HAIRSTREAK BUTTERFLIES OF THE GENUS SERRATOFALCA (LEPIDOPTERA: LYCAENIDAE)

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ABSTRACT.—Serratofalca includes six species distributed from Belize southward to Argentina. Although very similar in generalized wing pattern, interspecific structural differences are great. As revised, often synonymized historical taxa Thecla cerata Hewitson and Thecla palumbes Druce are titular taxa of two divergent species groups, former with sclerotized female genital structures occurring in linear configuration, latter in a spiral. The "cerata Group" includes S. cerata (Amazon Basin) and new species: S. sasha n. sp. (Central America and western South America), S. gorgoniensis n. sp. (Gorgona Island, Pacific continental shelf) and S. callilegua n. sp. (NW Argentina). The "palumbes Group" includes S. palumbes (Amazon Basin, Guyana Shield) and new species: S. iguapensis n. sp. (SE Brazil). S. cerata and S. palumbes are sympatric in the eastern Amazon Basin; S. palumbes and S. sasha are sympatric in the western Amazon Basin; S. iguapensis is divergent and may be the most primitive member of the group with some characters suggestive of a sister genus Klaufera Johnson 1991.

KEY WORDS: Amazon, Argentina, Belize, Bolivia, Brazil, Calycopis, Calystyrma, Central America, Colombia, Costa Rica, Ecuador, Eumaeini, French Guiana, Guatemala, Guyana, Klaufera, Neotropical, Nicaragua, Panama, Peru, Serratofalca callilegua n. sp., Serratofalca gorgoniensis n. sp., Serratofalca iguapensis n. sp., Serratofalca sasha n. sp., South America, Strymon, Surinam, Thecla, Theclinae, Venezuela.

In 1991, the senior author described a number of new genera from the poorly known "Calycopis/Calystyrma" grade of the Eumaeini (sensu Eliot, 1973). Members of this grade exhibit a variety of "W"-like elements in their undersurface wingbands and show great structural diversity. This has complicated identification and hindered development of a basic taxonomy for the many Neotropical members. Johnson's monograph elucidated twenty structural groups (genera) from this grade, including treatment of the available names, extant type specimens and report of the number of undescribed entities encountered during the initial study. The large number of these latter entities made it impossible to include all of them in the original study.

This paper elaborates taxa of the genus Serratofalca, a group showing few differences in the superficial wing characters of species, but great differences in their genital and tergal structures. Historically, because of confusion about wing patterns, available names have often been haphazardly applied or synonymized (see Bridges, 1988). Serratofalca, as defined by Johnson (1991) generally included species of Draudt's (1919) Thecla "cerata Group". Congeners share an inwardly serrate falces on the genitalia of males along with other distinctive characters of the genitalia and tergal morphology in males and females. Two available names within the group, S. cerata Hewitson and S. palumbes Druce (transferred by Johnson, 1991, from Thecla), have historically been considered synonyms (Draudt, 1919) or subspecies based on generalized wing characters (Bridges, 1988, and others in lit. therein). However, when studied from the types and other specimens, S. cerata shows (among other characters) sclerotized female genital structures occurring in a lineal configuration (Figs. 13-15) while those of S. palumbes occur in a spiral (Figs. 16-17).

Four widely distributed and variously sympatric populations of Serratofalca exhibit distinctive structural characters including a lineal female genital configuration like S. cerata; S. palumbes and an allopatric population show a distinctive habitus including spiral female genital elements. Based on the reliability of these differences in "blind" diagnostic tests, and sympathy apparent in three of the entities, we define a taxonomy for Serratofalca below including six species—four in the "cerata" Species Group and two in the "palumbes" Species Group. The paper illustrates the difficulties posed by reliance on superficial characters in some Neotropical Theclinae and in defining an alpha taxonomy from divergent structural characters when both sympatry and allopatry occur. The paper also indicates the need for biological studies in similar butterflies where coherent structural characters and sympathy suggest far more species than reflected by superficial wing resemblance.

MATERIALS AND METHODS

Collections

Samples were studied from the Allyn Museum of Entomology, Florida Museum of Natural History (AME), American Museum of Natural History (AMNH), Carnegie Museum of Natural History (CMNH), Hope Entomological Collections (Oxford) (HEC), Milwaukee Public Museum (MPM), Muséum National d'Histoire Naturelle (Paris) (MNHN) and the Natural History Museum (London) (BMNH).
Methods

In 1991, preliminary study was made by the junior author of all assembled material at the AMNH based on characters delineated for *S. cerata*, *S. palumbes* and three entities noted as undescribed by Johnson (1991). In 1992, based on delineation of additional characters supporting the presence of five taxonomic units, blind test dissections were performed by the senior author on remaining specimens at the BMNH. Subsequently, all remaining material was dissected and identified. Six taxonomic units were ultimately recognized as species, reflecting an alphatonomic procedure involving consistent differences in characters of the wings, genitalia and tergal morphology recognizable in the

Fig. 1-6 (a, male, b, female, uppersurface left, undersurface right). 1a. *S. cerata*, Pará (BMNH); 2ab. *S. sasha*, holotype, allotype; 3a. *S. gorgoniensis*, holotype; 4ab. *S. calilegua*, holotype, allotype; 5ab. *S. palumbes*, St. Jean de Maroni (MNHN); 6ab. *S. iguapensis*, holotype, allotype.
blind tests. The present paper emphasizes problems facing alpha taxonomy (Foote, 1977) (e.g. "dead bug-" or "museum-" taxonomy, Crowson, 1970) in superficially similar, wide-ranging, Neotropical butterflies and a subsequent Discussion section recognizes other options for delineating taxonomic statuses within the genus.

**Presentation**

Standard revisionary format is employed with reference to superficially similar wing patterns limited to the generic treatment and notes in an initial entry "Identification" under "Species". Thereafter, species diagnoses emphasize structural characters, employing for brevity certain telegraphic phrases to denote morphological structures referred to thereafter in the character tables and figure captions. Terminology follows Johnson (1991), particularly regarding the "sipc", "bilobed" and "caudal extension" elements of the valves in male genitalia and various elements of the female genital apparatus (Fig. 7). Morphological illustrations were prepared by the junior author using the camera lucida attachment to the Zeiss Stemi SV-8 binocular microscope (AMNH). Locality listings and diacritical usages follow Rand McNally & Company (Anon., 1992) with unlocatable names placed in quotation marks.

**SERRATOFALCA Johnson**


**DIAGNOSIS.**- Structural characters (as elaborated in more detail by Johnson 1991:14) include, most outstandingly, male genitalia with falces serrate along the inner margin (Fig. 7f) and female genitalia dominated by extremely large, generally ovate, genital plates (Fig. 13s,vs) terminating a short, robust, ductus bursae (13db). In addition, in males the vinctular dorsum is cleft but lacks brush organs (7v) and the terminal tergites are modified to an elaborate subordinate incised posterior cavity ("sipc", 7c); in females the *sipc* is limited to slight bilobate sclerotization of the terminal tergite (13t).

Wing pattern (Figs. 1-6) can generally be characterized as dull azure blue iridescence on the upper wing surfaces of both sexes contrasting gray to yellow-gray undersurface grounds crossed on the hindwing by a thin orange to reddish band forming a "W"-shape near the anal margin. Experienced workers will find this pattern distinguishes nearly all *Serratofalca* cerata: Johnson 1991:14.

**SPECIES**

**Identification**

All species, except one, fall within the "Wing pattern" diagnosis of the generic entry. Diagnoses below emphasize the structural characters summarized in Table 1 with descriptions listing the morphological characters by the character and species subset numbers from the table. Species’ males can be identified by any of three distinctive tergal or genital characters, females by a combination of two (species group members share a common linear or spiral habitus).

**Nomenclature**

**cerata Group**

Female genitalia with sclerotized elements in a lineal configuration; male genitalia with straight aedeagal shaft.

*Serratofalca cerata* (Hewitson)  
Figs. 1, 7, 13


*Caly copis* (?) *cerata*: Bridges *Ibid.*, op. cit.: I.76, II.20, III.68.


**DIAGNOSIS.**- Males identified by concave terminal margin of *sipc* (Tb. 1, Character ["Ch."] 1, Fig. 7) and short ovate valves terminating in short, slightly upturned, caudal extensions (Tb. 1, Ch. 2, Fig. 7); females showing each lobe of bilobate superior
genital plate showing only a single, usually short, distoterminal spine (Tb. 1, Ch. 6, Fig. 13).

**DESCRIPTION.**— Wings (Fig. 1AB) typical of genus, generally indistinguishable from congeners. Forewing: males, 12.0 - 13.5 mm. (n=5, MNHN.BMNH); females 12.5 - 13.5 mm. (n=3, MNHN, BMNH). Male Tergal Morphology and Genitalia: Fig. 7, Tb. 1, Chs. 1(1), 2(1), 3(1), 4(1). Female Genitalia: Fig. 13, Tb. 1, Chs. 5(1), 6(1).

**TYPES.**— Lectotype male* (BMNH) (Johnson 1991, Fig. 6) designated by Johnson 1991 from Hewitson type syntype 4, labelled "Para" [Brazil]; two BMNH parallectotype males, syntypes 1 and 2 designated by Johnson 1991, same data (but 1 noted as without abdomen and thus identification now tenuous). Syntype male 3 represented a sympatric specimen of *S. palumbes* (see below).

**DISTRIBUTION.**— Spatial (Fig. 18): restricted to northeastern Brazil from mouth of Amazon River (Pará State) southeastward to Pernambuco and Bahia states. To date indicated as sympatric with *S. palumbes* at four localities in Pará State (see Remarks). Temporal: all known specimens are old and lack collection dates; however, one can infer from the well-known sympatric congeners that occurrence is year-round.

**REMARKS.**— General. This familiar name is restricted by the facies of its lectotype; various parts of pan-Neotropical range traditionally attributed to "Thecla cerata" hereafter assume new species names as appropriate to this revision.

**Characters.** In addition to the characters summarized in the Diagnosis and Table 1, pertinent comment on structural features also includes the following.

Most *cerata* Group members show a contoured juncture of the male valval bilobed configuration and caudal extension (Figs. 7-10) contrasting the more even contour in the elongate valvae of the *palumbes* Group (Figs. 11-12). However, the character is not included in Tb. 1 because *cerata* Group member *S. gorgoniensis* lacks a caudal extension of the valvae (Fig. 9). We have said above that *cerata* Group males show a "straight" shaft on the aedeagus. By this we refer to the aedegaal habitus posterior of the caecum and anterior of the terminal recurvature apparent in most species surrounding the vesica and cornuti (this same area posterior of the caecum is undulate in the *palumbes* Group).

**Distribution.** Restricted herein to Brazilian localities near the mouth of the Amazon River and southward along the coast to Bahia and Pernambuco states. Sympatric with *S. palumbes* along the Amazon River through Pará State, sympatric specimens currently known from four localities in Material Examined ["ME"], listed hereafter from first ME entry word and as shown from east to west in Fig. 18, (1) Bragança, (2) Pará, (3) Santarém, (4) Óbidos. Most of these specimens are old and with generalized locality data.

**MATERIAL EXAMINED** (in addition to types).— BRAZIL.— Bahia: *1* male (BMNH); *Pernambuco: *1* male (BMNH). *Amazonas: Santarém, 1880, leg. de Methan, **1** male, **1** female (BMNH); Tonantins, 1880, leg. de Mathan, *1* male, **1** female (BMNH). *Pará [=Belém], leg. Miles Moss, **1** female (BMNH); Bragança, leg. Miles Moss, **1** male (BMNH); Óbidos, **1** male, **1** female (MNHN).

*Serratofalca sasha* Johnson & Sourakov, **new sp.**

Figs. 2, 8, 14


**DIAGNOSIS.**— Males distinguished by terminally notched and laterally undulate shape of sipc (Tb. 1, Fig. 8) and pentagonal ventral habitus of valvae (Tb. 1, Fig. 8 & Remarks); females differ from other group members by each lobe of the superior genital plate exhibiting an elongate distoterminal spine and shorter proximal spine (Tb. 1, Fig. 14).

**DESCRIPTION.**— Wings (Fig. 2AB) typical of genus and generally indistinguishable from congeners. Forewing: males 11.0 - 13.5 mm. (n=15, AMNH.BMNH); females 11.5 - 14.0 mm. (n=15, AMNH.BMNH). Male Tergal Morphology and Genitalia: Fig. 8, Tb. 1, Chs. 1(2), 2(2), 3(2), 4(2). Female Genitalia: Fig. 14, Tb. 1, Chs. 5(2), 6(2).

**TYPES.**— Holotype male*, allotype female*, Barro Colorado Island, Panama, leg. W. J. Gertsch, 11-19 March 1936, deposited (AMNH).

**DISTRIBUTION.**— Spatial (Fig. 18): widespread, occurring from Belize southward through the Isthmus of Panama, eastward to coastal Venezuela and (sympatric with *S. palumbes*) into the upper Amazon River basin east to at least Tefé, west and southward along the Andean/upper Amazon margin to the "yungas" region of northcentral Bolivia. Temporal: dates on specimens indicate year-round occurrence.

**REMARKS.**— General. The new species name applies to the most widespread population historically referred to as "Thecla cerata", identity of latter being restricted herein by its types (see Remarks, *S. cerata*).

**Characters.** "Pentagonal", used herein to describe the ventral shape of the valvae, refers to the stout, angulate, shape formed by the lateral edges of the paired valval elements (two caudal extensions, two bilobes), with the valval base forming the fifth side (Fig. 8). The only group member with stout paired valval elements forming an angulate ventral shape is *S. callilegua* but its elongate caudal extension (rival only by *S. palumbes* of the sister species group) distends terminal shape to triangulate (Fig. 10). Typical of the *cerata* Group, the aedeagus of *S. sasha* is straight posterior of the caecum but terminates with a gradual dorsal inclination in the posterior one-fourth (Tb. 1, Ch. 4, Fig. 8).

Surprisingly little variation in structural facies of males and females across the trans-Neotropical range of *S. sasha* and no evidence of traits converging towards those of other adjacent or sympatric species (Tb. 1 Remarks) strongly supports the view of species limits in this revision and underscores the very different traits of males offshore Colombia on Gorgona Island characterized in the subsequent entry.

**Distribution.** *S. sasha* is quite common in collections from Belize southward through the Andes of South America. Its range follows the Amazon River eastward where, thus far, it is indicated as sympatric with *S. palumbes* at three localities (listed hereafter from first ME entry word and as shown from east to west in Fig. 18, (1) Tefé, (2) São Paulo de Olivença, (3) Iquitos. Most of these specimens are old and with generalized local data.

**ETYMOLOGY.**— Patronym for Sasha Shapiro, wife of the junior author.

male (BMNH). BRAZIL. - Amazonas: Juhuty, Apr 1905, leg. de Mathan, *1 male, *1 female (BMNH); San Juan, Solimões, *1 male, **1 male (BMNH); Tefé, **1 male (BMNH); São Paulo de Olivença, Jan 1933, leg. S. Waenner, **2 males, **1 female (BMNH); Ega, leg. Bates, ***2 males, ***2 females (BMNH); Ega, *1 male (BMNH); Juhuty, Apr 1905, leg. de Mathan, **1 male (BMNH); Tefé, **1 male (BMNH); "Tefé", sic, Jan 1905, leg. de Mathan, *1 male (BMNH); Tonantins, 1880 de Mathan, *1 male, *1 female (BMNH); São Paulo de Olivença, leg. de Mathan, 1878, *1 male (BMNH); São Paulo de Olivença, Jan. leg. S. Waenner, Jan 1933, **1 male, **2 males (BMNH). COLOMBIA. - "Colombia", *1 male (MNHN), Bogotá, *1 male, *1 female (BMNH); Interior of Colombia, leg. Wheeler, *1 male (BMNH); Novella Grenada [=Colombia], *2 males, *1 female (BMNH), Cundinamarca, 1900, leg. de Methan, *1 male, *1 female (BMNH); Rio Putumayo, *1 male (AMNH), Rio Tacona, Amazonas, *1 male (AMNH), Rio Couto, Amazonas, *1 female (AMNH); Bogotá, Novella Grenada, Cundinamarca, 1900, leg. de Mathan, **2 males; Interior of Colombia, leg. Wheeler, *1 male (BMNH); "El Lumto", Cundinamarca, Jul 1903, leg. de Mathan, **1 male. COSTA RICA. - Irazú *2 males (BMNH); Volcán Irazú, leg. Fassli, *1 male, *2 females (MNHN); Guápiles, *1 male (AMNH); Guápiles, May-Nov. *1 male, **1 female (BMNH); "Esperanza", May, *1 male (BMNH); Costa Rica, leg. G. M. Gillott, ***1 male (BMNH). ECUADOR. - La Chima, Sep 1893, leg. de Mathan, **1 male (BMNH); Cachabe, Jan 1897, leg. Rosenberg, *1 female, *1 male (BMNH); La Chima, Sep 1893, leg. de Mathan, *1 male, *1 female (BMNH); Cachabe, Feb 1897, leg. Rosenberg, *1 male. GUATEMALA. - Verapaz, leg. Champion, *1 male, *1 female (BMNH), Rabinal, *1 male, *1 female (AMNH). NICARAGUA. - Chontales, leg. T. Belt, *1 male (BMNH); Chontales, leg. T. Belt, ***1 male (BMNH); PANAMA. - Chiriquí, ex. coll. Godman & Salvin, *1 male (BMNH); Calobre, *1 male (BMNH), Summit, *1 male, *1 female (AMNH); Chiriquí, *1 male (BMNH); Isthmus of Panama, leg. Walker, **1 male (BMNH); Isthmus of Panama, Dec 1907, leg. Pemberton, ***1 male (BMNH); Chiriquí, Arce, ex. coll. Godman & Salvin, ***1 male, *1 female (BMNH). PERU. - Rio Tono, *1 male (BMNH); Tingo María, *1 male (AMNH); Iquitos, *1 male (AMNH); San Ramón, *1 male (AMNH); Putumayo River, *1 female (AMNH); Iquitos, leg. Fruhstorfer, *1 male (BMNH); Rio Ucayali, *1 male (BMNH); Rio Marañon, ***1 female (BMNH); Iquitos, February 1932, leg. G. King, ***1 male (BMNH); Iquitos, Peru, leg. Fruhstorfer, ***1 male; *1 female (BMNH); Tarapoto, ***1 male (BMNH); Iquitos, Feb 1932, leg. G. Klug, ***1 male, ***2 males (BMNH); Rio Cachiyacu, 1893, leg. Stuart, ***1 male (BMNH); Champiyacu, Yurimaguas, 1885, leg. de Mathan, ***1 male (BMNH); Rio Tono, 1200 ft., leg. Watkins, ***1 male, ***1 female (BMNH); Pebas, Amazonas, leg. de Mathan 1880, ***1 male (BMNH). VENEZUELA. - Caripito, 9-20 Mar 1942, *1 male, ***3 males, *1 female, ***2 females (AMNH).

Serratofalca gorgoniensis Johnson & Sourakov, new sp.

Figs. 3, 9

DIAGNOSIS. - Three known males are all larger than mainland congener specimens (see below) and show extremely elongate hindwing tails. Male genital habitus is distinctive with a terminally notched but laterally entire sipc (Tab. 1, Fig. 9) and flattened valvular terminus showing no appreciable caudal extension (ventral & lateral view, Fig. 9, Remarks below and under Tab.1).

DESCRIPTION. - Wings (Fig. 3) typical of genus except for large expanse and more elongate hindwing tails. Forewing: males 15.0 - 15.5 mm. (BMNH types). Male Tergal Morphology and Genitalia: Fig. 9, Tab. 1, Chs. 1(3), 2(3), 3(3), 4(3). Female Genitalia: Unknown.

TYPE. - Holotype male: COLOMBIA, Gorgona Island, 7 Sep 1924 ("9/7/24"), St. George Expedition, C. L. Collenette. Paratypes. Same data as primary type, two males (BMNH) (see Remarks).

DIAGNOSIS. - Spatial (Fig. 18): limited to Gorgona Island, some 60 km. offshore equidistant the coasts of Nariño and Cauca departments, western Colombia. Temporal: known only from the September or July ("9/7") type data.

REMARKS. - General. This taxon illustrates the dilemma of alpha taxonomy when dealing with distinctive characters in an offshore isolate. Although unique characters of the eventual holotype were initially observed, they were omitted from the blind test data matrix because the specimen was a singleton. However, without our knowledge, two specimens from Gorgona Island were also included in the blind test series and these stood out as noted immediately below.

Characters. Blind test specimens nos. 11 and 19 were not scoreable as any known species for any character in the blind test matrix (Table 1 minus gorgoniensis and character 4, see Remarks thereunder). However, in all characters both specimens were only like each other. Subsequent examination of specimen data confirmed concurrence of all characters with the initially known Gorgona Island specimen. The population is perhaps either an early dispersal isolate or offshore vicariate of the larger S. sasha population but shows distinctive character in every structure shown to be informative at the species level in congeners. Because of its geographic position, some lepidopterists would consider S. gorgoniensis a "subspecies" of S. sasha either a priori or because the female is currently unknown. However, such practice would break the coherence of species level characters demonstrated in this study (including those disclosing apparent sympatry in three of the species level entities). Since there are no objective character criteria to group S. gorgoniensis with another species of this study, we consider it distinct. However, in Discussion we note it as a fine "test case" when considering systematic problems elicited by alpha taxonomic studies.

Distribution. Gorgona Island appears to be an emerged offshore element of the Sanguinanga and Munchique montane coastal system with no independent tectonic significance. The population may have been introduced by dispersal or perhaps by former land contiguity reflecting eustatic changes of the Cenozoic (see Discussion).

ETYMOLOGY. - Named for Gorgona Island.

Serratofalca callilegua Johnson & Sourakov, new sp.

Figs. 4, 10, 15

DIAGNOSIS. - Males recognized by prominently lobate pseudo-valvae (sensu Scott 1990) on sipc (Tab. 1, Ch. 1, Fig. 10) and stout, triangulate ventral valvae shape (Tab. 1, Ch. 2, Fig. 10); females differ congeners by each lobe of the bilobate superior genital plate exhibiting an elongate distoterminal spine and two shorter proximal spines (Tab. 1, Ch. 6, Fig. 15). The species is also smaller than any other group member (see below).

DESCRIPTION. - Wings (Fig. 2AB) typical of genus, generally indistinguishable from congeners. Forewing: males 10.0 - 10.5 mm. (AMNH types); females 11.0 mm. (allotype). Male Tergal Morphology and Genitalia: Fig. 8, Tab. 1, Chs. 1(4), 2(4), 3(4), 4(4). Female Genitalia: Fig. 14, Tab. 1, Chs. 5(4), 6(4).

TYPES. - Holotype male*, allotype female*: ARGENTINA.
Jujuy Province, Dept. Ledesma, Parque Nacional Calilegua, park track 11-13 km, W. of Rt. 34, 1600 m., upland mesic forest, 14 Feb 1991, leg. K. Johnson and D. Kroenlein, deposited AMNH, Paratypes. ARGENTINA. Data as on primary types, 1 male (AMNH); "Jujuy Prov.", no other data, 2 males, 1 female (IML).

**DIAGNOSIS.** Spatial (Fig. 18): currently known from limited upland tropical forest in northern Argentina. Temporal: dated specimens include only February.

**REMARKS.** Old material was located in unprepared specimens at the IML. The species has been collected recently in Jujuy Province at Parque Nacional Calilegua [spelling confirmed here to Anon., 1992] and may, therefore, also occur in upland tropical forest biome at "Cucho" [see Site Description 5A in Johnson, Eisele and MacPherson 1988], south slopes of the Cerro Labrador and, considering southern extent of tropical forest in Argentina, perhaps as far south as "La Corniza" [see Site Description 112A in Johnson, Eisele and MacPherson 1990] in the Alto da las Saucos of Salta Province.

**ETYMOLOGY.** Noun in apposition, referring to the type locality spelled in the local colloquial.

**palumbes Group**

Female genitalia with sclerotized elements in spiral configuration; male genitalia with aedeagal shaft undulate posterior of the caecum.

*Serratofalca palumbes* (H. H. Druce)


*Thecla cerata* [not *cerata* Hewitson 1863-1878 [1877]: vol. 1, 191, vol. 2, pl. 76, Figs. 607, 608 (synonymy in error, *palumbes* considered described as an aberration).

*Thecla cerata palumbes*: Comstock and Huntington, *ibid., op. cit.*


**DIAGNOSIS.** Males recognized by produced convex terminal characters 5(5), 6(5).

**DESCRIPTION.** Wings (Fig. 5AB) typical of genus and generally robust and more elongate ductus bursae (Fig. 16) (see Remarks). Forewing: males 11.5 - 13.0 mm. (n=15, AMNH,BMNH); females 12.0 - 13.5 mm. (n=15, AMNH,BMNH). Male Tergal Morphology and Genitalia: Fig. 8, Tb. 1 characters 1(5), 2(5), 3(5), 4(4). Female Genitalia: Fig. 14, Tb. 1 characters 5(5), 6(5).

**TYPES.** Holotype male (BMNH type No. 960): "Cayenne, French Guiana".

**DISTRIBUTION.** Spatial (Fig. 18): known throughout the Guyana Shield region of South America; sympatric with *S. cerata* along the mouth of the Amazon River in Brazil and with *S. sasha* along the upper Amazon of Brazil and Peru (see Remarks). Temporal: many specimens are old and lack collection dates; however, dated specimens from March, April, June and November, along with data on more well-known sympatric congeners, suggest year-round occurrence.

**REMARKS.** General. This taxon appears to have few literature citations due to its synonymic association with *T. cerata* after Draudt (1919).

**Characters.** The spiral ductus bursae in genitalia of some females of *Serratofalca* stood out immediately in the initial study of the group (Johnson 1991). Subsequent analysis of male/female pairs with duplicate collection data (see ME below) showed the spiral ductus to co-occur with males exhibiting the distinctive characters of the *S. palumbes* type. Such males are distinctive by numerous genital features, including the most distinctive aedeagus of the genus (Tb. 1). A spiral ductus bursae was also discovered subsequently in the southeast Brazilian population described below as *S. iguapensis*. Female genitalia in *S. palumbes* and *S. iguapensis* differ the least among congeners. We note some small differences in these species’ Diagnoses but, considering sample size in *S. iguapensis*, did not include these in the data matrix for blind tests (Tb. 1).

Hitherto in the Eumaeini, a spiral ductus bursae has been observed only in the widely distributed and well known genus *Strymon* Hübner, for which it is considered a generic character. The occurrence in one subgroup of *Serratofalca* is apparent homoplesious and coincides with the presence of an undulate aedeagus in males. An undulate aedeagus also characterizes *Strymon* (Johnhon et al., 1990). Considering the sympathy of *palumbes* with two congeners showing linear female genitalia, this genus may be a good study group regarding "lock and key" hypotheses in butterfly genitalia (Porter and Shapiro 1990) since no intermediate genitalic configurations have been noted from numerous dissections in the present study (Tb. 1 and ME).

The above is particularly interesting since wing character distinctions in one species of this species group, *S. iguapensis* described below, are the most outstanding of the genus.

**Distribution.** Currently known localities of sympathy for *palumbes* are as follows: with *S. cerata* at Bragança, Para; Santarém, and Óbidos, Brazil and with *S. sasha* at Tefé and São Paulo de Olivenca, Brazil and Iquitos, Peru. While it is desirable to confirm such sympathy by modern specimens with detailed distributional data, the long series from early resident collectors like Miles Moss at Bragança and Pará (=Belém) and MNI expeditions across the Guyana Shield may well never be equalized by modern workers. Little current material has been available for study of this genus.

**MATERIAL EXAMINED.** BRAZIL. Pará: **1 female (BMNH), Bragança, **1 male (BMNH); *Tonantins, **1 male (BMNH); Pará, **1 male (BMNH); "Amazon Valley", leg. Bates, **1 male (BMNH); Maranhão, *1 male (BMNH); Pará, **1 male, **1 female (BMNH); Pará, leg. Miles Moss, **1 male (BMNH); Tapajós, leg. Bates, **1 male (BMNH); Pará, *1 male; **1 female (BMNH); Pará, **1 male, **1 female (BMNH); Pará, leg. Watts, **1 male (BMNH); Maués, Amazon, leg. Bates, **1 female; Amazons, leg. Fassl, **1 male; Pará, 1893, **1 female (BMNH); Pará, **1 male; Pará, leg. de Methan, **1 male; Bragança, **1 male (BMNH); Rio Tapajós, Itaituba Fassl, **1 female (BMNH); French Guiana.**" Getsia* (Franca), **1 female (BMNH); Maroni, **1 male; "Valley of the Amazon" 1 male (BMNH); Bas Maroni, F. G., Feb-t Sept 1921, **2 male, **3 males (BMNH); Guyane Française, June, A. Brabant, **1 male (BMNH); Maroni, 2 Mar 1919, **1 male (BMNH); Guyane Française, leg. Le Moul, **1 male (BMNH); Guy Française, leg. C. Bar, **2 males, **5 males (BMNH); Maroni, Feb-t Sept 1921, **1 male (BMNH); Maroni, **1 female (BMNH); "Guiana" 1 male (BMNH); Guyane Française, leg. Le Moul, **1 female (BMNH); Guyane Française, leg. C. Bar, **2 males, **5 males (BMNH); Maroni.
Serratofalca iguapensis Johnson & Sourakov, new sp.

Figs. 6, 12, 17

DIAGNOSIS.—Structurally, males recognized by deeply cleft terminal margin of sipc (Tb. 1, Ch. 1, Fig. 12) and elongate but ventrally multiplanar valvae (Tb. 1, Ch. 1, Fig. 12); known female differing from specimens of group congeners by slightly less angulate terminal and lateral margins of bilobate lamellae (Fig. 17) and more robust and elongate ductus bursae (Fig. 17) (see Remarks). In the wings, males of S. iguapensis are blackish blue (Fig. 6A) confusing them with some members of sister genus Klaufera (Tb. 1 Remarks).

DESCRIPTION.—On wings (Fig. 6AB) under surfaces generally indistinguishable from congeners but male with upper surface of wings markedly darker, black-hued blue. Forewing: males, 11.5 (holotype); females, 10.5, 12.0 mm. (AMNH types). Male Tergal Morphology and Genitalia: Fig. 8, Tb. 1, Chs. 1(6), 2(6), 3(6), 4(6). Female Genitalia: Fig. 14, Tb. 1, Chs. 5(6), 6(6).

TYPES.—Holotype male*, allotype female*: BRAZIL, Paraná State, Iguape, Dec 1914 (AMNH).

Paratypes: Same data as primary types, *1 female (AMNH); BRAZIL, São Paulo State, Goyaz, Campinas, Mar 1933, leg. R. Spitz, Niedhoffer Collection (MPM), ***1 male, 2 females.

DISTRIBUTION.—Spatial (Fig. 18): currently known only from older material suggesting coastal forest habitat in southeastern Brazil (see Remarks). Temporal: label data indicates at least December through March.

REMARKS.—General. Initial dissection of the specimens representing this species led us to examine much larger series of SE Brazilian Theclinae with somewhat similar superficial facies. Most of these (n=16), however, proved to be species of Klaufera. Similarly, among BMNH specimens historically identified as "Thecla cerata" and used in the 1992 blind tests, other Klaufera specimens (bluer than some of their congeners) also appeared (Tb. 1 Remarks). We discuss this further immediately below and suggest that likely locations of further S. iguapensis material are in the AMNH series from highlands near Blumenau (undated but acquired by E. I. Huntington in the 1940's), various additional early SE Brazilian material from the Gargarin Collection at MPM, widely deposited specimens of C. M. Biezanko which often predate the 1940's, and historical material at the Museo Zoologia Universidade Federal do Paraná, Curitiba. The problem with assembling study material is the superficial similarity between the respective dark blue-black and brighter blue species of Serratofalca and Klaufera.

Characters. In the 1991 study by Johnson, Serratofalca was figured (Fig. 87) as a rather isolated lineage within the larger genus. However, upon delineation of the Serratofalca species herein, it is evident that the sipc in males of S. iguapensis (like that, to some extent, of S. callilegua) shows supralimital development of the lateral lobes (pseudovalvae sensu Scott, 1986) much resembling the deeply cleft sipc typifying Klaufera and a few other members of the Calycopis/Calystryma grade. Considering this, the widely bilobate superior genital plates of female Serratofalca and Klaufera also become evident as a possible shared character. Thus, S. iguapensis may represent the primitive character habitus of Serratofalca resembling certain species on the basal stem of Klaufera. Johnson (1993) and Johnson and Kroenlein (1993a, b) describe a number of peculiar eumaeine species known only from old SE Brazilian material. These also emphasize the odd characters typifying many of the unique species of original SE Brazilian coastal forests.

ETYMOLOGY.—Noun in apposition referring to type locality.

DISCUSSION

Serratofalca well illustrates the perplexing problem faced by alpha taxonomy when diversity in structural habitus belies superficial similarity in wing pattern. Studied with reference to both external and internal features, Serratofalca taxa show a consilience of structural characters and geographic sympathy indicating a much larger diversity of distinctive populations than would be apparent by simple reference to the overall wing habitus. Systematic problems illustrated by the genus accentuate that, as well known for many groups of moths, Neotropical Eumaenii will not always be readily identified by simple comparison to field guide photographs, series of specimens "identified" at museums or photographs of type specimens. The problems are more complex and, quite beyond applying consistent methods of alpha taxonomy, suggest the need for biological fieldwork to determine which distinctive populations may be considered "biological" species (see Cracraft, 1983; Wiley, 1981).

Tropical Lepidoptera, with its wide circulation among lepidopterists specializing in Neotropical faunas, is apt for reporting these results. Problems of nomenclatural usage concerning the many poorly known Neotropical Eumaenii require candid comment. Each year, the senior author receives many letters asking for a simple photo book or "keys" for identifying the diverse Neotropical Theclinae. Some workers (including professionals) state they disregard Theclinae classifications which refer to structural characters and, for convenience, prefer older classifications based on generalized wing habitus. Such classifications cluster voluminous historical names in omnibus genera like "Thecla" and
"Calycopis". Their purpose, to quote one worker, is to have "names handy" for faunal lists and local biological commentary. Such views suggest the need for serious reflection concerning the purposes of systematic study. We aggressively question the scientific veracity of methods which simply list taxa based on external similarity and ignore reference to structural characters because the latter are considered too cumbersome or impractical. Certainly, nearly all lepidopterists would agree that such methods would never be considered satisfactory for well-known groups like the Papilionidae where members of the Papilionini and Troidini often appear confusingly alike.

Alpha taxonomic studies, like the one herein presented for Serratofalca, should probably be considered the "first step" in larger processes to determine whether taxa have significance as "morphological", "cladistic" or "biological" species (see e.g. Cracraft 1983, Wiley 1981). Certainly, the apparent sympatry of the populations described in Serratofalca as S. cerata, S. palumbes and S. sasha suggest a fruitful area of study for field workers in the Amazon River basin. Equally compelling are the peculiar characters of the outlying allopatric taxa S. iguapensis, S. callilegua and S. gorgoniensis. The biological status of these entities also needs to be investigated before determining the appropriateness of infraspecific taxonomic categories. For instance, the subspecies category might be used for taxa comprising the respective morphoclusters (herein, the "species groups") of Serratofalca— limiting the genus to two species, palumbes and cerata. However, this currently contradicts the distribution of morphological characters and patterns of sympathy. The subspecies category might also be applied to immediate sister vicariates like S. sasha and offshore oddity S. gorgoniensis, which appear to represent elements of the same ancestral area of endemism (Colombian Andes and an offshore mountaintop). However, current restriction of this category exclusively to S. sasha and S. gorgoniensis is inconsistent with the morphological data. S. gorgoniensis, though currently known only from males, shows no exclusive morphological affinity to S. sasha and, instead, unique characters of its own. One either follows a consistent set of criteria or is left to guess and/or erect arbitrary categories.

As is well-known, much literature concerning centers of endemism in the Neotropical Realm (e.g. tropical forest "refugia") attributes current taxonomic interrelations to comparatively recent climatic events of the Pleistocene (see, for instance, summary of Brown, 1982). Workers seeing the "Thecla cerata complex" from this viewpoint would not expect the structural diversity reported here for Serratofalca. At most, recognizing sympathy of populations showing "linear" and "spiral" female genitalic configurations might lead to recognition of two species—S. cerata and S. palumbes. However, the geographic ranges of the elements comprising these complexes must be accounted for and here the earlier Quaternary period invites interest. Events from mid-Miocene forward (Gansser, 1973; Brooks and McLennan, 1993) original westward drainage of the Amazon basin, mid-Miocene inland sea dividing the basin north from south, and subsequent uplift of the Andes prompting eastward flow of the Amazon may better account for (1) north/south disjunction of S. cerata and S. palumbes species groups, (b) isolation of a species around the mouth of today's Amazon [S. cerata], (c) widespread occurrence of a species westward along the Andes mountains and across the Pliocene bridge into Central America [S. sasha], and (d) morphologically unique entity confined to an emergent peak of the western Colombian coast [S. gorgoniensis]. The origin of Serratofalca purely from simultaneously occurring Pleistocene forest refugia would appear to predict a more homogeneous morphology (certainly a less dichotomous one), little morphological distinction (if any) of sympatric subunits, less distinct allopatric units, and clearer association of the offshore element with one of the contemporaneous mainland populations. Without doubt Pleistocene events further affected pan-Neotropic Serratofalca. However, the dichotomy of the morphologic ground plan in modern entities, and their South and Central American occurrence, suggest the ancestral population (as well as its two major subunits) were most likely in place by the Pleistocene.

In considering complex Neotropical groups, it appears the function of basic alpha taxonomy is to provide initial benchmark. These latter then serve to guide further systematic study aimed at answering various, or even different, kinds of questions about these natural populations. Certainly, in the case of a group like Serratofalca, none of the interesting and perplexing problem presented by the group would ever be exposed by the "quick fixing" of arbitrary names based on superficial characters. They would recognize only one "easily distinguished... dult-lustroids indigo" species (Draudt, 1919; Bridges, 1988). Morphologic assessment of the complex across its entire Neotropical range exposes two major morphoclusters comprised of six distinct populations, three of which are sympatric. These results should be kept in mind by those prone to consider every delineation of new taxa in the Neotropical Eumaeini as a matter of simply "taxonomic splitting".

**TABLE 1**

**CHARACTERS**

The six taxa of Serratofalca recognized in this revision were identified in the "blind tests" (N=73, including 3 misplaced BMNH Klauffera specimens) by scoring five unequivocal characters of the male tergal morphology and genitalia and female genitalia as summarized below.

Descriptions are repeated briefly from text employed in the diagnoses; species are denoted by numbers following the taxonomic order of the revision: 1 (cerata), 2 (sasha), 3 (gorgoniensis), 4 (callilegua), 5 (palumbes), 6 (iguapensis). Figures and references assume the structure indicators ("a", "b", etc.) used initially in Figs. 7 and 13; remarks concerning blind test scoring consistency of results, etc. are footnoted below.

**MALE**

**Character 1.** Tergal Morphology, shape of sipc dorsum: terminal margin concave (Fig. 7c); 2, terminal margin central notched, lateral margin undulate (Fig. 8c); 3, terminal margin centrally notched, lateral margin entire (Fig. 9c); 4, show predominantly lobate pseudovalvae (Fig. 10c); 5, terminal margin greatly convex (Fig. 11c); 6, terminal margin deeply cleft bifurcate fashion (Fig. 12c).
Fig. 7-12. *Serratofalca* Male Genitalia and Tergal Morphology (format a, genitalia, ventral view, aedeagus removed; b, same, lateral view; c, dorsal plate sipc, dorsal view; d, aedeagus, lateral view). *cerata* Group. 7. *S. cerata*, Pará (BMNH); f= serrate falces, bl= bilobes, ce= caudal extensions, v= cleft vinculum lacking brush organs. 8. *S. sasha* holotype. 9. *S. gorgoniensis* holotype. 10. *S. callilegua* holotype. *palumbes* Group. 11. *S. palumbes*, St. Jean de Maroni (MNHN), bl= bilobes, ce= caudal extensions. 12. *S. iguapensis* holotype.
Fig. 13-17: *Serratofalca* female genitalia (genitalia, ventral view from terminal plates, above, to juncture of ductus and cervix bursae, below). *cerata* Group. 13. *cerata*, Pará (BMNH); s = superior genital plate, vs. ventral scutes, db, ductus bursae, pa, papillae anales; immediate right, t, terminal tergite (dorsal bilobate v terminus right). 14. *S. sasha* allotype. 15. *S. callilegua* allotype. *palumbes* Group. 16. *S. palumbes*, St. Jean de Maroni (MNHN); ds, ductal spiral. 17. *iguapensis* allotype.
Character 2. Genitalia, shape of valvae: 1, ventrum basally ovate terminating in short, slightly upturned, caudal extensions (Fig. 7bl,ce); 2, ventrum shape (comprised of caudal extension, bilobe, and basal margins), pentagonal (Fig. 8bl,ce); 3, terminus flat, showing no appreciable caudal extension (Fig. 9bl); 4, ventrum shape (comprised as above in 2) triangular (Fig. 10bl,ce); 5, ventrum elongate and elliptical in shape with ventrum generally of even contour (Fig. 11bl,ce); 6, ventrum elongate and elliptical in shape with ventrum undulate, separating caudal extensions and bilobes (Fig. 12bl,ce).

Character 3. Genitalia, shape of aedeagus shaft adjacent juncture with caecum: 1, 2, 3, 4 straight (Figs. 7d-10d); 5, 6 undulate (Figs. 11d-12d).

Character 4. Genitalia, shape of aedeagus posterior of caecum: 1, shaft element contiguously straight after a strong angle at caecum (Fig. 7d); 2, straight shaft with gradual dorsal inclination in terminal one-fourth (Fig. 8d); 3, shaft straight until posterior one-fifth, then with emphatic dorsal arch (Fig. 9d); 4, shaft straight until terminal one-sixth, then with slight dorsal inclination (Fig. 10d); 5, shaft elongate and undulate throughout (Fig. 11d); 6, shaft shorter, posterior with one undulation followed by slight dorsal inclination in terminal one-fifth (Fig. 12d).

FEMALE

Character 5. Genitalia, shape of ductus bursae: 1,2,4, straight, then arched in anterior two-fifths (Figs. 13db-15db); 5, 6 spiral in anterior one-half (Figs. 16ds-17ds).

Character 6. Genitalia, terminal shape of bilobate superior genital plate: 1, each lobe with a single, usually short, distoterminal spine (Fig. 13s); 2, each lobe with elongate distoterminal spine and shorter proximal spine (Fig. 14s); 3, unknown; 4, each lobe with a distoterminal spine and two shorter proximal spines (Fig. 15s); 5, 6, terminal shape entire (Figs. 16s, 17s).

REMARKS

The 1992 blind tests dissected every third specimen in the BMNH collection historically identified as "Thecla cerata/palumbes" (beginning from the upper left hand side and proceeding down rows) without regard to label data or sex identification (specimens lacking abdomens were skipped) (N=73). The following comments are pertinent:

1. None of the characters of Table 1 "blurred" where taxonomic units defined herein were sympatric (see Remarks under S. cerata, sasha and palumbes).

2. Taxa 2 and 6 in male Character 2 are similar but identification unequivocal by other characters.

3. Taxa 5 and 6 in female Characters 4 and 5 are similar but identification not only unequivocal by males, finer analysis indicates more angulate genital plate in S. palumbes and robust ductal spiral in S. iguapensis consequently located less remote from the terminal genital plates (see palumbes Group Diagnoses).

4. Confusion in scoring occurred in 3 instances involving degree of serration of a female genital plate margin determining the number of distoterminal spines. The occurrence was in three specimens finally distinguished as S. sasha from S. cerata and appeared irrespective of geographic location (e.g. BRAZIL, Ega and Sao Paulo de Olivenca; COLOMBIA, Cundinimara [see S. sasha ME for complete data]).

5. Original scoring did not include a character category for S. gargoniensis because only a single Gorgona Island specimen was known at the time; however, unbeknownst, the blind test included two additional specimens from the island and these (i) could not be scored as any of the other taxa but (ii) were noted as showing characters matching only each other.

6. Though unknown at the beginning of the test, specimens did not include representatives of S. iguapensis or S. callilegua.


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NOTE ADDED IN PROOF
A recent publication (1992. A Guide to the National Park System of Colombia. Inst. Nac. Rec. Natr., Bogota. 198pp) reports that Gorgona Island is part of an old mountain chain extending southward to the Darién of Ecuador, separated from mainland Colombia by a 270m deep ocean trench, and physically akin to the Serranía de Baudó mountains of Ecuador. This supports the view that S. gorgoniensis is probably an relict.