

A NEW SPECIES OF *PAIWARRIA* (LEPIDOPTERA: LYCAENIDAE:
EUMAEINI) FROM WESTERN ECUADOR

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Abstract.—A new eumaeine lycaenid species, *Paiwarria chuchuvia*, n. sp., is described and illustrated from wet premontane forest in the western Ecuadorian Andes. Its sister species, *Paiwarria episcopalis* (Fassl), appears to be distributed allopatrically in the central and eastern Andes. The generic placement of both species is discussed.

Key Words: Andes, Colombia, Ecuador, *Fasslantonius*, *Paiwarria*, *P. episcopalis*

During nearly fifteen years of studying lycaenid butterflies in Ecuador, as part of our “Butterflies of Ecuador” project (see <http://www.butterfliesofecuador.com>), we have collected nearly 100 undescribed species. Nearly 130 Ecuadorian lycaenid species in total still require description, approaching one quarter of the country’s lycaenid fauna. We continue here our lycaenid descriptive work (Torres et al. 1996, Hall et al. 2005) by describing from the western Ecuadorian Andes a new species in the genus *Paiwarria* Kaye, one of four genera in the *Eumaeus* section (Robbins 2004) of the Eumaeini (Eliot 1973). The other genus in this section with undescribed Ecuadorian species is *Mithras* Hübner, but these will be treated elsewhere.

METHODS

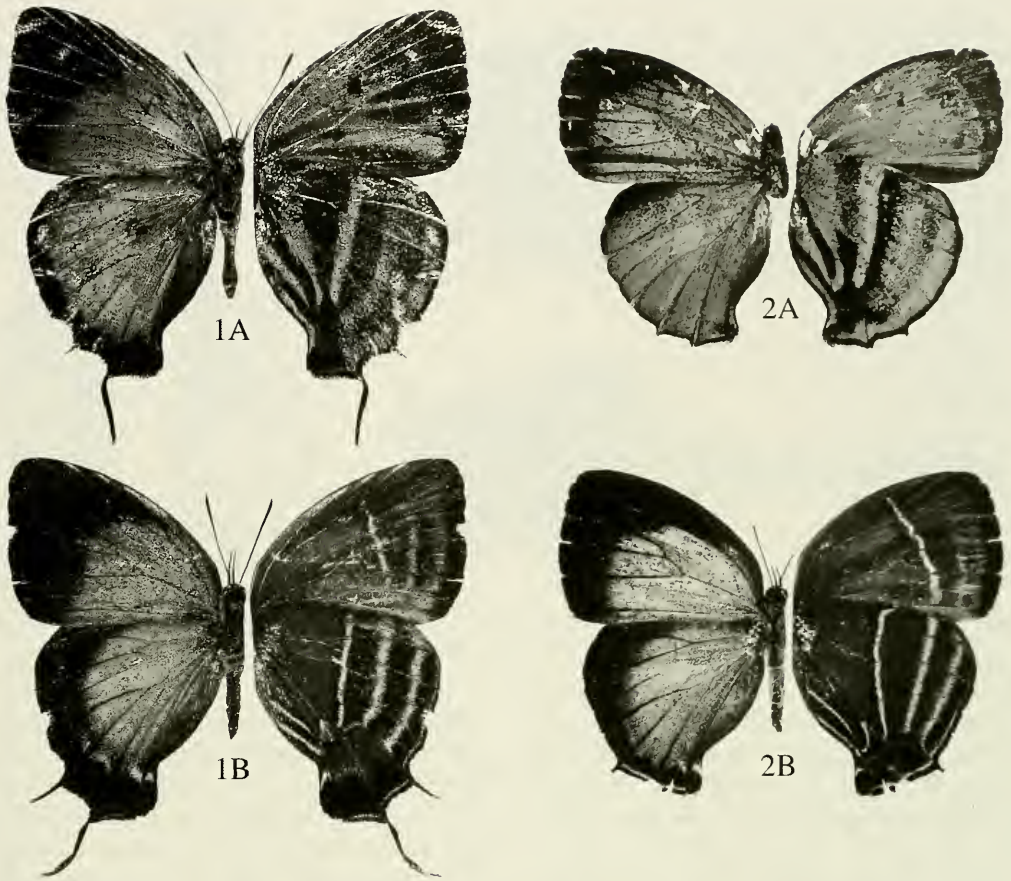
Morphological terms for genitalia largely follow Eliot (1973) and Robbins (1991), and terminology for wing venation follows Comstock and Needham (1918), with cells named for the vein above, or anterior. Light microscopy examination was done using an Olympus SZH. The digital images in Figs.

1–2 were taken using a Nikon Coolpix 995, and those in Figs. 3–4 were taken using a Nikon D1X attached to a Microptics Digital Imaging System.

Paiwarria chuchuvia Hall and Willmott, new species

(Figs. 1A, B; 3; 4)

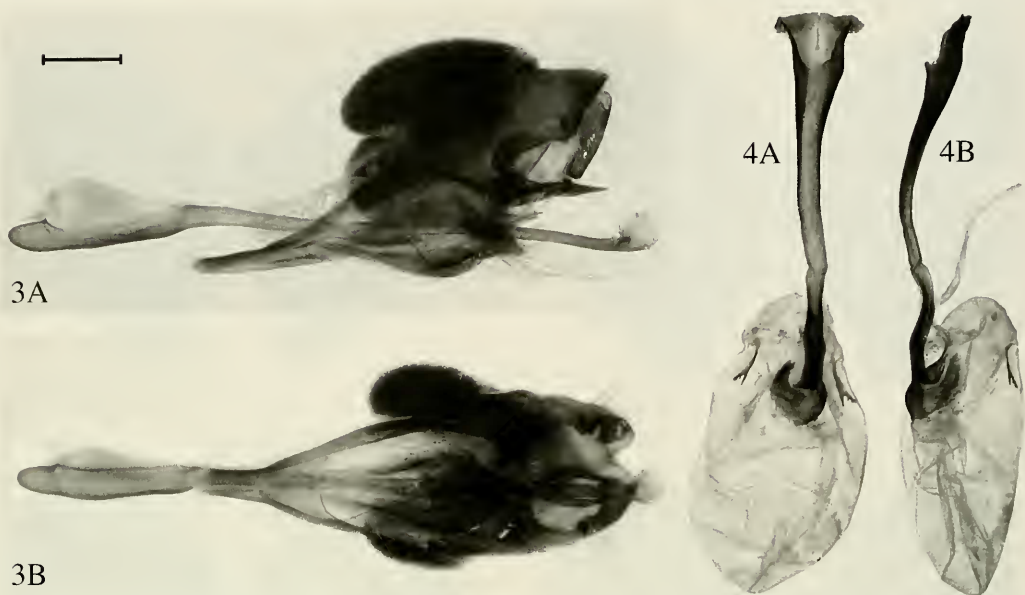
Description.—Male: Forewing length 19 mm. Forewing costal margin convex, distal margin approximately straight; hindwing anal margin convex then slightly indented before tornus, apex rounded and distal margin slightly undulating towards tornus, a long tail at vein Cu_2 and a short tail at vein Cu_1 ; forewing with four radial veins. *Dorsal surface:* Both wings pale iridescent green, with a broad black apex on forewing extending from tornus to just beyond midpoint of costa, a uniformly broad black border around distal margin of hindwing, and a gray hindwing anal margin, distal margin of green area angled at vein M_3 on forewing and undulating on hindwing, tips of long (and probably short) tails white; forewing androconial cluster appears to be a scent pad versus a scent patch (*sensu* Clench



Figs. 1–2. *Paiwarria* adults (dorsal surface on left, ventral surface on right). 1A, Holotype ♂ *P. chuchuvia*, Río Chuchuví, W. Ecuador (USNM). 1B, Paratype ♀ *P. chuchuvia*, Anchayaçu, W. Ecuador (JHKW). 2A, Paralectotype ♂ *P. episcopalis*, Río Aguacatal, W. Colombia (BMNH). 2B, ♀ *P. episcopalis*, Río Abanico, E. Ecuador (JHKW).

1975, Robbins 1991) and consists of a very small, circular, dense patch of elongate, smooth-tipped brown scales (half width of surrounding green scales) in upper distal corner of discal cell; visible fringe on both wings black. *Ventral surface*: Ground color of forewing bright iridescent green, with broad black anal and distal margins, subapex a mixture of green and black scales, a large triangular area of black scales towards base of both cells Cu_1 and M_3 , area in discal cell occupied dorsally by scent pad largely bare, revealing a dark reddish brown substance between two wing membranes, a large rectangular scent pad immediately below this bare area (containing similar scales

to dorsal scent pad) occupies center of discal cell end; ground color of hindwing bright iridescent green, with two uniformly narrow black stripes along anal margin below vein Cu_2 extending from wing margin to near tornus, a broad black discal band that extends vertically from near costal margin to near tornus, tapering sharply towards tornus, a uniformly broad, slightly curved, postdiscal black band that extends from costal margin to same point near tornus, and a uniformly broad, curved, submarginal black band that extends from apex to vein Cu_2 , all three broad black bands scattered with dark iridescent green scales that are most readily visible at an oblique angle, cell



Figs. 3–4. *Paiwarria* genitalia. 3, Male genitalia of *P. chuchuvia* in lateral (A) and ventral (B) views. 4, Female genitalia of *P. chuchuvia* in ventral (A) and lateral (B) views. Scale bar = 1 mm.

Cu₂ with a very thin pale bluish line at distal margin, a large black rectangle proximally, and a large, round, dark red spot proximal to that, tails black, long (and probably short) tails with a white tip.

Head: Labial palpus black, with white scaling at outer base of segment two, second and third segments elongate, third segment pointed slightly downwards; eye brown and setose, surrounded by iridescent green scaling; frons entirely iridescent green; antenna 40% length of forewing, segments brown with darker sclerotization around tip and white scaling at base, elongate clubs black.

Body: Dorsal surface of thorax (including tegula) and abdomen pale iridescent green, ventral surface black; all legs black.

Genitalia (Fig. 3): Uncus rectangular in lateral view, with a pointed ventral posterior corner, additional sclerotization along inner posterior margin, and a shallow “V”-shaped medial indentation dorsally; gnathos smoothly rounded at elbow, constricted in diameter before tip; tegumen flattened dorsally to accommodate a dorsolateral pair of large, elongate brush organs, with a broadly

triangular, slightly inwardly curved, posteroventral projection four to six times width of lower portion of vinculum; vinculum extends at nearly 45° almost seamlessly into a long and narrow saccus; valvae in lateral view approximately oval shaped, with smoothly convex ventral and dorsal margins, bluntly triangular posterior tips and a desclerotized medial area, valvae in ventral view laterally bulbous medially before gradually tapering to pointed tips, valvae joined at anterodorsal margin by membranous tissue; aedeagus long, uniformly very narrow and approximately straight, with a pointed posterior tip, ductus ejaculatorius exits anterior region of aedeagus from an elongate dorsal area immediately before rounded anterior aedeagal tip; single cornutus, positioned in posterior mouth of aedeagus when vesica uneverted, posteriorly bulbous with a serrate dorsal margin, tapering to a long and narrow, flattened anterior rod; eighth abdominal tergite rectangular.

Female: Forewing length 17 mm. Wing shape similar to male, but hindwing slightly more elongate, with a more prominent tornal lobe. **Dorsal surface:** Differs from male

by a paler black ground color on both wings, considerably broader black margins on both wings, particularly in apex, a duller and slightly more turquoise green iridescence, a more angular distal margin to forewing green, and submarginally positioned semicircles of white scaling in three tornal cell spaces below vein Cu_1 . *Ventral surface*: Ground color of both wings pale brown, with a faint, dull greenish tinge to basal third of wings, basal greenish-brown area on hindwing well-defined; both wings with three narrow, dirty white lines, approximately evenly spaced and parallel to distal margin, one immediately distal to discal cell end, one submarginal and one in-between, basalmost line slightly thinner, more crisply defined and brighter white, lines on forewing less prominent and confined to middle of wing between radial veins and middle of cell Cu_2 , basalmost line on hindwing forms a "W" shape in middle of cell Cu_2 before extending proximally towards anal margin, distal two lines on hindwing interrupted by red markings in cells Cu_2 to M_3 , with middle line extending proximally to anal margin and outer line extending directly to anal margin, largest subtornal red marking in cell Cu_1 and smallest in cell M_3 , three large black spots occupy tornus distal to red markings and below vein Cu_1 , very thin white line extends along entire distal margin of hindwing.

Head: Differs from male as follows: Second and third segments of labial palpus more elongate, third segment at least twice as long; eye surrounded by white scaling; frons black with white scaling along lateral margins; antenna 30–40% of forewing length, antennal segments with a narrow nudum area visible ventrally.

Body: Differs from male as follows: Dorsal surface of thorax and abdomen duller iridescent green, ventral surface grayish; all legs brown, with white scaling on ventral surface of tibiae and white banding on tarsal segments.

Genitalia (Fig. 4): Bursa copulatrix oval, with a pair of sclerotized invaginated signa

that have one large and two very small anteriorly directed spines towards anterior tip; ductus seminalis exits bursa copulatrix immediately posteriorly to junction of ductus bursae and is lightly sclerotized along ventral base; anterior ductus bursae a sclerotized, convex-concave tube that forms a broad, "horseshoe"-shaped, sclerotized bursal pouch at junction with bursa copulatrix, junction of anterior and posterior portions of ductus bursae slightly desclerotized and flexible, posterior ductus bursae a slightly curved sclerotized tube that broadens gradually towards posterior opening and has a faint dorsal desclerotized band along its entire length; lamella postvaginalis with a "U"-shaped ventral margin, a smoothly uneven posterior margin, and a broad band of dorsally folded sclerotization along posterior margin.

Type material.—Holotype ♂, ECUADOR: *Esmeraldas*, Río Chuchuví, km. 12.5 Lita-San Lorenzo rd., 0°53.01'N 18°30.90'W, 800–900 m, July (R. Aldas) (National Museum of Natural History, Smithsonian Institution, Washington, DC, USA [USNM]).

Paratypes, ECUADOR: *Esmeraldas*, 1 ♀, same locality data as holotype, 1 November (K. R. Willmott) (Collection of Jason P. W. Hall and Keith R. Willmott, Washington, DC, USA [JHKW]); 1 ♀, Anchayacu, km. 15 Lita-San Lorenzo rd., 900 m, 1 July (K. R. Willmott) (JHKW). *Imbabura*, 1 ♀, Río Verde, km. 16 Lita-Ibarra rd., 1450 m., 3 August (K. R. Willmott) (Museo Ecuatoriano de Ciencias Naturales, Quito, Ecuador [MECN]).

No additional specimens have been located in other major World museums (as listed in Hall 1999, 2002).

Etymology.—The species name is a feminine noun derived from the name of the type locality.

Diagnosis.—*Paiwarria chuchuvia* can be genuinely confused only with *P. episcopalis* (Fass!). The fact that both species share a unique male ventral wing pattern, consisting of a brilliant green iridescence

crossed on the hindwing by broad, evenly spaced black bands, and a patch of androconial scales at the end of the forewing discal cell on both wing surfaces, suggests that they are sister species. Fassl (1912) described *P. episcopalis* from three male specimens, all from Río Aguacatal in western Colombia (2000 m), and stated that they were deposited in the collections of Brabant, Fassl and Courvoisier. As these specimens reside in multiple European collections and exhibit significant wing pattern variation (primarily in the prominence of green scaling overlying the black bands on the ventral hindwing), Faynel and Bálint (2004) deemed it prudent to designate a single putative male syntype in the Muséum National d'Histoire Naturelle, Paris, France (MNHN), to be a lectotype. Although this MNHN male seems quite likely to be a syntype, it is not the ex. Fassl coll. specimen, as Faynel and Bálint (2004) hypothesized, because this specimen is currently housed in the Senckenberg Museum in Frankfurt, Germany (G. Lamas, personal communication). As it is also not the ex. Brabant coll. specimen, which belongs to The Natural History Museum in London, England (this paralectotype is illustrated here in Fig. 2A), we suggest it is the ex. Courvoisier coll. specimen. Although Faynel and Bálint (2004) suggested that the ex. Courvoisier coll. specimen might be in the Naturhistorisches Museum in Basle, Switzerland, where some Courvoisier specimens apparently reside (Horn et al. 1990), G. Lamas (personal communication) reports finding no such specimen in a cursory examination of that collection. The fact that the MNHN male bears a handwritten Fassl label with the locality "Villa Elvira," his base of operations in the Río Aguacatal (Fassl 1914), and the date "4/7/08," the year the type series was collected (Fassl 1912), strongly suggests that it might be the third missing syntype of *P. episcopalis*.

The male of *P. chuchuvia* differs from that of *P. episcopalis* in its considerably larger size (19 mm compared to 13–15

mm), and by having a more pointed forewing apex (at least compared to the BMNH paralectotype), a slightly elongate hindwing, a larger forewing scent pad on both wing surfaces, a broader black distal margin on the dorsal forewing, slightly longer hindwing tails, a broad black band along the entire distal margin of the dorsal hindwing, two large black triangles at the base of cells Cu_1 and M_3 on the ventral forewing, green scaling (visible at an oblique angle) covering all instead of only some black areas above vein Cu_2 on the ventral hindwing, a discal black line on the ventral hindwing that is twice as broad, and a large red spot in the tornus of the ventral hindwing.

These two species are so strongly sexually dimorphic that Draudt (1920) described the female of *P. episcopalis* as the distinct species *Thecla phacana* (Bálint and Salazar 2003; Robbins 2004). However, similarities in wing shape, palpal length, the extent of dorsal green iridescence, and the banding pattern on the ventral hindwing allow us to match the sexes of both species with confidence. The female of *P. chuchuvia* differs from that of *P. episcopalis* by exhibiting the same type of size and wing shape differences of the males, and by having considerably broader black margins on both dorsal wings, a slightly more vertically positioned postdiscal white line on the ventral forewing that does not extend to the wing margins, a more proximally displaced postdiscal white line on the ventral hindwing, and considerably more elongate red spots in the tornus of the ventral hindwing, with larger black spots distally. Some female specimens of *P. episcopalis*, particularly those from the central Andes, have more extensive hindwing tornal red than the figured specimen, but the red is never as extensive as it is in *P. chuchuvia*. Central Andean females of *P. episcopalis* also seem to have a slightly more proximally positioned white postdiscal line on the ventral hindwing than east Andean females.

The genitalia of these two species are very similar. The male genitalia of *P. chu-*

chuvia differ only by having a more broad and bluntly triangular tip to the valvae, and the female genitalia differ only by having additional small anteriorly directed spines on the signa and a broader band of dorsally folded sclerotization along the posterior margin of the lamella postvaginalis. Bálint and Salazar (2003) reported finding in female *P. episcopalis* a sclerotized line down the center of the bursa copulatrix between the signa, but we found no such line in the one female specimen of *P. episcopalis* that we dissected. Bálint and Salazar (2003) also described and purported to figure, in their Fig. 5, an “anteriorly pointed, sclerotized, ventral element of the bursal pouch” on the bursa copulatrix, but again we could find no such structure. The only structure fitting this description that we can discern in their Fig. 5 is a single signum floating beneath the bursal pouch.

Systematic placement.—Kaye (1904) described the new monotypic genus *Paiwarria*, for *Papilio venulius* Cramer, using such a short and vague description, which concentrated on very weakly diagnostic characters of the head, wing shape, venation and tail position, that the generic name was only infrequently used subsequently. Bridges (1994) additionally included in *Paiwarria* the species *telemus* (Cramer) and *antinous* (C. & R. Felder) (mistakenly as a synonym of *telemus*), with a question mark, presumably based on the combination of *telemus* with *Paiwarria* by Lamas et al. (1991) in their Pakitza butterfly checklist. Most recently, Robbins (2004) additionally included in *Paiwarria* the species *aphaca* (Hewitson) (a combination also used by Brown and Freitas 2000), *episcopalis* and *unbratus* (Geyer), to form a total of six described species for the genus. He placed *Paiwarria* with *Eumaeus* Hübner, *Theorema* Hewitson and *Mithras* in his *Eumaeus* section of the Eumaeini, because the species in these genera share male genitalia with brush organs (when present) that actually or nearly (in *Paiwarria*) surround the genital capsule (Robbins 2004). However, an alternative

generic placement has been proposed for *episcopalis* by Bálint and Salazar (2003). They recently erected the new monotypic genus *Fasslantonius* for *episcopalis*, without mentioning *Paiwarria* as a potentially close relative to *Fasslantonius* in either the diagnosis or subsequent discussion, instead concentrating on comparing *Fasslantonius* with *Thereus* section genera. As the name *Fasslantonius* was published after the text for Robbins' (2004) checklist was in press, it could not be included in that publication. However, as Robbins (2004) provided a comprehensive new generic classification for the Eumaeini, which included the descriptions of new genera for all those species groups that lacked generic names, it can reasonably be inferred that *Fasslantonius* would have been treated by him as a synonym of *Paiwarria* if the name could have been included in the checklist.

Based on external characters, including wing shape, dorsal and ventral wing pattern, and the shape and position of the forewing scent pad, the *Paiwarria* of Robbins (2004) can broadly be divided into three species clusters: *telemus* and relatives, *episcopalis*, and *unbratus*. Having examined the male and/or female genitalia of representatives from each of these three *Paiwarria* groups, the male and female genitalia of *Theorema sapho* (Staudinger), and both genitalia dissections and illustrations of various *Eumaeus* (in Constantino and Johnson 1997) and *Mithras* species (in Johnson and Constantino 1997, Bálint and Moser 2001), we can make the following preliminary observations concerning the systematic placement of *episcopalis* and the new species *chuchuvia*. Many of the genital characters cited by Bálint and Salazar (2003) to diagnose *Fasslantonius* are present in *Paiwarria* species, including a rounded “appendix angularis” to the tegumen, a dorsally dentate aedeagal cornutus, and a notched tip to the papillae anales, and both *episcopalis* and *chuchuvia* do indeed seem to be closely related to the *Paiwarria telemus* group of species. The expanded *Pai-*

warria is a morphologically rather heterogeneous grouping, but Robbins (personal communication) informs us that he regards the presence of anterior vinculum processes that abut the inner side of the brush organs, and a groove on the outer surface of the vinculum that is almost flush with the anterior edge of those processes, to be universal synapomorphies for the genus within the context of the *Eumaeus* section. We tentatively follow the conservative arrangement of Robbins (2004) for now, and place the new species *chuchuvia* next to *episcopalis* in *Paiwarria*. However, their unique male ventral wing pattern, strong sexual dimorphism in ventral wing pattern, very long palpi, unusual male forewing scent pads, and "horseshoe"-shaped bursal pouch and very prominently undulating ductus bursae in the female genitalia clearly set *episcopalis* and *chuchuvia* apart from the remainder of Robbins' (2004) *Paiwarria* species, and *Fasslantoni* may yet be worth retaining if it can be shown that the *telemus* group and/or the *telemus* group + *unbratus* are monophyletic, a task that is beyond the scope of this paper.

Biology.—*Paiwarria chuchuvia* appears to be confined to premontane forest, and is currently known from about 800 to 1,450 m. We know of *P. episcopalis* specimens from the eastern slope of the Andes and in the Cauca valley of Colombia (1,000 to 2,000 m), suggesting that *P. chuchuvia* may allopatrically replace *P. episcopalis* on the western slope of the western Andean cordillera. *Paiwarria chuchuvia* females were recorded flying across ridgetop lightgaps two meters above the ground from 1300 to 1430 h.

Distribution.—*Paiwarria chuchuvia* is currently known from only a few localities in a small area of northwestern Ecuador, but it is presumably more widespread along the western slope of the Andes from western Colombia to western Ecuador.

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