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A REVIEW OF TWO EASILY CONFUSED SPECIES OF *BRASSOLIS*, WITH A DESCRIPTION OF A NEW SUBSPECIES FROM CENTRAL AMERICA (LEPIDOPTERA: NYMPHALIDAE)

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ABSTRACT: The easily confused species *Brassolis granadensis* and *Brassolis isthmia* are reviewed and their diagnostic features defined. *Brassolis granadensis* comprises three subspecies: nominate *Brassolis granadensis*, *Brassolis granadensis wallengreni* **stat. rev.** and *Brassolis granadensis isidrochaconi* **ssp. nov.** from Costa Rica and Nicaragua. *Brassolis isthmia* also comprises three subspecies, but the population of one of these, *Brassolis isthmia boliviana* Rothschild, is so disjunct and different when compared with the other two that it may warrant species rank. All three subspecies of *Brassolis granadensis* are disjunct populations and are interspersed with disjunct subspecies populations of *Brassolis isthmia* with which they have been confused. The two species co-occur in the Magdalena Valley, Colombia, in central Panamá and over part of central northern Costa Rica.

KEY WORDS: Area de Conservacion Guanacaste, caterpillars, *daisye*, DNA barcoding, food plant, *granadensis*, *isthmia*, pupa, subspecies.

INTRODUCTION

Brassolis granadensis was described by Stichel (1902) as a species from a mixed type series containing specimens of both *Brassolis granadensis granadensis* from the Magdalena Valley, Colombia, and *Brassolis granadensis wallengreni* (as taxonomically defined herein) from western Ecuador. The name only survived as a species epithet for fourteen years before

being renamed as a subspecies of *Brassolis isthmia* (Rothschild 1916). It was re-instated as a species by Bristow (2008), who defined its range as being the Magdalena Valley. Specimens from western Ecuador (including those included in the mixed type series) and south-west Colombia he named *Brassolis isthmia wallengreni*, but erroneously placed them in the species *Brassolis isthmia* instead of *Brassolis granadensis*, to which, upon further examination and review, we now conclude they belong.

Brassolis Fabricius 1807 specimens from Central America are invariably referred to *Brassolis isthmia* Bates, the description of which was based on specimens from Lion Hill, Panamá. The range of *Brassolis isthmia isthmia* is said to include most of Central America (Costa Rica, Nicaragua (Stichel 1909) and Guatemala (DeVries 1987)), but in reality, it appears to be confined to Panamá and south-eastern Costa Rica. We have not been able to locate any *Brassolis isthmia* specimen from Guatemala, but a pair of *Brassolis* from Chontales, Nicaragua, in the TNHM and those reared from Area de Conservacion Guanacaste (ACG), Guanacaste, Costa Rica, differ significantly from *Brassolis isthmia isthmia* from Panamá. These specimens appear to be *Brassolis granadensis* Stichel. The unifying facies feature in both sexes of *Brassolis granadensis*, *Brassolis granadensis wallengreni* and the new taxon *Brassolis granadensis isidrochaconi* from northern Costa Rica and southern Nicaragua is in the details of the orange dorsal forewing band; in the males, the forewing band in space CuA_1 - CuA_2 extends right up to the cell (Figure 1.1; 2.1, 2.3, 2.5) and is a diagnostic character of the species.

Both *Brassolis granadensis* and *Brassolis isthmia* are characterised by a dark brown ground colour and with a broad orange or yellowish orange forewing band that crosses the apical part of the cell and encloses one, possibly two, small, dark brown spot(s) at the cell apex. There is no hindwing band (but see comments under *Brassolis isthmia* below). On the hindwing underside, there are three (in some specimens only two) submarginal ocelli. A small orange spot at the proximal end of the cell on the hindwing underside in both sexes ('f' in Figure 2) usually occurs in both species, but can be absent or vary from very faint (especially in female *isthmia*) to quite well developed.

Collections examined

AMNH: American Museum of Natural History, New York

ANSP: Academy of Natural Sciences, Philadelphia

CAS: California Academy of Sciences, San Francisco

CRB: Roger Bristow, Sidmouth, UK

CROM: Jean-François Le Crom collection, Bogotá

FLMNH: McGuire Center for Lepidoptera and Biodiversity, Gainesville, Florida

IAvH: Instituto Alexander von Humboldt, Bogotá

ICNUN: Instituto de Ciencias Naturales, Bogotá

INBio: Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica

MECN: Museo Ecuatoriano de Ciencias Naturales, Quito

MNCR: Museo Nacional de Costa Rica, San José, Costa Rica

MNHN: Muséum National d'Histoire Naturelle, Paris

NCM: Norwich Castle Museum, Norwich, England

NNM: Nationaal Natuurhistorisch Museum, Leiden

TNHM: Natural History Museum, London

UPI: Universidad Pedagógica, Bogotá

USNM: United States National Museum, Washington

YALE: <http://discover.odai.yale.edu/ydc>

ZMA: Zoological Museum, Amsterdam

ZMHU: Zoologisches Museum an der Humboldt-Universität, Berlin, Germany

Data for specimens examined relevant to this study are listed in appendix 2.

Distinguishing features between *Brassolis granadensis* and *Brassolis isthmia*

Following on from Garzón and Penz (2009) who made a comparative phylogenetic analysis of *Dynastor* and *Brassolis*, the principal distinguishing features between nominate *Brassolis granadensis* and *Brassolis isthmia* are as follows (see Figure 1 and 2):

***Brassolis granadensis* has**

- a) in both sexes, forewing band a deeper orange than that of *Brassolis isthmia isthmia*;
- b) in space CuA_1 - CuA_2 , the male forewing orange band extending right up to the cell;
- c) on male forewing underside, only a small area of orange scaling in the cell;
- d) androconial patch below vein CuA_2 on the male hindwing not obvious, but is represented by a linear, darker, area in *isidrochaconi* and to a lesser extent in nominate *granadensis*, and a smoother, paler, area in worn specimens of *wallengreni*;
- e) on the male dorsal hindwing there is a submarginal, arcuate, darker area of specialised spatulate scales extending almost from the tornus to the cell (and just entering it in *isidrochaconi*) (this looks like an area of discolouration);
- f) both sexes tending to be slightly smaller than are those of *Brassolis isthmia isthmia*.

On the available evidence, except in the Magdalena Valley, Colombia, these two species appear to be mainly allopatric (Figure 4). However, in Central America where *granadensis* is a much scarcer species than *isthmia* (at least in Museum collections), there is evidence of a slight overlap in northern Costa Rica and central Panamá (Figure 5).

Garzón and Penz (2009, p.5) concluded that the male and female genitalia are remarkably uniform across all the *Brassolis* species.

***Brassolis granadensis* Stichel, 1902**

(Figures 1.1-1.2; 2.1-2.6)

Diagnosis. *Brassolis granadensis* males are characterised by a broad orange forewing band that crosses the apical part of the cell and encloses one small, dark brown spot at the cell apex; in particular, the orange scaling extends right up to the cell in space CuA_1 - CuA_2 . On the hindwing underside, the distal submarginal ocellus has an inner, narrow, well-defined, dark brown line, the median one is rounder, much smaller and indistinct (virtually absent in some specimens, especially females), and has only a diffuse brown ring, whilst the one towards the proximal margin is also round, but has a diffuse dark brown ring. Unlike the male, in the female, the orange scaling in space CuA_1 - CuA_2 does not extend up to the cell, but it is slightly more extensive than that of female *isthmia*. Where the band crosses the upper part of the cell, it can enclose one small brown spot (as in *B. granadensis isidrochaconi*), or two co-joined, more extensive, brown spots (*B. granadensis wallengreni* and *B. granadensis granadensis*). The forewing band extends right to the tornus, unlike that of *B. isthmia isthmia*, where it ends just before the tornus.

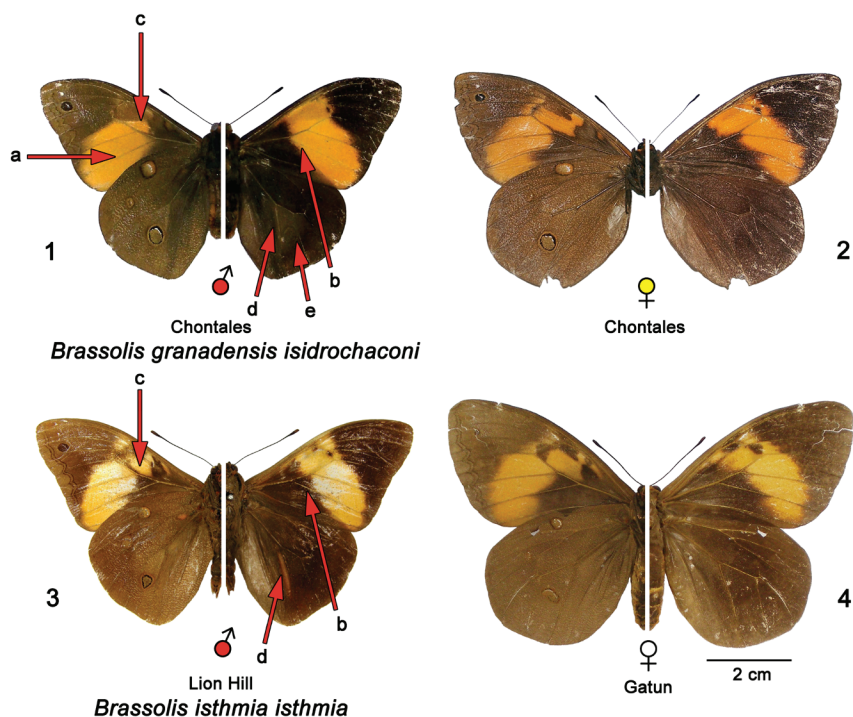


Figure 1. *Brassolis granadensis* and *B. isthmia* with diagnostic features indicated by arrows: **1-1)** *B. granadensis isidrochaconi* Paratype ♂ NICARAGUA: Chontales, TNHM; **1-2).** *B. granadensis isidrochaconi* Paratype ♀ NICARAGUA: Chontales, TNHM; **1-3).** *B. isthmia isthmia* Lectotype ♂ PANAMÁ: Lion Hill, TNHM; **1-4).** *B. isthmia isthmia* ♀ PANAMÁ: Gatun, TNHM. See text for key to lettered features.

Three subspecies are now recognised:

Brassolis granadensis granadensis Stichel from the Magdalena Valley, Colombia, between 580 and 1350m (Figure 4).

Brassolis granadensis wallengreni Bristow, **stat. rev.** from western Ecuador and western Colombia from sea level to 1600m, but mostly between 500 and 1000 m (Figure 4).

Brassolis granadensis isidrochaconi **ssp. nov.** from southern Nicaragua and extending into northern Costa Rica between 300 and 650m; there is a single male from central Panama which appears to be this taxon (Figures 4 and 5).

The distinguishing features between the three subspecies are as follows (see Figure 2):

- a) the amount of orange scaling of the forewing band beyond the cell on both the upper and lower surfaces;
- b) in female *isidrochaconi*, there is just one small brown spot at the apex of the forewing cell; there are two conjoined spots in *granadensis* and *wallengreni*;
- c) in the males, the extent of orange scaling in the cell on the forewing underside;
- d) the colour of the indistinct linear androconial patch on the hindwing (pale brown in *wallengreni*, dark brown in nominate *granadensis* and *isidrochaconi*);
- e) the darkened area of spatulate cells on the hindwing (enters the cell in *isidrochaconi*);
- f) the presence/absence (absent in *isidrochaconi*) of a small orange spot at the apex of the cell on the hindwing underside in both sexes.

***Brassolis granadensis isidrochaconi* Bristow ssp. nov.**

(Figure 1.1-1.2, 2.1-2.2)

Description. Both sexes of *Brassolis granadensis isidrochaconi* have a much deeper orange forewing band than do *Brassolis isthmia* ('a' in Figure 1). In the male, this band dorsally extends for about 1 mm beyond the cell; in space CuA_1 - CuA_2 , the band extends right up to the cell ('b' in Figure 1) and extends closer to the distal margin near the tornus. On the underside, where the forewing band crosses the cell, it is represented by just one very small orange patch ('c' in Figure 1). The androconial patch below vein CuA_2 on the hindwing is not so prominent as is that of *B. isthmia*, and varies from dull orange-brown to chocolate-brown and merges with the ground colour ('d' in Figure 1). The yellowish orange forewing band of female *B. granadensis isidrochaconi*, where it cross the cell, encloses one small (and a very small second) dark brown spot; unlike the male, in space CuA_1 - CuA_2 , the forewing band does not extend right up to the cell. On the underside, where the forewing band crosses the cell, it is represented by a larger area of orange than the male, but unlike female *Brassolis isthmia*, this does not extend proximally to partially enclose a small dark brown spot. Unlike *B. granadensis granadensis* and *B. granadensis wallengreni*, the small orange spot at the proximal end of the cell on the hindwing underside in both sexes is either absent or only weakly developed ('f' in Figure 2). The holotype male measures 40 mm in forewing length; other males vary from 41-43 mm in forewing length. The paratype female forewing length is 48 mm; other females measure 47-48 mm in forewing length. This subspecies may be raised to species-level status when these butterflies are better understood.

Distribution (see Figure 4, and Figure 5 for detailed distribution). So far, *Brassolis granadensis isidrochaconi* is only known from Chontales in Nicaragua, in the Caribbean mid-elevation (300-650m) rain forest of northern Costa Rica (except for one record from Guanacaste province in the intergradation between Caribbean rain forest and Guanacaste dry forest on the Pacific slope of Volcan Santa Maria), and a singleton from Cerro Jefé, Panamá. We anticipate that this subspecies will be found to have a more extensive range in this region when more specimens from these countries are examined. The Panamanian male is anomalous as it is at least 500km from its nearest neighbour in both Costa Rica and Colombia. The underside wing markings, particularly the restricted orange area in the forewing cell and the extremely faint orange spot in at the apex of the cell on the hindwing underside, indicates that this specimen is *isidrochaconi* and not *granadensis* nor *wallengreni*.

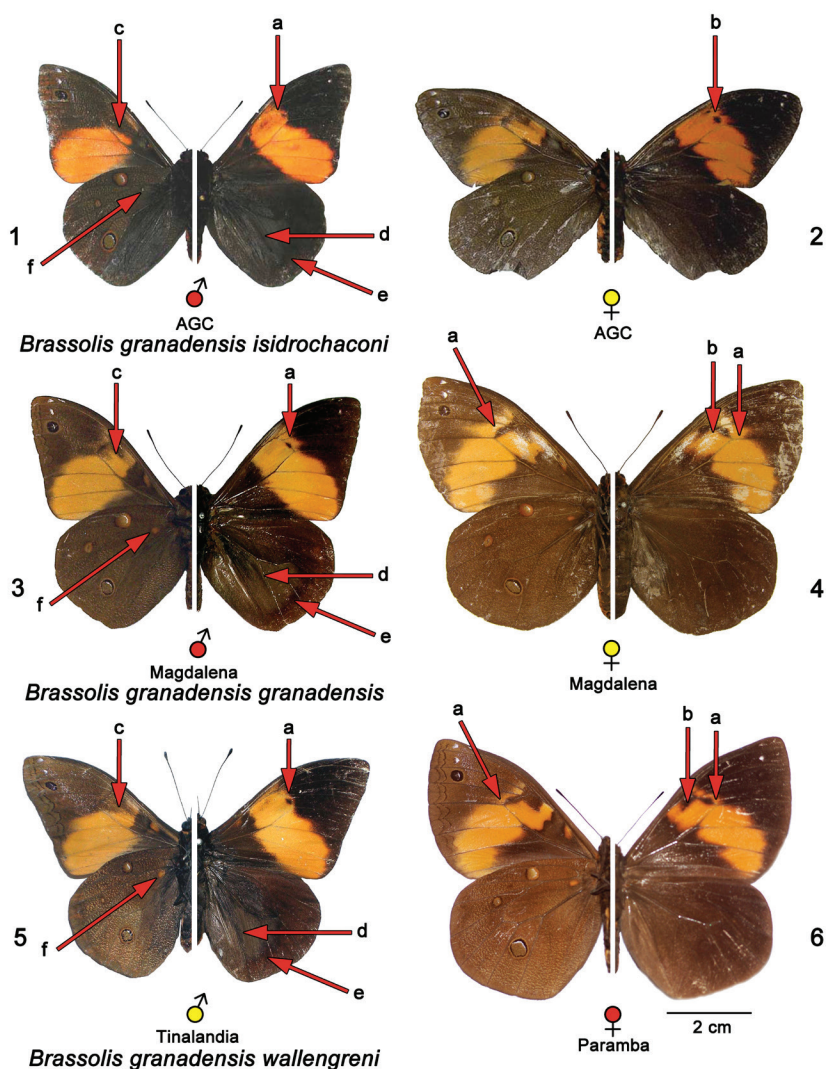


Figure 2. The three subspecies of *Brassolis granadensis* with diagnostic features indicated by arrows: 2-1) *B. granadensis isidrochaconi* Holotype ♂ COSTA RICA: Area de Conservacion Guanacaste, Buenos Aires, Alajuela province; 2-2) *B. granadensis isidrochaconi* Paratype ♀ COSTA RICA: ACG, Rincon Rain Forest, Alajuela Province; 2-3) *B. granadensis granadensis* Lectotype ♂ COLOMBIA: Río Magdalena, TNHM; 2-4) *B. granadensis granadensis* Paralectotype ♀ COLOMBIA: Río Magdalena, TNHM; 2-5) *B. granadensis wallengreni* Paratype male, ECUADOR: Tinalandia, TNHM; 2-6) *B. granadensis wallengreni* Holotype ♀, ECUADOR: Paramba, TNHM.

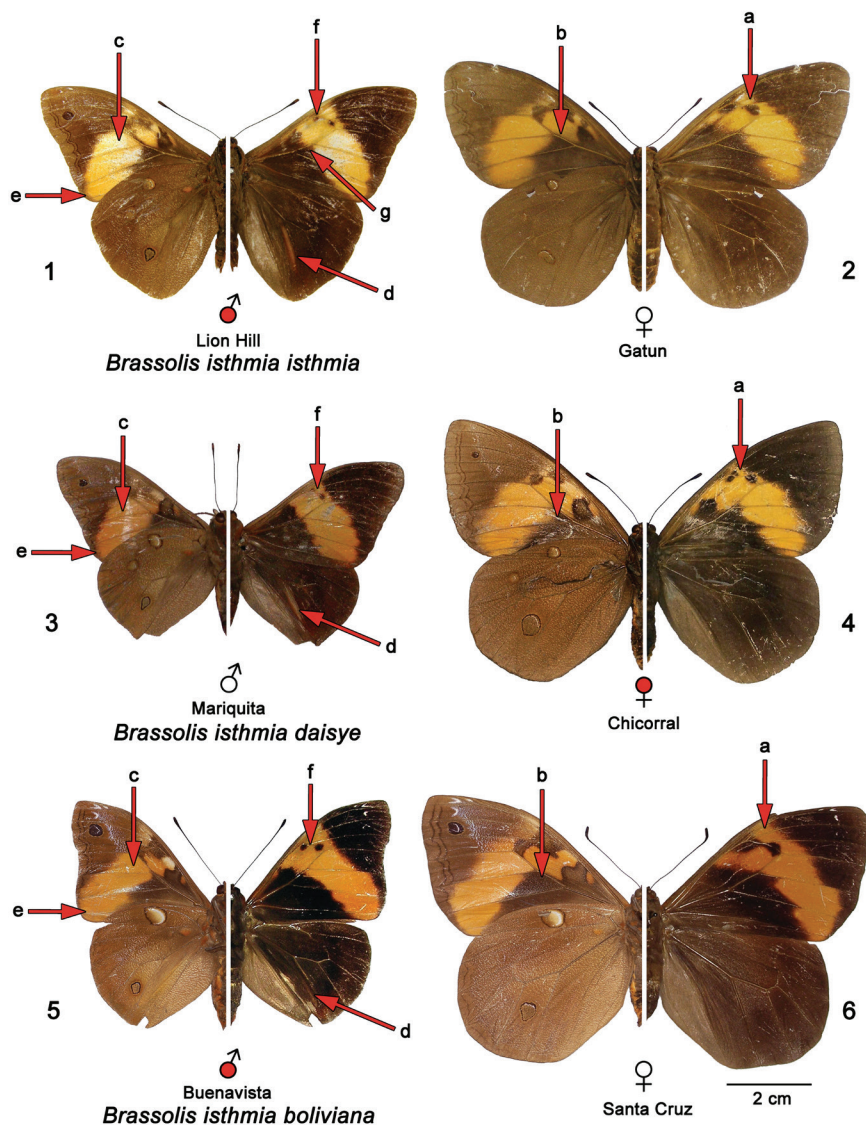


Figure 3. The three subspecies of *Brassolis isthmia* with diagnostic features indicated by arrows: **3-1)** *B. isthmia isthmia* Lectotype ♂ PANAMÁ: Lion Hill, TNHM; **3-2)** *B. isthmia isthmia* ♀ PANAMÁ: Gatun, TNHM; **3-3)** *B. isthmia daisye*, Paratype ♂ COLOMBIA: Mariquita, UPI; **3-4)** *B. isthmia daisye* Holotype ♀, COLOMBIA: Chicorral, TNHM; **3-5)** *B. isthmia boliviana* Lectotype ♂; BOLIVIA: Buenavista, TNHM; **3-6)** *B. isthmia boliviana* Paralectotype ♀. BOLIVIA: Santa Cruz de la Sierra, TNHM.

Food plants and immature stages. On the lower Caribbean slopes (300-500 m) of the Cordillera Guanacaste (and once in the rain forest - dry forest intergrade on the Pacific side of Volcan Santa Maria) within Area de Conservacion Guanacaste (ACG) in north-western Costa Rica (see database at <http://janzen.sas.upenn.edu>) (Figure 5), clutches of free-living caterpillars of *B. granadensis isidrochaconi*, and only this subspecies of *Brassolis*, have been reared nine times from *Cocos nucifera* (Arecaceae) (see Figure 6). The one rearing from *Prestoea decurrens* (Arecaceae) from the mid-elevation (650 m) forest upslope from the La Selva Biological Station (OTS) is also *B. granadensis isidrochaconi* (Isidro Chacon, pers. com.) and only about 100 km from the location of the ACG rearing records.

Adult butterflies have only been bred through from final instar larvae which form large groups living in a tangle of defoliated palm fronds, silk webbing and debris. The larvae, which reach lengths of between 60 and 65 mm, are a rich chestnut-brown with a composite dorsal yellow stripe composed of three yellow bands separated by two narrow chestnut-brown bands; laterally, there are two similar composite stripes separated from the dorsal stripe by a wide chestnut-brown band (Figure 6). Pupae, which come in two colour morphs (one orange, one yellow, even from the same batch of caterpillars) are between 34 and 36 mm long (Figure 6). The pupation stage lasts between 15 and 21 days (average of 8 = 18 days).

Types. Holotype ♂: COSTA RICA: ACG, Buenos Aires 00-SRNP-12526 1/x/2000 [=emergence date], TNHM; Paratype ♂ as Holotype but 00-SRNP-12357 2/ix/2000; Paratype ♂ as Holotype but 00-SRNP-12358 2/ix/2000; Paratype ♂ as Holotype but 00-SRNP-12538 3/x/2000; Paratype ♂ COSTA RICA: Estacion Quica 09-SRNP-72565 18/x/2009; Paratype ♂ COSTA RICA: ACG, Finca la Lucha 07-SRNP-40992 24/v/2007; Paratype ♀ COSTA RICA: ACG, Finca la Lucha 07-SRNP-40991 24/v/2007 TNHM; Paratype ♀: COSTA RICA: ACG, Buenos Aires 00-SRNP-12532-DHJ35166/7 30/x/2000; Paratype ♀ as preceding, but 00-SRNP-12524 29/ix/2000; Paratype ♂ COSTA RICA: Alajuela, San Carlos Arenal, 500m, 13/xii/2003 MNCR (figure d, www.butterfliesofamerica.com/t/Morphinae_a.htm); Paratype ♀ COSTA RICA: Valleverde, 00-SRNP-16218 11/viii/2009; Paratype ♀ COSTA RICA: Santa Maria 07-SRNP-61094 06/i/2008; Paratype ♂ NICARAGUA: Chontales, Belt leg TNHM; Paratype ♀ NICARAGUA: Chontales, Belt leg TNHM.

The holotype and a paratype female will be deposited in the TNHM; a pair of paratypes will be deposited in the FLMNH, and all other types will be deposited in the USNM.

Additional material. A male caught by Gordon Small at Cerro Jefé, Panamá, on 16/iii/1978 is not included in the type series. DeVries (1987, plate 41, fig. 8) also illustrates a male *B. isthmia* which is probably *B. granadensis isidrochaconi* from Peralta, Costa Rica. This specimen closely resembles *isidrochaconi* in the deep orange colour of the forewing and the lack of a prominent linear androconial patch on the hindwing. However, the forewing band in space CuA_1 - CuA_2 does not touch the cell. Additionally, the two prominent brown spots in the distal part of the cell are more typical of *isthmia*.

Etymology. This subspecies is named for Sr. Isidro Chacón Gamboa of San José, Costa Rica, in recognition of the tremendous amount of Lepidoptera research, collecting, curating and systematic studies that he has conducted in Costa Rica, and especially in the Museo Nacional de Costa Rica and in the Instituto Nacional de Biodiversidad (INBio) while simultaneously facilitating the research of thousands of other people who care about tropical Lepidoptera.

DNA barcode. The DNA barcode is listed in Appendix 1 for future research and analysis.

***Brassolis isthmia* Bates, 1864**

(Figures 1.3,1.4; 3.1-3.6)

Brassolis isthmia, like *granadensis*, is characterised by a dark brown ground colour with a broad (though slightly narrower than that of *B. granadensis*), yellowish orange forewing band that crosses the apical part of the cell, but encloses one or two small, dark brown spots at the cell apex. On the male forewing underside, the forewing band in space CuA_1 - CuA_2 does not extend right up to the cell. The small orange spot at the proximal end of the cell on the hindwing underside is weakly developed ('f' in Figure 2). The female forewing band, where it crosses the cell, encloses two small dark brown spots that coalesce to form a dumbbell shape. On the underside, where the forewing band crosses the cell, it extends proximally to partially enclose a small dark brown spot. Female forewing lengths vary from 44-62 mm; the forewing length of males measures 43-46 mm. There is no hindwing band (two males from Panamá in the FLMNH (Carla Penz, *pers. com.*) and one from Colombia (Jean Le Crom Collection) have a very faint hindwing band). On the hindwing underside, there are three submarginal ocelli (in some specimens only two, in some others there is a fourth, very faint). Of these spots, the distal one, which can be round or pear-shaped, has an inner, narrow, well-defined, dark brown line. The median spot is rounder, much smaller, indistinct (virtually absent in some specimens, especially females), and has only a diffuse brown ring. The spot towards the proximal margin is also round, but has a diffuse dark brown ring.

Distribution (see Figure 4, and Figure 5 for the detailed distribution of *Brassolis isthmia isthmia*). *Brassolis isthmia isthmia* extends westwards from its type locality of Lion Hill, Panamá, at least as far as Guapiles, and then Limón, Limón Province, Costa Rica, at elevations from sea level to 300 m (DeVries, 1987, p. 249, pl. 41, fig. 9). Among the specimens in the collections of the Museo Nacional de Costa Rica and INBio, all of those from Siquirres, Limon, Sixaola, Pital and Fortuna (0-650 m elevation), Costa Rica, are *B. isthmia isthmia*. The eastward extent is not known, but it is presumed to extend as far as the Colombian border. It is now known that the 'Cauca' specimen mentioned by Bristow (2008, p. 49) is in fact *Brassolis isthmia daisye*.

Brassolis isthmia daisye occurs principally in the Magdalena Valley, but as well as having been recorded at 'Cauca', is also known from Apartado, Antioquia Province, on the Caribbean coast of Colombia (Jean LeCrom Collection).

Brassolis isthmia boliviana is known to us only from three specimens, all from Bolivia: Buenavista (Lectotype), Santa Cruz de la Sierra, and 'Yungas'. It is so distinct that it probably will be raised to species rank with further study.

The distinguishing features between the three subspecies of *Brassolis isthmia* are as follows (see Figure 3):

- a) the extent of the orange scaling of the forewing band beyond the cell;
- b) the extent of the orange scaling on the female forewing underside in space CuA_1 - CuA_2 ;
- c) the extent of the orange forewing scaling in space M_3 - Cu_1 ;
- d) the length and brightness of the male androconial patch on the hindwing;
- e) in the male, the proximity of the forewing band to the tornus;
- f) the size and shape of the brown spots at the apex of the forewing cell.

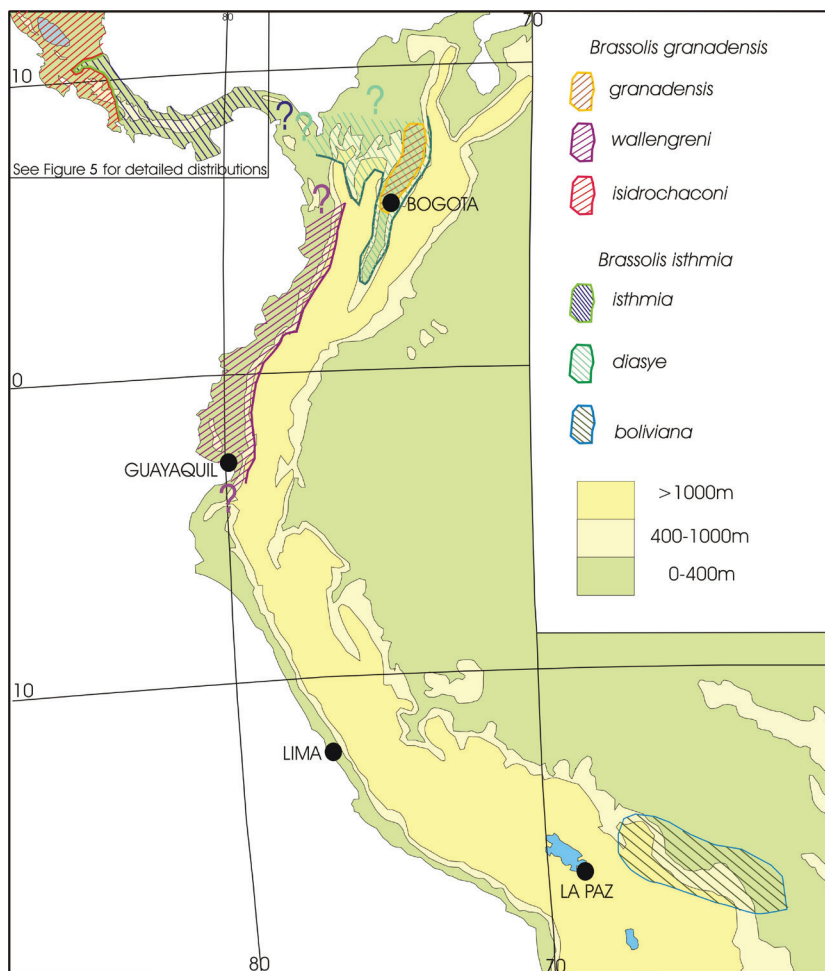


Figure 4. Distribution map of the subspecies of *Brassolis granadensis* and *B. isthmia*.

ACKNOWLEDGEMENTS

Special thanks are owed to Blanca Huertas for ease of access to the NHM collections, especially during the difficult times of moving the collections to Wandsworth and then back again. To Jean LeCrom for photographs of the Apartado male of *Brassolis isthmia daisye*. To Sr. Isidro Chacón Gamboa for help with determining *isthmia* specimens in INBio and for food plant data for *granadensis* larvae. Brian Harris and Bob Robbins of the USNM kindly provided a photograph of the Cerro Jefé male caught by Gordon Small. This research was supported by NSF grant DEB-0515699 to DHJ, and by the ACG parataxonomists who found and reared the *Brassolis granadensis isidrochaconi* caterpillars.

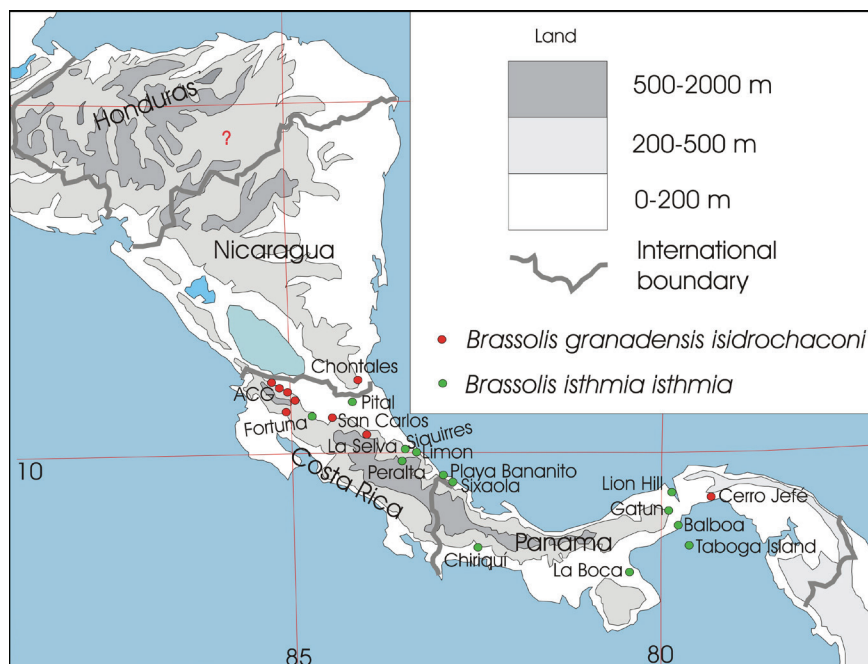


Figure 5. Distribution map of *Brassolis granadensis isidrochaconi* and *B. isthmia isthmia*.

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APPENDIX 1

It is unfortunate that, at the moment, we have DNA barcodes for only one of the taxa discussed herein, but it at least provides a foundation on which to build. The specimen is a female (Figure 2.2) of *Brassolis granadensis isidrochaconi* (still listed on the web site as *Brassolis isthmia* until its new name is published) number 07-SRNP-40991, and is as follows:

MHMXO591-08|07-SRNP-40991|*Brassolis granadensis isidrochaconi*|COI-5P
 ACTTTATATTTTATTTTGGAAATTTGGGCAGGAATAATAGGAACCTTCTTTAAGTCTTAT-
 TATCCGAATAGAATTAGGAAATCCAAGATTTTAAATTGGAGATGATCAAATCTATAATA-
 CAATTGTTACAGCTCATGCTTTTATTATAATTTCTTTATAGTTATACCCATTATAATTG-
 GAGGATTTGGAAATTGATTAATTCCTTAATGTTAGGAGCCCCAGATATAGCTTTCCCC-
 CGAATAAATAATATAAGTTTGTGACTTCTCCCCCTCTTAACTCTTAATTTCAAGTAGT-
 ATTGTAGAAAATGGAGTCGGAACAGGATGAACGTCTATCCCCCCTTTTCATCTAATATT-
 GCTCATAGAGGAGCTGCTGTTGATTTAGCTATTTTCCCTTCATTTAGCGGGTATTTCC-
 CAATCTTAGGGGCTATTAATTTTATTTCCACAATTATTAATATACGAATTAATAATTTATCT-
 TATGATCAAATACCTTTATTTATTTGAGCTGTAGGAATTACAGCTTTACTATTACTAC-
 TATCTTTACCTGTATTAGCTGGAGCTATTACTATACCTTTAACTGATCGTAATTTAAATAC-
 CTCTTTTTTGTATCCTGCTGGAGGGGAGATCCAATTCTATATCAACATTTA
 (source www.boldsystems.org/views/login.php).

APPENDIX 2. MATERIAL EXAMINED

Brassolis granadensis granadensis

COLOMBIA: 2 ♀, Otanche, Boyaca, leg. Urbina, CROM; 1 ♂, Otanche, Boyaca, 800m, xi/88, leg. Urbina, CROM; 1 ♂, Otanche, Boyaca, 800m, viii/86, leg. Urbina, CROM; 1 ♂, 1 ♀, Muzo, Apoll. Marie, TNHM; 1 ♂, Int. of Colombia, Wheeler, TNHM; 1 ♂ Otanche, Boyaca, 800m, 1983/07/00, MNHN; 1 ♂ Otanche, Boyaca, 800m, 1983/07/00, MNHN; 1 ♂, Guamocó, 580m, AMNH; Cerro de la Paz, Santander, 6°58'N, 73°25'W, 1350m, 2004/01/11, Huertas, TNHM; 1 ♂ lectotype, Rio Magdalena, TNHM; 1m, S. José del Guaviare, 500m, CROM.

Brassolis granadensis isidrochaconi

NICARAGUA: 1 ♂, 1 ♀, Chontales, Belt, TNHM; COSTA RICA: 1 ♀, Santa Maria, Guanacaste, 10°44'N, 85°19'W, 566m, 2008/01/06, USNM; 1 ♂, Valleverde, Alajuela, 10°49'N, 85°14'W, 400m, 2000/08/11, USNM; 1 ♂, Estacion Quica, Guanacaste, 10°59'N, 85°23'W, 470m, 2009/10/18; 1 ♂, San Carlos, Alajuela, 500m, 2003/12/13, Nishida, UCR; 1 ♂ holotype, Buenos Aires, Alajuela, 10°53'N, 85°18'W, 400m, 2000/10/01, Pereira, G, TNHM; 1 ♀, Finca La Lucha, Alajuela, 10°50'N, 85°14'W, 452m, 2007/04/23, Perez, TNHM; 3 ♂, 2 ♀, Buenos Aires, Alajuela, 10°53'N, 85°18'W, 400m, 2000/10/01; PANAMÁ: 1 ♂, Cerro Jefé, 1000m, 1978/03/16, Small, USNM

Brassolis granadensis wallengreni

ECUADOR: 2 ♀, Los Rios Province, Rio Palenque, 400m, Dodson, FLMNH [genitalia preparation Garzón and Penz, 2009, IG 07-06 & 08 (as *haenschi*) (MGCL)]; 1 ♂, Tinalandia, Pichincha, 0°17'55"S, 79°03'09", 700m, 1975/06/29, Bristow, TNHM; 1 ♀, Santo Domingo, Pichincha, Ecuador, 600m, 1972/05/04, Venedictoff, FLMNH; 1 ♂, Tinalandia, 700m, 1972/05/04, Venedictoff, FLMNH; 1 ♂, Tinalandia, 700m, 1972/08/00, Venedictoff, FLMNH; 1 ♂, Alluriquin, Pichincha, 750m, 1996/01/20, Piñas, F, Piñas; 1 ♂, Dos Puentes, 510m, 1929/01/00, Coxey, ANSP; 1 ♀, Alluriquin, 750m, 1984/06/22,

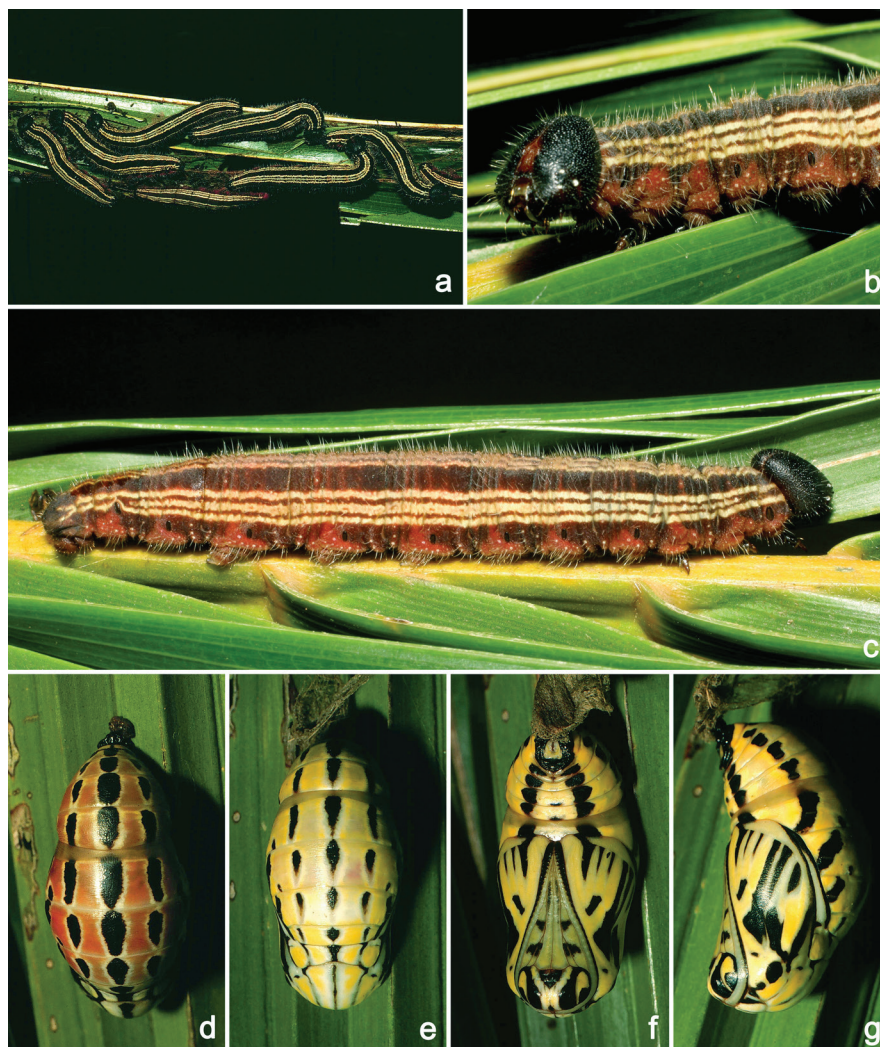


Figure 6. Final instar larvae and pupae of *Brassolis granadensis isidrochaconi*: **a)** clutch of caterpillars on *Cocos nucifera*, length 50mm; **b)** lateral view of larva showing front of head capsule; **c)** final instar larva, lateral view, length 60mm; **d, e)** dorsal views of pupae; **f)** pupa, ventral view; **g)** pupa, lateral view.

Bastides, MECN; 1 ♀, Tinalandia, 700m, 1972/08/31, Venedictoff, MNHN; 1 ♀, Tinalandia, 700m, 1973/01/06, Venedictoff, MNHN; 1 ♀, Santo Domingo, 650m, 1973/06/12, Venedictoff, MNHN; 1 ♂, Santo Domingo, 650m, Benoist, MNHN; 1 ♂, Santo Domingo, 600m, 1972/08/01, Venedictoff, FLMNH; 1 ♀, Santo Domingo, 830m, F. Piñas; 1 ♀, Alluriquin, Pichincha, 750m, 1996/02/02, Piñas, F. Piñas; 1 ♀, Tinalandia, 700m, 1971/11/07, Venedictoff, Piñas; 1 ♀, Paramba, 1070m, 1913/00/00, Rosenberg, TNHM; 1 ♀, Balzapamba, 900m, 1894/04/03, Mathan, TNHM; Santo Domingo, Venedictoff, MNHN; 1 ♂, Tinalandia, 700m, 2007/06/15, Marqua, USNM; 1 ♂, Alluriquin, 750m, 1972/03/29, Venedictoff, FLMNH; 1 ♂, 1 ♀, Tinalandia, 0°17'55"S, 79°03'09', 700m, 1974/09/06, Bristow, CRB; 1 ♂, Tinalandia, 0°17'55"S, 79°03'09', 700, 1975/06/29, Bristow, TNHM; COLOMBIA: 1 ♀, Mistrato, Risaralda, 1590m, 1992/07/27, leg. Andrade, ICNUN; 1 ♀, San José del Palmar, Choco, 800m, 1994/08/27, Silva, CROM; 1 ♀, Rio Dagua, TNHM; 1 ♂, Dept. de Risaralda, Mpio de Pueblo Rico, 640m, 1991/04/16, ICNUN.

Brassolis isthmia boliviiana

BOLIVIA: 1 ♀, Yungas de la Paz, 1000m, Rolle, FLMNH; 1 ♂, Buenavista, Santa Cruz, 750m, Steinbach, TNHM; 1 ♀, Sta Cruz de la Sierra, 416m, 1904/04/00, Steinbach, TNHM.

Brassolis isthmia daisye

COLOMBIA: 1 ♂, 1 ♀, San José de Nus, Antioquia, 6°29'N, 74°50'W, 760m, CROM; 1 ♀, Payande, Mina Vieja, Tolima, 8-900m, 1974/03/20, Steinhauser, FLMNH [genitalia preparation Garzón and Penz, 2009 CMP 07-141 (MGCL)](as *isthmia*); 1 ♀, Macarena, Sierra de, Meta, 380m, enero 1950, Richter, ICNUN; 1 ♂, Río Guayapas, Macarena, Meta, 500m, enero 1951, Richter, ICNUN; 1 ♂, La Jagua de Ibirico, Cesar, 9°32'47"N, 73°16'48"W, 365m, 07-Abr-05, Perez, Luis J., Crom; 1 ♂, Apartado, Antioquia, 80m, Mar.1981, Madrigal, A, IAvH; 1 ♀, Fredonia, Antioquia, 1800m, 1957/02/00, Gallego, IAvH; 1 ♀, Guayabetal, Meta, 800m, Corzo?, UPI; 1 ♂, Macarena, Río Guayapas, Meta, 600m, 1950/01, Dr Richter, ICNUN; 1 ♂, 1 ♀, Cauca, 1902, Ribbe, H., MNHN; 1 ♀, Chicorral, 500m, 1920, Pomeroy, TNHM; 1 ♀, Honda, Tolima, 5°12'31"N, 74°44'22"W, 250m, iv.1957, Schmidt Mumm, IAvH; 1 ♂, Mariquita, Tolima, Agosto 1992, Moreno, UPI; 1 ♀, Nariño, Cundinamarca, 240m, 1993/09/25, Jaramillo, ICNUN; 1 ♀, Nariño, Cundinamarca, 263m, 1993/09/25, Jaramillo, ICNUN; 1 ♂, Remedios Casabe, Antioquia, 6°57'N, 74°38'W, 800m, i.1959, Schmidt Mumm, IAvH; 1 ♀, Chaparral, Tolima, 600m, 1993/05/20, Rozo, ICNUN; 1 ♀, El Centro, Santander, AMNH.

Brassolis isthmia isthmia

PANAMÁ: 1 ♂, Panamá City, 1945/04/26, Michener, AMNH; 1 ♀, Flamenco Island, Salvin, TNHM; 1 ♂, Arraiján, 1946/09/15, Barnes, AMNH; 1 ♂, La Boca, 1907/10/28, AMNH; Panamá City, 1945/04/03, Michener, AMNH; 1 ♀, Fort Clayton, 1932/02/02, Edwards, AMNH; 1 ♀, Ancon, 1959/04/17, Lundy, AMNH; 2 ♂, Lion Hill, McLeannem, TNHM; 1 ♂, 2 ♀, Taboga Island, 1924/09/17, Collenette, TNHM; 1 ♀, Panamá City, 1945/05/01, Michener, AMNH; Balboa, 1962/02/10, Small, FLMNH; 1 ♂, Balboa, 1962/07/10, Small, FLMNH; 1 ♂, Balboa, 1966/04/22, Small, FLMNH; 1 ♂, Gatun, 1945/10/17, RJJ, FLMNH; 1 ♂, Balboa, 1962/10/06, CAS; 1 ♀, Canal Zone, 1945, RJJ, FLMNH; 1 ♀, Tocumen, 1976/10/31, Jenkins, FLMNH [genitalia preparation Garzón and Penz, 2009 IG 07-05 (MGCL)]; 1 ♀, Samboa=?Gamboa, 1955/04/23, FLMNH; 1 ♂, Howard, 1975/09/28, FLMNH; 1 ♂, 1 ♀, Tocumen, Panamá, Rents, Carter & Mullinex, CAS; 1 ♀, Colon, 1936/08/05, Berlioz, AMNH; 1 ♀, Fort Amador, 1975/04/26, FLMNH; 1 ♂, 1 ♀, Balboa, 1963/04/29, USNM; 1 ♀, Chiriquí, ZMA; 1 ♂, 1 ♀, Gatun, 1946/07/00, Harrower, D.E., ANSP; 1 ♂, Río Gatun, Ribbe, ZMHU; 1 ♀, Chiriquí, USNM; 1 ♂, 1 ♀, Taboga Island, Busck, USNM; 1 ♀, Balboa, 1952/10/27, USNM; 1 ♂, Panamá City, 1965/04/07, USNM; 1 ♂, 1 ♀, Canal Zone, 1972, Keenan, USNM; 1 ♂, Panamá, Bradley, Yale; 1 ♂, Canal Zone, 1975, Leigh, E.H., Yale; 1 ♀, Ancon, 1920, Remington, P.S., Yale; 1 ♀, Canal Zone, 1965/04/15, USNM; 1 ♂, 1 ♀, Tabernilla, Canal Zone, Busck, USNM; 1 ♂, Colon, NCM; 1 ♂, Panamá,

Leiden; Lectotype ♂, Lion Hill, McLeannem, TNHM. COSTA RICA: 1 ♀, Port Limón, AMNH; 6 ♂, 5 ♀, Horquetas, Heredia, 10°17'N, 84°02'W, 630m, 1991/09/24, Chacon, INBIO; 1 ♂, San José, 1920, AMNH; 1 ♂, Playa Bananito, Limon, 1986/03/05, Austin, FLMNH; 1 ♀, Cahuita, 0-50m, 1988/12/24, Menke, USNM; 1 ♀, Sixaola, Limón, 9°38'N, 82°39'W, Quesada, Freddy, INBIO; 1 ♂, Pital, Alajuela, 10°40'N, 84°14'W, 50-100m, 2004/06/25, Hernandez, Braulio, INBIO; 2 ♂, Fortuna, Guanacaste, 10°26'N, 84°43'W, 650m, 1999/08/00, Rodriguez, Gladys, INBIO; 1 ♀, Siquirres, Limón, 10°07'N, 83°32'W, 300m, 2001/07/04, Vega, G., MNCR; 1 ♀, Limón, DeVries (1987, pl. 41); 2 ♀, Limón, 10°00'N, 83°02'W, 1975/05/22, Dean, G., INBIO/MNCR.

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