

# Life history of *Porthoecla ravus* (Druce) (Lepidoptera: Lycaenidae), with discussion on the use of Annonaceae by Eumaeini butterflies

LUCAS A. KAMINSKI<sup>(1)</sup>, LUÍSA L. MOTA<sup>(2)</sup> & ANDRÉ V. L. FREITAS<sup>(1)</sup>

<sup>(1)</sup> Departamento de Biologia Animal, Instituto de Biologia, Universidade Estadual de Campinas, CP 6109, 13083-970, Campinas, SP, Brazil

<sup>(2)</sup> PPG-Ecologia, Instituto de Biologia, Universidade Estadual de Campinas, CP 6109, 13083-970, Campinas, SP, Brazil

**Abstract.** The morphologies of the penultimate and last instar larvae and pupae of the hairstreak butterfly *Porthoecla ravus* (Druce 1907) are described and illustrated for the first time. Larvae feed on flower buds and/or leaf primordia of *Xylopia aromatica* (Lam.) Mart. (Annonaceae). As observed for the closely related genus *Oenomaus* Hübner 1819, host plant records for *P. ravus* suggest a feeding specialization on Annonaceae. The obtained results on immature stage morphology and host plant use are compared with other related genera in Eumaeini and discussed.

**Résumé. Mode de vie de *Porthoecla ravus* (Druce) (Lepidoptera : Lycaenidae) avec une discussion sur l'utilisation des Annonaceae par les papillons Eumaeini.** La morphologie des chenilles (des dernier et avant-dernier stades) et chrysalides de la Thécla *Porthoecla ravus* (Druce 1907) est décrite et illustrée pour la première fois. Les chenilles consomment les boutons et/ou les bourgeons foliaires de *Xylopia aromatica* (Lam.) Mart. (Annonaceae). Comme dans le cas du genre voisin *Oenomaus* Hübner 1819, les plantes-hôtes mentionnées pour *P. ravus* suggèrent une spécialisation alimentaire aux dépens des Annonaceae. En ce qui concerne la morphologie pré-imaginale et les plantes-hôtes exploitées, les résultats obtenus sont discutés et font l'objet d'une comparaison avec d'autres genres proches de la tribu des Eumaeini.

**Keywords:** Florivory, host plant, *Oenomaus*, *Pantheides* Section, polyphagy.

With approximately 1,200 species, the tribe Eumaeini (Lepidoptera: Lycaenidae: Theclinae) is one of the richest and least-known groups of Neotropical butterflies (Brown 1993; Robbins 2004a). Unfortunately, that species richness is proportional to the taxonomic problems within the group. According to Robbins (2004b), the main causes of confusion in Eumaeini classification include: (1) the rarity of specimens in collections, which hinders the understanding of geographical and seasonal intraspecific variations, and (2) the lack of a higher classification, making it difficult to delimit genera.

An emblematic example of the aforementioned problems with Eumaeini involves two genera: *Oenomaus* Hübner 1819 and the recently described *Porthoecla* Robbins 2004. The two genera are only distinguishable by a single characteristic of male genitalia, and cannot be separated based on wing pattern alone (Robbins & Duarte 2004; Faynel & Moser 2008; Faynel *et al.* 2011).

In recent years, characters from immature stages have been largely used in the taxonomy and systematics of several butterfly groups, helping to resolve points of uncertainty that cannot be clarified through adult morphology alone (*e.g.* Willmott & Freitas 2006). However, basic information on immature stages is available only for a very few Eumaeini, including three species of *Oenomaus* (see Fennah 1937; Calvo 1998; Castañeda-Vildózola *et al.* 2011; Janzen & Hallwachs 2011; Faynel *et al.* 2012), and is completely unavailable for *Porthoecla*. This paper describes for the first time the immature stages of *Porthoecla ravus* (Druce 1907), providing important information for future comparative studies. Immature morphology and host plant use by *Porthoecla* are also discussed and compared with other related Eumaeini genera.

## Material and Methods

Samplings were made at a cerrado savanna site in Itirapina (21°15'S, 47°49' W), São Paulo, Southeast Brazil. The vegetation is a dense scrubland of shrubs and trees, classified as cerrado *sensu stricto* (Oliveira-Filho & Ratter 2002). On 24 January 2010 and 30 May 2011, respectively, two mature larvae of *P. ravus* were collected from flower buds and leaf primordia of *Xylopia aromatica* (Lam.) Mart. (Annonaceae) (fig. 1). The collected larvae were reared in the laboratory in a plastic pot in ambient conditions with food *ad libitum* (following Kaminski *et al.* 2012). Shed head capsules, pupal exuviae, and the adults are deposited in the Museu de Zoologia “Adão José Cardoso”

E-mail: lucaskaminski@yahoo.com.br, lulismota@yahoo.com.br, baku@unicamp.br

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(ZUEC), Universidade Estadual de Campinas, Campinas, São Paulo, Brazil.

Measurements were taken and general aspects of morphology were observed using a Leica<sup>®</sup> MZ7.5 stereomicroscope equipped with a micrometric scale. The head capsule width of larvae was measured as well as the distance between the most external stemmata. The total lengths of larvae and pupae were measured in dorsal view. Colour patterns of immature stages *in vivo* were photographed with a digital camera. The terminology for immature stage descriptions follows Stehr (1987) for general morphology of larvae, Mosher (1916) and Duarte *et al.* (2005) for pupae, and Fiedler (1991) for ant-organs.

## Results

**Natural history.** Adults of *P. ravus* are found infrequently in cerrado sites of the state of São Paulo, and are usually observed while visiting flowers in the cerrado canopy (3 to 5 metres high). Oviposition events have never been observed, but a copulating pair was observed at 1:05 P.M. on 22 March 2010 in a cerrado area in Mogi-Guaçu (22°18'S, 47°10'W). Larvae are solitary and feed on flower buds and/or leaf primordia of *X. aromatica*, an arboreal species with a distribution ranging from Central to South America, and very common in cerrado areas of Brazil (see Varanda *et al.* 2008). Larvae were observed feeding with the head inside a hole chewed into the plant tissue; when the aperture is large enough, the larvae enter the flower buds and leaf primordia to feed on host plant tissues (figs. 2–3). We did not observe symbiotic interactions with ants.

**Penultimate instar larva** (fig. 3). Onisciform with hypognathous head retracted beneath the thorax. Inconspicuous body division, without dorsal projections. Light brown head, cream-coloured prothoracic shield, uniform body colour, with cryptic larval polychromatism ranging from green to reddish. Integument covered with short brown setae and translucent lateral setae. Head capsule width 0.90 mm (n = 1); maximum total length 6.40 mm.

**Last instar larva** (figs. 4–6). General morphology similar to the penultimate instar; softly sliced body covered with light beige translucent short setae, giving the larva a velvety appearance. Dark brown head, cream-coloured prothoracic shield, body colour ranging from green to reddish according to the host plant substrate, light brown spiracles. Subrectangular prothoracic shield with tactile SD1 setae; a row of forward-turned conspicuous setae in the posterior region of prothoracic shield. Dorsal nectary organ present on abdominal segment 7. Head capsule width 1.60–1.70 mm (n = 2), maximum total length 1.30 cm. Stadium duration: 8 days (n = 2).

**Pupa** (figs. 7–8). Dark brown colour with conspicuous white mesothoracic spiracles. Tegument covered with brown setae. Spiracles are beige, elliptical, arranged in a uniform row. Silken girdle around pupa at abdominal segment 2. Anterior margin of prothorax with a row of translucent brown setae. A5–A6 and A6–A7 intersegmental areas functioning as stridulatory organs. Specialized dendritic setae present on the T1 and A6 segment around the spiracles. Segment A10 with ventrally flat cremaster comprised of several short hooked setae. Total body length 0.92–1.11 cm (n = 2), width at A1 0.37–0.40 cm (n = 2). Stadium duration: 16–18 days (n = 2).

## Discussion

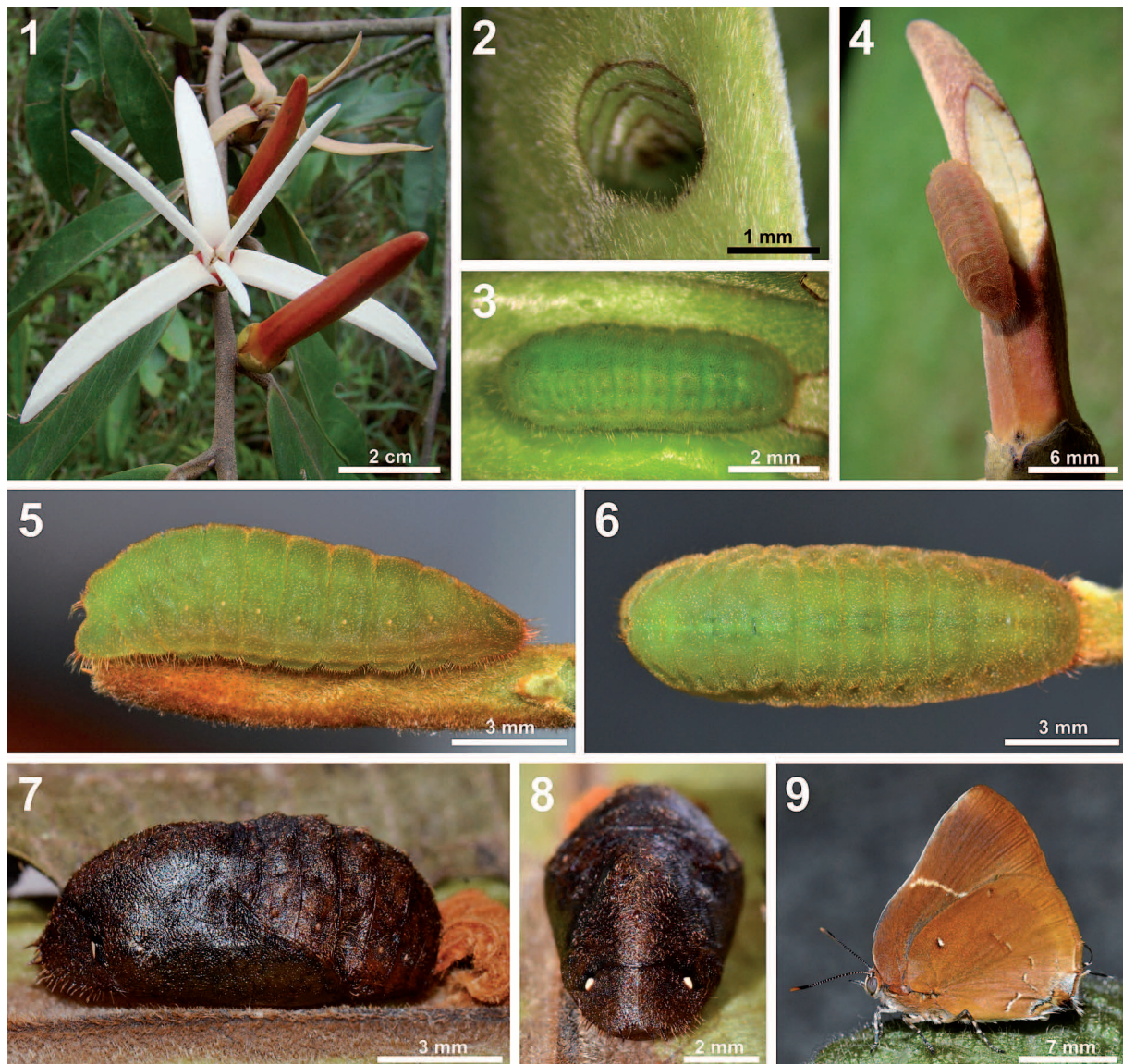
The last instars of *Porthocla ravus* are generally quite similar to those of other species in the *Panthiades* Hübner, [1819] Section (*sensu* Robbins 2004a), such as *Michaelus* Nicolay 1979, *Oenomachus*, *Parrhasius* Hübner, [1819], and *Thepytus* Robbins 2004, whose larvae present a softly sliced body covered with short setae and whose pupae are inconspicuous and dark in colour (Kaminski *et al.* 2012 and unpublished data). Pupation behaviour was not observed, but most known species in the *Panthiades* Section usually pupate in the litter (with the possible exception of *Panthiades*, whose green pupae remain on the host plant (see Callaghan 1982; Janzen & Hallwachs 2011)). The conspicuous mesothoracic spiracles of the *P. ravus* pupae (fig. 8) are similar to an eye-like colour pattern (see Janzen *et al.* 2010). These white spiracles are present in all known pupae of the *Panthiades* Section, including the genera *Michaelus*, *Oenomachus*, *Panthiades*, *Parrhasius*, and *Thepytus* (LAK unpublished). A detailed comparative analysis of immature stage morphology in these lineages appears to be a promising way for a better understanding of yet unresolved generic relationships in the Eumaeini.

The main ecological trait shared by *Porthocla* and *Oenomachus* is the use of Annonaceae as larval host plants (see Fennah 1937; Calvo 1998; Castañeda-Vildózola *et al.* 2011; Janzen & Hallwachs 2011; Faynel *et al.* 2012; this paper). This plant family is not a recorded larval host of any other genus in the *Panthiades* Section, and within the Eumaeini, Annonaceae have been reported as host plants only for *Arcas ducalis* (Westwood 1852) and *Pseudolycaena marsyas* (L. 1758) (Zikán 1956; Lamas 1975; Brown 1992). Based on host plant records, most species within Eumaeini appear to be polyphagous, a trait possibly related with their specialization in reproductive tissues of plants (florivory) (see discussion in Kaminski *et al.* 2012). Exceptions to this pattern, i.e. specialization in a single plant family (oligophagy),

seem to occur in some Eumaeini genera whose larvae feed on plant families that offer abundant floral resources and present sequential flowering (Kaminski & Freitas 2010). Both traits are present in Annonaceae: their flowers have thick petals (providing abundant food) and are often available throughout the year (both traits related to their specialized pollination system, see Gottsberger 1999). The use of Annonaceae by *Porthecla* and *Oenomaus* arising from the exploitation of the pollination systems with the subsequent use of fruits, as seen in the annonaceous fruit pest *Oenomaus*

*ortygnus* (Cramer 1779), is a plausible hypothesis. Interestingly, a similar scenario could explain the evolution of a specialized pineapple feeding habit in the genus *Strymon* Hübner 1818 (see Robbins 2010; Schmid *et al.* 2010).

The information provided herein is only a small part of a larger puzzle. Much more information is needed to understand the intra-tribal relationships and the evolution of host plant use in Eumaeini. We hope that this paper will encourage additional basic studies on the immature stage biology of neotropical Eumaeini.



**Figures 1–9**

Life history of *Porthecla ravus* on its host plant *Xylopia aromatica*: **1**, an open flower and two flower buds of *X. aromatica*; **2**, feeding hole on the leaf primordium; **3**, penultimate instar after dissection of leaf primordia; **4**, last instar on flower bud; **5**, last instar in lateral view; **6**, last instar in dorsal view; **7**, pupa in lateral view; **8**, pupa in frontal view (note the conspicuous white spiracles); **9**, freshly emerged adult.

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