

Research article

Immature stages and natural host plant of the Neotropical skipper *Pheraeus pulcher* Grishin, 2023 (Lepidoptera: Hesperiidae: Moncina) in the Peruvian Amazon

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Abstract: Skippers (Lepidoptera: Hesperiidae) are an extremely diverse group of butterflies in the Neotropics. However, basic biological information is still lacking for the vast majority of species, hindering studies of the group's evolutionary relationships, diversification, and species interactions. Here, we describe the immature stages, natural host plant, and larval shelter construction of *Pheraeus pulcher*, a recently described species in the particularly diverse subtribe Moncina from southeastern Peru. The life cycle, based on an individual reared from the egg, lasted 61 days and included six larval instars. The host plant is *Guadua weberbaueri*, a widespread bamboo species that forms dense stands throughout the study region. Our findings represent a significant improvement in our knowledge of this highly diverse yet poorly studied group of skippers in one of the world's most important biodiversity hotspots.

Keywords: bamboo, butterfly, larvae, larval biology, plant-insect interaction, Poaceae

Introduction

The skippers (Lepidoptera: Hesperiidae) are an extremely diverse group of butterflies, especially in the Neotropics, where approximately 2,700–2,800 species have been described to date (e.g., Mielke, 2004; Zhang et al., 2022, 2023, 2025). Although detailed studies remain scarce overall, improved molecular evidence has contributed to major changes in our understanding of skipper taxonomy and systematics in recent decades, (including multiple new phylogenetic hypotheses (e.g., Warren et al., 2009; Zhang et

al., 2019a, 2023, 2024; Xiao et al., 2025) and the description of multiple new species and clades (e.g., Zhang et al., 2019b, 2023). While studies of the immature stages and host plant associations are limited or non-existent for most Neotropical species and groups (Duerr et al., 2022), when these data have been incorporated they have proven useful in supporting genetics-based taxonomic hypotheses (e.g., Janzen et al., 2005), the recognition of cryptic species (Hebert et al., 2004), the inference of macroevolutionary histories (Sahoo et al., 2017), and even the clarification of diversity patterns in complex groups

(Hernández-Roldan et al., 2012; Bächtold et al., 2017). Life and natural history characteristics may become even more critical in highly diverse and complex groups in which adult morphology exhibits convergence, causing commonly-used derived characters to be poorly informative for supporting classifications (Li et al., 2019).

The largely Neotropical skipper subtribe *Moncina* currently comprises more than 800 recognised species (Warren et al., 2026), making it one of the most diverse lineages within HesperIIDae. *Moncina* species are highly abundant throughout the Neotropics and most species are usually small, typically brown (Zhang et al., 2023), causing them to be extremely difficult to identify based on adult morphology. This lineage has consistently been recovered as a natural group in phylogenetic studies (Warren et al., 2009; Zhang et al., 2023), although no morphological diagnosis has yet been established that encompasses all species (Saraiva et al., 2020). In this context, characters derived from the immature stages could represent an additional source of evidence for comparative approaches aimed at improving our understanding of taxonomy, phylogenetic relationships, evolutionary patterns, and the remarkable diversification of this group.

The genus *Pheraeus* currently includes 13 species, which are widely distributed throughout the Neotropics (Steinhauser, 1991; Saraiva et al., 2020). The most recent descriptions have been made during the last decade, with the description of *P. guandu* Saraiva, Carneiro, O. Mielke & Casagrande, 2020 from Espírito Santo, Brazil (Saraiva et al., 2020), based on adult morphological characters, and *P. pulcher* Grishin, 2023 from the upper Amazonian region (Zhang et al., 2023), where the species was delimited primarily by genetic differences and only subsequently compared phenotypically with *P. honta* Evans, 1955 and its relatives. Despite the above-mentioned limited advances in the taxonomy and phylogenetic placement of *Pheraeus*, no information is currently available on the genus' basic biology and the immature stages of all species remain unknown. To address this important knowledge gap, in this study we present detailed descriptions of the immature stages, including larval shelter structures and head capsules, of *P. pulcher* and document the species' host plant in the southeastern Peruvian Amazon. This is the first study to document and describe the

larval biology of any species of the genus *Pheraeus* and adds to a small but growing body of knowledge (e.g., Raby et al., 2024; Medeiros et al., 2025; Suênia-Bastos et al., 2026) on the natural history of Neotropical HesperIIDae.

Methods

Study site

This study was conducted at the Finca Las Piedras (FLP) field station located in the department of Madre de Dios (12°13'40" S, 69°6'40" W; 240 m a.s.l.) in southeastern Peru. FLP is covered mostly in upland or terra firme forest where Brazil nut (*Bertholletia excelsa* Bonpl.) is a dominant canopy species, although the site also borders areas of active agricultural fields and regenerating secondary forest, as well as swamps dominated by *Mauritia flexuosa* (Arecaceae). FLP is characterised by a tropical monsoon climate with a strong dry season from May to September, during which fewer than 100 mm of precipitation occur per month, and a wet season from approximately November to March with >200 mm of precipitation per month (for more information about the climate and tree species composition at FLP, see Fortier et al., 2025). This project is part of the Alliance for a Sustainable Amazon's long-term Lepidoptera Diversity and Biology Project in southeastern Peru.

Rearing

An egg of *P. pulcher* was found on August 27, 2025 during a regular search for immature Lepidoptera in one of several patches of *Guadua weberbaueri* Pigl. and subsequently brought to the FLP field laboratory for rearing and documentation under controlled conditions. Rearing was conducted following the protocol established at FLP (e.g., Baine et al., 2019), in which immatures are kept individually in 1L containers supplied with fresh host plant leaves kept hydrated using floral water tubes. The individual was photographed every two to three days using a Nikon D7100 digital SLR camera equipped with a Nikon AF-S VR Micro-Nikkor 105mm f/2.8G IF-ED lens. The eclosed adult was mounted and deposited in the Lepidoptera collection of the Alliance for a

Sustainable Amazon (ASA) in Puerto Maldonado, Peru.

Morphology

Measurements included the maximum diameter of the egg and length of the larvae and pupa taken in lateral view from the anterior portion of the head to posterior margin of the tenth abdominal segment. Examination and photography of head capsules were carried out using a Leica S9D stereomicroscope with a View 4K HD Camera. Measurements for all life stages, except for the cephalic capsule of the first instar, were made by counting pixels calibrated to scale in high resolution digital photographs using ImageJ 1.54d (Schneider et al., 2012). The description of the egg and larval instars followed the terminology in Minno (1994), except for the terms frontoclypeus and epicranial notch, which are in accordance with Stehr (1987); the description of the pupa was based on nomenclature proposed by Mosher (1915). Because the first-instar head capsule was lost, the nomenclature of setae and pores was established based on the second-instar head capsule, following the terminology proposed by Stehr (1987). The classification of shelter groups and types follows the scheme proposed by Greeney (2009).

Identification

Because the colouration, number, and shape of the spots on the ventral hindwing (VHW) are diagnostic for species identification in *Pheraeus* (Saraiva et al., 2020), we compared our specimen with the type material illustrated in Warren et al. (2024). Since the two most recently described species, *P. pulcher* and *P. guandu*, were not included in that study, we also compared our material directly with the holotypes figured in Saraiva et al. (2020) and Zhang et al. (2023), respectively. To discriminate between *P. honta* and *P. pulcher*, we primarily followed the diagnostic characters proposed by Zhang et al. (2023), who demonstrated that populations previously identified as *P. honta* from Ecuador and Peru correspond to *P. pulcher*, and we verified the presence of a tuft of long orange scales tinged with brown near the apex and inner margin of the dorsal hindwing (DHW), a diagnostic feature of *P. pulcher*.

Results

Description of immature stages

Pheraeus pulcher Grishin, 2023
Voucher: 2025-FLP-IMM-0228

Egg (Fig. 1A–C): Diameter 1.1 mm. Semi-spherical shape, similar to a dome or cup. Pale yellow; base whitish. Chorion with multiple longitudinal stripes; micropylar region slightly concave. Laid on abaxial side of mature leaves. Duration: Unknown, hatched 6 days (n=1) after collection.

First instar (Fig. 1D–E): Head capsule black; shiny; pitted sculpting; vertex rounded; insignificant epicranial notch (Fig. 3A). Body yellowish, slightly green dorsally due to feeding, creamy in subspiracular region. Black prothoracic shield present. Whitish tracheal system. Short translucent setae scattered across body, longer and thicker on anal plate. Anal plate not differentiated from the integument. Body length: 4.80 mm. Duration: 5 days (n=1).

Second instar (Fig. 1F–G): Head capsule (Fig. 2) width 0.46 mm; light brown; pitted sculpting; vertex rounded; insignificant epicranial notch; stemmata black throughout the instar (Fig. 3B). Setae F1, AF2, P1, P2, A3, S1, S2. Clypeus with six setae on each side. Body similar to preceding instar, but yellow, turning dark green after feeding. Body length: 6.70 mm. Duration: 7 days (n=1).

Third instar (Fig. 1H–I): Head capsule width 0.60 mm, similar in colour and shape to preceding instar, but surface irregularly reticulate; secondary translucent setae more abundant; light brown line on each side, parallel to epicranial suture; adfrontal area light brown; median brown vertical line on frontoclypeus (Fig. 3C). Body similar to preceding instar, but green dorsal line more conspicuous; intersegmental lines dark green; body yellow from A8 to A10, slightly orange around the spiracle of A8. Body length: 8.70 mm. Duration: 4 days (n=1).

Fourth instar (Fig. 1J–K): Head capsule width 1 mm, similar in colour and shape to preceding instar, but light brown markings more evident; light brown spot starting from adfrontal area extending to stemmata region; light brown frontoclypeus; vertex slightly concave, bearing small pointed protuberances (Fig. 3D). Body similar to preceding instar, but T1–T3 and A7–A10 slightly yellow-orangish; dorsal region slightly whitish with small

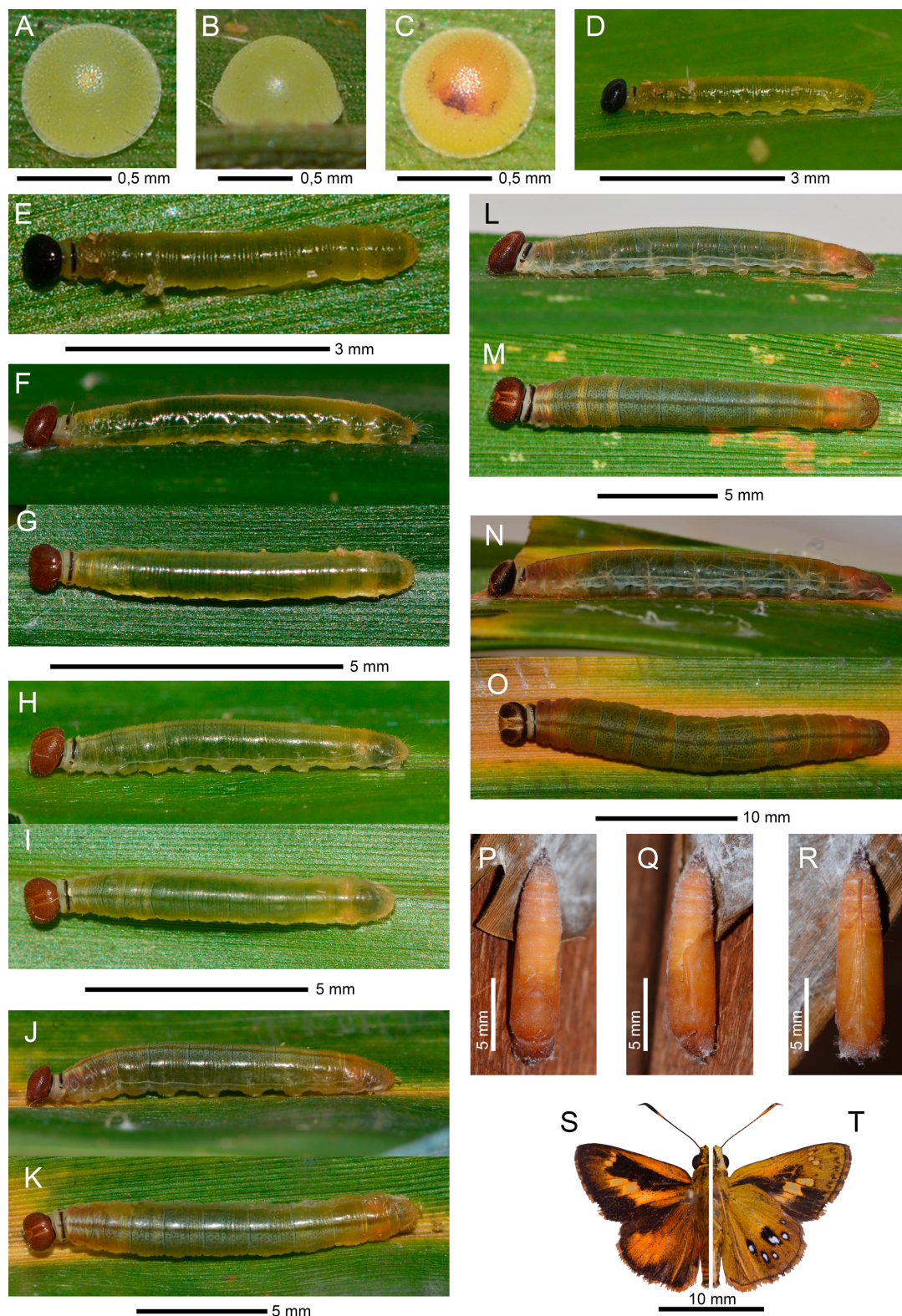


Fig. 1. Life stages of *Pheraeus pulcher* (voucher: 2025-FLP-IMM-0228): (A–B) egg in dorsal view and lateral view; (C) egg with head capsule visible (dorsal view); (D–E) first instar in lateral and dorsal views; (F–G) second instar in lateral and dorsal views; (H–I) third instar in lateral and dorsal views; (J–K) fourth instar in lateral and dorsal views; (L–M) fifth instar in lateral and dorsal views; (N–O) sixth instar in lateral and dorsal view; (P–R) pupa in dorsal, lateral, and ventral views; (S–T) adult in dorsal and ventral views.

dark green circular spots. Body length: 15.20 mm. Duration: 5 days (n=1).

Fifth instar (Fig. 1L–M): Head capsule width 1.34 mm, similar in colour and shape to preceding instar, but light brown markings paler and more conspicuous; vertex slightly more concave; epicranial notch V-shaped (Fig. 3E). Body similar to preceding instar, but T1–T2 slightly pinkish dorsally and matte; transverse yellow bands on A1–A2; area around spiracle of A8 more orange; anal plate ochre-yellow to brown, with black punctuations. Body length: 18.50 mm. Duration: 7 days (n=1).

Sixth instar (Fig. 1N–O): Head capsule width 1.90 mm, similar in colour and shape to preceding

instar, but light brown markings becoming cream-coloured; creamy lateral band extending from the vertex to stemmata 1–4; vertex concave; epicranial notch V-shaped, deeper than in preceding instar (Fig. 3F). Body similar to preceding instar, but mid-dorsal line darker; thoracic and posterior abdominal segments slightly purplish; posterior margin of each segment with a yellowish transverse band. In prepupa, body becomes pale yellow; wax present ventrally between segments A3–A9. Body length: 29 mm. Duration: 14 days (n=1).

Pupa (Fig. 1P–R): Body elongated and fusiform. Head, thorax, and wing cases ochre. Galea of the maxilla extending to A7. Head with small dark brown trapezoidal process. Translucent setae present in ocular and supraocular regions, thorax dorsally, and abdomen. Mesothorax anteriorly with a pair of ochre eye-pieces. Abdominal segments pale yellow. Triangular cremaster reddish-brown. As development progresses, head and thorax become darker; pupal eyes become dark brown to black. Body length: 17.50 mm. Duration: 13 days (n=1).

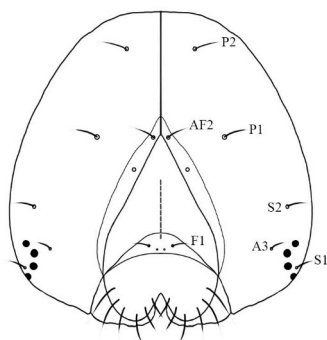


Fig. 2. Chaetotaxy of the head capsule of the second larval instar of *Pheraeus pulcher*.

Host plant, behaviour and shelter structure

The host plant was identified as *G. weberbaueri* (Poaceae: Bambusoideae: Bambuseae) that had been identified by previous studies at the site (Corahua-

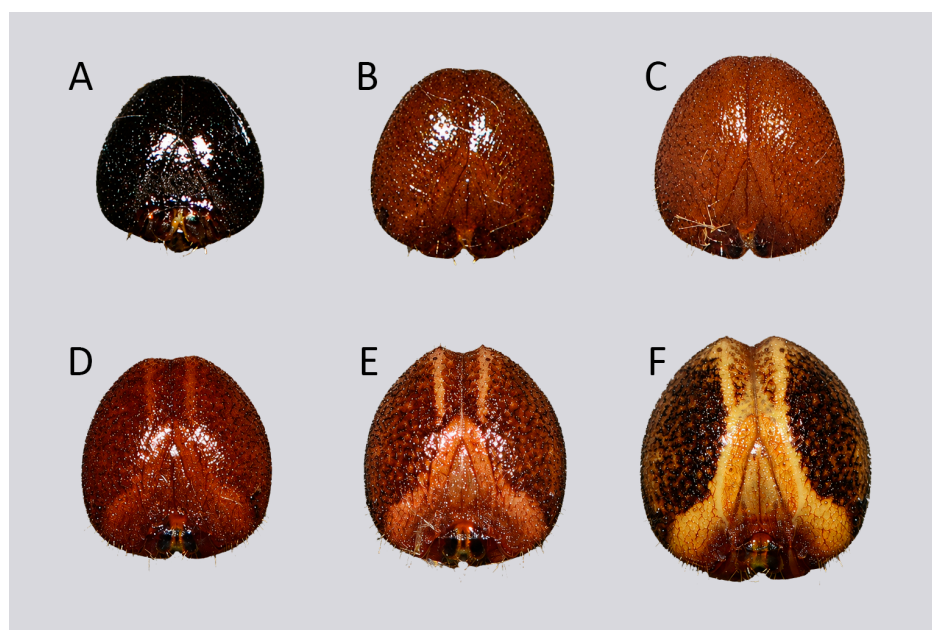


Fig. 3. Head capsules of *Pheraeus pulcher* (all in frontal view): (A) first instar; (B) second instar; (C) third instar; (D) fourth instar; (E) fifth instar; (F) sixth instar.



Fig. 4. Habitat of *Pheraeus pulcher* at Finca Las Piedras in southeastern Peru: (A) bamboo patch, *Guadua weberbaueri*, at forest edge; (B) view inside of *Guadua weberbaueri* patch.

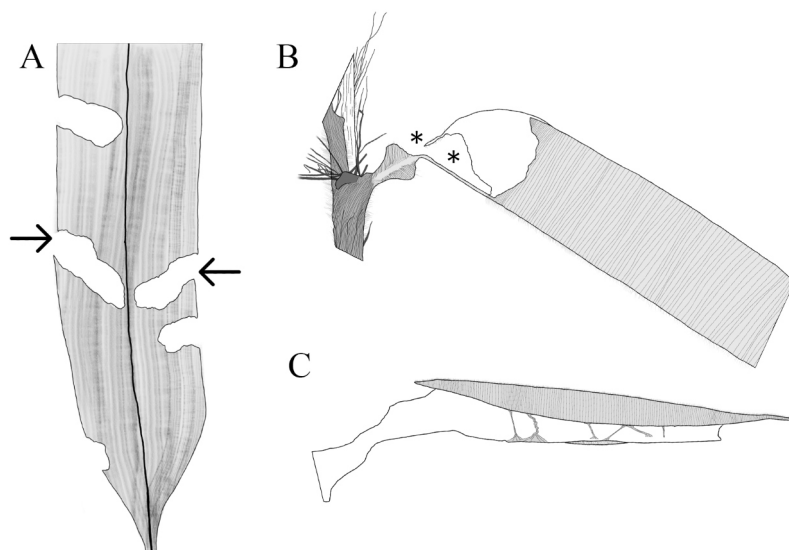


Fig. 5. Shelter structure of *Pheraeus pulcher*: (A) leaf damage caused by larval feeding; arrows indicate the initial cuts made to construct the shelter; (B) shelter in lateral view, note that the leaf damage (indicated by *) is located at the base of the leaf; (C) shelter in dorsal view. The shaded area represents the underside of the leaf in all drawings.

Espinosa et al., 2022). This species is a common bamboo widely distributed throughout the Amazon Basin that can reach up to 10–20 m in height and can form extensive patches in disturbed areas or within forested habitats (Londoño & Peterson, 1991; Tovar, 1993). The egg of *P. pulcher* was collected from a plant growing in a patch located at the forest edge, adjacent to a deforested area dominated by a *Urochloa* P.Beauv. species (Poaceae; Fig. 4). The egg was found 2.5–4 m above the ground on the abaxial surface of the leaf, near the base and close to the leaf margin.

In all instars, the larva initially fed perpendicular to the leaf midrib, producing a narrow, elongated feeding scar (Fig. 5). The leaf midrib was never consumed. Subsequent feeding occurred around this initial damaged area. The larva preferentially consumed the basal portion of the leaf, leaving the remainder of the leaf blade attached only by the midrib (Fig. 5A).

Shelter construction was not observed during the first instar or early second instar. From the late second instar to last instar, the shelter was tubular and was constructed by making two initial cuts on opposite

sides of the leaf blade, followed by folding the leaf margins together with silk and suspending the structure from the midrib in late instars (Fig. 5). This type of shelter belongs to Type 5, according to the classification by Greeney (2009).

Discussion

The descriptions of the immature stages of *P. pulcher* provided in this study constitute the first detailed information regarding the immature stages, as well as the first host plant record, for the genus *Pheraeus*. The morphology of the larval stages and pupa is consistent with that of other *Moncina* species (e.g., Greeney & Warren, 2011; Duerr et al., 2022; Raby et al., 2024; Medeiros et al., 2025), notably the tubular body, the presence of a prothoracic shield, the progressive development of markings and a more pronounced epicranial notch on the head capsule throughout the larval instars, and a fusiform pupa. Larvae with tubular bodies and fusiform pupae have been recorded in other *Hesperiidae* that use grasses or bamboos as host plants, regardless of their taxonomic position (Greeney & Warren, 2009a; Duerr et al., 2022; Vega et al., 2025; Suênia-Bastos et al., 2026), suggesting that these shared characteristics probably reflect adaptations to the structural traits of the host plant leaves, as has been proposed for other *Hesperiidae* that feed on other monocotyledons (e.g., Freitas, 2018; Freitas, 2020; Raby et al., 2024).

On the other hand, we consider that characters of the head capsule and the shape of the pupal head process may be potentially informative for distinguishing among groups or even species of *Hesperiidae*. The markings on the head capsule of *Hesperiidae* larvae in the later instars vary in position, colouration, and complexity, but in *Moncina* they are typically located along the adfrontal area, the epicranial suture, and the lateral regions of the head capsule. In *P. pulcher*, the pattern of markings (Fig. 3), particularly in the final instar, differ from those reported for other *Moncina* larvae (e.g., Greeney & Warren, 2009a; Cock, 2013; Medeiros et al., 2025), where the spot surrounding the epicranial suture is particularly broader and extends toward the stemmatal region, in addition to the development of an epicranial notch that is much more pronounced than in other species of the subtribe (e.g., Greeney & Warren, 2009a, 2009b; Ccahuana et al., 2021; Duerr et al.,

2022; Medeiros et al., 2025). Regarding the head process of the pupa, *P. pulcher* exhibits a trapezoidal shape, differing from the long and pointed process reported in other species (Cock, 2013; Freitas, 2020; Ccahuana et al., 2021; Duerr et al., 2022), the short and conical form (Duerr et al., 2022; Vega et al., 2025), the short and triangular form (Greeney & Warren, 2011), or the complete absence of this structure (Cock, 2013; Raby et al., 2024; Medeiros et al., 2025) observed in other Neotropical skippers.

The record of *G. weberbaueri* as the host plant of *P. pulcher* is consistent with the association of most *Moncina* species with Poaceae (e.g., Beccaloni et al., 2008; Janzen & Hallwachs, 2018). This association has been suggested as one of the factors underlying the high diversification rates observed in skippers, especially in *Hesperiinae* (Sahoo et al., 2017), given the diversity of this plant family. In addition, our field observations suggest that patches of *G. weberbaueri* in the region constitute an important resource for several other lepidopteran species. We have observed multiple skipper genera belonging to different tribes (e.g., *Xeniades* Godman, 1900, *Metron* Godman, 1900, *Eutocus* Godman, 1901, *Dubia* (Bell, 1932), and *Perichares* Scudder, 1872), as well as multiple *Euptychiina* (*Nymphalidae*: *Satyrinae*: *Satyrini*) (e.g., *Pseudodebis valentina* (Cramer, 1779), Corahua-Espinoza et al., 2022 and *Harjesia blanda* (Möschler, 1877), Nakahara et al., 2026; some species of *Argentaria* Huertas & Willmott and *Caeruleuptychia* Forster, 1964) and a few tiger moths (*Erebidae*: *Arctinae*) feeding on this plant as larvae.

Larval shelters constructed of folded leaves held together with silk are a common feature among many lepidopteran families, with shelter form and ontogeny often varying characteristically across taxa (Greeney & Jones, 2003; Lill et al., 2007). Skipper shelters can generally be divided into five different types that are defined by the number of leaves used, whether they are cut, and how many cuts are involved in construction (Greeney, 2009; Greeney & Jones, 2003). In general, skipper larvae construct shelters of two types during different stages of their larval development, with Type 1 (no-cut fold, tubular, formed using only one leaf) and Type 4 (one-cut fold, conical or tubular, constructed using only one major cut) shelters being the most common among *Moncina* (e.g., Greeney & Warren, 2009b; Greeney & Warren, 2011; Cock, 2013; Ccahuana et al., 2021). The shelter type observed in *P. pulcher* remained unchanged

throughout its development and contrasts with the shelter types typically reported for grass-feeding skippers. From the second instar onward, larvae constructed a Type 5 (two-cut fold on opposite sides of the leaf midvein) shelter (Fig. 5), a shelter type that appears to be relatively uncommon among documented *Moncina*. To our knowledge, this shelter type has been reported within *Moncina* only for fourth instar larvae of *Corra coryna* (Hewitson, 1866) (Greeney & Warren, 2009a), although it is likely that this shelter type also occurs in other taxa of the subtribe, as it has also been documented in other grass-feeding hesperiines (Greeney & Jones, 2003).

We consider that the morphological characteristics of the immature stages of *P. pulcher* reported herein, together with its shelter-building behaviour and association with *G. weberbaueri*, may provide a starting point for refining the taxonomy and phylogenetic placement of the genus by incorporating potentially valuable characters that have not been commonly considered previously (Warren et al., 2009). These characteristics may also facilitate macroecological studies at infraspecific levels aimed at revealing processes of speciation and adaptation (e.g., Allio et al., 2021). It is evident that our knowledge of the immature stages of Neotropical butterflies remains severely limited, as studies of this kind require detailed long-term monitoring and considerable effort, which is compounded by the immense species richness of the region. Nevertheless, such basic biological studies provide valuable information across multiple disciplines, helping to elucidate patterns of diversification and contributing to the conservation of biodiversity in the Neotropics at a time when human impacts on natural ecosystems are increasing at an unprecedented rate.

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Conflicts of interest

No potential conflict of interest has been reported by the authors, reviewers, or subject editor.

Author's contributions

(using [CrediT](#) )

Yeison Vega: conceptualisation, data curation, formal analysis, investigation, methodology, resources, software, validation, visualisation, writing—original draft, writing—review and editing; Zunilda Escalante-Arteaga: conceptualisation, data curation, formal analysis, investigation, methodology, resources, software, validation, visualisation, writing—original draft, writing—review and editing; Karla Fiallos-Yanez: data curation, investigation, methodology, validation, writing—review and editing; Geoffrey Gallice: funding acquisition, project administration, writing—review and editing.

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