

## Two phylogenetically significant new *Calycopis* species (Lycaenidae: Theclinae: Eumaeini)

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**Abstract:** *Calycopis sullivanii* Robbins & Duarte is described from wet lowland rain forest on the Atlantic Coast of Central America, and *Calycopis cicero* Robbins & Duarte is named from cloud forest on the eastern slope of the Andes of Ecuador. Both new species and *C. caesaries* have the ductus ejaculatorius entering the penis ventrally, a character state that has not been reported for the Eumaeini. These three species and *C. cerata* share muted blue color dorsally in males. The phylogenetic positions of *C. caesaries* and *C. cerata* were unstable in ongoing phylogenetic analyses, and the two new species are described because we are adding them to the analyses.

**Key words:** butterflies, hairstreaks, Lepidoptera, Neotropics.

### INTRODUCTION

*Calycopis* Scudder is the largest genus of the thecline tribe Eumaeini (Lycaenidae). It contains 62 described species, 12 undescribed species, and many more names of uncertain status (Robbins 2004). In preliminary phylogenetic analyses of the major clades of *Calycopis* (including several previously recognized genera, such as *Calystryma* Field), the positions of *Calycopis caesaries* (H.H. Druce) and *C. cerata* (Hewitson) were “relatively primitive” and unstable (Duarte & Robbins, in prep.). To increase taxon sampling “density”, we added to the analyses two undescribed species that share some unusual characters (detailed below) with *C. caesaries* and *C. cerata*. The purpose of this paper is to provide names for these two undescribed species before the phylogenetic results are published.

The two species described below belong to the *Eumaeini* because they have 10 forewing veins, greyhound shaped male genitalia lacking a juxta, and a male foretarsus that is fused, stubby tipped, and used for walking (Eliot 1973). They are members of the *Lamprospilus* Section of the Eumaeini because they lack

androconia, have the lateral edge of the female 8<sup>th</sup> abdominal tergum sclerotized and curved inwards, and have “fan-shaped” signa on the corpus bursae (Figs. 12 & 13) (Duarte & Robbins, in prep.). They are placed in *Calycopis* because they have an orange-red spot in ventral hindwing cell Cu2-2A distal of the postmedian line (Figs. 2,4,6,8) and piliform setae on the ventral surface of hindwing vein 2A (Fig. 9) (Duarte & Robbins, in prep.).

We describe the two new species by comparison with *Calycopis caesaries* and *C. cerata*. These are the only *Calycopis* species that share with the new species muted blue color on the dorsal surface of male wings (Figs. 1 & 5, the described species are figured in D’Abrera 1995). *Calycopis caesaries* and the two new species also have male genitalia in which the ductus ejaculatorius enters the penis ventrally (Figs. 10 & 11). This structure has not been previously reported in the Eumaeini (e.g., Eliot 1973), suggesting that these three form a monophyletic lineage. However, the ductus ejaculatorius enters laterally in *C. cerata* and some other *Calycopis*, and phylogenetic interpretation of this structure is yet uncertain.

Although associating the sexes of *Calycopis* species is often difficult, the newly described species have

distinctive ventral wing patterns and restricted known geographical ranges, factors that allow us to associate the sexes with a high degree of confidence.

## MATERIALS AND METHODS

The results in this paper are based upon a comparison of adult morphology using 5,700+ *Calycopis* specimens in the National Museum of Natural History (USNM), Smithsonian Institution, Washington, DC, USA, plus numerous specimens in other museums. Of particular relevance, we examined 340 specimens of *C. cerata* from 11 countries and 26 of *C. caesaries*—including three pairs *in copula*—from six countries. In addition to specimens of the new species in the USNM, we borrowed specimens from the Allyn Museum of Entomology (AME), Florida State Museum (via loan to J.B. Sullivan); Instituto Nacional de Biodiversidad (INBIO), Santo Domingo de Heredia, Costa Rica (via loan to J.B. Sullivan); and Robert Busby (RCB), Andover, MA, USA. Finally, specimens are being deposited in Museo Ecuatoriano de Ciencias Naturales (MECN), Quito, Ecuador.

We used standard entomological techniques (Robbins 1991) and state for each result below the number of specimens on which it is based. Genitalic terms follow those in Klots (1970), as illustrated in Robbins and Nicolay (2002), and wing vein terminology follows Nicolay (1971, 1977). Forewing lengths were measured with a vernier caliper and reported statistically as a mean and standard deviation (SD) with sample size.

### *Calycopis sullivanii* Robbins & Duarte, New Species

*Diagnosis.* *Calycopis sullivanii* and *C. caesaries* differ in the shape of the ventral hindwing cubital spots (compare Figs. 2 & 4 with those of *C. caesaries* in D'Abrera 1995, p. 1228 & in Draudt 1919-1920, plate 158) and the shape of the male genitalia labides in dorsal aspect (Fig. 10) (*C. caesaries* lacks a notch between the labides). *Calycopis sullivanii* differs from *C. cerata* by yellow ventral hindwing cubital spots (orange-red in *C. cerata*), a wider black border on the dorsal surface of male forewings than *C. cerata* (compare Fig. 1 with those of male *C. cerata* in D'Abrera 1995, p. 1226 & in Draudt 1919-1920, plate 158), the shape of the male genitalia labides in dorsal aspect (Fig. 10) (*C. cerata* lacks a notch between the labides), gnathos without small teeth (Fig. 10)

(present in *C. cerata*), and presence of piliform setae on ventral hindwing vein 2A (Fig. 9) (lacking in *C. cerata*, presumably a homoplasy). Occasional individuals of *C. cerata* have aberrant yellow cubital spots that are similar to those of *C. sullivanii*, but they can be immediately distinguished by the lack of the piliform setae.

*Description of male* (N=6). Mean forewing length 11.0mm, SD=1.14.

*Dorsal wing pattern* (Fig. 1). Forewing basal 65-80% muted blue. Border dark brown, basal edge is diffuse. Fringe brown. Hindwing basal 80-90% muted blue with basal edge of dark brown border diffuse. Submarginal black spots in cell Cu1-Cu2 and Cu2-2A. A marginal line, white basally and black distally, extends from Cu1 to the dark brown anal lobe. Fringe scales between Cu1 and anal lobe basally white and distally black except at the end of Cu2, where the scales are all white. Short (1-1.5mm) white-tipped tail at terminus of vein Cu1. A second white-tipped tail (3-3.5mm) at terminus of vein Cu2.

*Ventral wing pattern* (Fig. 2). Forewing ground color silver-gray. Dark brown postmedian line from vein R2 to Cu2 bordered distally with white scales and basally with occasional red scales. A similar line, but with less dark brown, at distal end of discal cell. Dark brown marginal line with fringe of dark brown scales that have some orange-red color basally. Hindwing ground color, postmedian line, and discal cell line similar in color to forewing except that the postmedian line is bordered basally with yellow scales. A conspicuous orange-red spot just distal of the postmedian line in cell Cu2-2A. Submarginal band complex. In cell 2A-3A, black anal lobe bordered basally with white, gray, yellow, and a black line. In cell Cu2-2A, a black submarginal spot with scattered white/blue scales bordered basally with yellow scales and a black line. In cells Cu1-Cu2 and M3-Cu2, a black pupilled yellow submarginal spot bordered distally with a black line. The other cells have vestigial components of the coloring in cell M3-Cu2. Vein 2A with regularly spaced piliform setae (Fig. 9).

*Head.* Antennae with 17-19 white-ringed segments on the stalk and 10-12 segments on the club. Nudum confined to the club. Eyes bordered with white scales. Frons brown. Third segment of labial palps brown with white scales only at the tip.

*Description of female* (N=1). Forewing length 8.7mm.

*Dorsal wing pattern* (Fig. 3). Same as male except blue scaling is more extensive and of a lighter hue.



Figs. 1-8. *Calycopis* adults, 1.75x actual size.

1. *C. sullivanii*, male, dorsal; 2. same, ventral; 3. *C. sullivanii*, female, dorsal; 4. same, ventral; 5. *C. cicero*, male, dorsal; 6. same, ventral; 7. *C. cicero*, female, dorsal; 8. same, ventral.

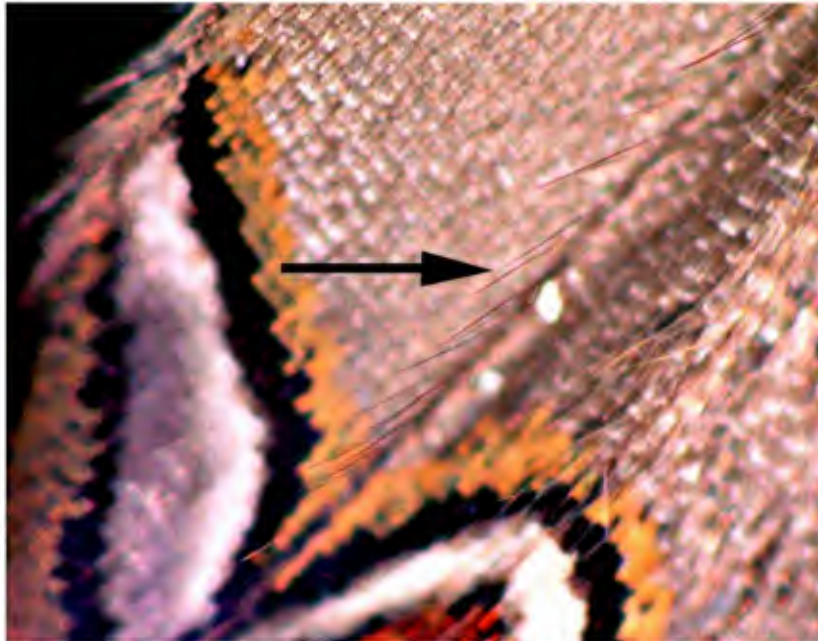
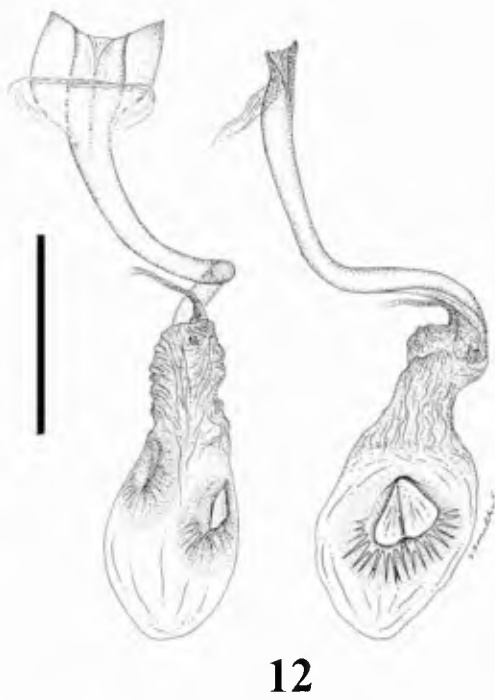
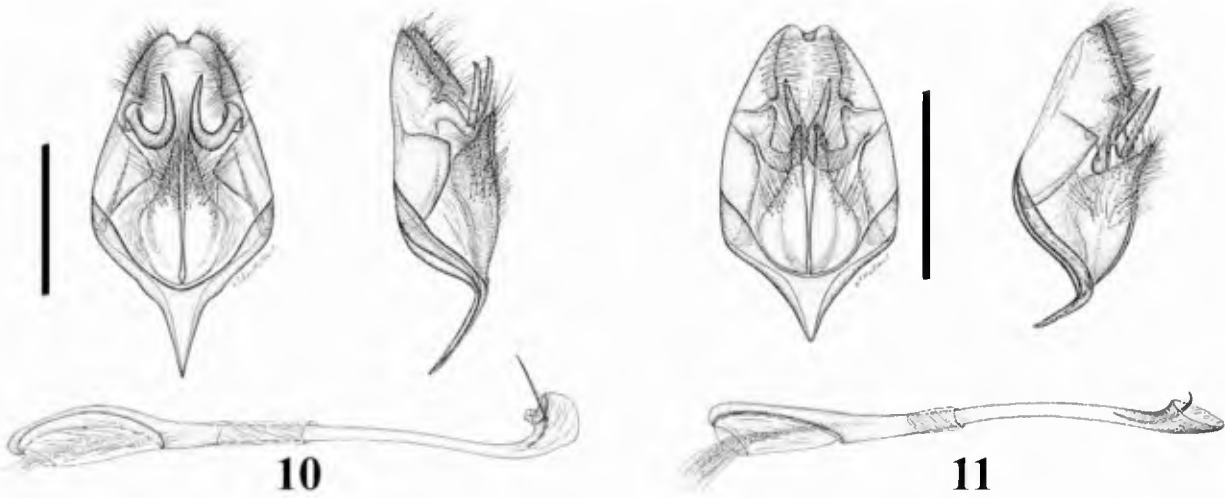


Fig. 9. Ventral hindwing *C. sullivanii* showing pilliform setae on vein 2A (arrow).



Figs. 10-11. Male genitalia in ventral and lateral aspects, with penis in lateral aspect. Ductus ejaculatorius enters the penis ventrally. Scale 1mm. 10. *C. sullivanii*; 11. *C. cicero*.

Figs. 12-13. Female genitalia (bursa copulatrix) in ventral and lateral aspects. Scale 1mm. 12. *C. sullivanii*; 13. *C. cicero*.





Fig. 14. Distribution of *C. sullivanii* (circle), and *C. cicero* (triangle).

*Ventral wing pattern* (Fig. 4). Same as male.

*Head*. Same as male, but there are no antennae on the only known female.

*Types*. Holotype (Figs. 1 & 2). 'M' Panama, Canal Zone (now Canal Area), Gatún, 2 May 1970, Leg. G. B. Small. Deposited USNM.

*Paratypes*\* (5'M' & 1'F'). 3'M' & 1'F' USNM (Figs. 3 & 4), Costa Rica, Heredia, Finca La Selva, 3 km S Pto Viejo (10°46'N, 84°01'W), leg. H. Hespenehede, 3 April 1985, 4 April 1985, 6 April 1989, 3 April 1985. 1'M' INBIO, same data except Est. Biol. La Selva, 50-150m, leg. J. Bolling Sullivan, 29 August–2 September 2003 (ALAS # INB0003602140). 1'M' AME, Panama, Canal Zone (now Canal Area), Piña, 20 April 1970.

*Etymology*. This species is named for J. Bolling Sullivan, who collected one of the paratypes and recognized it as an undescribed species.

*Type locality*. The type locality is in the Canal Zone (now Canal Area) of Panama to the south, south-west of Gatún (9°16'N, 79°55'W) in the vicinity of the road to Escobal (cf. map in Ridgely 1976). In the 1970s the Canal Zone's Achiote Road began at Lake Gatún

and ended in the forest south of Piña (9°16'N, 80°02'W, the road has since been extended to Piña). Those specimens that Small collected along the road to Escobal and near the beginning of Achiote Road were labeled "Gatún, Canal Zone", and those collected near the north end of Achiote Road were labeled "Piña, Canal Zone" even though Piña is in Panama Province just west of the border with the Canal Area. Although the data label on the "Piña" paratype is Gordon Small's handwriting, the specimen apparently was given to AME by Vernon King (J.Y. Miller, pers. comm.). King and Small exchanged specimens extensively, and it is unclear who actually collected the specimen.

*Habitat*. The localities in the type series are in the wet Atlantic Coast lowlands. These areas receive 3 m or more annual precipitation and lack a significant dry season (Rand & Rand 1982, Coen 1983).

*Distribution*. *Calycopis sullivanii* is known from Gatún/Piña and La Selva (Fig. 14). It is sympatric with *C. caesaries* and *C. cerata* at both, but is rare in collections despite years of field work in Panama and Costa Rica. This rarity makes it difficult to predict whether it is more widespread than the Atlantic coast of Panama and Costa Rica.

\* NOTE: in whole paper 'M' = male, 'F' = female

*Discussion.* We have seen no specimens in museum collections outside of the type series, although some might be misplaced under *C. cerata*. The conspicuous yellow cubital spots on the ventral surface of the hindwings should facilitate identification of additional specimens. As noted above, aberrant specimens of *C. cerata* may have cubital spots that are yellow or orange-yellow, but can be distinguished by genitalic structures and by the lack of piliform setae on hindwing vein 2A.

### ***Calycopis cicero* Robbins & Duarte, New Species**

*Diagnosis.* *Calycopis cicero* differs from *C. caesaries*, *C. cerata*, and *C. sullivanii* in the shape, number, and color of the ventral hindwing cubital spots (Figs. 6 & 8). More generally, the orange-red postmedian band on the ventral hindwing bordered with black scales basally and distally distinguishes it from all other *Calycopis* except *C. centoripa* (Hewitson), especially the females. Markings at the end of the ventral hindwing discal cell are basal of the orange-red band in *C. cicero* (Figs. 6 & 8) and are contained in the band in *C. centoripa*. We know of no other evidence to suggest a close relationship between *C. cicero* and *C. centoripa*. The shape of the male genitalia labides of *C. cicero* in dorsal aspect (Fig. 11) differs from those of *C. caesaries* and *C. cerata*, which lack a notch between the labides. The shape of the genital capsule in lateral aspect (Fig. 11) is less elongate than that of *C. caesaries*, *C. cerata*, and *C. sullivanii* (Fig. 10). The ductus bursae, which is similar to that of *C. cerata*, is gently curved (Fig. 13), as opposed to the "sigmoid-shaped" ductus bursae of *C. caesaries* and *C. sullivanii* (Fig. 12).

*Description of male* (N=12). Mean forewing length 11.5mm, SD=1.06.

*Dorsal wing pattern* (Fig. 5). Forewing muted blue with a narrow dark brown border (~1mm in width) on the costa and outer margin. The border has a diffuse basal edge. Fringe brown. Hindwing same blue color with dark brown border (~0.5mm in width). Submarginal black spots in cell Cu1-Cu2 and Cu2-2A. A marginal line, white basally and black distally, extends from Cu1 (sometime partially absent) to the dark brown and orange anal lobe. Fringe brown except at the end of Cu2, where the scales are all white. Short (1-1.5 mm) white-tipped tail at terminus of vein Cu1. A second white-tipped tail (~3mm) at terminus of vein Cu2.

*Ventral wing pattern* (Fig. 6). Forewing ground color

dark gray. Postmedian line from vein R2 to Cu2. Dark brown basally, a wide (~0.75 mm) orange-red band bordered distally with dark brown scales, in turn bordered with faint white scales. An off-white line at the end of the discal cell bordered basally and distally with dark brown scales. Two diffuse submarginal dark gray bands are variably developed. Fringe orange-red with scale tips brown. Hindwing ground color, postmedian line, and discal cell line same as forewing except that the postmedian line is wider (1-1.5mm), the white part of the postmedian line is more conspicuous, and there are orange-red scales bordering the discal cell in some individuals. Markings distal of the postmedian line are complex. In cell 2A-3A, the black anal lobe is bordered basally with white, orange-red, a black line, and gray. In cell Cu2-2A, there is a conspicuous orange-red spot just distal of the postmedian line, and there is a submarginal spot composed of black, white, and orange scales. In cell Cu1-Cu2 there is a black-pupilled orange-red submarginal spot bordered basally by a charcoal gray line. The other cells have various dark gray markings, perhaps the most conspicuous being dark gray patches just distal of the postmedian line in the medial cells. Vein 2A has regularly spaced piliform setae.

*Head.* Antennae with 16-18 white-ringed segments on the stalk and 10-12 segments on the club. Nudum confined to the club. Eyes bordered with white scales. Frons brown. Third segment of labial palps brown with white scales only at the tip.

*Description of female* (N=1). Forewing length 9.9mm.

*Dorsal wing pattern* (Fig. 7). Same as male.

*Ventral wing pattern* (Fig. 8). Same as male.

*Head.* Same as male.

*Types.* Holotype. 'M' Ecuador, Morona-Santiago, Río Abanico (02°15'S, 78°12'W), 1600-1800m, 12 September 1999, leg. Robbins & Aldas. Deposited USNM.

*Paratypes* (12'M' & 1'F'). 1'M' USNM Ecuador, Sucumbíos, Rosa Florida, 1400m, December 2001, leg. I. Aldas, R.C. Busby. 6'M' (2'M' to be deposited in MECN) Ecuador, Napo, Km 49 Tena-Loreto Rd., 1350m, 18 March 2004, leg. J.P. Hall. 1'F' USNM (Figs. 7&8), Ecuador, Pastaza, Km 42 Puyo-Arajuno Road (1°18.4S, 77°42.4'W), 1000m, 8 September 2000, leg. R.C. Busby. 1'M' USNM, same data as holotype. 2'M' USNM, same data as holotype except 8 September 1999. 1'M' RCB Ecuador, Morona-Santiago, 20 km W of Macas, 1800m, 29 September 1998, leg. Robert C.

Busby (about 6 km west of the holotype locality). 1'M' USNM & 1'M' MECN & 2'M' RCB (Figs. 5 & 6), Ecuador, Zamora Chinchipe, Zamora (ridge W of town), 1450m, 20 May 2000, 18 September 2000, 22 September 2001, 22 September 2001, leg. Robert C. Busby. 1'M' USNM & 1'M' RCB, Ecuador, Zamora Chinchipe, 15 km Zamora/Romerillos Rd., La Pituca, 1500m, 23 September 2001, leg. Robert C. Busby. 1'M' RCB, Ecuador, Zamora Chinchipe, 10 km E of Namirez Bajo, 1800m, 20 May 2000, leg. Robert C. Busby.

*Etymology.* This name is meant to be associated with *C. caesaries*, the described species to which it appears to be most similar, because of the historical association of Caesar and Cicero in ancient Rome. The name is a noun in apposition.

*Type locality.* The Río Abanico type locality is along the only road currently going west from Macas. A logging path begins where the road crosses the river and rises steeply. The fauna at this locality is typical of cloud forest habitats.

*Male behavior.* In the middle afternoon, the senior author observed males perching on shrubs from 2-6 meters above the ground (specific records for four males range from 1358-1426 hours). As with most *Calycopis* and a few species of *Electrostrymon*, in which it is difficult to associate the sexes by behavior (Robbins unpubl.), males landed only briefly. According to notes from J.P. Hall, "Males perch in groups of 3-10 on ridge tops and in light gaps 4-5m above the ground from 1400 to 1530 hours, with the usual *Calycopis* flight and landing behavior. They flew in bright sun and in obscure conditions, even with a light drizzle when everything else had disappeared."

*Distribution.* Since *Calycopis cicero* was discovered in September 1998, it has been found at localities throughout eastern Ecuador from Sucumbíos to Zamora-Chinchipe at elevations from 900-1800m (Fig. 14), but is unknown from Colombia and Peru, where it probably also occurs. It is somewhat puzzling that this species was not discovered during the preceding decades, but once discovered, was found in many different widely scattered localities.

*Discussion.* *Calycopis* is a genus of primarily lowland species. Among the 62 previously described species, *C. vidulus* (H.H. Druce), *C. cyanus* (Draudt), *C. gizela* (Hewitson), *C. boliviensis* (K. Johnson), *C. suda* (Draudt), and *C. johnsoni* (Salazar) are unrecorded from the lowlands. All inhabit the eastern Andes and share an unusually wide red postmedian line on the ventral wings. *Calycopis cicero* is the sixth montane

species from the eastern Andes and also has a wide red postmedian line, but is distinguished by the postmedian line being basally bordered with black scales.

The ventral wing pattern of *C. cicero* superficially resembles that of *C. centoripa* (D'Abrera 1995 p. 1215 for an illustration of the male). It differs in that the distal end of the ventral hindwing discal cell is basal of the red line in *C. cicero*, as noted. It also occurs in montane habitats whereas *C. centoripa* occurs in lowland rain forest throughout the Amazon Region. The muted blue dorsal color of males and the ventral entrance of the ductus ejaculatorius in *C. cicero* suggest that it is more closely related to *C. caesaries* and *C. cerata* than to *C. centoripa*.

The ventral wing pattern of *C. cicero* also resembles that of some species in other genera, such as *Aubeygina hesychia* (Godman & Salvin). However, the piliform setae on vein 2A and the red spot in cell Cu2-2A distinguish *C. cicero*, as should the late afternoon behavior already mentioned, from virtually any other hairstreak with which it might be confused.

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