

Taxonomic Revision of Genus *Pareronia* Bingham, 1907 (Papilionoidea : Pieridae) from India with New Status for Two Taxa

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ABSTRACT

This study concentrates on the taxonomic situation of the genus *Pareronia* (Bingham, 1907) in India and recommends revisions. There are three species of genus *Pareronia* in India and all these three species are evaluated under this study using the specimens from the collections located at the Zoological Survey of India (ZSI), Kolkata. Based on the critical examination of morphological characters and well pronounced differences in the male genitalia, the status of *Pareronia valareia hippia* (Fabricius) is raised to species level and the dry season form of *Pareronia avatar* (Moore) form *tarina*, Fruhstorfer (1903), is upgraded to species level, *Pareronia tarina*.

Keywords: *Pareronia avatar*, *Pareronia ceylanica*, *Pareronia valareia hippia*, dry season form, genitalia

INTRODUCTION

Bingham (1907) erected the genus *Pareronia* Bingham with type species *P. valeria* Cramer from Java with range Indo-Malayan region. This genus is represented by 15 species which are confined to south-east Asia (Nishimura, 1996; Schroder & Treadaway, 2004). From India, three taxa have been recorded so far i.e., *Pareronia valareia hippia* (Fabricius), *P. ceylanica* (Felder), *P. avatar* (Moore) (Bingham, 1907; Evans, 1932; Talbot, 1939; Varshney and Smetacek, 2015). Varshney and Smetacek (2015) states that the genus is distributed all over India except the northern parts. However when the collections from National Zoological Collections (NZC) of ZSI, Kolkata are studied it can be seen that *Pareronia valareia hippia* (Fabricius) is also distributed in the northern regions also (Evans, 1932). In this study all the species of genus *Pareronia* were re-evaluated and their male genitalia studied in detail. Based on the distinct differences in male genitalia, the status of *Pareronia valareia hippia* (Fabricius) is raised to species level i.e. *Pareronia hippia* (Fabricius) and the dry season form of *Pareronia avatar* (Moore) form *tarina* given by Fruhstorfer (1903) is upgraded to species level, *Pareronia tarina* (Fruhstorfer).

MATERIAL AND METHODS

To study taxonomically, the species belonging to genus *Pareronia* preserved in the National Museum of Lepidoptera, Zoological Survey of India, Kolkata, West Bengal were examined and identified by consulting the fauna, keys and catalogues (Evans, 1932; Talbot, 1939; Kehimkar, 2008; Varshney and Smetacek, 2015). The adult images both from the dorsal and ventral sides were taken with a digital camera (Nikon digital camera 18-105 mm). The genitalia dissections were performed by adopting the method proposed by Robinson (1976). The terminology for the male genitalia was adopted from Klot (1970). The photography of the male external genitalia were taken by using Leica microscope equipped with a photographic unit.

Abbreviations: Sc = Subcosta vein; R1 = Radius vein 1; R2 = Radius vein 2; R3 = Radius vein 3; R4+5 = Radius vein 4+5; Rs = Radial sector; M1 = Median vein 1; M2 = Median vein 2; M3 = Median vein 3; Cu1 = Cubitus vein1; Cu2 = Cubitus vein 2; 1A+2A = Anal vein 1+2; 3A = Anal vein 3; AED = Aedeagus; TG = Tegumen; UN = Uncus; VLV = Valva; VIN = Vinculum; SA = Saccus; DU.EJ = Ejaculatory duct; HRP = Harpe; VES = Vesica.

RESULTS AND DISCUSSION

Genus *Pareronia* Bingham, 1907

Common name: Wanderers

Bingham, 1907; Fauna Brit. Ind., Butts 2:276.

Valeria, Winhard, 2000, Butterflies of the World 10:6.

Pareronia, Vane-Wright & de Jong, 2003; Zool. Verh. Leiden 343: 102.

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Type species: *Papilio valeria* Cramer, 1776

Cramer, 1776; Uittl. Kapellen 1(8): 133.

Diagnosis: Forewing veins M1 and R5 originate from a point; discocellular veins between M1-M2 angled, discocellular veins between M2-M3 straight; vein R3 present; in male genitalia uncus undivided, down-curved, valve triangular with apex narrow, aedeagus slender, vesica antriodorsad.

Distribution: Borneo, China, Hainan, India, Java, Lombok, Moluccas, Myanmar, New Guinea, Peninsular Malaya, Philippines, Singapore, Sri Lanka, Sumatra.

Key to species of the genus Genus *Pareronia* Bingham

- 1) Upperside with narrow black marginal borders. Male genitalia with costa convex, apex of valva finger like.....2
 - Upperside with broad black marginal borders. Male genitalia with costa straighter, bears pilose ridge near middle, apex of valve narrow but without finger like process.....3
- 2) Apex widely black, termen marginal black boarder broader, broadly bordered the veins. Male genitalia with uncus in dorsal view Y-shaped, median arm longer than lateral arms.....*P. avatar* (Moore)
 - Apex narrowly black, termen marginal black border narrow, narrowly bordered the veins. Male genitalia with uncus in dorsal view Y-shaped, median arm almost as long as lateral arms.....*P. tarina* (Fruhstorfer)
- 3) Forewing black border dorsally without marginal spots. Male genitalia with costa raised to a broad ridge with sparse setae.....*P. ceylanica* (Felder)
 - Forewing black border dorsally with marginal spots. Male genitalia with costa straight, in middle raised to form a dome-shaped ridge hirsute with dense setae.....*P. hippia* (Fabricius)

***Pareronia avatar* (Moore, 1858) (Plate 1, 2)**

Common name: Pale Wanderer

Eronia avatar Moore, 1858; Cat. Lep. Ins. Mus. East India Coy 1: 161.

Pareronia avatar, Bingham, 1907; Fauna Brit. Ind. Butts. 2: 277.

Pareronia avatar avatar, Evans, 1932 ; Ident. Indian Butts: 84.

Adult (Male): Wings dorsally pale bluish in colour; forewing costa dorsally black, apex widely black; termen blackish inwardly dentate, broadly bordered the veins near margin; the black margin thin on the tornus; veins light black; ventral surface silver-blue; veins well marked, brownish black. Hindwing dorsal surface with thin black margin, light black veins; ventral side silver blue, veins conspicuous, brownish black.

Wingspan: 60-95 mm

Male Genitalia: Uncus narrow, long, with sharply down-curved tip, in dorsal view Y-shaped, median (median) arm longer than lateral arms, inner margins of the lateral arms more sclerotized, arc-shaped; tegumen broad at base, narrow posteriorly, in dorsal view two narrow, pointed projections widely apart, arising from the posterior part of tegumen, pressed against the lateral sides, reaches up to middle of the tegumen; vinculum almost straight, slightly curved, broad towards tegumen; saccus spatula-shaped, smaller than tegumen, appendices angulares small, slightly broad towards valva, narrow towards tegumen; juxta u-shaped; valva oblique in orientation, protrudes beyond uncus, costa arch shaped, apex of the valve narrow, finger like, moderate in length, curved upwards to form acute pointed tip, sides and apex of valve setose; aedeagus short, robust, slightly curved, vesica anteriodorsad, subzonal area short, slightly broader than suprazone, coecum absent, ductus ejaculatorius enters porterioidorsal.

Female Genitalia: Not studied.

Material examined: ZSI, Kolkata, National Zoological Collections: 1♂, 1860, Darjeeling; 1♂, 15.10.1880, Sikkim; 3♂♂, 22.88.1883, 5♂♂, 3♀♀ (without abdomen), Sikkim; 5♂♂, Sikkim.

Distribution India: Arunachal Pradesh, Mizoram, Nagaland, Sikkim, North East India.

Elsewhere: Nepal, Thailand, Laos, Myanmar

Remarks: Bingham (1907) described the species *avatar* Moore under the genus *Pareronia* wherein he considered species *paravatar* as a variety of *P. avatar*. Fruhstorfer (1910) and Evans (1932) considered *paravatar* Bingham as the subspecies of *P. avatar* and Talbot (1939) also considered *paravatar* as the subspecies of *avatar* but under the genus *Valeria* Horsfield. DÁbrera (1982) and Pinratana (1983) illustrated *paravatar* and *avatar* as an independent species. Nishimura (1996) also considered *P. avatar* and *P. paravatar* as two independent species on the basis of the male genital organ. The same nomenclature *Pareronia avatar* is followed here.

***Pareronia tarina* (Fruhstorfer, 1903) st. nov.** (Plate 3)

Nepheronia avatar f. *tarina* Fruhstorfer, 1903, Berl. ent. Zs. 48 (1/2):101.

Adult (Male): Wings dorsal side pale bluish in colour; forewing dorsal surface costa narrowly black, apex black; marginal black border narrowly bordered the veins; black margin narrow on the tornus; veins light black; ventral surface silver-blue, veins brownish-green. Hindwing dorsal surface with thin black marginal border; ventral side bluish-white with yellow tinge, veins brownish yellow.

Wingspan: 60-70mm

Male Genitalia: Uncus narrow, thicker, moderate in length, downcurved, in dorsal view Y-shaped, median arm almost as long as lateral arms, proximal inner margins of the lateral arms more sclerotized; tegumen broad at base, narrow posteriorly, dorsally two narrow, widely separated pointed processes, arising from the posterior part of tegumen, reaches up to middle of the tegumen; vinculum almost straight,

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slightly curved, broad towards tegumen; saccus spatula-shaped, narrow, appendices angulares short, broad near valva, narrow towards tegumen; juxta u-shaped; valva oblique in orientation, protrudes beyond uncus, costa strongly convex, apex of the valve narrow, long, finger like, curved upwardly to form pointed tip, margins of valve setosed; aedeagus small, robust, curved, vesica anteriodorsad, subzonal area short, slightly broader than suprazone, coecum absent, ductus ejaculatorious enters posteriodorsad.

Female Genitalia: Not studied.

Material Examined: ZSI, Kolkata, National Zoological Collections: Sikkim; 1♂, Naga hills; 2♂♂, 1♂, 10.03.1969, Teju, (150m), Lohit (Coll. S. K. Tandon).

Distribution India: Sikkim, Nagaland, Arunachal Pradesh

Elsewhere: North Myanmar

Remarks: Fruhstorfer (1903) proposed a new name *tarina* for dry season form from Sikkim of *Pareronia avatar*, stating that "this dry season differs so much from avatar typical, that I want to give her a name *tarina*, as which suggests and almost gives the impression of a special kind". He differentiates the form *tarina* from typical avatar by small size, only very narrow black border on forewing and the absence of the black marginal margin of the hindwing. Evans (1932) synonymized *tarina* under *avatar* though he considered dry and wet season forms of *avatar*. Talbot (1939) again gave the nomenclature *tarina* for dry season form. In this study, two males from Sikkim and Darjeeling of typical avatar and two males from Lohit, Teju (Arunachal pradeh) and Sikkim of Dry Season form of *avatar* were dissected from the collections housed in National Zoological Collections (NZC) from Kolkata. Their male genital organs are studied in detail. In *P. avatar* the uncus from dorsal view is Y-shaped with median arm longer than lateral arms whereas in case of *P. tarina* the uncus from dorsal view is Y-shaped but the median arm is almost as long as lateral arms. The apical process of valve is longer and stout in *P. tarina* whereas it is shorter and weakly sclerotised in *P. avatar*. The saccus is slightly small and broad in case of *P. avatar*. In addition to these characters, the adult males also differ in wing maculation. The black markings on the dorsal side of *P. avatar* are broader than in *P. tarina*. In latter, the ventral side is bluish-white with yellow tinge and veins brownish yellow whereas in case of *P. avatar* the ventral side is silver blue and veins are brownish black.

In view of above strong differences, the form *tarina* is well separated from species avatar and hence raised to species level i.e. *Pareronia tarina*.

***Pareronia ceylanica* (Felder, 1865)**

Common name: Dark Wanderer

Eronia ceylanica, Felder, 1865; Reise Fregatte Novara, Bd 2 (Abth. 2) (2): 191.

Nepheronia fraterna, Moore, (1881); Lepid. Ceylon 1 (4):139.

Nepheronia spiculifera, Moore, (1881); Lepid. Ceylon 1 (4):139.

Pareronia ceylanica ceylanica, Evans, 1932; Ident. Indian Butts: 84.

***Pareronia ceylanica ceylanica* (Felder, 1865) (Plate 4)**

Eronia ceylanica, Felder, 1865; Reise Fregatte Novara, Bd 2 (Abth. 2) (2): 191.

Adult (Male): Forewing dorsally dark blue with broad black borders, the latter generally unspotted, costa thick black, apex and termen thick, broadly black, all veins prominently black; ventral surface bluish-silver with dark brownish veins. Hindwing dorsal surface dark blue with thick broad black marginal border; ventral surface bluish-silver with thick brownish veins.

Wingspan: 65-80 mm

Male Genitalia: Uncus Y-shaped dorsally with median arm as much long as the two lateral arms of Y, in lateral view median arm narrow, arched, blunt distal tip; tegumen broad, somewhat triangular, sclerotized, longer than uncus, somewhat rectangular from dorsal view, in dorsal view two narrow, pointed projections arising from the posterior part more inclined towards lateral sides, reaches up to middle of the tegumen; vinculum broad, straight; saccus rounded distally, smaller than tegumen; juxta u-shaped; valva triangular in shape, broad proximally, narrow distally with short, upturned blunt apical process, costa convex in the middle, bears broad ridge with sparse setae, valve pilose; aedeagus small, robust, slightly curved, subzone smaller than suprazone, ductus ejaculatorius entering dorso-caudally; apex of aedeagus with broad antero-dorsal vesica.

Material examined: ZSI, Kolkata, National Zoological Collections: 1♂, 18.09.1880, 2♂♂, 1♀, 27.09.1880, Calicut; 2♂♂, 10.1885, 2♂♂, 09.1886, 1♂, 10.1886, Kanara; 2♂♂, 05.09.1915, Coorg; 1♂, 1♀, Travancore; 2♂♂, Malabar.

Distribution India: South India (Kerala, Maharashtra, Goa, Karnataka, Tamil Nadu).

Elsewhere: Sri Lanka.

Remarks: The species *Pareronia ceylanica* (Felder) is endemic to South India and Sri Lanka and is represented by two subspecies i.e. *P. c. ceylanica* and *P. c. naraka* (Moore). The former subspecies is distributed in South India and Sri Lanka where as *P. c. naraka* is confined to Andaman Islands. The material has been examined from NZC, Kolkata and its male genitalia is described and illustrated for the first time.

***Pareronia hippia* (Fabricius, 1787) n. stat. (Plate 5, 6)**

Common name: Common Wanderer

Papilio hippia Fabricius, 1787; Mantissa Insectorum 2: 55.

Danais anais Lesson, 1837; in Bougainville, Voyage Thetis, 2: 343.

Eronia gaea Felder, 1865; Reise Fregatte Novara, Bd 2 (Abth. 2) (2): 190.

Nepheronia valeria persides Fruhstorfer, 1903; Berl. ent. Zs. 48 (1/2): 98.

Pareronia valeria persides Fruhstorfer, 1910; in Seitz, Gross-Schmett. Erde 9: 178.

Adult (Male): Forewing dorsal side dark blue, veins well marked with black, costa thick dark black, apex and margin thick black, marginal spots present, increase in

size towards apex; ventral surface bluish-silver, apex and termen grayish-silver, dark black veins. Hindwing dorsal surface dark blue with broad black marginal border; veins Sc+R1, RS, and M1 thick black; ventral surface bluish-silver, vein M1 thick black.

Adult (female): Wings dorsally black with blue streaks, cilia white, marginal spots prominent, forewing cell bears two bluish-white stripes, anterior stripe longer than posterior stripe, post-discal stripes of unequal lengths, two parallel stripes in area CuA2 separated by thin black line, streak in area 3 smaller, series of bluish white submarginal spots; ventral side dull blackish with dusky bluish markings, cell possess two bluish-white stripes, post-discal stripes of unequal lengths, two parallel stripes in area CuA2 separated by thin black line, streak in area 3 smaller, series of dusky bluish-white submarginal spots. Hindwing cell possess two bluish-white stripes, bar of post-discal stripes, series of bluish-white submarginal spots; ventral surface dull black, veins dark blackish-grey, cell possess two bluish-white stripes, post discal stripes of unequal lengths, series of dusky bluish rounded submarginal spots.

Wingspan: 65-80mm

Male genitalia: Uncus Y-shaped dorsally with median arm much longer than the two lateral arms of Y, in lateral view median arm is down curved, tube-like with blunt apex; tegumen broad anteriorly, gradually narrow towards posterior, longer than uncus, in dorsal view two narrow, pointed, spine-like projections arising from the posterior part, more inclined towards centre, reaches up to the middle of the tegumen; vinculum broad, sclerotized, slightly curved towards saccus; the latter flattened, broadly rounded distally; juxta u-shaped with curved arms; valva triangular in shape, broad proximally, narrow distally, with apical process, the latter very short with blunt tip, costa straight, in middle raised to form a dome-shaped ridge hirsute with dense setae, valve pilose sparsely; aedeagus rounded, broad, curved, subzone smaller than suprazone, suprazone curved upwards, coecum absent, ductus ejaculatorious enters caudally, apex of aedeagus of same width with antero-dorsal wide vesica.

Female genitalia: Corpus bursae large, somewhat oval in shape, wall of corpus bursae minutely setose; signum v-shapes, arms narrow, strongly divergent, studded with spines, middle constriction protrudes upwardly with pointed tip, well sclerotized; appendix bursae rounded, smaller than corpus bursae, well separated from corpus bursae; ductus bursae slender, moderately long, well sclerotised at base; papilla analis sclerotized and setosed; posterior apophysis thick, well sclerotized, blunt tips, almost as long as the length of anterior apophysis; anterior apophysis slightly curved upwardly, blunt tips.

Material examined: ZSI, Kolkata, National Zoological Collections: 2♂♂, 2♀♀, 07.11.1867, Lucknow (Coll. Jerdon); 3♂♂, 3♀♀; 1♂ 07.08.1879, Calcutta, (Coll. de Niceville); 1♀, 27.07.1880, Barrackpore; 1♂, 10.1882, Poona; 1♀, 06.12.1882, Khurda; 2♂♂, Malabar; Central India; 1♀, 04.11.1884, Orissa; 07.11.1884, 1♂, 1♀, N.W Himalaya; 1♂, 23.08.1885, Bangalore; 1♂, 26.03.1886, 1♂, 1♂, 1♀, 12.1896, Calcutta; 1♀, 08.1886, Bombay; 1♂, 08.04, Khandalla; Masuri, (Coll. Jerdon); 1♂, Rurki, (Coll. Jerdon); 1♀, North India; 1♀, 03.1906, Jabalpur; 1♂, 1♂ 19.09.1964, Calcutta, (H. Ghosh); 2♂♂, 18.11.1965, Chandanagar, Hooghly, West Bengal, (P.K Maiti); 1♂ 20.10.1998, East Godavari, Andhra Pradesh, (Coll. Chakraborty); 1♂, 12.12.1999 Guntimadugo black forest, Andhra Pradesh (Coll. Roy); 1♀, 30.10.2000,

Dehradun, Uttarakhand, (Mukhopadhyaya); 1♂, 20.09.2001, 1♂, 1♀, 21.09.2001, Barivali, Mumbai, Maharashtra, (P.H.Roy); 1♀, 24.02.2006, Saharanpur, Uttar Pradesh, (B. Biswas); 1♂ 18.09.2006, Prayagpur, Sultanpur, Uttar Pradesh, (Coll. P.C. Gura); 1♂, 13.12.2010, Dhalkidanga, (B. Mitra); 1♂, 03.10.2016, Madanpur, West Champaran, Bihar, (Coll. Mondal); 1♀, 06.10.2016, Hazra Tolla, West Champaran, (T.K. Mondal); 6♂♂, 5♀♀, 19.10.2017, Biahnupur, Behraich, Uttar Pradesh; 1♀, 21.11.2017, Lion Safari, Haveli, Dadra Nagar, (Coll. G.P. Mandal); 1♂, 1♀, Ganjam; 1♂, Bombay.

Distribution India: All over India except Union territories of J&K and Ladakh, Punjab and Rajasthan.

Elsewhere : South Myanmar, Sumatra, Philippines, Peninsular Malaya, Singapore, Borneo, Nias, Lombok, Bawean, Kangean, Sumbawa, Sumba, Flores, Hainan, Jawa.

Remarks: Evans, 1932 considered *hippia* Fabricius as a subspecies of *Pareronia valeria* (Cramer). Talbot, 1939 also kept the subspecies status of *hippia* under *Valeria valeria*. However while discussing the species status of *Valeria valeria*, he divided it into two groups *hippia* and *valeria* on the basis of small ventral process which he called the harpe. This is his statement: "In *hippia* group, this process (harpe) is well rounded, broad ventrally and projects beyond edge of the valve; aedeagus is strongly curved posteriorly, whereas in *valeria* group this harpe is long, narrow, lying entirely within the valve; aedeagus straight or slightly curved and anteriorly broader than *hippia* forms". He also stated only the *hippia* group is known to occur in Indian area. Varshney, 2015 also considered *hippia* as subspecies of *valeria*, which is known to occur throughout India except Jammu & Kashmir, Punjab and Rajasthan. In National Zoological Collections present at ZSI, Kolkata, the *hippia* is reported as subspecies under species *P. valeria* i.e. *Pareronia valeria hippia*.

In the present work, the male genitalia of *Pareronia hippia* has been studied and compared with the structure of male genitalia of *Pareronia valeria* as given by Klots (1931). In the male genitalia of *Pareronia hippia* valve process rounded, costa straight, whereas in figure of male genitalia given by Klots (1931), the valve process is small, within valve, costa highly arched, crescent shaped. From the strong differences in male genital characters, it is hereby inferred that the *Pareronia hippia* should be raised to species level and is distinct from *Pareronia valeria*.

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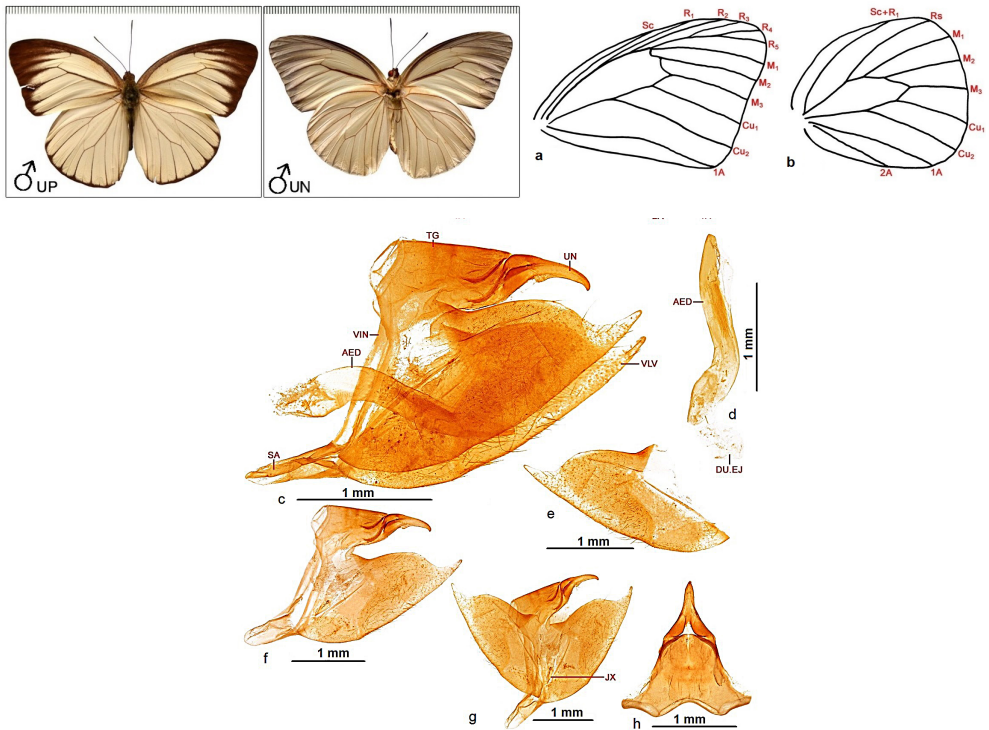


Plate 1. *Pareronia avatar* (male): a) forewing, b) hindwing, c) male genitalia, d) aedeagus, e) valva, f) male genitalia (lateral view), g) male genitalia (lateral view), h) uncus.

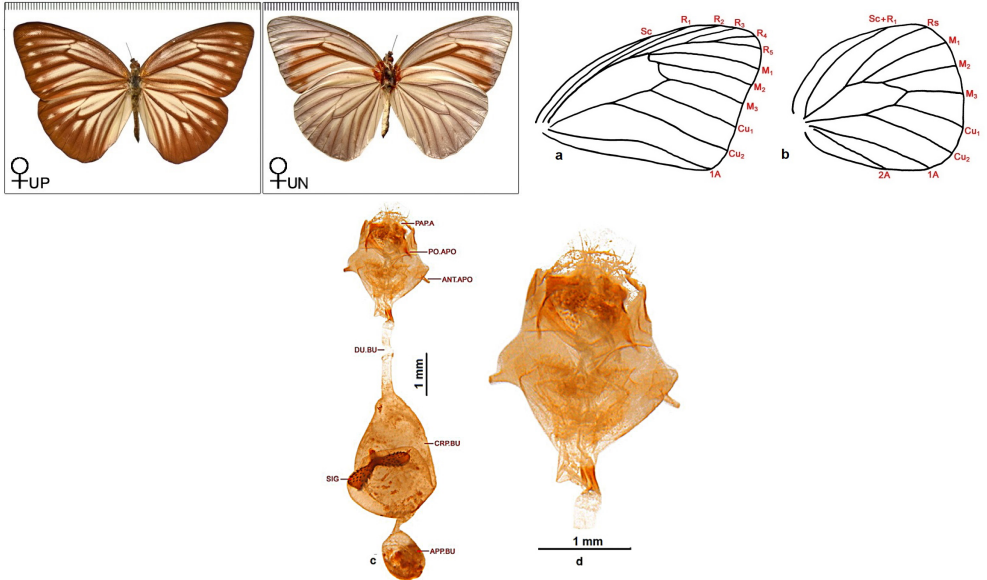


Plate 2. *Pareronia avatar* (female): a) forewing, b) hindwing, c) female genitalia, d) papilla analis.

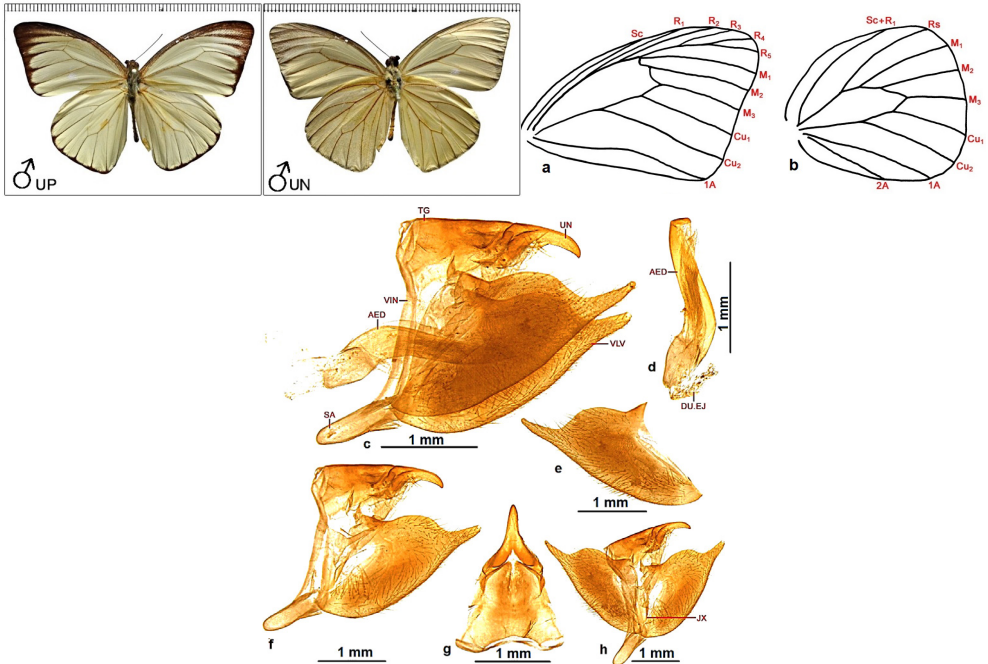


Plate 3. *Pareronia tarina* (male): a) forewing, b) hindwing, c) male genitalia, d) aedeagus, e) valva, f) male genitalia (lateral view), g) uncus, h) male genitalia (lateral view).

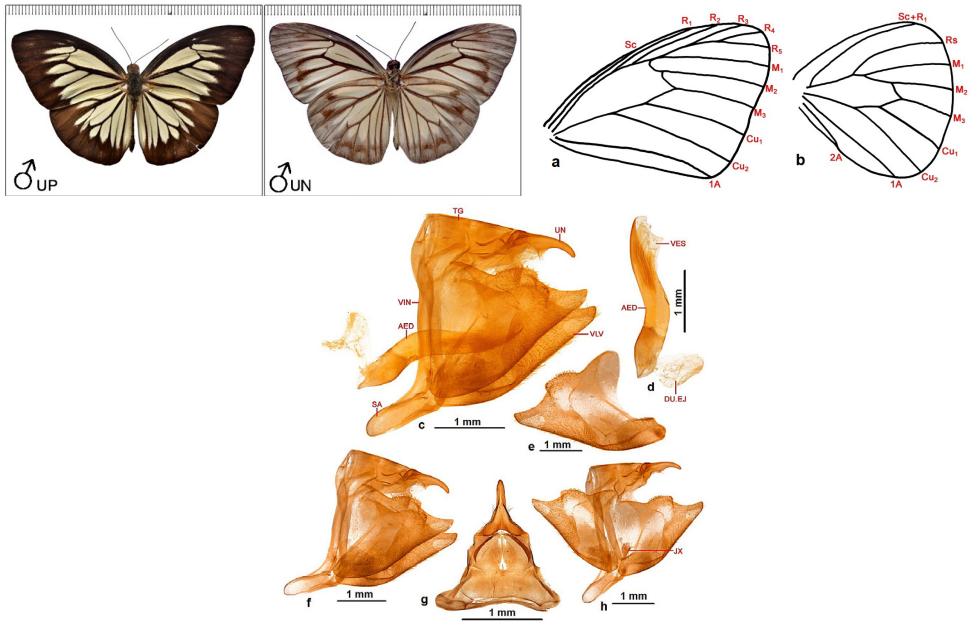
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Plate 4. *Pareronia ceylanica* (male): a) forewing, b) hindwing, c) male genitalia, d) aedeagus, e) valva, f) male genitalia (lateral view), g) uncus, h) male genitalia (lateral view).

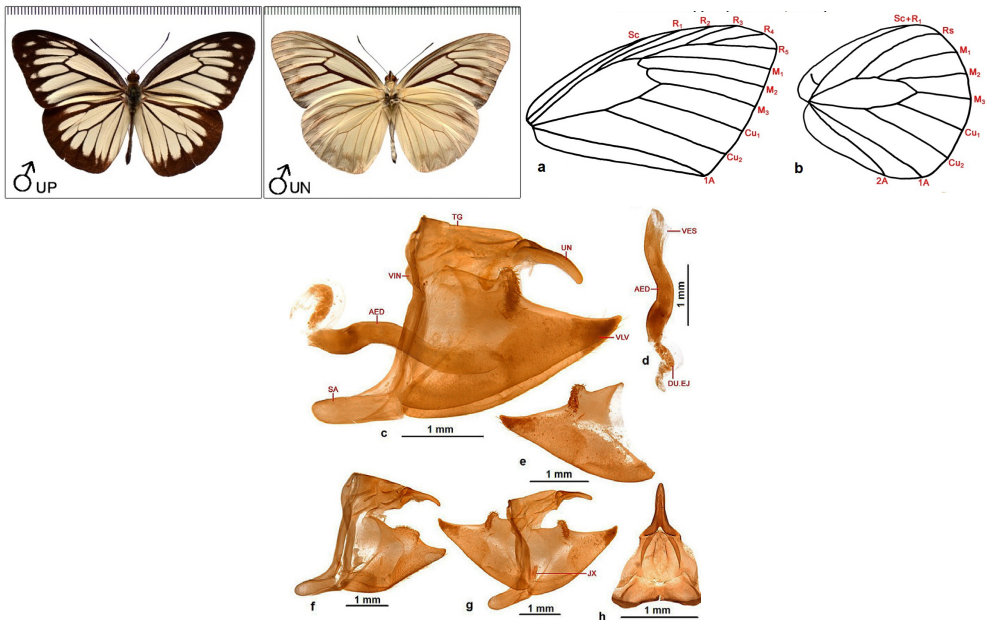


Plate 5. *Pareronia hippia* (male): a) forewing, b) hindwing, c) male genitalia, d) aedeagus, e) valva, f) male genitalia (lateral view), g) male genitalia (lateral view), h) uncus.

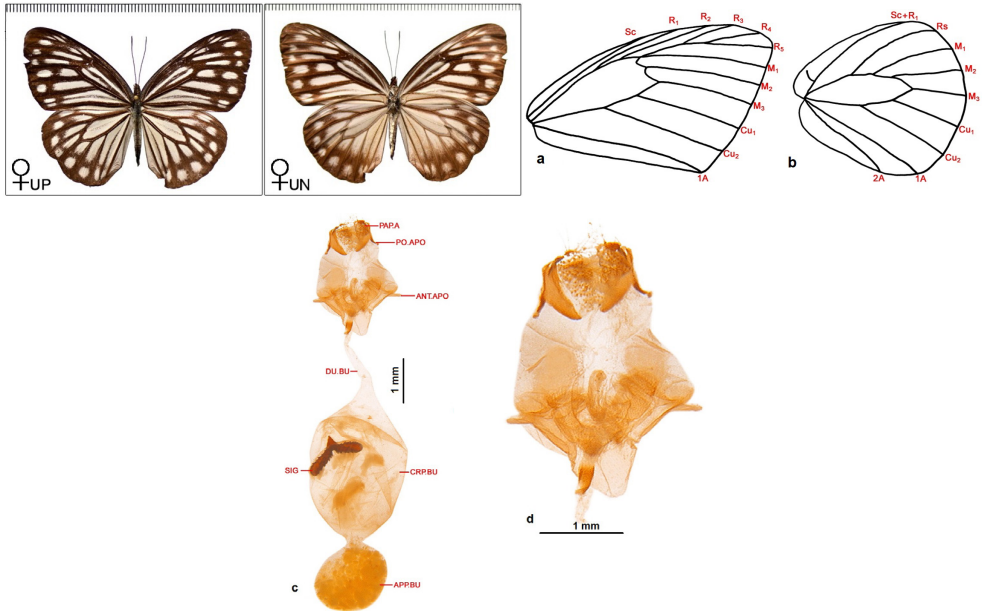


Plate 6. *Pareronia hippia* (female): a) forewing, b) hindwing, c) female genitalia, d) papilla analis.