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A REVISION OF THE NEOTROPICAL BUTTERFLY GENUS *SECO* HALL AND HARVEY (LEPIDOPTERA: RIODINIDAE)

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Abstract.—The South American riodinid genus *Seco* Hall and Harvey is revised. The taxonomy and biology of its species are discussed, locality data and range maps are given, and the adults and male and female genitalia (where known) are illustrated for all species.

Key Words: *Charis,* Neotropics, Riodinini, *Seco,* xeric habitats

A recent phylogenetic review of the Neotropical riodinid genera *Charis* Hübner [1819] and *Calephelis* Grote and Robinson 1869, showed that the heterogeneous *Charis* was paraphyletic with respect to *Calephelis,* prompting the division of *Charis* into three monophyletic genera (Hall and Harvey 2002). One of these genera, *Detritivora* Hall and Harvey 2002 (containing the *cleonus* and *gynaea* groups), has been revised already by Hall and Harvey (2001) and Harvey and Hall (2002). The purpose of this paper is to revise the remaining genus, *Seco* Hall and Harvey 2002, a small group of rare and very poorly known riodinine butterflies that are uniquely restricted to xeric habitats around the periphery of South America. The adults and genital structures of all species (where known) are illustrated, and a distribution map is presented based on an extensive compilation of specimen data.

METHODS

Dissections were made using standard techniques, abdomens being soaked in hot 10% potassium hydroxide solution for approximately five minutes, and subsequently stored in glycerol. Morphological terms for genitalia follow Klots (1956) and Eliot (1973), and the terminology for wing venation follows Comstock and Needham (1918). The protocol for listing material examined follows Hall (1999).

Seco specimens have been examined and their locality data recorded from the following collections:

AME	Allyn Museum of Entomology, Florida Museum of Natural History, Sarasota, FL, USA
AMNH	American Museum of Natural History, New York, NY, USA
BMNH	The Natural History Museum, London, UK
CMNH	Carnegie Museum of Natural History, Pittsburgh, PA, USA
DA	Collection of David Ahrenholz, St. Paul, MN, USA
JHKW	Collection of Jason Hall & Keith Willmott, Washington, DC, USA
MUSM	Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Peru
SMF	Senckenberg Museum, Frankfurt, Germany
USNM	National Museum of Natural History, Smithsonian Institution, Washington, DC, USA

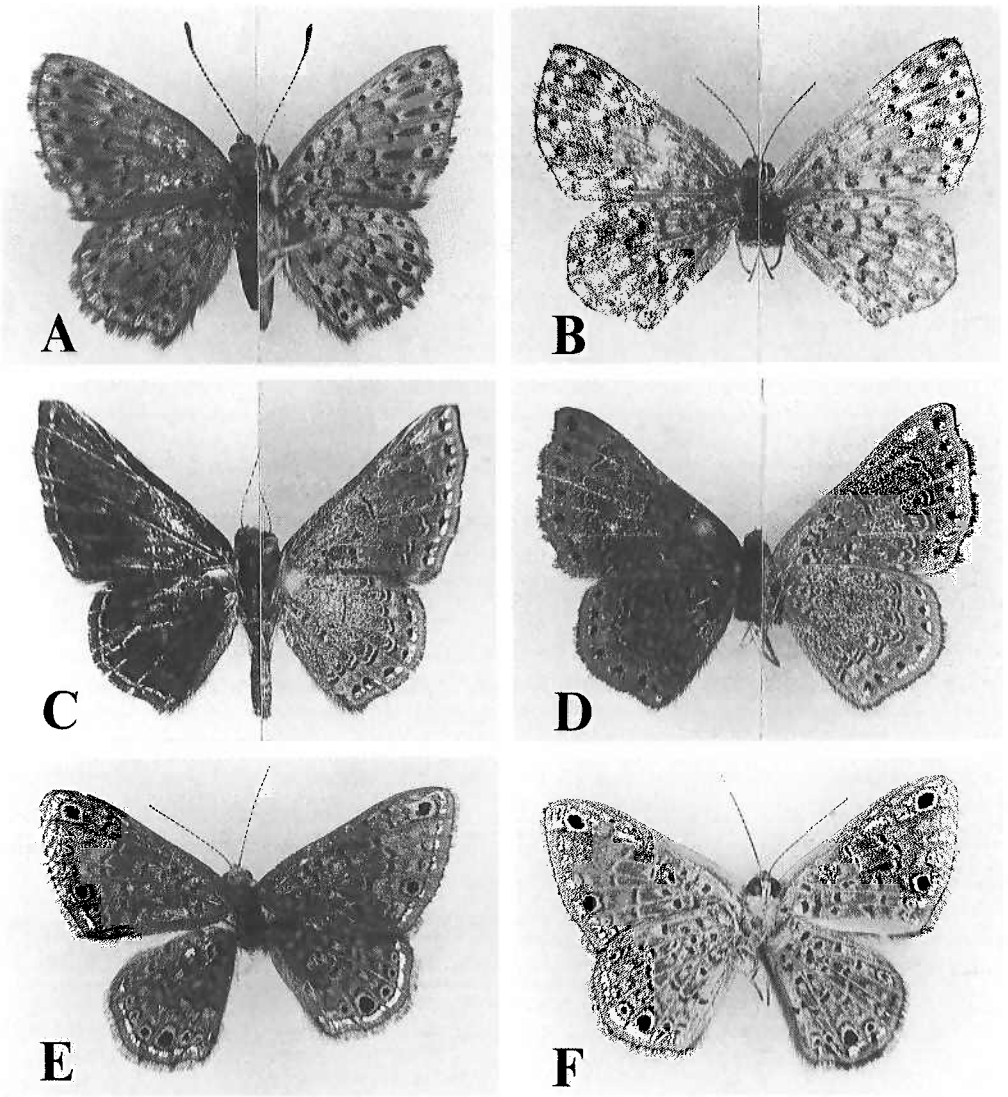

Fig. 1. Adults of *Seco* species (dorsal surface on left, ventral surface on right, unless otherwise stated). A, ♂ *S. aphanis,* Iguazú, Argentina (BMNH). B, ♀ *S. aphanis,* La Soledad, Argentina (BMNH). C, ♂ *S. calagutis,* nr. Macará, Ecuador (JHKW). D, ♀ *S. calagutis,* Salto de Napac, Ecuador (USNM). E, ♂ *S. ocellata,* dorsal surface, Puerto Colombia, Colombia (CMNH). F, ♂ *S. ocellata,* ventral surface.

ZMHU Museum für Naturkunde, Humboldt-Universität zu Berlin, Germany

Revision of *Seco*

Seco Hall and Harvey 2002
(Figs. 1–4)

Seco Hall and Harvey 2002: 415–417. Type species by original designation: *Charis calagutis* Hewitson 1871: pl. 46, figs. 11, 12.

Diagnosis and systematic position.—*Seco* species are small riodinids (forewing length 10–12 mm) with compact wing shapes and rounded wings. The sexes are monomorphic. The dorsal surface is brown with prominent discal and postdiscal lines, the latter containing individual spots that

are unusual in being outwardly curved, and a single submarginal silver line (rays along veins in *aphanis*). The fringe varies from entirely brown (*ocellata*) to entirely white (*calagutis*). The ventral surface differs only by having additional silver markings in the forewing apex (*calagutis* and *ocellata* only). This arrangement of submarginal silver markings is unique in the family. All members of *Detritivora* and *Charis* have two dorsal submarginal silver lines and lack the elongate silver markings in the ventral forewing apex (Hall and Harvey 2002).

The male genitalia of all *Seco* species possess the deep notch in the anterior margin of the tegumen characteristic of the tribe Riodinini (Harvey 1987). The uncus is rectangular, the falces and tegumen are of average size and shape for the tribe, and the vinculum is evenly narrow and sinuate. The aedeagus is narrow and sigmoidal with a pointed tip that opens broadly; no cornuti are present. The pedicel is highly modified into the posteriorly elongate structure with fine acanthae (acellular projections) restricted to a raised distal area (termed a "vogelkopf" by Stichel 1910–11) that is so common in the Riodinini. The valvae consist of a typically elongate and somewhat membranous lower process and a short upper process that is joined above the aedeagus to form a transtilla. The transtilla is developed into a pair of lateral upwardly curved projections similar to those found in *Chalodeta* Stichel 1910 (Hall 2002), but in *Seco* species the transtilla is short instead of markedly elongate and downwardly curved, and the lateral projections are asymmetrical.

The female genitalia are interspecifically variable. The corpus bursae is elongate, the signa small spine-like invaginations (*calagutis*) or very small sclerotized pads (*aphanis*), the ductus bursae membranous with only the very distal portion sclerotized, the ductus seminalis membranous, the ostium bursae a simple hole either centrally positioned (*calagutis*) or displaced to the right (*aphanis*), and only abdominal sternite eight is sclerotized.

Seco appears to be most closely related to *Detritivora, Charis* and *Calephelis,* but its exact phylogenetic relationship to them and other closely related genera such as *Chalodeta* is not certain. Depending on how certain characters were coded and which outgroup(s) was used in the analysis, Hall and Harvey (2002) found *Seco* to variably be sister to *Detritivora, Charis* and *Calephelis,* sister to *Charis* and *Calephelis* or sister to *Chalodeta* and *Detritivora.* The first of these evolutionary scenarios seems the most plausible (Hall and Harvey 2002).

Key to the Species of *Seco*

1. Outer silver submarginal line on all wings complete and parallel to outer wing margin (Figs. 1C–F) 2
– Outer silver submarginal line on all wings consists of rays along veins (Figs. 1A, B) . . *aphanis*
2. Postdiscal line displaced distally, submarginal black spots on all wings of even size (Figs. 1C, D) . . . . . *calagutis*
– Postdiscal line positioned medially, submarginal black spots on all wings of uneven size (Figs. 1E, F) . . . . . *ocellata*

Biology.—*Seco* species are distributed allopatrically in certain lowland xeric regions around the periphery of South America. They occur in western Ecuador and Peru, northern Colombia and Venezuela, and southern Brazil, eastern Argentina and Uruguay. All *Seco* species are rare in collections and hence little is known of their biology. However, at the right time and place they appear to be relatively common. Males are encountered perching in small groups along streamsides or shaded forest paths within several meters of the ground and have been recorded nectaring from asteraceous flowers (Hall and Willmott, unpublished data). The food plants and early stages are unknown.

Seco aphanis (Stichel 1910)
(Figs. 1A, B, 2A, 3A, 4)

Charmona aphanis Stichel 1910: 19–20. Type locality: Uruguay. Syntypes, 2 ♂ and 1 ♀, ZMHU [examined].

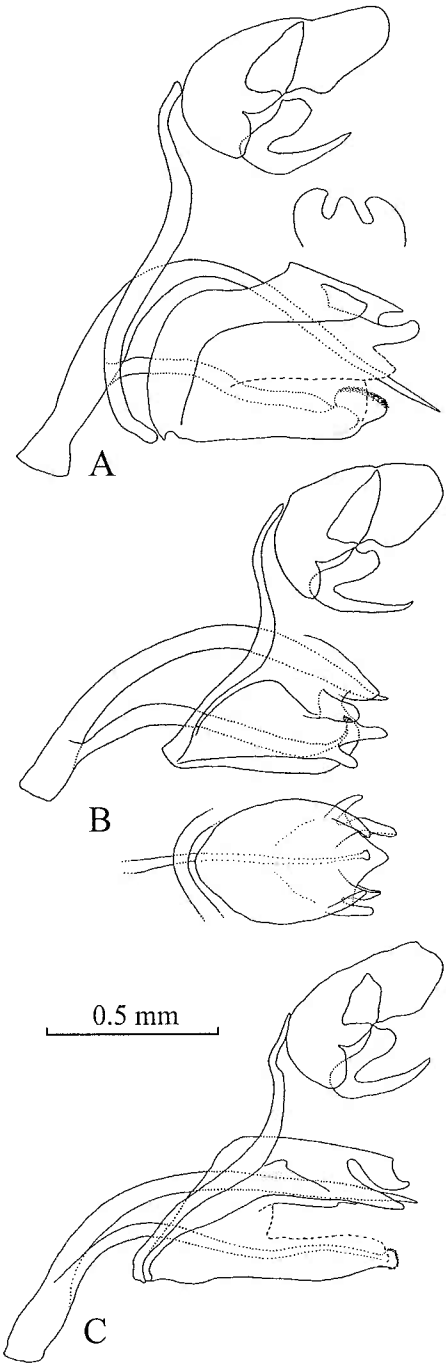

Fig. 2. Male genitalia of *Seco* species in lateral view unless otherwise stated. A, *S. aphanis,* also transtilla tip in ventral view. B, *S. calagutis,* also pedicel and valve complex in ventral view. C, *S. ocellata.*

Identification and taxonomy.—Typical forewing length of both sexes 11 mm. *Seco aphanis* is readily distinguished from its congeners by its possession of an outer silver submarginal line on all wings that consists of rays along veins instead of a continuous line paralleling the distal wing margin, and sparsely setose instead of bare eyes. The male genitalia have a more prominent "vogelkopf" covered with more prominent acanthae, a short triangular upper valve process, an asymmetrical laterally tilted transtilla, and lateral transtilla processes that are broad and dorso-ventrally instead of laterally compressed and inwardly as well as upwardly curved.

This is the most poorly known of all *Seco* species and, perhaps because it is not similar in appearance to other *Charis* species, the genus in which it used to be treated (Stichel 1930, 1931; Bridges 1994; Callaghan and Lamas 2002), specimens in museums are curated under several different genera or, more typically, in "protem" drawers of unsorted material. Even in the BMNH (and hence in d'Abrera 1994), it is incorrectly identified as *Audre zachaeus* (Fabricius 1798).

Biology.—Biezanko et al. (1979) reported that *S. aphanis* is "frequent in the southeast region [of Rio Grande do Sul, Brazil], flying among flowering bushes in April." The known months of capture are October and April, the earliest and latest months of summer.

Distribution.—*Seco aphanis* is currently known from the southeastern Brazilian state of Rio Grande do Sul, eastern Argentina, and Uruguay (see Fig. 4), but it should also occur in southeastern Paraguay and at least as far north as the Brazilian state of Paraná.

Material examined.—ARGENTINA: *Misiones,* Iguazú (Oct) 1 ♂ BMNH; *Entre Ríos,* La Soledad (Apr) 4 ♂, 1 ♀ BMNH. BRAZIL: *Rio Grande do Sul,* Pelotas 1 ♂, 1 ♀ SMF. URUGUAY: "Buschantal" [= forested valley] 1 ♂ SMF; No locality data 2 ♀, 1 ♂ ZMHU.

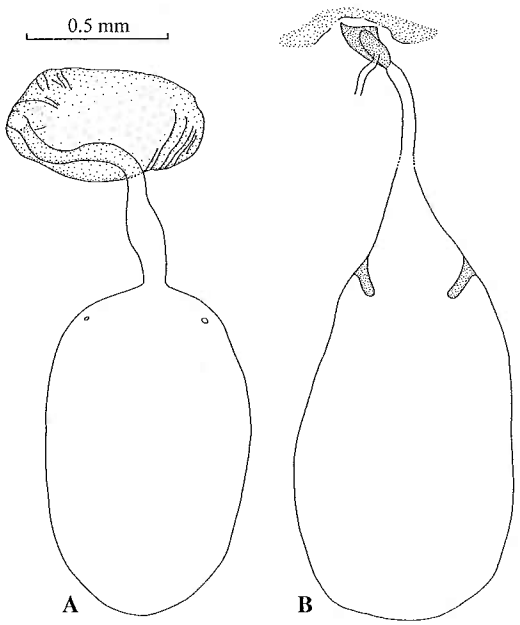

Fig. 3. Female genitalia of *Seco* species in dorsal view. A, *S. aphanis.* B, *S. calagutis.*

Seco calagutis (Hewitson 1871)
(Figs. 1C, D, 2B, 3B, 4)

Charis calagutis Hewitson 1871: pl. 46, figs. 11–12. Type locality: La Chima, W. Ecuador. Syntype ♂ BMNH [examined].

Identification and taxonomy.—Typical forewing length of both sexes 12 mm. *Seco calagutis* is most similar to *S. ocellata* but has a markedly distally displaced postdiscal line on all wings, submarginal black spots on all wings that are of an even size (in *ocellata* they are expanded into "eyespots" in forewing cells Cu1 and R4+5 and hindwing cell Cu1), no additional silver triangle at the base of ventral forewing cell R4+5, and yellow-brown speckling across much of the ventral surface. The male genitalia of *S. calagutis* have a vertically elongate and slightly recurved tip to the pedicel which is not weakly bifurcate as in *S. ocellata,* a more elongate and well sclerotized lower valve process, a considerably shorter and more angular upper valve process, a more posteriorly elongate transtilla, and more elongate and prominently asymmetrical lateral transtilla projections.

Biology.—*Seco calagutis* is the most commonly represented species of the genus in collections. In Ecuador, it becomes increasingly rare towards the northern wetter end of its range, but can be locally common in the dry semi-deciduous woodlands of the southwest (Hall and Willmott, unpublished data). It has been recorded from sea-level to 1,100 m. In Ecuador, it has been collected in March, May, and September, and in Peru during May, June, and October, all months around the beginning and end of the rainy season. Males are encountered perching in small groups along forest edges, trails and streamsides, and more rarely on hilltops, between 1 and 3 m above the ground. They rest with their wings outspread under the tips of leaves and their flight is somewhat weak. Males have been observed visiting flowers of Asteraceae (Hall and Willmott, unpublished data).

Distribution.—*Seco calagutis* is restricted to central and southwestern Ecuador and northwestern Peru (see Fig. 4). The following additional localities were reported by G. Lamas (personal communication, in coll. MUSM) for PERU: *Tumbes,* Matapalo, La Totora; Quebrada Angostura, Hualtaco; Puesto [de Vigilancia] Campo Verde; *Cajamarca,* Hacienda La Viña.

Material examined.—ECUADOR: *Pichincha,* Río Tanti, Tinalandia 1 ♂ JHKW; Salto de Napac 1 ♀ USNM; *Manabí,* Palmarcito, nr. Pedernales 1 ♂ DA; Ayampe 1 ♂ JHKW; *Los Ríos,* Río Palenque 1 ♂ AME; *Bolívar,* La Chima 1 ♂, 1 ♀ BMNH; *Chimborazo,* Dos Puentes 3 ♂ AMNH; Chimbo 2 ♂ BMNH; *Guayas,* Duran [= Eloy Alfaro] 1 ♂ AMNH; *Loja,* Quebrada Curichanga, Río Sabiango, nr. Macará 4 ♂ JHKW. PERU: *Piura,* 3 km. W. of Canchaque 1 ♂, 1 ♀ USNM; Ulunche 3 ♂ USNM; La Tina 2 ♂ USNM.

Seco ocellata (Hewitson 1867)
(Figs. 1E, F, 2C, 4)

Symmachia ocellata Hewitson 1867: pl. 45, fig. 8. Type locality: Venezuela. Syntypes, 2 ♂, BMNH [examined].

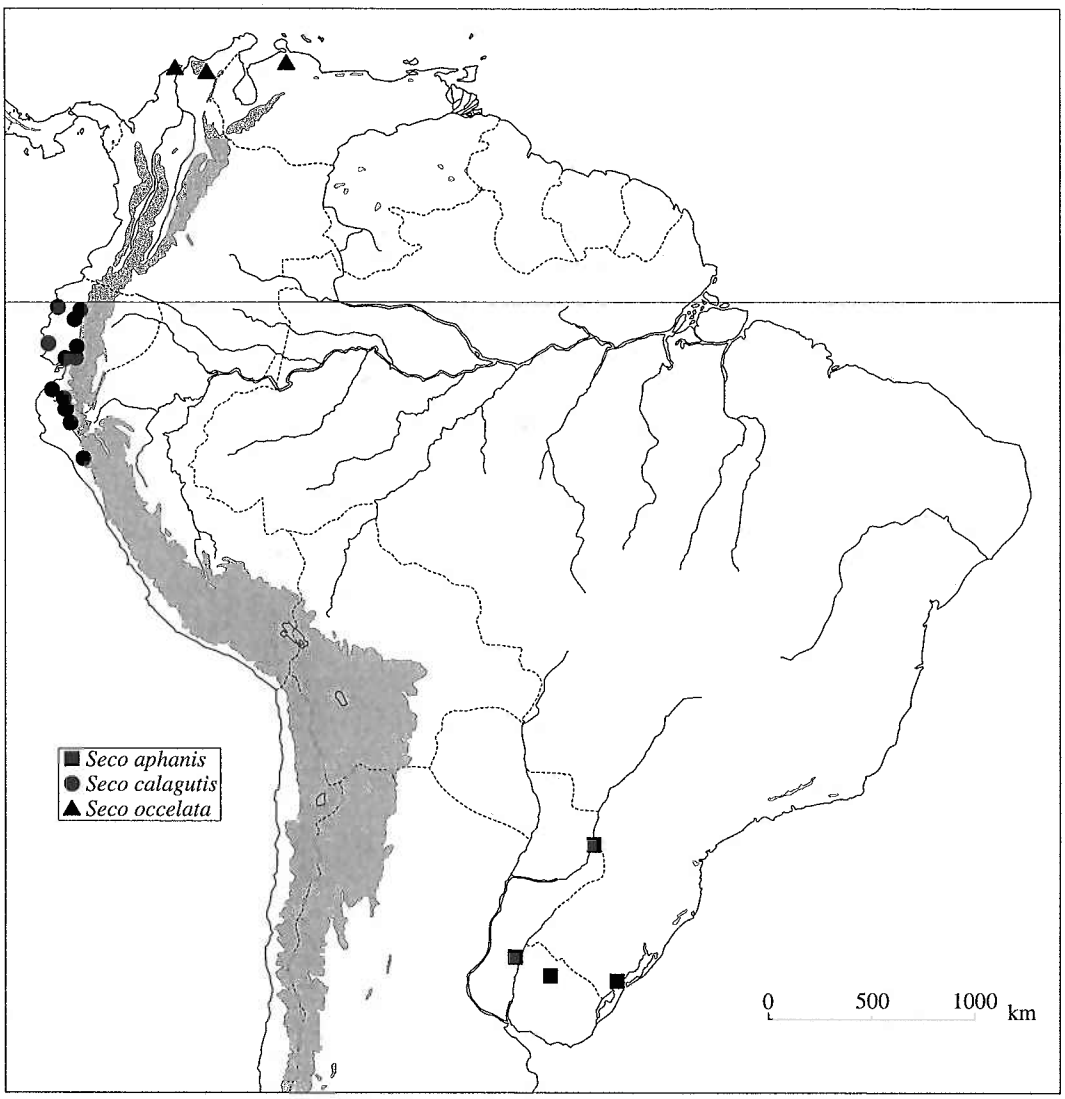

Fig. 4. Map of South America illustrating distributions of *Seco* species.

Identification and taxonomy.—Typical forewing length of male 12 mm. *Seco ocellata* is most similar to its sister species *S. calagutis* and is distinguished in that species account. The female is unknown to us.

Biology.—This is the most poorly represented *Seco* species in collections, perhaps only because it is endemic to an infrequently collected region. The label data of a Colombian specimen indicate the habitat of the species to be "dry hills with thick scrub."

Distribution.— *Seco ocellata* is restricted to northern Colombia and presumably the dry regions of northwestern Venezuela (the only Venezuelan specimens examined have no precise data).

Material examined.—COLOMBIA: *Atlántico,* Puerto Colombia (Jul) 1 ♂ CMNH; *Magdalena,* Atanques 3 ♂ BMNH. VENEZUELA: No locality data 2 ♂ BMNH.

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