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EARLY STAGES AND NATURAL HISTORY OF *PERISAMA OPPELII* (LATREILLE, 1811) (NYMPHALIDAE, LEPIDOPTERA) IN EASTERN ECUADOR

ESTADÍAS INMADURAS E HISTORIA NATURAL DE *PERISAMA OPPELII* (LATREILLE, 1811) (NYMPHALIDAE, LEPIDOPTERA) EN LA REGION ORIENTAL DE ECUADOR

Harold F. Greeney [1], Lee A. Dyer [2], Philip J. DeVries [3], Thomas R. Walla [4], Lucía Salazar Vega [1], Wilmer Simbaña [1] & Luis Salagaje [1]

[1] Yanayacu Biological Station & Center for Creative Studies, Cosanga, Ecuador
c/o 721 Foch y Amazonas, Quito, Ecuador. *E-mail:* revmmoss@yahoo.com
[2] Biology 0314, University of Nevada, Reno, 1664 N. Virginia St., Reno, Nevada 89557.
[3] University of New Orleans, Department of Biological Sciences, New Orleans, LA 70148
[4] Department of Biology, Mesa State College, 1100 North Avenue, Grand Junction, CO 81501, USA

Resumen: Presentamos la primera descripción completa del ciclo de vida de una especie del género *Perisama*. *Paullinia* sp. (Sapindaceae) es la planta hospedera de *Perisama oppelii* Latreille, 1811 en el noreste de Ecuador. *Perisama oppelii* tiene cinco estadías, todas están descritas e ilustradas. El ciclo de vida, desde nacimiento hasta adulto, dura 61-72 días. En la primera y segunda estadía construyen y descansan en cadenas de excremento cuando no están comiendo, mientras que las estadías posteriores descansan en la parte superior de las hojas de la planta hospedera. La morfología y comportamiento de las larvas son similares a los géneros relacionados en la tribu Callicorini.

Palabras clave: Andes, planta hospedera, cadena de excremento, larva, *Paullinia,* pupa, Sapindaceae.

Abstract: We present the first complete description for the larvae of any species of the genus *Perisama*. *Paullinia* sp. (Sapindaceae) is the larval food plant for *Perisama oppelii* Latreille, 1811 in north eastern Ecuador. *Perisama oppelii* has five larval stadia, all of which are described and illustrated. The life cycle, from hatching to adult lasts 61-72 days. First and second instars construct and rest on frass chains while not feeding, while later instars rest on the upper surface of food plant leaves. Larval morphology and behavior is similar to related genera within the Callicorini.

Key words: Andes, food plant, frass chain, larva, *Paullinia*, pupa, Sapindaceae.

INTRODUCTION

Perisama Doubleday, 1849 (Nymphalidae) contains over 40 described species (Attal & Crosson-du-Cormier, 1996), and ranges from Venezuela to Argentina in montane areas, and reaches its peak diversity in the Central Andes. *Perisama* belongs to the tribe Callicorini (Freitas & Brown, 2004) and is closely allied to *Diaethria* Billberg, 1820 and *Callicore* Hübner, 1819, tending to replace members of these genera at higher elevations (DeVries, 1987; Neild, 1996). As a member of the Callicorini, we may infer from the food plant associations of other genera (DeVries, 1987; Neild, 1996) that those of *Perisama* are likely in the family Sapindaceae. Attal & Crosson-du-Cormier (1996) describe the larvae and report the use of *Serjania* (Sapindace) by *Perisama bonplandii* Guèrin, 1844, but there is no other published information on the early stages and food plant associations for this speciose genus.

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Based on the focal taxon *Perisama oppelii* Latreille, 1811, here we present the first complete description of larval development for *Perisama*.

METHODS

Our study site was the Yanayacu Biological Station & Center for Creative Studies (00°35.949 S, 77°53.403 W), located in Napo Province, northeastern Ecuadorian Andes. The study site is five kilometers west of the town of Cosanga and adjacent to the private bird-watching and conservation reserve Cabañas San Isidro. Habitat in the area is predominantly primary cloud forest bordered by cattle pasture and other disturbed habitats. For more complete site descriptions, see Greeney (2008) and Valencia (1995). We collected larvae at elevations ranging from 2000 to 2300 m, and reared them in glass jars at the ambient research lab, located at 2150 m.

We measured larvae immediately prior to each molt. Examples of most life stages are preserved in 70% etoh (larvae and pupae) or in glassine envelopes (adults), and are deposited in the collections of the first author and the Smithsonian Natural History Museum.

RESULTS

Larval behavior. Larvae were found feeding on an unidentified species of *Paullinia* (Sapindaceae). First and second instars rest on the skeletonized midveins of leaf apices that have been extended by silking frass into a chain (Figs. 1c, f-g, 2a, e). Molting occurs near the tips of these frass chains. Later instars rest on the dorsal surface of leaves with their head tipped forward and scoli pressed to the leaf surface. Their body is held either straight (Fig. 4d) or in a slight S-curve (Figs. 4c, 5a, 6c). When disturbed, larvae thrash their head and abdomen, attempting to brush the offending object away with their head scoli. They drop from the plant only reluctantly, and must be strongly provoked before thrashing.

First instar. (Fig. 1; n = 5; 2-4.5 mm; ca. 8-9 days). Head round to almost square, shiny black with a strong epicranial crease (Figs. 1d-e); body round in cross-section, roughly parallel sided, tapering slightly posteriorly; pale orange-brown upon hatching, darkening to green after feeding commences (Figs. 1a-b); prothoracic shield well developed and broken into two black, roughly triangular sections; segments T1-A9 bear subdorsal, supra-spiracular, and spiracular tiny black scoli with single, short black setae arising from each; those on thorax are in-line, those on abdomen have the supra-spiracular scolus slightly offset posteriorly from other two (Figs. 1a-b); by mid-stadium larvae appear all dark orange (Figs. 1c, f-g), scoli not apparent and body with faint patterning of white markings.

Second instar. (Fig. 2; n = 9; to 6 mm; 7-9 days). Head roughly square, black to dark brown, bearing two thick, rounded, short scoli with irregular bumps (Figs. 2c-d); immediately after molt (Fig. 2a) head and body ground color pale orange-brown, head scoli clear white; body round in cross-section, roughly parallel-sided, tapering at A9; by mid-stadium (Fig. 2b) body ground color dark orange-brown with many small, prominent white tubercles and sparse, minute pale setae; body color fades prior to molt (Fig. 2e), prothoracic shield weakly sclerotized and not prominent.

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Third instar. (Fig. 3; n = 12; to 10.5 mm; 8-11 days). Head nearly square, narrowed epicranially and bearing two long, well developed scoli with three sets of whorled, lateral projections and sparse, long, dark setae (Figs. 3b, d), ground color dark with area below fork in cranial suture paler, some individuals with two indistinct small white spots near ommatidia; body shape as described for earlier instars, early in stadium (Fig. 3a) ground color dark orange with white granulations and setae as described for first instar; later in stadium (Fig. 3c) ground color becomes green and larvae develop indistinct, thin, pale yellow-white supraspiracular and spiracular lines as well as a more prominent, brighter ventrolateral stripe; venter pale yellow-green; A9 spiracle prominent and pale (Fig. 3e), A10 bears a pair of short green scoli terminating in a star-like radiation of 3-4 dark-tipped spines (Fig. 3e).

Fourth instar. (Figs. 4-5; n = 14; to 16 mm; 8-10 days). Head similar to that described for third instar, but scoli proportionately longer and with an additional basal cluster (not tightly whorled) of lateral spines (Figs. 4b, d, 5b-d); ground color dark but with shafts of the scoli between whorls paler reddish in some individuals (Fig. 4d), posterior portion behind scoli pale cream or greenish-white (Figs. 5b-c), most individuals with a pale marking near ommatidia (Fig. 4b); body similar to description for late third instar, white punctuations not prominent; A1-A8 bear laterally projecting, pale, short scoli subspiracularly (Figs. 4e-f); A10 scoli still short but spines more developed with a longer, dark spine centrally and a whorl of three dark spines basally; prior to molting (Figs. 4a-b, 5a) T1 becomes very swollen and orange-brown.

Fifth instar. (Figs. 6-8; n = 17; to 22 mm; 12-14 days including pre-pupa). Head similar in form to 4th instar (Figs. 7b-e), ground color red-brown, but scoli still dark and marked as described for 4th instar, posterior portion greenish behind scoli (Fig. 7c), large pale areas mark anterior and lateral portions (Figs. 6e, 7e), scoli with tufts of soft dark setae near apices of spines (Fig. 7d); body soon after molt (Figs. 6a-c) similar to description for 4th instar, lines more yellowish but becoming less distinct later in stadium (Fig. 7a) and entire body with sparse yellow granulations; venter with chalky-white patches (Fig. 6e); A10 scoli as described for 4th instar but more developed (Fig. 8a).

Pre-pupa. (Fig. 8b; n = 11; ca. 18 mm; 2-3 days). Pre-pupae become brighter green, yellow spotting fades, head becomes mostly orange-brown including scoli, larvae spin a white silk pad on dorsal surface of a leaf.

Pupa. (Figs. 9, 10a; n = 11; ca. 18 mm; 18-19 days). Pupa oriented horizontally, parallel to dorsal surface of substrate (Fig. 9a); shape robust with weak mid-dorsal keel, dorsolateral keel along edge of wing pad, small triangular lateral projections on meso-thorax, head with two short conical projections; ground color emerald green with small white punctuations (Fig. 9c), wing pads paler with fine dark reticulations (Fig. 9a); several hours after molting pupae develop a supraspiracular line on abdomen behind wing pads and prominent white spots mid-dorsally on A2 and on apex of thoracic keel, lateral keeled portions white, dorsal surface of head projections white; 1-2 days prior to eclosion wing pads and abdomen darken, eyes become pale (Fig. 10a).

Adult behavior. (Fig. 10b). Males of *P. oppelii* are among the most commonly encountered *Perisama* species in our area. They conspicuously patrol perches from the mid to upper canopy on sunny days near the tips of leaves, generally in bright sun patches, and hold their

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wings partially opened or folded over the back. They chase small to medium sized butterflies, but generally ignore the numerous species of dark-colored *Pronophilina* (Satyrinae). Males are attracted to wet sand enriched with urine or mammal feces, and they are often found feeding on the cement on the sides of buildings. When feeding on such substrates they periodically curl their abdomen under their body and exude a droplet of liquid which is then re-ingested. In contrast, the females have rarely been observed.

DISCUSSION

The first major treatment of the genus *Perisama* was nearly 100 years ago (Rober in Seitz, 1907-1924). Subsequent works have added to this treatment (e.g., Oberthür, 1916; Descimon, 1985), but only recently (Attal & Crosson-du-Cormier, 1996) has a major revision been undertaken. Due in part to their flashy colors and popularity with collectors, many species of dubious validity have been described, and this recent revision has provided a much needed tool. As pointed out by Freitas & Brown (2004), however, the use of larval characters in combination with adult morphology is a crucial step in elucidating the phylogenetic relationships of the Nymphalidae, and this has been demonstrated in some groups (e.g., DeVries et al., 1985; Kitching, 1985; Brown & Freitas, 1994; Penz, 1999).

The only information available for *Perisama* with which to compare our findings is the description of the early stages of *P. bonplandii* Guèrin, 1844 provided by Attal and Crosson-du-Cormier (1996). While this brief description is limited in scope and includes no images, the early stages of *P. oppelii* appear to be similar. Larval morphology, behavior, and food plant associations of *Perisama* lend further support the close relationship between this genus and other Callicorini (e.g., *Callicore*, *Diaethria*). All are known to feed on Sapindaceae and/or related plant families, build frass chains as early instars, and pupate on horizontal surfaces with the body held parallel to the substrate (DeVries, 1987; Muyshondt, 2005). Larval morphology is also similar to other genera of Callicorini, with later instar heads adorned with long elaborately spined scoli that are held flat against the substrate when at rest. With further life history descriptions and a more developed understanding of the intra-generic relationships of *Perisama*, we suggest that Callicorini would make an excellent group for testing evolutionary hypotheses on biogeography and diversity within the Andes, as has been done with other speciose Andean taxa (e.g., Patton & Smith, 1992; Garcia-Moreno et al., 1998; Willmott et al., 2001). We encourage others to publish their findings on this and other poorly known Lepidoptera.

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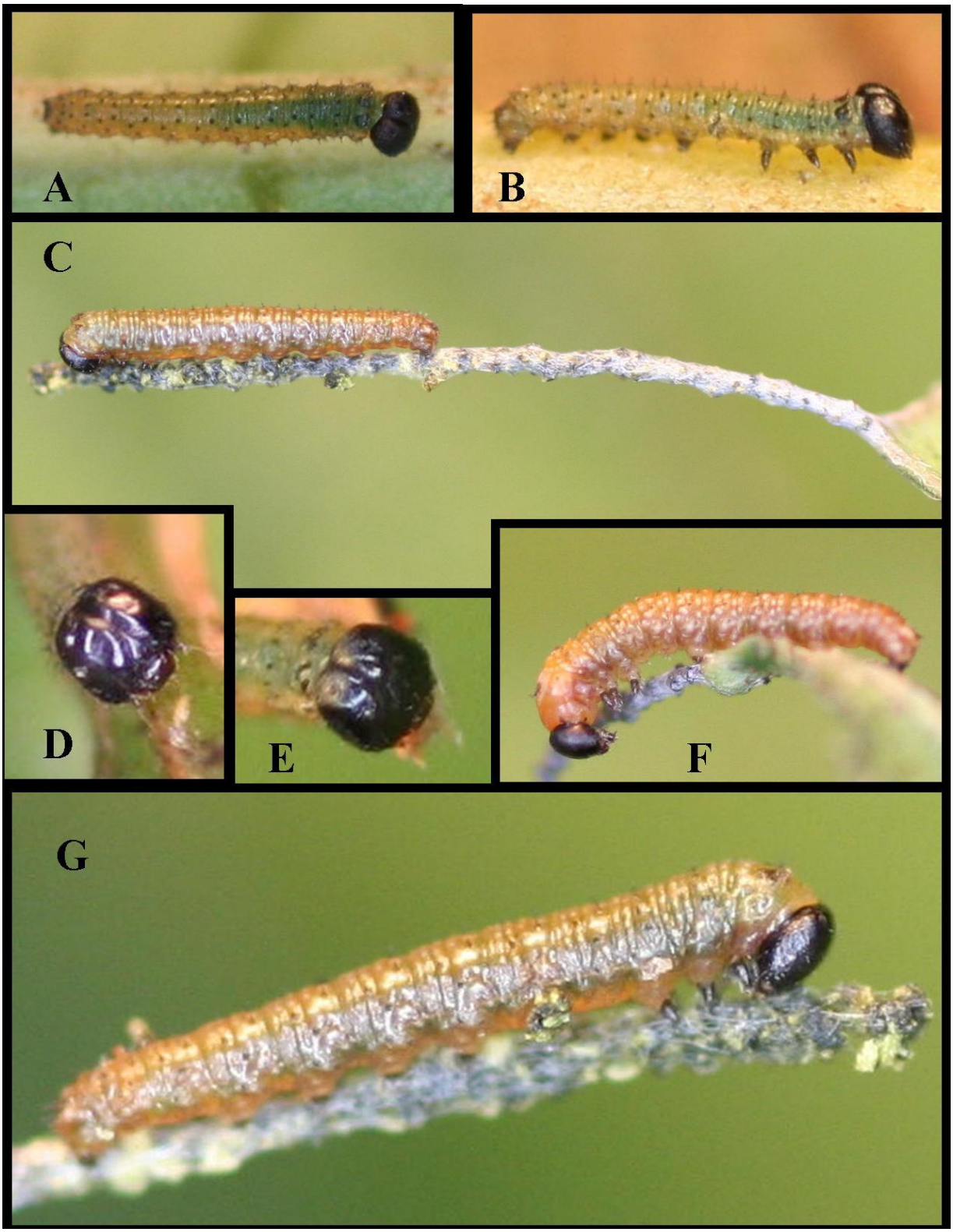

Figure 1. First stadium larvae of *Perisama oppelii* at Yanayacu Biological Station, Napo Province, 2100 m, Ecuador: a-b) early stadium larvae; c) mid-stadium larva; d-e) detail of head capsule; f-g) pre-molt first instars.

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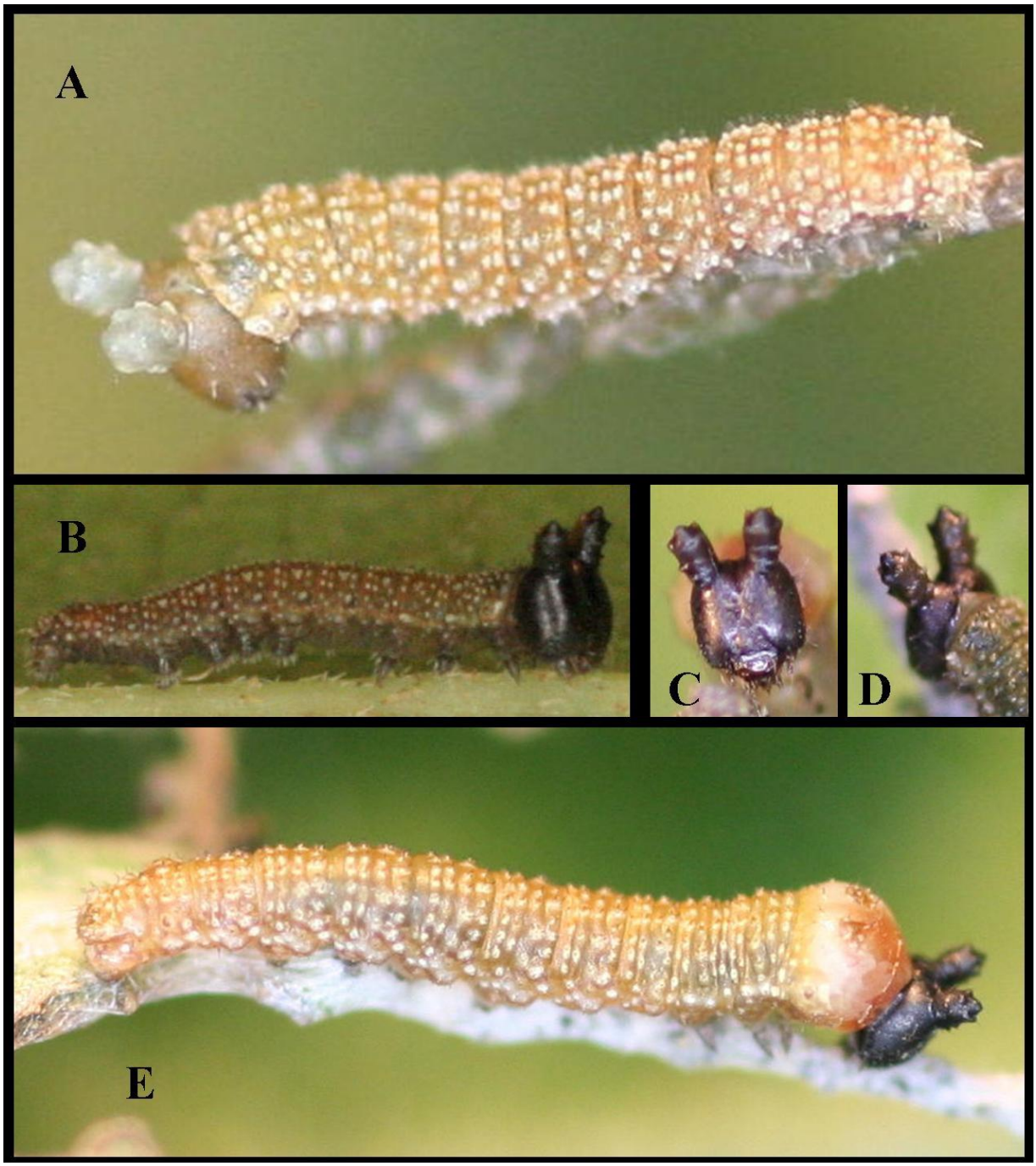

Figure 2. Second stadium larvae of *Perisama oppelii* at Yanayacu Biological Station, Napo Province, 2100 m, Ecuador: a) recently molted larva; b) early-stadium larva; c-d) detail of head capsule; e) pre-molt second instar.

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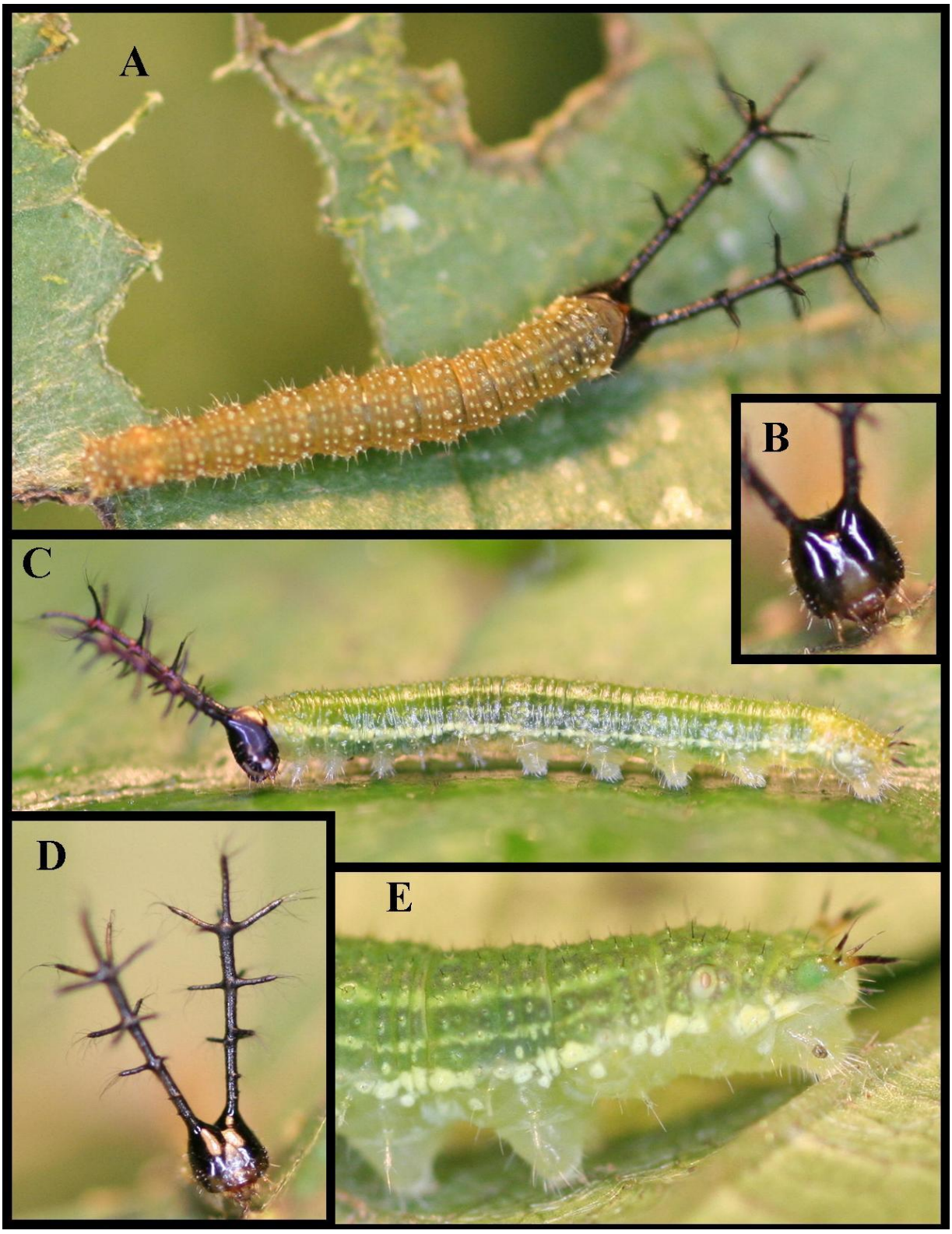

Figure 3. Third stadium larvae of *Perisama oppelii* at Yanayacu Biological Station, Napo Province, 2100 m, Ecuador: a) early stadium larva; b and d) detail of head capsule; c) late-stadium larva; e) detail of A10 scoli.

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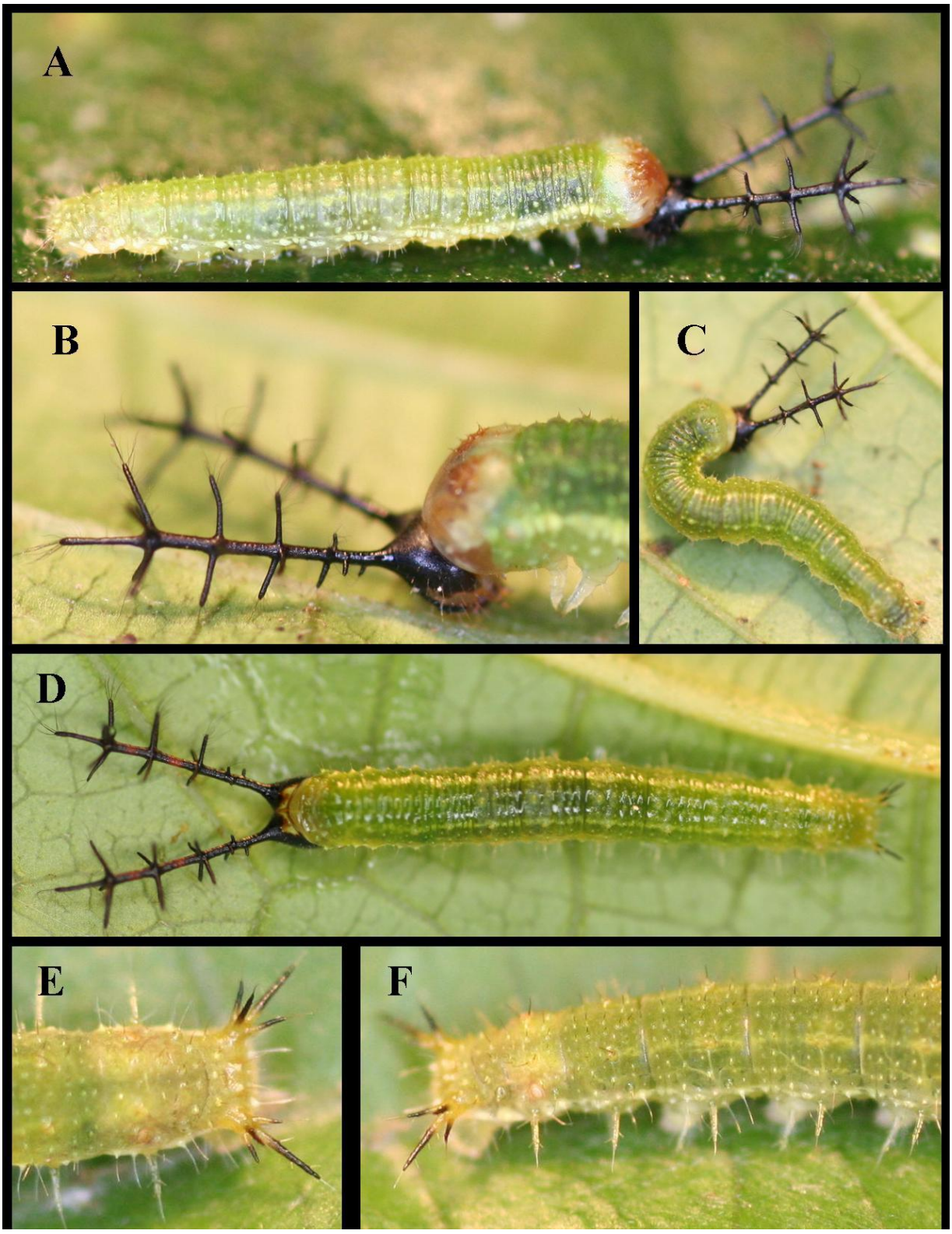

Figure 4. Fourth stadium larvae of *Perisama oppelii* at Yanayacu Biological Station, Napo Province, 2100 m, Ecuador: a-b) pre-molt larvae; c- d) late-stadium larvae; e-f) details of A10 scoli.

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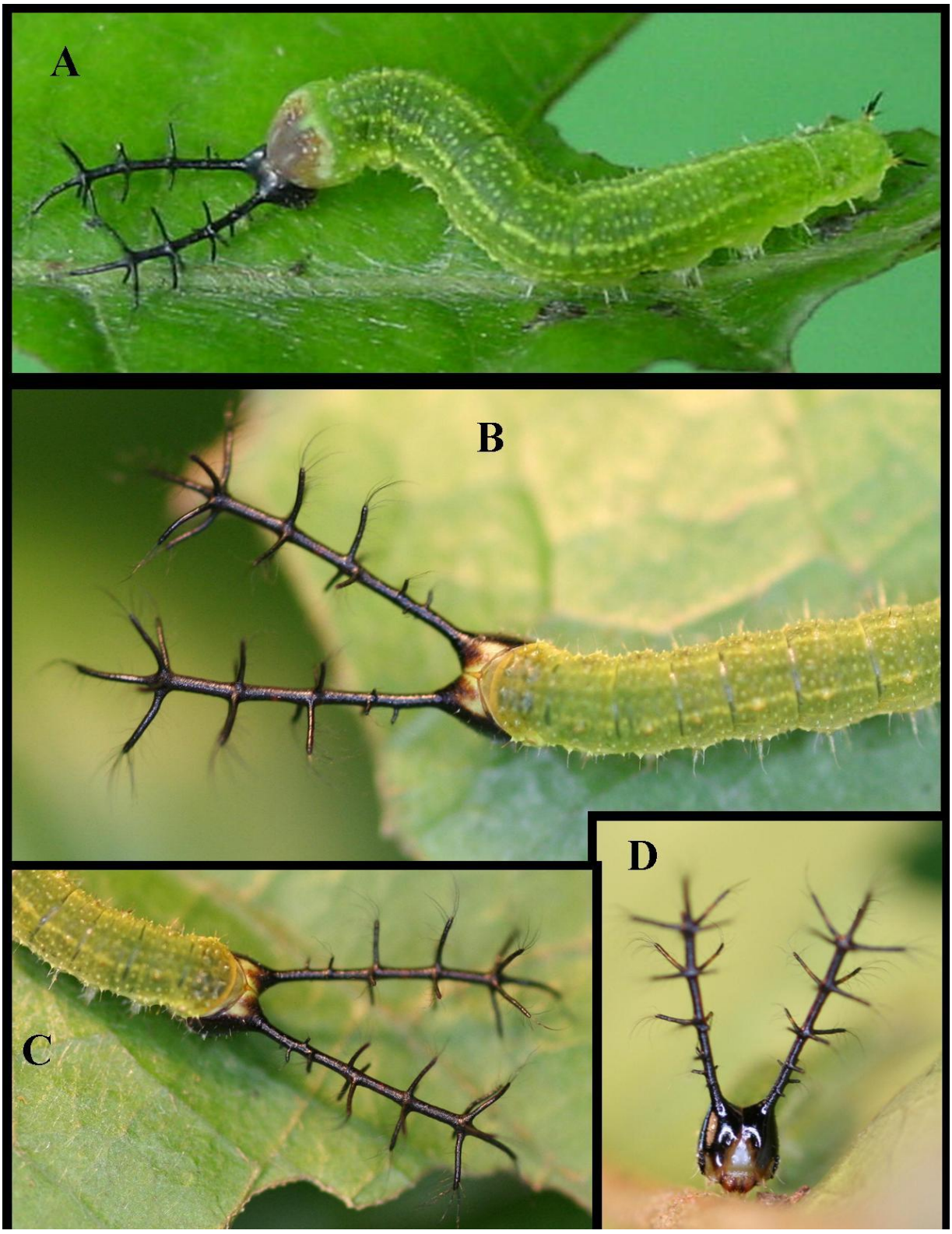

Figure 5. Fourth stadium larvae of *Perisama oppelii* at Yanayacu Biological Station, Napo Province, 2100 m, Ecuador: a) pre-molt larva showing typical resting position of later instars; b-d) details of head capsule.

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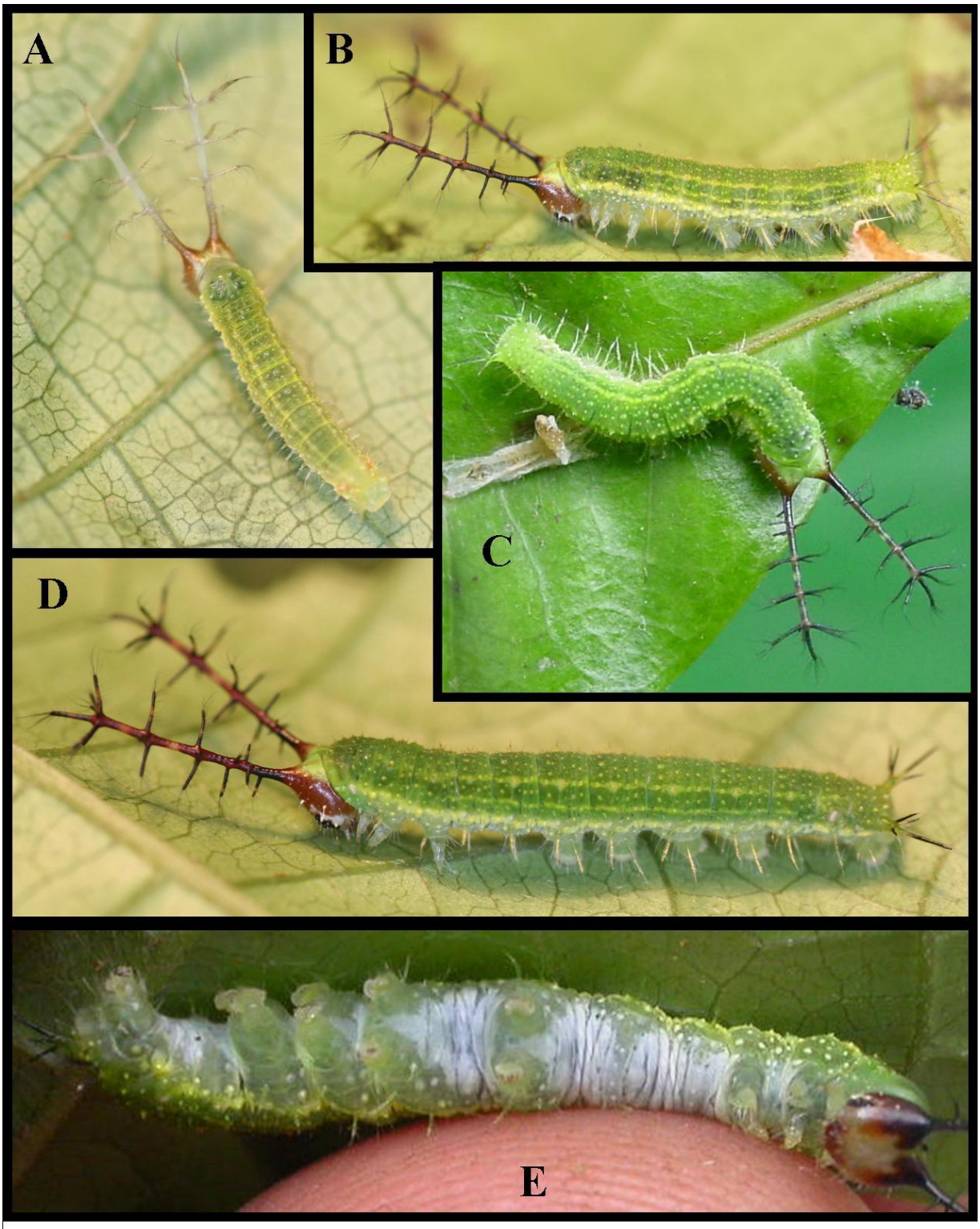

Figure 6. Fifth stadium larvae of *Perisama oppelii* at Yanayacu Biological Station, Napo Province, 2100 m, Ecuador: a-c) recently molted larvae; d) early stadium larva; e) ventral portion of mid-stadium larva.

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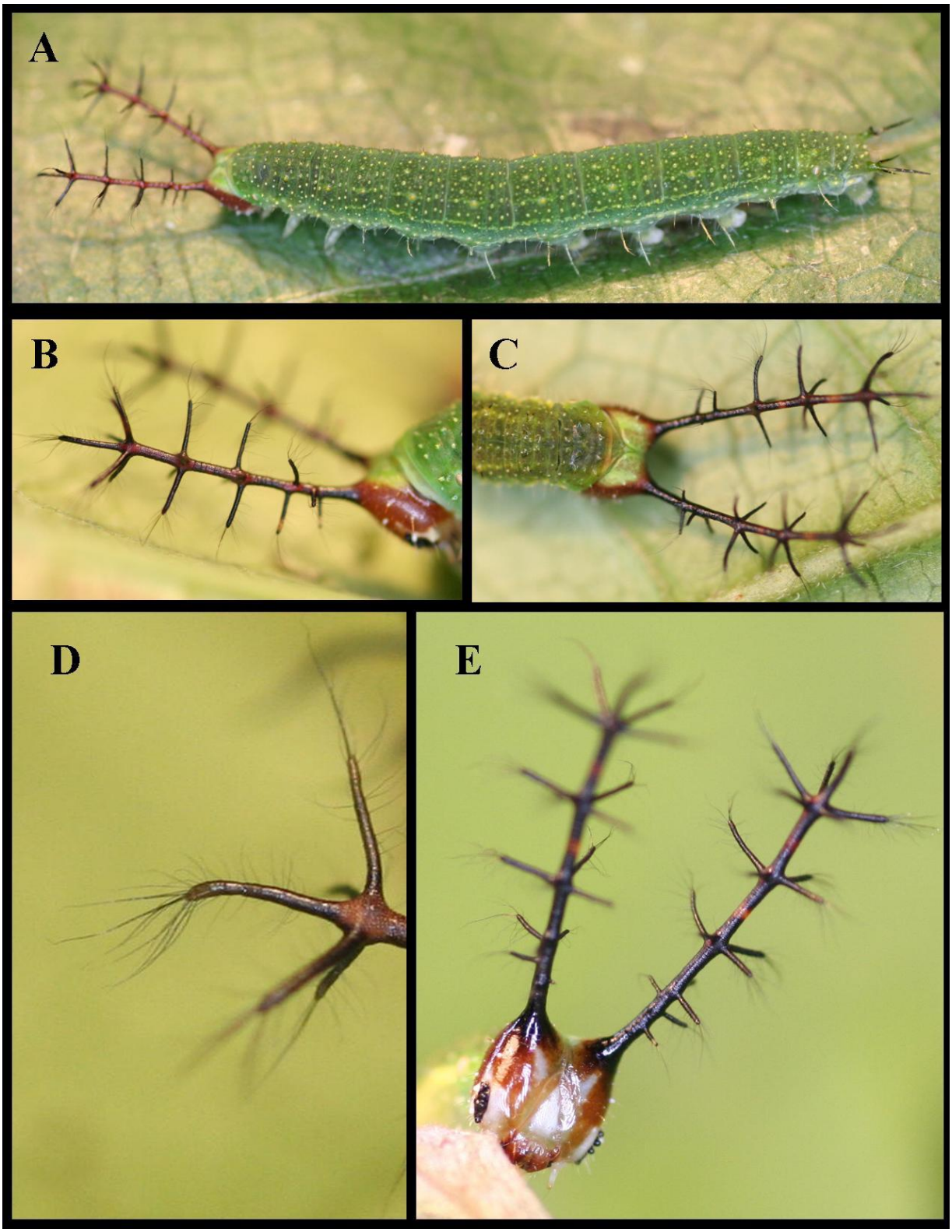

Figure 7. Fifth stadium larvae of *Perisama oppelii* at Yanayacu Biological Station, Napo Province, 2100 m, Ecuador: a) mid-stadium larva; b-e) details of larval head.

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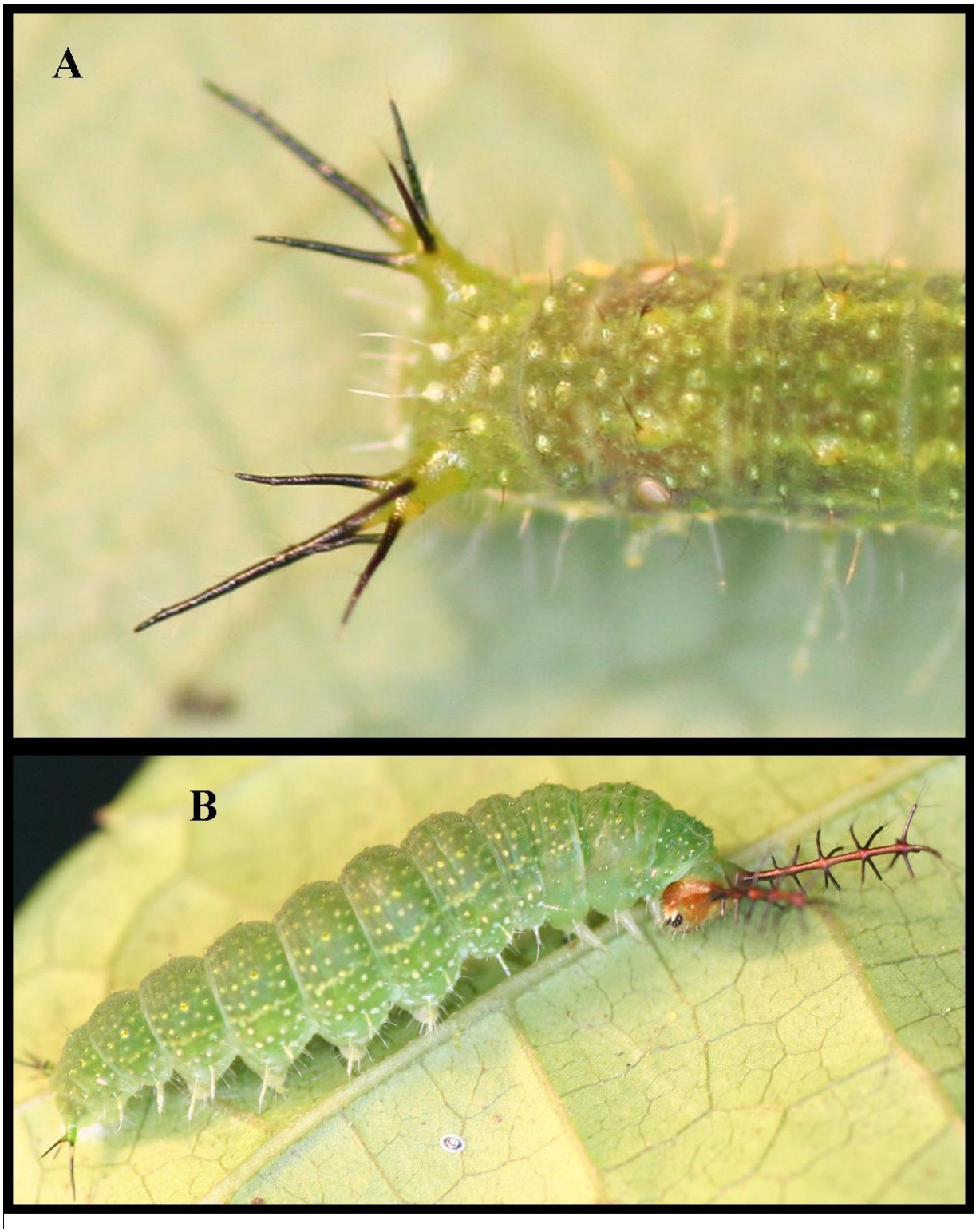

Figure 8. Fifth stadium larvae of *Perisama oppelii* at Yanayacu Biological Station, Napo Province, 2100 m, Ecuador: a) recently detail of A10 scoli; b) pre-pupal larva.

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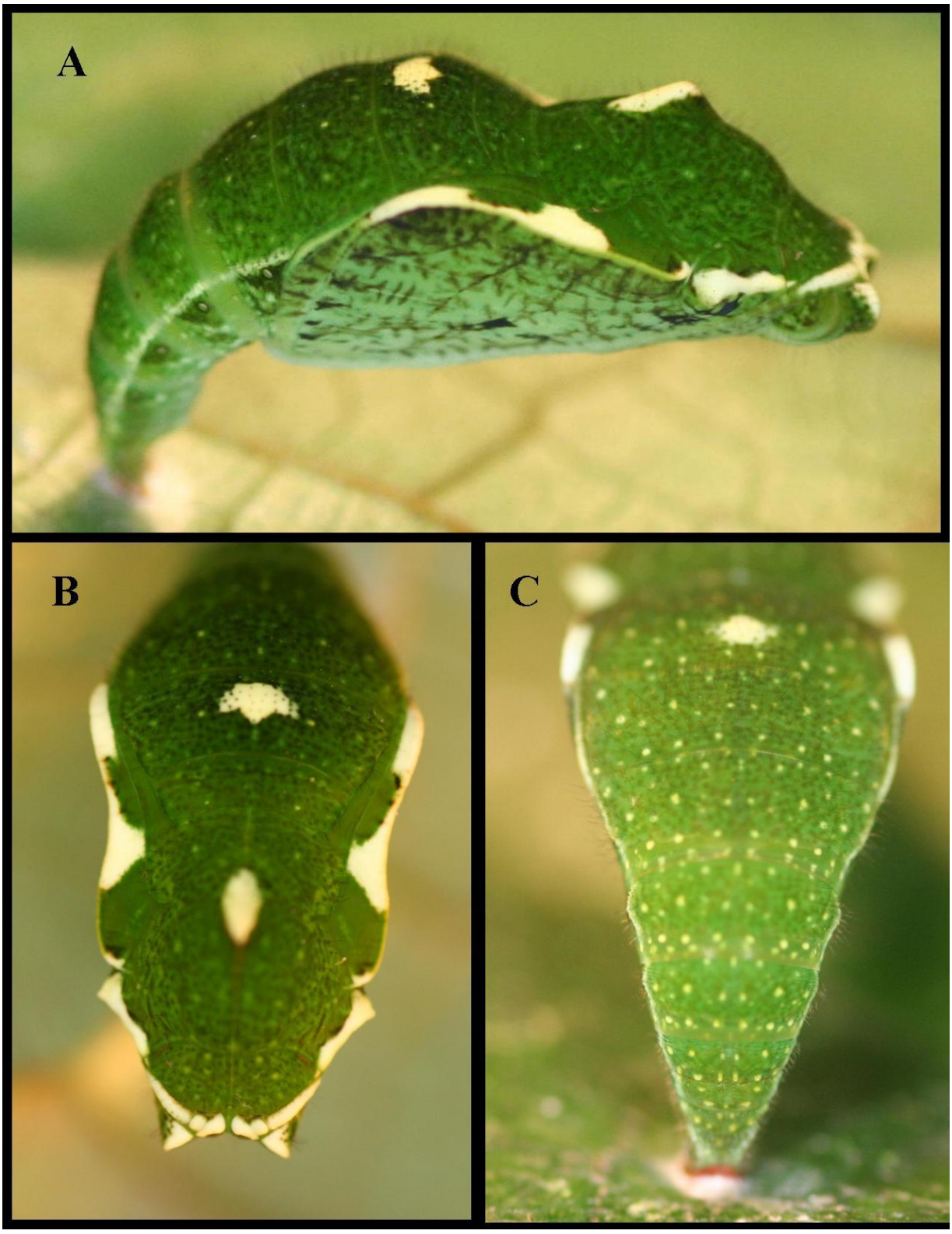

Figure 9. Pupa of *Perisama oppelii* at Yanayacu Biological Station, Napo Province, 2100 m, Ecuador.

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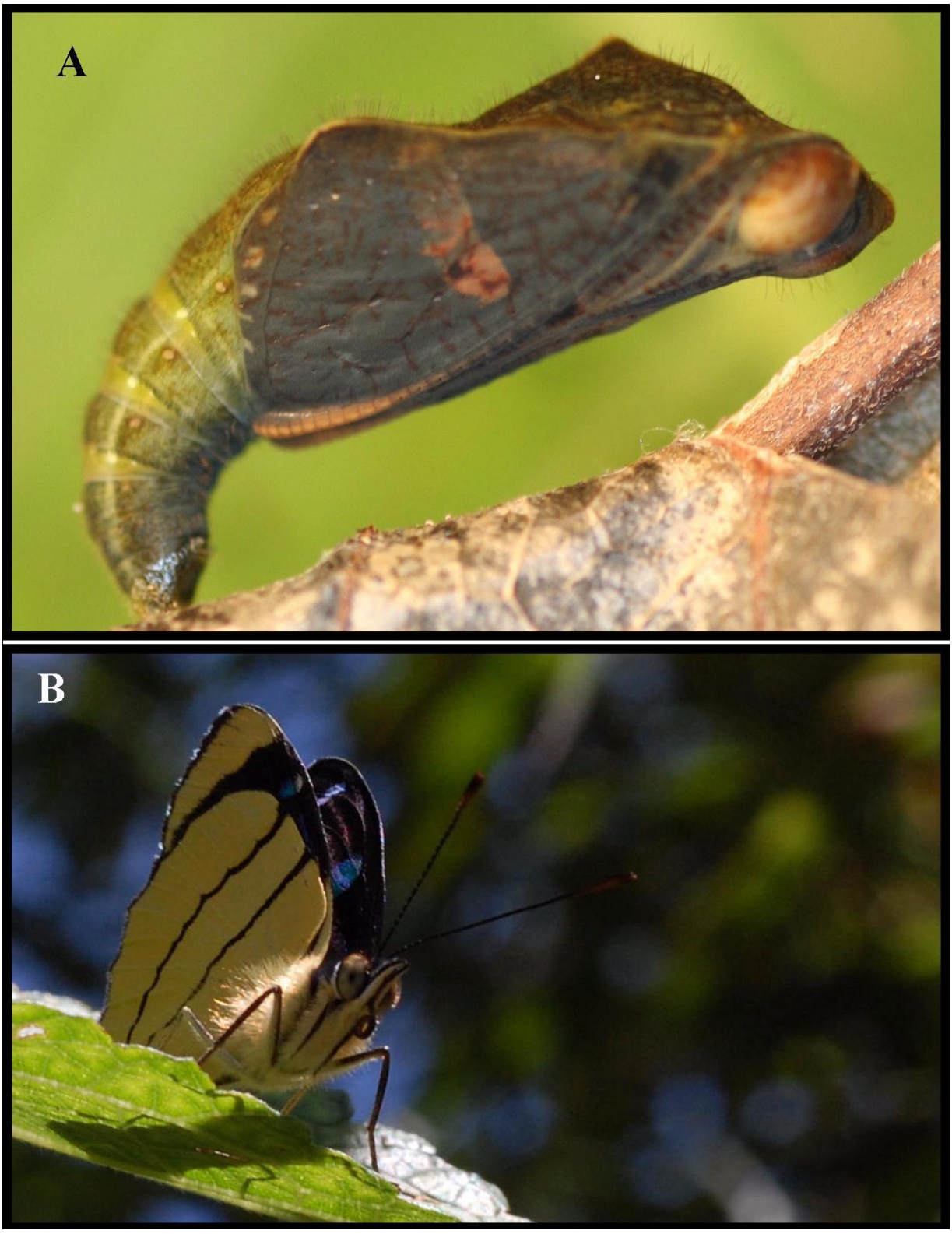

Figure 10. Life stages of *Perisama oppelii* at Yanayacu Biological Station, Napo Province, 2100 m, Ecuador: a) pre-eclosion pupa; b) adult male guarding territorial perch in sun.