

Immature stages of two *Moneuptychia* from southeastern Brazil (Nymphalidae: Euptychiina)

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Abstract: The present paper describes the immature stages of two species of *Moneuptychia*, namely *Moneuptychia soter*, the type species of the genus, and *Moneuptychia vitellina*. The immature stages of the two species are very similar; eggs are white and round, with longitudinal and transverse ribs; first instars are light green, turning light brown with longitudinal zigzag stripes in the last instars; pupae are short, brown, without ornamentation or projections and with short squared ocular caps. The immature stages of both species here described are quite similar to other species of the genus *Moneuptychia* and to other representatives of the “*Megisto* clade”, underlining the potential importance of immature stages as sources of phylogenetically informative characters in Euptychiina.

Resumo: O presente trabalho descreve os estágios imaturos de duas espécies de *Moneuptychia*, a saber, *Moneuptychia soter*, a espécie tipo do gênero e *Moneuptychia vitellina*. Os imaturos das duas espécies são bastante similares; os ovos são brancos e esféricos, marcados por estrias verticais e horizontais; os primeiros instares são esverdeados, passando a castanho com marcas em zigue-zague longitudinais nos últimos instares; as pupas são curtas, marrons e sem ornamentações ou projeções, com as capas oculares curtas. Os imaturos de ambas as espécies são muito similares àqueles de outras espécies do gênero *Moneuptychia* e de outros representantes do “clado *Megisto*”, mostrando a importância dos caracteres dos imaturos como fonte de informação filogenética em Euptychiina.

Key words: Atlantic Forest, Satyrinae, Satyrini, Natural history

INTRODUCTION

The genus *Moneuptychia* Forster, 1964 was erected to include the single species *Euptychia soter* Butler, 1877, based on the absence of the gnathos (= subunci) in the male genitalia (Forster, 1964: 92). Later, Lamas (2004) listed five species in *Moneuptychia*, including three species previously assigned to the genus *Carmina* Dias, 1998, a proposal that has subsequently been discarded based on morphological and molecular data (Ebert & Dias, 1997; Dias, 2011; Freitas, 2007; Peña *et al.*, 2010). In recent years, six additional species have been described in *Moneuptychia*, with the genus now containing eight described species (Freitas, 2007; Freitas *et al.*, 2010, 2015).

All known species of *Moneuptychia* occur mainly in southeastern Brazil, with some species spreading onto the cerrado savanna domain in northeastern and central Brazil, such as *Moneuptychia itapeva* Freitas, 2007, *Moneuptychia giffordi* Freitas, Emery & Mielke, 2010, and *Moneuptychia wahlbergi* Freitas, Barbosa, Siewert & Mielke, 2015. Most species are typical of open habitats, such as high altitude grass fields

(“campos de altitude”), rocky fields (“campos rupestres”) and savannas (“cerrados”). However, two species are more strongly associated with forested habitats; the type species, *M. soter*, is common in medium to high altitudes forests in southeastern and southern Brazil; the recently described *Moneuptychia vitellina* Freitas & Barbosa, 2015 is common in forest edges above 1600 m in the Serra da Mantiqueira mountain range (Freitas, 2007; Freitas *et al.*, 2010, 2015).

Immature stages have been described for three *Moneuptychia* species, namely *M. itapeva*, *Moneuptychia montana* Freitas, 2015 and *Moneuptychia pervagata* Freitas, Siewert & Mielke, 2015 (although not illustrated for the later species, see Freitas, 2007; Freitas *et al.*, 2015). In all three above mentioned species the immatures are very similar; larvae pass through five or six instars, are solitary and brownish in color in the last instars, and pupae are also similar in general shape.

This paper describes the immature stages of two further *Moneuptychia* species: the narrowly distributed *M. vitellina* and the more widespread *M. soter* (the type species of the genus) and compares them with the immatures of other Euptychiina.

STUDY SITES AND METHODS

Study sites. Adults and immatures of *M. vitellina* were studied at one site in montane forest in Campos do Jordão, São Paulo state, southeastern Brazil (1700-1800 m; 22°44'S, 45°31'W). Adults and immatures of *M. soter* were studied in three sites of semi-deciduous forests in São Paulo state, southeastern Brazil: 1) Serra do Mursa, Campo Limpo Paulista, (900-1000 m; 23°15'S, 46°48'W); 2) Reserva Biológica Municipal da Serra do Japi, Jundiá (900-1100 m; 23°13'S, 46°57'W); 3) ARIE Mata de Santa Genebra, Campinas (600 - 620 m; 22°49'S, 47°6'W).

Sampling and rearing of immature stages. Fertile eggs were obtained from wild-captured females confined in plastic bags warmed by a 40 W bulb and provided with leaves of several bamboos and grasses from the site where adults were found. Larvae were reared in plastic containers cleaned daily and provided with fresh plant material every two or three days (following Freitas, 2007). Data were recorded on morphology and development time for all stages. Dry head capsules and pupal cases were retained in glass vials. Immature stages were fixed in Kahle-Dietrich solution (Triplehorn & Johnson, 2005) when the number of specimens was sufficient. Voucher specimens of the immature stages were deposited in the Museu de Zoologia "Adão José Cardoso" (ZUEC-AVLF), Universidade Estadual de Campinas, Campinas, São Paulo, Brazil.

Morphology. Measurements were taken and morphology was observed using a Leica®MZ7.5 stereomicroscope equipped with a micrometric scale. Egg size is presented as height and diameter, and head capsule size is the distance between the most external stemmata (as in Freitas, 2007). Terminology for early stages descriptions follows García-Barros & Martín (1995) for eggs and Stehr (1987) for larvae and pupae.

Adult ecology. Adults of *M. soter* were studied through a seven-year trap study in Serra do Japi, Jundiá, São Paulo. Fifty traps were placed in five transects at two heights: 25 in the understory (1.5 m above ground) and 25 in the canopy (8-18 m above ground, beneath tree crowns). Traps were installed in groups of ten per transect at alternating heights to avoid the interference of canopy traps on understory traps (following Ribeiro & Freitas, 2012). A standard mixture of mashed banana with sugar cane juice, fermented for at least 48 h, was used as attractant. The bait was placed inside the traps in plastic pots with a perforated cover. The traps were checked every 24 h, and the baits were replaced at each visit. All traps were kept open simultaneously in the field for periods of five days. Butterflies were sampled monthly from October 2011 to August 2018. All butterflies were marked with an individual number on the ventral surface of the hind wings and released unharmed. For further details about the methods, see Freitas *et al.* (2014).

RESULTS

Moneuptychia vitellina

Egg (Figs. 1A, B). White and round with 22-23 longitudinal ribs and 12-14 transverse ribs that become more widely spaced and delimiting hexagonal cells towards the egg apex. Height 0.78-0.90 mm (n=3); diameter 0.80-0.90

mm (n=3); duration 9-10 days (n=4).

First instar (Figs. 1C, D). Head capsule width 0.54-0.58 mm (mean=0.56 mm, SD=0.016 mm, n=10); head scoli 0.06-0.08 mm (mean=0.078 mm, SD=0.006 mm, n=10). Head black, bearing a pair of short scoli on vertex, each with two long narrow black setae. Third stemma larger than other stemmata. Body light green, with white longitudinal stripes; caudal filaments very short. Legs and prolegs light green. Setae light green, all dorsal and subdorsal setae clubbed at tip. Maximum length 4 mm. Duration 6-7 days (n=4).

Second instar (Figs. 1E, F). Head capsule width 0.82-0.90 mm (mean=0.84 mm, SD=0.032 mm, n=8); head scoli 0.16-0.20 mm (mean=0.18 mm, SD=0.015 mm, n=8). Head light brown with cream markings, with two short pointed scoli on vertex. Body green, with light green poorly marked longitudinal stripes; caudal filaments short. Legs and prolegs light green. Maximum length 7 mm. Duration 5-7 days (n=4).

Third instar (Figs. 1G, H). Head capsule width 1.20-1.40 mm (mean=1.26 mm, SD=0.073 mm, n=8); head scoli 0.24-0.30 mm (mean=0.29 mm, SD=0.021 mm, n=8). Similar to second instar in color and general shape; head scoli not pointed; body with several longitudinal zigzag patterns. Maximum length 12 mm. Duration 5-7 days (n=4).

Fourth instar (Figs. 1I, J). Head capsule width 1.70-1.80 mm (mean=1.75 mm, SD=0.047 mm, n=8); head scoli 0.36-0.46 mm (mean=0.39 mm, SD=0.032 mm, n=8). Similar to third instar but larger. Maximum length 15 mm. Duration 7-8 days (n=4).

Fifth (last) instar (Figs. 1K, L). Head capsule width 2.30-2.42 mm (mean=2.36 mm, SD=0.043 mm, n=5); head scoli 0.50-0.54 mm (mean=0.52 mm, SD=0.017 mm, n=5). Head light brown, with two diverging short scoli on vertex. Body light brown with several zigzag longitudinal stripes; legs and prolegs light brown; caudal filaments short. Maximum length 23 mm. Duration 7-13 days (n=4).

Pupa (Figs. 1M, N, O). Short and smooth; mostly dark rusty brown, with short squared ocular caps; cremaster broad, dark in ventral portion; dorsal abdomen with a paired series of short subdorsal white protuberances. Total length 11-12 mm. Duration 11 days (n=3).

Behavior and natural history. The information here presented is modified and expanded following Freitas *et al.* (2015). 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 Chinese bamboo easily accepted by several Euptychiina and Pronophilina larvae (Freitas, 2007, 2017; Freitas *et al.* 2015, 2016b; pers. obs.). Larvae are isolated and move slowly; first to third instars were observed resting in a "J" position. Adults (Fig. 1P) were recorded in partially shaded areas and forest/grassland ecotones with an open understory covered by grass. Adults of both sexes were observed flying near the edges of the shaded areas, where males perched and chased other males. Males are apparently territorial, and were observed interacting with other males, when it was possible to hear a clicking noise and when two or more males flew together. No courtship behavior was observed. Adults were observed feeding on flowers and one male was observed feeding on fermented bananas in a baited trap placed in the understory. The conservation status of this species was recently assessed (Freitas *et al.*, unpublished data). Despite its narrow and restricted range on mountain top areas above 1600 m in the Serra da Mantiqueira, *M. vitellina* does not meet IUCN criteria to be placed in a threatened category, and was thus categorized as "Near Threatened" (NT).

Moneuptychia soter

The following descriptions and measurements are based on material reared from a female from Serra do Mursa, Campo Limpo Paulista, São Paulo. Material reared from Serra do Japi gave similar results in terms of morphology and measurements; larvae rearing from Santa Genebra passed through five instars.

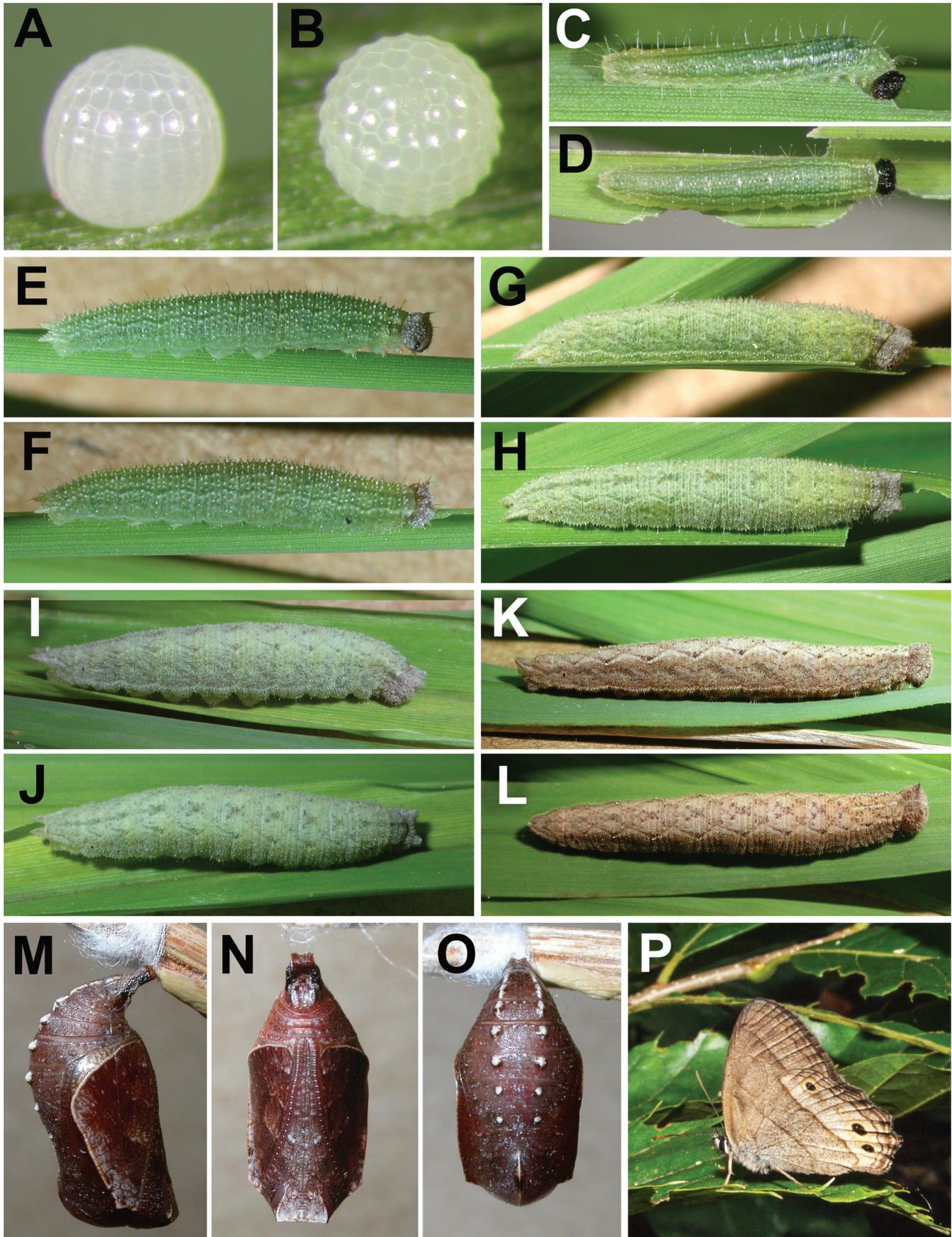


Figure 1. Life stages of *Moneuptychia vitellina*. **A, B.** egg, lateral and dorsal; **C, D.** first instar, lateral and dorsal; **E, F.** second instar, lateral and dorsal; **G, H.** third instar, lateral and dorsal; **I, J.** fourth instar, lateral and dorsal; **K, L.** fifth (last) instar, lateral and dorsal; **M, N, O.** pupa, lateral, ventral and dorsal; **P.** adult male from Campos do Jordão, São Paulo.

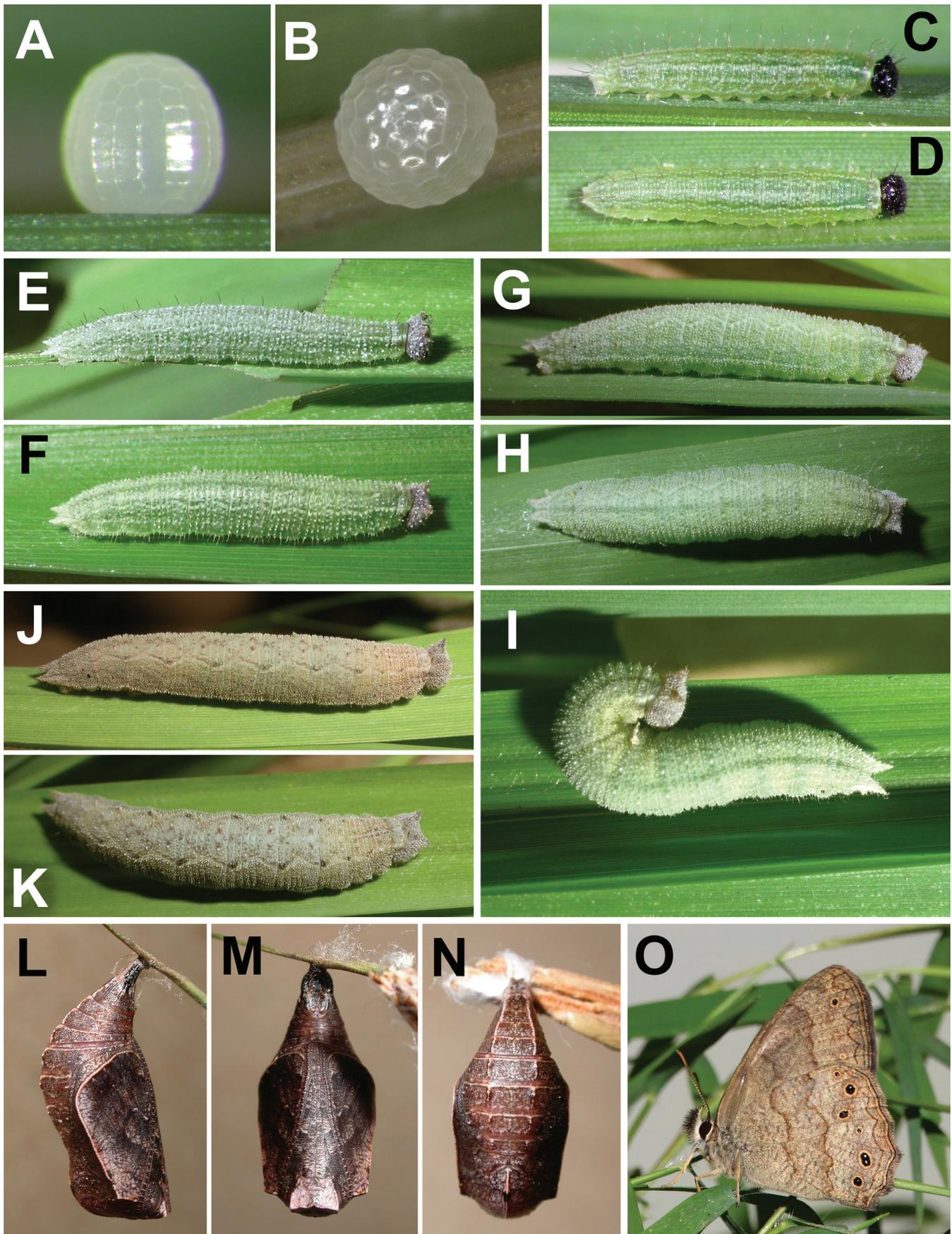


Figure 2. Life stages of *Moneuptychia soter*. **A, B**, egg, lateral and dorsal; **C, D**, first instar, lateral and dorsal; **E, F**, second instar, lateral and dorsal; **G, H, I**, third instar, lateral, dorsal and resting in “J” position; **J, K**, fourth (last) instar, lateral and dorsal; **L, M, N**, pupa, lateral, ventral and dorsal; **O**, adult male from Campo Limpo Paulista, São Paulo.

Egg (Figs. 2A, B). White and round with 18-19 longitudinal ribs and 10-11 transverse ribs that become more widely spaced and delimiting hexagonal cells towards the egg apex. Height 0.89-0.90 mm (n=3); diameter 0.82-0.85 mm (n=3); duration 6-7 days (with two eggs lasting 2 and 3 days respectively) (n=12).

First instar (Figs. 2C, D). Head capsule width 0.52-0.58 mm (mean=0.56 mm, SD=0.017 mm, n=14); head scoli 0.06-0.10 mm (mean=0.080 mm, SD=0.011 mm, n=14). Head black, bearing a pair of short scoli on vertex, each with two long narrow black setae. Third stemma larger than other stemmata. Body light green, with white longitudinal stripes; caudal filaments very short. Legs and prolegs light green. Setae light green, all dorsal and subdorsal setae clubbed at tip. Maximum length 4.5 mm. Duration 6-9 days (n=12).

Second instar (Figs. 2E, F). Head capsule width 0.82-0.90 mm (mean=0.85 mm, SD=0.037 mm, n=10); head scoli 0.14-0.20 mm (mean=0.18 mm, SD=0.018 mm, n=10). Head light brown, with two short pointed scoli on vertex. Body green, with light green poorly marked longitudinal stripes; caudal filaments short. Legs and prolegs light green. Maximum length 8 mm. Duration 5-8 days (n=10).

Third instar (Figs. 2G, H, I). Head capsule width 1.30-1.42 mm (mean=1.36 mm, SD=0.039 mm, n=14); head scoli 0.26-0.32 mm (mean=0.30 mm, SD=0.021 mm, n=14). Similar to second instar in color and general shape; body with several longitudinal zigzag patterns. Maximum length 12 mm. Duration 7-10 days (n=10).

Fourth (last) instar (Figs. 2J, K). Head capsule width 1.98-2.16 mm (mean=2.05 mm, SD=0.065 mm, n=8); head scoli 0.50-0.60 mm (mean=0.55 mm, SD=0.039 mm, n=8). Head light brown, with two diverging short scoli on vertex. Body light brown with several zigzag longitudinal stripes; legs and prolegs light brown; caudal filaments short. Maximum length 22 mm. Duration 11-13 days (n=8).

Pupa (Figs. 2L, M, N). Short and smooth; mostly dark rusty brown, with short pointed ocular caps; cremaster broad, dark in ventral portion; dorsal abdomen with a paired series of short subdorsal light brown protuberances. Total length 10-11 mm. Duration 11-13 days (n=7).

Behavior and natural history. Oviposition behavior was not observed in nature, and the host plant in the field is unknown. In the laboratory, larvae refused several species of grasses but easily accepted an unidentified species of *Chusquea* bamboo and *Bambusa gracilis* Hort. ex Rivière & C. Rivière (Poaceae),

a Chinese bamboo easily accepted by several *Euptychiina* and *Pronophilina* larvae (Freitas, 2007, 2017; Freitas *et al.*, 2015, 2016b; pers. obs.). Larvae are isolated and move slowly; second and third instars were observed resting in a “J” position (Fig. 2I). Adults (Fig. 2O) are present in several different types of forests, being more common from 600 to 1400 m. Adults of both sexes were observed usually flying in clearings and forest edges from ground level to the canopy (see next section). No courtship behavior was observed. The conservation status of this species was recently assessed (Freitas *et al.*, unpublished data). *Moneuptychia soter* has a wide geographic distribution and is found in several different habitats, including primary and secondary forests, clearings and forest edges, showing it to be tolerant of disturbance. Accordingly, this species was categorized as “Least Concern”.

Adult population biology. In total, 44 individuals were captured over seven years of sampling in Serra do Japi, 39 in the canopy (23 males, 15 females and one with sex not recorded) and 5 in the understory (3 males and 2 females), indicating a clear preference for the canopy ($\chi^2=26.27$, $P<0.0001$, $DF=1$). Recaptures were not recorded. Adults showed low abundance over most of seven years of sampling, being more abundant in 2014 and 2015 (Figure 3). The sex could be attributed to 43 of the captured individuals, which comprised 26 males and 17 females, a sex ratio not significantly different from 1:1 (1.52:1, $\chi^2=1.884$, $P=0.169$; $DF=1$). Forewing length of females varied from 1.8 to 2.1 cm (mean=1.90 cm, $SD=0.073$, $n=15$) and of males from 1.7 to 1.9 cm (mean=1.78 cm, $SD=0.084$, $n=23$), with females being significantly larger than males ($t=4.70$, $P<0.0001$, $DF=36$).

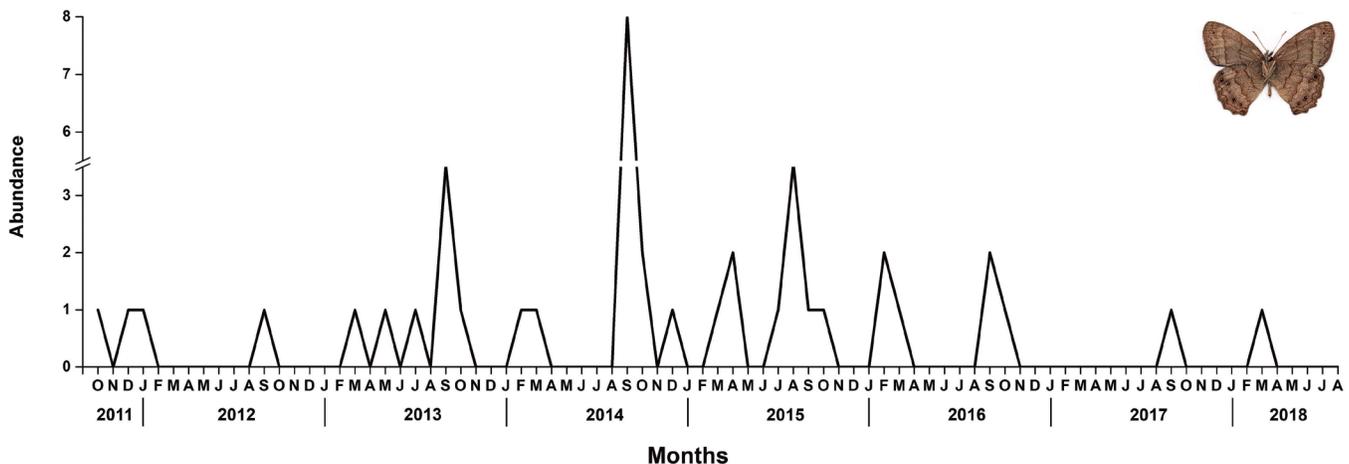


Figure 3. Monthly number of individuals of *Moneuptychia soter* recorded in fruit-baited traps in Serra do Japi, Jundiá, São Paulo State, from October 2011 to August 2018.

DISCUSSION

The immature stages of both species of *Moneuptychia* here described are quite similar to those of several *Euptychiina*: eggs are isolated, larvae are slow-moving, lack body scoli, present short head horns and caudal filaments and the pupae are stubby and smooth, with short ocular caps. In particular, larvae and pupae are very similar to those of *Moneuptychia*,

Pharneuptychia, *Yphthimoides*, *Carmina*, and *Cissia* (Barbosa *et al.*, 2018 and references therein), all phylogenetically related genera in the “*Megisto* clade” of Peña *et al.* (2010) and Espeland *et al.* (2018) (see also Marín *et al.*, 2017). Similar characteristics among the above genera include the brown last instar patterned with thin longitudinal zigzag stripes, the profile of the head capsule and shape of head horns, and the general pupal shape and profile. Although some of these features may be present

in other Euptychiina in different clades, recent observations suggest that different euptychiine lineages in general show distinct characteristics in terms of larval color and pattern, size and shape of the head horns and caudal filaments, and pupal profile and shape (DeVries, 1987; Murray, 2001; Freitas, 2003, 2004, 2017; Freitas & Peña, 2006; Kaminski & Freitas, 2008; Cosmo *et al.*, 2014; Freitas *et al.*, 2016a,b). This conclusion has previously been reported for *Taygetis* and some related genera (Murray, 2001; Freitas, 2017), for *Forsterinaria* (Freitas *et al.*, 2016a) and for some subgroups of the polyphyletic *Splendeuptychia*, *Ypthimoides* and *Parypthimoides* (A. V. L. Freitas, unpublished data), highlighting the potential importance of immature stages as sources of phylogenetically informative characters in Euptychiina.

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LITERATURE CITED

- Barbosa, E. P., Siewert, R. R., Mielke, O. H. H., Lamas, G., Willmott K. R., Freitas, A. V. L. 2018. Redescription of *Ypthimoides patricia* (Hayward, 1957), with taxonomic notes on the names *Euptychia saltuensis* Hayward, 1962 and *Ypthimoides manasses* (C. Felder & R. Felder, 1867) (Nymphalidae: Satyrinae). *Zootaxa* 4422: 537-557.
- Cosmo, L. G., Barbosa, E. P., Freitas, A. V. L. 2014. Biology and morphology of the immature stages of *Hermeuptychia atalanta* (Lepidoptera: Nymphalidae: Satyrinae). *Annales de la Société Entomologique de France* 50: 82-88.
- DeVries, P. J. 1987. *The Butterflies of Costa Rica and their Natural History. Papilionidae, Pieridae, Nymphalidae*. Princeton, Princeton University Press. 327 pp.
- Dias, M. M. 2011. Taxonomic considerations on the genera *Moneuptychia* Forster and *Carminia* Dias, reval. (Lepidoptera, Nymphalidae, Satyrinae). *Brazilian Journal of Biology* 71: 537-540.
- Ebert, H. & M. M. Dias. 1997. Novos gênero e espécie de Satyrinae (Lepidoptera, Nymphalidae) do sudeste brasileiro. *Revista Brasileira de Zoologia* 14: 283-298.
- Espeland, M., Breinholt, J., Barbosa, E., Casagrande, M. M., Huertas, B., Lamas, L., Marín, M. A., Mielke, O. H. H., Miller, J. Y., Nakahara, S., Tan, D., Warren, A. D., Zacca, T., Kawahara, A., Freitas, A. V. L., Willmott, K. R. 2018. Four hundred shades of brown: Higher level phylogeny of the problematic Euptychiina (Lepidoptera, Nymphalidae, Satyrinae) based on hybrid enrichment data. *Molecular Phylogenetics and Evolution* 131: 116-124.
- Forster, W. 1964. Beiträge zur Kenntnis der Insekten fauna Boliviens XIX Lepidoptera III. Satyridae. *Veröffentlichungen der Staatssammlung München* 8: 51-188.
- Freitas, A. V. L. 2003. Description of a new genus for "*Euptychia*" *peculiaris* (Nymphalidae: Satyrinae): Immature stages and systematic position. *Journal of the Lepidopterists' Society* 57: 100-106.
- Freitas, A. V. L. 2004. A new species of *Ypthimoides* (Nymphalidae, Satyrinae) from southeastern Brazil. *Journal of the Lepidopterists' Society* 58: 7-12.
- Freitas, A. V. L. 2007. A new species of *Moneuptychia* Forster (Lepidoptera: Satyrinae, Euptychiina) from the highlands of southeastern Brazil. *Neotropical Entomology* 36: 919-925.
- Freitas, A. V. L. 2017. Immature stages of the Neotropical satyrine butterfly *Taygetis acuta* (Nymphalidae: Euptychiina). *Tropical Lepidoptera Research* 27: 1-5.
- Freitas, A. V. L., Peña, C. 2006. Description of genus *Guianaza* for "*Euptychia*" *pronophila* (Lepidoptera: Nymphalidae: Satyrinae) with a description of the immature stages. *Zootaxa* 1163: 49-59.
- Freitas, A. V. L., Emery, E. O., Mielke, O. H. H. 2010. A new species of *Moneuptychia* Forster (Lepidoptera: Satyrinae: Euptychiina) from Central Brazil. *Neotropical Entomology* 39: 83-90.
- Freitas, A. V. L., Iserhard, C. A., Santos, J. P., Carreira, J. Y. O., Ribeiro, D. B., Melo, D. H. A., Rosa, A. H. B., Marini-Filho, O. J., Accacio, G. M., Uehara-Prado, M. 2014. Studies with butterfly bait traps: an overview. *Revista Colombiana de Entomologia* 40: 209-218.
- Freitas, A. V. L., Barbosa, E. P., Siewert, R. R., Mielke, O. H. H., Zacca, T., Azeredo-Espin, A. M. L. 2015. Four new species of *Moneuptychia* (Lepidoptera: Satyrinae: Euptychiina) from Brazil. *Zootaxa* 3981: 521-541.
- Freitas, A. V. L., Barbosa, E. P., Marín, M. A. 2016a. Immature stages and natural history of the Neotropical satyrine *Pareuptychia ocirrhoe interjecta* (Nymphalidae: Euptychiina). *Journal of the Lepidopterists' Society* 70: 271-276.
- Freitas, A. V. L., Carreira, J. Y. O., Santos, J. P., Barbosa, E. P. 2016b. Immature stages and natural history of two species of *Forsterinaria* from southeastern Brazil (Lepidoptera: Nymphalidae). *Tropical Lepidoptera Research* 26: 13-18276.
- García-Barros, E., Martín, J. 1995. The eggs of European satyrine butterflies (Nymphalidae): external morphology and its use in systematics. *Zoological Journal of the Linnean Society* 115: 73-115.
- Kaminski, L. A., Freitas, A. V. L. 2008. Immature stages of the butterfly *Magneuptychia libye* (L.) (Lepidoptera: Nymphalidae, Satyrinae). *Neotropical Entomology* 37: 169-172.
- Lamas, G. 2004. *Nymphalidae. Satyrinae. Tribe Satyrini. Subtribe Euptychiina*, pp. 217-223. In: Lamas, G. (Ed.), *Checklist: Part 4A. Hesperioidea - Papilionoidea*. In: Heppner, J. B. (Ed.), *Atlas of Neotropical Lepidoptera. Volume 5A*. Gainesville, Association for Tropical Lepidoptera, Scientific Publishers.
- Marín, M. A., Peña, C., Uribe, S. I., Freitas, A. V. L. 2017. Morphology agrees with molecular data: phylogenetic affinities of Euptychiina butterflies (Nymphalidae: Satyrinae). *Systematic Entomology* 42: 768-785.
- Murray, D. L. 2001. Immature stages and biology of *Taygetis* Hübner (Lepidoptera: Nymphalidae). *Proceedings of the Entomological Society of Washington* 103: 932-945.
- Peña, C., Nylín, S., Freitas, A. V. L., Wahlberg, N. 2010. Biogeographic history of the butterfly subtribe Euptychiina (Lepidoptera, Nymphalidae, Satyrinae). *Zoologica Scripta* 39: 243-258.
- Ribeiro, D. B., Freitas, A. V. L. 2012. The effect of reduced impact logging on fruit-feeding butterflies in Central Amazon, Brazil. *Journal of Insect Conservation* 16: 733-744.
- Stehr, F. W. 1987. *Order Lepidoptera*, pp. 288-305. In: Stehr F. W. (Ed), *Immature Insects. Volume 1*. Dubuque, Kendall-Hunt Publishing Company.
- Triplehorn, C. A., Johnson, N. F. 2005. *Borror and DeLong's Introduction to the Study of the Insects*. Belmont, Thomson Brooks/Cole. 864 pp.