ring surrounding, black ocellar spot distally and with no pupils. **Abdomen**: dark brown covered by whitish short scale; 8th tergite rectangular and strongly sclerotized, excepted by the antero-dorsal unsclerotized region (Fig. 4B, C); 8th sternite reduced. **Male genitalia** (Fig. 4A, D–H): Tegumen subtriangular laterally; appendix angularis absent; ventral projection of tegumen and dorsal projection of saccus fused and angulated at mid-region; anterior projection of saccus well-developed and ventrally open; uncus robust, tapering at apex laterally; gnathos smaller than uncus and robust; valvae trapezoid, 2/3 length of saccus with two reduced spines at apex, covered by small filiform scales, costae reduced; phallus 2/3 length of anterior projection of saccus, vesica without cornuti. **Female**: Unknown.

Distribution. *Cristalinaia vitoria* sp. nov. is known only from its type locality in the region of Cristalino Lodge, Alta Floresta, northern Mato Grosso. The site is a private protected area (the “Reserva Particular do Patrimônio Natural Cristalino”).

Natural history. This species is extremely scarce; only three individuals have been observed (and collected) over the course of about 600 h of field work, distributed over more than 250 days in all months, from September 2015 to August 2018. In addition, previous collecting trips to the type locality by Keith S. Brown Jr. and AVLF (in February and June 2000) and several butterfly watching groups that visited the area did not detect this species (LLM & AVLF *in prep.*). Based on the very few available data from the three known individuals, *C. vitoria* sp. nov. is restricted to the dense bamboo patches that are common within the forests of the region. The two adults were found within 5 m from each other, although more than two years apart. They were both observed in the shady understory of the bamboo patch at around midday with temperatures above 30 °C, which are not unusual in the area (LLM pers. obs.). Their flight was low (between 0.5 and 1.0 m) and erratic, and they rested on the



Fig. 5. Immature stages of *Cristalinaia vitoria* gen. et sp. nov. Last instar: (A) lateral, (B) dorsal, (C) frontal view of last instar head capsule. Pupa: (D) dorsal, (E) lateral.



Fig. 6. Maximum Likelihood consensus tree showing the phylogenetic relationships between *Cristalinaia vitoria* gen. et sp. nov. and other Euptychiina genera. Numbers above branches are bootstrap values. Values below 75 are not shown.

upper side of leaves with wings closed. A single last instar (Fig. 5A, B) was found in the field, in a sunny area about 100 m away from where the adults were collected, feeding on mature leaves of the common bamboo *Guadua* aff. *paniculata*. The larva is entirely green with numerous longitudinal thin light stripes on the body and with a pair of caudal filaments about four times the length of the 10th abdominal segments. The head is green with a pair of short scoli, one on each side of the epicranial/vertical notch (Fig. 5C). The total larval length was 27 mm, the head capsule width was 2.34 mm and the head scoli were of length 1.1 mm. The pupa (Fig. 5D, E) is elongated and smooth, entirely green with thin subtle dorsal dark green stripes and a white line dorsally bordering the wing cases. The ocular caps are very short and rounded, the cremaster is green and the dorsal abdomen is smooth, without projections. The total pupal length was 13 mm.

Etymology. The specific name is after Vitoria da Riva Carvalho, in recognition of her pioneering work on the conservation of the southern Amazon, and founder of the Cristalino group (which includes the “Fundação Ecológica Cristalino”, Cristalino Lodge and Cristalino Private Natural Heritage Reserves). The specific epithet should be considered feminine and indeclinable in accordance to the Article 31.2.3 (ICZN, 1999).

Phylogenetic analyses

Maximum Likelihood analysis using DNA sequence data from three genes (Fig. 6) supports the description of this new genus and new species, although more sequence data and/or taxa are needed to more confidently refine the relationships of *Cristalinaia* gen. nov. within Euptychiina. Based on the current analysis, the new genus appears as an isolated long branch and cannot be assigned to any of the known genera or any of the Euptychiina clades previously proposed by Peña et al. (2010), Marín et al. (2017) and Espeland et al. (2019) or in ongoing studies (EPB unpublished data), a situation similar to that reported for other studies describing new monobasic genera (Freitas et al., 2016c; Kaminski et al., 2017; Nakahara et al., 2019).

Discussion

The wing color pattern of *Cristalinaia vitoria* gen. et sp. nov. is at first glance somewhat similar to that of several other Amazonian satyrines, especially some species of *Splendeuptychia* Forster, 1964. The pattern of the whitish coloration on the DFW and DHW of *Cristalinaia vitoria* gen. et sp. nov. resembles that of *Pseudeuptychia*

hemileuca (Staudinger, [1886]), *Splendeuptychia toynei* Willmott & Hall, 1995, *S. aurigera* (Weymer, [1911]), *S. triangula* (Aurivillius, 1929) and most species of *Pareuptychia* Forster, 1964. However, *C. vitoria* **sp. nov.** can be easily distinguished from all of these species by the curved median line from the Radius to 2A on the VFW, one tiny ocellus in Rs-M₁ and five ocelli with broad orange ocellar ring from M₁ to 2A on VHW.

The male genitalia of *C. vitoria* **sp. nov.** resembles that found in species of *Stenaria* Vitoria, Costa, Neild & Nakahara, 2016 (see Costa et al., 2016, Figs 40–41), mainly by the long saccus and phallus occupying more than a half of the abdomen length, but there are significant differences in other structures of *C. vitoria* **sp. nov.**, as such the robust gnathos, phallus with small spine at the dorso-apical region (Fig. 4G), apex of the valvae with two reduced spines (Fig. 4D) and vesica without cornuti. Similar long saccus and phallus are known to occur in some clearwing butterflies in the subtribe Godyridina (Danainae: Ithomiini; see Willmott and Freitas, 2006), a group not closely related to Satyrinae (Wahlberg et al., 2009). Another interesting feature of *C. vitoria* **sp. nov.** is the pattern of sclerotization of the 8th abdominal tergite (Fig. 4B, C); in other species of Euptychiina, the 8th tergite is membranous with a sclerotized half-ring at the anterior region (Nakahara et al., 2016; Willmott et al., 2018; TZ pers. obs.). The above cited characteristics make *C. vitoria* **gen. et sp. nov.** unique among the Euptychiina. Other characters of the male genitalia and wing color pattern were also inconclusive to assign *C. vitoria* **gen. et sp. nov.** to any known Euptychiina clade, agreeing with the molecular data.

Concerning the immature stages, the last instar is at first glance similar to those of several Euptychiina with green-striped larva, especially those of *Zischkaia pacarus* (Godart, [1824]) and *Godartiana muscosa* (A. Butler, 1870) (Freitas and Peña, 2006; Freitas et al., 2016a, 2016b; Zacca et al., 2017; See et al., 2018). However, the shape of last instar head scoli and the pupal profile are quite distinct from all these species. In fact, the larval color pattern is very similar to the ground color present in the elongated leaves of bamboos and grasses, suggesting that camouflage could be involved (see also Freitas, 2017 for a similar case), explaining why several unrelated species of Euptychiina are convergent in larval coloration.

Finally, it is important to draw attention to the conservation status of the entire region of the Cristalino River in the Alta Floresta municipality. The forests of the region have been highly impacted in recent decades, especially in the western frontier of the Parque Estadual Cristalino (Cristalino State Park (de Paulo et al., 2015)). The regional landscape is now dominated by forest fragments embedded in a matrix of pastures, resulting in obvious loss of habitat quality and major changes in local climate (Dubreuil et al., 2012). However, in the “Reserva Particular do Patrimônio Natural Cristalino”, the type locality of *C. vitoria* **gen. et sp. nov.**, the forests are still preserved; moreover, the area is contiguous to the large Cristalino State Park and, hopefully, the total preserved area (summing 184,000 ha) is large enough to protect the new taxon here described, as well as the entire regional biota. This work thus underlines the importance of conservation efforts in the Southern Amazon, where other remarkable, phylogenetically distinctive species surely await discovery.

Author contributions

Manuscript idealization: AVLF and LLM; collecting and immature stages rearing: LLM; morphology: TZ; phylogeny: EPB; writing, review and figures: All authors.

Conflicts of interest

The authors declare no conflicts of interest.

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