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A New Species of *Moneuptychia* Forster (Lepidoptera: Satyrinae, Euptychiina) from the Highlands of Southeastern Brazil

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Uma Nova Espécie de *Moneuptychia* Forster (Lepidoptera: Satyrinae: Euptychiina) das Serras Altas do Sudeste do Brasil

RESUMO - Este trabalho descreve uma nova espécie de *Moneuptychia* Forster das partes altas das serras da Mantiqueira e do Espinhaço, no Sudeste do Brasil, detalha a morfologia de adultos e imaturos desta espécie, e discute a definição do gênero *Moneuptychia*.

PALAVRAS-CHAVE: Borboleta, ciclo de vida, campos de altitude, páramos

ABSTRACT - This paper describes a new species of *Moneuptychia* Forster from the summits of the Mantiqueira and Espinhaço mountain ranges in southeastern Brazil, details the morphology of adults and immatures of this species, and discusses the definition of the genus *Moneuptychia*.

KEY WORDS: Butterfly, life history, paramos

The high altitude butterfly fauna has attracted the attention of naturalists since the earliest voyages throughout the Neotropics. Many studies have discussed the biogeography and ecology of montane species, focusing on patterns of origin, evolution and diversification of this fauna (Willmott *et al.* 2001, Pyrcz & Wojtusiak 2002, Hall 2005). However, while the majority of these studies concern the Andean region, little is known for the remaining high altitude areas in South America besides species lists (e.g., Zikán & Zikán 1968, but see Vilorio & Pyrcz 1994 and Pyrcz & Fratello 2005 for the fauna from the “Tepuys”).

In the highlands of Southeastern Brazil, a series of cool-humid grass-dominated formations, (“Paramos”) occurs scattered along the mountain summits above 1600 -1800 m. These Brazilian Páramos are locally known as “Campos de Altitude”, and little is known about the ecology, biogeography and origins of these systems (Safford 1999). In the last six years, an ongoing project focusing on the diversity of Lepidoptera in São Paulo and neighboring states (see acknowledgments) uncovered about 10 undescribed species of Satyrinae, four of which from the “Campos de Altitude” (Freitas 2004).

The Satyrinae is the most diverse subfamily within the Nymphalidae, including about 2400 species of world-wide distribution (Ackery *et al.* 1999). Although the Neotropical nymphalids are relatively well known, the subfamily Satyrinae remains poorly understood. Many species await description, many genera and tribes are not monophyletic (Lamas 2004, Freitas 2004, Freitas & Peña 2006), and only recently a preliminary phylogenetic hypothesis for the

subfamily has become available (Peña *et al.* 2006). One of the last and most comprehensive attempts to organize the Neotropical species in different genera was that by Forster (1964). Forster’s classification was largely followed by Lamas (2004), which is the basis for the present study. However, Forster (1964) did not provide detailed diagnoses, making it difficult to assign new species to the genera he erected.

The present study describes a new species of *Moneuptychia* Forster, 1964 from the highlands of Southern Brazil, including early stages. The validity of this genus as presently defined is also discussed based on morphology and molecular evidence.

Study Sites and Methods

The species was studied in the field in three montane sites in SE Brazil: Pico do Itapeva, Pindamonhangaba, São Paulo State (1980-2000 m; 22°45’S, 45°30’W), Parque Estadual de Campos do Jordão, Campos do Jordão, São Paulo State (1600-1800 m; 22°41’S, 45°27’W), and Serra de São Domingos, Poços de Caldas, Minas Gerais (1650-1680 m; 21°46’S, 46°34’W) (all located in the Serra da Mantiqueira range).

Dissections were made using standard techniques. Legs, palpi, and abdomens were soaked in hot 10% KOH solution for 10 min and dissected parts were stored in glycerol. Morphological terms for genitalia largely follow Klots (1956).

Fertile eggs were obtained from two wild-captured females confined in plastic bags warmed by a 40W bulb, with leaves of

several species of bamboos and grasses. Larvae were reared in plastic containers cleaned daily, with fresh plant material provided every two or three days (following Freitas 1991). Data were recorded on behavior and development times for all stages, and dry head capsules and pupal castings were kept in small glass vials. When there was sufficient material, immatures were fixed in Kahle solution (Borror & DeLong 1971). All samples from immatures (preserved eggs and larvae, head capsules and pupal castings) are deposited at the Museu de História Natural (Unicamp) (AVLF leg.) All measurements were made using a stereomicroscope fitted with a calibrated micrometric ocular. Egg size is presented as height and diameter, and head capsule size is the distance between the most external ocelli (as in Freitas 1991).

Moneuptychia itapeva Freitas, New Species (Figs. 1-5)

Adult: Diagnosis. Eyes naked, entirely brown. Palpus length 2.0 times head height, brown with long brown hairs. Antenna (9-10 mm in length) with 32-34 segments extending to mid-costa; shaft dark brown, dorsally covered by dark brown scales, club with 11-12 segments, not conspicuously developed. Male wing venation shown in Fig. 2A. Forewing relatively short, hindwing outer margin slightly wavy, especially in males. Male foreleg covered by long brown hairs and with two elongated tarsomeres, the first as long as tibia, and the second extremely reduced; female foreleg with five tarsomeres (Fig. 2D,E). The midleg and palpus are shown in Fig. 2B,C.

Male (Figs. 1A, 5A-F). Forewing length 17-20 mm (average 18.6 mm, SD = 0.82, n = 11); hindwing length 14-16 mm (average 14.7 mm, SD = 0.65, n = 11). Body entirely dark brown. Dorsal ground color dark brown with few markings, restricted to marginal and submarginal lines in both wings; hindwing with one or two ocelli in spaces CuA1-CuA2 and CuA2-2A (smaller or absent in some individuals); these are black, surrounded by orange scales, and with white pupil (usually absent in the smaller ocelli). Ventral ground color of wings same as dorsal; forewing crossed by two dark brown lines, the first irregular and obsolescent extending from discal cell to 2A one third from base; the second wavy, extending from costa to 2A at two thirds from the wing base and delimiting a light brown distal area; a dark brown zigzag submarginal line and a brown regular marginal line extending from costa to 2A; two minute black ocelli in spaces R5-M1 and M1-M2 (larger, encircled by orange scales). Hindwing crossed by two dark brown irregular lines from costa to anal margin, the first one-third from the wing base and the second two-thirds from it; second crossing line delimiting a lighter distal area with pinkish tint; a dark brown zigzag submarginal line and a brown regular marginal line extending from costa to 2A; a series of five or six black ocelli outlined by an orange ring, and with white pupil can be found in spaces Rs-M1 (ocellus 1), M1-M2 (2), M2-M3 (3), M3-CuA1 (4), CuA1-CuA2 (5) and CuA2-2A (6); ocellus number 1 usually small and absent in some individuals (Fig. 5E, F); ocellus 3 double (as two partially fused ocelli, usually the distal smaller than the basal) and even triple in a few individuals (Fig. 5A); ocelli 2 and 5

larger than the others, and the 5th always with double white pupil. No conspicuous androconial scales observed.

Male genitalia (Fig. 3). Saccus short and triangular in ventral view; tegumen rounded with a small gnathos shaped as forked lateral structures with two pointed upright processes; appendices angulares extremely conspicuous projecting posteriorly as a long process; uncus elongated and pointed; valvae elongated, ending in a single point, internal margin with a series of small teeth; aedeagus slightly curved upwards; cornuti absent; juxta broad and weakly sclerotized.

Female (Figs. 1B, 5G-I). Forewing length 18-20 mm (average 18.7 mm; SD = 0.79, n = 11); hindwing length 14-16 mm (average 14.8 mm; SD = 0.60, n = 11). Body entirely dark brown. General color and pattern very similar to, but in general paler than that of males and with wings more rounded. Some females also present additional black ocelli in spaces M2-M3 and CuA1-CuA2 in ventral forewing (Fig. 5G).

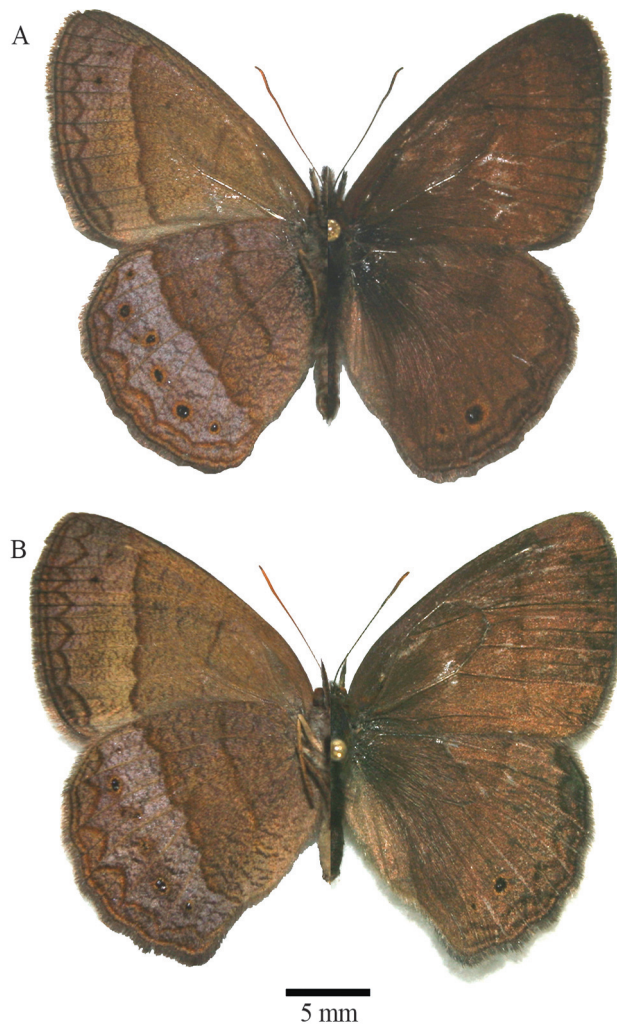


Fig. 1. Adults of *Moneuptychia itapeva*, ventral on the left, dorsal on the right. A, holotype male from Pico do Itapeva, Pindamonhangaba, São Paulo: Brazil; B, allotype female, same locality.

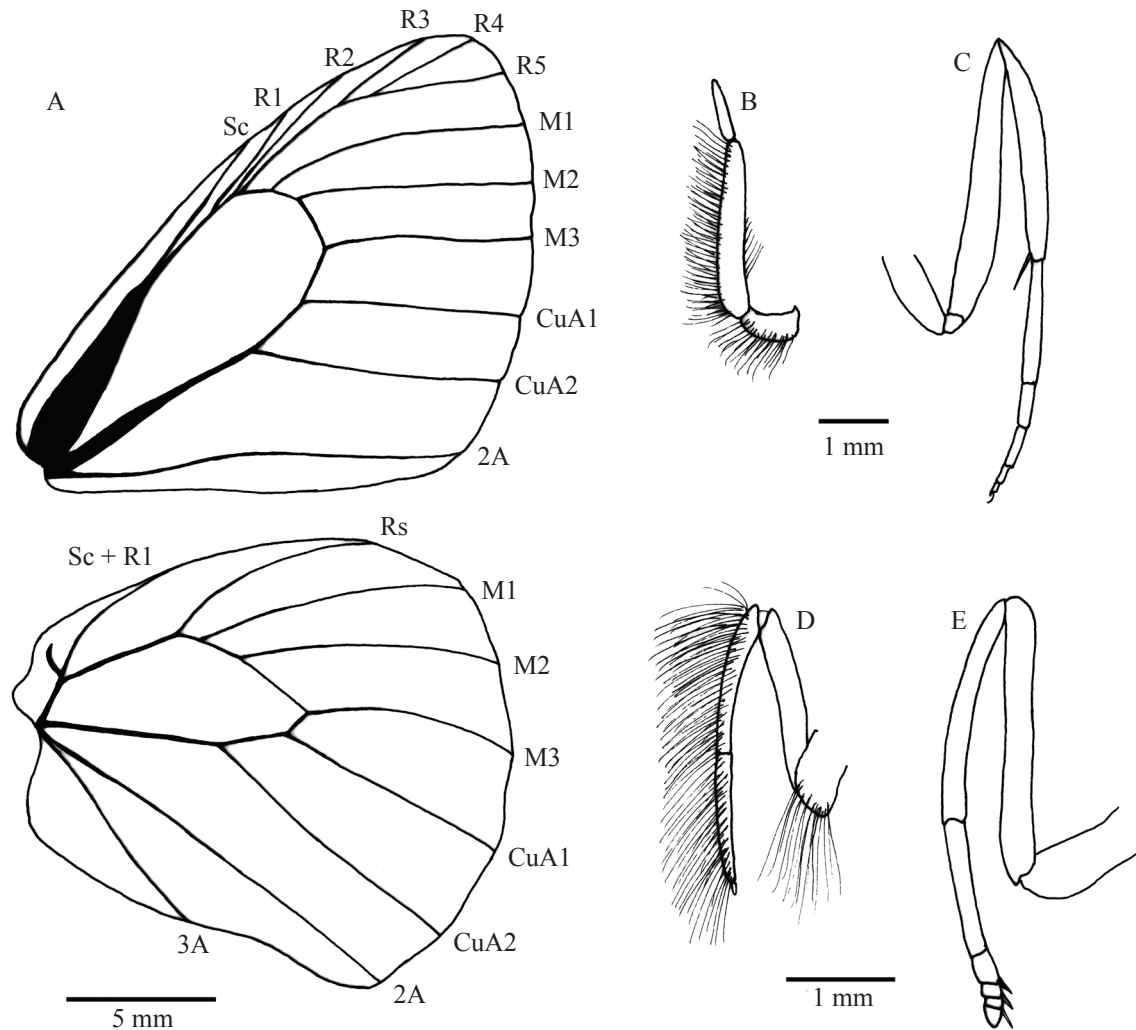


Fig. 2. Morphological characters of *M. itapeva*. A, male wing venation - forewing above and hindwing below; B, male palpus; C, male midleg; D, male foreleg; E, female foreleg.

Remarks on color variation. Variation on the dorsal wing surfaces is small, limited to the number of dorsal ocelli (one or two). The ventral surface of both wings shows some variation in intensity of pigmentation and line shape, and especially in the number and shape of the ocelli (as described above in both sexes) (Fig. 5).

Early stages

Egg. Spherical, yellowish, with 23-25 weakly marked longitudinal ridges and many faint transverse ridges outnumbering the longitudinal. Height 1.00 – 1.14 mm (mean = 1.09 mm, SD = 0.04, n = 8); diameter 1.00 – 1.10 mm (mean = 1.05 mm, SD = 0.04, n = 8). Duration five days (N = 2).

First instar (Fig. 4A, B, J). Head capsule width 0.6 mm; scoli 0.12 mm (n = 1). Head capsule black, with enlarged chalazae, bearing a pair of short scoli on vertex, each with two long narrow setae ending in a fine point (Fig. 4J). Third stemmata larger than the other stemmata. Body green, smooth, with red longitudinal stripes; caudal filaments very short. Setae transparent elongated. Maximum length 5 mm. Duration nine days.

Second instar (Fig. 4C). Head capsule width 0.7 mm; scoli 0.2 mm (n = 1). Head dark brown with two diverging short scoli on vertex. Body striped longitudinally with white and reddish; caudal filaments short. Maximum length 7 mm. Duration 11 days.

Third instar (Fig. 4D). Head capsule width 1.26 mm; scoli 0.26 mm (n = 1). Head brown, with two diverging very short scoli on vertex. Body brown with many longitudinal stripes; caudal filaments short. Maximum length 12 mm. Duration 14 days.

Fourth instar (Fig. 4E). Head capsule width 1.96 mm; scoli 0.3 mm (n = 1). Very similar to third instar. Maximum length 17 mm. Duration 18 days.

Fifth (last) instar (Fig. 4F). Head capsule width 2.6 mm; scoli 0.56 mm (n = 1). Head brown, with two diverging short scoli on vertex. Body brown with many longitudinal stripes; middorsal stripe conspicuously dark; ventral region dark brown; legs and prolegs light brown; caudal filaments short. Maximum length 23 mm. Duration 22 days. One additional larva reared from the same site underwent 6 instars, but the larva died just before pupation.

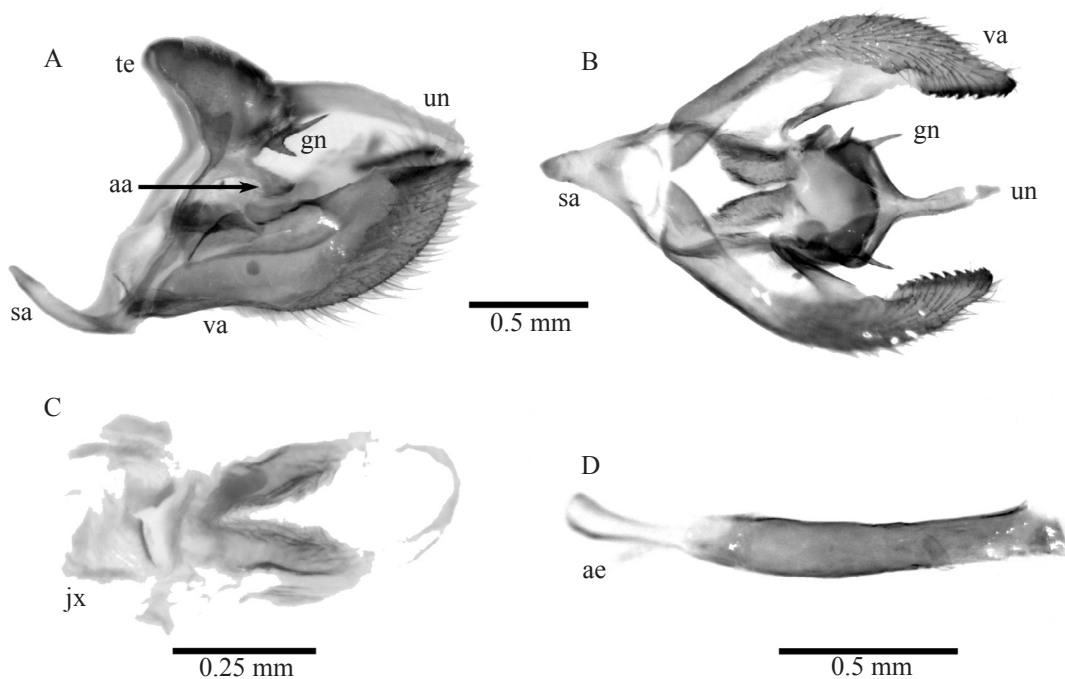


Fig. 3. Male genitalia of *M. itapeva*. A, lateral view; B, ventral view; C, juxta; D, aedeagus (lateral view); sa = saccus, va = valva, ae = aedeagus, un = uncus, gn = gnathos, te = tegumen, jx = juxta, aa = appendices angulares.

Pupa (Fig. 4G-I). Short and smooth; mostly dark brown, with short squared ocular caps; cremaster dark in ventral portion; dorsal abdomen with a paired series of short subdorsal white protuberances bordered with white. Total length 12 mm. Duration 12 days.

Behavior and natural history. Oviposition behavior was not observed in nature, and the host plant in the field is unknown. In the laboratory, larvae easily accepted *Bambusa gracilis* hort. ex Rivière & C. Rivière (Poaceae), a common ornamental Chinese bamboo. Adults were observed only in open habitats and grasslands, flying among grass patches and perching usually on the ground. Males were observed chasing other males on sunny occasions.

Distribution. Besides the three localities mentioned in the methods section, the species was also observed in the Serra do Cipó region including the Serra do Cipó National Park (Serra do Espinhaço mountain range; see details of the region in Freitas 2004), and in the Parque Estadual de Ibitipoca, Lima Duarte (21°41'S, 43°53'W) (in the Serra da Mantiqueira mountain range), both in Minas Gerais, Brazil.

Etymology. The specific epithet refers to the Pico do Itapeva, the type locality.

Holotype. Adult male (Fig. 1A) from Pico do Itapeva (22°45'S, 45°30'W), 1980-2000 m, Pindamonhangaba, São Paulo, Brazil, collected by A. V. L. Freitas on December 31, 2005. Deposited in the Museu de Zoologia (MZSP), Universidade de São Paulo, São Paulo, Brazil. Labels on the holotype (three labels, separated by transverse bars):

HOLÓTIPO/B-817 ITAPV 31-XII-2005, Pico do Itapeva - lago, Pindamonhangaba, SP: Brasil, 22°46'S 45°31'W - Alt. ~ 2000m/Holótipo *Moneuptychia itapeva* Freitas.

Allotype. Adult female, ex-larva (Fig. 1B), same locality as holotype (head capsules and pupal casting deposited in the Museu de História Natural da Unicamp - AVLf leg.), also deposited in the MZSP. Labels on the allotype (three labels, separated by transverse bars): ALÓTIPO/A 311 - *Moneuptychia* sp., ex larva I-II-2006, Pico do Itapeva - lago, Pindamonhangaba, SP: Brasil, 22°46'S 45°31'W - Alt. ~ 2000m/Alótipo *Moneuptychia itapeva* Freitas.

Paratypes (Fig. 5B, D). One adult male same locality data as holotype (Fig. 5B); two males, same locality as holotype, collected in January 10, 2006 by the author, all deposited in the Museu de História Natural (Unicamp) (AVLF leg.); one female, Campos do Jordão, São Paulo, B. Pohl leg., no date (MZSP).

Molecular data. DNA sequences COI, *EF1a* and *wingless* sequenced (DNA voucher CP12-04, as *Ypthimoides* sp. in Peña *et al.* 2006), GenBank accession numbers DQ338815, DQ338962 and DQ338675 respectively.

Additional material. Seven males and 10 females (all from Brazil). *São Paulo*: Campos do Jordão, Parque Estadual de Campos do Jordão (one female); Pindamonhangaba, Pico do Itapeva (two males, three females); *Minas Gerais*: Poços de Caldas, Serra de São Domingos, Cristo (one male, five females), Serra do Cipó, Santana do Riacho, Travessão (one male), P. N. Serra do Cipó (three males); Lima Duarte, P. E.

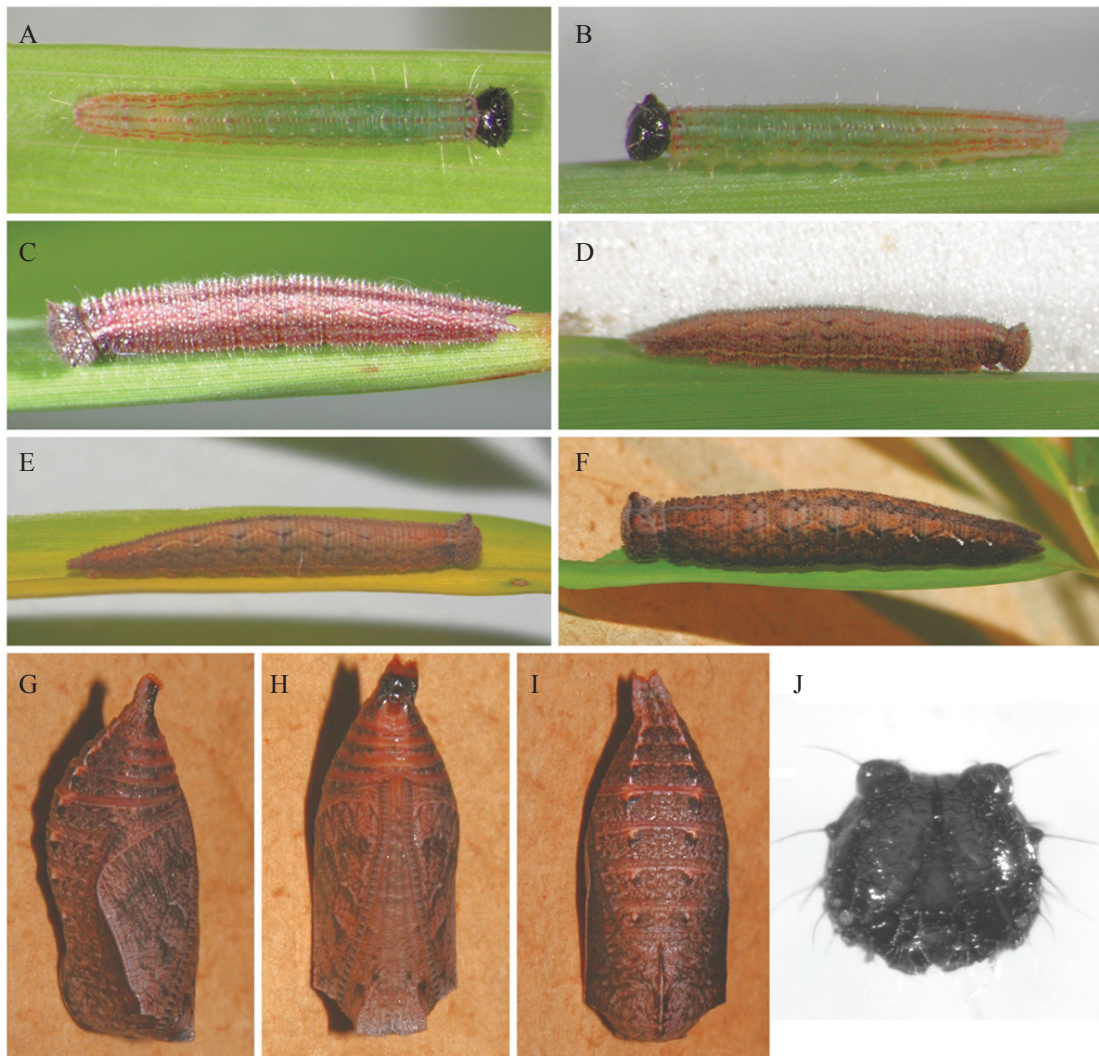


Fig. 4. Immatures of *M. itapeva* (adult = allotype female, see Fig. 1). A, first instar, dorsal view; B, first instar, lateral view; C, second instar; D, third instar; E, fourth instar; F, fifth (last) instar (all lateral view); G, pupa lateral view; H, pupa ventral view; I, pupa dorsal view; J, first instar head capsule, frontal view.

Ibitipoca (one female); all deposited in the Museu de História Natural (Unicamp) (AVLF leg.).

Discussion

The genus *Moneuptychia* was erected by Forster (1964) to include the single species *Euptychia soter* Butler, 1877, based on the absence of the gnathos (as subunci) in the male genitalia (Forster 1964: 92). However, intrageneric variation in the presence/absence of the gnathos has been reported before in *Euptychiina*, as for example in *Forsterinaria* Gray, 1973 (Forster 1964, Peña & Lamas 2005). On the other hand the genitalia of *M. soter* shows extremely well developed projecting appendices angulares that project posteriorly (Forster 1964: 92), a pattern that was not mentioned by Forster (1964), but possibly an important diagnostic character for *Moneuptychia*. This character has not been observed in

any other known *Euptychiina* (Forster 1964, Ebert & Dias 1997, Freitas 2003, 2004, Freitas & Peña 2006, Peña & Lamas 2005, and unpublished results), and might be considered an apomorphic trait for *Moneuptychia*. Based on this single character, the taxon described was placed in *Moneuptychia*, even if the gnathos is present in this species.

Recently, Lamas (2004) reorganized *Moneuptychia* to include four additional species: *Euptychia melchides* Butler, 1877 (very much similar to *M. itapeva* based on wing pattern), and the three species included in the genus *Carminda* Ebert & Dias, 1998, whose species present a well developed gnathos (Ebert & Dias 1997), but not the conspicuously projecting appendices angulares. In Peña *et al.* (2006), *Moneuptychia*, represented by *M. itapeva* (as *Yphthimoides* sp.) and *Moneuptychia paeon* Godart, [1824] (= *Carminda paeon* of Ebert & Dias 1997) appears as polyphyletic, with *M. itapeva* sister to *Euptychoides* Forster, 1964, and *M. paeon* sister to *Paryphthimoides* Forster, 1964 in two separate clades (Peña



Fig. 5. Adult males (A-F) and females (G-I) of *M. itapeva* showing variation in underside wing pattern. A, Serra de São Domingos, Poços de Caldas, MG, Feb/1999; B, Pico do Itapeva, Pindamonhangaba, SP; Dec/2005 (Paratype); C, Pico do Itapeva, Pindamonhangaba, SP; Jan/2001 (genitalia illustrated); D, Pico do Itapeva, Pindamonhangaba, SP; Jan/2006 (Paratype); E, Pico do Itapeva, Pindamonhangaba, SP, May/2004 (DNA voucher CP12-04 in Peña *et al.* 2006); F, Serra do Cipó, MG, May/2002; G, Serra de São Domingos, Poços de Caldas, MG, Feb/1999; H, Parque Estadual de Campos do Jordão, C. do Jordão, SP, Jan/2001; I, Pico do Itapeva, Pindamonhangaba, SP; Mar/2000.

et al. 2006:44). However, since the type species of the genus, *Euptychia soter*, was not included in their analysis, it is not possible to go further at this time.

Based on the present results, the genus *Moneuptychia* should be reorganized to contain only three species: *M. soter*, *M. itapeva* (both sympatric in SE Brazil) and *M. melchiades* (known only from Argentina).

It is obvious that much work is needed to determine the validity, limits and specific composition of most satyrine genera. It is also important to combine efforts to describe all recognized new taxa, even if it appears difficult to assign them to available genera. Additionally, description of early stages of as many species as possible, and comprehensive comparisons within the Euptychiina, could bring important new information to understand relationships within and among some large apparently unnatural groups, such as the genera *Ypthimoides* Forster, 1964, and *Splendeuptychia* Forster, 1964 (Murray & Prowell 2005, Freitas & Peña 2006, Peña *et al.* 2006). With these combined efforts of morphology and with new results from molecular studies, we can hope to have a general overview of the Satyrinae that will improve our understanding of their ecology and evolution.

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