

A REVIEW OF THE GENUS *SAROTA* (LEPIDOPTERA: RIODINIDAE)

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ABSTRACT.— A review of the genus *Sarota* Westwood, 1851, is presented which includes a brief overview of the biology, biogeography and taxonomic history of its component species, a key to the identification of adults, illustrations of all known species and subspecies (including many type specimens) with accompanying taxonomic notes and the descriptions of five new species and two new subspecies: *Sarota chloropunctata* n. sp., *Sarota chochoensis* n. sp., *Sarota completa* n. sp., *Sarota harveyi* n. sp., *Sarota willmotti* n. sp., *Sarota estrada sabanilla* n. ssp., and *Sarota gamelia alba* n. ssp.. Twenty species are recognised. Neotypes are designated for *Sarota acantus* (Stoll, 1782) and *Sarota gyas* (Cramer, 1775). The tribe Sarotini (= Charitini Auctt.) is synonymised with the tribe Helicopini (n. syn.), and a cladogram based on a small character matrix is used to illustrate generic relationships within the more inclusive, newly conceived tribe.

KEY WORDS: Amazon, *Anteros*, Araceae, Argentina, behavior, biogeography, Bolivia, Brazil, *Callistium*, Central America, *Charis*, Charitini, *Charmona*, Chocó, cladistics, Colombia, *Comphotis*, Costa Rica, Ecuador, *Emesis*, Fabaceae, French Guiana, Guatemala, Guyana, Helicopini, *Helicopis*, Honduras, hostplants, *Hypochrypsops*, Lejuniaceae, Lycaenidae, Mexico, Neotropical, *Nymphidium*, *Ourocnemis*, Panama, Peru, *Phaenochitonina*, pheromones, *Sarota chloropunctata* n. sp., *Sarota chochoensis* n. sp., *Sarota completa* n. sp., *Sarota harveyi* n. sp., *Sarota willmotti* n. sp., *Sarota estrada sabanilla* n. ssp., *Sarota gamelia alba* n. ssp., Sarotini, South America, Sterculiaceae, Surinam, taxonomy, *Theope*, Tiliaceae, Trinidad, Venezuela.

The jewelled ventral wing patterns of *Sarota* species are spectacularly distinctive and rather reminiscent of those of the Oriental lycaenid genus *Hypochrypsops* C. & R. Felder, 1860. The genus *Sarota* contains a well defined, relatively homogeneous, monophyletic group of species whose close phylogenetic relationship to the genera *Anteros* Hübner, [1819], and *Ourocnemis* Bethune-Baker, 1887, is well known (Stichel, 1911, 1930; Harvey, 1987). However, while the systematic position of the genus is reasonably well established, its alpha level taxonomy has remained poorly understood, no doubt because of the great phenotypic similarities between its species and their diminutive size, and previous authors have grossly underestimated its species diversity. Seitz (1916-18) figured a mere 6 species and both Stichel (1930) and Bridges (1994) list only 10 species, no significant additions being made to our taxonomic knowledge of the genus during that intervening period. D'Abbrera (1994) also misleadingly illustrates only a fraction of the diversity in *Sarota* with 6 species. For these reasons, coupled with the perpetual misidentification of species in published photographs and popular literature (see appendix) and the discovery of several new *Sarota* taxa in Ecuador during a comprehensive survey of the papilionoid fauna of that country, I decided to review the entire genus with a view to ending the aforementioned confusion and providing an illustrative benchmark against which potentially new taxa can be compared. To this end, the *Sarota* collections of the following institutions, whose acronyms are used throughout the text, were examined:

- AME Allyn Museum of Entomology, Florida Museum of Natural History, Sarasota, FL, USA
- AMNH American Museum of Natural History, New York, NY, USA
- BMNH Natural History Museum, London, England
- FSCA Florida State Collection of Arthropods, Division of Plant Industry, Gainesville, FL, USA
- GWB George W. Busby collection, Boston, MA, USA
- JHKW Jason P. W. Hall and Keith R. Willmott collection, Gainesville, FL, USA
- MNHN Musée Nationale d'Histore Naturelle, Paris, France
- MCZ Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA
- PJD Philip J. DeVries collection, Dept. of Biology, University of Oregon, Eugene, OR, USA
- RCB Robert C. Busby collection, Boston, MA, USA
- USNM National Museum of Natural History, Smithsonian Institution, Washington, DC, USA
- ZMHU Zoologische Museum, Humboldt Universität, Berlin, Germany

Characteristics of *Sarota*

All species in *Sarota* are essentially sexually monomorphic, typically small, often possess hindwing tails, and while usually having dull brown dorsal surfaces, have characteristic ventral surfaces. The ventral surface is predominantly shades of orange-brown with yellowish margins and all species have a double row of silver lines around the submargins of both wings, although the innermost forewing line is often broken into or inclusive of one or more proximally directed silver streaks; the basal portion of the wings consists of alternating transverse lines of small black spots and silver markings. Despite the remarkable resemblance of some *Sarota* species to certain *Anteros* species, most notably those of the "*carausius* Westwood, 1851, group" (see Hall and Willmott, 1998), the *Sarota* species can be distinguished by their less robust thoraces, typically more rounded or tailed hindwings and different genitalic structures. The male genitalia of *Sarota* are far more homogeneous than in *Anteros*, barely differing even between species groups; all species have a small serrate aedeagal cornutus that is not present in those *Anteros* species dissected and the valvae always consist of a long upper portion and typically a bluntly triangular lower portion, with a prominent basal lateral bulge, whereas in *Anteros* the lower portion is often as long as or longer than the upper portion. The upper valva arms in *Sarota* are also connected dorsally in a "V" shape by membranous tissue toward the tips whereas in *Anteros* they are joined towards the base, often by sclerotised rods that almost enclose the aedeagus.

The slight interspecific differences in wing pattern between many sympatric species, combined with the often significant intraspecific geographic or altitudinal variation and the seemingly endless combinations of the same basic ventral markings involved, can make identifications difficult, but the genus is at least readily separated into three distinct and roughly evenly sized groups on the basis of wing shape (see Fig. 1), as partially proposed by Stichel (1930). Members of the "*chrysus* group" are considerably larger than most species of the other groups, they have distinctive hindwing tails with a pointed tornus and two long tail elements at veins M_3 and Cu_2 either side of a shorter central one and typically white or cream spots on the dorsal forewing; with few exceptions, these species are also the only ones to have orange-brown tipped antennal clubs. Species identification characters include forewing shape, the pattern of spots on the dorsal forewing, the tone of the ventral orange-brown coloration, and the ventral silver

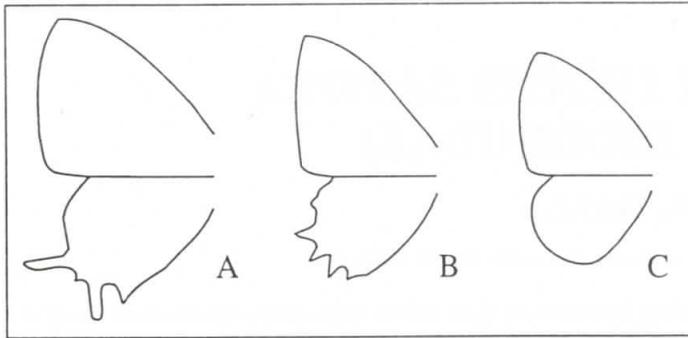


Fig. 1. Schematic drawings of *Sarota* wing shapes, highlighting hindwing differences between species groups: A) "*chrysus* group"; B) "*acanthoides* group"; C) "*gyas* group".

patterning. Members of the "*acanthoides* group" are smaller and have a pointed hindwing tornus with three smaller hindwing tail elements of roughly equal size at veins M_3 to Cu_2 , often with tiny points at veins M_2 and M_1 ; those of the "*gyas* group" are variably sized but typically small and do not have a pointed hindwing tornus or any hindwing tails. Identification characters for both latter groups include the pattern of silver markings in the submarginal and apical areas of the ventral forewing, the extent of ventral brown background coloration, the tone of the ventral orange-brown coloration, size, leg color and in females of the "*gyas* group", the presence/absence and extent of red-brown at the distal margin of the dorsal hindwing. The monophyly of these groups, in particular the "*gyas* group", is uncertain but their recognition allows the genus to be broken up into manageable portions.

Biology

Sarota species occur almost exclusively in wet forest habitats, but at least one species, *S. craspediodonta* (Dyar), appears to be tolerant of more xeric conditions. Most are found only below 1000m but a few occur as high as 1700m and one species, *S. myrtea* Godman & Salvin, flies as high as 2400m. The "*gyas* group" probably contains the largest number of more commonly encountered species while all members of the "*acanthoides* group" are uncommon to rare and, overall, most *Sarota* species are poorly represented in collections and only a few are likely ever to be seen in the field by the casual observer or collector.

Males of most species, particularly those in the "*acanthoides*" and "*gyas*" groups, perch in small groups, typically on low vegetation 2-5m high, along forest edges, on certain isolated trees or most commonly on streamside vegetation or in large clearings nearby. They are predominantly active on their perches in the early morning from about 0630h in some cases to about 1000h and are then only more sporadically encountered as solitary individuals in a wide range of forest microhabitats throughout the remainder of the day, but especially in the late afternoon. They frequently fly out to investigate passing objects with a fast, erratic flight and often engage in aerial spiralling with other male *Sarota*, factors that, combined with their small size, can make them difficult to see. They rest both beneath and on top of leaves with their wings shut but, like their close relatives, typically keep their hindwings slightly apart; they are sometimes observed to rub their hindwings together in a manner reminiscent of lycaenids (Robbins, 1986; pers. observ.). Occasionally, diverse perching communities are found with as many as five or more species co-occurring in the same small vicinity. While each species may be partitioned to some extent in space and time, to aid their reproductive isolation (Callaghan, 1983), this is not in my experience as rigid as is often reported in *Sarota* or riordinids in general (Callaghan, 1983; Brévignon and Gallard, 1995; DeVries, 1997). While the division of perching behavior into species specific windows of time and space is

clearly a characteristic phenomenon in riordinid butterflies, it is one that has large numbers of exceptions. Thus, several *Sarota* species may be found perching at the same time (although their mean activity time may be different) and on the same clump of leaves indicating the possibility that pheromonal chemistry plays a more important role in the reproductive isolation of riordinids than has previously been suggested.

Solitary females are encountered in the vicinity of male perching areas or flying low to the ground along forest edges in the understory and in lightgaps throughout most of the day. The females of two species, *S. acantus* (Stoll) (as *gyas*) and *S. chrysus* (Stoll), have been observed to oviposit on the leafy liverworts and mosses (Lejuniaceae) that grow as epiphylls on top of the old leaves of a variety of understory shrubs and these are thought to be the dominant foodplants for the genus (DeVries, 1988, 1997; DeVries *et al.*, 1994). The larvae of the only reared species, *S. acantus* (Fig. 2), are very similar to those of related genera (see DeVries, 1997; Brévignon and Gallard, 1998) in having very long dorsolateral tufts of downy white setae that may be moved in defense against ants and a cluster of bladder or balloon-like setae on the anterior edge of the prothoracic shield. Inside a rolled leaf, the long larval setae are used to surround the pupa to form a loose cocoon (DeVries, 1997).



Fig. 2. Fifth instar larva of *Sarota acantus* (photo by P. J. DeVries).

It is interesting to note that no *Sarota* species has been recorded feeding on rotting carrion, a behavior that is so pervasive in the closely related genera *Anteros* and *Ourocnemis* (Hall and Willmott, 1995, 1998, in prep.). This difference can be statistically correlated with wing area to thoracic volume ratio; in other words, slight bodied species, like those of *Sarota*, do not tend to feed on rotting carrion while larger bodied species, like those of *Anteros* and *Ourocnemis*, do, possibly because of differing nutrient requirements (Hall and Willmott, in prep.). Both sexes of at least one species have been recorded feeding on the flowers of *Croton* and *Alibertia* (DeVries, 1997) and several species are reported to visit the extrafloral nectaries of plants in a number of families, including the Araceae, Fabaceae, Sterculiaceae and Tiliaceae (DeVries, pers. comm.).



Fig. 3. Map of the Neotropical region showing *Sarota* diversity in selected areas. A single number or that to the left of a "/" is the number of recorded species, that to the right of a "/" is the expected number of species.

Biogeography

The genus *Sarota* is distributed from southern Mexico, through Central America to southwest Ecuador and throughout the Guianas and Amazon basin to southeast Brazil. Figure 3 shows the number of *Sarota* species known to occur in selected well-studied areas, indicating that the peak of diversity for the genus occurs along the base of the eastern Andes, where a single locality could theoretically harbor as many as 14 species (or 13 in the northern Andes where *S. harveyi* n. sp. probably does not occur). These data and those in Table 1 reflect with reasonable accuracy the distribution of overall riodinid diversity in the Andean countries, with Colombia and Ecuador sharing the highest species numbers (Hall, unpubl. data), but there are certain distributional anomalies in *Sarota*. Most notable of these is the high number of species from Costa Rica and neighbouring countries, a phenomenon explained by the diversity in the "chrysis group" west of the Andes; while five species in this group occur in the Transandean region, only a single representative occurs east of the Andes. This is in sharp contrast to the other two species groups in which about twice as many species occur east of the Andes as to the west. Mexico also has a slightly higher number of *Sarota* species than might be expected based on the distribution of overall riodinid diversity but conversely Brazil has slightly lower species numbers, no doubt because of the lack of lower Amazon and south-east Brazilian endemics.

Table 1. The number of recorded and expected *Sarota* species for selected Neotropical countries.

Country/ Region	Recorded no. of species	Predicted no. of species
Mexico	6	6
Costa Rica	10	11
Panama	8	11
Venezuela	6	14
Colombia	13	17
Ecuador	15	17
Peru	13	14
Bolivia	4	14
Brazil	11	11
Guianas	7	7

Taxonomy

Acceptance of the generic name *Sarota* has been patchy since its description by Westwood (1851) nearly 150 years ago, probably because it was only initially given subgeneric status. Before and after that publication, the species now placed in *Sarota* were most frequently regarded as belonging to the genera *Charis* Hübner, [1819] and *Anteros*, and it was not until the work of Godman & Salvin (1886) that their names were again used in combination with *Sarota*. Stichel (1910, 1911, 1930) further complicated matters by again disregarding the validity of the name *Sarota*. He placed its component species into the genus *Charis*, which he erroneously believed had the taxon *gyas* as its type species, and placed the taxon *aiuius* Cramer, 1776, and relatives, which currently constitute the genus *Charis*, into the invalid genus *Charmona* Stichel, 1910. Hemming (1967) recognised these errors and finally validated *Sarota* as the only available name for the group of species reviewed in this paper.

Stichel (1911) erected the tribe Charitini for *Sarota* (as *Charis*), *Anteros*, *Ourocnemis* and *Callistium* Stichel, 1911, on the basis that all shared a posterior projection from the dorsum of the uncus in the male genitalia. However, this character is found elsewhere in the family (e.g., *Comphotis* Stichel, 1910, and *Phaenochitonina* Stichel, 1910; see Hall and Willmott, 1996) and Harvey (1987) redefined the tribe on the basis that females possess spatulate scales surrounding the ovipositor lobes. Since the single member of *Callistium*, *C. cleadas* (Hewitson, 1866), lacks this character, Harvey (1987) transferred it to an *incertae sedis* section (four forewing radial veins). The tribal name Charitini has been extensively used since its erection, but as it is based on a misidentified type genus it is nomenclaturally invalid. Bridges (1988) provided the tribal name Sarotini (as an infratribe) as a replacement; however, it has largely been overlooked by subsequent authors.

Harvey (1987) used the presence of tails at veins M_1 and Cu_2 to define his sister tribe Helicopini, citing their different position and extreme development to distinguish them from those of, for example, *Sarota*. However, the tails of the two genera are not in different positions but merely developed to different extremes along different veins, a phenomenon that occurs within the clearly monophyletic genus *Sarota*, which of course even has members lacking tails altogether. I propose that the morphological differences between members of the tribe Sarotini and those of the Helicopini Reuter, 1897 (= Helicopidi Stichel, 1928, and Helicopini Clench, 1955), are insufficient to warrant their sustained separation and I synonymise the tribe Sarotini into the Helicopini (n. syn.). The more inclusive tribe, as informally used by Brown (1993) (as a subtribe), contains *Helicopis* Fabricius, 1807, *Sarota*, *Anteros* and *Ourocnemis*, and can be defined by the known larvae of its members possessing yellow or white bladder-like setae on the anterior edge of the prothoracic shield

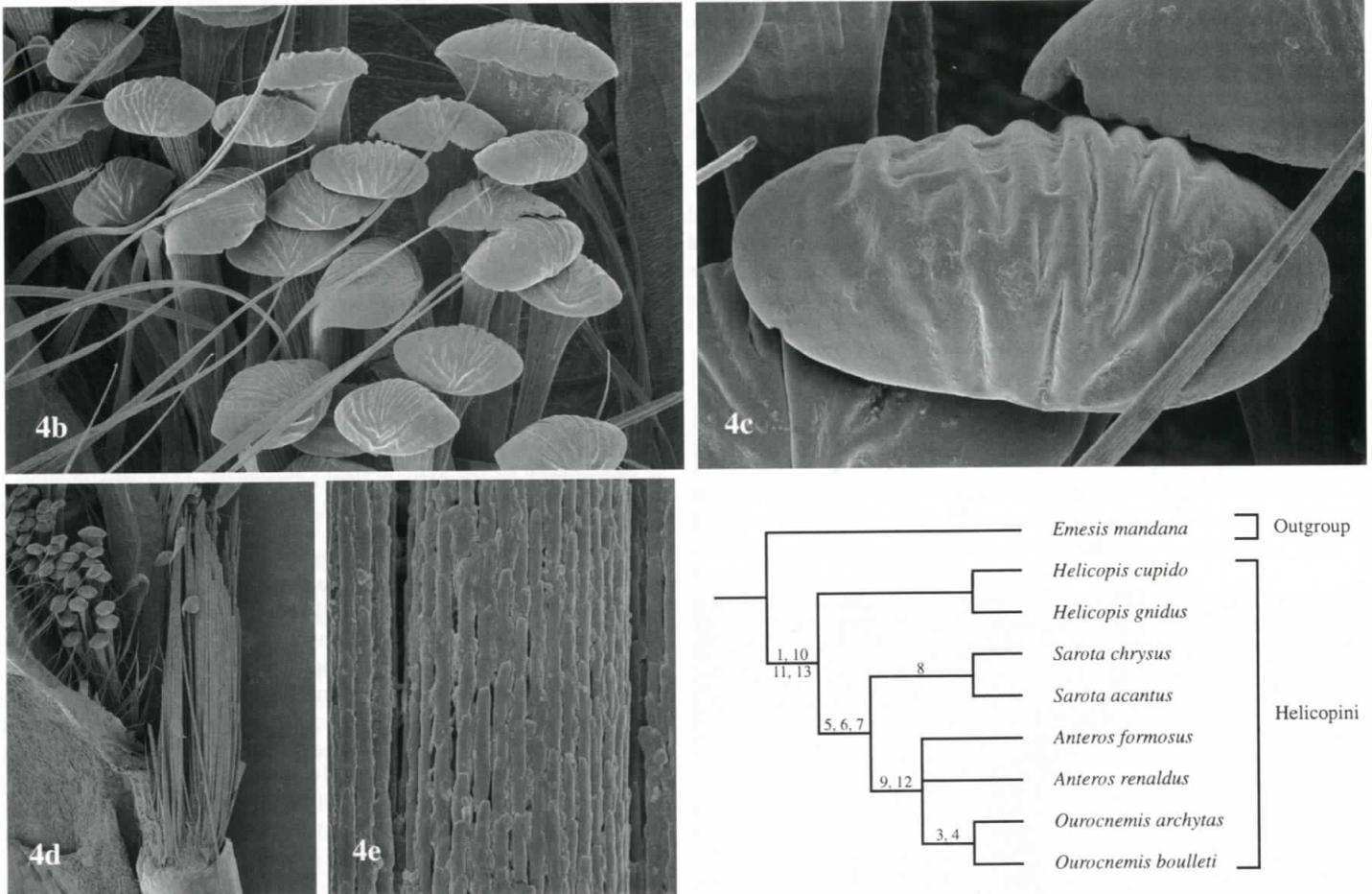


Fig. 4a (lower right). A cladogram showing generic relationships within the tribe Helicopini. The numbers at the nodes represent the characters (the derived character state in each case) that support each in-group clade.

Fig. 4b-e. Scanning electron micrographs of female genitalic morphology for *Sarota chrysus*. **4b,c.** Spatulate scales surrounding the papillae anales (b: x400; c: x2000). **4d,e.** Long spine-like setae between the papillae anales and ostium bursae (d: x90; e: x6000).

(Harvey, 1987; DeVries, 1988, 1997). These setae differ in fine structural details from those found on the larvae of certain species in the tribe Nymphidiini (e.g. *Theope* Doubleday, 1847, and *Nymphidium* Fabricius, 1807) and are deemed to have arisen independently (Harvey, 1987). Behavioral characters, such as hindwing rubbing, not seen elsewhere in the Riodinidae (Robbins, 1986; pers. observ.), and resting with wings shut instead of open, not seen in any closely related genera, also support the newly proposed tribal arrangement.

Preliminary phylogenetic analyses were performed with PAUP version 3.0s (Swofford, 1991) to illustrate generic relationships within the Helicopini, using *Emesis mandana* (Cramer, 1780) as an outgroup and the type species plus one other of each in-group genus. The following list of 13 binary characters used encompasses wing pattern, adult behavior, and the morphology of larvae, male and female genitalia and adult appendages. All characters are equally weighted. Using an exhaustive search, one most parsimonious tree was generated (Fig. 4a) of 15 steps (consistency index = 0.867) upon which supporting characters for each in-group clade are marked.

List of characters employed in cladistic analysis (see Table 2):

1. Silver ventral markings absent (0); present (1).
2. Hindwing tails absent (0); present (1).
3. Ventral surface of antennae black with some white scaling (0); red-brown (1).

4. Setae on palpi, and tibia and tarsi of forelegs not densely layered (0); very densely layered (1).
5. Spatulate scales surrounding the papillae anales of the female genitalia absent (0); present (1) (Fig. 4b,c). The assignment of character state (1) to *O. archytas* is based on data in Harvey (1987).
6. Long spine-like setae between the papillae anales and ostium bursae of the female genitalia absent (0); present (1) (Fig. 4d,e).
7. Posterior projection from the dorsum of the uncus in the male genitalia absent (0); present (1).
8. Lateral bulge at the base of the valvae in the male genitalia not prominent (0); prominent (1).
9. Valvae of the male genitalia join dorsally towards tip (0); towards base (1).
10. Adults rest with wings spread open (0); with wings closed over the body (1).
11. Adults do not rub hindwings together (0); do rub hindwings together (1). Character state (1) is expected to occur in most if not all in-group taxa.
12. Adult males have not been recorded as attracted to rotting fish (0); have been recorded as attracted to rotting fish (1).
13. Larvae without a cluster of bladder-like setae on the anterior edge of the prothoracic shield (0); larvae with bladder-like setae (1). The assignment of character state (1) is based on data in Harvey (1987) and DeVries (1988, 1997). Character state (1) is expected to occur in all in-group taxa.

Table 2. A binary character matrix for selected taxa in the tribe Helicopini, including *Emesis mandana* as an outgroup.

Taxon	1	2	3	4	5	6	7	8	9	10	11	12	13
<i>Helicopsis cupido</i> Linn.	1	1	0	0	0	0	0	0	0	1	1	0	1
<i>Helicopsis gnidus</i> Fab.	1	1	0	0	0	0	0	0	0	1	?	0	?
<i>Sarota chrysus</i> Stoll	1	1	0	0	1	1	1	1	0	1	1	0	?
<i>Sarota acantus</i> Stoll	1	0	0	0	1	1	1	1	0	1	1	0	1
<i>Anteros formosus</i> Cr.	1	0	0	0	1	1	1	0	1	1	1	1	1
<i>Anteros renaldus</i> Stoll	1	0	0	0	1	1	1	0	1	1	1	1	?
<i>Ourocnemis archytas</i> Stoll	1	0	1	1	1	?	1	0	1	1	?	1	?
<i>Ourocnemis bouletti</i> Le C.	1	0	1	1	?	?	1	0	1	1	?	1	?
<i>Emesis mandana</i> Cr.	0	0	0	0	0	0	0	0	0	0	0	1	0

Helicopsis, characterised by having clustered, yellow, bladder-like setae on the prothoracic shield of the pupa (Harvey, 1987), a unique foodplant association (in the Riodinidae) with the semi-aquatic Araceae (Kaye, 1921; Barcant, 1970; Mallet in Harvey, 1987; DeVries et al., 1994), and extreme hindwing tail development in the adults with the longest tail on vein Cu₁, is the most plesiomorphic genus in the tribe. The remaining clade is well supported by the presence of stiff spatulate scales around the female ovipositor lobes and long spine-like setae between them and the ostium bursae. Interestingly, morphologically very similar spatulate scales have been independently derived in certain tortricid and geometrid moths (Pellmyr, 1980); in these moths they are known to be used for scraping dirt over eggs after they have been deposited (Scoble, 1991) but observations on their function in helicopine riodinids are lacking. The majority of species in this clade also possess a posterior projection from the dorsum of the uncus in the male genitalia, although this is lacking in certain "gyas group" species of *Sarota*; whether its absence in these species represents a plesiomorphic condition for the clade or a secondary loss is not clear at present because of a conflict with the character polarity of, for example, the presence of hindwing tails. Within the clade previously conceived as the Sarotini, *Sarota* would appear to be the most basal genus, defined by its characteristic male genitalic valvae, which invariably consist of a long upper arm connected dorsally in a "V" shape by membraneous tissue toward their tips, often a bluntly triangular lower projection, and a prominent basal, lateral bulge, and unique foodplant association (in the Riodinidae) with the epiphylls of old leaves. The most derived group within the tribe appears to be *Anteros* + *Ourocnemis*, but while the latter genus is clearly monophyletic, defined by the red-brown ventral surface to the antennae and the clubbed and densely setose palpi, I could find no character in this preliminary analysis to characterise *Anteros* exclusive of *Ourocnemis* and there is a distinct possibility that the former genus is paraphyletic with respect to the latter.

Key to the Species of *Sarota*

- 1. - Hindwing with distinct tails 2
- Hindwing without tails (or vestigial) 12
- 2(1) - Hindwing with three tails: two long and rounded outer ones and a shorter and more pointed central one (Fig. 1A) 3
- Hindwing with several short and pointed tails (Fig. 1B) 7
- 3(2). - Pale areas of discal cell on both ventral wing surfaces whitish-silver or white, two black spots at base of ventral hindwing costa, dorsal forewing spots white *subtessellata*
- Pale areas of discal cell on both ventral wing surfaces silver, one black spot at base of ventral hindwing costa, dorsal forewing spots cream 4
- 4(3). - Ventral forewing with strongly marked white spots in the apex and in cell Cu₂ *chrysus*
- Ventral forewing without such strongly marked white spots 5
- 5(4). - Ventral forewing with a fragmented postmedial silver line that has more than two proximally directed silver streaks *turrialbensis*
- Ventral forewing with a continuous postmedial silver line that has two proximally directed silver streaks in the apex 6

- 6(5). - Ventral surface richly colored, dorsal forewing with only two prominent cream spots in the apex *neglecta*
- Ventral surface pale, dorsal forewing with one spot in the apex and one in cell Cu₂ *chocoensis*
- 7(2). - Ventral surface heavily dusted with white scaling *psaros*
- Ventral surface without extensive white scaling 8
- 8(7). - Silver in cell Cu₁ of the postmedial silver line on both ventral wing surfaces displaced proximally by a large black spot *craspediodonta*
- Postmedial silver line on both ventral wing surfaces even 9
- 9(8). - Ventral surface very dark, forelegs black *spicata*
- Ventral surface paler, forelegs shades of yellow 10
- 10(9). - Postmedial silver line on ventral forewing has only one proximally directed silver streak at its apex, male forewing pointed *willmotti*
- Postmedial silver line on ventral forewing has two proximally directed silver streaks at its apex, male forewing rather rounded 11
- 11(10). - Proximally directed silver streak in cell M₂ complete, relatively small area of brown background color visible on both ventral wing surfaces *acanthoides*
- Proximally directed silver streak in cell M₂ partially (male) or completely (female) divided, relatively large area of grainy brown background color visible on both ventral wing surfaces *harveyi*
- 12(1) - Hindwing without tails (Fig. 1C); other characters different -13
- Hindwing intermediate between those in Fig. 1B and 1C, without white fringe elements; forelegs black; both wings ventrally with extensive black distal to postmedial silver lines; ventral hindwing with postmedial silver line incomplete *chloropuncta*
- 13(12). - Ventral forewing with a postmedial silver line that has no long proximally directed silver streaks 14
- Ventral forewing with a postmedial silver line that has two or more proximally directed silver streaks 15
- 14(13). - Central and basal black spots on both ventral wing surfaces encapsulated by orange-brown coloration, apex of forewing postmedial silver line divided into two silver spots *completa*
- Central and basal black spots on both ventral wing surfaces typically not encapsulated by orange-brown coloration, apex of forewing postmedial silver line divided into three silver spots *lasciva*
- 15(13) - Ventral forewing with a postmedial silver line that has two proximally directed silver streaks 16
- Ventral forewing with a postmedial silver line that has more than two proximally directed silver streaks 19
- 16(15). - Outer forewing margin uneven with sections of white fringe in cells 1A+2A and Cu₂, more extensive ventral brown background coloration, proximally directed silver streaks in apex of ventral forewing short and of equal size *myrtea*
- Outer forewing margin even without any sections of white fringe, less extensive ventral brown background coloration, proximally directed silver streaks in apex of ventral forewing not of equal size or longer 17
- 17(16). - Discal cell of ventral hindwing contains single large black square, black spot at base of ventral forewing absent, male forelegs yellow *acantus*
- Discal cell of ventral hindwing contains two smaller black marks, black spot at base of ventral forewing present, male forelegs blackish 18
- 18(17). - Proximally directed silver streak in cell M₁ of ventral forewing typically divided, black scaling distal to postmedial silver line on ventral forewing minimal, distal forewing margin of male typically straight *gyas*
- Proximally directed silver streak in cell M₁ of ventral forewing undivided, black scaling distal to postmedial silver line on ventral forewing extensive, distal forewing margin of male typically convex *miranda*

- 19(15). - Average forewing length 14mm, postmedial silver line on ventral hindwing broken, legs predominantly brown *estrada*
 - Average forewing length 12mm, postmedial silver line on ventral hindwing complete, legs predominantly yellow *gamelia*

SAROTA Westwood, 1851

Sarota Westwood, 1851. In: Doubleday, *Gen. Diurn. Lep.* (2):424. Type species by selection by Scudder (1875, *Proc. Amer. Acad. Arts Sci.*, Boston 10:265): *Papilio chrysus* Stoll, 1782.

SAROTA Westwood, 1851 (20 species)

("-" denotes a subspecies and "-" a synonym)

- acanthoides* (Herrich-Schäffer, [1853])
acantus (Stoll, 1782)
chloropunctata Hall, n. sp.
chocoensis Hall, n. sp.
chrysus (Stoll, 1782)
 --*polypoecila* (Stichel, 1910)
 --*dematria* (Westwood, 1851)
completa Hall, n. sp.
craspediodonta (Dyar, 1918)
estrada Schaus, 1928
 --*sabanilla* Hall, n. ssp.
gamelia Godman & Salvin, 1886
 --*alba* Hall, n. ssp.
gyas (Cramer, 1775)
harveyi Hall, n. sp.
lasciva (Stichel, 1911), n. stat.
 --*flavicincta* (Lathy, 1932), n. syn.
 --*atlantica* Brévignon & Gallard, 1998, n. syn.
miranda Brévignon, 1998
myrtea Godman & Salvin, 1886, stat. rev.
neglecta Stichel, 1910, n. stat.
 --*alacer* (Stichel, 1929), n. syn.
psaros Godman & Salvin, 1886
 --*albidisca* (Lathy, 1932)
 --*psaronius* (Stichel, 1911)
spicata (Staudinger, 1888), stat. rev.
subtessellata (Schaus, 1913)
turrialbensis (Schaus, 1913)
willmotti Hall n. sp.

"chrysus group" (Chrysiiformes of Stichel (1930))***Sarota subtessellata*** (Schaus, 1913)

Fig. 5a-d; 25a,b

Charis subtessellata Schaus, 1913, *Proc. Zool. Soc. Lond.* 3:351, pl. 53, fig. 11. TL: Carrillo, Costa Rica. Holotype male USNM [Examined] (Fig. 5a,b).

Identification and taxonomy: Average FW length 16mm.

This is the largest species of *Sarota* and it can only really be confused with the much more common *S. chrysus*. Both sexes differ from that species by having a more pointed forewing, a darker dorsal surface, white instead of cream dorsal forewing spots, and a ventral surface with more whitish-silver markings, basal red-brown markings in the discal forewing cell that are non-convergent, broken apical forewing silver streaks that, in part, form two characteristic isolated whitish-silver marks at the costa, and typically more red-brown at the base of the hindwing with two black costal spots instead of one.

Biology: *S. subtessellata* is sparsely represented in collections, most specimens originating from Costa Rica and Panama from sea-level to about 1000m. DeVries (1997) states that in Costa Rica:

"The males are encountered as solitary individuals perching from 2 to 5 meters above the ground along forest edges and in light gaps between 12:30 and 13:30 hrs. The females are most frequently found in the shaded forest understory between 12:00 and 14:00 hrs".

Distribution: Costa Rica to west Colombia and probably west Ecuador, although it has yet to be recorded there.

Sarota chrysus (Stoll, 1782)

Fig. 6a-f; 26

Papilio chrysus Stoll, 1782, in Cramer, *Uitl. Kapellen* 4 (32):178, pl. 380, fig. D, E. TL: Surinam. Types unknown, figures [Examined].

= *Charis chrysus* f. *polypoecila* Stichel, 1910, *Berl. Ent. Zeit.* 55(1/2):27. TL: Bugaba, Panama. Holotype female ZMHU [Examined].

= *Helicopsis dematria* Westwood, 1851, in Doubleday, *Gen. Diurn. Lepid.* 2:424, pl. 71, fig. 10. TL: Honduras. Syntype female BMNH [Examined].

Identification and taxonomy: Average FW length 15mm.

There is no extant type specimen for this species, but since the type illustration in Cramer (1775-82) (Fig. 6a) is reasonably accurate and no other "chrysus group" species occur in the type locality, Surinam, there is no problem identifying it and I deem a neotype designation to be unnecessary. It is distinguished from *S. subtessellata* as outlined in that species account and from *S. neglecta* and *S. chocoensis* n. sp. (described below) by having four spots on the dorsal forewing, a broken postmedial silver line on the ventral forewing and more prominent white coloration at the base of both ventral wing surfaces, and in the apex and cell Cu₂ of the ventral forewing.

The species is quite variable over its wide geographic range, the most distinct populations being those occurring from Mexico to Honduras, named by Westwood (1851) as a full species, *dematria* (see Fig. 6f). I recognise as a heretofore unlabelled syntype a female specimen in the BMNH from Honduras with a handwritten label saying "*Helicopsis dematria*". Both sexes of this taxon tend to have darker ventral pattern elements, reduced white markings in the apex of the ventral forewing, where there are also more elongate black marks in cells Cu₁ and M₃, and a complete row of postdiscal black spots on the ventral hindwing. I considered recognising *dematria* as a subspecies of *chrysus* but the observed variation is clinal, the most extreme forms occurring in Mexico. The female type of the form *polypoecila* has unusually prominently marked dorsal forewing spots but is otherwise typical. On a nomenclatural note, it is worth mentioning that in the paper in which *polypoecila* was described, although Stichel (1910) was confusingly using the generic headings of *Sarota* and *Charis* interchangeably in the text, *polypoecila* was clearly described under the heading of "*C. chrysus*". Thus, contrary to the assertions of Stichel (1930) and Lamas *et al.* (1995), *polypoecila* was not described in *Sarota*, parentheses therefore being required around its author's name.

Biology: *S. chrysus* is one of the most widespread and commonly encountered species in the genus, occurring in primary and secondary growth habitats from sea-level to 1350m. Both sexes are typically seen as solitary individuals along open forest trails, forest edges and streambanks, although females are the most commonly encountered sex. A male was once observed puddling on a forest path in the late afternoon. Both sexes visit flowers of *Croton* and *Alibertia* (DeVries, 1997). Females have been observed to oviposit on mosses and liverworts (Lejuniaceae) that grow as epiphylls on old leaves and are assumed to be the larval hostplant (DeVries 1988, 1997; DeVries *et al.*, 1994).

Distribution: Mexico to west Ecuador, Venezuela to Bolivia, Brazil (Amazon, Mato Grosso and southeast), Guianas, Trinidad.

Sarota neglecta Stichel, 1910, n. stat.

Fig. 7a-d; 27

Sarota chrysus neglecta Stichel, 1910, *Berl. Ent. Zeit.* 55(1/2):27. TL: Río San Juan, W. Colombia. Syntype males and females ZMHU [Examined].

= *Charis chrysus neglecta* f. *alacer* Stichel, 1929, *Dtsch. Ent. Zeit.* 1929:205. TL: Río Dagua, W. Colombia. Holotype female ZMHU [Examined], n. syn.

Identification and taxonomy: Average FW length 14.5mm.

This taxon was described as a subspecies of *S. chrysus*, but as the two taxa occur sympatrically and show numerous phenotypic differences, I raise *S. neglecta* to specific status. The species was described from a conspecific series of two males and three females, all from the same locality, and as such no lectotype designation is necessary. The female type of form *alacer* has a more prominently marked dorsal surface than any of the aforementioned syntype females but it falls within the normal range of variation for *S. neglecta* into which I synonymise it. *S. neglecta* has a very similar wing shape and ventral pattern to that of *S. chocoensis* n. sp. (described below) and the diagnostic differences are discussed in that species account.

Biology: Throughout most of its range, *S. neglecta* tends to be the most commonly encountered of the "chrysus group" species and it is thus frequently misidentified in museum collections, published photographs and books (see appendix) as *S. chrysus*. It occurs in primary and secondary forest habitats from sea-level to approximately 1400m where both sexes, but more commonly females, are found resting low to the ground both on top of and beneath large leaves along forest edges, streamsides and ridgetops. Males especially are most active in the early to late morning and then again in the mid to late afternoon.

Distribution: Costa Rica to west Ecuador and northwest Venezuela.

Sarota chocoensis Hall, new sp.

Fig. 8a-d; 28

Description.— MALE: forewing length 14.5mm. Forewing costa slightly convex towards apex, distal margin smoothly convex; hindwing tornus pointed, three tails at middle of distal margin, two long ones at end of veins Cu_2 and M_3 , one very small central one at end of vein Cu_2 . **Dorsal surface:** forewing ground color brown; a large, ovoid cream spot in middle of cells Cu_2 and M_2 ; fringe orange-brown. Hindwing ground color brown, paler at anal margin; a submarginal orange-brown square in cells $1A+2A$ to Cu_2 ; margin and tails between veins $1A+2A$ and M_2 pale yellow brown with black, then white, then a thin layer of black scales distally forming fringe, fringe at margin of cell M_2 white. **Ventral surface:** forewing ground color pale yellow-brown, paler at anal margin; black line at discal cell end surrounded by orange-brown with silver mark above, pale yellow-brown triangle surrounded by silver towards discal cell end, orange-brown "U" shape extends from vein $1A+2A$ to costal edge of discal cell and back with internal black scaling especially below discal cell, orange-brown surrounds costal edge of discal cell, remainder of discal cell silver, silver at base of costa; uneven, orange-brown postdiscal line extends from costa to vein $1A+2A$, contains black spots, is largely black below vein Cu_2 , has an uneven silver line proximally that is broken above vein M_1 , and dark silver marks distally in cells Cu_1 and M_3 ; a parallel silver line in each of cells M_2 and M_1 that parallel costa, former pale yellow-brown in proximal half with vertical, pale silver line extending from near distal edge to vein $1A+2A$, some darker orange-brown scaling proximally; orange-brown at costal and distal margins, latter divided by thin submarginal silver line that extends from near apex to vein $1A+2A$; fringe orange-brown. Hindwing ground color pale yellow-brown; orange-brown band at base lined by silver contains small black spot at costa; postdiscal orange-brown band lined on both sides with black and containing black spots extends from costa, curving inwards to vein Cu_1 , kinking inwards in cell Cu_2 , then continuing to anal margin; another similar, more proximal, parallel band extends from near costa at vein $Sc+R_1$ to vein M_3 with silver inbetween; more proximal, uneven triangle of orange-brown containing black spots in left and upper apices, lined on both sides with black and encircled by and encircling silver, extends from anal margin to cell $1A+2A$ to costal edge of discal cell and back; orange-brown at submargin extends from apex to tornus, contains black spot in cell Cu_1 , has silver proximally, except in cells M_3 and M_2 , and distally below vein M_1 ; margin and tails between veins $1A+2A$ and M_2 pale yellow brown with black, then white, then a thin layer of black scales distally forming fringe, fringe at margin of cell M_2 white. **Head:** labial palpi yellow-brown with some hairs that are tipped with black. Eyes brown and bare, margins with yellow-brown scaling. Frons yellow-brown with some black hairs. Antennal segments black with white

scaling at base, that increases immediately before clubs, then small bare brown patch laterally and ventrally; clubs black, bare tips orange-brown. **Body:** dorsal surface of thorax and abdomen brown, ventral surface pale brown. Forelegs yellow-brown, mid and hindlegs yellow-brown with black banded tarsi. **Genitalia** (Fig. 28): uncus rounded, small posteriorly projecting point from dorsal edge; vinculum evenly thin; valvae have basal, lateral bulge, long upper portion that is of even width and slightly upturned at tip, and connected by membranous tissue dorsally, and small triangular point at lower posterior edge; aedeagus narrow and pointed at tip, tiny cornutus at base; pedicel long.

FEMALE: differs from HT in the following respects: forewing length 13mm. A small cream mark at discal cell end of dorsal forewing, more pronounced postmedial cream markings on dorsal hindwing, an extra black spot, in cell Cu_2 , in the submarginal orange-brown of the ventral hindwing. All of these characters are also present in certain male specimens.

Types.— *Holotype male:* ECUADOR.— *El Oro Prov.:* Zaruma, 1891 (M. de Mathan) (diss. # 4423); in the BMNH.

Allotype female: ECUADOR.— *Pichincha Prov.:* Tinalandia, Río Tanti, 750m, 8 May 1994 (J. P. W. Hall); in the coll. of JHKW.

Paratypes: ECUADOR.— *Pichincha Prov.:* same locality data as AT, 3 ♀: 2 Aug 1993, 1 ♀ (J. P. W. Hall); 26 June 1993, 2 ♀ (K. R. Willmott); all in the coll. of JHKW. Tinalandia, 700m, 20 Sep 1975, 1 ♀ (S. S. Nicolay); in the coll. of D. Ahrenholz, St. Paul, MN. *Manabí Prov.:* nr. Pedernales, Cerro Pata de Pájaro, 750m, 11 Aug 1996, 2 ♂ (K. R. Willmott); in the coll. of JHKW. *El Oro Prov.:* same data as HT, 1 ♂ (BMNH). *Chimborazo Prov.:* Chimbo, 1000ft, Aug 1897, 1 ♀ (Rosenberg) (BMNH). COLOMBIA.— *Chocó:* Río San Juan, San Pablo, 1 ♀ (ex Staudinger coll.) (BMNH). PANAMA.— *Coclé:* El Valle, 26 Aug 70, 1 ♂ (H. L. King) (FSCA).

Etymology.— This species is named after the Chocó region to which, as defined in its broadest sense, it currently appears to be largely confined.

Diagnosis.— *Sarota chocoensis* n. sp. has an almost identical ventral pattern to that of *S. neglecta*, but in both sexes the yellow-brown and orange-brown pattern elements are paler, the black markings less prominent, the pale yellow-brown on the lower of the two forewing apical silver streaks is proximally instead of centrally positioned, the silver at the discal cell end of the hindwing lacks a white spot and, most diagnostic of all, it has a pure yellow-brown basal band on the hindwing instead of a broken silver one that contains a white spot near the costa. On the dorsal surface, *S. chocoensis* also has two prominent cream spots in cells Cu_2 and M_2 of the forewing, positioned one above the other, whereas *S. neglecta* has an additional tiny spot towards the base of cell M_1 , both of those in the subapex are smaller and that in cell Cu_2 is virtually absent in males, present as a prominent spot only in females. The male genitalia of the two species differ very little from each other, as do all those in the "chrysus group", but the lower portion of the valvae in *S. chocoensis* is slightly less produced.

Discussion.— This species is currently known from central Panama to west Ecuador, but it may also occur in eastern Costa Rica. The majority of locality data indicate that *S. chocoensis* predominantly inhabits lower premontane forests between 700 and 1300m, although one historic record suggests that it may occur as low as 350m. At one well collected locality, Tinalandia, situated at about 750m, *S. chocoensis* has been found sympatrically with *S. neglecta* and *S. chrysus*. Solitary males of *S. chocoensis* have been observed perching low to the ground in hilltop lightgaps in the early morning and again in the late afternoon. The more common females can be found resting beneath large, low leaves along streamsides, forest edges and in secondary growth areas throughout much of the day.

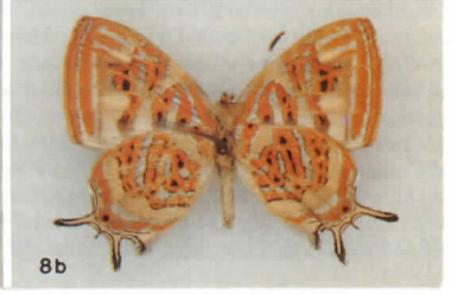
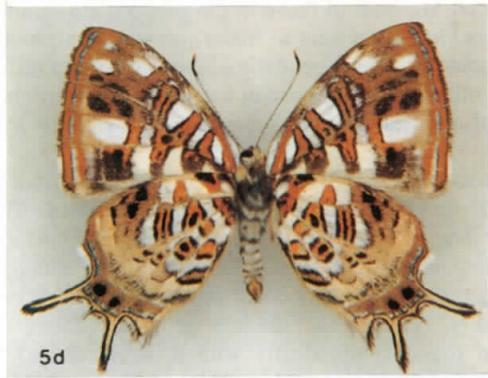
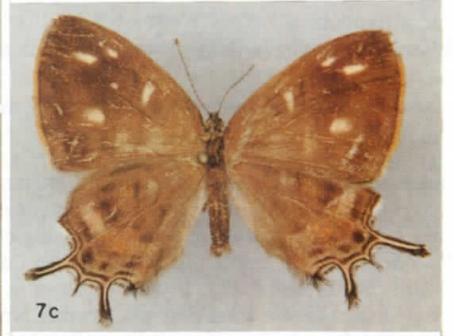
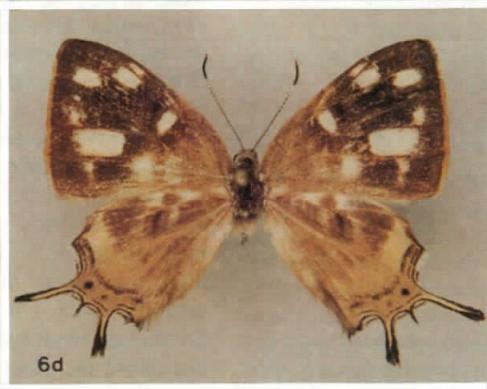
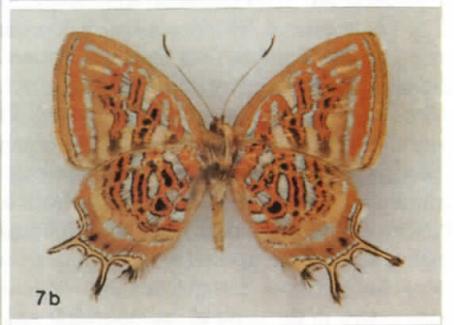
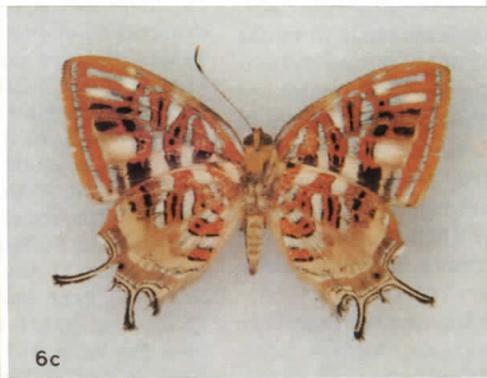
Sarota turrialbensis (Schaus, 1913)

Fig. 9a,b

Charis turrialbensis Schaus, 1913, *Proc. Zool. Soc. Lond.* 3:352, pl. 53, fig. 13. TL: Turrialba, Costa Rica. Holotype male USNM [Examined] (Fig. 9a,b).

Identification and taxonomy: FW length 13.5mm.

S. turrialbensis is the smallest "chrysus group" species and easily



distinguished from all others by lacking dorsal forewing spots. In this regard and by having more than two proximally directed postmedial silver streaks and small hindwing tails, it would appear to be somewhat intermediate towards species of the "*acanthoides* group".

Biology: The unique specimen of *S. turrialbensis* forms part of the Schaus material in the USNM and is labelled "Turrialba, 5800ft". Nothing is known of its biology, but given its apparent rarity, the lack of associated females and its intriguing phylogenetic position within the genus, any information would be worth publishing.

Distribution: Costa Rica.

"*acanthoides* group" (in part, Gyadiformes of Stichel (1930))

Sarota craspediodonta (Dyar, 1918)

Fig. 10a-d; 29

Charis craspediodonta (Dyar, 1918), *Proc. U. S. Natl. Mus.* 54:335. TL: Presidio, Mexico. Holotype female USNM [Examined] (Fig. 10c,d).

Identification and taxonomy: Average FW length 10.5mm.

The dark ventral surface of this species is reminiscent of *S. spicata* but the hindwing margin is dark orange-brown instead of yellow, there is an enlarged black spot in the submargin of cell Cu_1 on both wings, additional silver spots distal to the postdiscal forewing line of black spots in the apex and the male has white legs while that of *S. spicata* has black forelegs and black mid and hindlegs with partially white tibia and white tarsi.

Biology: Nothing is known about the biology of this species but, from locality data, it would appear to predominantly occur in or at least be tolerant of drier semi-deciduous habitats, a phenomenon that does not occur elsewhere in the genus. It is very rare in collections.

Distribution: Mexico and Guatemala.

Sarota spicata (Staudinger, 1888), *stat. rev.*

Fig. 11a-d; 30

Anteros acanthoides var. *spicata* Staudinger, 1888, *Exot. Schmett.* 1:252. TL: Pebas, Peru. Lectotype male ZMHU [Designated] (Fig. 11a,b).

Identification and taxonomy: Average FW length 10.5mm.

This species was described from two males (Pebas and Iquitos) and one female (Pebas) but as the female belongs to a separate species, *S. willmotti* n. sp. (described below), I designate the male from Pebas (the type locality stipulated in the original description) as a lectotype (Fig. 11a,b) to avoid confusion. It bears the following three labels: "*Anteros* sp ?, near, *A. acanthoides*, H-Sch., (G&S)", "Pebas, Hhl" and "Origin".

Although *spicata* was described as a variety of *S. acanthoides* the sympatry of the two taxa and their numerous phenotypic differences clearly show them to be distinct species and I return *spicata* to the full species status that it was once accorded by Stichel (1910) (the species status accorded to it by DeVries (1997) was based on an error of identification; see appendix). *S. spicata* has the darkest ventral patterning of all the sympatric Amazonian "*acanthoides* group" species and is distinguished from most by not having elongate, proximally directed silver streaks in the apex of the ventral forewing. It somewhat resembles *S. willmotti* n. sp., especially in the female, but has an even smaller final apical silver streak on the ventral forewing, broken postmedial silver lines on both ventral wing surfaces with heavy distal black, a much darker ventral ground color and largely black legs (part of the tibia and tarsi are white) instead of largely orange ones. The last character also separates *S. spicata* from its most

similar species *S. craspediodonta* which is additionally distinguished in that species account.

Biology: This uncommon species is confined to primary forest and its immediate environs below 600m. Males perch as solitary individuals or in small groups on low bushes in large lightgaps along forest edges or more commonly near streamsides from 0645-1100h and then again more sporadically in the late afternoon. Females are encountered as solitary individuals throughout much of the day in similar microhabitats. DeVries (pers. comm.) reports finding *S. spicata* in Ecuador feeding from the extrafloral nectary of a *Montrichardia* species (Araceae) and also at a light at night.

Distribution: Colombia to Peru, west Brazil.

Sarota willmotti Hall, *new sp.*

Fig. 12a-d; 31

Description. - MALE: forewing length 11mm. Forewing pointed, distal margin straight; hindwing apex and tornus produced into small points, three roughly equally sized tails at middle of distal margin. *Dorsal surface:* ground color of both wings brown; faint, darker brown discal, postdiscal and postmedial hindwing markings; fringe brown on forewing, white then dark brown on hindwing. *Ventral surface:* forewing ground color brown, paler at anal margin; black line surrounded by orange-brown with silver streak above and silver distally at discal cell end and towards cell end with a vertical black line, that is surrounded by orange-brown and has silver distally, in cells below; small black spot surrounded by triangle of orange-brown towards base of discal cell with silver distally and proximally and black square in cell below, orange-brown surrounds base of costal edge of discal cell, silver at base of costa; orange-brown postdiscal line containing black spots extends from cell M_3 to cell 1A+2A curving slightly outwards in upper half, a small black spot surrounded by orange-brown with silver streak distally toward base of cell R_3 ; slightly broken, postmedial silver line edged proximally with black gradually increases in width from cell M_2 to cell 1A+2A, broader proximally directed silver streak in cell M_1 ; remainder of costa and submargin orange-brown, margin yellow-orange, thin submarginal silver line extends from apex to vein 1A+2A; fringe brown. Hindwing ground color brown with a light scattering of pale brown scales; orange-brown band at base lined distally and proximally by silver contains two small black spots towards costa, a tiny silver spot at middle; postdiscal orange-brown band containing black spots extends from costa, curving inwards to vein M_3 , kinking inwards in cells Cu_1 and Cu_2 , then continuing to anal margin, kinking inwards below vein 1A+2A, disjunct silver proximally at costa, discal cell end and towards anal margin; black mark surrounded by orange-brown at discal cell end and in middle of discal cell with silver inbetween, similarly marked band extends below latter silver patch to anal margin, and above and below medial discal mark to the costal and anal margins respectively; uneven, postmedial silver line with thin layer of black scaling distally curves sharply inwards at costal and anal margins and thins in cells M_3 and M_2 ; orange-brown at submargin extends from apex to tornus and has a thin silver line distally below vein M_1 ; margin and tails between tornus and vein M_1 yellow with black, then white, then a thin layer of black scales distally forming fringe, fringe at apex brown. *Head:* labial palpi yellow-orange. Eyes brown and bare, margins with brown scaling. Frons brown with some yellow hairs. Antennal segments black with white scaling at base that increases laterally and towards clubs; clubs black, bare tips dark brown. *Body:* both surfaces of thorax dark brown; dorsal surface of abdomen dark brown, ventral surface cream. Forelegs yellow-orange, femur of mid and hindlegs brown, remainder yellow-orange except tarsi brown banded. *Genitalia* (Fig. 31): uncus rounded, small posteriorly projecting point from dorsal edge; vinculum evenly thin; valvae have basal, lateral bulge, long upper portion that narrows slightly towards tip and is connected by membranous tissue dorsally, and small bluntly rounded lower posterior edge; aedeagus narrow and pointed at tip, tiny cornutus at base; pedicel long.

FEMALE: differs from male in the following respects: forewing length



10mm. Forewing more rounded with convex distal margin. Ground color of both dorsal wing surfaces paler brown; forewing with white fringe elements at distal margins of cells 1A+2A and Cu₁, dorsal hindwing with pale grey-brown at margin, dark red-brown spots at submargin (very faint in some specimens).

Types.— *Holotype male*: ECUADOR.— Napo Prov.: Río Napo, Limoncocha, 240m, 3 Oct 1973 (S. S. Nicolay) (diss. # JPWH 53); in the USNM.

Allotype female: PERU.— Madre de Dios: Parque Nacional del Manu, Pakitza, 12°07'S 70°58'W, 400m, 2 Oct 1991 (O. Mielke); in the USNM.

Paratypes: PERU.— same locality data as AT, 1 ♂, 4 ♀: 15 Oct 1991, 1 ♂ (G. Lamas); 15 Nov 1990, 1 ♀ (W. Rowe); 2 Oct 1991, 1 ♀ (O. Mielke); 10 Oct 1991, 1 ♀ (M. Casagrande); 5 Oct 1991, 1 ♀ (O. Mielke); all in the USNM. AMAZONAS: Río Huallaga, Achinamiza, 27 Aug 1927, 1 ♀ (Bassler) (AMNH). ECUADOR.— Napo Prov.: km 20 Tena-Puyo rd., Apuya, 600m, 30 Aug 93, 1 ♀ (J. P. W. Hall); km 12 Tena-Puyo rd., Finca San Carlo, 600m, 19 Feb 95, 1 ♀ (K. R. Willmott); both in the coll. of JHKW. Sucumbios Prov.: 75 km ESE of Coca, Garza Cocha-Añangu, 17 Nov 1996, 1 ♂ (P. J. DeVries); in the coll. of PJD. BRAZIL.— Pará: Pará, 2 ♀ (H. W. Bates); Amazon, 1 ♂ (diss. # 4422); all in the BMNH.

Etymology.— This species is named for my life-long friend Keith R. Willmott, who has been a constant field companion around the globe and an indefatigable co-author on many projects including "The Butterflies of Ecuador".

Diagnosis.— *S. willmotti* n. sp. differs most conspicuously from *S. spicata* by having a paler ventral surface and yellow-orange instead of black and white legs but is additionally separated as outlined in that species account; and from *S. acanthoides* by having a more pointed forewing (in the male) and only one elongate silver streak in the apex of the ventral forewing instead of two. *S. willmotti*, especially the female, is probably most similar to *S. harveyi* n. sp. (described below), which has two ventral forewing apical silver streaks that are not as prominent as in *S. acanthoides*, the lower one being divided through the middle, a character that is exaggerated in the female; *S. willmotti* never has silver immediately distal to the black spot in cell M₂. *S. willmotti* additionally differs from *S. harveyi* by having a more pointed forewing (in the male), a smooth postdiscal row of black spots on the ventral forewing that is not enlarged in cell M₃, and less grainy (pale brown scales over brown) background coloration on both ventral wing surfaces.

Discussion.— This species is currently known from Ecuador, Peru and Brazil (Amazon) but appears to be more common in the western Amazon. It is uncommon to rare in primary forest habitats below 600m and I have only encountered solitary females (also by far the most commonly represented sex in collections) low to the ground in lightgaps and along forest trails during the afternoon.

It is worth noting here that there are two female specimens from Costa Rica, in the collections of PJD (figured in DeVries (1997) as *S. spicata*) and the ZMHU, that have ventral wing patterns somewhat intermediate between *S. willmotti* and *S. turrialbensis*. They may well represent an undescribed taxon, but more material, including males, is needed to come to any firmer conclusions.

Sarota acanthoides (Herrich-Schäffer, [1853])

Fig. 13a-d; 32

Nymphidium acanthoides Herrich-Schäffer, [1853], *Samml. aussereurop. Schmett.* 1:55, pl. 13, fig. 49-50. TL: Surinam. Holotype male, Staatliches Museum für Naturkunde, Stuttgart (SMNS); type photograph [Examined courtesy of G. Lamas].

Identification and taxonomy: Average FW length 11mm.

Because of its relatively pale ventral surface, *S. acanthoides* superfi-

cially resembles *S. willmotti* n. sp. (described above) but it differs most conspicuously by having two prominent proximally directed silver streaks in the apex of the ventral forewing. However, its rounded wing shape and overall ventral patterning place it closest to *S. harveyi* n. sp. (described below). It differs from that species most conspicuously on the ventral surface by having more orange-brown coloration and thus less grainy (pale brown scales over brown) background coloration and two prominent, unbroken proximally directed silver streaks in the apex of the forewing. Interestingly, *S. acanthoides* is the only described species (at least in the male) outside the "*chrysus* group" to have orange-brown tips to the antennal clubs. **Biology:** Brévignon and Gallard (1998) report finding this species in French Guiana on hilltops from 1000-1200h then later in flat forest from 1300-1400h.

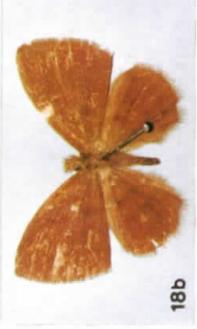
Distribution: Venezuela to Peru, Brazil (Amazon, Mato Grosso), Guianas. Most specimens in collections originate from Brazil (central and lower Amazon, Mato Grosso) and the Guianas, those from the western Amazon being very rare.

Sarota harveyi Hall, new sp.

Fig. 14a-d; 33

Description.— MALE: forewing length 11mm. Forewing costal and distal margins convex; hindwing apex and tornus produced into small points, three roughly equally sized tails at middle of distal margin. *Dorsal surface:* ground color of both wings brown; faint, darker brown discal, postdiscal and submarginal markings on both wings; fringe brown on forewing except for some white scaling at margin of cell 1A+2A, white then dark brown on hindwing. *Ventral surface:* forewing ground color brown scattered with pale brown scales, paler at anal margin; black line surrounded by orange-brown with silver streak above and silver distally at discal cell end and towards cell end with a vertical black line, that is surrounded by some orange-brown and has silver distally in cell Cu₂, in cells below; small black spot towards base of discal cell surrounded by triangle of orange-brown, that joins to middle cell marking at upper edge of cell, with silver distally and proximally and black square in cell below, orange-brown surrounds base of costal edge of discal cell, thin line of silver at base of costa; postdiscal line of black spots surrounded by some orange-brown extends from cell M₃ to cell 1A+2A curving slightly outwards in upper half and enlarged in cell M₃, a small black spot surrounded by orange-brown with silver streak distally toward base of cell R₃; broken, postmedial silver line edged proximally with black is largely black in cell 1A+2A, has a complete proximally directed silver streak in cell M₁, and one in cell M₂ that is thinned medially and almost divided in two; remainder of costa and submargin orange-brown, margin dark yellow-orange, thin submarginal silver line extends from apex to vein 1A+2A; fringe brown except for some white scaling at margin of cell 1A+2A. Hindwing ground color brown scattered with pale brown scales; orange-brown band at base lined distally and proximally by silver contains one small black spot towards costa, a small silver spot at middle; postdiscal band of black spots surrounded by some orange-brown extends from costa, curving inwards to vein M₃, kinking sharply inwards in cells Cu₁ and Cu₂, then continuing to anal margin, kinking inwards below vein 1A+2A, some disjunct silver proximally at costa, discal cell end and towards anal margin; black mark surrounded by orange-brown at discal cell end and in middle of discal cell with silver inbetween, similarly marked band extends below latter silver patch to anal margin, and above and below medial discal mark to the costal and anal margins respectively; uneven, slightly broken, postmedial silver line with thin layer of black scaling distally curves sharply inwards at costal and anal margins and thins in cells M₃ and M₂; orange-brown at submargin extends from apex to tornus and has a thin silver line distally below vein M₁; margin and tails between tornus and vein

Fig. 8-15. 8. *S. chocoensis* Hall n. sp., allotype female, Río Tanti, W. Ecuador [JHKW]: c) DS; d) VS. 9. *S. turrialbensis*, holotype male, Turrialba, Costa Rica [USNM]: a) DS; b) VS. 10. *S. craspediodonta*, male, Xcan, Quintana Roo, Mexico [FSCA]: a) DS; b) VS. Holotype female, Presidio, Mexico [USNM]: c) DS; d) VS. 11. *S. spicata*, Lectotype male, Pebas, Peru [ZMHU]: a) DS; b) VS. Female, Cotundo, E. Ecuador [USNM]: c) DS; d) VS. 12. *S. willmotti* Hall n. sp., holotype male, Limoncocha, E. Ecuador [USNM]: a) DS; b) VS. Allotype female, Pakitza, Peru [USNM]: c) DS; d) VS. 13. *S. acanthoides*, male, Diamantino, S. Brazil (MaGr) [USNM]: a) DS; b) VS. Female, Pará, Brazil (Pa) [BMNH]: c) DS; d) VS. 14. *S. harveyi* Hall n. sp., holotype male, Diamantino, S. Brazil (MaGr) [USNM]: a) DS; b) VS. Allotype female, nr. Cauca landia, S. W. Brazil (Ron) [USNM]: c) DS; d) VS. 15. *S. psaros psaros*, male, Potrerillos, Panama [USNM]: a) DS; b) VS. Female, Cerro Campana, Panama [USNM]: c) DS; d) VS. *S. psaros albidisca*, holotype female, Chanchamayo, Peru [BMNH]: e) DS; f) VS. *S. psaros psaronius*, male, E. Brazil (Ba) [ZMHU]: g) DS; h) VS. Syntype female, Leopoldina, S. E. Brazil (MiGe) [ZMHU]: i) DS; j) VS.



M₁ yellow with black, then white, then a thin layer of black scales distally forming fringe, fringe at apex brown. *Head*: labial palpi yellow-brown. Eyes brown and very sparsely setose, margins with brown scaling. Frons dark brown. Antennal segments black with white scaling at base that increases laterally and towards clubs; clubs black, bare tips dark brown. *Body*: both surfaces of thorax dark brown; dorsal surface of abdomen dark brown, ventral surface cream. Forelegs yellow-brown, femur of mid and hindlegs pale brown, remainder yellow-brown except tarsi black banded. *Genitalia* (Fig. 33): uncus rounded, small posteriorly projecting point from dorsal edge; vinculum evenly thin; valvae have basal, lateral bulge, long upper portion of even width that is connected by membranous tissue dorsally, and small bluntly triangular lower posterior edge; aedeagus narrow and pointed at tip, tiny cornutus at base; pedicel long.

FEMALE: differs from male in the following respects: wing shape slightly more elongate. Ground color of both dorsal wing surfaces slightly paler brown; lower of the two proximally directed silver streaks in apex of ventral forewing broadly divided by grainy brown.

Types.—*Holotype male*: BRAZIL.—*Mato Grosso*: Alto Rio Arinos, Diamantino, 14°13'S 56°12'W, 350-400m, 23 Feb 1991 (E. Furtado) (diss. # JPWH 52); in the USNM.

Allotype female: BRAZIL.—*Rondonia*: vic. Caucalandia, 10°32'S 62°48'W, 160-350m, 19 Oct 1991 (J. MacDonald); in the USNM.

Paratypes: BRAZIL.—*Mato Grosso*: Cuiabá, 2 ♂; no specific locality, 1886, 1 ♂ (P. Germain); all in the BMNH. PERU.—*Madre de Dios*: Parque Nacional del Manu, Pakitza, 12°07'S 70°58'W, 400m, 6 ♂: 8 Oct 1990, 1 ♂ (R. K. Robbins); 11 Oct 1990, 1 ♂ (R. K. Robbins); 28 Sept 1991, 1 ♂ (R. K. Robbins); 5 Oct 1991, 1 ♂ (M. Casagrande); 4 May 1991, 1 ♂ (D. J. Harvey); 26 Sept 1991, 1 ♂ (G. Lamas); all in the USNM.

Etymology.— This species is named for my friend Donald J. Harvey, whose contribution to the higher systematics of the Riodinidae has been enormous and who has independently spent time unraveling some of the taxonomic mysteries of *Sarota*.

Diagnosis.— The wing shape and overall ventral patterning of *S. harveyi* n. sp. place it closest to *S. acanthoides*. It differs from that species by having markedly more grainy background coloration on both ventral wing surfaces and thus less orange-brown, which is slightly darker, a more exaggeratedly enlarged black spot in cell M₃ of the postdiscal line on the ventral forewing, a partially (male) or completely (female) divided proximally directed silver streak in cell M₂ of the ventral forewing apex, slightly reduced postdiscal silver and slightly more broken postmedial silver lines on both ventral wing surfaces.

Discussion.— This rare species is poorly represented in collections and currently only known from south Peru and the states of Mato Grosso and Rondonia in south and southwest Brazil. It is not clear whether this unusual range for a riodinid represents reality or whether the species is more widely distributed in the central and western Amazon. In south Peru, it is sympatric with its closest relatives *S. acanthoides*, *S. willmotti* n. sp. (described above) and *S. spicata*.

Sarota psaros Godman & Salvin, 1886

Fig. 15a-j; 34

Sarota psaros Godman & Salvin, 1886, *Biol. Cent.-Amer., Lepid. Rhop.* 1:437; 3: pl. 43, fig. 14-15. TL: Cahabón, Vera Paz, Guatemala. Holotype female BMNH [Examined].

Identification and taxonomy: Average FW length 10.5mm.

The grainy white ground color to the ventral surface of *S. psaros* makes it one of the most distinctive species in the genus.

Biology: This widespread species appears to be associated with wet, lower premontane forest habitats from about 500-1400m. DeVries (1997) states that in Costa Rica:

"males are encountered as rare, solitary individuals perching from 3 to 5m above the ground on isolated trees or shrubs between 12:00 and 12:30 hrs, in the company of other *Sarota* species".

Curiously, solitary males have been reported as attracted to black lights at night in both Costa Rica (N. Greig in DeVries, 1997) and French Guiana (M. Thouvenot in Brévignon and Gallard, 1998).

The nominate subspecies of *S. psaros* is uncommon in collections while the other two are very rare, subspecies *albidisca* being known only from the holotype. The validity of these subspecies is uncertain, but since they do show discernible differences and are confined to different biogeographical regions, I maintain them until further material becomes available from the intervening east Andean region to better assess the extent of intrapopulation and clinal variation.

Distribution: Mexico to Panama, Guianas.

Sarota psaros albidisca (Lathy, 1932)

Fig. 15e,f

Charis psaros albidisca Lathy, 1932, *Ann. Mag. Nat. Hist.* (10)9:70. TL: Chanchamayo, Peru. Holotype female BMNH [Examined] (Fig. 15e,f).

Identification and taxonomy: The ventral patterning of this subspecies is somewhat intermediate between the other two but the female holotype has two prominent white spots in the middle of the dorsal forewing.

Distribution: East Peru.

Sarota psaros psaronius (Stichel, 1911)

Fig. 15g-j; 34

Charis psaros psaronius Stichel, 1911, *Gen. Ins.* 112B:250. TL: Leopoldina, Espírito Santo, S.E. Brazil. Syntype females ZMHU [Examined] (Fig. 15i,j).

Identification and taxonomy: Both sexes of this subspecies differ from the nominate by having an orange-brown instead of yellow margin on the ventral hindwing, equal amounts of black distal to the innermost submarginal silver line on both ventral wing surfaces, slightly less dense white ventral scaling that forms a smaller spot in cell Cu₂ of the forewing in relation to the cells above and below, markings in the middle of the ventral forewing discal cell that do not meet the black mark below in cell 1A+2A and marks towards the discal cell end of the ventral hindwing that are coalesced.

Distribution: Southeast Brazil.

Sarota chloropunctata Hall, new sp.

Fig. 24a,b; 35

Description.— **MALE**: forewing length 10.5mm. Forewing pointed, apex slightly angular; hindwing tornus pointed, barely discernible points at end of cells Cu₂, Cu₁ and M₃. *Dorsal surface*: ground color of both wings brown; fringe of both wings brown. *Ventral surface*: forewing ground color brown; black line at discal cell end surrounded by orange-brown with silver streak above, proximally and distally; remainder of discal cell orange-brown except for silver streak at middle that extends to vein 1A+2A where it becomes paler and has a black spot either side, a medial black spot, and silver streak at base; entire costa orange-brown; postdiscal line of black spots surrounded by orange-brown above vein Cu₂ consists of three spots in cells M₁ to M₃, the former being much smaller, and a slightly more proximally positioned,

Fig. 16-21. 16. *S. estrada estrada*, male, Barbarena, Guatemala [BMNH]: a) DS; b) VS. Female, Barbarena, Guatemala [BMNH]: c) DS; d) VS. *S. estrada sabanilla* Hall n. ssp., holotype male, Sabanilla, S. Ecuador [JHKW]: e) DS; f) VS. Allotype female, Sabanilla, S. Ecuador [JHKW]: g) DS; h) VS. 17. *S. gamelia gamelia*, male, Piña, Panama [FSCA]: a) DS; b) VS. Allotype female, Sinanja, Vera Paz, Guatemala [BMNH]: c) DS; d) VS. *S. gamelia alba* Hall n. ssp., holotype female, Yahuarimayo, S. Peru [BMNH]: e) DS; f) VS. 18. *S. acantus*, type illustration (in Cramer, 1782), Surinam: a) VS. Neotype male, Bartica, Guyana [BMNH]: b) DS; c) VS. Female, Piña, Panama [FSCA]: d) DS; e) VS. 19. *S. miranda*, male, Río Yuturi, E. Ecuador [JHKW]: a) DS; b) VS. Female, nr. Coca, E. Ecuador [JHKW]: a) DS; b) VS. 20. *S. gyas*, type illustration (in Cramer, 1775), Berbices, Guyana: a) VS. Neotype male, Bartica, Guyana [BMNH]: b) DS; c) VS. Female, Montañita, Caquetá, Colombia [USNM]: d) DS; e) VS. 21. *S. myrtea*, holotype male, Cubilguitz, Vera Paz, Guatemala [BMNH]: a) DS; b) VS. Female, km 49 Tena-Loreto rd. (1300m), E. Ecuador [JHKW]: c) DS; d) VS. Male, nr. Cosanga (2000m), E. Ecuador [JHKW]: e) VS. Female, nr. Cosanga (2000m), E. Ecuador [JHKW]: f) VS.

increasingly broad band below vein M_3 ; slightly curved, postmedial silver line edged distally with increasingly more black towards tornus consists of two short, proximally directed streaks in cells M_2 and M_1 , a tiny distally positioned spot in cell M_3 , and a broad but increasingly smaller, divided band of silver spots in cells Cu_1 to $1A+2A$; remainder of costa, submargin and margin orange-brown, thin submarginal silver line extends from apex to vein $1A+2A$; fringe brown. Hindwing ground color orange-brown with a light scattering of pale brown scales; black spot at base of costa, basal silver line then broken line of black spots distally both extend from costa to anal margin; black line marking discal cell end and proximally displaced black spot below have equivalent silver marks proximally; postdiscal line of black spots contains a large, coalesced spot in cells M_3 and M_2 and is slightly concave between cells Cu_1 and $1A+2A$, with a proximally elongate spot in cell Cu_2 ; broad, even, postmedial silver line with isolated black spots distally in cells Cu_1 to $1A+2A$ and brown proximally extends from anal margin to vein M_3 , black continues to apex, only faint trace of silver in cell M_1 ; thin, silver submarginal line extends from tornus to apex; fringe brown. **Head:** labial palpi brown. Eyes brown and bare, margins with brown scaling. Frons brown. Antennal segments black with white scaling at base that increases laterally and towards clubs; clubs black. **Body:** dorsal surface of thorax and abdomen dark brown, ventral surface pale brown. Forelegs dark brown, femur of mid and hindlegs dark brown, remainder yellow, tarsi black banded. **Genitalia** (Fig. 35): uncus rectangular, dorsal posterior tip weakly bifid; falci very long; vinculum slightly broader at middle; valvae have basal, lateral bulge, long upper portion of even width that is connected by membranous tissue dorsally, and small bluntly pointed lower posterior edge; aedeagus narrow and pointed at tip, tiny cornutus at middle; pedicel long.

FEMALE: unknown.

Types.— *Holotype male:* ECUADOR.— *Carchi Prov.:* nr. Lita, ridge to east of Río Baboso, 900m, 6 Jul 1998 (K. R. Willmott); to be deposited in the BMNH.

Etymology.— The name of this species is derived from the greenish color of the ventral silver markings.

Diagnosis.— *S. chloropunctata* n. sp. can be distinguished from all other species of *Sarota* by having tiny points at the distal margin of the hindwing but no tails, placing its wing shape inbetween those of species in the "*acanthoides*" and "*gyas*" groups and suggesting that it is an evolutionary intermediate between those two groups. Certain elements of its ventral wing pattern, most notably the tapering postmedial silver band of the forewing, the incomplete postmedial line of the hindwing and the presence of significant amounts of black distal to the postmedial silver lines of both wings, additionally distinguish it from species of the "*gyas* group" and indicate a closer affinity to species of the "*acanthoides* group", although *S. chloropunctata* does lack the white fringe elements of the hindwing that are associated with tails. Its black forelegs separate it from all species in the "*acanthoides* group" except *S. spicata*, which has white instead of yellow tibia to the mid and hindlegs and a substantially different ventral pattern. Notable male genitalic characters of *S. chloropunctata* include a weakly bifid dorsal posterior tip to the uncus and very long, thin falci.

Discussion.— The holotype was encountered perching 2m above the ground along an open ridgetop path at 1145h. It seems likely that this species is a Chocó endemic and it should be looked for in Colombia.

"*gyas* group" (in part, Gyadiformes of Stichel (1930))

Sarota estrada Schaus, 1928

Fig. 16a-h; 36a,b

Sarota estrada Schaus, 1928, *Proc. Ent. Soc. Wash.* 30:48. TL: Guatemala. Holotype male USNM [Examined].

Identification and taxonomy: Average FW length 14mm.

Nominate *S. estrada* is most conspicuously separated from nominate *S. gamelia* in Central America by its larger size, predominantly brown instead of yellow frons and legs, setose instead of bare eyes, the presence of a white subapical dorsal forewing spot (in the female),

more extensive areas of grainy brown ventral background color on both wings, a darker yellow-orange margin and by having a shorter proximally directed silver streak in cell M_2 of the ventral forewing that does not reach the perpendicular postdiscal silver line. The ventral markings of *S. estrada* are variably blue-silver or green-silver.

Biology: This species is associated with premontane and lower montane forest habitats from about 600-1700m. It is uncommon in collections, the vast majority of specimens originating from Mexico and Guatemala, records from further east being very rare.

Distribution: Mexico to Costa Rica.

Sarota estrada sabanilla Hall, new ssp.

Fig. 16e-h; 36b

Description.— **MALE:** forewing length 14.5mm. Forewing pointed, costal margin convex at base, distal margin slightly convex; hindwing pointed at tornus, very slightly pointed at end of vein Cu_2 . **Dorsal surface:** ground color of both wings dark brown; faint, darker brown basal, discal, postdiscal and submarginal markings on both wings; fringe brown on both wings (and both surfaces) except for some white scaling at margin of cells $1A+2A$ and Cu_1 on the forewing. **Ventral surface:** forewing ground color brown; black line surrounded by orange-brown and then silver at discal cell end, uneven yellow triangle at costa near discal cell end becomes white at tip, "U"-shaped mark extends from vein $1A+2A$ to costal edge of discal cell and back, black below discal cell, orange-brown within discal cell, remainder of discal cell silver, orange-brown surrounds base of costal edge of discal cell, thin line of silver at base of costa; postdiscal line of black spots surrounded by orange-brown above vein Cu_2 extends diagonally inwards from cell M_3 to vein $1A+2A$, slightly broader in cell M_3 , a small black spot surrounded by orange-brown toward base of cell M_1 , long silver streak in cell R_3 ; series of postmedial, proximally directed silver streaks which align at distal edge set in orange-brown consists of a long one in cell M_1 that is white at middle, a very long one in cell M_2 that joins proximally to postdiscal silver, a short ovoid one in cell M_3 , and two slightly longer ones in cells Cu_2 and Cu_1 , cream rectangle below in cell $1A+2A$; remainder of costa and submargin orange-brown, margin dark yellow-orange, thin submarginal silver line extends from apex to vein $1A+2A$, very thin line of black scaling distally, black scaling proximally in cell $1A+2A$. Hindwing ground color brown with a very faint scattering of pale brown scales; orange-brown band at base lined distally and proximally by silver contains one faint black spot at costa and one streak at middle; postdiscal band of black spots surrounded by orange-brown extends from costa, curving outwards then inwards to vein Cu_2 , kinking outwards in cell $1A+2A$, then continuing to anal margin, some disjunct silver proximally at costa, discal cell end and towards anal margin; black mark surrounded by orange-brown at discal cell end with silver proximally, two similarly marked spots below discal cell end in cells $1A+2A$ and $3A$, a similarly marked band extends from vein R_s to vein $1A+2A$ through middle of discal cell; broken, postmedial silver line with thin layer of black scaling distally curves sharply inwards at costal and anal margins; orange-brown at submargin extends along anal margin and distal half of costal margin, and has a silver line distally, with very thin line of black scaling distal to it, below vein M_1 which thickens at tornus; margin below vein M_1 dark yellow-orange; tuft of black hairs at tornus and smaller one at end of vein Cu_2 . **Head:** labial palpi mixture of yellow and brown scales. Eyes brown and setose, margins with brown scaling. Frons dark brown with some yellow scales. Antennal segments black with white scaling at base that increases laterally and slightly towards clubs; clubs black, bare tips dark brown. **Body:** both surfaces of thorax dark brown; dorsal surface of abdomen dark brown, ventral surface dark brown with some pale brown scaling. Forelegs mixture of pale and dark brown scaling, femur of mid and hindlegs black, remainder dark yellow-brown except ventral surface of tibia red-brown. **Genitalia** (Fig. 36b): uncus rounded, small posteriorly projecting point from dorsal edge; falci long and thin; vinculum thickened slightly at middle; valvae have elongate, basal, lateral bulge, long upper portion of even width that is connected by membranous tissue dorsally, and small bluntly triangular lower posterior edge; aedeagus narrow and pointed at tip, tiny cornutus at middle; pedicel long, sharply bent towards tip.

FEMALE: differs from male in the following respects: forewing length 13mm. Forewing less pointed, distal margin more convex. Ground color of

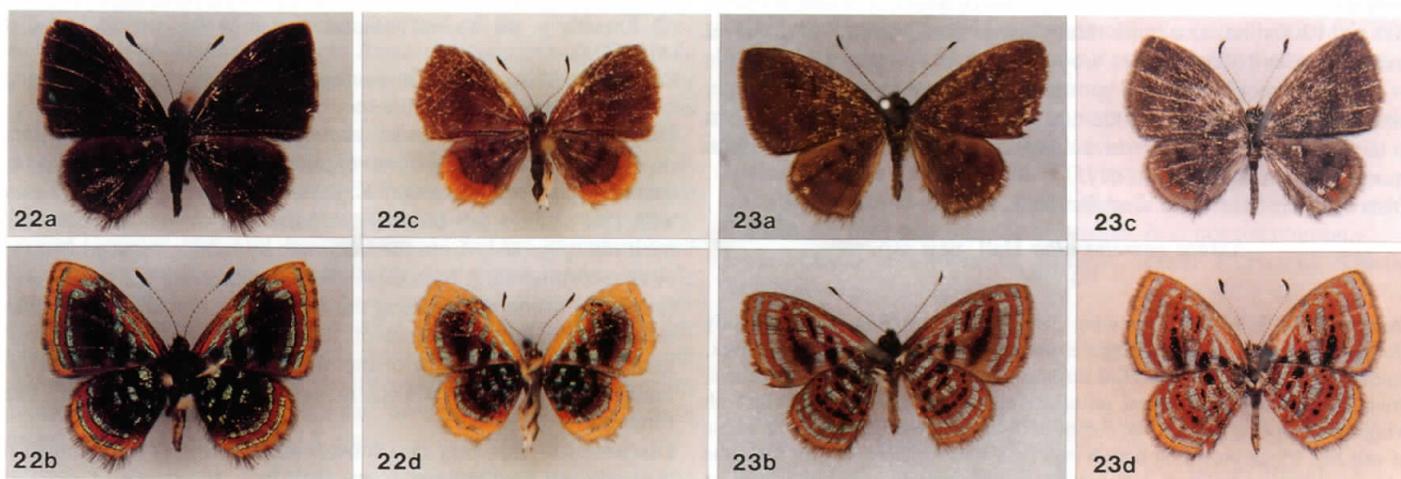


Fig. 22-23. 22. *S. lasciva*, male, Río Negro, Meta, Colombia [USNM]: a) DS; b) VS. Female, Río Negro, Meta, Colombia [USNM]: c) DS; d) VS. 23. *S. completa* Hall n. sp., holotype male, Ega, W. Brazil (Am) [BMNH]: a) DS; b) VS. Allotype female, El Capricho, E. Ecuador [JHKW]: c) DS; d) VS.

both dorsal wing surfaces slightly paler brown, more prominent darker brown basal, discal, postdiscal and submarginal markings on both wings, small white fleck in middle of cell M_1 on forewing, faint red-brown scaling in tornus of hindwing.

Types.— *Holotype male*: ECUADOR.— *Zamora-Chinchipe Prov.*: Zamora-Loja rd., nr. Sabanilla, Quebrada San Ramon, 1700m, 27 Oct 1997 (K. R. Willmott); to be deposited in the BMNH.

Allotype female: ECUADOR.— same data as HT; in the coll. of JHKW.

Etymology.— This taxon is named after its capture location.

Diagnosis.— I deliberated for a long time over the correct systematic placement of this taxon and my decision was influenced by the existence of the taxon *S. gamelia alba* ssp. n. (described below) from the base of the eastern Andes. While at first I had cursorily considered *S. estrada sabanilla* ssp. n. and *S. gamelia alba* conspecific, closer examination revealed that several differences existed between them and also united each to *S. estrada* and *S. gamelia* respectively, the only similar species, occurring allopatrically to the west of the Andes. The situation is confounded by the fact that in Central America, *S. estrada* and *S. gamelia*, although very similar, may be separated with relative ease while in South America *S. e. sabanilla* and *S. g. alba* are even more similar to each other. I describe *sabanilla* as a subspecies of *S. estrada* as opposed to *S. gamelia* because it shares with *S. estrada* its large size (forewing length on average 2mm larger than *S. gamelia*), compact and pointed wing shape (the wing shape of *S. gamelia* is more elongate with a less pointed forewing), predominantly brown leg and frons coloration (they are typically yellow in *S. gamelia*), setose eyes (they are bare in *S. gamelia*), dark yellow-orange margin on both ventral wing surfaces (this tends to be yellow in *S. gamelia*), general tendency to have a straight, inwardly diagonal postdiscal line of black spots on the ventral forewing (this tends to become vertical or even curve in the opposite direction in cell 1A+2A in *S. gamelia*) and a line through the middle of the discal cell on the ventral hindwing that kinks slightly inwards below the discal cell (this tends to be straight in *S. gamelia*), slightly broken postmedial silver line on the ventral hindwing (this is complete in *S. gamelia*), and its presence in lower montane forest habitat (*S. gamelia* does not occur quite so high and also occurs lower, near sea-level).

Sarota estrada sabanilla differs from the nominate on the ventral surface by having less grainy brown background color on both wings, a complete proximally directed silver streak in cell M_2 of the forewing that joins the perpendicular postdiscal silver line, slightly larger silver streaks in cells Cu_2 and Cu_1 of the forewing, no black spot in cell R_3 of the forewing or distal to the postmedial silver streaks and no trace



Fig. 24. *S. chloropunctata* Hall n. sp., holotype male, nr. Lita, W. Ecuador [JHKW]: a) DS; b) VS.

of postmedial silver in cell 1A+2A of the forewing, there instead being a cream rectangle. Despite these differences, I believe the number of fundamental similarities between *sabanilla* and *S. estrada* warrant placement of the former as a subspecies of the latter instead of as a full species.

Discussion.— This very rare subspecies is currently only known from lower montane forest in southern Ecuador but it surely has a broader altitudinal and geographical distribution that probably extends at least from east Colombia to east Peru. The male holotype was perching at the top of a 10m tall tree in the middle of a stream at 1010h, on top of a leaf with its wings shut. The allotype was encountered flying nearby along a wide path at the forest edge at 0800h.

Sarota gamelia Godman & Salvin, 1886

Fig. 17a-f; 37

Sarota gamelia Godman & Salvin, 1886, *Biol. Cent.-Amer., Lepid. Rhop.* 1:436. TL: Bugaba, Panama. Holotype male BMNH [Examined].

Identification and taxonomy: Average FW length 12mm.

The nominate Central American subspecies of *S. gamelia* is distinguished from the sympatric *S. estrada estrada* as outlined in that species account. *S. gamelia* exhibits quite some wing pattern variation, the extent of which has even led one author (DeVries, 1997) to express the belief that two species are involved. However, although two slightly different phenotypes do exist, they result from altitudinally clinal variation. Above about 1000m, the frons and legs begin to have more brown setae, the margin of both ventral wing surfaces becomes a darker yellow-orange, all orange-brown ventral markings become slightly darker and the silver tends to be more bluish than greenish but there are no pattern element differences. A similar but more extreme phenomenon occurs in *S. myrtea* (see that species account).

Biology: This relatively common species is typically found between 500 and 1200m but also more rarely occurs nearly as low as sea-level and as high as 1600m. Males are encountered as solitary individuals or more commonly in small groups perching along the forest edge, often on an isolated tree, in the early to mid morning and then again in the late afternoon. The rarer, solitary females are encountered more sporadically throughout the day.

Distribution: Mexico to west Ecuador.

Sarota gamelia alba Hall, new ssp.

Fig. 17e,f

Description.— FEMALE: forewing length 13mm. Wing shape slightly elongate; forewing costal margin convex at base, distal margin convex; hindwing pointed at tornus. **Dorsal surface:** ground color of both wings brown; faint, darker brown basal, discal, postdiscal and submarginal markings on both wings; white spot at upper distal corner of discal cell, white fleck towards base of cell M_1 ; fringe brown on both wings (and both surfaces) except for some white scaling at margin of cells 1A+2A and M_1 on forewing and 1A+2A to Cu_1 and M_2 on hindwing. **Ventral surface:** forewing ground color brown; black line surrounded by orange-brown and then silver at discal cell end, uneven yellow triangle at costa near discal cell end becomes white at tip, "U"-shaped mark extends from vein 1A+2A to costal edge of discal cell and back, black below discal cell, orange-brown within discal cell with internal black in outer arm, remainder of discal cell silver, orange-brown surrounds base of costal edge of discal cell, thick line of silver at base of costa; three white blocks in cell 1A+2A, one thin rectangle towards base inbetween "U" shape, one larger rectangle below discal cell end, one larger square towards tornus; postdiscal line of black spots surrounded by orange-brown above vein Cu_2 extends diagonally inwards from cell M_3 to vein Cu_2 , then curves slightly outwards in cell 1A+2A, broadly elongate in cell M_3 , a small black spot surrounded by orange-brown toward base of cell M_1 , long silver streak in cell R_3 ; series of postmedial, proximally directed silver streaks which align at distal edge set in orange-brown consists of a long one in cell M_1 that is white towards base, a very long one in cell M_2 that joins proximally to postdiscal silver, a tiny round spot in cell M_3 , and two long ones in cells Cu_2 and Cu_1 ; remainder of costa and submargin orange-brown, margin yellow, submarginal silver line extends from apex to vein 1A+2A, very thin line of black scaling distally. Hindwing ground color brown with a scattering of pale brown scales; orange-brown band at base lined distally and proximally by silver; postdiscal band of black spots surrounded by orange-brown extends from costa, curving outwards then inwards to vein Cu_2 , kinking outwards in cell 1A+2A, then continuing to anal margin, some disjunct silver proximally at costa, discal cell end and towards anal margin; black mark surrounded by orange-brown at discal cell end with silver proximally, two similarly marked spots below discal cell end in cells 1A+2A and 3A, a similarly marked band extends from costal margin to vein 1A+2A through middle of discal cell; postmedial silver line with very thin layer of black scaling distally that thickens in cell Cu_2 , curves sharply inwards at costal and anal margins; orange-brown at submargin extends along anal and costal margins, and has a silver line distally below vein M_1 that also has a very thin line of black scaling distally; margin below vein M_1 yellow; tuft of black hairs at tornus and increasingly smaller ones at other distal vein endings. **Head:** labial palpi yellow with some brown scales. Eyes brown and bare, margins with predominantly yellow scaling. Frons yellow with some brown scales. Antennae missing. **Body:** both surfaces of thorax dark brown; dorsal surface of abdomen dark brown, ventral surface cream. All legs yellow with some brown scaling, tibia black banded.

MALE: differs from female in the following respects: forewing length 11.5mm. Forewing more pointed, distal margin less convex; hindwing more pointed at apex and tornus. Dorsal ground color of both wings darker, pattern elements fainter. Postdiscal line of black spots on ventral forewing reduced, those in cells M_1 and M_3 absent. Postdiscal line of black spots surrounded by orange-brown absent, except for trace at anal margin, and replaced by grainy background color, postmedial silver line thickens at anal margin. Antennal segments black with white scaling at base that increases laterally and slightly towards clubs; clubs black, bare tips dark brown. Legs more brightly yellow colored, some white hairs on tibia of mid and hindlegs.

Types.— *Holotype female:* PERU.— *Puno:* Yahuarimayo, 1200ft, Feb/Mar 1912 (H. & C. Watkins); in the BMNH.

Allotype male: PERU.— *Madre de Dios:* Boca Río La Torre, 300m, 16 Feb 1988 (G. Lamas); in the Museo Nacional Mayor de San Marcos, Lima, Peru (MNMSM).

Etymology.— The name of this subspecies refers to the conspicuous white marks at the anal margin of the ventral forewing.

Diagnosis.— See the diagnosis section under *S. estrada sabanilla* ssp. n. (described above) for an explanation of why *alba* ssp. n. is described as a subspecies of *S. gamelia* and what characters unite it with that species (all those in parentheses). *S. gamelia alba* differs most conspicuously from the nominate by having reduced (forewing) or absent (hindwing) postdiscal black markings on the ventral surface (in males), white marks along the costa of the dorsal forewing that are reflected in similar positions on the ventral surface, prominent white marks at the anal margin of the ventral forewing, and longer proximally directed silver streaks in cells Cu_2 and Cu_1 of the ventral forewing.

Discussion.— This very rare subspecies is currently only known from the male and female types from south Peru, but it should occur along the length of the base of the eastern Andes. Nothing is known about its biology.

Sarota acantus (Stoll, 1782)

Fig. 18a-e; 38

Papilio acantus Stoll, 1782, in Cramer, *Uitl. Kapellen* 4 (29):179, pl. 380, fig. K, L. TL: Bartica, Guyana. Neotype BMNH [Designated] (Fig. 18b,c).

Identification and taxonomy: Average FW length 10mm.

Although this species was illustrated in the original description (Cramer, 1782) with reasonable accuracy, the lack of any extant type specimens has meant that it has always been misidentified in the literature and since there are two confusingly similar congeners, one that similarly lacks a type and another that was described very recently, in the interests of nomenclatural stability, I designate a neotype. The following points explicitly address the qualifying conditions for a valid neotype designation:

1) The two most likely repositories for the types of species described in or by Cramer (1775-82) are the Natural History Museum, London, England (BMNH) and the Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands (RNH). I have thoroughly searched the BMNH (as well as the MNHN and the ZMHU) and found no specimen bearing a type label or any other label to indicate that it might be an otherwise unlabelled type. Gerardo Lamas (pers. comm.) has similarly searched the BMNH and the RNH without finding any potential type specimens.

2) No specimens could be located in the BMNH from the original type locality of Surinam, so a specimen was selected from as near to it as possible that was in good enough condition to clearly allow identification. The male neotype selected (Fig. 18b,c) in the BMNH bears the following three labels: "Bartica, Br. Guiana", "Rothschild Bequest, B. M. 1939-1." and "S. acantus, Neotype, det. J. Hall".

3) As evidence that the neotype is consistent with what is known of the former name-bearing type, I figure the original type illustration (Fig. 18a).

4) *S. acantus* belongs to a trio of very similar species but it is the most readily identified of the three. The male of *S. acantus* differs from those of *S. miranda* and *S. gyas* by having yellow legs instead of black legs with white tibia (on the mid and hindlegs), and on the ventral surface by having a paler, broader yellow margin on both wings, a paler orange-brown ground color on both wings, a proximally directed silver streak in cell M_2 of the forewing that more often connects with the perpendicular postdiscal silver (it never does so in *S. gyas*), reduced postdiscal black markings on both wings, a single, large black square with a prominent, proximal silver square in the distal half of the discal cell of the hindwing instead of a thinner silver mark inbetween two smaller black marks, by lacking black shading distal to the postmedial silver line of the forewing and a small black spot between the two basal-most silver lines at the anal margin of the forewing and by typically having the silver

discal cell end marking of the forewing joined to the proximally positioned vertical silver line along the base of the discal cell (less prevalent in west Andean and west Amazonian specimens). The male genitalia of *S. acantus* differ from those of *S. miranda* and *S. gyas* by typically having a tiny posterior projection from the dorsum of the uncus instead of a slightly indented region.

The female of *S. acantus* is even more easily confused with those of *S. miranda* and *S. gyas* as the legs of the latter are more of a yellow-brown color and their ventral coloration is typically paler than that of the males. However, females may still be distinguished by the aforementioned ventral wing pattern characters; additionally, they always have an entirely brown dorsal surface whereas in *S. miranda* and *S. gyas* there are invariably red-brown markings at the distal margin of the hindwing that may also rarely extend to the forewing. The silver coloration in both sexes of *S. acantus* is also more consistently bluish than greenish when compared to *S. gyas* and *S. miranda* and the wing shape is typically more rounded, especially compared to *S. gyas*.

Biology: *S. acantus* is one of the most widespread species in the genus and occurs in primary and secondary wet forest habitats from sea-level up to 1300m. It is considerably rarer east of the Andes. Males are most frequently encountered perching in small groups in the early to mid morning along streamsides and forest edges but may be found less commonly along with females throughout much of the day along forest trails. DeVries (pers. comm.) reports *S. acantus* in Costa Rica and Panama visiting the extrafloral nectaries of *Heliocarpus* (Tiliaceae), *Inga* (Fabaceae) and *Byttneria* (Sterculiaceae) species.

S. acantus is the only species in the genus whose life history is largely known. Females oviposit around mid-day on the mosses and liverworts (Lejuniaceae) that grow as epiphylls on old leaves (DeVries 1988, 1997; DeVries *et al.*, 1994 — all as *S. gyas*). The tiny white globular sponge-like egg, which is covered with irregular ellipsoid holes and a patchy glue-like substance obviously important in substrate affixation, is laid singly. The fifth instar larva (Fig. 2) is covered in dense tufts of long downy white dorsolateral setae that project outwards in all directions and has a dorsal cluster of whitish bladder-like setae on the anterior edge of the first thoracic segment. When at rest, the caterpillar's head capsule is kept flat against the substrate and when molested by an ant its setae may be moved toward it and detached as an irritant. Pupation takes place inside rolled leaves where the long larval setae surround the pupa to form a loose cocoon (DeVries, 1997).

Distribution: Honduras to west Ecuador, Venezuela to Peru, Brazil (Amazon, Mato Grosso and southeast), Guianas, Trinidad.

Sarota miranda Brévignon, 1998

Fig. 19a-d; 39

Sarota miranda Brévignon, 1998, *Lambillionea* 98:313, fig. 45-48. TL: Lac des Américains, Matoury, French Guiana. Holotype male coll. L. & C. Brévignon, Guadeloupe; type illustration [Examined].

Identification and taxonomy: Average FW length 10mm. This recently described species has wing pattern elements that are somewhat intermediate between those of *S. acantus* and *S. gyas* but, although the variation expressed in its wing pattern sometimes makes identification very difficult with respect to *S. gyas*, I tentatively regard it as a valid species. It is amply distinguished from *S. acantus* in the previous species account but is most readily separated by having blackish or brownish male forelegs (contrary to the assertion in the original description that these are yellowish), a darker ventral ground color, additional proximal and distal black markings at the anal margin of the ventral forewing and two black marks in the discal cell of the ventral hindwing instead of one. In all these regards, *S. miranda* is the same as *S. gyas*. However, *S. miranda* typically has a more rounded wing shape than that species, more extensive black scaling distal to the postmedial silver line of the ventral forewing, slightly thicker

postmedial and submarginal silver lines on both ventral wing surfaces and always has an undivided, proximally directed silver streak in cell M_1 of the ventral forewing whereas it is usually divided in *S. gyas*; as in *S. acantus*, the proximally directed silver streak in cell M_2 of the ventral forewing in *S. miranda* is variably divided or undivided whereas it is always divided in *S. gyas*.

Biology: Brévignon and Gallard (1998) state in the original description that, in French Guiana, *S. miranda* flies at the forest edge during the late morning and into the afternoon. It is not uncommon.

Distribution: Colombia to Bolivia, Brazil (Amazon), Guianas, Trinidad.

Sarota gyas (Cramer, 1775)

Fig. 20a-e; 40

Papilio gyas Cramer, 1775, *Uitl. Kapellen* 1 (3):45, pl. 28, fig. F,G. TL: Bartica, Guyana. Neotype BMNH [Designated] (Fig. 20b,c).

Identification and taxonomy: Average FW length 10mm.

For the same reasons outlined in the account of *S. acantus*, I designate a neotype for this species. The following points explicitly address the qualifying conditions for a valid neotype designation:

- 1) See the account of *S. acantus*.
- 2) No specimens could be located in the BMNH from the original type locality of Berbices, Guyana, so a specimen was selected from as near to it as possible that was in good enough condition to clearly allow identification. The male neotype selected (Fig. 20b,c) in the BMNH bears the following three labels: "Bartica, Br. Guiana, H. S. Parish", "Joicey Bequest, Brit. Mus., 1934-120." and "S. gyas, Neotype, det. J. Hall".
- 3) As evidence that the neotype is consistent with what is known of the former name-bearing type, I figure the original type illustration (Fig. 20a). It is somewhat ambiguous whether this illustration represents the species treated in this paper as *S. gyas* or *S. miranda*, but it appears to more closely resemble the former and this position facilitates nomenclatural stability.
- 4) *S. lasciva* and *S. completa* n. sp. (described below) have different patterns of silver in the apex of the ventral forewing and *S. gyas* is most similar to *S. myrtea*, *S. acantus* and especially *S. miranda* from which it is distinguished in those species accounts.

Biology: *S. gyas* occurs not uncommonly in wet forest habitats below 700m. Males are typically encountered in small groups perching from 0730-1000h on low bushes in streamside lightgaps and along forest edges but may be more sporadically found as solitary individuals until about 1400h in forest lightgaps, along trails and ridgetops. Solitary females fly in the same microhabitats.

Distribution: Colombia to Peru, Brazil (Amazon, Mato Grosso), Guianas.

Sarota myrtea Godman & Salvin, 1886, *stat. rev.*

Fig. 21a-f; 41

Sarota myrtea Godman & Salvin, 1886, *Biol. Cent.-Amer., Lepid. Rhop.* 1:436. TL: Cubilguitz, Vera Paz, Guatemala. Holotype male BMNH [Examined] (Fig. 21a,b).

Identification and taxonomy: Average FW length 11mm.

S. myrtea was described as a full species by Godman and Salvin (1886), but inexplicably treated as a subspecies of *S. acanthoides* by Stichel (1930). Because the two taxa are sympatric at the base of the eastern Andes and they exhibit numerous wing pattern differences, including of course the lack of hindwing tails in *S. myrtea*, I officially reinstate *myrtea* as a full species (the species status accorded to it by DeVries (1997) was based on an ambiguous identification; see appendix).

S. myrtea is most similar to *S. gyas* and *S. miranda*, but differs on the ventral surface by having more brown background coloration in evidence, two equally sized, small, proximally directed silver markings in the forewing apex, typically with the paler apical yellow-orange

extending inbetween them, larger black postdiscal spots on both wings that have relatively less orange-brown surrounding them and extend to the costa on the forewing, and, possibly most diagnostically, more angular wings in the tornal area particularly on the forewing where white fringe elements in cells 1A+2A and Cu₁ accentuate the undulating distal margin that is mirrored in the submarginal silver line. Females of *S. myrtea* also do not have red-brown around the distal margin of the dorsal hindwing.

S. myrtea is the most variable species in the genus, so variable that an extreme form warrants illustration to avoid confusion (see Fig. 21e,f). Although the ventral surfaces of the figured specimens look rather different, they exhibit no fundamental pattern element differences and those superficial ones that are apparent can be explained by clinal altitudinal variation, as in *S. gamelia*. The type of *S. myrtea* (Fig. 21a,b) is representative of lower elevation populations but above about 1400m in the Andes (slightly lower in Central America), the ventral surface becomes darker, the margin of both wings becomes dark orange-brown, postdiscal markings become reduced and the grainy brown background color is even more in evidence on both wings. All manner of intermediates exist from intervening altitudes. As is typical in the genus, populations from higher altitudes also tend to have more bluish than greenish silver markings.

Biology: *S. myrtea* is a widespread and relatively common species that is typically encountered between 700 and 2000m, but it is occasionally found as low as 400m and as high as 2400m, making it the highest flying species in the genus and one of the highest flying rioidinids. Males are most frequently found perching in small groups on streamside vegetation 3-10m high in the early to mid morning from 0730-1130h, while solitary females may be found throughout much of the day. In cloudy montane forest habitats, *S. myrtea* is one of the first species to fly when the sun appears. DeVries (pers. comm.) reports *S. myrtea* in Costa Rica visiting extrafloral nectaries of *Inga* (Fabaceae) and *Byttneria* (Sterculiaceae) species.

Distribution: Mexico to west Ecuador, Venezuela to Argentina.

Sarota lasciva (Stichel, 1911), n. stat.

Fig. 22a-d; 42

Charis gyas f. *lasciva* Stichel, 1911, *Gen. Ins.* 112B:250. TL: Manaus, C. Brazil. Holotype female ZMHU [Examined].

= *Charis acantus flavicincta* Lathy, 1932, *Ann. Mag. Nat. Hist.* (10) 9:70. TL: San Ramon, C. Peru. Holotype male BMNH [Examined], n. syn.

= *Sarota flavicincta atlantica* Brévignon & Gallard, 1998, *Lambillionea* 98:313, fig. 41-44. TL: Matoury, French Guiana. Holotype male coll. of J.-Y. Gallard, Matoury, French Guiana; type illustration [Examined], n. syn.

Identification and taxonomy: Average FW length 10mm.

S. lasciva was described as a female form of *S. gyas*, but since the two taxa are widely sympatric and *S. lasciva* possesses numerous diagnostic characters, as described below, I raise it to species status. The taxon *flavicincta* was described nearly twenty years later by Lathy (1932) as a subspecies of *S. acantus*, but the type represents the male of *S. lasciva*; the taxon *atlantica*, described by Brévignon and Gallard (1998) as a subspecies of *S. flavicincta*, does not differ significantly from nominotypical populations of *S. lasciva* and it is also a synonym.

S. lasciva is a rather distinctive species because of its variably bright yellow margin on both ventral wing surfaces that extends beyond the submarginal silver line into the forewing apex of the male but also around the entire submargin of both wings and costal margin of the forewing in the female. This is in stark contrast to the dark medial areas of both wings that lack orange-brown coloration encircling the black spots (traces may be seen in some specimens), leaving a purely black and silver pattern. The reduced silver markings in the apex of the ventral forewing mean *S. lasciva* is similar only to *S. completa* n. sp. (described below), with which it is contrasted in that species account.

Biology: *S. lasciva* is one of the rarer "gyas group" species, occurring in intact wet forest habitats up to 1050m. Males perch singly or in pairs on streamside bushes or along forest edges about 3m above the ground from 0700-0800h and then more rarely in the mid to late afternoon. Females are found in forest lightgaps and along forest trails throughout the middle of the day. DeVries (pers. comm.) reports *S. lasciva* in Ecuador visiting the extrafloral nectaries of a *Machaerium* species (Fabaceae).

Distribution: Colombia to Peru, Brazil (Amazon), Guianas.

Sarota completa Hall, new sp.

Fig. 23a-d; 43

Description.— MALE: forewing length 10mm. Wing shape rounded. *Dorsal surface:* ground color of both wings dark brown; faint, darker brown basal, discal, postdiscal and submarginal markings on both wings; fringe brown on both wings (and both surfaces). *Ventral surface:* forewing ground color brown, paler at anal margin; black line at discal cell end surrounded by dark orange-brown and then silver above, distally and proximally, silver square below in cell 1A+2A, "V"-shaped mark extends from vein 1A+2A to costal edge of discal cell and back, black below discal cell, dark orange-brown within discal cell, black spot in discal portion of distal arm, remainder of discal cell including entire costal edge silver, basal half of costa orange-brown; postdiscal line of black spots surrounded by dark orange-brown above vein Cu₁ extends from vein 1A+2A curving sharply inwards at costa; thick, postmedial silver line extends continuously from vein 1A+2A to the costa, before which it curves inwards, except for narrow dark orange-brown breaks along veins M₁ and R₄₊₅; submargin dark orange-brown, margin dark yellow, thin submarginal silver line extends from apex to vein 1A+2A, very thin line of black scaling distally. Hindwing ground color brown; dark orange-brown band at base lined distally and proximally by silver contains a faint black spot at costa; postdiscal line of black spots surrounded by dark orange-brown extends in a semicircle from costa to anal margin, some disjunct silver proximally at costa, discal cell end and in cell 1A+2A; black mark surrounded by dark orange-brown at discal cell end with silver proximally, two similarly marked spots below discal cell end in cells 1A+2A and 3A join at anal margin with postdiscal line, a similarly marked band extends from vein R_s to anal margin through middle of discal cell; thick, postmedial silver line extends from near apex to near tornus; submargin dark orange-brown, margin dark yellow, thin submarginal silver line extends from apex to tornus below vein M₁, very thin line of black scaling distally. *Head:* labial palpi black. Eyes brown and bare, margins with black scaling. Frons black. Antennal segments black with white scaling at base that increases laterally and slightly towards clubs; clubs black, bare tips black. *Body:* both surfaces of thorax black; dorsal surface of abdomen black, ventral surface brown. Forelegs black, mid and hindlegs black except lower portion of tibia and tarsi cream, tips black. *Genitalia* (Fig. 43): uncus rounded, small posteriorly projecting point from distal dorsal edge; vinculum of even width; valvae have elongate, basal, lateral bulge, long upper portion of even width that is connected by membranous tissue dorsally, and bluntly triangular lower posterior edge; aedeagus narrow and pointed at tip, tiny cornutus at middle; pedicel long.

FEMALE: differs from male in the following respects: forewing length 9mm. Wing shape more rounded. Dorsal ground color of both wings paler brown; thin, broken submarginal band of dark red-brown spots on hindwing. Margins of both ventral surfaces brighter yellow. Frons and palpi pale brown. Forelegs pale brown, femur of mid and hindlegs brown, remainder pale brown, tips brown.

Types.— *Holotype male:* BRAZIL.— *Amazonas:* Ega (H. W. Bates) (diss. # 4871); in the BMNH.

Allotype female: ECUADOR.— *Napo Prov.:* Tena-Puyo rd., El Capricho, 800m, 26 Oct 1996 (K. R. Willmott); in the coll. of JHKW.

Paratypes: ECUADOR.— *Napo Prov.:* nr. Talag, Rfo Jatunyacu, Pimpilala, 600m, 14 Sept 1996, 1 ♂, 1 ♀ (K. R. Willmott); Tena-Puyo rd., Satzayacu, 700m, 13 Sept 1996, 1 ♀ (K. R. Willmott); all in the coll. of JHKW. Tena-Pano rd., 700m, 21 Sep 1987, 1 ♂ (S. S. Nicolay); in the coll. of D. Ahrenholz, St. Paul, MN. *Morona-Santiago Prov.:* nr. Gualaquiza, Bomboiza, 850m, 26 Jul 1993, 1 ♂ (J. P. W. Hall); all in the coll. of JHKW. PERU.— *Loreto:* Pebas, Nov 1906, 1 ♂ (M. de Mathan) (BMNH). 65 mi. E. of Iquitos,

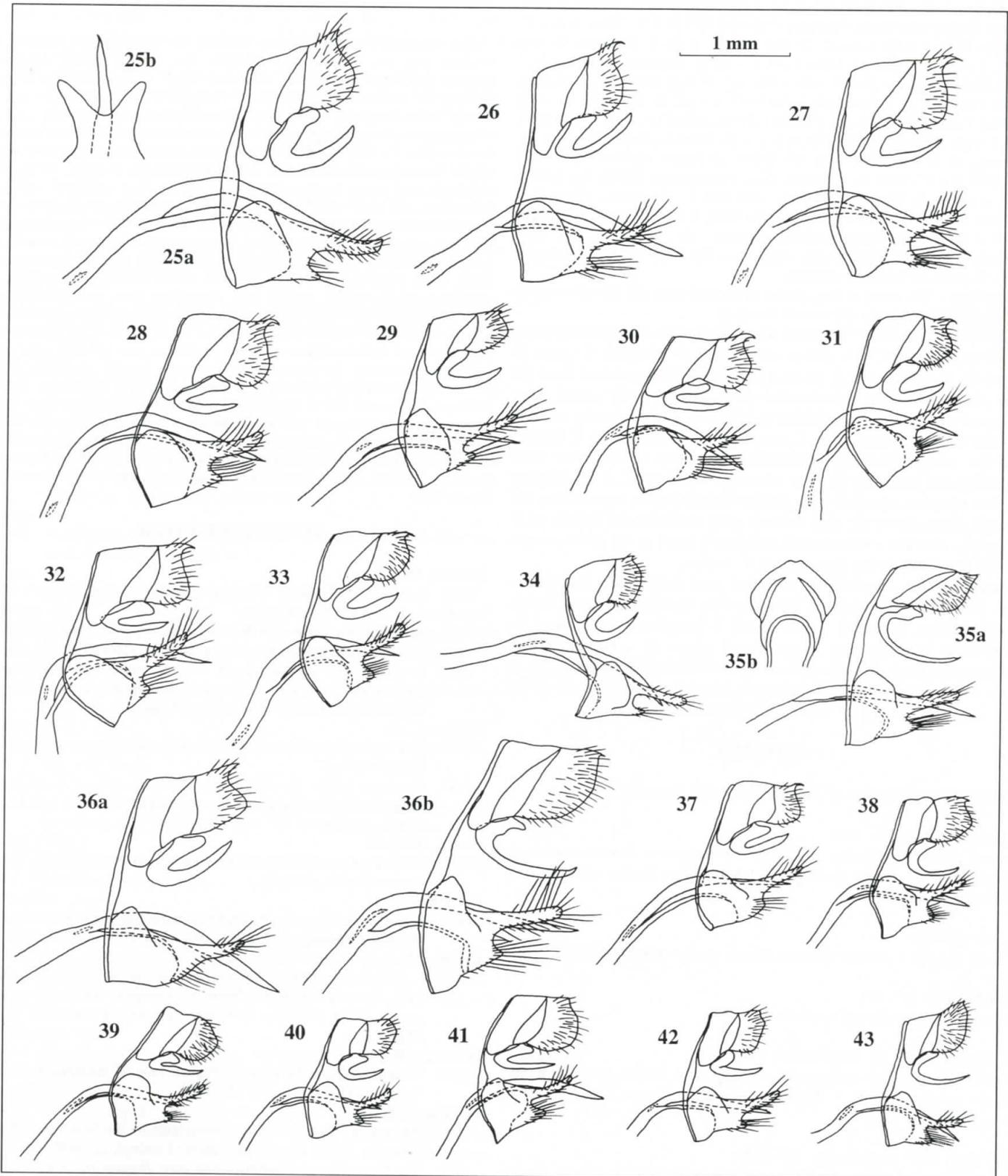


Fig. 25-43. Male genitalia: 25. *S. subtessellata*, Cerro Campana, Panama [FSCA]: a) lateral view of genitalia; b) dorsal view of valve tips. 26. *S. chrysus*, Chiapas, Mexico [AME]. 27. *S. neglecta*, Río Tanti, W. Ecuador [JHKW]. 28. *S. chochoensis* Hall n. sp., holotype [BMNH]. 29. *S. craspediodonta*, Xcan, Mexico [FSCA]. 30. *S. spicata*, Apuya, E. Ecuador [JHKW]. 31. *S. willmotti* Hall n. sp., holotype [USNM]. 32. *S. acanthoides*, Potaro river, Guyana [AME]. 33. *S. harveyi* Hall n. sp., holotype [USNM]. 34. *S. psaros psaronius*, Brazil (Ba) [ZMHU]. 35. *S. chloropunctata* Hall n. sp., holotype [JHKW]: a) lateral view of genitalia; b) dorsal view of uncus. 36. a) *S. estrada estrada*, Chiapas, Mexico [AME]; b) *S. estrada sabanilla* Hall n. ssp., holotype [JHKW]. 37. *S. gamelia*, Piña, Panama [FSCA]. 38. *S. acantus*, Piña, Panama [FSCA]. 39. *S. miranda*, Río Yuturi, E. Ecuador [JHKW]. 40. *S. gyas*, Apuya, E. Ecuador [JHKW]. 41. *S. myrtea*, Cerro Campana, Panama [FSCA]. 42. *S. lasciva*, Pimpilala, E. Ecuador [JHKW]. 43. *S. completa* Hall n. sp., holotype [BMNH].

Explorama Lodge, 6 Mar 1984, 1 ♂ (C. D. Linwood) (FSCA). *Madre de Dios*: Parque Nacional del Manu, Pakitza, 11°55'48"S 71°15'18"W, 3400m (5 ♂, 4 ♀): 27 Sept 1991, 1 ♂ (G. Lamas); 27 Sept 1991, 1 ♂ (R. K. Robbins); 28 Sept 1991, 1 ♂ (R. K. Robbins); 2 Oct 1991, 1 ♂ (R. K. Robbins); 13 Oct 1991, 1 ♂ (O. Mielke); 28 Apr 1991, 1 ♀ (D. J. Harvey); 28 Sept 1991, 1 ♀ (O. Mielke); 5 Oct 1991, 1 ♀ (I. Bohorquez); 5 Oct 1991, 1 ♀ (R. K. Robbins); all in the USNM. Tambopata Reserve, 12°50'S 69°17' W, 300m (3 ♂, 2 ♀): 25 Oct 1991, 1 ♂, 1 ♀ (O. Mielke); 26 Oct 1991, 1 ♂, 1 ♀ (O. Mielke); 26 Oct 1991, 1 ♂ (G. Lamas); all in the USNM. 50 km WSW of Puerto Maldonado, 12°45'S 69°35'W, 2 ♂ (C. Tello E.) (USNM). *Puno*: Chaquimayo, 2500ft, Apr 1912, 1 ♂, 1 ♀ (H. & C. Watkins) (BMNH). VENEZUELA.— *Amazonas*: Cerro de la Neblina, basecamp 0°50'N 66°9'W: 21 Mar 1984, 1 ♂ (R. K. Robbins); 20 Mar 1984, 1 ♀ (R. K. Robbins) (USNM). BOLIVIA.— *La Paz*: Mapiri, 1 ♂ (coll. Bethune-Baker) (BMNH). BRAZIL.— *Amazonas*: São Paulo de Olivença, Jun/Jul 1883, 3 ♂ (M. de Mathan) (BMNH).

Etymology.— The name of this species is derived from the almost complete postmedial silver line on the ventral forewing.

Diagnosis.— A number of ventral wing pattern characters clearly place *S. completa* n. sp. in a group comprising *S. acantus*, *S. gyas*, *S. miranda*, *S. myrtea* and *S. lasciva*. It is easily distinguished from the first three by having a postmedial silver line on both ventral wing surfaces which is of even thickness and without proximally directed streaks in the forewing apex. *S. completa* is most similar to *S. lasciva*, but the ventral forewing postmedial silver line of the latter thins centrally and has some broader elements in the apex, it has brighter yellow margins, a yellow apex and no orange-brown surrounding the medial black marks on both ventral wing surfaces; the female of *S. completa* also has a thinner dark red-brown band at the distal margin of the dorsal hindwing than that of *S. lasciva*.

Discussion.— *S. completa* has a typical west Amazonian distribution that stretches from southern Venezuela to Bolivia and west Brazil. Small groups of males perch about 2-5m above the ground in streamside clearings and along forest edges in association with primary and secondary forest from 0615-0745h and then later only as rarer solitary individuals. Females are found throughout much of the day in a wide variety of forest microhabitats.

APPENDIX

Errors of identification of *Sarota* in popular literature:

Seitz (1916-18: plate 113):

Sarota dematria = *Sarota neglecta*; *Sarota gyas* = *Sarota acantus* or *Sarota miranda*; *Sarota gamelia* = *Sarota myrtea*; *Sarota acanthus* [sic] = *Sarota gyas*.

Lewis (1973: p. 71):

Charis chrysus = *Sarota chrysus*; *Charis gyas* = *Sarota acantus*.

Smart (1975: p. 178):

Sarota chrysus = *Sarota neglecta*.

D'Abbrera (1994: pp. 1052-1053):

Sarota gyas = *Sarota acantus*; *Sarota acantus* = *Sarota completa* n. sp.; *Sarota craspediodonta* = *Sarota acanthoides*; *Sarota* ? sp. = *Sarota gamelia alba* n. ssp..

DeVries (1997: plate 15, pp. 198-203):

In text: *Sarota dematria* (p. 202) = *Sarota neglecta*. Plate 15: 11. *Sarota spicata* = *Sarota* sp. nr. *willmotti* n. sp. (see discussion in text); 15. and front cover *Sarota gyas* = *Sarota acantus*; 16. & 18. *Sarota acantus* = *Sarota myrtea* (# 9 is correctly identified as *Sarota myrtea*).

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